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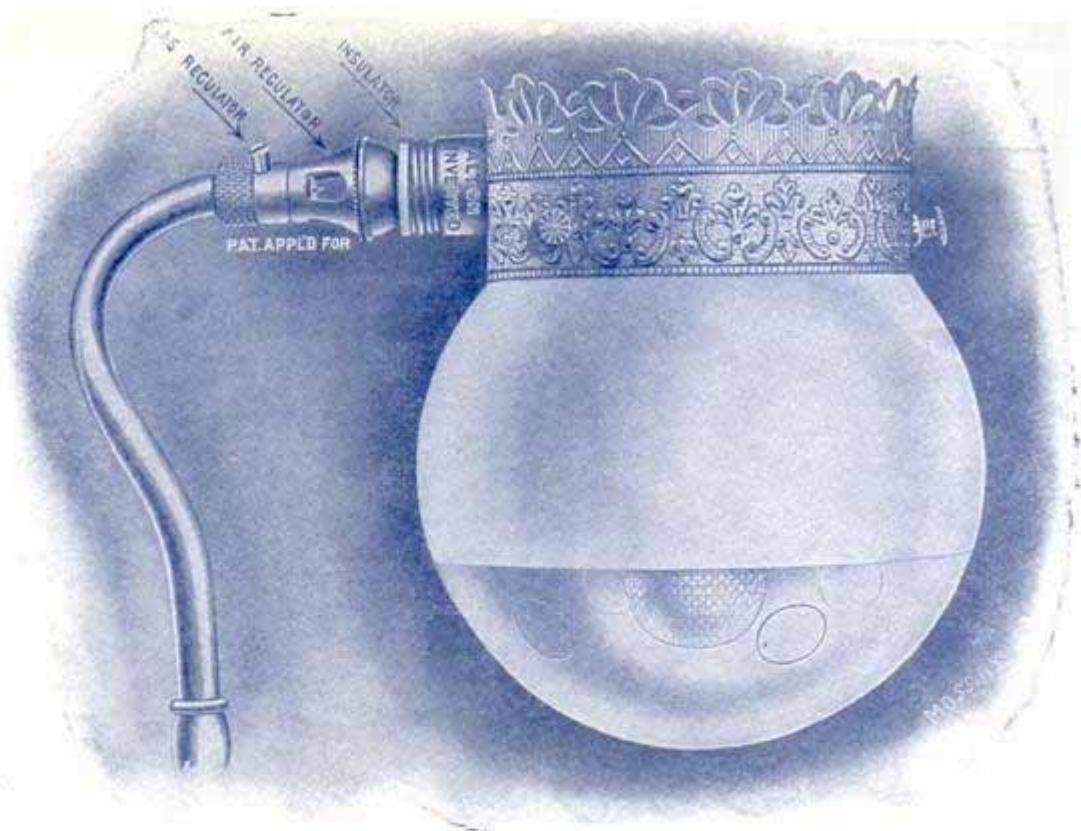
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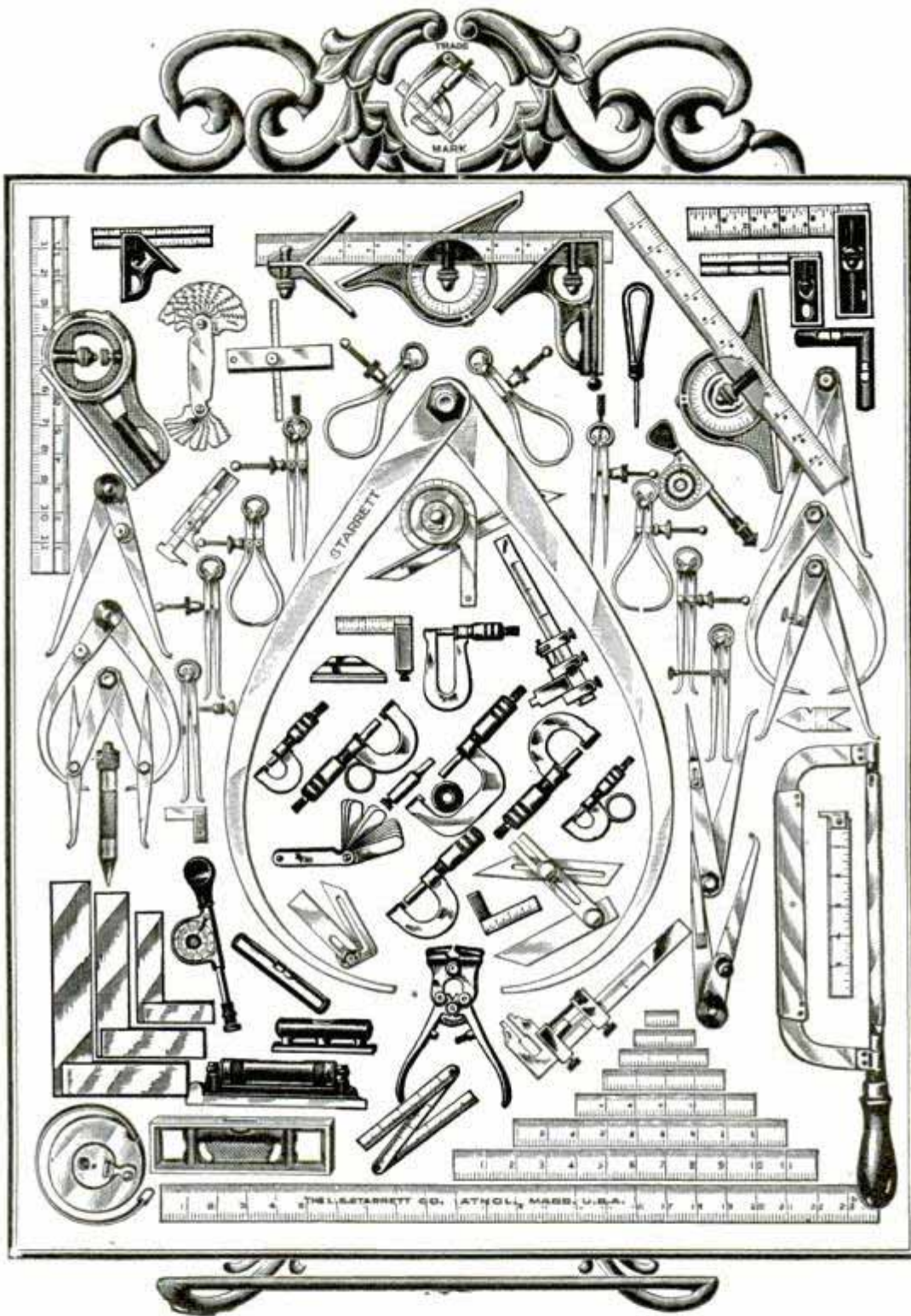
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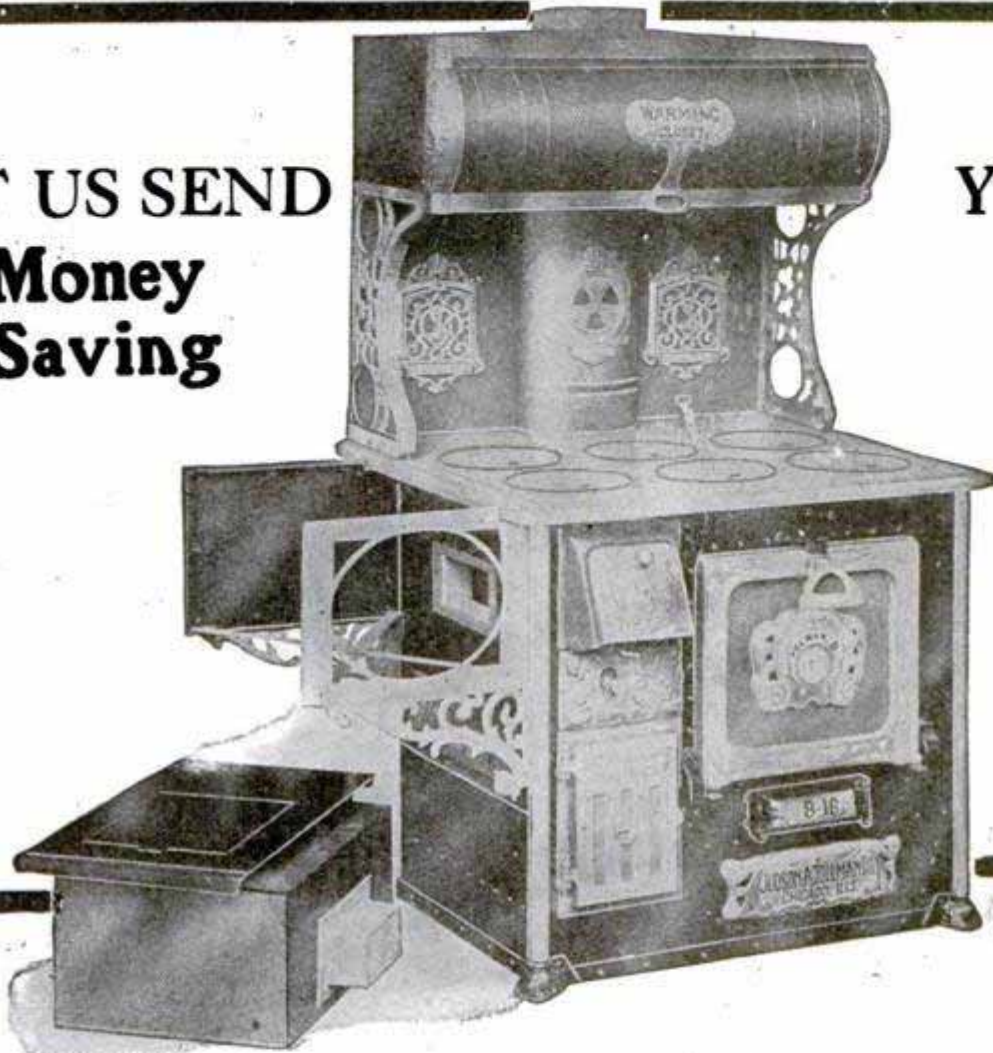
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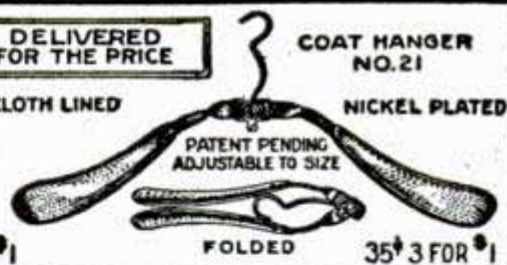


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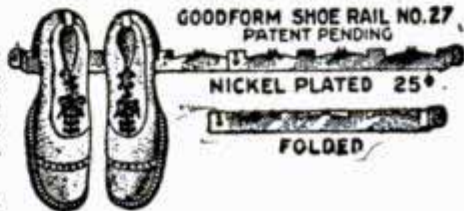
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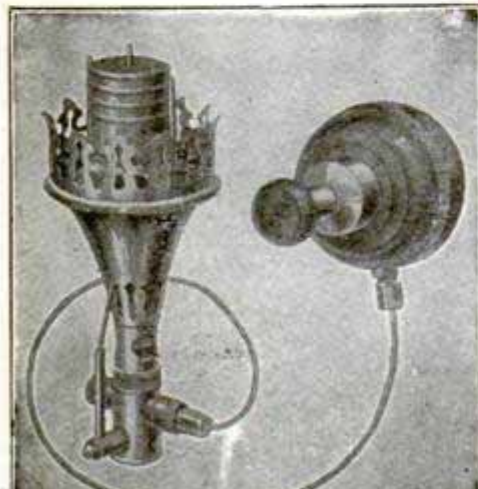
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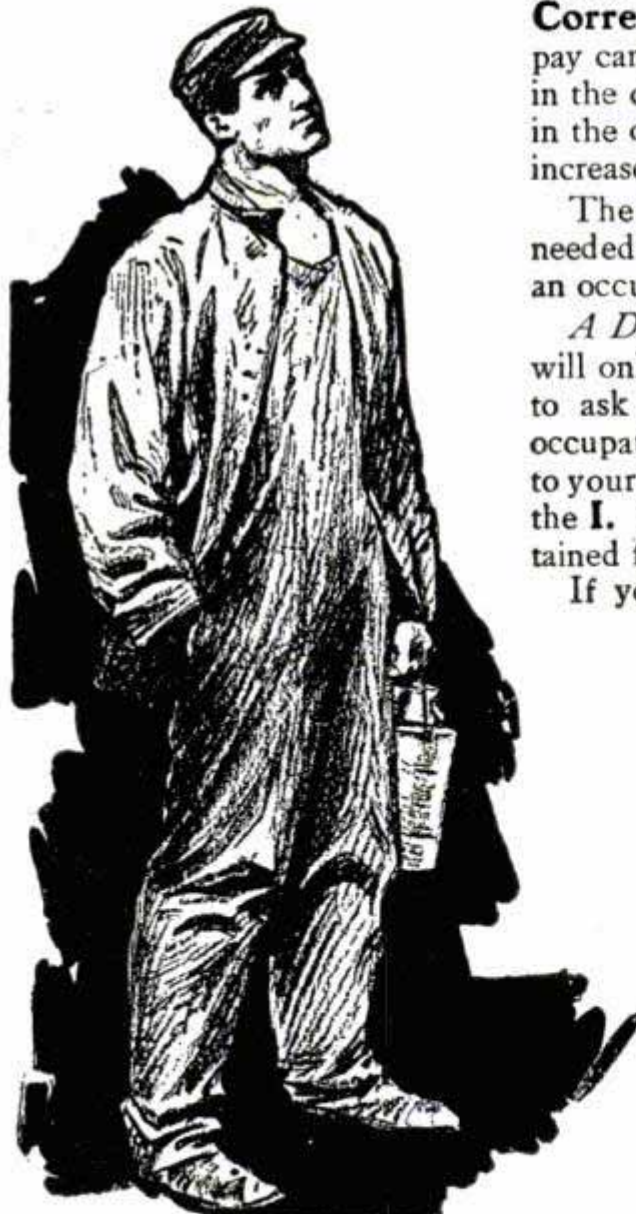
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POPULAR MECHANICS

Vol. 8. No. 12.

CHICAGO, DECEMBER, 1906.

10 Cents a copy
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AUTOMOBILE HOSPITAL CARAVAN

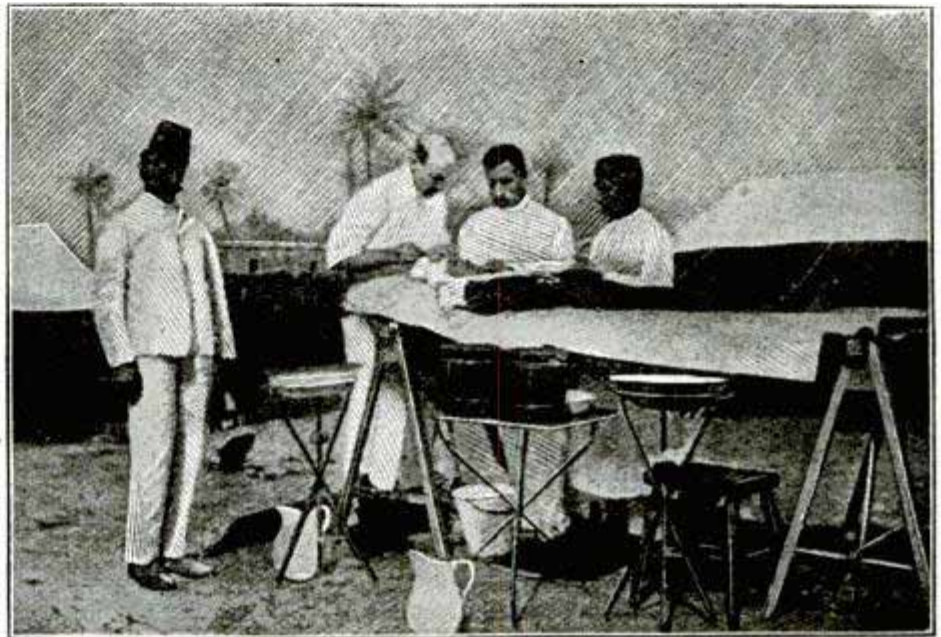
Travels the Deserts of Egypt--Over 18,000 Free Cases Treated Last Year

The most remarkable, and one of the largest and most benign, free clinics in the world is now traveling the deserts of Egypt in automobiles. The enterprise is made possible by the gift of \$1,500,000 by Ernest Cassel, the income from which is being used in maintaining an optical hospital, at present in charge of Dr. MacCallan.

Unlike all other hospitals, this one owns no grounds or buildings, and remains in any one place not to exceed two or three weeks. The hospital outfit, however, is very complete, and includes a large corps of expert eye specialists and nurses who travel in automobiles and live in tents.

Owing to the heat and dust from the driving sands, as well as their food and mode of life, the people of Lower Egypt are afflicted with cataracts and other eye troubles to a much greater extent than almost any other nation. In fact those who are not sufferers from some malady of the eyes are the exception. As the natives are poor and could not be brought to a central hospital, it became necessary to take the hospital to them. During July and August the heat is so intense that butter cannot be kept from turning into oil, and no effort is made to treat patients; but during the remainder of the year the train of automobiles may be seen threading its way across long stretches of desert waste, in the land of the Pharaohs, to some oasis where the presence of the white tents is soon known for miles around. Then the natives come swarming in by the hundreds.

On account of the heat, operations are



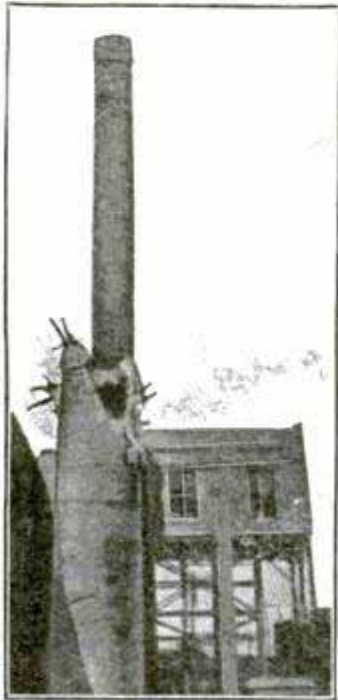
Surgeon Operating in Open Air on Account of Heat

frequently conducted in the open air, and the illustration is from a photograph showing Dr. MacCallan operating for cataract. The doctor, to whom was assigned the task of organizing the service, is considered the leading eye specialist in London. He went to Egypt with the hospital service last year, and will now direct its work from England.

When the caravan arrives at a stopping place the tents are erected and ropes stretched all around to keep out the curious crowd. A native doctor makes the preliminary examination, rejecting all but the most urgent cases. These form in line to enter the examining tent, from which the patient is sent to the particular tent occupied by the doctors who are specialists in the treatment decided on at the examination. Last year—the first—there were treated 18,943 cases, and so great is the demand and need of the service that additional caravans will now be organized to go into other districts of the country.

200-FT. CONCRETE CHIMNEY FALLS

The recent failure of a reinforced concrete chimney will doubtless prove a lasting warning against all future carelessness in the manner of mixing and applying the concrete. It appears that the disaster was due to a combination of causes, one of which, a high wind, could not be avoided. An analysis of the broken fragments, however, showed that the concrete was applied too late after the mixing, which, moreover, was improperly done, and some portions of the reinforcing steel were found in a perfectly clean condition, indicating that the concrete was not wet enough when applied.



The Wrecked Chimney

These defects so weakened the chimney that the subsequent gale of 30 miles an

hour caused it to fall. The stack was 200 ft. high and the break occurred 75 ft. from the base.

SALTON SEA CONTROLLED

The Salton sink which for two years has been steadily rising and spreading with water from the Colorado river has at last been put under control. At an expense of one million dollars engineers have filled the gap confining the waters of the river in their old channel. The sea will now slowly dry up and a further threatened damage of many millions is probably saved.

PROPOSED AUTO TOLL ROAD

With a few exceptions the toll road in this country is a thing of the past. A project, however, is now on foot to construct the greatest toll road in the world between New York and Chicago for the use of automobiles. If built it will have a roadway 66 ft. wide, cost \$10,000,000 and be the most perfect road in the world. Motorists would pay a toll of one cent per mile, or \$10 for the through trip, and motor cars in which the public may ride as passengers would run daily between stated points for fare.



FLOODING A CITY TO FLOAT A SHIP

An ocean-going steamer was recently launched from one of the big shipyards at Amsterdam. The water in the slip into which the vessel slid proved to be too shallow, and the result was the hull plowed down into the muddy bottom and tugs could not move it. Finally it was decided to open the sea-sluices at Ymuiden and raise the water level. This was done, and at 2 o'clock in the morning houses in the lower part of the town were flooded and the occupants forced to escape to higher points leaving their possessions behind.

The ship was floated, but this method of accomplishing the undertaking is not likely soon to be repeated—at least not in that vicinity.



"At 2 a. m. Houses Were Flooded"

A MUSICAL MYSTERY



The Explanation

At a recent concert in one of the pleasure parks of Chicago the audience was greatly surprised and mystified by a sudden outburst of music from above. Many attributed it to concealed cornettists, who they supposed had stationed themselves in the many trees in the park. Others ascribed the sound to ventriloquism, and many were at a loss to explain it in any way, but as the mysterious music was in harmony with the orchestra, which then played the part of an accompaniment, the result was pleasing to all.

Had the audience been allowed to observe the trees during daylight it would have found at least a partial solution of the mystery in the large horns or megaphones which were suspended from the branches and connected by wires with a central sending station. The horns, which were simply very sensitive telephone receivers with attached megaphones, were all operated by a single cornettist, who had a telephone receiver held to his ear, thus enabling him to keep time with the orchestra—which was some distance away—while he played into an ordinary telephone receiver.

This invention, which is known as the transmittograph, can also be used in connection with piano or vocal music; in fact it will transmit any kind of a sound, and may possibly prove useful for public speakers when addressing very large assemblies.

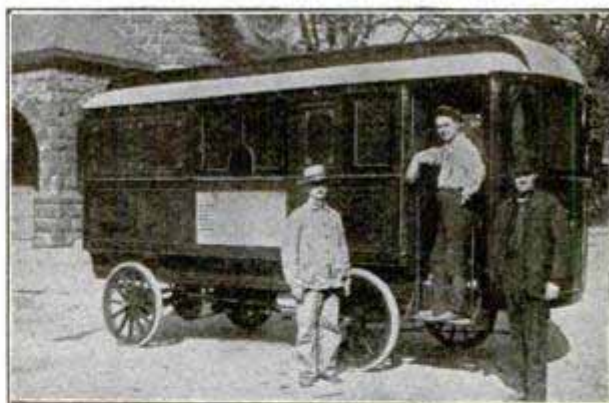
NIAGARA RUNS SYRACUSE CARS

The electric street cars of Syracuse, N. Y., are operated by power generated at Niagara Falls, 160 miles away. Eighty-two

cars are operated, using 3,000 hp. The old power house will be preserved for use in case of emergencies.

MOTOR LUNCH CAR

The old-time waffle wagon with the single white horse is doomed to go since the advent of the motor car restaurant. The new car is 17 ft. long, 5½ ft. wide and travels 12 miles an hour with its 26-hp. gas engine. The car is equipped with hot and cold water, cooking range, has its own electric light plant and a cold storage compart-



"Red Hots" Auto

ment holding 500 lb. of meat. Electric fans and screens for the windows make it attractive in summer. The wheels are artillery type with 3-in. solid rubber tires. The car is painted like a Pullman, and cost \$3,500. The owner is now engaged in building a larger one.

Acetylene headlights for locomotives are growing in favor, and are already in use on several roads.



TEST SHOT WITH TORPEDO

While the gun crews of torpedo boats are allowed practice with blank torpedoes which are quickly recovered, it is seldom a real fully loaded torpedo is fired in times of peace. The reason is the great expense, as these projectiles each cost "from \$1,500 up."

The English navy, however, recently ordered a test shot, which was delivered from a torpedo boat, running at full speed, against the rocky shore of cliffs far removed from any human habitation. The shell contained 200 lb. of gun cotton, and when the explosion occurred enormous quantities of water were thrown into the air, reaching a

height of 200 ft. or more. The illustration, which is quite unusual, forcibly suggests what happens to a battleship when one of these deadly missiles makes a hit.

PEARY HOLDS NORTH POLE RECORD

Commander R. E. Peary, of the U. S. Navy, in his expedition to the North Pole in the steamer "Roosevelt," with 20 men, has transferred the record from Italy to this country. Peary has been absent nearly 18 months on the present cruise and reached 87 deg. 6 min., which is about 250 miles from the pole. The previous high record was that of the Duke of Abruzzi, who in 1900 reached 86 deg. 34 min. The Peary expedition encountered unusually severe hardships, but no lives were lost.

THE ATLANTIC CITY ACCIDENT

The accident to the electric train of the West Jersey & Sea Shore Ry., at Atlantic City, in which 58 passengers were killed or drowned, appears to have been the result of carelessness on the part of the motorman. The cars entered the draw span of the bridge at a high rate of speed and one truck climbed the rails of the draw. One steam railroad journal in commenting on the disaster says there should be even greater safeguards in the operation of electric cars than are deemed necessary on steam roads for the reason that the electric cars attain a high speed so much quicker than steam locomotives.

Germany has commenced construction of an \$11,000,000 ship canal which will permit men-of-war to enter the city of Berlin.

BIG LOADS OF COTTON

What are said to be the largest loads of cotton ever put on to a railroad car were recently loaded at San Antonio, Texas.

The cars are built entirely of steel. One car contained 203 bales weighing 108,000 lb., valued at nearly \$10,000, while the other had 197 bales weighing 103,000 lb. The cars are each 41 ft. long.



400 Bales on Two Cars

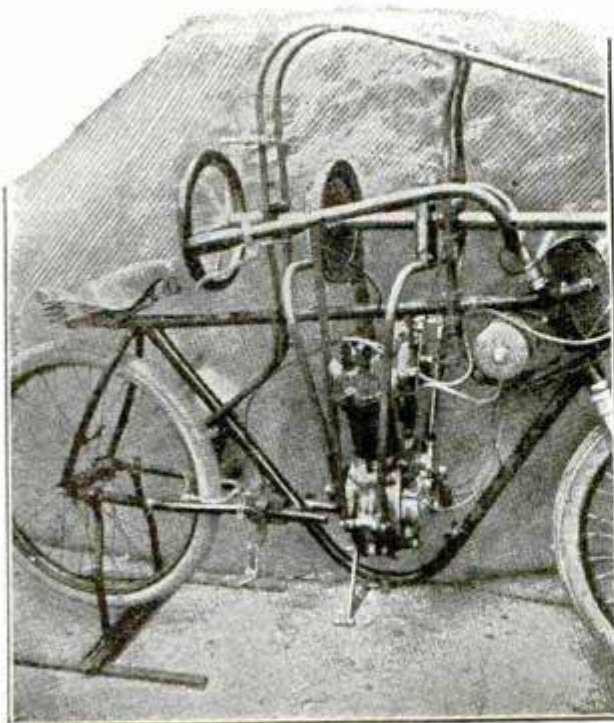
AIR PROPELLERS ON LAND AND WATER



Propeller in Front

The air-propelled motorcycle of M. Archdeacon, president of the Aero Club of France, was mentioned last month; details are presented herewith.

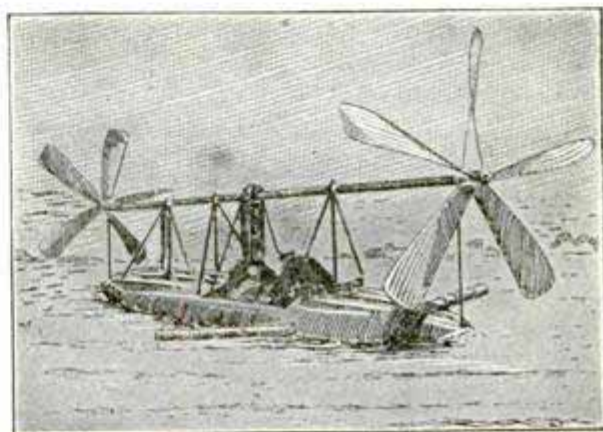
In this machine propulsion is obtained by means of a two-bladed propeller mounted in front of the handle bars, driven with a belt from a 6-hp. gasoline engine. The propeller is made of aluminium, and is further lightened by being pierced with a number of small holes. The whole surface is, however, covered with gold-beaters' skin. It is



The Archdeacon Machine

about 4 ft. 9 in. in diameter. The motor runs at 1,500 revolutions per minute, and the propeller at 1,100. The weight of the machine complete is 154 lb. With a rider weighing 180 lb. the machine on its trial trip made a speed equal to 49 miles per hour. The main purpose in building the machine has been to experiment with propellers with a view to their adaptation to flying-machines.

The foreign press reports the surprising record of 40 miles an hour by Forlanini with his "Hydroplan," or gliding boat. This statement has not yet been verified and is probably incorrect, as the boat has only 70 hp., which would not give any such speed



The "Hydroplan"

with water propellers. The air propellers, however, are very large and are supposed to exert also a lifting influence so that the boat skims the surface of the water rather than passes through it.

TRAVELING CHICKEN SHOW

The first traveling chicken show has been successfully inaugurated in Missouri, the state which leads all others in its production of poultry. The show filled two special cars and was taken to all parts of the state, where free lectures were given in connection with the display. The idea is to stimulate poultry raisers to larger and better efforts.

All sorts of mechanical devices for use in the work were exhibited, the most novel being a machine for converting ordinary chicken feathers, worth only 6 or 7 cents a pound, into down for pillows which sell from 80 cents to \$1.50 per pound. Missouri sold last year over \$37,000,000 worth of poultry.

GREATEST AIRSHIP EVER BUILT

Count Zeppelin's Great Balloon 420-Ft. Long

The prediction that airships will in the near future assume the length of ocean greyhounds seems in a fair way to be realized. Indeed an airship 1,000 ft. long will doubtless be in operation within two years.

The largest air craft to date is the monster cigar-shaped balloon of Count Zeppelin, measuring 420 ft. from bow to stern. In fact, the gas container is not one, but a series of 16 oiled cotton compartments stretched over a framework of aluminum. The motive power consists of two gasoline engines of 83-hp. each.

The trials of this great mechanical bird were given over Lake Constance, and were extremely successful and promising. The ship remained in air two hours, rising at the will of the navigator to heights of 1,000 ft. and descending gracefully to within a few feet of the water. This performance was repeated several times.

MECHANICAL POTATO PEELER

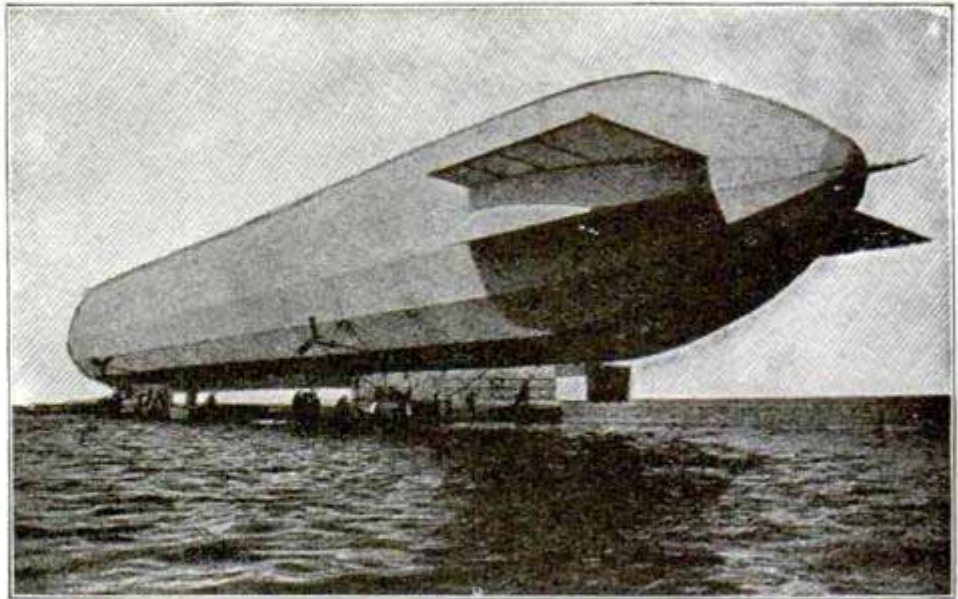
And now a machine for paring potatoes, and the entire process of planting, cultivating, digging, loading, sorting and preparing for cooking form one consecutive



Peels a Bushel in 90 Seconds

mechanical process. The potato peeling machine consists of a cast-iron bowl in which is a cylinder with thousands of

small holes, like an immense nutmeg grater. The bottom of the cylinder revolves at high speed, throwing the potatoes by centrifugal



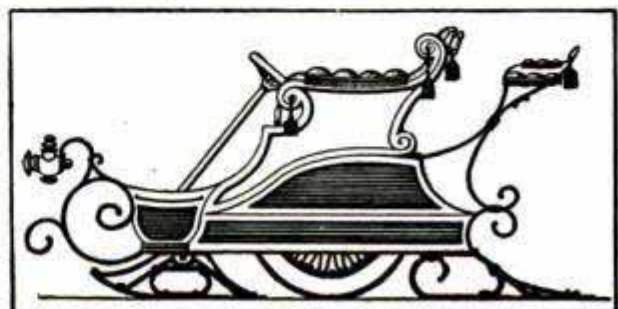
Airship 420 ft. Long

force with a circular motion against the roughened cylinder. This action removes the peel, which a stream of water removes in the form of a soft pulp.

One person with the machine can do the work of 25, peeling a bushel of new potatoes in 90 seconds, and tough ones 9 months old in three minutes. Power can be belted from a shaft or gasoline engine, or a small electric motor attached direct. The machines at present are made only in large sizes for use in hotels, etc. Several are already in service in the army and navy.

AUTOMOBILE SLEIGHS

Automobile lovers are not going to be content much longer without a machine for use specially on snow and ice. The speed possibilities would certainly indicate something very exhilarating. One of the latest inventions in this class is shown herewith. A single driving wheel in the center of the car furnishes the contact for propulsion.



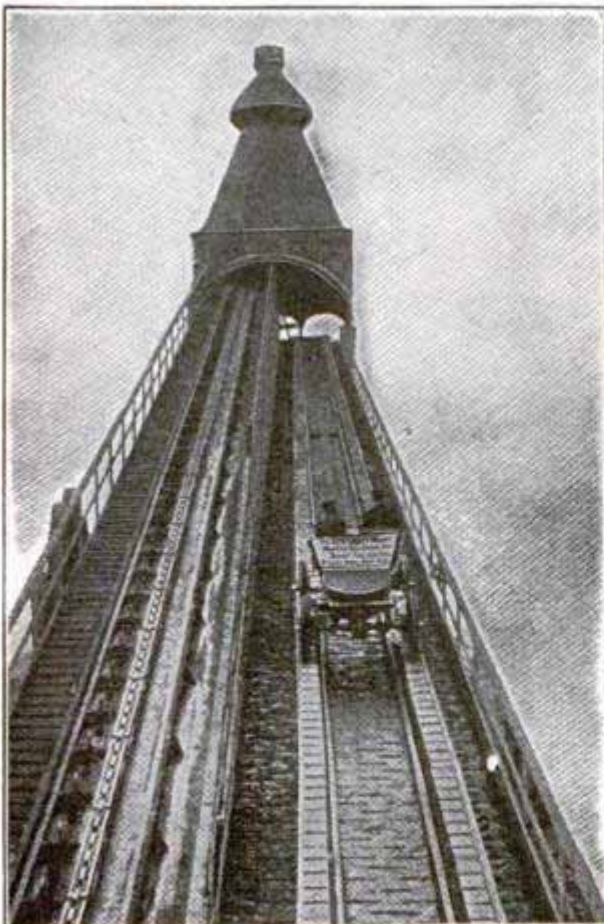
High-Speed Auto Sleigh

RAILWAY ABANDONS GREENHOUSE

The big greenhouses erected and operated by the C., B. & Q. Ry. at Aurora, Ill., have been torn down to make more room for the locomotive blacksmith shop. The novel undertaking—for a railroad—will now be abandoned, and hereafter flowers will be purchased of professional growers. The greenhouses cost \$12,000 and were built to supply cut flowers for the road's dining cars and potted plants for ornamenting depot grounds along the line.

REMARKABLE AUTOMOBILE PERFORMANCE

One of the most remarkable demonstrations of hill climbing was given on the chutes in a Pittsburg park. The grade is 33 per cent and 285 ft. long. The car was a 32-hp. and carried two persons. The ascent was made at an average speed of 14 miles per hour. At the top it was turned on a turn table and the descent accomplished at 8 miles per hour. Half way down the car was stopped, after which the brakes were released, and the car struck the water at a 16-mile rate, but was run through the pond to the farther end, where it climbed out with its own power.

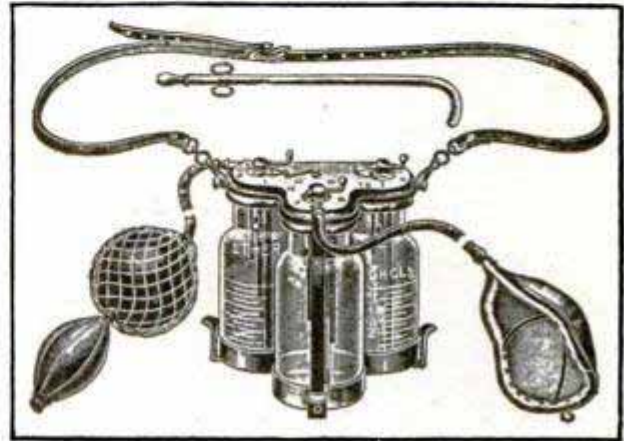


Motor Car Climbing Chutes

ANESTHETIC APPARATUS

Administers Chloroform, Ether or Oxygen as Required and Greatly Reduces Danger

A greatly improved apparatus for use in surgical work was demonstrated by its inventor, Dr. James T. Gwathmey, of New York, at the American Medical Association, and is described in detail in the Journal of the Association. The apparatus consists of



Administers Anesthetic Without Danger to Life

two 6-oz. bottles, one for chloroform, one for ether. Both bottles are placed on a tin vessel containing thermalite. This "thermalite warmer," if placed in boiling water for three minutes, will stay warm for over one hour and a half. If the heat is to be continued, this can be accomplished by simply taking the stopper out, thus exposing the thermalite to the atmosphere. The liquid now begins to re-crystallize and in turning to a solid again gives off heat for another hour and a half. Or the instrument can be boiled for three minutes, cooled immediately by placing in cold water, and the stored heat turned on at any time needed by taking out the stopper, and thus starting up re-crystallization.

The small switches on the top of each bottle are so arranged that chloroform or ether, combined or separately, can be given and in any strength desired. All of the vapor being warmed, it is more respirable, reducing the after effects, and at the same time increasing its safety as regards life. In each bottle are three tubes varying in length from one which reaches the bottom of the bottle to one that penetrates only the stopper. These tubes represent three degrees of vapor strength. For a strong man the longest tube is used, representing nearly 2 per cent; the shortest, only $\frac{1}{10}$ per cent vapor. By starting with an administration of cologne and gradually turning on the anesthetic the

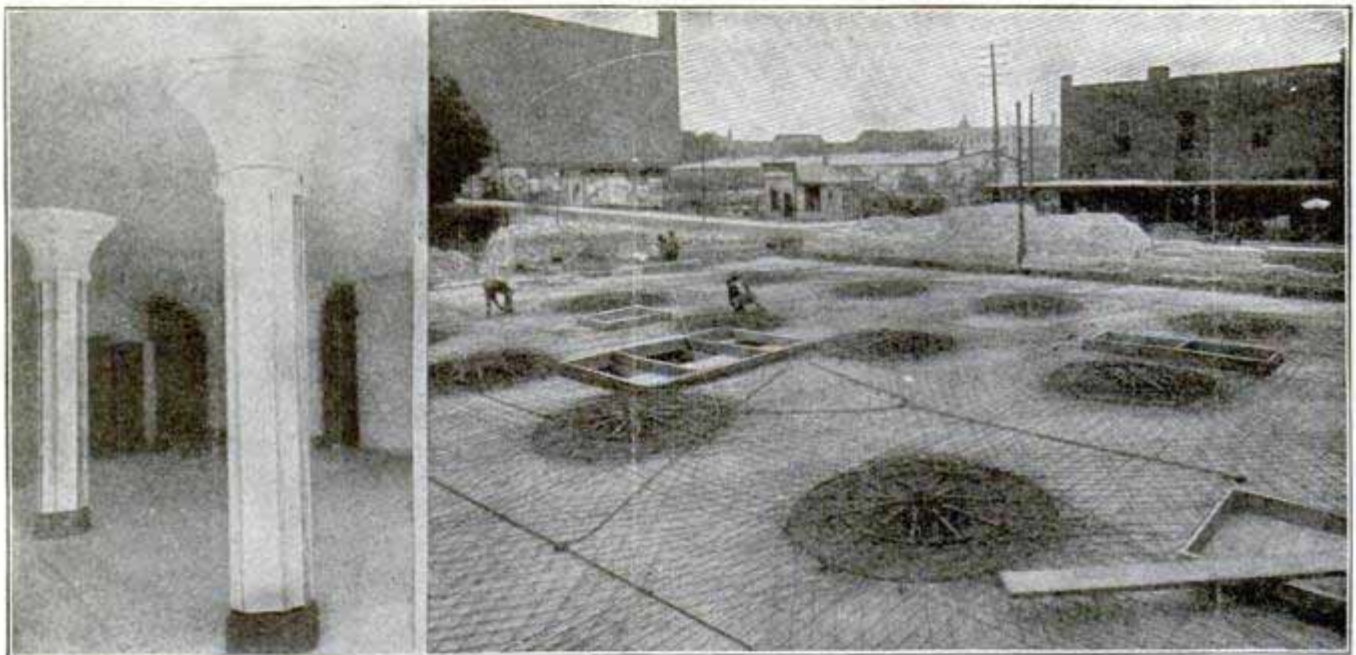
patient is entirely unaware of the change, and sinks into a quiet and natural sleep.

Dr. Gwathmey urges the warming of the chloroform as greatly decreasing possible danger, and states that in tropical climates chloroform is given with less danger to life than elsewhere.

NEW SYSTEM OF CONCRETE FLOORS

Solid Slab of Concrete--No Beams Used

A Minneapolis engineer has invented a new type of concrete floor construction which he has named the "mushroom" system. By this plan a network of steel rods radiate from the top of each concrete pillar



Concrete Floor Reinforcement Plan--No Beams Used

and when covered with cement harden into a solid mass, making the entire floor practically a single sheet of stone. The pillars are made by pouring the concrete into cast-iron moulds which can be removed as soon as 15 hours. The form work for the floor is wood, which is taken down and used over and over.

In a five-story wholesale grocery the pillars were placed at intervals of 16 ft. and 18 ft. and the floor stood a test load of 750 lb. per square foot. The system is said to effect a great saving over the usual timber mill construction, amounting in the case of one medium sized warehouse to \$10,000.

The "Colima," a 50-ft. Philadelphia tug, safely made a 12,000-mile voyage from that city to the west coast of Mexico, passing around Cape Horn. The trip took 100 days.

PANAMA PIPE LINE

The pipe line for transporting oil across the Isthmus of Panama is now in operation. Tank steamers on the Pacific will bring the crude oil from California, and a fleet on the Atlantic side will distribute the fuel to Atlantic seaboard cities. The pipe line is 52 miles long and will deliver 25,000 bbl. a day.

WOOD USED FOR PULP

While the destruction of forests to furnish material for paper making is great, it amounts to only 4 per cent of the annual

production of lumber. In 1905 there were 237 mills manufacturing wood pulp, and during that year they consumed 3,192,222 cords of wood, valued at \$17,735,000, and produced 2,084,000 tons of pulp. The bulk of the wood for pulp is found in 12 states, and at present rate of consumption the wood supply averages 21 years per state.

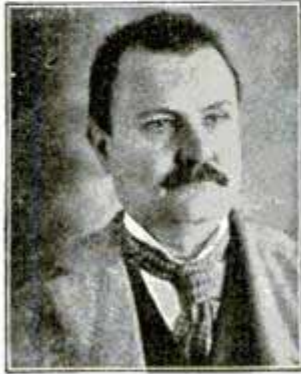
CHANCE FOR INVENTORS

The prediction is made that cement will soon be shipped largely in bulk on account of the increasing cost of bags and barrels. There were 40,000,000 barrels of cement made in this country last year. There would seem to be a good field for the inventor to provide some improved package in which to ship cement.

WILL WIRELESS LOCOMOTION SOLVE THE PROBLEM OF AERIAL NAVIGATION?

By Edward E. Harbert

Some years ago, before wireless telegraphy was developed to its present state of perfection, I conceived the idea of a new form of antennae, little dreaming that my device would some day aid in solving the problem of aerial navigation, but as will appear later, my invention was destined to become an important factor in this wonderful achievement.



E. E. Harbert

The adoption of my device for this purpose was brought about by the construction of a wireless electrical flying-machine, which only lacked suitable means for collecting the electrical waves to make the machine a success.

The machine was constructed by Captain Raymond Anglemire and Prof. Howard Tazewell, of Boston, and consists of three of Dr. Bell's tetrahedral kites, a large lifting propeller, and a wireless electric motor direct-connected to the propeller by means of a vertical shaft.

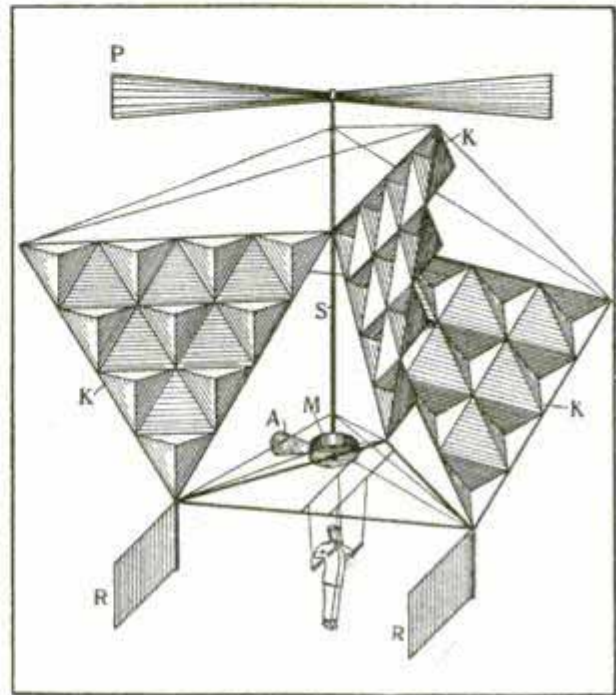
Captain Anglemire selected my antennae as the most suitable for this purpose because of their extreme lightness and large area of exposed surface and because they possessed the additional advantage of receiving the electrical waves with equal efficiency from all directions.

When Captain Anglemire first outlined the undertaking to me it seemed so unfeasible to my understanding that I would have dismissed the proposition without any further consideration had it not been for my implicit confidence in his ability and admiration for his achievements, but after being honored with the privilege of witnessing the first ascension that was ever made in a machine heavier than air I feel fully repaid for my contribution to the enterprise.

The test was made August 27 at Brantford, Ontario, the city in which Alexander Graham Bell resided when he invented the now indispensable telephone. A small lake near the outskirts of the city was charged with electricity, the current being taken from a nearby trolley wire and passed

through some kind of a transforming device, which was furnished by Prof. Tazewell. A number of railroad ties were floated on the surface of the lake and these were all connected by a wire, which carried the current.

The number of spectators was limited to a few friends and two newspaper reporters, and no photographs were allowed to be



KKK—Dr. Bell's Tetrahedral Kites; P—Propeller; S—Shaft; M—Wireless Motor; A—Antennae; RR—Rudders

taken during the test, as the details of the system of wireless locomotion will not be divulged at present.

When everything was in readiness Prof. Tazewell took his position at the switch and Captain Anglemire suspended himself beneath the slender framework of the machine. "All right," he said, and Prof. Tazewell turned the switch. Instantly there was a cracking noise accompanied by flashes of light which appeared all over the surface of the lake. The wireless motor quivered and then began humming with ever increasing acceleration until the huge propeller lifted the machine from the ground. At a height of 200 ft. Captain Anglemire signaled Prof. Tazewell, who turned off the current gradually and thus allowed the machine to descend slowly to the ground.

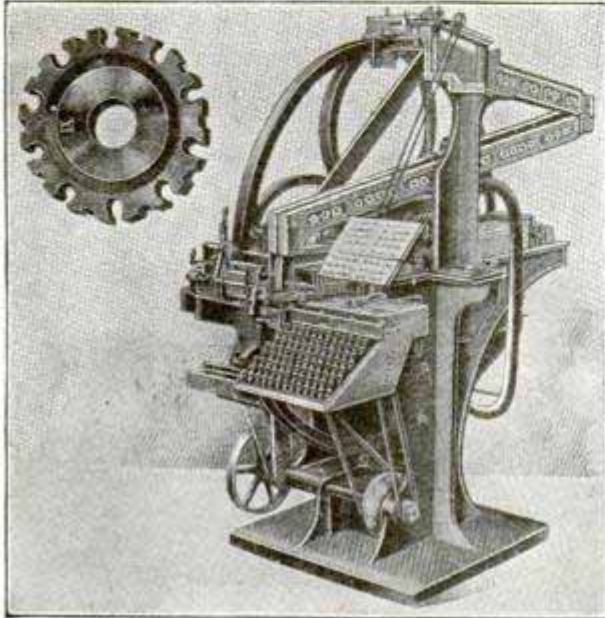
The test proved fatal to many of the small fish and frogs that inhabited the lake, but proved beyond all doubt the possibility of operating a flying-machine heavier than air.

Should any of our readers wish information which this article does not furnish, the author will be very glad to answer any letters addressed to him at his residence, 1627 Briar Place, Chicago.

SIMPLE NEW TYPE COMPOSING MACHINE

A new type-composing machine said to be capable of composing 6,000 letters per hour with $\frac{1}{8}$ -hp. is called the rototype and is the invention of an Austrian.

The principal movements of the machine are rotary and, as in some other machines, each line is cast in a single block.



Rototype and Matrix

A great central wheel, resembling an ordinary fly-wheel, carries upon its periphery at equal intervals four collectors which receive the separate matrices for each line. Each matrix is in the form of a 10-sided disk for 10 characters, some disks being thin for the letters i, l, etc., and others thick for the capitals M, W, etc. The magazine for the matrices has a sharp incline down which they roll by their own weight. The matrices may be seen through apertures in the sides of the magazine from which they are transferred to the carriers by means of a rapidly revolving friction wheel. An ingeniously arranged magnifying glass enables the operator to watch the progress of the work. The magazine is double and carries both roman and italic characters.

The keyboard has 96 keys. As soon as the line is set and molded, it is trimmed and smoothed and pushed out of the mold by the mechanism, and falls upon a moving table which carries it to a workman, who places it in a galley. The matrices are returned to their correct places in the magazine automatically.

The rototype has many advantages; the operator can turn the wheel backwards to

correct mistakes and he can cast the same line many times in succession if desired. There are 60 matrices of each kind, which places 1,200 characters at the disposal of the operator. No water is needed for cooling the castings, as the melting pot is so remote from the operator that he does not feel the heat. The flames are automatically regulated so that the temperature of the metal is always the same. Petroleum burners can be used when gas is not available.

COST OF DIGGING COAL

The average cost of mining soft coal is stated by the Coal Trade Journal to be 60 cents per ton, to which must be added 30 cents for other labor by the time it is in the car at the mines. With soft coal selling for \$1 a ton at the mine, the claim is the operator is making no money after paying for the other expenses than labor. The cost of mining hard coal is put at 60 cents, with \$1.20 additional for other labor.

LARGEST CONCRETE STANDPIPE IN THE WORLD

A concrete stand-pipe 40 ft. in diameter and 100 ft. high was built at Attleboro, Mass., about a year ago at a contract price of \$34,000, the best bid for a steel stand-pipe being \$37,500. The lower first cost is not the only advantage in favor of concrete for this purpose. In the old steel stand-pipe of much smaller size over two tons of scale was removed annually and the safe life of a steel stand-pipe is only 20 years, while a concrete stand-pipe lasts indefinitely.

AUTOMATIC SPRING FINDER

A Swiss inventor claims to have perfected an instrument which will automatically indicate the presence of subterranean water, and believes it will also locate veins of oil. The apparatus is mounted on a tripod, and a needle moves from its normal position when over a spring or sheet of water.

Some of the European scientific journals express considerable doubt as to the reliability of the instrument. The inventor's name is Adolph Schmid.



RAPID DEVELOPMENT OF THE MARINE STEAM TURBINE

[Condensed from a paper on Turbine Vessels, by R. J. Walker, read before the Engineering and Machinery Exhibition, Olympia.]

The development of the marine steam turbine has been remarkably rapid, especially when it is remembered that builders of sea-going vessels are much more reluctant to experiment with their machinery than users of power on shore. It is only 12 years since the "Turbinia," a single screw 1,500-hp., was built. Although several types of propellers were tried, the results were quite disappointing, as a speed of only 18 miles per hour was attained under best conditions.

The English navy then built two torpedo boat destroyers and electrified the marine with one of them, the "Viper," which, with a speed of 36.86 knots per hour, took rank as the fastest vessel in the world. The "Viper" and her sister, the "Cobra," were both wrecked, and in 1900 the "Turbinia" remained the only turbine steamer. In 1901 the commercial steamer "King Edward" was finished, and her trial trip attracted marine engineers from all parts of the world. Other vessels followed rapidly, until now there are 31 turbine steamers, with a total of 105,000 gross tonnage and a combined horsepower of 235,000.

The development from the "Turbinia," 100 ft. long, only 44 tons displacement, and 1,500 indicated horsepower, to the big Cunarders, "Lusitania" and "Mauretania," 785 ft. length, 45,000 tons displacement and 70,000 indicated horsepower, is shown in the profile illustration from the Shipping World, in which all the vessels are drawn to the same scale.

Careful records during the past six months of turbine and paddle boats crossing the Channel show a saving of 15 per cent in time in favor of the turbines, and for the same displacement a saving of 25 per cent in coal.

Uncle Sam will now proceed to build the largest battleship ever floated.

RUBBER FROM WHEAT

An English inventor, son of a wealthy silk manufacturer, declares he has made rubber from wheat and that his process is commercially practicable. If his claims prove true he will revolutionize the rubber business. His name is William T. Carr.

He insists his new product is genuine rubber, and not an imitation or substitute,

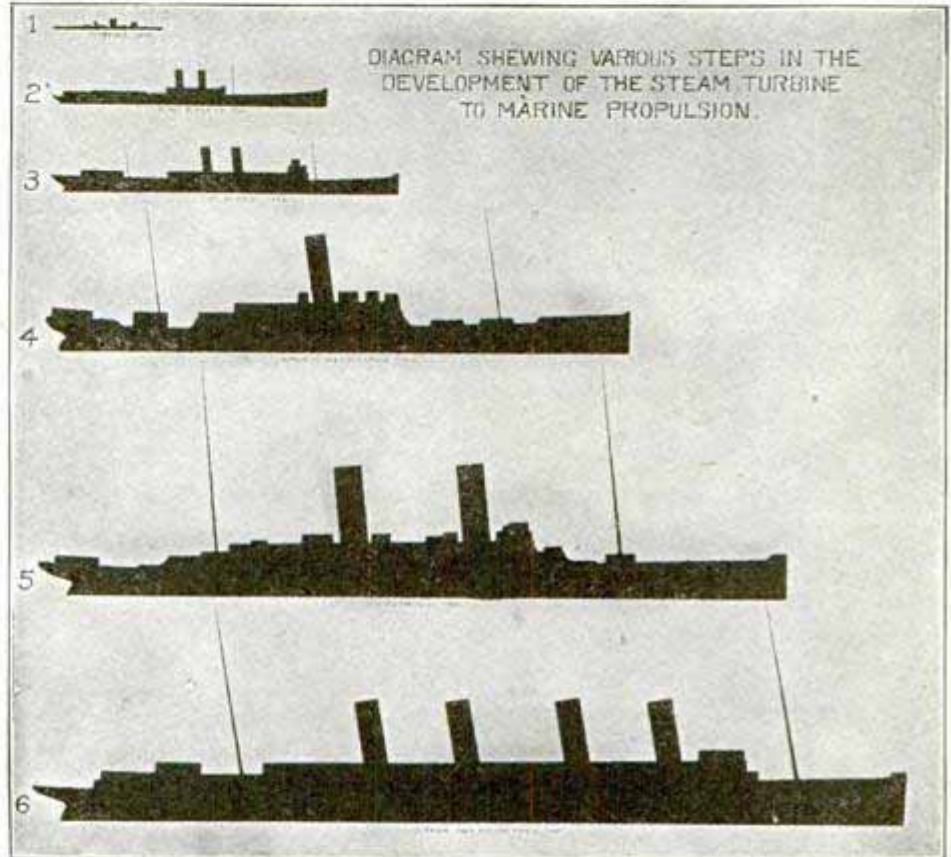


Fig. 1—Turbinia, 1894; Fig. 2—King Edward, 1901; Fig. 3—The Queen, 1903; Fig. 4—Victorian, 1904; Fig. 5—Campania, 1906; Fig. 6—Lusitania, 1907.

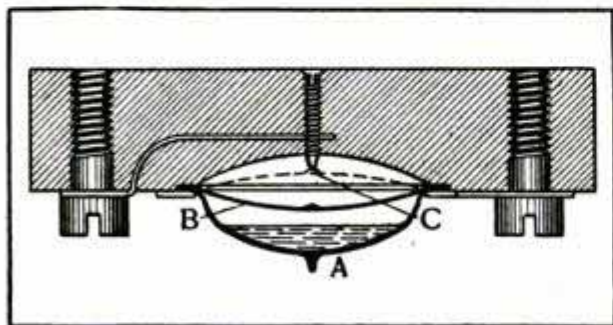
and in proof shows samples which have been successfully vulcanized. Cereal rubber is made by a process in which the wheat is ground and subjected to a series of chemical treatments. The use of rubber is comparatively recent, really dating from the importation of 25 tons into England in the year 1830.

The difference in time—1 o'clock in the afternoon at New York when it is 10 a. m. at San Francisco—is offered as an objection to a long distance telephone service between the two cities. The business day in one city would be more than half over when beginning in the other.

Wireless telegraph stations have been installed at two ports on the west coast of Mexico.

TESTING IN THE UNDERWRITERS' LABORATORIES

"They did everything but smash it with an ax," said one discouraged inventor, who had for the second time submitted his invention to the Underwriters' Laboratories, only to have it returned in many pieces, unaccepted. The invention, which comprised reciprocating mechanical movements and electrical contacts, was intended for use in



Suicide's Device

damp places where it would be subject to the effects of moisture, and for this reason the first test was that of placing it under water for a few weeks. It was then removed and, being found defective on account of its rusted condition, was returned to the inventor. He then reconstructed the device, using materials that would not rust, and submitted it again.

This time it was given the mechanical test. A small electric motor was geared down and connected in a way that would operate the device continually. After running two days, one of the parts became broken, thus breaking many other parts and ruining the device, which was again returned to the inventor.

Not long ago an inventor became so discouraged when his device was rejected that he committed suicide. His invention, which is shown in the accompanying sketch, was intended for use in ringing a bell when the temperature exceeded a certain degree. A small metal cup, A, was partly filled with ether and hermetically covered with a flexible metallic diaphragm, B, which was raised by the expansion of the ether when heated, thus making contact at C and sounding the alarm.

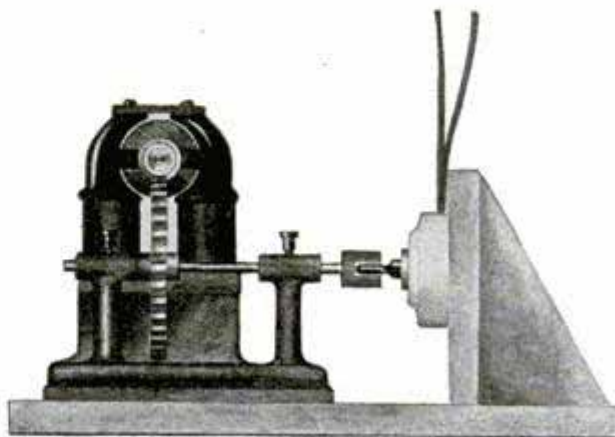
The device worked perfectly in the hands of the inventor and never once failed to operate in the many tests that he gave it, but in the laboratories the first test resulted in failure. As the device was intended for use on ceilings in factories and other places where calcimine is used, it was given the

whitewash test. This was done by lowering it in a barrel of whitewash, where it was allowed to remain for some time, after which it was dried and tested. The result was that the whitewash had covered the contacts and thus prevented the closing of the circuit.

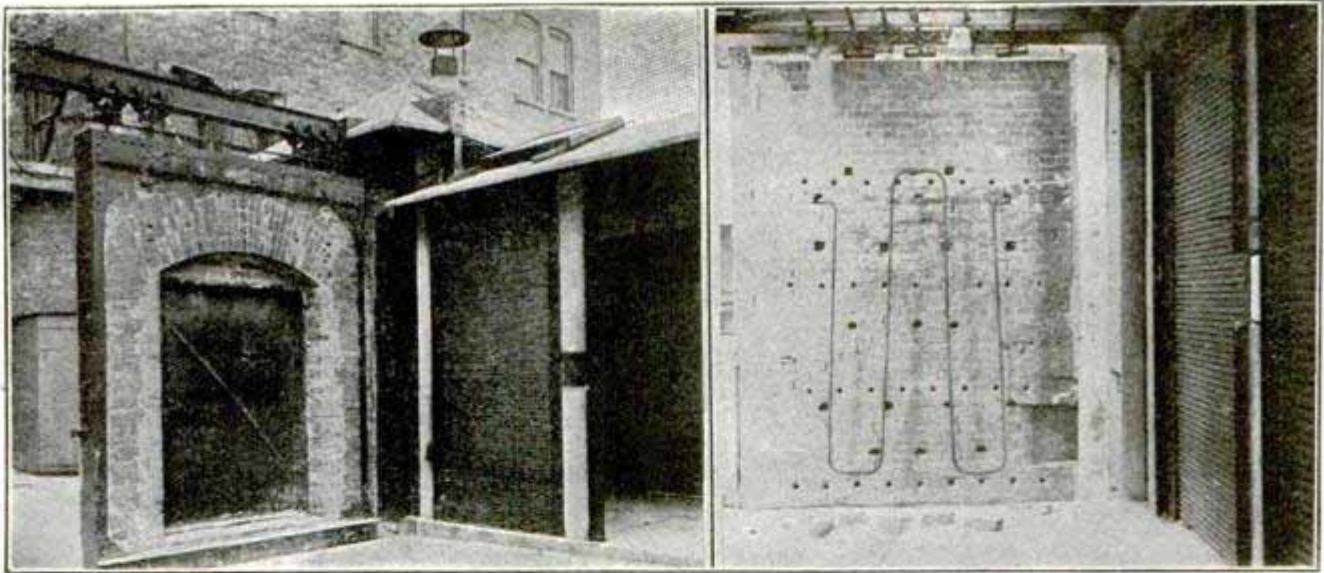
Although seemingly severe, the tests performed in the laboratories are usually no more exacting than is necessary to determine the truth of an enthusiastic inventor's claims, and while the laboratories are indirectly responsible for the loss of one life, as mentioned above, they would be directly responsible for the loss of many lives if a device were allowed to pass which would fail to operate at the critical time.

In order to prevent enterprising electrical manufacturers from overrating the capacity of switches, electrically operated testing machines have been provided, which automatically open and close the switches with the rated current passing through them. The switch-testing machine shown in the illustration can only be used for testing switches that operate by turning, other machines being provided for testing push switches and throw switches. Every switch must stand at least 6,000 operations before it is accepted and at the end of the test the contacts must be in good condition and unburned, as a defective contact is liable to cause a fire.

The testing of some devices involves considerable expense and mechanical ingenuity. Thus for testing fireproof doors and windows the special testing oven shown in the illustration was constructed. In these tests the exact conditions of a fire are produced as nearly as possible, and for this purpose a large, oil-heated oven is built, having an arched partition constructed of fire brick and capable of being drawn out on an



Switch-Testing Device



Exterior and Interior of Testing Furnace

overhead trolley track, like a sliding door. The object of constructing the partition in this way is to allow withdrawing the heated window or door, which is then deluged with water from a fire hose, thus giving it the same severe treatment it would very likely undergo during an actual fire.

In order to determine the insulating properties of the window or door that is being tested a fireproof room is constructed as shown at the right in the illustration. In this room are placed strips of cloth, or other material of an inflammable nature, at varying distances from the door or window that is being tested. The distance at which the cloth becomes scorched will then indicate the degree of insulation of the door, which is placed between the cloth and the fire.

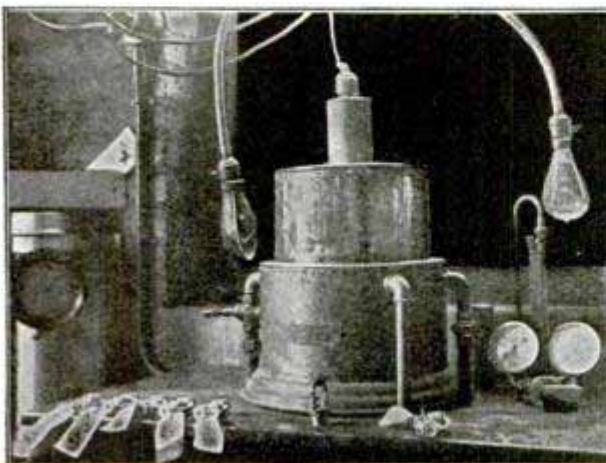
As the insurance companies depend more on the automatic sprinklers than on any other device for the prevention of fire, extreme care is used in testing the sprinkler heads turned out by the various manufac-

turers. If a sprinkler head is claimed to operate at 165° it is raised to that temperature with the normal pressure applied, and if it fails to operate it is rejected. The device for performing these tests consists of a glass box containing a connection for the sprinkler head and a thermometer. A gas burner underneath supplies the necessary heat and the pressure is supplied by means of a small pump.

ENGLISH CHAINS BEST

Mariners say the hand-made chains from South Staffordshire, England, are the best in the world. The excellence of the chains is partly in the selection of a special grade of iron, but chiefly in the skill of the workmen.

Recognizing this fact, some German manufacturers have tried for years to secure some of the English experts who are known to possess the secret. Their efforts were fruitless until recently, when six of them were induced to go to Germany. Alarmed at the prospect of a rival in the business, the English firm made such attractive offers the men returned to their old places. Now the Germans claim to have discovered the secret so carefully guarded for two centuries, while the English maintain they have done no such thing. The fact is both sides are guessing whether Germany really has found out or not.



Sprinkler Head Tester

An American engineer claims to have discovered cement worker's tools in one of the Egyptian pyramids, and believes these monuments were built of cement.

LAKE STEAMER AFTER COLLISION



Effects of the Collision

The accompanying photograph pictures the result of one of the collisions of the present season on the Great Lakes, when the steamer "Eugene Zimmerman" was sunk in the "Soo" river by the steamer "Saxona." After being on the bottom five weeks she was pumped out, raised and towed to the "Soo," where her cargo was unloaded, a patch having been put over the hole in her bow. She was next brought to the shipyards at Cleveland and has since received an entirely new bow. All the plates and frames forward of the collision bulkhead were broken or bent out of shape. In bringing her to

Cleveland a temporary wooden bulkhead was constructed aft of the collision bulkhead.

SMALLEST CHURCH IN THE WORLD

At Penon, Mexico, a suburb of Mexico City, may be seen what is perhaps the smallest church in the world. It nestles under the shadow of a small volcano. The church is about 10 ft. high and 12 ft. wide. Modern Mexico says: "Whenever a couple is married at the little altar of the church there is barely room for the groom and bride to turn around at the same time."



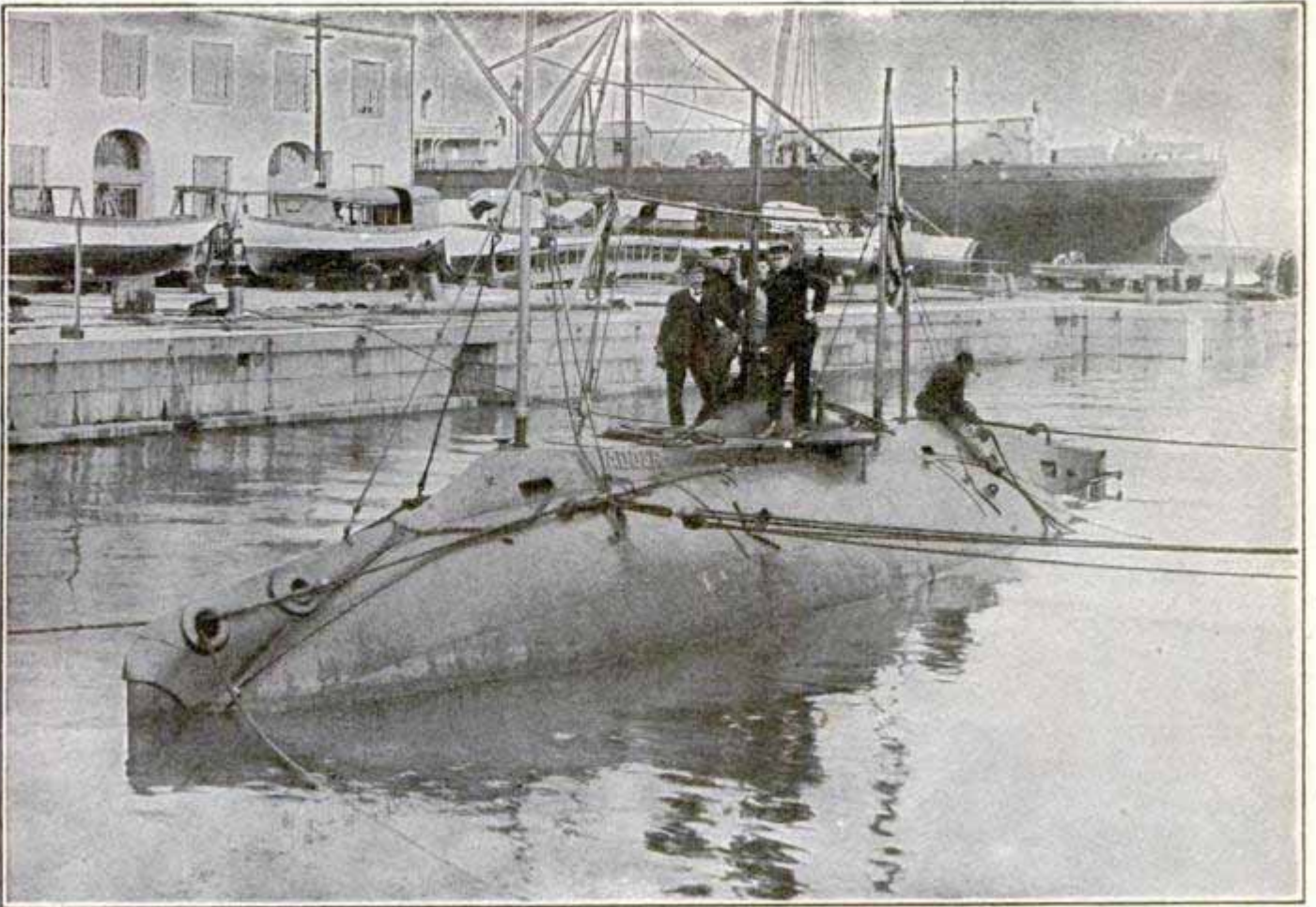
Church 10 Feet High

SHIP WITH ICE CARGO WILL NOT SINK

Ice as cut for use—not the piece your ice-man delivers—certainly appears to be a heavy commodity, and abundantly able to sink a ship which might spring a leak. But quite the contrary is true, for a vessel loaded with ice will not sink—at least not until the ice has nearly all melted. A Boston firm had a ship loaded with ice waterlogged in the Indian Ocean, and it drifted helplessly for one entire month before the warm water melted the ice to a point where it could no longer float the hull. Had the accident occurred in the North Atlantic the ship would have remained afloat, though partly submerged, for many months.

The Cunard steamer "Mauretania," recently launched, will burn enough coal on each trip to keep 3,000 small houses warm for a year.

The Trans-Alaska-Siberian railway, plans of which were recently described in these pages, has been incorporated at Jersey City.



Courtesy The Blue Jacket

U. S. S. Submarine Boat "Adder"

REGULATIONS FOR DENATURED ALCOHOL

The Commissioner of Internal Revenue has issued regulations concerning denatured alcohol from which the following is condensed:

There will be two classes of denatured alcohol—first, that styled "completely denatured," which will pass into general use for general consumption, and can be purchased at the stores without limiting regulations as against the private consumer; and second, "especially denatured," in which the material demanded by the needs of manufacturing interests will be regarded. As to this latter there are limitations confining it to the special manufacturing industry for which it is prepared.

For the completely denatured article 10 parts of wood or ethyl alcohol and $\frac{1}{2}$ part of benzine will be added to 100 parts of ethyl alcohol. In other words, to every 100 gal. of ethyl alcohol will be added 10 gal. of wood alcohol and $\frac{1}{2}$ gal. of benzine.

The denaturing process will be accomplished on the distillery premises where the alcohol is produced, in special bonded

warehouses designated and used alone for denaturing purposes and for the storage of denaturing materials. These buildings and the operation itself will be under closest governmental inspection and control. Denatured alcohol will supplant very largely the consumption of wood alcohol for both domestic and manufacturing purposes, as it will be cheaper.

While the price of the completely denatured product can not now be definitely stated, it is believed it will not be more than 35 cents a gallon. The price of the specially denatured alcohol will naturally vary according to the cost of the denaturing ingredients selected to meet the necessities of the manufacturing industries. These special formulas will only be used where it is made perfectly apparent to the Department that the industrial interests involved can not use completely denatured alcohol by reason of the presence of wood alcohol or benzine. In that case some other denaturing agent or agents, which will accomplish the purposes of destroying, as far as possible, the potable or beverage qualities of the alcohol, and at the same time adapt the denatured article to the special ends desired, will be determined upon.

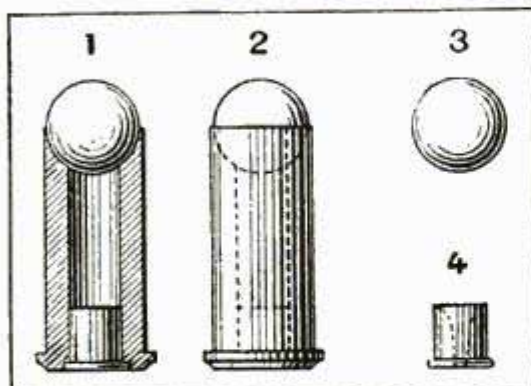
BLOODLESS DUELING WITH WAX BULLETS

Armies May Adopt New Harmless Projectile for Practice Shooting

Shooting at human targets merely for the sport derived from it and as a test of marksmanship; in other words, bloodless dueling or fencing with pistols, has been made possible through the invention by a Frenchman of a harmless wax projectile. This new diversion is really no more serious than fencing with swords, and has that spice of realism in it that tends to make any sport popular.

The new bullet is an ingenious device and required a great deal of experiment before being perfected. The situation was thus: A heavy projectile must necessarily have a wounding force, a light one loses its precision and a soft bullet will be changed in shape and describe an irregular trajectory; therefore a harmless projectile to be effective must differ from all these. The Frenchman's product is a spherical ball of wax and fat, with a small charge, and in tests 24 balls were lodged in succession in a rectangle 4 by 5 in. at 20 yd. At a 6-day tournament held in the Tuileries the efficiency of the wax bullet was demonstrated.

The combatants wear thick screens for masks, with heavy glass over the eyes, and wear thick clothing to prevent bruising from the impact of the balls. The distance

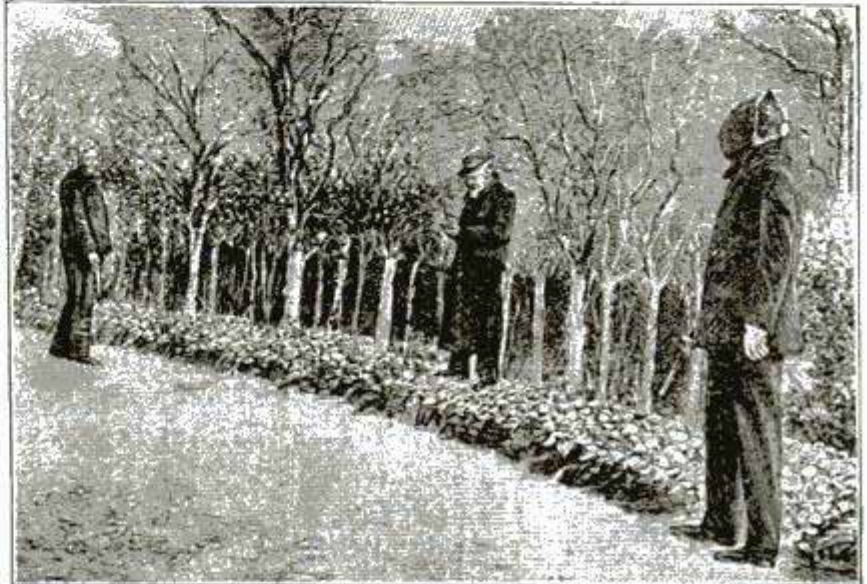


1, 2. False Steel Cartridge for Shooting New Bullets.
3. Bullets of Wax and Suet, Caliber .44.
4. Priming Device.

is 25 paces and the weapons are revolvers held as seen in Fig. 1. The director of the combat, keeping his gaze fixed upon a metronome which beats 80 to 100 times a minute, makes the inquiry as in an actual duel,

"Are you ready?" and when they reply "Yes!" the director, timing his words exactly to the beats of the pendulum, cries, "Fire—one—two—three!"

At the command "Fire!" the adversaries raise their weapons and shoot. The two shots must be made before the command "Three!" As the participants in these trials were experts, they made a good average, hitting their man 6 or 7 times out of 8 shots. Although more than 1,600 balls were



Dueling with Wax Bullets

fired, there was not the slightest accident.

The wax bullets can be used in apartments as well as in the open air, without the inconvenience of the lead ball of small caliber, says *La Nature*, which will probably lead to its introduction into the armies of the various nations for practice shooting.

SUBMARINE SIGNAL SYSTEM ADOPTED

The U. S. Lighthouse Board has decided to extend the submarine signal system to a number of important lightships on the Atlantic coast as a result of tests made the past summer. The submarine bell and its operation were fully described in the August, 1905, *Popular Mechanics*. Signals were transmitted and read as far as 15 miles. The lightship sounds its number on a submarine bell hung over the side of the ship at a depth of 15 or 20 ft. The navigator receiving the signal locates the lightship by referring to its number on his chart.

A trolley line will be built from the steam railroad to the pyramids at San Juan Toetihauca, Mexico.

MAKING ALCOHOL FROM SAWDUST

A Valuable Use for the Waste of Sawmills

By Carl Shelley Miner

Wood alcohol is made by heating wood in the absence of air, under which conditions vapors are given off and charcoal left behind. This process is called dry distillation. The vapors are cooled and condensed to a liquid. This liquid is separated into its constituents, one of which is wood alcohol. That wood alcohol should be the product of wood, and grain alcohol the product of grain is only right and natural. That grain alcohol should be produced from wood is upsetting the natural order of things. However, upsetting the natural order, or rather, what has been assumed to be the natural one, is the business of the chemist and, although in this case he has allowed the natural order to rest in peace for many years, he has now, at last, succeeded in proving it to be not natural, but wholly fictitious. With all calmness he announces that henceforth he will produce from wood either wood alcohol or grain alcohol (which will be referred to during the remainder of this article simply as alcohol) or both.

Fifty years ago a chemist discovered that by boiling sawdust for a long time in a fairly strong acid, he produced a sugar which could be fermented to alcohol. The yield he obtained was too small to make the process of any commercial value, and it was relegated to the realm of laboratory curiosities, a strange place where the scientist stores vast quantities of facts which the world is not yet ready to use. This was a tempting bit of knowledge to the chemist, however, for the financial reward to the investigator who should finally make this method commercially profitable, was sure to be great, and so hundreds of chemists have taken their turns at trying to solve the problem. Many of them have patented processes, but most of the patents were so much waste paper. The first patent to have even a vestige of commercial value was that of Simonsen, a Swedish chemist, who proposed to treat the sawdust with three times its weight of strong sulphuric acid at a high temperature and pressure. This method was difficult and expensive and did not give a good yield of alcohol. A number of patents were issued which were merely variations of this process, among

them being that of Classen, a German chemist. He treated the sawdust with strong acid and afterward submitted it to hydraulic pressure. He, however, was not satisfied, and went on gradually perfecting a method, taking out patents as his work progressed, and, finally, about three years ago, he patented a process which is now in successful operation in this country.

The process is designed especially to make use of waste material of saw mills. When you realize that for every thousand feet of finished lumber a ton of wood waste is produced, it is evident that the amount of raw material available for this process is simply enormous. The plan is, of course, to establish the alcohol plants in connection with the saw mills and to utilize their waste wood, which can be obtained for almost nothing. As outlined in the patent, the process is comparatively simple, and the reports of a number of excellent chemists, as well as the results obtained in a factory already established in Mississippi, show that it can be worked on a commercial scale. The sawdust, or wood waste, in pieces up to the size of a lead pencil, is dampened and placed in a large cylinder, which is lined with lead so as to resist the action of the acid used during the process. Then sulphurous acid, which is the acid formed by running the gas from burning sulphur into water, is introduced, in the proportion of 1 part of 3 per cent sulphurous acid to 3 parts of wet sawdust. The cylinder is revolved, in order to thoroughly mix the contents, which are rapidly heated up to 300° F., the temperature corresponding to a steam pressure of 52 lbs. The mass is kept at this temperature and pressure for about an hour. During this treatment the sawdust shrinks to about two-thirds of its original bulk, and takes on a brownish color. At the end of an hour the steam and acid (the acid being gaseous at this temperature) are blown off, and the acid saved to be used again. The sawdust is thoroughly washed with water in order to extract all the sugar which has been formed. This solution is then treated with lime to neutralize the small amount of acid it contains, and yeast is added. The fermentation begins almost immediately,

and is practically complete after eight hours. It is in this particular that the Classen method has been found to be superior to the other methods which have been tried and have failed, for in most of them it was very difficult to start the fermentation, which proceeded very slowly and was not complete even after several days.

After the fermentation is complete, the liquor is distilled and the alcohol purified in exactly the same manner as the alcohol from corn, and the resulting product is ethyl alcohol, differing in no way from the best grades of ethyl alcohol produced from grain, potatoes or molasses. The yield is excellent, amounting to 25 gal. of absolute alcohol per ton of wood, and this value is about the same for all available woods. The sawdust from which the sugar has been extracted may be used for the manufacture of charcoal and the usual products of the wood distillation process—wood alcohol, acetone, acetic acid and wood tar. It is also possible to make an excellent fuel by pressing the extracted sawdust in briquetting machines. In this way, a very hard briquette can be made without the use of any binding material. This part of the process is, however, at present undeveloped. Until recently, the process as above outlined was successful only in the case of pine or soft wood. For a long time it was found impossible to use hard wood waste because the tannin of such woods gave, during the acid treatment, products which subsequently interfered with the fermentation. A recent patent by Mr. Classen is designed to obviate this difficulty by removing the tannic acid

with iron and calcium salts previous to the fermentation, and this will probably open the way for the utilization of the large quantities of hard wood waste for which the process has heretofore been found useless. Although this is the only process now in operation in this country, there are several other process patents which seem likely to compete with it. One French patent, which combines the treatment with acids, high pressure and electric current, seems promising. Another patent involves the use of ozone and acid, and most of the others are mere variations of the acid treatment. As to the cost of production of alcohol by the Classen method, the industry is not sufficiently well worked out for that matter to be definitely settled, but it seems safe to say that it will not exceed the expense of producing alcohol from corn and, since the raw material costs practically nothing, it will, in time, be able to compete with alcohol from all sources. The one factory in this country has been operated intermittently for six months, and is said to be finally running on a satisfactory basis. The company which controls the Classen patents is planning to build five new factories. Though the amount of alcohol likely to be produced from wood waste is large, it is not likely to be more than a small percentage of the alcohol which this country will produce from all sources.

*Should any of our readers wish information which this article does not furnish, the author will be very glad to answer any letters addressed to him, at the Bryant-Miner Laboratories, 353-357 Dearborn street, Chicago.

ROOF TANKS IN LONDON

A handsome building was recently completed in London on the top of which was a roof tank 5½ ft. deep. The idea of these overhead cisterns is rapidly spreading. The illustration shows a view of one of these



Huge Tank on Roof

tanks which is 86 ft. long, 25 ft. wide and holds 2 ft. of water. Where roof tanks are desired the buildings are constructed with special reference to supporting the great weight of water.

Another practical use of the housetop has been inaugurated in New York City, where an open-air reading room has been provided for use in summer on the roof of one of the public libraries.

FRENCH SUBMARINE SINKS

The French submarine "Lutin," while in practice off the coast of Africa, sank in 110 ft. of water and the entire crew of 16 men were lost. To escape heavy seas the boat made a dive but turned over and in some way opened and filled with water. At this writing all efforts of both French and British relief ships had failed and the boat was still partly embedded in the sand.

INSTALLATION OF LARGE OIL ENGINES

Crude Oil is now Replacing Coal in Engines of from 5 to 2,000 Horsepower

By Trent Rossel, Consulting Engineer, De La Vergne Machine Co.

[Engines of as small as 5 hp. are now made, which use crude oil instead of gas or gasoline; until recently the oil engine was made only in large units.—Editor.]

Until recently the reciprocating steam engine has been used universally as a prime mover for large installations. The advent of the internal combustion engine in larger sizes during the last two or three years has altered the situation, and now installations are being frequently made where engines of this type are used in preference to steam engines.

engines as compared with the steam engine was not so great.

The rapid development on large internal combustion engines within the last two or three years has been remarkable, and a number of installations in which internal combustion engines have been used are now in satisfactory operation. One of the largest power plants in which oil engines

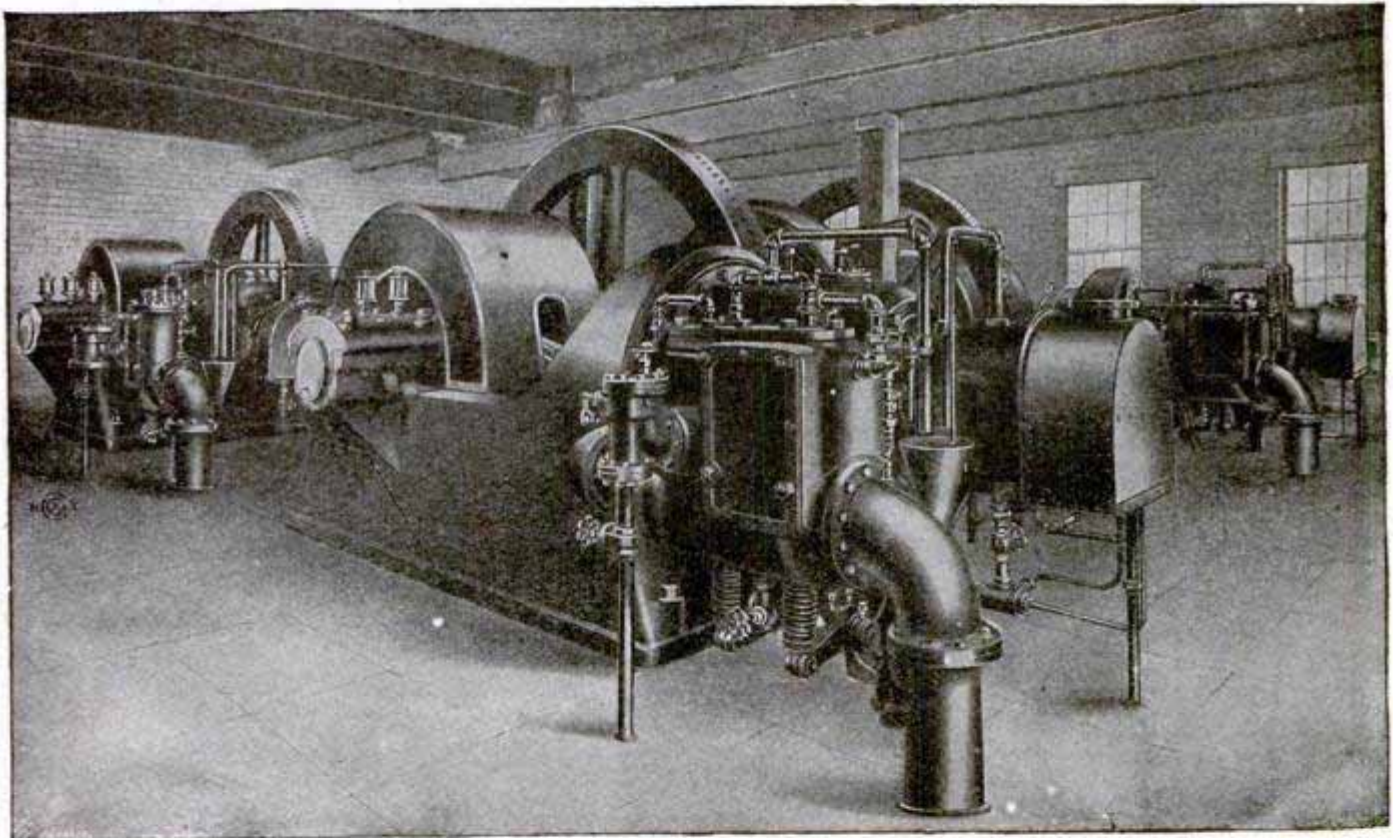


Fig. 1--250-Hp. Units--Oil Engines

The chief features to be considered in large installations are, first of all, economy, and, secondly, reliability in operation. In Europe, greater opportunities were offered for the development of the internal combustion engine than was the case in the United States and, consequently, installation of large engines is more common there than has been the case in this country hitherto. Owing to the relative cheapness of fuel in this country, the economy effected in Europe in favor of the large gas or oil

are used is that of the Baldwin Locomotive Works. Oil engines of a total capacity of over 5,000 hp. are now being installed there. The method of operation and the many advantages obtained by the use of these engines are so well known that it is not necessary to refer to them here in detail. They use fuel or crude oil, and consume a little less than a pint per actual horsepower per hour.

The 250-hp. engines are twin cylinder, each cylinder being 125 hp. Some of these

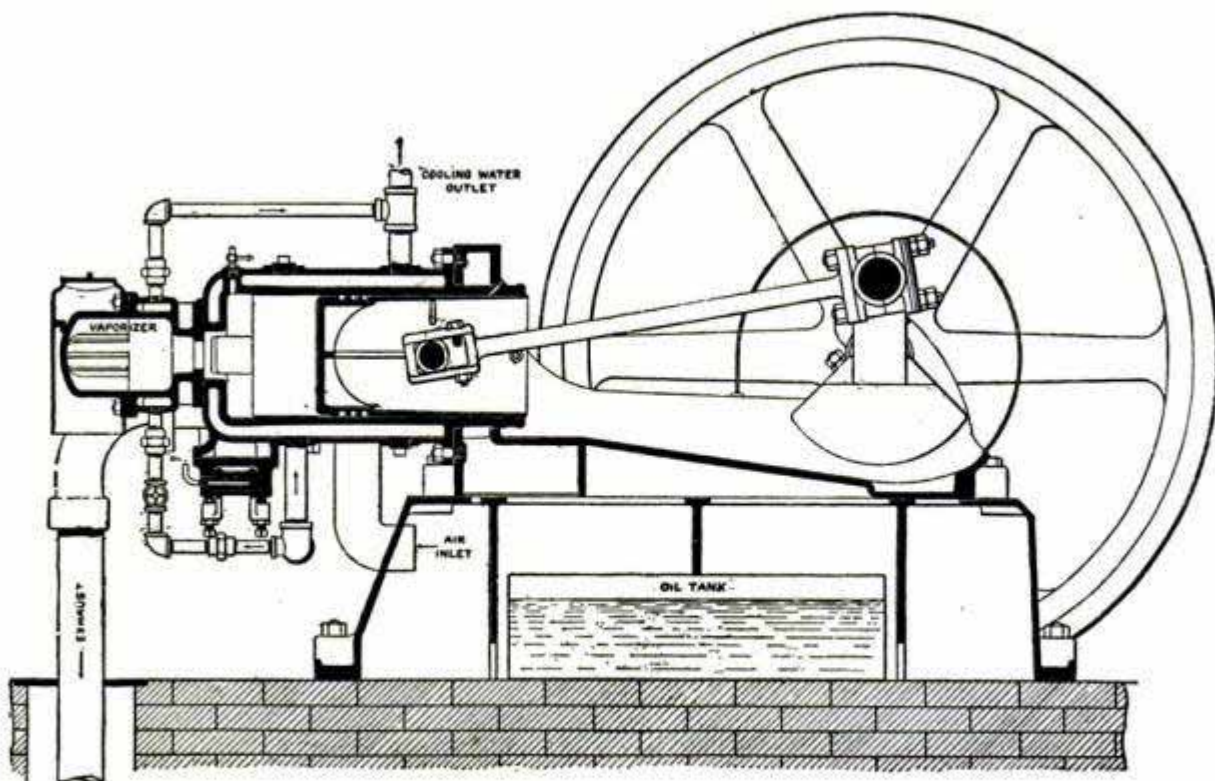


Fig. 2--Sectional View 125-Hp. Oil Engine

are direct connected to air compressors and some to generators, the latter being placed between the cylinders as shown in Fig. 1. The engines are run from Monday morning until Saturday night.

Figure 2 shows a sectional view of one of these engines, from which can be seen their method of operation. They run on the four-stroke cycle or that in which the piston on

one stroke sucks in the charge of air; on the second, an in stroke, the air, together with the fuel, is compressed. Just after the beginning of the third (out) stroke, the combustible mixture is ignited and, expanding by its own heat of combustion, exerts pressure on the piston, thus driving the engine. In the fourth (in) stroke the products of combustion are forced out of

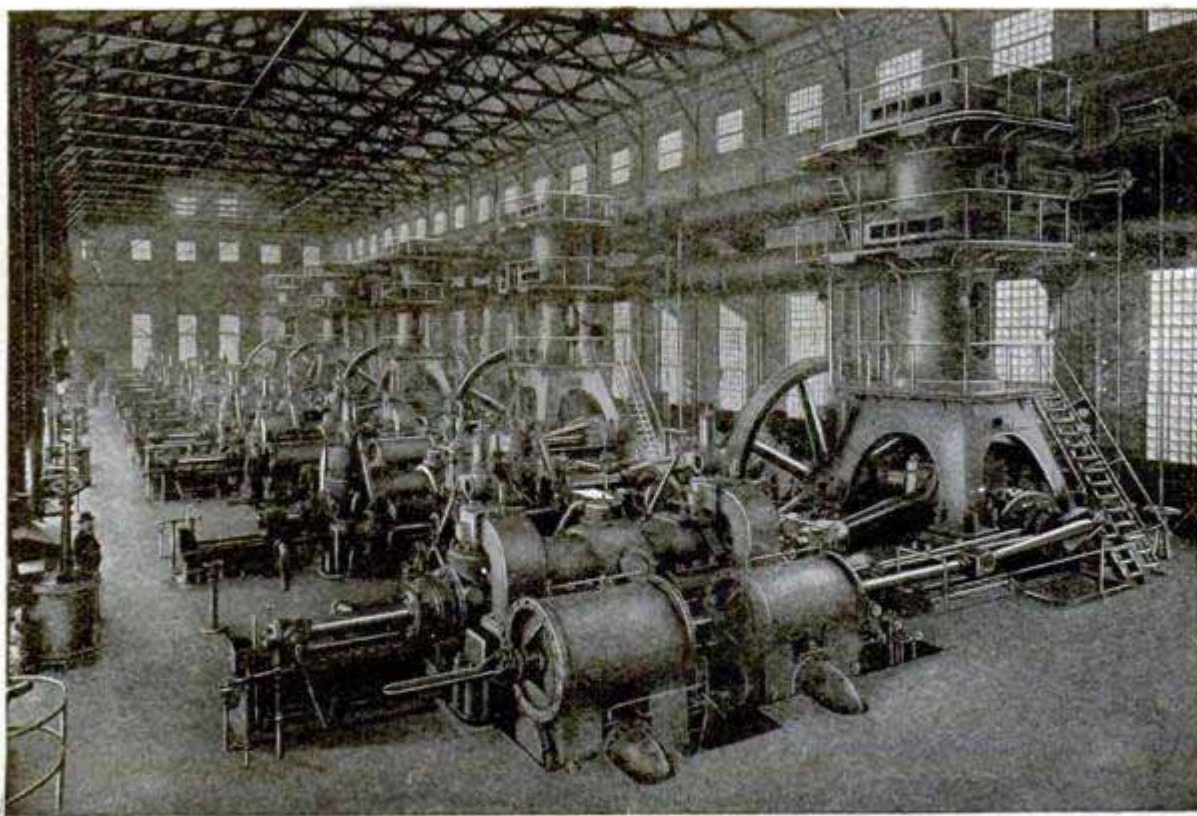


Fig. 3--Sixteen 2,000-Hp. Gas Engines

the cylinder. It will be seen from section A that the oil intended for fuel is kept stored in a tank in the base plate of the engine. From this tank the oil is pumped to the vaporizer, which is a cast-iron chamber connected by a narrow neck to the main engine cylinder. The vaporizer is kept hot by the combustion of gases within.

As the oil is entering the vaporizer a charge of air is drawn in through the port shown in the side of the main engine cylinder (section A). The oil is vaporized by the heat of the vaporizer walls and the piston starts its compression stroke, forcing all the air into the vaporizer where it mixes with the oil. The heat of compression, combined with that from the walls of the vaporizer, is sufficient to ignite the combustible mixture. The products of combustion leave the cylinder through the same port by which the air enters.

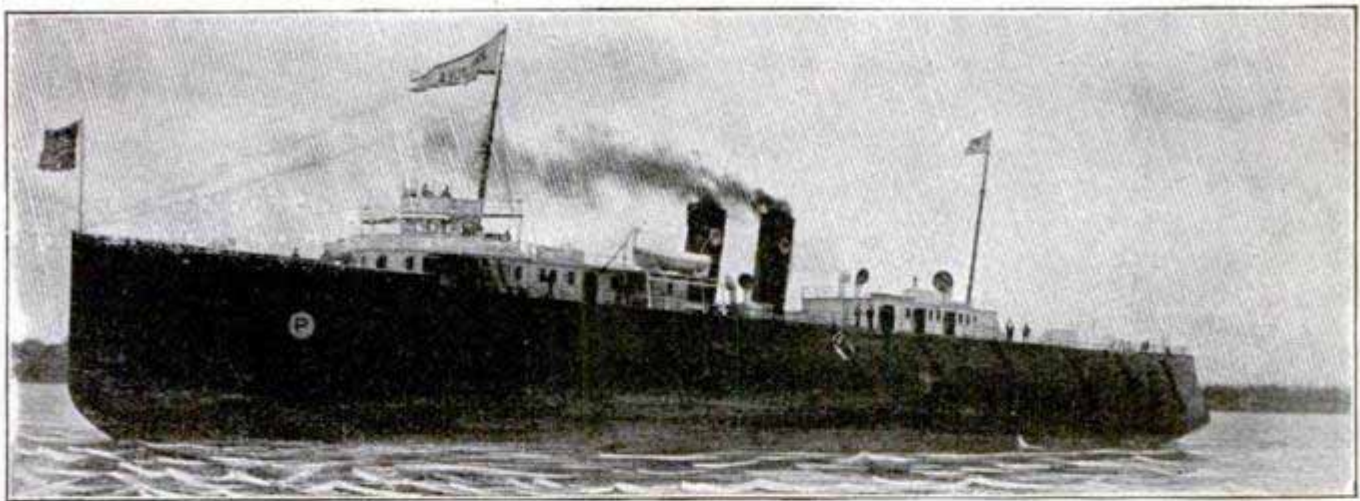
In case the load on the engine is decreased the governor opens a by-pass valve, which allows part of the oil to flow back to the storage tank.

This type of engine is built in units of from 5 to 250 hp. and is widely used both in this country and abroad, there being several thousand of them now in operation.

In the field of gas engines also this country has the largest installation in the world. It was completed about two years ago and was erected for the Lackawanna Steel Company. This plant, through its size and importance, has become quite well known to engineers in all parts of the country. It consists of eight 1,000-hp. and sixteen 2,000-hp. units.

The whole plant is run on the waste gases taken from the tops of the blast furnaces. Of the total power of the plant 32,000 hp. is employed for driving blowing engines and 8,000 hp. for driving direct current and alternating current generators. Five of the 16 gas engines driving blowing engines are shown in Fig. 3.

It is perhaps not too much to predict that the internal combustion engine, excepting rare cases, will eventually entirely supersede the steam engine.



ICE-RIDING CAR FERRY

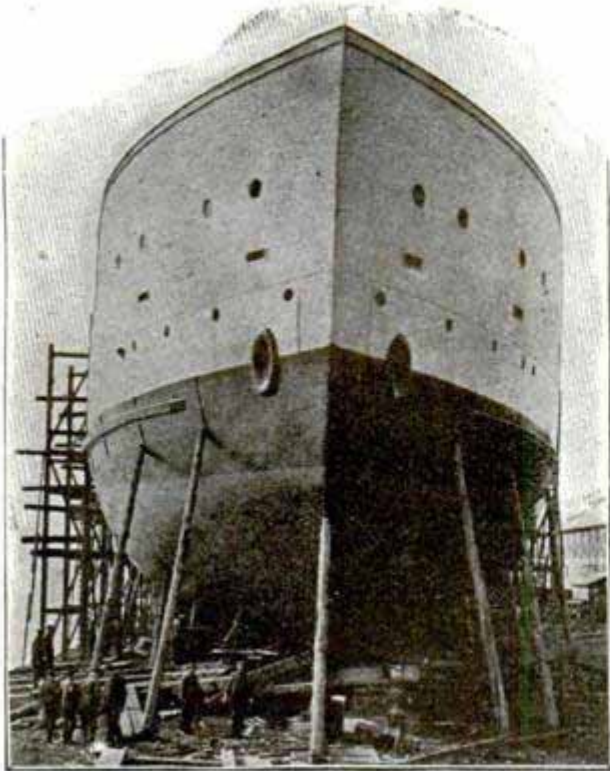
A car ferry which will ride the ice instead of crushing its way through it is to do battle with Lake Erie and the elements this winter, plying between the Ashtabula (Ohio) harbor and Port Burwell, Canada.

The bottom of the ferry is divided into compartments by eight transverse bulkheads, six of which run to the car or main deck and two to the lower deck. The compartments are filled with water, which is controlled by ballast pumps, one of which may be used to pump the water out of a compartment at the same time that another is pumping water into another compart-

ment. To make the ferry ride the ice, the bulk of the water is pumped into the stern and the bow, rising lightly, climbs the ice, which is crushed down and passes under the ferry. When light, the ferry draws but 10 ft. 6 in. This method is not advisable under all ice conditions, however, and to plow directly into a field of ice the compartments are all filled to the same level. By the same pumping system the ferry may be listed to one side or the other, as necessary.

The vessel is 350 ft. over all, 56 ft. beam and 20 ft. depth. She has two triple expansion

engines and twin screw propellers and four Scottish boilers. She easily carries 30 cars of 100,000-lb. capacity on her four



The Bow

tracks. To fuel her, drop bottom cars are run aboard and their contents dropped through the deck into the bunkers. At the end of each of the four tracks there are bumping posts, and these are used not only to stop the cars, but also to hold them stationary during the trip across the lake. The cars are coupled together and then fastened to the couplers of these posts.

At the ferry docks a great apron weighing 75 tons and hanging from a powerful balance is used to run the cars out on. This apron can be raised or lowered to the level of the deck of the ferry.

The "Ashtabula" is equipped with all modern conveniences for the comfort of the crew and on her official test made a speed of 15 miles an hour.

PREVENTS SIDE SLIPS ON AUTOS

One of the latest safety devices for autos or motor busses has been demonstrated in London. It consists of a light two-wheel trailer connected by a ball-and-socket joint to the casing of the differential. When the vehicle skids, the trailer, being independent in its movements, remains in its normal position. The jerk opens a valve on the side where the skid occurs, causing a stream of sand to shoot out under the wheels, instantly arresting the skid.

MAY TUNNEL IRISH SEA

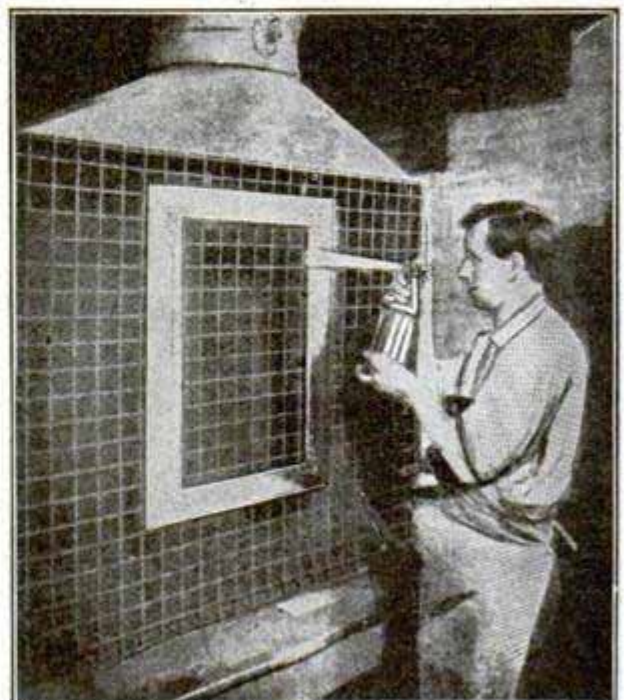
A tunnel connecting the north of Ireland with the south of Scotland is being seriously considered. The work would cost \$50,000,000 and occupy 13 years in construction. Midway on the proposed route is a great submarine chasm, which the tunnel will have to make a detour to avoid.

LIMITATIONS OF AERIAL FERRY

The opening of another aerial ferry in England to travel, and the proposed construction of such a structure across the Mississippi at St. Louis, has directed the attention of engineers to the merits of this plan. The Engineering News sums up the question with the belief that for large volumes of traffic this type is "more notable as an engineering curiosity than as a valuable new means of over-water transit."

BRONZING PICTURE FRAMES

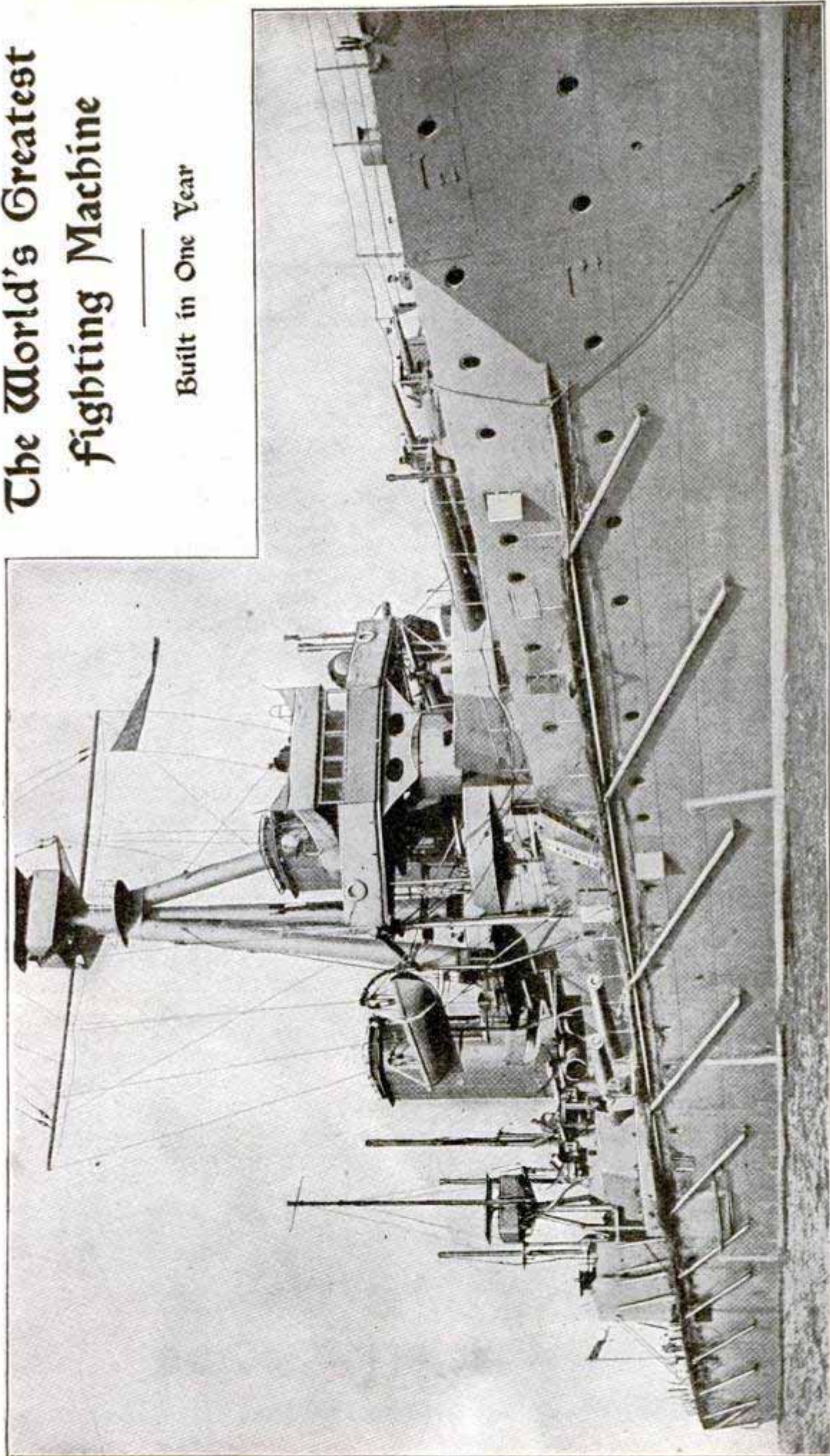
The modern method of gilding and bronzing picture frames is an interesting operation. When the frame comes to the gilders it is ready prepared with its ornamentation of a composition resembling putty. The gilt and bronze, thinned with banana oil, says the Detroit News, are applied by means of compressed air, a device similar to an atomizer being used. At the back of the frame is a flue supplied with a forced draft which carries away all superfluous oil.



Applying the Bronze

The World's Greatest Fighting Machine

Built in One Year



DREADNAUGHT IN COMMISSION.—The world's greatest fighting machine is now in commission. Her construction was a notable event in point of time as well as size. The keel was laid October 2, 1905; launched February 10, 1906; and given her steam trial on October 1, 1906. The most radical change which is visible is the use of the tripod of three steel cylinders, from the apex of which rises a short mast carrying a fighting top. Her armament is the heaviest ever made. Ten 12-in. guns are carried; few other battleships have more than four. Germany is already building a larger ship.

AIRSHIP INSECT SHAPED

Like some fierce goblin in a fairy tale is this extraordinary airship, the creation of



"Passengers Ride in the Body"

the Aero Club, of Belgium. The model, which is now on exhibition in Brussels, resembles a gigantic bee. The ship is a true flying-machine, being heavier than air and depending on its wings and propellers for movement. The inventors are Captain Marga, M. de la Hault and M. Jensen. A 60-hp. motor furnishes power to drive the propellers at the tremendous velocity of 30,000 revolutions per minute, according to the builders. The passengers ride in the body, which has four square windows. In the tail are three air bags to reduce the shock of alighting. The conception is certainly a very original one.

BICYCLE HAND AMBULANCE

A novel form of ambulance particularly adapted to use on large estates, such as

ranches, etc., or in small towns where no large vehicle for the purpose is maintained, is an English invention. The device consists of a bicycle, carrying two poles slung on hooks under the seat, where they do not interfere with the rider. To form an ambulance the frame of the bicycle divides into two sections in the middle bar, each section having a wheel. The sections are movably fitted on an additional curved vertical bar, where they are held at right angles by two rods. The poles are then unslung and placed to form the litter sides and the cloth is pulled over them, making a complete ambulance. The rider carries an emergency case containing bandages, restoratives, etc.

TELAUTOGRAPH FOR BATTLESHIPS

Telautographs will be installed on vessels of the American navy if the experiments now being made on the battleships "Pennsylvania" and "Alabama" prove as successful as anticipated. At present communication from the conning tower to the gunners is had by means of telephones and speaking tubes, but in the din of battle both are inefficient. Captain Philip, on board the "Texas" in the battle of Santiago, was obliged to depend entirely upon messengers, giving to each messenger the name of the gunner. In this way he would call out the name of the gunner to whom he wished to give an order, and the messenger would respond, thus saving valuable time.

In the Spanish war the impracticability of the speaking tube and the telephone caused naval experts to set to work at once to apply some system whereby the orders to "Cease firing," "Fire faster," "You are firing too high," etc., could be transmitted to the gunner in the quickest time possible. This work led to the installation of the telautograph on the "Pennsylvania" and "Alabama" just before the spring target practice.



The Bicycle as an Ambulance

The telautograph is an electrical instrument by which writing can be transmitted. A person can sit at one end of the electric wire and by writing on paper the identical writing appears at the other end. Those which were installed on the battleships were equipped with typewriter keys. Instead of the standard keyboard, however, characters were used which covered all the orders which might be needed in a battle.

The captain, by pressing the key "Fire faster," would cause the command to be instantaneously played up before the gunner, thus doing away with the possibility of delay and the delivery of an incorrect order. It also will do away with the giving of verbal orders, which are difficult to understand during an engagement, owing to the noise of the guns.

SUBMARINE COAL MINING IN NOVA SCOTIA

Mining coal beneath the bed of the Atlantic ocean is carried on by six collieries at Cape Breton, off the coast of Nova Scotia. The largest of these is the Princess, or Sydney pit, where the seam of coal averages between $5\frac{1}{2}$ and 6 ft. thick of the best quality. The seaward inclination is about 1 ft. vertical in 12 ft. horizontal.

The workings are distant from the shore line 5,800 ft. to the dip and at this point the overhead cover is 1,140 ft. thick, with from 33 to 40 ft. depth of water above it. The undersea workings in the whole coal cover 1,620 acres and there is practically no leakage from the sea. From the main seam of the submarine area some 5,250,000 tons of coal has been taken.

AMERICA LEADS IN COAL PRODUCTION

In 1904 the world's output of coal was 867,021,000 tons; in 1905 it was 929,623,000 tons, or an increase of $7\frac{1}{4}$ per cent. Every country, excepting Russia and Belgium, shared in the gain, but the greatest advance in production is shown by the United States, jumping from 351,816,398 to 392,919,341 tons. America is the largest producer; while the United Kingdom is second and is also the largest exporter.

It is interesting to note that in 1814, the date of the earliest record, Pennsylvania was credited with 22 tons (short tons of 2,000 lb.), the total recorded output of this country. Ninety-one years later a total of

392,919,341 tons is recorded and nearly all the states and territories contributed.

HIGHEST OFFICE BUILDING IN THE WORLD

Top Will Tower 612 Feet Above the Street



The highest building in the world for practical use is now being erected in New York City. It will contain 42 stories, of which the 28 upper floors take the form of a tower 65 ft. square. The height from sidewalk to top of cupola will be 612 ft., or 57 ft. higher than the Washington monument. It will contain $9\frac{1}{2}$ acres of floor space and be used as an office building; with accommodations for 6,000 people. The tower section will weigh 23,000 tons exclusive of furniture, fittings and occupants.

The chief engineering problem was to provide against wind pressure, which has been done by a system of anchoring the steel columns. The tower is an addition to a building already 14 stories high, and when completed will certainly be a genuine and record-breaking skyscraper.

HALF-MILLION-POUND LOCOMOTIVE

Two in One

Some mammoths in locomotive construction have been turned out during the past few weeks by the Baldwin Locomotive Works for the Great Northern Railway. Their great size is best realized by comparing the man and the machine.

This engine is known as the Mallet compound, and is intended for freight service. The rear group of wheels are driven by the pair of high pressure cylinders from which the steam exhausts into the low-pressure cylinders, driving the forward set of wheels. Length of engine and tender is 73 ft. 2¼ in.; weight of both, 503,000 lb.; tractive power, 71,600 lb.

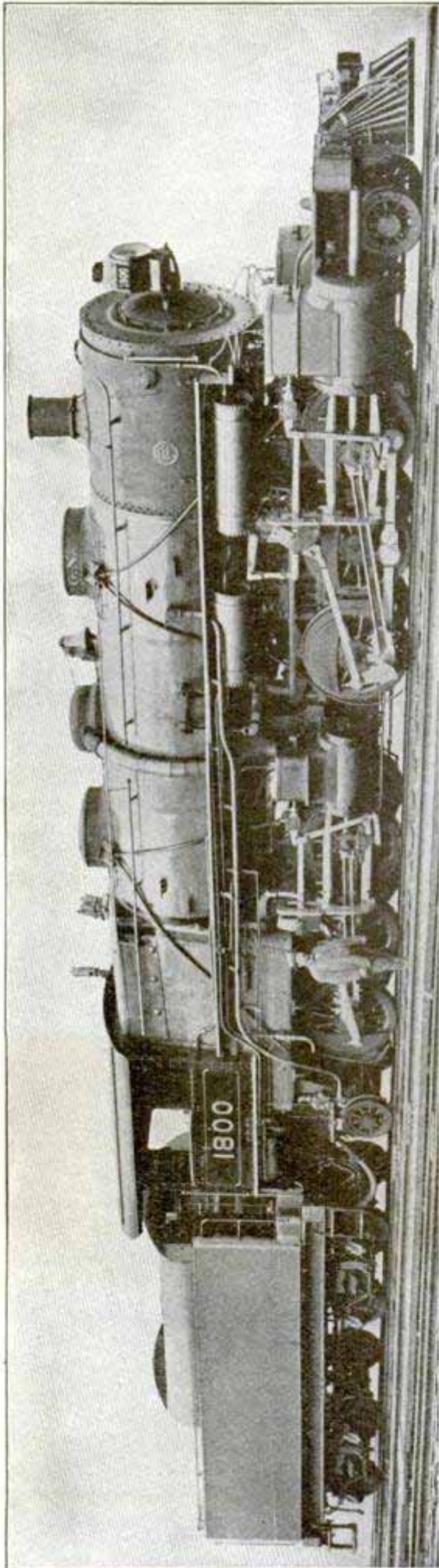
GASOLINE ENGINES IN COAL MINES

If one unfamiliar with the matter takes up almost any catalogue of the leading gas and gasoline engine manufacturers, he will be astonished at the number of uses to which these labor-savers are now adapted. They are found furnishing power for grain elevators, electric lighting, modern shops, agricultural machinery, combined with pumps for water works, hoisting machinery, air compressors, marine engines and other purposes too numerous to mention.

In mines they are used for hoisting, pumping and running blowers, and in many instances engines far down in the earth close by the seeps of water are almost without attention, yet sending a steady flow of water to the surface hundreds of feet away. The extensive use of the engines in this connection is singular, considering that coal for fuel costs nothing in these mines, yet it is found economical to use the gasoline engine for power.

VARIED USES OF CEMENT

In a single copy of a cement paper last month description was given of construction from cement of the following: Residences, school house, hotel, apartment building, car barn, warehouse, wholesale bakery, cemetery monuments, mantels, electric power house, canal locks, dam, tunnel, curbstone, sidewalk, subway, railroad bridge, factory, cistern, roof, culvert, reservoir, 200-ft. smoke stack, city hall, cement brick, docks, packing house and a life-saving station.



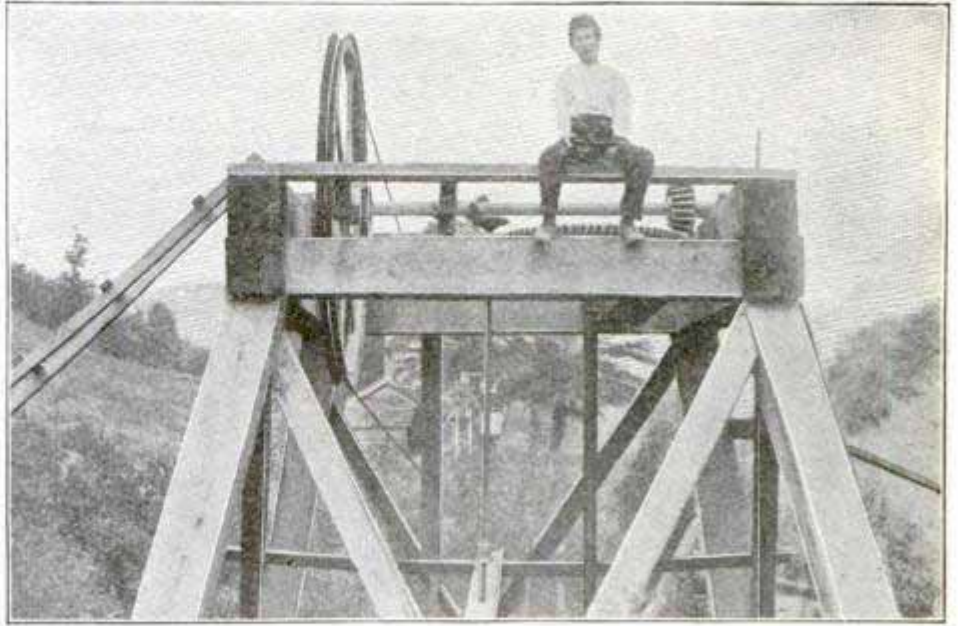
Largest Locomotive Ever Built

POWER HOUSE IN A CAVE

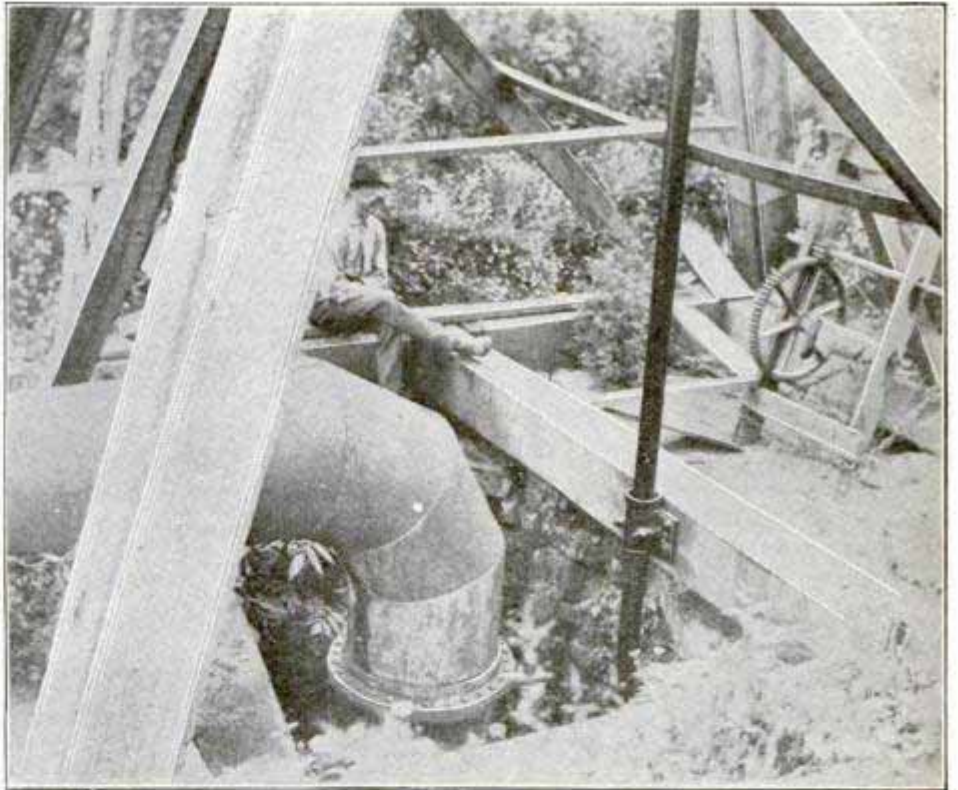
Mysteriously Operated Mill Has Water Wheel 50 Feet Under Ground

In northern Tennessee, not many miles from Nashville, there stands one of the most unusual mills in existence, teeming with work, its busy rolls ever in motion, yet operated by a power invisible. About the structure there is nothing remarkable; it has its generous grist of fine white dust and its old frame vibrates to the whirr of machinery, but what keeps that machinery going? There is no wheel; there is no steam plant. Out of the side of the building, however, pass several steel cables, and if we follow these to a distance of 365 ft. from the mill where they terminate in the ground we will find the solution of the mystery.

In a cave 50 ft. deep, hollowed out of the solid rock, revolves the great wheel. The idea is an ingenious one. The cave is located near a small creek and was formed by nature, but its opening had been enlarged by man in a previous attempt to locate a water wheel there. The present wheel is 28 ft. 10 in. in diameter. The cave is circular, 29 ft. in diameter and 4 ft. wide, so that there is little space between it and the wheel. The walls are as smooth as though they had been dressed by a stone mason and at the center where the shaft is, the space is wider to allow for the gearing. The sills to carry the bearings rest in niches cut out of the solid rock and are fastened by iron pins drilled into the stone. The top of the water wheel lacks about 30 in. of coming to the top of the rock cavity, and from the rock to the surface of the ground is a distance of nearly



Transmission Machinery at Top of Cave



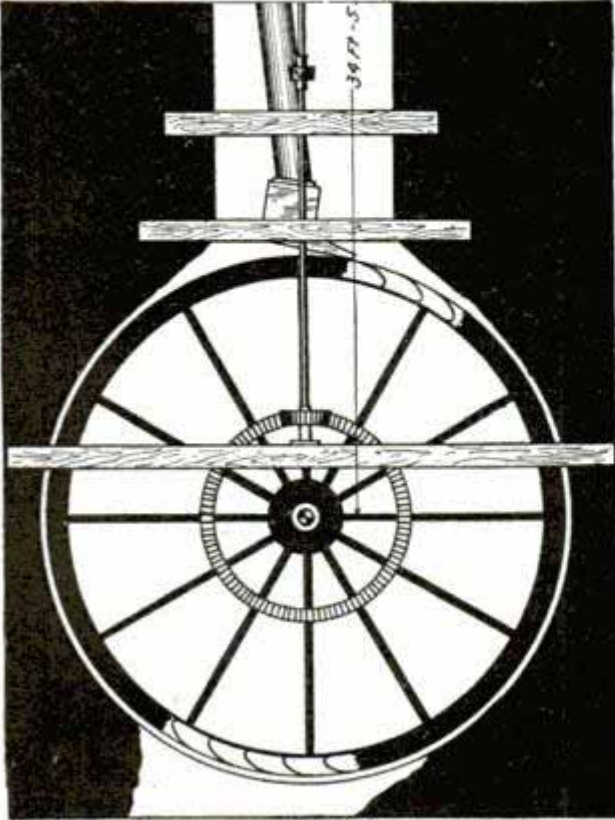
Entrance to Cave

18 ft., giving a fall of over 20 ft. from the bed of the stream to the top of the water wheel.

The opening above the circular rock pit has a stone wall built to keep the earth from caving in upon the wheel.

An iron pipe 24 in. in diameter carries the water from the surface to a closed steel

tank just over the wheel. This discharges the water to the wheel at such an angle as to utilize the force of the 20 ft. pressure in



Plan of Wheel in Cave

the pipe. The curved buckets of the wheel discharge the water right at the bottom on a solid stone. The water then runs west about even with the breast of the wheel where there is a hole a little larger than a sugar barrel. It falls through this perpendicularly about 6 ft. and then runs on down through the cavern.

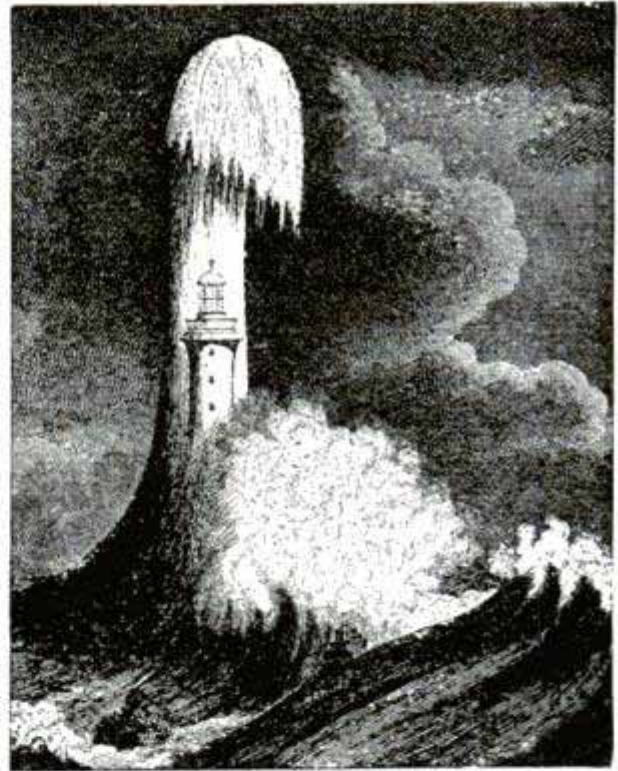
The flour mill operated by this unique system has four double roll stands, 6 in. by 20 in. rolls, reel system; corn mill has two double stands, 9 in. by 24 in. rolls, with gyrator for bolting. Power is transmitted from the water wheel pit 365 ft. away by a single span $\frac{5}{8}$ -in. steel cable, made endless, and the water can be turned on or off the wheel as desired from the mill. The mill is owned by N. B. Kittrell and was formerly run by steam power.

NEW YORK HAS LARGEST GAS-HOLDER

The largest gasholder in the world is located in New York. Its capacity is 15,000,000 cu. ft. The dimensions of the tank are: Diameter, 300 ft., and depth, 48 ft. 6 in. Formerly a tank of 12,000,000 cu. ft. capacity, located at East Greenwich, England, was the largest.

FAMOUS LIGHTHOUSE DURING STORM

Many lighthouses have been built on the Eddystone rocks in the English channel, 9 miles off the Cornish coast, all to meet destruction in one form or another. The first was a wooden polygon 100 ft. high with a stone base; built in 1696-1700; washed away in 1703 in a furious storm. The second was of the same description, but 92 ft. high; built in 1706-1709; destroyed by fire in 1755. The third was built of blocks, weighing from one to two tons, of Portland oölite, encased in granite, the granite being dovetailed into the solid rock, and each block into its neighbors. This tower was 82 ft. high. This was constructed in 1757-1759. The action of the waves undermined and weakened it and another house of the same construction was completed in 1882.

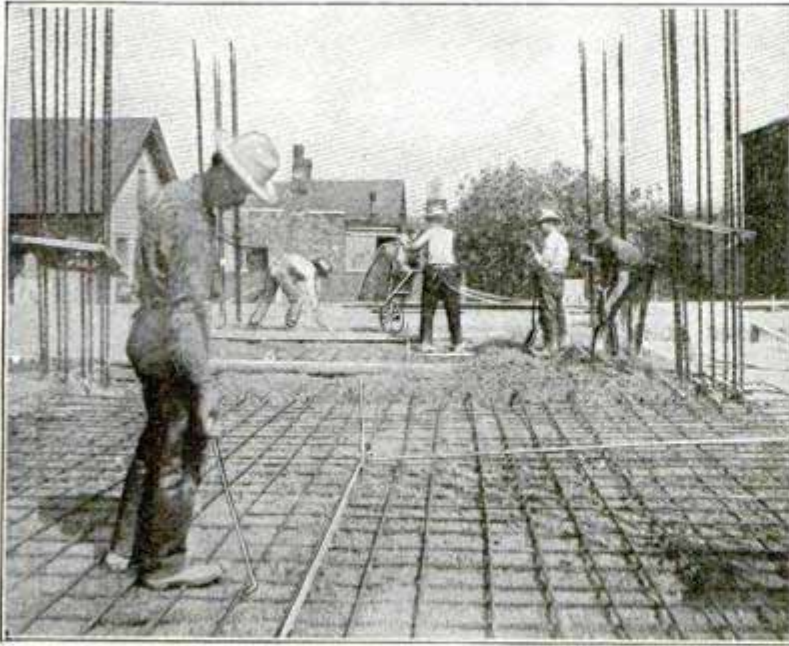


Eddystone Lighthouse in a Storm

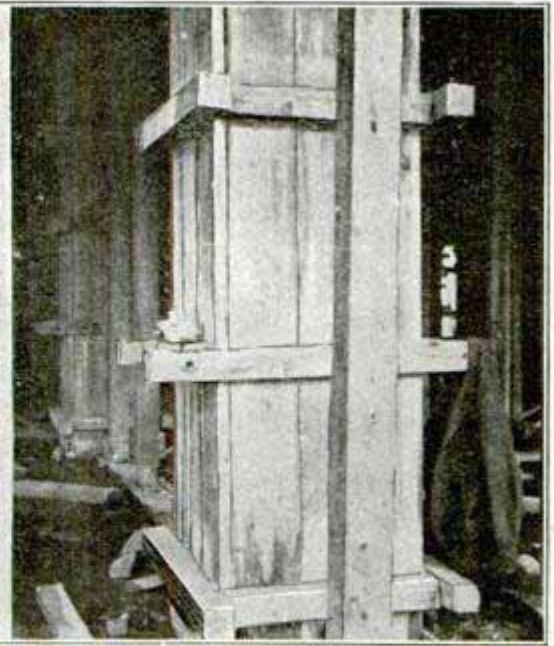
At an elevation of 133 ft. its light is equal to 159,600 candles and can be seen to a distance of $17\frac{1}{2}$ miles. Our illustration shows the famous structure during a tempest.

A new method of ridding wines of mustiness consists of adding 8.8 oz. coffee grounds and 5 grams pulverized orris root to each 26.5 gal. of the wine. The coffee grounds possess strong deodorizing properties, it is said. After four or five days the wine is poured off.

FIRST ENTIRE CONCRETE BUILDING IN CHICAGO



Concrete Floor



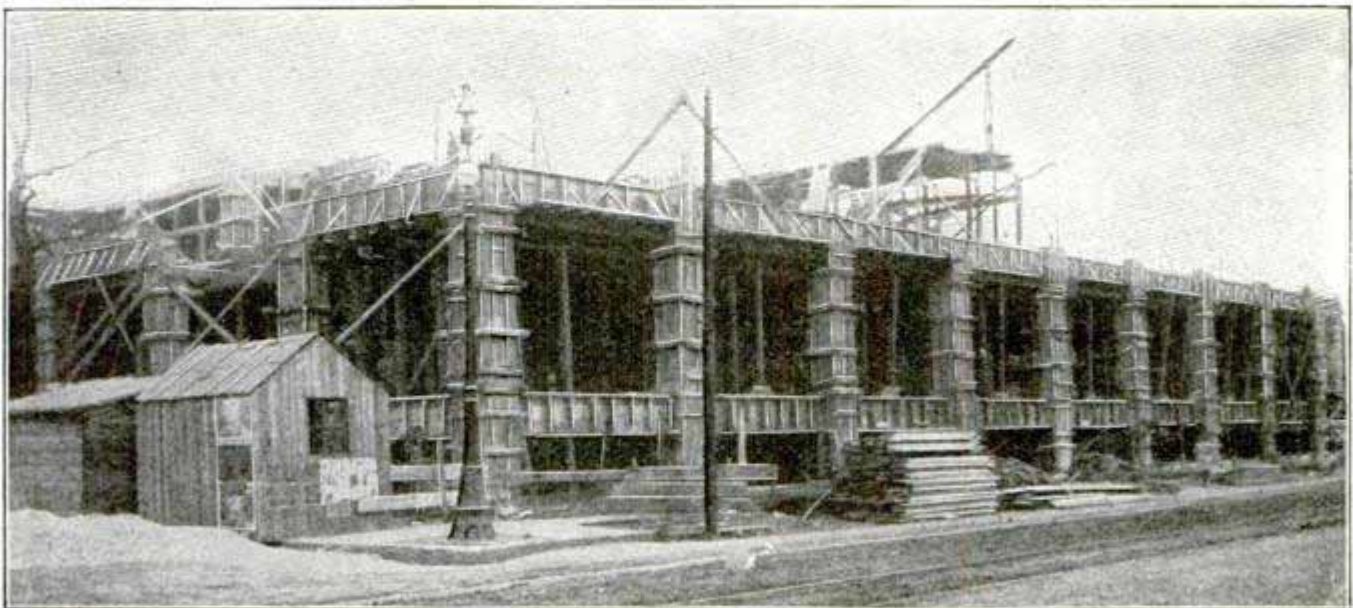
Column Mould

Many of the so-called concrete buildings have been named as such because of the fact that concrete floors, beams, roofs, or other concrete parts have been used in their construction, but the building here shown, which is now under process of construction in Chicago, will be entirely of concrete, with the exception of a few face bricks to be used between the piers and window frames.

The only steel in this building is that used for reinforcing purposes and consists of long square twisted bars, which are embedded in the concrete in order to increase its tensile strength. The tensile strength of ordinary concrete, or its resistance to

being pulled apart, is very low, but its crushing strength, or resistance to compression, is very great and for this reason concrete which has been reinforced, successfully stands the strains in both directions. The steel bars used for reinforcing are twisted for the double purpose of increasing their tensile strength and producing a more suitable surface for holding the concrete.

The floors, piers, columns, girders and even the stairs of this building are of concrete and the roof will also be made of that material, thus producing a building which will be absolutely fire-proof. The cost of a concrete building compares favorably with



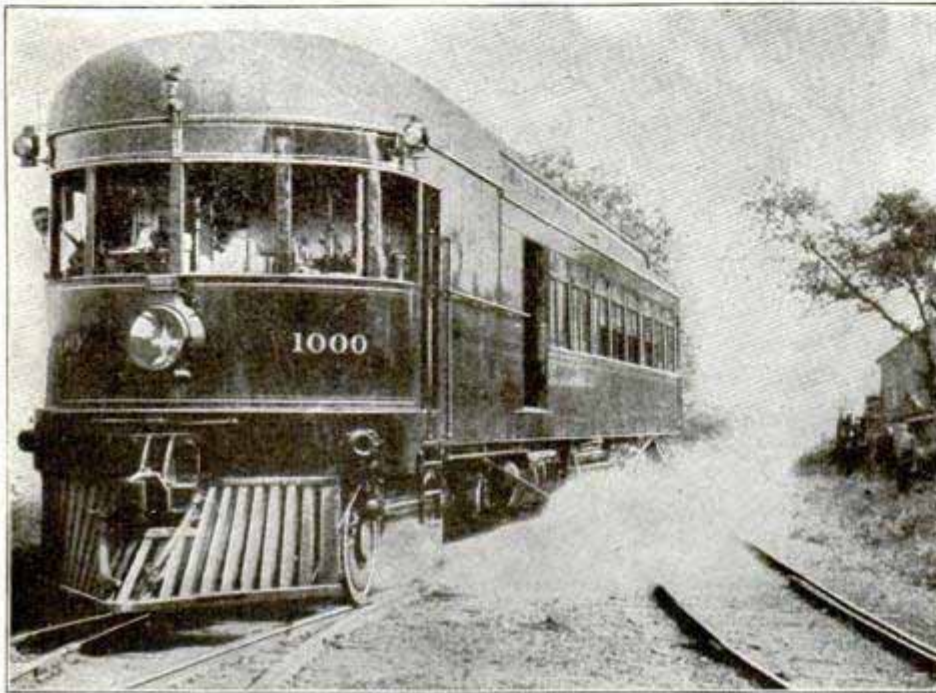
Reinforced with Twisted Steel Bars

that of steel or fire-proof construction and can be designed to suit any special requirements, as the material used in its construction is susceptible of the most artistic treatment and can be proportioned to give any desired strength.

It is true that more time is required to erect a concrete building than a steel building of the same size, but this is offset by the prompt delivery of concrete materials, which can always be obtained on short notice.



AMERICAN STEAM MOTOR COACH



Steam Motor Coach Under Way

An American car builder has brought out a steam motor coach for suburban and short line work on steam roads, and for inter-urban lines. England and Germany have already made considerable progress with cars of this type, where a number of these combined motor coaches are in service.

The car illustrated is 82 ft. 6 in. long with four compartments: engineer's, baggage, smoker and coach. It weighs 89 tons, of which 56 tons are on the motor truck. The boiler is a quick steaming torpedo boat type, burning crude oil and carrying a working pressure of 250 lb. The engine is a double-cylinder, 11 by 12 in.,

developing 275 hp., and transmits power to one axle by means of gearing similar to that of an electric car. Side bars serve to make drivers of all four wheels of the motor truck. The engine is inclosed in a dust-proof case. Oil cups are placed conveniently outside and feed through small pipes to the various bearings. After exhibition at leading railroad centers the car will go into service on the Missouri Pacific railway.



Congress will be asked at its next session to adopt the revised international rules for preventing collisions at sea with fishing vessels, through a rearrangement of signal lights to correspond with those adopted by most of the other nations.



One and a half million railroad ties are being imported on a single order, from Japan, at a cost of 56 cents per tie.

BEST MAPS MADE IN GERMANY

The largest map-making establishment in the world is located at Gotha, Germany, and was founded more than 120 years ago. Besides a geographical library of 80,000 volumes, it has a collection of over 150,000 maps. It has all the route surveys of explorers and all the sheets of topographic and other surveys procured by the various nations. European establishments do not use the wax process of map production generally employed by American map houses, as they consider the results inferior. Good maps are excellent masters. One German professor, noted for his knowledge of regional geography, studies maps more than he does books, and obtained nearly all his material for a large geographical work in this way. Poor maps are harmful agents, however, as the mind, once given a wrong impression through the eye, finds it difficult to accept the correct one afterwards.

SIX-STORY CONCRETE BUILDING TIPS WITHOUT CRACKING

Most remarkable of the many strange occurrences which concrete construction has to its credit is the performance of a six-story concrete building in Tunis. The structure was scarcely completed when some



It Leans 10 Degrees

change took place in the earth under one side, letting down the foundation and causing the building to lean, as shown in the illustration. The London Sphere says: "A large warehouse which has just been constructed entirely of concrete is to be seen leaning as much as 10 degrees from the perpendicular, outdoing the famous Tower of Pisa. No cracks have appeared in the walls." The engineers are hopeful of being able to restore the building to its original and proper angle.

RAILROAD COMPANY STARTS A SCHOOL

A department for instruction in scientific railroading is to be established in connection with the Nevada State University at Sparks by the Southern Pacific Railroad. The school will be conducted for the benefit of railway employes holding responsible positions, with an effort to raise the standard of efficiency. It will be under the joint supervision of the university and railroad company, with a corps of expert railroad men to assist the professors.

Two classes of men will be trained for service on the lines—apprentices and journeymen. Classes will meet for two hours twice a week.

TALL TELEPHONE POLE

One of the tallest telephone poles in the world is where the wires of the Pacific States Telephone Company cross the Chehalis river near Aberdeen, Washington.

For some years past the shorter pole shown in the illustration and which was 90 ft. high was sufficient to keep the wires clear of river craft. But the increasing passage of ocean steamers made a higher pole necessary, and a new one 126 ft. high was set up. This pole is one single stick of Washington fir, 18 in. at the butt and 8 in. at the top; the pole weighs 6,000 lb.

The stick was cut at a point 12 miles distant and towed down the river where it was erected by six men using a 12-hp. hoisting engine. The American Telephone Journal says:

For making attachment to the pole and moving it a $\frac{5}{8}$ -in. steel cable was employed, run through 10-in. steel blocks. The pole was set 12 ft. in the ground, and guyed with four $\frac{1}{8}$ -in. steel stranded wires at the top, and also guyed about 40 ft. from the top with four $\frac{5}{16}$ -in. stranded wires. The guys are fastened to dead men set in the ground to a depth of 8 ft. These dead men are of cedar 8x8 in. in section, and 7 ft. long.

Although the steps upon the old pole show clearly,



those upon the new one are so placed that they are not visible from the point from which the photograph was taken. They are,



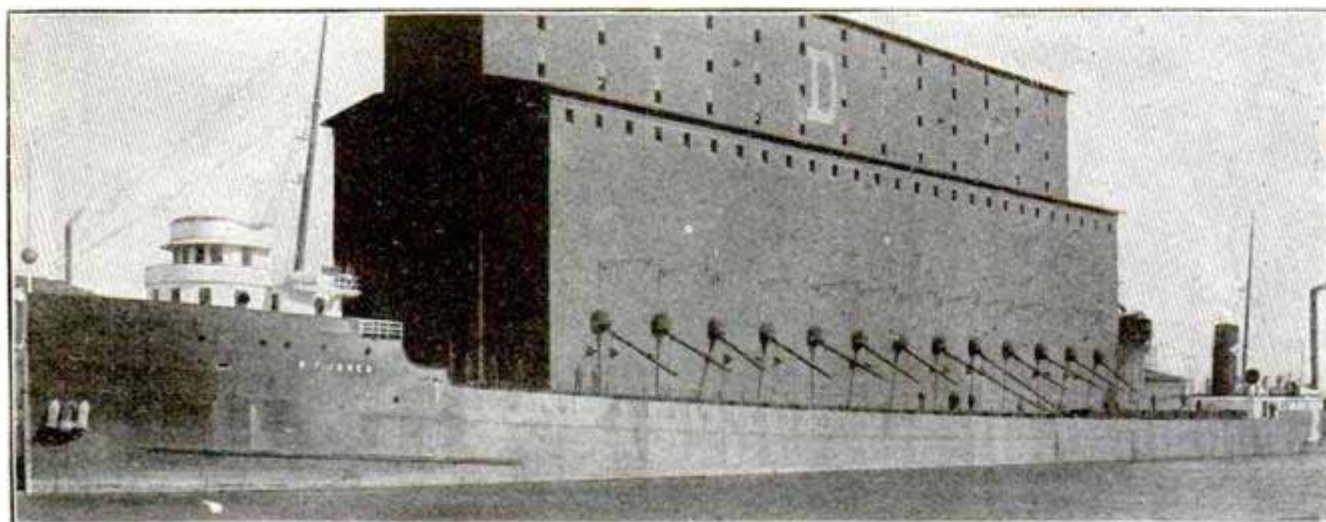
however, provided, being $\frac{5}{8}$ by 10-in. galvanized steps of the usual type. Ample support for the wires is furnished by cross arms of the ordinary style, 4x4 in. in section, and 10 ft. long. These are fastened with one $\frac{5}{8}$ -in. machine bolt through the center of the pole, and one $\frac{5}{8}$ -in. bolt through the double arms 8 in. from the pole on either side, and one $\frac{5}{8}$ -in. double

arm bolt on each end of the double arms. The span between the poles on the opposite sides of the river is 900 ft., and the wire used for the purpose is ordinary No. 14 steel galvanized wire.

Four linemen will be seen perched on the slender cross arm; only those who have ever climbed a tall pole or stack realize how high 100 ft. seems from a slender support.

BIGGEST GRAIN CARGO EVER LOADED

370,273 Bushels of Wheat--Value \$277,000



This Cargo Would Fill 360 Cars

What is declared to be the largest cargo of grain ever loaded into one vessel, on either fresh or salt water, was put into the lake steamer "B. F. Jones," at Elevator D, Duluth. There were 370,273 bu. of wheat

for export to the Mediterranean, the cargo and vessel being valued at \$750,000. To load the same quantity on rail would have required 12 trains of 30 cars each. The steamer is 552 ft. long with 56 ft. beam.

PLOWING WITH AN AUTOMOBILE

An automobile concern put one of their machines to a strange use recently. A hard cinder drive at the side of the factory was graded so high that during heavy rains the water ran into the building, and it was decided to lower the grade. Accordingly a car was hitched by a double rope to a plow and the first furrow started. It was rather tough pulling for the car until the plow bit into the hard surface, but once started it worked all right and the whole drive was loosened up by the help of the auto.

The Erie is changing the lights in switch targets all along its lines from white to green to indicate safety. Other railways are planning to adopt the change.



Automobile Pulling Plow

CONCRETE FREIGHT DEPOT AT LOS ANGELES

**Operation of a Single Lever Opens One-Half Mile
of Windows**

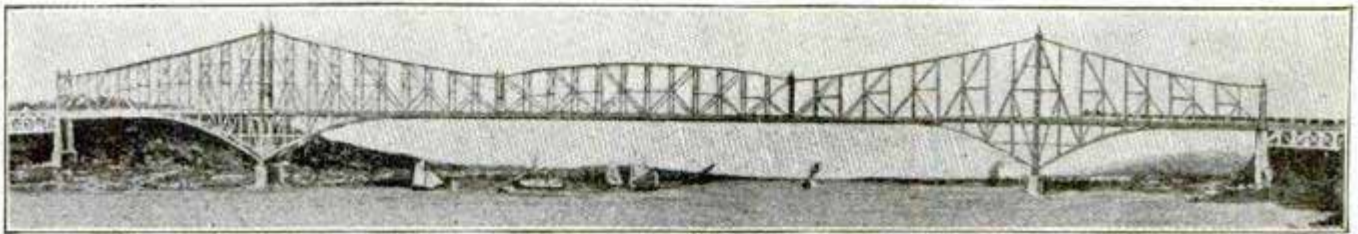
The use of the concrete construction is growing in favor rapidly on the Pacific coast, the railroad systems which are building large freight and passenger depots of the material being important instrumentalities in its introduction. The Santa Fe now has an immense freight depot under construction at Los Angeles, which will be almost entirely of reinforced concrete.

When finished this depot will be 1,320 ft. ($\frac{1}{4}$ mile) long, 95 ft. wide and two stories high, with a roof of red tiling. By the turning of a single powerful iron lever it will be possible to open one-half mile of pivoted

BRIDGE OF 1,800-FT. SPAN ACROSS THE ST. LAWRENCE

**Will Carry Two Railway Lines, Two Trolley Lines,
Two Highways and Two Sidewalks**

The St. Lawrence river, hitherto unspanned from Montreal to the sea, a distance of 1,000 miles, is now being crossed by the greatest girder span in the world. The bridge is being built about six miles above Quebec and 165 miles below Montreal at a point where the river narrows to 2,000 ft. at low water, and the great central span, 1,800 ft. long, with a central suspended girder 675 ft. long and 130 ft. deep, extends almost from bank to bank. The two anchor spans are each 500 ft. long, making the total length of the bridge 2,800 ft. Besides this, there are the two approach spans, each 210



How the Big Bridge will Look when Finished

transom windows, converting the depot into an open building, and by use of a reverse lever to close them in the same manner. The cost of the building will approximate \$250,000.

PAPER FROM PEAT

An immense paper mill is being established at a Michigan peat bog, some 10 or 12 square miles in extent. The character of the peat in this bog was not suitable for manufacturing peat fuel, but, it is said, is just right for the manufacture of certain kinds of paper.

The process consists of digging the raw material from the bog, transporting it to the mill in trolley hopper cars and there converting it into paper. The mill runs day and night and wires strung with incandescent lights illuminate the bog, which before was an unfrequented, treacherous waste. At present the company, which owns 1,900 acres of the bog, is manufacturing box board only, turning out 30 tons a day. Later building paper will be one of the products.

A new artificial lumber made of asbestos and cement is said to be fireproof.

ft. long. The bridge, which is to carry two railroad lines, two trolley lines, two highways and two sidewalks, will have a clearance of 150 ft. above high water mark. The great width of span was necessitated from the fact that the river deepens rapidly from the banks to a maximum of 200 ft.; the tide water rises 15 ft., and the velocity of the current is over three miles an hour.

Work on the bridge was begun in April of 1904 and is to be finished in December of 1908. The height of the post over each river pier will be 315 ft. The post is 10 ft. wide by 4 ft. in depth and rests at its lower end on a pin 24 in. in diameter. Throughout pin connections are used, those on the main and anchor spars usually being 12 in. The cross-girders, carrying the roadway, are 10 ft. deep. The bridge is built up entirely of rolled plates and angles, no castings being used.

One of our illustrations shows the bearing for one of the river piers, with the pin-plates for the vertical and inclined members in position. The total weight represented is 537,000 lb.

Some of the pieces used in the construction of the bridge are of enormous size and weight, the floor beams, for instance, being girders 66 ft. long and 10 ft. deep. Special

cars were required for bringing these pieces from the steel works at Phoenixville to the bridge site. Work proceeds from both sides of the river, and two 60-ton electric traveling cranes of 60-ft. span with 750-ft. runways, beside a special 450-ton steel traveler with thirty-eight 10-ton tackles, operated by four special electric hoisting engines, are in operation at the anchors. Hitherto the Forth bridge, Scotland, has been the longest girder span in the world.

The Quebec bridge is being built to connect several important railway lines. Below Quebec the St. Lawrence widens rapidly to the sea so that it is probable that for a distance of about 825 miles no bridge will ever cross it.

KEEPING CREAM WITHOUT ICE

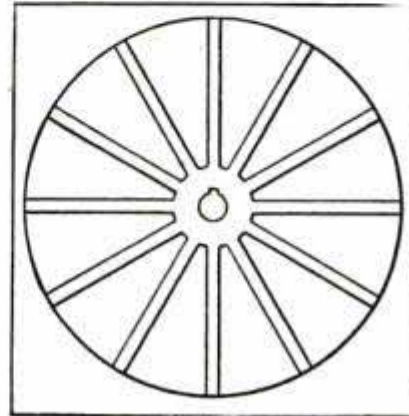
"For two years," says a practical dairyman, "I have kept the cream from ten cows in first-class condition without ice. In the corner of my house cellar, near the drain outlet, I built a platform about 3 ft. high and 3 ft. square. I nailed to the sides burlap sacks so as to hang to the ground. On the platform I placed a half barrel with both heads in. In the top head I bored a hole to take in a hose pipe, which I ran to a pail in the sink where we pump water from the well and fill the half barrel with water. I place the cream cans under the platform,

equal to the tank of water with ice in it to keep the cream. The cream gatherers say my cream has been in as good order as the best."

England is building three more powerful battleships, to have as heavy broadsides fire as the "Dreadnaught," but to be much faster. They will be turbine propelled.

MACHINE CLEANS BRICK

Millions of bricks are being reclaimed from the ruins of San Francisco, but the

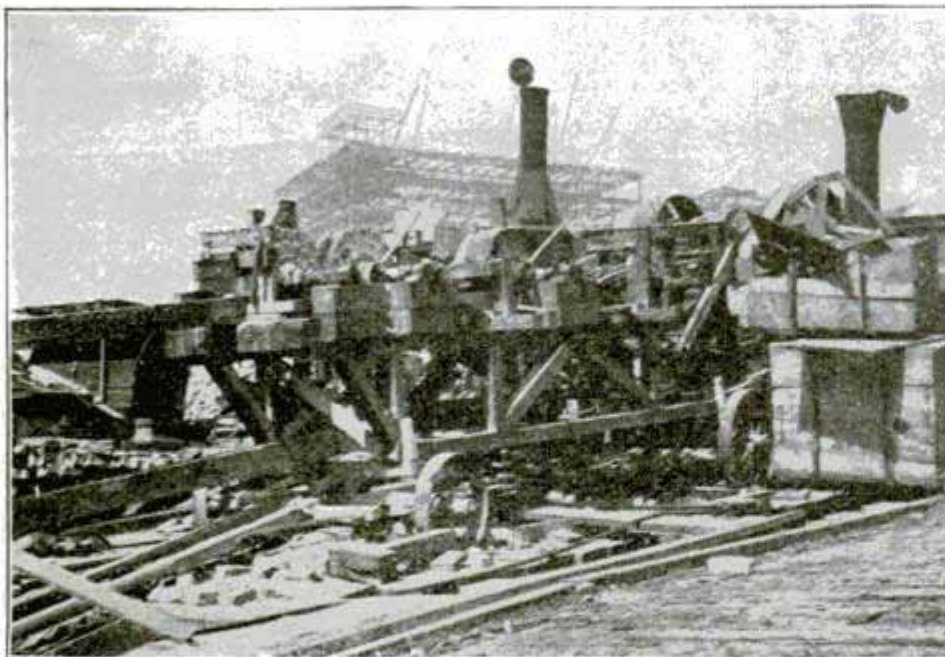


For Cleaning Bricks

old-time method of cleaning the mortar from the brick with a hatchet was found too slow and expensive. At present cost of labor it was cheaper to throw the bricks away and buy new

ones. The necessities of the case resulted in the construction of labor-saving machines.

Machinery, driven by electricity and steam, is being extensively used. One of the largest and most successful brick cleaning machines is that shown in the photograph.



Electric Brick-Cleaning Machine

and by several small gimlet holes let the water onto the top of the cans. This forms a cold storage chamber, and I think it is

Several iron wheels about 30 in. in diameter and 2 in. thick are used. Each wheel has a number of cleats, or flanges, on the sides—radiating from a common center. These flanges are each about 1 in. thick and 2 in. wide, with sharp, square corners or edges. The wheels are made to revolve quite rapidly. The rough, mortar-covered bricks are brought up to the wheels by an endless iron chain elevator. By means of a clever mechanical arrangement the sides and ends of each brick are brought successively in contact with the whirling

flanges or cutters, the mortar cut off and the brick delivered in a pile ready for use again.

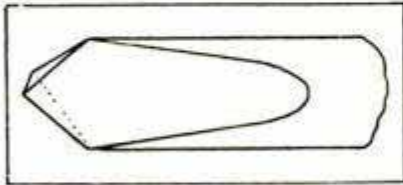
All the articles appearing in this department are reprinted in book form at the end of each year.

SHOP NOTES

Contributions to this department are invited. If you have worked out a good idea or know of one, please send it in.

OLD DRILLS USEFUL

The shanks of broken or worn-out drills may be easily restored to usefulness by grinding down the end, as shown in the sketch. The drills thus formed are very useful for drilling brass, white metal or other soft material.—Contributed by W. J. S., Emsworth, Pa.



TO FROST WINDOWS

Make a strong solution of epsom salts in hot water and while hot wash it over the glass with a brush. When cool the salts will be deposited on the window in crystalline form, beautifully frosting the window. Be careful to entirely cover the window with the liquid and do not let it run or the pattern will be spoiled.

ELECTRICALLY OPERATED PLATE BOX

Owing to the great number of undeveloped plates and films which were being spoiled by the careless opening of the plate box, the following device was constructed and is now in successful operation.

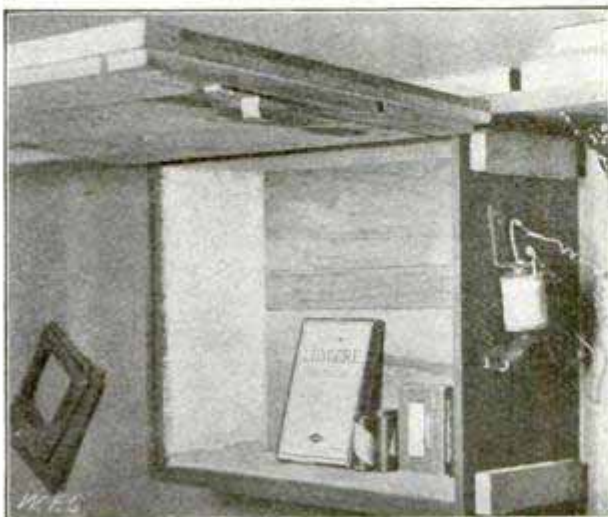


Fig. 1--Plate Box for Dark Room

The plate box (Fig. 1) was provided with a home-made latch operated by an electromagnet. When the photographer desires to open the box he presses a push button within easy reach of the box, which com-

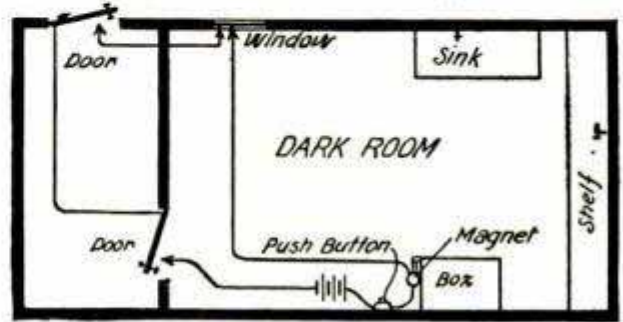


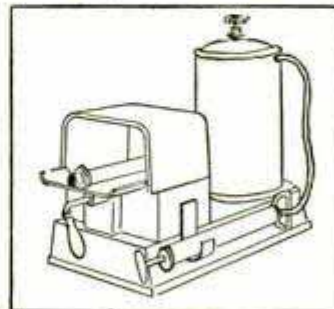
Fig. 2--Wiring Diagram

pletes the circuit and energizes the magnet, thus allowing the lid to be raised. If, however, the window or either of the two doors should be open the current would not be complete and the box could not be opened.

This is accomplished by using ordinary burglar alarm contacts in both doors and window and connecting in series as shown in the wiring diagram (Fig. 2). It will be seen that the opening of either door or window will open the circuit and prevent operating the magnet by the push button.—Contributed by Wm. F. Groose, Photographer, Oconomowoc, Wis.

IMPROVED SOLDERING FURNACE

Any one who has had any experience with this style of soldering furnace will at once see the advantage of using a bicycle foot pump (attached as shown) over the old rubber bulb with its slow, weak action, leaky valve, and short-lived rubber tube.

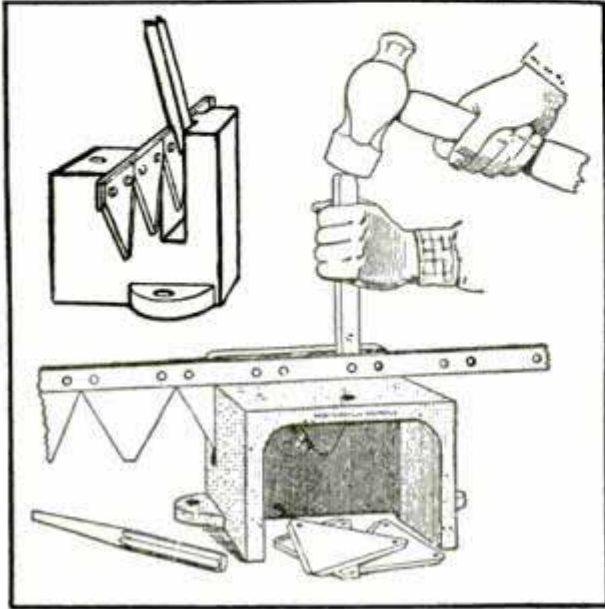


A bicycle valve may be soldered on the air valve and the hose connection screwed into that, or the bicycle connection may be removed and the hose simply slipped over tube on tank plug.—Contributed by Ora S. Harmas, Fennimore, Wis.

DEVICE FOR REMOVING REAPER KNIVES

The accompanying illustration, reproduced from the *Implement and Machinery Review*, shows a device designed to quickly remove worn or damaged sections from reaper and mower knives.

It is a special appliance of much utility,



Removing Blades from Sickle Bars

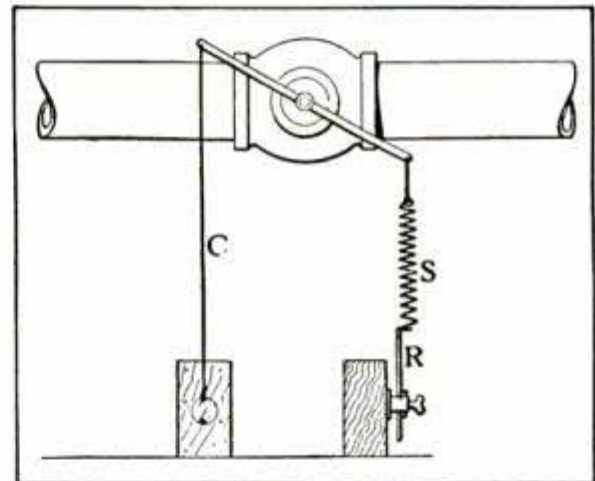
one of its chief recommendations being that by using this tool it is impossible to bend or injure the knife-back. By placing the knife-bar in the block any man or lad should be able readily, by means of the hand tool and a hammer, to remove twenty sections in five minutes. The tool should be held with the shoulder resting on the top of the section over the rivet, so that it may not slip between the section and the block. The simplicity of the tool should commend itself, for there are no screws, bolts, or springs, and it does not require any adjustment. A blow with a hammer, and the rivet is cut through. Its universality is another good point about this new tool, for it is by no means restricted in its sphere of action, since it will remove any section from either a light or heavy binder or mower.

DEVICE FOR REGULATING BACK PRESSURE

A clattering valve on the valve seat as the engine cut off and exhausted caused a correspondent of the *Engineer's Review* great annoyance; also there was difficulty in regulating the pressure to send the right amount of steam through the factory at the

best operating pressure. He remedied the matter as follows:

A long lever was arranged on the valve stem and to one end a cord and spring, S, were attached; a hollow piece of round brass tubing 2 ft. long was soldered to the lower end of the spring. This tubing passed through a clamp as shown, which was made of a piece of brass, cast square and drilled out with a hole somewhat larger than the brass rod. A thumb screw was put in on one side, and to the end of the screw a piece of brass was fitted and filled out concave to fit the rod. The ends were turned over at the top and bottom of the body of the clamp to prevent it from falling out. The concave piece was for the purpose of protecting the rod from the end of the thumb screw. A cord, C, was attached to the other end of the lever on the valve stem, also, for the purpose of fastening the valve open when the exhaust steam was not wanted for heating purposes.



For Regulating Back Pressure

When steam is wanted for the shop the rod R is pulled down until the desired back pressure is obtained, and then clamped in place. This prevents the valve disk from clattering on the seat and the spring prevents unsteady jerking of the cord. Cord C is left free.

DRAUGHTSMAN'S CENTER

A brass thumb-tack with a centerpunch hole in the center of the top will prove valuable when the center of several concentric circles becomes so worn and enlarged that future work will be inaccurate.

The thumb-tack may then be placed in the worn center and the compass used from the hole in the top.—Contributed by John Weldon, Brooklyn, N. Y.

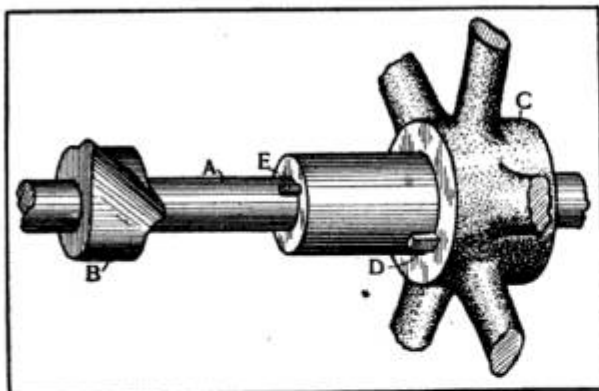
MAKING AND COOLING A 105-TON CASTING

The pattern for a big casting recently poured at Milwaukee was 32 ft. long, 11 ft. wide and 10 ft. high, and ten patternmakers were kept busy four months in making it. The casting was an engine bed, weighing, when completed, 105 tons. It was poured from nine ladles, 108 tons of metal going into the rough casting. Fifteen days were allowed for cooling, but at the end of 20 days the heat given off could be felt at a distance of several feet.

POUNDING IN ENGINE

A sharp metallic pounding in a four cylinder engine was found to be due to accumulated carbon in the combustion chamber causing preignition and loosening of the spark-timing mechanism, says a correspondent of the Motor Age.

Ignition was by contact spark, and the spark timing was changed by shifting the inlet valve and ignition camshaft—which performed both functions—along its axis. The arrangement is shown roughly in the sketch, in which A is the camshaft, B one of the ignition cams and C the hub of the two-to-one gear. This gear was keyed on a bronze sleeve, D, which turned in a bearing and in which the shaft slid lengthwise. A feather, E, established the connection be-



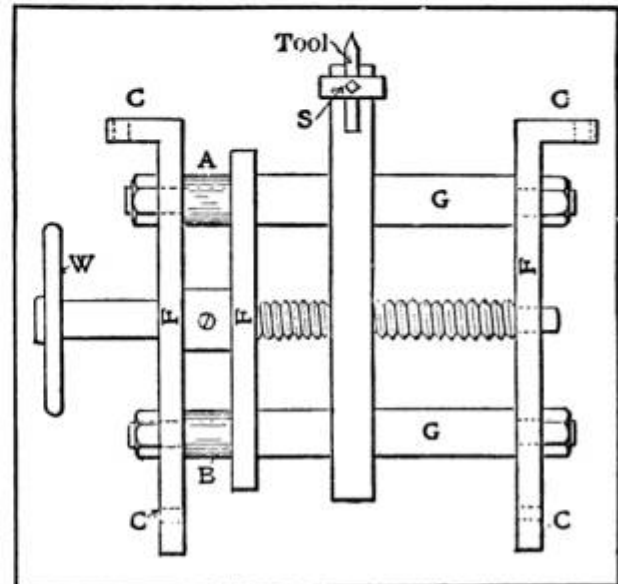
Arrangement for Ignition

tween A and D. On taking things apart it was found that the feather was exceedingly loose in both A and D, and it was inferred that the springs of the inlet valves exerted so much force on A as to cause it to jump rotatively back and forth when the valves opened and closed. A tight feather, which was let deeply into A, cured part of the trouble, and scraping the carbon from the combustion chambers cured the rest of it.

HOME-MADE RIG FOR TRUING COMMUTATORS

An easily made device for truing commutators and one strongly recommended by a correspondent of Power is shown in the accompanying illustration.

This device was used to true up the rectifying commutator on a large alternator,



For Truing Commutators

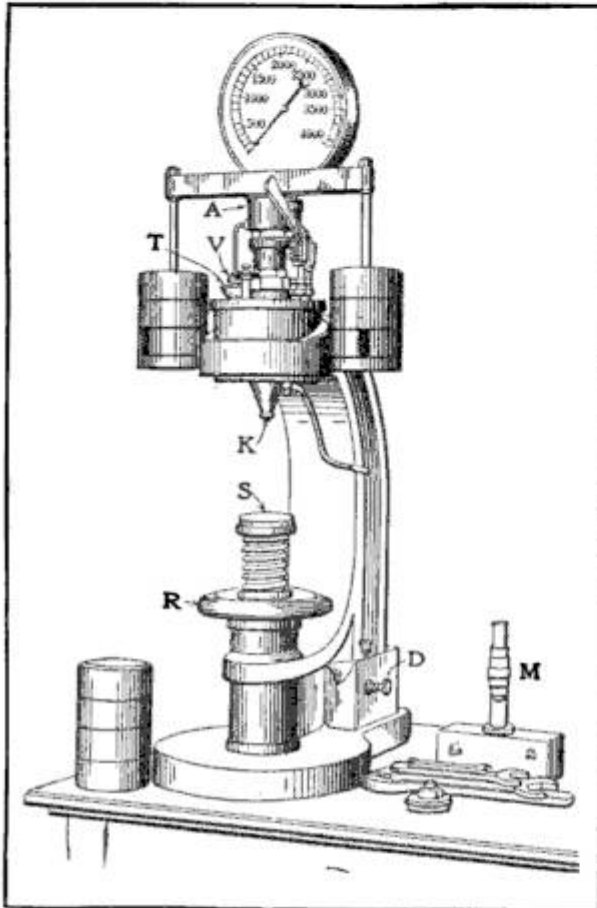
the hole in the brush-holder yoke being used to line up by. The device was clamped in position by inserting the rod A in the brush stud hole, and then bracing the corners C C C C of the frame to foundation, brush yoke and bearing bolts, respectively, with $\frac{1}{2}$ x2-in. wrought iron, to insure rigidity. The toolpost guide bars, G G, were made of $\frac{1}{4}$ -in. key steel, turned and threaded at each end for the four nuts shown. The toolpost was made of $1\frac{1}{4}$ x3-in. Swedish iron planed smooth, and with two true, square holes to receive the guides, G G, and work free without lost motion. The tool was of lathe-tool material and attached by inserting in a slot on top of the post and tightening the set-screw, S. The frame, F F F, was made of $\frac{1}{2}$ x3-in. wrought iron planed smooth and true. The guides were turned down at A and B to take the two collars, which fitted holes in brush-holder yokes of two sizes of dynamos, the whole device being made reversible. The tool was fed by the long screw, turned by the hand-wheel, W.

It is estimated that London sends up into the air 1,000 tons of soot each year. The natives claim that fully a million tons come down.

MACHINE FOR TESTING HARDNESS

One of the most important properties of cast iron is its hardness. An iron which is too hard is brittle, weak and more difficult to finish and the results are inferior to those obtained when soft iron is used.

In order to determine the degree of hardness various machines have been designed,



Hardness Tester

some of which depend on the impact of a sharp-pointed object or the effects of scratching, and others on the effects of an ordinary twist drill. In the last named machines a given size drill with a constant pressure applied will make a hole of a given depth in a certain number of revolutions, the number of revolutions determining the hardness of the iron or other material that is being tested.

The machine which is herewith illustrated, by courtesy of the American Machinist, is one which was recently invented by a Swedish engineer, and is regarded by leading technicians as the most reliable machine of its kind that has ever been devised. In this machine the degree of hardness of any substance is measured by the amount of indentation caused by the pressure of a hardened steel ball on the sample to be tested. The pressure is obtained by means of a small hydraulic press, operated by a hand pump, and connected to a gauge which

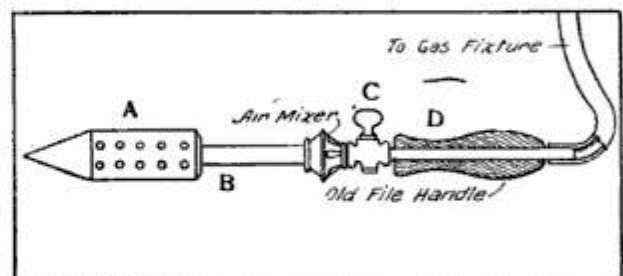
indicates the amount of pressure that is being applied.

A small auxiliary cylinder A, supports a beam on which are suspended a number of weights. These weights are changed to suit the material to be tested, and when the pressure passes a certain point they are raised, thus preventing any excess over the desired amount.

When a sample is to be tested it is placed on the end of the screw S, and the wheel R is then turned until the sample is brought against the steel ball K. The necessary pressure is then produced by working the pump, after which the sample is removed and placed under the microscope M, which has a lens engraved with a scale which is always visible, and thus allows measuring the exact size of the indentation. In order to get the most accurate results the surface of the sample should be polished. After obtaining the exact size of the indentation produced by a given pressure the hardness can be obtained from a table which gives the value in standard degrees.

HOW TO MAKE A SELF-HEATING SOLDERING IRON

A good self-heating soldering iron, having nearly all the advantages of an electric soldering iron, can be easily made by using the devices shown in the accompanying sketch. A is the copper head of an ordinary soldering iron, and is drilled with $\frac{1}{8}$ -in. holes on the sides as shown. It is also drilled to receive the $\frac{1}{4}$ -in. pipe, B, which is screwed into the air mixer. The stop cock, C, can be omitted if desired, but is very handy when the gas fixture is high and not easily reached. A $\frac{1}{8}$ -in. pipe, D, is pushed through an old file handle drilled for the



Self-Heating Soldering Iron

purpose, and connects with the hose as shown. The air mixer can be taken from an old Wellsbach light.

When the gas is turned on and lighted and the air mixer properly regulated, a blue flame surrounds the copper and keeps it at just the right temperature.—Contributed by Edw. J. Snyder, Buffalo, N. Y.

ACETYLENE TESTER FOR EGGS

An acetylene lantern has been discovered by a poultry dealer to be ideal for egg-



Testing Eggs

testing purposes. The lantern, which gives a clear white flame of great brilliancy, was first used on an incubator full of eggs by a correspondent of the Poultry Journal as an experiment. A piece of black enamel cloth with a hole in it was fitted over the lens and the eggs in turn held before the lens in the manner illustrated. The intense white light rendered the eggs nearly transparent, so that at the end of the third day of incubation the fertile ones were easily detected, the minute blood vessels showing distinctly.

CLARIFYING RAIN WATER

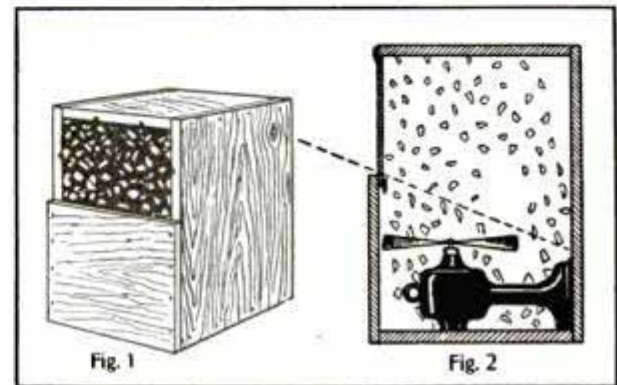
Many people catch their rain water in barrels placed under the eaves spout. In a long dry spell the roof will become dirty, and the first rain will fill the barrel with dirty water. If the rain is long continued it may clear itself, but will not if the shower is of short duration. In the latter case the barrel will be filled with dirty water.

To clear the water quickly extend the spout within an inch or two of the bottom of the barrel. The incoming water will stir up the water in the barrel, so that it will clear itself in one-eighth of the time ordinarily required. This also applies to cisterns, but the smaller the cistern the quicker the clarifying process.—Contributed by T. L. Reed, La Porte City, Iowa.

To make the elevator pump run smoothly, dissolve a package or two of good washing powder in the water contained in the open tank of the elevator system.

MYSTERY DEVICE FOR SHOW WINDOW

Mechanical devices have always proved attractive when used in show windows and usually increase the amount of sales sufficiently to pay for the cost of making in a very short time. One of these devices, which was recently described in the Keystone, consists of a wooden box with a piece of glass in the upper half of the front and a fan motor on the inside. Numerous bits of tissue paper are kept in motion by the fan, thus giving the appearance shown in Fig. 1. It will be necessary to place the device back in the window far enough to

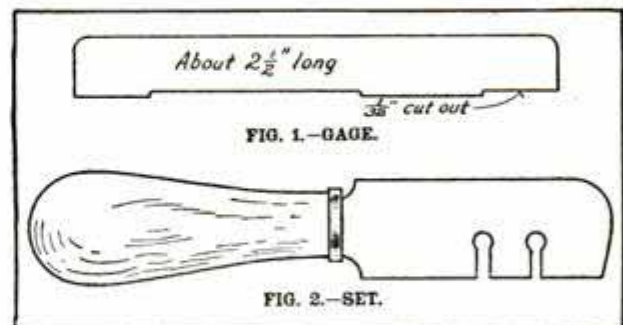


The Mystery Solved

hide the fan and keep the angle of vision above the dotted line shown in Fig. 2. An enclosed, dust-proof motor is the best for this purpose, but any ordinary motor can be used by encasing it in a frame of wire netting.

SAW SETTING TOOLS

These tools will be found very convenient for use in spring-setting small rip saws, and can be easily made, says the Wood-Worker. The gauge (Fig. 1) can be made out of a broken scroll saw blade, one of the beveled

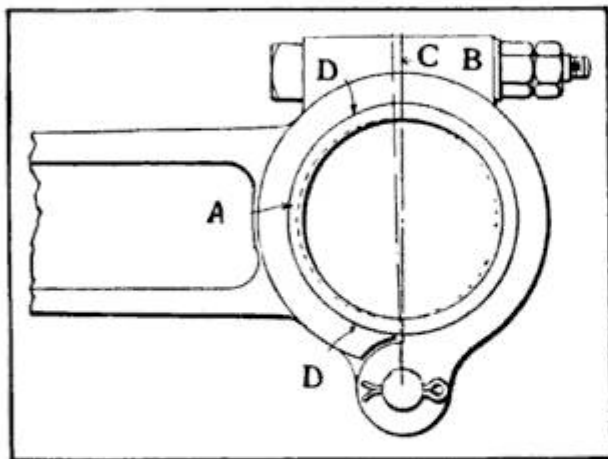


For Setting Saws

back kind of, say, 15-gauge thickness. Mine is filed away 1-32-in. for set of saw. The set (Fig. 2) can be made from a large worn-out flat file. Cut two slots, for thinnest and thickest saws.

REFITTING CONNECTING ROD

About the worst form of connecting rod to refit after it has worn out of round is that with the hinged cap shown in the



Refitting Connecting Rods

sketch, says Motor Age. The reason for this is easily understood by reference to the dotted lines, which show, slightly exaggerated, the wear which may take place in the brass, A, and the corresponding movement required of the cap to take it up. It is evident that whatever wear A has sustained double its extent must be filed off from the upper portion of B of the cap to produce a fit on the crankpin, and, moreover, the surface, C, must be filed slightly tapering instead of parallel. It is next to impossible, always undesirable, to attempt to refit a crankpin bearing by putting a liner between the brass, A, and its seating. The reason lies in the fact that the pressure per square inch on these bearings is so great that it

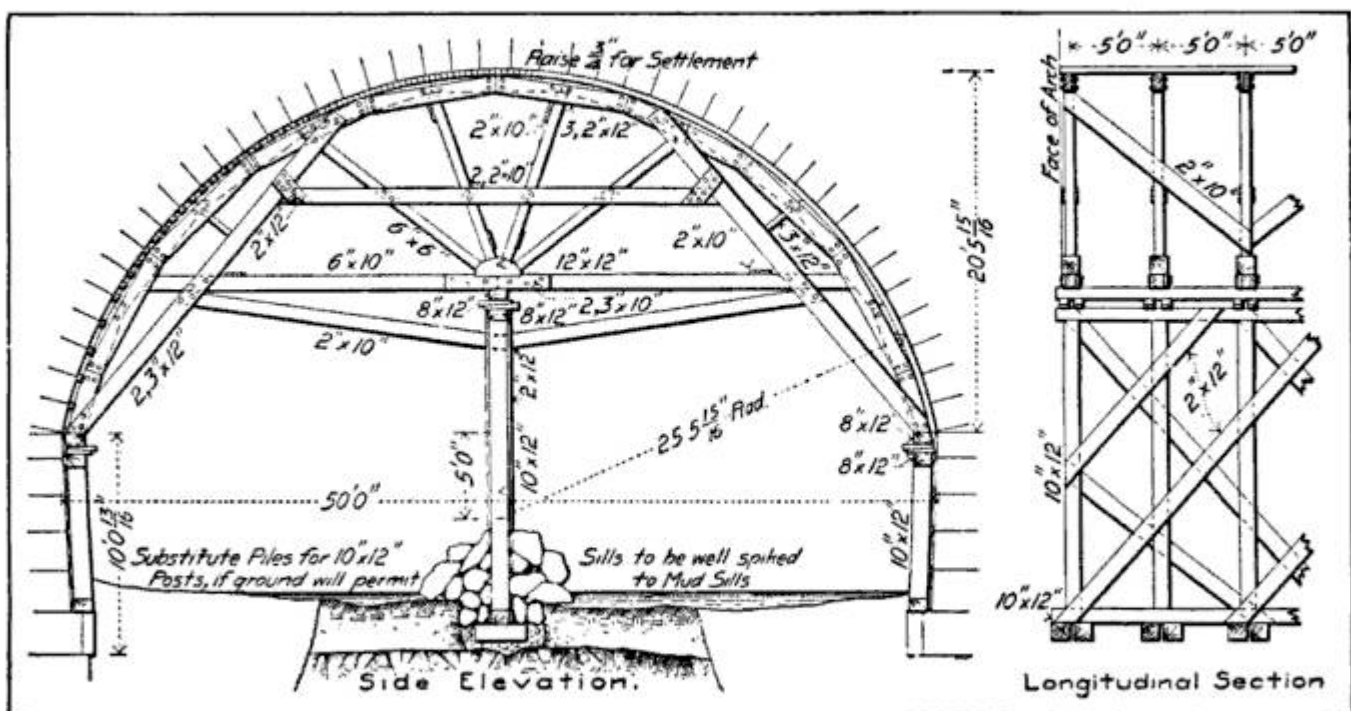
is impossible for a brass so treated to stay around after it has been run. Paper is the only lining that can be used, and the paper will crush more or less under the pressure and allow the bearing to squeeze out of shape. For this reason the only way a crankpin bearing can be refitted without replacing the worn brass is to close in the cap to make the bearing round, and then to scrape the brass as true as possible. This is a short operation after the parts are removed, and requires little skill.

CENTERING LARGE ARCHES

The accompanying illustration shows the centering of a segmental arch of 50-ft. span, which was designed by a correspondent of the Engineering News.

Owing to the stream becoming rather wild at times, it was desirable to place as little obstruction as possible in the bed of the stream. A truss was considered with supports at each abutment only, but as the cost was excessive, and there were doubts as to its rigidity (the angle of main supports being so flat, due to rise of arch), and not caring to use iron rods, it was discarded in favor of the plan herewith. The centering shown is well bolted, so that it can be moved, the section used being one-third of the whole length of arch.

Possibly some of the readers have had occasion to solve a similar problem lately for segmental arches of 50-ft. span or over, in which case it would be interesting to learn something of the design and what the

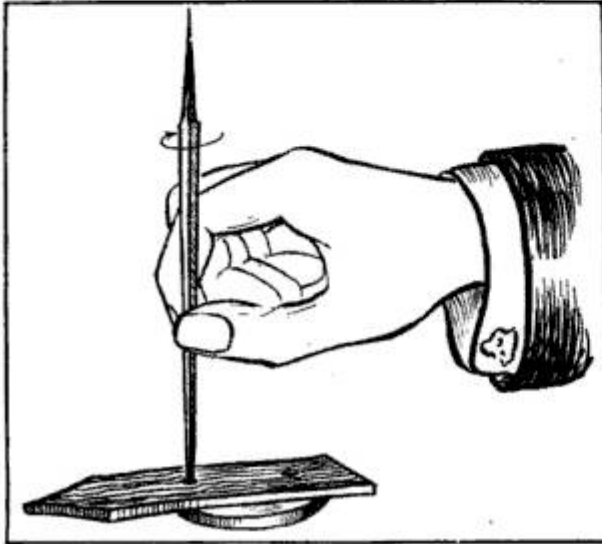


Centering for an Arch of 50-Ft. Span

results were, as some of the stresses in centering for arches are so indefinite it is difficult to proportion the whole economically.

TO DRILL SMALL HOLES IN GLASS

The following method of drilling holes in eyeglasses, which can also be used for drilling other glass articles, is described by a correspondent of the Optical Journal as follows:



Drilling an Eye Glass

Take an old three-cornered file and grind it to a point, being careful not to draw the temper, and make the point sharp as can be with a moderately long taper. Now break off the point by pressing the file with one of the flat sides against a piece of steel or your vise. This will leave the end slightly rough, with three cutting corners. Now slip a strap over the lens where you want to drill the hole and insert the point of the file through the large hole in the strap and rotate the file, using a moderate pressure. When about half way through the lens reverse and drill from the other side, as the lens is apt to chip or break if you drill all the way from one side.

Moisten the drill with benzine to which a small quantity of oil has been added, or turpentine. If worst comes to worst, and neither benzine nor turpentine is handy, moisten the tip of the drill liberally by wetting it on the tongue.

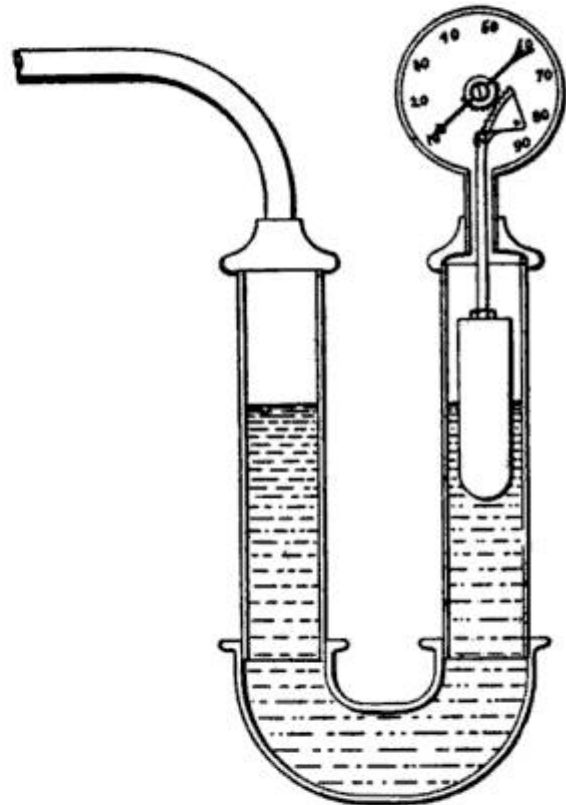
To enlarge the hole use a reamer or a small round file moistened as above. If you use the file turn it backward. Drills may be made in other shapes, as grinding the end of a broken round file to an edge like a chisel or like an ordinary drill. If made chisel edge be sure that the corners are

sharp. When the three-cornered drill gets dull grind a new point and break off as before.

HOME-MADE DRAFT GAUGE

Screw two pieces of 1-in. pipe about 8 in. long into a 1-in. return bend, and put a reducer on the top end of each pipe, reducing it to $\frac{1}{4}$ in. Remove the plunger from a small bicycle pump and solder a piece of copper on the top of the pump, making it airtight. This is to be used for a float, as it drops down in one of the 1-in. pipes nicely.

Remove the pressure spring from a small steam gauge and attach the gauge to one end of the pipe as shown in the illustration. Solder a fine stiff brass wire to the center of the float, letting the wire extend up



U-Tube and Gauge

through the reducer to which the gauge is screwed and connect the upper end of the wire to the bottom corner of the triangular ratchet of the gauge. Fill the U-tube with machine oil until the float raises enough to turn the hand back to zero, says the Engineer's Review.

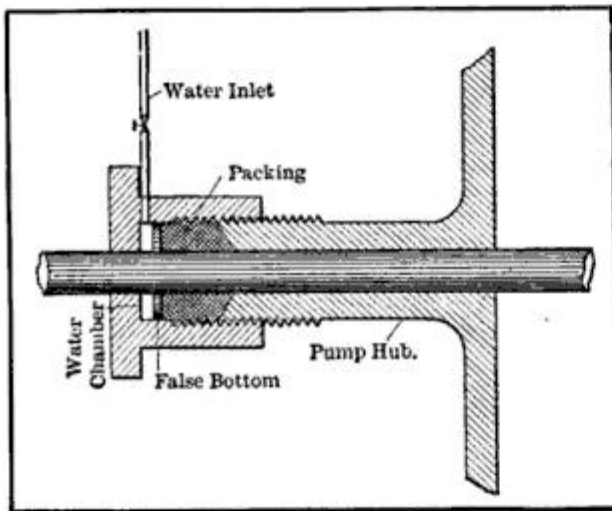
Screw a piece of $\frac{1}{4}$ -in. pipe in the other reducer and run to the side of the smoke-box. As the draft tends to create a vacuum, the oil in the $\frac{1}{4}$ -in. pipe raises on the side connected to the smoke flue, and lowers on the gauge side. This causes the float to drop, thus pulling down on the ratchet, and

turns the hand upward. Oil is a good liquid to use, as it neither freezes nor evaporates.

HYDRAULIC STUFFING BOX

A short time ago I was called upon to operate a centrifugal pumping plant, says a correspondent of Power. The equipment consisted of a 10x30 Corliss engine and a 10-in. pump with boilers and accessories, which outfit was to throw 4,500 gal. per minute to a height of 50 ft., 12 ft. of which was suction lift.

Trouble commenced upon the first day. The pump was speeded so high that the stuffing-box could not be kept tight and cool at the same time. The speed could not be reduced, and the packing burnt out repeatedly. Water and oil applied in the ordinary manner failed to overcome the trouble.



Water-Packed Pump

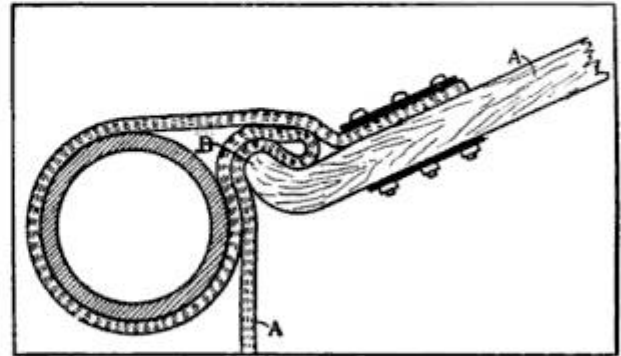
After several days of heart-breaking delay I had the gland taken off and a false bottom inserted on the air side of the packing, leaving a chamber about three-eighths of an inch deep. This chamber was tapped for a quarter inch pipe, a valve was put on at the gland, and the pipe connected into the main discharge of the pump. This practically made a water-packed pump; the packing was left loose and the pump forced to take water instead of air. We had no more trouble with the gland and the packing lasted almost indefinitely.

I hope that this may be of value to some other victim, as I know of nothing so contrary as a centrifugal pump that is taking air. The accompanying sketch is self-explanatory.

An unloading coal record was recently made at Escanaba, Mich., when 4,200 tons of hard coal was taken out of the steamer "H. S. Sill," in 10 hours, with two hoists.

FRICITION PIPE WRENCH

A simple friction wrench for manipulating polished brass and nickel plated pipe is shown in the accompanying sketch and is constructed of the handle, A, a piece of oak wood 1 in. thick, 3 in. wide, 14 in. long, with end of same rounded as shown at B; a piece of canvas, C, so folded as to make three thicknesses and the same width as



Pipe Wrench for Polished Work

handle and about 18 in. long, so that it will encircle all ordinary work. It is fastened about 3 in. from end of handle by means of two brass plates 3 in. square and five countersunk bolts as shown.

To use the wrench pass the canvas around the pipe or other cylindrical object and tuck the folded end between the canvas and wood, as shown in the sketch. Then, when the handle is pulled down, the canvas will tighten around the pipe and under all ordinary conditions produce sufficient friction to turn it.

The use of this wrench will not mar the surface of the work, nor bend the pipe, because the compression is distributed evenly over nearly the entire circumference.—Contributed by John Weldon, 433 Columbia St., Brooklyn, N. Y.

STEAM SOFTENS CLINKERS

Clinkers in the ashpit can be softened and the grates preserved by the introduction of steam, either alive or exhaust, says the National Engineer. Also, the fire, it is claimed, will burn with a longer flame than where dry air is used.

USING A NEW FILE ON BABBITT

When using a new file, on babbitt or aluminum, rub it with a piece of chalk or soapstone. This fills the teeth of the file so the chips cannot stick in them and cut scores in the work.—Contributed by Wm. Ed. Jackson, Tarrytown, N. Y.

LAMPLIGHT PHOTOGRAPHY

When two or three lamps carefully placed in the right positions are used, splendid negatives can be made by lamplight, says a correspondent of the *Photographic Times*.

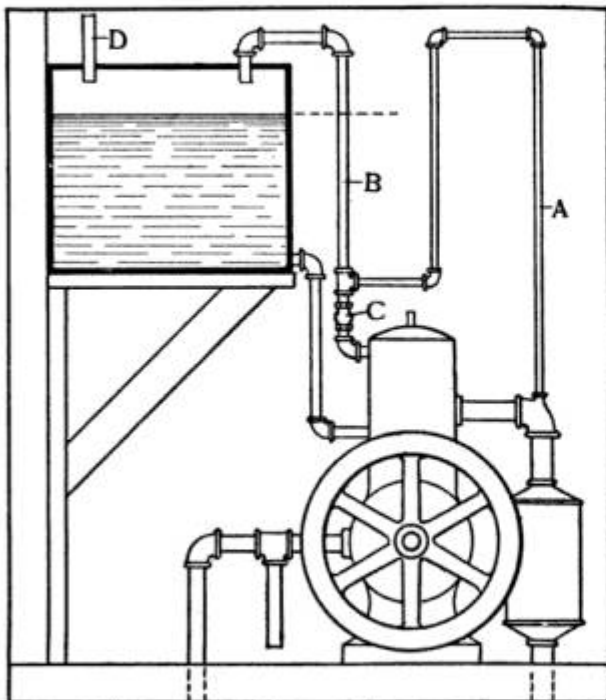
Two 20-cp. oil lamps placed in front and to each side of the sitter at a distance of about 4 ft. will give excellent results. The exposure should be from two to four minutes, according to the plates and lens.

CIRCULATING DEVICE FOR GAS ENGINE

Very often a gas engine, having no pump, will become over-heated after running for a few minutes, especially if the tank is not very large or is made of wood. The reason is, that as soon as the water gets warm it does not circulate as fast or cool the engine as well as when it is cold.

The simple device here illustrated, which consists of ordinary pipe and fittings, will effectually cool the engine without the use of a pump and without reducing its power.

A small pipe, A, connects the exhaust pipe with the water outlet, B, at a point above the check valve, C. At each explosion of the engine there will be a discharge into the water pipe, thereby forcing the water into the tank, where the consumed gas separates and escapes through the pipe, D.—Contributed by E. H. Klipstein, 116 Prospect St., East Orange, N. J.



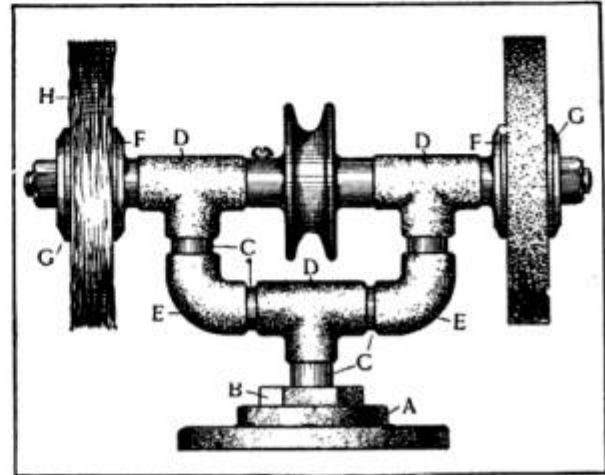
Simple Cooling Device for Engine

LUBRICATE LAG BOLTS

Put a bit of tallow into the hole bored for a lag bolt and it will go easier. The bolt squeezes the tallow ahead of it and greases the hole as it advances.—Contributed by Wm. Ed. Jackson, Tarrytown, N. Y.

HOW TO MAKE A BUFFER AND GRINDER

The materials necessary for making this machine are a pipe flange, A; a bushing, B; five ½-in. nipples, C; three ½-in. tees, D;



Home-Made Buffer and Grinder

two ½-in. ells, E; two collars, F; two washers, G; a number of cloth discs, H; a small emery wheel; piece of ½-in. shaft; pulley with set screw, babbitt, and sal ammoniac.

In order to prevent the fittings from turning loose, apply a solution of sal ammoniac and water to the threads before screwing up. This will rust the two pieces together and prevent loosening. If the threads are greasy so that the sal ammoniac does not adhere, heat slightly and then dip in sal ammoniac.

The tees which form the bearings should be drilled on top for the double purpose of pouring the babbitt and making an oil hole. In pouring the babbitt it will be necessary to cover the ends of the nipples to prevent the melted metal running down inside the base. This may be done by using a small piece of asbestos. Be sure that the shaft is lined up in the center of the bearings before pouring the babbitt.

The emery wheel is fastened to the shaft by a nut and washer as shown and the buffer is fastened in the same way. To make the buffer cut a number of circular pieces of cloth, H (almost any kind of cloth

will answer), and cut a hole in the center of each piece large enough to receive the shaft, assemble all the pieces of cloth concentrically and sew them together near the center.

Then place the buffer on the shaft and screw the nut up tightly.

A GOOD SOLDERING ACID

A soldering acid which can be used to tin and solder cast iron is made by dissolving zinc in muriatic acid and burning the gas generated by the chemical action.

Place the acid in a stone jar having straight sides, something like a closed-circuit battery jar. Add plenty of zinc (you cannot put in too much) and immediately throw a lighted match into the jar. There will be a slight, but harmless, explosion. Have a good supply of matches and if the fire goes out, light it immediately. Keep this up until the acid has ceased to boil, then filter to remove remaining zinc and the matches.

Do not make this acid within doors, as it will rust and tarnish everything metal the room contains.

I have tinned iron castings and wiped lead joints on them with this solution for several years and it is the one and only one I have found to do the work satisfactorily. The acid is good for all soldering purposes, excepting electrical, which is excluded because the preparation is an excellent conductor.—Contributed by V. J. Davis, 314 Fargo St., Buffalo, N. Y.

India has 28,295 miles of steam railroad, of which about half is 5 ft. 6 in. gage.

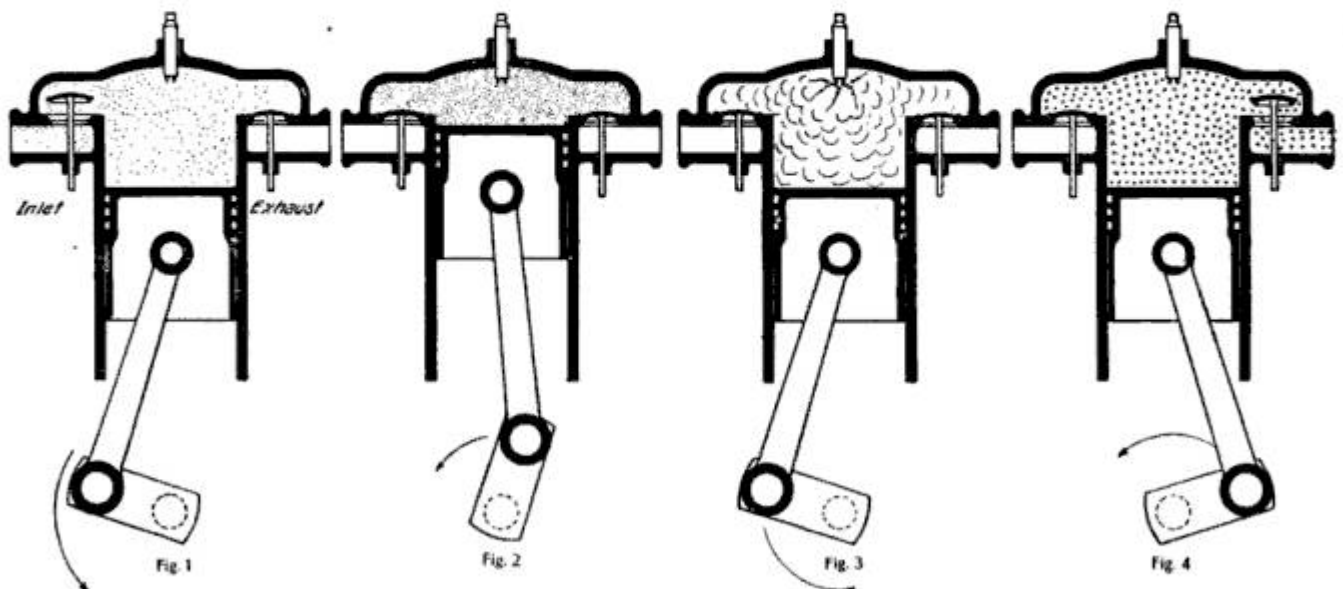
DIFFERENCE BETWEEN A 2-CYCLE AND A 4-CYCLE GAS ENGINE

The accompanying illustration shows the working cycles of both 2-cycle and 4-cycle gas engines. Although more complicated in construction, the principle of the 4-cycle engine is the simpler of the two and will be described first. The explosive mixture of gas and air is first drawn into the cylinder by the downward movement of the piston, as shown in Fig. 1. The inlet valve, which is shown open, is operated mechanically in some engines, but in the simplest engines it operates automatically, being opened by the partial vacuum in the cylinder.

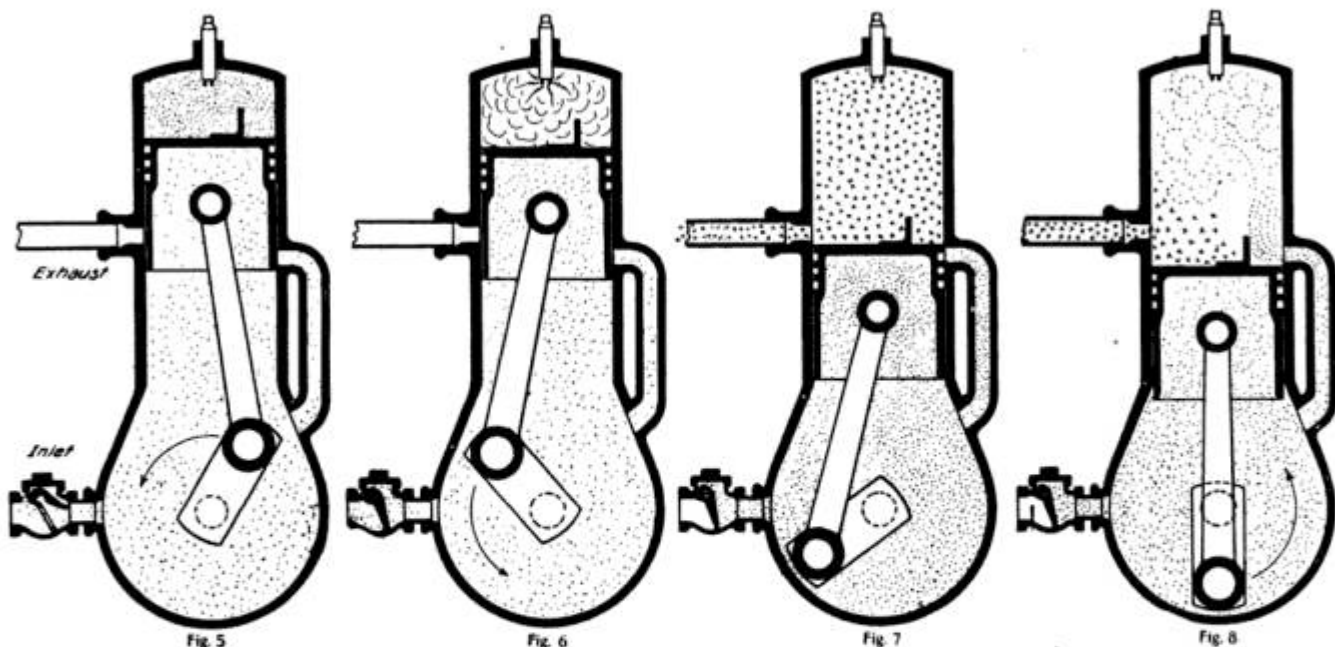
When the piston reaches the bottom of the stroke, the inlet valve closes so that when the piston returns to the top the mixture will be compressed, as shown in Fig. 2. The electric spark or other ignition device then explodes the mixture, which expands and forces the piston down, as shown in Fig. 3. This is the power stroke of the engine and it is here that the flywheel receives the necessary momentum to carry the engine over the other three cycles.

In Fig. 4 is shown the exhaust stroke in which the upward movement of the piston forces the burnt gases out through the exhaust valve, which is opened mechanically in all 4-cycle engines.

In the 2-cycle engine an airtight crank case is used, in which the explosive mixture of gas and air is stored and partially compressed, previous to ignition. The working cycle is best understood by starting at the compression period (Fig. 5) where the upward movement of the piston compresses the mixture in the cylinder, at the same time drawing in a new supply through the check valve at the inlet.



Working Cycle of 4-Cycle Engine



Working Cycle of 2-Cycle Engine

When the piston nearly reaches the top the spark or other ignition device explodes the mixture (Fig. 6), which expands and forces the piston down, thereby partially compressing the mixture in the crank case. The expansion continues until the exhaust port is uncovered by the piston, as shown in Fig. 7, which allows the burnt gases to escape.

The piston in finishing its downward stroke uncovers the inlet port, as shown in Fig. 8, and allows the partially compressed mixture to fill the cylinder, thereby driving out the remainder of the burnt charge. In this view the function of the small vertical plate on the top of the piston will be clearly understood. If it were not for this plate the entering mixture would shoot across the cylinder and out through the exhaust port, but with the plate in position the gases are deflected and forced into the upper part of the cylinder, as indicated.

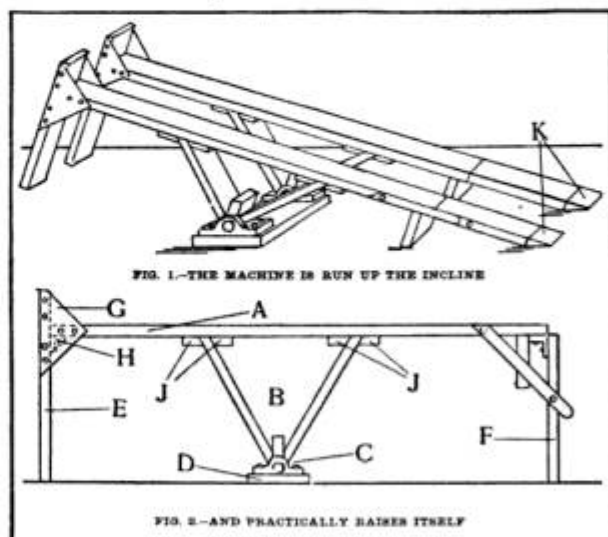
WHY BOILER MAN-HOLES ARE MADE ELLIPTICAL

In a certain technical college, when the question, "Why are man-holes made elliptical, and not circular?" was put to the class in examination, the majority answered by describing the shape of a man's head or body, or in some other manner going into the details of the human anatomy. The others answered that the reason for making them elliptical is that the covers may be placed on the inside, an operation which would be impossible with a circular man-hole.

A DEVICE FOR RAISING AUTOMOBILES

The accompanying illustration shows a device which was constructed by a correspondent of the American Blacksmith and used with great success in repairing automobiles.

In choosing material for building, nothing but the best should be used, as a breakdown, liable to occur from faulty material or construction, is likely to result in serious injury to the repair man. The platform consists of two good, strong planks, A. These rest on two V-shaped supports, B, which in turn work on hinges, C, which are secured to the base board, D. The end supports consist of a stationary board, E, at one end and a hinged leg, F, at the opposite end. The leg at F is attached to the main plank by means of a heavy hinge. When the machine is in proper position, this leg is turned under



Automobile Raising Device

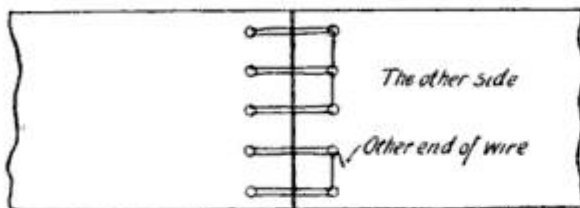
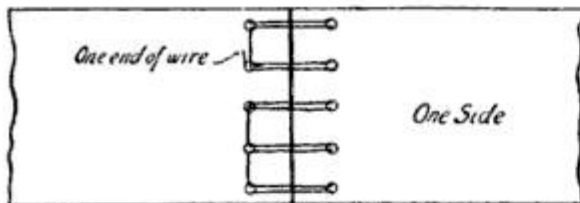
the platform and held in position by means of a rod and thumb screw.

The stationary support is attached to the plank by means of a three-cornered plate, G, and a bracket, H. The V-shaped supports are attached to the planks by means of the blocks at J J. The three-cornered plate on each side of each V support takes up the wear at this point and likewise helps to strengthen the support. Should it be necessary, a cleat or two may also be used to strengthen this support. However, this will not be necessary if good, stout stock is used. To facilitate running the machine up on the platform, a small wood block is attached to the floor at K, Fig. 1.

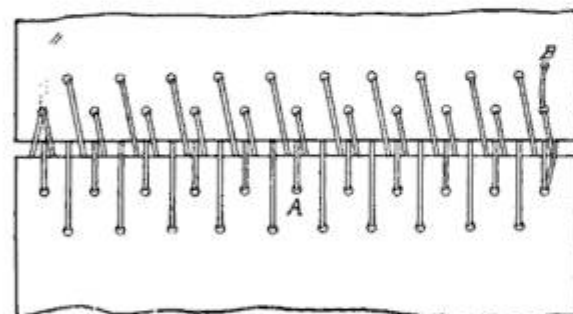
To place a machine on the platform, place the device in the position shown in Fig. 1 and run the machine up the incline. After reaching a certain point, the device will come to the second position when the hinged leg may be swung under the platform and bolted rigidly to support the machine.

WIRE BELT LACING HINGE JOINT

Some mill men have an idea that wire lace is all right in some places, but can not be used where both sides of the belt run to a pulley, as on some feed belts or bottom



WIRE BELT LACING



LACE LEATHER JOINT.

cylinder planer belts that run over a pulley on a counter. That this is a mistaken idea you will readily see if you lace your belt alike on each side, like sketch, writes a

correspondent of the Wood-Worker. This is a 2-in. feed belt. Lace the larger sizes same way. Be sure you cut out the small grooves on both sides of the belt and hammer the lace down good and tight. Then you have a job that will last.

With apologies to those who know, and for the benefit of some who may not, I give a rough sketch of a very satisfactory joint made with rawhide lace leather. Start at A, which is half way across belt, and lace both ways. Punch very small hole at B and draw lace end up tightly, to cut off. Then with your knife cut a gash half through the lace close up to the belt. Cut lace end off, say $\frac{1}{4}$ in. from the notch, or gash, and hammer end down flat. This will make a good, smooth joint which will last a long time; but if you once get to using good wire lacing, and put it in right, you'll not want any more rawhide lace leather. If you doubt its being strong enough, make it double; that is, lace back across belt again after going once across.

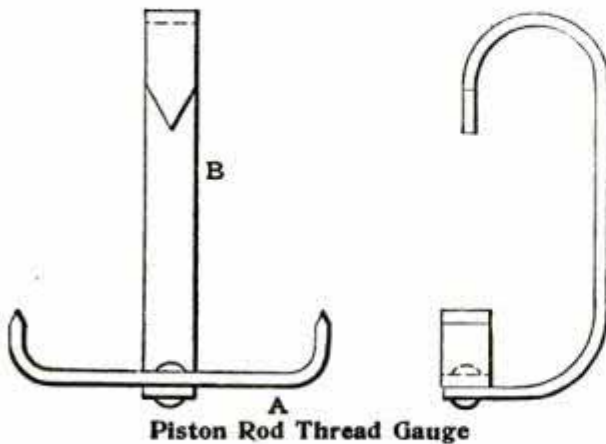
GAUGE FOR PISTON-ROD THREADS

In repairing modern high-speed automatic cut-off steam engines in sizes up to 24-in. diameter of cylinders, a correspondent of the American Machinist experienced considerable difficulty in fitting new pistons and piston rods—particularly in getting the right pitch for the screw thread. In most of these engines the piston rod is secured to the crosshead by a thread on the rod fitting into a tapped hole in the crosshead and with a lock nut behind the boss of the crosshead to make all rigid. To get around this difficulty the piston-rod thread gauge illustrated was devised and it was found that by its use a fair fit could be made every time on the first trial.

To make this gauge, take a piece of $1 \times 1\frac{1}{4}$ -in. flat iron, A, bend its two ends up about $\frac{1}{2}$ in. and file to form two V edges of 60° or the same angle as the threads, in order to fit fairly to the old thread. The distance between the two ends should be about equal to the length of the thread in the crosshead, in order that these V's may approximately represent in the gauge the first and the last thread in the crosshead.

Bend up another piece of the same flat iron as shown at B and rivet it to the middle of A, bringing its free end over and into line with the two V edges and at such distance from them that when a V-point is filed on the free end of B, the old thread will slip in between the three points. Finish

piece B by bending and filing the point until a good caliper fit is secured. The gauge so made not only will give the diameter of the thread at one point, but will give the effective diameter at points where it is important that it should be known, and also provides a means of gauging the new thread,

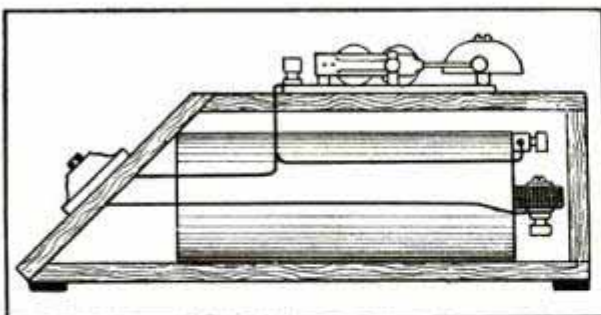


Piston Rod Thread Gauge

which may or may not be of the exact pitch of the old one, but which if made to this gauge will screw in every time and make a fair fit, which is all that the repair man either expects or desires—and, in fact, is all that the builder did in the first place.

HOW TO MAKE A PORTABLE BELL OUTFIT

Make a box with one beveled end, as shown in the sketch, and mount an ordinary electric door bell on the top and a push button on the beveled end. One or two dry batteries will furnish enough current to ring the bell. The outfit may be used at



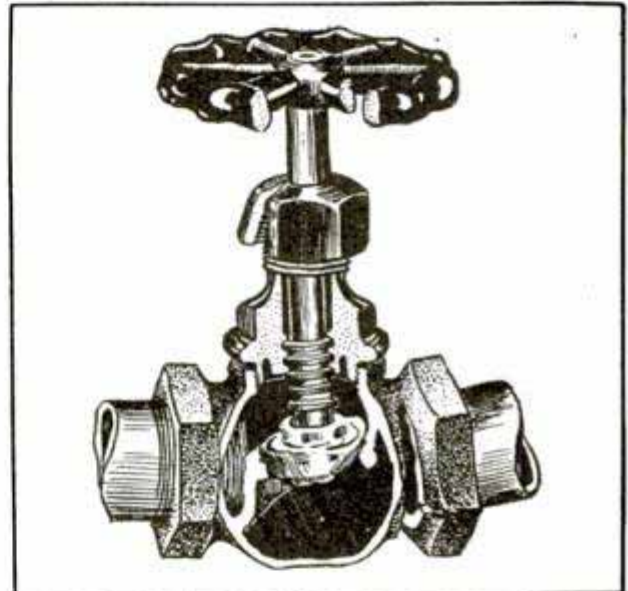
Portable Bell Outfit

the table or for invalids' use, and I have often used mine to imitate the triangle effect in our orchestra.—Contributed by Arthur L. Schacha, 4732 Broadway, Cleveland, O.

A man of average strength can develop .1 hp. with his arms or .4 hp. with his legs for 10 hrs. a day.—Trautwine.

THE ABUSE OF VALVES

Many steam fitters and engineers, upon discovering a leak in a valve, immediately condemn its workmanship instead of trying to learn the true cause of the trouble. Undoubtedly there are cases in which valves defective in construction escape detection until they have been in service for a time; but in most cases the criticism that is directed to the manufacturer does not belong to him, and affects his reputation unjustly. When valves that are thus returned as defective have been received by the maker, and carefully examined and tested, it is found, in the great majority of cases, that the leakage was plainly due to the abuse and carelessness of the persons who installed them.



Effects of Improper Installation and Operation

In discussing this subject, the Valve World gives the following directions for installing and operating valves to obtain the best results.

1. Don't allow any cement or dirt to lodge on the valve seat. Failure to observe this precaution is responsible for more leaky valves than all other causes combined and the trouble can be easily avoided by applying cement to the pipe only and in small quantities, thus preventing any cement getting inside the valve. Remove all the loose rust, scale, or dirt inside the pipe that is to be installed by standing it on end and striking with a hammer and, if convenient, after the pipe is in place, open all the valves and blow live steam through the line.

2. Don't cut threads on the pipe longer than standard, as an extra long thread will allow the pipe to strike the partition, as shown in the cut. This will spring the seat

and make it slightly oval shape, thus making a good fit with the disc impossible.

3. Never apply a pipe wrench on the opposite end of a valve from the end that is being screwed on the pipe, and never clamp a valve in a vise sidewise. This should be particularly observed with the lighter class of valves as it is almost certain to spring the valve and hence cause a leak.

4. Don't try to fix a leaky stuffing box by tightening the stuffing nut with a long wrench, when the trouble can be remedied by renewing the worn-out packing.

5. Avoid undue strains on valves to be installed by placing offsets in the line, when necessary to take up expansion, and don't allow the valves to bear the weight of unsupported pipe.

6. When a valve leaks don't undertake to

tighten it by using some kind of a lever on the wheel. The wheels are so proportioned that sufficient power can be obtained by using the hand alone and any dirt on the seat is only pressed in by the application of powerful leverage upon the stem.

It is far better to remove the dirt from the seat by unscrewing the centerpiece or bonnet. If it is found impossible to remove the bonnet or centerpiece by ordinary methods, heat the *body* of the valve just outside of the thread with a blow-torch, or any other available means that can be applied to the body and not to the centerpiece. Then tap lightly all around the thread with a soft hammer. This method never fails, as the heat expands the body and breaks the joint made by the litharge or cement.



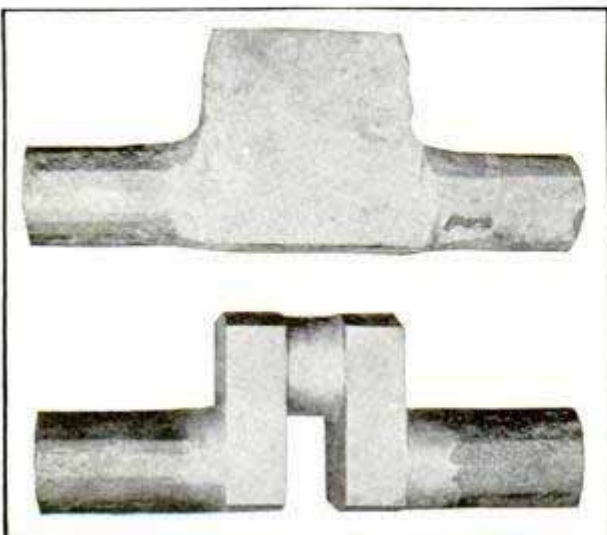
MACHINE FOR FINISHING CRANKSHAFTS

The method of manufacturing crankshafts in general has always been unsatisfactory. A large mass of metal must be removed from the center of a forging to form a crankshaft. This work has always been done by drilling holes across the web and then cold-sawing to meet the holes and breaking out lump from the throw; a rough square pin resulting. It was then necessary to center the pin and shaft and balance the forging with jigs so that the pin could be turned up in a lathe. To finish the cheeks of the crank, a powerful milling machine has generally been used.

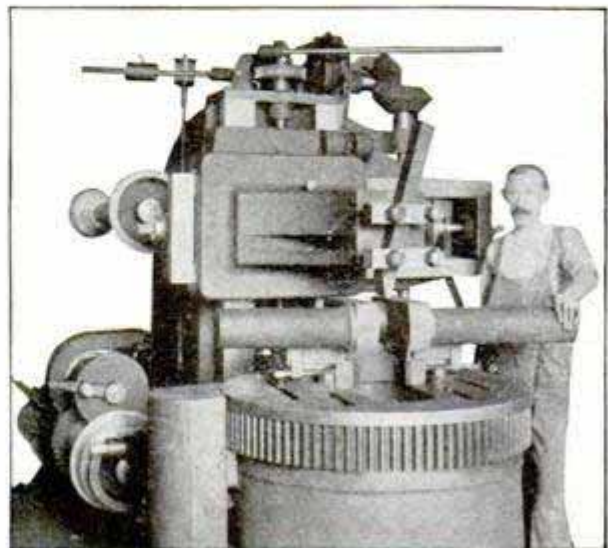
The machine shown in the illustration, which will turn up a finished crank from

the rough forging, is provided with a patent universal vise for roughing out and a stationary vise for finishing the crankshafts. The vises are easily adjusted to different sizes of crankshafts and will hold the work in a horizontal position for finishing the cheeks, as shown, or in a vertical position for finishing the shaft and crank pin.

By the use of this machine a rough forged crank can be finished all over in one hour and thirty minutes. This remarkably fast work is made possible by the crank being held vertically in the machine, thereby avoiding the rise and fall of the weighty lump of the forging when same is turned in horizontal position.



Rough and Partly Finished Work



Crankshaft Machine

TO FIND THE HORSEPOWER PRODUCED OR CONSUMED IN ANY MACHINE

The standard horsepower is equivalent to 33,000 foot pounds per minute, or 550 foot pounds per second, i. e., one horsepower will lift 1 lb. 33,000 ft. in one minute, or 550 ft. in one second. If the weight is increased and the distance proportionately decreased, the power required to lift it will remain the same. Thus, one horsepower would raise 1 lb. 33,000 ft. in one minute, or it would raise 1,000 lb. 33 ft. in one minute, or 330 lb. 100 ft. in one minute.

It therefore follows that the pull or force of any machine multiplied by the distance through which the force acts in one minute divided by 33,000 lb. will give the horsepower. Thus, in turning up a casting on a lathe having a cutting speed of 20 ft. a minute and producing 200 lb. pressure on the cutting edge, the power consumed will be $200 \times 20 \div 33,000 = .121$ hp.

If the cutting speed and cutting force were unknown, the horsepower could be found as follows: Stop the lathe and connect a spring balance to the belt. Then turn the lathe by pulling the balance and note the number of pounds required. Measure the circumference of the pulley and count the number of revolutions per minute. Now, supposing the speed to be 100 revolutions per minute and the belt tension 20 lb. on a pulley of 2 ft. circumference; then the power consumed would be, $2 \times 100 \times 20 \div 33,000 = .121$ hp.

Of course, these results give the theoretical horsepower and do not include the loss occasioned by the transmission, although the extra power required to start the lathe when using the balance will partly compensate for this, as it takes more force to start it than to keep it in motion.

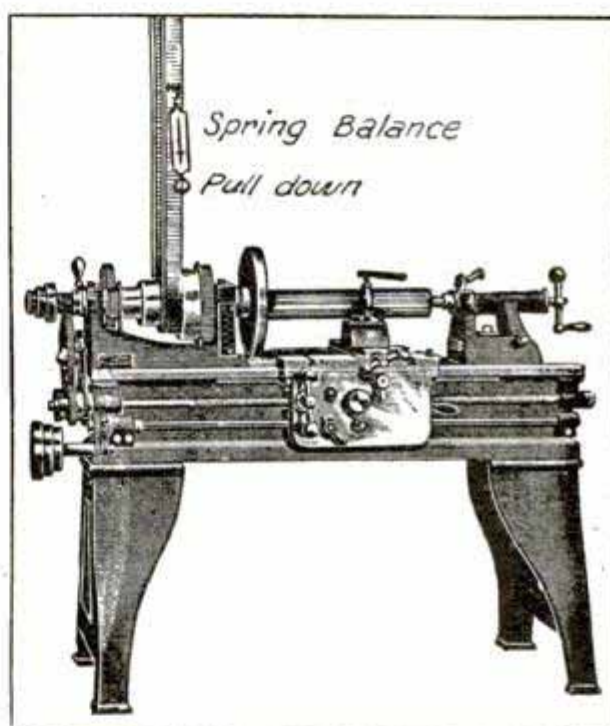
In some machines the force is not uniform. Thus, in a steam engine the pressure on the piston at the beginning of the stroke is several times the pressure at the end of the stroke and even with the pressure remaining constant the force applied to the shaft would be variable, as it would diminish to 0 at the dead center.

The usual method of finding the horsepower of a steam engine is as follows: An indicator is attached to the engine cylinder while running, for the purpose of recording on a piece of paper the exact pressure in the cylinder at all positions of the piston. The indicator consists of a small cylinder, provided with a piston, which is held down

by a spring and connected by a lever to a pencil. The pencil moves on a revolving paper and traces the record of the pressure.

As stated before, there is a considerable difference between the maximum and minimum pressures, so the mean effective pressure is computed from the indicator card and this pressure times the area of the piston times twice the length of the stroke in feet times the number of revolutions per minute divided by 33,000 will give the indicated horsepower.

Thus, a 10-in. by 12-in. engine running at



To Obtain the Horsepower of a Lathe

125 r.p.m. with 65 lb. mean effective pressure would give $65 \times 78\frac{1}{2}$ (area of piston) $\times 24$ (stroke $\times 2$) $\times 125 \div 33,000 = 463.8$ hp.

In some machines the problem of figuring the power is presented in the primitive conditions that determine the value of a horsepower. Thus, a bucket elevator capable of raising material 100 ft. at the rate of 2,000 lb. a minute would require $100 \times 2,000 \div 33,000 = 6.1$ hp.

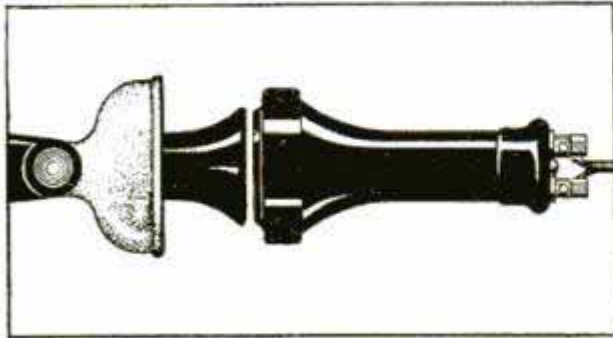
Stated in a general way the horsepower of any machine equals power times motion divided by 33,000, in which the power is in pounds and the motion in feet per minute.

—•••—
A gale blowing 80 miles an hour exerts a pressure of nearly 32 lb. to the square foot.

MECHANICS FOR YOUNG AMERICA

A SINGING TELEPHONE

Those who have not already tried the experiment may be interested to know that a telephone can be made to sing by holding the receiver about $\frac{1}{16}$ in. from the trans-



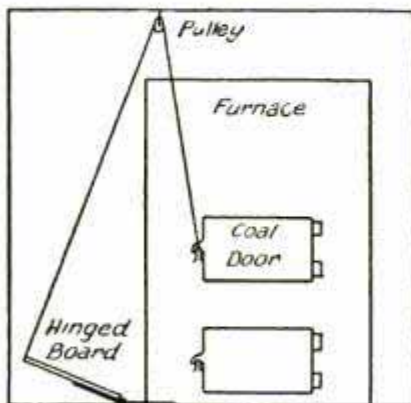
To Make a Telephone Sing

mitter, as shown in the illustration. The experiment will work well on most telephones, but not on every one.

When the receiver is placed in the position shown it acts like an ordinary buzzer, and the function of the transmitter will then be that of an interrupter. The slightest movement of the transmitter diaphragm will cause an increased movement of the receiver diaphragm. This in turn will act on the transmitter, thus setting up sympathetic vibrations between the two, which accounts for the sound.

DOOR OPENER FOR FURNACE

The accompanying diagram shows an arrangement to open the coal door of a furnace. When approaching the furnace with a shovelful of coal it is usually necessary to rest the shovel on the top of the ash door, while the coal door is opened.



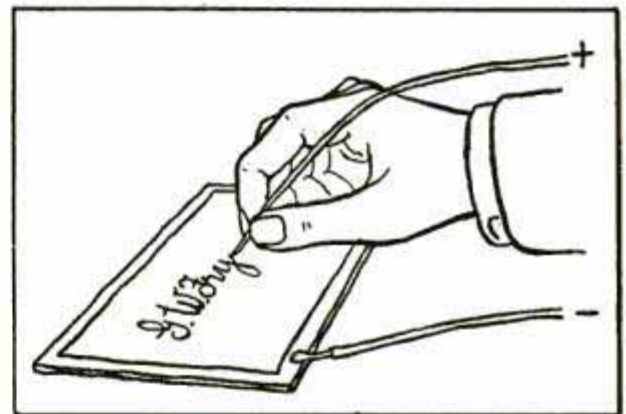
With my device it is only necessary to press the foot pedal, which opens the door. After putting in the coal, pressing the pedal closes the door. The pulley in the ceiling must be

placed a little in front of the door, in order to throw the door open after lifting it from the catch.

A large gate hinge is used to hold the pedal to the floor.—Contributed by Edward Whitney, 18 E. Gorham St., Madison, Wis.

WRITING WITH ELECTRICITY

Soak a piece of white paper in a solution of potassium iodide and water for about a minute and then lay on a piece of sheet metal. Connect the sheet metal with the negative or zinc side of a battery and then, using the positive wire as a pen, write your name or other inscription on the wet paper. The result will be brown lines on a white

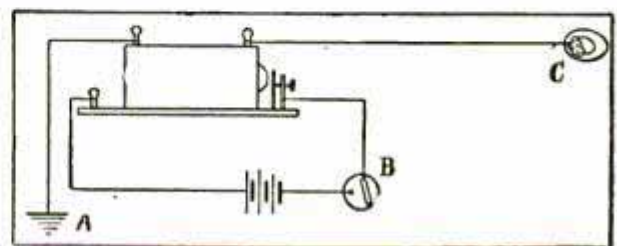


Electrolytic Writing

background.—Contributed by Geo. W. Fry, 1250 Locust St., San Jose, Cal.

TO DRIVE AWAY DOGS

The dogs in my neighborhood used to come around picking up scraps. After I connected up my induction coil, as shown in the sketch, we were not bothered with them. A indicates the ground; B, switch; and C, a bait of meat, or a tempting bone.—Contributed by Geo. W. Fry, 903 Vine St., San Jose, Cal.



Shocking Machine

HOW TO BUILD A TOBOGGAN SLED

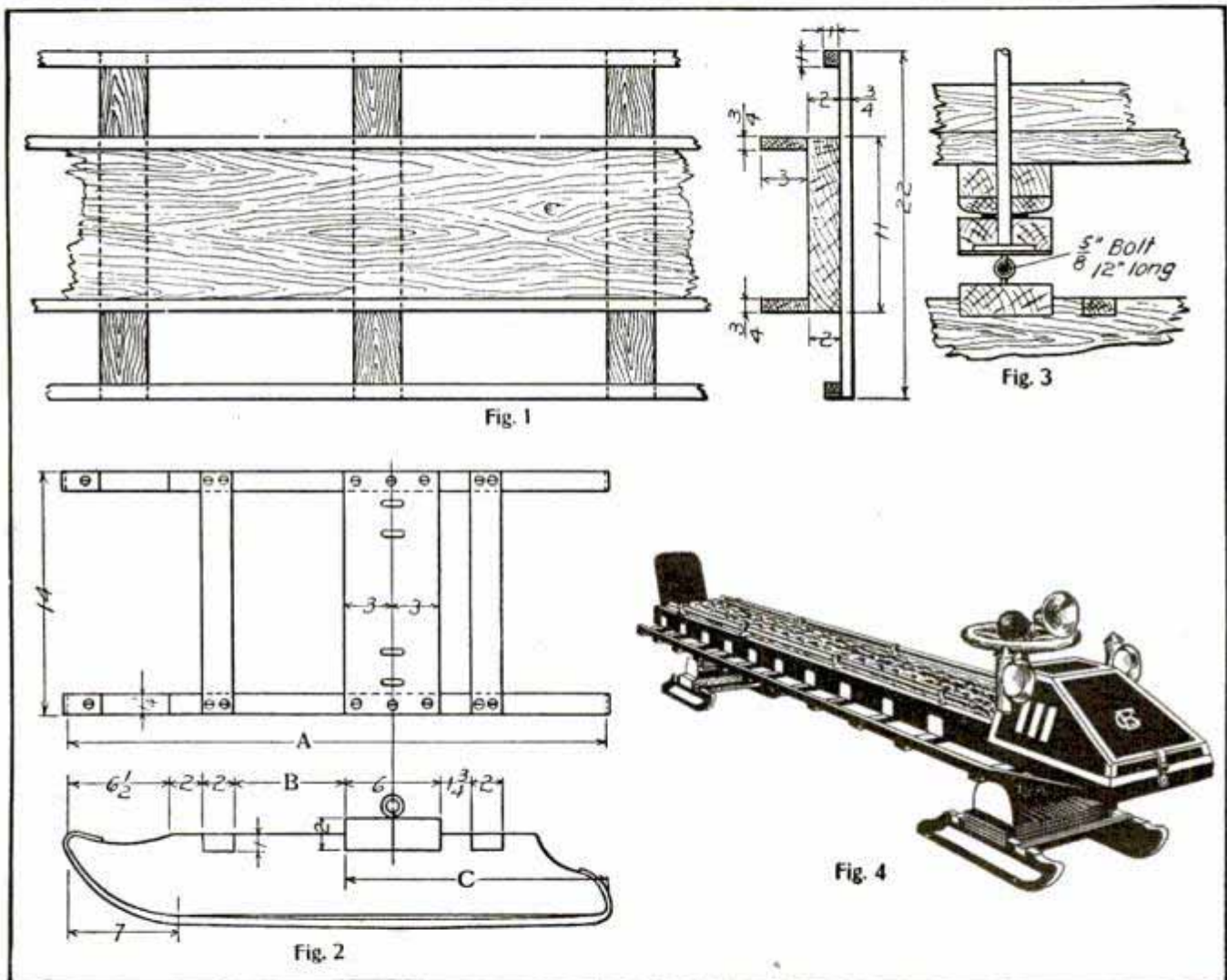
By A. Boette

The first object of the builder of a sled should be to have a "winner," both in speed and appearance. The accompanying instructions for building a sled are designed to produce these results.

The sled completed should be 15 ft. 2 in. long by 22 in. wide, with the cushion about 15 in. above the ground. For the baseboard select a pine board 15 ft. long, 11 in. wide and 2 in. thick, and plane it on all edges.

length of the sled from the back to the auto front. These are to keep the cushion from falling out. See Fig. 1. For the back of the sled use the upper part of a child's high chair, taking out the spindles and resetting them in the rear end of the baseboard. Cover up the outside of the spindles with a piece of galvanized iron.

The construction of the runners is shown at Figs. 2 and 3. The stock required for



Constructing a "Winner" Toboggan Sled

Fit up the baseboard with ten oak foot rests, 22 in. long, 3 in. wide and $\frac{3}{4}$ in. thick. Fasten them on the underside of the baseboard at right angles to its length and 16 in. apart, beginning at the rear. At the front 24 or 26 in. will be left without cross-bars for fitting on the auto front. On the upper side of the cross bars at their ends on each side screw a piece of oak 1 in. x 1 in. by 14 ft. long. On the upper side of the baseboard at its edge on each side screw an oak strip 3 in. wide by $\frac{3}{4}$ in. thick and the

them is oak, two pieces 30 in. x 5 in. x $1\frac{1}{4}$ in., two pieces 34 in. x 5 in. x $1\frac{1}{4}$ in., two pieces 14 in. x 6 in. x 2 in., and four pieces 14 in. x 2 in. x 1 in. They should be put together with large screws about 3 in. long. Use no nails, as they are not substantial enough. In proportioning them the points A, B and C, Fig. 2, are important. For the front runners these measurements are: A, 30 in.; B, 4 in.; C, $15\frac{1}{2}$ in., and for the rear runners: A, 34 in.; B, 7 in.; C, $16\frac{1}{2}$ in. The screw eyes indicated must be placed in a

straight line and the holes for them carefully centered. A variation of $\frac{1}{16}$ in. one way or another would cause a great deal of trouble. For the steel runners use $\frac{3}{8}$ -in. C. R. steel flattened at the ends for screw holes. Use no screws on the running surface, however, as they "snatch" the ice.

The mechanism of the front steering gear is shown at Fig. 3. A $\frac{3}{4}$ -in. steel rod makes a good steering rod. Flatten the steering rod at one end and sink it into the wood. Hold it in place by means of an iron plate drilled to receive the rod and screwed to block X. An iron washer, Z, is used to reduce friction; bevel block K to give a rocker motion. Equip block X with screw eyes, making them clear those in the front runner, and bolt through. For the rear runner put a block with screw eyes on the baseboard and run a bolt through.

Construct the auto front (Fig. 4) of $\frac{3}{4}$ -in. oak boards. The illustration shows how to shape it. Bevel it toward all the sides and keep the edges sharp, as sharp edges are best suited for the brass trimmings which are to be added. When the auto front is in place enamel the sled either a dark maroon or a creamy white. First sandpaper all the wood, then apply a coat of thin enamel. Let stand for three days and apply another coat. Three coats of enamel and one of thin varnish will make a fine-looking sled. For the brass trimmings use No. 27 B and S sheet brass 1 in. wide on all the front edges and pieces 3 in. square on the cross bars to rest the feet against. On the door of the auto front put the monogram of the owner or owners of the sled, cutting it out of sheet brass.

For the steering wheel procure an old freight car "brake" wheel, brass plated. Fasten a horn, such as used on automobiles, to the wheel.

Make the cushion of leather and stuff it with hair. The best way is to get some strong, cheap material, such as burlap, sew up one end and make in the form of an oblong bag. Stuff this as tightly as possible with hair. Then get some upholstery buttons, fasten a cord through the loop and bring the cord through to the underside of the cushion, and fasten the button by slipping a nail through the knot. Then put a leather covering over the burlap, sewing it to the burlap on the under side. Make the cushion for the back in the same way. On top of the cushion supports run a brass tube which will serve the double purpose of holding the cushion down and affording something to hold on to.

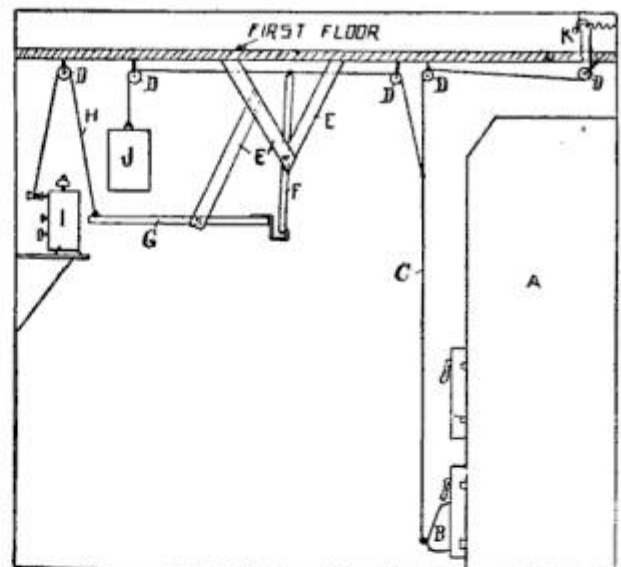
If desired bicycle lamps may be fastened to the front end, to improve the appearance, and it is well to have a light of some kind at the back to avoid the danger of rear-end collisions.

The door of the auto front should be hinged and provided with a lock so that skates, parcels, overshoes, lunch, etc., may be stowed within. A silk pennant with the monogram on adds to the appearance.

If desired, a brake may be added to the sled. This can be a wrought iron lever $1\frac{1}{2}$ in. by $\frac{1}{2}$ in. by 30 in. long, so pivoted that moving the handle will cause the end to scrape the ice. This sled can be made without lamps and horn at a cost of about \$15, or with these for \$25 and the pleasure derived from it well repays the builder. If the expense is greater than one can afford, several boys can share in the ownership.

AUTOMATIC DRAFT OPENER

A simple apparatus that will open the draft of the furnace at any hour desired is illustrated. The parts are: A, furnace; B, draft; C, draft chain; D, pulleys; E, wooden supports; F, vertical lever; G, horizontal lever; H, cord; I, alarm clock; J, weight. K shows where and how the draft is regu-



lated during the day, the automatic device being used to open it early in the morning. The spool on the alarm clock is fastened to the alarm key by sawing a slit across the top of the spool and gluing it on. When the alarm goes off a cord is wound up on the spool and pulls the horizontal lever up, which releases the vertical lever and allows the weight to pull the draft open.—Contributed by Gordon Davis, 518 W. Dutton St., Kalamazoo, Mich.

"JUST MY LUCK"

NO
HELP
WANTED

¶ "Out of work!" What does it mean to you? Have you ever been face to face with this possibility? Do you know what it means to meet the sign, "No Help Wanted" at every turn? Do you know what it means to crowd to the very doors of the newsboys' room of the big daily papers to get the first copy containing the day's "Help Wanted" advertisements—to race with *hundreds* of other applicants for a position which but *one* man can fill? Do you know what it means to be turned away with a sharp "You won't do"? Isn't it worth a little attention—not your time or money—to learn how you can avoid ever being placed in this position? Isn't it worth a two-cent stamp to gain *independence*?

¶ It is not good luck that puts another man in the position that you would like to fill. It's not bad luck that keeps thousands out of work. It's simply lack of education—lack of special training to fill positions that require trained hands and brains. No matter what your age, employment, or location may be, you can start now to fit yourself for a position that you are ambitious to fill. Better pay, better hours, better future, better work, have a real meaning that *you* understand. Let us start you in a profession or trade of your own choice *to-day*. You do not need to dread the constant annoyance of a solicitor.

WE EMPLOY NO AGENTS

to bother you with repeated calls at your home or place of business. We talk to you only by mail. The money you pay us is not used to maintain an expensive organization of high-priced agents, but is used to give you better instruction at a lower cost.

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- ☞ *Popular Mechanics believes in a square deal for the Newsdealer, and has withdrawn all clubbing arrangements of every character. We shall refuse to accept orders after October 31, 1906, from any agency or publication which advertises to club the magazine with any other. We appreciate what the Newsdealers are doing for us, and we intend to protect them.*
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POPULAR MECHANICS CO.

NEW EXPLOSIVE KILLED INVENTOR.—Frank Wurtemberger, a German chemist living in the East, was blown up and killed at a demonstration of a powerful new explosive of his own invention. The man had devoted practically his whole life to perfecting an explosive more powerful than any in use which would not explode by concussion and could be fired by electricity. He seemed to have attained his aim, but at the demonstration mentioned, while tamping the explosive into holes drilled in rock, it was accidentally detonated, killing the inventor and wounding others.

THE MOTION PREVAILED.—An old town official of the city of Macon, Ga., says, in Short Stories, that during the night of the earthquake disturbances of 1886 the city council was in session.

When the quake shook the city hall from basement to attic, the councilmen ran out, thinking the house would topple over, whereupon the wag who kept the minutes of the meeting concluded his record with the following sentence:

"On motion of the city hall, the council adjourned."

PATENT MEDICINE ADVERTISING.—A man went into a chemist's shop and bought a bottle of some patent stuff, which was advertised thus:

NO MORE COUGHS

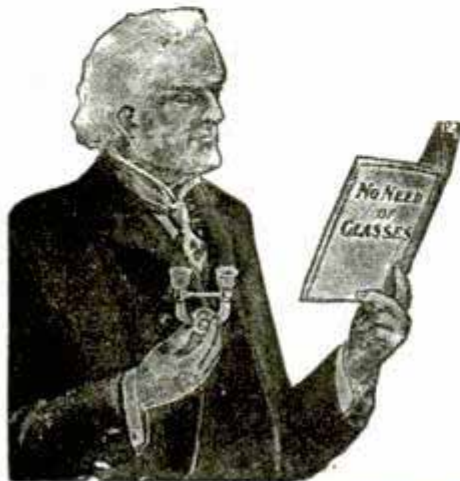
NO MORE COLDS

50 CENTS THE BOTTLE

Three days later he went to the chemist, complaining that his throat was stopped up, and that he could scarcely breathe. "I've drunk all that patent cough mixture," he said.

"Drunk it?" yelled the chemist. "Why, that's an India-rubber solution to put on the soles of your boots."

ICE POWDERS.—During the past summer a mail order fakir reaped a big harvest from advertisements offering to sell information which would enable any one to freeze 100 lb. of ice at a cost of only 10 cents. The formula turned out to be a mixture of carbonate of soda and nitrate of ammonia, but it would take 30 cents worth to freeze 2 lb. of water.



THE IDEAL SIGHT RESTORER

The Ideal Eye Masseur

Indistinct Vision; Muscular Troubles, Chronic Diseases of the Eye all successfully treated by Scientific Massage at any age.

English, German or Spanish pamphlet mailed free.

THE IDEAL COMPANY, 239 Broadway, New York.

OTTO ENGINES

UNSOLICITED PRAISE

Farrand Bros., proprietors of the Lakeside Stock Farm, Colon, Michigan, write: "Our engine has run nine years without trouble, but all machinery is bound to wear out." They then ask for platinum with which to tip the electrodes—a trifling and inexpensive repair. *Nine years* and just beginning to need attention. The average life of the *cheaper* makes is about *five* years. There is a moral in this for the prospective buyer—Get the "**Otto**" for long life, and no trouble.



OTTO GAS ENGINE WORKS, Phila., Pa.

STANDARD OF THE WORLD

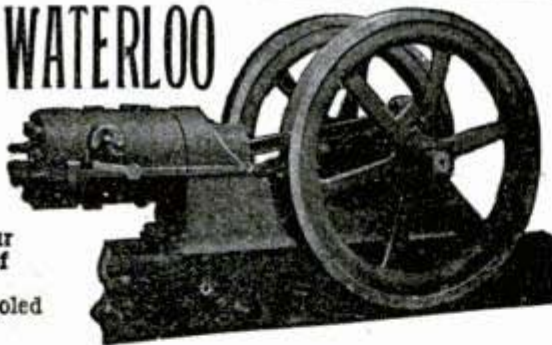
SEND FOR IT

MY REVISED LIST OF MACHINERY AND CONTRACTORS' EQUIPMENT IS NOW READY, AND COVERS TWELVE PRINTED PAGES WITH LOCATION AND PRICES. I WILL BE VERY PLEASSED TO SEND A COPY TO YOU IF YOU WILL LET ME HAVE YOUR ADDRESS.

Willis Shaw, Machinery

171 La Salle St. CHICAGO, ILL.

THE WATERLOO



Secure our Catalog of Air and Water Cooled Engines

The Most Popular Gasoline Engine in the World

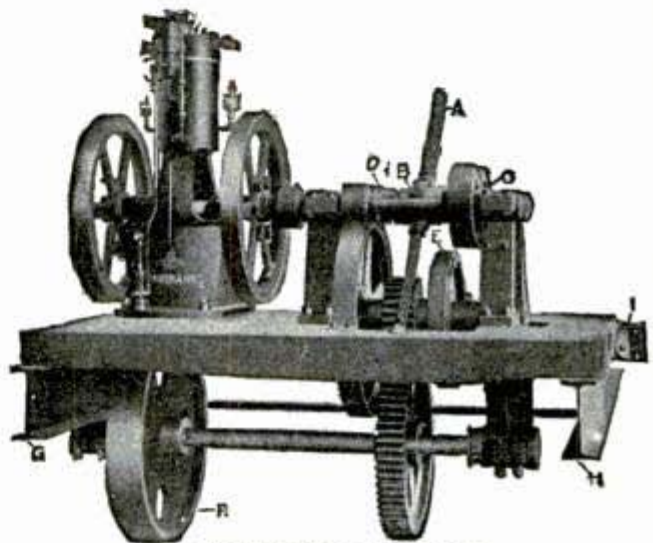
A high-class engine at a reasonable price

WATERLOO GAS ENGINE CO.

1021 Cedar Street

WATERLOO, IA.

FAIRBANKS GAS ENGINES



TURNTABLE OUTFIT

use manufactured, natural or producer gas, gasoline, alcohol, or distillate as fuel; there are six distinct types ranging from 1 to 100 H. P., including stationary, portable and marine, of both two and four cycle. We send experts to make direct connections of these engines to pumps, compressors, generators, hoists, etc. We are also headquarters for Scales, Trucks, Transmission, Valves, Railroad, Factory and Mill Supplies, Machine Tools, etc. Write us for catalog.

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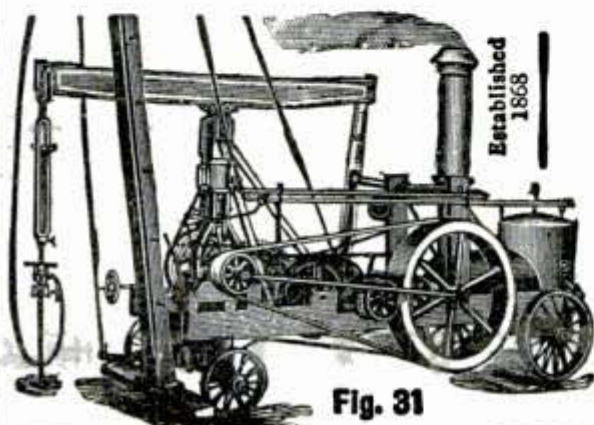


Fig. 31

**You Want Practical
WELL DRILLING MACHINERY**

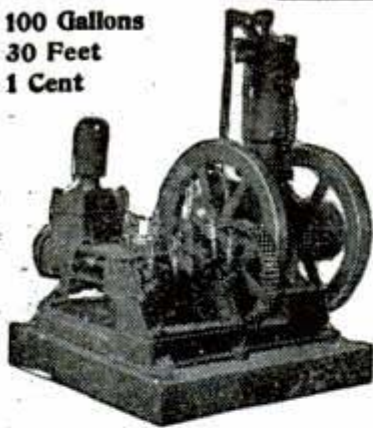
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Mineral, Oil or Water**

**proposition; we have it. Guarantee
it to work satisfactorily.**

Tell us about the formations, depth, diameter holes; will send printed matter and can save you money.

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AURORA, ILL., U. S. A.
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100 Gallons
30 Feet
1 Cent



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Provides all the conveniences of city water works at moderate cost.

Gas, Gasoline or Kerosene Engines for all purposes from 2 h. p. up.

Cut out complete advertisement and send to

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Please send me Illustrated Catalogue No. W 449 Gasoline Engines.

I may want _____ h. p. to _____

Name _____ Street No. _____
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RUNS LIKE A BIKE.

**BALL-BEARING
STEEL-FRAME GRINDSTONE**

Frame strong and rigid.

Fine stone 20-in. diam.
2-in. thick.

Shipped crated.
Weight 75 pounds.



Price \$3.50 F. O. B. Chicago, Ill.

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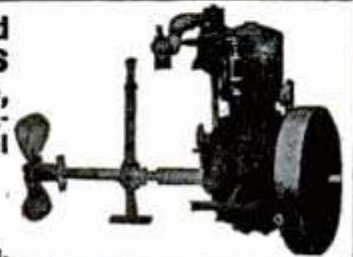
204 Dearborn Street,

CHICAGO, ILL.

**High-grade MARINE and
AUTOMOBILE ENGINES**
2 to 30 H.P. 2 and 4-cycle,
latest improvements; best material;
lowest prices. Also sell castings,
with drawings.

State your want.

HOULE MOTOR WORKS,
580 East St., Holyoke, Mass.



CEMENT BLOCK MACHINE 100 BLOCKS A DAY **\$10**

MOLDS for Cisterns, Silos, Fence Posts, Drain Tile. Write today for particulars.

A. D. MACKAY & CO.,
84 Washington St., Chicago, Ill.

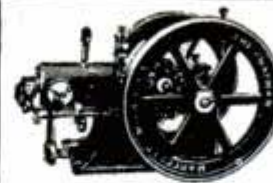
Gas and Gasoline Engine and Motor Castings 1 to 16 H.P.

Bicycle, Auto, Marine and Stationary Booklet on Request

We sell blue print drawings of either 2 or 4 cycle type

THE GEBHARDT MOTOR CO.,

2930 Hancock St., Philadelphia, Pa.



Chapman Economizer

1½ horse, but tested to 33½ per cent above rated power. DON'T buy a CHEAP engine; it doesn't pay. Buy the simplest, strongest and best designed engine at the lowest possible price; that's right, we build them.

CHAPMAN ENGINE WORKS, Marcellus, Mich.

Popular Mechanics, Journal Building, Chicago

I would like to act as your agent in the shop or works of

Firm's Name _____ employing _____ men.

If you have no agent in this plant send me full particulars with statement of commissions paid.

Name _____

Street _____

City _____ State _____

SMALL MOTORS All Variable Speed

Alternating dental and jewelers' motors...	Each \$32.50
Direct current " " " " " " " " " "	23.00
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These motors are the newest improved variable speed motors, and guaranteed for two years.

Send for booklet "A." A thousand other motors in stock.
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MAKE YOUR OWN CEMENT BLOCKS

BRICK, FENCE POSTS, DRAIN TILE, Etc.

We furnish the machine and instructions.
SAVE MONEY on your buildings.

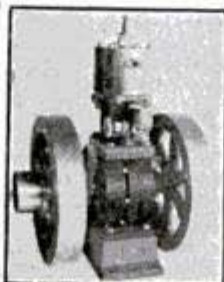
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Build Your Own Gasoline Engine

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Engine Castings

4 H. P.

Complete set, with Prints

\$32.50

Finished Engine

\$100.00

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Nelson Motor Works

St. Joseph, Mo.



BAIRD DOLLAR WATER MOTOR



Simplest, strongest, most powerful water motor made. Sold under an absolute "money-back" guarantee to develop

1-4 Actual PRICE **\$1.00**
HP only

Attach to any faucet. Runs fan, emery wheel, buffing wheel, milk bottle and chimney washer, jewelers' and dentists' lathes, sewing machine, washing machine, small dynamo, etc.

Send money by P.O., or Express money order. Motor sent by express promptly on receipt. Money back if not satisfactory and exactly as represented. Send today. Circular FREE.

SAINT CLAIR MOTOR CO.

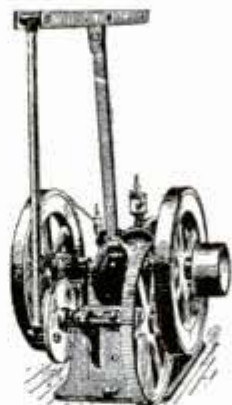
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GOES LIKE SIXTY SELLS LIKE SIXTY SELLS FOR SIXTY \$60 GILSON GASOLINE ENGINE

For Pumping, Cream Separators, Churns, Wash Machines, etc. **FREE TRIAL**
Ask for catalog—all sizes
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SAVE MONEY by using **Reed's Carborundum** grind-

ing stand. Costs less than any other and does away with counter-shafts. Cast iron boxes reduce cost of maintenance over 1/2; has loose pulley, and dust-proof over-hanging bearings. **Luther Bros. Co., 25 Poplar St., North Milwaukee, Wis.,** sole makers of hand and foot power grinders and sharpeners fitted with Carborundum Grinding Wheels.

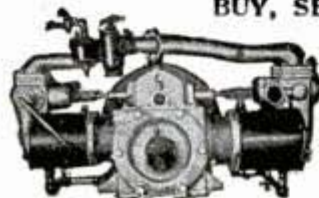


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For foot or power as wanted. Has power cross feed and compound rest. A strictly high-grade modern tool. We also build a 9-inch lathe. Descriptive circulars of each lathe upon request.

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PRESSURE BLOWERS. VENTILATOR WHEELS.
HEATING AND VENTILATION.

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EXETER, N. H.



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List price, \$65.00 and up according to size. When ready to buy send for Lathe Catalog and prices

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TAPS—Fully warranted, money back if not satisfied.

12 Machine Screw Taps, no two alike. 75c
Any Machine Screw Tap under No. 18 10c

Hand Taps, Plug-Taper on Bottom

1/8 and smaller, 24 to 48 thread	14c
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1/2, 1/4 and 3/8, 16 to 32 thread	18c
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7/8 and 1, 14 to 24 thread	22c
1 1/8 or 1 1/2, 12, 13, 14, 16, 18, 20, 24, 27 thread	25c
1 3/8 or 1 1/2, in above threads	30c
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1 1/8 x 11, 80c; 1 1/2 x 10, 40c; 1 3/4 x 9, 50c.	
1 1/2 x 6, 1 3/8 x 5, 1 3/4 x 4 1/2, 1 1/2 x 4 1/2, \$1.00 each.	
15 Bicycle Taper Taps in Case, 1/4 to 1/2 inch, 12 to 82 thread, \$3.00.	
Round Dies, any size under 1/2, 80c.	
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STEEL RULES with Handles

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BUILT UPON HONOR—ACCURACY, EFFICIENCY, MODERATE PRICES.

Foot and Power Lathes, all sizes. Send for Catalogue.

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9 to 15 in. Swing.
New Features.



Wood Working Machinery

Foot, Hand and Light Power

For ripping, cross-cutting, mitring, rabbeting, grooving, dadoing, boring, scroll and band sawing, edge moulding, beading, mortising, etc. Built for hard work, accurate work and long service. Send for catalogue "A."

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JESSOP STEEL
 IS YET ON TOP AND THE VERY BEST FOR ALL FINE TOOLS
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The newest, cleverest and most satisfactory in use, and the first to be offered at so reasonable a price that every up-to-date mechanic could buy tools of their quality and character. Other tools are very good tools, but, "Yankee" Tools are better. Sold by leading dealers in tools and hardware. Ask dealer to see them.


 Ratchet Screw Driver No. 10 and 11. (8 Sizes.)


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Every Tool Covered by a Broad Guarantee.

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 Columbus, Ohio.



COLUMBUS
 GAS AND GASOLINE Engines
 Simple, Reliable and Economical
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ONE OF THESE HANDY CALIPERS
FREE
 for a few minutes of your time. Drop us a postal and we will tell you how.
E. G. SMITH CO., Columbia, Pa.



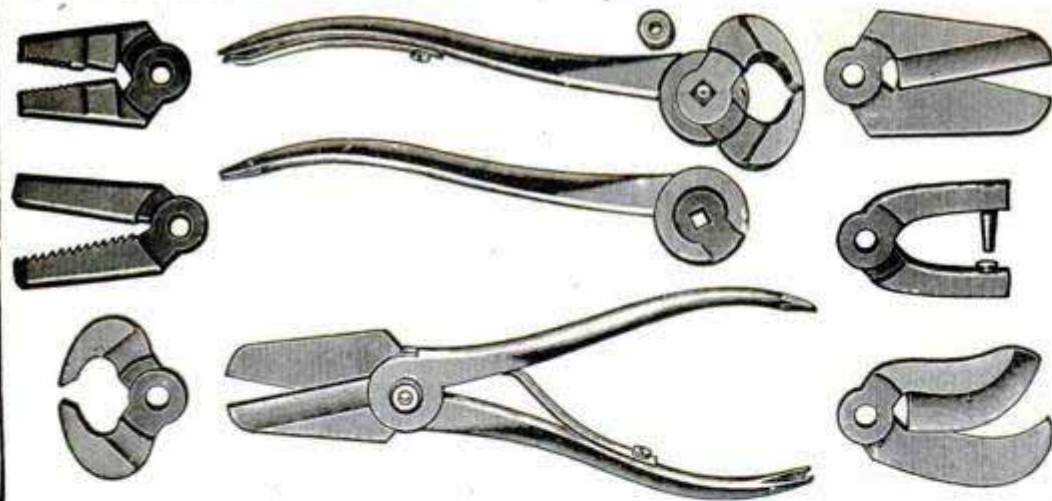
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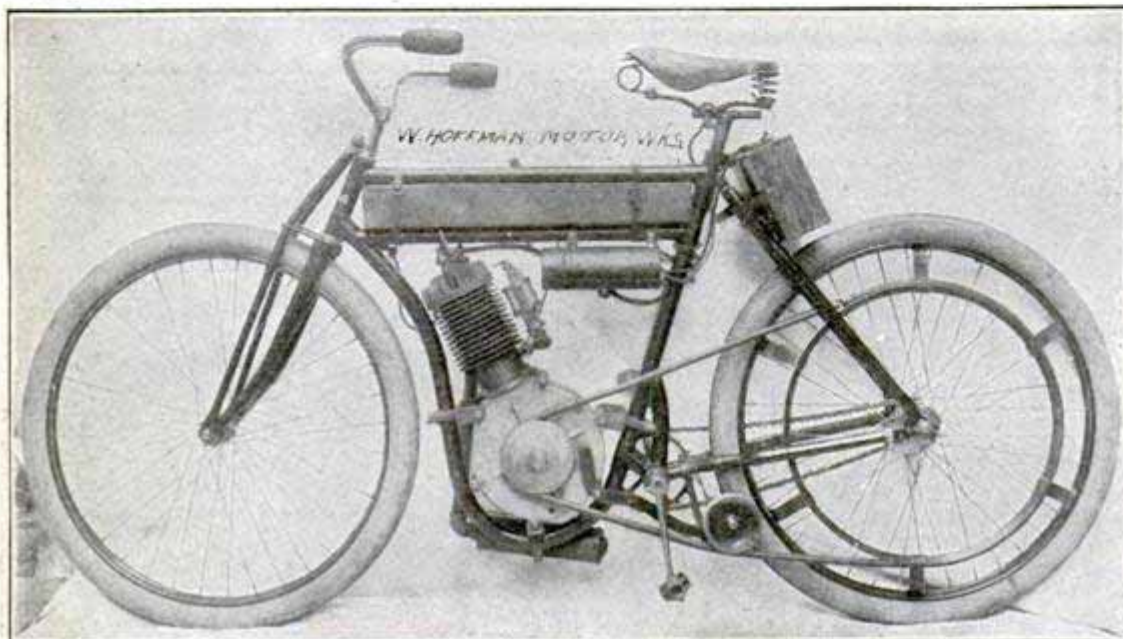


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PARCELS POST FOR DENMARK AND AMERICA.—Acting Postmaster-General Hitchcock has signed a parcels-

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**SPECIAL
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PATENTS PENDING.



Bolts before and
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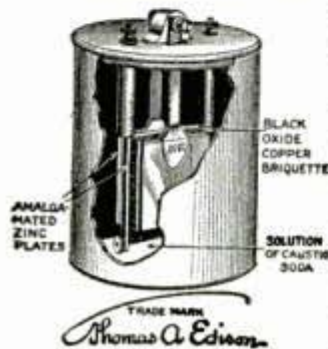
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YOUR INVENTION. ALL MODERN FACILITIES ARE OURS, AND WE ARE AT YOUR SERVICE. WE EMPLOY EXPERT MECHANICS ON

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SEND US YOUR DRAWING OR MODEL AND WE WILL SUBMIT OUR LOWEST PRICE

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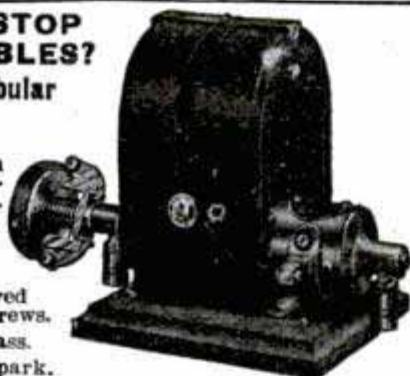
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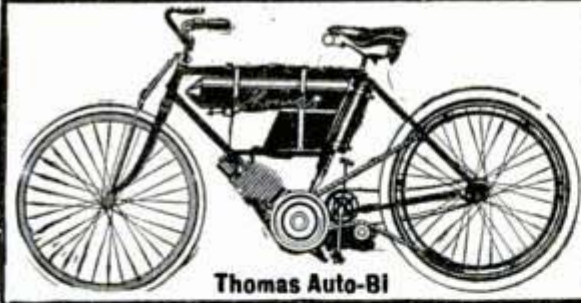
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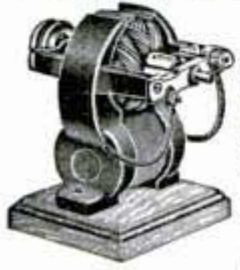


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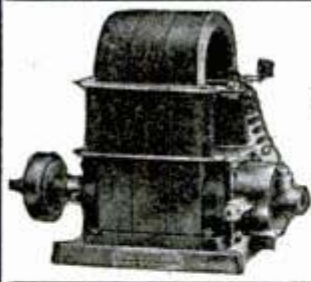
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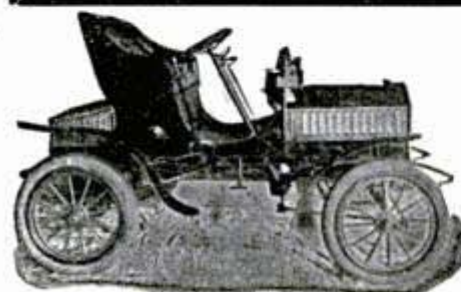
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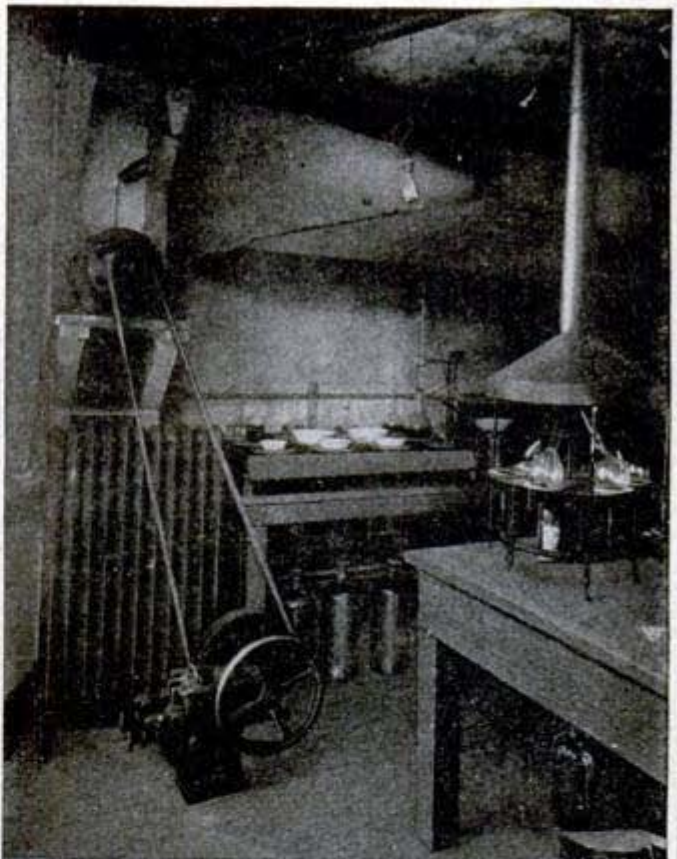
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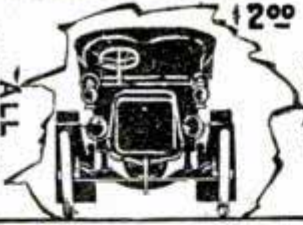
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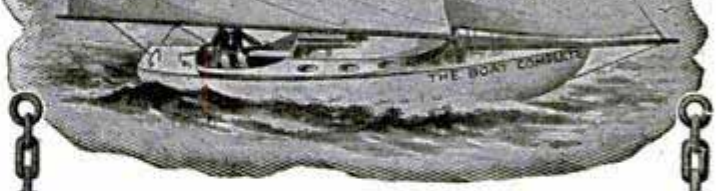
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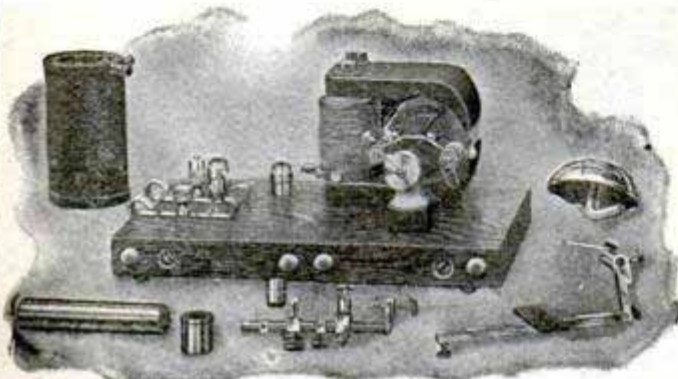
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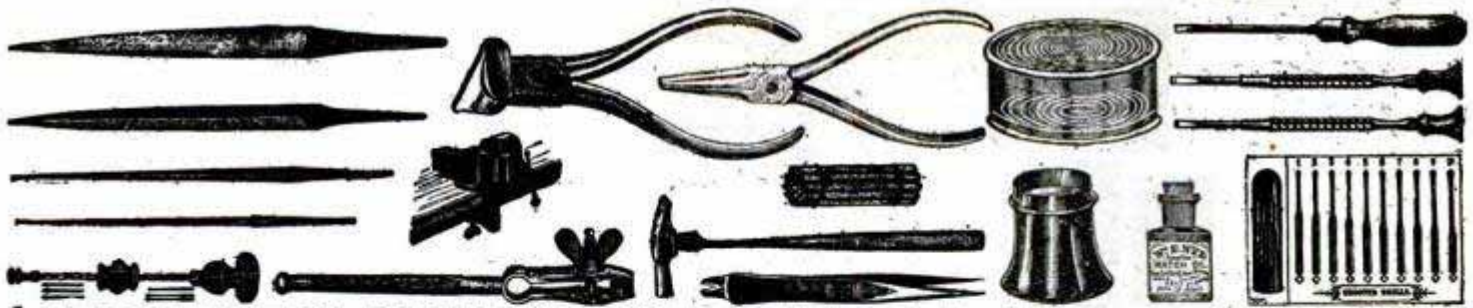
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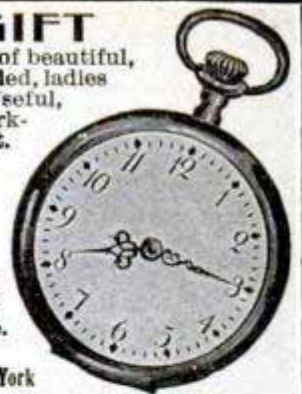
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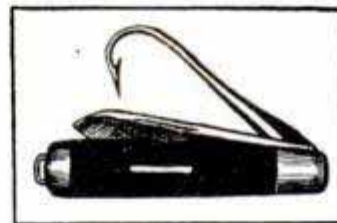
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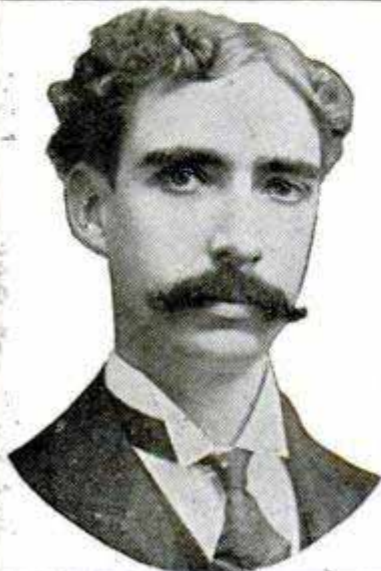
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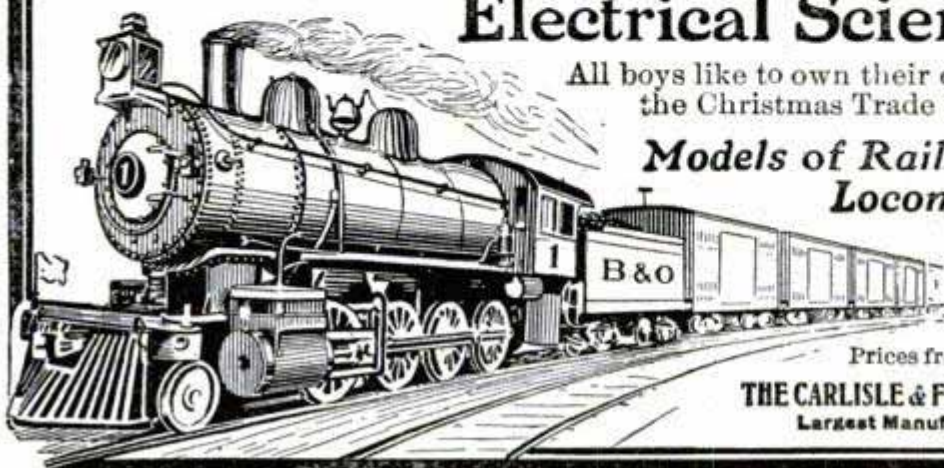
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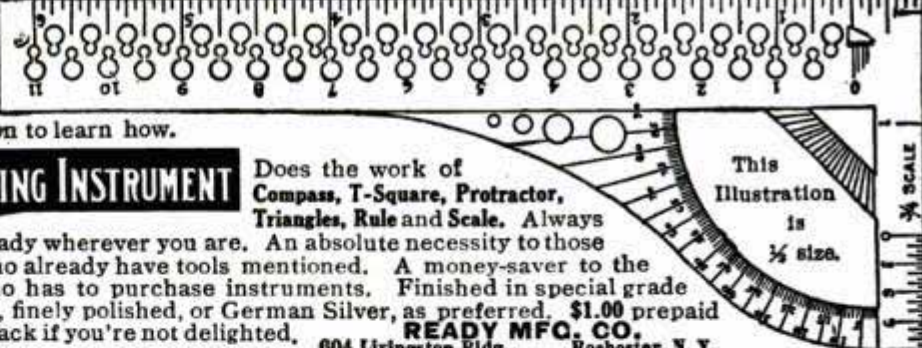
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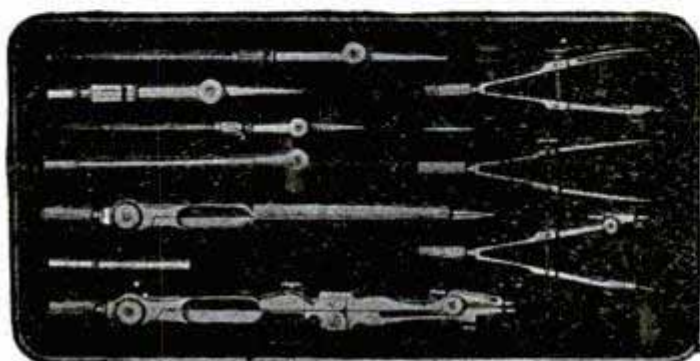
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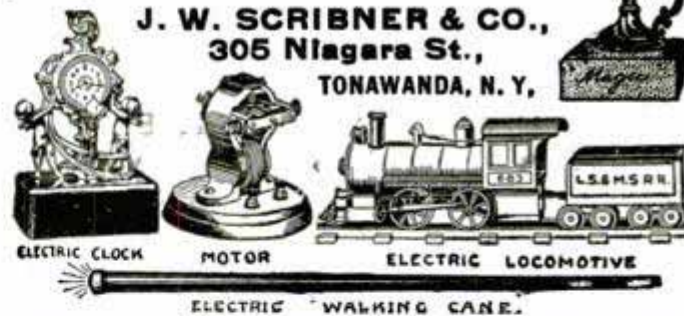
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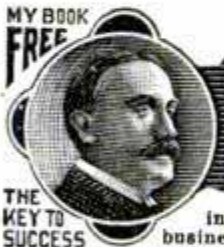
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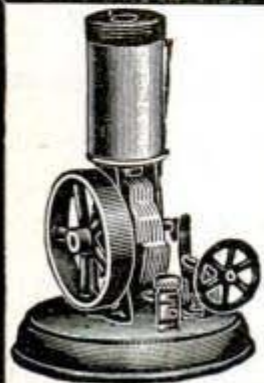
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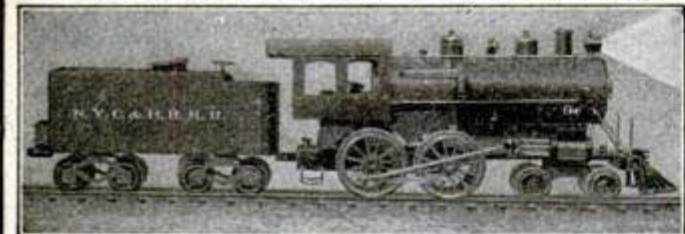
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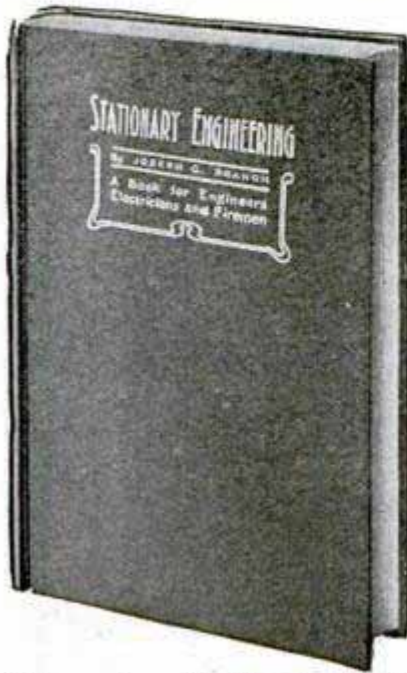
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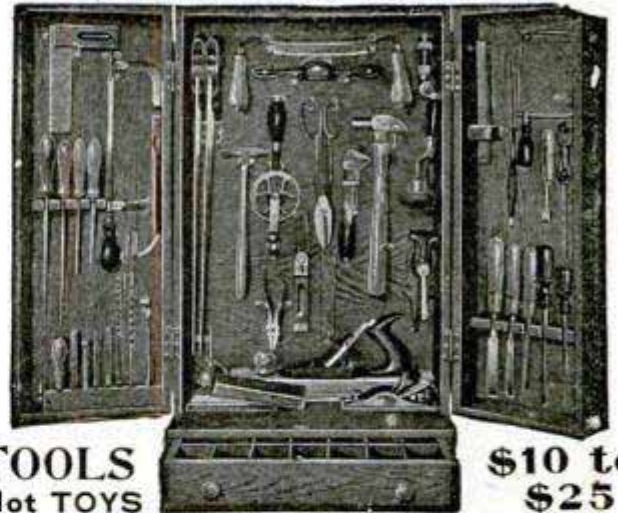
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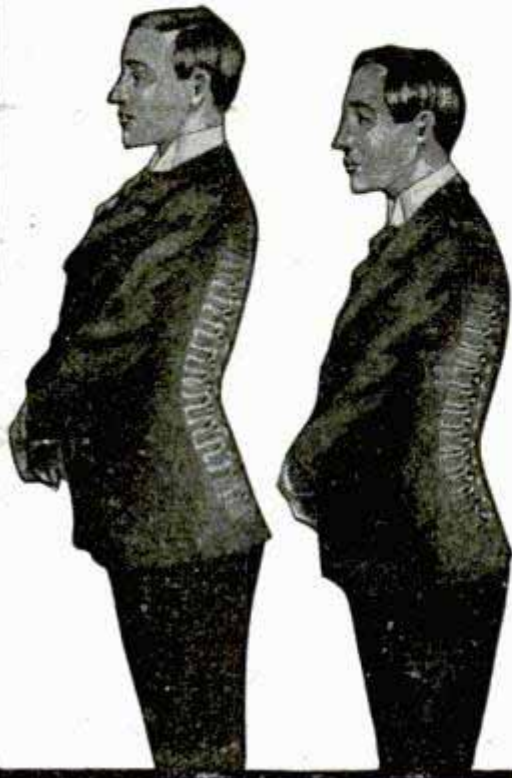
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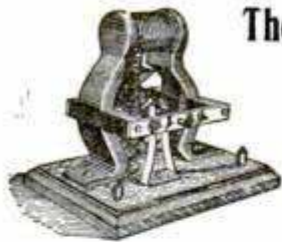
"Well, then, there's Grimmer," I continued. "I'm about ready to let him go. We can't afford to have any old fogies like him around the place any longer. He's behind the times, out of date. I guess you'd better tell him that we'll drop him next Saturday."

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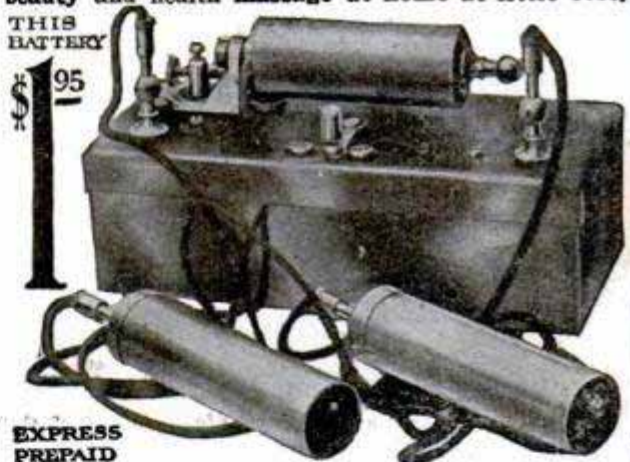
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WONDERFUL ELASTIC VINES.—The owner of a large cacao plantation in the northeastern part of Chiapas says he has discovered a rubber vine on his property that excels all others. The discovery was made by Chinese laborers working for him, says Modern Mexico.

The Chinese gathered vines which grow in a dense, tangled mass, and wove them into rude hammocks. The hammocks were especially elastic on account of the large amount of rubber in them, and this was particularly so if the vines were dried some time. This fact was the cause of the popularity of the vine hammocks with the Chinese. The attention of the owner of the hacienda was naturally called to the peculiar properties of the strange vine. Upon investigation, according to the reports, it was found to carry a high percentage of rubber. It amounts to about 20 or 25 per cent of the weight of the vine, and is so strong that, on breaking the wood, the rubber still holds.

In other rubber plants, as far as is known, there is so much rosin and essential oil in the rubber that it is not elastic at all until extracted and treated. It is more like a viscous sap, like that of the fig tree. In the new vine, however, there appears to be a total absence of essential oil and rosin. It is not so certain a fact, however, that this property will add to the facility of extraction. It may make it more difficult.

If it shall be found that it is possible to separate this new rubber from the plant in any economical manner, the discoverer believes that it will greatly affect the industry. There are vast tangles of the vine, and the percentage of rubber is higher than in any other known plant, he says.

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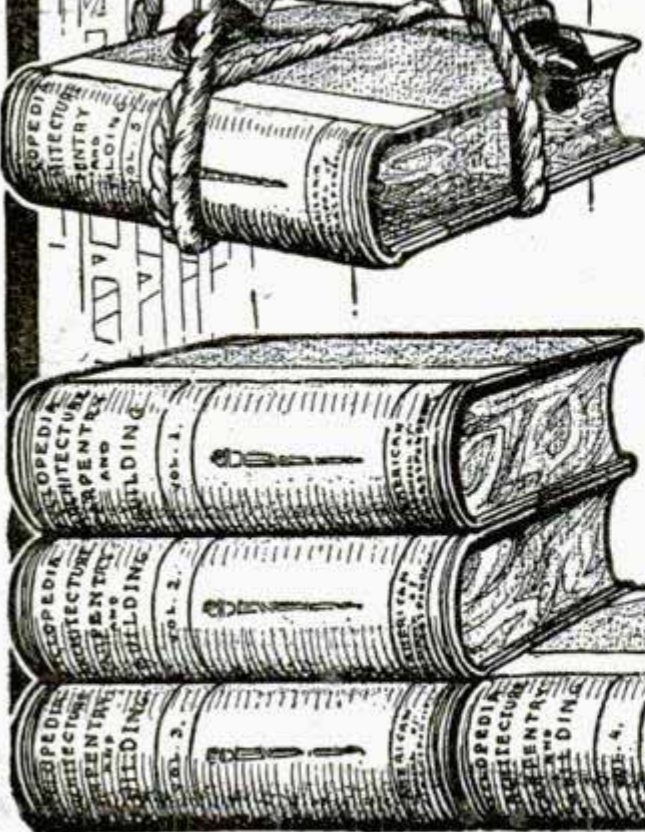


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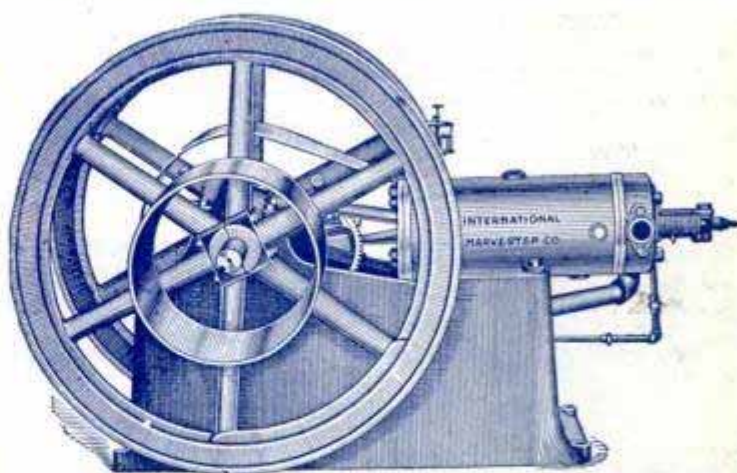
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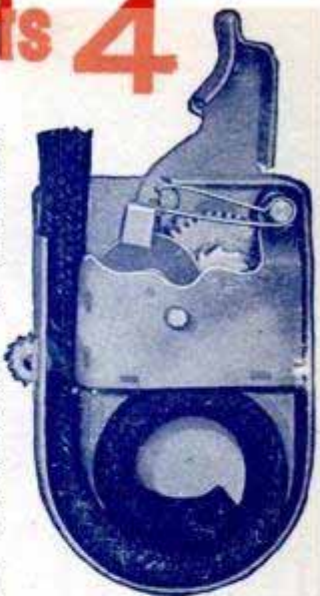
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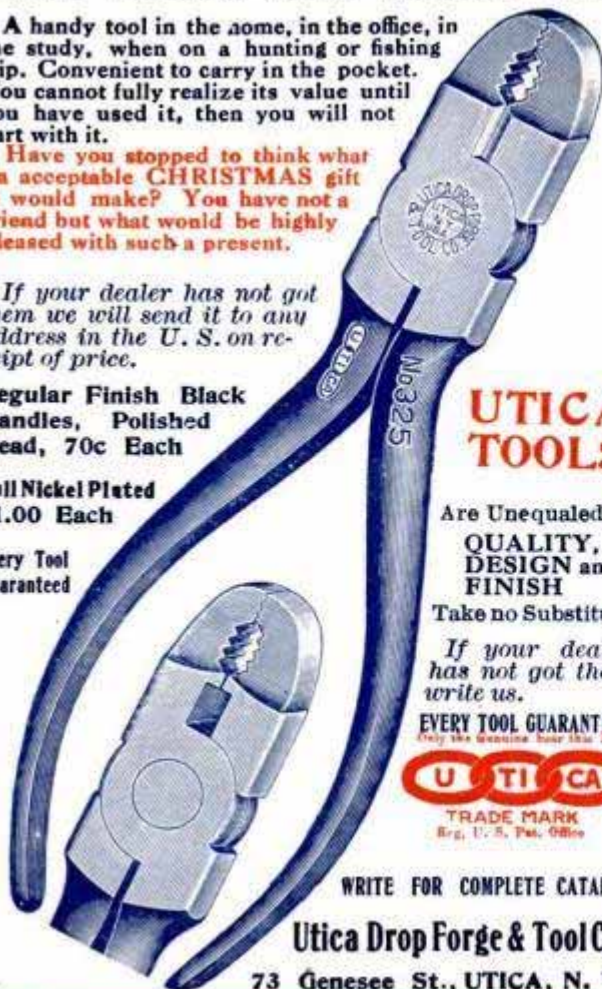
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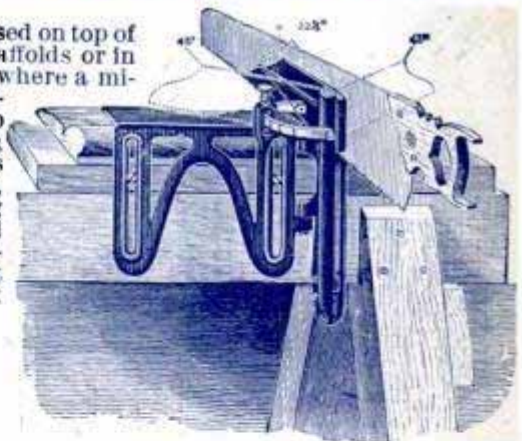
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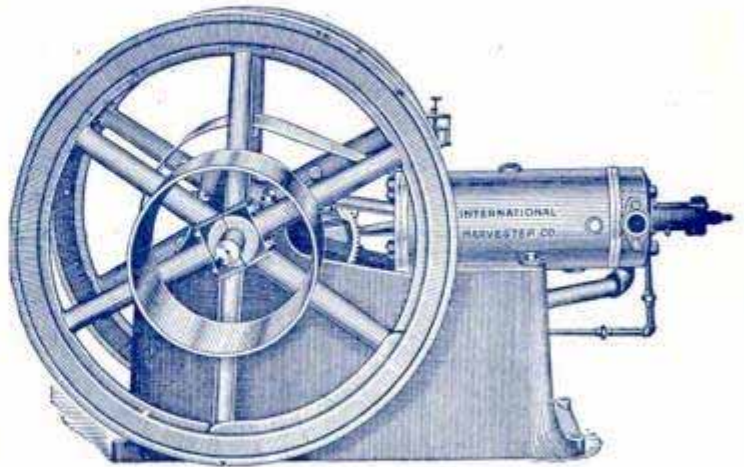
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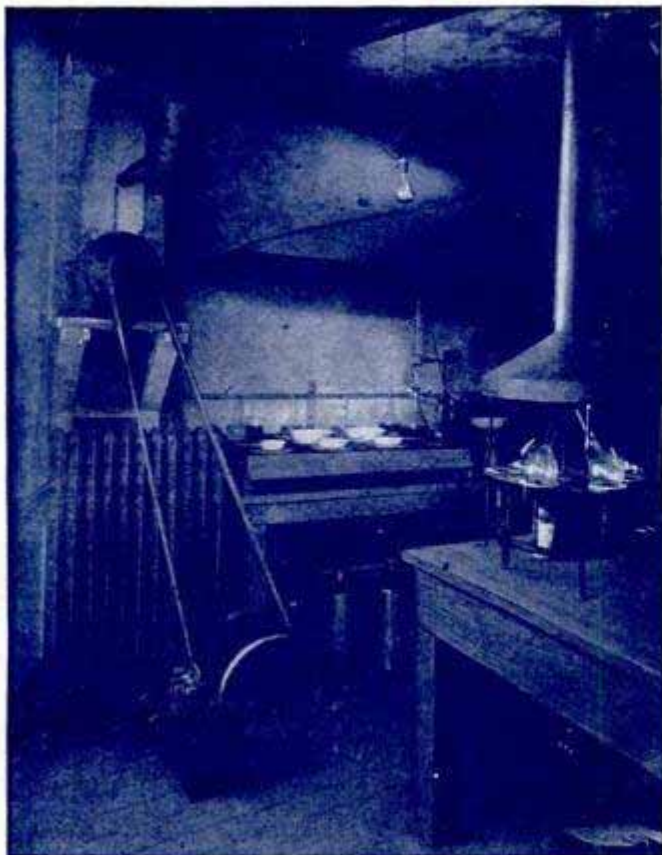
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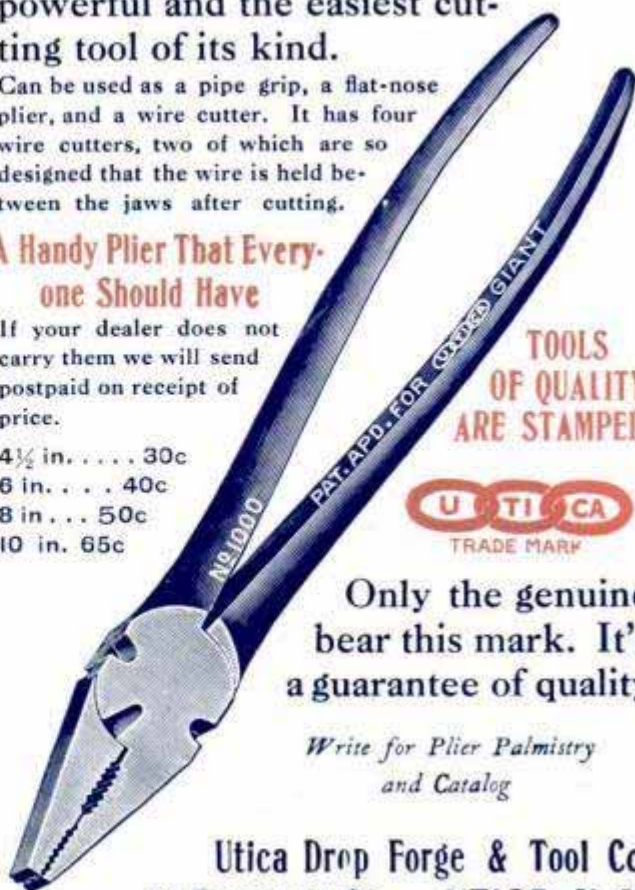
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