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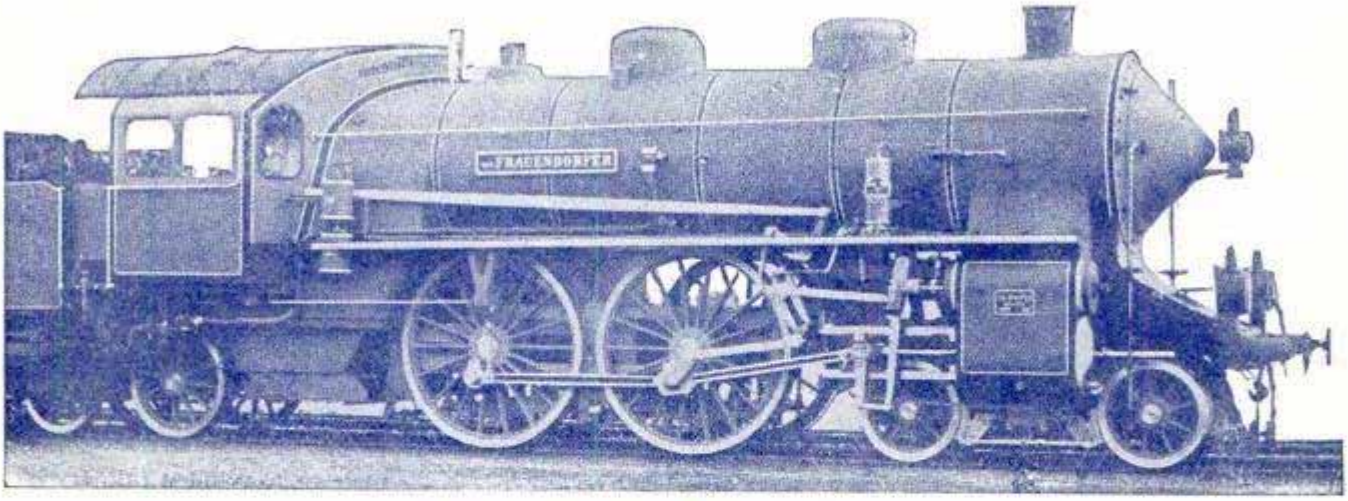

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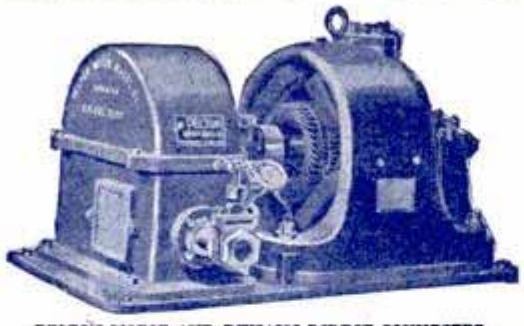

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CONTENTS.

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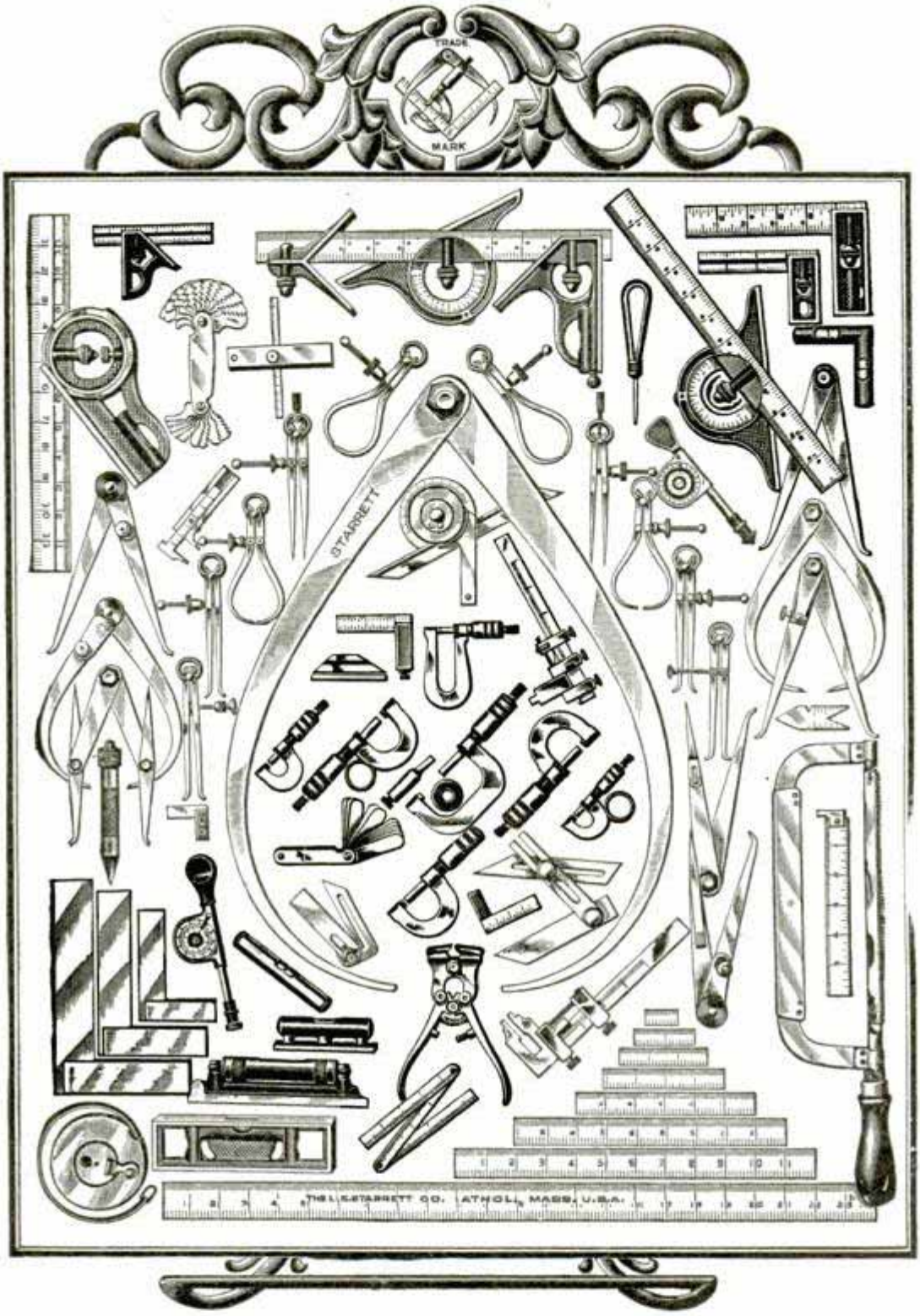

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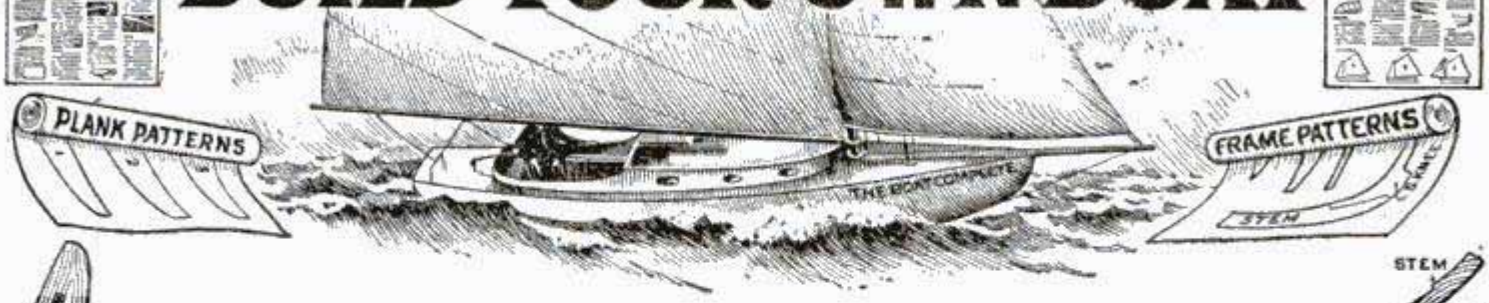

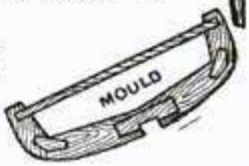

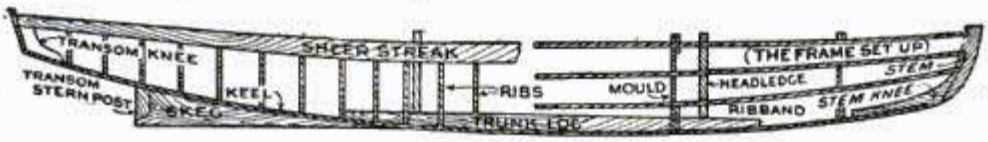

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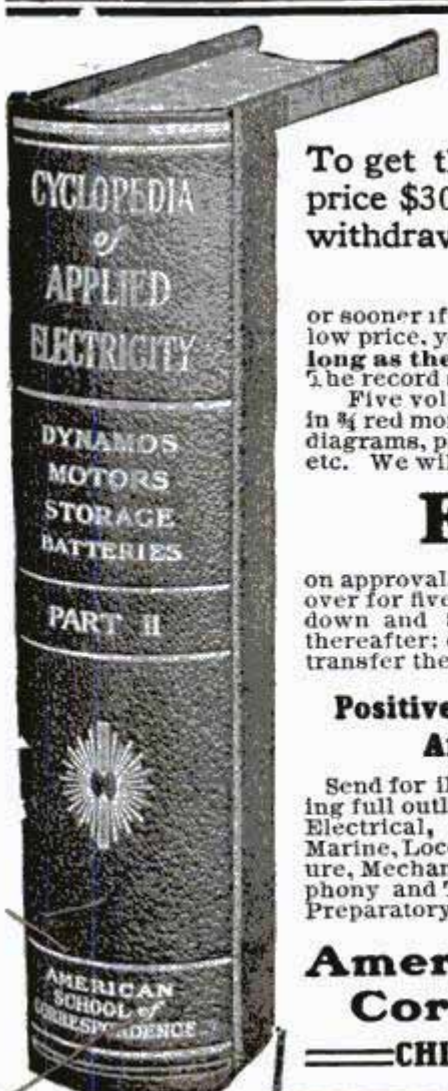

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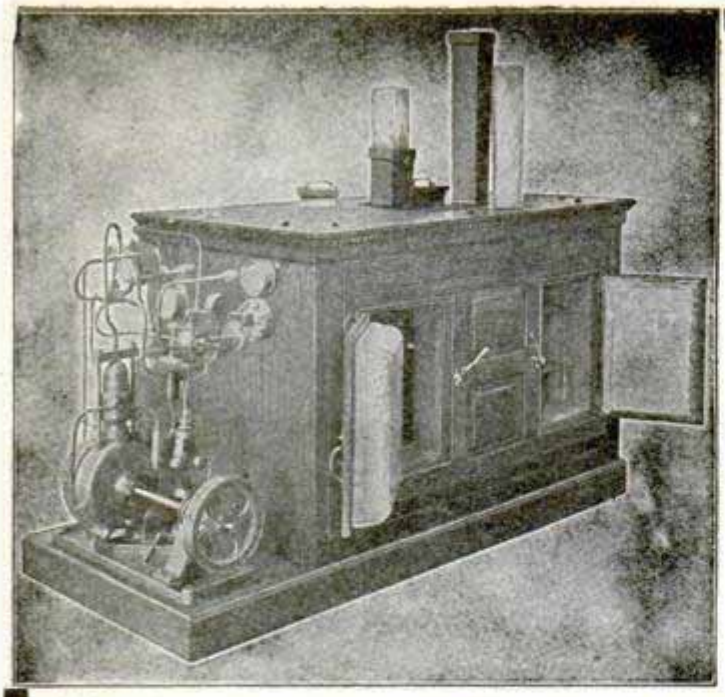

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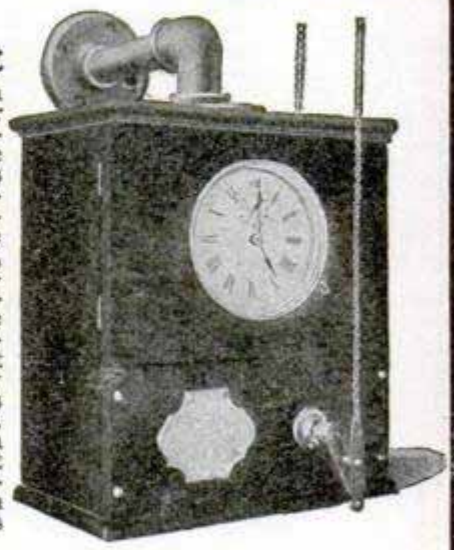

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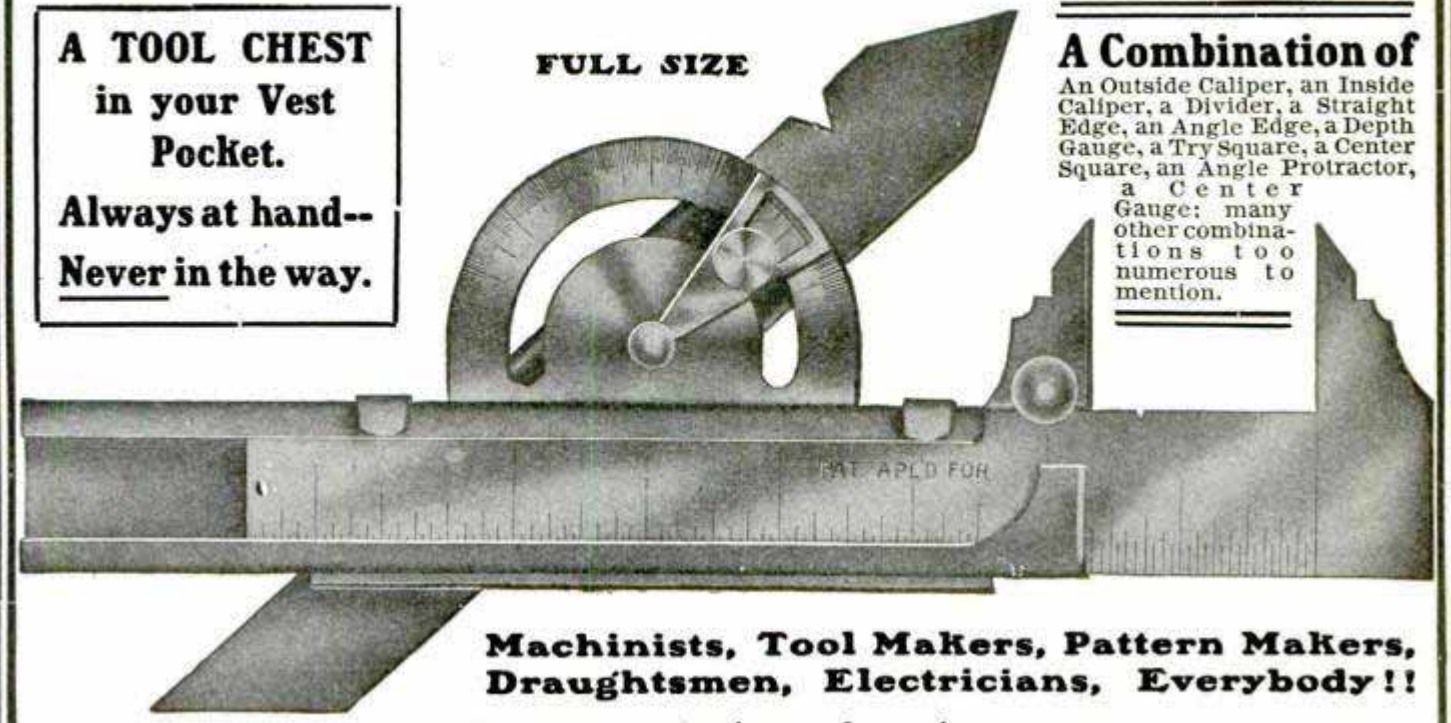

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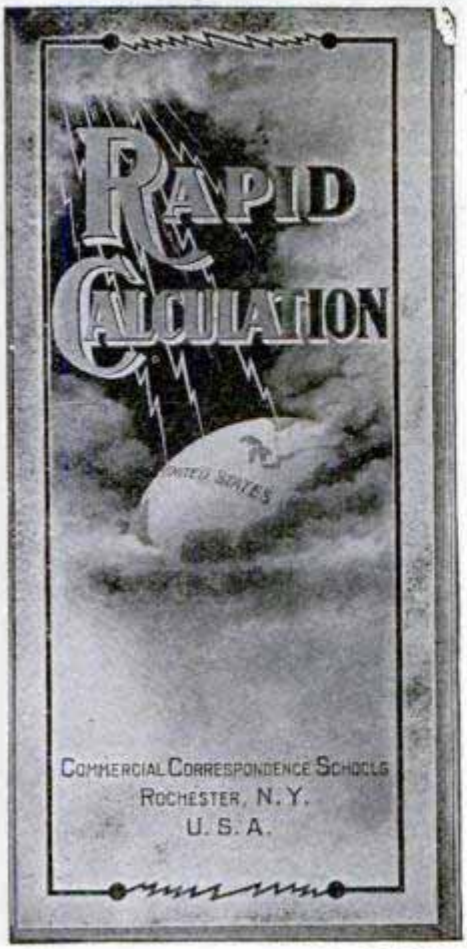

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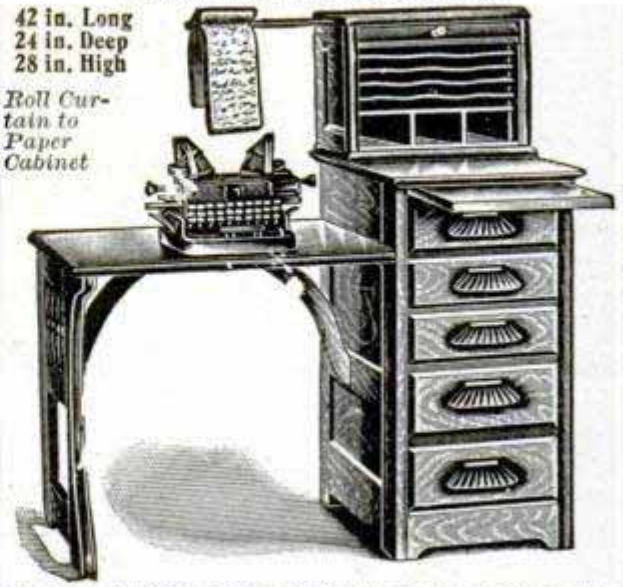

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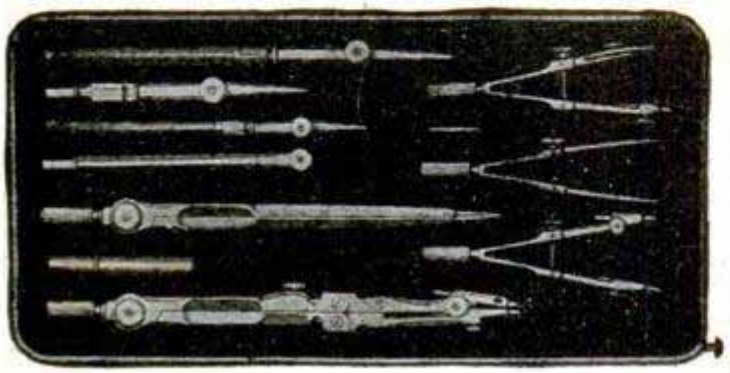

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POPULAR MECHANICS

Vol. 8. No. 1. CHICAGO, JANUARY, 1906. 10 Cents a copy. $1.00 a year

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By A. Sheldon Pennoyer

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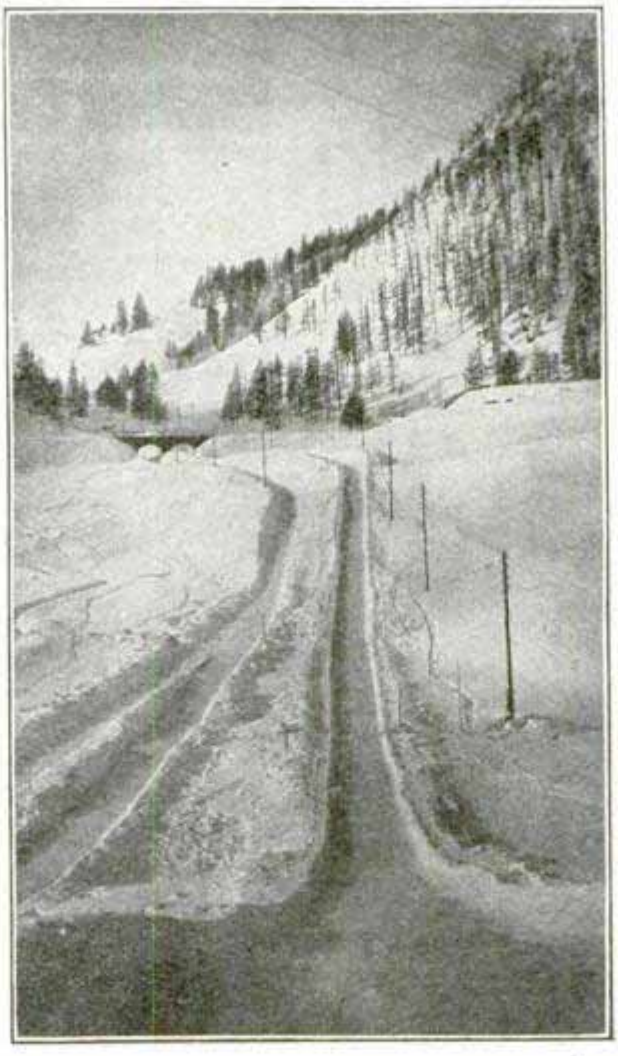
The Cresta Run has been built each winter for more than 20 years past. At first tobogganers used only the "schlittli" or "Swiss" sled which resembles a woodsleigh on a small scale. Running was done in a sitting posture and steering was by means of sticks held in the hands or simply with the feet. But the sportive Englishman arrived on the scene and developed matters to a scientific point by inventing a new toboggan (called the "steel skeleton"), new methods of steering and of riding. The toboggans are now of steel, the lying posture has been patronized altogether and the run is of glittering ice instead of snow as formerly.

To ease the riding, cushions are placed on the board of the sled. The runners are a little more than ½ in. in diameter, and the gauge from 12 to 15 in.: The height with cushion about 6 in. and length about 4 ft. There are two distinct models of the "skeletons" in use on the Cresta Run. The simpler is shown in the sketch. The other model differs in that it has a sliding body rest. Experience has shown that the weight should be back on a "skeleton" when rounding curves, such as are found on the Cresta, and that it is better to have the weight forward on straight stretches. The body rest is on rollers and fulfills its purpose exactly.



"Cresta Leap"--Finishing Point at Telegraph Pole at the Right

Each winter that magnificent toboggan slide is staked out, the banks are formed and the whole length iced by applying water and allowing to freeze. The temperature goes often lower than 30 degrees below zero, but is not uncomfortable on account of the dry climate.

To make a record on the Cresta means that one must have skill. The numerous curves,

with their high banks, necessitate accurate and delicate steering. Though the banks on the curves are like the inside of a bowl, an inexperienced rider may easily go over the top. These banks are from two to ten feet

and more above the bottom of the run, as the case may require.

The Cresta start is at the head of a canyon in the Engadine. There are eight sharp curves, and three exceedingly steep stretches, commonly called "leaps", although the toboggan does not leave the track. Six hundred feet below the starting point is the finishing line, about three-quarters of a mile separating the two. After the finishing point the run goes up a hill, and some who have not put their feet down to reduce the pace, have travelled as much as 40 ft. through the air at the top of the hill.

Bobsleighing, as well as skiing and skating, play a great part for many, too, in the Engadine. The record on the Cresta Run was made in the Grand Nationale of 1905, when an Englishman completed the course in 59 seconds and a fraction.

A telegraph line follows the run, and exact and automatic electric instruments record the instant of start and finish. The apparatus has previously been described in these pages. There are two runways: that shown on the left in the illustrations is for bobsleighs; on the right for "skeletons."

HAS THE SIZE LIMIT IN OCEAN STEAMERS BEEN REACHED?

There are some wise old sea dogs who shake their heads and declare that the extreme limit in mammoth ocean passengers has already been attained, if not actually overreached. They maintain that the danger in case of accident or panic is very greatly increased in the case of the extremely large craft. Smaller ships and more frequent sailings are said to be the coming thing. The American Shipbuilder says: "We might say that their great size tends to their structural weakness and early decay * * there is a limit to safety in ocean steamers as on every other class of carriers."

On the other hand naval constructors have a constantly increasing experience in their work, and appliances for working great steel sections which did not exist five and 10 years ago. Only a short time ago 20 stories was considered the limit for skyscrapers. Our age is one which rebels at the thought of having reached the extreme limit in anything. The limit in locomotive weight has been fairly approached, if not reached, but only on account of the economic limitations of track and bridges. With the ocean greyhound no such restriction exists, and while the mammoth is more difficult to get in and out of port, this consumes but a small part of her time. We predict the 1,000-ft. steamer within the next five years.

The Cresta Run, With the Engadine Valley in the Distance—(Run Closed for Repairs)

Where the Cresta Run (right) and the Bobsleigh Run (left) Pass Under the Railroad Bridge

WAGES IN THE CANAL ZONE

"To hear many of these self-constituted commentators talk one might think that the two continents could be severed with a cross-cut saw. * * The work undertaken on the Isthmus is the greatest ever undertaken by man." So writes the editor of the "Bricklayer" on his recent return from Panama.

In order to make the zone habitable for Americans it was found necessary to provide all the living requirements—water works, sanitation, places of abode, and food supplies. The housing system includes hotels for single men, houses for families, rooming houses for men who board elsewhere, and barracks for laborers. Bricklayers receive $150 per month; general foremen $150; ordinary foremen, $125; master mechanics, $175 to $200; carpenters, etc., 56 cents per hour. Payment is in U. S. currency. The climate is very hard on drinking men.

SNOW WILL BURST A GUN

A little plug of snow in the muzzle of a gun is sufficient to cause the gun to burst, if it is fired while in that condition. The time required for the snow to discharge is short, indeed, but quite long enough for the tension of the powder gases to become sufficiently great to burst the barrel.

Index to Vol. VII. 1905, is now ready and will be mailed free on request.

TELEPHONE IN MID-LAKE

"Come on in, the water is fine."

This was the message sent from a telephone installed on a small pier in Salt Lake, half a mile from shore, to a friend sitting in his office in Salt Lake City, nearly 20 miles away. The lake is very shallow and bathers can go out a long distance. The wires connecting the instrument with land are inclosed in a half- inch iron pipe.

WINDMILLS ON BOARD SHIP

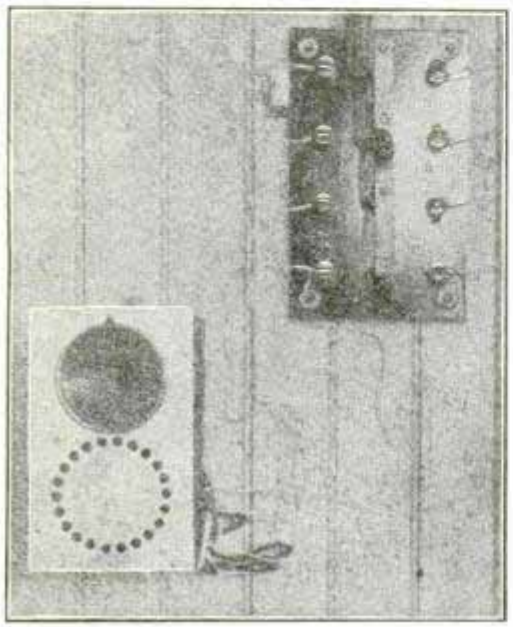
A novel use of windmills was made on board the exploring ship "Arctic." To save fuel, all of which must be carried, a set of windmills were erected when the ship became ice-bound. The power was employed in compressing air which was used to run a generator and charge storage batteries for lighting the ship. The system was sufficiently successful to warrant the American Shipbuilder in recommending the adoption of windmills on board the lightships which serve as floating lighthouses along our coast.

These vessels are where they are subject to almost continuous winds from some direction, and it is believed would make enough current not only to light their signal lamps, but sufficient to cook with and possibly warm the ship in winter. The suggestion is made that the experiment be given a thorough trial, not only on the lightships but with lighthouses also, which are usually in exposed locations.

A WHISPERING TELEPHONE

Transmits Words Spoken in Ordinary Tone 30 Ft. From Instrument

The dictograph is the latest in telephones. You can stand 10 ft. away and whisper your message, or when 30 ft. distant speak



Latest Telephone

in an ordinary tone of voice and the message will be clearly and audibly transmitted. Its construction is a secret of the inventor, the chief difference from the ordinary telephone being in the receiver which has less induction coils or none at all, and which can be heard at some distance, thus avoiding the necessity of holding a receiver to the ear.

The Western Electrician says: "It can very easily be used by an employer for dictating to a stenographer, as the latter could take the dictation at any distance from the speaker, without having to hold a receiver to the ear. It, of course, works both ways, allowing both persons to converse equally well." This explains the name "dictograph."

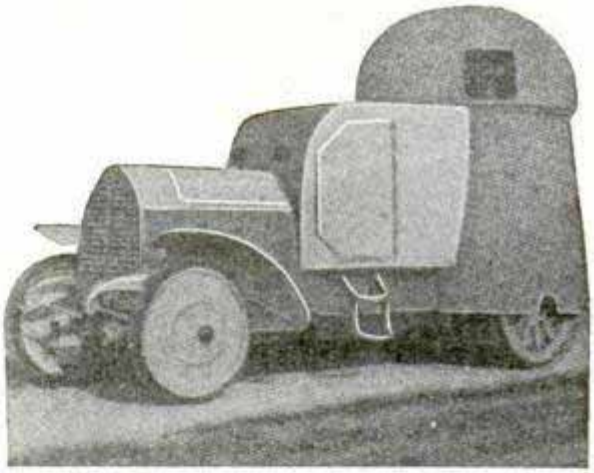
In detective work it promises to prove an exceedingly valuable adjunct. Where a third party is desired to hear an interview between two others it will no longer be necessary for the witness to hide behind screens and in other inconvenient places. The dictograph can be hung behind a picture or under a desk or even placed in a partly opened drawer of the desk and will transmit faithfully the entire conversation to one or more witnesses in another room, or to a stenographer.

NARROW GAUGE ROADS OBSOLETE

Narrow gauge railroads are no longer built in this country and have almost entirely disappeared. Even the rolling stock is of little use when mounted on standard gauge trucks. It is too light for safety in heavy trains and too small to meet the shipping demands of today. One road scrapped $163,000 of such equipment last year.

PROTECTED FIGHTING MOTOR CAR

A new and advanced type of armored motor car has been built in Austria. It is a rapidly moving fort in which the gunners are protected from all small arms fire while working rapid-fire machine guns on the enemy. The rear part of the car carries the revolving turret containing the gun and space for three men. A 40-hp. motor provides an average speed of 25 miles an hour on country roads and over pastures. It is especially geared to all four wheels for hill climbing and is said to mount a 60 per cent grade. The armor is ½-in. steel plate.



Austrian Armored Motor-Car Gun Carriage

So successful has the experiment proved, that the builders already have under construction a 220-hp. armored motor boat, and also a fast running armored ambulance.

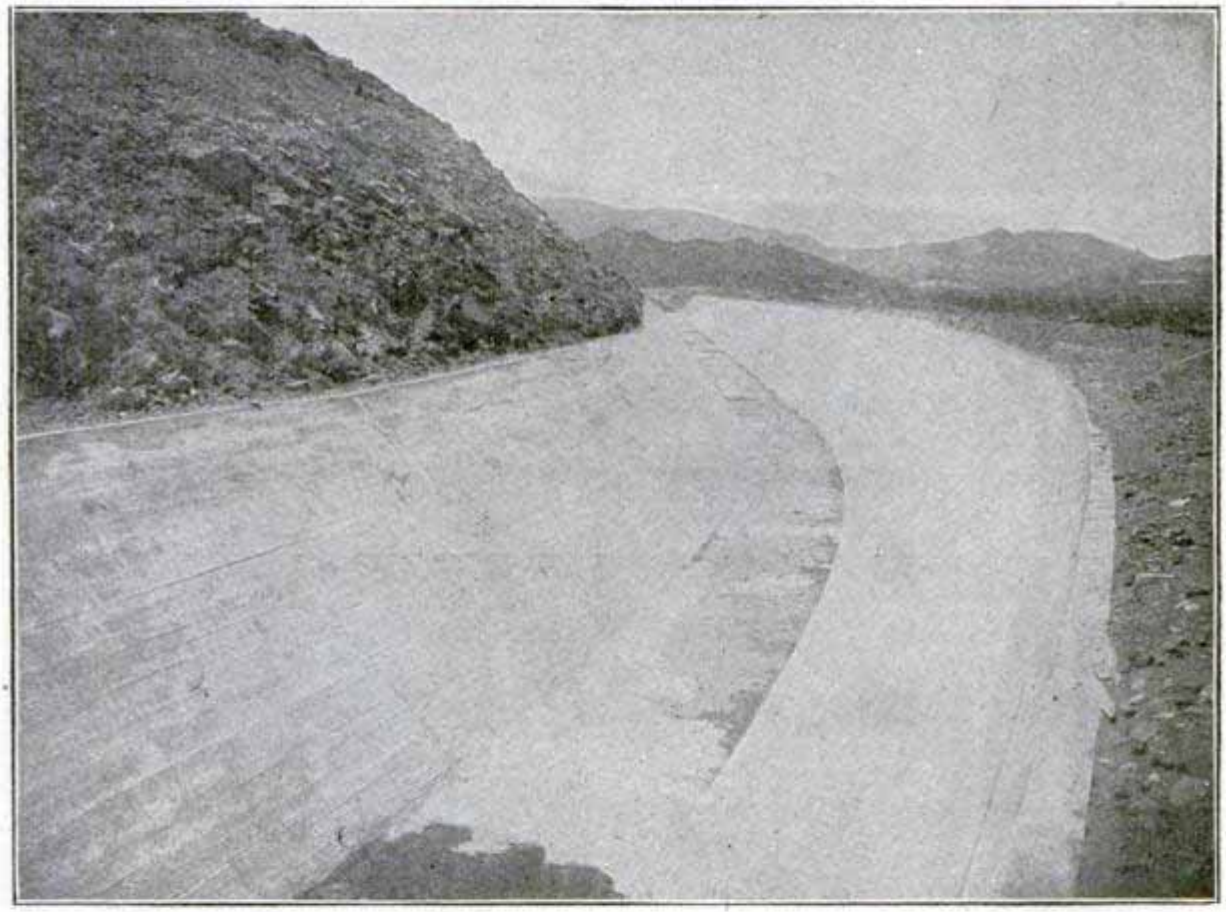
TWO-SPEED STEAM TURBINE

An English inventor has built a steam turbine which is capable of adjustment to two, and possibly more, speeds. This is accomplished by means of two steam admission ports into either of which the steam may be directed at will. The slow speed is about one-half that of the high speed.

THE GREAT TRUCKEE-CARSON-SINK CANAL

With 200 Miles of Waterway, Costing $9,000,000 Will Reclaim 385,000 Acres of Nevada Desert--Now Worthless Land Will be Worth $100,000,000 in Ten Years

In our far west lie millions of acres of arid, desert waste, whose monotony is unrelieved, save for an occasional sage bush or stunted cactus, and infested with rattlesnakes, centipedes and other deadly reptiles. The sun pours down incessant heat which the alkali plain hurls back, while shrouding the daring traveler in a cloud of stifling dust. Rain is unknown for months and even years. Absence of food and water constitute barriers more effective than any wall, and deny to man his right of possession.

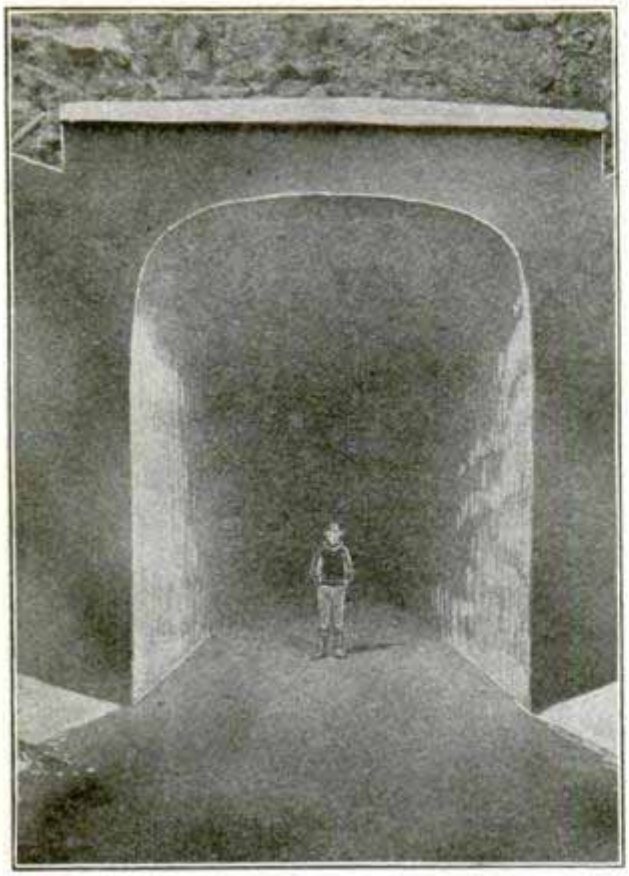


Section of Canal Before Water Was Let in

And yet this most unpromising and worthless of soils, when touched with the magic in a little stream of water bursts into an extreme of fruitfulness, and becomes most valuable of all lands for cultivation.

The miracle which the hardy Mormons worked in the Salt Lake valley is being repeated on a larger scale by the government. Where those early pioneers toiled with pick and spade and wheelbarrow to coax a tiny brook across which a little child might step, the engineering department of a great Nation turns a river from its course and carves a new channel through mountains and across plains. With dynamite and locomotives and steam shovels it works; nor pauses by night, for there is no night beneath the glowing electric arc.

Nine millions of dollars, advanced by the government for the work, will provide 200 miles of waterway and reclaim 385,000 acres which will be sold to settlers at $26 per acre, payable during 10 years, without interest. Long before the final payment becomes due each acre will be worth $300. A large part of the undertaking is already finished, and next month will mark its



Mouth of One of the Tunnels

completion. The work is called the Truckee-Carson-Sink Irrigation canal.

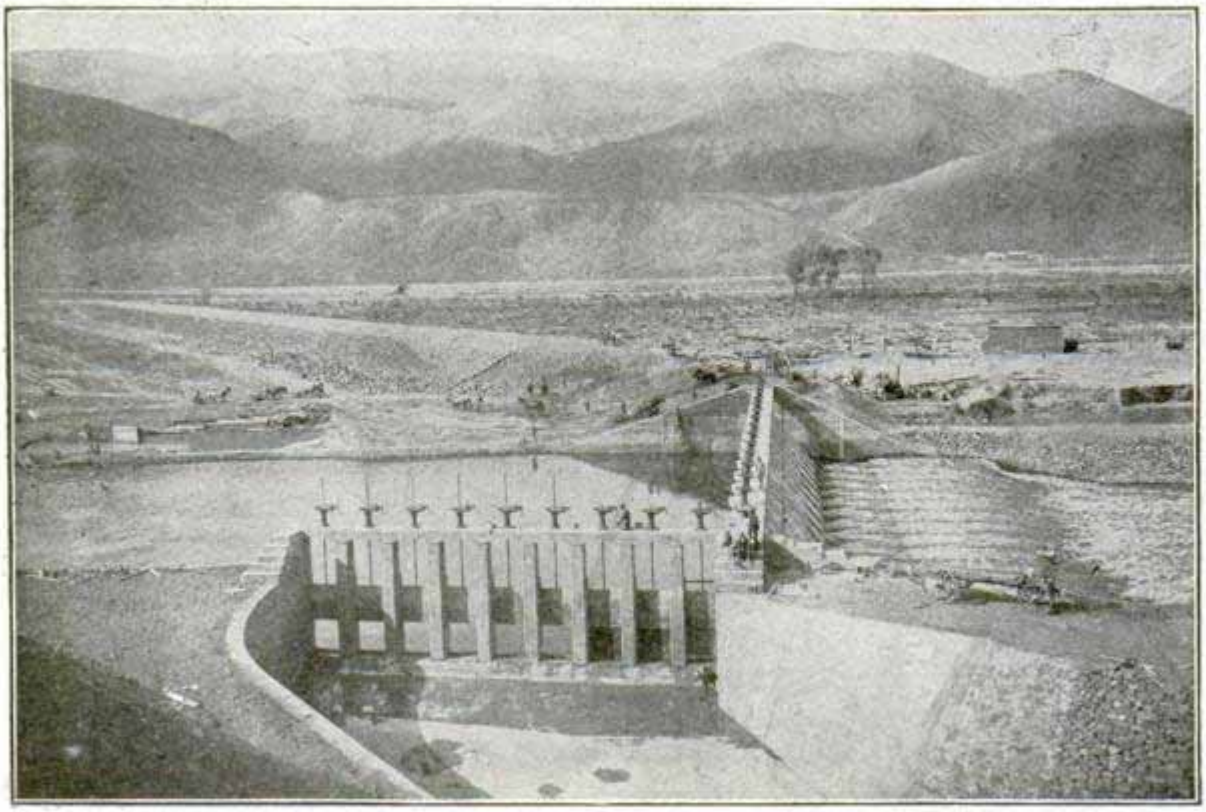
Fifteen miles east of Reno, Nevada, a great dam has been thrown across the Truckee river, diverting its waters and sending them southeast through 31 miles of canal to the Carson river, whose channel is used for several miles until a second dam is reached. At this point the water is divided into two canals, which separate like a letter V and subdivide into branch canals to cover the district.

The Truckee river dam, as shown in the illustration, is a fine piece of engineering work, its construction involving many difficulties not suggested by the picture, as the river is dangerously swift. Gates control the flow to both canal and river.

Four tunnels were cut through rock, respectively 1,600 ft., 900 ft., 400 ft. and 250 ft. long, and are faced with 1 ft. of cement, as also are those open canal sections passing through sandstone. The main canal is 32 ft. wide at top, sloping to 20 ft. wide at the bottom. To provide sufficient storage water seven reservoirs will be required, some of which are already completed.

The canal for the first six miles of its course has a capacity of 1,400 cu. ft. of water per second. At the end of this section a branch with a capacity of 250 cu. ft. per second branches off to the north, crossing the Truckee river by means of an inverted syphon running in the direction of Pyramid lake, supplying some 27,000 acres of land, part of which is in the Pyramid Lake Indian Reservation.

In the prosecution of the work there were



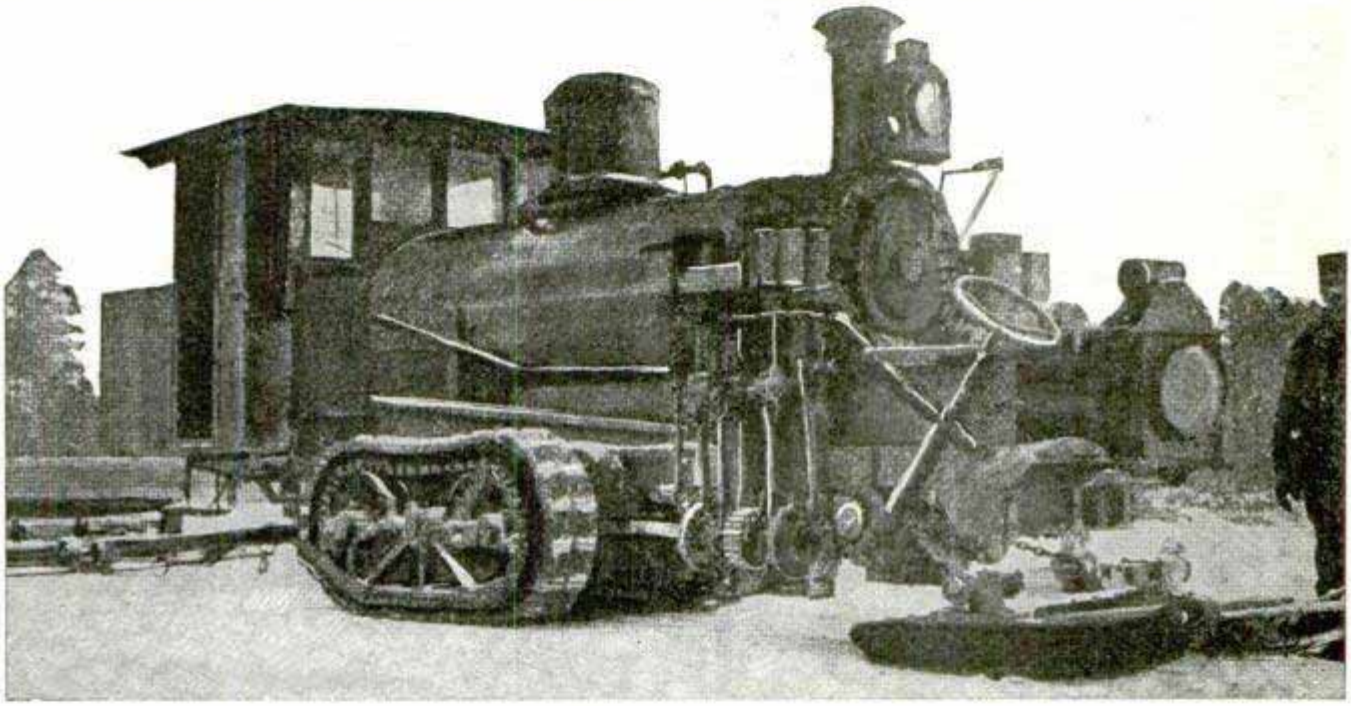
Main Dam--Entrance to Canal

constantly employed 2 locomotives and trains, 4 steam shovels, 800 teams and 1,500 men.

The sale of land will just about reimburse the government for its $9,000,000 outlay, but in 10 years the value of this land should be over $100,000,000, thus adding about $90,000,000 to the wealth of the nation.

A LOCOMOTIVE ON SKATES

Of all the unusual purposes to which locomotives were ever put, a locomotive on skates undoubtedly is the most unique. The locomotive is one used on a logging road in Minnesota, of the geared type common on such lines. The owners had occasion to do a large amount of hauling from points some distance from the end of the track, and concluded to try the novel experiment. The front truck was removed and a strong sled substituted which not only supports the forward end of the locomotive, but serves to guide its course by means of a hand wheel and gearing. The man who steers sits in front next the lower headlight.



"A Locomotive on Skates is Unique"

Traction is secured by means of an endless metal belt which covers the driving wheels and moves as the drivers turn. The belt is provided with steel points or caulks, which are driven into the frozen ground or ice and render movement of the machine possible. The engine can be operated either forward or backward, the runners being turned up at both ends. The movement of the drivers is controlled by the reverse lever and throttle just as when running on rails.

A part of the route to be hauled over was across a lake, and the danger of breaking through the ice was chanced in order to save the long distance around the shore. The ice proved firm and thick, and this portion of the trip is made with the least power and at highest speed. From five to seven miles an hour are maintained with a long train of heavy logs loaded on to "bobs." Railway Engineering says one of the rules of the company is "no skating on thin ice," and that there is no desire on the part of the employes to disregard the order.

TELEPHONES ON BARBER CHAIRS

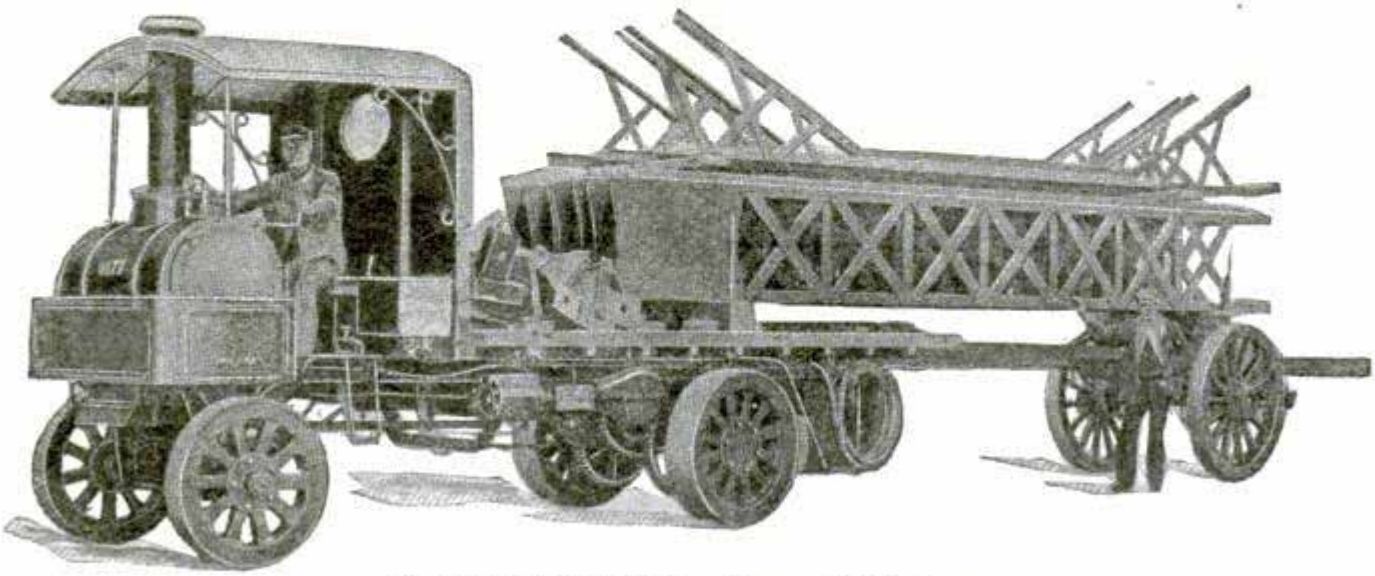
A barber shop in Paterson, N. J. has installed a telephone for each barber chair and the customer can talk on social or business matters while having his hair cut. The experiment is said to have been so satisfactory that other shops in the city have had to do the same.

A thrilling incident in the experience of Chief Campion, of the Chicago Fire Department occurred recently. At the head of a rescue party he entered a burning building, and found on emerging that the fireman he bore out in his arms was his own son, Capt. Campion.

STEAM WAGON 50 FT. LONG

Steam wagons 50 ft. in length are in service in Leeds, England. The boiler, steering and controlling levers are at the front. The rear wheels of the motor truck are the drivers. The engine is compound, with cylinders 4½ in. and 7½ in. by 7½ in. stroke. The heating surface is 56 sq. ft., and the grate area 2¾ sq. ft.; steam pressure 175 lb. The engine runs at 500 revolutions, but has two gears to the axle, one 5.5 to 1, the other 8 to 1; the working load is 5 tons for the main truck and two tons on the trailer.

The two-wheel trailer may be of any desired length up to 50 ft. over all for entire wagon. The trailer is connected by means of a bolster, and can be detached for short loads. For hauling long girders, timbers, etc., the trailer is a great convenience.



Six-Wheel Steam Motor Wagon 50 Ft. Long

TURBINE OR ELECTRIC LOCOMOTIVE?

That the steam locomotive has probably reached its ultimate improvement is frankly conceded by many prominent railroad men. The Railway Age in an editorial says: "The principal objection to the usual design for the simple engine in locomotives is the destructive effect of the counterbalance for the reciprocating parts at high speed which is damaging to the track and to the engine. There is also the wear and expense for repairs, much of it due to the constant stopping and starting of the piston crosshead and valve twice during every revolution. The former objection, relating to counterbalance, is successfully overcome by the use of four cylinders with pistons arranged so that the reciprocating parts balance each other, but it is at the expense of a duplication of parts which still retain the longitudinal motion of piston and crosshead, and the expense for the repairs of these parts must increase with the number. There is also the constant uncertainty of the crank axle."

The electric motor moves its car in either direction desired, but in doing so has no forward and backward motion; it revolves constantly in one given direction like a wagon wheel. Hence railroad experts were rapidly coming to the conclusion that the electric motor would be the logical successor to the steam locomotive. H. Lentz, a prominent engineer of Berlin has invented a steam turbine for locomotives, in which one turbine is placed on each driving axle, the steam passing from one to the next. The application of the turbine to railroad work requires radical changes from its use in either stationary engines or marine service, but there are those who predict it will be the accepted type for locomotives within a short time, and continue for many years thereafter.

CLAIM NORTH POLE DISCOVERY

Capt. Amundsen, the Norwegian Arctic explorer, has reached Eagle City, Alaska, having been the first white man to make the northwest passage. He claims to have located the magnetic north pole. Capt. Amundsen left Norway on June 1, 1903, reaching Eagle City December 5, 1905. His surveys in the region of the magnetic north pole are believed to have at last located the pole. Whether he found the pole to be a fixed point or a circumscribed area is not yet known.

MAY DREDGE A FAILING RIVER

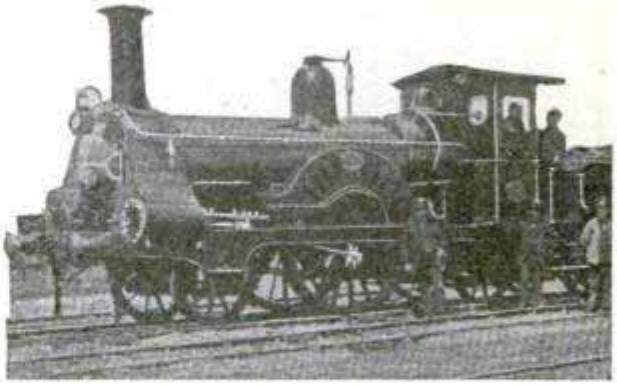
The construction of the Panama canal revives the question of deepening the Mississippi, which each year becomes more difficult of navigation. The destruction of thousands of acres of timber in Wisconsin and Minnesota during the past 20 years has practically denuded the headwaters and caused alternate periods of flood and drought. The rains and melting snows no longer soak into the ground to be given out in springs, but go off with a rush.

The plan to spend millions to provide a deep channel in the Mississippi seems extremely poor policy unless the government previously secures vast forest areas at the headwaters. With a sufficient water supply the great river would teem with a freight traffic never known even in the good old steamboating days of the '60's.

Man can chop down in a few months what required 30 years to grow, and the sooner this nation gets real busy planting trees the better off it will be.

ENGLISH LOCOMOTIVE OF 1870

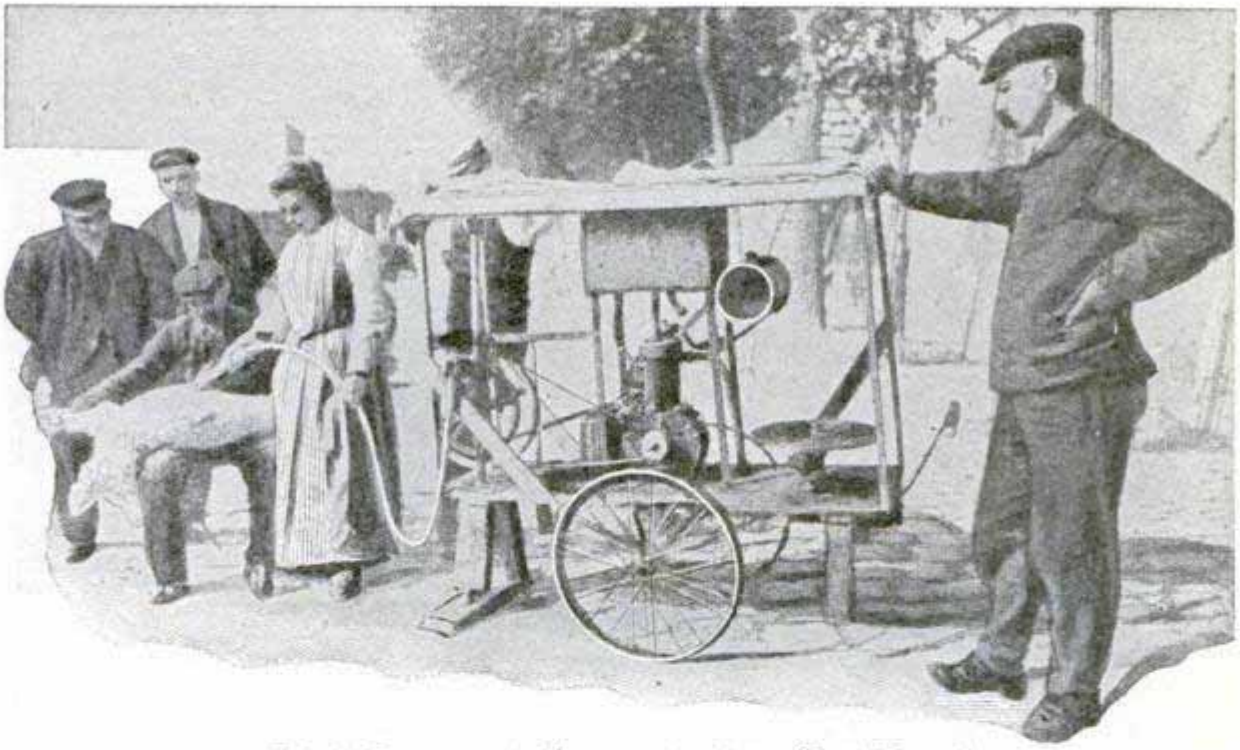
The photograph of an English locomotive which was the pride of railroad men in 1870 is interesting in comparison with present types. These locomotives were built in



Vintage of 1870

France at a cost of about $12,000 each, and were used to draw the fastest express trains. A curious feature will be noticed in the fact that the diameter of the drivers exceeds the height of the tender.

PORTABLE MOTOR DOG CLIPPER



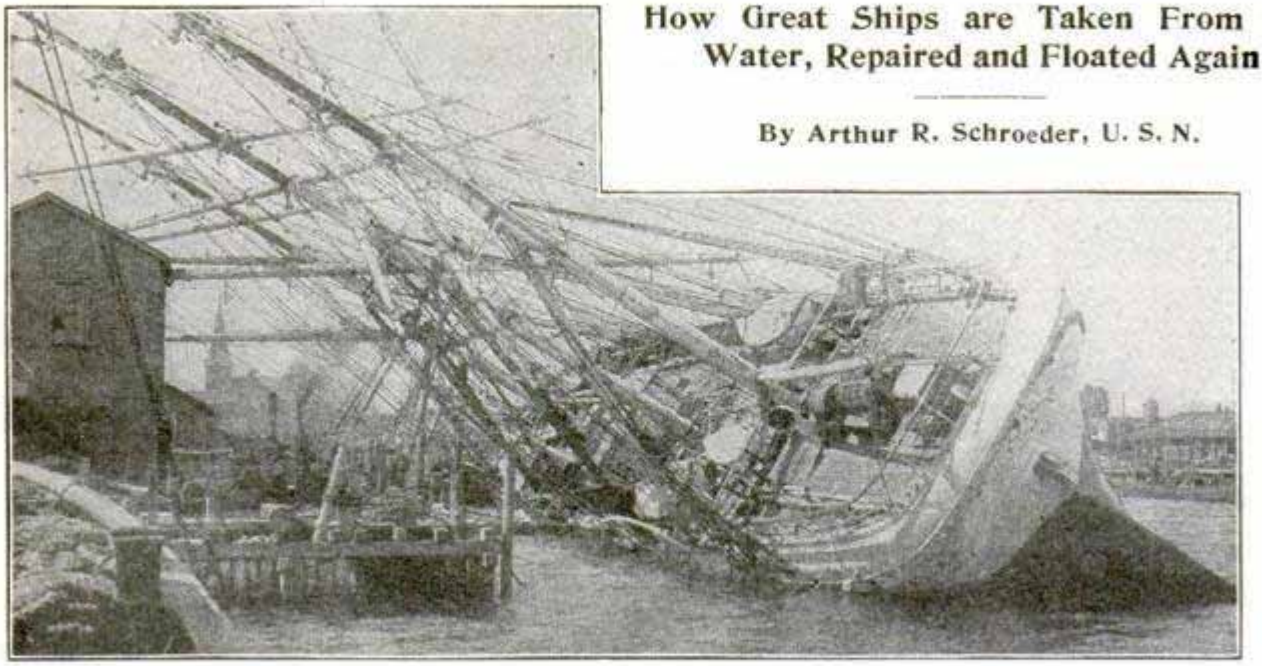
This is Dangerously Near to the Motor Hand Organ!

The gas engine has added another and most unique of all services. It is a portable dog clipping or shearing machine, mounted on a two-wheeled push cart. The Motor Age says: "On the front of the gig is a large flywheel revolved by round leather belt from a small wheel on the end of the crankshaft, and the axle of the flywheel is continued in the form of a flexible shaft, much the same as that used by dentists. On the end of the shaft is fastened a small pair of ordinary hair clippers. The sheep or dog is held on the knees of an attendant when a second party, generally a woman, seizes the end of the flexible shaft carrying the clippers which work rapidly."

THE CONSTRUCTION AND USE OF DRY DOCKS

How Great Ships are Taken From the Water, Repaired and Floated Again

By Arthur R. Schroeder, U. S. N.



Ship "Hove Down"—The Old Way

The advent of iron and steel vessels, and the ever increasing tonnage of our marine, both naval and merchant, has all helped to raise the standard of design, workmanship and skill in the construction and operation of dry docks of today.

In the early part of the Nineteenth century it was frequent practice to beach all ships requiring repairs and cleaning to the underbody. This was made practicable, because the rise and fall of the tide on most ocean coasts is sufficient to allow vessels of the then prevailing displacement, to be examined in this manner, and even to this day on many of the smaller craft on the coast-wise trade repairs are still made with the assistance of this simple method; the only requisites necessary being a fall of the tide to exceed the draft of the vessel, and a beach composed of good foundation material.

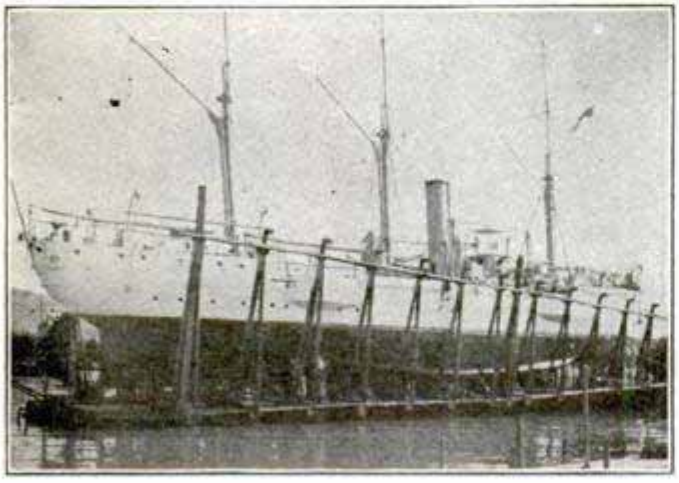


Fig. 1—U. S. S. "Petrel" in Railway Dry Dock

Beginning with 2,200-tons for ships in 1800 the tonnage rose slowly to 5,000 tons in 1870, at which point it remained for 20 years; but since 1890 this tonnage has so rapidly increased that already 40,000 tons has ceased to be a wonder. This increase has called for great improvements in dry docks to meet the new demands.

The marine railway, shown in Fig. 1, was for a long time the only improvement, and shows the 900-ton gun-boat, U. S. S. "Petrel," having her bottom scraped and painted, and sea-valves examined. From the illustration all points of advantage and objection are visible, and may be readily noted. The advantages lay in the smaller first cost, cheap maintenance and quick docking, but the objections are so serious, that this design is no longer considered in a time of increasing tonnage, ship dimensions and congested harbors. For a long vessel the design is structurally weak, and this objection is magnified for vessels over 18 ft. draft and 50 ft. beam. Moreover, the shore and water space occupied is almost prohibitive, and if located close to a pier or wharf is always a source of danger and annoyance to large ships intending to come alongside, by striking the submerged portion of the railways. The principle of operation is not complex. The dock is allowed to slide down the inclined plane on which the rails are laid under water, until the

floor of the structure has reached a depth that will safely permit the vessel to enter. The cradle and vessel having safe and suitable positions are hauled together up the plane, and as the receding water allows the ship to rest upon the keel blocks first at the bow point, the chocks are hauled in and the tendency to capsize is prevented. This operation continues until the vessel ceases to be a floating body. Fig. 2 shows to what extent the vessel is pulled clear of the water.

The floating dry dock succeeded the marine railway, in places where for commercial and engineering reasons the use of the latter was not desirable, and even now there are over a dozen of this design capable of handling ships of 12,000 tons. The operation, like the marine railway, consists of two moves: First, submerging; second, lifting; but instead of the motion being in an inclined plane, it is vertical, and is independent of any fixed position, the whole outfit being self contained. The structure consists of a number of pontoons so arranged as to be filled with water, thus sinking the floor to any required depth, to suit the hull of the ship. These pontoons are connected by suitable pipe lines to large pumps, located on each side of the dry dock, and discharging overboard. When the ship has been floated in and measurements taken that show her in a central position over the keel blocks, the pumps are started and the pumping and floating process begun; and since the dock is so designed that the weight of the sinking fluid is so much in excess of the weight of the ship, upon the removal of this water floating readily takes place and is governed by the weight of the discharge from the pumps. The chocks are set as the keel blocks reach the keel and the ship lifted clear of the water ready for repairs and examination.

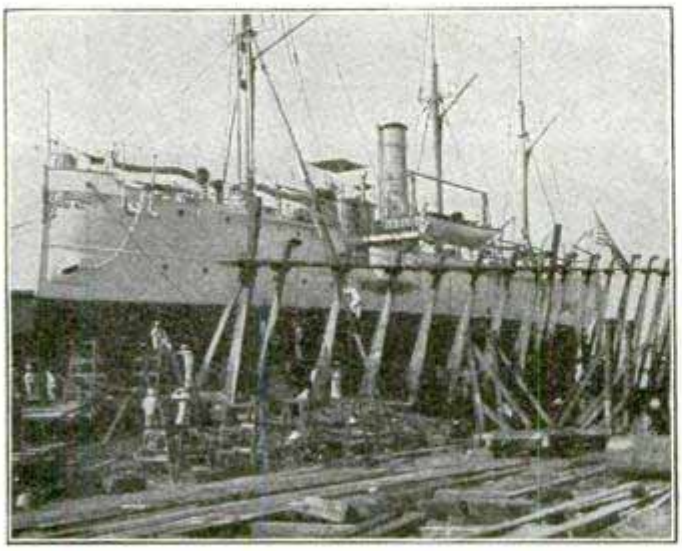


Fig. 2--In Railway Dry Dock

Fig. 3--U.S. S. "Princeton" in Gravity Dock at Mare Island, Cal.

While the construction and maintenance is greater than the type first mentioned, it is more common. This dock is capable of transportation over long distance and easily adapts itself to all harbors. The space occupied is confined to the structure itself, no outside auxiliaries being used. The construction can be made very strong. While this dock is still made of wood, the large docks of recent dates, such as we have at Algiers, La.; Havana, Cuba; and a new floating dry dock to be situated at Manila, Philippine Islands, are of steel with the latest and most approved method of structural work. The most desirable docks for large ships which have yet been used may be seen at all of our large ship yards and the navy yards of the United States. The design is the most simple we have dealt with, yet the details of workmanship and building require skill of the highest order. The new dock for use in the Philippines was described in the August, 1905, number. Fig. 3 shows the U. S. S. "Princeton" in the gravity dock at Mare Island Navy Yard, California. This type can be safely built to accommodate any vessel that may be constructed, and asking no other conditions, save a good solid foundation.

Fig 4--Filling Gravity Dock at High Tide

The operation of this dock is rather a reversal of the conditions for the floating dry dock. In one the ship is taken away from the water, and in the other the water is taken away from the ship. At high tide the dock is allowed to fill to the greatest depth through the sluices, shown in Fig. 4, when this is completed the same operation occurs on the "gate" as takes place on the floating dry dock. The gate is raised, floated away from the sill and the dock is open to the river or bay on which it is located. The ship is entered and moved to the proper position, when the gate is returned and sunk. Centrifugal pumps remove the enclosed water, which, as it recedes, allows the ship to descend and rest upon the keel blocks while the chocks and side shores are fitted. Great care must be exercised in the construction and workmanship of the gate to insure a water-tight joint, for upon its success depends the safety of both dock and ship. These docks cost a great deal more than any others, but the cost of repairs is very small in like proportion.

The gravity docks, located practically on dry land, and in close proximity to the shops and forges, permit repairs to be made quickly and efficiently, and are free from any interference with shipping. Floating the vessel is the reversal of the events for docking, and is shown in Fig. 4. The original docks were built of stone and long outlive any timber docks now in use. As an example of these changes we have the old stone docks and the later timber dry dock at the Brooklyn navy yard. However, to safely handle the big ships of today, both of these materials have given way to reinforced concrete, of which the new Boston navy yard dry dock is made.

The necessity of dry docking a ship is not always for repairs, but more frequently for the purpose of cleaning the submerged portion of the hull of any submarine growth

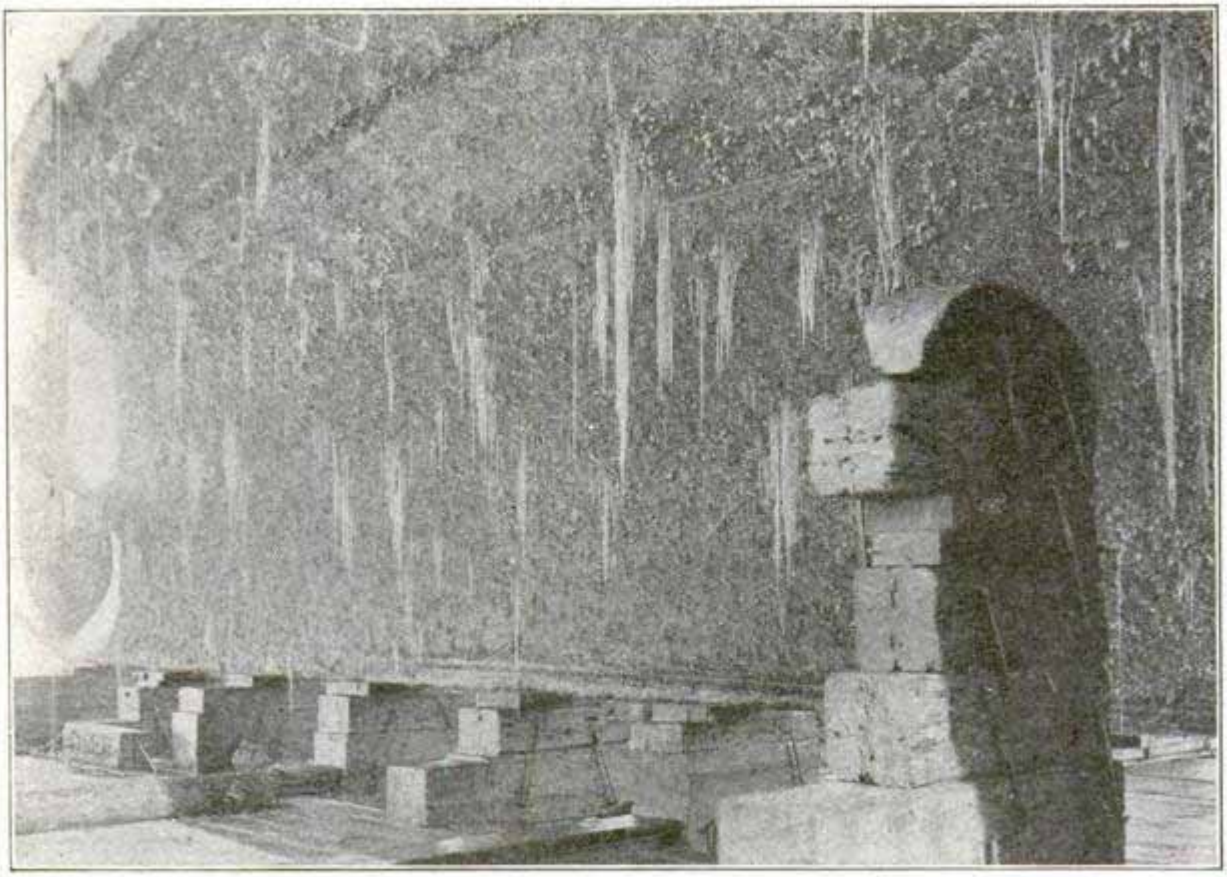
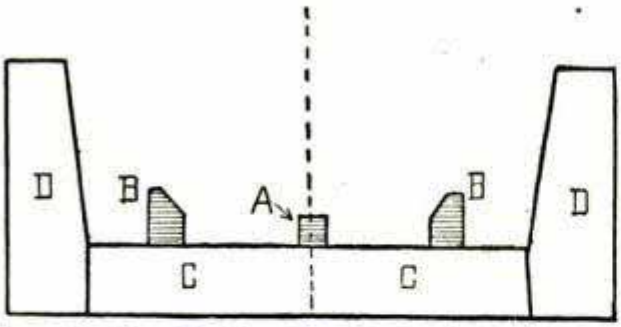


Fig. 5--Hull of Steel Vessel After Cruise of Less than Five Months in Tropical Waters

that may attach itself. All iron and steel bottoms become seriously coated with barnacles and vegetation, and this often be-



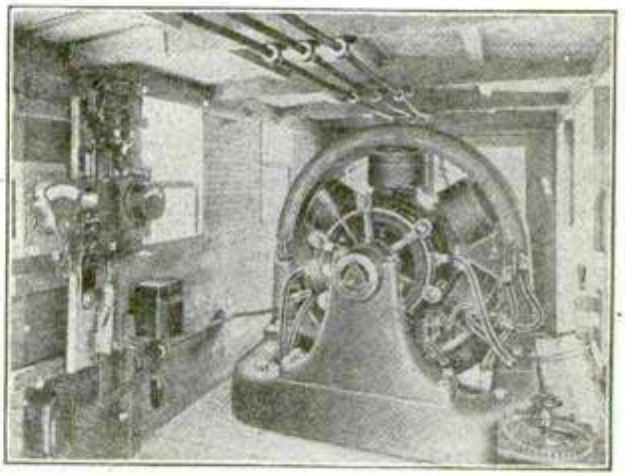
Cross Section Floating Dry Dock--A, Keel Block; B, Chocks; C, D, Pontoons

comes as bad as shown in Fig. 5, which is an iron vessel, less than five months in tropical waters and practically clean at the start of this period. Such a growth as this causes the speed to decrease and requires a much greater expenditure of coal to cover the distance. Many of our wooden ships are covered with copper sheeting to prevent the adherence of these growths and preserve the wood; also naval vessels operating in tropical waters are copper sheeted, thus permitting them to remain long periods out of dry docks, the submarine animal and vegetable matter having but little effect on the copper. While many devices have been tried to overcome the difficulty, copper sheeting or a coating in which copper sulphate is the chief ingredient has proved the only practical remedy.

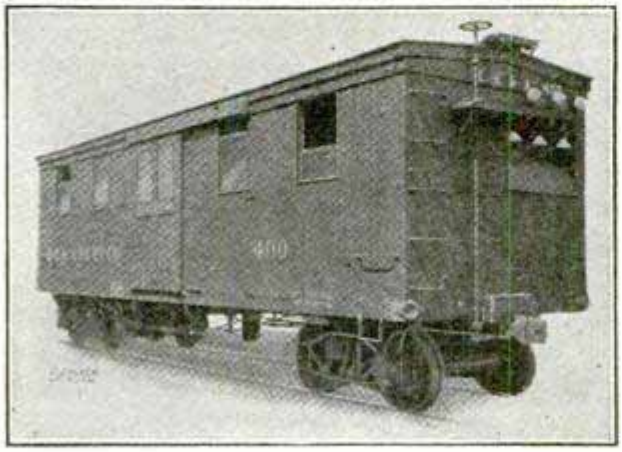
PORTABLE SUB-STATIONS FOR ELECTRIC RAILWAYS

A complete sub-station for transforming installed in a car which can be hauled to any place on the line of the road is now available. The car contains the full complement of machinery found in a sub-station of equal capacity, including transformer, rotary converter, high-tension switchboard and all the usual details. These cars are strongly built and range from 30 ft. to 41 ft. in length according to capacity of the station. This portable sub-station is used as an auxiliary in cases of emergency, such as an unusual event drawing great crowds to some point on the line where ordinarily the travel is light. In case of accident to any of the permanent sub-stations the car can be substituted while repairs are being made.

On most large electric railway systems current is generated at the power house at from 2,000 to 15,000 volts alternating current, as this can be transmitted on smaller wires and with much less loss than the direct current of from 500 to 600 volts, which the street car motors require. Hence the necessity, at intervals throughout the system, of transforming, or sub-stations, where this high voltage alternating current is changed to the much lower voltage direct current.



Interior of Car Showing Transformer



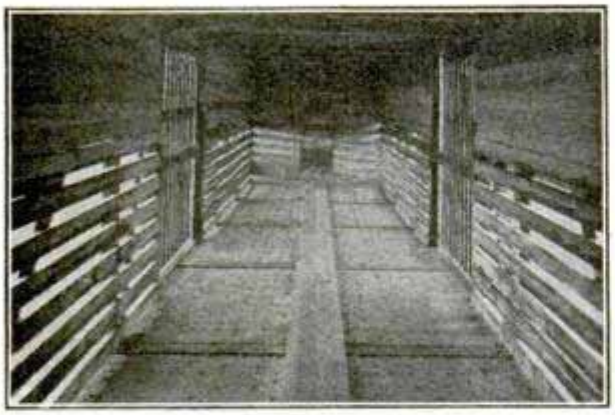
Transformer Car

An enormous amount of railroad reconstruction work is being done in the far West. The Santa Fe road will spend $12,000,000 in shortening its line to the coast and the Southern Pacific twice that amount. Eight tunnels will be cut through the Sierra Nevada mountains which will shorten the line forty miles and reduce the grade 2,000 ft. Thirty-two miles of snowsheds will be abandoned when the tunnels are completed.

Index for Vol. VII., January to December, inclusive, 1905, is now ready and will be sent free upon request.

TO HAUL COAL IN STOCK CARS

A new style of stock car is now being built which is equally adapted to hauling coal, coke or ore. Every time an empty

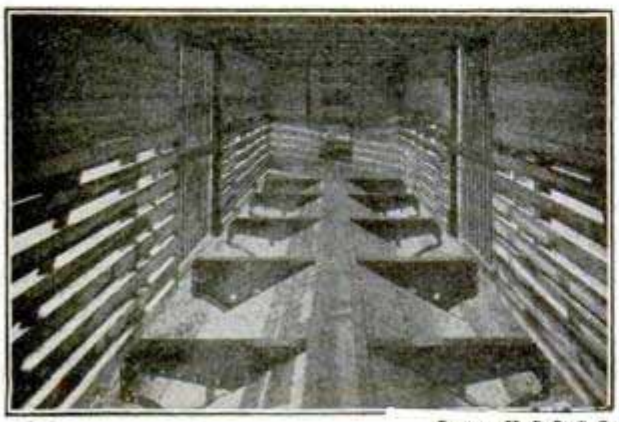


Floor Closed for Stock

car is hauled over a line it is a clear loss to the railroads, and when a car which has carried live stock from Chicago to the seaboard is hauled back empty there is a thousand miles of car service gone to waste. It not only involves the expense of pulling the car, but there is the additional loss of several days' use of the car when it should have been earning money.

Not all the stock cars are returned empty, but the trouble of unloading coal, coke and ore has made them very undesirable carriers. Western roads find that they are able to get only 125 days actual earning service out of a stock car during each 365 days. In other words, taking an average of the entire year a stock car earns money only one day out of three.

The new car which is available for coal and ore has its floor made in 12 sections which are hinged to center sills of 6 by 10 in. timber. By means of hand wheels three floor sections at a time can be lowered, as shown in the illustration, allowing the contents to empty by gravity.



Courtesy N. C. D. C. Co.

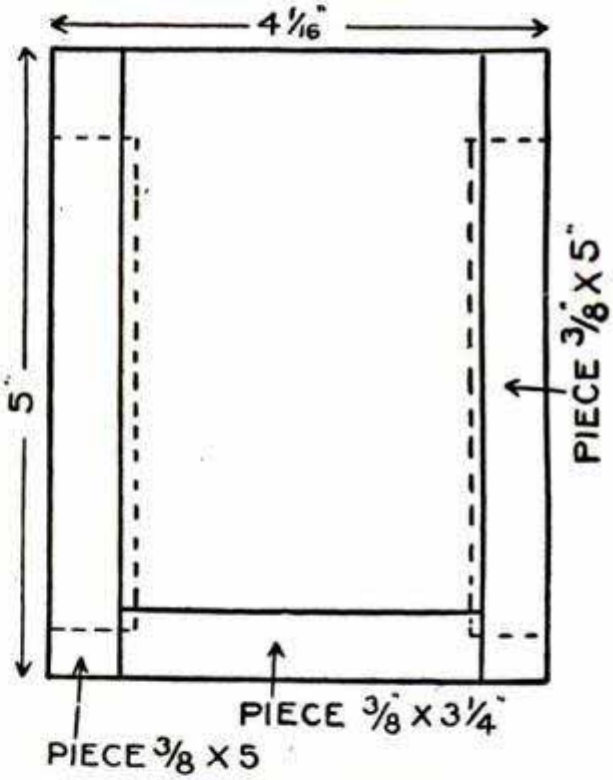
Floor Open for Dumping

This enables the unloading of the car on either side, or both. The car is otherwise of usual construction, and is 36 ft. long inside and 9 ft. wide.

KITS FOR PHOTOGRAPHIC PLATE HOLDERS

An ingenious photographer who had some small plates to work with, but only large holders and no kits made some kits for himself. An amateur may do the same by following the instructions below:

Cut out pieces of thin, stiff cardboard 4 1-16 in. wide by 5 in. long. The 1-16 in. is allowed for variation in the size of plates. From pasteboard of about the average thickness of the plate, cut for each kit two pieces ⅜ in. wide and 5 in. long and one piece ⅜ in. wide and 3¼ in. long, and glue them



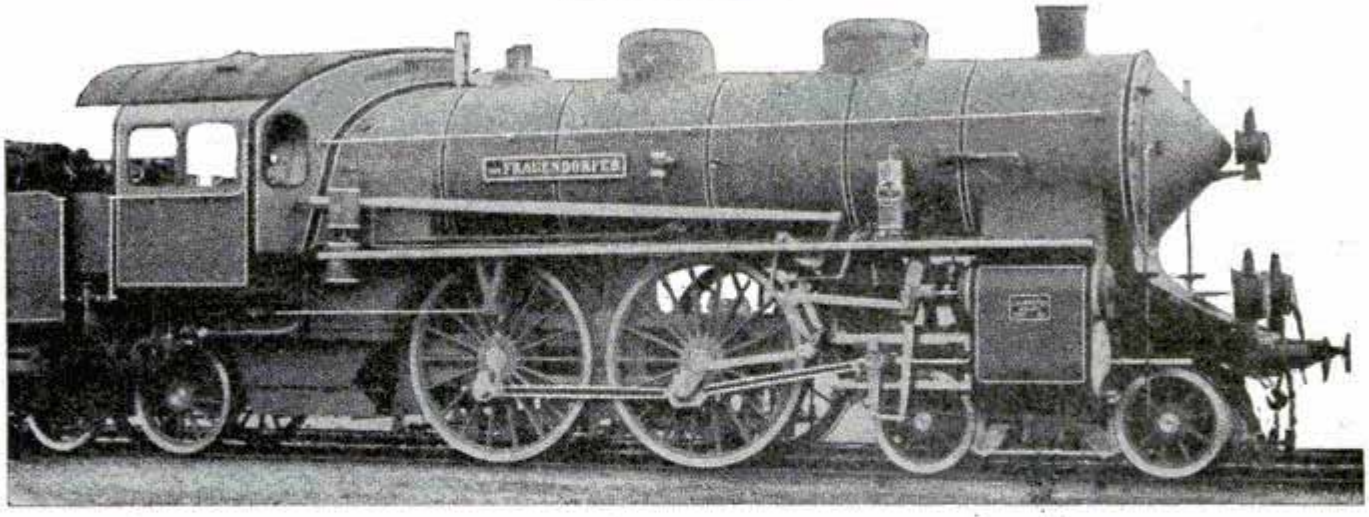
Home-Made Plate Holder

on the large piece of thin board in the arrangement shown in the illustration.

To hold the plate in place, cut out for each kit two pieces of the stiff thin board 7-16 in. wide and 4¼ in. long. Glue these on in the positions indicated by the dotted lines, to extend over the edges of the plate. Slide the plate in from the open end of the kit.

To fasten the pasteboards firmly together, says the Photographic Times, brush the surfaces with good hot glue and set under pressure for about 24 hours. A couple of books or a stack of plates will give sufficient pressure for the purpose.

NOVEL HIGH SPEED LOCOMOTIVE



A High Speed "Wind Splitter"—Made in Germany

A German high speed, compound locomotive with superheater, of unusual appearance, has been built in Munich, for the Pfalzischen Eisenbahnen. The weight would be considered light in this country being 74 tons.

To deflect the air at high speeds the front is made cone shape, and the cab is also pointed in a V-shape. A steam pressure of 240 lbs. is carried. The tender loaded, weighs 47 tons. Several of these engines will be put in service.

WINTER ROOF GARDENS

Winter gardens on the flat roofs of city houses promise to become popular and numerous. A very satisfactory sun parlor can be built on the ordinary roof for $200 for a room 15 ft. by 20 ft. Concerns which sell greenhouse supplies will supply the iron framework for the roof, and ordinary window glass is cheaper than plate and does not break as easily. The glass roof may be the single slant like the roof of a "lean-to" or the peak roof, as desired. The roof-sash should be double. The House Beautiful says: "The upright posts of the garden should be made of pine 4 x 5 in. and 10 ft. high. These should be firmly attached to the roof beams by means of L-shaped iron braces and then by supports of wood reaching 3 ft. up from the floor. These posts of wood should be placed every 5 ft. apart, which would make three in front and back and four on the two sides. When placed in position the side boards should be nailed on to hold them together. Six-inch planking should be used for this, making an inside and outside wall with an air space between. The flooring should be double. The first should be laid with ordinary 6 or 10-in. spruce boards laid diagonally. This flooring should be laid on beams placed across the roof and nailed to each wooden upright post. The top floor of 2 or 3-in. pine or hard wood should be laid over this rough flooring when the roof is enclosed."

Heating apparatus, shades and other interior furnishings need not exceed $100, making the entire cost within $300, and less where one can do part of the work himself. Plants may be arranged in pots around the room and on tables, leaving the center of the room for rug and chairs, or greenhouse benches can be placed where desired and a greater variety of plants raised.

In many cases a good part or all of the heat can be secured from the house, but a heater should be provided for extremely cold weather.

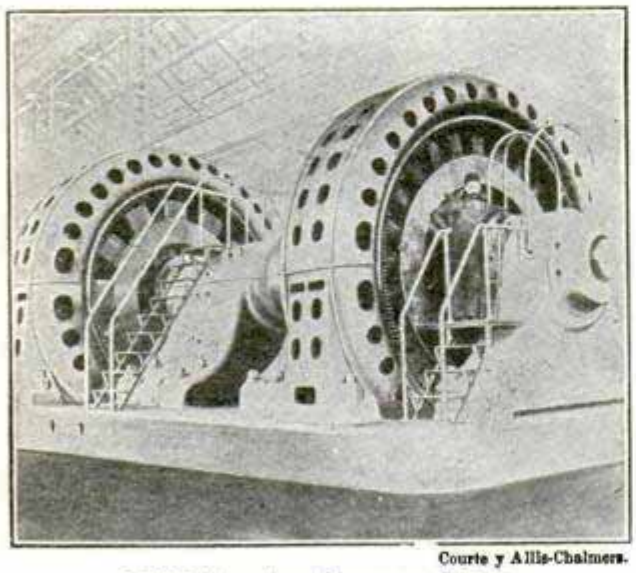
If the occupants do not care for flowers and plants, the sun parlor provides an ideal place for physical exercise in the warm, health-giving sunshine, and is the next best thing to summer weather or a trip to California during the snow season. The sun parlor would pay for itself, in some families, in one or two winters, in doctor's bills saved, to say nothing of the pleasure it affords.

Try a sun bath.

A New Jersey mayor used the city steam roller to pull down a bridge which a street railway had built without legal authority.

8,000-HP. ELECTRIC MOTOR--LARGEST EVER BUILT

The largest electric motor ever built was recently made in Cincinnati and is now in



Courte y Allis-Chalmers.

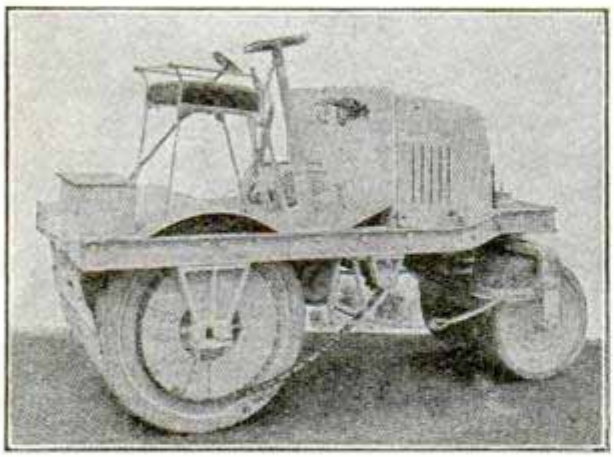
8,000-Hp. Synchronous Motor

operation at Shawinigan Falls, Quebec. The machine is a synchronous motor of 8,000 horsepower and is rated at 5,750 kw. at 300 revolutions per minute.

NEW GASOLINE ROAD ROLLER

"Just look at that steam roller running by means of a gasoline motor," was the unconscious remark of a bystander, whose long acquaintance with road rollers operated by steam had served to fix the name in his mind.

However, that is what is happening to



Gasoline Road Roller

the steam roller; the gasoline roller is rapidly taking its place in England and Europe. The same power and ease of control are found in the new departure while the annoyance of smoke and escaping steam are absent.

FRANCE EQUIPPED FOR AERIAL WARFARE

Remarkable results have been achieved in France with the Lebaudy steerable war-balloon which was recently put to the most severe tests to ascertain its practicability. The balloon has a 40-hp. motor and its envelope consists of two thicknesses of silk, joined with a double coating of liquid rubber. It was used under various conditions of the weather, without a hitch in its operation. It rose easily to a height of 1,500 ft. and during the experiments it was found that with four persons on board the balloon could maintain a speed of from 20 to 25 miles an hour; that it could remain in the air at least six hours and during that time could travel 124 miles without alighting.

At a height of 130 ft. 50 per cent of the aerial torpedoes dropped from the balloon struck a flat target 82 ft. square and rifle bullets striking the balloon had no effect whatever. Where the envelope was perforated it closed up immediately so that little or no gas could escape. It is stated that it would require 200 effective bullets to disable the machine and that even then its high speed would probably enable it to reach a point of safety before collapsing.

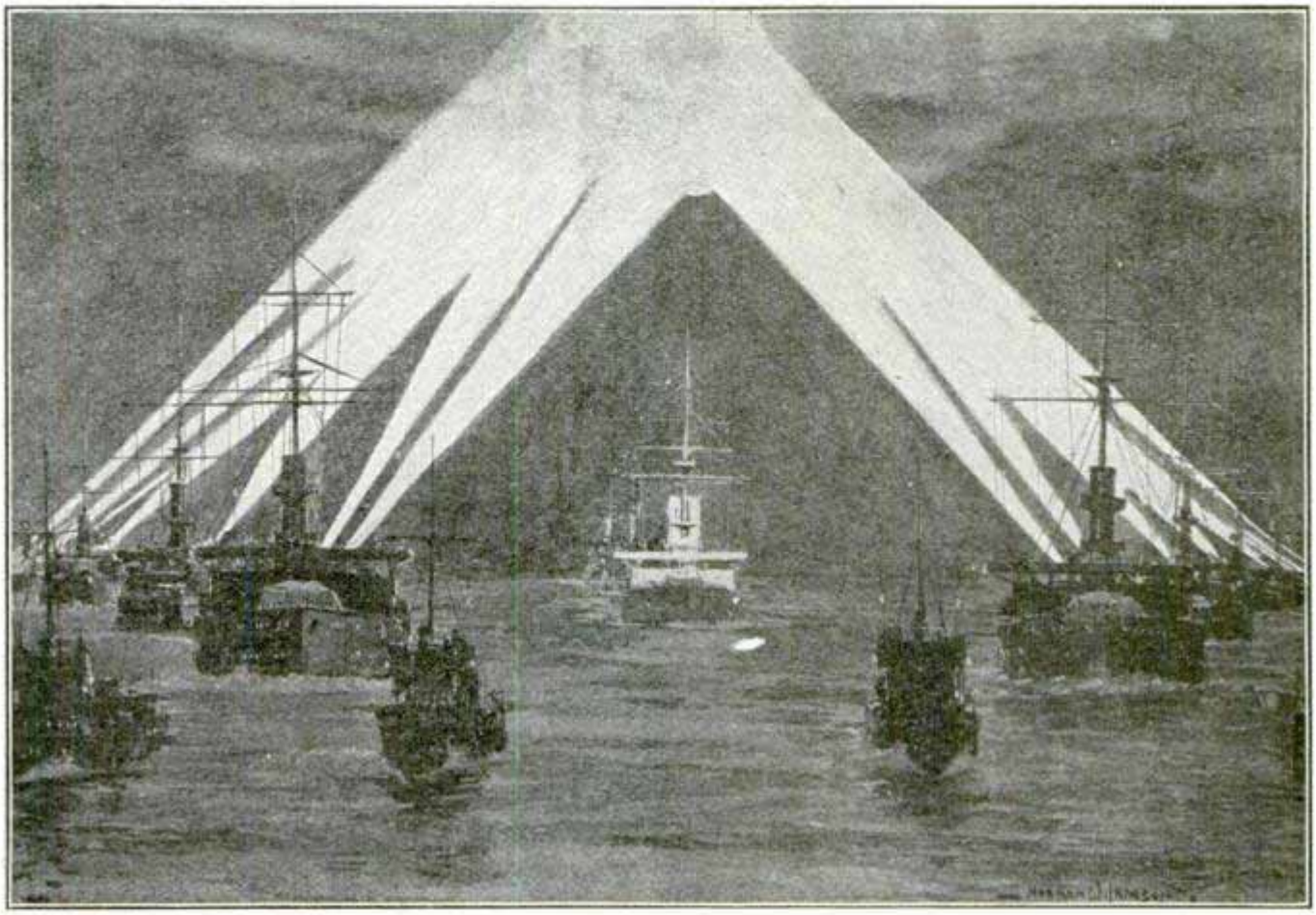
Attacks were made on the balloon by artillery mounted on motor cars running at about the same speed, and with the balloon at an altitude of 650 ft. it was almost impossible to hit it. Observations made from the balloon were telegraphed to the earth. The French minister of war, M. Berteaux, rode on the war balloon and directed the experiments.

France is in advance of every other nation in experiments of this nature.

THE YEAR ON THE GREAT LAKES

The furious storms of the past few weeks on the great lakes have proved a surprise to ship builders in the losses of big steel vessels. When the fresh water mammoths were launched it was predicted they could weather any sea. The test has not proved them to be more immune than the smaller craft which preceded them. The death roll for 1905 is 215 sailors lost against 49 the year before. Of all the millions of passengers carried only two were drowned. Marine men have believed that with the new steel ships lake navigation was the safest of all occupations; the three great storms have entirely disproved this claim.

A SEARCHLIGHT ARCHWAY



When the British vessel "Renown," on which the Prince and Princess of Wales sailed for their Indian our, passed through the Mediterranean Squadron near the Straits of Messina, the big war vessels lined up on either side and, turning their searchlights to meet each other in the sky, created an archway of light through which the "Renown" passed. The scene was spectacular in the extreme. Our illustration is by courtesy of the Illustrated London News.

GASOLINE CAR DELIVERS PAPERS

A remarkable record has been made with a gasoline car which makes the early morning delivery of a daily paper at Dayton, O. The paper has been going out on the electric cars of the interurban line to all the towns between Dayton and Springfield. The electric line recently discontinued its all-night service, and to secure prompt delivery the paper ordered built a gasoline motor car. This car leaves at 3:10 a. m. and travels at a high speed without stops, the bundles of papers being thrown off as the car passes the carriers waiting along the line. One stretch of 6 miles of track is travelled in 7 minutes, and the run to Springfield is made in 48 minutes.

Thirteen thousand motor cars were built in Great Britain last year. The increase over the past year is phenomenal.

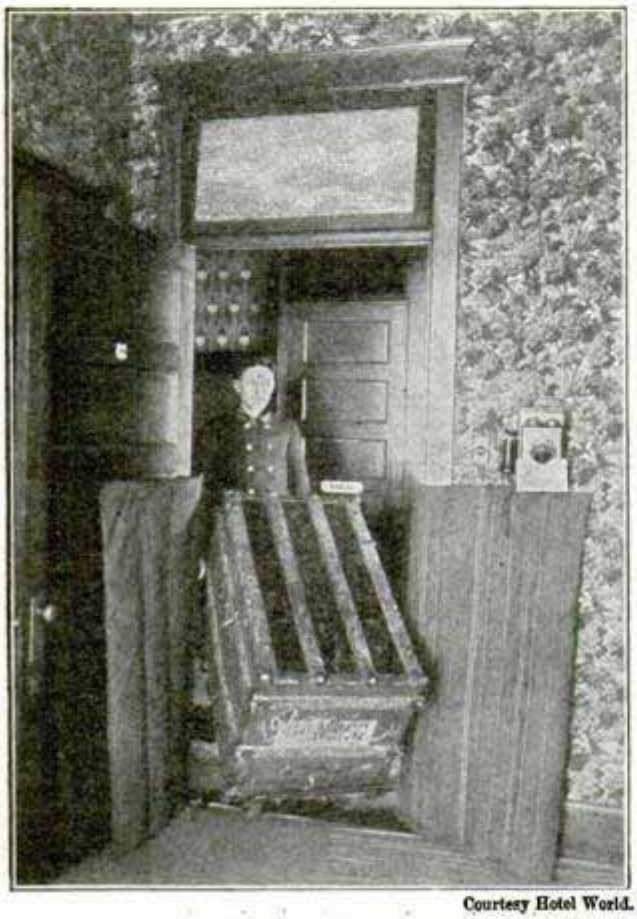
HOW CREOSOTE OIL IS SHIPPED

Creosote oil is the best preservative for wood known and has been used and tested as such through a period of 50 years, hence the timber department of the Santa Fe, which uses millions of gallons of the oil annually in the treatment of ties, has dropped its experiments with all other preservatives for wood.

Formerly the oil was shipped to the plant in barrels; now, however, it is shipped in bulk in the hull of a vessel with a great saving over the old method. Heating coils are used in the ship to keep the creosote at a certain temperature and prevent it solidifying, while the pipe line that conveys the creosote from the loading racks and tanks to the cars has a small steam pipe within it to keep the oil warm enough to flow freely. Last year one plant consumed 5,000,000 gallons of the oil.

PORTABLE PADDING TO PROTECT DOOR CASINGS

The wife of a prominent hotel keeper in Iowa has invented a pad to protect the casings of doors when trunks are being taken in and out of a room. The pad is four feet high, made of heavy ducking stiffened



Courtesy Hotel World.

Saving the Door Case

with slats and stuffed. The pad stands like a screen when in use and rolls up into small space afterward. The trunk man at the hotel takes a pair of them with him whenever handling a trunk. The protectors are inexpensive and in a private house would last a lifetime. Expressmen who will use something of the kind would certainly receive the most patronage.

PRESERVING TIMBER FROM ANTS

A method of preserving timber in tropical climates from the ravages of white ants has been discovered by the Powell Wood Process Syndicate of London, England. Specimens of woods, prepared by this company and sent to various tropical countries have successfully resisted the attacks of the ants, or termites, as they are called.

In the natural state the only woods that resist the termites are eucalypti and teak. All soft woods are saturated with kerosene before using

MACHINISTS, NOT SAILORS, FOR NAVY

Central West the Great Recruiting Ground for American Warships

Admiral Dewey, in his Chicago speech, stated that the American navy needs educated machinists and engineers, and that for some years past the best material has come, not from the seaboard as in the past, but from the farms and cities of the central west. The Admiral proudly remarked that the American navy has no equal, and that should every officer on an American battleship be killed in action, the crew could and would fight the ship to victory.

Years ago when sails were used and fighting was hand to hand, men were needed who could hoist, trim sails and board the enemy with cutlass and revolver. In these days where anchors are raised, the ship steered, guns turned to range, and all other heavy work is performed by steam and electricity, machinists and engineers with educated brains have taken the place of sailors with brawn.

The Mississippi valley is the great recruiting ground and for this reason the new naval training station has been established on Lake Michigan a few miles from Chicago. As soon as this station is in operation the number of western recruits will be larger than ever.

BIND YOUR POPULAR MECHANICS

Those of our readers who have saved the twelve numbers during 1905 can have them bound at a local bindery at from 75 cents to $1. We have prepared a very complete index, which will be mailed free on request. To the very numerous requests for back numbers, we regret to announce that they are all exhausted for the months January to June, inclusive.

A bound volume of Popular Mechanics for 1905 constitutes an extremely instructive history of the year's great events in mechanics and engineering. There are over 700 pages, containing 1,526 articles and 1,224 illustrations. Our readers may be interested to know that the sales to news stands for the month of December were 41,400, or a few hundred more than double the same month a year ago. Our paid mailing list has also been growing at the same satisfactory rate. Popular Mechanics has the largest circulation of any mechanical journal in the world.

POPULAR CHEMISTRY

By Max D. Slimmer, M. A., Ph. D.

This department will appear regularly in the future and will contain talks on chemical subjects of general interest written in unscientific language "so that you can understand it." It is hoped that the readers of Popular Mechanics will assist us in making this section of the magazine as helpful as possible and with this end in view suggestions as to articles of interest or inquiries on chemical subjects will always be appreciated. In this connection its editor will be pleased to answer for our readers all questions that may be addressed to him, only stipulating that the answer must not require the expenditure on his part of any expense for analytical work or extended research. Address all inquiries with self-addressed and stamped envelope to Dr. Max D. Slimmer, 357 Dearborn Street, Chicago.

In the previous article concerning Popular Chemistry we learned that, whenever a substance combines with oxygen, heat is evolved. We know, further, that the amount of heat produced varies with different substances. In the rusting of iron, for example, the heat produced cannot be measured directly, because it is so small. For measuring heat, it is obvious that we have some definite unit. The unit in use is the British Thermal Unit. A British Thermal Unit, which is commonly written "B. T. U." for convenience, may be defined as the quantity of heat required to raise the temperature of one pound of pure water one degree Fahrenheit, at or near its point of greatest density. This point of greatest density is approximately 39.1 degrees F. The quantity of heat required to convert one pound of water, at 212 degrees F., to steam of the same temperature is called the Unit of Evaporation, or "U. E." It is equivalent to 965.7 B. T. U.

In the operation of converting water into steam, the temperature of the steam is not raised. The quantity of heat which apparently disappears when a solid is converted into a liquid, or when a liquid is transformed into a gas, is called by science "latent heat," and during the operation which involves these changes, no change in temperature of the substance under consideration can be observed. Thus, when a pound of ice at 32 degrees Fahrenheit is converted into water at the same temperature, 142 "B. T. U." become latent, and, as we saw above, the latent heat of steam is 965.7 "B. T. U."

When any substance which can undergo combustion combines with oxygen, it always generates a definite amount of heat per pound of combustible substance. We can measure the amount of heat produced by means of an instrument called a calorimeter. To secure such a measurement, a definite amount of material is burned in the calorimeter in such a way as to raise the temperature of a surrounding quantity of water. The change in temperature of the water can be accurately determined by means of a very delicate thermometer. By the employment of the calorimetric method, it has been proved that one pound of pure carbon yields, when burned, 14,600 "B. T. U.," or enough heat to evaporate 15.12 pounds of water from and at 212 degrees F. In the same way one pound of hydrogen gives 62,000 "B. T. U.," or the equivalent of the heat necessary to evaporate 64.20 pounds of water.

The theoretical value of some of the different fuels is, approximately, as follows:

Variety.	B.T.U. per lb. of combustible material.
Anthracite	14,900
Semi-anthracite	15,500
Semi-bituminous	15,700
Bituminous	14,000
Lignite	12,000
Dry Peat	10,000
Oak Wood	5,000
Long Leaf Pine	9,000
Dry Tan Bark	6,000
Dry Straw	6,000
Petroleum	20,000
Natural Gas (30,000 cu. ft. = 1 ton of good coal)	30,000

COAL.

According to the geologists, coal was, many years ago, a mass of vegetable matter; in short, a peat bog such as we find to-day in many parts of the country. For many years the bog lay covered with mud, which was gradually hardened into slate. Under the pressure to which it was subjected, and also through the marked rise in its temperature, the process of hardening continued, and the bog became slowly converted into coal. To the stage at which the process is checked, are due the various kinds of coal, which vary from lignites, which have undergone but little change, to bituminous, or soft coal, and, still further, to anthracite, or hard coal. In some places, coal is found,

which is so hard it can no longer be burned. This substance is known as graphite, and is useful in a great number of ways. The hardness of coal is dependent upon the amount of fixed carbon which it contains. The various coals differ, however, in other points besides in hardness. They vary in the amount of moisture that they contain, and also in their ash. The latter may range from 2 per cent to 30 per cent; the water varies from less than 1 per cent in some samples of anthracite to 25 per cent in lignite, and over 14 per cent in some of the coal mined in Illinois.

In practice it is customary to classify coal, according to the relative percentage of fixed and volatile matter, as follows:

Variety	Fixed Carbon	Volatile Matter	Heat Value per Pound of Combustible	Relative Value
Anthracite	97 -92.5	3- 7.5	14,600-14,800	93
Semi-anthracite	92.5-87.5	7.5-12.5	14,700-15,000	94
Semi-bituminous	87.5-75	12.5-25	15,600-16,000	100
Bituminous (East)	75 -60	25 -40	14,800-15,200	95
Bituminous (West)	65 -70	35 -50	13,500-14,800	90
Lignite	Under 50	Over 50	11,000-13,500	77

BRONZING METALS.

We often have inquiries from the readers of "Popular Mechanics" as to some simple method of coloring or bronzing metals. The following method quickly colors and produces many very fine effects:

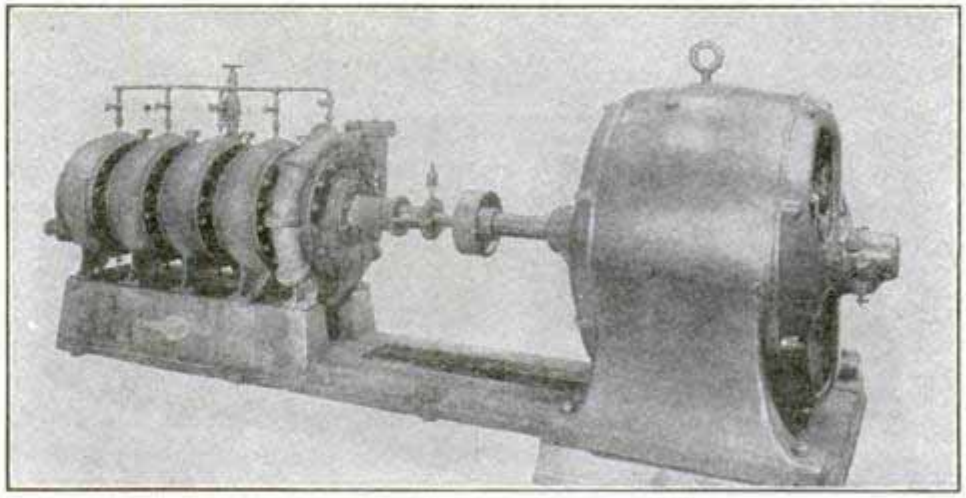
Prepare a solution of 1½ ounces of sodium hyposulphite in one pint of water and add to the same a solution of 1½ ounces of lead acetate dissolved in one pint of water. When this mixture is heated to a temperature a little below the boiling point it precipitates sulphide of lead in a state of fine division. If some metal is present, some of the lead is precipitated on the surface and, according to the thickness of the layer, different colors are produced. To produce an even color the articles must be evenly heated. By immersion of brass articles for five minutes the same may be coated with colors varying from gold to copper red, then to carmine, dark red, and from light blue to blue white and at last a reddish white, depending on the time the metal remains in the solution and the temperature used. Iron objects treated in this solution take a steel blue color, zinc a brown color. In the case of copper objects a golden yellow cannot be obtained.

If instead of lead acetate an equal weight of sulphuric acid (1½ ounce) is added to the sodium hyposulphite and the process carried on as before, the brass becomes coated with a very beautiful red, which changes to green and finally a splendid brown with a green and red iridesence. This last is a very durable coating and may be especially recommended.

In conclusion, it may be said that it is very difficult to obtain exact shades by this process without some experience. The thorough cleansing of all articles from grease by boiling in potash is absolutely necessary to success. By substituting other metal salts for the lead acetate many changes in tints and quality of the coatings can also be effected.

STEP PRESSURE PUMPS FOR HIGH HEAD WORK

To California engineers belongs the credit for first successfully compounding centrifugal pumps for lifting water to high levels. Frequently these machines are made with four or five pumps in series, and often all the pumps are upon the same shaft, as in the illustration. The advantages of the step pressure pumps include large capacity in small space and the ability to handle muddy and gritty water. Each pump in the series delivers the water to the next with a greatly increased pressure.



"Five Pumps in Series"

WHERE HEAVY OBJECTS WILL NOT FALL

Articles dropped into the mouth of the famous Red Jacket shaft of the Calumet & Hecla mine at Calumet, Mich., never reach the bottom. The shaft is the deepest in the world, and no matter what the size, shape or nature of the object dropped, the result is the same. A monkey wrench dropped, accidentally, was found lodged against the east side of the shaft several hundred feet down. A marble tied to a thread was suspended 12 ft. below the mouth of the shaft and when it had ceased moving it was released by burning the thread with a lighted taper. It, too, sought the east wall at a depth of 500 ft. This is invariably the result. Interesting experiments are being carried on at this shaft with a view to developing data as to the thickness of the earth's crust.

The occupation of ship carver is defunct. The elaborately carved figurehead once used to decorate the stems of vessels has disappeared from the merchant marine almost entirely, and in its place is the straight sharp stem built for utility and without attempt at beauty.

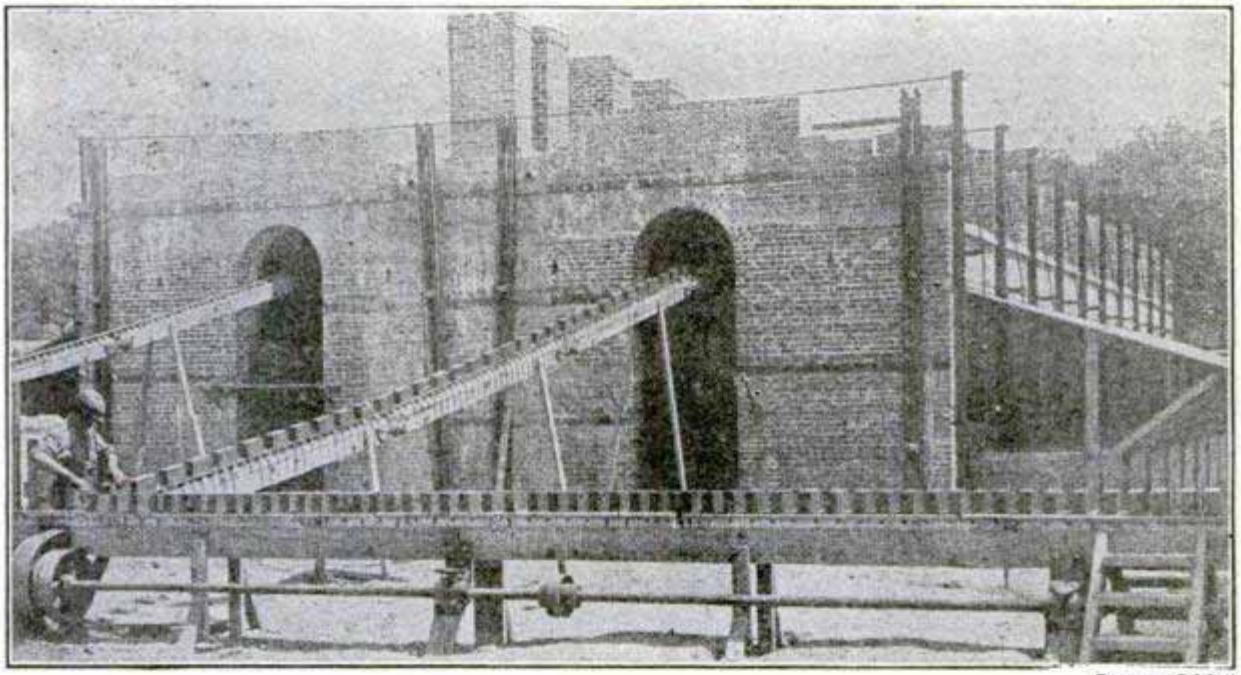
Two miles a minute is the mark set for the automobile races to be held in the Ormond-Daytona beach tournament. If this is accomplished, it will mean a speed of about 176 ft. a second.

NEW SYSTEM OF HANDLING BRICK

Five Men Can Now Set 50,000 Brick In Kiln In One Day

A new method of filling a brick kiln, which saves 70 per cent of the labor formerly required is now in successful operation. A system of endless belts on which the brick are carried from the machine in which they are made direct to the hands of the men setting the kiln, does the work.

As the brick leave the press they pass onto a horizontal belt conveyor which carries them any required distance until opposite the kiln where they are to be burned. At this point a man removes the brick and places them upon a similar belt conveyor which moves at right angles to the first. This conveyor extends into and through the kiln, and as the kiln is filled the conveyor is raised from time to time until at the last it is close to the top of the kiln as seen in the illustration.



Courtesy "Brick."

Main Belt--Transfer Man--Conveyor Entering Kiln

The help required is: 1 man changing brick from main belt to kiln belt; 1 man to arrange belts, etc.; and 3 brick setters; a total of 5 men against 18 previously required to do the same amount of work. The following description is condensed from Brick.

The brick are set from 6 to 10 high, and covered with sheets of paper, one side of the kiln being left uncovered to allow the vapor of the drying brick to escape. Thin sheets of galvanized iron are laid upon

First Course Laid

the paper to hold it down, and for the workmen to stand upon later. Hot air from a blower is then forced through the brick, which are allowed to dry until the next day, when another setting is made, the men standing on the metal sheets which are removed as the work progresses. This course is continued until the kiln is filled, other kilns being carried along at the same time. By this method the brick are dried ready for burning in the same kiln where they are fired, thus avoiding the extra expense of providing, and the labor of taking, the green brick in and out of the dry-kilns. The process is believed by many to mean a revolution in the manufacture of common and paving brick, competition in the manufacture of which has become very strong.

If you want anything and don't know where to find it, write Popular Mechanics. Information free.

WHAT WILL PANAMA CANAL EARN?

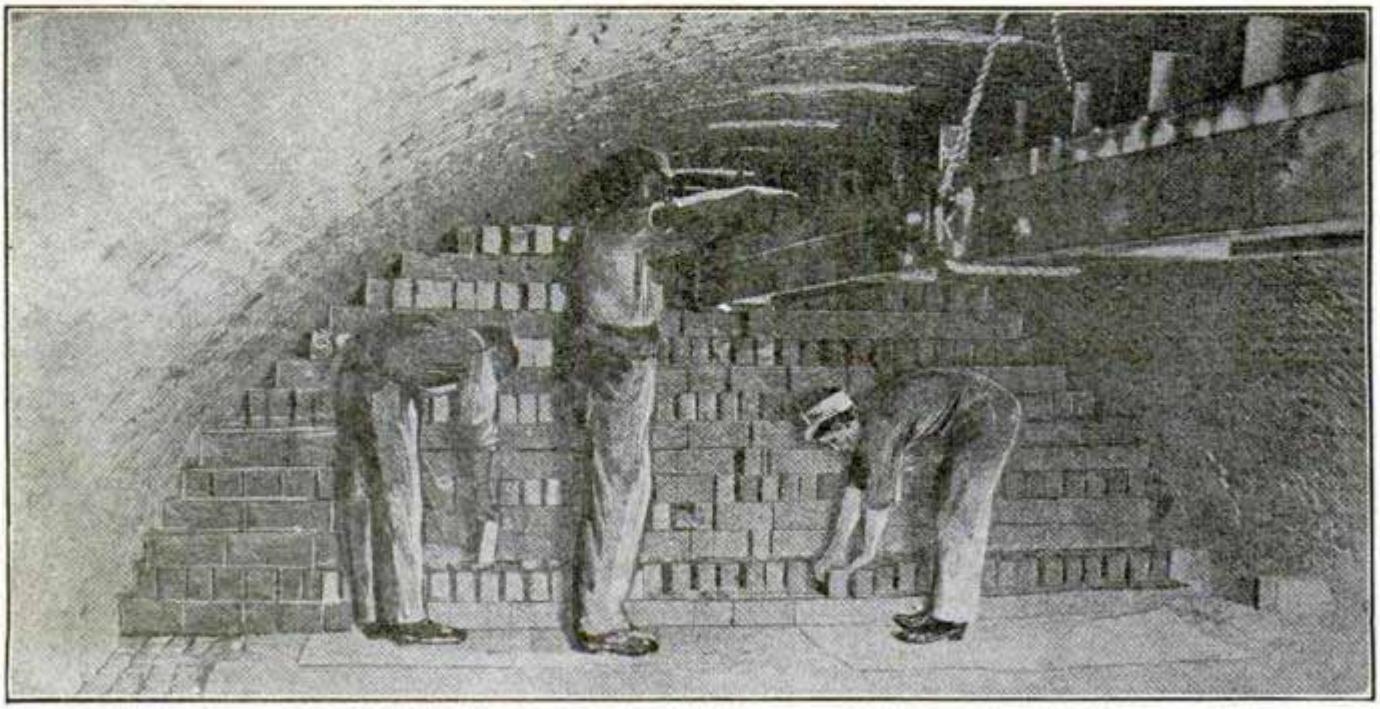
The earnings of the Panama canal are somewhat problematical for the reason that no one knows what will be the created business to and from the Orient and to western South America.

The traffic on the Suez canal increased from 765 steamers, 361,467 tons, paying $1,800,000 tolls in 1870, to 3,699 steamers carrying 10,823,840 tons and paying $20,079,200 tolls in 1901. Charges since January 1, 1903, have been $1.64 per ton of freight and $2 per passenger. Commencing with the present month the freight toll is reduced to $1.55 per ton.

The largest cargo ever passing through the Suez was the Grosser Kerfuerst with 13,200 tons cargo, on which the tolls were $21,648.

Assuming the Panama canal to cost $200,000,000, with the bonds drawing 3 per cent, and toll rate being, say, $1.50 per ton, there would be required 4,000,000 tons yearly cargo through the canal to meet the interest charges alone. As the Suez canal passed 4,000,000 tons through as long ago as 1881, there would seem good prospects that the Panama canal should not be many years in getting on a good paying basis and being able not only to carry itself but retire its bonds.

An American importer of automobiles is bringing over some 200-hp. machines which will be offered with a guarantee of two miles a minute or no sale.



Conveyor at Top—Kiln Nearly Filled

WHAT OCCUPATION SHALL I FOLLOW?

A Symposium on the Necessary Qualifications for, and the Inducements Offered by the many Mechanical, Engineering, and Industrial Lines of Work and Business. These Articles are Contributed by the Managing Editors of Publications which are Recognized as Leading Papers in their Respective Fields.

The Old Professions are Overcrowded; the Whole World is Calling for Educated Mechanics and Engineers.

WHY A YOUNG MAN SHOULD BECOME A TINNER

By W. F. Wallace, Editor "The American Artisan," Chicago

Thirty-five years ago a light-eyed little waif strayed from an unattractive roof in nowhere to the doors of a tinshop on East Lake street, Chicago. He was ragged, barefoot and so dirty that to judge from appearances one might infer that he sprang full-weaned from one of the catch basins lately installed in that section of the city. In spite of the filth and the apparent irresponsibility of the lad, his pathetic little tale pierced the hardened crust of the tinsmith's heart and Joe, as we shall call him, was given the job of errand boy.

W. F. Wallace

The master tinsmith's chief source of emolument was a canning factory not far away. It was Joe's duty to trundle a little cart filled with cans two or more times a day from the tinshop to the factory. Between times Joe would stand around the shop watching the tinners rounding the shiny metal into shape, stamping on the bottoms, seemingly molding them into form with a caress. The work was fascinating.

The more Joe watched the more fascinated he became. Joe was not fascinated as a bird is fascinated by a snake, or a street loafer by the erection of a building. Joe did not look at the work; he saw through the work.

Joe slept on one of the benches at night. One night he lay down at about nine o'clock, his accustomed hour, and closed his eyes to go to sleep. Instead of the usual Nothingness, however, there passed before his eyes the most vivid array of tin cans—tin cans, tin cans, a countless, endless number of tin cans. The procession wouldn't disappear. It passed in rotation and came around again and again. Finally Joe rose and went into the shop. He would try for himself. He would make a can with his own dirty hands; his master was asleep.

But the dirty little hands were not skilled. The can would not shape itself. There were dents and sharp edges and the edges didn't fit. Joe went back to his bench and fell asleep. The next night he made another can, a little better but still far from perfect. Each night before going to sleep he visited the shop and attempted the fascinating work.

Weeks and weeks—all of four years—were spent in this manner. Joe was a kind of tinner himself now and there was another lad to trundle the wagon. Still Joe was not contented. He could turn out cans that were flawless, that were smooth, without a dent or a kink and utterly impermeable to water with a hundred-pound pressure, but the work was too slow. The spirit of "divine discontent" was born in Joe and he soon got to spend his evenings, not in practicing in the shop, but in thinking—not dreaming—but thinking, devising an unheard of, hitherto undreamed of black devil that would turn out the cans, rounded and stamped with bottoms at one operation and a hundred to the hour. Gradually the plan took material shape. A pattern machine was made with all of Joe's savings and most of his master's. The machine was sold, together with Joe's services and at present Joe is an executive officer in one of the largest can manufacturing establishments in the world.

You ask how it was done? Mechanically, Joe was as little gifted to startle the world as any of the other tinners with whom he worked. But in addition to a natural inclination for mechanics, Joe was imbued with the attribute of "divine discontent." This is the faculty that Carlyle displayed when he tore up his manuscript and rewrote

the whole work; when he corrected and recorrected the proofs; when he ordered the recorrected type "killed" and wrote the story a third time. This is the faculty that Americans display in their mad race for money—that engineers display in their efforts to increase the strength and decrease the cost of bridges. It is the attribute that lying in an embryonic state in primitive man burst forth in never-dying splendor with the discovery of fire. "Divine discontent" is to be accredited with all the improvements won by man and because Joe was copiously endowed with the attribute he found old methods not to his liking.

"Divine discontent" is not the discontent that a fretful baby displays. It is not the discontent that drives a man to Socialism. A man possessed of "divine discontent" strives not to change but to improve. Accepting the fundamentatl principles of nature and life, seeing through them and taking them as they are, he endeavors to utilize them for the ends of man, to improve upon the creations of his fathers. "Divine discontent" does not mean pettiness; it means largeness, magnanimity. "Divine discontent" means that its possessor sees through and beyond the old. He is too big for the old.

"Divine discontent" in itself may be assigned as the single cause for the success of any and every successful man. No man can succeed without it. Various other attributes entering into the temperament of a man determine whether this "divine discontent" will be utilized in improving conditions in a tinshop or a studio, but the discontent must be present in every case, if improvement is to be made, if the subject is to be successful.

As requisites for success as a tinner, I should name "divine discontent" first of all. The tyro must also be of a mechanical nature. He should have a head for mathematics. He should feel, without in the slightest degree showing it, that all in all he is better fitted to succeed than most men, but that every other man can impart a wealth of valuable information. He should feel that his knowledge comes from without, not from some fountain of genius within.

I should say in summarizing that the tinshop offers as many opportunities for success as other fields. Its opportunities are greater than most. The metals are coming into greater and greater use in all kinds of industry and practice. The different ends to which they can be put seem limitless. Tin is one of the most useful metals as it is the oldest. While it is not used in so great quantities as iron and steel, it is used for perhaps as many different functions. The ever increasing demand for pig tin has led to incessant assaying, and with the opening up of new mines, the different uses to which tin can be put will be multiplied many times.

WHY A YOUNG MAN SHOULD BECOME A STATIONARY ENGINEER

By Oscar C. Schmidt, Editor "The Practical Engineer," Philadelphia

Perhaps one of the best illustrations which will explain why a young man should be a stationary engineer can be had by referring to the last report of the United States Census Bureau. In this report is shown the marvelous growth in electric lighting and power stations. In 1881 there were only eight central stations in existence, which number rose to 100 in 1886, and to 247 in 1892; while to-day there are over 3,600 central electric stations employing over 30,000 wage earners whose salary aggregates $21,000,000 per year. These statistics do not include the 50,000 or more isolated electric light and power plants installed in manufacturing establishments, hotels and office buildings which furnish light and power, nor the thousands of factories and mills throughout the country which also require stationary engineers.

Oscar C. Schmidt

The result of this rapid growth has been a demand for stationary engineers which has been unprecedented, and to-day there is not a good stationary engineer who could not obtain more than a dozen positions at almost a moment's notice, owing to the many new power plants springing up throughout the country.

While it is of the utmost importance to a young man that he can obtain a good remunerative position in the field which he selects for his life work, there is also an

ethical side of stationary engineering which should not be overlooked. This relates to the character of the work which must be performed.

In this connection it may be said that no man ever truly graduates from a course in stationary engineering, as the number of things which must be learned are innumerable, and the engineer who occupies the best positions realizes this more and more. To-day the chief engineer of a large plant must be a walking encyclopedia. He must be familiar with the different kinds of fuel available, the kind of feed water used and the proper methods of avoiding scale formation; he must be acquainted with the different types of prime movers and dynamos, boiler feed pumps, feed water heaters, heating systems, refrigerating machines, elevators, methods of illumination and hundreds of other things equally as important.

This growth in responsibility has meant a growth of intelligence, and the young man entering the stationary engineering field, may be assured that he has got something to work for. It has also meant an increase in salary, which is illustrated by the fact that the recent appointment of a chief engineer in one of the large power plants in the east carried with it what, fifteen years ago, would have seemed a princely salary.

The factor which has unquestionably contributed most to this sudden advancement of the stationary engineer, has been the advent of electricity and its numerous applications, for without it, the steam engine would have found a much smaller field of usefulness and have undergone a smaller field of refinement. The influence and importance of the operating stationary engineer in the industrial field are therefore increasing with marked rapidity and it is safe to say that no other trade or profession has risen so rapidly in the esteem and respect of the general public during the past decade.

A young man entering the stationary engineering field to-day can therefore expect a bright future, for the position carries with it enough remuneration to make it attractive, enough chances of advancement to make it sought after, and enough intelligence to make it a calling of high standing. All these things appeal to the ambitious and should be good reasons why young men should become stationary engineers.

WHY A YOUNG MAN SHOULD BECOME A BLACKSMITH

By A. A. Hill, Editor "Blacksmith and Wheelwright," New York

Why? Because the indispensable conditions to a real successful life are health and independence, and these are more likely to come to the blacksmith than to any other trade or profession. Just at the present time there is a tendency to pay a higher respect to enormous wealth than to anything else, and this degree of wealth the blacksmith cannot reasonably hope for. But the air will be purer and clearer soon. The get-rich-quick and the get-rich-no-matter-how age is right at high tide; it will soon begin to recede, if it has not begun to do so already. Recent disclosures of so-called "high finance" have a tendency to make some people less ashamed of the modest returns of honest industry than others have cause to be of their enormous fortunes. But with ordinary industry the blacksmith business is sure to give a good living and enough more so that the family may be educated and a competency insured for an old age. I don't know of a single other kind of business that offers such a positive assurance of these liberal returns.

A. A. Hill

So much for the material features of blacksmithing. Now monotony is death and variety is life. There is no monotony about blacksmithing, but it is as full of variety as any calling that can be named. No blacksmith can imagine what is coming next. It may be the fashioning of a pair of andirons or some scroll work; it may be the shoeing of a valuable horse; it may be the repair of a complicated farm implement or an automobile. The work usually requires a pretty constant going from one interesting thing to another.

Although there is, of course, competition among blacksmiths, it has not yet reached

that blighting state where it has come to be the death rather than the life of trade, as is the case in so many other kinds of business at the present day. Those who go into it are never ruined by competition or anything else save lack of industry or a deficiency in brain work.

Blacksmithing is a healthful business. Many trades and professions kill strong men. The blacksmith business makes strong men. True, it is hard on flabby muscles and soft hands, but this soon corrects itself.

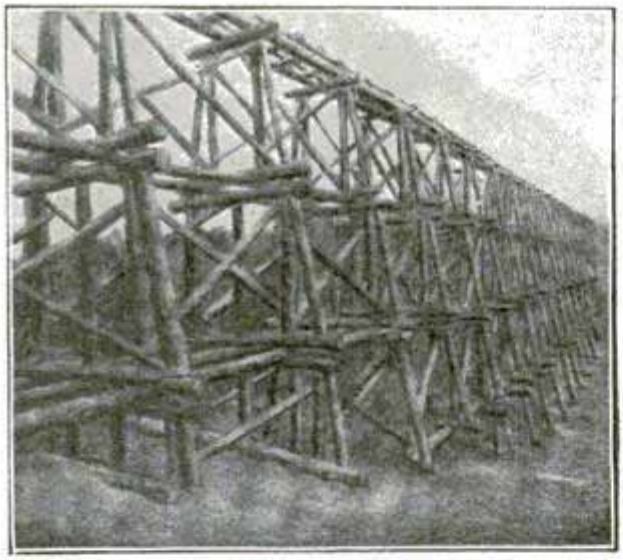
Finally, the civilized world is its field. The chances for employment are always good and there are opportunities for opening new shops all over the country. No other trade gives a stronger invitation for the employee to go into business for himself.

As for the social position of the young blacksmith, there are always ignorant and vulgar minds that admire a genteel employment where there is little work to do, more than one that insures good health and good pay, just as there are always minds that prefer wealth to talent. But this doesn't matter. The educated, upright, industrious blacksmith can be and is a power in the community and an influential member of society, just as such a man is who pursues any other honest calling.

(Continued next month.)

FEAT IN BUILDING A BRIDGE

The four-tier trestle railway bridge shown in the illustration spans the valley of Curzon's Bridges in India and was built in just



Four-Tier Trestle Bridge Built in Short Time

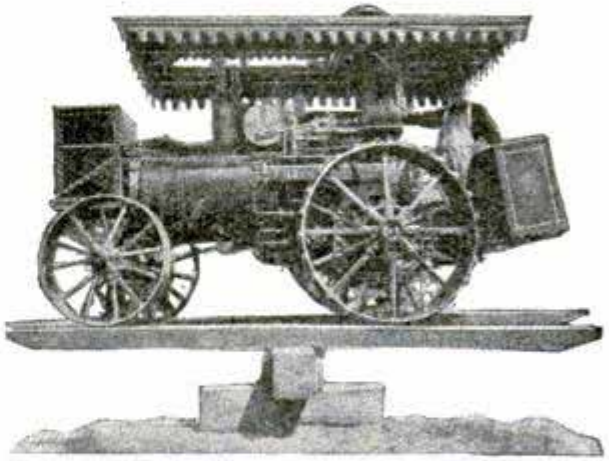
27½ working days by four sergeants and 95 sappers, using three derricks. The bridge is 341 ft. long, 41 ft. high, and the width of the rail is 2 ft. 9 in. It is suitable for light railway traffic, and has been tested successfully to carry ten tons.

FROM WHEAT TO BREAD IN ONE PROCESS

A "milling bakery" is nearly completed in London, where a wonderful series of machines will take in bushels of wheat at one end and deliver tons of bread at the other. The way that mother used to make it appears infantile compared with this modern method which is expected to produce 300,000 loaves of bread per day and effect a saving of 40 per cent in cost. The process is entirely mechanical throughout. The wheat is ground only once, separating into flour, middlings and bran. The flour is conducted to the bin, the bran is mechanically carried and automatically weighed into sacks, while the middlings pass into tepid water, by which all the floury part is washed out. This water, impregnated with nutritive material, flows into the kneading pan, in which the dough is automatically produced. The dough is left to rise for one hour and a half or two hours, is then shaped into loaves, and 40 minutes later an electric carrier delivers the hot bread.

TRACTION ENGINE PERFORMANCE

The even balance in weight of a traction engine was demonstrated by a manufacturer



Balanced on Two Timbers

recently. The machine was run upon two timbers which rested on a cross beam only 12 in. square, as shown in the illustration.

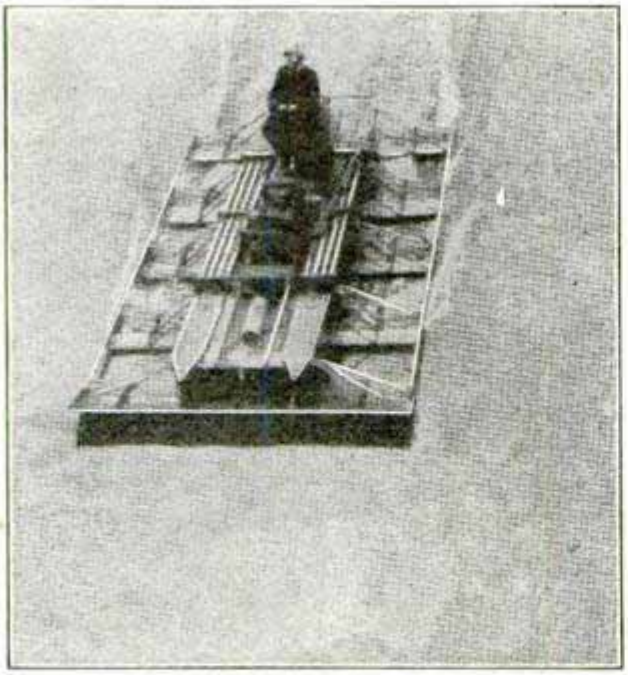
ELECTRICITY FOR CANADIAN RAILROAD

Electric locomotives to take the place of steam on Canadian railroads have taken a big step in the recommendation of Chairman Smith of the Northern Ontario railway commission. One hundred miles of the Temiskaming railway will be electrified at once. This is the first work of this character in Canada, but is expected to be greatly extended.

THE HYDROPLANE, OR GLIDING BOAT

A French count has invented a boat with an entirely new method of propulsion. The same idea that has been tried with indifferent results in building flying-machines has been successfully carried out in the hydroplane, or gliding boat, as the invention is called.

The boat is built with a series of planes and is furnished with a 14-h. p. motor. Started electrically, it depends for its attainment in speed on the new principle—the use of the planes. As the machine proceeds the water impinges against these planes more and more until the front of the boat is lifted out of the water and only the screw is submerged, while the craft goes skimming along over the surface like a swallow.



"The Craft is Lifted Out of the Water"

The lifting of the boat by the impinging water is exactly the same principle as that by which a kite rises when dragged against the wind. Its greatest speed is 20 miles an hour. Without the planes 30 h. p., would be required to attain that speed, but with them, the resistance is so slight, that 14 h. p. performs the work of 30 h. p.

BRITISH WARSHIPS' SHORE TELEPHONE

It will surprise many people to learn that within one hour after the British fleet which recently visited this country, dropped anchor in New York harbor telephone connection with the shore had been established.

Courtesy American Telephone Journal.

Shore Telephone

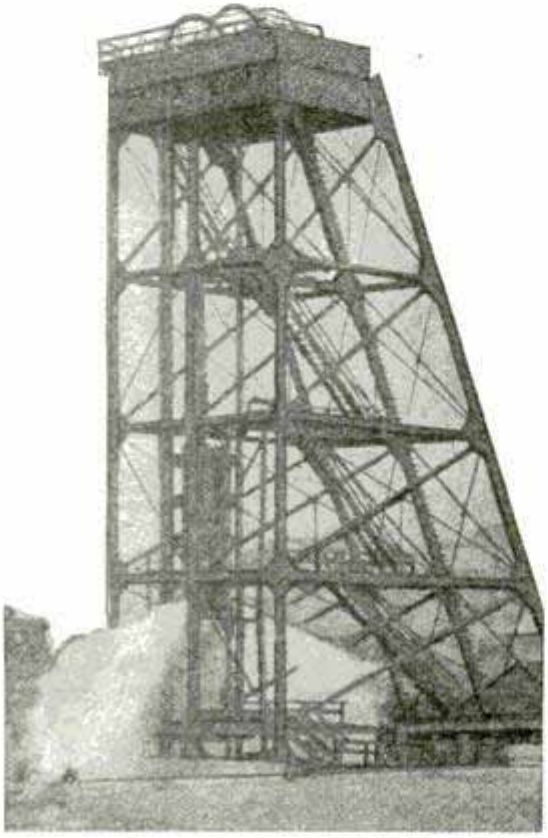
The English officers could talk not only with all subscribers of the New York exchange, but on long distance wherever that service extends throughout the country. The American Telephone Journal says: "Exceptional care was exercised in the installation of the wires to protect them as much as possible from injury. Cables are used exclusively, varying in sizes to meet the different requirements. The interior insulation is a powerful damp resisting compound known as Hooper's. A lead sheath envelope is provided to protect the cable from mechanical injury and over this is a heavy wrapping of jute. Terminal boxes are provided for all connecting joints and these are fitted with water-tight cases."

The telephone service on a British ship of war is very complete; the instruments used are known as naval telephones and made expressly for that purpose. All parts and officers of the ship are connected. A gun captain without even taking his eyes from the sights or moving in his bicycle-like, saddle seat, can talk with the conning tower. Telephone connection is also maintained with the wireless telegraph room, which is guarded with the greatest possible secrecy.

BUCKET HOLDS 17 TONS OF WATER

And Raises 550 Ft. Per Minute--Requires 610 Hp.

The old oaken bucket would not recognize itself if placed alongside its latest big brother which is delivering 4,000 gallons, weighing 17 tons, per minute. This unusual construction has been installed at the hard coal



Delivers 4,000 Gallons Per Minute

mine of an eastern railroad. Two buckets are used; one coming up as the other goes down. Each bucket is 6 ft. in diameter and 19 ft. high. Two lift gates are placed at the bottom of the bucket which open upward on entering the water and close the instant the bucket begins to lift.

One bucket with its 2-in. steel cable and contents of water weighs 27 tons. This great weight goes soaring skyward a distance of 550 ft. at the rate of 10 ft. per second, requiring 610 hp.

On reaching the surface an automatic device opens the bucket and the water rushes out in two directions into great troughs, forming a good sized stream. Night and day with the regularity of a pendulum these great steel twin tanks make their ceaseless journeys down into the earth, for the supply is apparently inexhaustible and any delay would soon flood the mine. The hoisting drums are driven by means of an electric motor.

ENGINEER SKEEVERS' DEMONSTRATION

[From Locomotive Engineering.]

Jim Skeevers runs a freight engine on a small road. He takes great pride in her tidy appearance and his coal and oil record is the best on the division. His fireman became weary of so much wiping and being called a chump by the other firemen, so one day he didn't wipe the dust off her.

When Skeevers got to the engine he put his siege-can in the box, got out his overclothes, put them on, and started around with the long can, Billy sat on his seat and smoked a cob pipe. Skeevers got up on the deck, wiped off his can, and remarked rather hintfully:

"Forgot to dust her off this time, didn't ye, Bill?"

"No," said Bill, "I got sick of being guyed by the rest of the gang, and called names, and bein' accused of trying to make firemen do more work, and cleaning."

"Billy," said Skeevers, "it's all right; don't blame you at all. It takes a long time to find out that you know your own business best. Now, haven't you often heard it from all quarters that we had the best-looking engine on the road? Yes, 'course you have. Don't she run lightest on coal and on oil? Never was beat. Do you have to wipe a dose off her once a year because she was too full of water? No; because we are careful and take pains in our work. We may be suckers, but it's a good deal of satisfaction for me to know we're doin' our work about right—near as we can, anyhow. But it's wrong, I guess, Billy, dead wrong, after all. So let's do as the rest do; you fire and clean just as the other boys do, and I'll run just as the other runners do; there's no use in bein' odd."

Billy had expected a row with Skeevers, and felt quite relieved that he took to the change so good naturedly, and in a few minutes both were busy, as they pulled out with a big train.

Skeevers jammed the injector on full just as they started, and Billy had a hard half-hour's work bringing his green fire up, with the pressure down 20 lb.; he was tired and sweaty when the engine commenced to churn water through her stack, plastering the front windows with dope. Skeevers jerked his head inside the window, smiled, said he forgot it, shut off the injector, and eased off the throttle, then she commenced to howl and Billy opened the door.

Skeevers was working her down a notch further than usual, and it told on the coal pile, and Billy remarked that it was an awful hard pulling train, by way of calling Skeevers' attention to it, but Skeevers agreed that the train did pull hard.

Skeevers forgot to put the injector on again till the water was down to one gauge, then he acted startled, and put it on full. The fire was low, and Bill had another fight. This was repeated all day, and each time the coal got further and further away.

Half-way over the division they took 150 bushels of coal, where they never took more than 100.

Skeevers kept good-natured. Bill was mad.

"I think you're doin' this a-purpose," said Bill, at last.

"Doin' what?" asked Skeevers, as innocent as a child.

"Why pounding this engine so hard, and workin' water, startin' out in the corner, wide open, and pullin' my fire all to pieces."

"Is there any other engine on this road that don't burn more than six tons of coal over this division?" asked Skeevers.

"No; but she never burnt but four and a half and five before," said Billy.

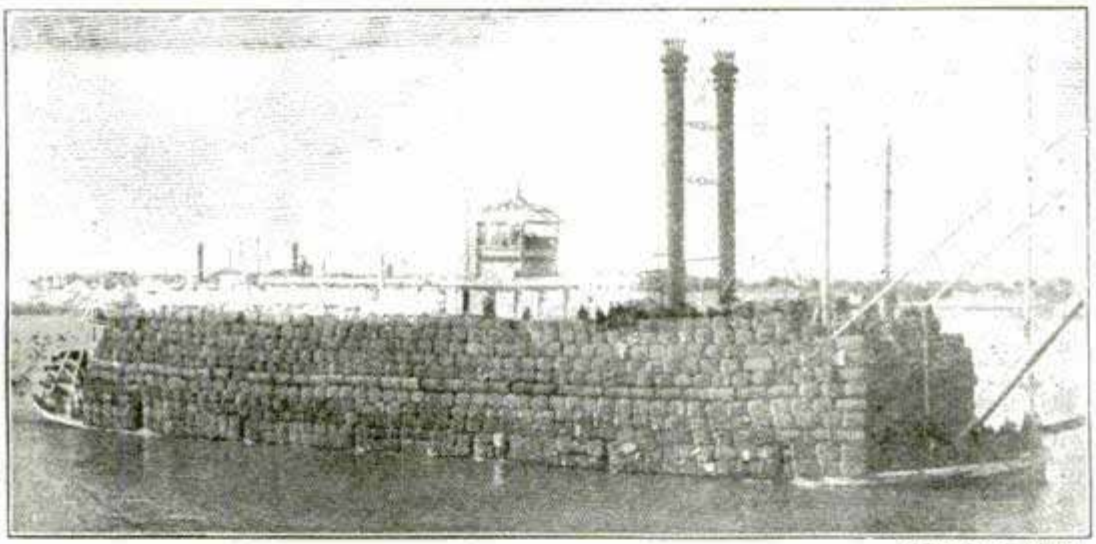
"Yes, but that was when we was both careful and worked together," said Skeevers, as he prepared to get off at the end of the run; "but none of the rest of the engineers are careful about coal; what's the use of me being? And when a man works as hard as you have today he would be a fool to put in an extra hour cleaning and fussing around; we get just as much money when we don't as when we do. Good night, Billy."

The next morning when Skeevers came down to go out, the "Mary Ann" was wiped up, her front end black, and Billy was whistling "Annie Rooney" and spitting on the side windows to make the whiting take hold.

"Skeevers," said he, "I'd a good deal rather put in half an hour a trip cleaning than to shovel coal against that extra notch and an injector that 'forgits.' Just run her like you used to, Skeevers, and I'll keep her tidy."

MOVING THE COTTON CROP

The transportation facilities of the South for the past two months have been taxed to their utmost moving the great cotton crop. The illustration shows a Mississippi river steamer about to land at Memphis with 4,000 bales on board. Memphis handles 700,000 bales valued at $30,000,000 annually.



Courtesy Valve World.

Loaded to the Limit--4,000 Bales

HORIZONTAL PROPELLER SHAFT FOR GASOLINE LAUNCH

A somewhat unusual method of driving the screw of a racing gasoline launch has been adopted in the construction of the De Dietrich auto-boat. The hull changes from a fish-body shape forward to a flat bottom hull from amidship to stern. In order to get the screw down into solid water and give the propeller a true vertical plane, the shaft is hung from a frame and driven with a chain drive.

The authorities at Birmingham, Eng., have stopped the quarter-hour chimes on the big town clock between the hours of 7:30 p. m. and 5 a. m., on account of disturbing sick people.

SEWER RUNS OVER A RIVER

Unusual and Interesting Features in Sewer Construction in New Jersey

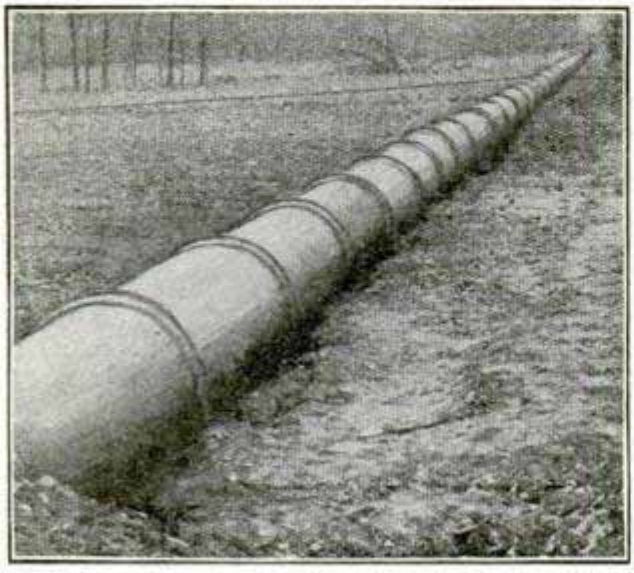
A sewer while a necessary thing is usually an uninteresting one. A sewer to drain Newark and six other places covering

Tunneling in Quicksand

an area of 66 sq. mi. recently completed, affords some novel features. Part of the construction was through quicksand, saturated with water, along a river course. This section was after many failures completed by using compressed air to hold the water back while the men worked.

At another point the line was laid on the surface across a field where driven wells furnish the water supply for the city of Elizabeth. This was accomplished by using iron pipes laid on concrete base.

One crossing of a small river was made



Exposed Section of Sewer

in three steel pipes suspended from steel girders resting on concrete piers. Another river crossing was on Y-shaped steel frames set in concrete piers. The outlet of the sewer is at tide water.

VALUABLE PRODUCTS FROM WASTE WOOD

Oil, Turpentine, Tar and Charcoal Among the Many Products to Be Reclaimed

Valuable wood products are to be reclaimed from pine and hemlock slabs, stumps, and other waste woods. The Department of Agriculture is conducting promising experiments, and soon there will be calls for chemists all over the land in sawmills which now burn slabs and other mill waste to get the stuff out of the way. Nature has been so lavish in this country that Americans are the most extravagant and wasteful people on the face of the earth. We are suddenly waking up to find our forests almost gone, and from this time forward efforts must be made to utilize a tree as completely as a packer does a beef or hog.

The Forest Service outlines the plan thus: The outfit for a plant with a capacity of 100 cords of wood every 36 hours, which is as small as can be profitably handled, consists of a "battery," or two retorts holding 5 cords of wood each. These retorts are set in brickwork, about 50,000 bricks being required for a "battery." In addition are needed a coil or condenser of copper, a copper still of a capacity of 1,000 gallons, a second condenser, sufficient collecting and storing tanks, a boiler of not less than 10 hp., and pumps to handle the products. All piping should be, if possible, of copper, except after the second distillation, and the pumps should be brass-lined.

From such a plant the yield should be approximately from 75 to 100 gallons of oil or tar per cord, and from 10 to 15 gallons of wood turpentine. There are also produced about 25 bushels of charcoal. The amount of products is in direct ratio to the resinous constituents in the raw material. The value of the products is variable. If properly made, the tar should bring the average market price of pine tar, and the spirits sell for from 15 to 5 cents below the market price of spirits of turpentine.

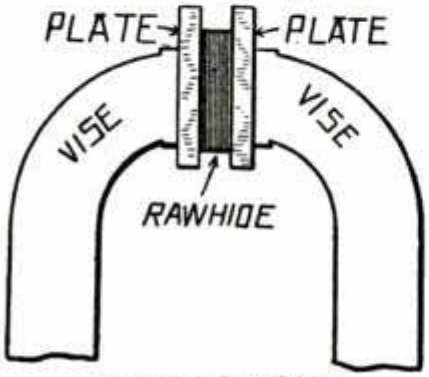
All the articles appearing in this department are reprinted in book form at the end of each year.

SHOP NOTES

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

TO FLATTEN AND SHAPE RAWHIDE

Warm two metal plates a little warmer than is comfortable to hold; put the rawhide between them and press solid in a



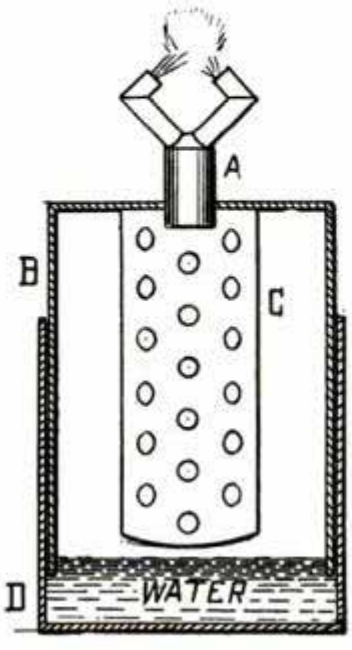
Shaping Rawhide

vise, leaving all there till the plates are cool. Be careful not to heat the plates hot enough to burn the hide.—Contributed by J. H. Jerome, Brighton, Mass.

HOW TO MAKE A SMALL ACETYLENE GAS GENERATOR

To make this machine the materials required are two tin cans, one of a size to fit into the other, a smaller can and an acetylene gas burner.

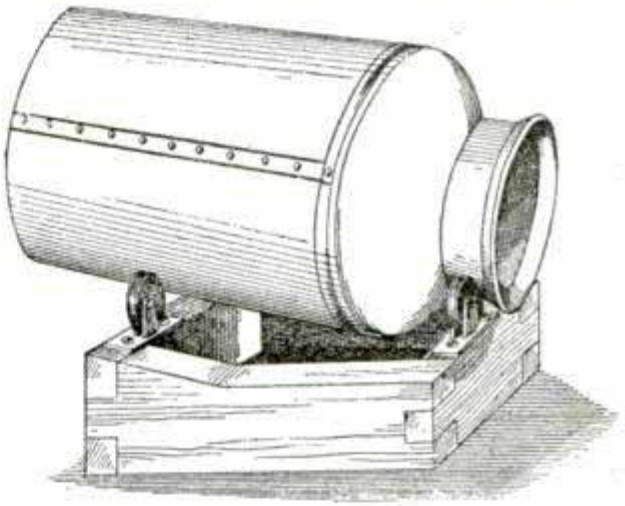
Solder the gas burner, A, to the smaller of the two large cans, B. Punch the smallest can, C, full of holes and fill it with carbide and fasten it to the under side of can B. Partially fill can D with water and place can B with its attached apparatus in can D, as shown in the illustration.



Wait a moment, then touch a lighted match to the burner. If too much gas is generated the carbide is automatically lifted out of the water, as shown, and the generation of gas ceases until more is needed.—Contributed by Fred Crawford Curry, Brockville, Ontario, Canada.

FRAME FOR HOLDING MILK CANS WHILE SOLDERING

In a shop where soldering milk cans forms an important item of repair work the frame shown in the illustration will be found convenient. Placed on this frame a 40-qt. milk can can be rotated freely so that the seams in the breast of the can may be



Frame for Holding Milk Cans While Soldering

quickly and easily soldered. The frame may be held in the lap of the operator, if it is more convenient. To solder the bottom seam, an arm is fastened to the frame, so as to support the bottom of the can when inclined for this soldering, says the Metal Worker, and the frame is then taken in the lap of the operator, who turns the can and at the same time solders the seam. The construction of the frame is shown in the illustration.

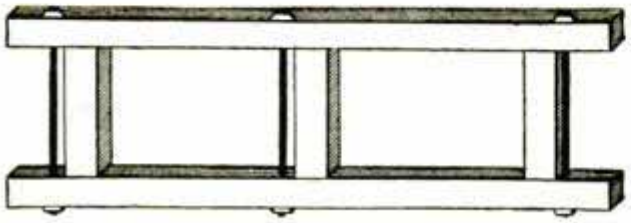
To renovate varnished work make a polish of 1 qt. good vinegar, 2 oz. butter of antimony, 2 oz. alcohol and 1 qt. oil. Shake well before using.

For oil gilding make an oil size of calcined red ocher ground with the best and oldest oil. Add oil of turpentine to make it work freely when ready to use.

QUICK BOILER MOVING

An engineer was given from Sunday morning until the following Wednesday at 2 p. m. to connect up some new boilers that had just been installed, and break the connections of the old boilers and move them from the plant to the cars on which they were to be shipped. He tells in the Engineer's Review how he did it with the help of but two white men and a gang of southern negroes. He says:

When the order came, I completed my measurements for connecting the new boilers to the engine and piping system and starting up the shop, cut and fitted the two 6-in. and one 4-in. connections that were necessary. Getting in some more men these



Skid for Moving Boilers

were erected in place that night and the old boiler connections broken and plugged.

The next morning the fronts and stays were taken off and the boilers stripped. A crib work of blocks was then placed under each end of the boilers, and with jacks they were raised clear of the settings and securely blocked. A gang of men then pulled down the brick setting. Meanwhile I had the carpenter get out some skids of 6 by 8-in. timber, as shown in the sketch. As soon as one of the boilers was clear enough to work on, it was lowered down onto a skid. While this work was going on, I had a hole made in the boiler room wall large enough for the boiler to pass out, and by the time I had the track ready the first boiler was on the rolls. Hitching the blocks to the skid we soon had the boiler walking out in great shape. Tuesday morning at 10 o'clock this boiler was on a car, with all the fittings, securely braced and ready for moving.

In the meantime the other setting had been removed and the rubbish cleared away so we had a clean sweep at the other boiler, and Wednesday morning at 7:40 o'clock everything was ready for the freight. This job might have been accomplished more quickly if we had had better facilities and competent help.

BEST ANTI-FREEZING SOLUTION

The best anti-freezing solution for the use of motorists is prepared by the following recipe:

Mix and filter 4½ lb. pure calcium chloride and a gallon of warm water and put the solution in the radiator or tank. Replace evaporation with clean water, says the Motor Age, and leakage with solution. Pure calcium chloride retails at about 8 cents per pound, or can be procured from any wholesale drug store at 5 cents.

A ROPE PIPE WRENCH

A rope pipe wrench which may be operated by one man is shown in Fig. 1. The rope is wrapped on the pipe and toggle as shown, then, holding the ends of the rope in one hand, the operator pulls the toggle with the other. In operating the device shown in Fig. 2, which is used for heavier work, one man is required to hold the rope ends and another to handle the toggle. This device, says American Machinist, is called a Spanish windlass, and is used by seafaring folk.

A method of grinding a pulley on a shaft, or grinding a shaft in the boxes, is shown in Fig. 3. The ends of the rope are pulled alternately. The hand-rails of marine engines are polished by wrapping them with emery cloth which is worked by a piece of spun yarn instead of rope, as in Fig. 3.

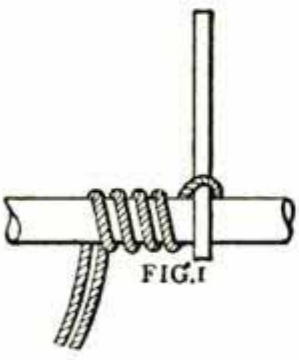


FIG.1

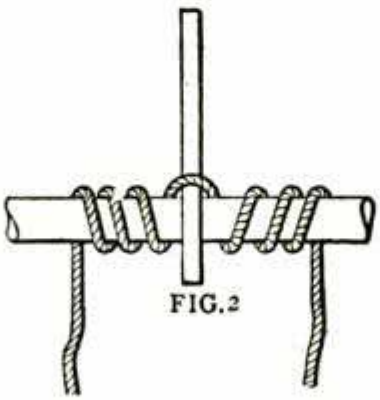


FIG.2

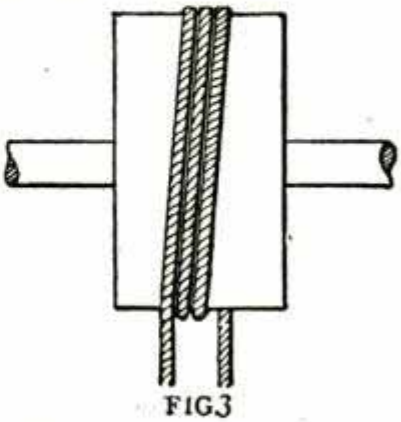


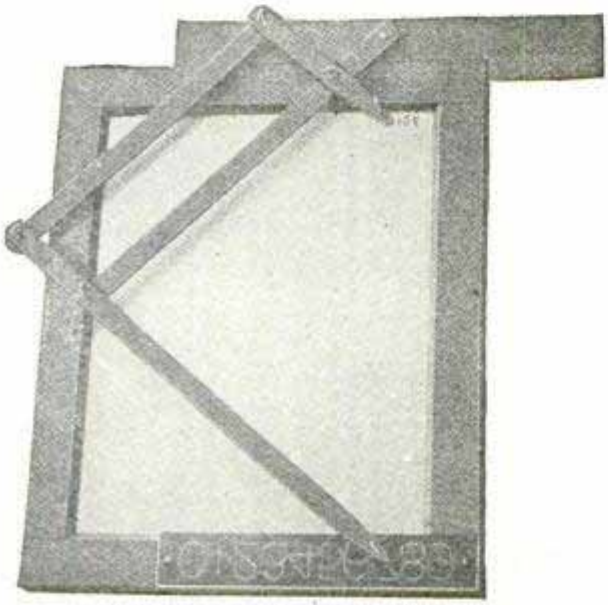
FIG3

NEGATIVE NUMBERING DEVICE

The negative-numbering or marking device shown in the illustration is very simple in construction and will save time for the photographer using it.

To make the device prepare a brass strip by cutting into its face the inverted numbers 0 to 9 and screw the strip to the edge of a printing frame. Then construct a small pantograph of light ash strips and brass screw eyes.

To number a negative put the plate, with its dull side out, into the frame and pick out the correct figures on the brass strip and transfer them neatly to the negative by holding the wooden block to which the pantograph is attached lightly against the



Tool for Numbering Negatives

frame with the right hand and tracing the figures with the left. Slip the wooden block backward or forward to get the right spacing.

Keep the tool with the printing frame in a drawer of its own, says a correspondent of the American Machinist, so that no time is lost in preparing or assembling the parts.

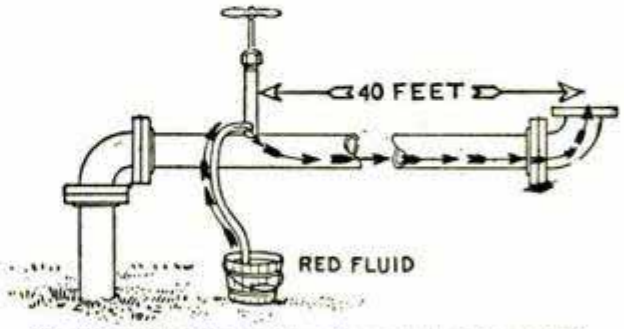
WATERPROOF POLISH FOR WOOD

Put into a stopped bottle 1 pt. alcohol, 2 oz. gum benzoin, ¼ oz. gum sandarac and ¼ oz. gum anime. Put the bottle in a sand-bath or in hot water till the solids are dissolved, then strain the solution and add ¼ gill best clear poppy oil. Shake well and the polish is ready for use.

TO TEST THE CAPACITY OF ARTESIAN WELLS

Where a weir cannot be built, the following test of the capacity of an artesian well is recommended by a correspondent of the Crane Valve.

Lay about 40 ft. of 10-in. pipe, with a 90 deg. elbow looking up from its outer end,

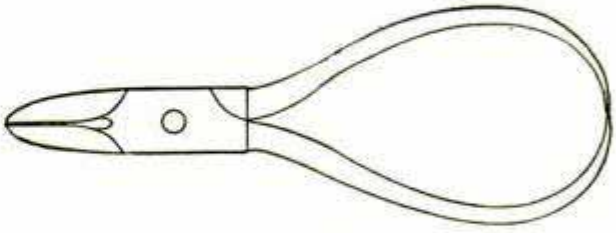


Testing the Capacity of an Artesian Well

horizontally from the well. Tap the pipe near the well and attach a small force pump. Let this pump draw from a bucket a solution of red aniline dye. One stroke of the pump will force about 4 oz. of the red dye into the water passing through the pipe. When this stroke of the pump strikes, start a stop watch, and when the colored water shows at the elbow, stop the watch. Thus the exact time taken to travel the length of the pipe may be ascertained, and with this time and the capacity of the given size of pipe the amount of water passing per minute may be figured. This test will come within three-fourths of one per cent of being absolutely correct.

CALIPERS MADE OF PINCERS

To make a pair of calipers of a pair of pincers, heat both handles of the pincers so that they will bend to meet at the ends



Handy Calipers

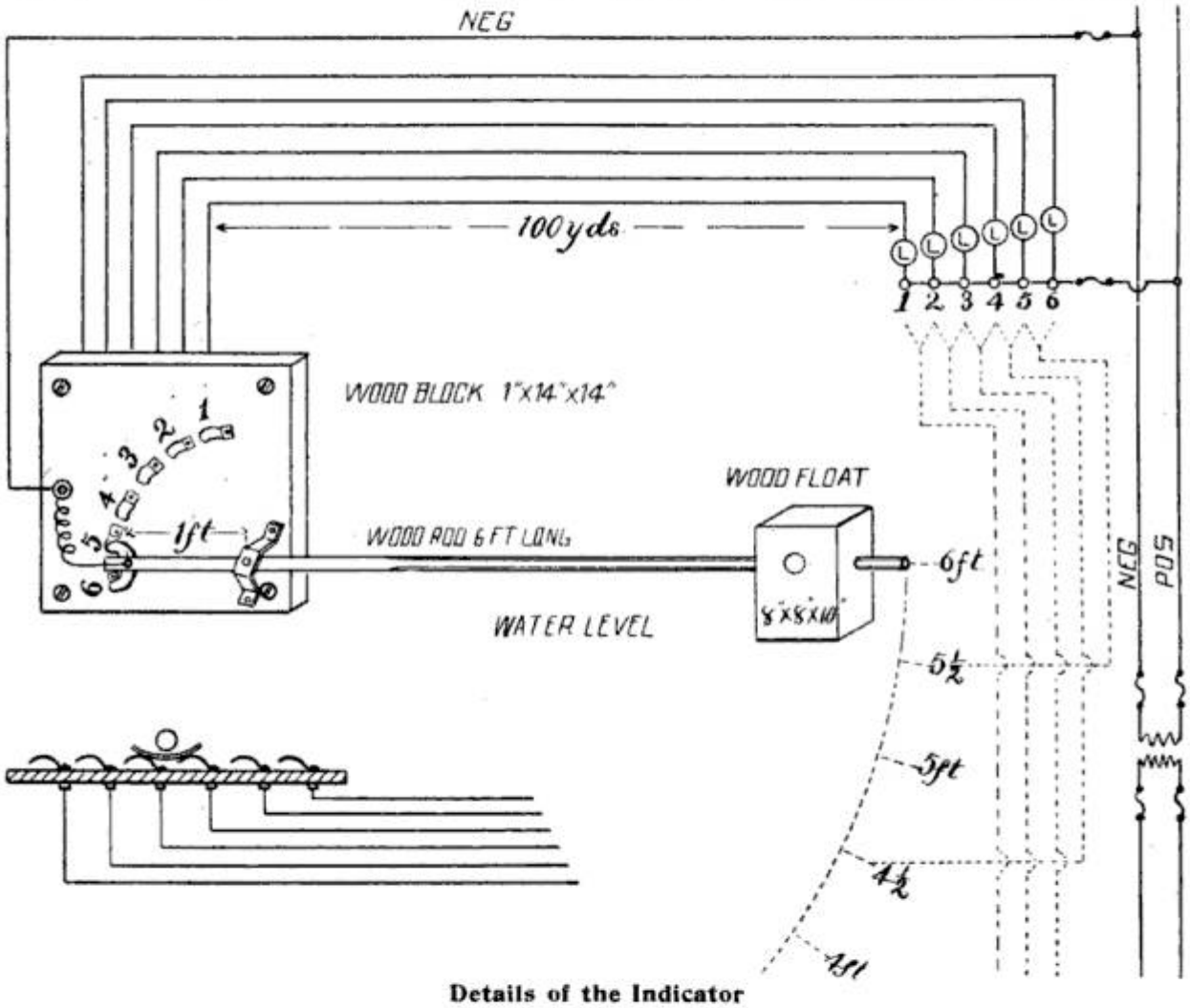
easily. Then file the tips of the bent handles to a point. This makes a very handy tool.—Contributed by Jack Wener, 2247 F St., Los Angeles, Cal.

AUTOMATIC ELECTRIC INDICATOR OF WATER LEVEL IN DISTANT DITCH

I am in charge of an electric generating plant which ordinarily operates with water-power. The water is brought in an open ditch to within 300 ft. of the station, where a waste gate is placed. From there the water is carried in a pipe. In order to carry the proper load without using too much water, it is necessary for me to know the depth of water in the ditch at all times. I am running a 90 kw. alternator in multiple with another set of alternators 10 miles away. Both plants are short of water at times and then it is necessary to use steam when the load is at the maximum. I can usually hold the load during the day. My plant has a 6-mile ditch and the other a 1-mile ditch. Both ditches cause a great deal of trouble in stormy weather.

The 100-yd. trip in the dark to get the water level was a great annoyance; even in the day time it took time, so I studied out the following plan to indicate the water. It is so simple any electrician can install one, and it has worked to my entire satisfaction. My indicator uses six lamps, as the ditch is 6 ft. deep. The diagram will make the construction readily understood. There should always be one of the six lights burning, and when two burn it indicates a 6-in. level. For example, when lamps 5 and 6 are burning there would be 5½ ft. of water in the ditch. If No. 6 goes out there is only 5 ft. of water; if No. 4 and No. 5 light there is 4½ ft. of water, and so on.

The contact points, 1, 2, 3, 4, 5 and 6, are placed on a wood block 14 in. x 14 in. x 1 in.



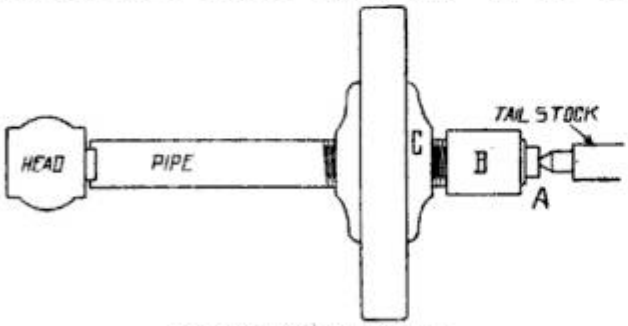
Details of the Indicator

The wooden lever is 6 ft. long, with the negative wire connected to the contact point on the lever with a flexible wire long enough to allow for travel over the six contacts. At the other end of the lever is a float which I made of a block of wood 8 in. x 8 in. x 10 in. At the station a positive bus bar connects to the six lamps, from each of which leads a wire to the contact block, where connection is made to its corresponding contact number. I used No. 16 wire for the outdoor lines, about 2,000 ft. was required. For the lamp

signals I used 8-cp. 110-v. lamps. By placing the contact points at nearer or farther intervals the device may be made to indicate changes in 3-in. levels, or 1 ft., but for my purpose the 6-in. change in level is sufficiently exact.—Contributed by Lee R. Clarke, R. R. No. 2, Bozeman, Mont.

EMERY WHEEL ARBOR

An emery wheel arbor to rig on a lathe is shown in the sketch and is the device of M. C. Warnock, of Farmington, Ill. It consists of a flange coupling, C, in this



Emery Wheel Arbor

case 3½ in. in diameter, and a length of piping. A coupling, B, is put on the tail stock end, into which is screwed a plug, A, for the center to hold. If the plug were inserted in the pipe without a coupling the threads would cut through, being threaded both inside and outside. A solid bar of iron may be substituted for the pipe. The flange may be trued in the lathe.

If you want anything and don't know where to get it, write Popular Mechanics. Information free.

AIR DRILLS FOR DRILLING MARBLE

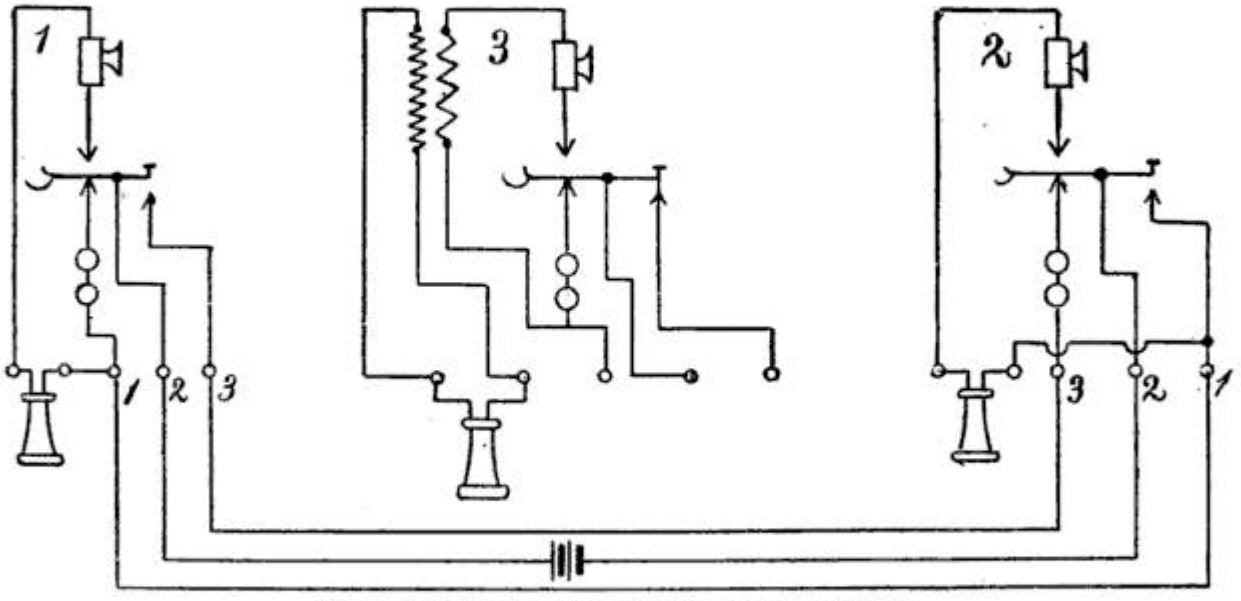
To successfully drill marble with a pneumatic drill, an ordinary twist drill is prepared as shown in the illustration. The twist is removed for a distance of about ½-in. from the point and the face of the

"The Drill is Ground Square"

drill is ground square, which gives it the appearance of an ordinary screwdriver. When running light with this drill the speed should not exceed 70 revolutions per minute, and when pressure is placed on the machine and the drill begins to cut, reduce it to 30 revolutions. In this way marble can be rapidly and economically drilled.

METHOD OF TELEPHONE WIRING

A method of wiring and connecting two short line battery call telephones is shown in the illustration. The chief feature of this method is that it permits the use of the ordinary two-contact push in place of the unreliable three-contact push generally made use of in this type of 'phone. Figures 1 and 2 show the transmitters and receivers in series with the battery when conversation is going on. Figure 3 shows induction coil in series with transmitter and having a closed secondary through receiver. This kink is contributed by a reader.

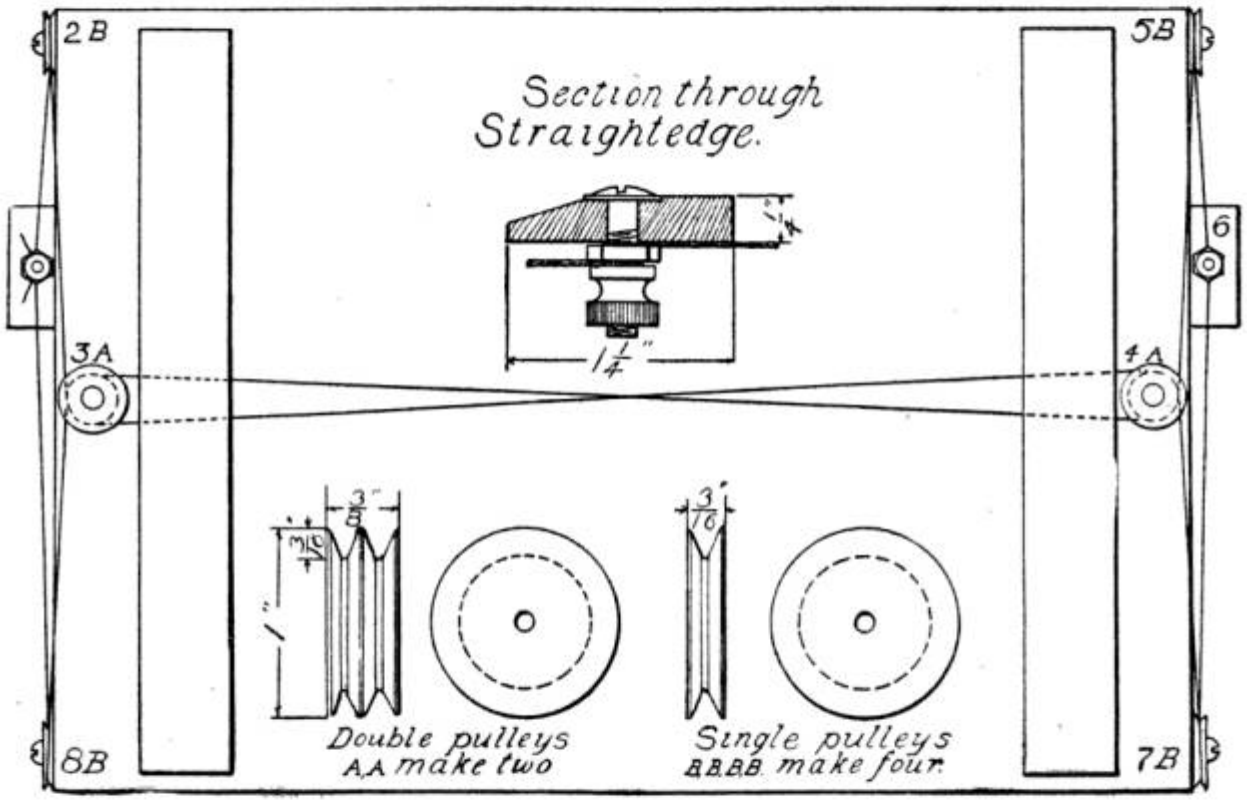


Plan of Wiring and Connecting Two 'Phones

HOW TO MAKE A PARALLEL RULE FOR THE DRAWING BOARD

A very useful drawing device, which saves time and does better work than the T-square, as by its use it is impossible to get a line out of parallel through carelessness, was constructed by C. D. Gilbert, St. Johnsburg, Vt., who tells how to make the instrument:

Unless one has a lathe the machine shop must be called upon to make six brass pulleys, four single and two double as shown in the drawing. This is the only expense, assuming, of course, that the device is to be used on a drawing board one already has.



Parallel Rule for the Drawing Board

The holes in the pulleys are drilled to fit easily a 1-in. round head screw. Other materials needed are a piece of hard wood, about 1½ in. longer than the board, and suitable for making the straight edge, as shown in illustration, two brass binding posts from the carbons of some discarded dry batteries, and a few feet of good fish-line.

To make, put one of the posts through the end of the straight edge, about ½ in. from one end, countersinking it slightly, and screw the check nut up snug, and with one side of the hexagon nut square with the end of the ruler, so that it will slide easily along the board.

Then lay the ruler on the board and put in the other post so that the ruler will slide up and down the board freely, but leaving very little end play. Screw the pulleys on the board, as shown by the drawing, and if there are cleats on the board remove them and proceed to connect up.

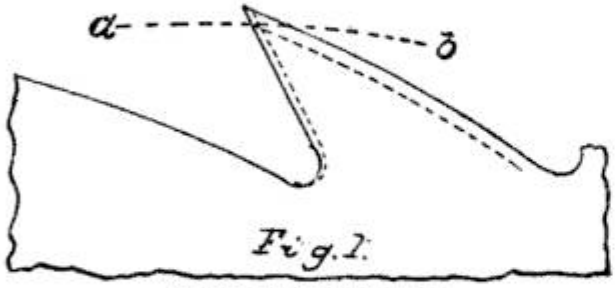
Beginning at Post 1 fasten the end of the line under the hexagon nut and bring it over the under side of Pulley 2 (the board being in the position shown in the drawing, face down), then to the lower groove of Double Pulley 3, to Double Pulley 4, then over the upper side of Pulley 7 and to Post 6. There it is given one turn around the post between the two nuts and starts back to Pulley 5, then to the upper groove in 4, crosses the other part of the string to 3, next passes to 8, and back under the milled nut on Post 1. Now if drawn snug all is ready for business unless the ruler has been pulled out of square; if so, loosen the milled nut at Post 6 and slide the ruler along the string till correct. The line will stretch at first and have to be taken up, but will soon work all right.

The cleats which were removed from the board must now be notched to allow the strings to pass and replaced, when all is complete. If one has several boards, a frame may be made which will hold the largest one, and the device attached to that, when one can readily change from one piece of work to another by simply changing boards—often an advantage to a busy draughtsman.

IDEAL TOOTH OUTLINE FOR CIRCULAR SAW

A saw expert in the Woodworker gives a sketch of what he considers an ideal tooth outline for a circular saw. He says:

Let us consider such a saw at work. Suppose the saw to be 24 in. diameter, with



Where a Saw is Dull

48 teeth, which makes the teeth practically ½-in. space. Supposing this saw is making a 3-in. cut—that is, 3 in. of feed for one revolution. It is obvious that each tooth cuts a shaving 1/16 in. in thickness. If we could draw a circle 1/16-in. smaller than that of the saw, we should find that the saw is dull only outside of the line where the said circle crosses the face of the tooth (Fig. 1, a b).

How shall we sharpen? This dull point is but a trifle over 1/16-in. long, but is probably less than 1/124-in. deep. Consequently, if we sharpen on the back, we must grind or file 1/16 off all along the periphery

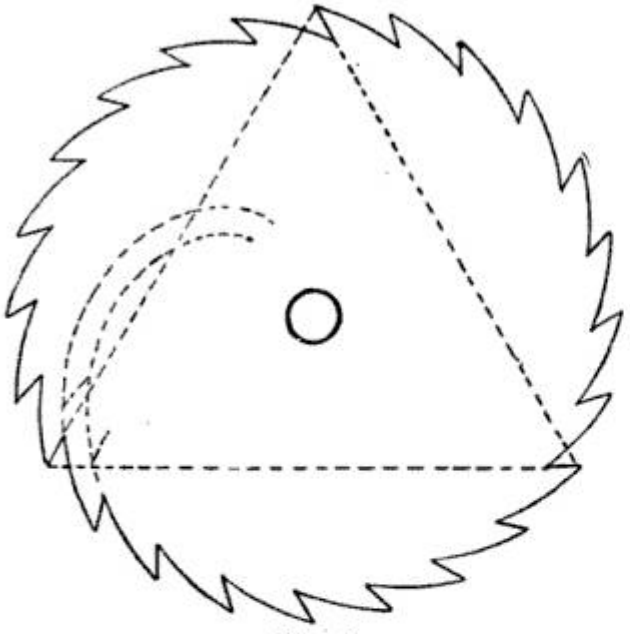


Fig. 2

line, and as stated by another, the saw is ⅛-in. smaller when we are done. On the other hand, if we grind or file on the face of the tooth, we will have less than 1/124-in. to grind to obtain a sharp point, but we sha'n't lose anything like ⅛-in. in diameter. Considering the size of said saw, and the gauge as well, I think it obvious that such a saw will stand up and rip for a long time; and I may safely contend that every semblance of a corner will be gone when it comes up to the file room. These conditions are true in conjunction with the upset swage, only to a greater extent.

ERASING MACHINE FOR DRAFTING ROOMS

Frequently in drafting rooms, such records as street records, plat books, main records, etc., are kept which have to be changed from time to time to show new pipe lines, etc., and thus a great deal of erasing is occasioned. To do this work quickly and neatly the erasing machine may be employed.

To make this machine, procure an ordinary dental engine or machine, such as is used for drilling teeth, and, instead of the drill used by the dentist, set a circular ink eraser in the mandrel by means of a small screw. An electric motor may be attached to the machine, or it may be run by foot power. In operating it, merely guide the eraser by means of the handle.

A few points, however, should be kept in mind, says the Progressive Age: The eraser must not be pressed too hard on the paper, and the machine must be kept at a good speed.

With a good paper the erased spot will have a hard surface, and the erasing will be hardly noticeable. The time required is very short, and the operator quickly becomes an expert at erasing by machine.

NATURALIST'S PASTE

For mounting specimens make a paste of thick mucilage of gum arabic and powdered starch. Suitable for artificial flower makers' use, also, and for sticking wafers, paper ornaments, etc., to candies and cakes. For the last mentioned purpose, add a little lemon juice.

HOW TO LAY GALVANIZED IRON ROOFING

The use of galvanized iron for general roofing work has increased greatly during the past few years. It has many features which commend it as a roofing material, but difficulties have been experienced by beginners as to the proper method of applying it to the roof. The weight of material used is rather heavy to permit of

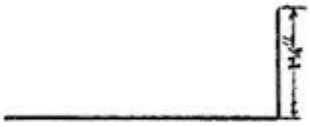


Fig. 1.

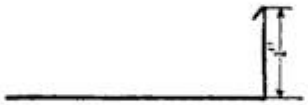


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

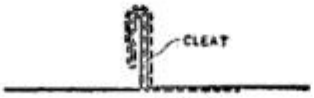


Fig. 6.

double seaming, but a method that has been evolved by a correspondent of the Metal Worker is found very satisfactory. By this he says that galvanized iron roofing can be put on at low cost, that it is water tight and is subject to no buckling in the joints, does away with double seaming and is considered more suitable than the latter for roofing purposes wherever it can be laid on a roof steeper than 1 to 12.

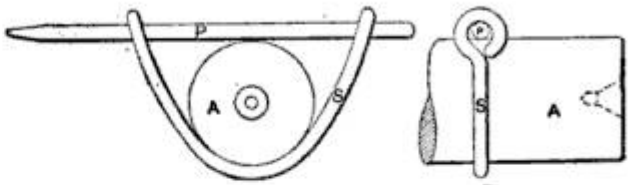
Galvanized iron of No. 28 and heavier gauges is used, the sheets being lap-seamed and soldered together in strips in the shop the proper length to apply to the roof. After the sheets are fastened together a 1¼-in. edge is turned up the entire length of one side of the sheet, as indicated in Fig. 1. This operation is done with tongs having gauge pins set at the proper point. The second operation consists in turning a strip ¼ in. wide toward the sheet, as shown in Fig. 2. This sheet is then laid on the roof, and a cleat about 8 in. long and 1 in. wide made of galvanized iron is nailed to the roof close to the sheet and bent over it, as shown in Fig. 3.

A second sheet having 1½ in. turned up is now brought against the first sheet and bent over both sheet and cleat, as shown in Fig. 4. The cleat is then bent backward over the second sheet and cut off close to the roof, as in Fig. 5, after which the seams are drawn together by double seaming tools, as the occasion demands, and slightly hammered with a wooden mallet. The finished seam is shown in Fig. 6. It will be seen that the second sheet of galvanized iron, cut ¼ in. longer than the first, laps over the former, making a sort of bead which prevents water from driving in. Cleats hold both sheets firmly to the roof and are nailed about 12 in. apart. Roofs of this character, when laid with No. 28 gauge iron, cost, he says, very little more than the cheaper grades of tin and do not have to be painted. Some of them have been in satisfactory use for eight and twelve years. A name applied to this seam which, though somewhat long, describes it well, is half double standing seam.

TO MAKE A SPRING FASTENER FOR A LATHE POINTER

A feeler or pointer, used for setting up work on the lathe where the work has a hole through it by which it is to be trued up, is shown in the illustration. The spring S is made of a straight piece of wire with an eye turned on each end. This spring is sprung around an arbor, A, and a pointer, P, is passed through the eyes of the spring and over the arbor. The tension is sufficient to hold the pointer in place.

When the arbor is rotated by hand, it carries the pointer around with it to test the accuracy of the setting. This device, says a correspondent of Machinery, is of the most service for heavy and awkward



Spring Fastener for a Lathe Pointer

shaped pieces, as they can be set and fastened without starting the lathe. For setting on the lathe carriage cylinders, bushings, etc., that are to be bored with a boring bar, it is handy also. For small holes in work, use a very light arbor, with a short spring and pointer. For setting to the outside of a hub, bend the end of the pointer hoop-shaped.

PLUMBERS' CEMENT

A good plumbers' cement consists of 1 part black rosin, melted, and 2 parts of brickdust, thoroughly powdered and dried,

MYSTERY OF BOILER EXPLOSIONS EXPLAINED

The "Lap-Joint Crack" is the Greatly Dreaded and Unseen Danger

A locomotive standing idly on the track or hauling a train, in apparently a perfectly normal condition, explodes without warning; a great factory is busy with hundreds of operatives at work, when suddenly the structure is torn asunder and the air is filled with the cries of the injured and groans of the dying. Both disasters were wholly unexpected. Usually the engineer and fireman are among the dead, and too often blamed by an unthinking public for carelessness, when in fact they were wholly innocent.

Brockton Lap-Joint Explosion--Boiler Was Hurled 215 Ft. and Moved House 16 In.

The explanation of a very large proportion of these accidents lies in the "Lap-Joint Crack"—an insidious, unseen danger, which cannot be found save by tearing a boiler to pieces, and which may exist for years without giving the slightest warning.

The expert of a well-known boiler inspection company, in the Locomotive, goes into details of this danger, from which the following is condensed or quoted:

A "lap-joint crack," as the name implies, is a crack in a boiler plate, which follows the general course of the longitudinal lap-riveted joints by which the plates of the boiler are held together. Any kind of a crack possessing this peculiarity of position would, strictly speaking, be a "lap-joint crack;" but the name is usually applied to one particular kind of defect, which is illustrated in Figs. 1 and 2. The main thing to observe in connection with Figs. 1 and 2 is that the crack, although it may occur in either the inner or the outer plate of the boiler, always starts from the face of the affected plate which is in contact with the overlapping plate, progressing into the metal more and more deeply until the boiler is weakened perhaps to the point of explosion; and being itself so situated that it cannot be seen from either the inside or the outside of the boiler. It is this peculiarity of position which makes the defect so dangerous, the strength of the plate being sometimes greatly reduced before there is any external, visible evidence that the crack exists at all.

One of the most unfortunate things about these hidden cracks is that they show a marked tendency to extend nearly through the affected plate for a considerable distance along the joint, without actually perforating it anywhere. Fig. 3 illustrates a well-marked case of this sort. The piece of plate which it represents was cut out of a boiler that was affected by a lap-joint crack. The crack, in this instance, did not actually perforate the plate at any point, but it extended so nearly through it that the specimen here shown was bent over by hand. The position of the edge of the overlapping plate is indicated, in this engraving, by the dotted line.

The two main causes of lap-joint cracks are the treatment the plates receive during manufacture, and the action to which the boiler is subject on account of steam pressure.

First, as to the processes of manufacture and their effects. In rolling plates into the cylindrical form, preparatory to riveting them up into shells, the rolls do not "grip" the plate as effectively near the end of the operation as they do in the middle of it; for the last end has a tendency to slip off the first roll, and spring back so as to be flatter than the desired radius would require. If the plate were solid, and had no rivet holes in it, the resulting cylinder would look something like Fig. 4, one end of the shell "standing off" from the general curve, as represented. If, on the other hand, there are one or more rows of rivet holes along the edges of the plate that is being rolled, it may easily happen that the plate takes a sharper bend along one or more of these rows of holes, owing to the weakening of the plate at these points,

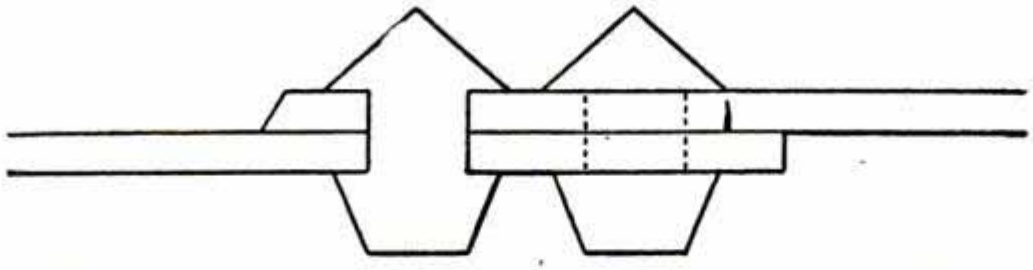


FIG. 1. — A LAP-JOINT CRACK UNDER THE OUTER EDGE OF THE RIVET HEADS.

FIG. 2. — SECTION OF A BOILER PLATE WITH A LAP-JOINT CRACK.

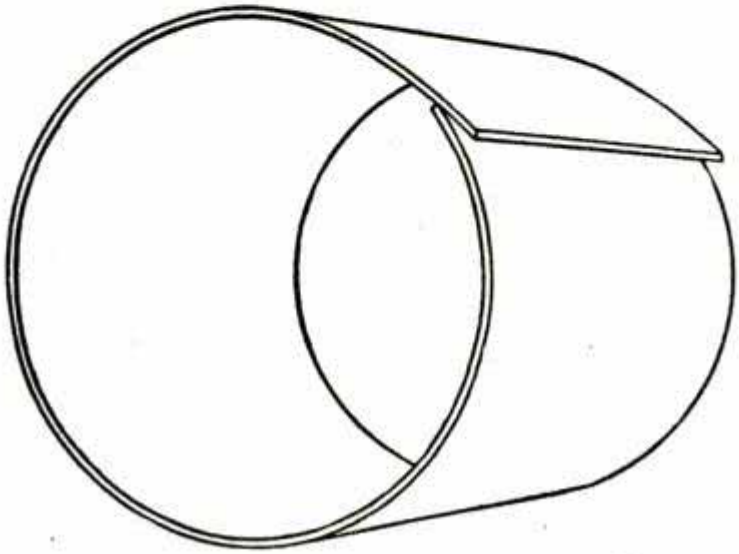


FIG. 4. — ILLUSTRATING THE "OFF-SET" OF THE LAP.

FIG. 3. — A PLATE ALMOST PERFORATED BY A LAP-JOINT CRACK.

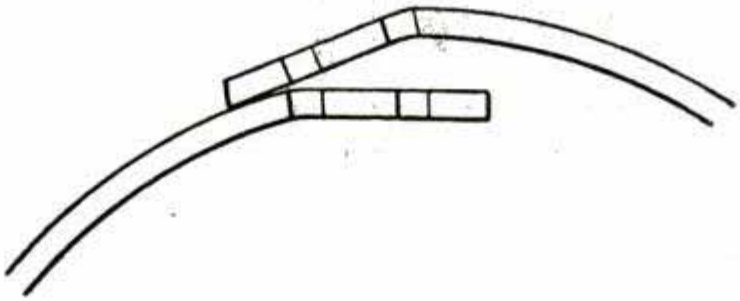
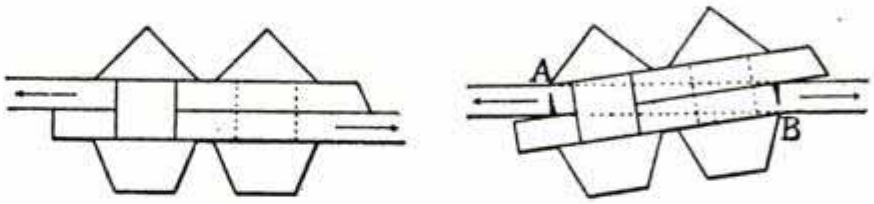


FIG. 5. — SHOWING THE ACTION OF THE ROLLS. (EXAGGERATED.)



FIGS. 6 AND 7. — BEHAVIOR OF A LAP-RIVETED JOINT UNDER PRESSURE.

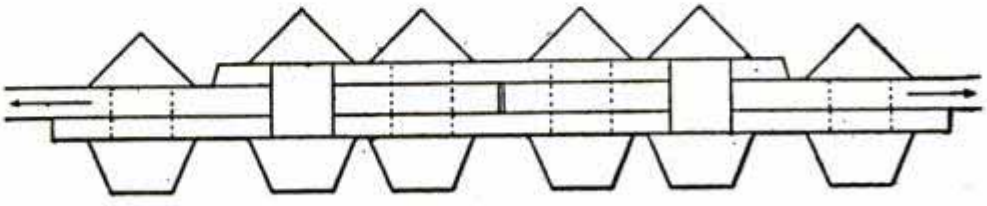


FIG. 8. — DOUBLE-STRAP BUTT JOINT.

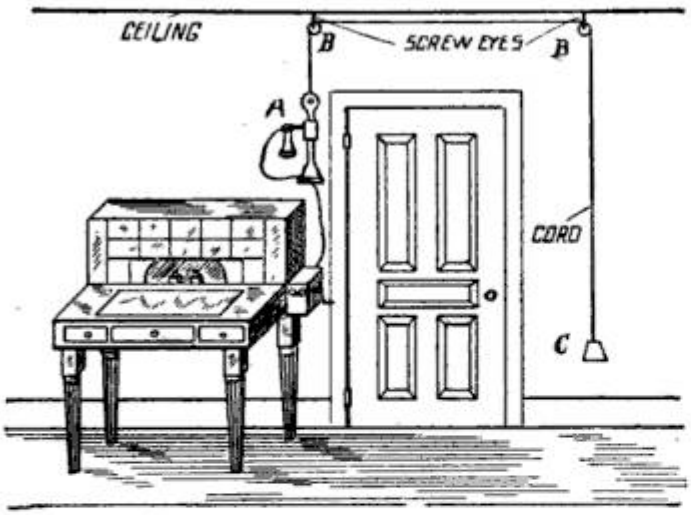
from the removal of the material in forming the holes. The ends of the plate, where they come together, may then present the aspect represented on a greatly exaggerated scale, in Fig. 5. Careless sledging produces stresses, often of considerable magnitude.

The steam stresses are shown in Figs. 6 and 7. Fig. 6 represents an ordinary double-riveted lap-joint, and it is to be observed that when the boiler is under steam, the tensions on the respective plates which are united by the rivets cannot possibly act in one and the same straight line. The plates do not abut against each other at the edges, but are laid one over the other, and the tensions to which the plates are subjected must be related to each other somewhat as indicated by arrows. It is evident, therefore, that there will be a tendency, in such a joint, for the rivets to "cock up" somewhat after the fashion shown in Fig. 7. The action will not be as violent as here represented, but the tendency will be for the joint to be deformed towards a position in which the two overlapping plates would come into one and the same straight line, as suggested by the dotted lines in Fig. 7. The parts of the plates which lie between the rivet shanks and under the rivet heads will be held firmly together by the rivets; and the bending action to which the plates are subjected will therefore be most severe immediately under the edges of the rivet heads, where it first becomes possible for the plates to bend to any perceptible extent. As the steam pressure in the boiler varies, the bending action upon the plates will also vary, and hence there will be a tendency, sooner or later, to form a crack in the plate, either at A in Fig. 7, or at B.

Inasmuch as the lap-joint crack appears only in lap joints, the use of butt joints, as shown in Fig. 8, is recommended as preventing the trouble. The use of the butt joint is increasing, but probably 85 per cent of all the boilers in use today in the United States still have lap joints and their manufacture continues.

IMPROVED DESK 'PHONE

The desk 'phone is often in a busy man's way and takes up too much space, also it is frequently knocked off with injurious effects to the instrument. An apprentice in our machine shop contrived the method



To Keep the Desk 'Phone Out of the Way

shown in the illustration for overcoming this difficulty. The device requires two pulleys, a cord, weight and two eye screws. The weight can be a shot bag of sand or shot of the same weight as the 'phone stand, A. The device has proved a great improvement over the old arrangement and is recommended to others.—Contributed by F. A. Grier, Jr., Salisbury, Md.

COMPOSITION OF BABBITT METAL FOR STREET CAR MOTOR BEARINGS

The following compositions are recommended by the Mechanical and Electrical Association:

The following babbitt metal composition makes a long-lived and tough metal, that will not pound out nor be too severe on the armature shaft: 100 lb. tin, 10 lb. copper, 10 lb. antimony.

We are using the following composition with good results: 83⅓ lb. tin, 8⅓ lb. antimony, 8⅓ lb. copper.

Our motor bearings have without rebabbitting an average mileage of 52,100, with an oil consumption costing $0.089 per 1,000 car-miles, the cars being equipped with two 125-h. p. motors.

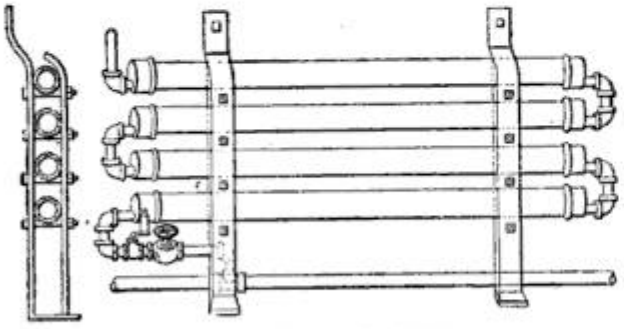
A good composition of bearing metal for motor bearings is: 105 lb. copper, 60 or 55 lb. phosphor-bronze, 9¾ lb. tin, 25 lb. lead. Phosphor-bronze is composed of copper, 79.7, tin 10, lead 9.5 and phosphorus, 0.8 per cent.

10 parts tin to 1 part antimony.

COIL HEATER MADE OF OLD CAR HEATERS

Old discarded street car heaters may be used to make a coil heater suitable for heating large barnlike structures, where doors are opened often and heating is ordinarily a problem. The kind of heater referred to is those made under Gold's patent of 1884.

Each section of the coil heater should con-



Heater for Large Building

sist of a length of 4-in. pipe capped at each end, and with a 1-in. opening tapped near the edge of each cap. Lay the section across a bench made of two barrels and some planks and assemble and connect them. Use short nipples and elbows for connections. Thread the middle nipple at each end, right and left-handed, and have left-handed threads in one of the elbows. Paint all outlets well with litharge. Fix the pitch by putting on wrought iron clamps, as shown in the illustration, when the parts are on the bench.

Make these clamps, says a correspondent of Power, of heavy ⅜-in. iron, with the back bar 1 ft. longer than the heater, and in a manner to serve as a foot and also to keep the heater free from the wall. Have the front bar shorter than the back one, and curve it at the top to hold the upper length of pipe in place. Offset the back bar at the top and bend it at the bottom as shown. Insert ½-in. bolts through the bars between each section of pipe and bolt the back bar to the wall.

Let the steam feed from overhead and put an air valve on the return line to insure circulation.

METAL FOR GONGS AND CYMBALS

A sonorous metal for cymbals, gongs and tam-tams consists of 100 parts copper with 25 parts tin. Ignite the piece after it is cast and plunge it into cold water immediately.

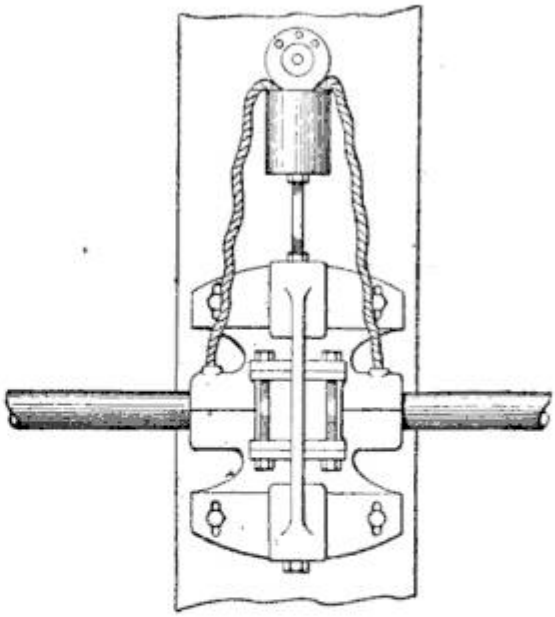
TO DO AWAY WITH SHIMS IN ENGINE BRASSES

In taking up the wear of engine brasses on wrist pin or crosshead pin when the key is driven clear down, back out the key and instead of putting in sheet-iron shims put in a small piece of pine wood of just the right thickness to allow the key to come even with the under side of the strap, then pour in melted babbitt. A hole must be drilled through the flange of the brasses to allow for pouring the babbitt.

Every engineer knows the trouble it is to put several shims between the brass box and the end of the strap, especially if the box is a round-end one, as many are. By using the method described, brasses may be worn up much closer, even if worn through; the babbitt will form part of the bearing. This kink is the idea of W. H. Nostrant, engineer, and will be found worth trying.—Contributed by F. A. Sustins, Stevens Point, Wis.

A CAN SHAFT OILER

To make a good shaft oiler, take a can that is opened at the top, turn the lid back and nail it to the beam. Stretch lengths of hemp packing from the can to each oil hole in the box and fill the can half full of oil. The can must be filled every two weeks.



Shaft Oiler Made of a Can

This method is used by a correspondent of the Engineers' Review for oiling a line shaft 150 ft. long and a countershaft. It works successfully, and he goes over the shafting every two weeks, only; thus saving an hour's work every day.

Original Frieze, "Night"--By Percy Lancaster, London

SMOOTHING TABLE LEGS IN A TUMBLER

A good method of smoothing table legs in a tumbler is described by a correspondent of the Wood-Worker as follows:

I have a tumbler about 6 ft. long and 3 ft. in diameter, with a shaft 11/16 in. extending the entire length of it. On each end and bolted to the head is a cast iron flange 12 in. in diameter, with 3½-in. set screws in the hub of each to hold the tumbler to the shafts; bearings are close to the ends of tumbler. On one end and attached to the head is secured a rim of the necessary size to secure the proper speed, which is 36 revolutions per minute. The tumbler is filled about half full of legs, and a lot of scrap sandpaper is put in with the legs, and the whole falling about together allows the sandpaper to assist in cleaning the legs. Our legs are turned from reasonably good air-dried stock, and after turning are placed in the dry-kiln and allowed to stay two nights and a day before going to the tumbler. In this way the legs become good and dry on the outside, which aids in getting them clean in the tumbler. They are run about two and one-half hours, which in our case cleans the legs well. In this way about 1,000 center table legs may be smoothed per day.

HOW TO ESTIMATE CONTENTS OF CIRCULAR TANK

The capacity of a circular tank may be determined by multiplying the diameter in inches by itself and by .7854 and by the length (or depth) in inches, which gives the capacity of the tank in inches, and then dividing by 231, the number of cubic inches in a U. S. gallon.

Old coins may be cleansed by first immersing them in strong nitric acid and then washing them in clean water. Wipe them dry before putting away.

Original Frieze, "The Storm"--Decorator's Magazine, London

HOW TO TURN A HOLLOW BALL

As most machinists are familiar with the turning of a sphere by means of the compound rest, it will not be necessary to go into details. Assuming we have a ball 1 in. in diameter, and wish to bore out the inside so as to leave a shell 1-16 in. in thickness: A piece of hardwood is clamped in the chuck and the end turned out cup-shaped (Fig. 2, first cut) so it will extend a trifle over the center line of the ball. A little chalk rubbed into the wood will help to hold the ball firmly in position. Now the tool rest (Fig. 1) is clamped in the tool post by an L-shaped piece of stock (L), riveted to the bottom, just high enough to allow the tool, when resting on the support, to come to the center line of the ball. The tool rest is made of two pieces of sheet metal, A and B, which are hinged together on the line CD, allowing A, which is only used as a gauge for setting the tool to be folded down. E, F, and G are guides for the tool holder, the former two also serving as stops. The tool holder, H, is made of ⅜ in. square stock, having a ⅛ in. hole in the end to insert the tools, which are held by means of a set-screw, I. Back of this is the guide screw, J, a piece of 3-16 in. stock is fastened to the end just long enough to reach down into the semi-circular aperture cut into B. K is a crosspiece fastened to the bottom of H to insure a wide bearing on the tool rest. To adjust the tool rest in position we measure the distance between the aperture cut in A and the line C-D, say ¼ in. in this case. Now the gauge A is folded down and the carriage moved towards the ball until the line C-D is ¼ in. away from the nearest point of the ball and locked there, then the cross slide is moved to bring the center line of H in line with the lathe centers. If there is any difference between the diameter of the ball and the hole in the gauge plate A, allowance for such difference must be made in adjusting the tool rest. Now the carriage is backed, the gauge is raised on a level with B and the first tool in the shape of a flat drill inserted in the tool-holder in such manner that when the tool-holder is up against the stops E-F-G the point of the drill will be 1-16 in. away from the edge of the hole (Fig. 1). Turning the gauge plate down the carriage is again moved up to the stop and locked there, the ball having been previously centered, we now take the first cut with the tool up to the stop. The chips may be removed by blowing into the hole with a blowpipe. Back up the carriage again and turn up the gauge plate and insert the second tool and turn the guide screw J to such position that both cutting edges of the tool will be 1-16 in. away from the edge of the hole in the gauge at either end. Once more the gauge is folded down, the carriage moved up to the stop and we take the second cut. In each of the subsequent cuts another tool must be inserted, shaped to fit that part of the circle to be cut away, and the guide screw J must be adjusted to the length of the cut.—Contributed by Wm. Lachmich, Chicago.

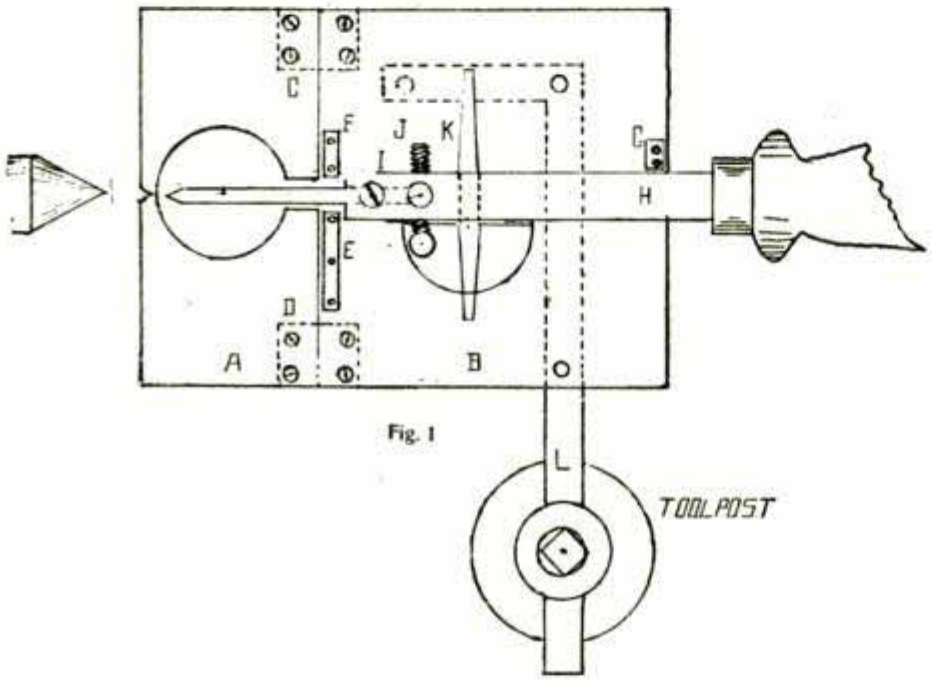


Fig. 1

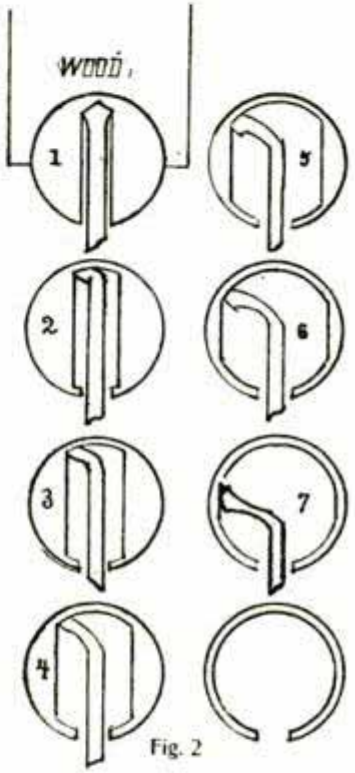


Fig. 2

MUFFIN PANS FOR SCREW CABINETS

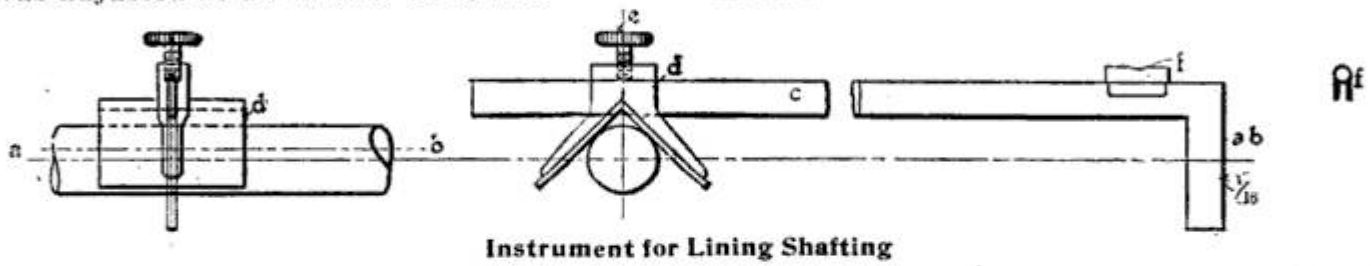
Tinned muffin pans make satisfactory drawers for cabinets to hold screws, brads, staples, etc. Procure the required number of pans (they cost about 10 cents each), nail a couple of strips on each side of them, provide the cabinet frame with suitable ways and the arrangement is complete and ideal. This is an idea of a correspondent of Wood Craft.

DEVICE FOR LINING SHAFTING

A convenient instrument for lining shafting, described by a correspondent of the American Machinist, operates as follows:

Referring to the sketch, a b is the line to which the shaft ought to be parallel horizontally; a square, c, slides in the slit of the head d, and may be clamped by the screw e to this head; a level, f, is put at a convenient place on the longer edge of the square.

After first securing the line a b so that its two ends are at the same horizontal distance from the ends of the shaft to be lined, put the head d on one end of the shaft and slide the square in the slit of the head until its vertical edge is about 1/16 in. or so from the line a b, while by the level f keeping the longer edge of the square horizontal. Then by the screw, e, clamp the square to the head and proceed along the shaft, putting the head d on the shaft and leveling the square to see whether the line a b be just at the same distance from the vertical edge of the square as when the latter was adjusted at the end of the shaft.



Instrument for Lining Shafting

By this method it is not necessary to know the varying diameter of the shaft, and no scale or graduation is wanted.

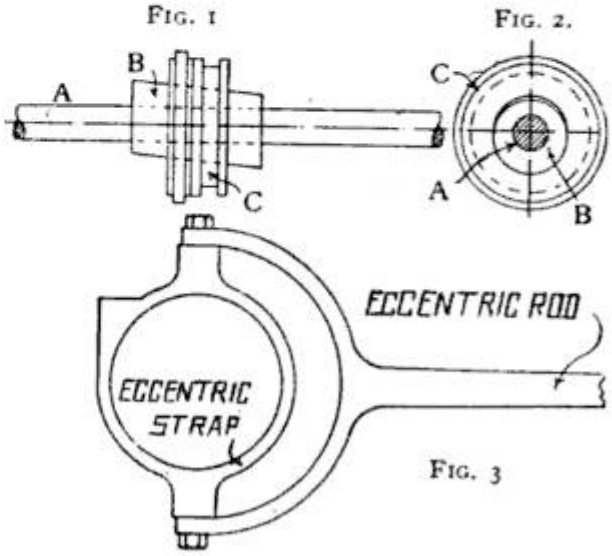
SEALING WAX RECIPES

To make black sealing wax use 5 parts shellac, 9 turpentine, 6½ pine resin, 4 chalk and 1¼ soot. For blue, use 7 parts shellac, 6 turpentine, 3½ pine resin, 1 magnesia, 2 chalk, 2 blue coloring matter.

SINGLE ECCENTRIC REVERSING GEAR

A single eccentric reversing gear, simple in action and efficient, is described in the Model Engineer, London.

Figure 1 is a front elevation of sheave and crankshaft; B is a disc, or cam, bored and turned diagonally as shown, and is



Simple Reversing Gear

keyed on shaft A, the throw at either end being equal to the travel of valve. C is a loose sheave and lever-clutch, which works on a feather-key let in B, and is operated by a forked lever, which is fitted with a pawl, and works in a quadrant placed horizontally, so that when moving the lever from right to left, or vice versa, it would operate the sheave and clutch, and thus reverse the valve from full forward to full backward or cut-off at any point of the stroke by simply notching up, as in link-motion.

Figure 2 is an end view of shaft and sheave, and Fig. 3 shows the eccentric strap with forked rod, in order to accommodate itself when thrown out of center line with valve spindle.

This attachment was fitted to a portable engine used for winding purposes at a small colliery.

HOW TO MAKE A DOG OR GRAB

A dog or grab, easily made and without a weld, requires a piece of iron 4 in. wide, ½ in. thick and 7 in. long which is enough for one pair. Split the iron with a hot chisel, as indicated in Fig. 1. Sharpen the bit, place the dog, back down, on the anvil and beat down until it is in the shape shown in Fig. 2. Punch a hole at A, Fig. 2, and round up the eye on the anvil horn so it will work easily in the link. The finished dog will look like Fig. 3. The point

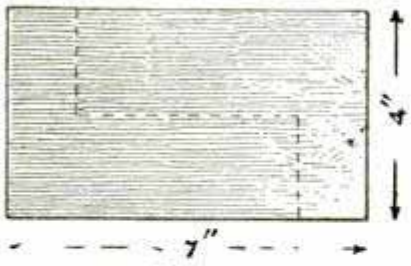


Fig. 1

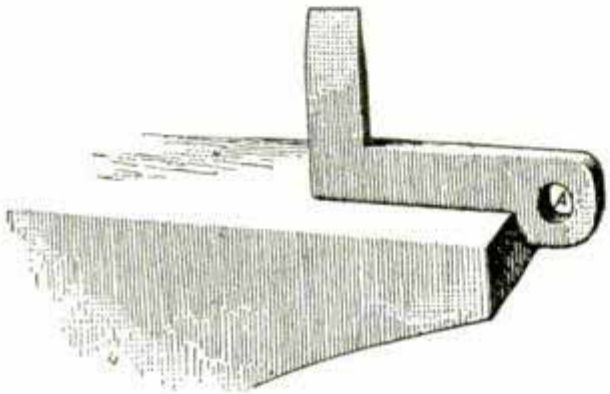


Fig. 2

should set in toward the eye ¾ in., so it will draw when driven into the log, says a correspondent of the Blacksmith and Wheelwright. The dotted lines in Fig. 3 show how to set the point.

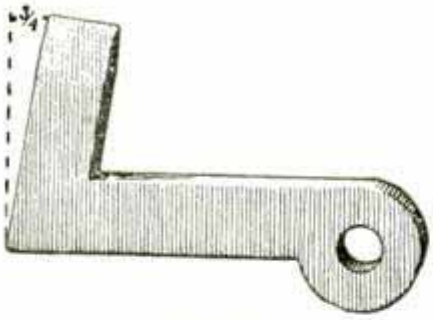


Fig. 3

SUBSTITUTE FOR WIRELESS COHERER

In experimenting with wireless telegraphy, writes Everett R. Hough of Johnstown, N. Y., I have found that an ordinary telephone transmitter will answer in place of the coherer, if one of the latter is not at hand. The decoherer hammer can be arranged to strike the transmitter and so jar the carbon particles apart after they have once cohered. It works very well, and is much better for a beginner to use than are many of the home-made coherers I have seen.

CEMENTS FOR IRON

To make a good cement for iron on iron, make a thick paste, with water, of powdered iron, 60 parts; sal-ammoniac, 2 parts, and sulphur flowers, 1 part. Use while fresh.

Another consists of sulphur flowers, 6 parts; dry white lead, 6 parts, and powdered borax, 1 part. Mix by sifting and keep as a dry powder in a closed tin box. To use, make into a thin paste with strong sulphuric acid and press together immediately. This cement will harden in five days. Recommended by the American Machinist.

REMOVING STRAINS IN METAL BY HEATING

In making springs of piano wire, or, in fact any wire, if the metal is heated to a moderate degree the spring will be improved. Piano or any steel wire should be heated to a blue, brass wire to a degree sufficient to cause tallow to smoke. Heating makes the metal homogeneous; before heating it is full of strains.

If a piece of metal of any kind is straightened cold and then put into a lathe and a chip turned off, it will be far from true. Before turning it was held true by the strain of the particles on the outside, they having changed position, while the particles near the axis are only sprung. The outside particles being removed by the lathe tool, the sprung particles at the center, return to their old positions. If, after straightening, the metal is heated to a temperature of 400 deg. the particles settle together and strains are removed.

This is the case in the manufacture of saws. The saw is first hardened and tempered and then straightened on an anvil by means of a hammer. After it is hammered true, it is ground and polished a little, then blued to stiffen it and then is subjected to the grinding process. Before bluing the metal is full of strains; these are entirely removed by the heat required to produce the blue color.

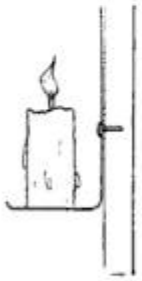
Often a piano wire spring will not stand if used without heating, while if heated it will last for years.—Contributed by J. H. Beebee, Rochester, N. Y.

MECHANICS FOR YOUNG AMERICA

PARLOR MAGIC FOR WINTER EVENINGS

By C. H. Claudy

You are seated in a parlor at night, with the lights turned low. In front of you, between the parlor and the room back of it, is an upright square of brightly burning lights, surrounding a perfectly black space. The magician stands in front of this, in his shirt sleeves, and after a few words of introduction proceeds to show the wonders of his magic cave. Showing you plainly that both hands are empty, he points with one finger to the box, where immediately appears a small white china bowl. Holding his empty hand over this bowl, some oranges and apples drop from his empty hand into the bowl. He removes the bowl from the black box, or cave, and hands its contents round to the audience. Receiving the bowl again, he tosses it into the cave, but it never reaches the floor—it disappears in mid-air.

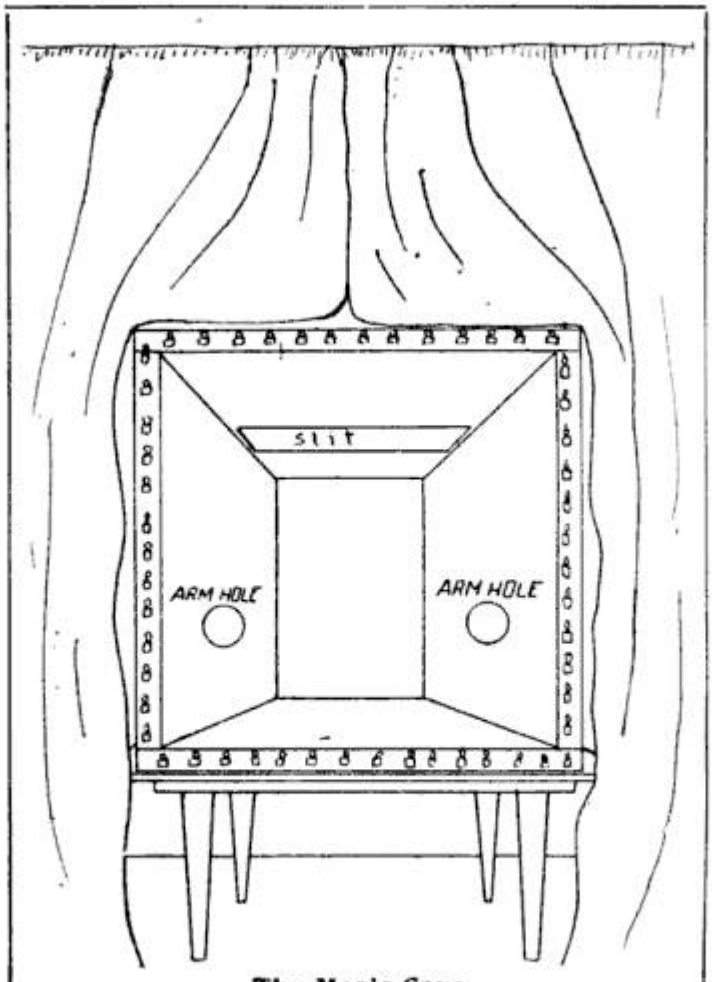


The illusions he shows you are too many to retail at length. Objects appear and disappear. Heavy metal objects, such as forks, spoons and jack-knifes, which have been shown to the audience and which can have no strings attached to them, fly about in the box at the will of the operator. One thing changes to another and back again and black art reigns supreme.

Now all this "magic" is very simple and requires no more skill to prepare or execute than any clever boy or girl of fourteen may possess. It is based on the "Black Art" performance of the famous Hermann, and relies on a principle of optics for its success. To prepare such a magic cave, the requisites are a large soap box, a few simple tools, some black paint, some black cloth, and plenty of candles.

The box must be altered first. One end is removed and a slit, one-third of the length from the remaining end, cut in one side. This slit should be the width of the box and about five inches wide. On either side of the box, half way from open end to closed end, should be cut a hole, just large enough to comfortably admit a hand and arm.

Next, the box should be painted black both inside and out, and finally lined inside with black cloth. This lining must be done neatly—no folds must show and no heads of tacks. The interior must be a dead black. The box is painted black first so that the cloth used need not be very heavy and consequently, inexpensive; but if the cloth be sufficiently thick, no painting inside is required. The whole inside is to be cloth-lined, floor, top, sides and end.



The Magic Cave

Next, the illumination in front must be arranged. If you can have a plumber make you a square frame of gas piping, with tiny holes all along it for the gas to escape and be lit, and connect this by means of a rubber tube to the gas in the house, so much the better;

but a plentiful supply of short candles will do just as well, although a little more trouble. The candles must be close together and arranged on little brackets around the whole front of the "cave" (see diagram), and should have little pieces of bright tin behind them, to throw the light towards the audience. The whole function of these candles is to dazzle the eyes of the spectators and prevent them seeing very far into the black box.

Finally, you must have an assistant, who must be provided with either black gloves or black bags to go over his hands and arms, and several black drop curtains, attached to sticks greater in length than the width of the box, which are let down through the slit in the top.

The audience room should have only low lights; the room where the cave is should be dark, and if you can drape portieres between two rooms around the box (which, of course, is on a table) so much the better.

The whole secret of the trick lies in the fact that if light be turned away from anything black, into the eyes of him who looks, the much fainter light reflected from the black surface will not affect the observer's eye. Consequently, if when the exhibitor puts his hand in the cave, his confederate behind inserts his hand, covered with a black glove and holding a small bag of black cloth, in which are oranges and apples, and pours them from the bag into a dish, the audience sees the oranges and apples appear, and does not see the black arm and bag against the black background at all.

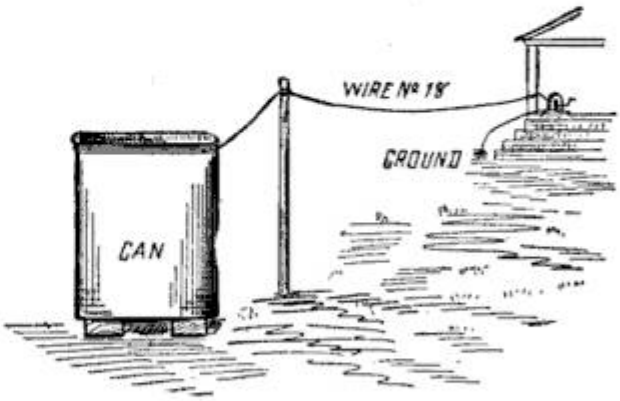
The dish appears by having been placed in position behind a black curtain, which is snatched swiftly away at the proper moment by the assistant. Any article thrown into the cave and caught by the black hand and concealed by a black cloth appears to disappear. Any object not too large can be made to "levitate" by the same means. A picture of any one present may be made to change into a grinning skeleton by suddenly screening it with a dropped curtain, while another curtain is swiftly removed from over a pasteboard skeleton, which can be made to dance either by strings, or by the black veiled hand holding on to it from behind, and the skeleton can change to a white cat.

But illusions suggest themselves. There is no end to the effects which can be had from this simple apparatus, and if the operators are sufficiently well drilled the result is truly remarkable to the uninitiated. The illusion, as presented by Hermann, was identical with this, only he, of course, had a big stage, and people clothed in black to creep about and do his bidding, while here the power behind the throne is but a black veiled hand and arm. It can be made even more complicated by having two assistants, one on each side of the box, which was why it was advised that two holes be cut. This enables an absolutely instantaneous change as one uncovers the object at the moment the second assistant covers and removes the other.

It is important that the assistants remain invisible throughout, and if portieres are impossible, a screen must be used. But any boy ingenious enough to follow these simple instructions, will not need to be told that the whole success of the exhibition depends upon the absolute failure of the audience to understand that there is more than one concerned in bringing about the curious effects which are seen. The exhibitor should be a boy who can talk; a good "patter"—as the magicians call it—is often of more value than a whole host of mechanical effects and helpers. It is essential that the exhibitor and his confederate be well drilled, so that the latter can produce the proper effects at the proper cue from the former. Finally, never give an exhibiton with the "cave" until you have watched the illusions from the front yourself; so that you can determine whether everything connected with the draping is right, or whether some stray bit of light reveals what you wish to conceal.

TO KEEP DOGS AND CATS AWAY FROM THE GARBAGE CAN

Last summer I was annoyed a great deal by dogs upsetting our garbage can on the



lawn, but finally executed a plan that rid the yard of them in one afternoon.

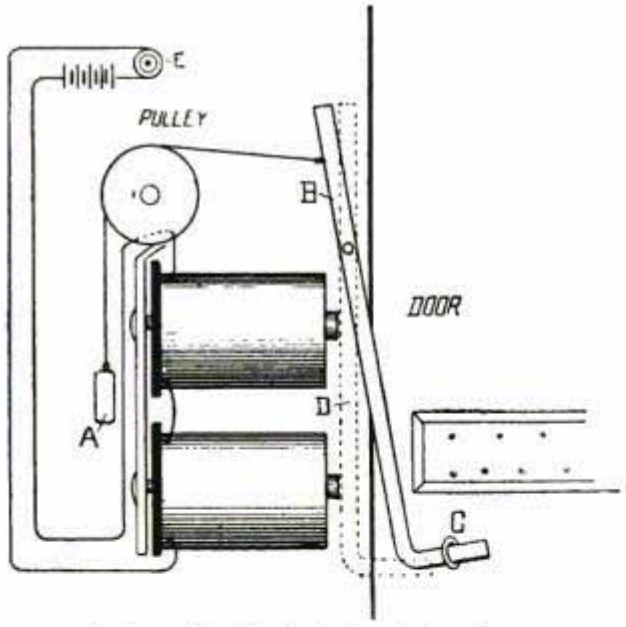
I first secured a magneto out of an old telephone, then drove a spike in a damp

place under the porch, attached a wire to the spike and run the wire to one of the poles of the magneto. Then I set the garbage can on some blocks of wood, being careful not to have it touch the ground at any point. I next ran a wire from the other pole of the magneto to the can, wrapping the wire around the can several times. Then I sat down on the porch to wait.

It was not long before a big greyhound came along, putting his forepaws on the top of the can to upset it. At the same instant I gave the magneto a quick turn, which sent the dog away a very surprised animal. This was repeated several times during the afternoon with other dogs with the same result.—Contributed by Gordon T. Lane, Crafton, Pa.

AN AUTOMATIC LOCK

The illustration shows an automatic lock operated by electricity, one cell being sufficient. When the circuit is broken a weight, A, attached to the end of the armature, B, tends to push the other end of the armature into the screw eye or hook, C,



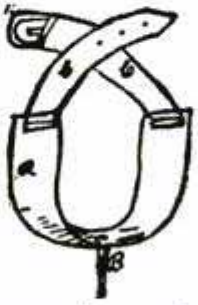
Automatic Electric Lock for Doors

which is in the door, thus locking the door.

To unlock the door, merely push the button, E. The magnet then draws the armature out of the screw eye and the door is unlocked. The dotted line at D shows the position of the armature when the circuit is complete and the door unlocked. The weight must be in proportion to the size of the magnet. If it is not, the door will not lock, or would remain locked. The button can be hidden, as it is the key to the lock.—Contributed by Claude B. Melchoir, Hutchison, Minn.

NEW METHOD OF LIFTING A TABLE

To perform this feat effectively the little device illustrated will be required. To make it take a sheet-iron band, a, ¾ in. wide and attach a strap to fasten on the forearm between the wrist and elbow. Put a sharp needle point, B, through the sheet-iron so that it extends ¾ in. outward. Make one of these pieces for each arm.

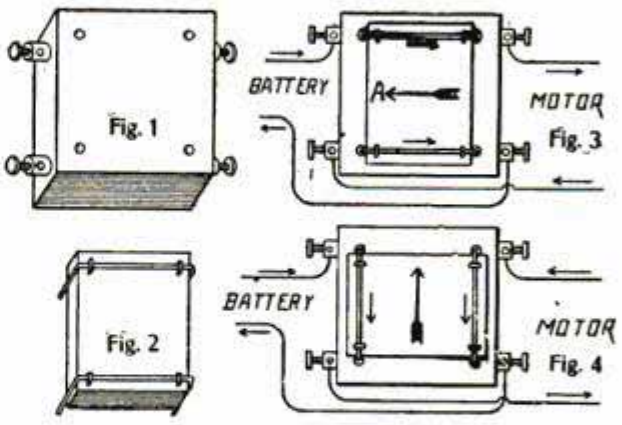


In lifting the table first show the hands unprepared to the audience and also a light table, removing the cover to show that the surface of the table is not prepared in any way. Then replace the table, rest the hands upon it and at the same time press the needle points in the arm pieces into the wood of the table, which will be sufficient to hold it, says a correspondent of the Sphinx. Then walk down among the audience.

SIMPLE CURRENT REVERSER

On a block of hardwood draw a square (Fig. 1) and drill a hole in each corner of the square. Fill these holes with mercury and connect them to four binding posts (A A A A, Fig. 1).

On another block of wood fasten two wires, as shown in Fig. 2, so that their ends can be placed in the holes in the first block. Then connect up with the motor and battery as in Fig. 3. When the block



For Reversing a Current

is placed on with the big arrow, A, pointing as in the direction indicated in Fig. 3, the current flows with the small arrows. To reverse turn through an angle of 90 degrees (Fig. 4).—Contributed by F. Crawford Curry, Brockville, Ontario, Canada.

COMBINED BOAT AND CART

A combined boat and cart for hunting parties, to be drawn by one horse, and with seating accommodations for three persons, is the latest French contribution to sportsmen's wants. The Sporting Goods Dealer

For Sport on Land or Water

says the boat is flat-bottomed, of some strong, light wood; the pair of shafts are easily attached or removed, as are also the wide-tired wheels. The appearance of the "rig" betokens convenience and comfort for the occupants, whether in navigating land or water, and is quite in consonance with the French idea of sport without effort. The idea is a novel one to American sportsmen and possesses valuable features. Providing there is sufficient strength to negotiate rough roads, the vehicle would be very handy for fishing or ducking parties. The American idea would include better springs and wheels.

WHY SPEED PHOTOGRAPHS ARE DISTORTED

Many a photographer, professional and amateur alike, has been chagrined at the development of a distorted view of an automobile or motorcycle at high speed, in which the upper parts of the wheels appeared to lean forward of the bottom parts. The Motor Way explains both the cause and prevention of this.

The pictures are taken with cameras equipped with focal plane shutters: That is, a black cloth curtain, C in the sketch, with a narrow slit, D, across it which runs rapidly from one edge to the other of plate B. Since the image of the car, thrown through the lens A, is inverted on the camera plate, and the shutter moves down from the top, the bottoms of the wheels are taken first, and the tops last—after the car is moved a perceptible distance, despite the great speed of the shutter. The body of the car appears distorted in the same way. No shutter manufactured is faster than the focal plane, and so far the only way found to overcome the difficulty is to swing the camera, at the moment of exposure, in the direction the car is going. Some photographers have become expert at this and hence secure good pictures.

HEATS ONE TON OF IRON FOR 40 CENTS

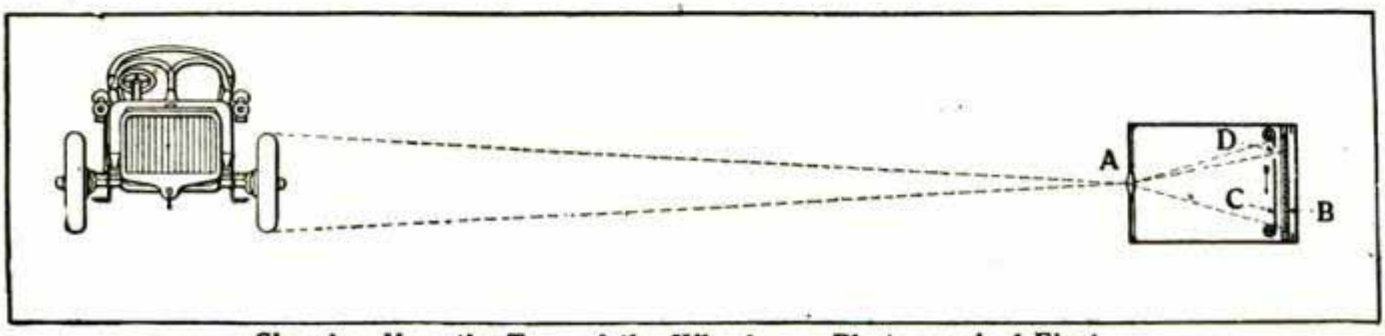
By Using Oil--Report of a Railroad Expert

Stephen Wren, the General Manager of the great Southern Pacific Railroad shops at Sacramento Cal., has just made a report to that company on the surprising economies effected by the use of fuel oil in those immense shops. Mr. Wren's report is attracting wide attention among railroad men in particular, and manufacturers generally all over the country.

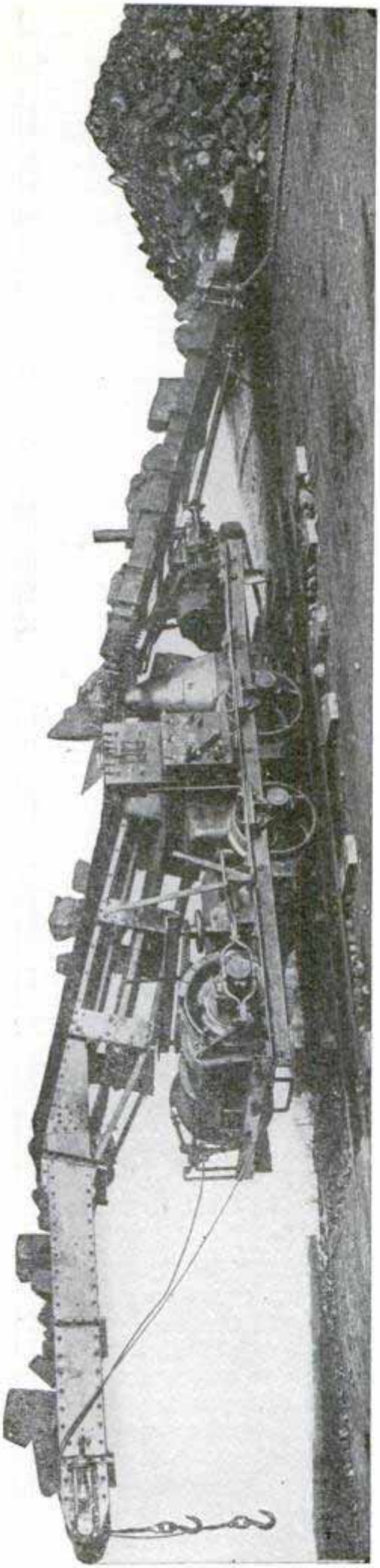
He says it costs 40 cents worth of fuel oil—40 gallons, at a cent a gallon, is what it costs in Sacramento—to heat one ton of iron to the welding point, as compared with 500 pounds of bituminous coal, costing $1.25.

This shows a saving of 68 per cent in the cost of fuel alone.

The report says that it costs $12 a day—six men at $2 each a day—to carry coal from the coal pits to the furnaces, while one man can distribute oil all over the whole works. Another factor is the hauling away of the ashes and cinders daily produced



Showing How the Tops of the Wheels are Photographed First



Coal Loader Which Gathers Up Coal at the Rate of 1,000 Lbs. per Minute

by the coal; also the work of a fireman and the great wear and tear of the brickwork in the fire chamber where the fire is used.

All of this hard labor is reduced 75 per cent by the use of oil. Furthermore, the output of a furnace heated with oil is at least 20 per cent more than the old fashioned way of the coal furnace.

The report declares that the most important question relative to the two fuels is the quality of the iron produced from the scrap material, and he has come to the conclusion that hammered iron for railroad appliances, such as for locomotive forgings, or, for any other purpose where the material is subject to compression, or tensile vibrating and torsional strains, when produced from fuel oil is far superior to meet those conditions than similar metal produced from coal.

In Manager Wren's opinion oil at 6 cents a gallon, and coal at $5 a ton, about balance, as far as the cost of the two fuels is concerned, but the improvement of the quality of the iron produced by heating with oil, instead of coal, is incalculable.

MACHINE LOADS COAL IN MINES

The faithful mine mule, serving through many centuries, has at last lost his prestige. A new machine, automatic, self-sufficient, has come to supplant him. This machine, which was recently tested at the Ziegler mines, enters the mine by its own power and moves from room to room, handling its own cars and loading the coal at the rate of 1,000 lbs. per minute.

A plate at the end of an arm at the forward end of the machine, gathers up all coal on the floor within a radius of 12 to 16 ft. and delivers it to a conveyer of the apron type, where it is freed of foreign substances while being carried to the pit car at the rear of the conveyer. As fast as a car is loaded a ⅜-in. wire rope, operated from a drum on the machine, hauls it to the entry. Another rope and drum pulls the empty car back from the entry.

The entire machine is moved on a self-propelling steel truck. The machine will handle its own cars and remove 105 tons of coal from six rooms in six hours' time. It is operated by two men. It is estimated that the machine will reduce the cost of coal production 25 cents per ton.

Index to Volume VII, January to December, inclusive, 1905, is now ready and will be mailed free on request.

VOLUNTEER FIRE DEPARTMENT

By Fire Chief Manley, Dalton, Ga.

[The Volunteer Fire Department in the United States is very far from approaching the efficiency attained in Austria and some other European countries. It is only 40 years since the volunteers went out of service in New York City, but considering the greatly improved apparatus now supplied, the general efficiency throughout the country is much below the standard of a generation ago. It is believed renewed interest is now being taken.—Editor's Note.]

For the very best volunteer service I would personally prefer every time the small department. Twelve or fifteen men to the company is more than enough. Twenty-five wide-awake, active firemen in a town of five to six thousand people is an amply large roll to handle any ordinarily bad fire and can really be made twice as effective as a much larger and more unwieldy force. The small, compact department has another important advantage in that the chief and other officers know each man and what he can do. The members can not only be selected with greater care, but can better and more quickly learn the expert handling of hose, ladders and other apparatus. Learning to implicitly obey orders is the snag on which perhaps more volunteer departments fall down than any other. It is the hardest thing in the world to hammer into the volunteer's head the supreme importance of doing at a fire exactly what he is told to do by his superior officer and of keeping at that same thing until directed elsewhere. It is unwise for the chief to give orders indiscriminately. His orders should, wherever possible, go through the company captain or foreman, as he is the man who is in the thick of the fight, who best knows his men and their capacities and whose business it is to see that his own orders to his men are executed. The volunteer chief cannot, of course, enforce anything like perfect discipline. It is all nonsense to talk about treating the volunteer exactly the same as the paid fireman. The volunteer chief must count good humor, tact and personal popularity as his chief asset in handling and directing his department.

Another hard problem that confronts the volunteer chief is to keep up interest and enthusiasm, especially when fires are infrequent.

If fires occur every week or so there is no trouble in keeping the department up to the mark, but it is the long waits between fires that dulls the edge of enthusiasm and which must be filled in with something to keep up interest. The first thing for a newly organized department to do is to join as a department the nearest volunteer firemen's association and attend and participate in its tournaments, or if none is near enough to make this practicable, organize a small association among the half dozen or so near-by towns and hold an annual tournament in some one of them each year. The months of practice drills for these contests are of inestimable value to firemen, developing the best energy, nerve and skill in the department, bringing out newer, quicker methods for handling the apparatus, and redoubling the interest of everybody, firemen and citizens, in the department.

A good, fast firemen's baseball team is worth a whole Carnegie library in creating and maintaining team enthusiasm. Atlanta's firemen's drum and bugle corps is the best advertisement the Gate City ever had and is as popular abroad as it is at home. They do whisper it, too, down there that a smooth baseball twirler or shortstop sometimes gets a job in the department and it is all right. It ought to be so. The two go together. The nerve, agility, energy and intelligence required to make a crack baseball player are exactly the qualities of the best fireman.

The chief should have the power given him by the department to suspend any member, without company action, for disobedience of orders at a fire. He is given special police power by most cities and he should not hesitate to use it when the occasion arises.

To sum up my idea of an ideal volunteer fire department: A small department of picked men, personally known to the chief and other officers. These men practiced in contests and drills until perfectly familiar with all of the apparatus and taught that a fireman's first duty is to obey orders. A strong department and team pride that will not stand for defeat on the track or at a fire, and that will stand by its colors to the last ditch. With such a department, headed by competent officers, and backed as it is sure to be by a liberal city policy, there is no such word as fail, and there is nothing finer, nobler, manlier and more worthy in all the world.

A Test Will Tell

What Liquozone Can Do for You--and It Is Free

You who are waiting—we ask you again to try Liquozone; to try it at our expense. You'll regret this delay when you learn what the product means to you.

Do as millions have done—stop doubting; give Liquozone a test. Then judge it by results. Germ diseases—and there are scores of them—call for a germicide. Those are the diseases to which Liquozone best applies. Don't cling blindly to old-time remedies, if you don't find them effective. Let us prove the power of the new.

What Liquozone Is

The virtues of Liquozone are derived solely from gases. The formula is sent to each user. The process of making requires large apparatus, and from 8 to 14 days' time. It is directed by chemists of the highest class. The object is to so fix and combine the gases as to carry into the system a powerful tonic-germicide.

Contact with Liquozone kills any form of disease germ, because germs are of vegetable origin. Yet to the body Liquozone is not only harmless, but helpful in the extreme. That is its main distinction. Common germicides are poison when taken internally. That is why medicine has been so helpless in a germ disease. Liquozone is exhilarating, vitalizing, purifying; yet no disease germ can exist in it.

We purchased the American rights to Liquozone after thousands of tests had been made with it. Its power had been proved, again and again, in the most difficult germ diseases. Then we offered to supply the first bottle free in every disease that required it. And over one million dollars have been spent to announce and fulfill this offer.

The result is that 11,000,000 bottles have been used, mostly in the past two years. Today there are countless cured ones, scattered everywhere, to tell what Liquozone has done.

But so many others need it that this offer is published still. In late years, science has traced scores of diseases to germ attacks. Old remedies do not apply to them. We wish to show those sick ones—at our cost—what Liquozone can do.

Where It Applies

These are the diseases in which Liquozone has been most employed. In these it has earned its widest reputation. In all of these troubles we supply the first bottle free. And in all—no matter how difficult—we offer each user a two months' further test without the risk of a penny.

Asthma	Fevers—Gall Stones
Abscess—Anaemia	Goitre—Gout
Bronchitis	Hay Fever—Influenza
Blood Poison	La Grippe
Bowel Troubles	Leucorrhea
Coughs—Colds	Malaria—Neuralgia
Consumption	Piles—Quinsy
Contagious Diseases	Rheumatism
Cancer—Catarrh	Skin Diseases
Dysentery—Diarrhea	Tuberculosis
Dyspepsia—Dandruff	Tumors—Ulcers
Eczema—Erysipelas	Throat Troubles

Also most forms of the following:

Kidney Troubles	Liver Troubles
Stomach Troubles	Women's Diseases

Fever, inflammation or catarrh—impure or poisoned blood—usually indicate a germ attack. In nervous debility Liquozone acts as a vitalizer, accomplishing remarkable results.

50c. Bottle Free

If you need Liquozone, and have never tried it, please send us this coupon. We will then mail you an order on a local druggist for a full-size bottle, and will pay the druggist ourselves for it. This is our free gift, made to convince you; to let the product itself show you what it can do. In justice to yourself, please accept it today, for it places you under no obligations whatever.

Liquozone costs 50c and $1.

CUT OUT THIS COUPON

Fill it out and mail it to The Liquozone Company, 458-464 Wabash Ave., Chicago.

My disease is.....

I have never tried Liquozone, but if you will supply me a 50c bottle free I will take it.

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M341-1 Give full address—write plainly.

Note that this offer applies to new users only. Any physician or hospital not yet using Liquozone will be gladly supplied for a test.

A FIT

The boss gets one if you make a bad one, sometimes a good fit is unnecessary, thereby making the job too expensive, then he gets "convulsions." One fit I saw recently on a new hydraulic pump was the job John, the screw machine hand, had done.

Our shop is comparatively small for the amount of work on hand, so that our force of expert mechanicians are bunched up two to one vise, causing each to be an eager workman, so much, in fact, that one must needs tack a sign on his lathe "Keep Off," otherwise the job is removed and the hustler's job put in its place; all done while a man hangs around the crib waiting for Mac, the keeper, to get good and ready to supply you with your necessary tools.

Well, one day all hands were exceptionally busy, so the boss, in order to make a showing on this new pump which had laid around a couple of weeks waiting for heads to be drilled, tapped and screwed on with ¼-in. cap screws, gave John the job, it having already been turned so that all John had to do was to drill and tap for the screws. John's screw machine is extremely close to my bench and he being a very congenial sort of young fellow, I often show him different methods about my work, and he seems anxious to know something more than he does, as it is his earnest desire to promote himself some day out of the ranks of operator to a second-class tool maker at least. However, when John got that pump he was slighted somewhat, as he had previously impressed upon the boss that he is a competent handy tool maker. So John began to hustle it out in no time, though I gave him warning to be careful and not to rush or the boss might think he didn't know how to do it. The whole thing is made of cast bronze; he laid out the holes with his rule, dividers and eyesight and then proceeded to work.

Now I would have put John wise to use a flat drill or fix up a twist drill so as not to "dig in" the bronze, but he seemed to have done that class of work before. Presently John came to me with an "up against it" look, and told me he had spoiled it. His intentions were to fasten the cover on with clamps and use a body drill to start, drill through the head for six screws, at the same time spotting the place for the tap drill in the crown of the pump chamber, but the body drill went all the way through somehow and it apparently left John in a bad fix. I suggested to follow it with a ⅜-in. drill and fit in a brass plug and sweat it in, and then try again with a tap drill.

Well, I played "cheese it" while John busied himself to make that "fit" while the boss was under cover in the pattern shop.

Now, nothing is so good for a juvenile mechanic as to be in a mess like that once in a while, for it is then he does his best to make a "fit" and do it quick.

John fixed it up all right, but pshaw! he told the next man on the job, who had to fit the piston, etc., of the brass bushings he put in. The man said it would be all right, so John was satisfied so long as the boss didn't know about it, inasmuch as he probably wouldn't get any more such work to do, and to work continually at the screw machine meant dissatisfaction to John, who is more than ambitious to be in with the bunch.

But the "crew had to help" and that fit reached the boss's ears, and to hear John relate how the boss ridiculed him you'd advise the trade school for John. And wasn't it mean of that man to "squeal"; it didn't make him a better liked man, but rest assured John is a better mechanic.—Contributed by Chas. Weslow, Harrison, N. J.

THE LATEST **$2.25 EACH** THE BEST

No. 602 **NAPANOCH** Pocket Knife Tool Kit

A USEFUL XMAS PRESENT

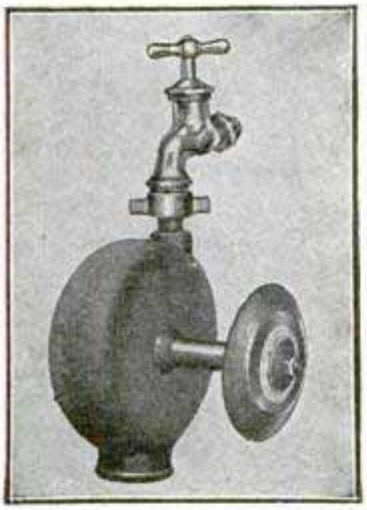
Most Useful Pocket Knife Combination. *Made in America by Skilled American Mechanics.* Warranted Leather Pocket Book 4 1-4 in. Long by 3 1-4 in. Wide. Contains Pocket Knife, File, Saw, Chisel, Screw Driver and Reamer. *Ask your dealer, or will be mailed to you on receipt of $2.25.*

U. J. ULERY, . . 7F Warren St., N. Y.

DIVINE'S RED DEVIL Faucet Water Motor:

THREE TIMES THE POWER OF ANY OTHER FAUCET WATER MOTOR

Grinds, Polishes, Buffs Anything



FURNISHES POWER FOR
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Small Lathes
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and 1000
other uses

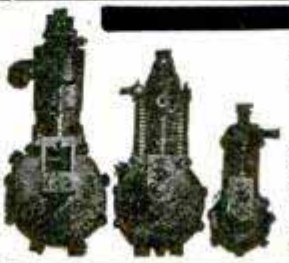
1-8 Horse Power on 80 lbs. Water Pressure

Full Line of Supplies Furnished for Any Kind of Work

Write for Full Particulars

PRICE COMPLETE, including Emery, Buffing and Pulley Wheels, Faucet Connection, Polishing Composition, etc., **$4.00.** This ad. and $3.50 will get the Motor complete.

DIVINE WATER MOTOR CO.
296 Broadway **New York**



1¾ H.P. Bike Motor, $7.50

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We also have a 2½ H. P. set of castings. Send stamp for catalogue and full particulars.

EUREKA MFG. & SUPPLY CO.,
ST. PAUL, - - - MINN.

DYNAMO CASTINGS

Sets of Material or Finished Parts for the

FRANKLIN MODEL DYNAMO

PRICE $3.50 AND UP

Will light six 6 c. p. lamps
Write for illustrated booklet 8

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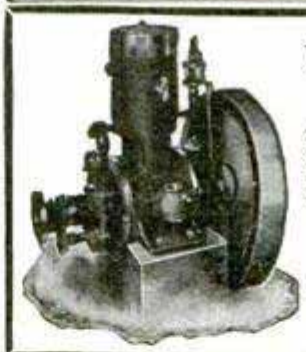

15 Days' Trial on this Engine

No cash payment required. We pay freight to any point within 1,000 miles of Chicago. Spark Plugs guaranteed for 365 days, $1.50 each.

Second-Hand Engines all Sizes

McDONALD & ERICKSON,
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DRAWING STUDENTS NEED THE DRAFTSMAN

25c for 4 months—Cleveland, Ohio

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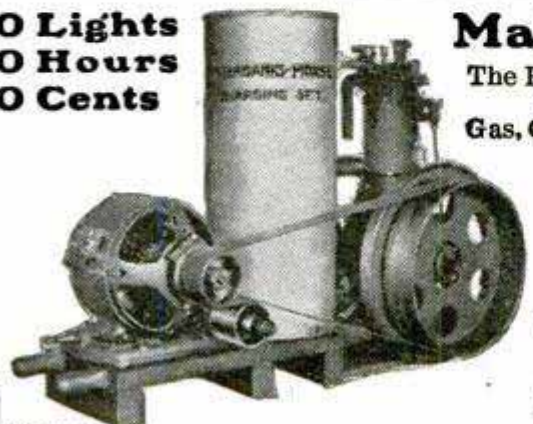
10 Lights
10 Hours
10 Cents



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The FAIRBANKS-MORSE Electric Light Outfit gives plenty of good light at a moderate cost.

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

Cut out complete advertisement and send to

Fairbanks, Morse & Co.,
Monroe St., Chicago, Ill.

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

I may want.....h. p. to run.....

Name..... Street No.....

Town..... State.....

THE AVERAGE MAN

W. D. Nesbitt, in Chicago Tribune.

The average man is the man of the mill,
The man of the valley, or man of the hill,
The man at the throttle, the man at the plow—
The man with the sweat of his toil on his brow,
Who brings into being the dreams of the few,
Who works for himself, and for me, and for you.
There is not a purpose, a project, or plan
But rests on the strength of the average man.

The growth of a city, the might of a land,
Depend on the fruit of the toil of his hand;
The road, or the wall, or the mill, or the mart,
Call daily to him that he furnish his part;
The pride of the great, and the hope of the low,
The toil of the tide as it ebbs to and fro,
The reach of the rails and the countries they span,
Tell what is the trust in the average man.

The man who, perchance, thinks he labors alone—
The man who stands out between hovel and throne,
The man who gives freely his brain and his brawn
Is the man that the world has been builded upon.
The clang of the hammer, the sweep of the saw,
The flash of the forge—they have strengthened the law,
They have built the realms that the wars overran,
They have shown us the worth of the average man.

So here's to the average man—to the one
Who has labored unknown on the tasks he has done,
Who has met as they came all the problems of life,
Who has helped us to win in the stress and the strife.
He has bent to his toil, thinking neither of fame
Nor of tribute, nor honor, nor prize, nor acclaim—
In the forefront of progress, since progress began—
Here's a health and a hail to the average man.

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There has been placed with me for sale, the U. S. Patent on a

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An Extension to Pedals, enabling a child to reach and operate them. Attachable to any Piano—readily and easily. It's inexpensive. Superior to anything for the purpose devised. Excellent Mail Order Article. U. S. Patent for sale or lease on royalty. I believe this a most attractive proposition. Details to responsible and interested parties.

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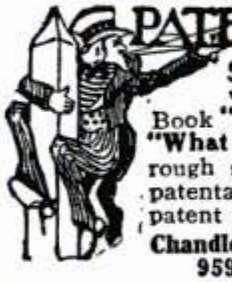

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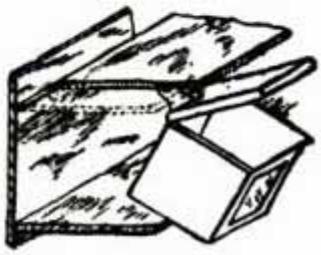
6. How much it costs to get a patent,
7. How long it takes to get a patent,
8. What protection a patent is,
9. How he can sell his patent after he obtains it.
10. How to handle his patent to get the most money out of it,
11. Where and at what expense he can have working drawings made of his invention,
12. Where and at what expense he can have models or experimental machines made,

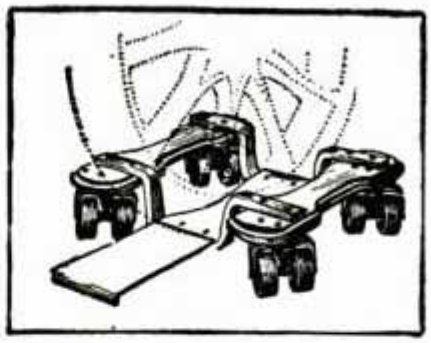
should send his questions to

POPULAR MECHANICS PATENT BUREAU,
Journal Bldg. - - Chicago, Ill.

BOX HOLDING DEVICE.—The cracker can or box holding device shown is intended especially for use on the cans commonly used by the biscuit companies and in connection with the cabinets which are put out by such companies as a means of displaying their goods. The advantage is that as the grocer draws the can forward on the shelf the lid is automatically raised so that he can hold the box with one hand while he removes the contents with the other. The covers of these cans are hinged at the rear so that in holding the cover the entire can is also held. The inventor is E. L. Reed, of Oregon, Ill.



AUTOMOBILE PORTABLE TURNTABLE—This is an inexpensive device for use in stables or other places where it is desired to turn an automobile about. The set of two occupy but little room, being 20 in. square; a depression in the steel concave support insures the wheel remaining in place. The castor trucks can be used under either the front or rear pair of wheels. A run-on is provided.



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Made in Three Sizes

No. 1	**6 inches**	**$0.65**
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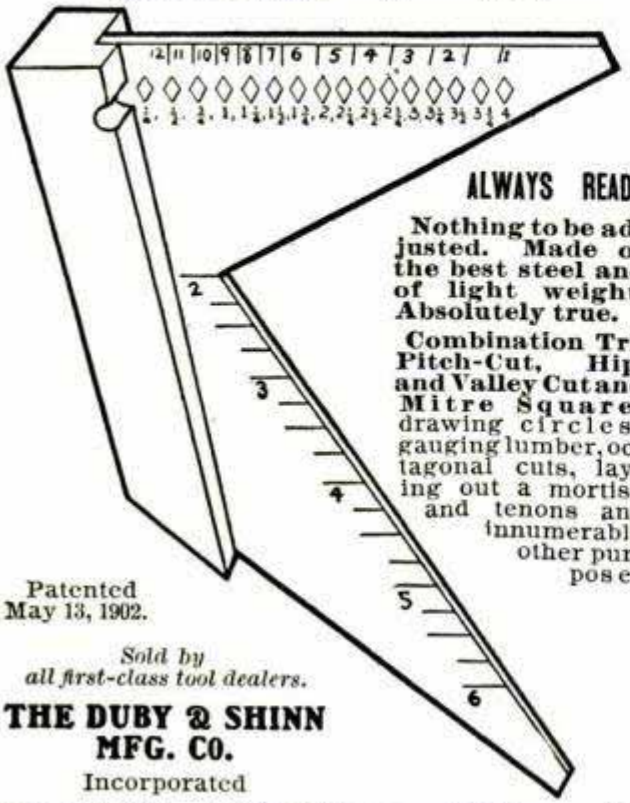

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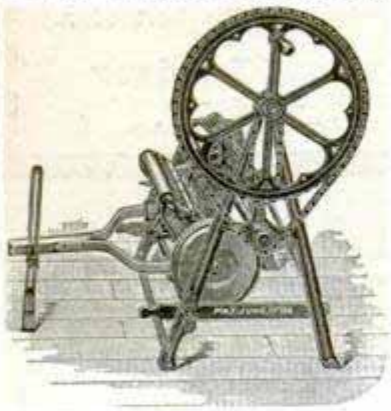

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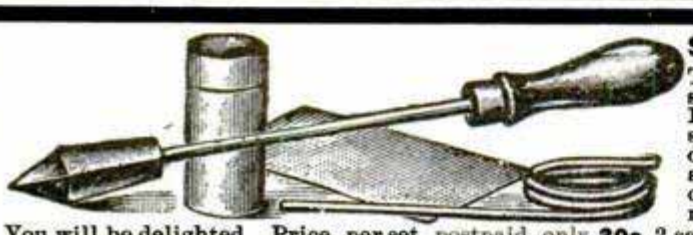

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One Set GENUINE Armstrong Stocks and Dies,
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ALCOHOL (OR GASOLINE)
BLOW TORCH

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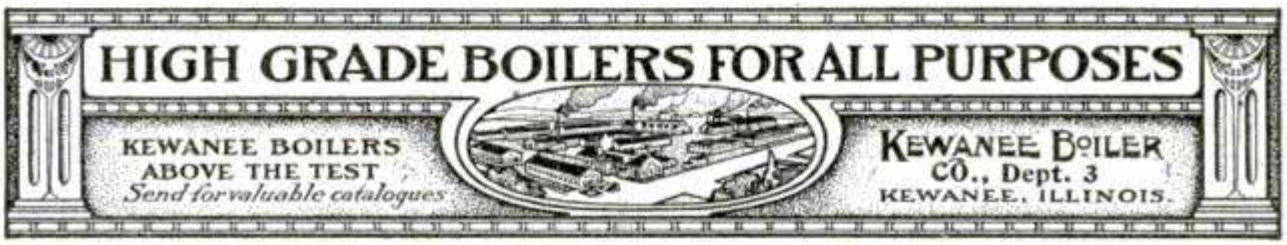

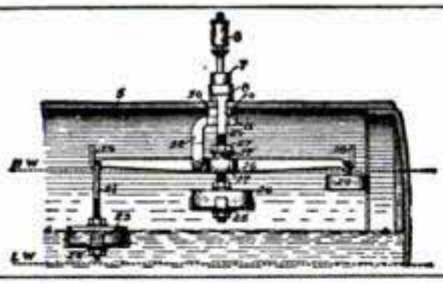

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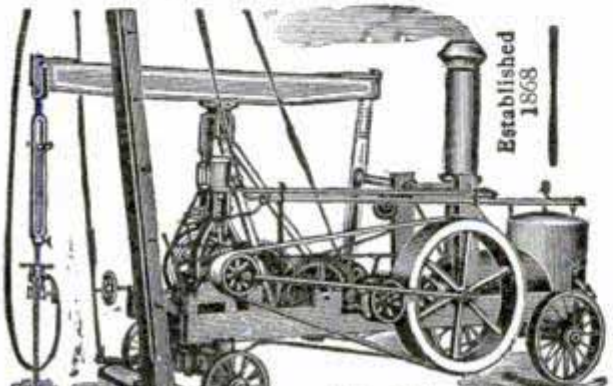

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SAVED THE HARNESS.—"There's a horse in the basement on Canal near Lake street and paw wants you to send the fire department to get him out," said a little Jewish boy to Chief Campion, of Chicago, the other day. After a few questions the chief ordered truck No. 2 out to rescue the horse, says the Western Fireman.

A teamster had driven his coal wagon too near an outside stairway with a small iron railing around it. The horse had rubbed up against the railing and dropped into the basement. The space was too small for the horse to turn around. Heavy planks were placed on the stairway and made slippery with water. The firemen tied the horse's feet, placed a rope around its body and commenced to pull. The horse beat its head against the brick wall several times, until Policeman Maloney protested.

"Can't you see the horse will butt its head off?" cried Maloney. "Wait a minute till I get a rope around the neck of the beast. Now we're ready," said Maloney, as he pulled the neck of the horse to a rainbow shape. The firemen and the bystanders commenced to pull and tug.

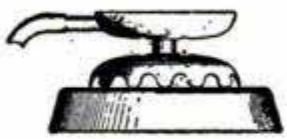
"We'll get him yet," remarked Maloney. "But if I had not been here the horse would never have been saved. Pull away, boys."

Finally the horse reached the top of the boards.

"A fine animal," kept on Maloney, as the firemen were unbinding its legs. Maloney unloosed his rope from the neck and the horse's head dropped to the ground. It had been suffocated.

"We saved him all right," remarked Maloney, "and he was an ungrateful beast to die."

THE BUNSEN BURNER ATTACHMENT—shown in the sketch was recently patented by E. R. Kelley, of Ashtabula, Ohio. The attachment consists of a suitable base through which a gas pipe passes and of a cup-shaped disk which fits loosely on the neck of the base and can be readily removed if desired. This disk is formed with scalloped edges and with openings near the neck of the base so that air can be drawn through, thus facilitating the combustion and at the same time spreading the flame so as to cover a large area of the bottom of the vessel placed on the upper edge of the disk. The device can be used with many forms of drop lights, is very handy for heating liquids or for chafing dish purposes and when not in use can be disassembled and packed in small space. All the parts are formed by stamping operations so that they can be cheaply manufactured.



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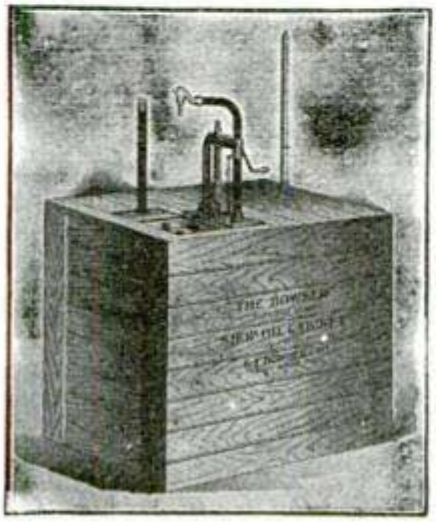

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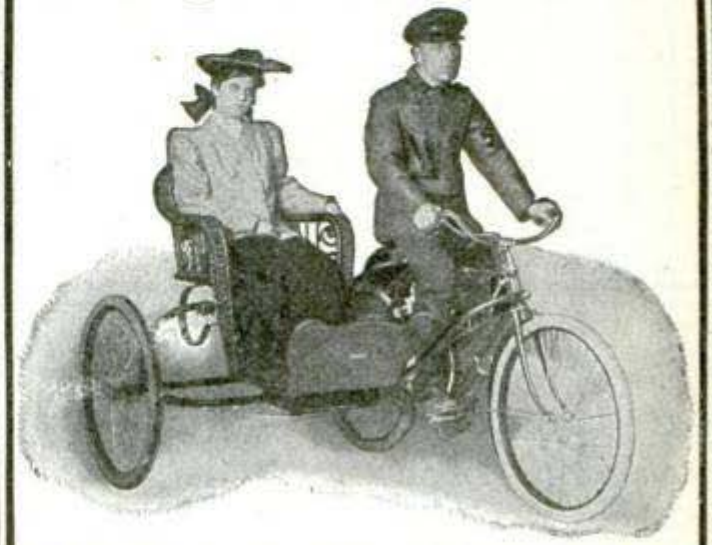

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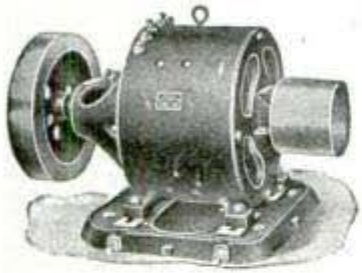

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SCIENTIFIC VENTILATON.—A new ventilating device which filters the air as it passes through and, when desired can be used to deodorize the air, and as a germ destroyer. All dust and dirt is taken out and ejected. The air is thus filtered somewhat on the principle of a water filter.

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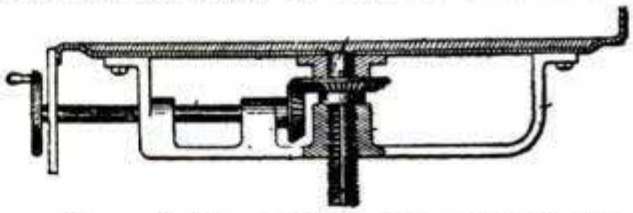

the position of the products being baked and preventing them from being burned on the top or bottom as the case may be. This device may be attached to any oven with very little work, and is adapted for domestic cooking stoves as well as for large bakers' ovens.

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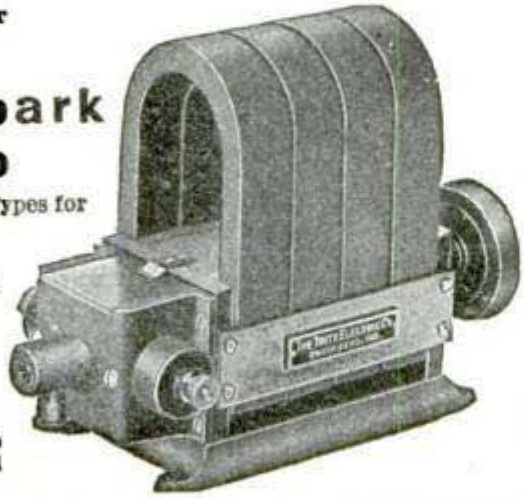

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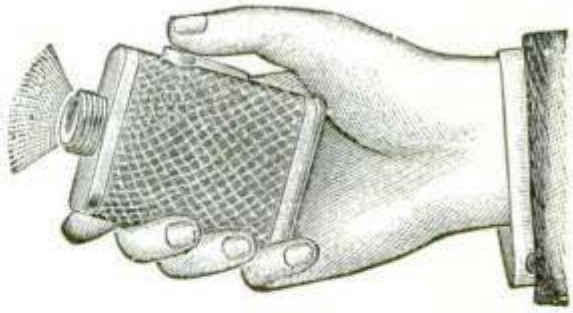

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NEW BOOKS.

GAS, GASOLINE AND OIL ENGINES. By Gardner D. Hiscox, M. E. Revised and enlarged. Illustrated by 500 engravings and drawings; 550 pages. Cloth, price $2.50. The Norman W. Henley Publishing Co., New York.

A comprehensive and up-to-date work treating on the theory of gas, gasoline and oil engines as designed and manufactured in the United States. Contains special information on producer and suction gases which will prove of value to all interested in the generation of producer gas and its utilization in gas engines. Explosive motors for stationary, marine and vehicle power are fully treated, together with illustrations of their parts and tabulated sizes, also their care and running are included. Electric ignition by induction coil and jump sparks is fully explained and illustrated and information on testing for economy and power and the erection of power plants is given, also the rules and regulations of the board of fire underwriters in regard to the installation and management of gasoline motors. Unique and valuable features of the work are a list of the leading gas and oil engine manufacturers in the United States and Canada, with their addresses and a list of United States patents issued on gas, gasoline and oil engines and their adjuncts from 1875 to date.

THE COMPETENT LIFE. By Thomas D. West, President American Foundrymen's Association. Illustrated; 272 pp. Cloth. Price, $1.25. Thomas D. West, Sharpsville, Pa.

"A treatise on the judicious development, direction and employment of man's inherited ability to aid in the betterment of labor," are the words in which the author describes his work. In other words, it is a study in character building elucidated by contrasts and some philosophy. Contains a number of good illustrations.

PRACTICAL PATTERN MAKING Edited by Paul N. Hasluck. Numerous drawings and engravings; 160 pp. Cloth. Price, $1.00. David McKay, Philadelphia.

A comprehensive treatise in convenient form. Contains chapters on Foundry Patterns and Foundry Practice; Jointing-up Patterns; Finishing Patterns; Circular Patterns; Making Core-boxes, Coring Holes in Castings, Patterns and Moulds for Iron Columns, Lathe-bed Patterns, etc.

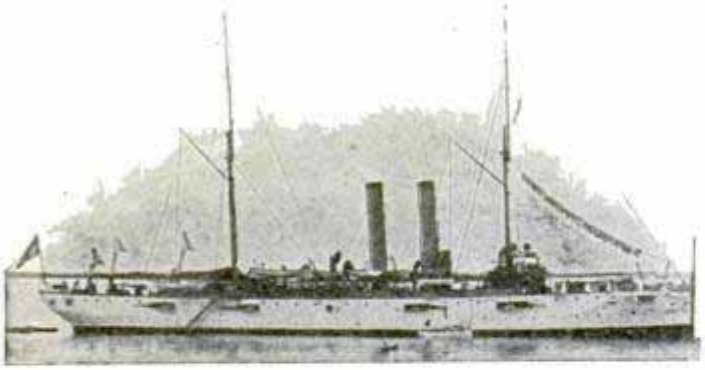
EDUCATIONAL WOODWORK. By A. C. Horth, with nearly 200 illustrations; 200 pp. Cloth. Spon & Chamberlain, New York.

This work provides a graduated educational course of woodwork, based on a succession of joints, with a model following each joint. Manual training of deaf, blind or otherwise physically deficient children is treated in one section.

COLORADO AS A WINTER RESORT, published by the Burlington Route management, is an illustrated folder describing scenes typical of a healthful and ideal climate in the winter time. Some interesting comparative statistics are given. One of these folders may be procured by application to the Chicago, Burlington & Quincy Railway Co., 209 Adams street, Chicago, Ill.

"POP" IN THE NAVY

"This is a photograph of the U. S. S. Denver, that has quite a few subscribers to 'Pop,' the most



up-to-date paper in the U. S."—John Rhodes, U. S. N.

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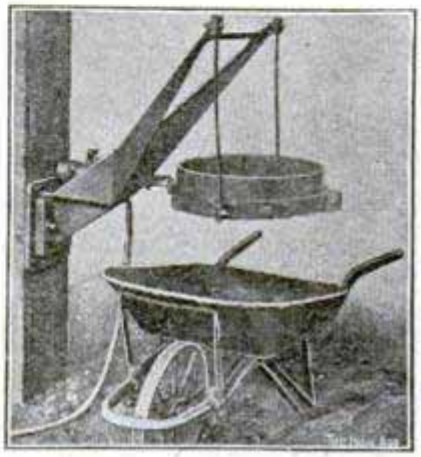

NEVER CAN TELL.—Keep up your courage an' stick to the song; "never kin tell what's a-comin' along!" Ship may reach home, though the tide's runnin' strong; "never kin tell what's a-comin' along!" Worl' topsy-turvy an' things goin' wrong; "never kin tell what's a-comin' along!"—Atlanta Constitution.

CHIPS FROM "THE WOOD-WORKER."—It pays to occasionally flush a bearing out with kerosene. * * * There are some men who find so much pleasure in tinkering with their machines that they can't spare time to do their own work properly nor to give the machine a fair chance at what it can do. * * * Wood has its virtues—always will have—but it cannot be denied that the virtue which has brought it most to the front in this country is cheapness, and that, as the price advances, it must give way to steel. * * * Always try and allow a little, wherever there is a chance, for error. You never made anything exact, and you never will, so it isn't best to figure on doing so. The makers of the finest instruments of precision do not claim that their productions are exact, though within a very small fraction of an inch; and when one hears a wood-worker claim that his work is exact, the natural inference is that he doesn't know what he is talking about. * * * A mill foreman writes: "One of the hardest things with which a foreman has to contend is having some one higher in authority than he come into the mill and, without consulting him at all, change some of the work in hand. This gives the crew a bad example, fosters a spirit of insubordination and is bad practice every way. I have had my share of that sort of thing, and, though I try to hold my temper, I do not always succeed so well; not as well as I should like, at any rate. When these things occur, I try to school myself to the feelings of the Frenchman who, wishing to express his contempt for the actions of another, remarked: 'I only perceive him.'"

SERIOUS ACCIDENT TO THE GASOLINE ENGINE.—When we started to run this edition off the engine gave way, allowing the guilderfluke to fall and break as it struck the plunkerflopper. This, of course, as anyone who knows anything about a benzine choochoo will readily understand, left the gangplank with only the flipflap to support it, which also dropped and broke off the wapperchoke. This loosened the fluking between the ramrod and the fiber snatcher, which also caused trouble. The report that the trouble was caused by over-indulgence in Peruna by ourself is a tissue of falsehoods, the peeled appearance of our right eye being caused by our going into the hatchway of the ashpan in our anxiety to start it and pulling the coupling pin after the slapbung was broken, which caused the dingus to rise up and welt us in the optic.—Okmulgee Democrat.

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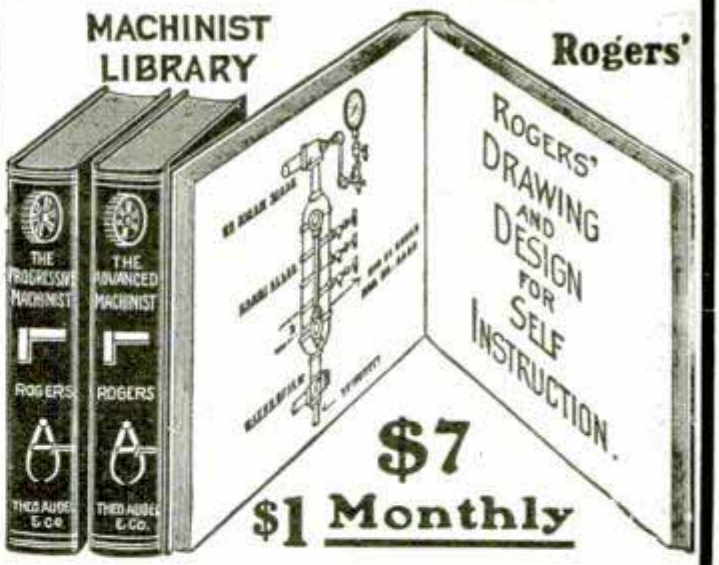

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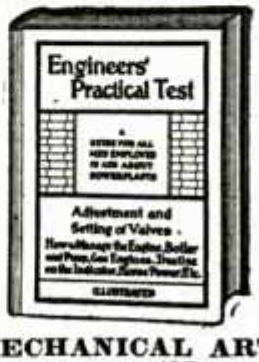

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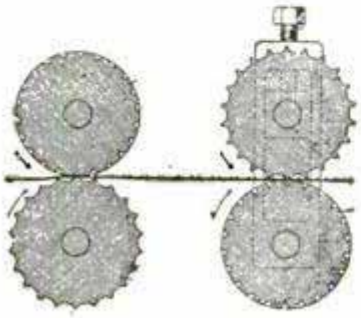

TO SUBSTITUTE KEROSENE FOR GASOLINE.—A patent has just been issued to a Chicago inventor for an appartus which is said to take ordinary kerosene and convert it into a gas which has all the properties of a gasoline gas. This means it can be used for lighting and power for all purposes for which gasoline is now employed. The apparatus is simple and inexpensive, and can be attached to a lamp, or motor. We are informed that a mixture of kerosene vapor and air is passed in contact with a red hot tube of catalytic material and the heavy oil particles are acted on chemically and broken up into lighter compounds and these possess when mixed with air all the essential and desirable qualities of a gasoline-and-air mixture.

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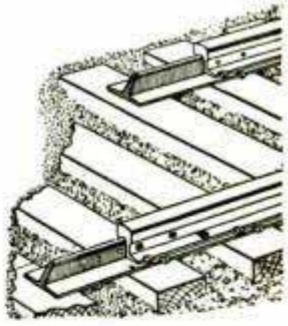

By Frederick Benjamin.

The examination of a recent issue of the Official Gazette of the United States Patent Office shows some interesting facts. Of a total of 615 patents issued in one week, 206 or more than one-third, were assigned in part or in whole to manufacturing companies or individuals for valuable considerations, before the patents were issued from the patent office,—that is to say, the records showed that interests were assigned and the assignments recorded, in that number of patents. It is, of course, more than probable that other interests were assigned in other patents without having the assignments recorded, or in some cases licenses were issued of which no record was made.

An analysis of the patents sold shows that 25 patents on electrical devices were assigned, of which the General Electric Company secured 14, while the Western Electric Company and the Westinghouse Company secured only one each. Of the patents sold, 16 were for hardware novelties, including locks, 15 were on improvements in railway appliances and cars, 14 related to garments, textiles or textile machinery, 10 related to the manufacture of articles from glass, 9 were on improvements in fire-arms and projectiles, and 9 were for recording and weighing devices, such as cash registers and scales; 5 were for improvements in typewriters, 6 related to automobile parts and 12 covered improvements in boilers and engines of different kinds and pumps.

As many patents are not sold until after they are issued, it is safe to assume from the above showing that about 50 per cent of the patents granted are disposed of by the inventors, either in whole or in part, for valuable considerations, varying from small sums to many thousands of dollars. Some of the purchasers of patents for the week noted, were the American Can Company, American Tobacco Company, American Pneumatic Service Company, International Harvester Company, Driggs-Seabury Company, all of which are very large concerns, showing that it is the policy of the largest manufacturers of machinery, notwithstanding the fact that they control, by reason of their combinations, the greater per cent of trade, to still depend on patent rights as means of keeping their hold on the markets of the world.

Hardly a week passes that does not disclose the sale of from three to a dozen patents to the General Electric Company. The American Can Company is also a liberal buyer of patents, as well as the International Harvester Company.

In many cases the patents purchased by these concerns are not used, that is to say, the inventions covered by the patents are not manufactured, but the patents are bought and held simply to prevent competitors from placing the inventions on the market and creating competition that might be expensive to meet.

In most of the European countries, the law provides that if a patented invention is not placed on the market within two or three years after the patent is granted, the patent will become forfeited, and this is a wise and just provision, because the theory of the patent law is that the inventor gives the public the use of his skill and ideas as shown in his inventions, in consideration of a certain profit or royalty to which he has an exclusive right for a period of 17 years.

The grant of a patent by the government is not based on admiration for the skill and ingenuity of the inventor, but on the theory that if he is encouraged to exercise his skill and inventive ability, the public will get the benefit of it in the way of improved or cheaper products. Therefore, the buying up of patents on useful devices and machines which are never permitted on the market, is subversive of the basic principles of the patent laws. It is evident that the time is coming in this country when the patent laws should be amended in this particular and possibly in some others.

It has been urged by many inventors with some show of force, that when the government issues a patent which recites on its face an exclusive grant to the patentee to make, use and to sell the thing covered by the patent, that the government should back up its grant by lending to the patentee without expense, the process of the United States courts for the purpose of enforcing protection under the patent against those who infringe it.

It is true that the United States courts are favorably disposed toward a patentee as against one who knowingly infringes the patent, but it is also true that the expense to which a patentee is placed in establishing his rights under his patent, is altogether too great, and it is knowledge of this fact, coupled with the knowledge of the financial inability of many patentees, that causes some manufacturers to wilfully invade patents to which they have no shadow of right.

If the inventors who are scattered throughout the country would combine in efforts to obtain remedial legislation in the respects mentioned, there is no doubt but they would obtain the hearty co-operation of members of the patent bar and of the great majority of manufacturers who have built up their business largely on the value of patented inventions which they have purchased, and that congress would be moved to grant relief. No more effective method could be devised for curbing the unjust encroachments of the trusts than amendments to the patent laws along the lines above suggested.

"SOCKER" FOOTBALL.—The appalling list of 19 deaths and 132 serious accidents during the American football season of 1905, has called forth the demand from press, public and college presidents, for an immediate and radical change. "Socker" football is suggested as much less strenuous. It is played as follows:

As in the American game of Rugby, eleven men constitute a team. The ordinary field is 130 yards long—twenty yards longer than that on which American college teams play—and 100 yards wide. For championship games the size of the field is sometimes decreased. The duration of play is 90 minutes, divided into halves, with five minutes' rest between halves. The game opens with a place kick from the center of the field. The opponents must not approach within ten yards of the ball until it is kicked off, nor can any of the players on either side pass the center of the field until the ball is kicked off. After a goal is scored the losing side kicks off, and after the change of ends at half time—the beginning of the second half—the ball is kicked off by the opposite side from that which originally kicked, which is all very similar to the American college game.

A goal is scored when the ball has passed between the goal posts under the bar, not being thrown nor carried by any player of the attacking side. Here is where the great difference to American Rugby is shown. The ball must not be carried and must only be advanced by kicking. This makes the game open, and, from an English point of view, much more spectacular and not nearly so rough as Rugby.

The goal keeper can, within his own half of the field of play, use his hands, but can not carry the ball. Neither tripping, kicking, nor jumping at a player is allowed. A player—the goal keeper except-

pretense, nor can he use his hands to hold or push an opponent.

After the kick-off, if the ball goes over the touch line—side line—a player of the opposite side to that which played it out tosses it high over his head back to the field from the point where it crossed the side line, and it is again in play and can be advanced by either side.

When a player throws the ball in from touch, any player of the same side who, at such moment of throwing in, is nearer to his opponents' line, is out of play, and may not touch the ball himself, nor in any way whatever interfere with an opponent until the ball has been again played.

When the ball is played behind the goal line by a player of the opposite side it is kicked off by any of the players behind whose goal line it went. During this kick-off an opponent is not allowed within six yards of the ball.

Players are not allowed to wear metal plates, projections, or gutta percha on their shoes or shin guards, and the cleats on the shoes must be flat and not less than half an inch in width. Any player discerned with narrower, sharp cleats is immediately removed from the game by the referee.

The referee decides all disputed points and in addition acts as timekeeper. In the event of any ungentlemanly behavior on the part of any of the players the offender is cautioned, and if the offense is repeated he is removed from the game. The referee also has power to suspend the game when he sees fit and to determine the game by reason of darkness, interference by spectators, or from any other cause that he may deem necessary.

The linesmen decide when the ball is out of play and assist the referee in carrying out the game in accordance with the laws.

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FOR SALE CHEAP—Second-hand motorcycle equipped with 3 h. p. engine in good condition, also motorcycle engines. Bong & Hoffman Co., 719 Sheffield Ave., Chicago, Ill.

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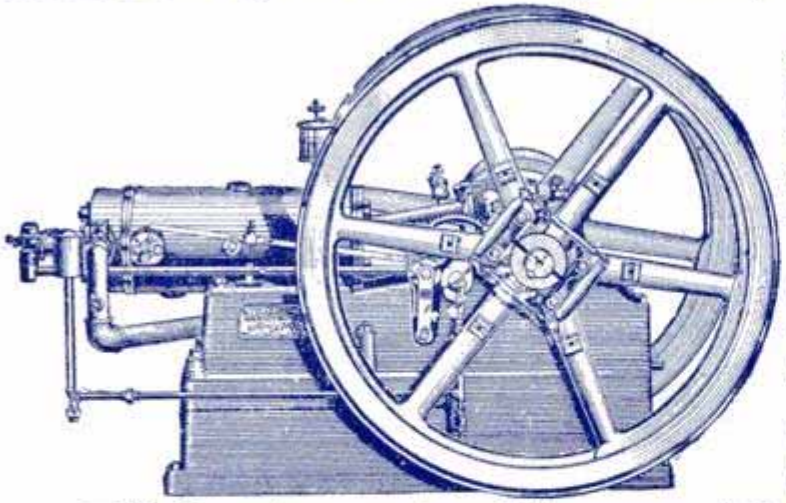

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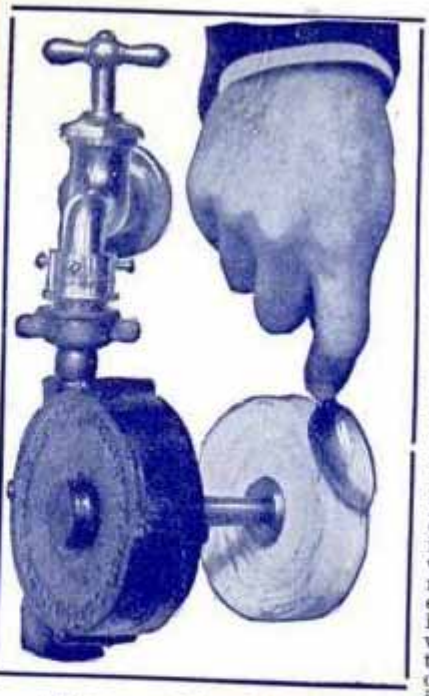

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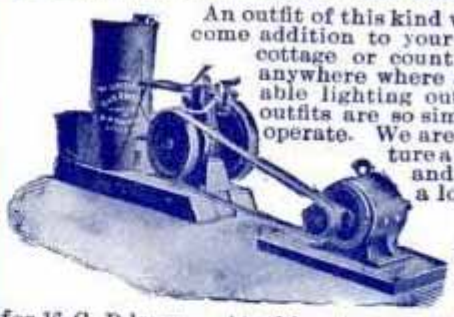
For Farm, Shop, Cottage, Private Residence or Boat House



An outfit of this kind will make a most welcome addition to your isolated farm house, cottage or country residence, in fact anywhere where an efficient and reliable lighting outfit is required. Our outfits are so simple that a child can operate. We are the first to manufacture a complete line of these, and we offer them at such a low price that anyone using only a few lights can install their own outfits and make it pay for itself. Think of it, only 1-10 of a cent per hour for 16 C. P. lamp. At this rate you can run ten lamps, ten hours for ten cents. This is less than one-half of what it would cost you for current from lighting companies. We manufacture in sizes from 6 to 100. We furnish the generator separately, also furnish, if you desire, outfits complete with suitable batteries for operating in connection with generator. The Wonder outfit is the most compact and weighs less than one-third of what the outfits of corresponding size weigh. The Wonder engine which is included in our outfit is the simplest engine on earth, something that anyone can operate. You can run the little engine during the day where an efficient power is required. A little engine of this kind will saw more wood in one day than two men will saw in a month. At a cost of less than two cents for fuel it will pump 1000 gallons of water. It will operate your cream separator and churn for less than a quarter of what it will cost you to operate them by hand. There is no limit to the number of places where these little outfits of this kind can be used. They give you a reliable power during the day, and at night in connection with our generators, they will transform your country home or cottage into a luxurious city residence. When you have your own power, we furnish dynamos of any size and all supplies. Engine is furnished separately, complete with tank mounted on wooden base that can easily be removed from one place to another. Now, what is the use of doing by hand what a little outfit of this kind would do for you at one-tenth the cost, and in a quarter of the time. You cannot afford to buy a power and lighting outfit until you have carefully looked over our catalogues and have our prices, for we give you a little outfit that will give you a more reliable and efficient light, for less money than you are spending for a poor one. Send for complete information. **Agents Wanted Everywhere.**

R. M. CORNWELL CO.

402 S. Salina Street