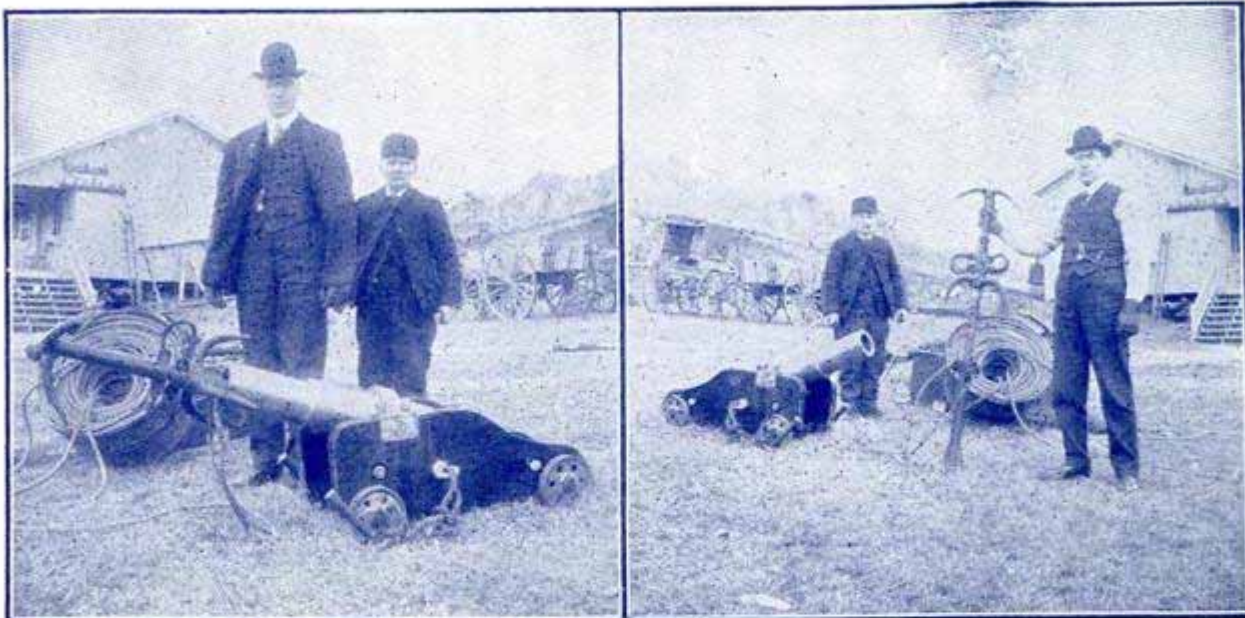


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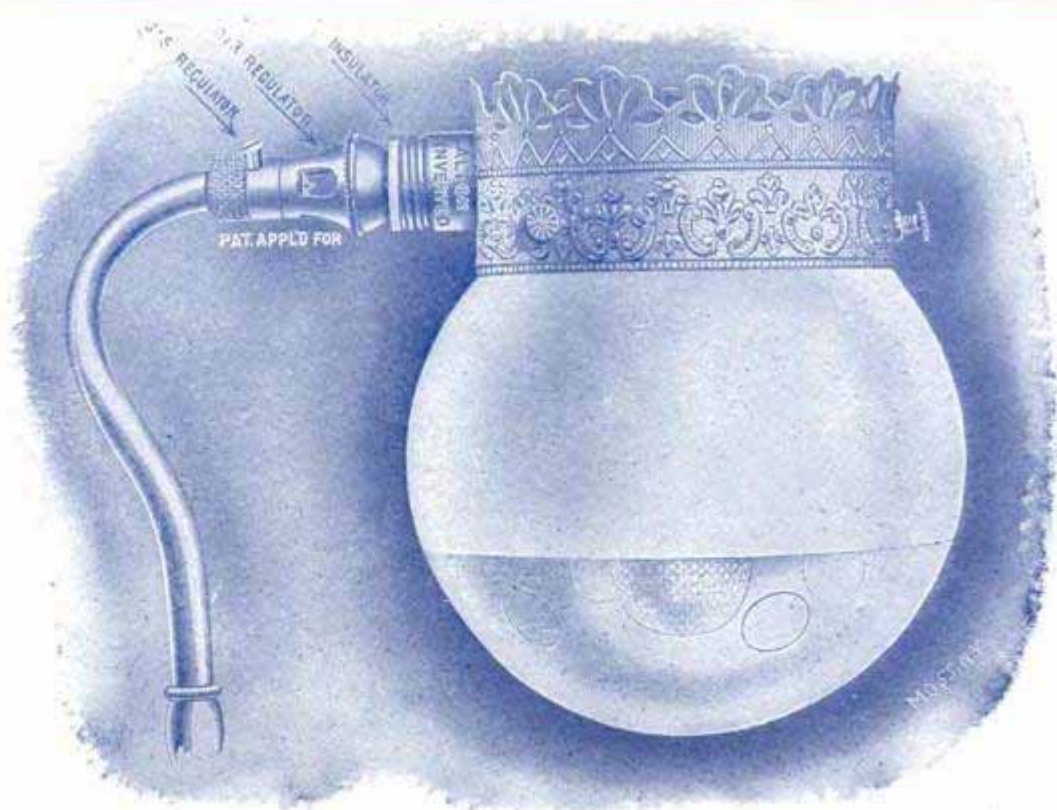
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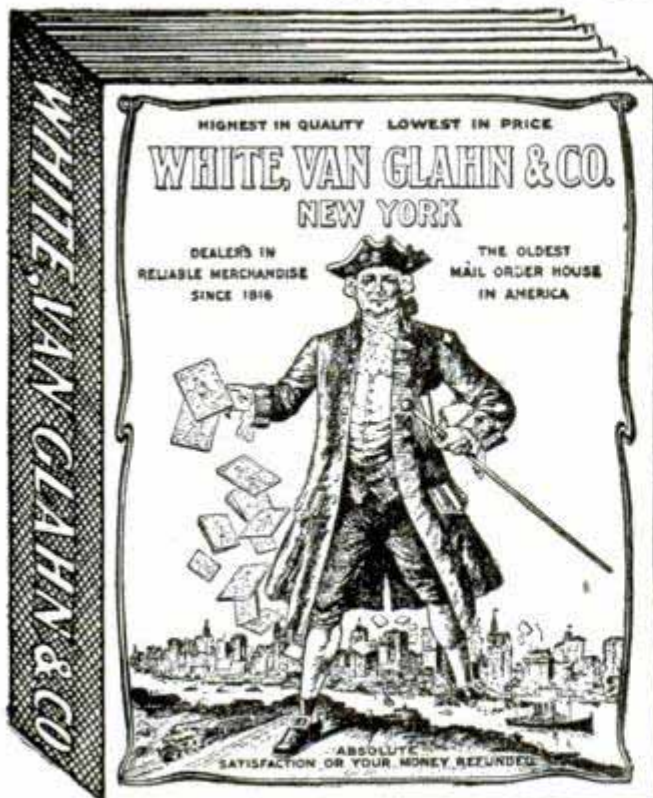


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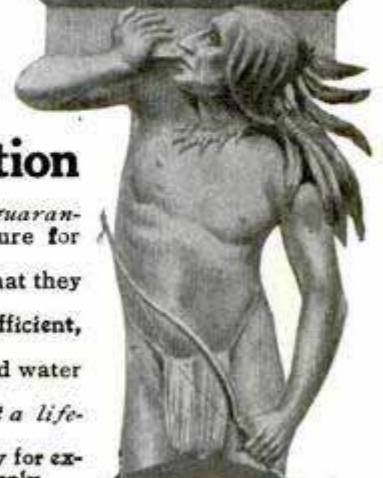
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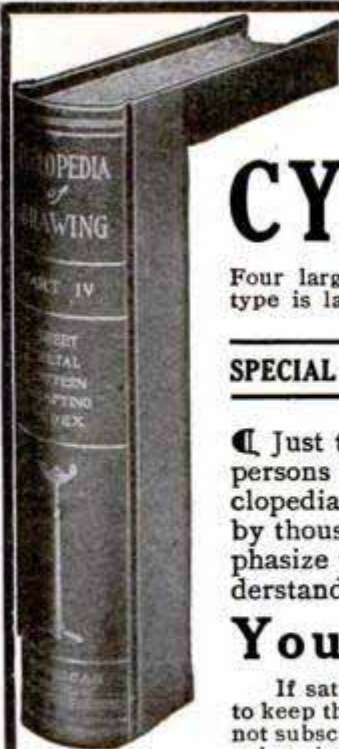
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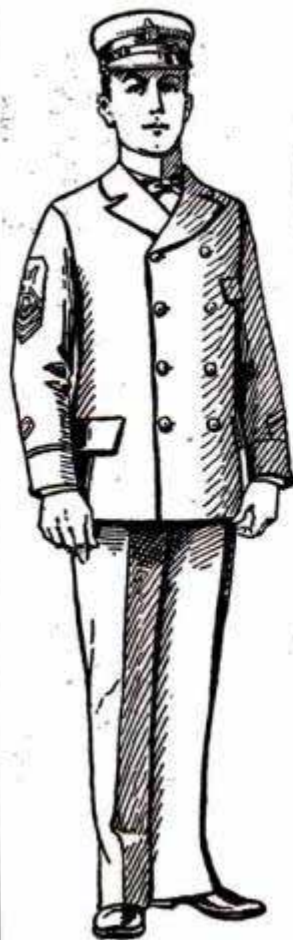
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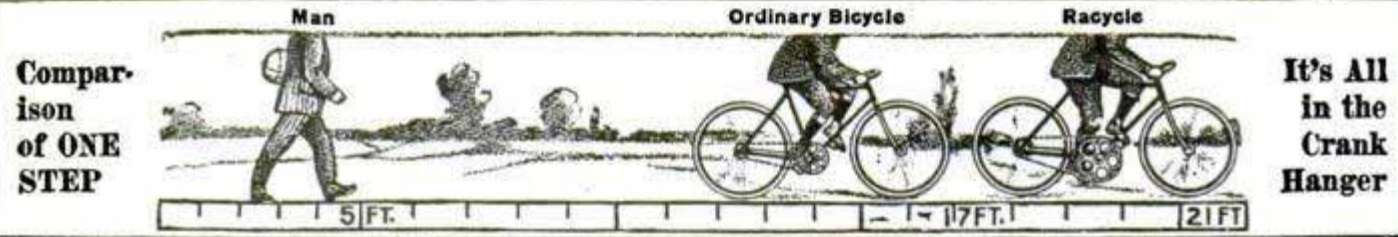
**T**HE CYCLING BOOM is on again and upon its crest rides the Racycle. It is the BEST wheel either for Travel or Recreation. Will run twenty miles with the same energy required to push an ordinary Bicycle fifteen miles. Racycle bearings turn 27.9% easier than any Bicycle made. Our illustrated pamphlet,

**“The Three Reasons,” Tells You Why**

Send for it, and if YOU can disprove the calculations made in the pamphlet, we will give you \$50 or a Racycle of equal value. In two steps a man covers five feet; one pedal revolution carries an ordinary bicycle seventeen feet, while the same turn takes a RACYCLE twenty-one feet (see illustration below). The crank hanger does it. We build the highest grade, easiest running wheel in the world and our sales are the largest,

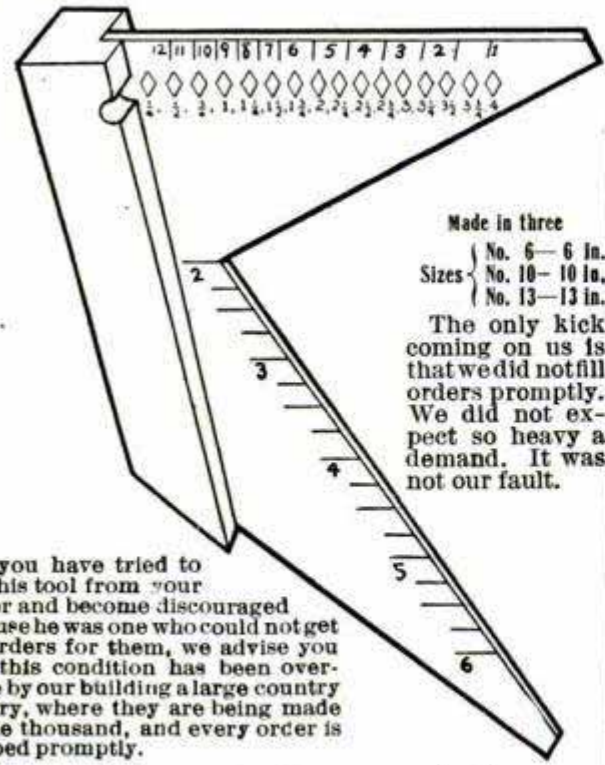
“The Three Reasons” and 1907 Illustrated Catalogue sent for 2c stamp, but we'll mail both FREE if you mention this publication.

**THE MIAMI CYCLE & MFG. CO., MIDDLETOWN, OHIO, U. S. A.**  
*We Make No Cheap Racycles, but Secure Us an Agency and get Yours Cheap.*



**The New Universal Square**

is proving itself sure to become the Standard Tool of its kind



Made in three Sizes  
 { No. 6—6 in.  
 { No. 10—10 in.  
 { No. 13—13 in.

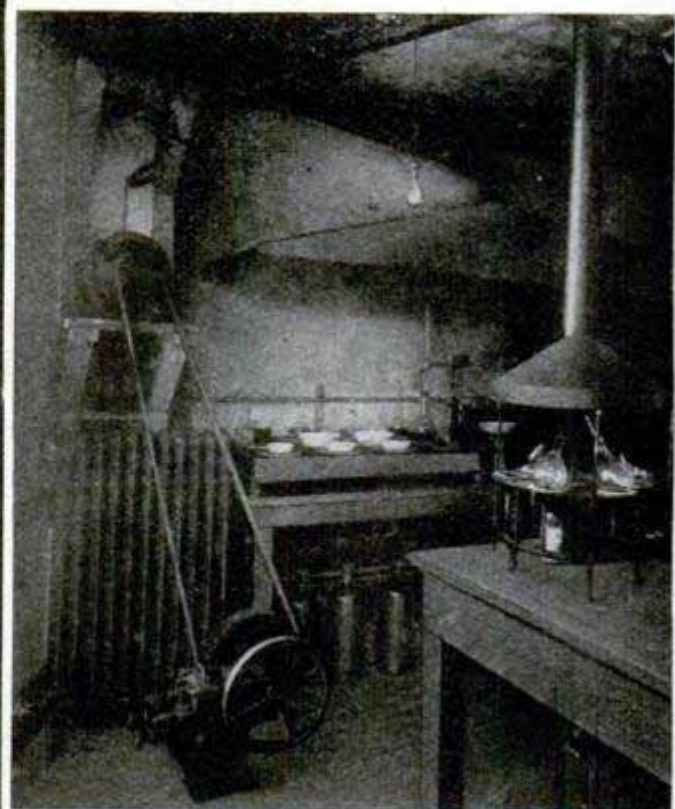
The only kick coming on us is that we did not fill orders promptly. We did not expect so heavy a demand. It was not our fault.

If you have tried to get this tool from your dealer and become discouraged because he was one who could not get his orders for them, we advise you that this condition has been overcome by our building a large country factory, where they are being made by the thousand, and every order is shipped promptly.

If your dealer cannot get them now, write direct  
**DUBY & SHINN MFG. CO., Inc.**  
 Home Office and Works: LONG BRANCH, N. J.  
 Branchport Station

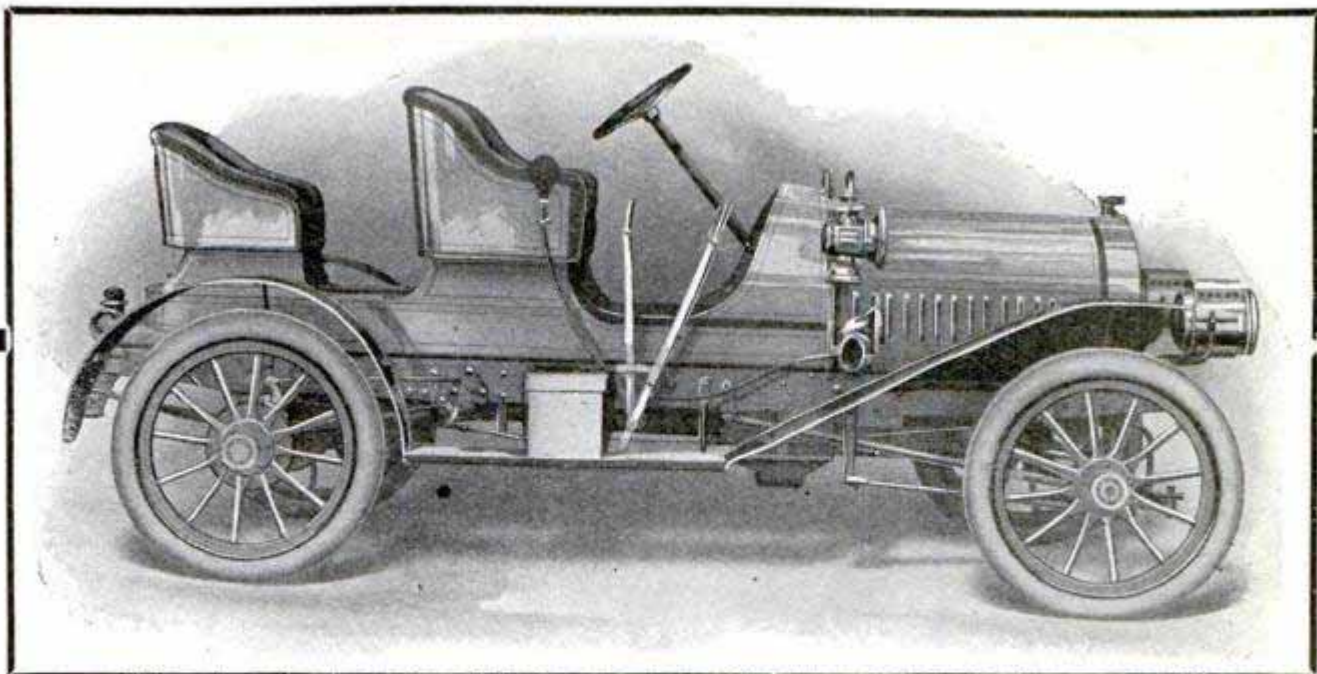
**“We Analyze Everything”**

EXPERT WORK AND MANUFACTURING PROBLEMS A SPECIALTY



**The Bryant-Miner Laboratories**  
 355-357 Dearborn Street CHICAGO





RACYTYPE with RUMBLE SEAT

# Mora Roadster

MECHANICALLY RIGHT.

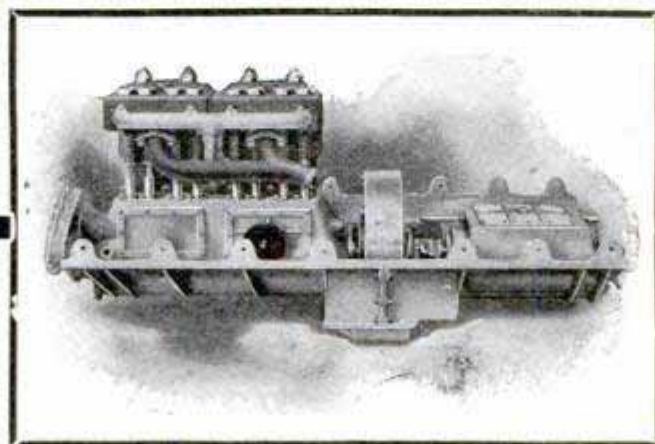
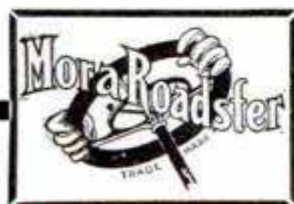
**The Speediest Light Car to Go Anywhere,  
At Anywhere Near the Price**

**Specifications:**—Four cylinder vertical engine, 24 horse power, water-cooled. 98-inch wheel base; 32-inch wheels. Weight 1750 pounds. Entirely mud proof. Price \$2300. Two individual passenger seats and rumble seat in rear for mechanician. Equipped with an Imported Magneto. Double Independent Systems of Ignition. Thoroughly up-to-date. **KNOW IT!**

Below is illustrated complete engine and gear-set installed in the MORA as a single unit. Only one of the "Mechanically Right" features of the IDEAL GENTLEMAN'S ROADSTER. Look at the solid aluminum pan supporting both. This is what makes our car absolutely mud proof.

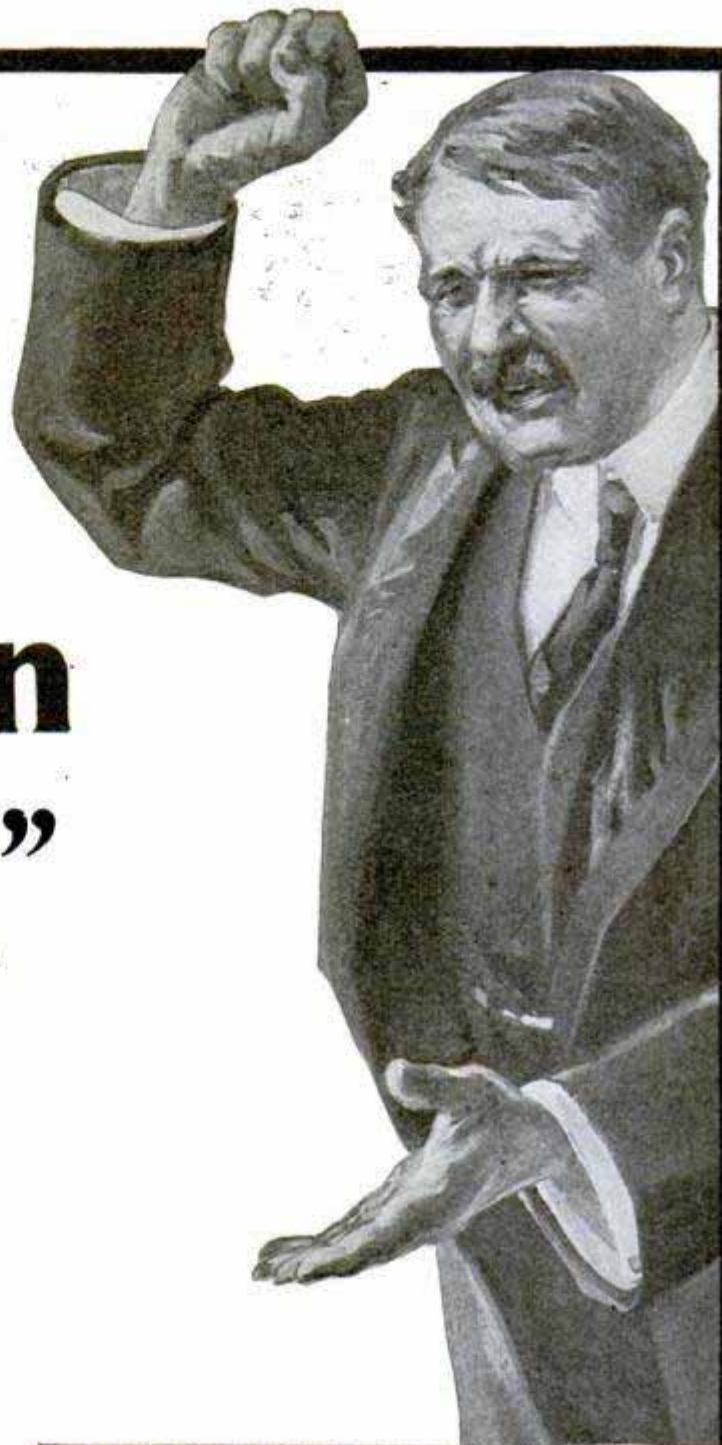
Our 1907 catalog tells more of the vital inside mechanism than any other manufacturer shows in print. It's free, and includes three other models.

MORA MOTOR CAR CO., 323 Livingston Building, ROCHESTER, New York  
*Works at Newark, New York*





# "You've GOT To Earn MORE"



It isn't a question alone of whether you *want* a better salary—it's a hard condition of life that you must face to protect yourself and those dependent upon you.

Earning more means holding a better position—independence, happiness and a chance to provide for the future.

*You can't stand still*—if you don't want to go backward, you must go forward—that is, *you've got to earn more*.

Thousands upon thousands who once held low, poorly paid positions now earn high salaries as a result of letting the **International Correspondence Schools** show them how to accomplish the change. During December, 1906, 320 students voluntarily reported an increase in salary and position as the direct result of I. C. S. training.

## HOW TO DO IT.

Simply select from the list the kind of occupation you prefer, writing a postal card to the INTERNATIONAL CORRESPONDENCE SCHOOLS, asking how you can become a success in that position. By return mail you will receive books, literature, and helpful advice that will surprise you.

Write the postal card to-day. INTERNATIONAL CORRESPONDENCE SCHOOLS, Box , Scranton, Pa.

**You've got to earn more money.**

The I. C. S. will help you.  
Will you take the start to-day?

## Here is a List of Good Positions

Select the one you prefer, write a postal to **The International Correspondence Schools, Box 872, Scranton, Pa.**, and ask how you can qualify to fill it at a good salary.

*Be sure to mention the position you prefer:*

- |                      |                       |
|----------------------|-----------------------|
| Bookkeeper           | Telephone Engineer    |
| Stenographer         | Elec. Lighting Supt.  |
| Advertisement Writer | Mechan. Engineer      |
| Show Card Writer     | Surveyor              |
| Window Trimmer       | Stationary Engineer   |
| Commercial Law       | Civil Engineer        |
| Illustrator          | Building Contractor   |
| Civil Service        | Architect'l Draftsman |
| Chemist              | Architect             |
| Textile Mill Supt.   | Structural Engineer   |
| Electrician          | Bridge Engineer       |
| Elec. Engineer       | Mining Engineer       |
| Mechanical Draftsman |                       |



# POPULAR MECHANICS

Vol. 9. No. 3.

CHICAGO, MARCH, 1907.

10 Cents a Copy  
\$1.00 a Year

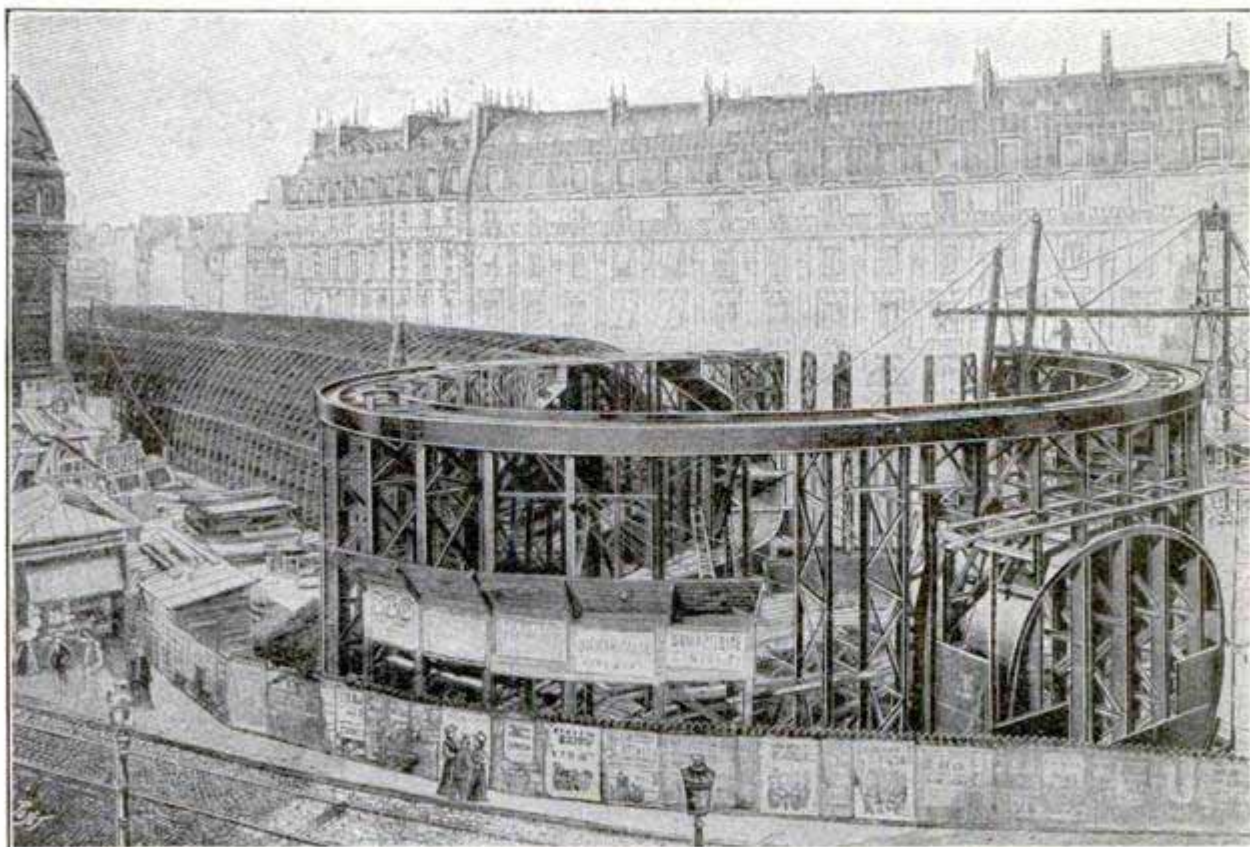
## TUNNELS BUILT ABOVE GROUND

**To be Undermined and Sunk 80 Ft. When Completed—A Very Unusual Undertaking**

Two underground depots and a considerable length of connecting tunnel, for the use of the Metropolitan subway lines of Paris, are being constructed on a public street, and when completed will be sunk into position. In other words, this unusual piece of engineering work consists in building a tunnel in the open air.

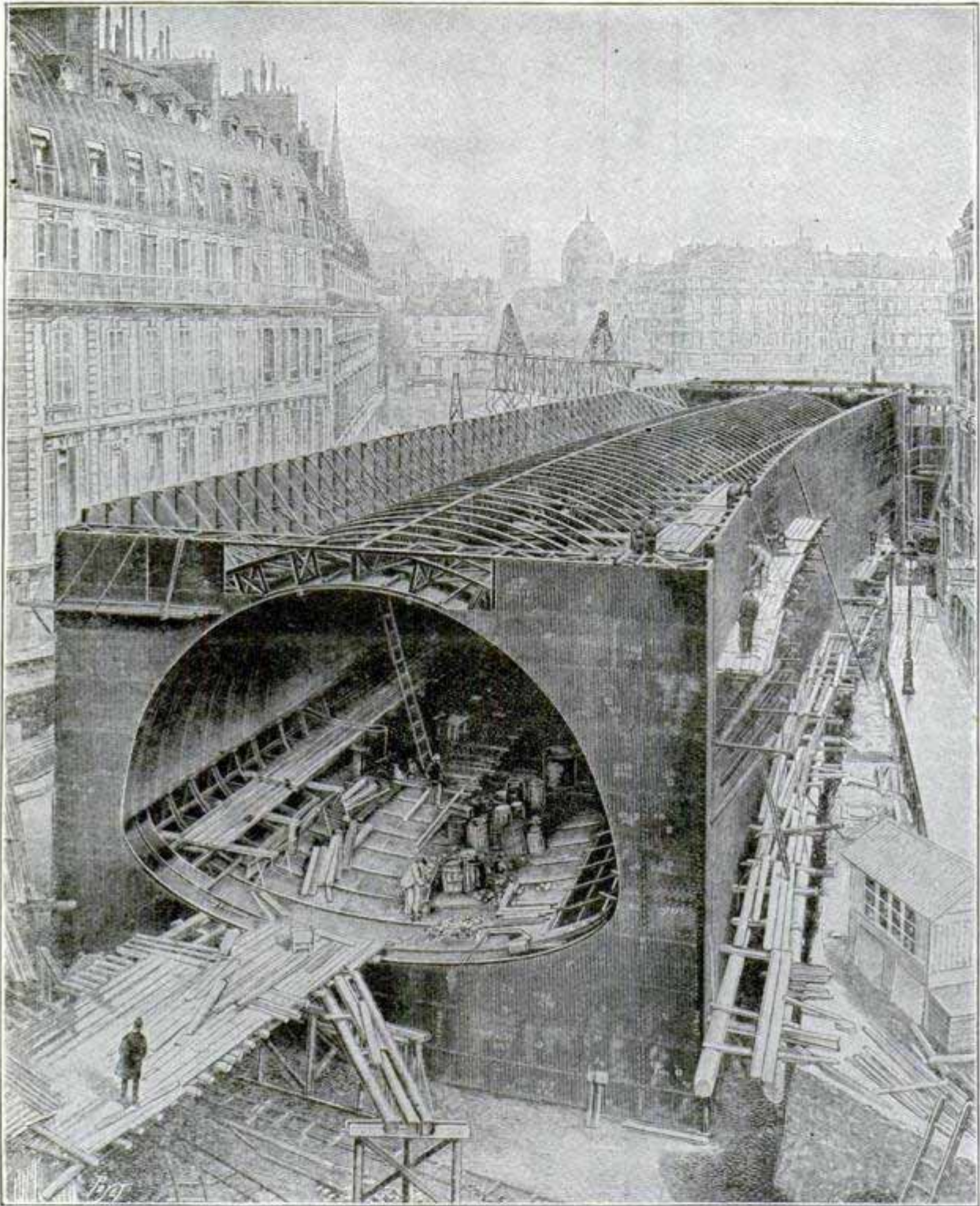
The main line of the Metropolitan railway crosses the two branches of the

Seine and the Isle of Cité, which divides the river, at a point just south of the Bridge St. Michel. That portion of the line which crosses the island is being built in the street, where the great steel framework rising to the top of the third story of abutting buildings attracts much attention. The sections which are to cross the river have already been described in these pages, having been built on land



Framework of Depot and Section of Tunnel; Weight 18,000 Tons





**Tunnel Being Built in the Street**

and floated to location, where they are being sunk to the required level below the bottom of the river. The land and water sections mentioned are 5,800 ft. in length.

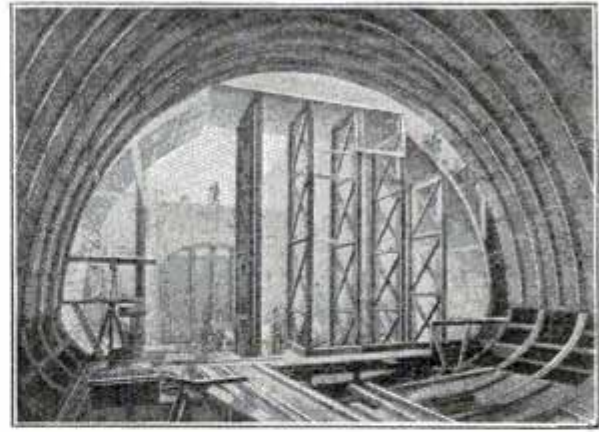
The illustrations convey a good idea of the construction. When completed the inside measurement of the tunnel will be 78 ft. wide by 56 ft. high. There are two land sections 1,500 ft.

and 1,800 ft. long respectively. Inside the steel framework will be placed a thick lining of concrete to exclude water, while the sides and arch will be covered with white enameled tiling and the floor with cut stone blocks and slabs, upon which the track will be laid. When the metal section is finished, excavation will be made beneath it and the great mass allowed to gradually



settle to permanent position at the proper depth.

Two depots are included in the work described, both located on the island. These are obtained by enlarging the tunnel to a ring-shaped construction, with provision for ticket offices, waiting rooms, etc. One of the depots with 500 ft. of tunnel weighs 18,000 tons. The reader will readily appreciate the nicety of operation by which all these metal sections are to be sunk to an exact level and then bolted together where the end of one length joins that of the next. The project is one of the largest and most interesting engineering undertakings in the world at the present time. When the tunnel



Showing Interior Work

and depots have been sunk, the street will be replaced and paved as before. All the riveting is being done with pneumatic hammers of American make.

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## PLAN TO DIG INTO A LIVE VOLCANO

**And Build a Breakwater with the Foaming Molten Lava—Most Unheard-of Engineering Project Ever Conceived**

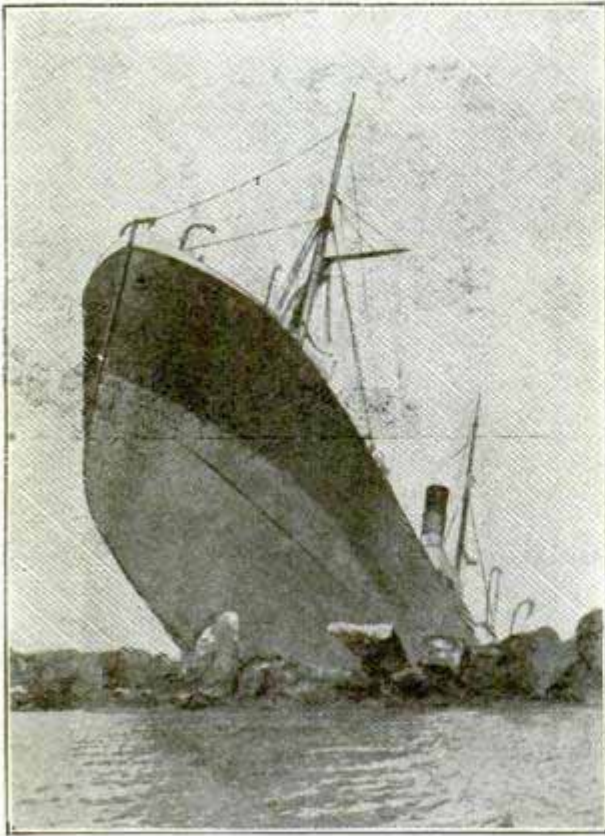
Volcanoes have ever been considered sources of tremendous destructive force, uncontrollable in their action and of no useful purpose to man. The unusual and daring proposition is now made to make at least one active volcano perform constructive work of positive commercial value. The idea seems to have been adapted from the familiar one of drawing molten iron from a furnace and conducting it along the earthen floor through shallow open trenches into molded spaces where it cools and becomes the pig iron of trade.

Hilo is the important seaport on the east coast of the Island of Hawaii, in the Sandwich Islands group. Its harbor facilities are insufficient to meet the demands of present day commerce, and in order to provide suitable shelter, great breakwaters must be constructed at large cost. Congress has been petitioned to make the necessary appropriation, but so far has not advanced beyond an order for a preliminary survey. The people of Hilo evidently realize that Congress is a long way off and, unless action is secured soon, propose to tap an active volcano on the island and make it furnish the material and do the work of construction at the same time. If the plan works a great sea wall will have been built, of greater extent and weight than any ever before constructed by human skill.

The idea is to construct a big trench from Mt. Kilauea to the shore and then tunnel into the pit of one of the craters and release the molten lava, just as a furnaceman opens a cupola when making pig iron. One difference will be that where the founder uses a long iron rod to poke a hole, the volcano is to be opened by letting off a big charge of high explosives.

Notwithstanding the somewhat fishy nature of the story, it is stated "engineers who have been considering the scheme are strongly inclined to the opinion that it is not impracticable." One thing is certain, there will be plenty of Yankee engineers who will not hesitate to undertake so difficult and dangerous a venture, if the necessary funds are provided.





### PECULIAR WRECK OF STEAMER

One of the most unique marine pictures ever made is that of the Steamer "Carrington" which went on the rocks recently. The ship was stranded in such a way that at low tide the stern being in deep water went down with the ebb, see-sawing the bow high in the air. Although the vessel was in this

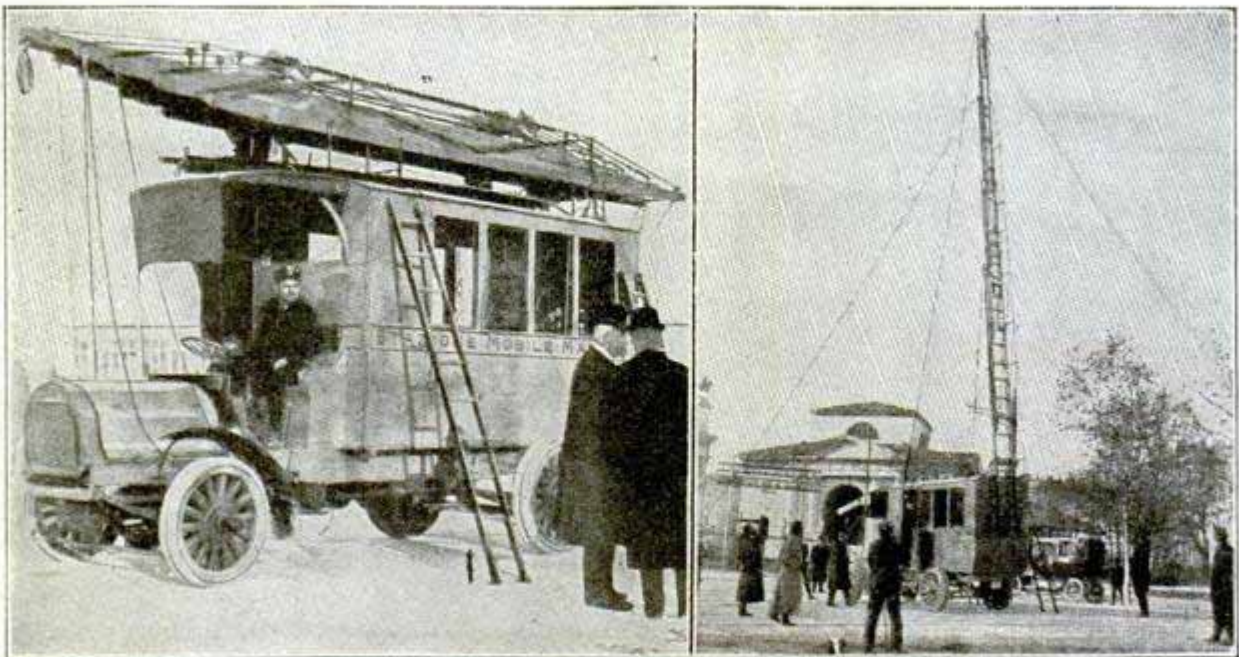
perilous position several days the hull did not break and the ship was finally pulled off, floated and saved.

### MOVING PICTURES SECURE NAVAL RECRUITS

The navy department is using moving pictures depicting the sailor's life, as a means of securing recruits for the service. The pictures show all phases of the life, from coaling the vessel and scrubbing decks to sham battles and drills. The apparatus is making a tour of the northwestern states, where there are many Swedes and Norwegians, who make the best sailors.

### MOTOR CAR FOR WIRELESS WORK

An interesting application of the motor car has been made by the Marquis Solari, secretary to Marconi. It consists of a wireless station complete with generator, receiving and sending apparatus, and a telescopic pole which can be quickly extended to considerable height. The station will work reliably over distances up to 90 miles. Some of them will be used in the Italian army.

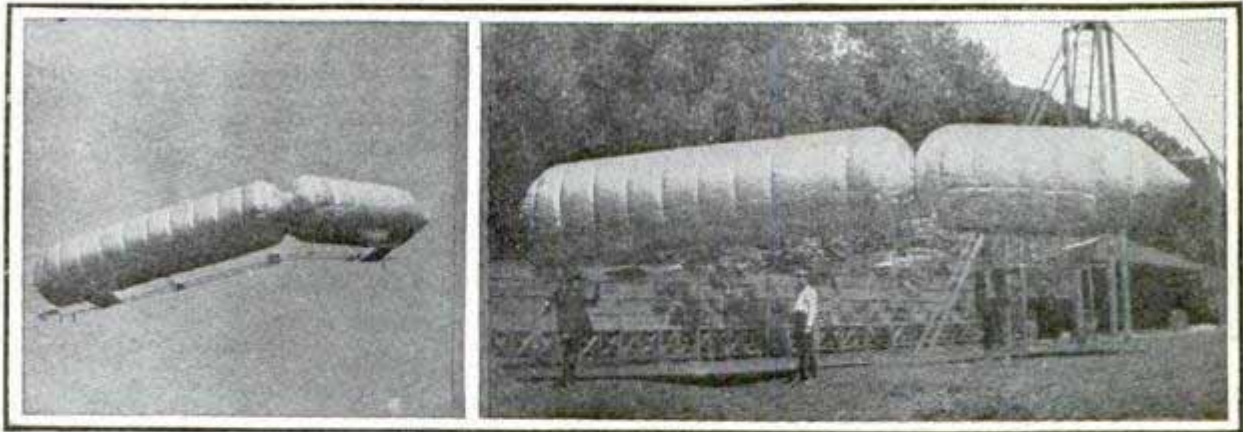


In Traveling Gear

Tower Raised



## AIRSHIP THAT STEERS LIKE A BOBSLED



In Mid-Air

Ready for Flight

From San Francisco, famous for aeronauts and airships, comes a new idea in construction. The inventor is August Kidder, who has been working on the problem for the past seven years. The illustrations show his latest model, 27 ft. long, with which he has secured results he considers very satisfactory; in fact, so promising, he is now at work on a large ship which will be 250 ft. long.

He uses two gas bags, the forward one being the smaller, and with this he steers, the larger following in the same way a train of cars follows an engine around a curve. The motor and operator are carried on frames suspended from the bags, of which there may be several if desired. The bow of the forward bag is cone-shaped.

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### BIG BATTLESHIPS ARE THE BEST

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Lieutenant-Commander William S. Sims, inspector of target practice in the navy, in an article written for the United States Naval Institute in reply to an argument by Captain Mahan for small ships, declares for big ships of the all big gun type, not only because they are the more efficient, ton for ton, than smaller battleships, but because they are more economical in both original cost and cost of maintenance.

"A fleet of ten 20,000-ton ships,"

says Lieutenant-Commander Sims, "each having a broadside fire of eight 12-in. guns, or 80 in all, would cost about \$100,000,000. A fleet of 20 smaller vessels, each having a broadside fire of four 12-in. guns, or 80 in all, and the usual intermediate guns, would cost about \$120,000,000 or \$130,000,000, though I previously assumed the cost of these fleets to be equal, in order to accentuate the tactical value of large ships.

"It requires fewer men to man the main battery guns of an all big gun ship than of a mixed battery ship. For example, it requires fewer men to serve the ten 12-in. guns of the 'Dreadnought' than the four 12-in. and sixteen 6-in. guns of the 'Missouri.'

"It will require no more men for the 'Dreadnought's' crew than it would for the 'Missouri's,' if she had a complement of men, as measured by European standards, which neither she nor any of our battleships has."

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### PRIVACY ON PARTY TELEPHONE LINES

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A New York inventor claims to have perfected a device that will put an end to eavesdropping on party telephone lines. The device can be connected to any 'phone and only those carrying on the conversation can hear what is said.



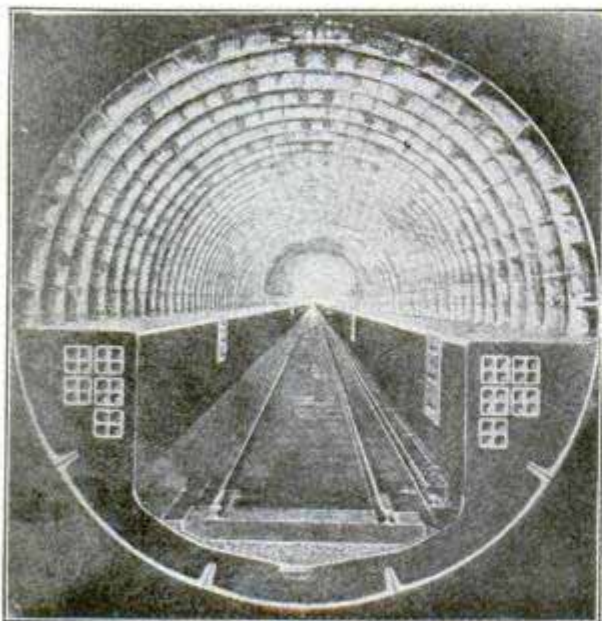
## VERY LATEST LARGEST OFFICE BUILDING

The largest office building in the world this month is the proposed down-



Contains 4,000 Offices

town terminal of the Hudson River Tunnel Co. This structure will rise 22 stories above the street and extend down through 25 ft. of basements. Features of the building include: Large arcade for stores; 4,000 offices



Section of Tunnel

accommodating 10,000 people; 39 elevators; 5,000 windows, and 30,000 incandescent lights; while in the basement depots tunnel and subway trains can be taken for Jersey City, Brooklyn, and all parts of New York City.

## DYNAMITE

By D. S. Brewster, Explosive Expert

Dynamite was discovered in 1866 by Alfred Nobell. The principle consisted in using an absorbent commonly called a "dope," which would take up the nitroglycerine and hold it somewhat after the manner of a sponge. A suitable "dope" should be of cellular structure, so that the nitroglycerine may be subdivided into minute globules, each globule held separately in its own cell, completely isolated from the others. In this condition its sensitiveness is greatly reduced, depending, of course, upon the amount of nitroglycerine absorbed.

Nitroglycerine is made by treating a quantity of exceedingly pure glycerine with a mixture of nitric and sulphuric acid. The proportion commonly adopted is 3 parts of nitric acid, 5 parts of sulphuric acid, and from 1 to 1.15 parts of glycerine. The glycerine is added very slowly and with constant stirring. Wood pulp, nitroglycerine, sodium nitrate and sulphur are thoroughly incorporated and put in cartridges, usually  $1\frac{1}{4}$  by 8 in. in size, these cartridges being packed in paraffine paper.

An explosion is a chemical reaction which is completed in an exceedingly short period of time with the evolution of a large quantity of gas at a very high temperature. If this reaction occurs in a body which is closely confined, the expansive effort of the highly heated gases produces disrupted effects. If the suddenness of the reaction is very great, disrupted action upon solid objects in contact with the body may be obtained even when it is not confined, because the cohesion of these objects can be overcome more



readily in an instant of time than the inertia of the surrounding air. This has given rise to a popular error that nitroglycerine and other high explosives act downward. As a matter of fact they act with equal force in all directions.

In small quantities, dynamite will burn quietly, but with large quantities the heat thus generated will bring the entire mass to the explosion temperature before it has burned away. It freezes at temperatures from 42° to 45° F., which often necessitates thawing it before it can be used. Dynamite should not be thawed by direct heat from a fire or a stove. There is also more or less peril of producing leakiness and starting decomposition by thawing it in the sun. There is peculiar peril from thawing it in the sun when the rays are turned through a window, as the imperfections in the glass are apt to focus the heat at a common point.

There are only two safe ways to thaw dynamite, viz: In a room heated by steam pipes, in which case the explosive must never be laid on the pipes, and in a vessel surrounded by warm water. The proper temperature of the water is 125° F., which is the approximate temperature at which the bare hand can just be held without pain. The water should be heated separately

and poured into the water space in the thawer, and the thawer should not be heated near a stove or other source of heat.

Many accidents occur from the use of dynamite, the usual cause being carelessness. Among these causes are the following: Quarrymen carrying cartridges and detonators in the same hand; forcing cartridge into hole with iron bar; striking portions of unexploded cartridge while clearing away débris after the blast; deepening a hole which had been fired and had not done its work; investigating misfires when fuse failed; testing a hole with an iron bar after the blast to see if any of the charge remained.

Besides ordinary blasting operations there are many other purposes for which dynamite has been successfully used. It is often used for blasting ice to make way for ships or other objects and is used quite extensively for removing stumps or trees. Dynamite is also useful for breaking up cannon, condemned machinery and large castings to be remelted, and in the hands of an expert can be used for these purposes without any danger. It is occasionally exploded under water for recovering dead bodies which have sunk to the bottom, and has been unlawfully used in the same manner for killing fish.

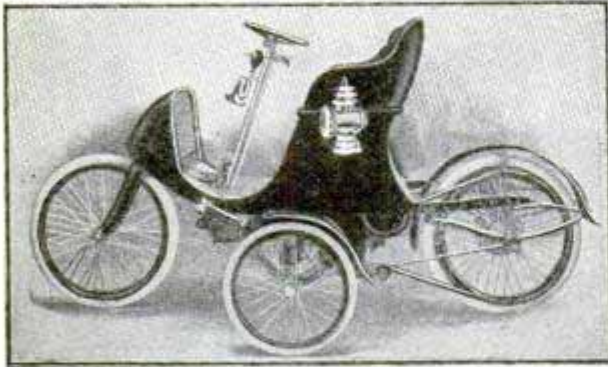


**NEW SUBMARINE "OCTOPUS" the Largest in the U. S. Navy, on Trial Test—What Appear to be Platforms Are Hydroplanes to Prevent "Plunging."**



### THE AUTOCYCLE

A new motor vehicle with four wheels but driven on the plan of a motorcycle has made its appearance.



Speed, 40 Miles

This machine weighs 380 lb., has a 6-hp. motor, is said to develop a speed of 40 miles an hour, and capable of turning in a radius of 7 ft. The seat will accommodate two passengers. Most of the weight is carried on the forward and rear wheels, which are 28-in. diameter. The side wheels, 24 in., are balance wheels. The front and side wheels are connected by steering gear and all turn in unison. It is claimed this machine will safely turn in a radius of 30 ft. at a speed of 20 miles an hour.

### ENGINEERING EVENTS IN ALASKA

By Chas. W. Tennant, Dawson, Y. T.

Mining with steam dredges last summer was so successful that 10 additional machines will be added this season. The ground is found to be less frozen than formerly supposed and in many places the frost does not exceed 10 ft. in depth, which is thawed by steam points taking steam from the dredge. Water powers are to be utilized in summer; one large turbine plant is already installed which will have a transmission line 35 miles long. Fuel is very high, which makes steam power expensive.

A leading greenhouse man of Dawson has installed an acetylene plant to

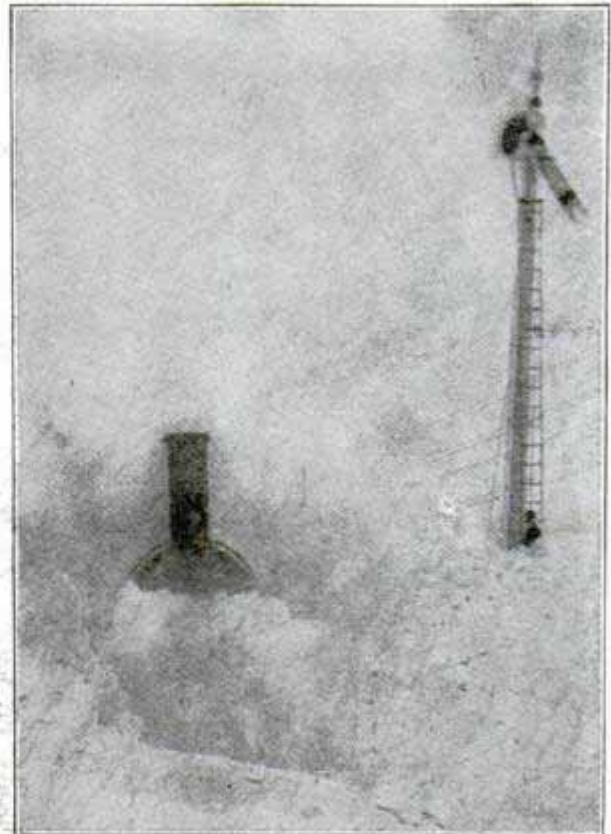
furnish light for growing vegetables and flowers during the dark season.

Capt. J. J. Healy has arrived with his men and will soon begin the survey for the Trans-Alaskan-Siberian railway. Local engineers consider the project of tunneling Behring straits a feasible one. The railroad now running into Dawson has been operating all winter and will be extended 75 or 100 miles this summer.

A large skating rink occupies one of our largest buildings: no trouble to freeze natural ice day or night.

### BUCKING SNOW IN SCOTLAND

During the past winter there have been unusually heavy snows in Scotland. The illustration shows a train which was stuck for 24 hours in a 10-ft. drift. The two engines sent to its relief were also stalled, and three more locomotives with plows were sent to release the other two, which were stalled in 15 ft. of snow. The line was finally opened by a shovel gang of 150 men, who dug through 600 ft. of drifts.



Unusual in Scotland



# CONQUEST OF RIVER AND SEA

Thrilling Account of the Building of the Great Dam to Check the Colorado River

By Edgar L. Larkin, Director Mt. Lowe Observatory, Echo Mt., Cal.

[This intensely interesting account of one of the most daring engineering feats ever undertaken is reprinted here from the copyrighted article in the Open Court for January by permission of its publishers. About the time the article appeared the river again broke its barriers. President Roosevelt has asked Congress for \$2,000,000 to check the flood which threatens to submerge 12,000 homes, 1,500,000 acres and destroy \$700,000,000 of property.—Editor's Note.]

"Water has stopped pouring into the Imperial Valley," said the telephone in a little hut of poles, thatched with willows on the brink of the subdued river. And the 12,000 people below heard all about it in an incredibly short time. Almost two years of brooding anxiety had been their fate, but suspense and care turned to joy in the space of one-fifth of a second when the news came. One of the most remarkable engineering problems of this or any other age had been solved. Here is the problem: A stream of water saturated with silt, whose width was 3,000 ft., had to be cut off. The depth of the water was from 9 to 12 ft., with a velocity of flow of 12 ft. per second. But the bottom, banks and adjacent lands for square miles round about are composed of pure silt. This substance is ground as fine as flour, and dissolves almost instantly when water touches it. The silt is of great but unknown depth, certainly not less than 2,000 ft., possibly 5,000. It came from Colorado and Utah and was ground in that great mill—the Grand Canyon of the Colorado, during hundreds of millions of years. Piles driven in it to hold up a railroad could not be depended upon for a day. The stream was growing wider and deeper minute by minute, and costly fields of grain, grass and fruit were being hurried away to the Salton Sea. Annual floods in the Colorado were sure to come and make the break miles in width, forever beyond hope of filling.

Epes Randolph, H. T. Cory, E. Corillo and Thomas J. Hinds stood on the bank of silt and wondered how the devastating floods could be conquered.

"Central, please." "Hello." "Give me the Southern Pacific, Los Angeles," said Mr. Randolph, speaking into the receiver of the telephone in the now historic hut.

History may never record the words spoken to and fro, but here is what happened right away: Two grand divisions of the Southern Pacific Railroad instantly went out of the goods-carrying business. Every car filled with any kind of freight was unloaded at once, and no more were received for shipment. Telegraphs and telephones everywhere began to speak. Now let us see what other events at once took place.

Thousands of men seized bars and picks, and with steam-drills and great cranes attacked granite mountains in every stone quarry within 350 miles. Dynamite and giant powder thundered at the rocks by night and by day. Every quarry was rushed with cars. Goods-cars, coal-cars, flat-cars, lumber-cars, steel-cars, cars, no end of cars, filled every siding. The entire southwest was stripped of cars. Passenger traffic often gave way to monster trains of stone-cars. When the battle with the flood was at its height, stone-laden cars were attached to express trains. Only mail trains had full right of way. Before this a spur railway from the main line had been laid to the brink of the flood. Before the thousands of cars from the quarries arrived new sidetracks were put down everywhere on the silt beds on which to store cars for the approaching conflict.

Excitement grew, and so did the width of the river. And then 2,200 cords



of tall, slender willows were cut and piled high on the bank where the end of the enormous dam was to begin. A large flat-boat or barge was anchored by the shore close to the willow heap. A straight row of piles was driven across the stream and  $\frac{5}{8}$ -in. braided wire steel cables were attached to them. These held the barge from going down stream. Twelve "dead-men," great logs, were buried in the silt banks. Twelve colossal spools of cable were placed on the far side of the flat-boat. Skids, or inclined planes, smooth on top, were placed between the spools and edge of the boat near the shore. The ends of the cables were anchored to the "dead-men." Many cords of willows were placed on the boat.

Then hundreds of men made fascines—bundles of willows 20 in. in diameter and 90 ft. long, bound with wire. Twelve cables nearly 8 ft. apart were twisted around the bundles in double loops. The fascines were the woof and the cables the warp of a leafy carpet 90 ft. wide and 3,000 long. When a strip had been woven of suitable length, a steamer pulled the barge into the river. The spools revolved, the cables unwound, the beautiful Brussels carpet slid down the skids, dropped into the water and sank to the bottom, anchored by cables to the row of piles up-stream. A pile driver followed and put down the carpet-tacks—piles from 40 to 60 ft. in length—through the willows and tacked this Axminster to the soft floor of silt. And then silt began immediately to settle in between the twigs and leaves. Then two rows of piles were set across the river; heavy timbers were laid on the tops, then the ties and rails of a railroad of great strength were placed on this massive foundation, quite necessary, as will be seen later.

Before any of these preparations had been made, a bypass 50 ft. wide had been cut around the place where the north end of the dam was to start. A massive head-gate was placed in this pass at a cost of \$55,000. The purpose of this cut was to carry part of the water from the front to the rear of the dam while building, and relieve pressure as the dam rose higher and higher. The gate was to have been kept open until the big dam was completed, and then closed. This and the dam would cause the water to rise and pour into its original bed and go smiling on its way to the Gulf of California.

When the sidetracks were filled with thousands of cars of rock, activity began. First, a long train moved from the north side of the river across to the south. This was occupied by hundreds of men armed with steel bars and pikes. The huge stones were pried off the cars, when they fell with crash, rattle and roar into the river and settled on the carpet. A train on the north end of the railroad was emptied at the same time; and then more trains, and still more. On they came without cessation, day or night. Thus the dam advancing from both ends kept narrowing the space between the approaching bulwarks of massive stones. When this space contracted the speed of the water began to increase. With more contraction, the river above the dam commenced to rise slowly, and then a little faster.

The water got its shoulder under the Rockwood gate and away it went with rush and roar. Consternation and dismay filled every mind—except those of the four engineers. Gloom spread throughout the Imperial Valley. It is not known what thoughts raced through the minds of the four; but the 1,050 workmen could not detect one trace of fear. Instantly every man left the great dam and attacked this unlooked-for danger-problem. For unless the bypass were closed immediately the silt banks would vanish and the two cuts would join into a break a mile or more wide and forever seal the doom of Valley Imperial.

Sleep disappeared, piles were driven, and a railroad was thrown across the bypass in haste. And then rocks rained. Trainload after trainload went out of sight in the boiling flood. And trainloads of gravel, clay and sand. Finally, the heap appeared above the water; and then more trains emptied on the crest



to bring it up to level with the banks. The floods in the deep cut were thus conquered, and then they backed around in front.

The diverted Colorado River that had been displaying its rage at the dam in low, sullen, but ominous tones, now began to roar. As the ends of the dam drew nearer, the roaring grew louder. The water surged, boiled and seethed in anger. Its speed increased with every trainload of rock hurled into its face. Water weighs 62 lb. to the cubic foot, and when in rapid motion its momentum becomes one of the most formidable powers in nature. When the gap grew narrower, not only did the velocity of the flood greatly accelerate, but the river began to rise, and pressure on the dam became enormous.

At sunset November 3, the time for fear, wavering and faltering came. No hope of help from the bypass; all the waters that went through that now had to be dealt with in the center of the great dam. The destruction of the gate changed every plan. Suppose one to be engaged in building a house by plans



**Piling for Railroad Bridge—Velocity of Water 12 Ft. Per Second. Photo by Lubken**

**Items of the Dam:**—Length, 3,000 ft.; width at bottom, 250 to 300 ft.; height when finished, 44 ft.; cords of willows used, 2,200; piles 40 to 60 ft. in length, 1,100; feet of railway trestle built, 3,800; miles of  $\frac{3}{4}$ -in. steel cable, 40; tons of rock in dam, 70,000; cubic yards of earth by cars, 200,000; cubic yards of earth by horses and mules, 300,000; locomotives employed, 8; men employed: Caucasians, 600, Indians, 450; cost of dam, \$1,250,000; time in building actual dam, 86 days; acres of rich land involved, 1,500,000; miles of canal jeopardized, 300.

made by an architect, and that when half finished something should suddenly occur to prohibit the use of the specifications, but circumstances were such that the house must be built in haste or a vast sum of money would be lost. The chances are that the scheme would fail and the loss ensue. The Assyrians and Babylonians in their engineering along the Tigris and Euphrates, and the Egyptians with the Nile, had ample time. But there was not a minute to waste on the Colorado.

Here is the case: 1,500,000 acres of land in the Imperial Valley, pronounced by United States government experts to be as rich as that in the delta of the Nile, were in danger of reverting back to a desert waste, forever deprived of water. The homes of 12,000 people, square miles of rich grains, grasses and fruits, six little cities, hundreds of miles of railway track, and thousands of domestic animals, these and more, were on the verge of destruction. For already the bottom of the diverted river was lower than its primeval bed by 10 feet, and still cutting lower. The fact stared them in their faces that the costly system



of canals would soon be destroyed; and that the awful desert conditions would assume dominion; and that every human being and animal must leave the beautiful vale, never to return.

Rays from the falling sun just before they were cut off by the vast granite rim of the Salton Sink fell on four faces and brought out lines of determination set and fixed as though cut in flint and adamant. These were the engineers "cumbered with a load of care." For the eyes of every hydraulic engineer were watching from afar every move to see which would come out victor, man or river. And the sun's fainting light fell on the faces of 600 men of the Caucasian race and 450 Indians—all selected men, trained like soldiers for this dangerous war: Americans, Spaniards, Mexicans, Frenchmen and Germans, together with Cocopahs, Mariposas, Pimas, Diguones, Yumas and Mojaves, who formed the largest number of American Indians ever at work in one body.

When darkness fell the electric lights flashed upon the weird and entirely unique scene. The river was rising and the impetuous flood roared louder than before. The terrific speed of the pent-up water was fearful to look upon even, to say nothing of man's audacity in attempting to stop its wild career. No shadow of fear, discomfiture or dismay appeared on the bronzed features of the engineers. For, if there had, it is probable that a panic would have ensued at once. It was just before a real battle, fraught with danger. These men had to go out over the awful flood 1,500 ft. from either shore. Who could say but that the dam might go when the water came up to the carwheels and sink every train on the tracks? Burning oil under the locomotive boilers roared hot words of defiance to the floods beneath; and the water hurled back derision and scorn to the roar of fire and hiss of steam, to exploding safety valves, and exhausts of monster engines and the hideous grinding of a thousand carwheels on granite grit. No such combine of noises was ever known on earth. "Go" was a word of command. Two entire trainloads of rock hailed into the jaws of the torrent. The floods howled in rage and rose a little higher. The empties moved to shore, and two more long trains came over the gap and hurled their loads into the teeth of the dragon below. Pelee was rivaled in the art of stone-throwing and Vesuvius, for a new Gettysburg was raging. Then long trains of enormous weight, of cars called "battleships," loaded with hundreds of tons of gravel, rolled over the tempest of water. These cars are made of steel, and their sides are suspended on hinges. At the word of command both sides of both trains flared out and a rain of gravel fell, the like of which was never seen. These small stones filled the interstices between the large. This caused the river to rise faster and the awful current to increase its fury. And pressure grew apace. At midnight a wonderful word of command was heard—"Faster!"

More oil went into the fires; steam could do no more. Pikes and bars of steel were grasped with renewed energy by many tribes and kindreds of men. Human hands could not move faster. "We must have large rocks now," was the order at 1 a. m. For rocks now began to be deflected out of a vertical line and go down-stream somewhat. "Bring the 5-ton rocks." One of these, weighing  $5\frac{1}{2}$  tons, was watched when it dropped. The water clutched the mass when it rolled and tumbled over similar rocks down the side of the dam 60 ft. It is still there—a witness to the momentum of running water. "More rocks!" was the incessant cry.

Behold! there was light in the east. It was dawn; the progress of time had not been noticed. More trainloads of heavy rock brought the crest of the dam up to the tracks. Then train after train of "battleships" expanded and thundered down gravel. As the sun rose, so did the river, and faster if possible came the rock and gravel. Here is the record of the battle when at its height:



One car of stone was thrown in during each interval of  $4\frac{3}{4}$  minutes! This broke the world's record. The throats of Aetna and Cotapaxi may have done better at times.

It was exact noon of Sunday, November 4th.

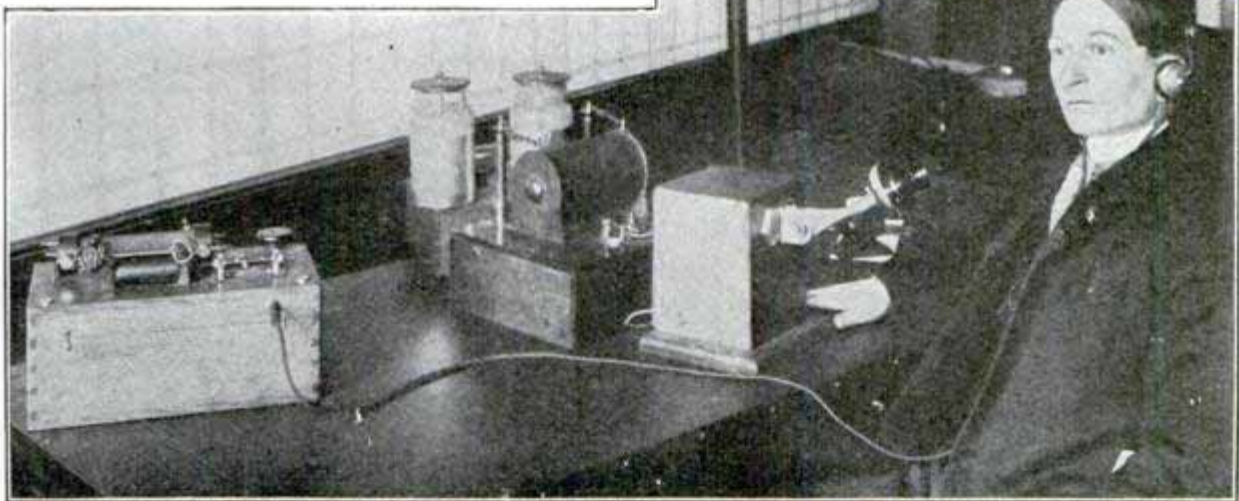
"Oh, look! The river is not rising," shouted some one. "The water is stationary," said another. And "it is beginning to fall," another. And then a triumphant shout, and a shout of victory, was heard in the wilderness.



## WIRELESS TELEPHONY IN USE

**Detroit Inventor Demonstrates Practicability—May Be Nucleus of Wonderful System**

Wireless telephony is an accomplished fact and now it only remains for its inventors to perfect their ap-



**Prof. Clark and Wireless Telephone Instruments**

paratus and adapt it to the commercial needs of the day. The world is no longer incredulous. The rapid advancement made in the use of wireless telegraphy has swept away the doubts of even the most conservative and business men are looking forward to the time when unrestricted verbal communication between New York and London, or Chicago and Berlin, may save them a trip across the ocean.

Thomas E. Clark, of Detroit, has produced a wireless telephone system which seems to be the nucleus of the world-connecting system yet to come. Instead of the air, as in wireless telegraphy, he uses the earth as his medium of transmission, success depending,

it is said, upon sustained vibrations.

As yet Mr. Clark has tried his instrument with only two dry cell batteries and with apparatus designed for short distances. These experiments, however, have been attended with promising success. The sound was carried without loss in volume, change of pitch, or the disagreeable sonorous defects incident to the metallic circuit 'phones.

Despite this wonderful achievement, the difficulties yet to be met are great. For instance, in order for one patron to call up another in a distant city, where hundreds of telephones were in use would necessitate that the sending instrument or transmitter be given the



right degree of power to overcome both the distance and the varying accidental conditions which affect transmission, and be attuned to set up vibrations in the particular 'phone desired, calling the attention of the owner and enabling him to hold converse over the wireless line. The field of operation, however, cannot be limited and may eventually include any two points on the earth's surface.

### 35-FT. CABIN CRUISER

The plans shown are those of a very commodious little cruiser described in *The Rudder*. This boat is 36 ft. over all, 33 ft. on the water line, and 9 ft. 3 in. breadth. Three watertight bulkheads will be fitted, making the boat practically unsinkable.

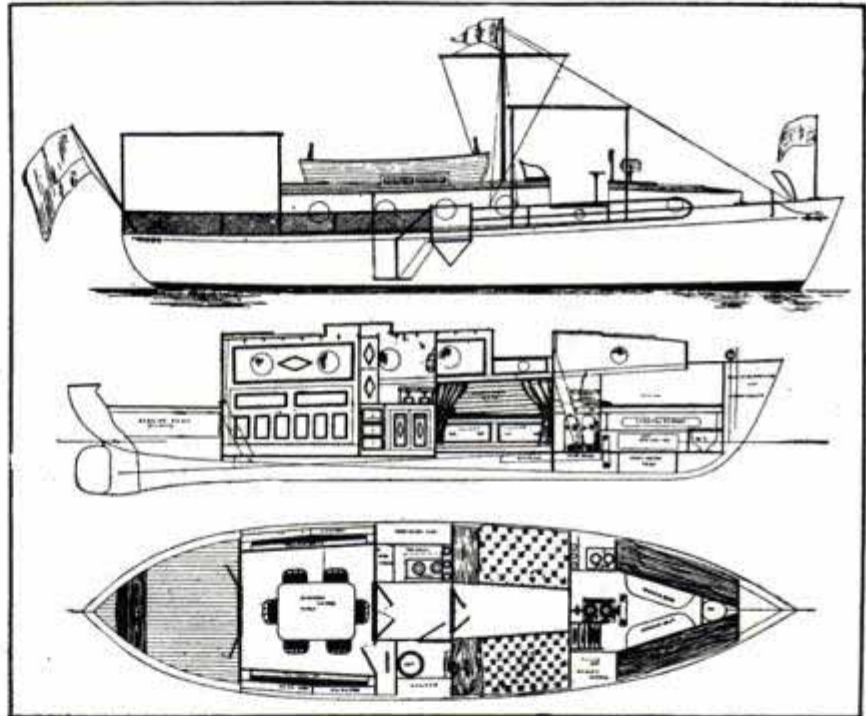
In general appearance the boat resembles the larger type of motor yacht. Every inch of space has been put to practical use. The deck is raised forward, and the deck house is divided by a bridge coming over the forward end of the double stateroom. The motor is located forward in what is properly the forecabin, which also includes berths and toilet accommodations for the crew. Next aft of this and separated by watertight bulkhead is the owner's stateroom with berths on either side, and from this again is a passage having the galley on the port side and owner's toilet room on the starboard side. The main saloon is at the after end of the cabin and has Pullman berths folding up in the joiner work on either side, and dining table in the center. From the main saloon one enters the self-bailing cockpit, in which is the fuel tank, with a capacity of 200 gal. The bridge deck and cockpit are covered by awnings, and a 10-ft. dinghy is carried on

davits on the port side. A signal mast and boarding ladders are fitted.

The motor is a 22-hp. gasoline engine. Equipment includes a generator, storage batteries, with incandescents and searchlight.

### QUEER VENTILATORS IN INDIAN CARS

The passenger coaches on the railways of India are using a peculiar ventilator to fan their patrons. Four wind scoops are placed on top the car, attached to a vertical shaft extending down into the car with two blades. When the car is in motion the scoops



Complete Little Cruiser

above and the blades below revolve, and also by means of gearing wind up springs which run the blades while the train is standing still. The *Railroad Gazette*, Calcutta, says the passengers in a compartment can regulate the operation of the fans.

An autobus line will operate between Tokyo and Kanagawa, Japan, a distance of 9 miles. Fare will be 2 sen (1 cent) per mile.

Eight bills for charters for railways to Hudson Bay are pending in the Dominion parliament.



## BRIDGE TRAMWAYS FOR GREAT LAKES DOCKS

**Crane Weighs 520 Tons; Trolley and Bucket, 35 Tons**

An immense bridge tramway, equipped with a 7-ton bucket for carrying iron ore from the wharf to a storage trough, and which is operated by electricity, is a notable feature of the Conneaut (O.) docks. It is said that one similar to it is to be erected on the new lake front docks of the Pennsylvania company at Ashtabula harbor the coming season, also another at Conneaut.

The bucket used on this machine is known as a "two-rope grab bucket." One rope operates the shell and the other the parts known as the "spades," which do the scooping of the ore. By this arrangement the spades can be engaged in digging without lifting the bucket. The weight of the crane is 1,039,000 lb. and that of the trolley and bucket is 69,000 lb. The speed of the trolley travel is 1,000 ft. per minute, the bridge travel 75 ft. per minute, and that of the hoist 225 ft.

Electricity in the operation of ore-handling machinery is comparatively new. It is rapidly gaining favor and one Great Lakes dock after another is being electrically equipped.

The cement trough into which the ore is dumped from the bridge tramway bucket represents a new feature of storage. The sides of this trough are so arranged that the ore is kept at all times at a point where it can be most easily grappled by the automatic grab buckets at the time of reloading it to cars.



7 Tons at a "Bite"

### ELECTRICITY CONFIRMS ABSOLUTE ZERO

There is no such thing as cold. The word cold means simply the absence of heat, just the same as darkness means the absence of light. No matter how brightly a room may be illuminated, by adding more lights the illumination will be increased, but a room in which there is not a ray of light is dark and it cannot be made any darker. It is the same way with cold. An object in which there is no heat is cold and it cannot be made any colder. The temperature of an object in this condition is said to be absolute zero, and although it has never been produced nor is even known to exist, it has been



measured and found equivalent to  $273^{\circ}$  C. below zero.

The method of measuring this unobtainable temperature is as follows: It has been found that all gases expand when heated and contract when cooled, the expansion and contraction being  $\frac{1}{273}$  of the volume at  $0^{\circ}$  C. for each degree. From these results it is evident that if a gas were reduced to the temperature of  $-273^{\circ}$  C. its volume would be reduced to  $\frac{0}{273}$ , or, in other words, the volume would be reduced to zero and it would therefore be impossible to reduce it any further. Although it is very improbable that any gas could be reduced to such a low temperature without liquefying, the constant rate of decrease in volume while it remains gaseous would indicate that  $-273^{\circ}$  C. is absolute zero.

Nevertheless, it might be rash to draw, without further precautions, so general a deduction from one particular set of facts. But in an entirely different field of investigation precise facts do appear which add substantial evidence to the foregoing deductions. It is well known that the electrical resistance of pure metals is increased by heat and decreased by cold, but it was at the suggestion of Maxwell, says L'Air Liquide, that the rate of decrease was used to determine the absolute zero of temperature. By very careful experiments the rate of decrease was found to be exactly  $\frac{1}{273}$  of the resistance at  $0^{\circ}$  C. for each degree, thus definitely establishing the equivalent temperature of absolute zero. These experiments are always performed with pure metals, only.

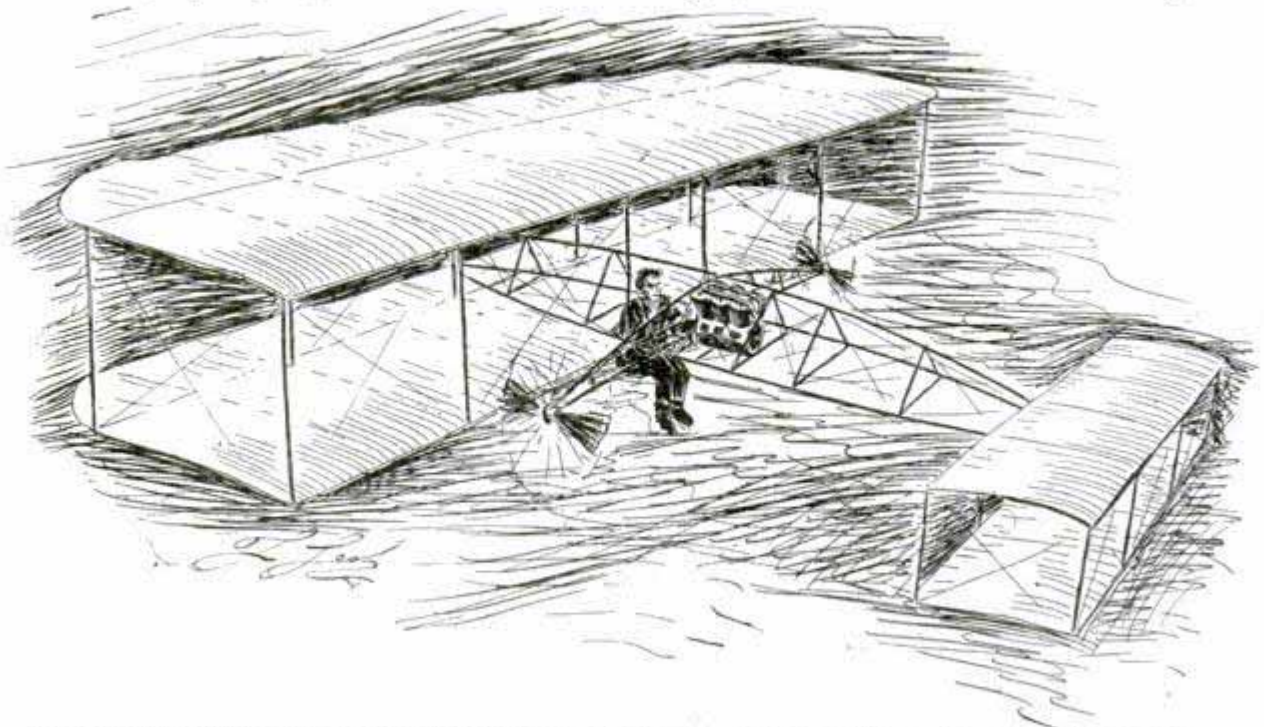
## FLYING-MACHINES OF TOMORROW

By L. J. Lesh

Now that human flight is an actual fact, demonstrated by Dumont and the Wright brothers in a way calculated to convince even the most skeptical, it will not be out of place to indulge in a little prophesying as to how the

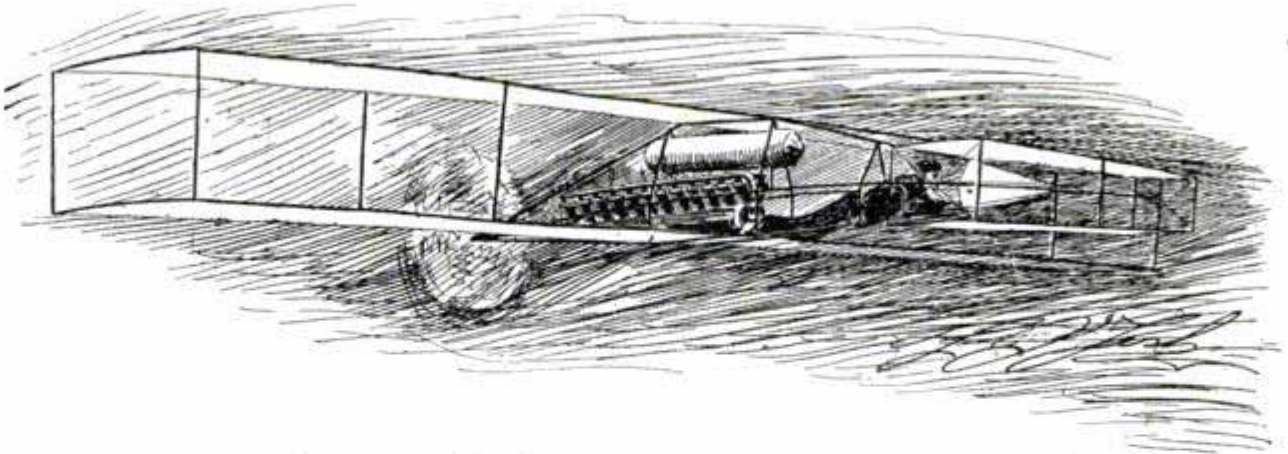
flyers of a few years hence will appear and perform.

The problem of flying has from the first been attacked by experimenters along two different lines—soaring flight, in which the sustaining and



A soaring machine equipped with a light motor for use only in rising and in flying in a calm or very light wind





**A very heavy motor flyer equipped with an extremely powerful engine which renders the whole machine unmanageable if it happens to stop in mid-air**

propelling power is obtained from wind and gravity, and dynamic flight, in which a motor takes the place of the forces of nature.

The first type of machine has been brought to a high state of perfection, but the skill of we aeroplanists is not yet well enough developed to enable us to soar off into the blue.

The motor-driven flyer is a success, but so far its relatively great weight has made experimenting high in air, or over localities where landing is impossible, dangerous because of the possibility of the motor giving out, or some accident happening, to the steering or supporting surfaces.

The Wrights' and Dumont's machines both had sufficient surface to make safe landings after accidents, but Santos' new machine, which is built entirely of aluminum and is consequently very heavy, will be absolutely unmanageable if its motor stops.

It is such machines as this that will shatter the public's faith in our ability to ever make flying safe. These projectile machines, depending entirely on their high-power motors for propulsion, will do very well for speed maniacs who are longing for new sensations and accompanying dangers, but most people will wait for a machine that will carry them through the air at a reasonable speed and without turning air-springs every time the motor feels indisposed.

Such a machine will have large supporting surfaces and will depend almost entirely on the wind currents for

its support in the air. A small and compact motor will be used in rising and when the conditions aloft prohibit soaring. Since it will not depend generally on its motor for support, the stopping of its propeller will merely necessitate its gliding slowly to the ground in a calm, or, if there is a wind, it will soar for a length of time proportionate to the skill of the operator.

Now a word as to safety. During almost ten years of experimenting with flying-machines (gliding and motor) constructed on the truss principles laid down by Mr. Octave Chanute, Messrs. Herring and Avery and the Wright brothers have made thousands of flights, yet neither machines nor operators have suffered mishap in free flight. Accidents, it is true, happened to the Wright glider when they attempted flying it as a kite, and Avery sprained his ankle on account of the breaking of a rope which he was using as a kite line in raising his machine at St. Louis; but these accidents were caused by conditions over which the aeronauts had no control, and only go to show that greater care will have to be taken in rising and in maneuvering near the ground where eddies of air constantly endanger equilibrium.

The question of cost will be of considerable moment in deciding the future importance of the aeroplane. While it is certain that at first the flying-machine will be merely an expensive toy of the rich, it is equally certain that as its construction is simplified and its cost of operation



reduced, it will find much better use and will finally become one of the, if not the favorite means of rapid transit.

Getting down to figures, I estimate that motor flyers will in a few years be selling at less than \$150. A glider built by O. Chanute in an extreme (spare no expense) manner cost less than \$100, and many of his former machines cut far below that mark. I have just finished building under Chanute's directions a glider which, though it is of sufficient size to carry a motor and is constructed with no idea towards economy, only cost \$20. A motor of sufficient power for this machine would cost about \$150 at the present time, but I am confident that motors will soon be put on the market at a much lower figure.

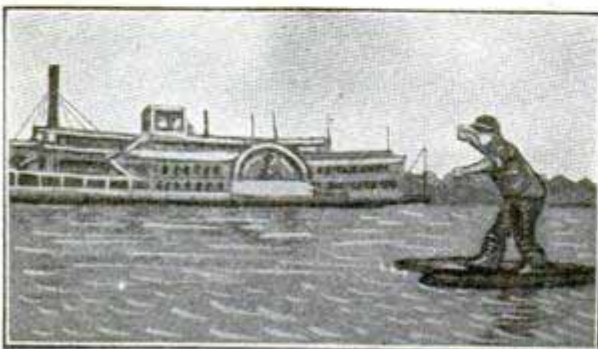
The construction of flyers during the past few years has brought out certain good points which we may safely predict will appear in the machines of the

future. Chief among these is the method of steel wire trussing, whereby the necessary strength and rigidity are assured for the framework. The frame itself will probably be made of spruce wood, its various parts being put together with steel or aluminum joints. The surfaces will probably be either of very thin aluminum or strong cloth, the latter made air-proof by a coat of collodion. While there is considerable doubt in the minds of experimenters as to the correct curvature for the supporting surfaces, my experiments have indicated that a surface curved slightly at the rear edge and balanced by a smaller surface placed well out in front of the machine has better stability and gives more lift than any other arrangement. This point, however, is not yet entirely clear and presents to the inventor one of the many problems he must solve before he can put before the public a perfect flying-machine.

### MAN WALKS ON WATER

A Boston professor is the inventor of some wonderful boots which enable him to walk on the surface of deep bodies of water, with no fear of sinking. The boots are made of cedar and are 4 ft. 2 in. long, 6 in. wide and 6 in. deep. The feet are held in the boots by an elastic webbing, and in walking they are never lifted from the water, short, quick strides being taken.

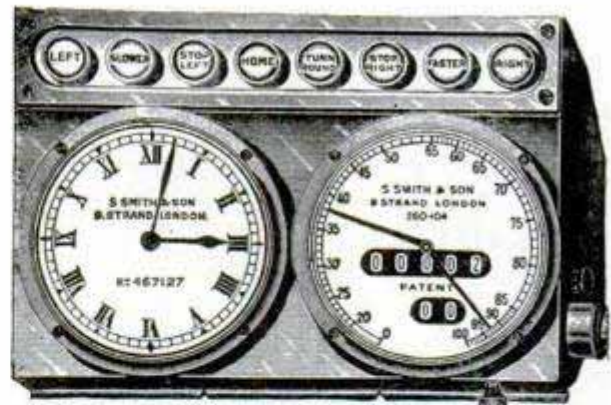
The inventor will attempt to walk down the Ohio and Mississippi rivers from Cincinnati to New Orleans in his strange shoes, to win a wager of \$5,000. He expects to make the trip in 40 days.



A Road Without Dust

### COMBINED CLOCK AND SPEED INDICATOR

This combined clock and speed indicator for automobiles also makes a

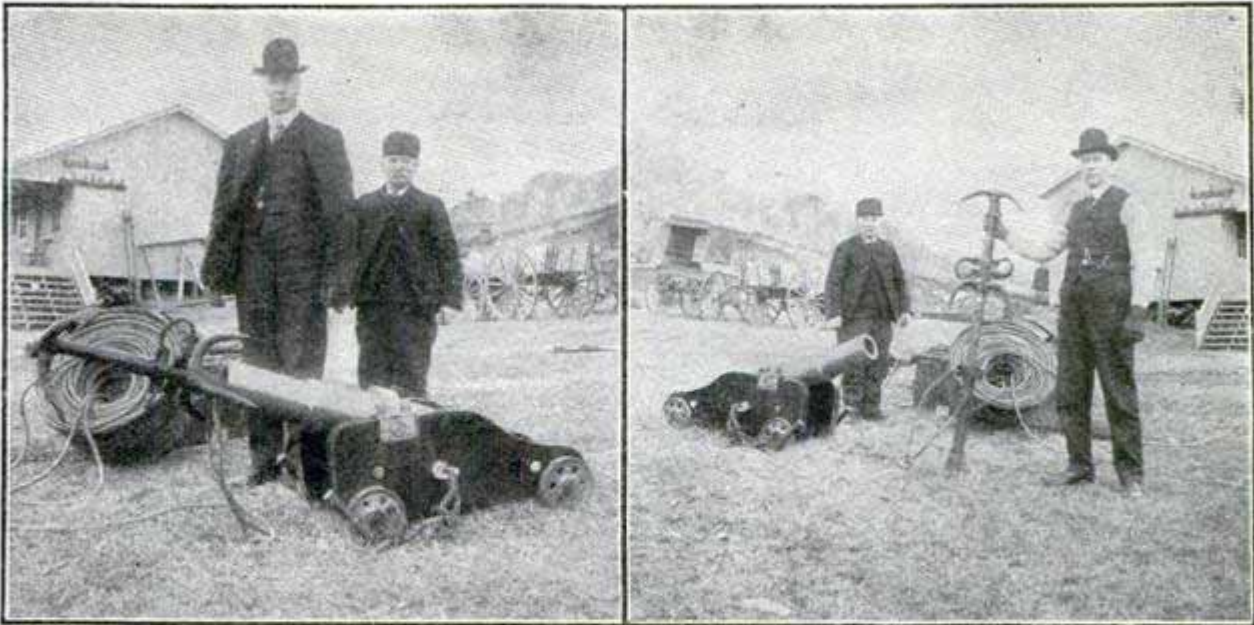


Tells Time; Indicates Speed

record of the miles traveled. The push buttons above are for communicating orders to the chauffeur.

One "prayer car" is attached to each passenger train on the "Holy" railway which the Turkish government is building. Pilgrims are carried free, but have been rather slow in patronizing the line.



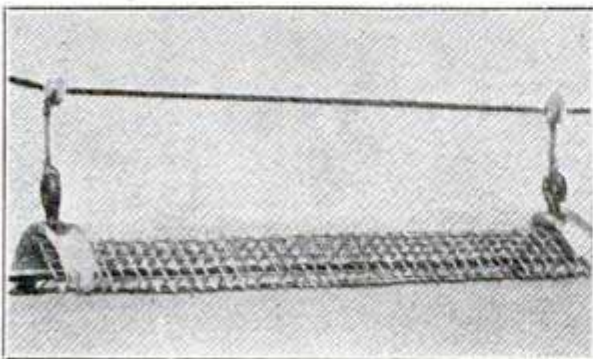


Copyright Walden Fawcett

The above illustrations show the latest invention in life-saving projectiles. Some of the United States Life-Saving Stations have already been equipped and the apparatus is being considered by chiefs of fire departments in several large cities. The outfit is easy to carry and operate, and with a little practice the anchor can be fired through a window several stories up, or thrown over the top of the building. The flukes are certain to catch.

## SAFETY TROLLEY FOR RAILROAD CROSSINGS

Every little while some trolley car becomes stalled while crossing the tracks of a steam road, and there are numerous cases on record where an express train has wrecked the street car because the conductor was unable to replace the trolley wheel on the wire in time to get out of the way. The Electric Traction Weekly describes a recent invention which is expected to prevent future accidents of this kind. A metal network in the shape of an inverted trough is stretched across the steam tracks close above the trolley wire. This wire netting is charged with the same current as the trolley

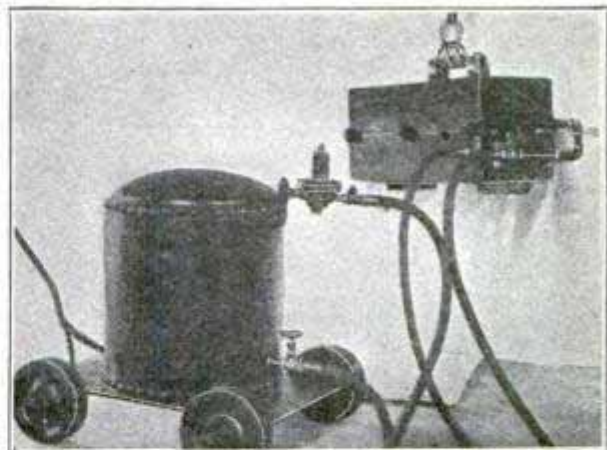


To Save Wrecks

wire and would enable the motor car to continue its passage even when the trolley wheel had jumped the wire.

## LOCOMOTIVE FIRE KINDLER

To save time and kindling in starting a fire in a locomotive, the device illustrated has been adopted on some



Makes a Quick Fire

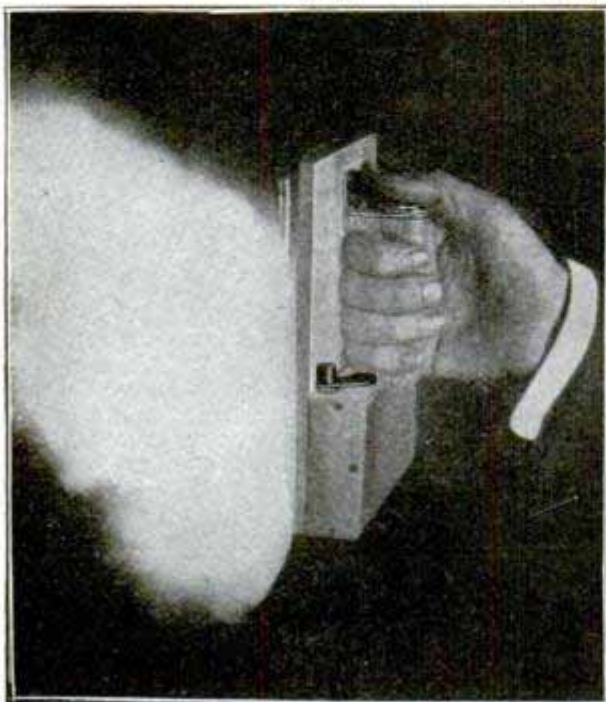
roads. Crude oil is used in large burners with a mixture of air, the necessary pressure being supplied by compressed air carried in a tank on wheels.

Electric power from the Canadian side of Niagara Falls is now propelling the street cars of Toronto.



## PRACTICAL FLASH-LIGHT HOLDER

The staff photographer of one of Chicago's leading dailies, whose original work in newspaper photography



Photographed by Its Own Flash

has attracted national attention, has invented the first really practical flash-light holder. In these days newspaper photographers have to work quickly; the managing editor cannot wait for the sun to shine, and nearly all interior views are now flashed. In working out of doors great difficulty is experienced in preventing the powder from blowing away; in making it flash at the exact moment, and in directing the light where most needed. Pictures of almost priceless value are lost daily through failure arising from one of these causes.

The device illustrated insures a good strong negative regardless of sun, wind or weather.

The powder is inclosed in thin flat bags about 4 by 5 in. which can be attached to the shield in an instant. The shield acts as a reflector and protects the operator from injury, and can be pointed up, down, or sideways, like a dark lantern. The explosion is caused by pressing a button in the handle, which makes a sure spark from

miniature batteries contained in the box below. The switch is thrown on when going into action, and the button sets off the flash at the moment required. Any photographer, professional or amateur, will recognize the advantages of the new method.

## KEYLESS CLOCKS FOR TELEPHONE SUBSCRIBERS

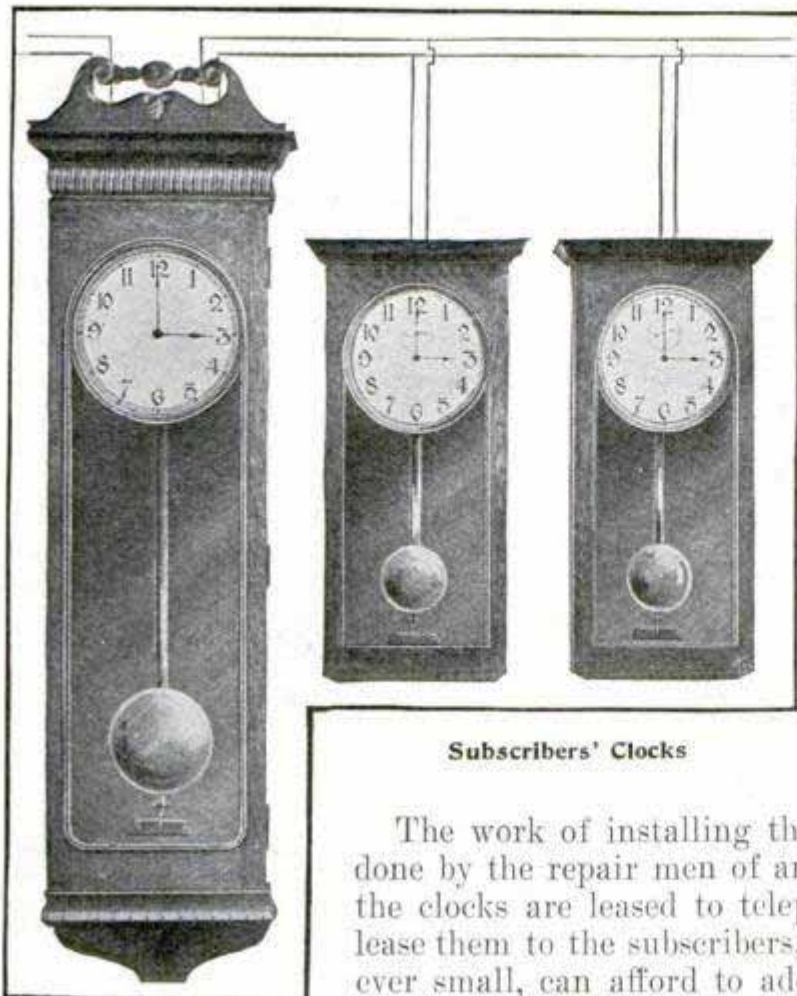
"Central" Does All the Winding—Observatory Time for Home and Office

The good old-fashioned clock operated with weights or springs is being crowded out of existence in these electrical days, and is rapidly becoming a curiosity. Telephone companies are now furnishing their subscribers at a small annual rental, self-winding electric clocks that give absolutely accurate time. The clock or clocks can be placed anywhere in the house and are connected to the telephone wires by means of concealed wires. The telephone clock never stops, for it never runs down, and should it vary a second or two in the course of the 24 hours it will be correct again within a few hours, for once each day all the telephone clocks in the city are synchronized, or set. This setting is done from the central office at some hour when the telephone is least likely to be in use, say 3:00 o'clock a. m. The setting requires only a moment and is accomplished by a separate current sent over the wires from the master clock.

The operation of the telephone clock is simple and will be readily understood by the illustration, Fig. 1. The winding is done by means of dry batteries, which energize the magnet, (see cut), and cause it to lift alternately the small round weights, each one of which in falling once will operate the clock  $7\frac{1}{2}$  minutes.

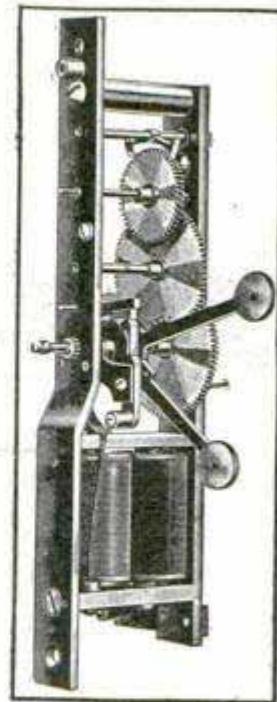
The system is absolutely safe and the rental of a clock is about the same price as people pay for having clocks cleaned each year.





"Master"

Subscribers' Clocks



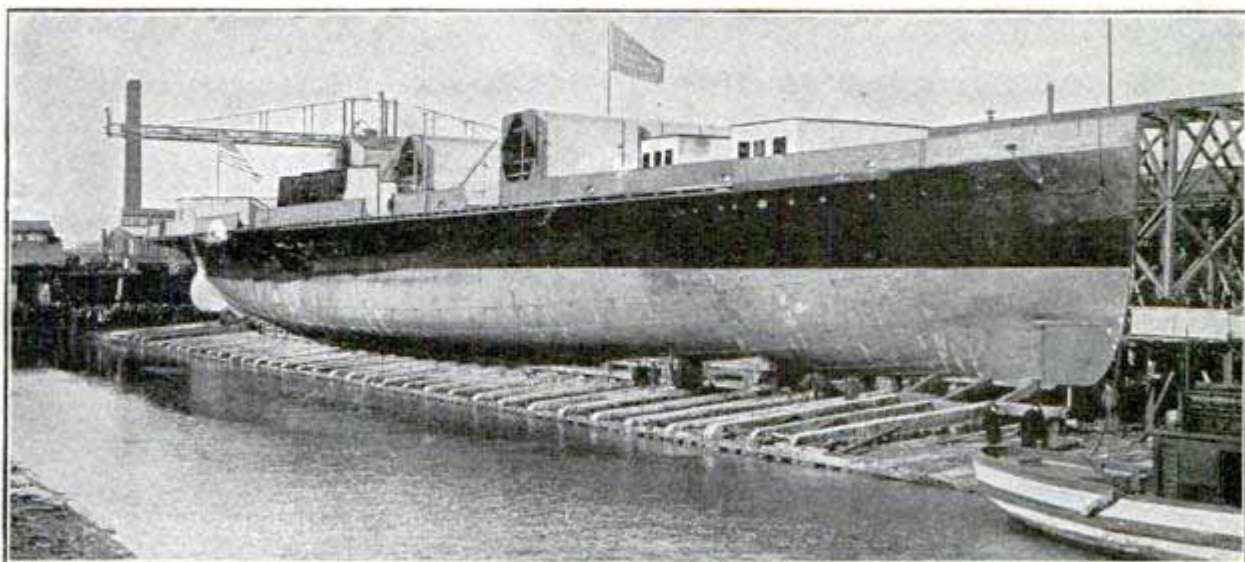
The Works

The work of installing the clocks is simple and can be done by the repair men of any telephone company, and as the clocks are leased to telephone companies, who in turn lease them to the subscribers, any telephone company, however small, can afford to adopt the system, as it yields just that much additional revenue without any investment.

## LARGEST SIDE-WHEELER IN THE WORLD

The largest side-wheel steamer in the world, the "City of Cleveland," was launched at Detroit on January 5th. Her dimensions are: Length, 444 ft.; beam, 96 ft. 6 in.; and depth, 22 ft.

There are seven decks with a passenger capacity of 5,000 and sleeping accommodations for 1,500. In addition, freight cargo equivalent to 110 carloads can be carried. Electric passenger



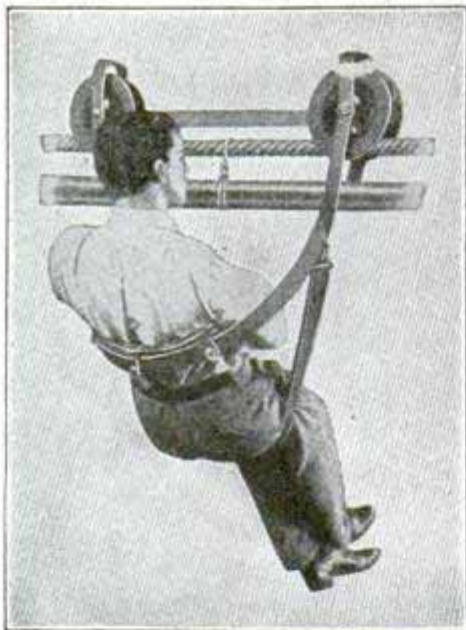


elevators connect the upper and lower decks. There is a telephone in every stateroom which will have connection with the city service when in ports. A complete wireless system will afford land communication when sailing. A speed of 25 miles is expected from the 8,000-hp. engines.

A unique feature is the bow rudder which can be seen in the illustration taken just before launching. The steamer will cost \$1,250,000 and run between Detroit and Cleveland the coming summer.

### SAFETY CAR FOR LINEMEN

A new safety messenger car for use of linemen is shown herewith. The



Will You Ride?

car weighs 28 lb. and the occupant can push himself along without assistance. One of the chief points of improvement is that the workman faces his work instead of being obliged to look up, and being securely strapped to the car, he has both hands free for work.

When hanging pressed paper over varnished paper, says the Master Painter, first cut the varnish with strong sal soda water, which will remove the glaze so the new paper will adhere firmly.

### SPRING MOTOR AUTO FOR CHILDREN

This juvenile auto, complete with pneumatic tires, horn, steering wheel, ball bearings and lamps, is now on the market for use by children. It weighs only 60 lb. and cannot travel faster

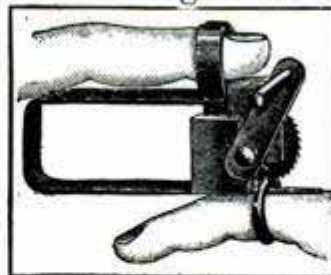


Speed 5 Miles

than 5 miles an hour. Starting and stopping is accomplished with two foot pedals. The motive power is a powerful spring which is wound up with a crank handle and is so geared that a child can wind it.

### REMOVING RING FROM FINGER

The old way to remove a tight ring from a finger was to file the ring in



two, using a thin, sharp file and placing a narrow strip of metal between the ring and finger to protect the skin. This

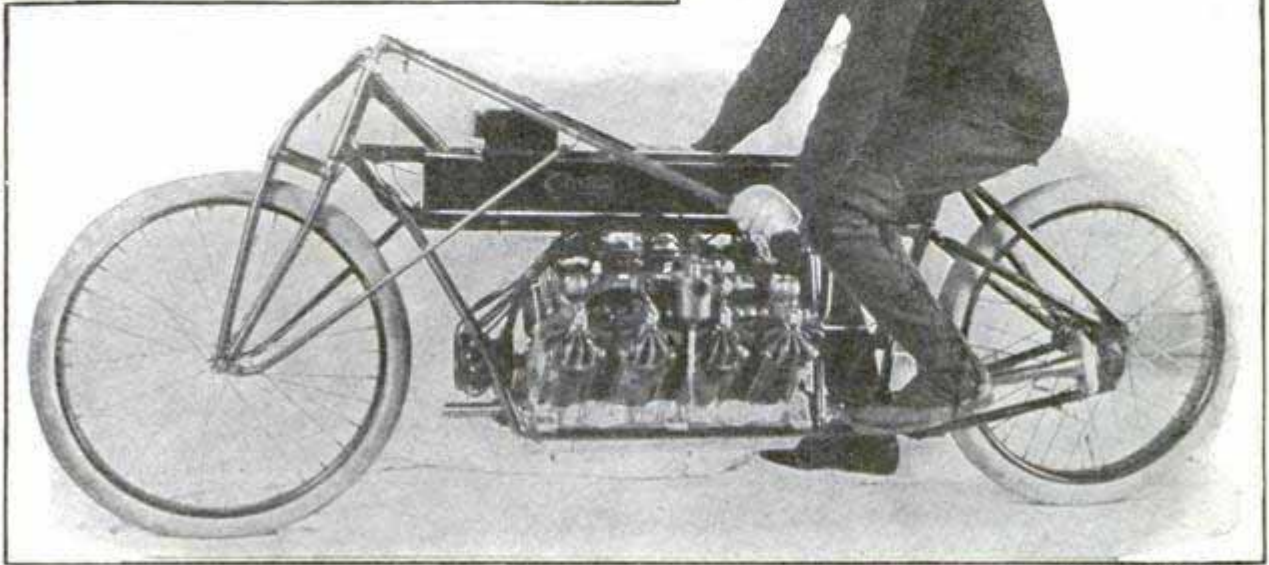
operation, while effective, is necessarily slow, and usually by the time such a measure is necessary the finger has become badly swollen and extremely painful.

The latest addition to a jeweler's kit of tools is a ring sawing machine, which is quick and painless. Its operation will be readily understood from the illustration.



### MOTORCYCLE MADE FASTEST TIME ON RECORD

The largest and most powerful motorcycle ever built has recently been completed and entered the contest in the 1907 Beach races. It is an 8-



Courtesy C. B. Curtiss Mfg. Co.

#### 40-Hp. Motorcycle Which Made a Mile in 26 2-5 Seconds

cylinder machine of 40 hp. The record for the 10-mile race is already held by the same builders who won the 10-mile race three years ago at Ormond Beach with a double cylinder machine in 8:54 2-5. Great expectations are placed on the performance of the new machine, which is driven direct with a one to one gear, with 26-in. rear wheel. The wheel base is 65 in. The entire machine weighs 300 lb. and is faster than any other mechanical motive power ever built by man.

long day from March to October. Think of night constantly from October to March. The imagination is staggered! There is no time at the north pole. A phenomenon to be remembered about the pole is that there is no north, no east, no west. You can only go one way, and that is south. In the Arctic there are ice cakes as high as the capitol at Washington."

#### DIAMOND DIES FOR DRAWING WIRE

#### PEARY READY FOR A RUSH ORDER

Commander Robert E. Peary says that if he receives a rush order he will be ready to undertake another polar expedition in the summer of 1908. He claims that his last trip simplified reaching the pole 50 per cent, and still believes that sledging is the only practicable means of transportation thither. Speaking of the far north, he said:

"In the Arctic 100 days is a century, because the sun shines through one

In the various wire factories of this country several hundred thousand dollars' worth of diamonds are used as dies for drawing fine wire to sizes less than 0.025 in. in diameter. The diamonds weigh four to five carats each, are worth from \$15 to \$20 a carat and are uncut except as to the die.

The hardest steel dies cannot be used for this purpose as the wear enlarges them so that the wire is not of sufficiently uniform diameter. With diamond dies platinum can be drawn to a diameter of five-thousandths of an



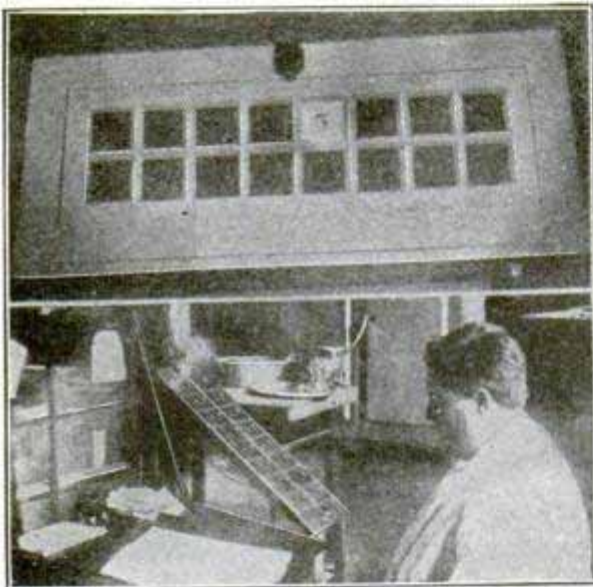
inch and in one pound of copper there are six miles of wire three one-thousandths inch in diameter.

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### MECHANICAL IMPROVEMENT FOR HOTEL DINING ROOMS

When a man takes his seat in the dining room of a hotel and has given the order for his meal, he usually waits patiently until he is served—unless he looks across the table and notices that the guest who came in some time later than he is served first. Then he gets mad.

Sometimes delays are unavoidable, but the new mechanical system of



"Cook Presses Electric Button When Order is Ready"

checking described in the *Hotel World* is expected to largely correct the trouble, and incidentally give prompter service with one-fourth less waiters. This is how it is done:

When the order—which is written on an order blank—reaches the kitchen the checker numbers it with the number of the waiter and by means of a time stamp prints the hour and minute it was received. Then it is passed along to the cooks. With the record of the time the order is received staring him in the face, even the most procrastinating cook sees no chance to lay the blame of delay on some one else. So he gets busy.

In the meantime the waiter has returned to his station in the dining room to wait upon the guests, and instead of making several fruitless trips to the cook's domain he does not start for the kitchen until he is called. This is a very simple but effective system. When the order is ready to leave the kitchen the cook presses an electric white button bearing the number of the waiter who brought the order and instantly in the dining room the same number is lighted in an annunciator. When No. 5 sees his number flash he knows there is something ready for him and he goes and brings it in. When he receives his eatables his number is extinguished by pressing a black button.

The apparatus is so simple any local electrician can install the device which should be worth many times its cost in any hotel, large or small.

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### THE NEW HELION FILAMENT LAMP

After having worked at the problem for several years, Prof. H. C. Parker, of the Physics Department at Columbia University, New York City, and W. A. Clark, an electrical engineer, have at last succeeded in perfecting a substance that will take the place of carbon in the incandescent lamp. They have named it "helion," and hope by means of it to reduce the cost of electric lighting to a third of what it now is. It is composed to a large extent of silicon; the other substances which go to make it up have not yet been made public. An experiment was tried on January 13th: A current was turned into two bulbs attached to the same wire. One of these bulbs was the regular 16 candlepower carbon filament variety, the other the same sized bulb but equipped with the helion filament. A slight current was turned on, the carbon filament lamp gave only a small dull red glow, while the other gave a bright glow sufficient to read by. The current was increased to 55 watts, the old lamp gradually brightened until it



equalled 16 candlepower. At 38 watts the helion lamp was equivalent to 40 candlepower. Mr. Clark said that if the power were increased the carbon filament would break, but the other lamp would stand a great deal of overloading. Out of the few thus far tried eight lamps have lasted from 485 to 1,270 hours.

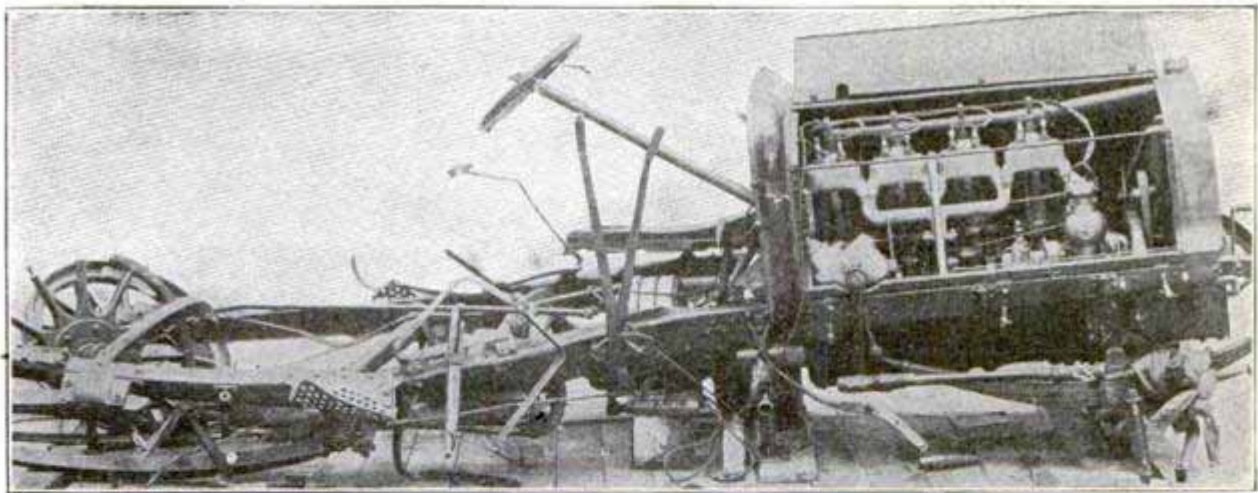
Prof. Parker said: "The lamp that ran 1,270 hours showed a rather interesting performance. It was started at 37 watts and 37 candlepower. At the end of 200 hours it began to show an increase in candlepower, which increase continued until the candlepower reached 40 at 400 hours, the wattage remaining practically constant at 37. At 400 hours the candlepower began to decline and again crossed the 37 mark at 500 hours. When the last reading was taken at 1,230 hours the illumination had dropped to about 35.5 candlepower and the consumption to about 26.5 watts. We have been able

to make filaments as low as 30 candlepower. We want them to get down to 20."

If this new lamp were to be manufactured right now, it would cost ten cents more than the carbon filament lamp, but it is hoped to reduce this cost. But this lamp will last twice as long as the old one, besides requiring a great deal less current.

About a year ago Dr. Siemann, a German scientist, announced that he had made a filament of tantalum. It consumed only 1.9 watts per candlepower and was called "the most startling advance in electric lighting invention since the pioneer work of Edison."

Dr. Kusel, another German, said that he had found tungsten—a rare metal—to be the perfect filament. It consumed 1.2 watts per candlepower. Prof. Parker and Mr. Clark say that 1 watt per candle has been reached in helion—not a metal—and that it can be made in great quantities.



### WHEN MOTOR CAR AND LOCOMOTIVE MEET

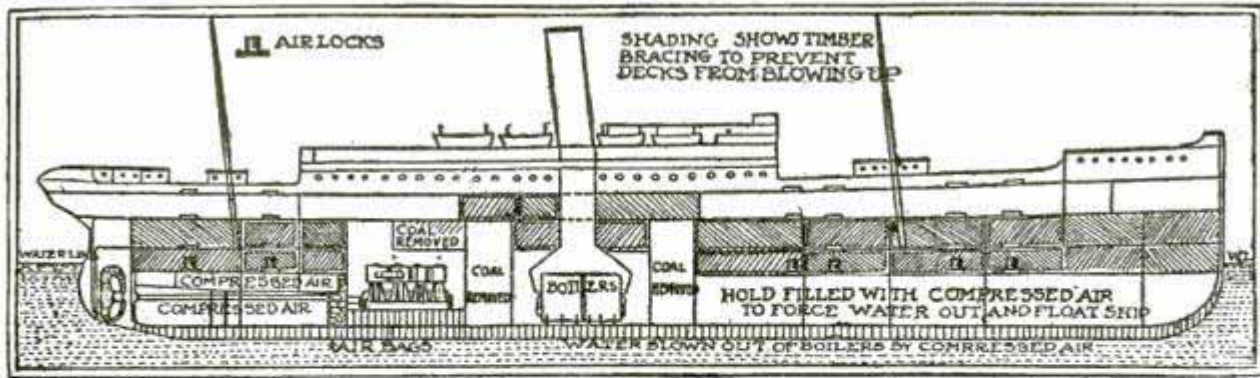
While too many of them have suffered the fate, what a motor car that has been struck by a railway train looks like is a sight seen by comparatively few eyes. The accompanying picture will therefore satisfy some little curiosity. It portrays a four-cylinder car that has been hit by a 60-miles an hour express train. A notable feature of this particular wreck

is that when it was first received at the factory for repairs the motor was tested and found to work almost perfectly despite the terrific impact to which it had been subjected.

◆◆◆

Canada is trying to pass a bill imposing an export duty on electrical power generated in the Dominion and sold in the United States.





## RAISING A 12,000-TON STEAMER

### How Two Young Engineers Succeeded After Experts Failed

It was a damp, foggy night on November 1, 1905, when the Royal mail steamer "Bavarian," bound for Quebec, struck on Wye Rock in the St. Lawrence river, 38 miles from her port. The great 12,000-ton ship was alone worth one million dollars, and the next day divers went down and reported the bottom of the hull torn out in great pieces and the wreck securely impaled on the sharp rocks.

One after another of the wrecking companies tackled the job, but all the various methods which had proved successful in other wrecks utterly failed with the "Bavarian." Finally the insurance companies, in desperation, began a search for men with new and untried ideas.

The announcement fell into the hands of Robert O. King and his friend, W. W. Wortherspoon, two young American engineers only recently graduated from technical schools. One of them then had a position on one of the tunnels under East river; he was also an expert diver. The two formulated a plan for expelling the water from the wreck by means of compressed air, in a manner similar to that employed in forcing water out of a caisson. The old-timers laughed at the scheme, but the young men were given permission to try. All the ship's compartments were made as air-tight as possible, the hatches were closed, sealed and fastened; and air locks were placed on the compartments which were full of water.

When all the preliminary work was done, several batteries of big air compressors were brought, anchored over the wreck and connected by flexible piping to the interior of the hull.

As the air was sent down into the hull the water was gradually forced out and on November 16, 1906, the wreck suddenly shook itself free from the rocky jaws which held it, and began to rise. As it came up through 60 ft. of water it rose faster and faster and then appeared above the surface covered with the slime of the river bottom. Tugs gathered around, made fast, and the triumphant procession steamed into Quebec with whistles blowing and flags flying.

The operations had cost only \$30,000 and the salvage reward is one-half her value, or \$500,000.

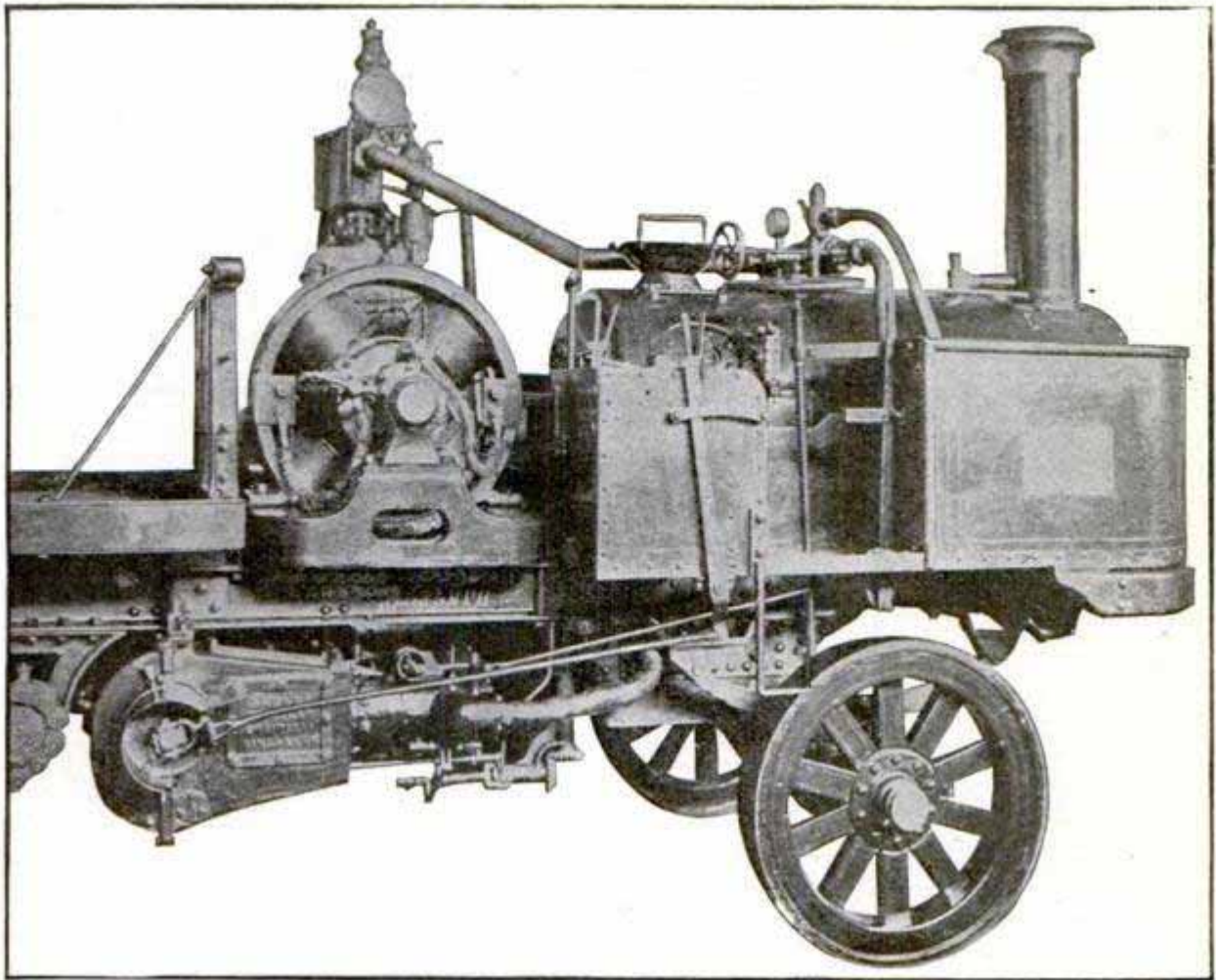
Brains and education had won.

### ELECTRIC FENCE TO GUARD GOLD MINE

A barbed wire fence heavily charged with electricity will surround and guard a gold mine at Reno, Nev., hereafter. Recent thefts of ore led to the erection of the fence and anyone attempting to climb it will meet with instant death.

Vienna policemen, it is said, are provided with pocket telephones which they can connect in a second to the wire in special call boxes placed in all important streets.





Latest Type English Steam Motor Car with Auxiliary Engine for Driving Electric Light Generator

## WHY THE CHINESE COMPASS POINTS SOUTH

At the city wharf in Oakland there is a Chinese pirate chaser, which has just been brought from China. On board they have a Chinese compass, the needle of which points south instead of north. When they put the Chinese compass on top of an American one the stronger magnetism of the American one makes it point north, too. Why does the Chinese compass needle point south instead of north?—S.

*Answer:* The Chinese skipper compass card has the south point, where we have our north on compass card, marked so by custom. His needle points out the magnetic meridian the same as the American compass. The reason the Chinese compass flew to his north on card (our south) was obeying the general law of magnetism, "Like poles repel, unlike poles attract." For sake of convenience in navigation the north end of needle is considered red polarity, the north magnetic pole, blue

polarity. Now when the American compass was placed over the other, obeying the above law, red to red repels, hence the needle being lighter and not as highly magnetized as the American compass, flew to their north (our south). The same thing would happen with two American compasses only the lighter would go to the south on our compass card.

## MACHINE SEWS BAGS OF FLOUR

One of the recent inventions for millers is an ingenious machine which takes an empty sack, fills it with flour to exactly the desired weight, and then sews up the bag more neatly than can possibly be done by hand. Nine hundred bags per hour is the maximum capacity of the machine.



## FIRING AN OIL BURNER LOCOMOTIVE

Owing to the abundant supply, and consequent low price of fuel oil in Texas, as compared with the cost of coal, most of the lines there are burning oil in their locomotives. The experience of a fireman on one of the Texas roads is related by himself in the Locomotive Firemen's Magazine, as follows:

The oil is stored in tanks in the tender, and it enters the firebox below the door. A small pipe, called the atomizer, connects with oil pipe just as it reaches the firebox, which sprays the oil evenly all over the firebox, which is lined with fire brick. The fireman has five valves to operate—the oil valve to regulate the supply of oil; the atomizer to spray it; the heater, which heats the oil in the tank; the superheater, which heats the pipes connecting tank with firebox, and the blower, which must be working a little when steam is shut off to create draft enough to keep oil burning.

Firing an oil-burner is a very particular job. The operation of the oil valve and the atomizer must correspond at all times with the amount of work an engine is doing; not enough fire starts an engine leaking, and too much oil makes black smoke (and incidentally black marks), which is not necessary, as it gums up the flues and makes less steam. It is then up to the fireman to get down on the deck and fill up a funnel with sand to clean the flues. By putting the end of the funnel into a hole in the firebox door the sand is drawn through the flues and out the stack; then the pointer on the steam gauge will stay up at the right place with the second injector on.

Firemen on helpers and yard engines prefer coal, as it requires less watching, but on a through freight, especially on the heavy hills, oil is all right. The engineer can drop her down a notch or so, and just as quickly can the fireman give her a little

more oil and the atomizer and look as unconcerned as the next one.

The hardest work an oil-burner fireman does is to take water. It is not a dirty job, either, but I have never seen a fireman wearing a white collar. It is all he can do to keep clean overalls. The pay was just the same as for the coal burners in that locality.

In reference to hiring experienced firemen, some roads do and some do not; but I think they all prefer to make their own firemen, as they will stay through the slack times when a "boomer" will not.

Just ten minutes before I approached the master mechanic for a job an honest "knight of the scoop," wearing the regulation 1,000-mile shirt, round black hat and the badge of our noble Order, called upon the same gentleman and stated his case, but was told that there was "nothing doing."

I was "wise" to the master mechanic on that particular railroad, and before I asked for work I visited a second-hand store and fitted myself out with long-legged boots, sombrero and a big red handkerchief (all I lacked was a gun), and then I told the master mechanic my trouble. He asked me if I ever fired an engine. I replied that I had never fired one, but that I had seen lots of them. He wanted to know what I had been working at, and I said that I had just come down from the Panhandle, where I had been chasing "longhorns" all my life. I got the job.

A bill before the Senate provides that reading matter for the blind, printed in embossed type, be sent through the mails to and from blind persons free of charge. Such reading matter weighs heavier than ordinary printed matter and the postage, therefore, costs more.

Santos Dumont says the bicycle aeroplane will be the poor man's automobile.



# LARGE STEAM TURBINE

The accompanying illustrations show a 10-ft. turbine in course of construction and a 27-in. turbine complete. The large exhaust shell, Fig. 1, shows the many nozzles through which the steam passes and gives some idea of the enormous amount of steam that can be converted into mechanical

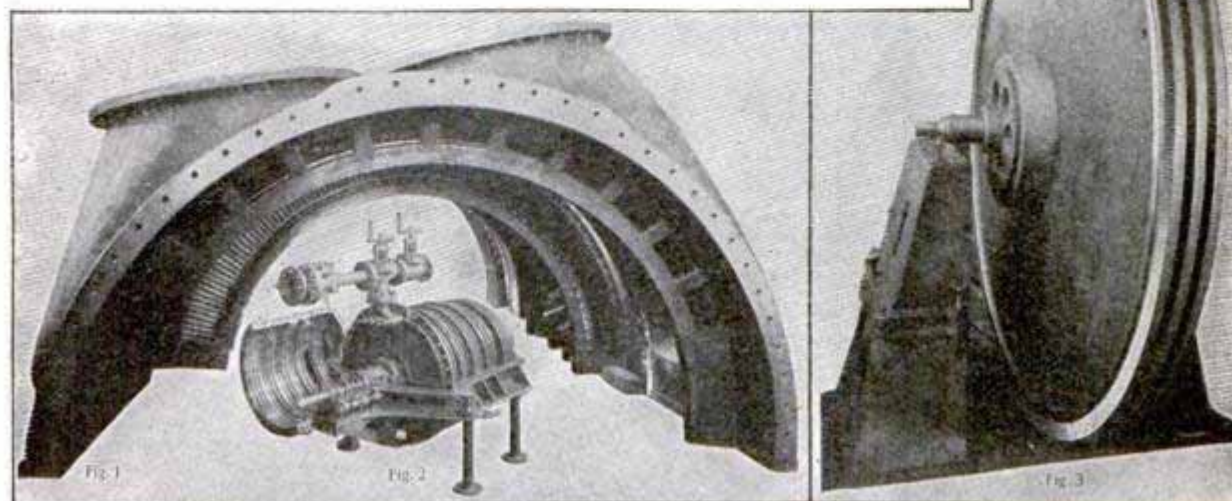


Fig. 1—Exhaust Shell

Fig. 2—27-In. Turbine Complete

Fig. 3—Rotor of 10-Ft. Turbine

energy in a comparatively small space.

In Fig. 3 is shown one of the 10-ft. rotors and the method of balancing. It is of extreme importance that the rotors be perfectly balanced, as the rapid revolutions when running would cause troublesome vibrations if one side were even a very little heavier than the other. The balancing is done by sup-

porting each end of the rotor axle on a steel-rail bearing as shown. The least difference in weight will then be shown by the rotation of the rotor.

The problem of setting the numerous blades is a very difficult one, as the clearances are so small that the slightest inaccuracy will prevent the successful operation of the turbine. The

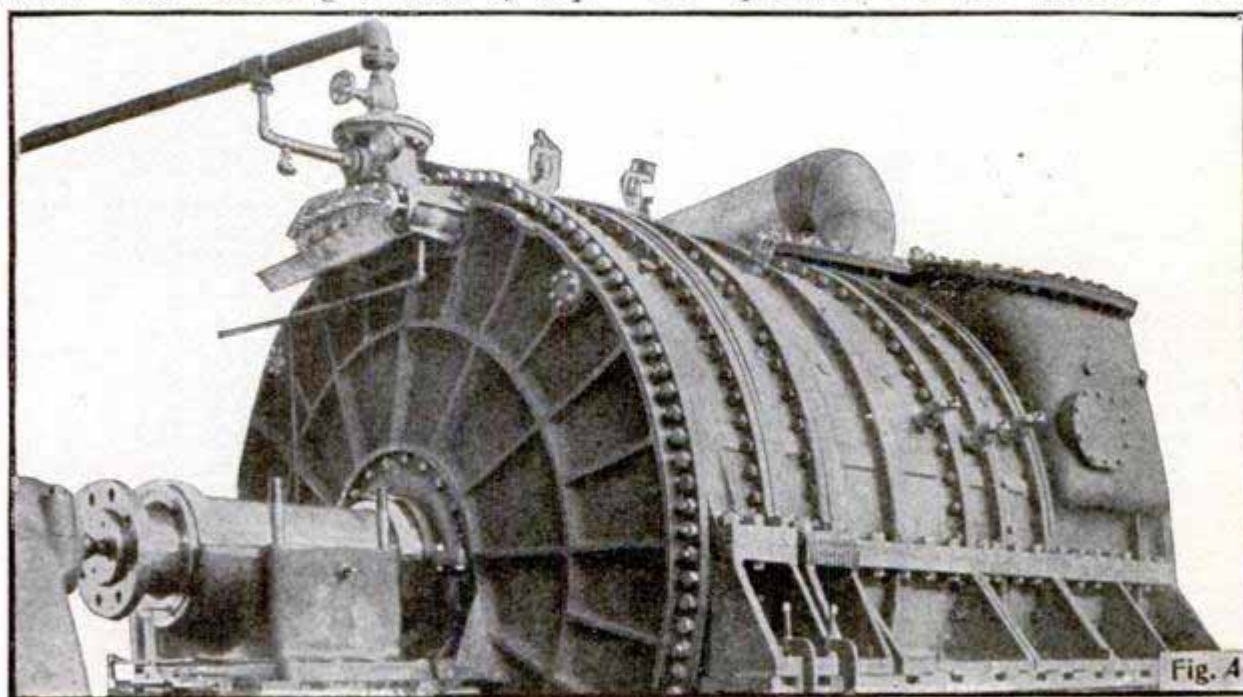


Fig. 4—Testing a 10-Ft. Turbine

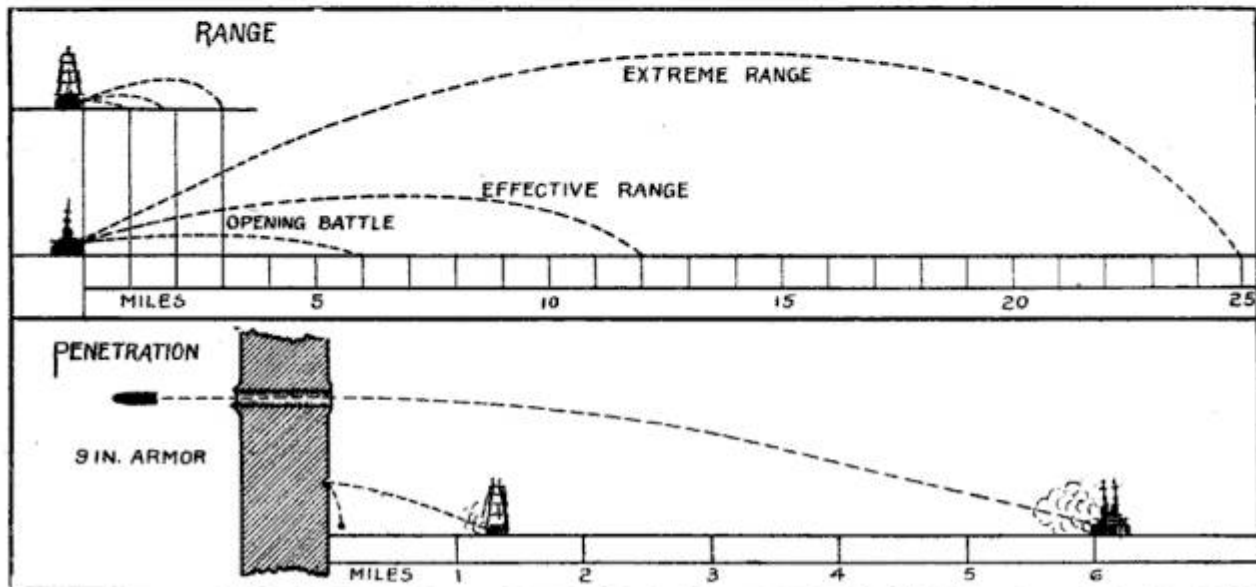


loosening and detachment of a single blade is liable to wreck the entire turbine, as one detached blade in the shell would probably catch in the nozzles and tear out several other blades which

would then work havoc with the remaining blades and nozzles.

The 27-in. turbine shown in Fig. 2 has the top shell removed to show the rotors.

## A CENTURY'S PROGRESS IN THE ENGLISH NAVY



Will the Coming Century Do As Well?

It is exactly 100 years from the old "Victory"—considered by Nelson the most efficient three-decker, and on that account chosen as his flagship before Trafalgar—to the reigning king of battleships, the "Dreadnaught." A comparison of the two vessels affords a forcible illustration of the progress of a century in the English navy.

Quite as interesting as any of the

tons draws only 18 in. more, while she has 70 men and 67 guns less than the "Victory."

The "Dreadnaught's" extreme range is 25 miles, with a penetration of 9 in. at 6 miles. The "Victory's" extreme range was only 3 miles, while at a mile and a quarter her shot would have made only a good sized dent in our modern armor.

	"DREADNAUGHT."		"VICTORY."	
Time Building	16 months	...	Five years ten months	...
Total Cost	£1,797,497	...	£89,000	...
Displacement	17,900 tons	...	3,400 tons	...
Total Weight Broadside	6,800 lb.	...	1,160 lb.	...
Heaviest Guns	12 inch	...	6 inch	...
Weight of Charge	265 lb.	...	10½ lb.	...
Time to make Gun	12 to 15 months	...	Four Guns a Week	...
Cost per Gun	£11,000	...	£57 15s.	...
Average Weight per Gun	58 tons	...	56 cwt.	...
Complement	780 men	...	850 men	...
Length	490 ft.	...	226 ft. 6 in.	...
Breadth	82 ft.	...	52 ft.	...
Mean Load Draught	26 ft. 6 in.	...	25 ft.	...
Number of Guns	37	...	104	...
Speed	21½ knots	...	10 knots	...

above figures are those comparing the number of men and guns, and draft. The "Dreadnaught" with her 17,900

The omission of a decimal point on page 111 of January issue made the muzzle velocity of a shot from the "Dreadnaught" read "5 miles per second"; it should have been .5 miles.





## HOW PENS ARE MADE

[Extracted from a lecture by Mr. Hawkes, manufacturing pen expert.]

Good steel of a uniform grade and rich in carbon is the material from which pens are made. The steel comes in sheets 19 in. wide and 5 ft. long and is imported, as American manufacturers have not yet attempted to make the higher grades of steel.

If a sheet of steel is heated red-hot and allowed to cool gradually it becomes so soft that it can be rolled, bent or squeezed into various shapes. If, on the other hand, it is heated red-hot and suddenly chilled it will become so brittle that attempts to bend will break it and a hammer blow will crush it to bits.

If the steel is heated gradually this hardness will be drawn out, and as the temperature rises the steel will become more and more tough, until at a temperature of about  $575^{\circ}$  it has the resiliency of a spring. It can be heated again to a red-heat and gradually cooled and brought back to its original softness, and the operation can be repeated over and over again without changing the chemical character of the metal.

The sheets of steel are cut into strips wide enough to permit of two pens

being cut with their points interlapping. The steel is annealed to a light cherry red for a number of hours and then cooled gradually, when it is soft enough to bend easily. The scale is then removed by pickling the steel in a bath of diluted acid, and the strip is ready to be passed through the rolling mill. The number of times it must go through the mills depends upon how thin it is desired to roll it. Each strip is tested with a microchronometer gauge, and should it be too thick it is again put through the mills. If too thin, it is laid aside for the production of a pen on which a thinner steel can be used. The steel then goes to the cutting room, where the pen blanks are cut out by machines. On one side of each blank there is a little dent, which is known as the "bit," and which is used as a guide in passing the metal through a number of succeeding operations.

The pens are pierced by machinery, some requiring but one piercing, others two or three, the latter being more expensive. From the piercing machine the pens go to the muffle room, where the blanks are annealed. Fifty or sixty gross of them are placed in each iron pot and heated and cooled just as was the strip steel. The name is then stamped on the blanks and the pen is ready to be formed. Some pens have to be "crushed," by which process a little wing of steel is bent under them.

If the pen is still soft, it is necessary to take it to the muffle room and again heat it to a light cherry red and chill it suddenly. This process renders the pens quite brittle, so much so indeed that they can be readily crumbled between the fingers. Later on this hardness is drawn out by the process already outlined. By this time the pen has become coated with an oxide, which is



The small motor boat for light freight traffic on the English seacoast is rapidly taking the place of sailing craft. The illustration shows a common type of small commercial boat.



removed by scouring or by a shaking process, by which the roughness is gradually rubbed off.

The next operation is grinding, some pens being ground twice, others three times, in some cases by hand and in others by automatic machinery.

The pen next passes to the slitting room. This operation is a very delicate one, as the pen is now hard and brittle and the slit must be cut cleanly through the hard steel without damaging it in any way. After slitting, the pens go to the rounding room, where they are made perfectly round and smooth, so that no matter at what angle the pen is held the paper will be in a tangent to its surface, and there will be no possibility of sticking or scratching.

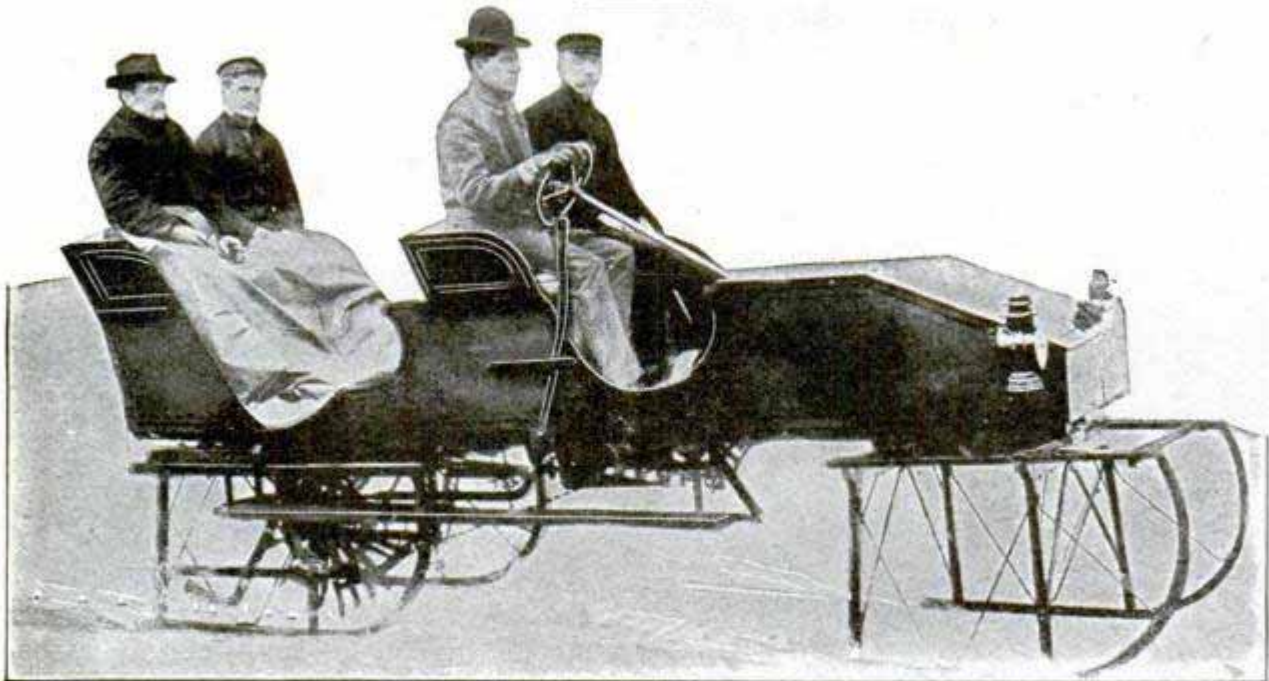
Every pen is now examined by an expert, so that the faulty pens which have accumulated in the various operations may be thrown out. This is the third examination. The pens now go back to the room in which the oxide was removed, to be polished by the shaking process before described. If they are to be colored, they are placed

in a tempering cylinder and heated to the desired color. The first heat brings them to a light straw color, a dark yellow, a brown, a purple and then a blue shade being obtained by increasing the heat. If the pen is to be left white, it is, of course, not reheated.

In order to preserve the pen and prevent it from rusting, a coat of lacquer is put on by means of machines. If the pen is to be plated with copper, bronze, silver or gold, however, it goes to the plating room before the lacquering operation is begun. Plated pens are now very popular and they can be plated with almost any metal desired.

The pens are now ready to go to the boxing room, where they are "counted" by ascertaining the weight. It will be found impossible to put a gross of pens in the box intended for them unless they are laid parallel. In order to do this quickly and easily they are put in a half cylinder and shaken. This quickly places them in a parallel position, and by a very quick move of the operative they are dumped into the boxes, which are then ready to be labeled and packed.

### HIGH SPEED MOTOR SLEIGH



The motor sleigh is making slow progress, but will some day become a very popular form of sport. The one illustrated is 14 ft. long with runners 22 in. high. The engine drives a spiked wheel by means of a sprocket chain, the wheel being held down by heavy spiral springs. Steering is accomplished with the front runners. Very high speed is obtained on smooth ice.



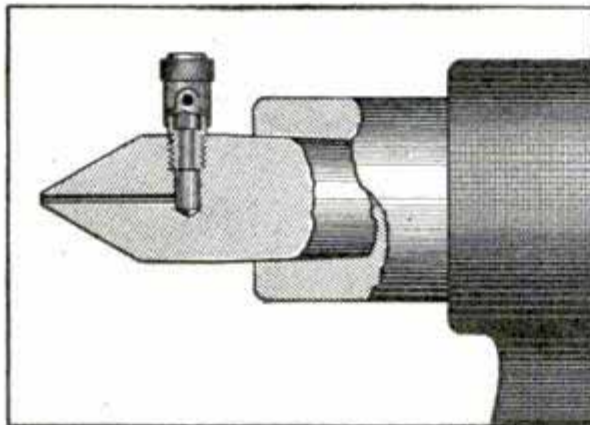


# SHOP NOTES



## Self-Oiling Lathe Center

A small oil cup attached to a lathe center in the manner here illustrated will prove a great convenience and will prevent the center running hot. A  $\frac{1}{8}$ -in. hole is drilled in the point of the center and carried back about  $1\frac{1}{4}$  in., or far enough to meet the vertical hole, which is tapped to receive the oil cup as shown. It is obvious that the point of the center will have to be removed before drilling the  $\frac{1}{8}$ -in. hole, but this will not decrease the bearing surface of



Oil Cup for Lathe Center

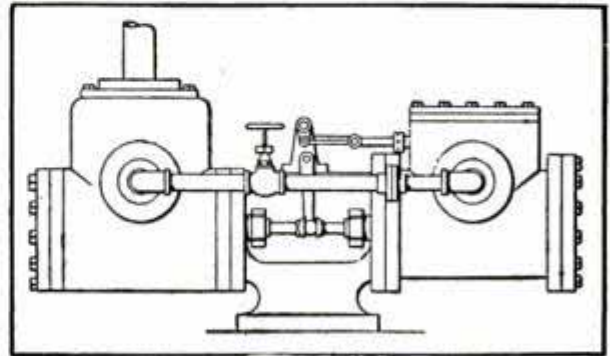
the center, as the extreme point never touches the work if the center hole in the same has been properly made.—Contributed by Alfred S. Cromer, 466 E. Buchtel Ave., Akron, O.

## Saving Exhaust from Pump

The accompanying illustration, from the Engineers' Review, shows an arrangement for returning the exhaust steam from a steam pump back to the boiler. In case the pump is used as a boiler feed, a feedwater heater is not required. It works satisfactorily on medium high temperatures and can be applied to either duplex or simplex pumps.

As all modern steam pumps are

tapped for suction and exhaust pipes on both sides, all that is necessary is

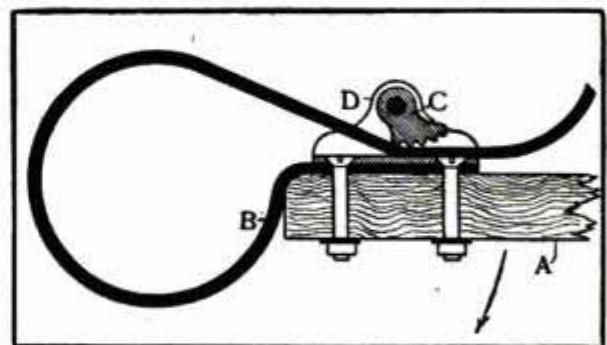


Exhaust Returned to Pump

to pipe up the plugged exhaust and suction openings, and a boiler feeder is obtained which cannot be excelled.

## Strap Wrench

A good strap wrench suitable for unscrewing lubricator bodies, glass oil cups and other polished articles, can be made from a piece of hard wood, A, 1 in. square and a foot or more long, a leather strap, B, a metal dog, C, and a piece of sheet brass, D, which acts as a bearing for the dog and as a clamp to hold the strap against the wood. To use the device, pass the strap around



For Removing Lubricator Bodies

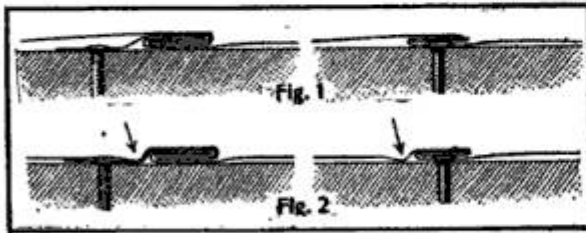
the object to be turned and pull the end through the dog as far as it will go. Then turn in the direction indicated by the arrow.—Contributed by Harry Hall, Brooklyn, Iowa.



### Cracked Seams on Tin Roof

Should the seams of a tin roof crack it is probably due to the fact that proper allowance for expansion and contraction was not made in laying the roof.

Metal laid under cold weather conditions is contracted to nearly its smallest size. Every tinner knows that



Old and New Method of Making Seams

when a seam is flattened down with a mallet it is about level, so that when expansion and contraction takes place the strain is directly on the solder. The main thing, then, is to overcome and take this strain off the solder and place it somewhere else, says a correspondent of the Metal Worker. I have done this by placing the strain on the tin plate itself. The best way to do it, I have found, is to take the hand groover and go over every seam before soldering it and drawing it down behind the seam as shown on the drawings herewith. Fig. 1 shows the tin as laid for flat seam roofing, fastened down with both the cleat and the nail driven through the sheet. Fig. 2 shows my method of bending the tin down back of the seam with the groover. By going over every seam in this manner before the soldering is done there is an excess of metal back of the seam or an extra length to the sheet, which gives material to draw upon when contraction takes place and entirely avoids any strain on the soldered seam. When the metal expands under heat this groove also relieves the strain that would otherwise be placed upon the solder.

Now that it is again possible to purchase a really first-class quality of tin for roofing purposes, the tin roof is rapidly coming into great favor again.

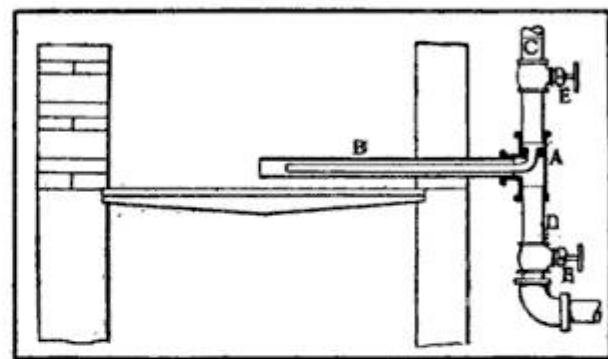
### To Make a Blind Man's Watch

An ordinary hunting case watch may easily be fixed so that a blind person can tell time by it, says a writer in the Keystone. Take out the crystal and file away the "cut" in the bezel which served to hold the crystal. Burnish smooth and then file across the bezel at each five-minute point on the dial. Above the XII make a distinguishing mark of some kind from which the owner may take his bearings.

### Simple Home-Made Oil Burner

By the following directions an efficient oil burner may be made at home: Into a 1-in. tee, A, place a  $\frac{3}{8}$ -in. elbow and run babbitt around it to hold it in place, and also to keep the steam from leaking into the oil. Screw a  $\frac{3}{8}$ -in. pipe, long enough to reach through the boiler front into the furnace, into the elbow. Over the  $\frac{3}{8}$ -in. pipe screw a 1-in. pipe, B, 3 in. longer than the other, into the tee, so that the smaller pipe is exactly in the center of the larger one.

Pipe C runs from the tee to the oil tank; pipe D to a steam main or air



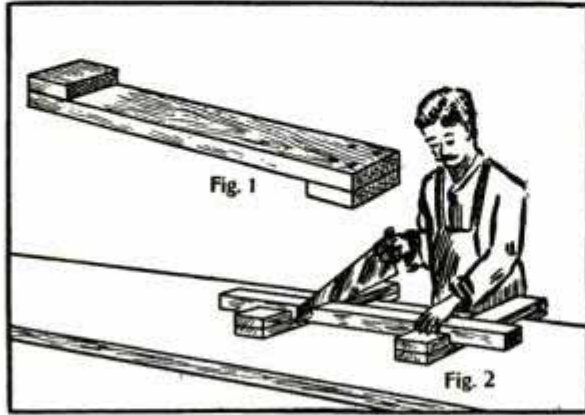
Construction of Oil Burner

tank, and EE are valves to regulate the amount of oil and steam or air. Partly cover the grates, so too much air cannot come through, says the Engineers' Review, and build the bridge-wall open, as illustrated. Compressed air is all right to use on getting up steam, but steam is better after it is raised to force the oil into the furnace.



**Handy Cleats for Sawing**

Wooden cleats like the one shown in the sketch, Fig. 1, are often much more convenient than a vice for holding the work when sawing, chiseling,



**Cleats Handy in Sawing**

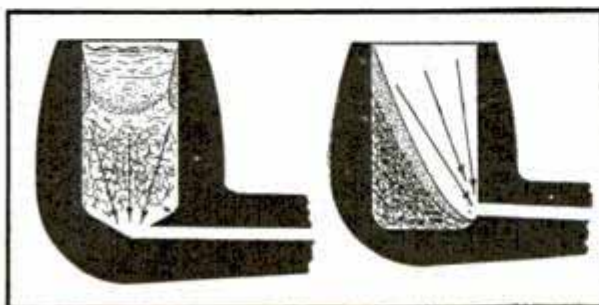
etc., and can be made at very little expense. Two of these cleats are necessary for sawing and are used in the manner shown in Fig. 2. I have several of these and find them very handy. They can be made any size and any length, as needed.—Contributed by F. B. Emig, Santa Clara, Cal.

**Paint for Muslin Signs**

Use colors ground in japan and thin them with turpentine, says the Modern Painter. Prepared muslin should be used to procure the best results.

**Draught in Pipes**

A good draught is just as important in a pipe as in a stove. If the draught is from the center it will cause the tobacco to burn evenly, while if it is from the side, as is the case in many pipes, including high-priced ones of



**Correct and Incorrect Designs**

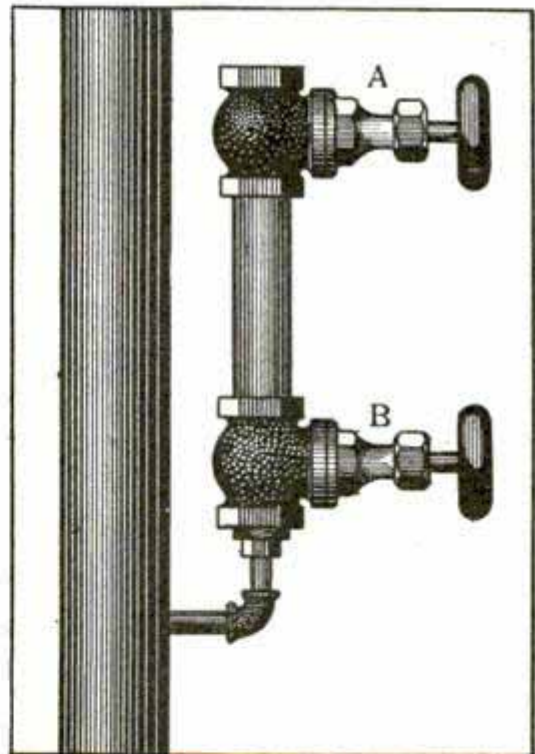
fancy design, the tobacco will burn down one side and smoulder on the other. This produces more or less distillation, causing a very disagreeable taste and a strong pipe.

**Thawing Pipes With Lime**

To thaw out frozen water pipes pack them with unslaked lime and wrap up in old rags or carpet. Pour water over the portions thus covered and the heat generated will melt the ice in the pipes.

**Emergency Lubricator**

When the lubricator on a steam engine becomes broken or out of order, the home-made device here shown will be found very useful. Connect two



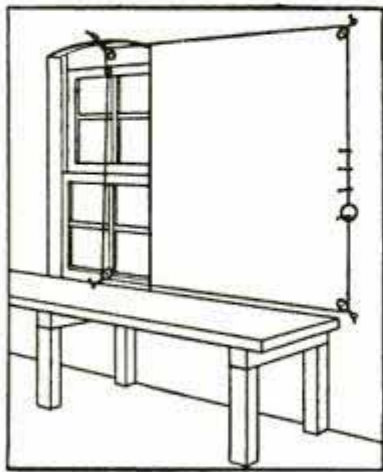
**Emergency Lubricator**

globe valves, A and B, with a short piece of pipe. Bush the open end of valve B to receive the lubricator connection and connect as shown. To operate, close valve B and open valve A and fill with oil. Then close valve A and partly open valve B from time to time, thus allowing a small amount of oil to run into the cylinder.—Contributed by Fred Eckley, Tekamah, Nebraska.



### Device for Opening Shop Windows

It is almost impossible to open and close a window over a wide bench by using a pole, and as it is very trouble-



some to climb up on the bench every time one wants to open the window, a device like the one shown in the sketch will prove a great convenience. Simply fasten a

screw-eye in the upper sash and carry a rope over suitable pulleys to a convenient place for operating. If there are no weights on the window, fasten a harness ring on the rope and drive a number of nails in the wall. The window may then be held open in any position desired.—Contributed by Ora S. Harmas, Fennimore, Wis.

### Building a Cement Reservoir

The placing of a big cement reservoir 38 ft. high and 10 ft. in diameter for the purpose of holding the supply of water for the town of Evans, Col., was done in a novel way.

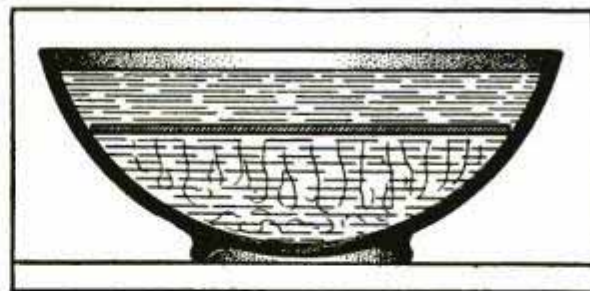
Two years ago the town put down several 125-ft. deep wells to furnish its water supply. The wells filled with seepage water and were considered unsanitary. Recently four wells each 230 ft. deep were driven to bed rock and a flow of artesian water obtained. The wells were piped and around them was built the cement reservoir.

The reservoir was constructed by outlining its dimensions with meshed wire—the ordinary chicken wire fencing—which formed the center of the circular wall, 1 ft. thick and 38 ft. high. When the cement circle was thoroughly dry, workmen entered the enclosure and dug away the earth to a

depth of 38 ft., the structure sinking by its own weight, gradually, into place. Seepage water was encountered toward the last but this was pumped out and a cement floor laid in the bottom of the reservoir. Into this big tank the artesian water is let at will and the result of the construction is most satisfactory.

### Washing Glass Negatives

A great deal has been written regarding the handling of glass negatives through the developing and fixing solutions, says a correspondent of the *Photographic Times*, but not much is being done towards improving the washing methods, which is the only part of the work that is really tiresome. My method for the last four years has been as follows: Procure an ordinary stoneware milk pan which can be found in nearly every kitchen, the round bottom kind are the best and most common, a one-gallon size fits a 5 by 7 plate and a half-gallon size fits the 4 by 5 plates to perfection. Fill the pan nearly full of water, and after rinsing the negative a minute or two in a basin of water, place it face



Washing Negatives

or film side down in the pan (it will find its seat about one-third the distance from the top), being careful not to allow any air bubbles on the under side. Should any bubbles have formed by letting the plate down too fast they can be ejected by tilting the plate slightly and then allowing it to settle back in a horizontal position again. After the negative has soaked in this way for thirty minutes, it is ready for the drying rack. Please note that

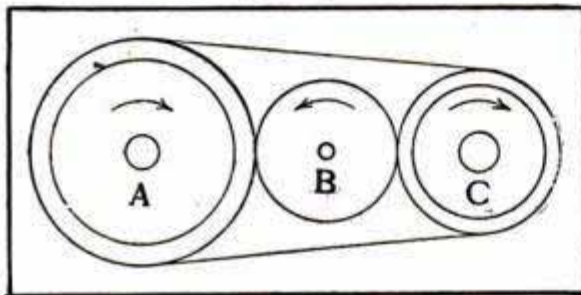


there was no change of water in the operation of this method of washing.

When the negative is placed film side down in water, the hypo, being heavier, releases itself and drops to the bottom of the vessel. In the four years that I have practiced this method I have not lost a negative through carelessness in washing.

### Auxiliary Friction Pulley

When power is to be transmitted a very short distance, as from A to C in the accompanying sketch, the necessary high tension on the belt usually results in excess journal friction and consequent wear. To prevent this a correspondent of the American Miller has used a friction pulley as shown at B.



Friction Pulley Used With Belt

This not only relieves the strain on the journals but also helps to drive.

### Stains for Oak

There are many ways in which oak may be stained, says the Master Painter, and any of the following will give fine results:

I. Apply ammonia with a sponge or brush. When dry give it a coat of turpentine, then fill with varnish. Or you may omit the filler and give a coat of shellac, then wax and rub to a polish; or simply shellac it, or omit the shellac and use wax only, according to the style of finish desired.

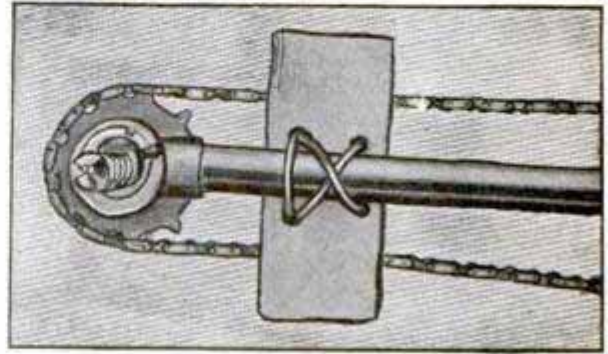
II. Use bichromate of potash dissolved in hot water instead of ammonia, as given in No. I, and you will get a still richer effect.

III. Apply a coat of freshly slaked lime; let this dry on; then brush off clean and apply a coat of boiled oil.

IV. A strong solution of sal soda will darken oak, but it will be necessary to apply two coats. Sandpaper lightly, then finish with oil rubbing.

### Electrician's Boring Machine

In electrical work holes for wires are

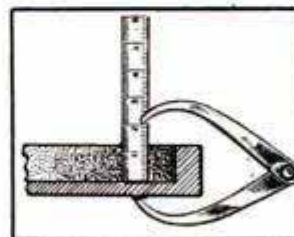


Boring Machine for Electricians

frequently required in places which are very inaccessible and it was for work of this kind that the machine here illustrated was constructed. The sprockets, crank, and part of the frame from an old bicycle are used for transmitting the power to the auger, which is attached to the rear axle. If the chain has a tendency to run off the sprocket when drilling vertical holes, a small piece of wood may be lashed to the frame as shown.—Contributed by A. J. Swift, Novelty Electric Works, Ocean Park, Cal.

### Transferring Dimensions

When it is impossible to transfer a dimension with ordinary calipers, owing to the form of the casting or other article that is being measured,



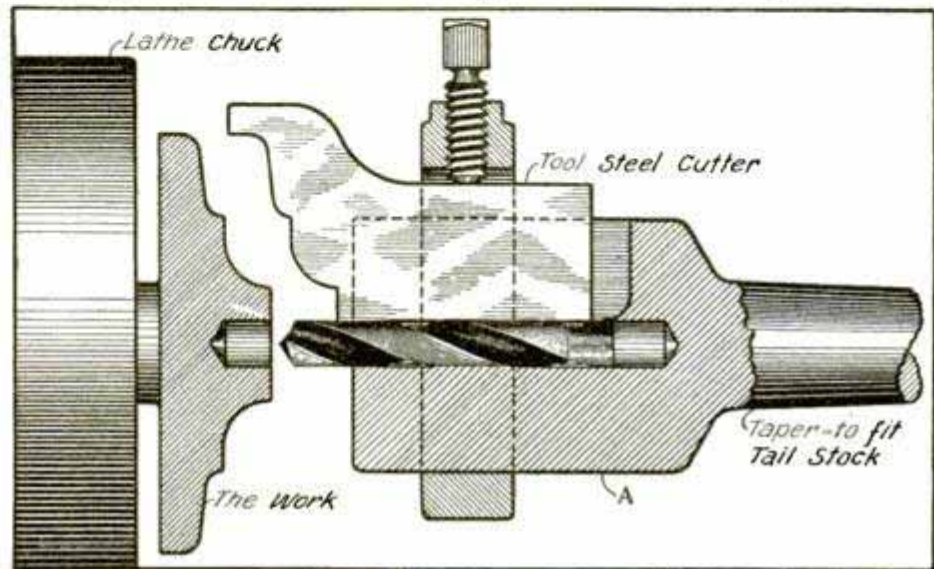
the dimension may be obtained by moving one leg of the calipers to one of the inch marks on a steel rule, as shown in the sketch. The calipers are then withdrawn and applied to the rule. The number of inches originally taken is then deducted from the total amount, thus giving the dimension as



accurately as may be obtained by using one of the many intricate calipers designed especially for this purpose.—Contributed by W. F. S.

### Forming Tool for the Lathe

A good forming cutter for duplicate work is shown in the accompanying illustration. The holder, A, is made of a piece of cold-rolled steel, slotted out to receive the cutter, which can be any desired shape, and turned down to fit the tail stock of the lathe. To use the cutter, simply turn the handle on the tail stock, thus forcing the cutter against the work. If the work is to have a hole in the center, this can be done in the same operation by making a hole in A to receive the drill, as shown.—Contributed by W. F. S.

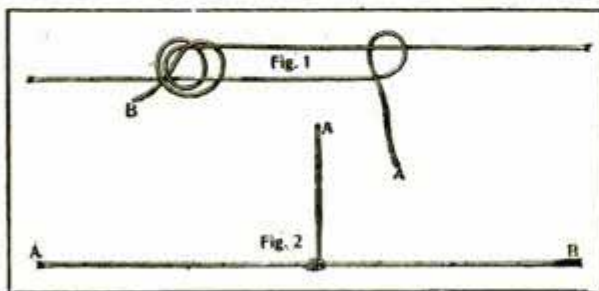


Useful for Duplicate Work

method are (1) that the knot is smaller and neater than any other; (2) there being only one short end where B is cut off close, air bubbles are reduced to a minimum as the end points downward toward the tail fly; (3) it cannot catch in fine weeds, such as flannel weed.

### Knot for Cat Gut

Many of the knots commonly used for rope are unsuitable for cat gut, as the structure of gut is such that the fibers are generally weakened or cut when tied in ordinary knots. The accompanying drawing shows a form



Attaching a Dropper Fly

of knot that is recommended by a correspondent of the Sporting Goods Dealer for attaching a dropper fly.

The points A and B are the two ends made by joining the cast where the dropper fly is required. Take end B and tie an ordinary double fisherman's knot round A, pull up tight; then pass A round B and turn back once through itself (a half hitch) taking care to leave the end sufficiently long to tie the fly on and gently pull tight onto knot at B as Fig. 2. The advantages of this

### Estimating the Power of a Screw and Lever

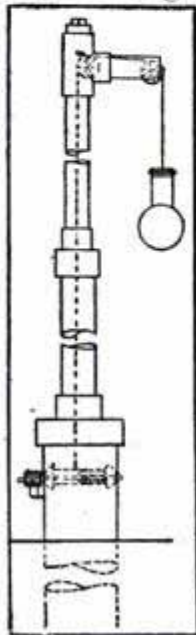
Problem:—What pressure will be obtained from a screw having three threads to the inch if acted on by a force of 1,000 lb. applied to the end of a lever 8 ft. long?—C. P. H.

As the end of the lever will travel 604 in. (the circumference of a circle of 8 ft. radius) in one revolution and thereby advance the screw only  $\frac{1}{3}$  in., the force produced by the screw will be  $604 \times 3 = 1812$  times that applied to the lever. It therefore follows that a force of 1,000 lb. on the lever will produce a pressure of 1,812,000 lb. or 906 tons on the screw. This calculation does not allow for friction.



### Electric Light Pole Made from Pipes and Fittings

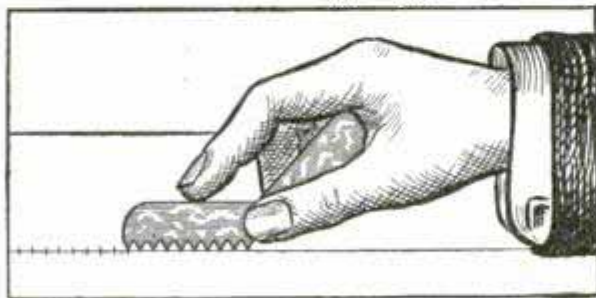
The sketch shows a home-made electric light pole, several of which were made by a correspondent of the Practical Engineer, from old steam pipe and fittings. The top or upper pipe is 2½ in. in diameter and about 15 ft. long; the middle length is 3 in. in diameter, 15 ft. long; the bottom pipe is 8 in. in diameter and 10 ft. long. This bottom pipe is sunk in the ground a distance of 6 ft. The rest of the construction can be understood by a glance at the sketch.



### Thread Gauge Used for Spacing

An ordinary thread gauge with the teeth blackened, by rubbing over a lead pencil, makes a very useful and convenient spacing instrument and is far preferable to the bow dividers as no trials are necessary and the paper is not pricked all full of holes. By holding the blade as shown in the illustration and moving sideways about 1/16 in. each tooth makes a fine hair line, thus dividing the line into equal parts, which may be made fine or coarse by using different blades of the thread gauge.

If the teeth are rubbed on a pencil each time after being applied to the



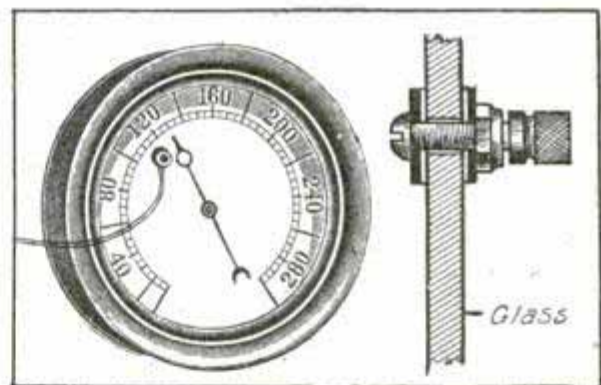
Spacing with a Thread Gauge

paper, the resulting divisions will be very distinct. Every draughtsman who

has frequent occasion to draw threads or other work requiring spacing, would find the purchase of a thread gauge a good investment.—Contributed by draughtsman, Chicago.

### Pressure Gauge Contact

An easily made electrical contact for a pressure gauge consists of an ordinary binding-post passed through a hole in the glass, as shown in the accompanying sketch. A contact fastened in this way is sure to be insulated from the other metal parts of the gauge and the hole in the glass can be easily made with a file or a drill by keeping it moistened with turpentine. In any gauge where the indicator hand makes electrical contact there is a possibility of the hand be-



Gauge with Electric Contact Applied

coming stuck and for this reason it is well to use a separate gauge for the contacts.—Contributed by Robert Glaubke, Malott Park, Ind.

### To Frost an Incandescent Lamp

A small piece of good emery cloth is all the material necessary to frost an incandescent lamp quickly, but effectually.

Rub the cloth over the entire lamp with a circular motion. Rubbing up and down will not produce the best results. About fifteen minutes' work will produce a very good frosting on an ordinary globe.—Contributed by D. P. Hein, Cherokee, Col.



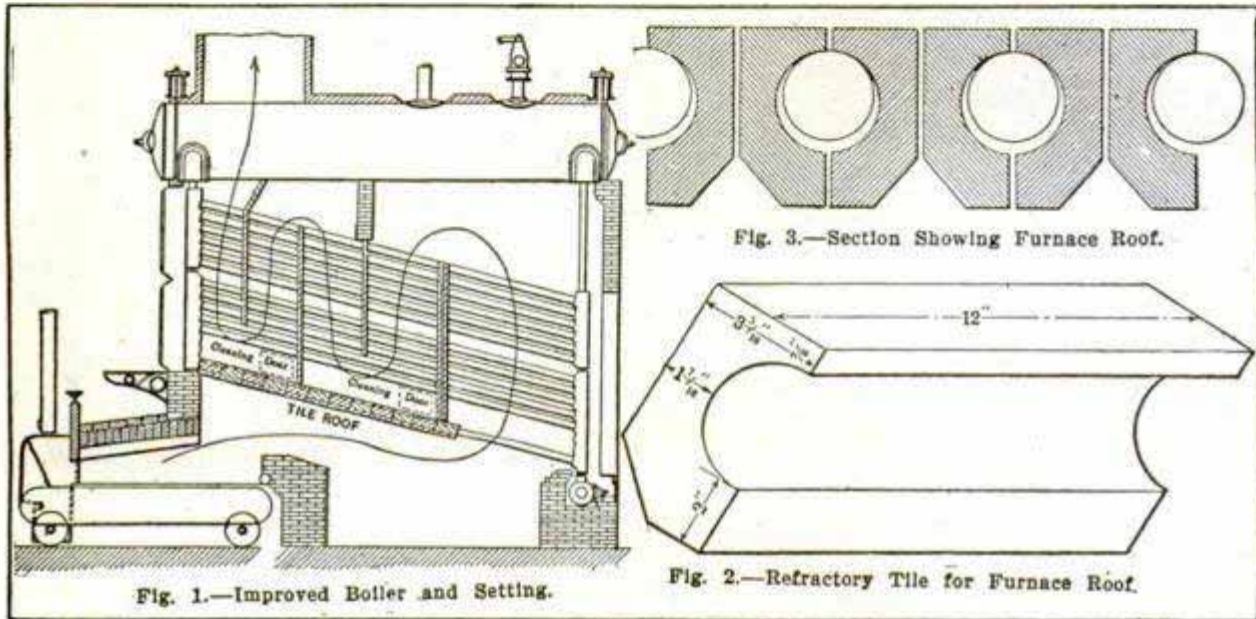
### Tile Furnace Roof for Boilers

In a paper read before the American Society of Engineers on December 3, Mr. A. Bement, of Chicago, discussed the advantages of tile roofs for water-tube boilers, from which the following has been condensed:

The objects sought are perfect and smokeless combustion and the full utilization of the boiler heating surface. The first requirement is secured by the employment of a tile furnace roof

third tiers of tubes is left vacant for the purpose of accumulating dust. The contracted passages among the tube surfaces produce a high resistance, and therefore a strong draft is required. The author considers that a combination of forced and induced draft secures the best combustion.

In the tests that were made with this boiler a very good efficiency was shown and the combustion was nearly perfect and without smoke, while similar boilers without the tile roof emit-



supported by the boiler tubes of the lower row. Fig. 1 shows an elevation and section of a boiler equipped with a chain grate stoker and using the tile roof. The individual refractory tiles used in the formation of this roof are illustrated in detail in Fig. 2 and by vertical cross section in Fig. 3. The tile roof prevents the flow of unburned gases among the tube surfaces of the boiler and causes them to travel a considerable distance before the heating surface is reached. Thus the gases and air become sufficiently mixed to insure complete combustion.

To insure the useful employment of all the boiler surface the gases are led over the whole of it by means of passages of less area than are commonly used. A space at the bottom of the boiler above the tile roof equal to that ordinarily required by the second and

ted heavy smoke under the same conditions of operation.

### Gasket for Auto Pump

A packing which will make a tight and very durable joint for a water pump is made by coating a sheet of thick paper or cardboard with shellac, in which a little red lead has been mixed. The paper is first cut out to the proper size, and is then painted with the shellac or red lead and allowed to dry till it is almost hard. If one expects to have to break the joint at all frequently, however, some other kind of packing might be preferable, since the shellac will adhere so strongly to both surfaces that it can never be used a second time. In such a case it might be better to use paper painted



with white lead, says Motor Talk, since it is possible to hold the slight pressure in a circulating pump with such a packing after the joint has been broken several times.

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### Recipes for Blue Stains

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1. Dissolve copper filings in aquafortis and brush it over the work. Treat with a hot solution of 2 oz. pearlash to 1 pt. water, until a blue color is produced.

2. Boil 1 lb. indigo, 2 lb. wood and 3 oz. alum in 1 gal. water, says the Master Painter, and coat the work until thoroughly stained.

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### To Fasten Linoleum to Concrete

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In order to make linoleum stick to a concrete surface a glue is used which has been boiled down till it is like carpenter's glue and into which wood ashes have been put. This glue is then stirred and makes a mass, somewhat like varnish. After applying it, the linoleum must be held firmly against the floor for some time.

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### Fillet for Pattern Making

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Heat and thoroughly stir together equal parts of beeswax, rosin and venetian red until thoroughly mixed. Apply while hot with a strip of sheet brass formed to a half circle having the radius of the required fillet. Then finish with a common cabinet scraper.—Contributed by Frank L. Smith, Peru, Ill.

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### Cement for Iron and Marble

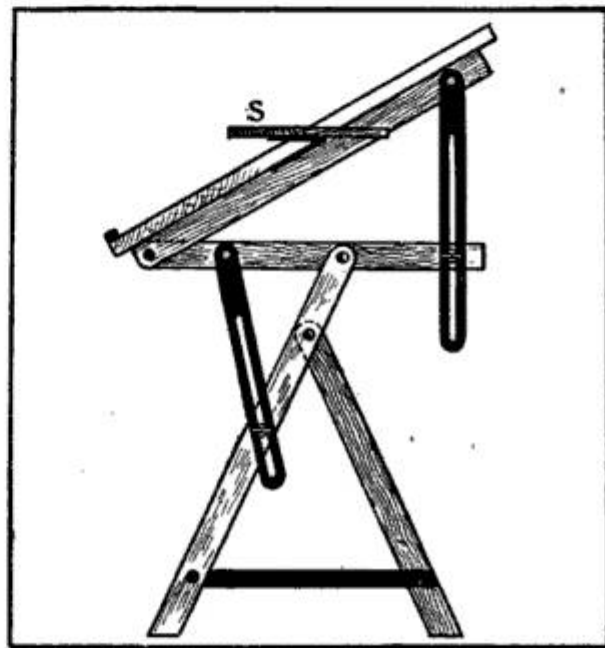
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Iron may be securely cemented to marble by the use of the following preparation: Plaster of paris, 30 parts; iron filings, 10 parts; sal ammoniac, 1 part; mix to a fluid state with vinegar and use immediately as it hardens rapidly.

### Home-Made Adjustable Drawing Table

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A very handy and useful drawing table for draughtsmen and others who do mechanical work at home, can be easily made at very little expense. In the table here illustrated the adjustment is accomplished by means of sheet iron strips, cut out in the center as shown and fastened with thumb screws in any desired position. An arrangement of this kind provides for adjustments of both height and incli-



Adjustable Height and Inclination

nation and will be found much more rigid than many of the expensive ready-made tables. A small shelf, S, fastened to the right end of the table will provide a convenient place for laying tools when not in use and will be especially useful when the board is inclined at a steep angle. When not in use a drawing table of this kind may be folded into a very small space and put away.—Contributed by Geo. C. Murphy, Owensboro, Ky.

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### Good Filler for Woodwork

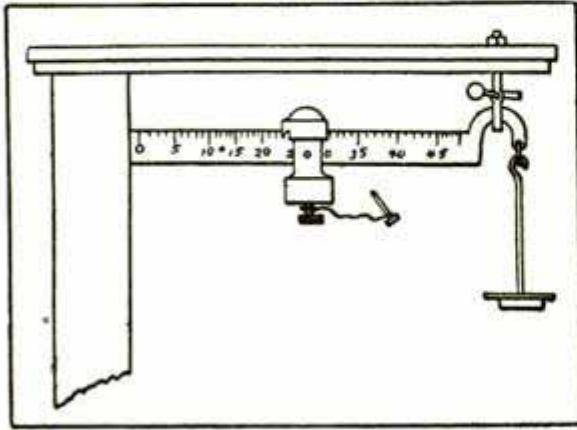
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Corn starch,  $\frac{1}{2}$  lb.; fine pumice-stone dust,  $\frac{1}{2}$  lb.; white polish or liquid shellac,  $\frac{1}{4}$  gill; boiled oil,  $\frac{1}{4}$  pt. Thin for use with turpentine.



### Scales for Duplicate Weighing

Ordinary platform scales may be made useful for duplicate weighing, such as measuring sacks of flour in a mill, or any other duplicate weighing, by drilling a  $\frac{1}{8}$ -in. hole in the traveling



Device for a Duplicate Weigh

weight and saving the shavings. A steel pin is then made and fastened to the weight by a short piece of string or wire. The combined weights of the string and pin should just equal that of the shavings, which explains the reason for saving them. The weight is then moved along the beam to the positions commonly used in weighing and the beam drilled through with a  $\frac{1}{8}$ -in. drill. Scales treated in this way, says a correspondent of the American Miller, will prevent many mistakes which are likely to occur when no means are provided for holding the weight in position.

### Moisture in Gas Engine

The "bucking and snorting refusal to start" of the gas engine is often due to moisture in the cylinder, preventing regular ignition till dried by the heat of several explosions. The difficulty may be obviated by shutting off the cooling water for a few minutes before stopping the engine, and not turning it on again until after the engine begins to explode regularly when again started, says Power and Transmission.

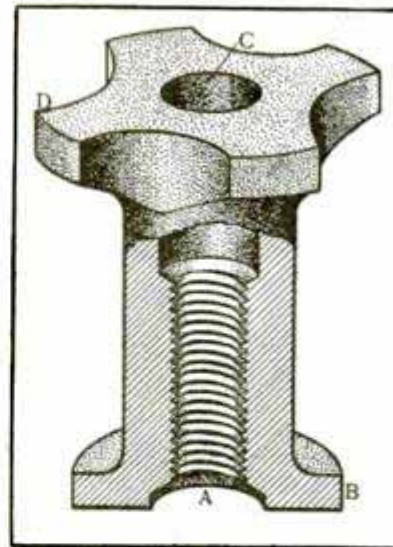
### Paint for Invalid's Room

It is sometimes inadvisable to use ordinary paint on apartments occupied by invalids. In such cases, milk paint can be used.

Take 2 qt. skim milk, 6 oz. fresh slaked lime, 4 oz. linseed oil and 3 lb. fine bolted whiting or Spanish white. Place the lime in an earthen vessel, or a clean bucket, says the Master Painter, and add to it enough skim milk to make it like thick cream, then add the oil, a little at a time, stirring with a wooden paddle; then add the remainder of the milk, and after this add the white. This paint will dry in about an hour. The lime and oil unite to form a sort of soap, and the oil loses its smell thereby. One coat may be enough. Coloring may be added. The formula given will do about 25 sq. yd.

### Hanger Nuts for Concrete

Appreciating the difficulties that many manufacturers have experienced in concrete buildings by insufficient or imperfect preparations for hanging to the ceiling, shafting, piping, shelving, etc., etc. I discarded all appliances and contrivances that I had ever seen used, and for a reinforced concrete building I am erecting for my factory purposes I designed and had made a ceiling support similar to the sketch herewith.



When a floor of one story is completed, the opening A shows in the ceiling of the floor beneath, the casting being imbedded in the cement.



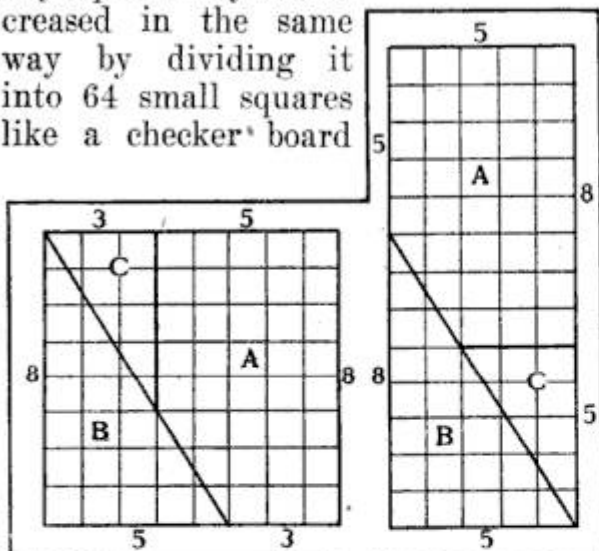
These castings weigh  $1\frac{1}{2}$  lb. and are  $3\frac{1}{2}$  in. in height, drilled and threaded, into which machine bolts or supporting rods with threaded ends can be fastened. Having a sharp collar, B, they can be readily fastened with lath nails to the temporary wood floors on which the concrete is poured. In opening C a cork is placed to prevent clogging. The wing D prevents this casting from ever turning.

As they are inexpensive, they can be set at 3- or 4-ft. centers in any ceiling where there is a possibility of supports being necessary.

They are such a success that in return for the many valuable suggestions I have received from Shop Notes, I pass this on, hoping it will prove of interest and benefit to other readers.—Contributed by Augustus D. Curtis, President Curtis Ledger Co., Chicago.

### Apparently Increases the Area of a Square

The sketch herewith shows how to cut a square of 64 sq. in. to form a rectangle of 65 sq. in. The area of any square may be increased in the same way by dividing it into 64 small squares like a checker board

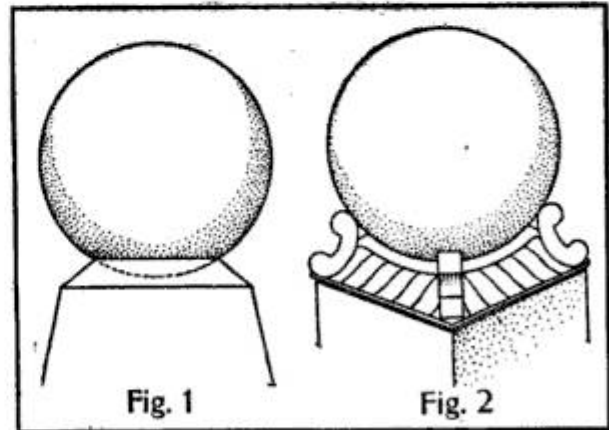


64 Sq. In. Cut and Arranged to Make 65 Sq. In.

and cutting as shown by the heavy lines in the sketch. The result is 65 squares from 64 squares. Where does the extra square come from?—Contributed by J. Peundorf, Lanesboro, Pa.

### Why Stone Balls on Monuments Revolve

Why stone balls mounted as shown in Fig. 1 should revolve has always been a puzzle to monument builders. The rate of movement is very slow, probably less than one revolution in two or three years, but is always in



Revolving Ball and Remedy

the same direction—from northwest to southeast. A very plausible explanation of this phenomenon is given by a correspondent of the Monumental News, who recommends the construction shown in Fig. 2 as a remedy for this trouble.

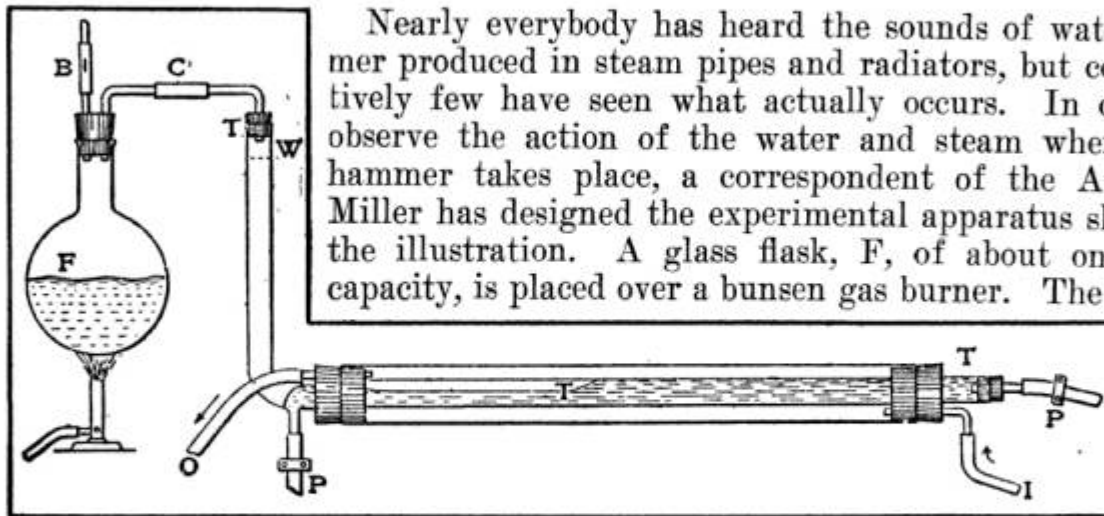
The explanation is based on the fact that a small amount of water leaks in between the ball and spherical cavity in which it rests, thus causing expansion and contraction, due to alternate melting and freezing, sufficient to lift the ball. In melting, the southeast side, which receives the morning sun, melts first and drops back on the die, losing a small fraction of an inch every time it freezes. When the side away from the sun melts it drops back, but does not get back as far as it was before freezing. This, it seems, is the best explanation, because a ball mounted as shown in Fig. 2 will not revolve, as it does not come in contact with the water.

The tensile strength of copper wire is diminished and that of iron wire increased by carrying a current of electricity.



## POPULAR MECHANICS

### VISIBLE WATER HAMMER



Showing Action of Water Hammer in Steam Pipes

#### To Clean a Gauge Glass

Drill and tap the upper valve (see illustration) for a  $\frac{3}{8}$ -in. bilb cock, and by means of a short piece of rubber



hose attach the small funnel. Close both valves, also lower bilb cock, and pour either a solution of hydrochloric acid or strong potash into the funnel. For accumulations of lime or similar sediment use the acid and if the dirt in the glass is of a greasy nature use the potash. After cleaning in this way blow water through in the usual manner. This is especially important after using the acid,

as a small amount left in the valves will cause corrosion.—Contributed by Chas. Hurt, Milwaukee, Wis.

#### To Cement Brass Work to Glass

Mix together 2 parts litharge, 1 part white lead, 3 parts linseed oil and 1 part gum copal. Use immediately.

of the flask is provided with a safety valve, B, which is merely a short piece of india-rubber tubing plugged at one end and slitted for about one-half an inch of its length. The flask is connected by the tube C with an L-shaped glass tube of about  $\frac{3}{8}$ -in. bore, marked T T T. The vertical leg is about 1 ft. high, and the horizontal leg about twice this length. A small glass tube with a pinch-cock, P, is fitted at the bend, and another at the right-hand end, as shown. Both pinch-cocks should be connected with a fair length of tubing to a water reservoir, from which the tube T T T can be filled up to the level, W.

As soon as steam is issuing freely from the slit B, one of the pinch-cocks is opened and the water level allowed to fall below the top of the horizontal arm of the tube T. The condensation of steam, which now takes place over a considerable water surface, raises a wave near the bend, and as the imprisoned steam is still being condensed, a vacuum bubble is formed which collapses with a sharp blow, sufficient frequently to drive out the plug at the right-hand end of the tube. After a few blows, the water becomes so warm that the rapid condensation is no longer possible, and the action gradually ceases. For continued demonstration, therefore, it is necessary to have the



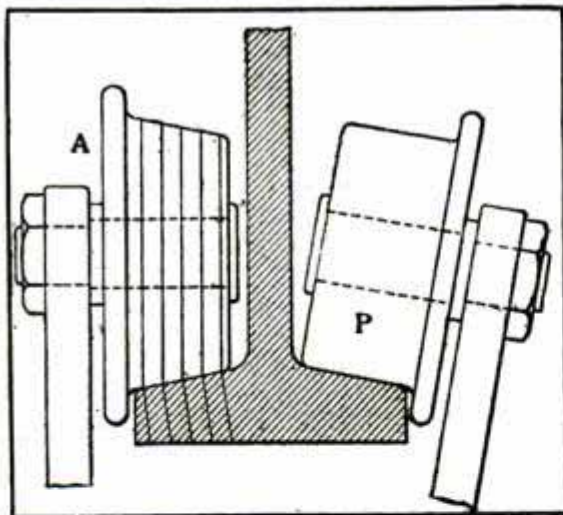
horizontal length of the tube T water jacketed, as is shown in the engraving, with the water entering at I and leaving at O.

### Design for Trolley Wheel

There seems to be some difference of opinion about the design of wheels for trolleys for carrying loads, to be used on I-beams, says a correspondent of the American Machinist. Among others I recently noticed an illustration of one in which conical wheels were used upon the beveled flanges of an I-beam, after the manner of the wheel A in the illustration.

I had always supposed that conical wheels were only adapted to circular pathways, which would preferably have a beveled face, corresponding to the angle of the conical wheel.

Referring to the illustration again, a number of lines have been drawn on the wheel A to represent circles on the periphery, and assuming that there is a load on the trolley, it is evident that



Wrong and Right Designs for Trolley

pressure is brought to bear equally at each of the points of intersection.

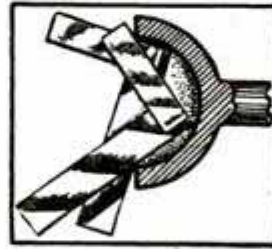
Now, when the trolley is moved it is evident that the linear speed of the largest circle is greater than that of any of the other circles, so that the wheel is bound to slip.

The wheel P is made cylindrical, and will run upon a beveled flange without the slippage incident to the

wheel A, and therefore seems preferable to it.

### Testing Hemispherical Cavities

To test a hemispherical cavity or a semicircular groove, place a steel square in the cavity in several different positions. If the work is true the square will touch at three points in all positions.



—Contributed by W. F. S.

### Trisecting an Angle

Problem.—What is the geometrical construction for trisecting any given angle?—F. L. G.

The solution of this problem has been declared impossible by some of the ablest mathematicians. Of course an angle may be approximately trisected by making numerous trials, and the results obtained in this way may be sufficiently accurate for all practical purposes, but as yet there is no direct method which can be demonstrated along geometrical lines.

### Painting Cement

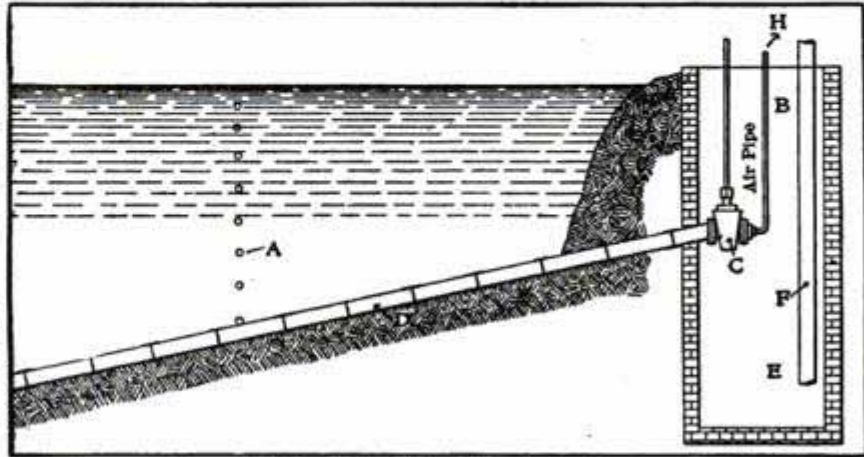
The following method of painting a cement wall was described at a recent convention of master painters. The building had become discolored in places and the joints were of a different color from the surface of the blocks. Two parts of Portland cement were mixed with one part of marble dust and mixed with water to the consistency of thin paint or a thick whitewash. The wall must be well wetted before the application of this paint and kept constantly wet while the material is applied, and then must be kept wet for a day longer, in order to make the cement wash adhere to the cement surface. The wash was applied with ordinary whitewash brushes, and a man was kept busy playing a hose on it while the work was being done.



### Locating a Leak in Submerged Pipe

In a system where a brick-lined well, E, was supplied at all times with clean, pure water through a pipe, D, running out into Lake Ontario a distance of 500 or 600 ft., a leak developed in the submerged pipe, so that after a windstorm muddy water found its way into the well. Divers tightened up the joints, but could not cure nor locate the trouble, says Power.

In the system F is the suction pipe from the pumps and C is a heavy cast-iron valve used to regulate or close off the flow of lake water into the well. The engineer connected an air pipe, H, to valve C and had air pumped into the pipe. After the pump had been working for some time he went out onto the lake in a canoe and soon discovered a string of bubbles rising to the surface as shown at A, about 200 ft. from shore in about 20 ft. of water. The diver descended at that point, found the break and repaired it.



Air Bubbles Show Leak in Pipe

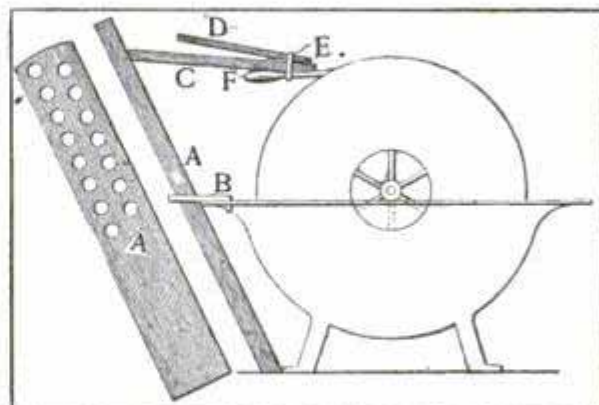
takes several hundred cast knife tips to make a pound.

### Tool Holder for Grindstone

In many shops there are numerous chisels, cutters and plane bits that must be ground from time to time, and if they all must be held by hand the process not only requires much skill, but becomes very tedious long before it is completed. If a clamp is installed like the one here described the work is hastened, the results are better, and the job now can be entrusted

### German Silver Knife Castings

Many of the German silver tips on pocket knife handles are castings, being probably the smallest that enter the brass foundry, says the Brass World. In the use of sheet German silver the tips must first be blanked out. This necessitates the production of 40 or 50 per cent of scrap. After the tips have been blanked they must be formed under a drop, with successive annealings, until they are formed into the oval shape ready for use. The cast German silver, however, only requires polishing and is ready for use. The tips are cast with a large number on a gate and with two gates in a flask. They are poured "on end." Scrap



A Grinding Device

to a boy, says a correspondent of Wood Craft.

First, a board must be fashioned similar to A. The lower end of this



must be beveled so that it rests flat on the floor when in position. The board is held in position by a hook forged of a light rod of iron with the ends passing down through the holes in the trough that originally were intended for attaching the name-plate. In this board, A, must be bored a number of holes. These afford a number of resting places for the clamp proper, C D.

The clamp is made up of two pieces of inch stock as wide as the widest plane bit and with one end of C rounded to fit the holes in A. Upon

strip C is fastened a little rib, F, which serves as a fulcrum for the piece D. At the end of D is fastened by staples an iron rectangle, E, made of welded strap iron which holds the chisel or plane bit against the lower side of C when the hand is pressed down upon the other end of D.

By moving the chisel forward or backward in the clamp, or by raising or lowering the rear end of C, any angle desired may be secured upon the chisel as it is pushed back and forth across the stone.

### Planing Large Engine Casting

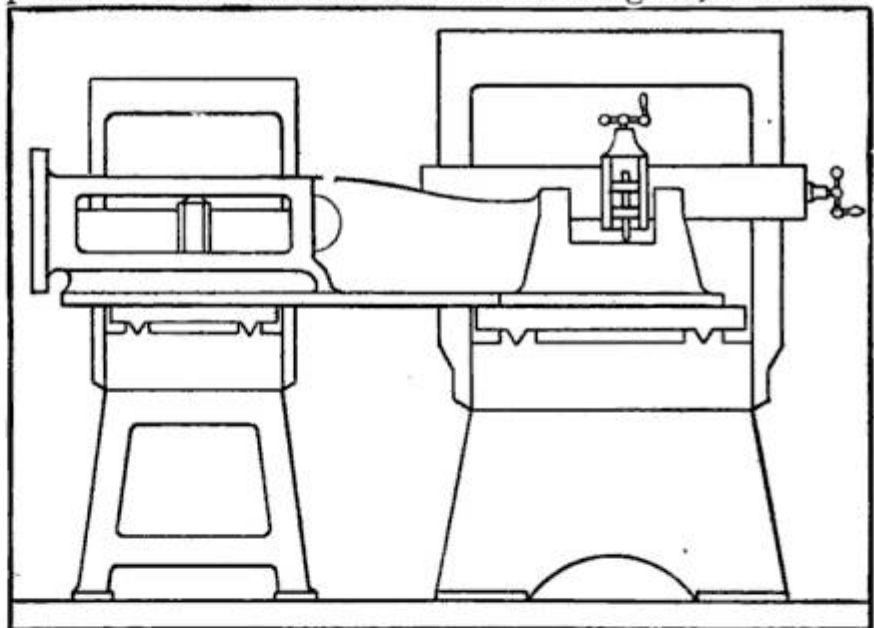
The accompanying cut shows how we planed a large engine frame which was too large for the largest planer. The length of the cut was greater than the stroke of either of the shapers in our shop which made it necessary to use the planer and in order to support the end not being finished a small planer was moved alongside the large one.

It was found that the reversing of the large planer made it necessary to use diagonal braces to prevent the work from slewing around at the end of the stroke. These braces were fastened from each end of the planer bed to the casting, near the cylinder end, the back brace being so placed as to clear the planer frame in all positions of the work. The entire work of finishing the casting, including bracing and moving the planer, was done in 1½ days.—Contributed by C. R. McGahey.

To attach metal letters to glass use 30 parts copal varnish, 10 parts spirits of turpentine, 10 parts glue dissolved in a little warm water, and 20 parts pulverized slaked lime.

### Cement for Porcelain

Soak 1 dr. of isinglass in water; pour upon this a sufficient quantity of alcohol to cover the isinglass, and allow



Planing with Two Planers

it to dissolve, placing it in a warm room. Next dissolve ½ dr. of mastic in 1 fl. dr. of rectified spirit of wine; mix both solutions together, add ½ dr. of powdered gum ammoniac, and evaporate the mixture in a water-bath until it has acquired the requisite consistency. Keep the cement in a glass bottle, and when it is to be used place the bottle in hot water, when the cement will become soft so that it can be conveniently applied to the fragments of porcelain to be cemented, which should be previously heated.





## Mechanics for Young America



### Young Mechanic Builds Successful Auto

The building of a small runabout is not such a difficult problem as would be imagined by those who have never tried it. All the machine work on mine was done on a small foot-power lathe, and the wheels, sprockets, hubs and other parts were taken from bicycle and motorcycle fittings.

The engine is of the 4-cycle type and was modeled after an ordinary motorcycle engine. The crank case is enclosed and made in two pieces with a longitudinal joint and a bearing in each half. Enclosed in the crank case are two flywheels, connected by a small pin, which is used for the crank pin. A small pulley on the engine shaft is connected to a larger pulley on a countershaft, directly under the operator's feet, by means of a slack belt, which may be tightened by means of a swinging idler pulley, operated by a hand lever. When the belt is slack the engine will run at full speed without driving the machine, but a very little pull on the lever will tighten the belt and perform the function of a clutch.

The drive from the countershaft to the rear axle is by means of a bicycle chain and sprocket. I used no differential gear on my machine, as I found that the hubs, which are of the "coaster" pattern, successfully prevent any slipping when turning a corner.

The frame of the car is built of

white ash with 1 in. by 2 in. sills, and the axles are made of 1½-in. heavy steel tubing. The seat is made of white wood with band-iron corners inside, to stiffen it, and is upholstered in imitation leather.—Contributed by Fred W. Pickles, 692 Wealthy Ave., Grand Rapids, Mich.

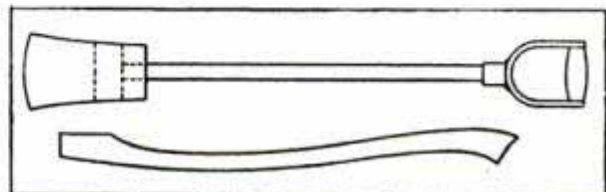


Auto Built by 15-Year-Old Boy

### A Handy Ice Chisel

Fishing through the ice is great sport, but cutting the first holes preparatory to setting the lines is not always an easy task. The ice chisel described below will be found very handy, and can be made at very slight expense.

In the top of an old axe head drill



Combination Axe and Ice Chisel

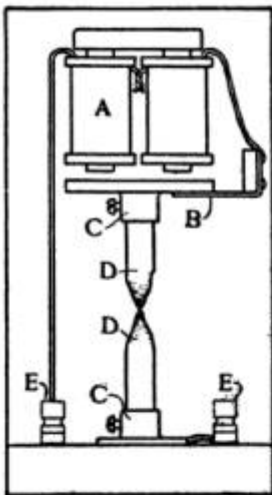


a  $\frac{1}{8}$ -in. hole, and then tap it for a  $\frac{3}{8}$ -in. gas pipe, about 18 in. long. Thread the other end of the pipe, and screw on an old snow shovel handle. When ready for use, screw the two pieces together and you have your chisel complete.

A short axe handle may be included in the outfit. When the holes are finished and your lines set, unscrew the pipe from the head of the axe, put in the handle and your axe is ready to cut the wood to keep your fire going.—Contributed by C. J. Rand, West Somerville, Mass.

### Home-Made Arc Light

By rewinding an electric bell magnet with No. 16 wire and connecting it in series with two electric light carbons, as shown in the sketch,



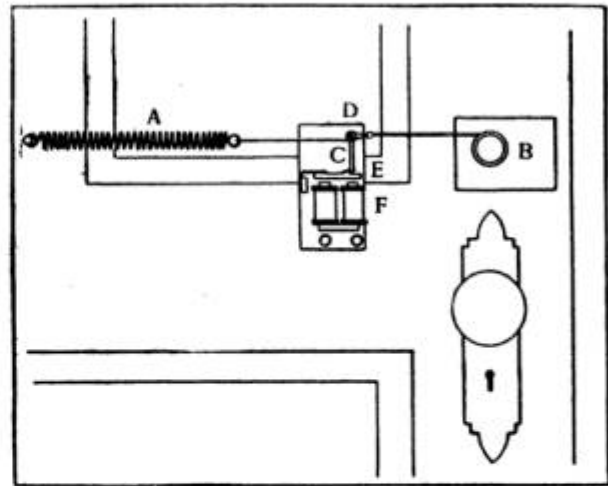
as shown in the sketch, a small arc will be formed between the carbon points when the current is applied. In the sketch, A is the electric bell magnet; B, the armature; C C, carbon sockets; D, carbons; and E E, binding - posts.

When connected with 10 or 12 dry batteries this lamp gives a fairly good light.—Contributed by Morris L. Levy, 512 San Pedro Ave., San Antonio, Tex.

### Electric Door Opener

A very convenient and efficient device for unlocking any door fitted with a spring lock is shown in the accompanying sketches. A fairly stiff spring, A, is connected by a flexible wire cord to the knob B. The cord is also fastened to a lever, C, which is pivoted at D and is released by a magnetic trigger, E, made from the armature and magnet of an old electric bell.

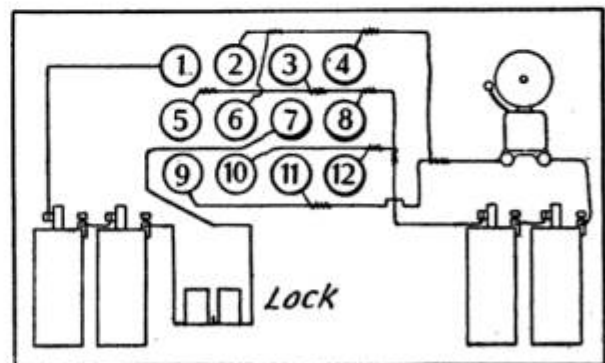
When the circuit is completed by means of a secret contact device out-



Apparatus Placed on Inside of Door

side the door, the magnet, F, pulls down the armature which releases the trigger and allows the spring to open the lock. If there are metal numbers on the outside of the door they may be used for the secret contact, if desired, but if there are no numbers on the door, a small contact board may be constructed by driving about 12 brass-headed tacks into a thin piece of wood and making connections at the back as shown in the wiring diagram.

In this particular diagram the tacks numbered 1 and 7 are used for unlocking the door, the others being connected with the electric bell circuit as indicated for the purpose of giving an alarm should anybody try to experiment with the secret contacts. By means of a pocket knife or other metal article the operator can let himself in at any time by connecting the tacks numbered 1 and 7, while a person not knowing the combination would be liable to sound the alarm. Of course the builder of this device can choose a combination of his own and can thus prevent anybody else from entering the



Wiring Diagram

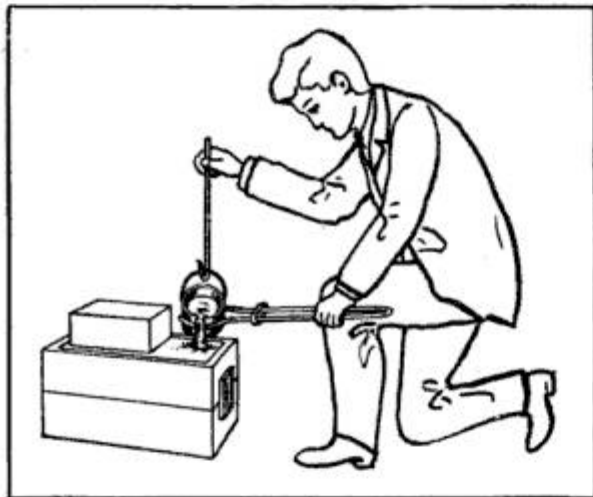


door; even those who read this description.—Contributed by Perry A. Borden, Mt. Allison University, Gachville, N. B.

## Foundry Work at Home

### Part III—Melting and Pouring

Having prepared one or more molds as described in the last chapter, the next operation is that of melting and pouring. An ordinary cast-iron glue pot makes a good crucible and can be easily handled by a pair of tongs, made out of steel rod, as shown in the sketch. In order to hold the tongs together a small link can be slipped on over the



Pouring the Mold

handle, thus holding the crucible securely.

A second piece of steel rod bent in the form of a hook at the end is very useful for supporting the weight of the crucible and prevents spilling the molten metal should the tongs slip off the crucible. The hook is also useful for removing the crucible from the fire, which should be done soon after the metal is entirely melted in order to prevent overheating. The metal should be poured into the mold in a small stream to give the air a chance to escape and should not be poured directly into the center of the opening, as the metal will then strike the bottom hard enough to loosen the sand, thus making a dirty casting.

If after being poured the mold sputters and emits large volumes of steam, it shows that the sand is too wet and the castings in such cases will probably be imperfect and full of holes.

A mold made in the manner previously described may be poured with any desired metal, but a metal which is easily melted will give the least trouble. One of the easiest metals to melt and one which makes very attractive castings is pure tin. Tin melts at a temperature slightly above the melting point of solder and although somewhat expensive the permanent brightness and silverlike appearance of the castings is very desirable. A good "white metal" may be made by mixing 75% tin, 15% lead, 5% zinc, and 5% antimony. The object of adding antimony to an alloy is to prevent shrinkage when cooling.

A very economical alloy is made by melting up all the old type metal, babbitt, battery zincs, white metal and other scrap available, and adding a little antimony if the metal shrinks too much in cooling. If a good furnace is available, aluminum can be melted without any difficulty, although this metal melts at a higher temperature than any of the metals previously mentioned.

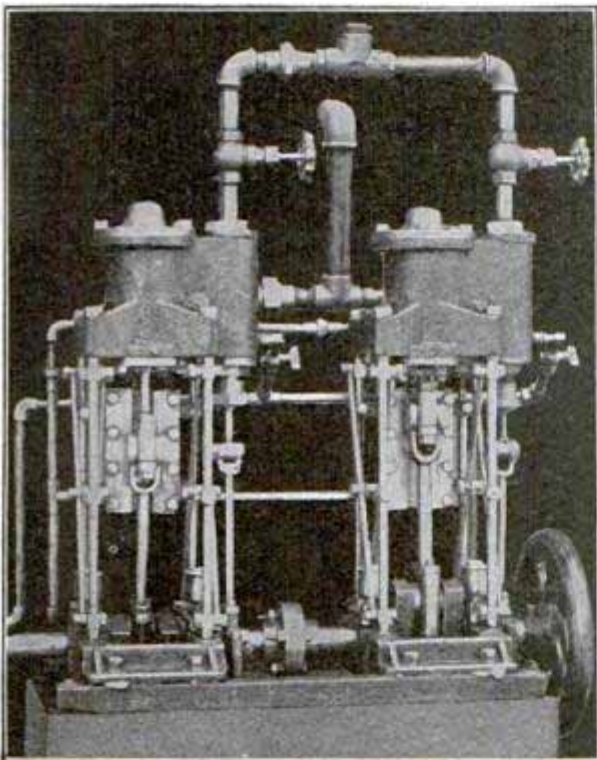
In casting zincs for batteries a separate crucible, used only for zinc, is very desirable, as the presence of a very small amount of lead or other impurity will cause the batteries to polarize. A very good way to make the binding-posts is to remove the binding-posts from worn-out dry batteries and place them in the molds in such a way that the melted zinc will flow around them.

The time required for a casting to solidify varies with the size and shape of the casting, but unless the pattern is a very large one about five minutes will be ample time for it to set. The casting is then dumped out of the mold and the sand brushed off. The gate can be removed with either a cold chisel or a hacksaw and the casting is then ready for finishing.



### Steam Engine Built in Amateur Shop

The amateur mechanic who has a lathe and shaper in his equipment may possibly be encouraged to build an engine along similar lines to the one here illustrated. In this engine, as in almost every engine, the cylinder and bed are of cast iron, but the frame is constructed of cold-rolled steel. The two units shown are exact duplicates, either of which may be run independently of the other by disconnecting the



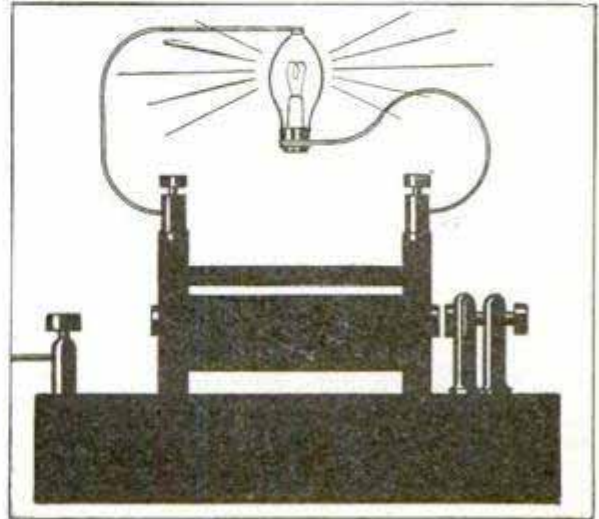
"Power is About 1 1-2 Hp."

coupling at the center and mounting on separate beds.

The complicated steam chests used in many engines are replaced in this one by simple cylinder valves with simple stuffing boxes, which may be taken from globe or angle valves, if the builder does not wish to construct them himself. The cylinders of this engine are  $2\frac{1}{2}$  in. diameter and the stroke is 3 in. With a steam pressure of 80 lb. acting on both cylinders and a speed of 250 r. p. m. the power is about  $1\frac{1}{2}$  hp.—Contributed by Dr. Mark G. McElhinney, Ottawa, Canada.

### Lighting Incandescent Lamp with Induction Coil

An incandescent lamp of low candle-power may be illuminated by connecting to an induction coil in the manner shown in the sketch. One wire is con-

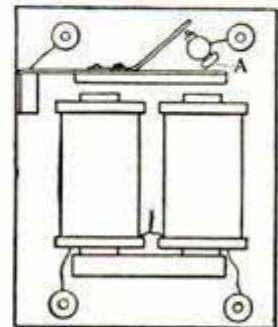


Geissler Tube

nected to the metal cap of the lamp and the other wire is fastened to the glass tip. If the apparatus is then placed in the dark and the current turned on, a peculiar phosphorescent glow will fill the whole interior of the lamp. The induction coil used for this purpose should give a spark about  $\frac{1}{2}$  in. long or more.—Contributed by Joseph B. Bell, 411 Herkimer St., Brooklyn, New York.

### Relay Made from Electric Bell

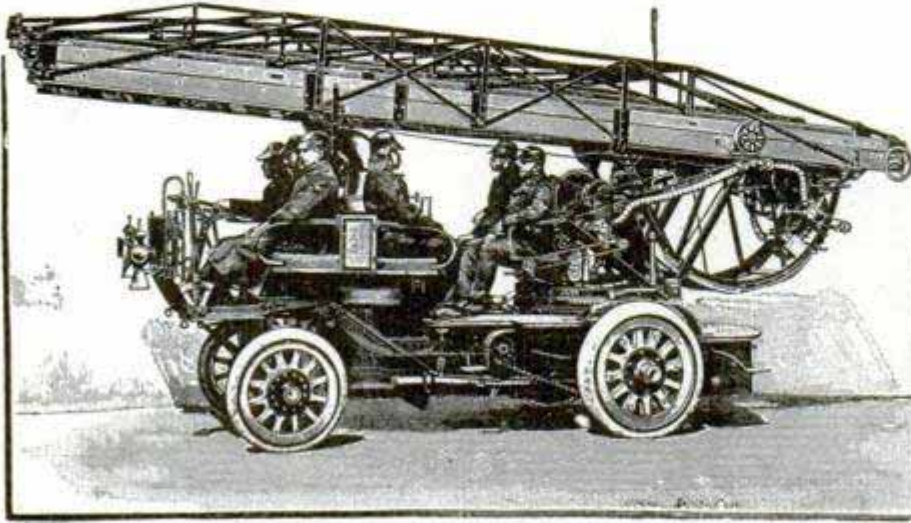
It is not necessary to remove the adjusting screw when changing an electric bell into a relay. Simply twist it around as at A and bend the circuit-breaking contact back as shown. It may be necessary to remove the head of the screw, A, to prevent short-circuiting with the armature.—Contributed by A. L. Macey, 231 West 40th St., New York City.





## MILLION BARRELS OF SAND FOR TUNNEL

For the concrete work of the Michigan Central railroad tunnel under the Detroit river 1,000,000 bbl. of sand has



been contracted for. That much sand is worth, at present, about \$90,000 and it is estimated that the contractors' little schooner will be able to deliver it in about 320 loads, requiring two years' time.

## TELEPHONE FROM MOVING TRAIN

Telephone communication from a train running 35 miles an hour on a line out of Madison, Ind., was had with Louisville, Cincinnati and Indianapolis. The apparatus may prove to be sufficiently reliable to warrant the equipment of all trains. This would put the train crew in constant connection with the train dispatcher which would be a great advance in safety of operation.

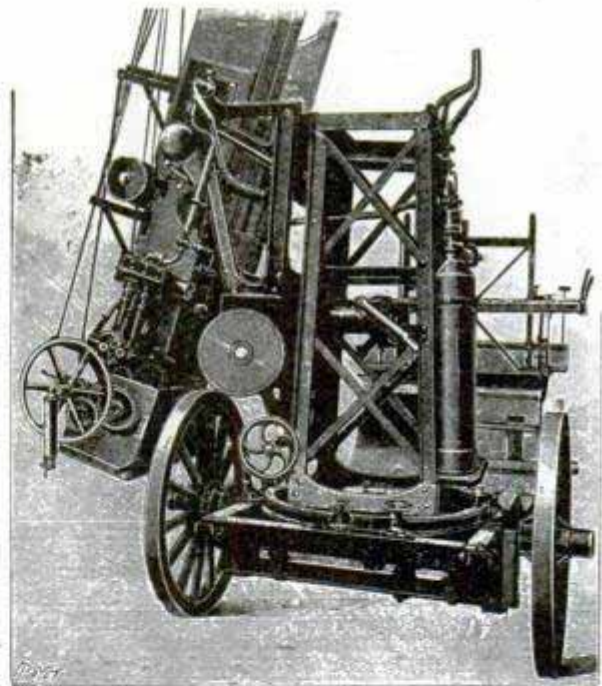
## SUBWAYS IN NEW YORK

When the seven subways in New York city are completed there will be 66 miles of construction which will have cost \$150,000,000. Twenty miles of track are already in operation and already taxed to their full capacity. The Brooklyn extension of 5½ miles is nearing completion.

## SELF-RAISING AUTO FIRE LADDERS

In the construction and use of extension ladders Germany and Austria lead the world. They were the first to build self-propelling trucks for fire departments, and now have made the extension ladders self-raising also. The ladders are raised or lowered by either power from the motor on the truck or by compressed air carried in tanks. Chemicals capable of generating high pressure gases have also been used to some extent.

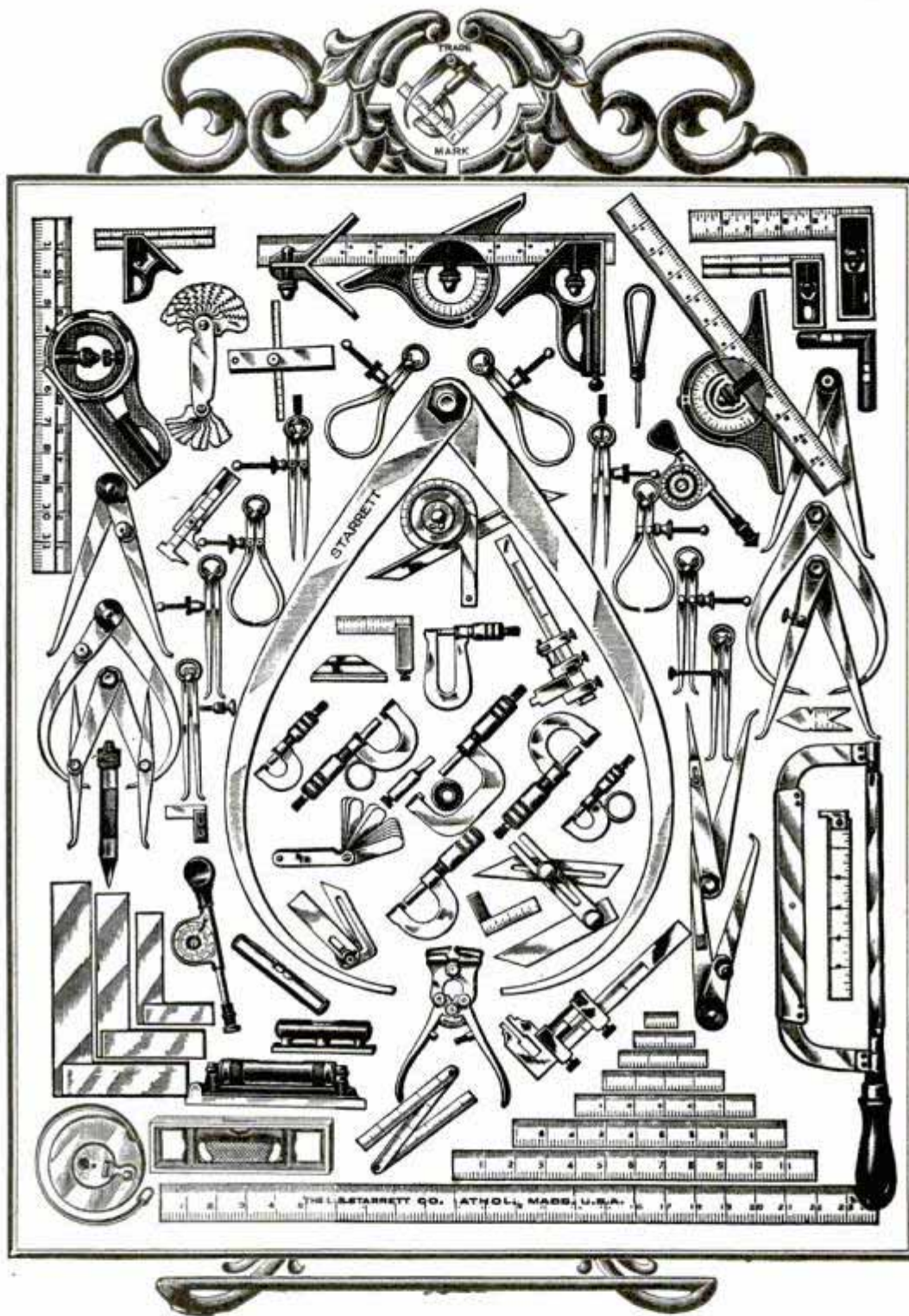
The extension ladder is not confined to fire departments, but is em-



Compressed Air Apparatus

ployed daily in commercial work such as washing windows and the fronts of tall buildings, stringing and repairing telephone and telegraph wires, and in construction work. In the army they are employed by the signal service in sending messages and making observations.





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In speaking of a person's faults,

Pray don't forget your own;  
Remember those with homes of glass  
Should never throw a stone.

If we have nothing else to do

But talk of those who sin,  
'Tis better we commence at home,  
And from that point begin.

We have no right to judge a man

Until he's fairly tried;  
Should we not like his company,

We know the world is wide.

Some may have faults—and who has not?

The old as well as young;

We may, perhaps, for aught we know,  
Have fifty to their one.

I'll tell you of a better plan.

And find it works full well,  
To try my own defects to cure,

Before of others tell;

And though I sometimes hope to be

No worse than some I know,  
My own shortcomings bid me let

The faults of others go.

Then let us all when we commence

To slander friend or foe,  
Think of the harm one word may do

To those we little know;

Remember, curses sometimes, like

Our chickens, "roost at home";

Don't speak of other's faults until

We have none of our own.

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The secret of quality in workmanship is not over at your neighbor's machine, nor in some other shop, but is to be found right in the details of your own work.

It's all right to hurry home after you leave the factory at night, but some people hurry only till they get outside the factory.

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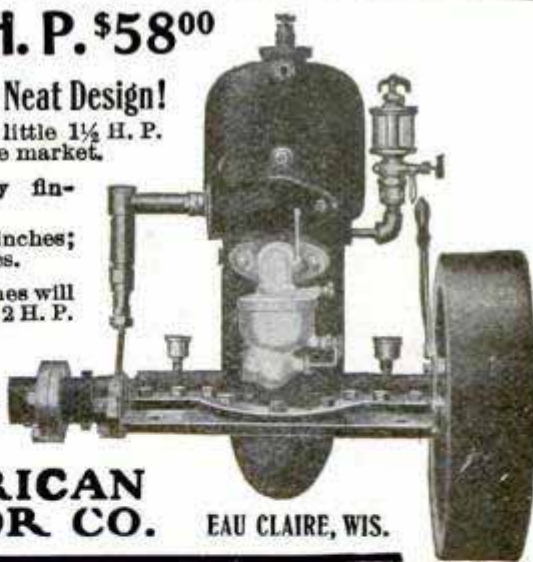
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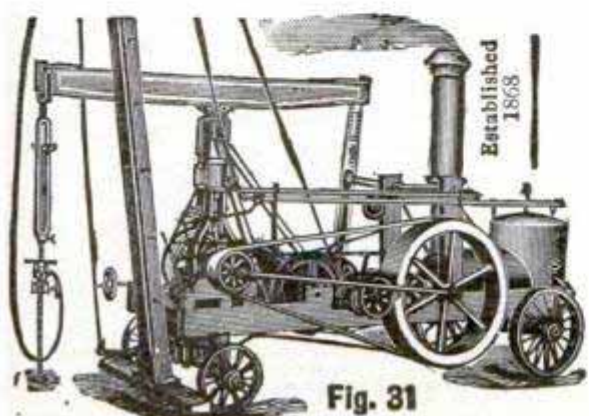
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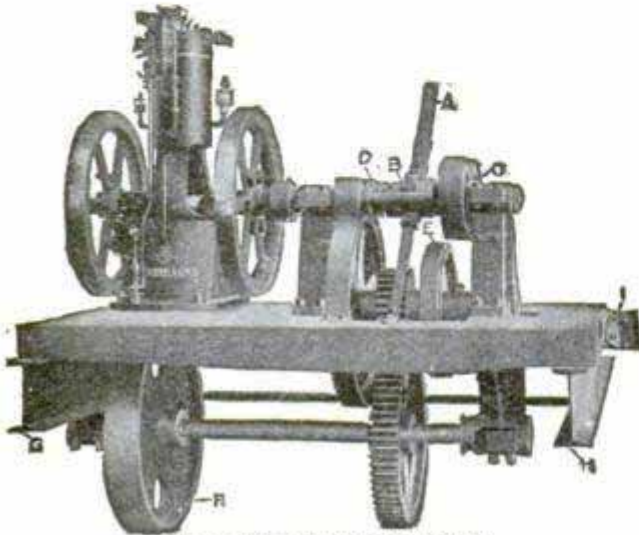
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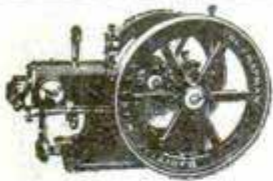


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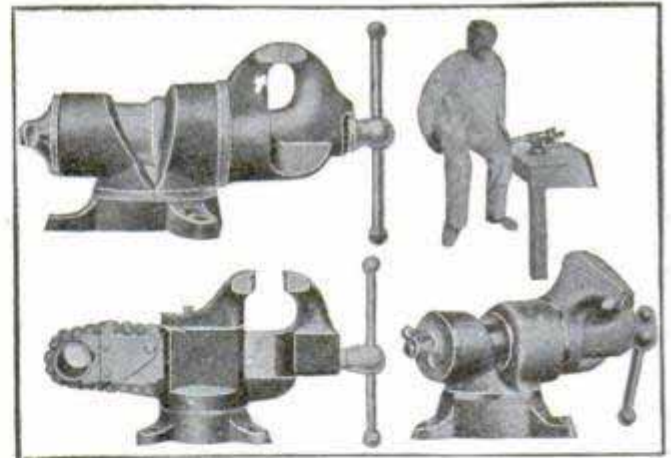
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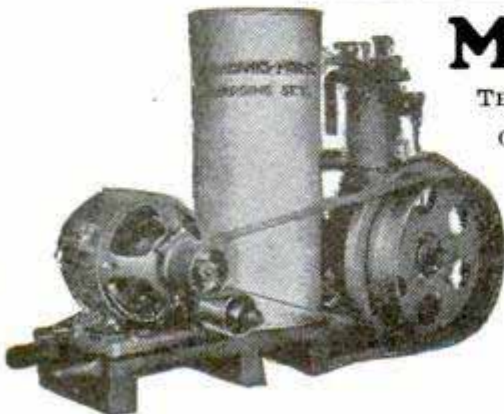
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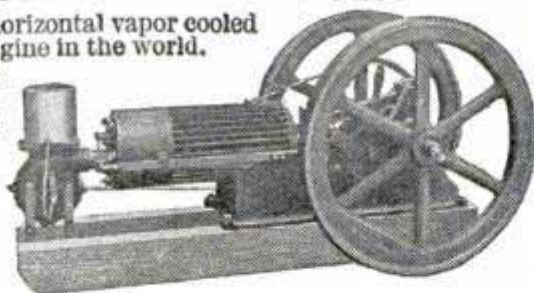


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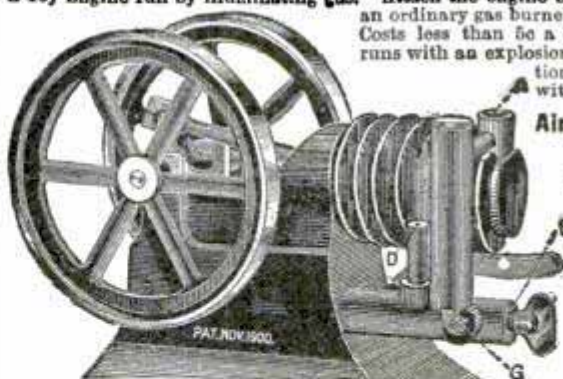


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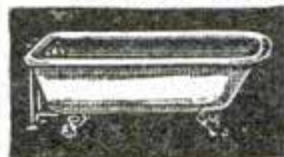
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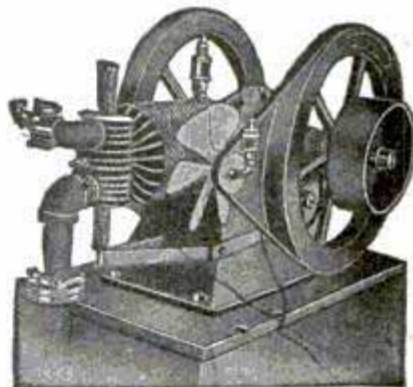
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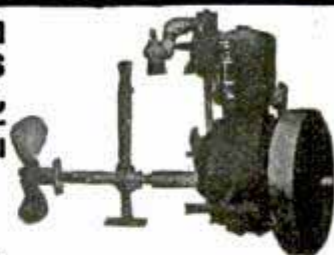
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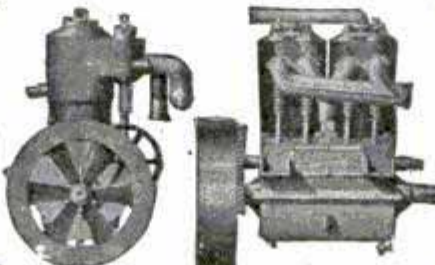
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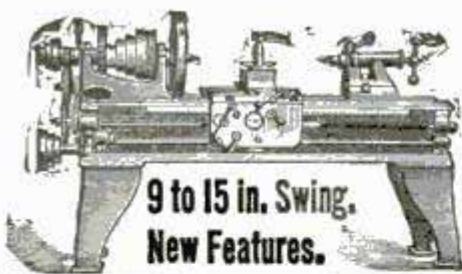


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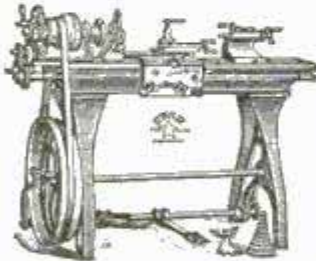
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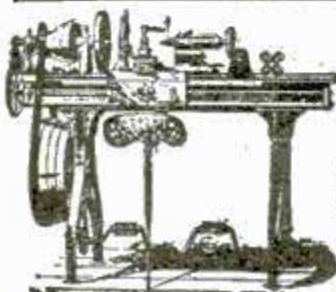
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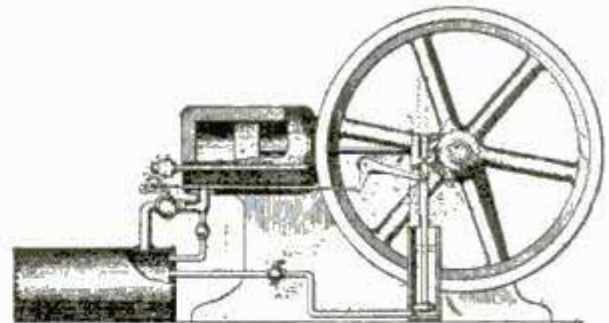
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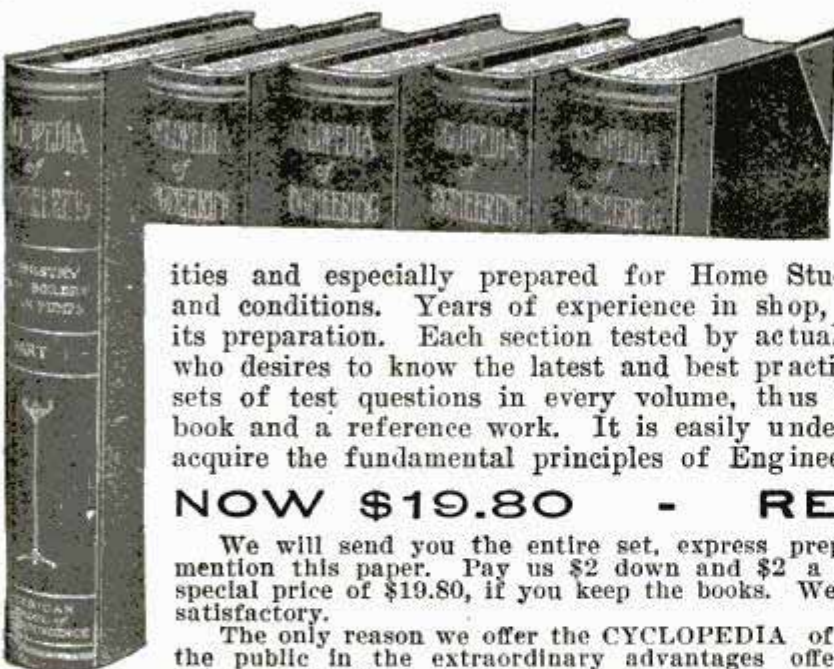
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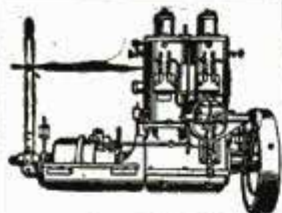
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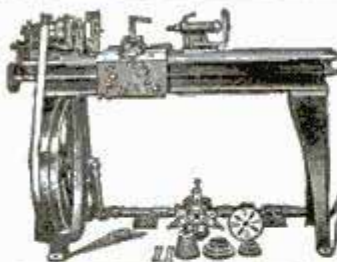
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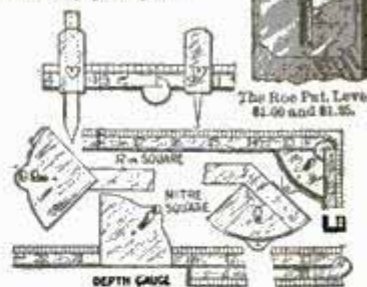
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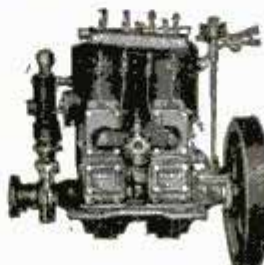
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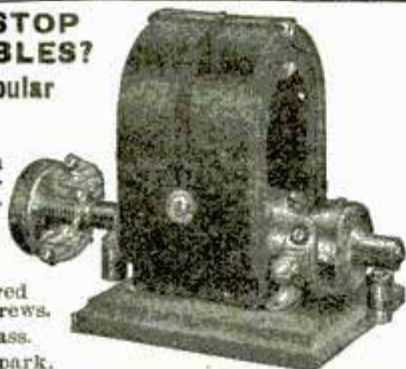
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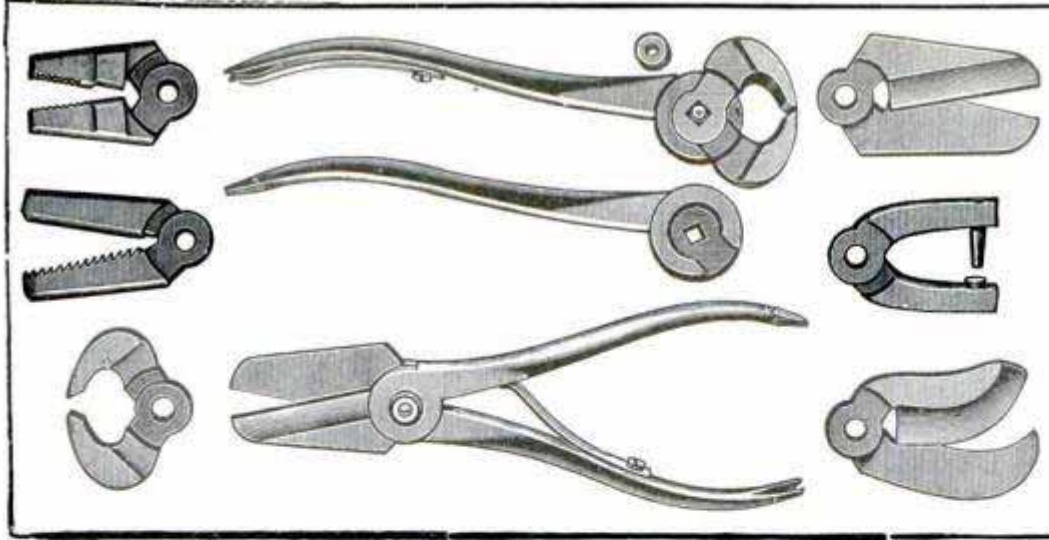
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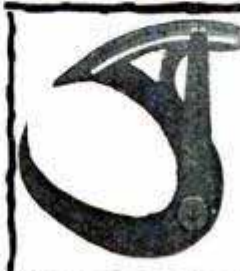
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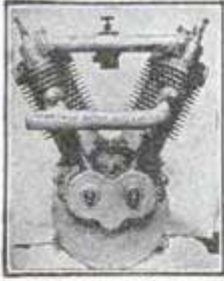


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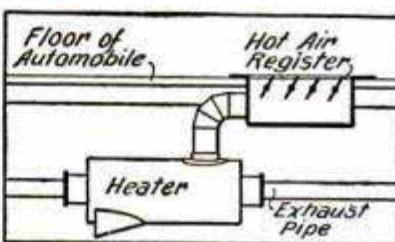
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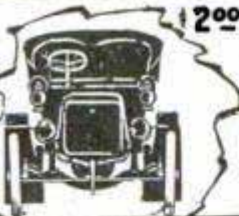


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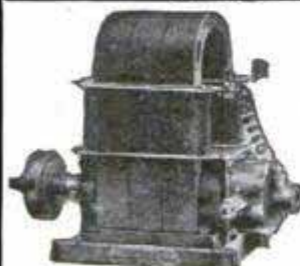
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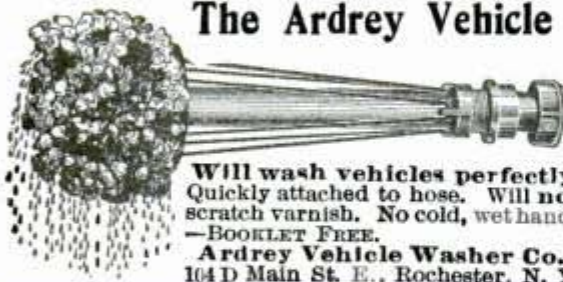
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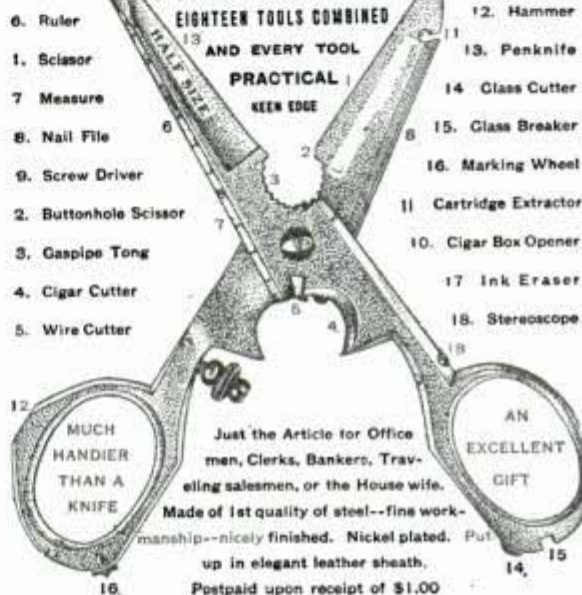
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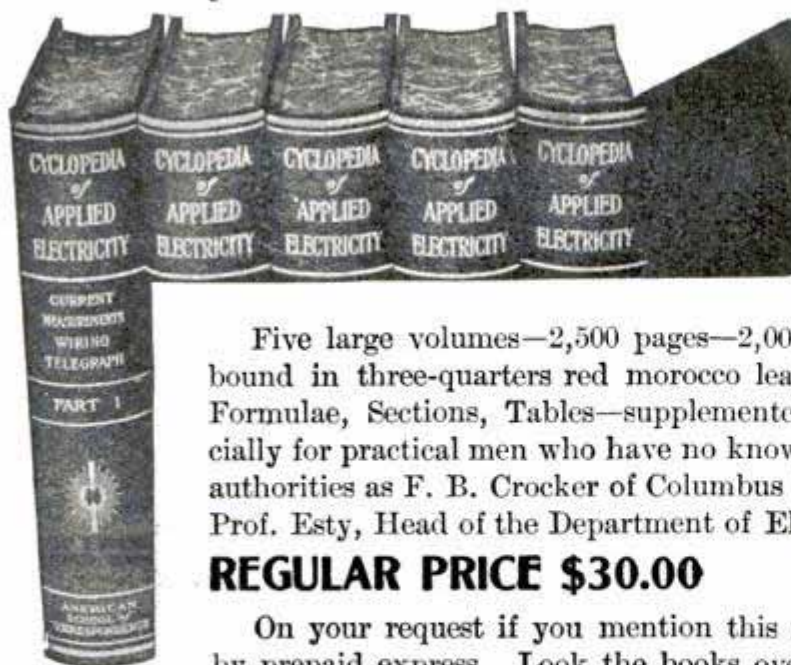
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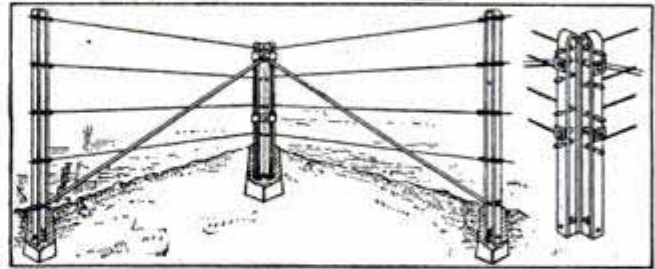
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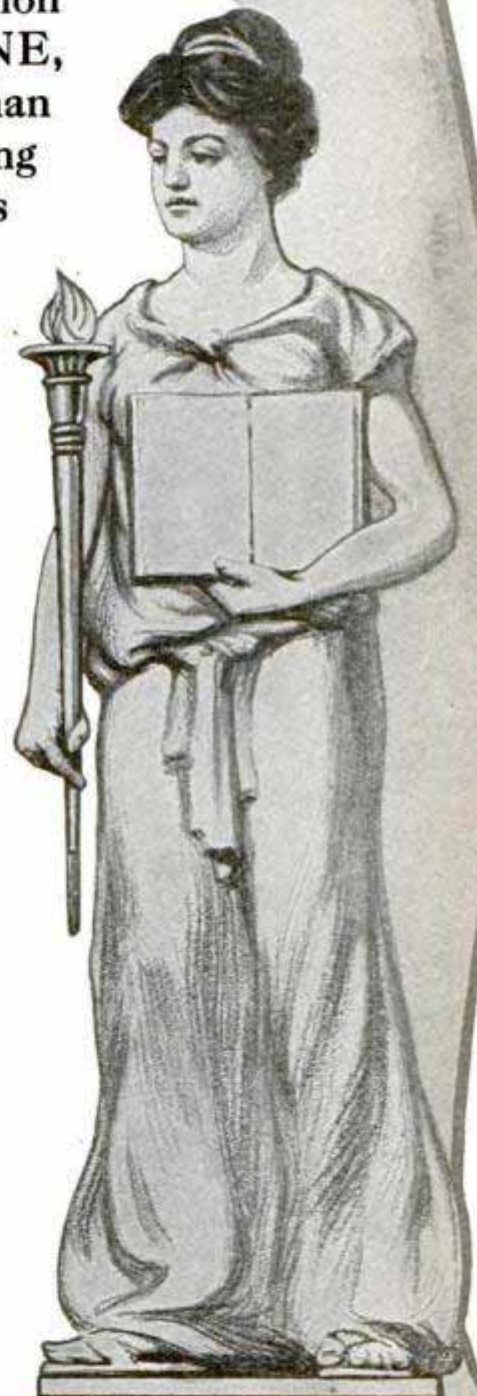
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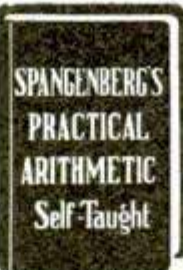
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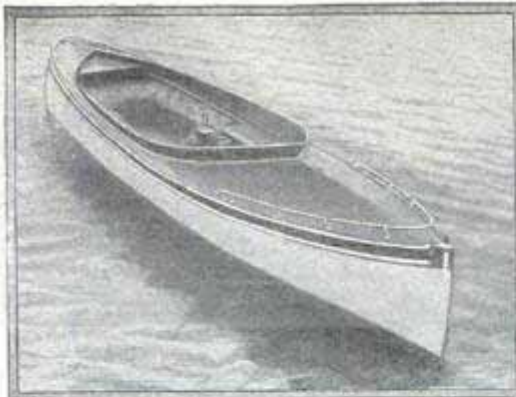
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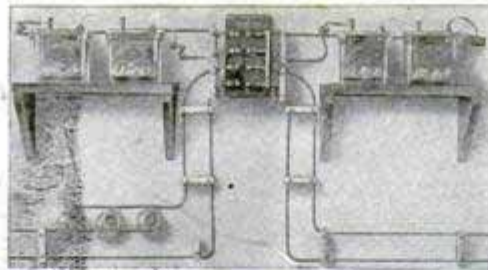
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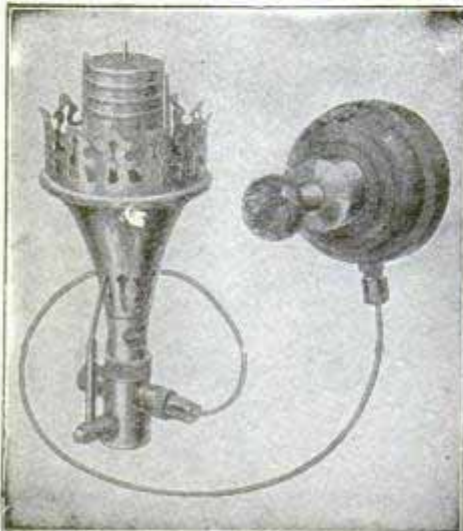
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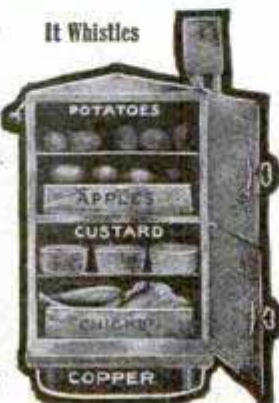
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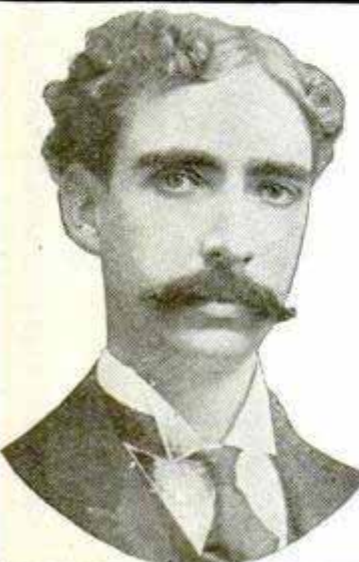
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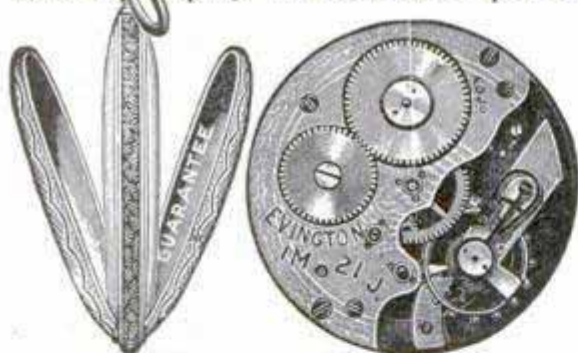


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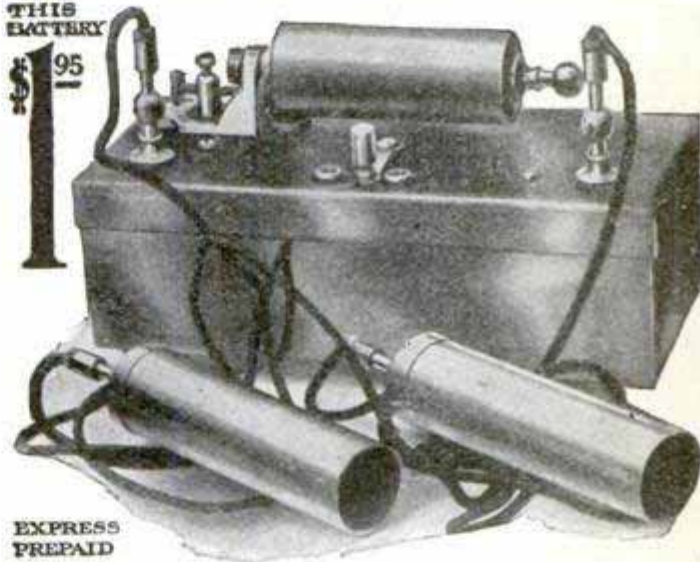
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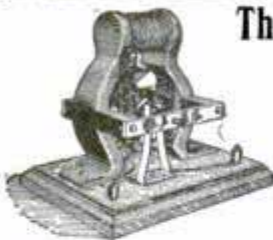
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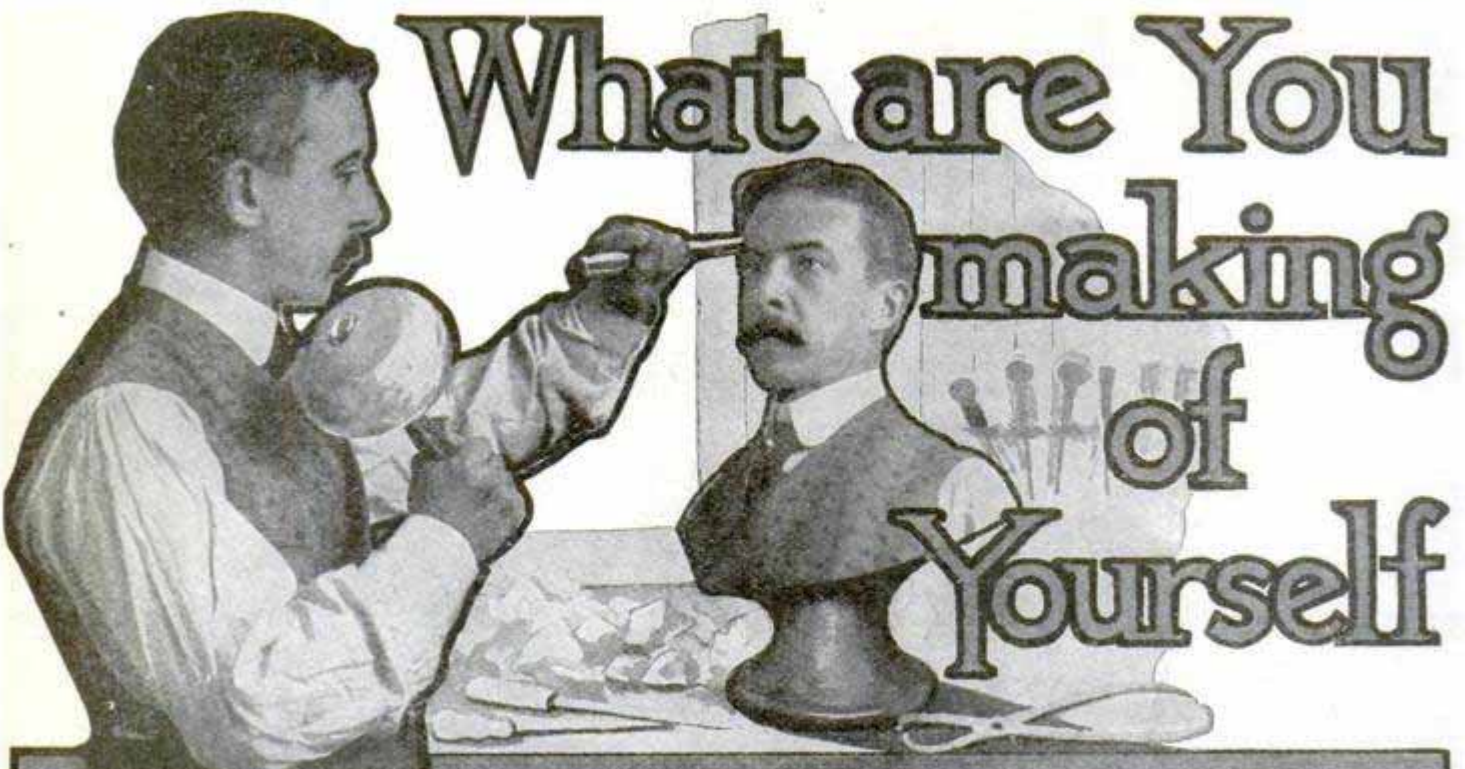
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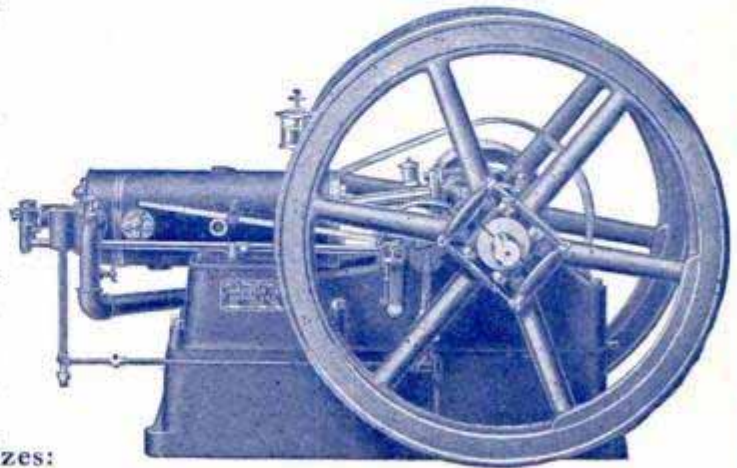
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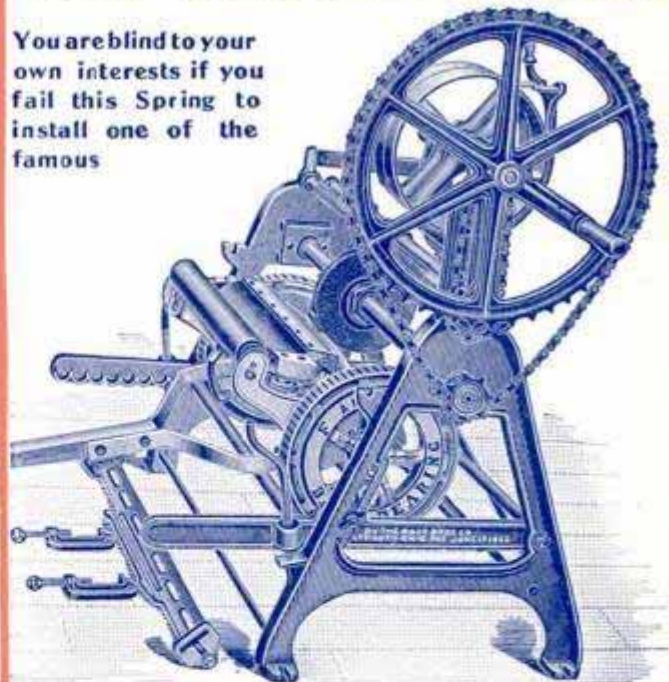
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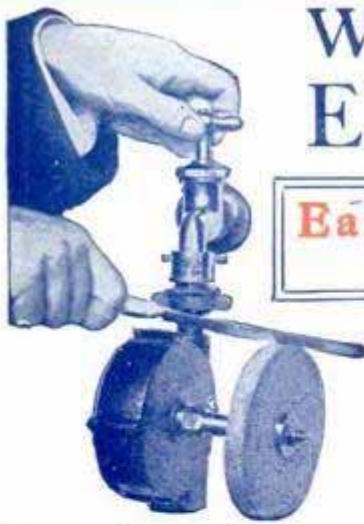


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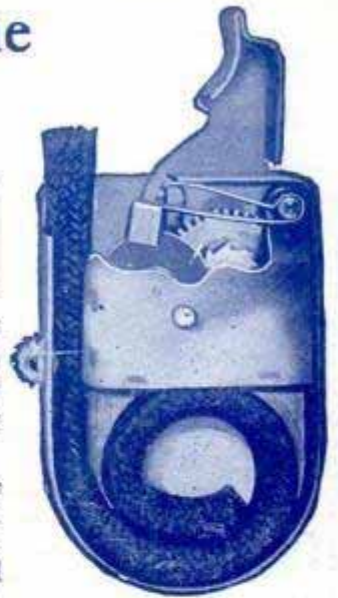
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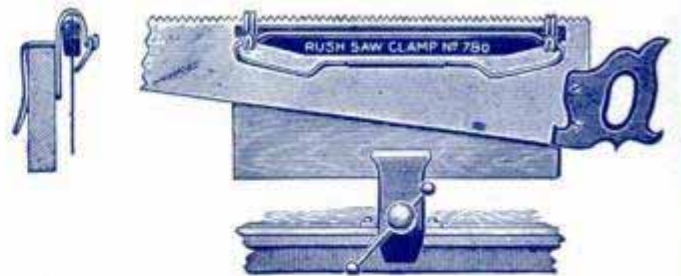
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