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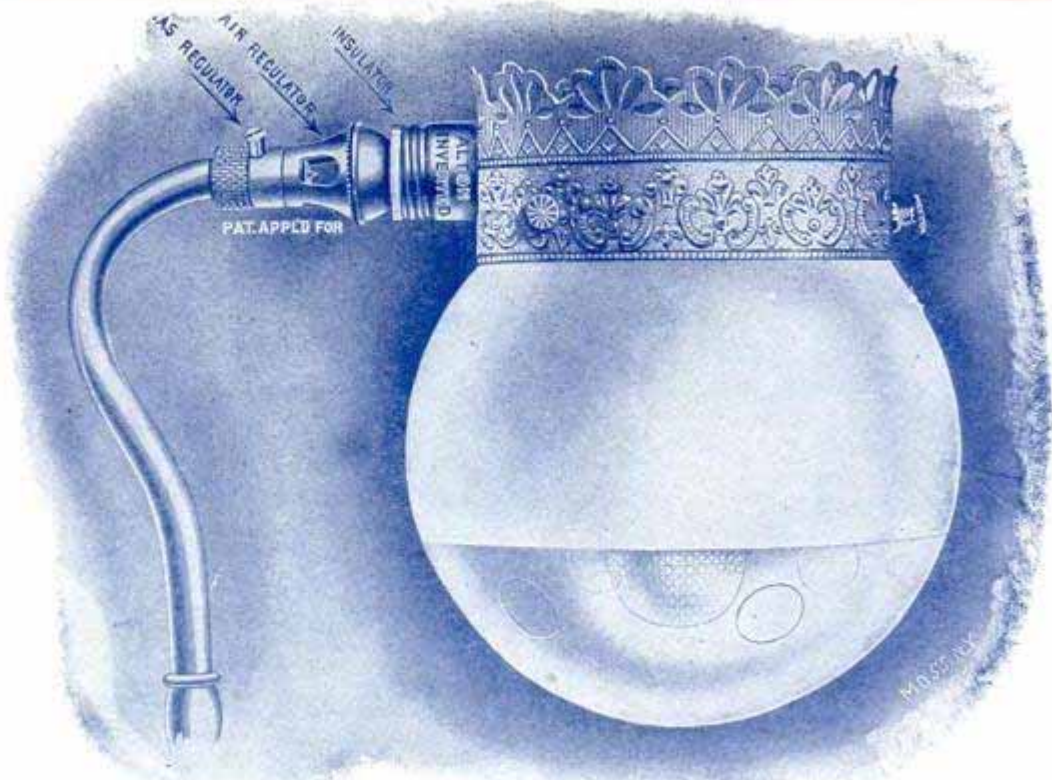
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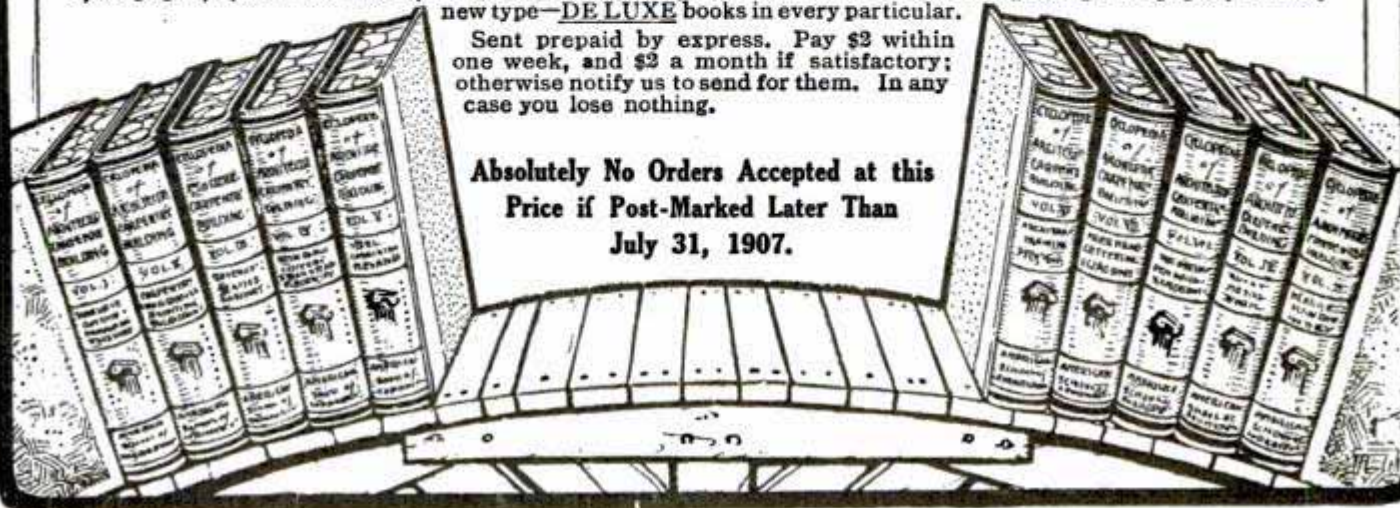
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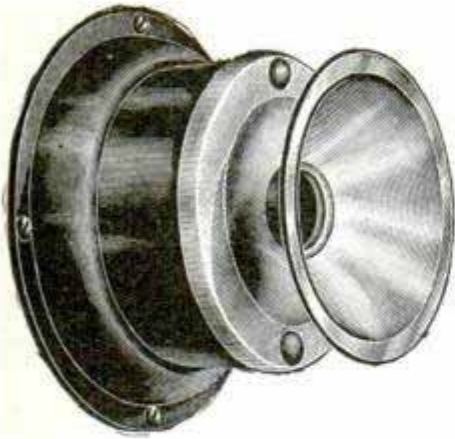
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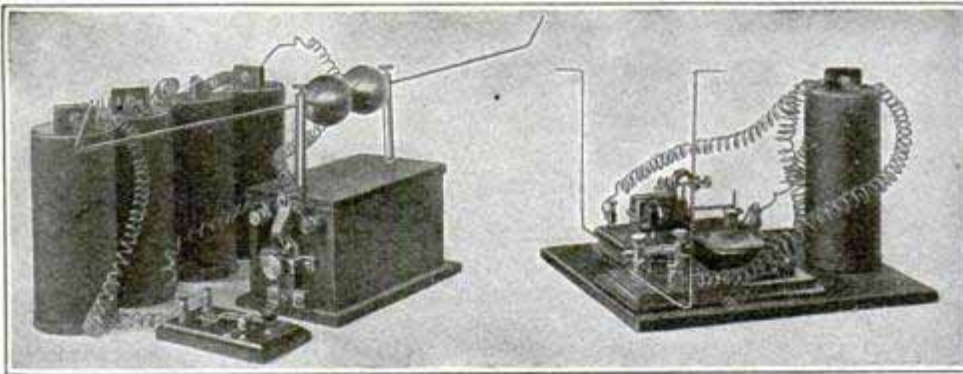
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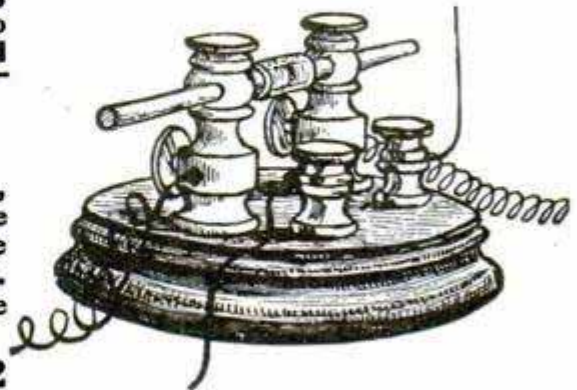
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CONTENTS FOR JULY, 1907

CARS BALANCED ON SINGLE RAIL.....	739
CANTEENS AS LIFE PRESERVERS.....	742
BERTILLON'S NEW SYSTEM OF PHOTO- GRAPHING THE DEAD.....	743
A Concrete Safe.....	743
NEW SENSATION COMING.....	744
Enforced Burial at Sea.....	744
TRAVELING BLACKSMITH SHOP.....	745
Front of Eight-Story Building Falls Out.....	746
PARIS PRINTS PAPERS WITH AUTOMO- BILES.....	746
TREATMENT INSTEAD OF DRUGS.....	747
Seven Years' Cruise in Small Boat.....	748
Log Railway.....	748
Power from the Bay of Fundy.....	749
LATEST FRENCH TORPEDO BOAT.....	749
HOW GRADIENTS ARE MEASURED.....	750
Unique Automobile Sprinkler.....	750
REPAIRING BROKEN FLOWERS.....	751
Autos Follow Horse Equipage Customs.....	751
Raising Serpent Cucumbers.....	752
Barge to Cross Ocean.....	752
Electric Light in Egyptian Tomb.....	752
AUTOS FOR PEKIN TO PARIS RACE.....	753
ROLLED STERLING SILVER.....	753
Milkstone Substitute for Ivory.....	754
Cadets Give Gymnastic Display.....	754
Church on Giant Volcano.....	755
Temperature in Storage Bins.....	755
BOSTON'S FIRE CHIEF'S AUTO.....	755
Nobody's Railroad.....	755
MINE RESCUE SCHOOL.....	756
A Lesson in House Lighting.....	756
20,000 Train Speed Indicators in Europe.....	757
Convenient Water Cooled Auto Brake.....	757
THE WORLD'S GREATEST GAS WELL.....	757
Officer Struck by Flying Fish.....	758
An Auto Duck.....	758
Theatre Concert European, Paris.....	758
KEEPING COAL UNDER WATER FOR YEARS.....	759
Acetylene Alcohol for Gas Engines.....	760
A Double Comforter.....	760
FLAG TALK OF OCEAN CRAFT.....	761
23 MEN UNDER WATER 24 HOURS.....	762
How Many Horsepower Equal One Ton of Ice..	762
Auto Electric Horn.....	762
Track Tamping Machine.....	763
Convenience of Compressed Air Cleaning.....	763
THE DANGERS OF FLYING.....	764
SUBWAYS FOR CITY PIPES AND WIRES..	765
LOADING A LAKE ERIE CAR FERRY.....	766
English Engine Used in the Soudan.....	766
Miner Saved by Diver.....	766
BIG ROPE DRIVE.....	767
Smokeless Soft Coal.....	767
Steel Canal in Sahara Desert.....	767
Port of Natal Improved.....	767
LARGEST CONCRETE ARCH IN THE WORLD.....	768
Long Traction Train.....	768

FINISHING THE GAS BAG OF AN AIRSHIP.....	769
"Turn Down" Electric Light.....	770
Spring Auto Wheels.....	770
Steel Sleeping Cars.....	770
Shriners' Train Wreck.....	770
BATTLESHIP IN DRY DOCK.....	771
Annual Water Supply of London.....	771
Cotton Growing in Korea.....	771
Irish Creamery.....	772
By Auto to South Pole.....	772
WOODEN ROLLING DOOR.....	772
Aerial Navigation a Success, Says Dr. Bell.....	772
Ventilating Air Port.....	773
Woodpeckers Ruin Poles.....	773
Heavy Keel—Odd Craft.....	773
Steel Box Cars.....	773
PHOTOGRAPHING LIGHTNING.....	774
Divorce by Wire.....	774
RAILWAY SCHOOL ON WHEELS.....	775
Mysterious Disappearance Explained.....	776

AMATEUR MECHANICS—

How to Photograph on Apples.....	792
Novel Wireless System.....	792
Home-Made Water Motor.....	793
Barrel-Stave Hammock.....	795
Mechanical Card Trick.....	795
To Explode Powder with Electricity.....	795
Picnic Dining Outfit.....	796
Safety Plug for Small Boats.....	796
400-Pound Vacuum Kills.....	796
Phonograph Burglar Alarm.....	796

SHOP NOTES.

Removing Mired Traction Engine.....	777
Circular Glass Cutter.....	777
Corner Design for Mosaic.....	777
To Fasten a Bolt in a Brick Wall.....	778
Measuring the Flow of Gas from Wells.....	778
Non-Corrosive Soldering Paste.....	778
Frieze Design.....	779
Oil to Preserve Ties.....	779
Device for Forming the Ends of Springs.....	779
Pipe Wrench for Soft Pipes and Hose.....	780
Drying Electric Plant After Flood.....	780
Cure for Hot Handle on Furnace Door.....	780
Table of Machine Screw Taps.....	781
Celluloid Drawing Templates for Draughtsmen..	781
Cheap Die Holder.....	781
A Home-Made Drawing Table.....	782
How to Manufacture Metal Polish.....	782
Cementing Iron to Stone.....	782
Filing Aluminum.....	782
To Show Working of Sight Glass.....	782
How to Burn Names on Brass.....	783
Spout Knocker for Mill.....	783
Sandpaper Holder.....	783
Sawing Steel.....	783
Device to Prevent Insects in Poultry Houses...	783
Cutting Belt Holes in Floor.....	784
Magic Polishing Cloths.....	784
Lifting by the Head.....	784
Reamer Holder.....	785
A Common Defect in Draughts.....	785
Ventilating a Cold Dry Storage Room.....	785
Insulatica Scraper.....	786
How to Make a Drill Gauge.....	786
Experience with a Gas-Producer Engine Plant..	786
Cleaning Zinc Articles.....	787
File-Sharpening Machine.....	787
Shearing Attachment for the Lathe.....	788
A Magnetizing Kink.....	788
Waterproofing Concrete.....	789
Chimney Brace.....	789
Easy Way to Temper.....	789
Speed for Grain Elevator Cups.....	790
To Mend Bursted Cold Water Pipes.....	790
Gilding Iron and Steel by Dipping.....	790
How to Draw Pen Lines.....	790
Short, Accurate Method for Securing Length for Belt.....	791
Emergency Repair for Broken Eccentric Rod..	791
A Wind Curtain.....	791

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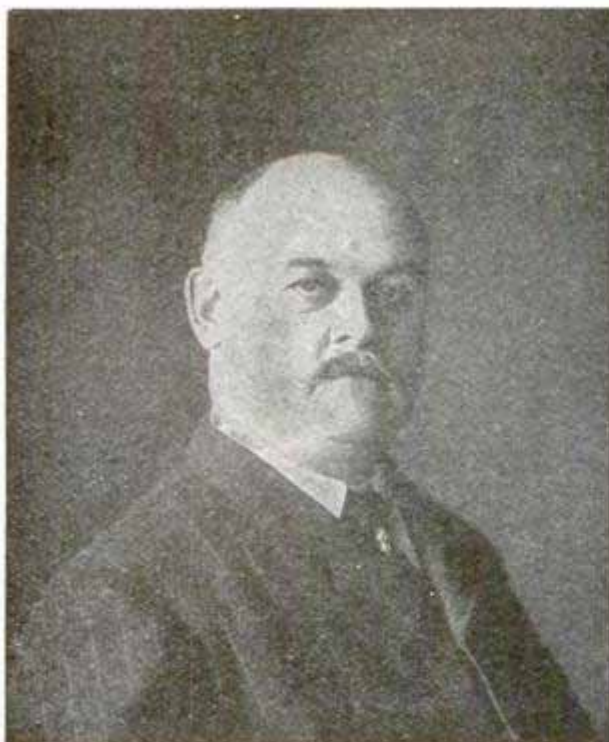


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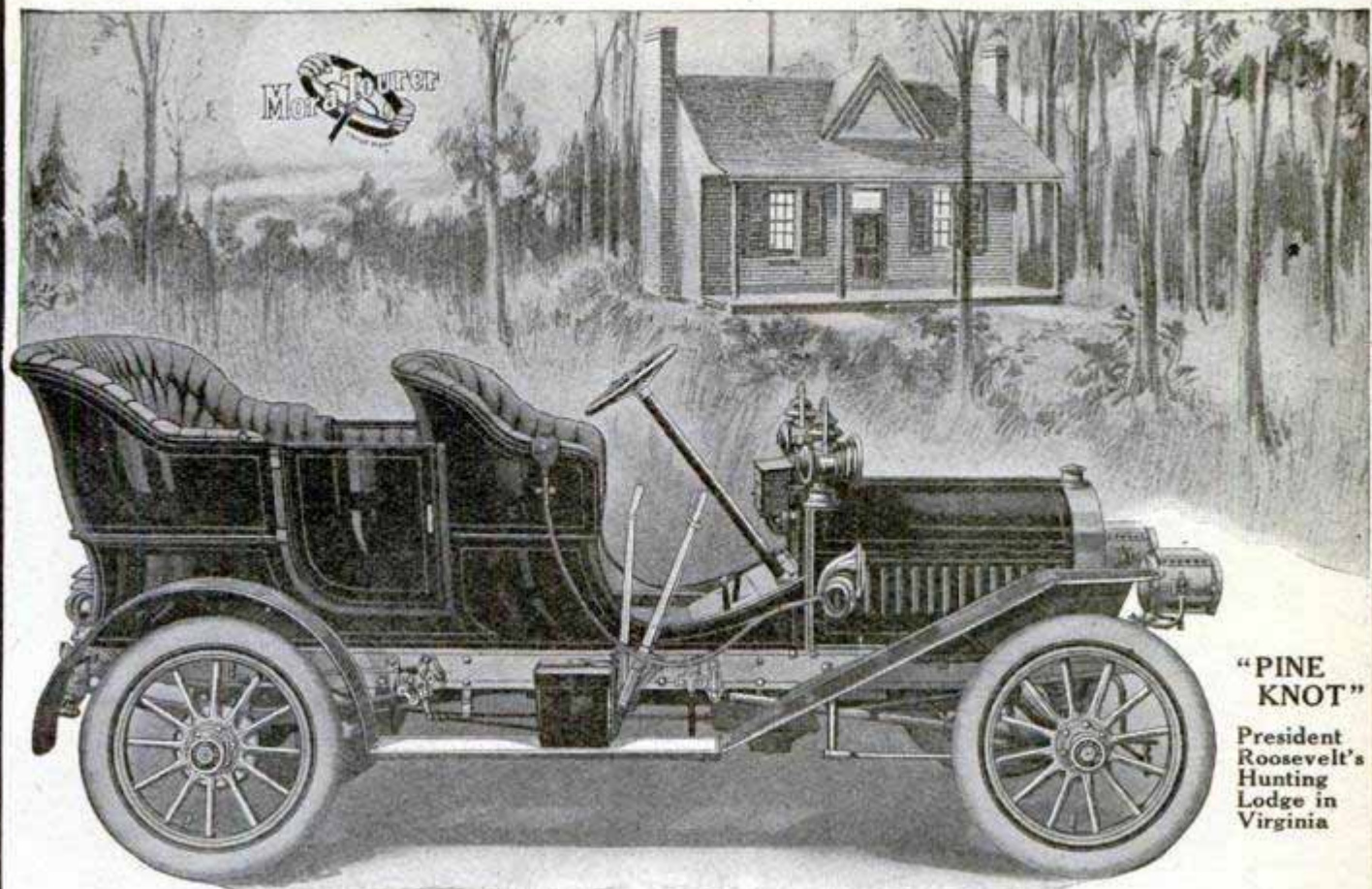
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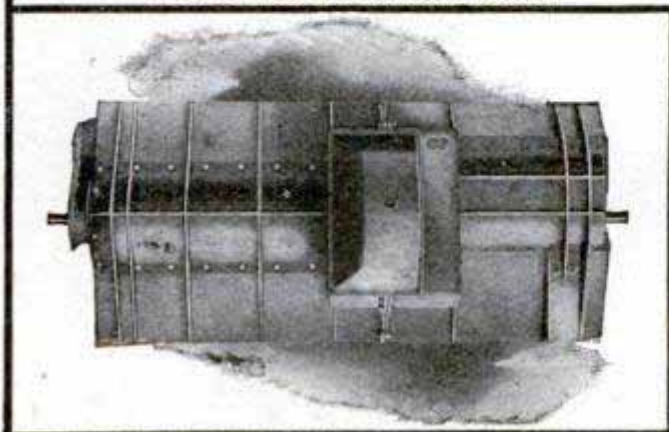
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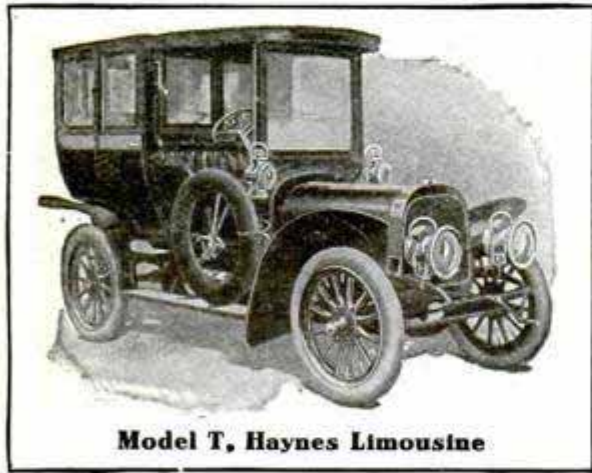
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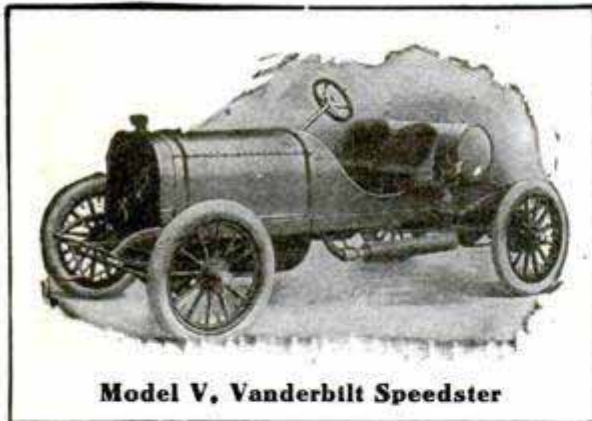


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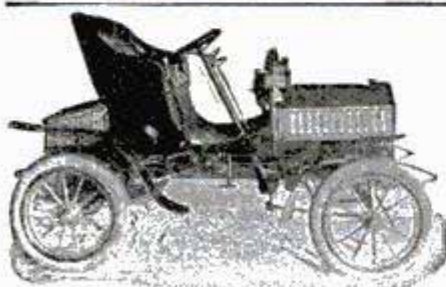
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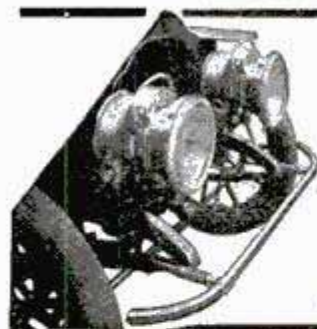
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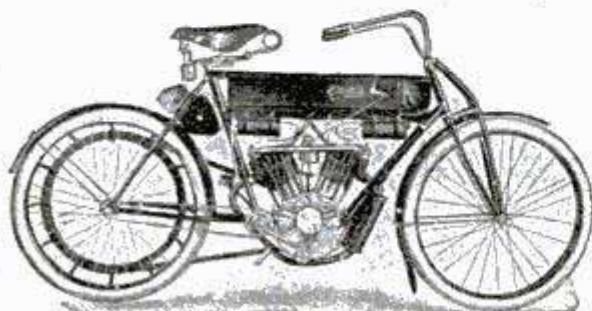
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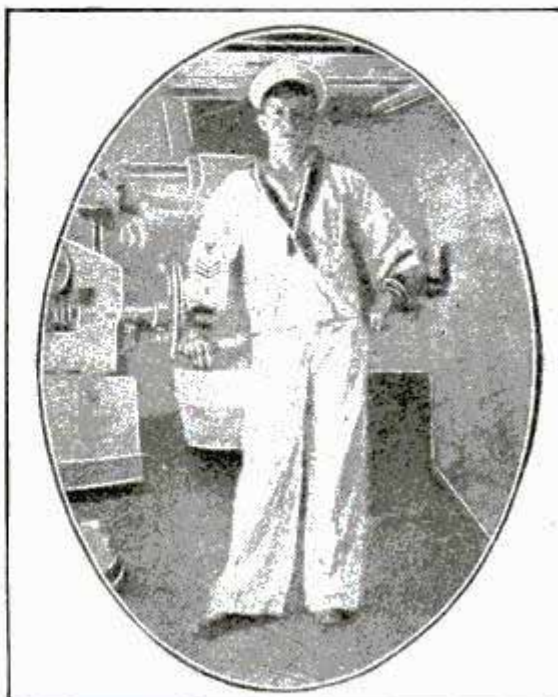
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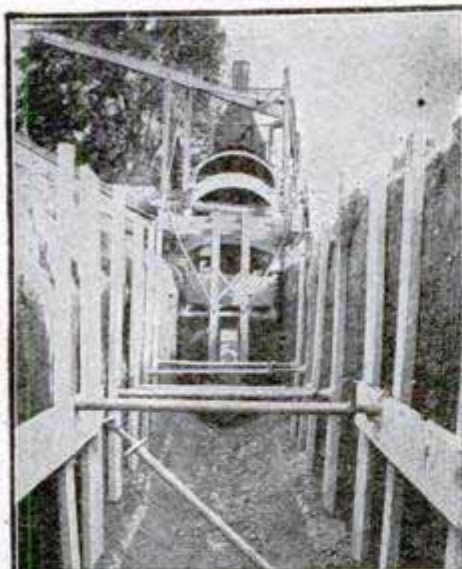
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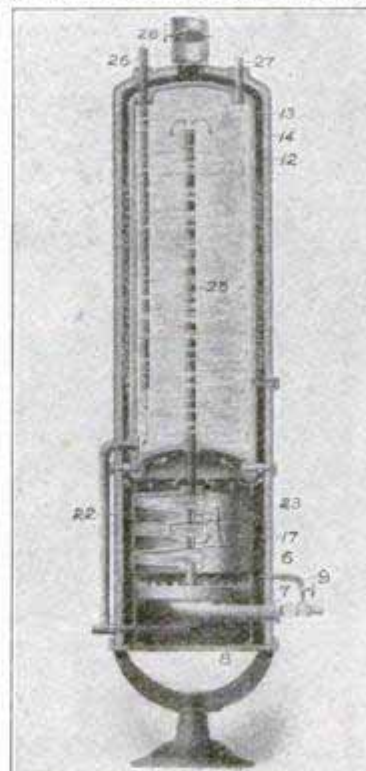
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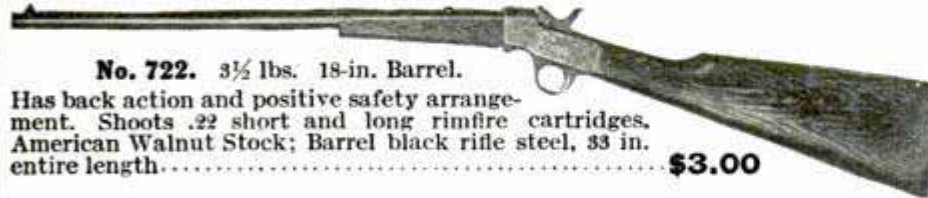
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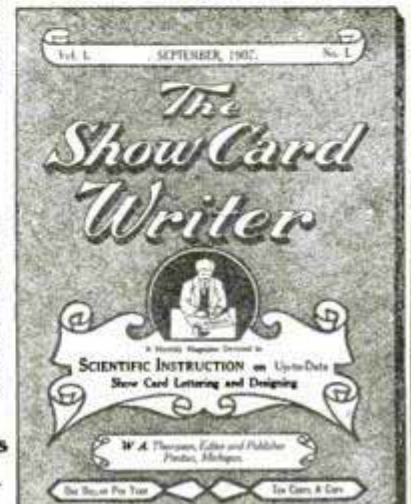
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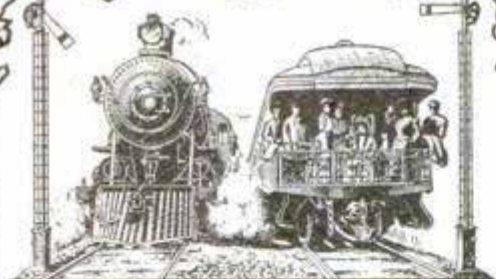
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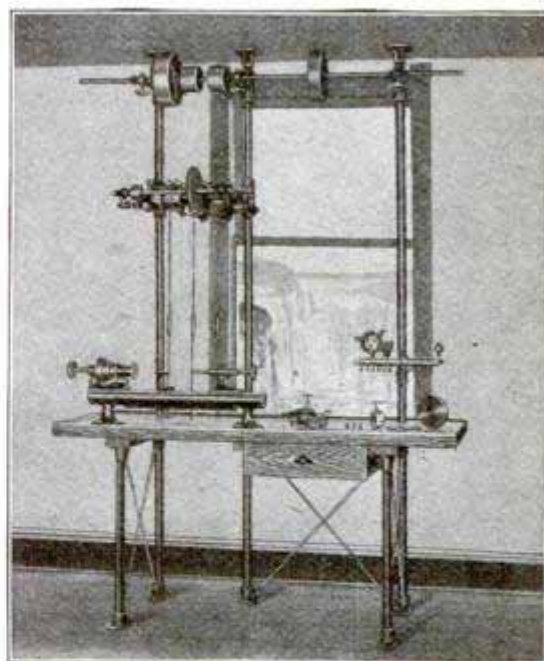
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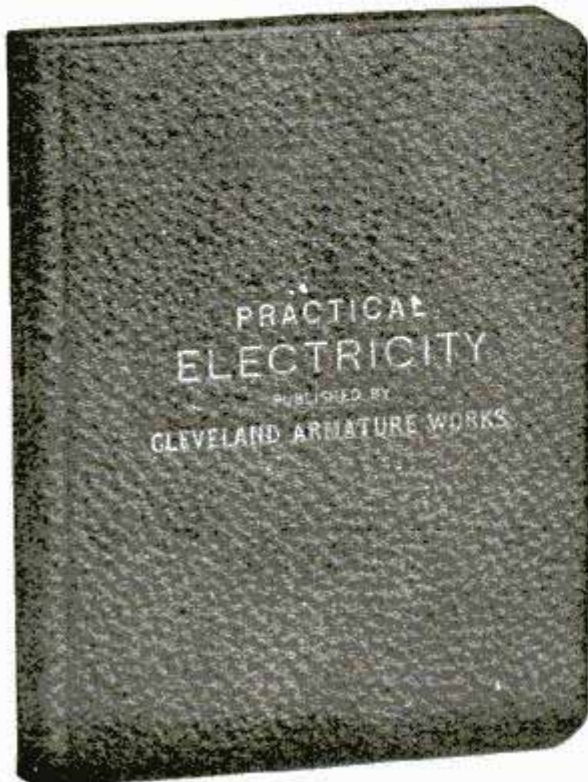


TABLE OF SUBJECTS:

CHAPTER	CHAPTER
I—Wiring	X—Counter E. M. F.
II—Electric Batteries. Electric Plating.	XI—Hysteresis and Eddy Currents
III—Magnetism	XII—Armature Reaction
IV—The Magnetic Circuit	XIII—Sparking
V—Magnetic Traction	XIV—Winding of Dynamos and Motors
VI—Magnetic Leakage	XV—Proper Method of Connecting Dynamos and Motors
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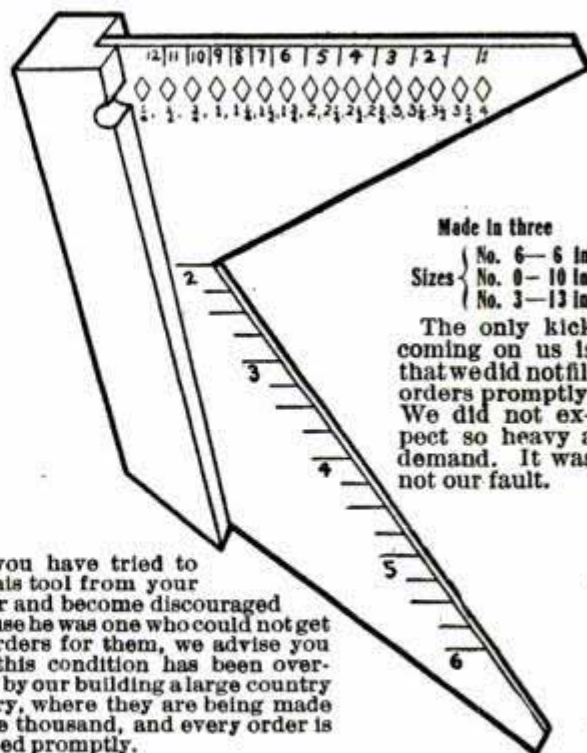
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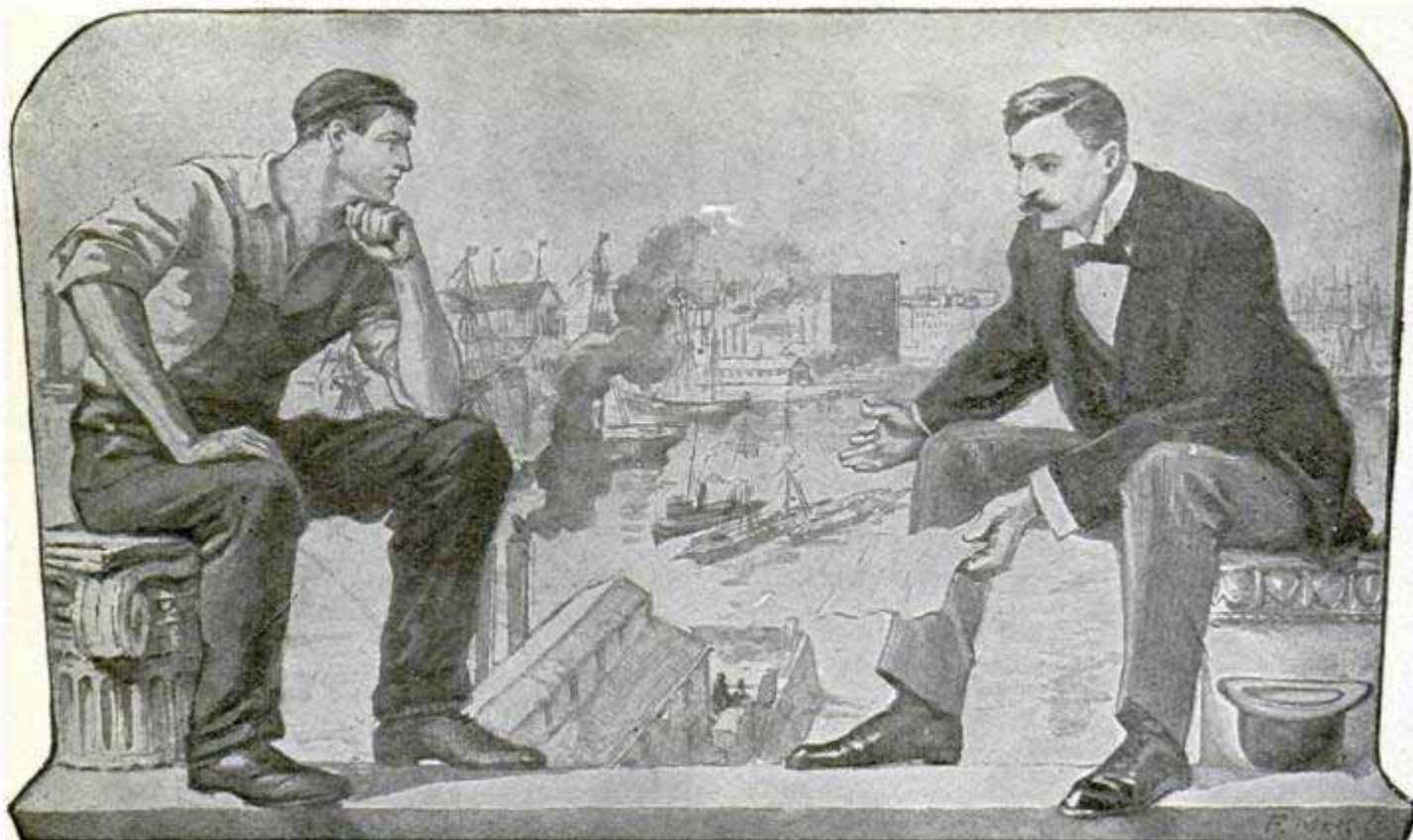


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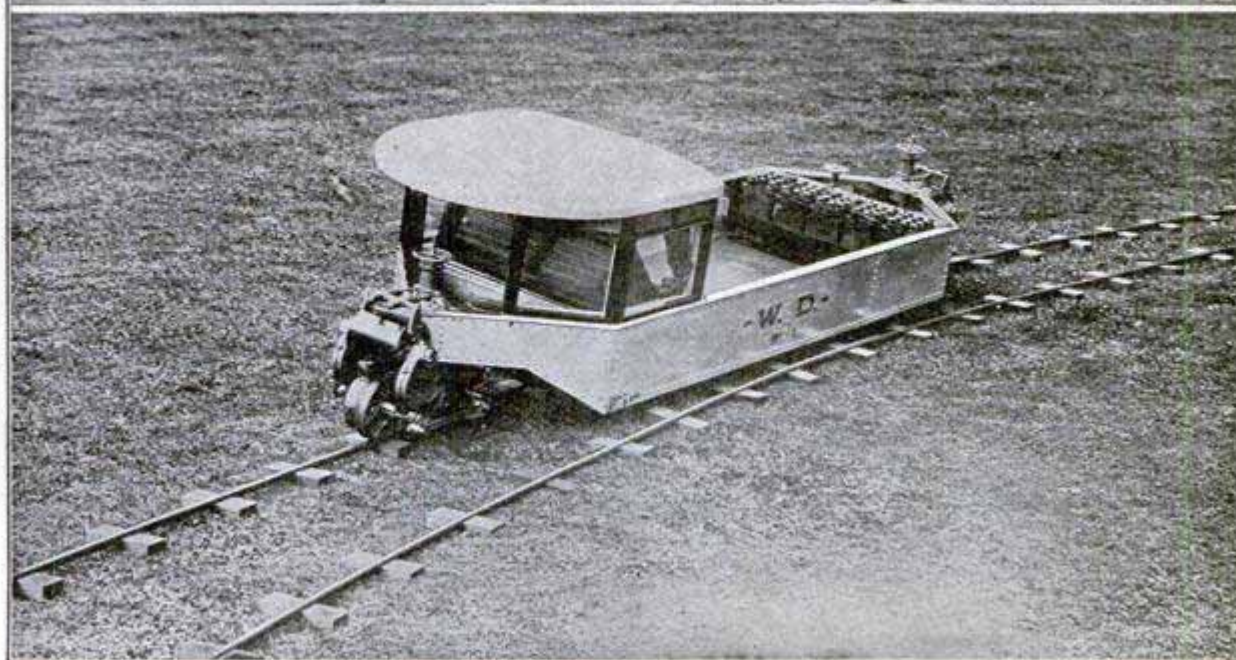
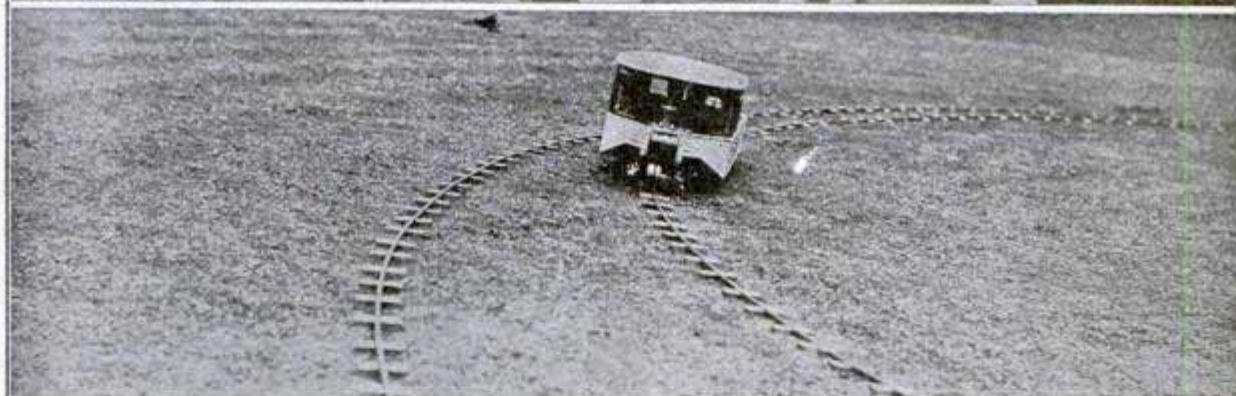
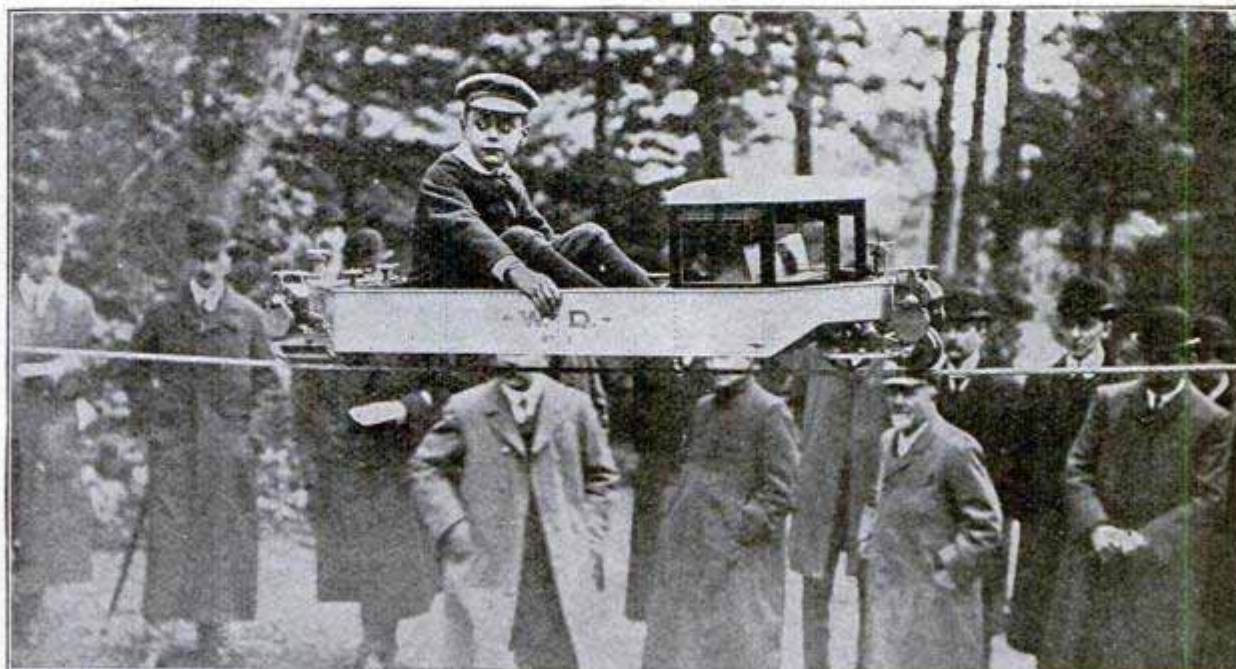
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POPULAR MECHANICS

Vol. 9. No. 7.

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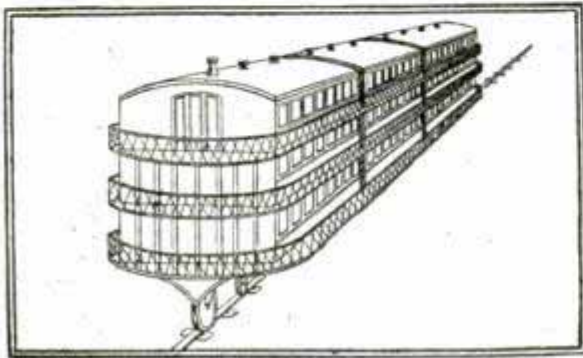


"The Car Maintains Its Balance Whether Standing Still or Moving"

CARS BALANCED ON SINGLE RAIL

Travel at 150 Miles an Hour—Predicted Greatest Mechanical Sensation in Years

Louis Brennan, an English inventor, has astounded the scientific experts with his demonstration before the Royal Society. Brennan is no ordinary dreamer, for the British government paid him \$550,000 for his patent torpedo, and is now spending \$25,000



Car of the Future

building a monorail car 12 ft. wide, under the direction of the war department. Indeed the inventor predicts the railway car of the future will be several times as wide as now, and two or three stories high. It will travel upon a single rail, and cross rivers on a single steel cable if conditions do not favor the use of piles or piers. The propelling power may be steam, electricity or gasoline. If Brennan's expectations are realized his system will revolutionize the operation of railways throughout the world.

Monorail systems are not new, but heretofore the cars have either been suspended, or held in poise by guide wheels on each side of the carrying rail.

The secret of the Brennan system is the use of a gyroscope within each car. He has studied this mysterious piece of mechanism for 30 years and is said to be one of only three men in the world who really understand it. He says:

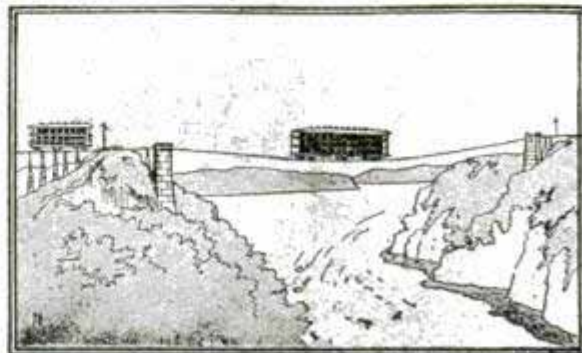
"The characteristic feature of the system of transportation is that each vehicle is capable of maintaining its balance upon an ordinary rail laid upon ties on the ground, whether it be standing still or moving in either direction

at any rate of speed, notwithstanding the center of gravity is several feet above the rail and the wind pressure, a shifting load, centrifugal action, or any combination of these forces may tend to upset it.

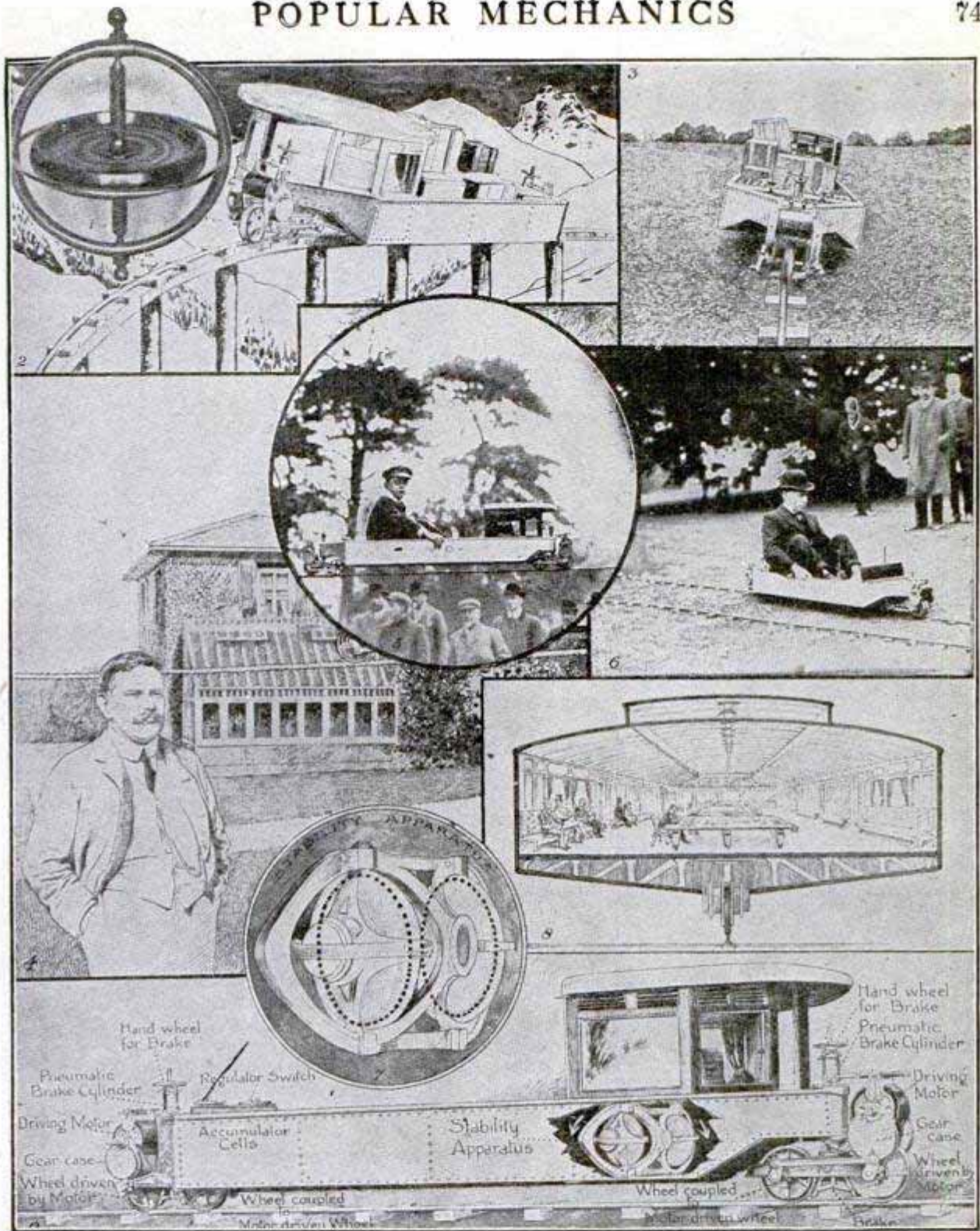
"Automatic stability mechanism of extreme simplicity, carried by the vehicle itself, endows it with this power. The mechanism consists essentially of two flywheels rotated directly by electric motors in opposite directions at a high velocity, mounted so that by their gyrostatic action their stored up energy can be utilized. These flywheels mounted on high-class bearings are placed in air exhausted cases, so both air and journal friction is reduced to a minimum, consequently the power required to keep them in rapid motion is extremely small.

"The wheels are placed in a single row beneath the center of the car and are carried on bogies or compound bogies, which are not only pivoted to provide for horizontal curves in the track but for vertical ones also. By this means the cars can run upon curves even of less radius than the length of the vehicle itself, or on crooked rails, or on rails laid over uneven ground without danger of derailment.

"The motive power may be either steam, petrol, oil, gas, or electricity. I use petrol (gasoline) and an electric generating set carried by the vehicle itself to supply the current to the motor's stability mechanism.



Crossing a Chasm



1. The active principle of the Brennan car: The Gyroscope in its simplest form, as it is sold for a toy—"The top that can't be knocked over." 2. The vehicle on the part of the track representing a mountainous district, showing the way in which it leans automatically towards the center in rounding a curve. 3. The vehicle on level ground, showing the way in which it leans automatically away from the heavier side when it is unevenly loaded. 4. The inventor at home. 5. A Blondin feat: The car crossing an iron hawser in the 6-ft. working model in Mr. Brennan's grounds, 5 ft. from the ground and keeping perfect balance. 6. The model car carrying a 150-lb. man. 7. The Brennan gyroscope. 8. Mr. Brennan's idea of travel in the future: A monorail vehicle very much larger and wider than present-day railway carriages. 9. Detail of the car.

"Everything points to a great economy resulting from making the cars wider in proportion to their length than on ordinary railways. Therefore it has been decided to make an experimental

coach 12 ft. wide. Brakes capable of being operated by pneumatic or manual power are provided for all wheels.

"The rail only requires to be of the same weight as one of the rails of an

ordinary line in order to carry the same load on the same number of wheels in each case. The ties also only require to be one-half the usual length.

"The bridges would be of the simplest possible construction, a single wire hawser stretched across a ravine or river being all that is necessary for temporary work. Strange to say, the lateral swaying of the hawser does not disturb the balance of the cars, and the strongest winds will fail to blow them off. In other cases for bridge building a single row of piles with the rail on top suffices, or a single girder carrying the rail may be conveniently used.

"The speed can be from twice to thrice that of ordinary railways, owing to the smoothness in running and the total absence of lateral oscillation."

Sir Hiram Maxim, while admitting the success of the demonstration, pronounces the apparatus "a highly scientific toy," but does not believe the same results will follow when the system is applied to actual practice with standard size cars operating out of doors, and states:

"I think his plan to keep the carriages from tipping by the action of the gyroscope will be beset with a great many difficult problems, so difficult, in fact, as to make the whole scheme absolutely impracticable.

"It is quite safe to say that if Brennan's trains were running east or west and there was a strong wind from the north, the wind would exert considerable force on the train in the same direction, and I think that, under these conditions, the plane of the gyroscope would gradually yield, capsizing the train.

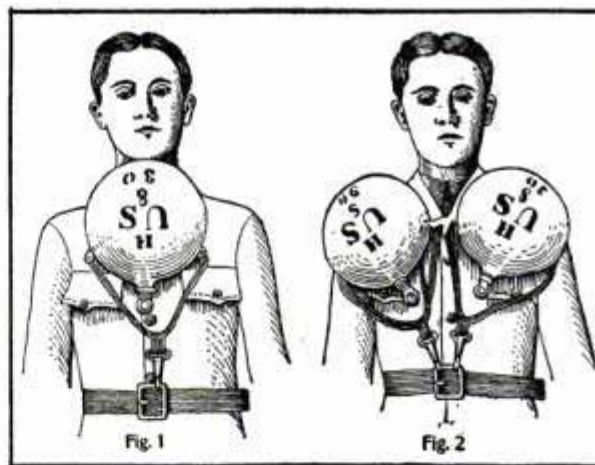
"No doubt there is nothing in the world so much of a mechanical paradox as the gyroscope. Perhaps I can best illustrate the construction, 30 years ago, by Sir Henry Bessemer of a ship with its cabins fitted with gymbals. He proposed to keep the ship in a horizontal position by the use of large gyroscopes. They had no effect at all in steadying the craft."

On the other hand Brennan operated

his small car with one side greatly overloaded, and claims that in proportion to size of car and its unbalanced load, any wind pressure short of a hurricane would be no more severe test to a car of ordinary size. What can be done under actual working conditions will remain a question until the government makes the test. Until then the subject will continue to be one of absorbing interest to engineers and scientists, some of whom pronounce the invention the "greatest since the electric motor."

CANTEENS AS LIFE PRESERVERS

A novel use of the canteen is to employ it as a life buoy or as an aid in learning to swim. The accompanying sketch shows the position of the canteen as it should be used. Whether there is one canteen or two, the idea is practically the same. Snap the canteen strap to the belt buckle and fasten the



Emergency Life Buoy

canteens upon the breast so that they cannot slip out of place, says the Journal of the American Cavalry Association. This may be accomplished by fastening a string or handkerchief to the side rings of the canteens, and then passing it around the neck. For still greater security, pass a cord around the body and fasten it to the outside rings.

By the end of the year trolley lines will connect Chicago and St. Louis, and it is planned to extend the road to Kansas City.

BERTILLON'S NEW SYSTEM OF PHOTOGRAPHING THE DEAD

M. Bertillon, whose system of identification of criminals has been adopted in all parts of the world, has just invented a new form of photographic apparatus. It is used in making photographs of the dead. The result of the present method of taking the picture of a dead person is shown in Fig. 1, and the greatly improved result with the new apparatus is seen in Fig 2. The body is laid on a platform on which are drawn the basic lines of the Bertillon system of measurement, and these lines are preserved in the photograph.

The camera is suspended directly over the subject, but other pictures are also made from the floor with another camera, giving a variety of positions. The chances of identification are very greatly increased by means of the new method.

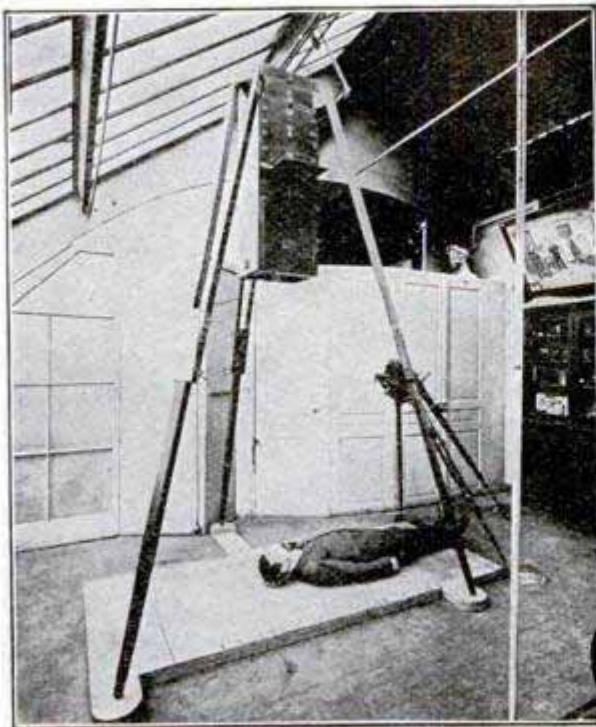


Former Way

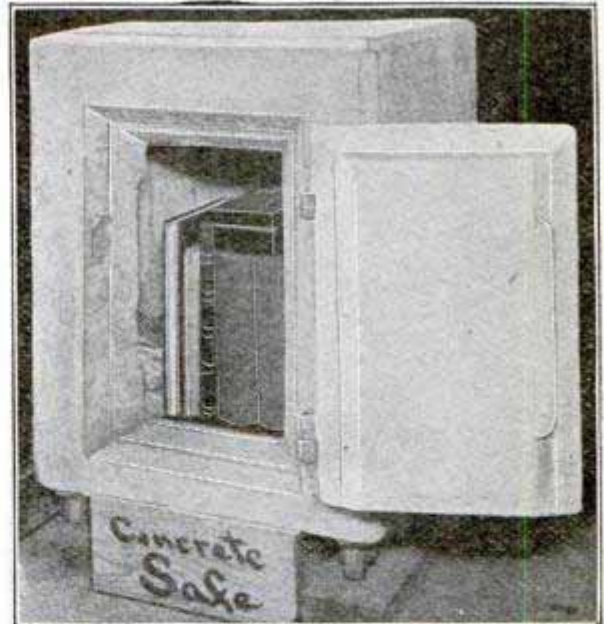
Bertillon Photo

A CONCRETE SAFE

If concrete safes come into general use the owner will find it cheaper to build a new one than to move the old safe; and safes can be had in all sorts of inaccessible places by carrying a



The Vertical Camera



few small bags of sand and cement and building the safe from the materials. The concrete safe is not burglar proof, neither is the average steel safe, but it is sufficiently strong for all ordinary requirements against theft and fire.

The concrete safe illustrated was

made in Seattle by a concrete building constructor. The Concrete Age says the safe is 2 ft. 4 in. square and 3 ft. high. Walls and doors are 4 in. thick, reinforced with $\frac{1}{4}$ -in. twisted steel, with the lock and hinges, cast in the center of wall and door. The handle and castors were also cast in place. The construction is not specially difficult—anyone handy with tools can make one, and the iron parts can all be purchased and are comparatively inexpensive. A few dollars and a little interesting work will provide a good, durable, substantial safe.

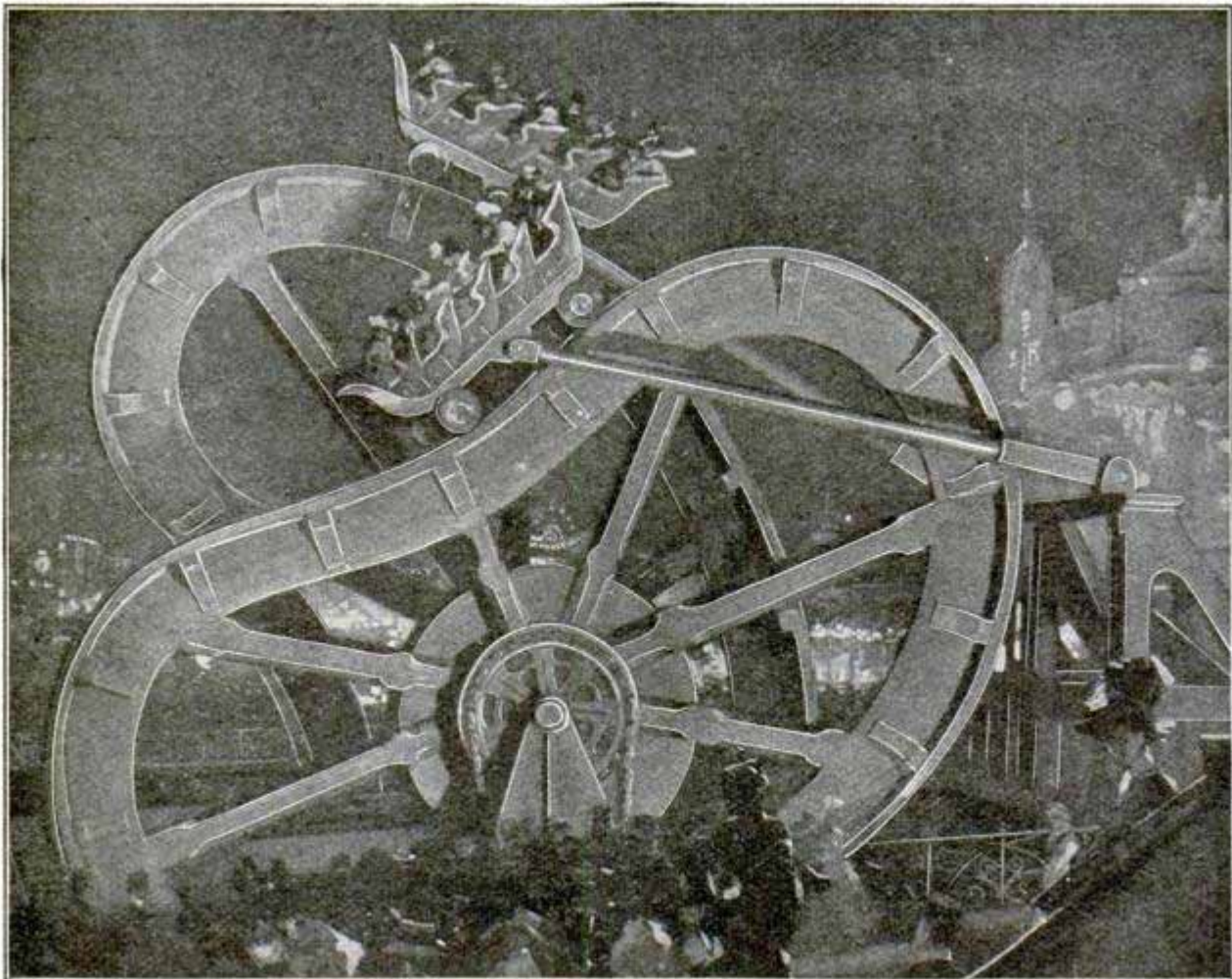
NEW SENSATION COMING

The amusement loving public, which each year demand some new sensation, are likely to get it in plenty when the Avernus wheel, now building, is completed. It gives all the exhilarating features of the most reckless roller

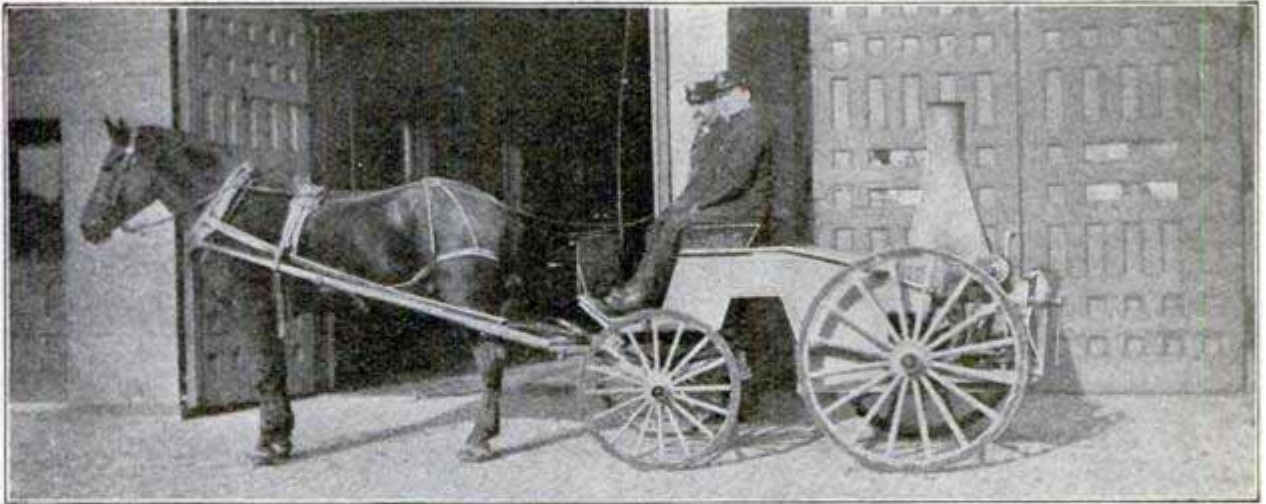
coaster but is much safer. The machine carries two wheels on the same axle, and on each wheel runs a car which can hold 20 people. The speed can be regulated, and the most wonderful varieties of motion can be obtained. The machine is an English invention.

ENFORCED BURIAL AT SEA

The enforced burial at sea of Mrs. Chalmers Prentice of Chicago by an Italian Commissioner aboard the "Koenigin Luise" of the North German Lloyd Steamship Company on April 27 has resulted in a suit for \$250,000 damages against the company, who have taken the matter up with the Italian government in the hope of preventing future occurrences of the kind. Mrs. Prentice had been traveling first-class and every necessity for embalming the body was at the disposal of the ship's physician, but no appeal availed against the Italian's arbitrary decree.



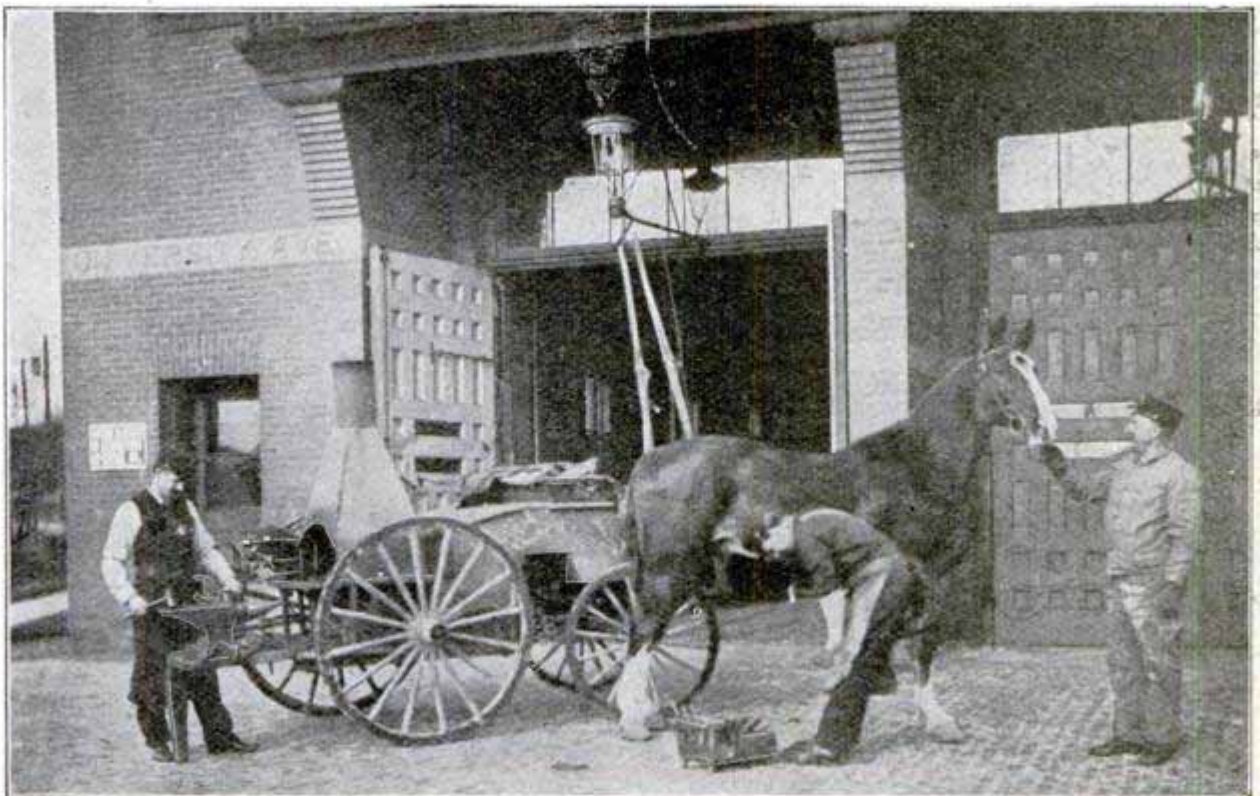
You Hold Fast While the Car Plunges Like a Wild Broncho



TRAVELING BLACKSMITH SHOP

The Minneapolis fire department possesses a valuable adjunct which has received the tribute of imitation by other cities. It is a device for saving time and money by bringing the blacksmith to the horse instead of the horse to the blacksmith. As the department has 180 horses, each of which should be available at a moment's notice, day and night, the importance of such saving is obvious. There is a further economy in having the shoeing done by city em-

ployes instead of by outside smiths. The device is a wagon built and designed under the supervision of Chief Engineer Canterbury, which is fitted up with all the tools and apparatus for horseshoeing, including forge, rotary blower, anvil and vise. The two side springs seen in the cut, under the front platform, have five leaves and are 40 in. long, the cross spring has six leaves and is 38 in. long. The front wheels are 36 in., and the rear 48 in. In order

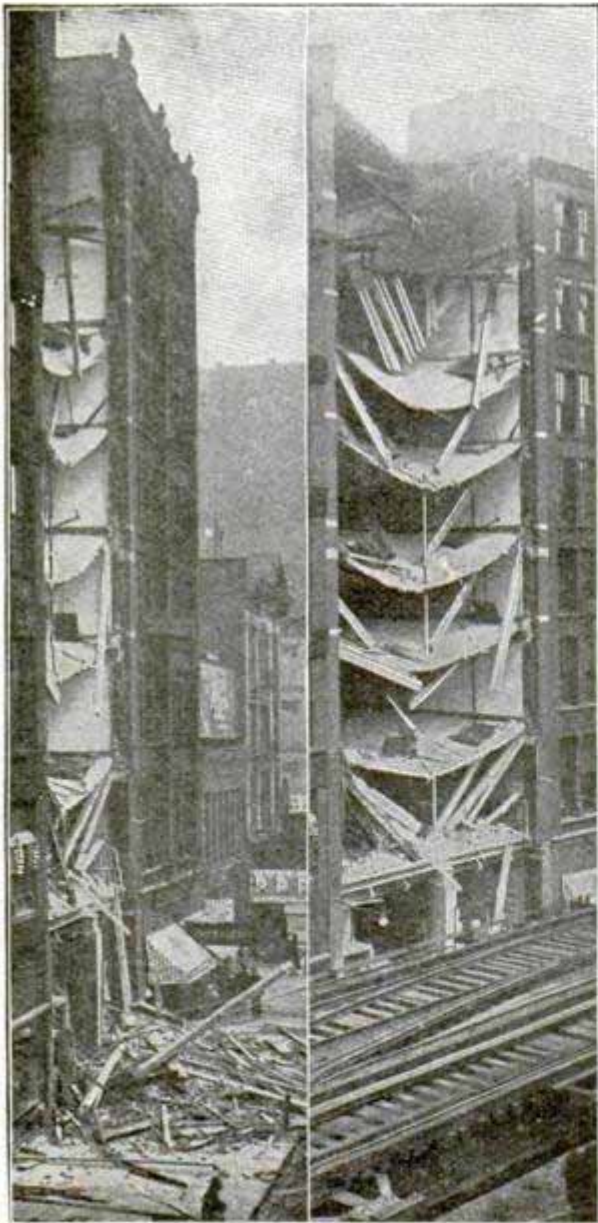


The Blacksmith Comes to the Fire Department Horse

that there may be no possible crippling of the service while a horse is being shod, the horse which draws the blacksmith wagon is put temporarily in the place of the one which is trying on his new shoes.

FRONT OF 8-STORY BUILDING FALLS OUT

A very unusual accident occurred to an 8-story brick business building on Wabash Ave., Chicago. The building had been remodeled and filled with goods by a furniture concern. About 3 a. m. the entire front fell out, blocking traffic on surface and elevated roads for several hours. The only persons in danger were two cabmen who heard the



"The Entire Front Fell Out"

building crack and drove out of the way just in time to escape death.

PARIS PRINTS PAPERS WITH AUTOMOBILES

Electric power is used to a very large extent in Paris, the newspapers depending almost entirely on it to operate



Traction Engine Furnishing Power

their typesetting machines and presses. When the recent strike in the power houses occurred there was not only darkness in the cafés, where candles stuck in wine bottles were improvised for lights, but the daily papers came to a sudden stop. The resourceful French mind, however, instantly conceived the best thing to do, and automobiles of large horsepower were at once secured and used to furnish power for driving temporary generators placed on the sidewalk or in the street. In one case a motor car was actually carried up into a composing room and used to run the typesetting machines by belt drive. Traction engines were also employed; one of these is shown in front of the daily Journal, driving a generator which rests on a motor truck.

A Wisconsin farmer boasts a mahogany sidewalk, built from barrels in which he received goods shipped from the West Indies.

TREATMENT INSTEAD OF DRUGS

Patients Climb Stairs and Kick Indian Clubs

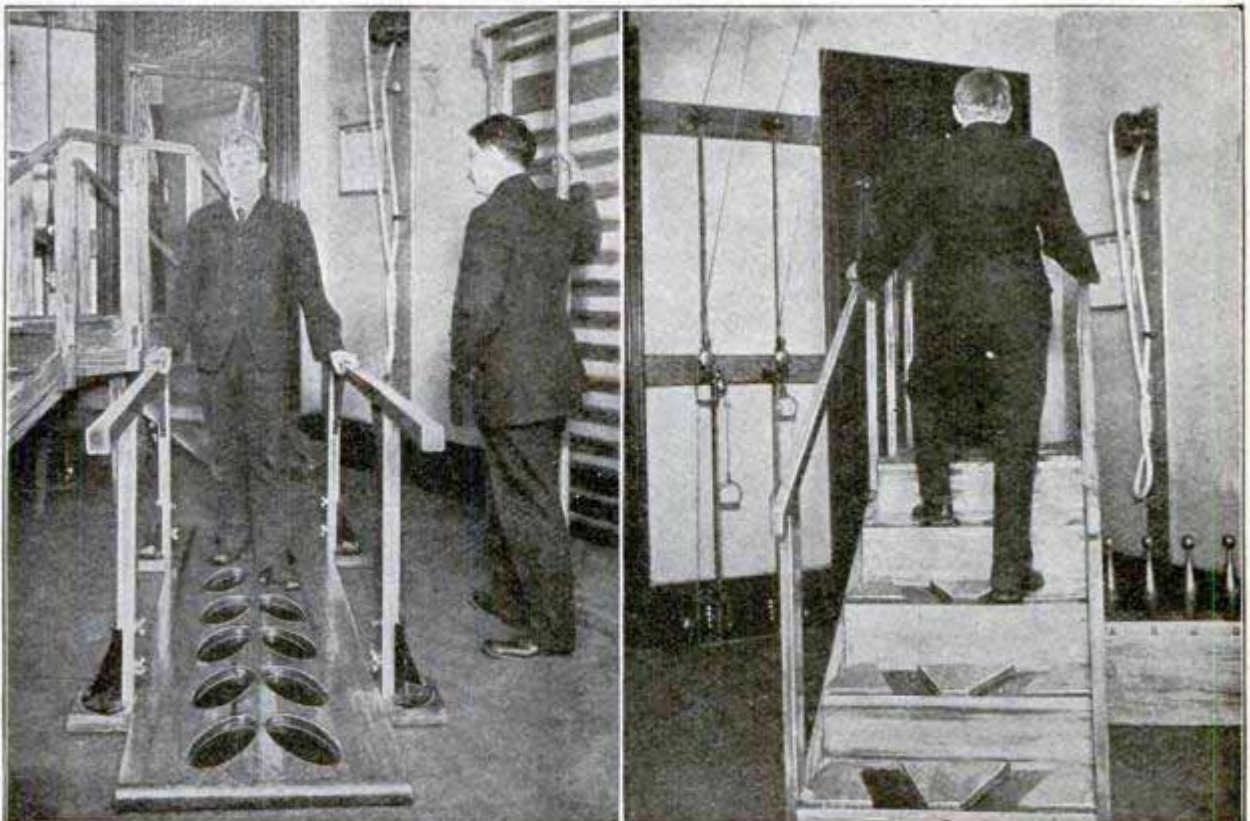
In many cases of nervous trouble the patients are now given mechanical exercises instead of drugs. One piece of apparatus is a stairway on which have been cut grooves for the feet of the individual who is condemned by fate and the physicians to tread the steps of this treadmill. This stairway, intended to bring back to those afflicted with locomotor ataxia the lost co-ordination of motion, has steps of a uniform height in each of which are cut-outs for the feet of the patient. As he walks up and down this odd stairway he supports himself by the handrails. He is compelled to place his feet in the cut-outs as he exercises and in time, it is claimed, regains the power of making his feet do as his mind dictates, instead of the pedal extremities wandering wildly off on excursions of their own. A variation of the same idea is the walking board, 20 ft. long, with handrails like the gang plank of a steamer.



Kicking the Clubs

This is for patients who lack the strength to mount the stairs.

A device that is still more curious is a ten-pin arrangement consisting of a block of wood on which are mounted on springs a number of pins similar to

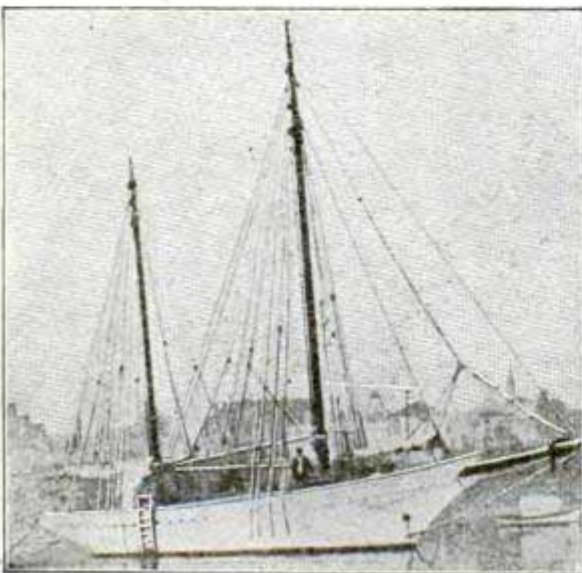


Walk and Stairs with Foot-Holes

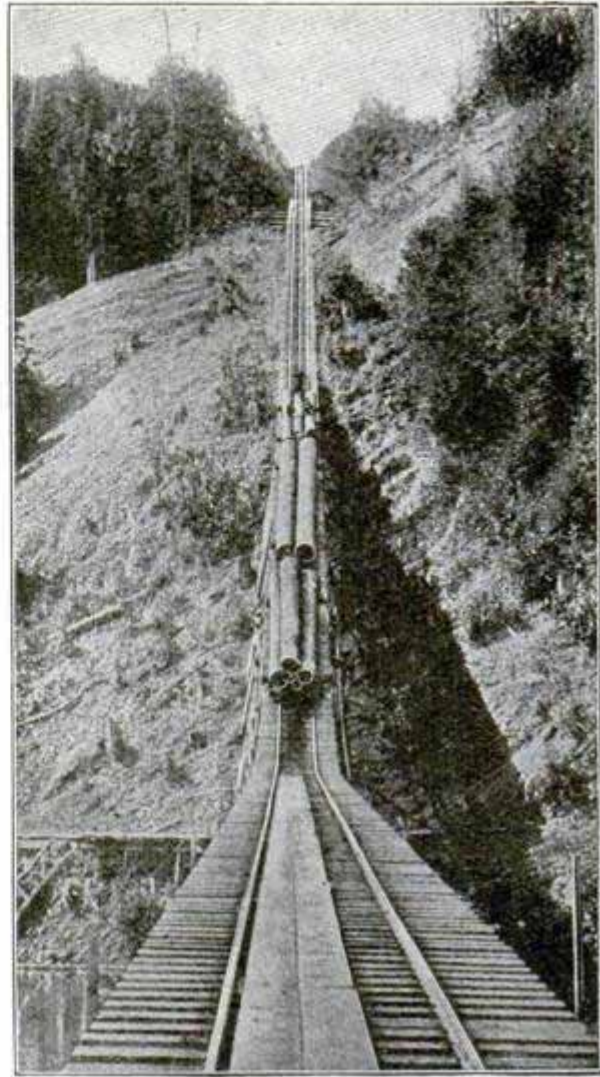
those used in our bowling alleys. Each pin is lettered or numbered and the patient sits in front of this apparatus and, upon the order of the nurse or attendant, kicks a certain pin either with the right or left foot, as ordered. The tendency of the erratic limbs is to attack the G pin when ordered to punish that marked A, or to inflict a jolt on B when it is the turn of the D pin to be kicked. Also the left leg refuses to obey orders and the right insists on taking up the kicking out of its turn, while the left will try to kick when it is right's inning. In time, however, according to the originators of this method of restoring lost co-ordination, the telegraph apparatus from the brain gets into working order again and the feet have to obey the will of their owner.

SEVEN YEARS' CRUISE IN SMALL BOAT

Jack London, the California author, is about to devote seven years to looking for trouble. He calls it adventure, and has invested \$25,000 in a 57-ft. boat and outfit for himself and wife, a navigator and three sailors, with whom he proposes to sail the Seven Seas for seven years. As he is under contract to several publishers to furnish "copy" as he sails, we shall hear all about the voyage in due time if the boat keeps right side up.



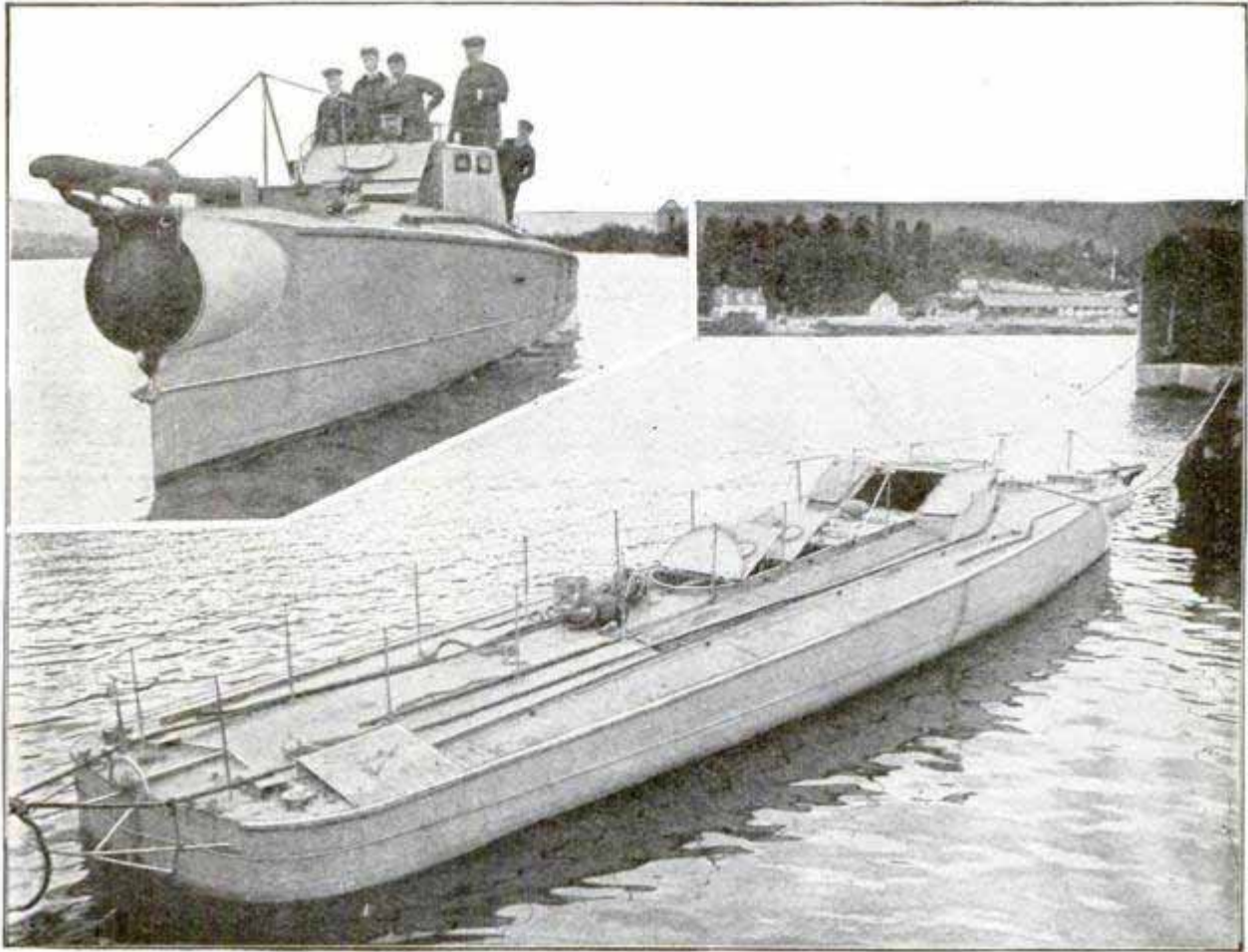
The "Snark" is 57 Ft. Long



A log railway over the mountains operated by a steel cable and winding drum.

His yacht, the "Snark," is only 57 ft. over all, 15 ft. beam and 7 ft. draft. The boat was built to order for this special purpose and is equipped with every foreseeable convenience and necessity, including three water-tight compartments. In case they are becalmed it is necessary only to start up the 75-hp. engine, which can be fed from a tank of 1,000 gal. of gasoline. Then there is a small arsenal of shot-guns, rifles, revolvers and one rapid-fire gun.

To remove paint from clothing or hands, turpentine will be promptly effective, if the paint is fresh. If it is dried, the removal will be more difficult. Soaking in strong ammonia water, or in a 2 to 1 mixture of ammonia and turpentine, may do it.



Torpedo Boat—50 Ft. Long

POWER FROM THE BAY OF FUNDY

Since the maximum tide from the Bay of Fundy is 60 ft. high, it is not strange that a company has been formed for the purpose of utilizing this tremendous power. One of the farthest points to which the tide rushes is Chignecto Bay, and at the northeast end of that bay is the outlet of the Lautramar River, and the town of Sackville. There it is planned to construct three huge dams of concrete 60 ft. high and 1,000 ft. long. Turbines will be turned by the head of water thus obtained, estimated to generate 75,000 hp. If all goes well, next winter the famous Fundy tides will be operating all kinds of public and private utilities in Sackville, Amherst, Moncton, and other towns around the head of the bay.

In France and Germany a new paper cloth is said to be manufactured at one-third the cost of cotton.

LATEST FRENCH TORPEDO BOAT

The French Government has just adopted a new model of motor torpedo boat, employing gasoline as fuel, which is sure to create a great sensation in naval circles.

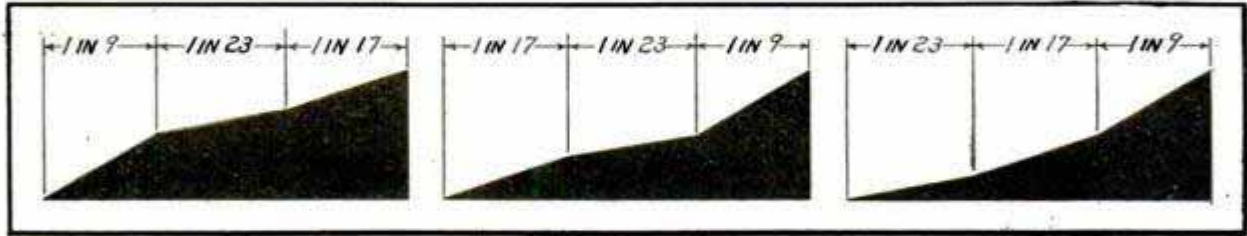
This craft has been built after the plans of Comte Récopé, engineer of the French navy and a prominent member of the Auto Club de France. She is 50 ft. long and built of steel of sufficient strength to remain at sea in the heaviest seas. She can carry and eject a torpedo of 992.07 lb., charged with 220.46 lb. of explosive, when traveling at a speed of 16 knots an hour. The motor consists of eight cylinders, built tandem fashion, and developing 150 hp. This new craft will be attached to the port of Cherbourg.

The shipyards of Great Britain, all working together, could turn out a big steamship every day of the year.

MEASURING GRADIENTS

The length, height and steepest grade are not the only elements to be considered in determining the difficulties in hill-climbing with automobile

It is this disturbing factor that makes the grading of the roads such an intricate problem, for to say that the hill is 1 in 9 in each instance is to present only a partial view of the case. What is wanted more than anything



Fair Hill

Stiff Hill

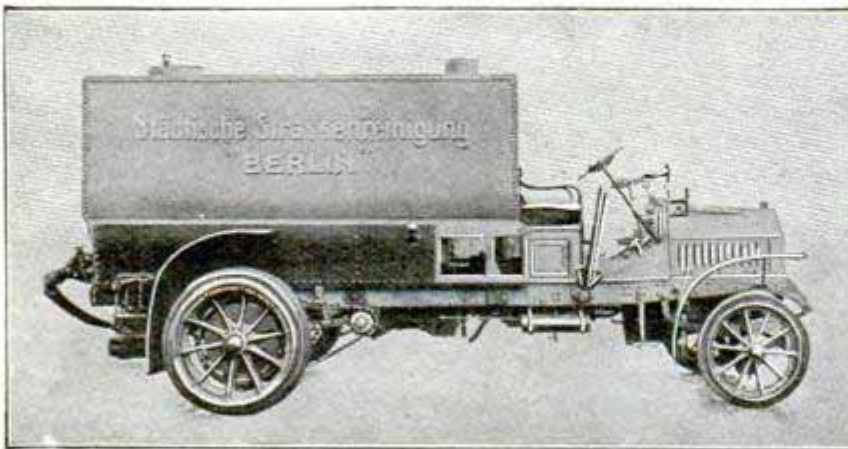
Bad Hill

or motorcycle. For instance, take three hills which happen to be compounded of different lengths of the same gradients in different order, say 1 in 9, 1 in 17, and 1 in 23, and most interesting results are obtained: one is easy, one is difficult, and the other a bad gradient. The explanation of this is simple, says a correspondent of *The Motor*, London, for on approaching the first example, the 1 in 9 grade is overcome by velocity, speed is again recovered on the 1 in 23, and the 1 in 17 is passed over without a change. The second diagram shows the same gradients transposed, and here again velocity is maintained up to the 1 in 23, when the 1 in 9 pulls down the momentum, necessitating changing gear

is what might be called an average steepness to the hill in keeping with its speed-retarding possibilities. After all, this is the real value of gradients to the motorist or cyclist, and I am afraid that until all roads are engineered like railway lines with an unvarying slope, the matter must remain as at present.

Only 5% of the total cargo of the American steamer "Dakota" has been saved, including 11,771 sacks of wheat and flour and 477 bales of cotton. The ship struck a reef near Yokohama March 3.

UNIQUE AUTOMOBILE SPRINKLER



Sprinkler Holds 1000 Gal.

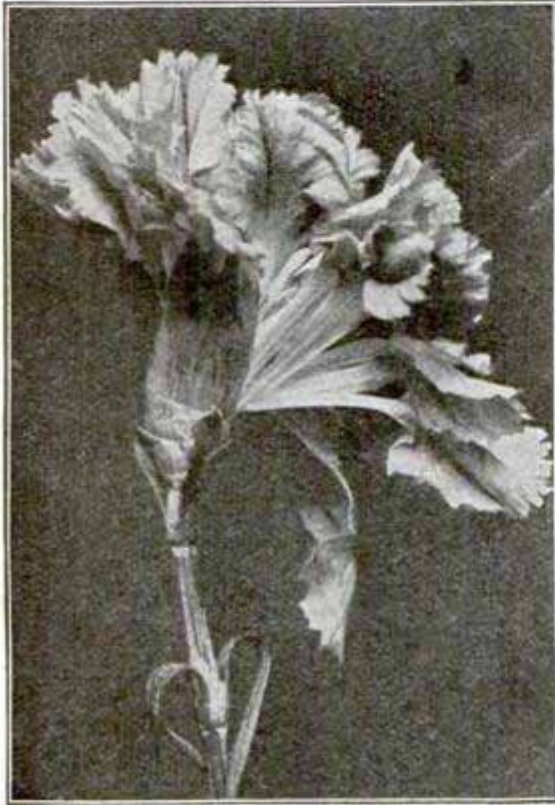
near the top. In the third diagram there is no relieving of the strain, and the steadily adverse gradient pulls down the momentum, till the last part is a hopeless struggle.

is carried on the rear wheels, which have double rubber tires. The success of the motor sprinkler has been so pronounced they are being adopted in other European cities.

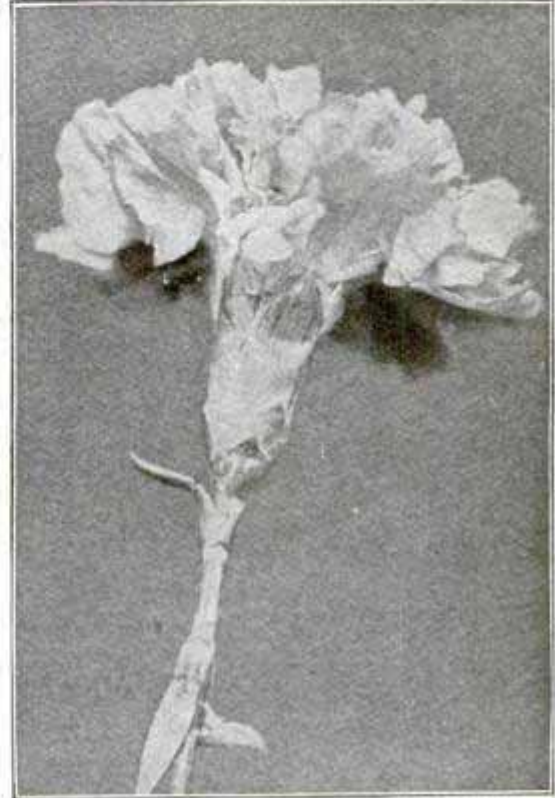
The streets of Berlin are being sprinkled with motor sprinklers, each of which does the work of five horse-drawn carts. The water is forced through the sprinklers at a uniform pressure by means of an air compressor which uses 3 hp. of the 18-hp. motor. The delivery of the water is controlled by four foot pedals. Most of the load

REPAIRING BROKEN FLOWERS

Machine for Correcting Nature's Mistakes



As Picked



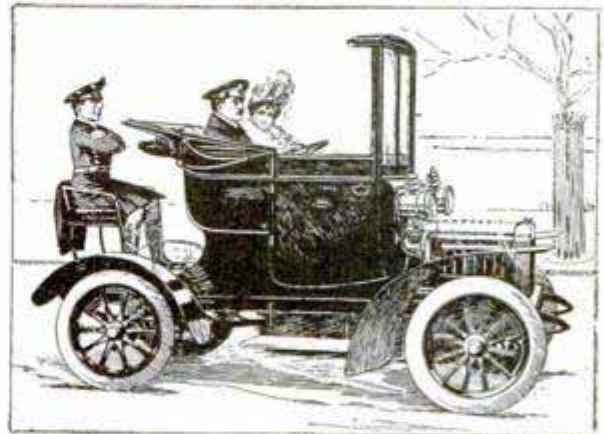
Courtesy Weekly Florists' Review

After Mended

The introduction of mechanical ideas in the greenhouse has resulted in great economies of labor and expense. The most unique scheme is the bright invention of a Pennsylvania florist, which will save thousands of dollars yearly to the shippers and dealers in flowers.

The demand for carnations goes on increasing year after year; frequently it is impossible to fill the orders. The purchaser insists on perfect blooms, but the carnation has a perverse habit of producing a large proportion of malformed blooms which are known to the trade as "splits." If the petals which hang down as shown in the picture at the left could be brought into symmetrical shape the flower would be salable. The inventor mentioned has succeeded in curing this defect and so skillfully is it done it is almost impossible to discover which are the repaired flowers. An instrument much like a pincers and a clip made of wire almost

as fine as a hair rapidly and securely bring the petals into place and hold them there. The wire is almost invisible, and the flower has all the good looks and lasting qualities of any other carnation.



HOW FAR SHALL WE GO?—A writer having protested vigorously against the moustached chauffeur, one wonders how far horse equipage customs are to be followed. Shall we retain the "Tiger"?—Motor, London.



RAISING SERPENT CUCUMBERS

This curious vegetable is raised in frames and requires considerable skill. When the fruit is ready to gather the effect is that of numerous snakes. The serpent cucumber is grown in certain warm, sheltered districts of France and is gathered in August.

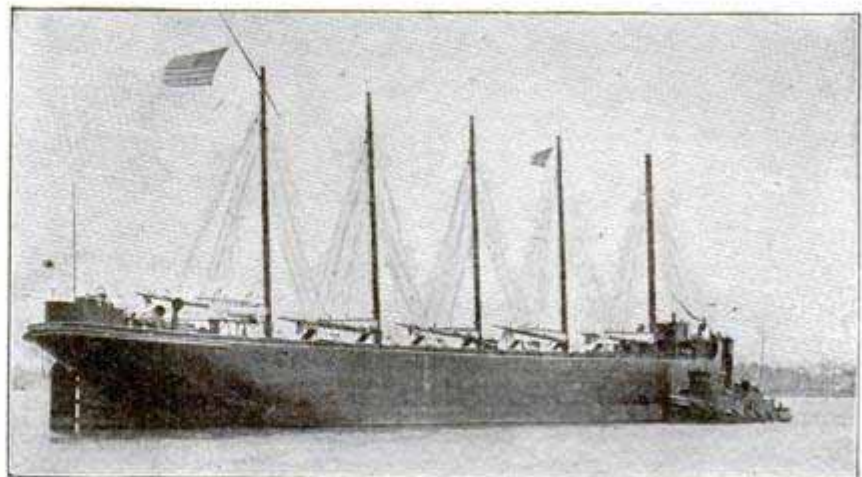
BARGE TO CROSS OCEAN

The Standard Oil Co. is to try the experiment of towing oil barges across the Atlantic. One of the barges is now being loaded with oil at Point Breeze, Philadelphia, and as soon as the cargo is aboard the barge will be taken in tow by a steamer, which will also be loaded with oil and towed to London. Both vessels will be deeply laden, having together 4,000,000 gal. of refined petroleum in bulk. It is expected that the run will be made in two weeks after leaving the Delaware breakwater. The trip is largely experimental for the purpose of ascertaining whether or not the towing of barges in the Transatlantic

trade is feasible. The barge that will be towed across is shown in the accompanying photograph, taken while she was lying in the Delaware preparatory to loading.

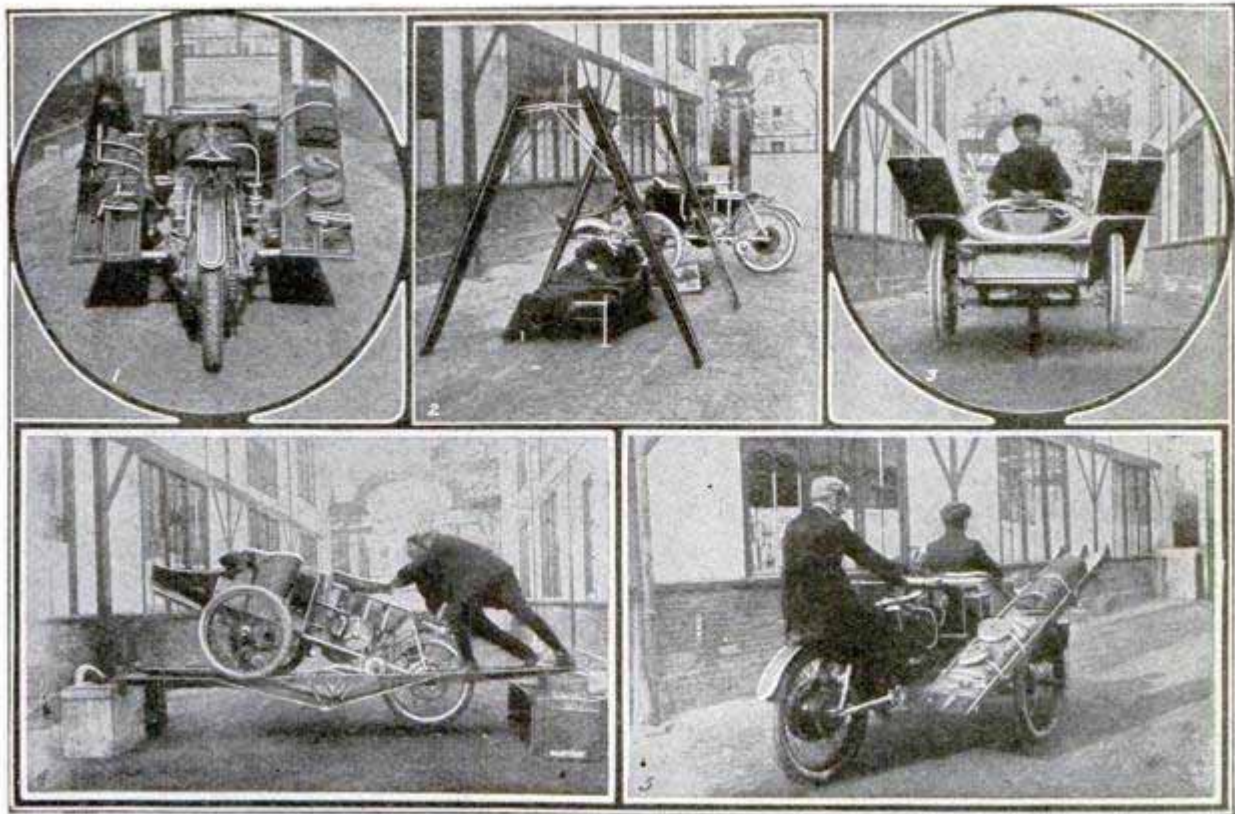


ELECTRIC LIGHT IN EGYPTIAN TOMB.—The tombs of the Egyptian kings of Thebes, near Luxor, 450 miles from Cairo, are lighted by electricity, says *Detroit News-Tribune*. The sarcophagus shown above contains the mummified remains of Amenophis II., of the eighteenth dynasty.



Barge Ready to Load

A youth in Washington, D. C., has been sending out wireless messages from a private station, which confuse the official messages.



Courtesy Illus. London News

The greatest long distance motor race yet undertaken started from Peking, China, on June 10th. The course lies through Mongolia, Siberia, Russia and Germany, to Paris, the destination. There were numerous entries. Some of the contestants have resorted to very original devices to help them on their way. One of these, a portable bridge, is seen in the illustrations. By means of this the riders expect to get their heavy three-wheeled motor over ditches and small streams. The illustrations are:

1. The portable bridge fitted to the car. 2. How the motorists will pitch their tent for the night. 3. The bridge packed on the car for transit. 4. The portable bridge in use; pushing the motor across. 5. Another view of the bridge packed on the car.

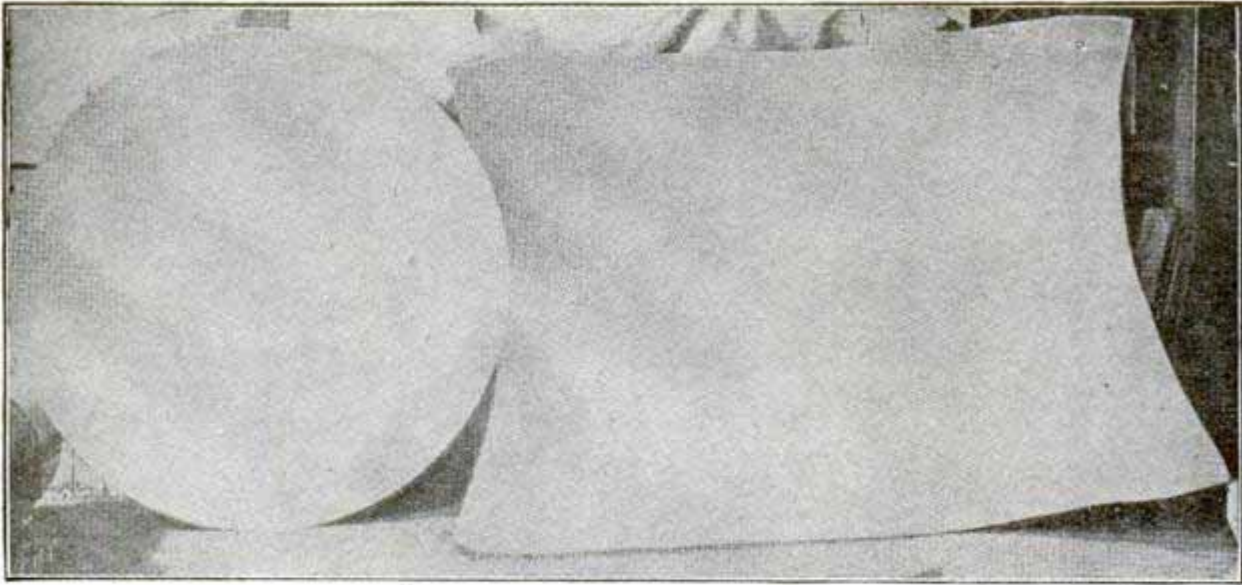
MANUFACTURE OF ROLLED STERLING SILVER

The last quarter century has witnessed a revolution in the manufacture of sterling silverware which has brought it within the reach of almost every one. This change has not been caused by the cheapening of silver, but by improved processes for producing rolled sheet silver and of machinery for stamping all kinds of articles from the sheet metal.

The old method was to use silver rods, which were sawed, hammered and filed by silversmiths into the required forms. This slow and expensive method is still used in Great Britain, but not in the United States, except in some special cases where it would not be worth while to make the dies. But the manufacture of silverware is quite distinct from that of sheet silver. The latter is such a long and expert process, requiring much special apparatus, that most makers of silverware prefer to

buy their silver sheets, just as in the brass trade.

The process of making sterling sheet silver may be summarized as follows: The first step is to buy pure silver "bars," which are really oblong blocks, usually containing 500 oz., the most convenient weight. These are 999 parts fine, which is as fine as any, even from the U. S. mint. The next step is to alloy the silver with pure copper, the laws of several states having prescribed that sterling silver shall be not less than 925 parts pure in 1000. In order to facilitate the weighing of the alloy, pure copper shot are poured first into the bottom of the melting pot until the necessary weight is obtained, and above these is placed the pure silver because its melting point is lower. The whole is then well covered with charcoal, to prevent oxidation of the copper. Five parts of cadmium are often substituted for 5 parts of the copper, to improve the malleability.



Largest Sheets of Silver Ever Rolled

During the melting the two metals must be thoroughly mixed by careful stirring. It is a matter of great experience and judgment to determine the exact moment for pouring out the melted metals; if they are too cold or too hot the casting will contain fatal imperfections. The casting is "sterling silver" and is 10 by 12 by $1\frac{1}{4}$ in.

Next comes a long series of cold rollings, interspersed with baths of sulphuric acid and chiselings to remove all impurities. In cutting them out it is necessary to leave a dish-shaped depression, otherwise the next rolling would cause the hole to fold upon itself, making a new defect. At last the sterling silver comes out of all its troubles a beautiful sheet of dead white, fit to be stamped into tableware for a king.

The illustration from the Brass World shows the largest sheets of silver ever rolled. The circle was cut from a sheet like the one at the right, and weighs 1,848 oz., and is worth over \$1,200. Four of these circles were made, each 54 in. in diameter. They are being used in making seamless kettles for a special chemical process.

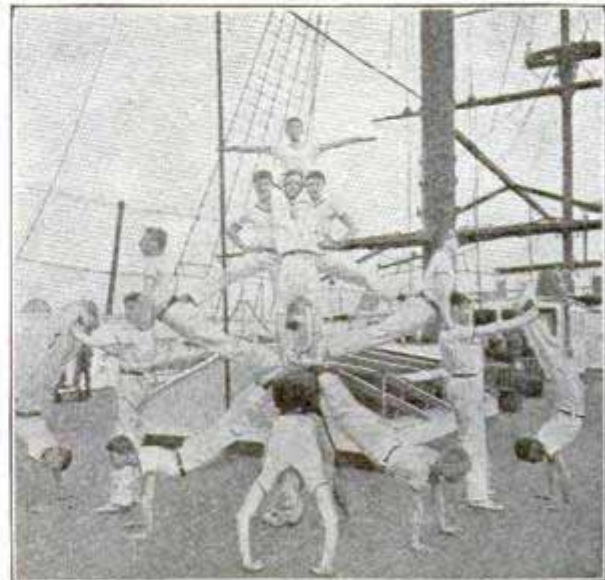
MILKSTONE SUBSTITUTE FOR IVORY

Skimmed milk in combination with formalin makes "galalith," or milkstone. It is good for manufacturing almost anything which is to look like

ivory without chipping, cracking, or burning and which must be tough and take tints finely. The list is long, including billiard balls, piano keys, umbrella handles, doll heads, cigar holders, pen holders and knives, door knobs and picture frames. In Austria 100,000 people are kept busy in supplying the world with skimmed milk in artistic and practical forms.

CADETS GIVE GYMNASTIC DISPLAY

Once each year the naval cadets of the English training ship "Worcester" hold a prize contest to which the public is invited. The illustration, from the Shipping World, shows one of the set pieces requiring 15 men.



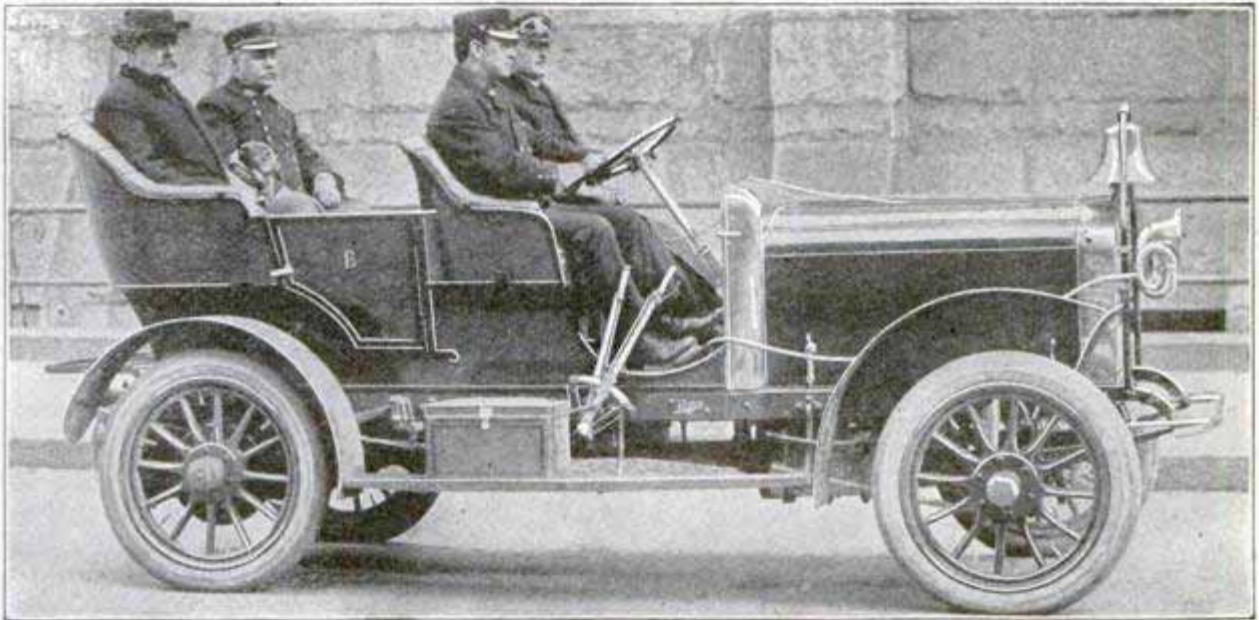
CHURCH ON GIANT VOLCANO

The most high church Episcopalians in the world are those who worship 4,000 ft. above the sea on the slope of a volcano on the island of Maui, Sandwich Islands. They are also nearest the mouth of the pit, for one of the largest craters on earth is but a short distance above the church. Regular services are held and are attended by many persons, and there is a church debt, which is more excusable than most church debts, in view of the difficulties to be overcome in building in such a location.

BOSTON'S FIRE CHIEF'S AUTO

The chief of the Boston fire department has turned his horse and buggy over to one of the captains and now goes to fires in the serviceable motor car illustrated. Its general utility was never dreamed of when the car was ordered, as shown in the record of the first two hours of the first day.

A rapid run was made to a fire in an outlying district, where several firemen were overcome by smoke. The men were placed in the car and rushed several miles to a hospital for emergency treatment. Returning to headquarters



The Boston Fire Chief's Machine

TEMPERATURE IN STORAGE BINS

Large quantities of stored material, as coal, grain, oil, vegetable or animal fibre, often become heated at the bottom or center of the pile, while the surface remains cool. Spontaneous combustion frequently results. A thermometer has now been constructed which will show in an instant the exact temperature in bins or piles by switching it on to a wire which terminates at the center or bottom of the bin. Where this system is installed readings of the temperature of all the filled bins are taken at regular intervals and recorded in a book for future reference purposes.

from the hospital a man was picked up who had just been injured by a runaway cab, then the runaway horse was chased and caught. Leaving an attendant in charge of the horse the car made another run to the hospital.

NOBODY'S RAILROAD

Railroads are stolen often enough, but seldom lost or strayed; an Irish road has succeeded in accomplishing all three. It was 12 miles long and plastered with mortgages. As it proved unprofitable, neither builders nor mortgagors cared to work it, still less did any one care to pay taxes on it; consequently the assessors could not find any one who would confess ownership.

The people along the right of way rose to the emergency with enthusiasm, settling the question of ownership by carrying off gradually everything which was worth anything, except the road-bed. They had even brought up a crane to take away the bridge when the police put an end to that final transfer of ownership.

MINE RESCUE SCHOOL

The frightful loss of life in the mines of this country during the last few years has aroused the Geological Survey to devise preventive measures. These fall naturally under two heads: the prevention of deadly explosions in mines and the early rescue of miners after an explosion has occurred. Under the first head come the testing of safety lamps, and of the effects of different blasting explosives on the gases

of mines. Those which are found safest will be urged upon the attention of mine owners.

For the study of explosives a cylinder of heavy boiler plate will be used, 100 ft. long and 6 ft. in diameter, lying upon the ground. This will be filled with an explosive mixture of fire damp and air, and then various explosives will be shot into it from a mortar and the effects noted. In other experiments the cylinder will be filled with coal dust and air.

For the study of rescue work a building will be fitted up in imitation of a mine to the last detail. After this imitation mine has been filled with smoke men will be instructed how to enter and search for bodies, carrying with them an apparatus for artificial respiration. It is probable that this experiment station will be located near Pittsburg.

A LESSON IN HOUSE LIGHTING



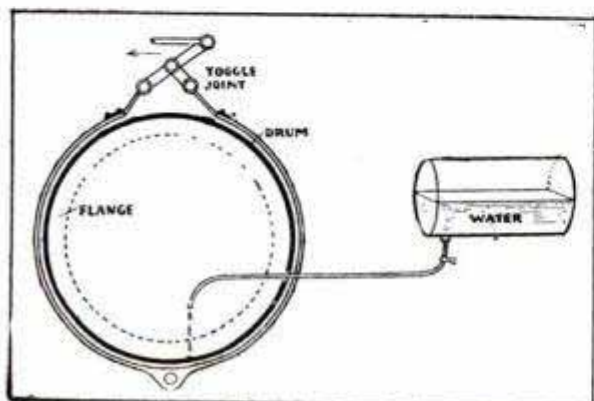
Light fixtures are too often placed without proper consideration of what the results will be. The Illuminating Engineer gives an excellent object lesson in the above illustrations which show the advantage of a properly placed side bracket, and the difference of working while standing so as to cast a shadow on one's work.

20,000 TRAIN SPEED INDICATORS IN EUROPE

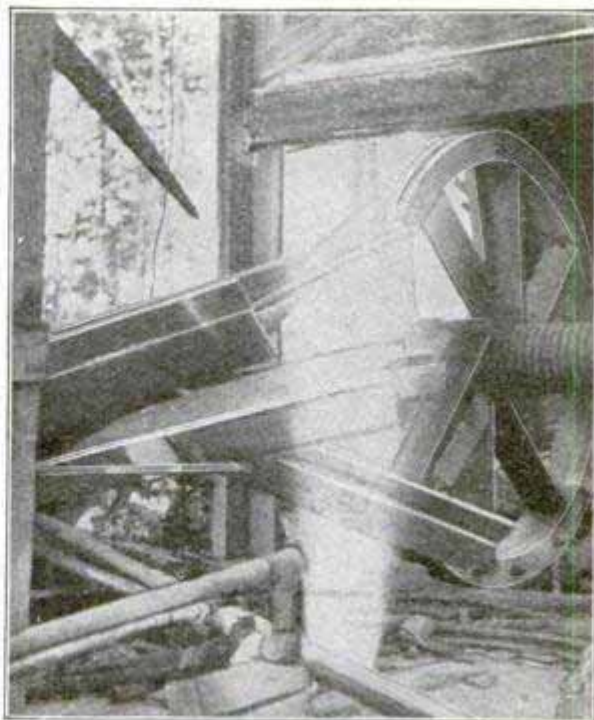
It is the law in France that every passenger engine must be equipped with a speed indicator, and similar laws will be enacted soon in Holland and Belgium. Their use is customary throughout the Continent, and in some of the countries even main-line freight engines are so equipped, since the indicators are considered quite as important as steam gauges and automatic brakes. In England, on the contrary, they are almost unused, and it is argued that the frightful accidents which have occurred there recently because of speeding faster than the regulations permitted would have been prevented by the use of speed indicators. The indicator not only shows constantly the speed, but records it in a locked compartment to which the engineer has no access. The trip record is taken to the office when an engine completes each run.

CONVENIENT WATER-COOLED AUTO BRAKE

Usually heating of the automobile brake is not sufficient to be serious, but in mountain touring involving long and steep descents some cooling device is often needed. One good method used is a small tank of water attached to a drip-pipe, from which the water drops upon the interior of the drum, says Motor, London. The latter is flanged to keep the moisture in, and water circulates also through the shoes, which are made hollow.



Water for Auto Brake



THE WORLD'S GREATEST GAS WELL

Drilled entirely by two brothers near the beautiful village of Kane, Pa., to a depth of 1,886 ft., considerably more than a quarter of a mile, is the world's greatest gas well, the only leak from earth's vast natural fuel works, it is said, from which the gas ever poured in such volume that it could be photographed. The accompanying illustration shows how for 50 days the stream of gas shot up like steam escaping from a safety valve on a high-pressure boiler.

For many long, weary days the two brothers worked their drill through the side of the mountain and finally, on September 22, 1906, penetrated the sand-rock and struck what is believed to be the largest gas pocket ever found. With a roar that could be heard 10 miles the liberated gas threw the tools out of the well and blew off the top of the derrick.

Then came a struggle with one of Nature's mightiest powers, but man conquered in the end and, on November 10, the giant well was capped. It is estimated that 100,000,000 cu. ft. of gas escaped at a pressure of about 1,500 lb. to the square inch, worth at the present price of the commodity about \$6,000, for natural gas now is bringing

a higher price than it did in the height of the boom some 20 years ago, when it was believed that the supply was inexhaustible and street lights, once ignited, were allowed to burn without interruption day and night because men were too reckless to conserve the supply.

Of the world's supply of natural gas about 93 per cent is produced in the United States, Pennsylvania furnishing a large share. At the wells in that state it is sold for 6 cents a thousand cubic feet; commercial consumers get it for 16 cents, while for domestic use the price averages 25 cents. Although it was discovered in 1873, it was several years before use was made of it.

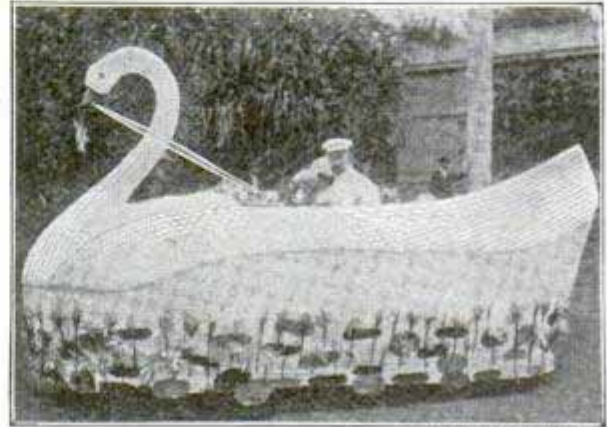
OFFICER STRUCK BY FLYING FISH

To the perils which beset those who do business in deep waters has been added a new one—flying fish. The first officer of the s. s. "Korea," just into San Francisco from Asia, was knocked senseless by a fish which struck him on the side of the head while the ship was between Yokohama

and Honolulu. That this fish was exceptionally strong and ambitious is indicated by the fact that the officer was standing on the bridge at the time, 50 ft. above the water.

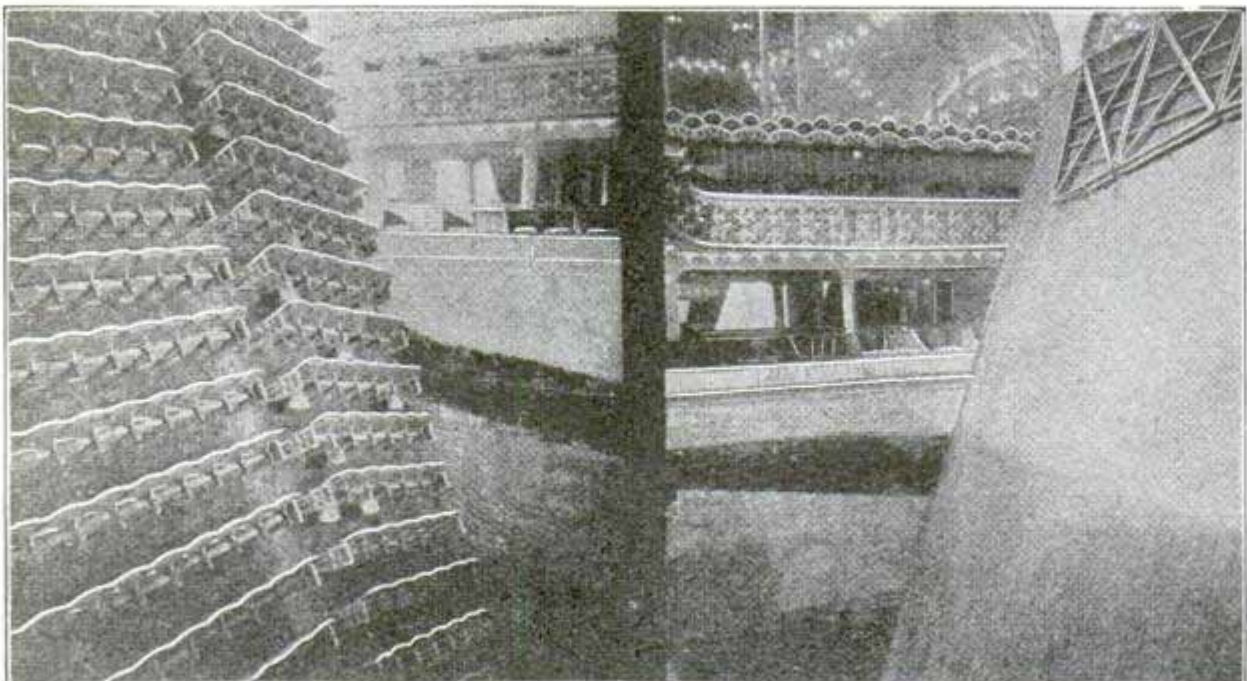
AN AUTO DUCK

The subject of this illustration formed an important part of the an-



Courtesy the Automobile

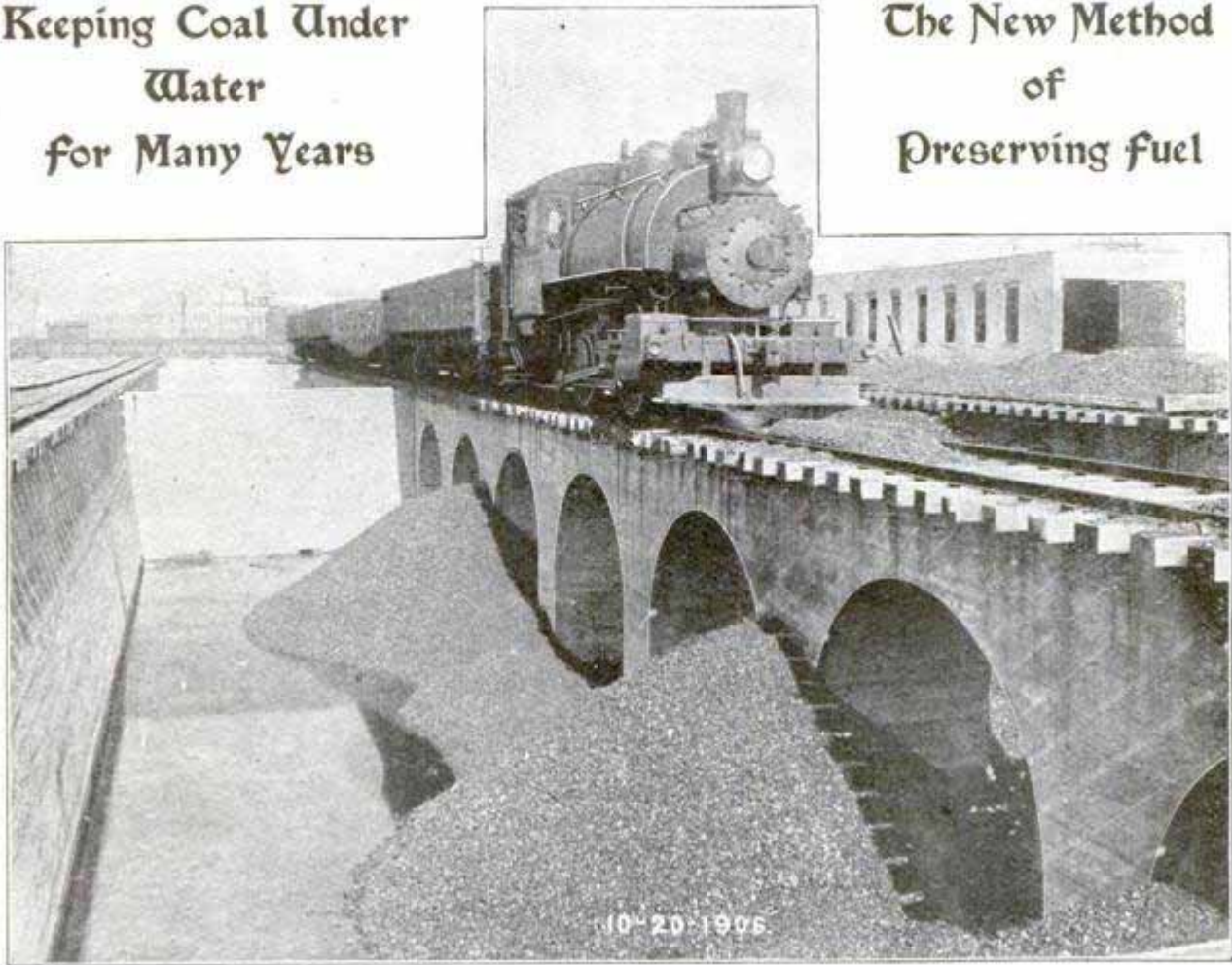
nual floral parade at Honolulu and took a prize. The motor being altogether out of sight, the whole affair glided along with a movement as mysterious as it was graceful. The spectators agreed that whatever else it might be, it certainly was "a bird."



The Theatre-Concert European, Paris, has a wonderful mechanical system, operated by electric motors, by means of which the floors turn completely upside down. In five minutes the floor can be reversed with the seats suspended below, and the upper surface an open dancing floor. So perfect is the balance that the revolution is accomplished with only a 1½-hp. motor.

Keeping Coal Under
Water
for Many Years

The New Method
of
Preserving fuel



Filling the Concrete Tanks

The storage of vast quantities of coal is indispensable to the Navy and to large manufactories, especially in anticipation of scarcity through strikes or other causes. But coal exposed to the air for any length of time deteriorates seriously in calorific value, and experiments have been directed toward reducing this loss to a minimum. It varies according to circumstances, especially climate, and therefore cannot be stated very definitely, but it is esti-

mated to range from a 12% loss in bituminous coal stored in England to a maximum of 40% at Hong Kong.

The best and simplest way to stop this oxygenization of coal seems to be by immersion, as tried by the British Admiralty at Portsmouth, Eng., and by the Western Electric Co. at Hawthorne, Ill. The latter has three large bins of concrete sunk in the earth, a total of 310 by 114 by 15 ft., and across them run four railway tracks on piers.

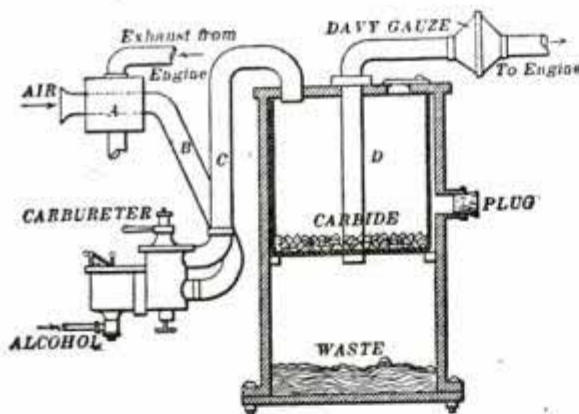


Piles Will Be Leveled; then Submerged

The cuts show more plainly than words how the storing is done. When coal is wanted they scoop it out with a steam shovel, and its being wet helps combustion and eliminates dust. Another advantage is that all danger of premature combustion, spontaneous or otherwise, is made impossible. The Western Electric floods the coal with fresh water, but English experiments with salt water are claimed to have increased the heating value.

ACETYLENE-ALCOHOL FOR GAS ENGINES

For years experimenters have puzzled over the problem of combining the advantages of both alcohol and acetylene gas into an ideal motor gas. At



last they have succeeded, and the new motive power is superior to gasoline in both efficiency and expense, thanks to the free denatured alcohol law which went into effect at the beginning of 1907.

Briefly stated, alkoethine is a mechanical combination of carbureted alcohol with calcium carbide. Experiments are still going on to perfect the process and determine all its features. One advantage observed is that the carbide extracts from the alcohol nearly all the contained water; also that there is a chemical reaction generating heat, which lowers the flashing point of the compound. Mr. P. C. Avery, of Milwaukee, Wis., has a two-cylinder auto-car fitted up to use either gasoline or alkoethine by the turning of a few valves, which affords good practical

tests of the comparative merits of the two gases. He dissolves 1 gal. alcohol in 8 gal. acetylene gas, and does away with any carburetor, injecting the combination into the cylinder by a slight pressure. The compound gas is kept in an ordinary gas tank with valve at top. The Acetylene Journal says:

"The defects of alcohol as a fuel have been that it works only with comparatively slow engines and that it is too slow in vaporizing to work effectively in high speed motors. Therefore no test of more than four hundred revolutions per minute has resulted satisfactorily. It requires very large quantities of alcohol, moreover, to obtain ordinary results and it will only work well when the cylinders are hot.

"Acetylene, on the other hand, owing to its high chemical purity, burns with rapidity and on this account has not lent itself with the greatest success to power combustion. The result of combining the two is that one offsets the other in a way that with denatured alcohol, low in price, makes it probable that gasoline as a fuel for motors and the like may find in the combination a strong rival."

Up to the present time the world's diamond production amounts to only about 20 tons. This would mean, however, 9,493,757 diamonds of one carat weight, each.

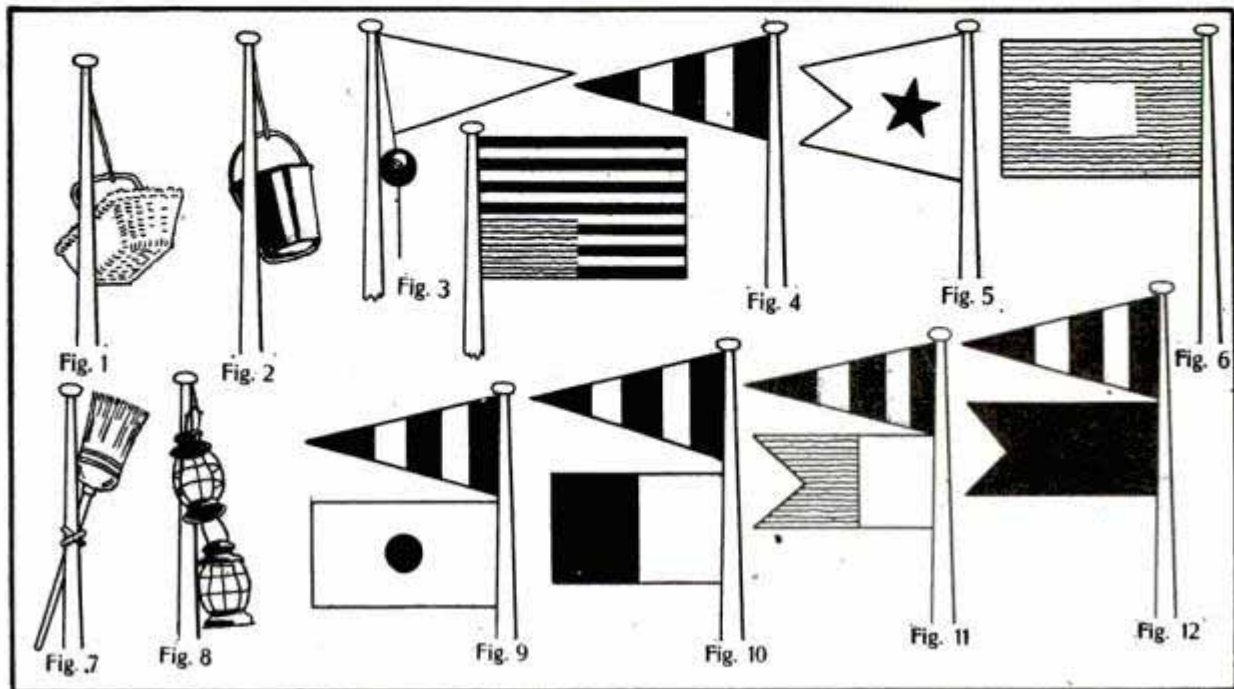
A DOUBLE COMFORTER

From England comes a novelty in creature comforts—a solid silver pocket



flask with cigarettes on the side. As shown in the cut, a compartment opens with a hinge and closes with a snap, protecting the contents from crushing or moisture. Notice that the flask is curved flat, making it fit very snugly in the pocket. Price only \$25, made in silver.

FLAG TALK OF OCEAN CRAFT



Courtesy Philadelphia North American

FIG. 1—Basket at masthead, "Cargo wanted." FIG. 2—Bucket at masthead, "Fresh water wanted." FIG. 3—Flag reversed or ball below pennant, distress signal. FIG. 4—Code pennant hoisted over every message; flag at masthead alone is answering signal. FIG. 5—House flag amidships tells ownership. FIG. 6—"About to sail; present your bills." FIG. 7—Broom at masthead marks maiden voyage. FIG. 8—Two lanterns on rear-most of tugs warns off tow following. FIG. 9—"I have not clean bill of health." FIG. 10—"I wish to speak to you." FIG. 11—"Get out of the way; I am on full speed." FIG. 12—"I am taking on explosives."

The flag language of the International Code Signals is spoken and understood in all parts of the world. Not a soul on one ship may understand a word of the language spoken by the men on another, but when either ship hoists a reversed flag the other instantly reads "Distress" and recognizes a call for help. This flag language provides for almost every contingency. In many ports, or sections of coast, the local trading boats have adopted the same system and have messages of their own. For instance a vessel approaching the fishing or oyster banks with a basket at its masthead is seeking a cargo.

Meeting steamers do not dread:
When you see three lights ahead
Port your helm and show your red.
For steamers passing you should try
To keep this maxim in your eye:
Green to green or red to red—
Perfect safety; go ahead.

The steel and electric manufacturing companies have orders amounting to \$1,200,000,000.

MANUFACTURING MATCHES NOT SO DANGEROUS

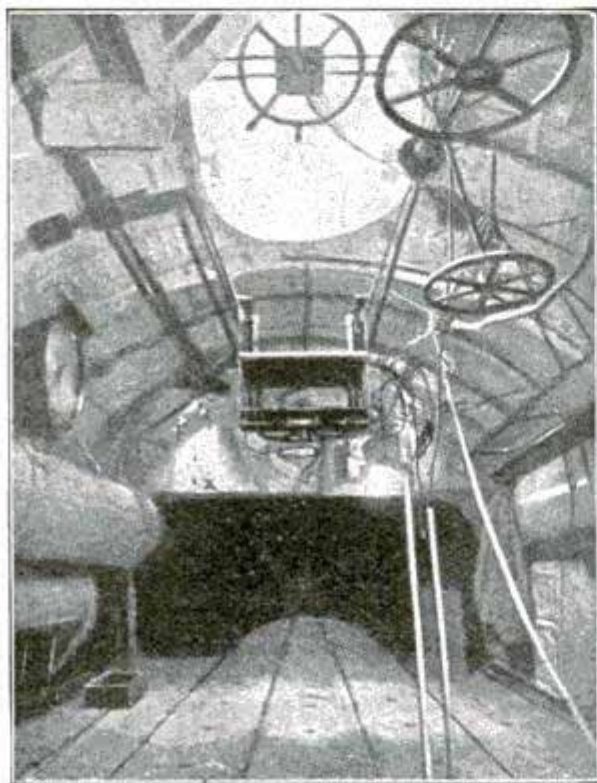
Modern methods have greatly lessened the dangers connected with the manufacture of matches, the entire process now being carried on without the touch of a human hand. Of old, as many as a hundred workmen a year in large factories would contract necrosis of the jaw by getting phosphorus into decayed teeth by inhalation or contact, the bones being actually consumed as by acid.

Now the teeth of the workman when he applies for employment are examined by one of the factory dentists, and unsound ones must be filled or drawn out. Also, the air in the factories is changed every four minutes.

Aluminum is hard to restore to its first beauty, especially the frosted finish. Immerse for a considerable time in water slightly acidulated with sulphuric acid.

23 MEN UNDER WATER 24 HOURS

That is the longest yet, 17 hours having been the top record for submergence until the test made in May with



Interior of Submarine

the "Octopus" and the "Lake." The first submarine carried 15 men, the other 8, and they went down in 30 ft. of water 7 miles from Newport, R. I. All the men had to do was to amuse themselves and be comfortable. They could read, sleep, eat, play cards, go fishing—anything but smoke. The fishing could be done out of the diving compartment door, and the meals, including one pie, were cooked on an electric stove. The news of the day was sent to them by telephone. The "Octopus" took down 70 cu. ft. of air compressed to 2,000 lb. to the sq. in; the "Lake" had 42 cu. ft. of compressed air aboard. Foul air was blown out through valves or through the door of the diving compartment, and this had to be done only twice for the "Octopus."

In every way the test was highly satisfactory. So little of the compressed air was used that both boats could have

stayed down a day or two more. Samples of the breathed air were bottled every two hours on board the "Octopus," and will be analyzed.

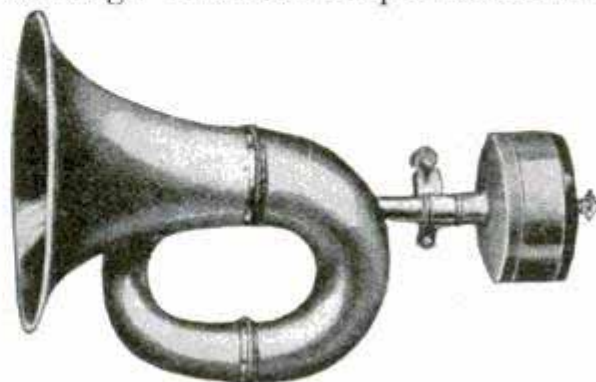
HOW MANY HORSEPOWER EQUAL ONE TON OF ICE?

That is to say—how many horsepower must be expended to liquefy sufficient ammonia gas to produce the same amount of refrigeration as will result from the melting of a ton of ice? It is a difficult question to answer, for it involves not only careful experiment and computation, but also a number of variable factors. Furthermore, it is always necessary to allow a liberal margin between theoretical and practical efficiency, due to loss by superheating, clearance, etc.

Theoretically, for a condensing pressure of 103 lb. and an evaporating pressure of 4 lb. the horsepower required to liquefy gas enough to produce as much refrigeration as the melting of one ton of ice is 1.0584. For a condensing pressure of 218 lb. and an evaporating pressure of 51 lb., the horsepower is .7629. But in practice these estimates of horsepower must be increased 15 per cent to 20 per cent, according to size of compressor, for reasons stated.

AUTO ELECTRIC HORN

A "press-the-button" electric horn for automobiles is the latest thing in honk-honking. The horn is operated from a



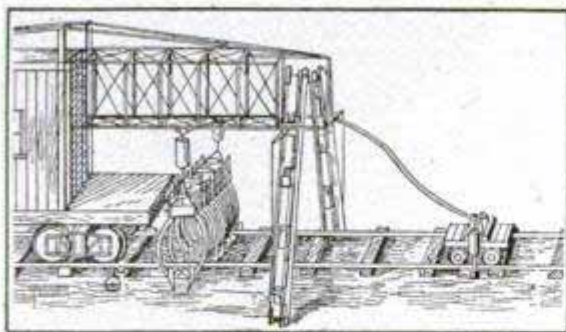
Makes New Kind of Noise

battery, and when the circuit is opened and closed a resilient diaphragm makes a new kind of noise.

TRACK TAMPING MACHINE

If you ever watched the construction gang who follow after the men who have spiked the rails to the ties, you saw them bring a straight, level, solid track out of a snakey, wavy, uneven, line of rails. It took a small army of men; and the work was all hand work, using levers and levels, track gauges, shovels, tampers, and crowbars. Your chief impression was: "What a lot of money it must cost."

It does cost money; one Canadian engineer who has built tracks for years says this part of the work alone on a 200-mile track costs \$140,000. And so he has invented a machine which is claimed to do this work for \$25 per mile, which would mean a saving of \$135,000 on 200 miles. His machine is 60 ft. long and does its work with air compressed in the car. First the track is lifted to the required level and held there while elevators bring up earth from either side. Next a row of sharp pointed arms get busy on both sides and ends of a tie and push the ballast down. These arms move as fast as a section hand when the "old man's" special comes along, and is warranted not to stop to light pipes or



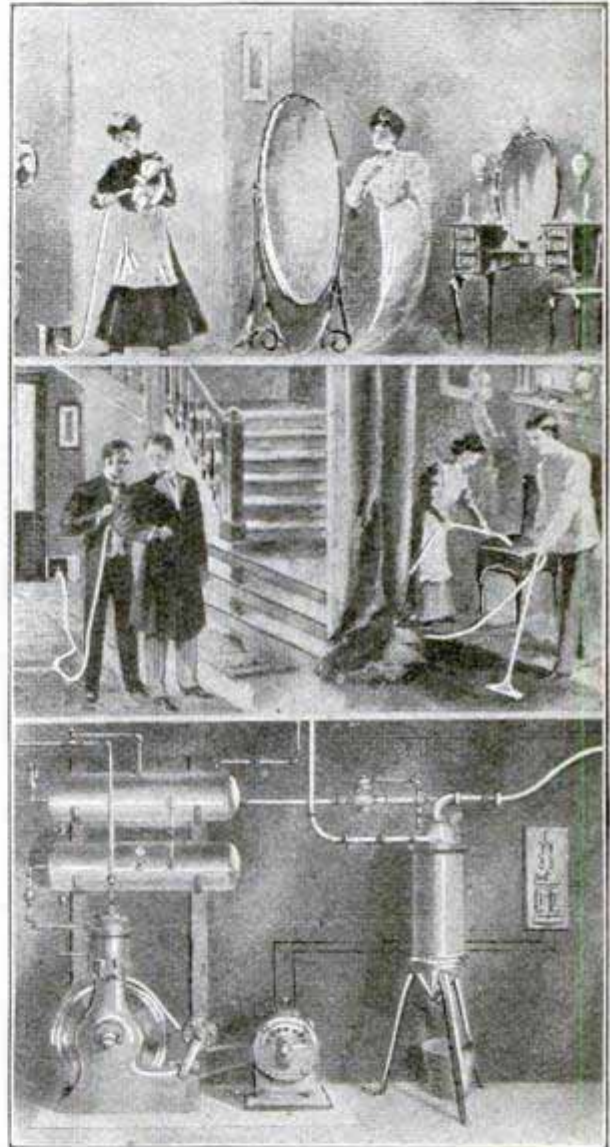
Compressed Air Tamping Machine

wait for the water boy. Altogether it is a great thing—if it works.

A large gyroscope located in the hold immediately ahead of the boilers in a German torpedo boat, and driven by a steam engine up to 3000 r. p. m., reduced the arc of rolling of the vessel from 30° with the gyroscope still, to 1½° with it in motion.

CONVENIENCE OF COMPRESSED AIR CLEANING

The uses of compressed air most familiar to the average citizen are those he sees when walking along the street,



Cleaning with Air

where some skyscraper is being riveted with pneumatic hammers, or a portable compressor is pumping dust from a residence or office building.

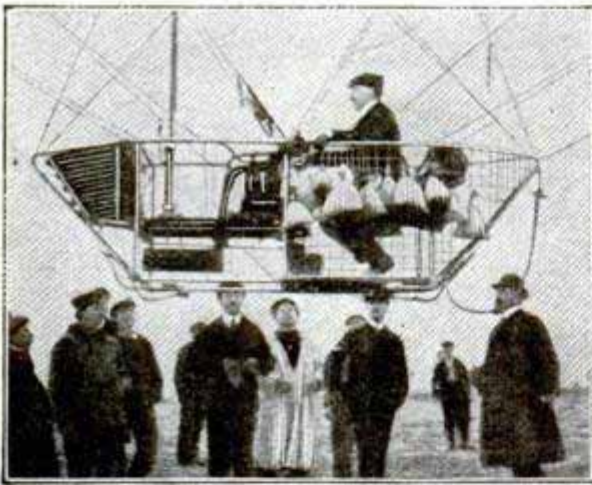
The air cleaning system which has revolutionized old methods has now been applied to residences, and small outfits occupying little space are now available as a permanent fixture in the home. The compressor can be operated with either a small gasoline engine or an electric motor, and concealed pipes extend to each floor or room. In addition to a daily or weekly removal of

dirt short hose connections are used for dusting wearing apparel as well as the house furniture. The apparatus is simple and requires no exertion in its use. All the dust is drawn to a receiver in the basement, from which it is removed as often as necessary, usually once a week. With compressed air an 8-year-old child can sweep and dust a house and do better and quicker work than several adults with brooms and dusters.

THE DANGERS OF FLYING

By L. J. Lesh

How often nowadays we hear remarks such as this: "He has succeeded in flying, has he? Well, let him fly; but you can excuse me when it comes to anything as dangerous as that." Yet the same person who swears that he would not ride a flying-machine for all



The Start

the money in the Bank of England does other things merely for sport that are fully as dangerous as flying (with the machines we now have at our command); things, too, that give him vastly less pleasure than he could get out of a strongly made and well tested aeroplane.

To the inexperienced aviation seems attended by dangers that loom up as almost too great to be braved by a human being, and the would-be flying man is accordingly quite surprised when he finds that, after a little practice,

a flying-machine is almost as safely and easily handled as a bicycle. In fact, he finds that about the only difference between coasting downhill on a bicycle and sliding upon the air on a gliding machine is that in the latter it is necessary to instinctively adjust the fore and aft balance, which in the bicycle is always preserved as long as the two wheels touch the ground.

The first machine to carry a man through the air for any considerable distance was the Lilienthal soarer, which, however, possessed such poor fore and aft balance that it could not be safely operated in winds of over 20 miles an hour. It was this defect, coupled with its bad condition of repair, that probably caused the death of its operator.

Since Lilienthal's death earnest attempts have been made towards producing a machine that should be structurally strong and possess good equilibrium, even though less important features had to be omitted to make these conditions possible. These efforts have produced the Chanute and Wright types of aeroplane, which are satisfactorily strong and safe to handle, and yet are quite efficient in flying qualities.

The truss construction now used by nearly all aeronautical engineers provides such a strong and rigid framework for the aeroplane surfaces that breakage of this part of the machine seems practically impossible. The part of future dynamic aeroplanes that will undoubtedly cause the most trouble will be the motor, for as yet none has been developed that is even reasonably immune from breakage and stoppage. Of course, if the motor stopped a flier would have to come down, and if it happened to be flying over an undesirable landing place and did not possess the power of gliding flight it might come to grief when it lit.

The recent flights of the Wright brothers seem to indicate that they have found either a successful equilibrium preserving device or a vastly improved arrangement of steering surfaces, so that at last we can cease bothering

about the balance and control of a machine.

The Wright flyer is capable of being steered with even greater accuracy than an automobile or bicycle, and yet the operators have spent far less time in actual practice than is required to obtain a mastery over either of the last two conveyances.

To a person who has had considerable experience in the air the possibility of accident seldom occurs, and indeed the motion is so rapid that there is no time to think about it during a flight. People seldom think of the risks they run while riding at 100 miles an hour in a railway car, or half a mile a minute in an automobile, and it is quite probable that after the novelty of the thing wears off there will be few people afraid to experience the quick rush of the aeroplane.



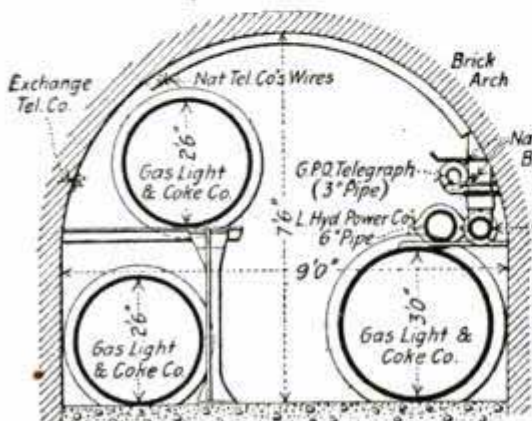
Manchester Subway

SUBWAYS FOR CITY PIPES AND WIRES

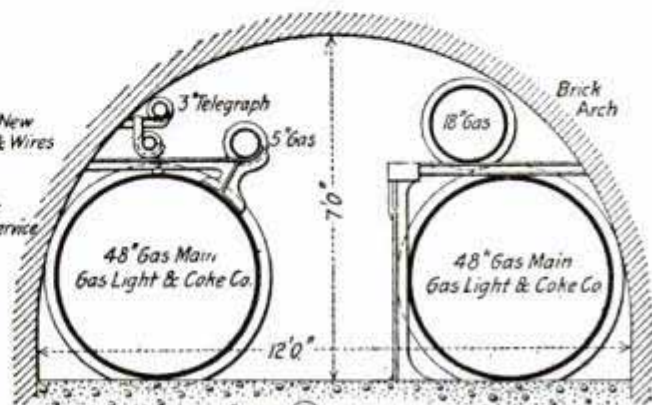
European cities are making great headway in the construction of subways beneath the streets to contain not only electric wires for light, power and communication, but also for the gas and water pipes. In London a subway for these utilities is now built whenever a new street is authorized. Some of the London subways are as large as 7 ft. high by 12 ft. wide; there are already seven miles of these pipe subways.

In Manchester the subway has now reached a length of 7,386 ft. and is used exclusively for electric wires,

which are contained in pipes carried on iron brackets fastened to the walls. The cost was \$39 per linear foot. Other cities where the system has been built are Leeds, Nottingham and St. Helens. The construction is paid for by the city, which charges an annual rental from the service companies, which more than pays the interest on the cost. These annual charges are based on the diameter of the pipe, ranging from 60 cents for 3-in. diameter or less up to \$12.50 for 36-in. per 300 ft. for water or gas. For other companies the rate is much higher, being \$6.50 for 3-in. pipes and \$20 for 18-in. per 300 ft. The freedom from leaks in water and gas mains, and the ease and economy with which repairs can be made make the



Victoria Embankment (At Charing Cross Station)



Commercial Road, East.

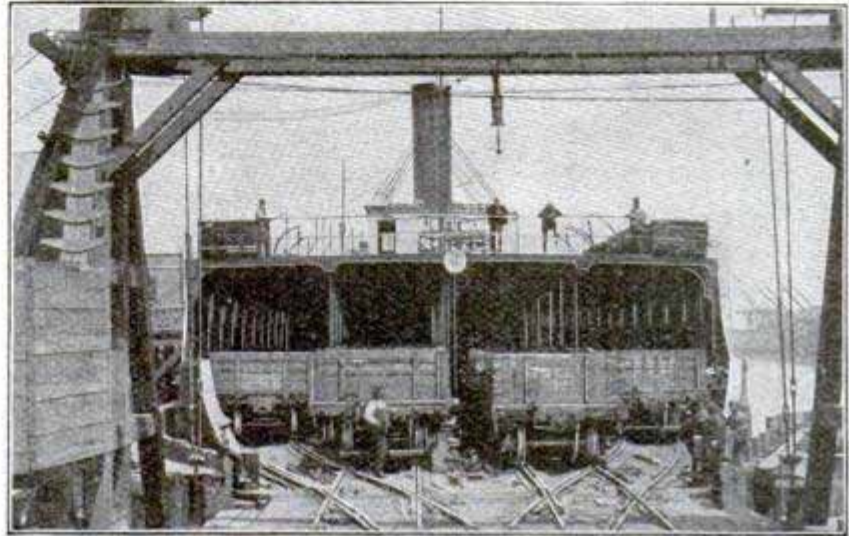
ENG. NEWS.

proposition an inviting one to the tenant companies.

Our American cities should take up the pipe subway question and not only provide a revenue producing power for all time to come, but save the everlasting tearing up of our streets.

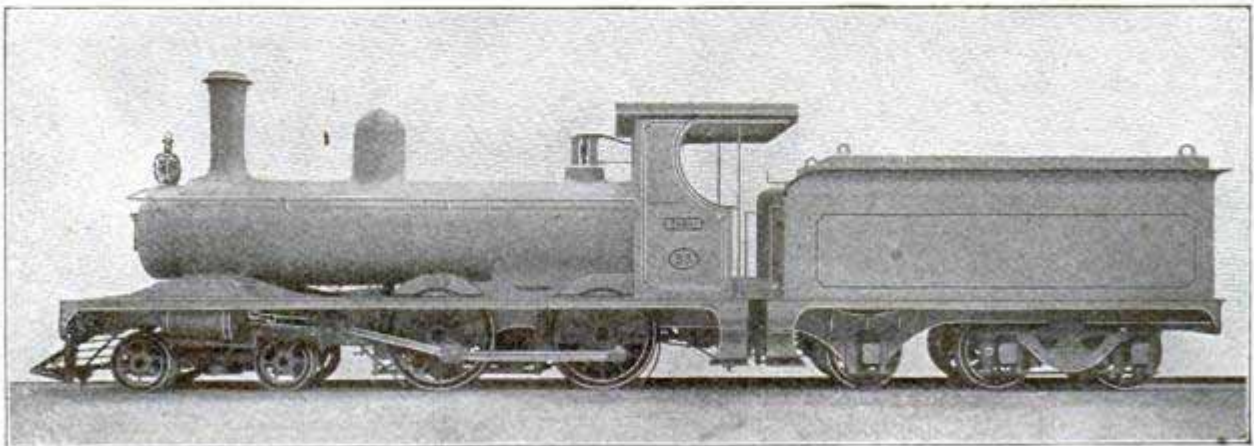
LOADING A LAKE ERIE CAR FERRY

Crossing Lake Erie on routes of 50 to 60 miles, between the United States and Canada, ply several car ferries, each carrying from twenty-five to thirty cars. These ferries are open at the rear above the car deck and are equipped with tracks of the same gauge as those of a railroad. The method of loading is to back the ferry up to an apron, which is lowered and raised by means of weights to the level of the ferry tracks. This level, of course, varies with the stage of the water in the river. The tracks of the apron connect those of the dock with those of the ferry and thus admit of switching cars aboard as shown in the photograph. Once the cars are in their place on the ferry they are fastened securely for the trip. Coal is one of the chief commodities carried in this manner.



Car Ferry Open at the Rear

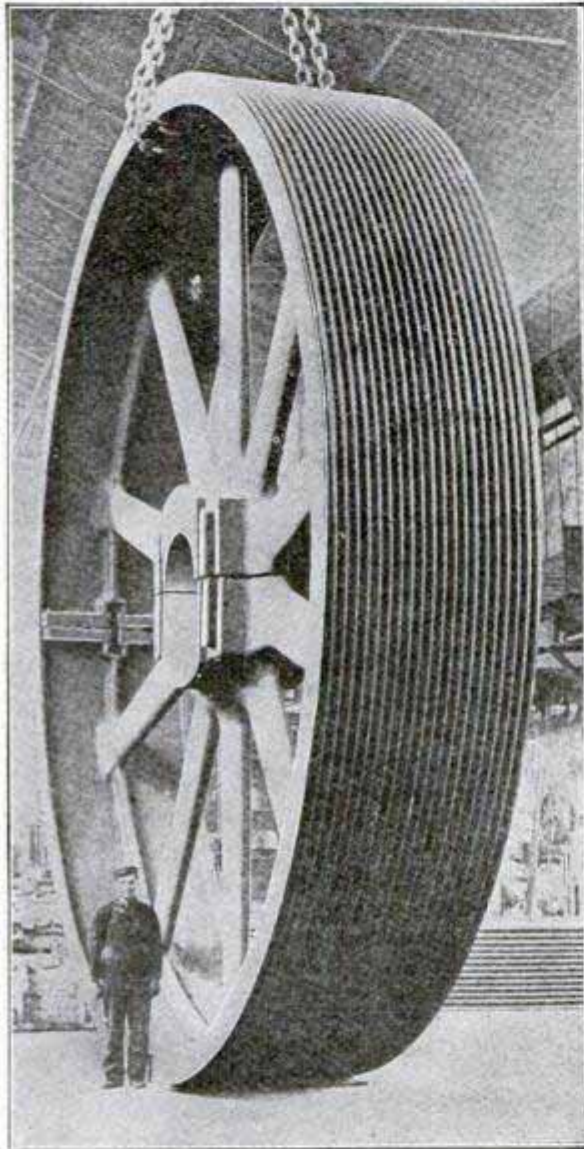
from the coast, 400 miles away, and were sent in. One of them found the man 500 ft. from the shaft, and carried him food, clothing and candles while the water was being pumped out with feverish haste. But it took nine days to get it down to a 5-ft. depth, and when the imprisoned miner tried to wade out he fainted and was carried most of the way.



FOREIGN LOCOMOTIVES—The above is one of the English built engines used in the Soudan. It is of rather light construction, weighing about 32 tons. It is built on American lines to a considerable extent—in fact, several were built in the United States.

BIG ROPE DRIVE

The illustration shows one of the three sections which when put together formed a rope driving wheel 24 ft. in diameter and 14 ft. face. The single



24 Ft. in Diameter

section weighs 90,000 lb.; the assembled wheel 135 tons. It has been put in service in a steel mill driving the sixty 2-in. transmission ropes at a mile a minute.

SMOKELESS SOFT COAL

A report comes from Manchester, England, that a company has been formed and five acres purchased near that city for the purpose of erecting large works to exploit a new invention.

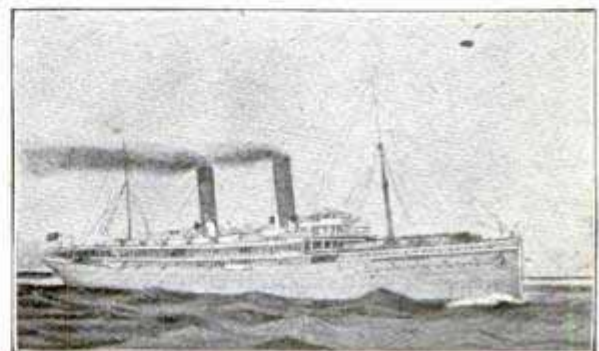
This is declared to be no less than a process for depriving soft coal of its smoke by extracting the valuable oils which produce it. The residuum is called coalite, looking like coke, but much more bulky and heat-producing, and salable at one-third the price of coal. Of course, the by-products are expected to be very valuable.

STEEL CANAL IN SAHARA DESERT

On account of the desert sand storms, the porosity of the soil and the extreme dryness of the climate, it was found necessary to build a canal of steel instead of using stone or cement at Kom-Ombo, in upper Egypt. The canal conducts water for irrigating purposes, is 19 ft. 8 in. wide at the top, 21 ft. deep and 5,610 ft. long. It was constructed of sheet steel which was riveted on the ground, 650,000 rivets being used. As the thermometer stood at 117° in the shade at noon, the difficulty of working inside the steel shell can be imagined.

PORT OF NATAL IMPROVED

Prior to the entry of this steamship the mail steamers were unable to enter the Port of Natal owing to the shallow entrance to the harbor. Several months' dredging have resulted in 35 ft. of water, and now the weekly mail steamers load and discharge passengers and cargo at the wharf.—Contributed by A. Leach Wood, Durban, Port Natal, South Africa.

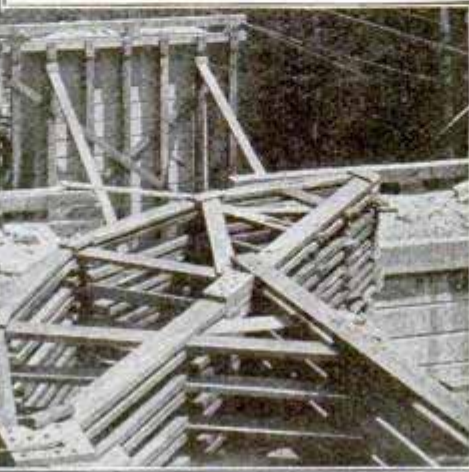


The First Steamer

LARGEST CONCRETE ARCH IN THE WORLD



What is undoubtedly the longest single span concrete arch in the world is now being constructed in a bridge at Germantown, near Philadelphia. The main span is 233 ft. between springing points, and 60 ft. wide. With four concrete arch approaches the entire length is 520 ft., and will cost \$256,000. The bridgeway will be 120 ft. above the creek, and will afford a driveway of 40 ft., with an 8½-ft. sidewalk on each side.

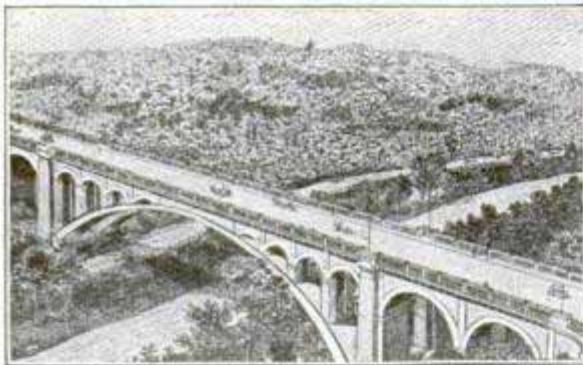


Framing for the Big Arch

The longest masonry bridge span is 295 ft. 3 in. long, at Plauen, Saxony; second comes the stone arch at Petrusse River, Luxemburg, 275 ft. 6 in.; and third the Cabin John bridge at Washington,

219 ft. 9 in. in length.

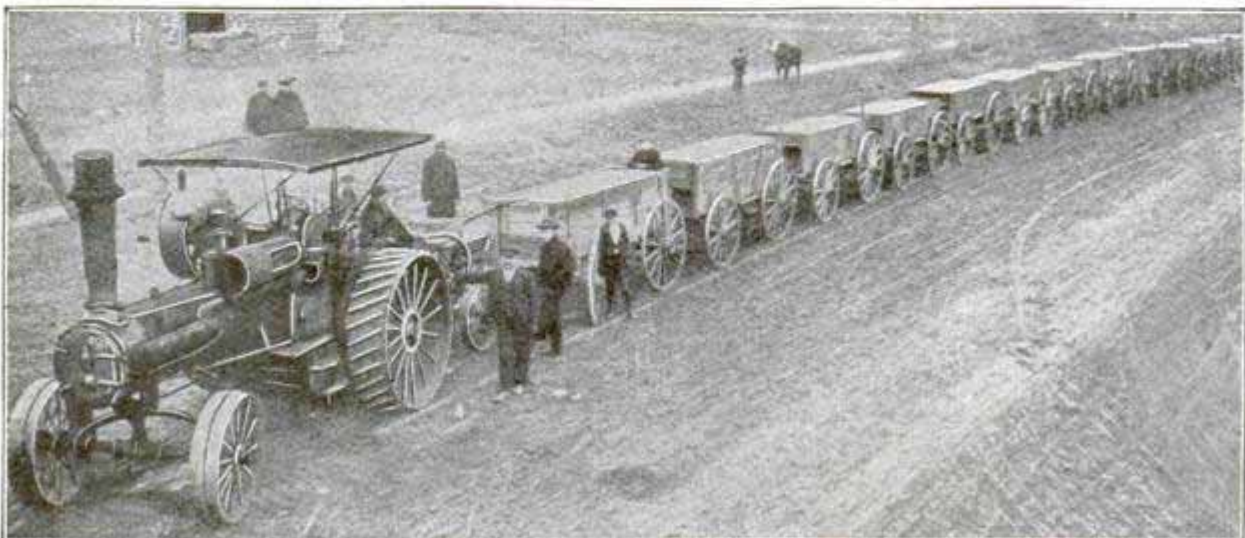
LONG TRACTION TRAIN



The Completed Bridge

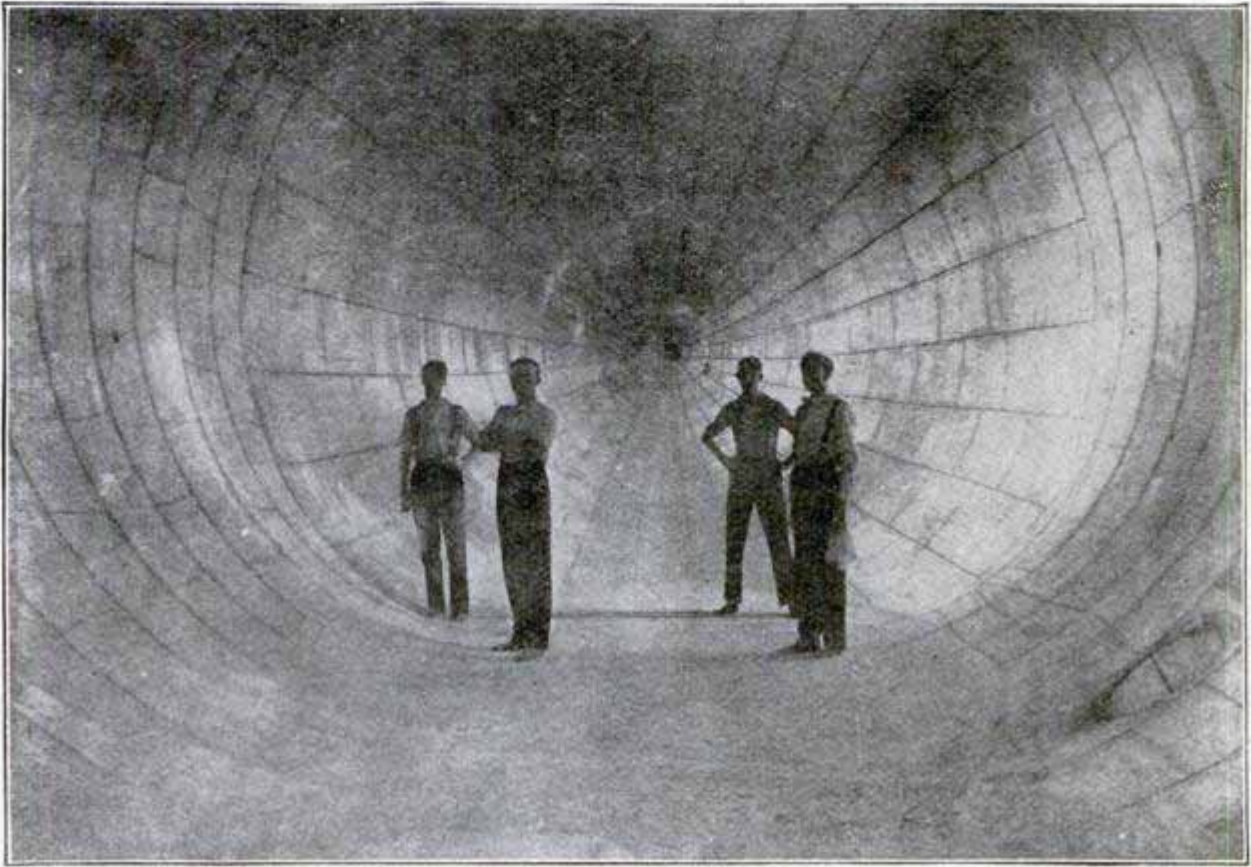
The traction engine is 20 hp. and drew the train of 14 loaded wagons eight miles on half a ton of coal. The outfit weighed 35 tons; the wagons contained 890 bu. of shelled corn, and the entire train was 180 ft. long.

This method of hauling requires only one man to a train.



The Train Was 180 Ft. Long

FINISHING THE GAS BAG OF AN AIRSHIP

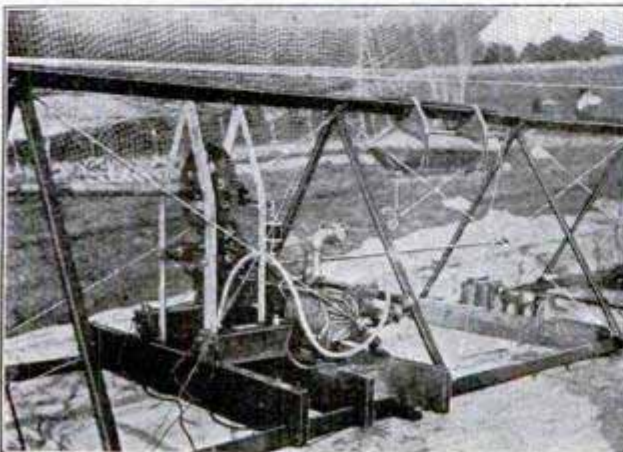


Interior of Gas Bag--Men Work in Stocking Feet

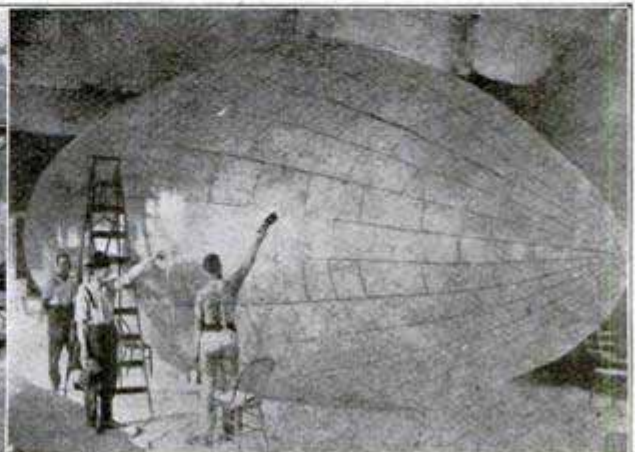
Finishing the interior of the big gas bag of an airship is one of the most delicate and important tasks in the entire construction. One of our illustrations shows the interior of the dirigible balloon built by W. H. Dilger of Cincinnati for entrance in the aerial navigation contests at the Jamestown Exposition. The bag is inflated with air and the men are working in their stocking feet in order not to injure the

delicate silk fabric, and have been applying white soapstone, which is used to keep the tissue from sticking together, as the varnish never becomes quite dry, but is always a little tacky.

The segments of the envelope are clearly shown in the views. These segments are sewn together and the seams reinforced on the inside with strips of the material. This construction prevents the material tearing farther than



The Driving Machinery



Varnishing the Bag

the nearest seam, should the balloon burst, and gives the navigator a chance for his life, as the gas cannot escape as fast as it would from a large rent. The varnish used is specially prepared, every builder having his own secret formula, and is applied in thin coats, so the pores of one coat will not come opposite those of another.

The engine in the frame supplies propelling power. It is of 12 hp. and weighs 80 lb. The hydrogen generator

is a big tank of 3,200-gal. capacity and makes 700 cu. ft. per hour. Cotton twine net is used to fasten the car to the balloon. On a spherical bag it always has a diamond mesh, and on a dirigible a square mesh.

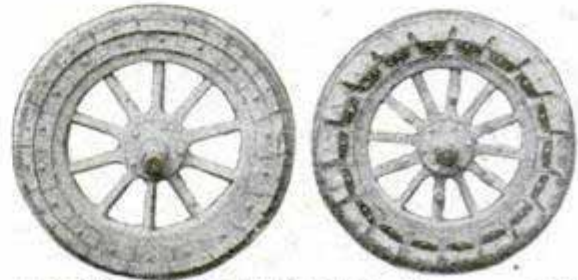
Mr. Dilger for several years conducted upper air explorations for the United States government, and also worked with M. Santos Dumont in Paris for two years. He will attempt to travel by airship to the Exposition.

“TURN DOWN” ELECTRIC LIGHT



The illustration shows the latest improvement in the way of an adjustable incandescent light. It fits on any ordinary wall socket, and by means of a small lever turns the light on or off in the same way a gas jet is controlled. The lamps heretofore have had only two degrees of light—half power or full light, but this burner can be set to give just the right amount desired.

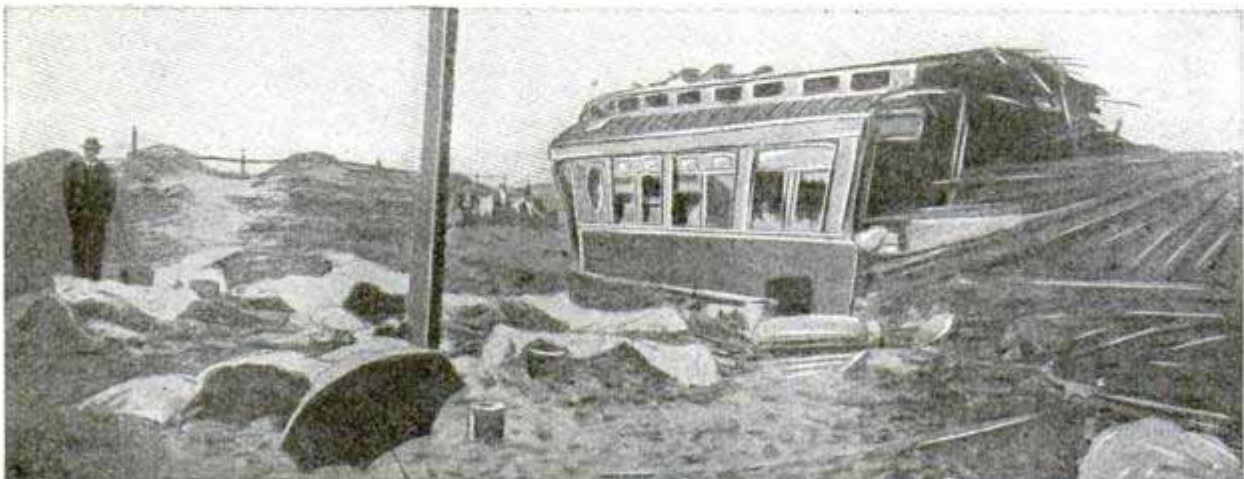
Bad air is bad for wood as well as for men. Seven weeks of it in a mine is said to have rotted 12-in. Oregon pine. Of course, some gas present in the mine had a chemical affinity for the wood.



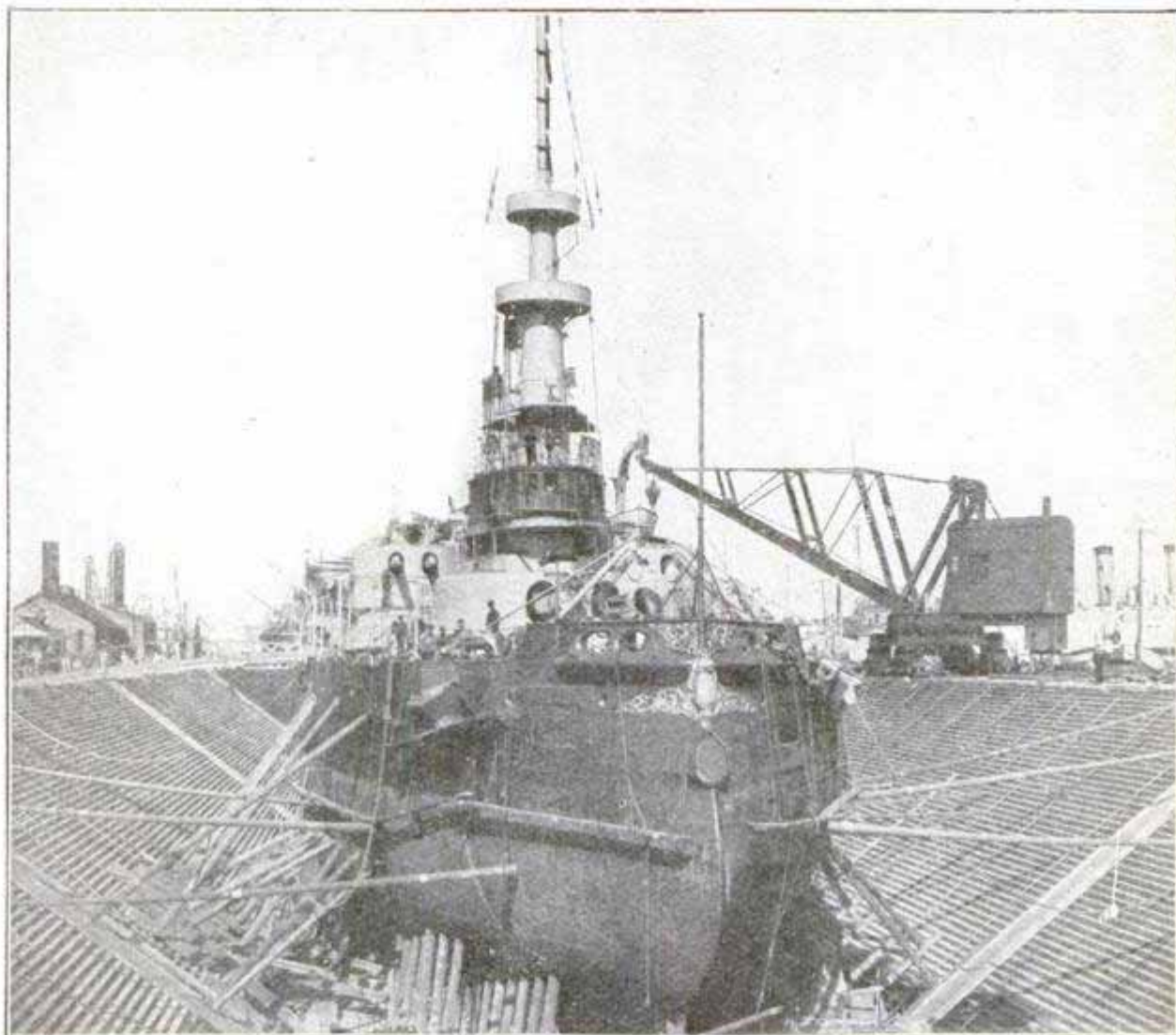
SPRING AUTO WHEELS—The one at the left is the front wheel; the other the rear wheel. A French construction.

STEEL SLEEPING CARS

A nearly all-steel sleeping car is one of the mechanical exhibits at the Jamestown exposition. The car is 72 ft. long, 14 ft. high and 10 ft. wide, and metal is used wherever possible; the seat frames and upper berth are of pressed steel, while the rivets in the outside panels are countersunk, leaving a perfectly plain surface. The effect is to more closely resemble a wooden car than any steel cars heretofore built.



Pullman Car in California Wreck of Shriners' Train—The White Sheets Cover Bodies of the Dead



First-Class American Battleship in Dry Dock Showing Manner of Holding Ship in Place with Timbers of Great Strength

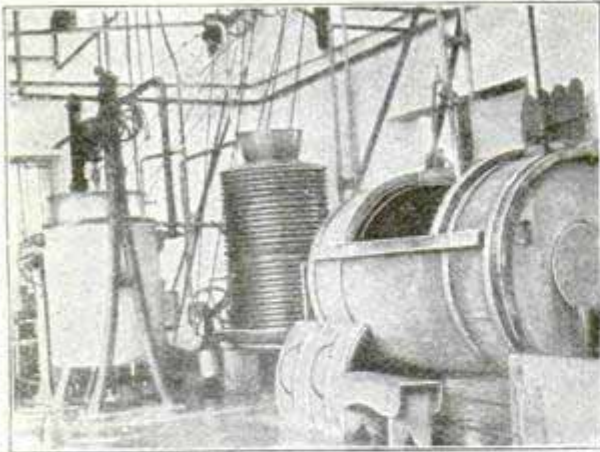
ANNUAL WATER SUPPLY OF LONDON

If all the inhabitants of the earth were gathered into one place, surrounded by a wall 10 ft. high, and the annual water supply of Greater London were poured in, the reservoir would be filled to overflowing. In other words, each man, woman and child in the world could be supplied with 50 gal. a year from the city mains, which, put end to end, would cover nearly $\frac{1}{4}$ of the earth's equator. Or, in other words, every person in London could take a 33-gal. bath daily, besides having plenty of water for drinking and other purposes. But that is just what they certainly do not do, so where does this flood of water go? Probably, as in other great cities, into breweries,

slaughter houses, factories, hydraulic elevators and other industries, besides an enormous wastage. But it has to be paid for just the same—over 16 tons of gold a year is what it costs.

COTTON GROWING IN KOREA

Korea is likely to become something of a factor in the world's cotton market. The Japanese department of agriculture has raised an experimental crop of 100 bales from American seed with highly satisfactory results. The yield per acre is said to be almost incredible and is explained by the unusual amount of hand labor employed in raising the crop, the coolie labor being so very cheap. The Japanese spinners now import 200,000 bales of American cotton annually.



Courtesy World's Work, London

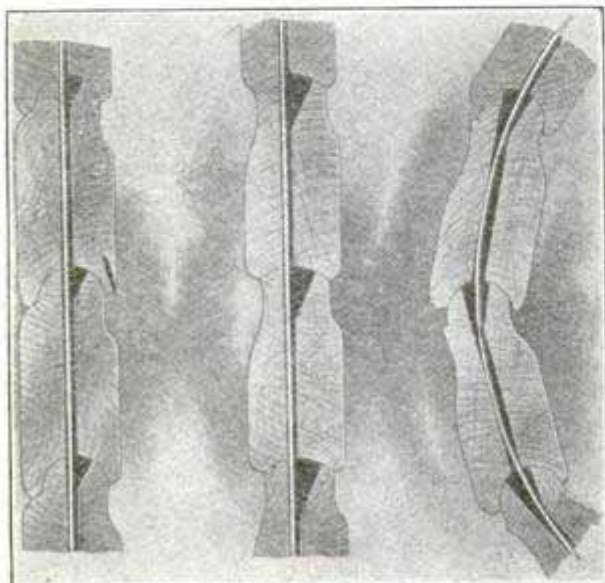
In Ireland mechanical methods are rapidly taking the place of hand work. The illustration shows a modern Irish creamery of which there are now several hundred.

BY AUTO TO SOUTH POLE

Next October a new Antarctic expedition will start from England. The ship will carry, in addition to the usual supplies for such an expedition, an automobile especially prepared for ice and snow traveling. Lieut. E. H. Shackleton, who has had Antarctic experience, will try for the South Pole with this substitute for dog sledges. It is a pretty bold venture, for the ship must return to New Zealand after landing him to avoid being frozen in.

WOODEN ROLLING DOOR

A patented door which rolls up like a curtain is now on the market and is



Rolls up Like a Curtain

desirable for use where room is not available for a solid sliding door. The wood seats are strung on phosphor bronze ribbons, and the edges slide in grooves at the sides of the doorway. The steel barrel on which the "door" is wound contains strong springs which counterbalance the weight of the curtain. A door 13 ft. wide and 17 ft. high can be opened or closed in thirty seconds.

AERIAL NAVIGATION A SUCCESS, SAYS DR. BELL

"The problem of aerial navigation already is solved and America is in advance of the rest of the world in heavier-than-air flying machines." This was the emphatic statement made by Professor Alexander Graham Bell in England, recently, whither he had gone to receive the degree of doctor of science conferred upon him by Oxford. Dr. Bell declares that "there is left only the problem of improving the machine that has been invented" by the Wright brothers, and others, and that "great credit is due Mr. Octave Chanute of Chicago," who not only induced young Americans to experiment, but paid much of the expenses out of his own pocket. In regard to future developments, Dr. Bell said:

"The development of the airship, I think, will come for other than commercial reasons, for the flying machine is destined to take an important part in warfare. The war departments of different governments are watching with greatest interest whatever is being done in this direction, and once a successful airship is given to the world its growth toward perfection will be more rapid than anything ever seen.

"The airship will overturn all present methods of warfare. Then, too, wealthy men will take to airships as they have taken to automobiles, and the machines will be developed for speed. They will undoubtedly be utilized for purposes of rapid and light transportation, such as carrying the mails."

VENTILATING AIR PORT



Partly Open

The air-port sash is operated by raising or lowering, in a similar manner to a window in a house, and is easily operated as the weight is balanced."

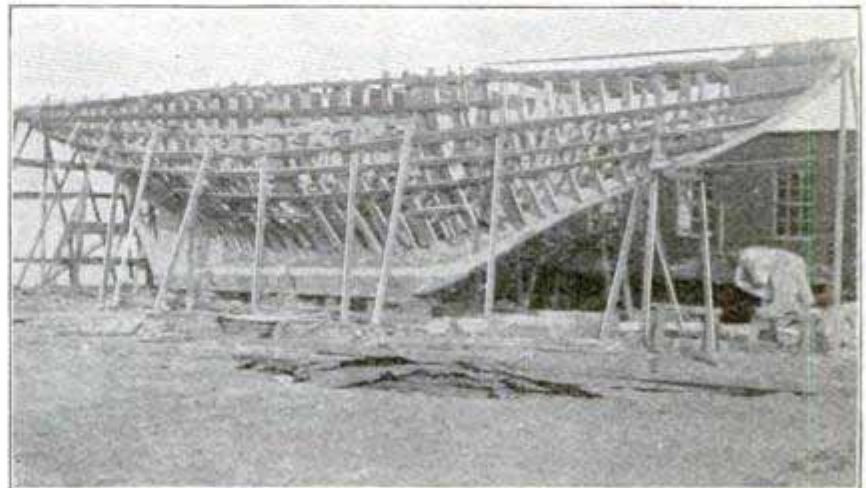
A valuable addition to the comfort of sea travel is a new ventilating air port which can be left partly open even in rainy or stormy weather. The Marine Journal says: "The air-

WOODPECKERS RUIN POLES

The Southern Pacific is about to build a new line, 250 miles long, in Old Mexico, which will require 7,000 telegraph poles. Now a nicely seasoned telegraph pole, deviled with juicy worms, is just nuts and raisins for a woodpecker, and the company has reason to fear that in a short time its 7,000 poles will be mostly holes. So the wise men of the Southern Pacific will try to spoil the woodpecker's appetite by steeping their poles in creosote.

HEAVY KEEL—ODD CRAFT

An odd craft is being built at San Diego for an Englishman from plans of his own design. The sailboat has a length over all of 68 ft., breadth $14\frac{1}{2}$ ft., while the keel, which is made of one piece of lead, weighs 15 tons. The lead is the lower dark portion shown in the photograph, and measures 24 in. wide at the middle by 15 in. deep, and is 27 ft. long.



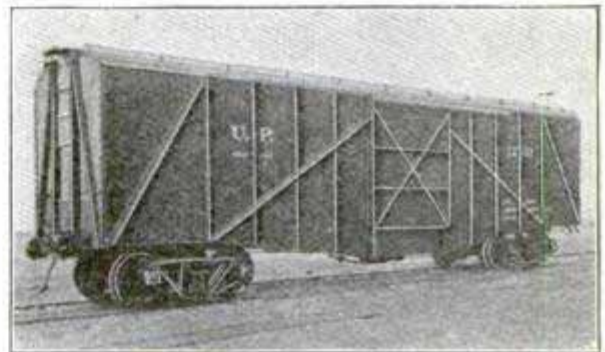
15 Tons of Lead for Keel

It tapers from the middle to about 8 in. wide at bow and stern.

The lead keel was cast out of doors in the ground, the mould being made from a one-piece pattern. As no melting facilities were at hand for pouring 15 tons at one time, three pots were secured, each holding about 2 tons, and these were kept going 12 hours, and poured alternately. The keel is fastened with heavy bronze bolts.—Contributed by Leo G. Haase, Pasadena, Cal.

STEEL BOX CAR

Steel box cars will eventually replace the wooden ones just as the steel gondolas are displacing that type of freight



Capacity 50 Tons

car. The illustration shows an all-steel car built at the Omaha shops of the Union Pacific Railway. This car is 40 ft. long inside, has a center door 8 ft. wide, weighs 37,000 lb. and has a capacity of 50 tons.

PHOTOGRAPHING LIGHTNING

The season of thunder storms is at hand, and anyone with a camera will find the photographing of lightning both instructive and fascinating. Some excellent suggestions are made by Dr.

after the wind has shifted the air column. Lightning may be photographed in the daytime by using an extremely deep yellow screen. The camera should not be moved during the flash; holding it in the hands will not yield perfect results; it must be rigid.



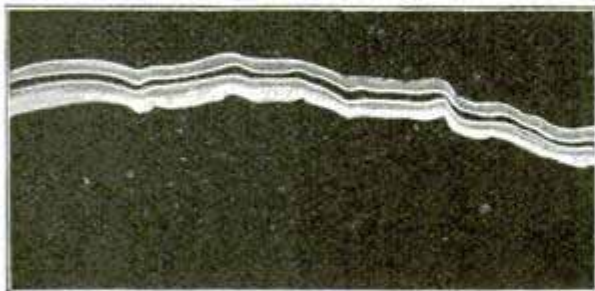
Fig. 1—Zig-Zag

Fig. 2—Sinuous

Fig. 3—Ramified

Lockyer in the *Photographic Journal*, London. He divides ordinary lightning into four general classes: Stream, sinuous, ramified, and meandering.

The photographing of lightning is a simple matter. The lens should be focused during the day upon a distant object, or at night on a distant lamp, and the baseboard marked if necessary, so that the lens can be set for infinity at a moment's notice when required. A dark night is best for the purpose, and, when the thunder clouds are seen to be gathering, the camera with the plate should be placed in position, being directed to the point where the flash is expected, the slide drawn, the lens uncapped, and the instrument allowed to remain until a flash has occurred.



A "Ribbon" Flash

Occasionally one flash will follow another and show double on the plate, producing a "ribbon" or "band" flash. This is caused by the second flash following the same heated column of air,

Thunder travels one mile in about four or five seconds; by counting the seconds between the flash and the report the distance can be fairly estimated. Some flashes descend from the cloud to the earth, and others ascend from earth to cloud. When both ends of the flash are included in the photograph it is a simple matter to trace the course. This method can only be used when the flashes are ramified. A ramified flash resembles a river with its tributaries, but the current travels in the reverse direction to the river flow; the lightning commences at the estuary end of the main trunk and breaks up into ramifications as it proceeds, so that when two images of a multiple flash are on the plate and the ramifications of one point towards the earth, and of the other towards the sky, it might be assumed that they traveled in opposite directions.

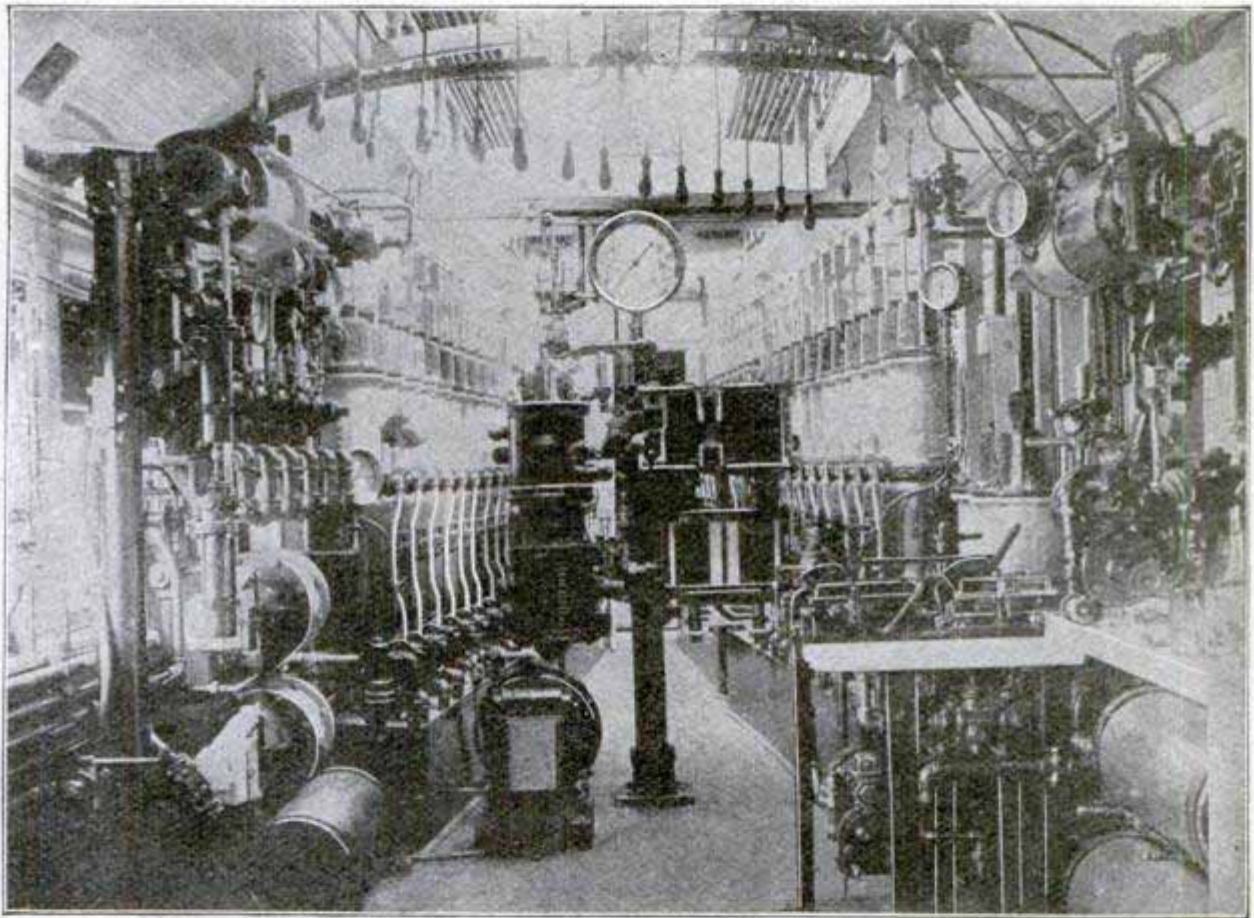
DIVORCE BY WIRE

The marriage tie is only a "granny" knot nowadays, as everyone knows, but a Los Angeles lawyer is the first to untie it at long distance. His client, a California woman, wished to enter a cross-complaint to her husband's action for divorce, instituted at Chicago, and the lawyer carried on the proceeding by telegraph, regardless of a bill that amounted to no small proportions.

RAILWAY SCHOOL ON WHEELS

The increasing complexity of modern mechanism demands technical knowledge as well as intelligence and faithfulness on the part of employes, and employers are adopting various methods for supplying this need. One of the best of these is a school-car fitted up by the C., B. & Q. Ry. for the instruction of its trainmen in all the details of mechanism—and operation of

class-room, 41 ft. long, and containing folding chairs for 18 men. In front of the students is grouped all the apparatus for instruction, and the large cut presents the view of it which each one has. The rows of rods seen on each side are the piston rods of 47 freight brake cylinders, each 8 by 12 in.; 36 being Westinghouse and 11 New York. Notice that these rows con-

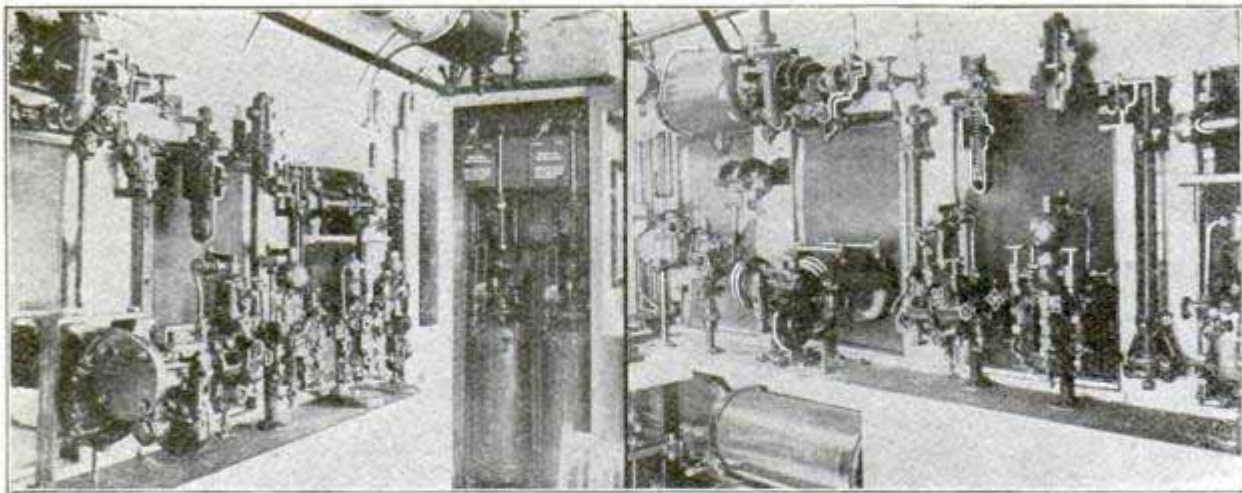


This Car Contains Brake Equipment of 47 Cars

the New York and Westinghouse brake systems, of electric and acetylene train lighting, and of air signal apparatus. All this is so skillfully packed into one car as to give an accurate idea of the equipment for a train of fourteen 60-ft. cars, and yet everything is in plain sight of each member of the class.

The car is designed to be moved from place to place as needed, therefore at one end there is an office and sleeping room; at the other end is a boiler room, with coal bin, water heater, etc. Between these two is located the

verge toward the rear, so as to bring each into plain view of the class. Besides these there are two tender brakes, 10 by 12 in., and two driver brakes 10 by 10 in., all Westinghouse, and mounted horizontally. Of these one tender brake cylinder is seen on the left of the picture, bolted to a swinging crane, by means of which it can be swung out from the side of the car into full view. Underneath this and attached to the same crane is a row of six triple valves having various defects, any one of which may be turned



Sectional Parts of Brake System

horizontally and connected with the cylinder above in imitation of actual use beneath a car.

The apparatus in the middle foreground can be swung either way for explanation of sectional parts of the two systems. Above hang 14 handles of signal cords of the air apparatus, one for each car in the train.

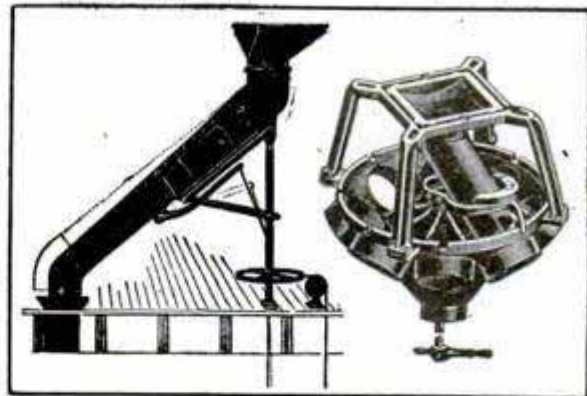
The two small cuts present views of the same portion of the car, taken from opposite directions. It is the portion which is seen partially on the right of the large cut—a bench on which stand various sectional parts for detailed study of air-brake and steam-heat apparatus, lubricators and injectors. The car is equipped with electric light and acetylene lighting. Vertical acetylene generators appear at the right of one of the small cuts.

MYSTERIOUS DISAPPEARANCE EXPLAINED

The following incident forcibly illustrates how unreliable circumstantial evidence may be: Three years ago a man living near a mill at Oakland, Iowa, was accused of stealing 25 bu. of wheat which had disappeared mysteriously from the mill. The man and his friends stoutly asserted his innocence, and the prosecution failed for lack of evidence, but, of course, an unpleasant cloud rested upon his name. This has now been happily lifted by the tearing down of the old mill, which revealed

the existence of a forgotten bin containing the 25 bu. of wheat.

In mills and elevators the grain bins are built in rows, open at the top. When the grain comes up the elevating trough it discharges into a spout. This spout is made to turn so as to empty into any bin in the mill. The turning is done with a lever on the ground floor, attached to an iron rod which extends up and is fastened to the discharge spout. The operator was



Spout Shifting Machinery—Operated from the Ground Floor

careless in setting his lever and the grain was thus run into the bin which was out of service.

From Montreal to Winnipeg, 1,430 miles, is the greatest distance the human voice has ever been transmitted. The medium was a copper wire installed by the Canadian Pacific Railroad Company for their telegraph system, by which a telegraph and a telephone message can be transmitted simultaneously.

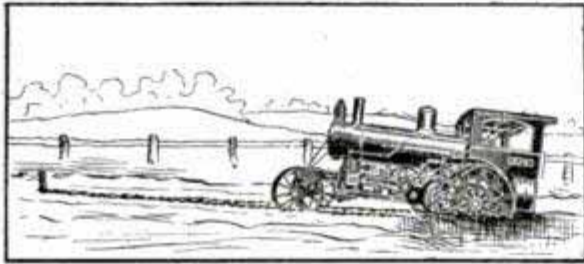


SHOP NOTES



Removing Mired Traction Engine

Last fall while moving over the road with a traction engine we encountered a large mud hole which let the drivers sink nearly to the hubs. It would have taken all the horses in the township to move the engine in that condition, so after experimenting for some time we finally hit upon the following plan: First we fastened a piece of chain to each of the driving wheels and laid the chains in a position such that they would wind up on the drivers when

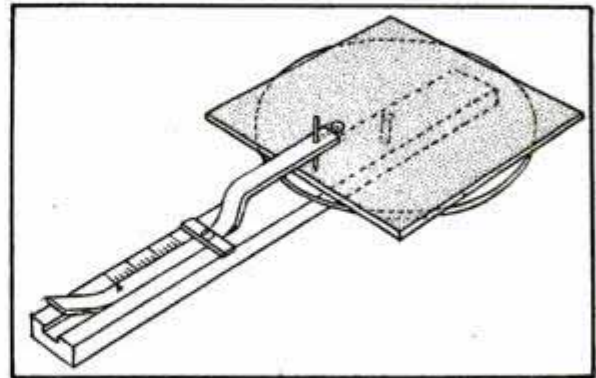


Hub Deep in the Mud

they revolved. Next we drove a strong stake some distance ahead and fastened the chains to the stake. The engine was then started and the drivers wound themselves up in the chain, thus removing the engine from the mud hole.—Contributed by Axsel Everson, Penn Yan, N. Y.

Circular Glass Cutter

For cutting out circles of glass for headlights or other purposes, a correspondent of the Electric Traction Weekly uses a device, the details of which are indicated in the drawing. This consists of a wooden base near one end of which is pivoted a circular rest for holding the glass. The rest is 14 in. in diameter and is made of cast steel covered with leather. The diamond cutter is carried on the end of an arm which slides on the base piece as shown. The scale permits the arm

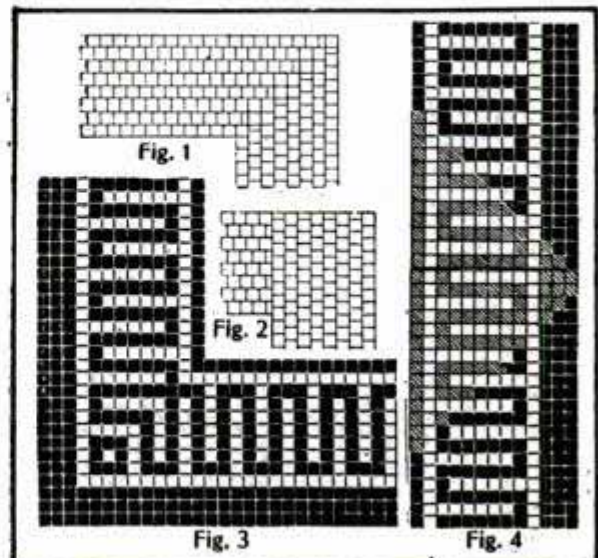


Circular Glass Cutter

to be set at any point to give the desired diameter of glass disc.

Corner Design for Mosaic

In laying ceramic floors the tile setter or mosaic worker frequently has occasion to cut and match the different design sheets, especially in laying the border, in making corners, and in filling in recesses in the floor of the room. The manner in which this cutting is done frequently determines whether the finished job is to look good or bad, says Mantle, Tile and Grate. The mitred corner, as shown in Fig. 1, can be executed with little difficulty, by simply cutting the margin along the lines



Corner Design for Mosaic

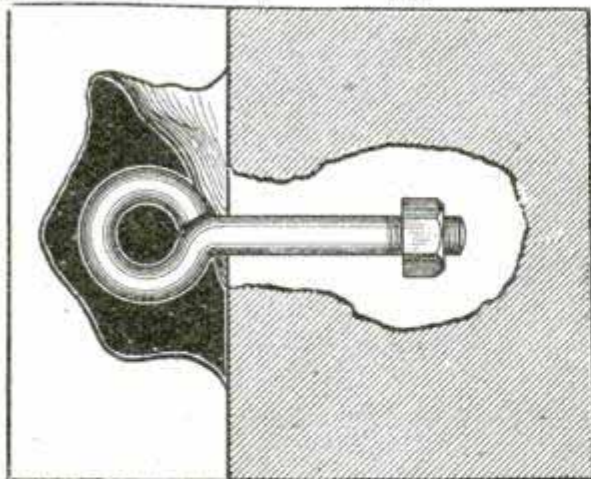
here indicated. This miter is symmetrical, artistic and appropriate to the general design. Every mosaic worker should know how to improvise this margin corner from the ordinary plain sheets of broken joint mosaic. Fig. 2 illustrates a common but undesirable method of applying a broken joint margin. This has an unfinished and unsymmetrical appearance, which is displeasing to the eye.

A very neat corner design for a border is shown in Fig. 3, and the manner of cutting and matching the design sheet is shown in Fig. 4. By making the bevel at 45° and omitting two squares at the outside edge, the design in the border will be made continuous, giving the pretty effect shown in Fig. 3.

Red aniline ink (except eosine) will be removed promptly by moistening with 95 per cent alcohol, adding acetic acid drop by drop till the stain disappears.

To Fasten a Bolt in a Brick Wall

When an expansion bolt is not available an ordinary bolt applied in the



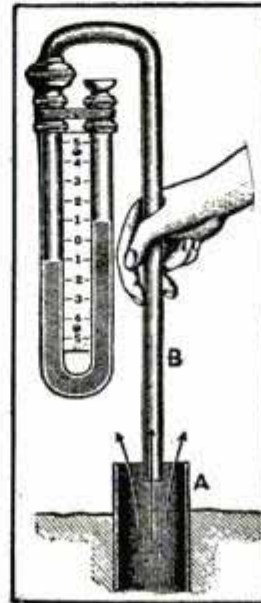
Ready to Pour

manner here illustrated will prove equally as good, if not better. A hole is made in the wall and roughly undercut as shown. A lump of clay is then pressed against the wall in such a manner that the bolt will be held in the hole in the proper position. An opening or gate is made to the cavity, which is then poured full of melted lead or

sulphur.—Contributed by H. G. L., Boston, Mass.

Measuring the Flow of Gas from Wells

In order to estimate the number of cubic feet of gas per hour that flows from a well, the instrument here illustrated is often used, says the Well Drillers' News. In



its simplest form this instrument consists of a bent glass tube, which can be made in any laboratory, with a wood or cardboard scale fastened between two of the legs as shown. Water is then poured in the tube until the level reaches the zero mark, or if the pressure of the gas is unusually high, mercury is used in the

tube in place of water.

The long leg of the tube is then held in the pipe, as near the center as possible, and the difference in the levels noted. The discharge in cubic feet per hour can then be obtained by consulting suitable tables, which give the rate of discharge from various sized pipes with gas under different pressures.

Non-Corrosive Soldering Paste

The following is now used extensively in electrical work as a flux for soldering, especially of copper wires, and wherever no acid should be used. It is a mixture of zinc chloride and some grease, such as petrolatum (practically the same as vaseline, but cheaper). Make the zinc chloride by dissolving zinc in strong muriatic acid, with excess of zinc to neutralize all acid. The solution will be thick and oily and is to be mixed thoroughly with the petrolatum in the ratio 1 fl. oz. to 1 lb. This makes an excellent soldering paste which neither spatters nor corrodes.



Original Frieze Design--London Decorator

Oil to Preserve Ties

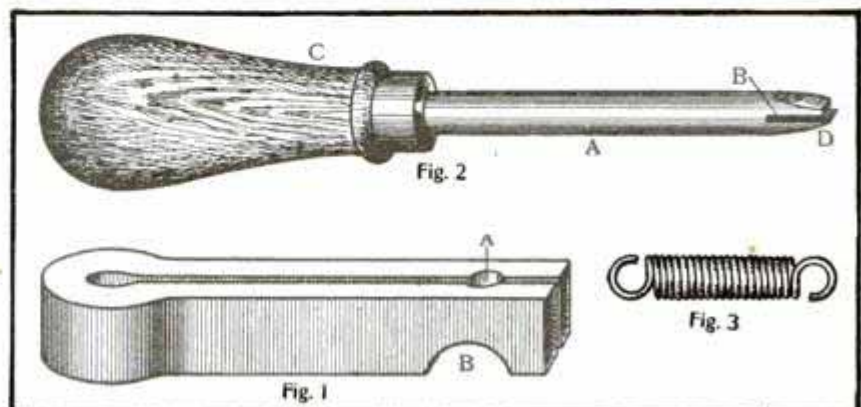
The experts have decided that heat and moisture when present at the same time are the forces which cause railroad ties to decay. Results of an experiment begun in 1902 have just been announced. Pine ties, thoroughly seasoned, were immersed in crude California oil heated to 180° and subjected to a pressure of 150 lb. per square inch. The ties absorbed from four to eight gallons each. A large number of these ties are found in sound condition after five years where the same quality of ties, untreated, lasted only two years.

Device for Forming the Ends of Springs

Having occasion to make 300 small helical springs I consulted Shop Notes and found a method of winding them by means of a brace, which proved very satisfactory. As an exchange for this valuable idea I send the following sketch and description of a device for forming the ends, after the springs are wound and cut. A piece of iron or machine steel is bent to the shape shown in Fig. 1 and drilled at A with a drill having the same diameter as the outside diameter of the spring. A cold chisel is then driven in the crack at the end

until the jaws are spread about 1/32 in. The device is then placed in a vise; a spring is inserted in the hole, A, and by means of the forming tool, Fig. 2, the end of the spring is bent up as shown in Fig. 3. The operation is thus easily and accurately performed and my 300 springs were quickly finished.

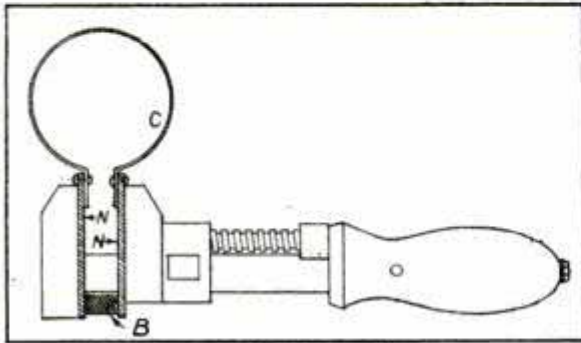
The forming tool, Fig. 2, is made from a piece of 3/8-in. drill rod, A, slotted at B by means of a hacksaw and driven into a file handle, C. The lower jaw, D, which is slightly longer and sharper than the other, is inserted in the last coil of the spring and the handle is then lifted up until the tool is in a vertical position. This forms the end successfully without spoiling the other coils of the spring. The springs I made were so short that I found it better to cut away a portion of the die or clamp shown at B, Fig. 1, in order to get hold of the spring, but this would be unnecessary when forming the ends of long springs.—Contrib-



uted by A. W. Griggs, 955 Market St., Kenosha, Wis.

Pipe Wrench for Soft Pipes and Hose

To make a wrench for gripping soft pipes or rubber hose secure a piece of heavy clock spring, punch a hole in each end and rivet to



Light and Pocket Size

two pieces of iron, N N, about 4 in. long. To use when it can not be gripped tight enough by hand, place any solid object between ends of handles and apply monkey wrench, as shown. It is light and small and may be carried in pocket. For gripping small pipes or hose, wind a leather strap about the pipe and grip the strap.—Experimenter.

Drying Electric Plant After Flood

The power house of a large Eastern manufacturing concern was recently flooded with water to a height sufficient to cover the two turbo-generators, two-thirds of the switch-board and a large part of the auxiliary apparatus, including the exciter units and the condenser pump motors. S. L. Sinclair and E. D. Tyree, who were called upon to get the plant in operation with the least possible delay, tell how they did so, in the *Electric Journal*.

Upon arriving at the power house it was found that the employes of the local company were attempting to dry out the generators by the use of a steam coil enclosed in an air flue. A blower was connected at one end of the flue and the other end opened at the generators so that hot air could be blown through the generator windings. This method would have taken an

indefinite time to dry out the generators. It was therefore abandoned and an enclosure of sheet iron and tin, that was found around the works, was built up around the generators. Inside of this enclosure were placed a number of charcoal furnaces made of powder kegs. Thermometers were suspended near the generators and the temperature inside the enclosure was maintained at 85° C.

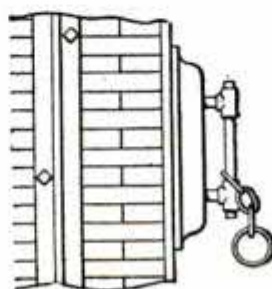
While the generators were being dried by this process a small hoisting engine was belted to a 20-hp. motor for use as an exciter. Arrangements were also made with the local railway company to furnish 500-volt direct current for making tests of insulation resistance. Insulation tests were made with a 600-volt direct-current meter having an internal resistance of 85,000 ohms.

After the generator had been drying for 36 hours, the insulation resistance was about half the normal value. The generator was then started on a short-circuit heat run, and at the expiration of 30 hours, making 66 hours in all, the readings showed that the insulation was thoroughly dry and the generator was ready to go into service.

The second generator was dried in the same manner, with the same results. The motors, exciters and switch-board were dried by the use of charcoal furnaces.

Cure for Hot Handle on Furnace Door

Usually there is nothing to assist the fireman to open the doors of the furnace, except a knob which is always too hot to handle, writes a correspondent of the *Engineers' Review*. In my plant the furnace doors have a wooden handle, but they become so hot that it is unpleasant to use them. To assist in opening the doors I have attached one



end of a chain of four links to the handles, and to the other end attached a ring, as shown. When a door is to be opened, pull on the ring and that is all there is to it.

Table of Machine Screw Taps

The following table gives the sizes, in fractions of an inch, of ordinary machine taps. The taps are all designated by the numbers in the first two columns. Thus a No. 2 tap is called 2—56; a No. 4, 4—36, etc., except when the number of threads is not standard, when it will then be called by the number in the first column, followed by the number of threads. Thus a No. 4 tap with 42 threads to the inch would be called 4—42, etc.

The last column gives the size of drill to use with any standard tap to cut perfect threads. In practice a drill one size larger is often used to avoid breaking the taps:

No.	Standard Threads to the inch	Diameter About	Size of Drill to Drill for Tapping
2	56	3/32—	No. 53
3	48	7/64—	48
4	36	7/64+	43
5	36	1/8 +	42
6	32	9/64	33
7	32	5/32	31
8	32	11/64	28
9	30	3/16—	26
10	24	3/16+	24
11	24	13/64	21
12	24	7/32	17
13	22	15/64	12
14	20	1/4 —	6
15	20	1/4 +	5
16	18	17/64	3
17	18	9/32	2
18	18	19/64	15/64"
19	18	5/16	1/4 "
20	16	21/64+	17/64"
22	16	11/32	9/32"
24	16	3/8	19/64"
26	16	25/64	5/16"
28	14	13/32	21/64"
30	14	7/16	11/32"

Celluloid Drawing Templates for Draughtsmen

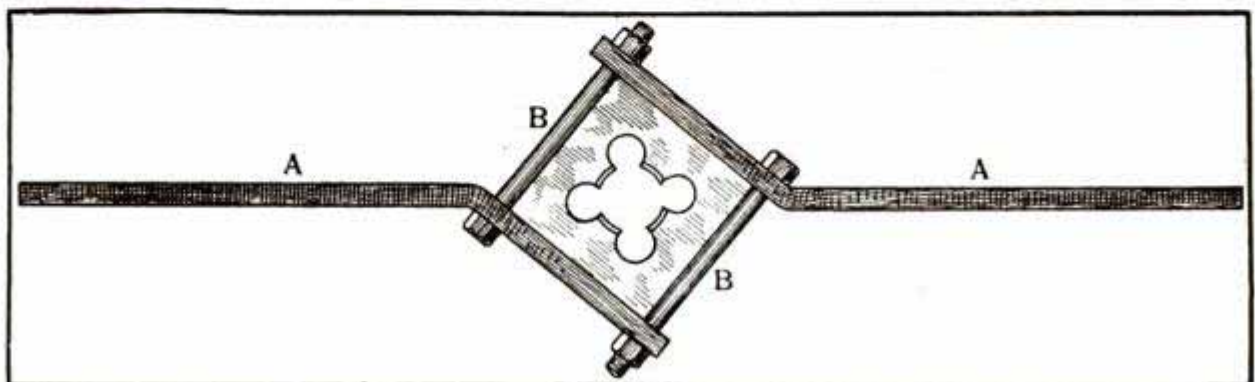
Draughtsmen whose work requires duplicate shapes such as gear-tooth curves, switchboard instruments and the like, will find the use of celluloid templates a great convenience. The celluloid used for this purpose should be quite thin ($\frac{1}{16}$ in. is thick enough) and should be transparent. To make the templates trace off directly from the drawing, using a pair of well-sharpened dividers. By bearing on a little, the celluloid will be scratched deep enough to be readily broken, thus leaving a clean, sharp edge of the required shape.



The accompanying sketch shows a templet that has saved much time and labor in our draughting office. It is used for drawing standard volt meters and ammeters and comes in very handy when making drawings of switchboards.—Contributed by Frederic Schaefer, M. E., American Telephone Co., Wheeling, W. Va.

Cheap Die Holder

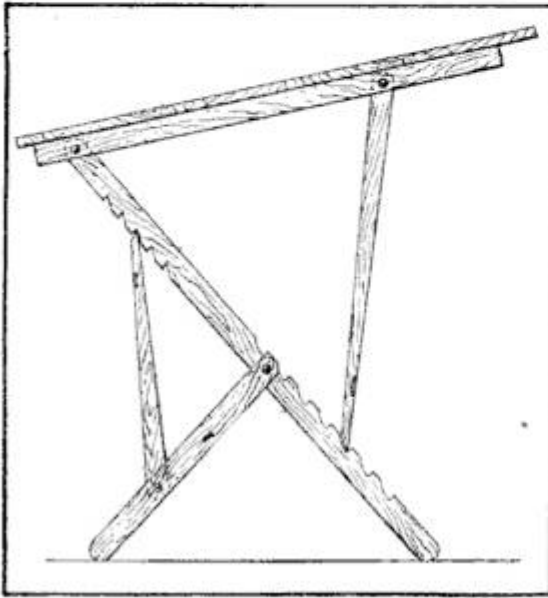
A very cheap, but efficient, die holder can be made by bending the ends of two pieces of iron, AA, a little less than 45° and drilling for the bolts, BB, which should be spaced far enough apart to allow the insertion of the largest size die.—Contributed by F. G. M., San Francisco, Cal.



A Cheap Die Holder

A Home-Made Drawing Table

Here is another style of table, adjustable for both height and slant, which presents the advantage of being made easily of wood. The cut needs no



Adjustable Drawing Board

explanation. Any wood may be used, but some hardwood like ash or maple for the supports will combine lightness with strength. If the whole is fastened together with $\frac{1}{4}$ by 2-in. stove bolts, instead of nails, it can be taken apart readily and packed in very small space.—Contributed by Fred Robinson, Chicago.

How to Manufacture Metal Polish

Metal polish is one of the easiest things in the world to manufacture, and, as the cost of materials is little or nothing, the profits are very large. Take any quantity of yellow or blue clay, perfectly free from sand, and allow it to dry. Pulverize by pounding it and run through a flour sieve, or a finer sieve if one is available.

To 5 lb. of this sifted clay add 1 lb. of sifted wood ashes and mix to a very stiff paste with a solution of water and lye, in the proportion of 1 gal. of water to 2 heaping tablespoonfuls of lye. Spread this mixture on a flat, planed board and level off the top until it has a uniform thickness of about 1 in.

When it has become set, mark it off into squares about 2 in. on a side and cut apart.

To use this polish, scrape off a little on a moist cloth and rub the article to be polished, thereby giving it a glittering, lustrous shine. To my own knowledge, one man has made a good living making and selling this polish. If the material is sifted carefully in the making the preparation will not scratch the finest polished surface.—Contributed by James E. Noble, 999 Queen St., West, Toronto, Ontario.

Cementing Iron to Stone

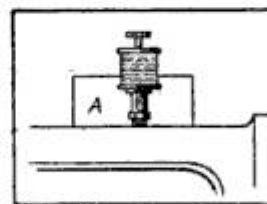
Grind brickdust fine, sift, and stir it into melted rosin to form a putty-like substance, which runs easily while hot. Set the iron into the hole in the stone and pour the hot putty in around it. Push bits of heated brick into the mass, smooth off and let cool. This cement is not affected by the weather and does not injure the iron, but secures it firmly.

Filing Aluminum

Aluminum is hard to finish, but I found by first rubbing the file on an oil stone that it can be brought to a good polish. A common mill file is the best.—Contributed by Claire Bird, Menominee, Wis.

To Show Working of Sight Glass

A convenient device in the engine room is a piece of tin painted white and placed behind the sight glass of the feed cups on the engine. Engineers know how difficult it is to tell just how



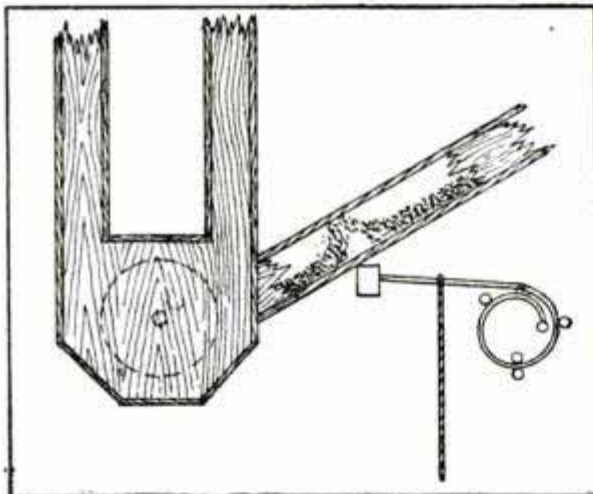
the oil cup is feeding, especially at night, says the Engineers' Review. With the white showing behind the sight glass the drops of oil can be distinctly seen as they fall. The arrangement is shown in the cut, where the white tin is marked A.

How to Burn Names on Brass

Melt some white wax smoothly and evenly over a brass plate and let it harden. With a point needle trace the inscription on the wax, penetrating through to the brass. Apply strong nitric acid to the design, let stand 60 seconds or less, then wash off the wax. Nitric acid requires care in handling, as it destroys whatever it comes in contact with. It is well to practice the process on old brass first.

Spout Knocker for Mill

In spite of good arrangement and size of spouts they will choke up. A correspondent of the American Miller has had good success with the simple



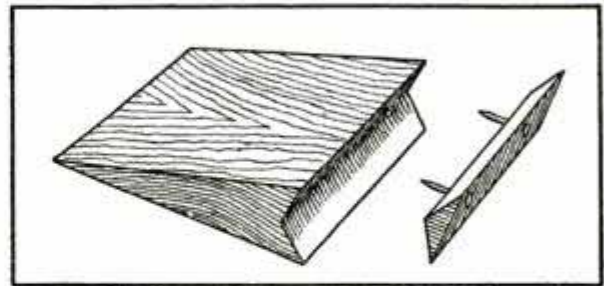
Clearing Choked Spout

device illustrated. The knocker rests against the under side of the spout and is fastened to a strong band spring which, when pulled down by means of a cord and quickly released, strikes a blow on the spout, which releases the contents.

Sandpaper Holder

Workmen who use sandpaper much, especially wood polishers, waste a great deal for want of a good holder for the sandpaper. The cut shows a simple and excellent model for such a holder, which almost explains itself. The edge of the wedge should be slightly rounded

so that it will not cut right through the paper, but not so much as to prevent getting into the angles of the woodwork to be polished. Cut your sandpaper so as to fold over both sides



Economical Sandpaper Block

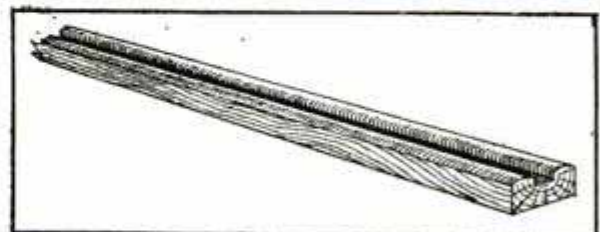
of the wedge and leave sufficient margins to turn back over each edge of the groove. Draw tight and screw the clamp into place.

Sawing Steel

Either drive your saw slowly, 25 ft. a minute, or else rush it up to 2 miles a minute, which will heat the steel so that you can go through it like cheese. The saw may or may not have teeth at that speed; it will cut through large I-beams or heavy shafting with ease.

Device to Prevent Insects in Poultry Houses

Take a piece of wood of suitable length and size for a roost and plane a groove in it as shown in the cut. Fill the ends of the groove with putty and the groove itself fill with any good fluid insecticide. The fumes will rise and penetrate the feathers of the fowls

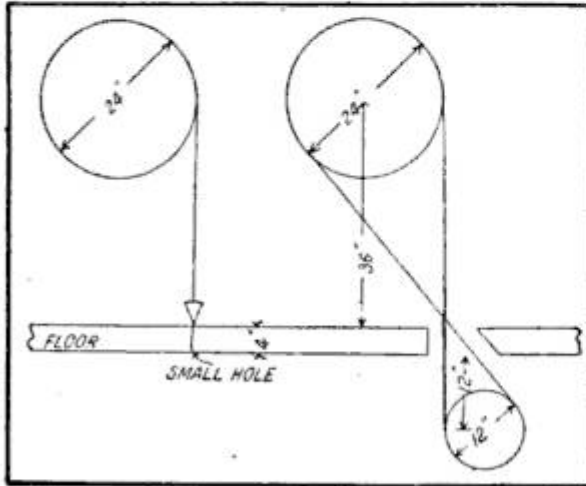


Fill Groove with Insecticide

and kill the vermin. Insects will not remain long on the bar. One filling of the groove will last quite a long time; when refilling first clean out the groove. —Contributed by "A Reader."

Cutting Belt Holes in Floor

When drawing board and instruments are not available it is sometimes a difficult problem to cut a belt hole in a floor so that it will come in exactly the right place. The problem here



Locating Hole in Floor

illustrated is one that confronted a correspondent of the National Engineer, who describes its solution as follows: The machine had to be located in a place where there was barely sufficient room for it, and the power to drive was to be taken from a shaft in the room below. The rotation of the driving shaft was such that we must use a cross belt for driving the new machine.

After getting the machine in place and line and leveled up, I dropped a plumb-bob from the face of the pulley on the machine to the floor, as shown in the illustration. A hole was then bored in the floor at the point indicated, which gave us the starting point from which to put up the counter-shaft, which was easily done.

The next question was that of locating the belt holes. I drew a sketch with chalk on the boiler room floor, making all the dimensions full size. First, was the thickness of the floor, 4 in., and then the distance from the floor to the center of the shaft on the machine, 36 in., and next the pulley on the machine, 24 in., and the counter-shaft pulley of 12 in. diameter.

The common tangents of the circles were then drawn, thus showing the

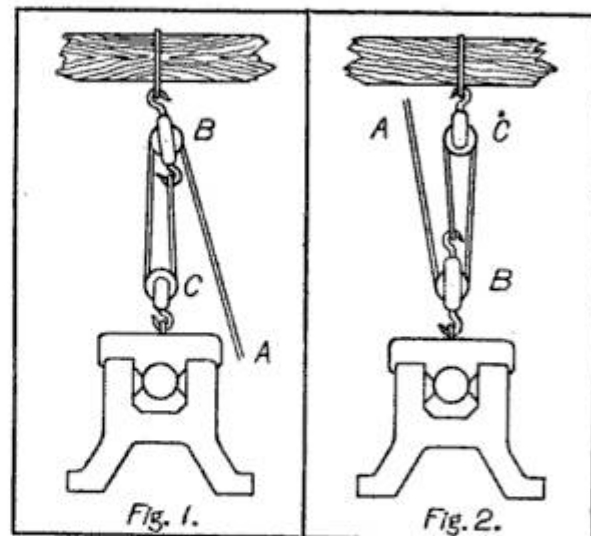
exact position of the belt. Following out this plan I cut the belt holes and found my calculations to be correct.

Magic Polishing Cloths

So-called "magic" polishing cloths are being sold at 25 cents each. The recipe for making them is as follows: Take 1 gal. gasoline, 2 lb. of whiting, and $\frac{1}{2}$ oz. oleic acid. Mix all together and shake up well. Soak pieces of woolen cloths in this mixture, wring them out and hang up to dry. It will be found that this will place a fine gloss on any polished surface or silverware, etc., and no matter how soiled the cloths become, they will not dirty the hands or lose their polishing efficiency. Contributed by James Elletthorn, Toronto, Ont.

Lifting by the Head

A few days ago I saw an engineer trying to lift the cap off his main bearing with a rope and a couple of pulleys which he had rigged up, as shown in Fig. 1. He pulled on the rope at A till he lifted himself clear off the floor, but could not raise the cap. By jerking down with his whole weight he



Ineffectual

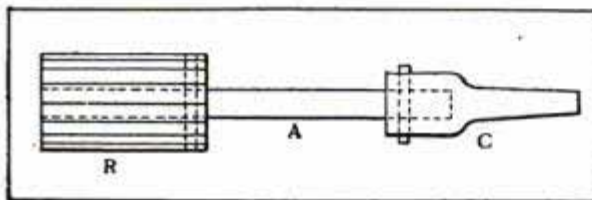
Easy

could just jerk up the cap about $\frac{1}{4}$ in., and there he was stuck. After he had tugged away in vain for a while I suggested that he make a change in his

rig and attach the pulley C to the beam and the pulley B to the cap and then get up on the beam himself and try pulling up; just the reverse of the arrangement which he had. He soon had the change made as shown in Fig. 2, and found that the cap came up easily. After a little study he figured that he could lift half as much again by the arrangement in Fig. 2, as by the arrangement in Fig. 1. That engineer was myself and I am learning that in working about machinery one can sometimes lift more with his head than with his hands.—R. Manley Orr, in *Canadian Machinery*.

Reamer Holder

One of the best and simplest ways of holding a shell reamer for use in a



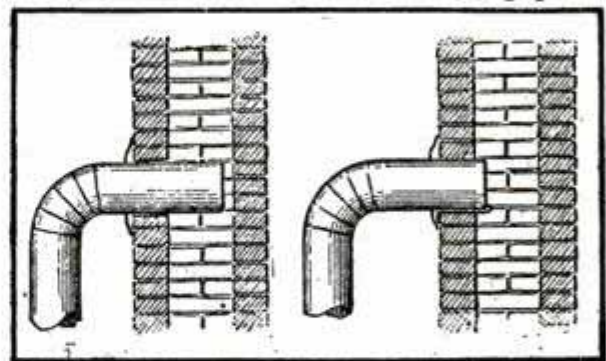
For Accurate Work

lathe is by using a "floating reamer socket," as it is sometimes called. It consists of an arbor, A, one end of which is attached to a socket center, C, and the other to the reamer, R. The arbor is kept from turning by pins which may be either tapered or provided with heads to hold them in place. The arbor should fit loosely in both reamer and center, in order to allow a slight amount of play in the reamer. This style of socket is used in all our general shop work and is the simplest and most accurate that I have ever seen.—Contributed by E. V., Menomoneie, Wisc.

A cheap and easy way to clean the clock is to saturate a little cotton, egg-size, with kerosene, and put it on the floor of the clock. Shut tight. In four days the works will be as clean as if new, and the cotton will be black with the particles of dirt which have been loosened by the kerosene fumes.

A Common Defect in Draughts

When a stove doesn't draw properly the trouble can often be found where the pipe enters the flue. The pipe is

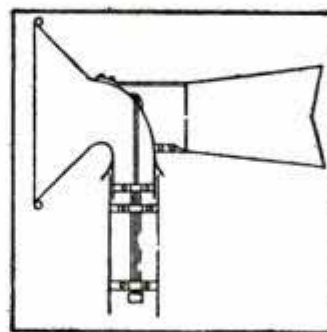


Remedy for Poor Draught

often pushed too far in, thus making the space at the end so small that the smoke cannot rise naturally. To avoid this a correspondent of the *Metal Worker* bends a piece of sheet iron 1 in. wide and 5 or 6 in. long, so that a $\frac{1}{4}$ -in. edge turns over the bottom side of the stove pipe, then when it is pushed into the chimney far enough the other end of this piece of sheet iron is turned down against the side wall to prevent the stove pipe being pushed in too far.

Ventilating a Cold Dry Storage Room

The most effective way of ventilating a room for cool dry storage is to lay a line of 8-in. drain tile, or better, sewer tile, lengthwise and at least 2 ft. below the bottom of the room in the ground, each end provided with an elbow and riser terminating just above the floor level. From one end of this cold dry-air duct carry up above the ridge of the

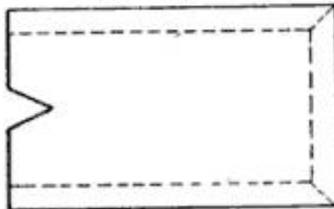


barn an 8-in. galvanized flue provided at the top with a revolving funnel 30 in. in diameter, which is made always to face the wind by means of a vane, the whole constructed as represented in diagram. With such an arrangement as this the wind pressure will force the

air down and through the sub-earth duct and up into the storage room, making it dry and cool, says the Rural New-Yorker. At the opposite end of the storage room from that where the air enters an 8-in. outlet in the ceiling should be provided. This need not rise above the roof. The storage room should be provided with a cement floor both to shut off dampness from below and to make it a better conductor of heat, thus more effectively cooling the room, and less favorable to the development of molds.

Insulation Scraper

A good one can be made from thin steel, spring brass, or stiff tin. If the latter, the edges should be turned over, to strengthen it. A good size for the scraper is $2\frac{1}{2}$ by $1\frac{1}{2}$ in. and the notch should be about $\frac{1}{4}$ by $\frac{2}{3}$ in.—Contributed by Geo. W. Fry, San Jose, Cal.



How to Make a Drill Gauge

It will not be necessary to follow any exact dimensions when making this gauge, as the divisions are to be marked by trial with actual drills. Simply measuring the distance between the bars and marking accordingly is a very poor way to make a gauge, because drills are manufactured with diameters slightly less than the nominal size. For instance, the actual diameter of a $\frac{3}{8}$ -in. drill is somewhat less than $\frac{3}{8}$ in., so that if the graduations on the gauge were exact dimensions of the nominal

sizes, a $\frac{3}{8}$ -in. drill would read $55/64$ -in.

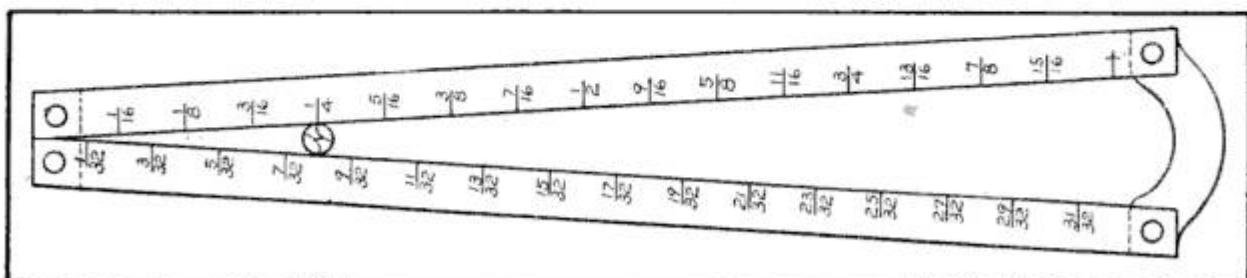
The accompanying sketch shows a form of gauge which is very accurate, convenient, and easily constructed. By making a more gradual taper, greater accuracy will be obtained at the expense of a reduction in range. It is of the greatest importance that all the pieces be fastened together in such a manner that there will be no movement at the joints, and if necessary, the joints should be soldered in addition to being riveted. The material for this gauge may be either machine steel or tool steel, but as it is very difficult to harden without warping, it would probably be advisable to construct it of machine steel.—Contributed by W. J. S., Emsworth, Pa.

Experience With a Gas Producer Engine Plant

[Extracts from paper read before the American Street Railway Association by Paul Winsor, of the Boston Elevated Railway.]

“As a result of my experience with these plants” [one is a 700-kw., the other a 975-kw. station feeding trolley lines—Editor.] “I am absolutely convinced of the economy and reliability of a gas-engine power station. The fuel consumption will be about one-half as compared with a steam plant, running less than 1.5 lb. to 1.75 lb., according to the load factor and almost regardless of the size of the plant, as against 3 to 4 lb. in similar steam plants.

“The disadvantages of a gas power station as compared with a steam plant are few. The gas-producing portion of such a station is simpler, easier to operate, and holds its efficiency better than a steam plant. The losses from banking fires are extremely small, and



$\frac{1}{4}$ -In. Drill in Position for Measuring

the plant can be gotten into service much quicker than can a steam plant. It is our practice to shut down at 11 at night and start at 7 in the morning. Fifteen or 20 minutes are required to get the gas plant into full operation, while of course with a boiler plant it takes from one to one and a half hours to get the fires into first-class shape. The ashes have to be periodically removed from the producer. In our plant this has to be done while the producers are out of commission and takes about 3 hours twice a week, although the plant can be run a couple of days longer without cleaning, if necessary. With some forms of producers the cleaning can be done while the plant is in operation, but I have had no experience on this point as yet, as our second plant, which has this form of producer, has not been in continuous operation. The wet and dry scrubbers have to be cleaned every two weeks, but this work is certainly no more difficult than the work required around a boiler, cleaning soot from the tubes and from the soot chambers.

"An ordinary gas man, such a man as would be considered a first-class fireman, can run at least as many horsepower of gas producers as he can of boilers. He can make a uniform grade of gas and will get regularly very much nearer the possible efficiency from the gas producers than from the boilers."

Cleaning Zinc Articles

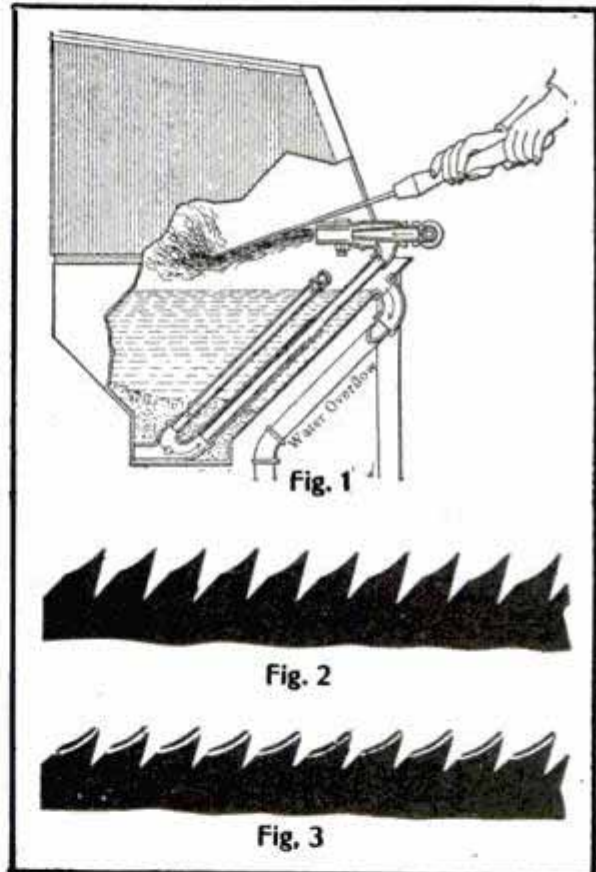
Make a paste of rye bran stirred into boiling water and add a handful of silver sand and a little vitriol. Rub the zinc articles with this paste, rinse with water, dry and polish with a cloth.

You can bleach your old straw hat by washing it in clean water and then tying it inside a barrel and turning the barrel down with its open end over a flat stone. On the stone ignite a bit of sulphur and let the hat bleach.

File Sharpening Machine

It would seem that a sand blast directed against a file would take the sharp edges from the teeth, but instead the files are sharpened by the treatment. The machine here illustrated is constructed on this principle. It consists of a sheet-metal hood with an opening in front for inserting the file and a small sand blast apparatus, operated by compressed air or steam.

The sharpening process will be clearly understood from the sectional view of the file teeth shown in Fig. 2 and



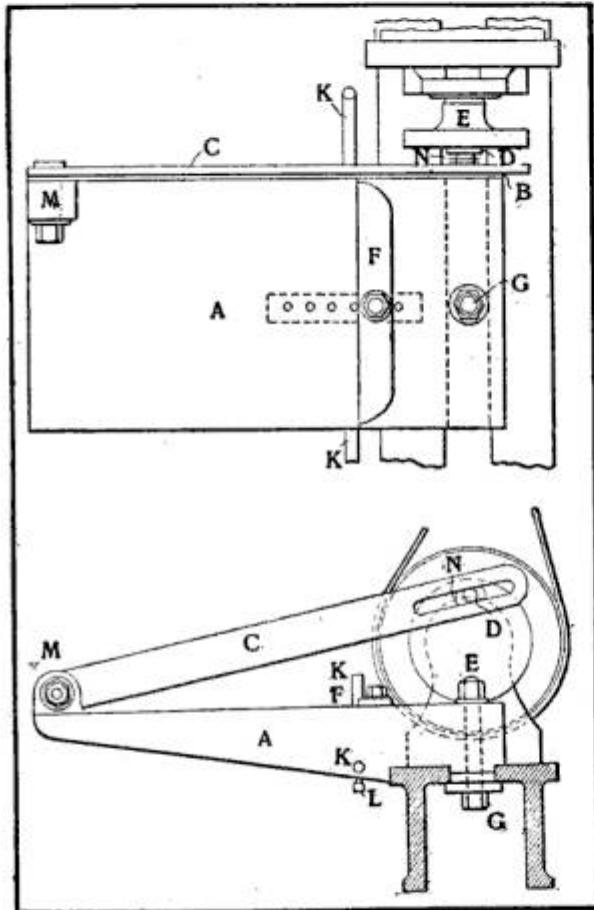
For Resharping Old Files

Fig. 3, which are drawn to an enlarged scale. The teeth shown in Fig. 2 are those of a new file, and those in Fig. 3 are the worn, rounded teeth of an old one. When the file is held in the sand blast the teeth are cut down, as indicated by the white lines, thus replacing the sharp cutting edges and making the file nearly as good as new. The number of times a file can be re-sharpened depends upon the work for which it is intended and upon the cut and

depth of the teeth. In any shop where a large number of files are used the installation of a file sharpening machine will prove a good investment.

Shearing Attachment for the Lathe

The accompanying illustration shows a rig for shearing sheets on the lathe.



Shearing Attachment for the Lathe

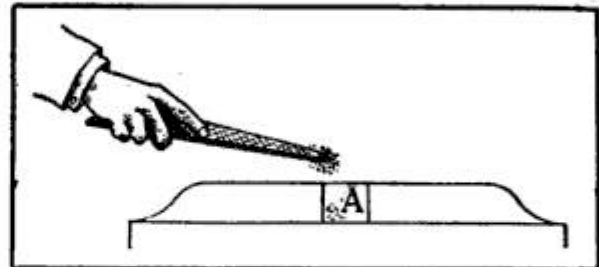
It consists of a casting, A, bolted to the lathe bed and having a boss at the outer end on which is pivoted the knife or shear, C. The shear side of the casting is faced with a plain steel strip about $\frac{1}{4}$ by 2 in. section, held by fillister-head screws, and set at a slight angle from the vertical, says the Practical Engineer, so as to provide clearance without the necessity of grinding to shape. The shear blade, C, $\frac{1}{2}$ by 2 in., is slotted for a crankpin, D. This crankpin is made in the form of a headless shouldered stud having a screw at the face-plate end which is inserted through a slot in the face-plate and held by a nut on the back side.

A coil spring, N, between the shear blade and stud collar keeps the blade in close contact with the opposite cutting edge. The action of the shear is obvious and needs no further explanation.

A Magnetizing Kink

This is a little kink which may be convenient for engineers to remember in case they are drilling or tapping out a hole which cannot be readily emptied, says a correspondent of the Engineers' Review. The other day I watched an erecting man who was employed in setting up a new engine. In order that the outer bearing should not bind, he found it necessary to enlarge the hole, A. In chipping out the hole to make it fit easy, the chips of course fell to the bottom, and as the hole had to receive a pin which would fit into the hole its full length, it was necessary that these chips be removed in some manner. To remove the babbitt casing would have made it necessary to block up the end of the shaft and remove the outer pillow block in order that the casing might be turned so that the chips would fall out of the hole.

While I was wondering what process would be employed in removing the chips, the erecting man procured



Removing the Chips

a file and, going to one of the generators which was in operation, magnetized it. It was then an easy matter to remove the chips from the hole, as shown in the illustration.

The darkest egg-stain may generally be removed from silver by rubbing it with salt on the end of the finger.

Waterproofing Concrete

Treated Blocks Practically Impervious to Water

In an article read before the Detroit Engineering Society by Clarence M. Barber, C. E., the problem of waterproofing concrete was discussed in detail, from which the following has been condensed:

Concrete can be made practically waterproof by making the aggregate as dense as practicable and using about one-half as much cement as sand. It is also claimed that a little thoroughly hydrated lime is an advantage. In the case of blocks, however, the quantity of cement required for a 2 to 1 mixture in the body of the block is generally prohibitive on account of its cost.

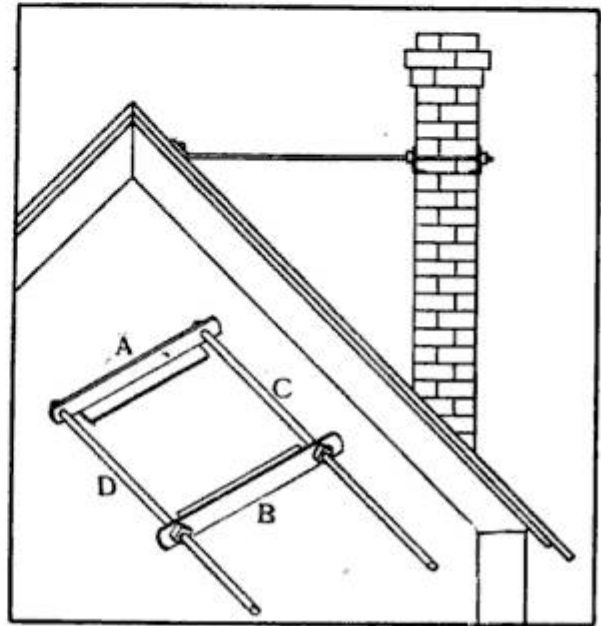
The most recent and, we believe, the best, method is to make the body of the block of a good strong concrete with properly graduated sizes of pebbles or broken stone and sand, together with cement enough to make a thoroughly strong concrete and then face the block with a thoroughly dense and waterproof mixture by using 1 to 2 cement and sand and 1 per cent of a good waterproof compound. This protects not only the inside face but the entire block and practically no moisture is absorbed even by the outer face.

A glass of water inverted on the face of such a block will hold the water for weeks with practically no absorption by the block. The writer has a glass of water inverted on a piece of a block that has been standing four weeks. About one-third of the water has escaped in that time. On an ordinary clay brick the water passed wholly out of the glass in an hour.

In a well equipped concrete block factory the freshly made blocks are kept for a time in rooms where the atmosphere is saturated with moisture and generally a sufficient quantity of steam is admitted to hold the moisture above the dew point. This treatment gives sharp, hard corners and edges to the blocks, and together with a little heat, it hastens the setting.

Chimney Brace

One of the simplest and strongest chimney braces consists of two pieces of angle iron, A and B, drilled to receive the steel rods, C and D. These can be fastened to the house in any substantial manner and should be



Bracing a Chimney

threaded for nuts to hold the angle irons against the chimney.—Contributed by H. L. M., Philadelphia, Pa.

Easy Way to Temper

Probably the easiest way to temper center punches, cold chisels, etc., is as follows: Heat the tool to a cherry red and dip the point in cold water about $\frac{1}{2}$ in. Hold in this position for about 3 seconds or more, depending on the size of the tool, and then remove. Place a little clean, dry sawdust on the cutting edge and wait until it begins to turn black. Then plunge the entire tool in water and allow it to remain there till cold.

If the sawdust turns black as soon as it touches the steel, it shows that the point was not held in the water long enough, and if it doesn't turn black at all, it was held in too long.—Contributed by Geo. A. Lowell, Chico, Calif.

Speed for Grain Elevator Cups

In order for the cups of a grain elevator to discharge the grain freely in the spouts at their head the wheel which drives the belt at the head should run of following speeds:

Diameter of head pulley	Revolutions per minute
24-in.	40 per min.
30-in.	36 per min.
36-in.	33 per min.
42-in.	32 per min.
48-in.	30 per min.
54-in.	28 per min.
60-in.	25 per min.
72-in.	22 per min.
80-in.	20 per min.

To Mend Bursted Cold Water Pipes

Get five or ten cents' worth of gutta percha chips at your druggist's; scrape bursted place about one inch past either end of burst; burn the gutta percha over the place to be repaired with a hot piece of iron (a stove poker will do); make the gutta percha about $\frac{1}{8}$ in. thick and while very hot wrap tight and closely with mason's twine and fasten the ends; let the repaired place cool, and turn on water very slowly, giving the gutta percha time to harden. Do not expect to get good results, if mending pipes larger than $\frac{3}{4}$ in. or above a pressure of 70 lb. Repairs made as above must not be made where ground will come in contact with the repaired place, as it will cause the twine to rot. I have used the above method with excellent results.—Contributed by A. C. J. Campbell, Altoona, Pa.

Gilding Iron and Steel by Dipping

The dipping process of gilding is not very durable, but may sometimes be found suitable for iron and steel articles. For gilding pin heads, use a solution of gold chloride in potassium cyanide, says the Keystone. Stick the points of the pins into holes in a thick sheet of zinc and hold the heads for a few seconds in the gilding fluid.

A solution of gold in aqua regia to which soda in sufficient quantity to

make an excess of this latter constituent has been added, is used for steel pens, which may be dipped entirely, or only the points, as desired.

For coating iron or steel with gold procure crystallized gold-and-sodium chloride by dissolving gold in aqua regia, evaporating the solution to dryness, mixing with an equal quantity of salt, dissolving again and evaporating to the point of crystallization; dissolve the gold-and-sodium chloride so procured in three or four volumes of water, shake the solution with ether, allow the ether to evaporate and then apply the fluid. This coating is susceptible to a high polish. Designs may be drawn on iron or steel with a quill pen dipped into the fluid. Or, coat the article with shellac, make the design with an etching tool, dip the article in dilute sulphuric acid which will etch in the design, and then dip the article into the gilding fluid. Remove the shellac by a treatment with strong alcohol.

How to Draw Pen Lines

As a rule draw pen lines from top to bottom, diagonally across the paper, beginning at the upper right hand corner, especially long sweeping lines where the fore-arm can be used as an axis, the entire hand swinging freely and with a rapid movement. When drawing slow lines, where much care is needed, such as the outlines, etc., says Art Students' Magazine, the lines are drawn more perpendicularly and with the finger movement, that is, the arm and hand remain rigid and only the fingers move. There are no hard and fast rules for holding or using a pen; all artists do not work in the same way, but the above points will help you. Taken altogether, you should acquire an easy swing to your strokes and avoid a slow, cramped movement, but this easy swing must come from practice and confidence gained through knowledge.

In "inking in" a drawing, ordinarily start at the upper left-hand corner and

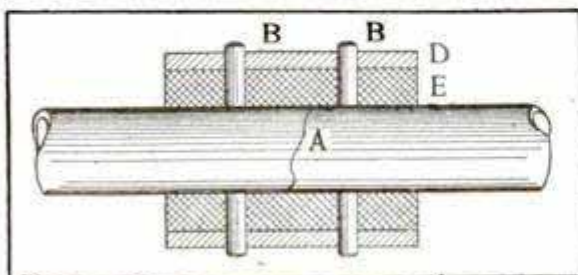
work towards the lower right-hand corner, thus keeping your finished work clean and always before your eye. Keep a sheet of paper or a clean blotter under your hand or fingers; be careful not to allow your hand, when moist or sweaty, to rest on the paper over which you have not worked, as this will make it greasy and it will not take ink readily. In holding and turning your paper with your left hand (as you should in finishing a drawing with pen) it is well to touch it only with the first and fourth fingers, or the thumb and second or third finger, whichever you find most convenient.

Short, Accurate Method for Securing Length for Belt

When it is not convenient, or possible, to measure with line the required amount of belt needed, add the diameter of the two pulleys together, divide the result by 2 and multiply the quotient by $3\frac{1}{2}$. Add your product to twice the distance between the shafts carrying the pulleys and your length for belt is found.

Emergency Repair for Broken Eccentric Rod

Recently a belt run off the flywheel of a small upright engine and jammed between the wheel and the eccentric, breaking the eccentric rod. Repair was made as shown in the illustration, says the Engineers' Review.



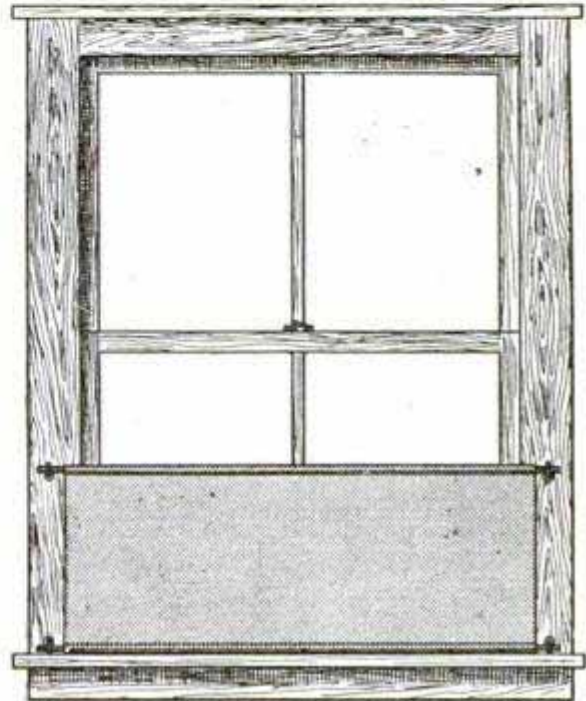
Rod as Repaired

Two $\frac{1}{4}$ -in. holes, B and C, were drilled through the rod A and a $1\frac{1}{2}$ -in. coupling, D. Pins were then driven through the holes. Babbitt, E, was

then poured into the coupling. This worked well for several weeks, when a new rod was put on.

A Wind Curtain

By using the device here shown an abundance of fresh air may be obtained without the objectionable wintry winds.



Admits Air but Prevents Draughts

It is very simple in construction, of practically no cost and easily put up. A piece of burlap, slightly wider than the window, is sewed at the top and bottom edges to form casings. Two pieces of curtain rod are then pushed through the casings and fastened to the window frame by means of brass hooks. The hooks should be placed far enough apart to hold the burlap taut, the upper hooks being turned up and the lower ones down.—Contributed by a reader.

Files clogged with tin or lead will be cleaned by a few seconds in strong nitric acid. For iron filings use blue vitriol, rinse in water and dip in nitric. For copper or brass, use nitric several times; for zinc, dilute sulphuric acid. After any of these treatments, rinse the files in water, brush vigorously and dry in sawdust or by burning alcohol on the file.



Amateur Mechanics



How to Photograph on Apples

That the skin of an apple is sensitive to the action of sunlight is shown by the coloring, especially on the sunny side. This fact suggested a happy idea to a contributor to *Camera Craft*, who substituted apple skin for photographic printing paper in the following manner: Selecting green apples which grow red in sunlight, he covered them with black paper in order to increase the sensitiveness of the apple skin. Ten days later he removed the paper and pasted on each apple a film negative, using white of egg as the best adhesive. To keep the rest of the apple

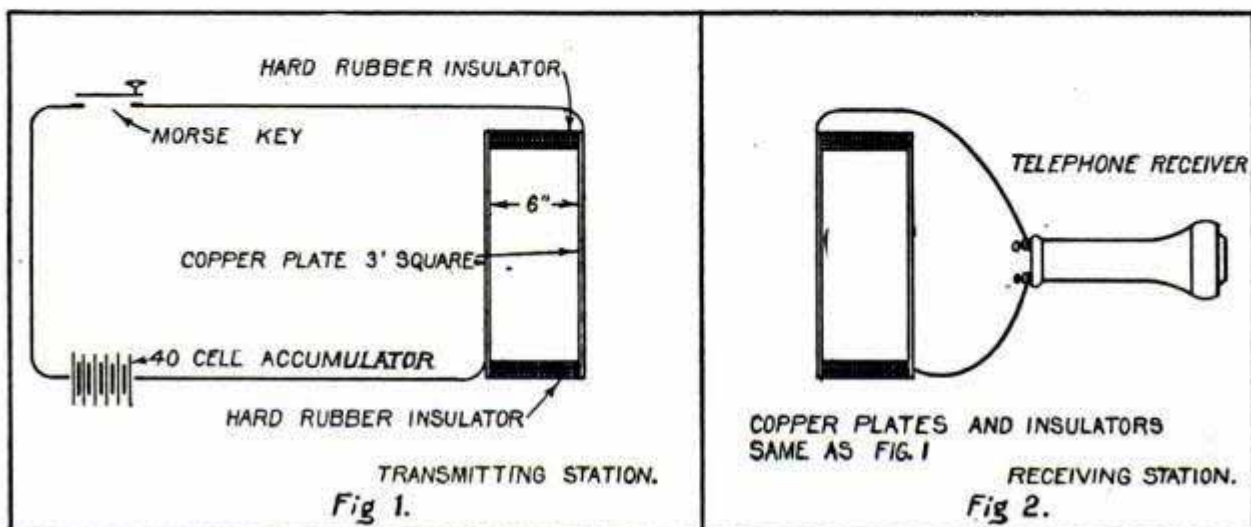
green, each of them was inclosed again in black paper, but with an opening cut opposite the picture. The resulting photograph was wonderfully clear and beautiful, as appears in the cut.

An autograph message may be written on thin paper and printed in the same way; also fern leaves, petals of flowers, and many other subjects.

Novel Wireless System

The illustrations will make plain a simple and inexpensive apparatus for wireless telegraphy by which I have had no difficulty in sending messages across $1\frac{1}{2}$ miles of water surface. It is so simple that the cuts scarcely need explanation. In Fig. 1 is seen the sending apparatus, consisting of a 40-cell battery connected with two copper plates 36 by 36 by $\frac{1}{8}$ in. The plates are separated 6 in. by a piece of hard rubber at each end.

In Fig. 2 are seen duplicates of these insulated plates, connected with an ordinary telephone receiver. With this receiver I can hear distinctly the electric signals made by closing and opening the Morse key in Fig. 1 and I believe that in a short time I shall be able to perfect this system so as to send wireless messages over long distances.—Contributed by Dudley H. Cohen, New York.



A Home-Made Water Motor

By Mrs. Paul S. Winter

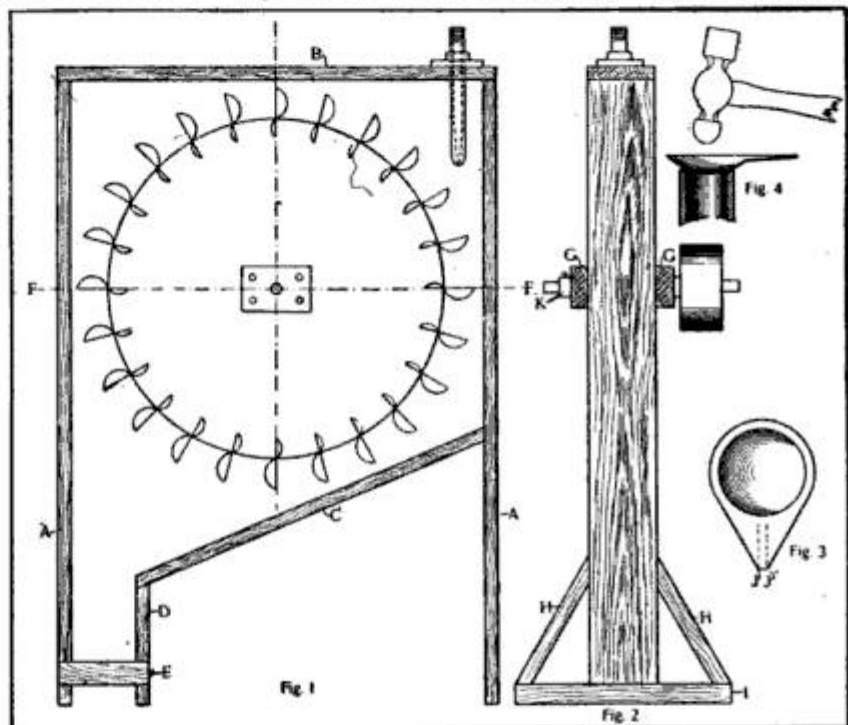
In these days of modern improvements, most houses are equipped with a washing-machine, and the question that arises in the mind of the householder is how to furnish the power to run it economically. I referred this question to my husband, with the result that he built a motor which proved so very satisfactory that I prevailed upon him to give the readers of this magazine a description of it, hoping it may solve the same question for them.

A motor of this type will develop about $\frac{1}{2}$ hp. with a water pressure of 70 lb. The power developed is correspondingly increased or decreased as the pressure exceeds or falls below this. In the latter case the power may be increased by using a smaller pulley. Figure 1 is the motor with one side removed, showing the paddle-wheel in position; Fig. 2 is an end view; Fig. 3 shows one of the paddles; and Fig. 4 shows the method of shaping the paddles. To make the frame, several lengths of scantling 3 in. wide by 1 in. thick (preferably of hard wood) are required. Cut two of them 4 ft. long, to form the main supports of the frame, AA, Fig. 1; another, 2 ft. 6 in. long, for the top, B, Fig. 1; another, 26 in. long, to form the slanting part, C, Fig. 1; and another, D, approximately 1 ft., according to the slant given C. After nailing these together as shown in the illustration, nail two short strips on each side of the outlet, as at E, to keep the frame from spreading.

Cut two pieces 30 in. long. Lay these on the sides of the frame with their center lines along the line FF, which is 15 in. from the outside top

of the frame. They are shown in Fig. 2 as GG. Do not fasten these boards now, but mark their position on the frame. Two short boards 1 in. wide by 1 in. thick (HH, Fig. 2) and another 1 in. by $1\frac{1}{2}$ in. (I, Fig. 2) form a substantial base.

Cut the wheel from sheet iron $\frac{1}{16}$ in. thick, 24 in. in diameter. This can be done roughly with hammer and chisel and then smoothed up on an emery wheel, after which cut 24 radial slots $\frac{3}{4}$ in. deep on its circumference by means of a hacksaw. On each side



Details of Home-Made Water Wheel

of the wheel at the center fasten a rectangular piece of $\frac{1}{4}$ -in. iron 3 by 4 in. and secure it to the wheel by means of four rivets; after which drill a $\frac{5}{8}$ -in. hole through the exact center of the wheel.

Cut 24 pieces of $\frac{1}{32}$ -in. iron, $1\frac{1}{2}$ by $2\frac{1}{2}$ in. These are the paddles. Shape them by placing one end over a section of 1-in. pipe, and hammer bowl-shaped with the peen of a hammer, as shown in Fig. 4. Then cut them into the shape shown in Fig. 3 and bend the tapered end in along the lines JJ, after which place them in the slots of the wheel and bend the sides over to clamp the wheel. Drill $\frac{1}{8}$ -in. holes through the wheel and sides of the paddles and rivet paddles in place. Next secure a $\frac{5}{8}$ -in. steel shaft 12 in. long

to the wheel about 8 in. from one end by means of a key. This is done by cutting a groove in the shaft and a corresponding groove in the wheel and fitting in a piece of metal in order to secure the wheel from turning independent of the shaft. Procure two collars or round pieces of brass (KK, Fig. 2) with a $\frac{5}{8}$ -in. hole through them, and fasten these to the shaft by means of set screws to prevent it from moving lengthwise.

Make the nozzle by taking a piece of $\frac{1}{2}$ -in. galvanized pipe $3\frac{1}{2}$ in. long and filling it with babbitt metal; then drill a $\frac{3}{16}$ -in. hole through its center. Make this hole conical, tapering from $\frac{3}{16}$ in. to a full $\frac{1}{2}$ in. This is best done by using a square taper reamer. Then place the nozzle in the position shown in Fig. 1, which allows the stream of water to strike the buckets full in the center when they reach the position farthest to the right.

Take the side pieces, GG, and drill a 1-in. hole through their sides centrally, and a $\frac{1}{4}$ -in. hole from the tops to the 1-in. holes. Fasten them in their proper position, with the wheel and shaft in place, the shaft projecting through the holes just mentioned. Now block the wheel; that is, fasten it by means of wedges or blocks of wood until the shaft is exactly in the center of the inch holes in the side pieces. Cut four discs of cardboard to slip over the shaft and large enough to cover the inch holes. Two of these are to be inside and two outside of the frames (one to bear against each side of each crosspiece). Fasten these to the crosspieces by means of tacks to hold them securely. Pour melted babbitt metal into the $\frac{1}{4}$ -in. hole to form the bearings. When it has cooled, remove the cardboard, take down the crosspieces, and drill a $\frac{1}{8}$ -in. hole from the top of the crosspieces through the babbitt for an oil-hole.

Secure sufficient sheet zinc to cover the sides of the frame. Cut the zinc to the same shape as the frame and let it extend down to the crosspieces EE. Tack one side on. (It is well to tack strips of heavy cloth, burlap will

do, along the edges under the zinc to form a water-tight joint.) Fasten the crosspiece over the zinc in its proper position. Drill a hole through the zinc, using the hole in the crosspiece as a guide. Then put the wheel in a central position in the frame, tack the other side piece of zinc in place and put the other crosspiece in place. Place the two collars mentioned before on the shaft, and fasten so as to bear against the crosspieces, in order to prevent the wheel and shaft from moving sidewise. If the bearings are now oiled, the shaft should turn easily and smoothly. Fasten a pulley 4 or 6 in. in diameter to the longest arm of the shaft.

Connect the nozzle to a water faucet by means of a piece of hose; place the outlet over a drain, and belt the motor direct to the washing-machine, sewing-machine, ice-cream freezer, drill press, dynamo or any other machinery requiring not more than $\frac{1}{2}$ hp.

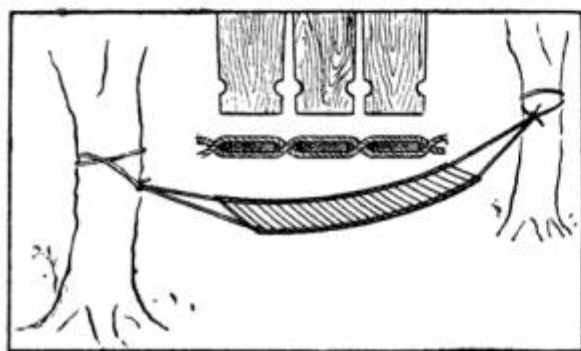
This motor has been in use in our house for two years in all of the above ways, and has never once failed to give perfect satisfaction. It is obvious that, had the wheel and paddles been made of brass, it would be more durable, but as it would have cost several times as much, it is a question whether it would be more economical in the end. If sheet-iron is used a coat of heavy paint would prevent rust and therefore prolong the life of the motor. The motor will soon pay for itself in the saving of laundry bills. We used to spend from 50 cents to \$1 a month to have just my husband's overalls done at the laundry, but now I put them in the machine, start the motor, and leave them for an hour or so. At the end of this time they are perfectly clean, and I have noticed that they wear twice as long as when I sent them to the laundry.

◆◆◆

A brilliant polish may be given to tarnished nickel by immersing in alcohol and 2 per cent of sulphuric acid from 5 to 15 seconds. Take out, wash in running water, rinse in alcohol, and rub dry with linen cloth.

Barrel Stave Hammock

A hammock made of barrel staves is more comfortable than one would think, considering the nature of the material employed in making it. Good smooth staves should be selected for this purpose, and if one cares to go to a little trouble a thorough sandpapering will make a great improvement. Cut half circles out of each stave, as shown at AA, and pass ropes around the ends as shown at B. When finished the weight will then be supported by four ropes at each end, which allows the use of small sized ropes, such as clothes lines. A hammock of this kind



Cheap and Comfortable

may be left out in the rain without injury.—Contributed by H. G. M., St. Louis, Mo.

Iron rust may be taken out of muslin or linen goods by wetting with lemon juice and salt and exposing to sunlight. If at first you don't succeed, try again.

A Mechanical Card Trick

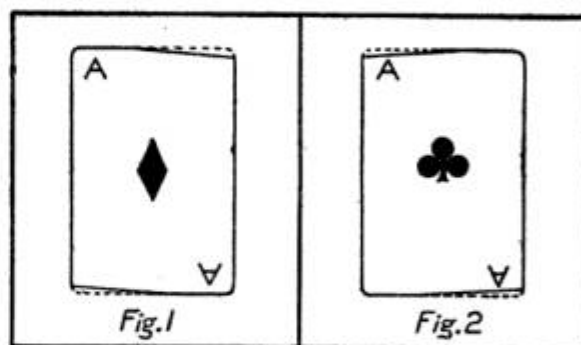
The following mechanical card trick is easy to prepare and simple to perform:

First, procure a new deck, and divide it into two piles, one containing the red cards and the other the black ones, all cards facing the same way. Take the red cards, square them up and place in a vise. Then, with a plane, plane off the upper right hand corner and lower left hand corner, as in Fig. 1, about $\frac{1}{16}$ in.

Then take the black cards, square

them up, and plane off about $\frac{1}{16}$ in. on the upper left hand corner and lower right hand corner, as in Fig. 2.

Next restore all the cards to one pack, taking care to have the first card red, the next black, and so on, every

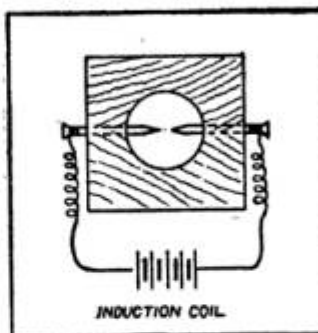


Mechanical Card Trick

alternate card being the same color. Bend the pack so as to give some spring to the cards and by holding one thumb on the upper left hand corner all the cards will appear red to the audience; place thumb in the center at top of pack and they will appear mixed, red and black; with thumb on upper right hand corner all cards appear black. You can display either color called for.—Contributed by Ralph Gingrich, Chicago.

To Explode Powder with Electricity

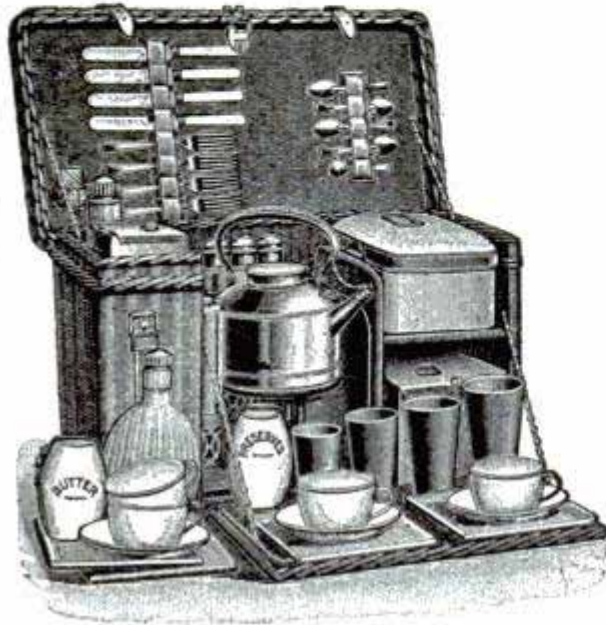
A 1-in. hole was bored in the center of a 2-in. square block. Two finishing



nails were driven in, as shown in the sketch. These were connected to terminals of an induction coil. After everything was ready the powder was poured in the hole and a board weighted with rocks placed over the block. When the button is pressed or the circuit closed in some other way the discharge occurs. The distance between the nail points—which must be bright and clean—should be just enough to give a good, fat spark.—Contributed by Geo. W. Fry, San Jose, Cal.

PICNIC DINING OUTFIT

The illustration shows a dining outfit much used in England, and containing equipment for four persons. The tea kettle is heated by an alcohol lamp;



A Complete Set

there are also boxes for bread, tea, sugar, and a nest of four drinking horns. There are two flasks, one for milk and the other for wine; cups, saucers and plates of the best quality enamel; serviettes and matchbox. Large jars are included for butter and preserves, and smaller for mustard, pepper and salt. The case is 18 in. long by 13 in. deep and sells complete for \$50.

SAFETY PLUG FOR SMALL BOATS

All life boats and ships' small boats have a small hole in the bottom to allow water to run out after washing. A wooden plug is provided to close the hole when boat is used. Frequently the plugs are lost when the boats are seldom used, and at other times they come out and allow the boat to fill when launched. Only recently at one of the stations in the Philippines a small boat with American soldiers was



Cap Unscrewed

crossing a bay when the plug came out and could not be found. As the boat was rapidly filling the officer ordered one of the men to close the hole with his forefinger, which he did. Before reaching the shore a small shark came up under the boat and bit off the protruding end of the man's finger.

The new automatic plug illustrated is always in working order, requires no attention, cannot get lost, and lets water out but prevents it entering a boat. The ball is rubber.

400-LB. VACUUM KILLS

A vacuum pressure of 400 lb. to the square inch drew practically every drop of blood from the body of W. D. Hunter, an engineer in one of the Chicago packing houses, and was the cause of a most unusual form of death. Hunter had gone to repair a tank used in the refrigerating process, had evidently slipped and one leg was drawn into the pipe, where it was held fast by the enormous suction. When discovered by his helper only a few minutes after the accident the body was shriveled, absolutely white, and cold.

PHONOGRAPH BURGLAR ALARM

Many people in Paris are putting in a new burglar alarm consisting of a phonograph with electric attachment to every door and window. If either is opened, voices begin shouting in every room of the house, "Help! Help! Police! Thieves! Murderers!" and keep it up for ten minutes without a break. At the same time the apparatus sends in an alarm to the nearest police station.

Copperas and nut-gall inks can be removed by strong oxalic acid, followed by pure water and frequent application of clean blotters. For most other black inks use a weak solution of chlorinated lime, followed by acetic acid and water, and frequent blotters.

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ALIVE UNDER 25 TONS FOR A DAY.—A feeble call for help from the bottom of a 25-ton carload of coal startled the workmen at Escanaba, Mich., recently. The man was quickly dug out, badly injured both internally and externally, but he may recover. Shooting the coal chute at the dock, he had gone into the car head first, and the coal had piled on top.

THIS DOG A RAILROADER.—I once was acquainted with a dog, writes a correspondent in the Locomotive Engineer, which had a partiality for riding on locomotives, and he rambled at will over all the railways in Great Britain, taking free rides upon the engines. This dog displayed strange likings and antipathies. He never rode farther than over one division on an engine, and when he had settled upon going to some particular point he knew which engine would take him there.

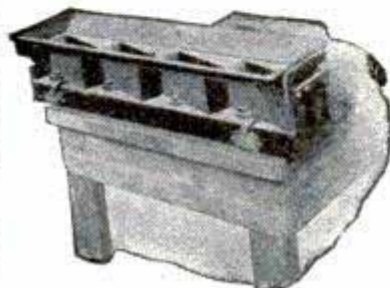
Sometimes he would visit about a station or town for a day or two, then he would start upon his travels again. One day he was waiting at Carlisle for a train to come in and he happened to be sitting with his tail across the rail where a passenger train was standing. The train moved on quietly and cut off Jack's tail. He took it as a personal outrage and never was seen in Carlisle afterward.

When Jack made up his mind to take a ride, he generally waited on the platform, near the water column, until an engine came up. Then he would look carefully at the enginemen, and if one was red haired he moved away. He was never known to ride with a red haired person. He preferred old acquaintances to strangers; but sometimes he showed a disposition to make new acquaintances so long as they were free from lurid hair. Most of the enginemen from Brighton to John O'Groat's knew him, and were ready to share their lunch with Jack.

One day at Rugby Junction Jack had made up his mind to change engines. He had seen an old friend on a locomotive that was starting out, and he attempted the dangerous feat of jumping upon the moving engine. He missed the foot plate and landed under the moving wheels, which ended his career.

AN IMMENSE PINE TREE in the McCloud River region, Shasta County, California, was recently felled and sawed into lumber. By actual measurement it made 23,330 feet, and loaded eight large platform cars, besides the limbs and such parts of the tree as could not be converted into lumber, which would have loaded several cars more.

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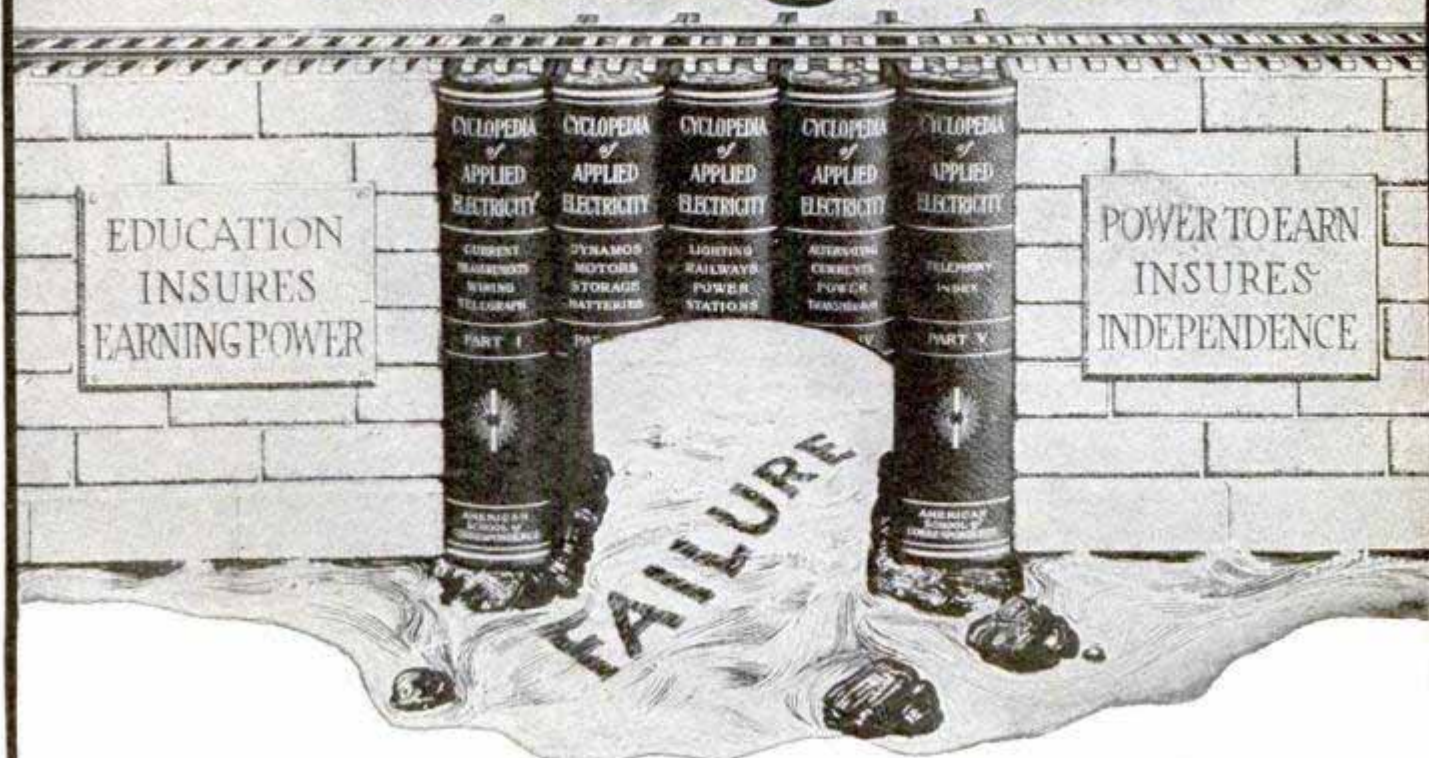
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The electric light has driven out the lamp and the gas plant, even in the most rural districts. The present day farm house is not complete without its telephone. The big railway systems are substituting electricity for steam, even over long distances. The inter-urban trolley service is developing to such an extent that sleeping cars and diners are now a regular feature on many lines. *A fortune awaits the man* who perfects a storage battery for automobiles which will run a car 100 to 150 miles without recharging. Under these circumstances, with such opportunities open before you, do you think that you can make any mistake by devoting a few hours a day to the *study of electricity*?

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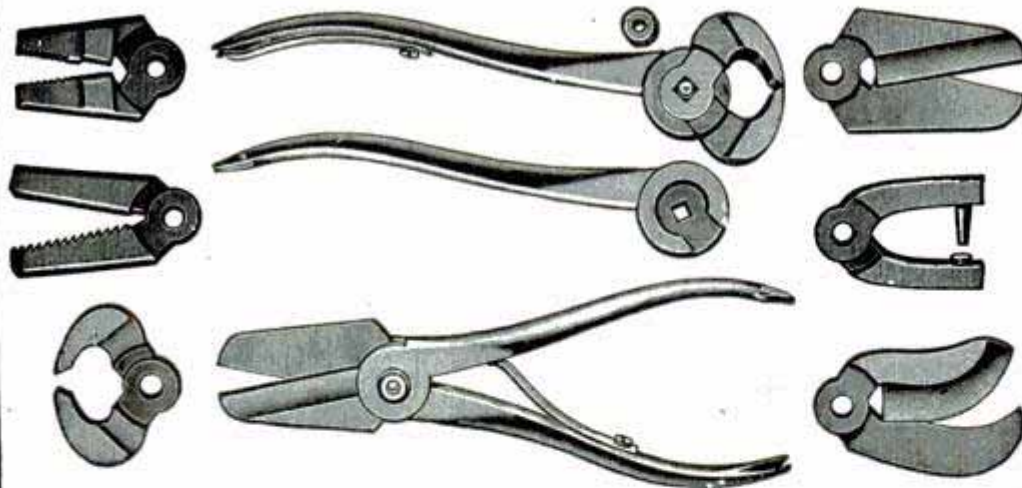
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HOW TOOL STEEL IS MADE—THE FIRST TOOL STEEL.—No one knows how, when or where the first tool steel was made, said E. T. Clamage, in an address before the Northwest Railway Club at Minneapolis. Without doubt, it was the result of an accident. Some primitive blacksmiths found that from contact with the fuel under certain conditions, iron became much stiffer, and that it would become very much harder if dropped into water at a red heat. By further experiment it was evidently found that iron bars would best take on this ability to harden if packed in muffles with charcoal, and kept at a high heat for a number of days. They had no idea whatever that they were carbonizing their iron; in fact, did not know that there was such a thing as carbon as we know it.

The science of chemistry itself is only about a hundred years old, and the old blister steel makers of Sheffield had nothing to guide them, and had no idea what they were doing.

Blister steel was simply iron carbonized the same as you caseharden your link motions, except that it was left in so much longer that the carbon went in much deeper. You occasionally hear some old fellow speak of the good old days when they had blister steel to make tools of. I only wish he had to make a tool out of some of it. The truth is that it was generally full of seams and the carbon was very unevenly distributed. The center of the bar generally had little or no carbon, and one of the first improvements was to turn a bar over and weld it upon itself, which allowed the carbon to soak through a little more uniformly, and thinned out the soft streak in the center.

This was called single-shear steel, and when this bar was again doubled over and welded on itself, it was called double-steel.

Some time about 1760 one company in England astonished the rest of the blister steel makers by producing a bar that would harden uniformly all the way through. The story is that the process was kept a secret until a competitor sought shelter on a cold, wintry night and was allowed inside for humanity's sake. His eyes saw what to him was a wonderful process. He found that they were packing the broken pieces of blister steel in a crucible and melting it. This was the beginning of the present crucible process, and really very few changes have been made since that time.

A few years ago someone who was a little more daring than the rest figured it out that the charcoal could just as well be put right into the crucible with the iron. The reason it had not been done before was probably because every one thought that the charcoal would all burn up the minute the crucible was put into the furnace. I told you that the science of chemistry is only about a hundred years

(Continued on Page 802)

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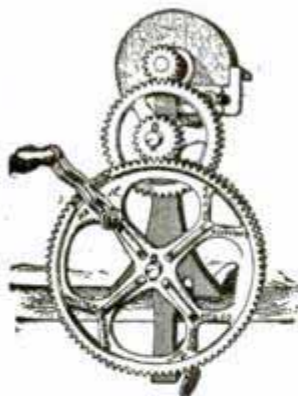


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Send for Catalogue C illustrating our full line.

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(Continued from Page 800)

old, but the practical application of chemistry to the arts is not over fifty years old.

Chemistry teaches us that in order to burn up this charcoal we would have to supply oxygen in the proportion of 32 parts by weight to each 12 parts of carbon. The amount of oxygen contained in the free air in the crucible is too small to enter into any calculation; consequently this charcoal simply gets redhot without being consumed.

A good illustration of this is the carbon in an incandescent lamp, which is not consumed as long as the oxygen of the air is kept away from it.

When the iron is brought up to a certain temperature it becomes very hungry for carbon, and the carbon in the charcoal is then taken up very rapidly. When this direct-carbonizing was first used I remember a certain English steel maker came out with a publication condemning it thoroughly, and saying steel could not be made in that manner. This same man is still making steel, and is now using this process the same as everyone else.

One thing of great importance was learned from experience and that was that certain kinds of iron made good steel, and others seemed for some reason unfit for the purpose. Mind you, they knew very little about phosphorus and sulphur, the two deadly enemies of steel, and it was only from many experiments that they found that certain grades of Swedish iron gave them the best results. This knowledge became tradition, and to this day we are guided by it.

Chemistry has taught us to compute accurately certain known impurities, such as phosphorus and sulphur, but we cannot tell why these Swedish irons are better than irons produced in this country of, as far as we are able to determine, the same chemical analysis.

When nature made those deposits of iron in Norway and Sweden it so happened that there was little or no phosphorus or sulphur present to contaminate it, and so far these conditions have not been discovered anywhere in America.

In hardening tool steel it is important to remember that overheating must always be avoided. The grain of the steel always records the last heat used. If it looks like a piece of cast iron it has been very badly overheated, no matter if the blacksmith does tell you that he only had it at a cherry heat. Perhaps he was brought up on white cherries. The grain of the steel always tells the truth. If you have broken tools, first of all look at the grain shown in the steel. If it is coarse, just take the same piece and put it back into the fire and heat it at a very low red, harden it and then look at the grain. That will tell the story.

A piece of tool steel properly hardened must always show a much finer grain than the unhardened bar.

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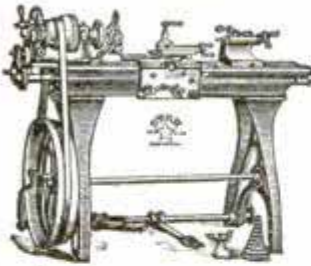
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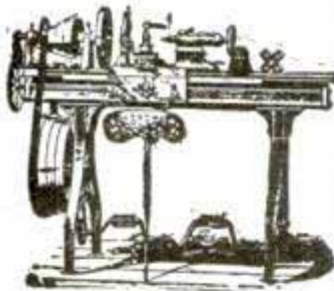
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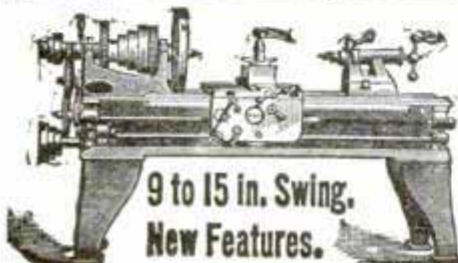
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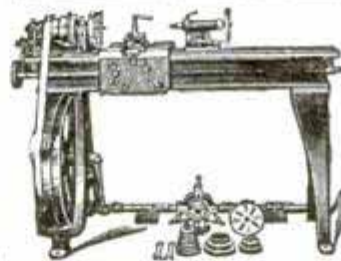
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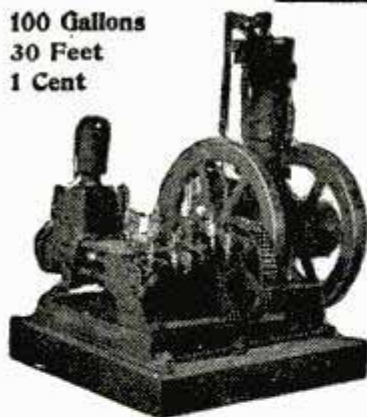
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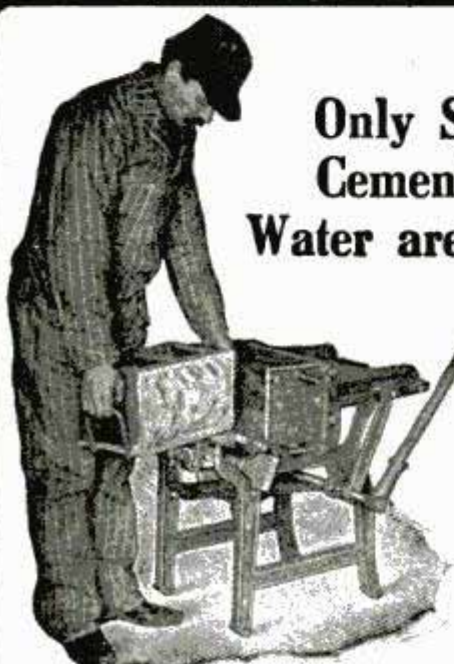
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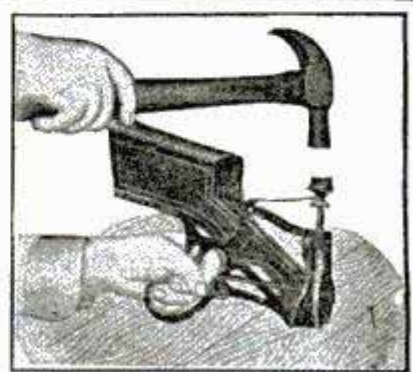
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—One bitter cold day a man had occasion to nail some new shingles on his roof. When his fingers became so cold he could no longer hold a nail he tried to continue operations with mittens. When he had pounded his left hand a few times he quit and climbed down the ladder, resolved to invent a machine which would hold and guide nails as small as shingle nails and which would enable one to drive nails all day in below-zero weather. After many failures he made one which works and is said to nearly double the number of nails driven in a given length of time. The nails are thrown by the handful into a hopper and the hammer does the rest.



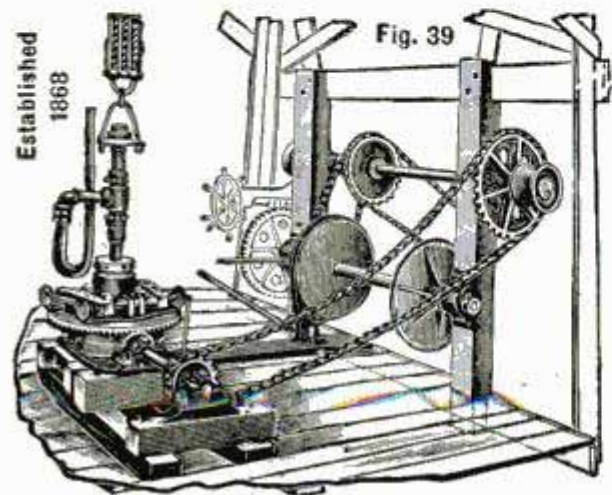
Laborers employed by the Chicago water department found an ingenious method of lightening their toll. When the "boss" was not looking, they shaved their shovels down to narrower size so that they would not lift so much mud. The boss detected the trick, however, and put a stop to it.

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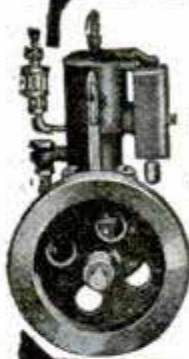
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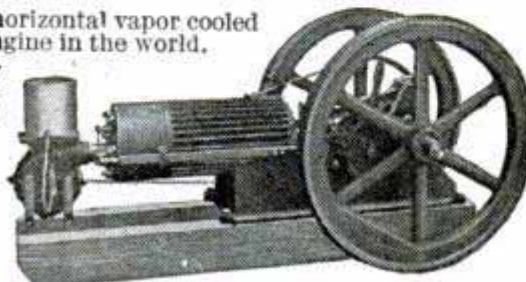


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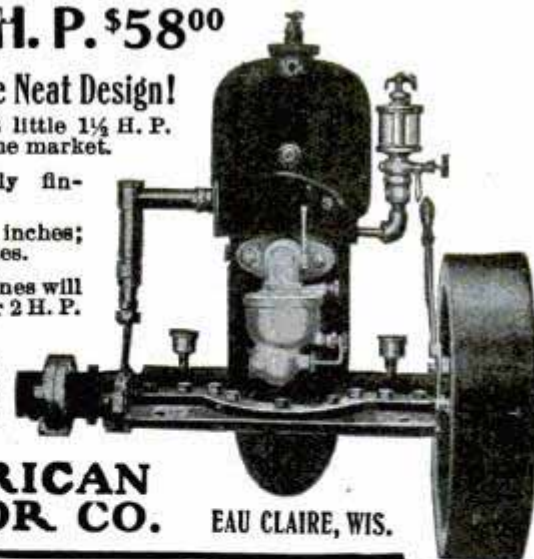
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2. Thou shalt not be content to go about thy business looking like a bum, for thou shouldst know that thy personal appearance is better than a letter of recommendation.

3. Thou shalt not try to make excuses, nor shalt thou say to those who chide thee, "I didn't think."

4. Thou shalt not wait to be told what thou shalt do, nor in what manner thou shalt do it, for thus may thy days be long in the job which fortune hath given thee.

5. Thou shalt not fail to maintain thine own integrity, nor shalt thou be guilty of anything that will lessen thy good respect for thyself.

6. Thou shalt not covet the other fellow's job, nor his salary, nor the position that he hath gained by his own hard labor.

7. Thou shalt not fail to live within thy income, nor shalt thou contract any debts when thou canst not see thy way clear to pay them.

8. Thou shalt not be afraid to blow thine own horn, for he who faileth to blow his own horn at the proper occasion findeth nobody standing ready to blow it for him.

9. Thou shalt not hesitate to say "No" when thou meanest "No," nor shalt thou fail to remember that there are times when it is unsafe to bind thyself by a hasty judgment.

10. Thou shalt give every man a square deal. This is the last and great commandment, and there is no other like unto it. Upon this commandment hangs all the law and the profits of the business world.

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1 1/2 and 2 1/2 H. P. Equipped with short connection for spray pump or walking beam attachment for pumping from wells. Will work against 150 lb. pressure. Gasoline in base of engine or outside. Write for agency.



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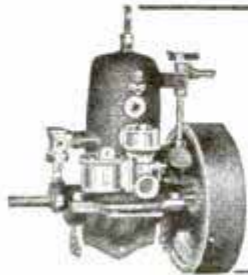


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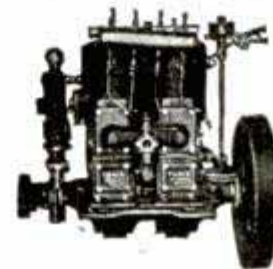
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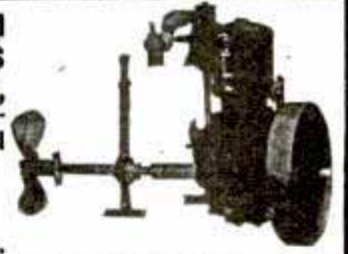
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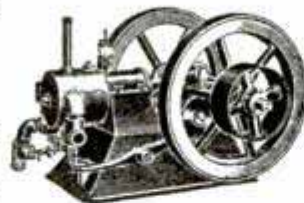


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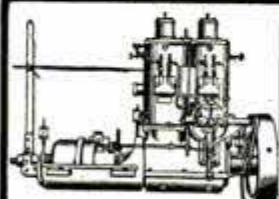
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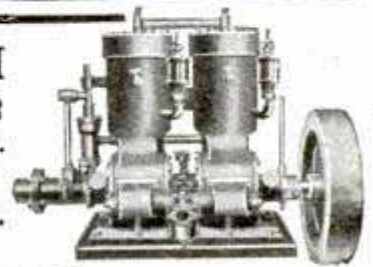
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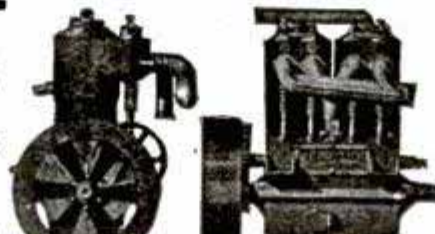
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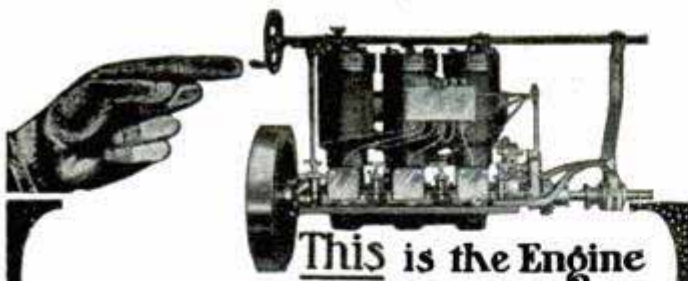
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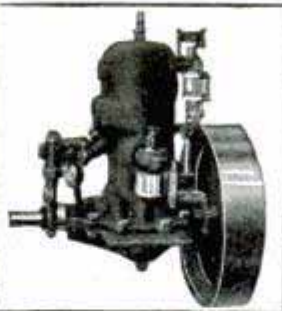
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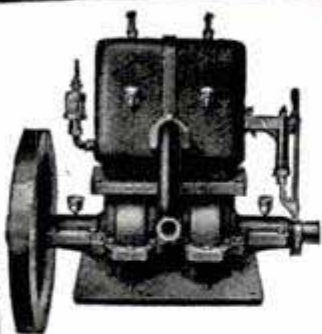
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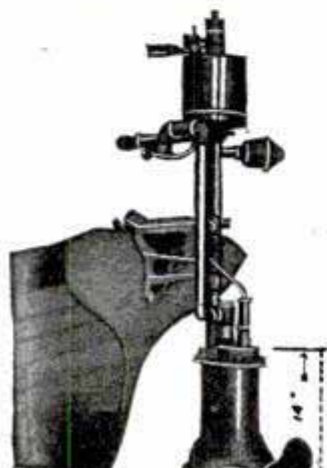
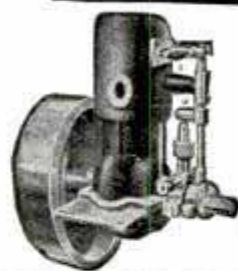
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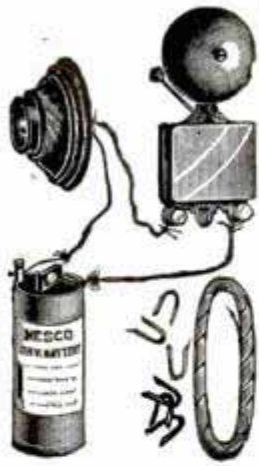


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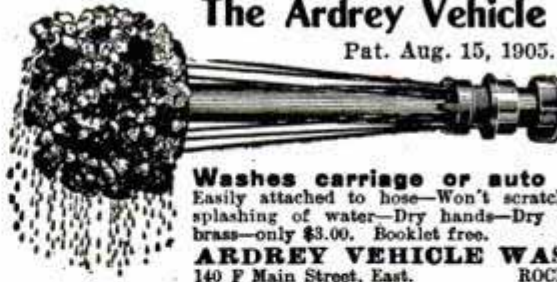
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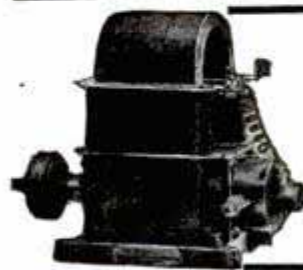
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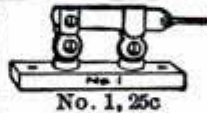


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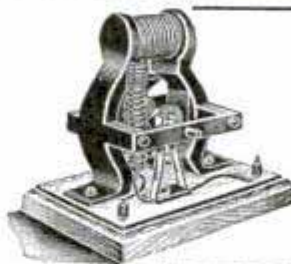


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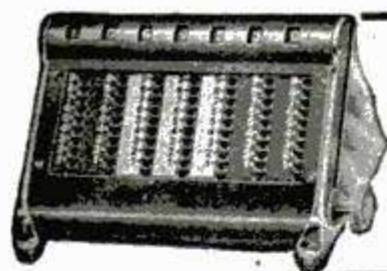
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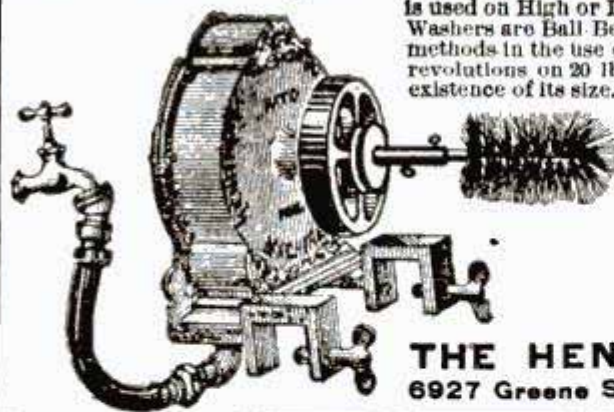
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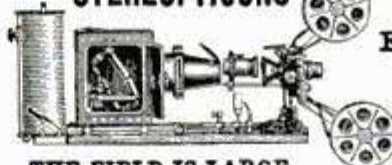
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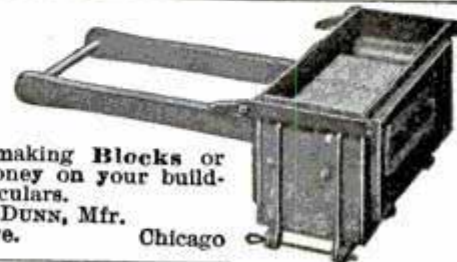
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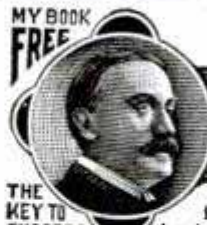
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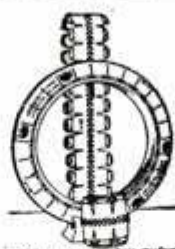
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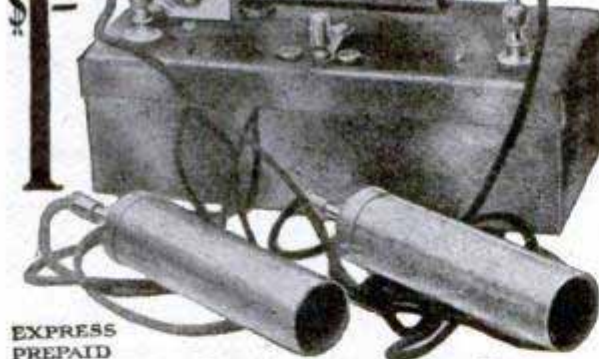
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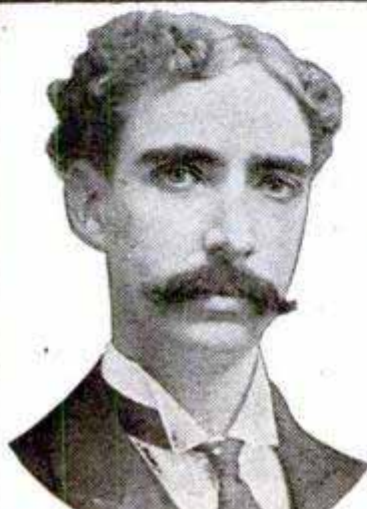
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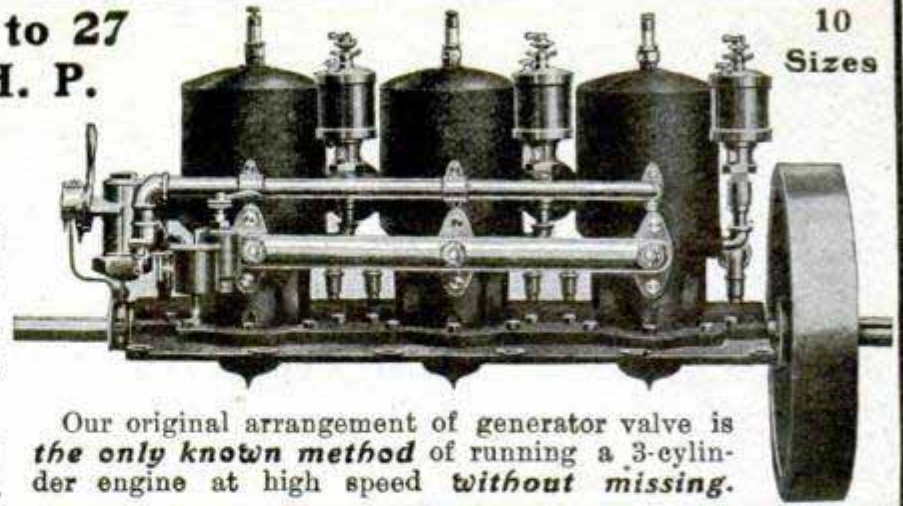
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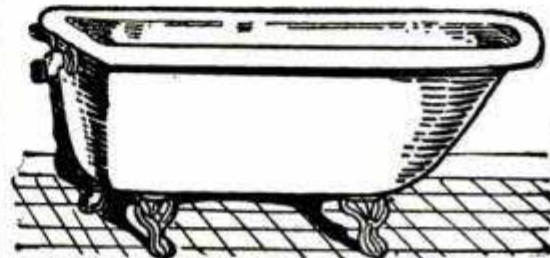


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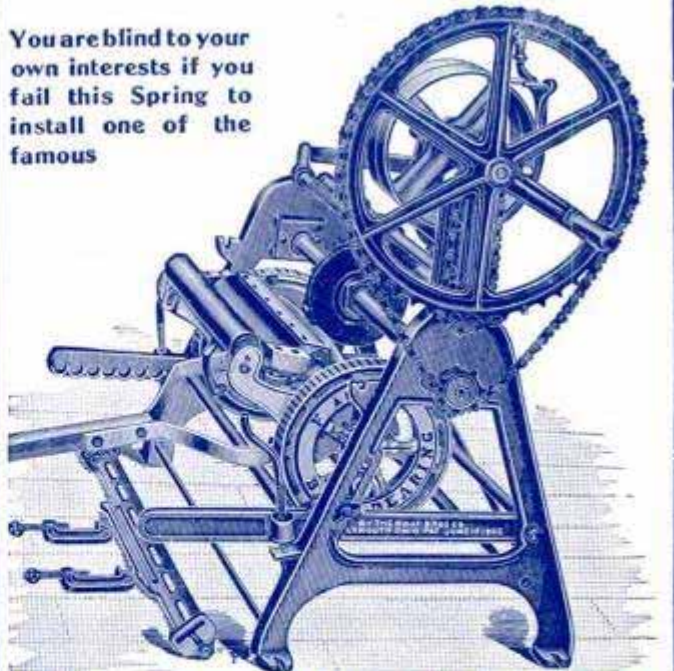
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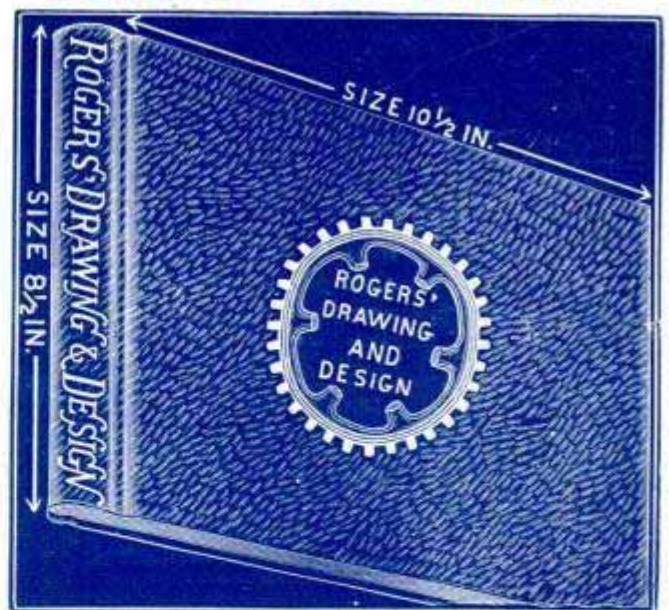
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