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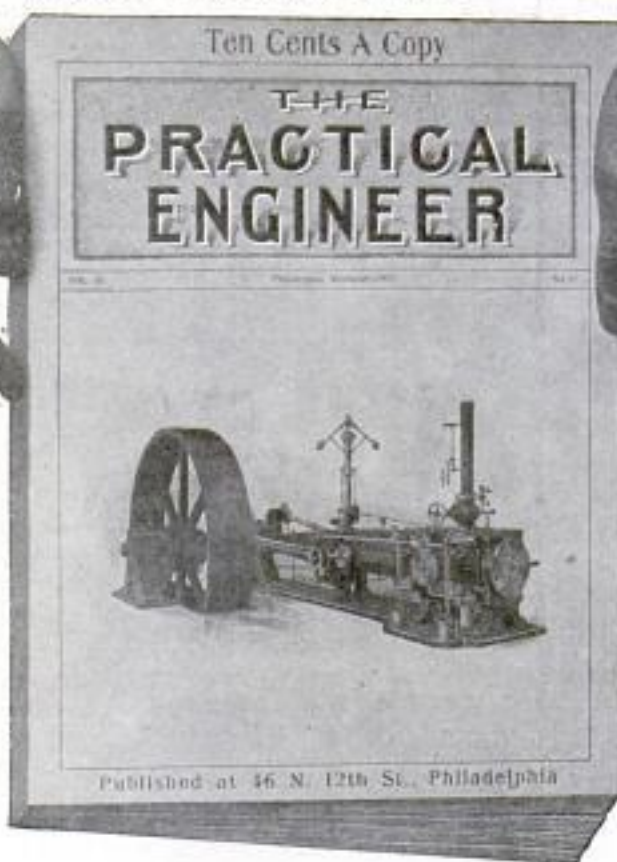
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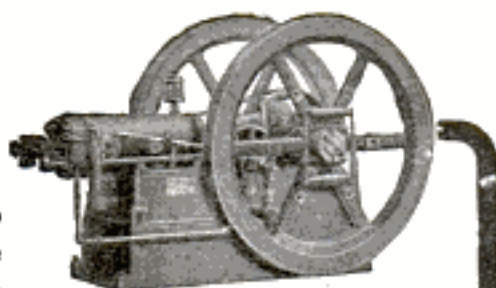
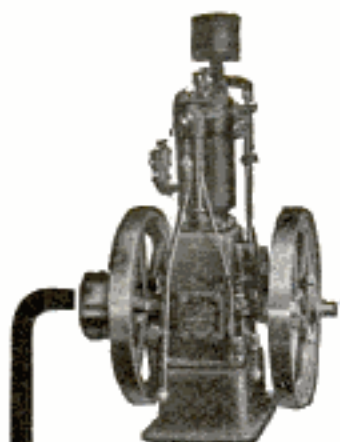
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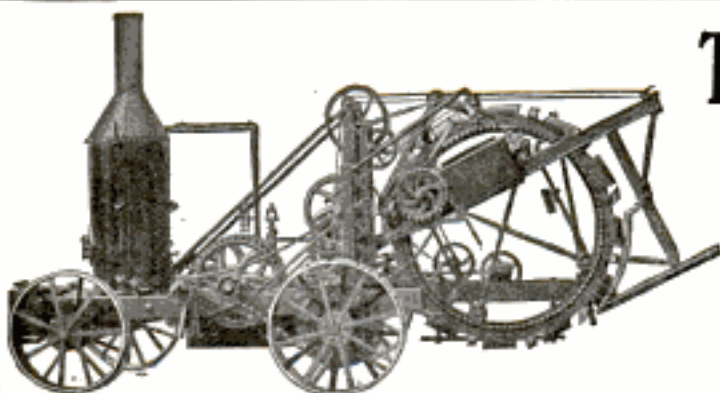
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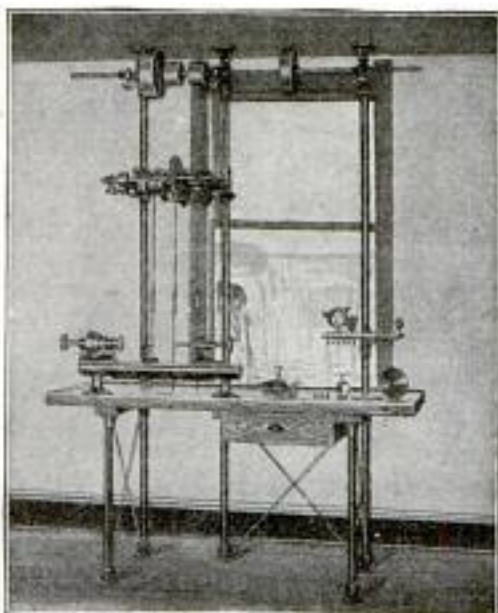
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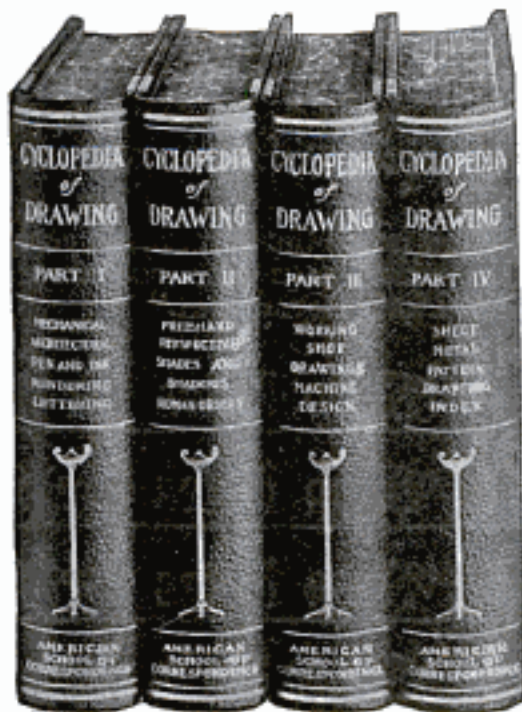
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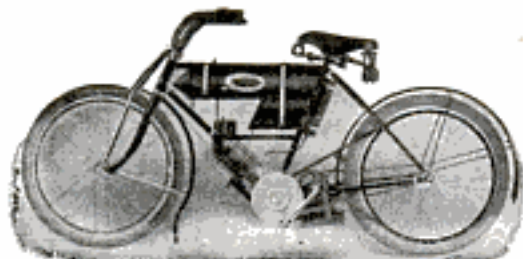
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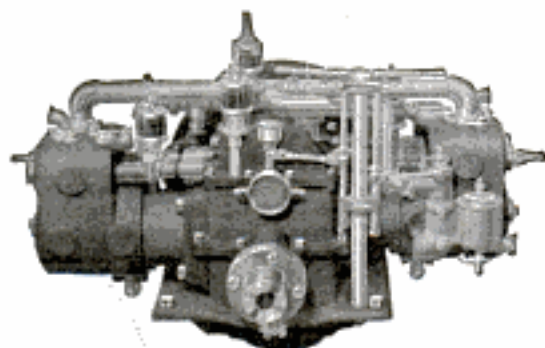
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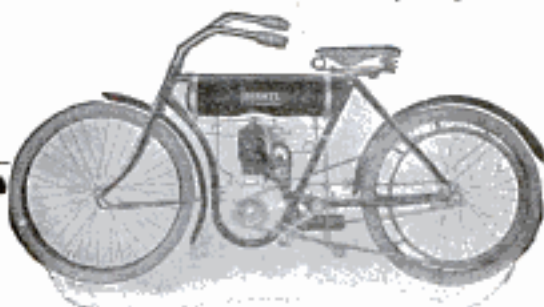
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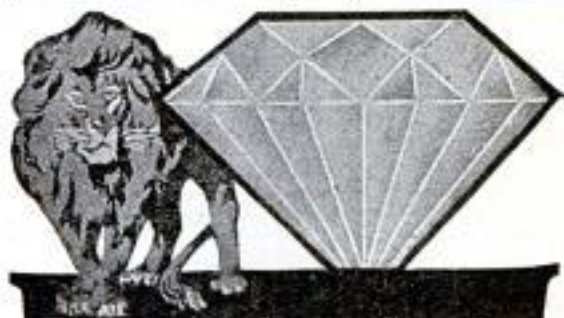
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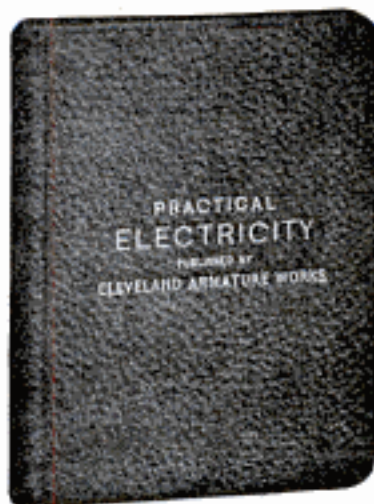
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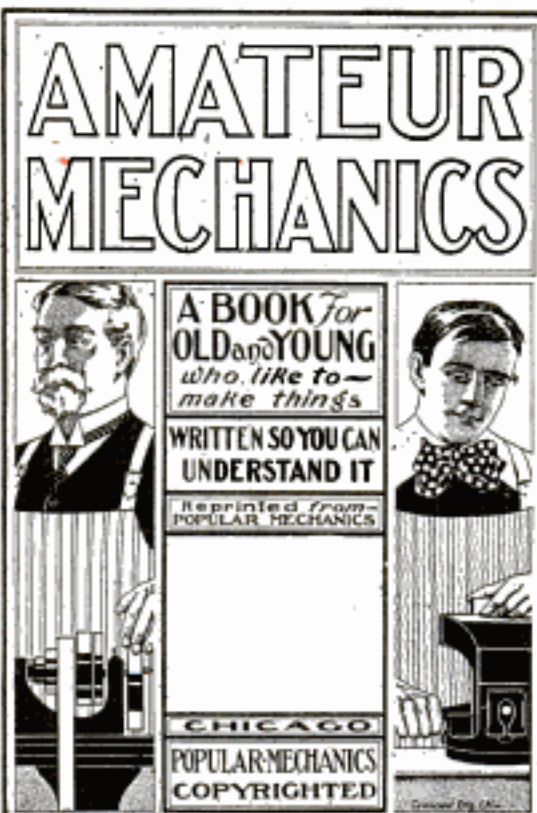
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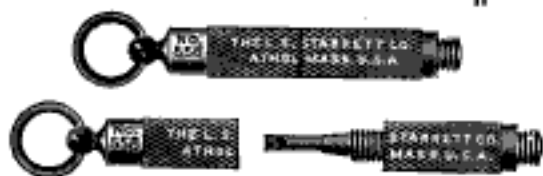
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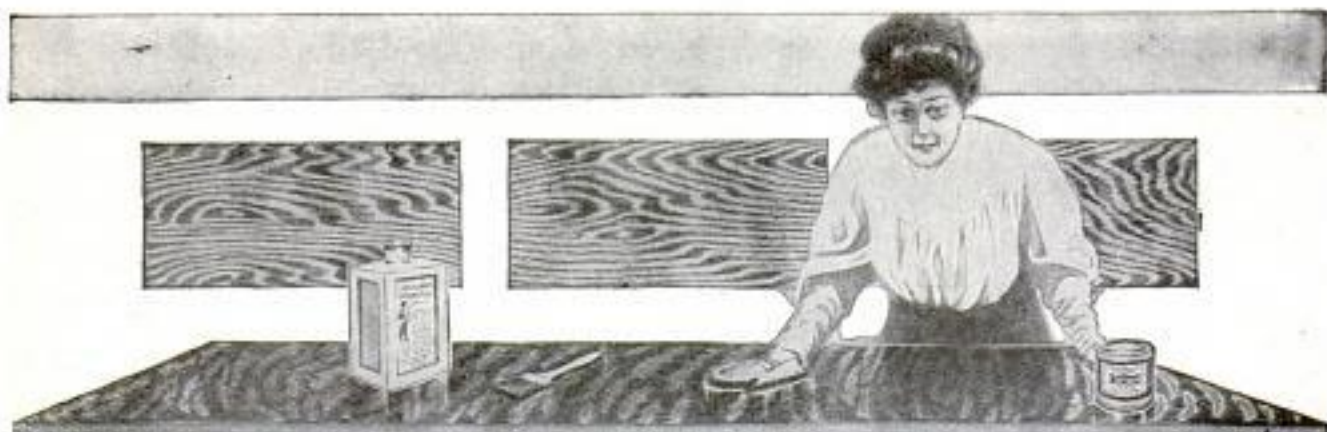
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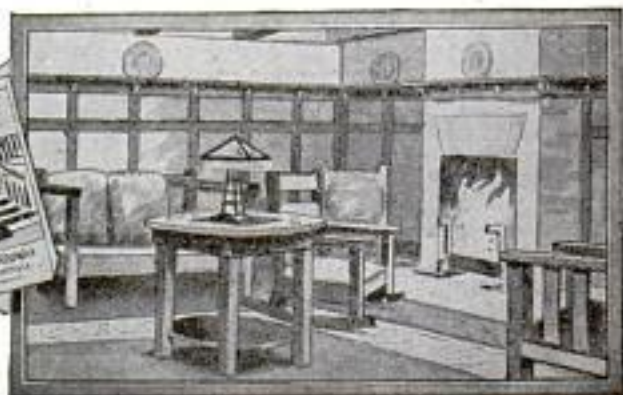
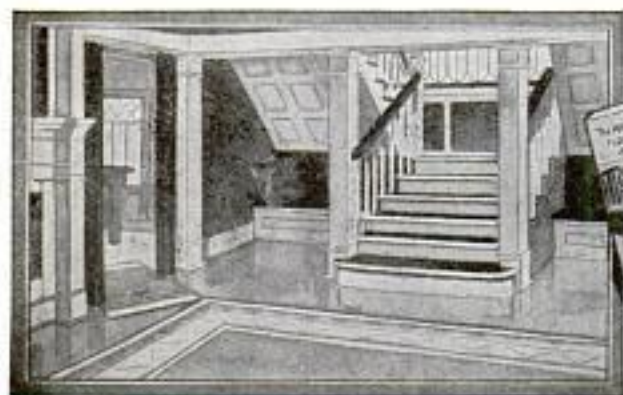
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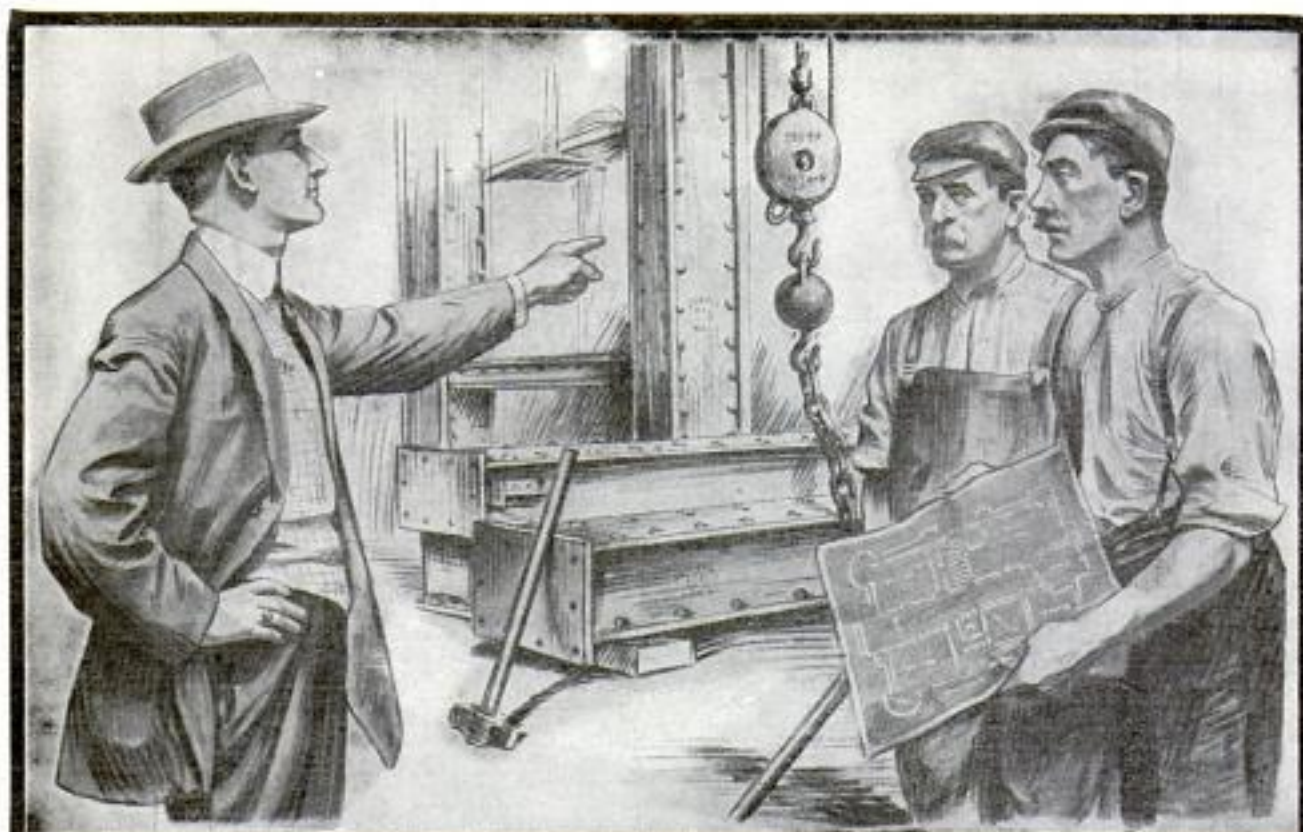
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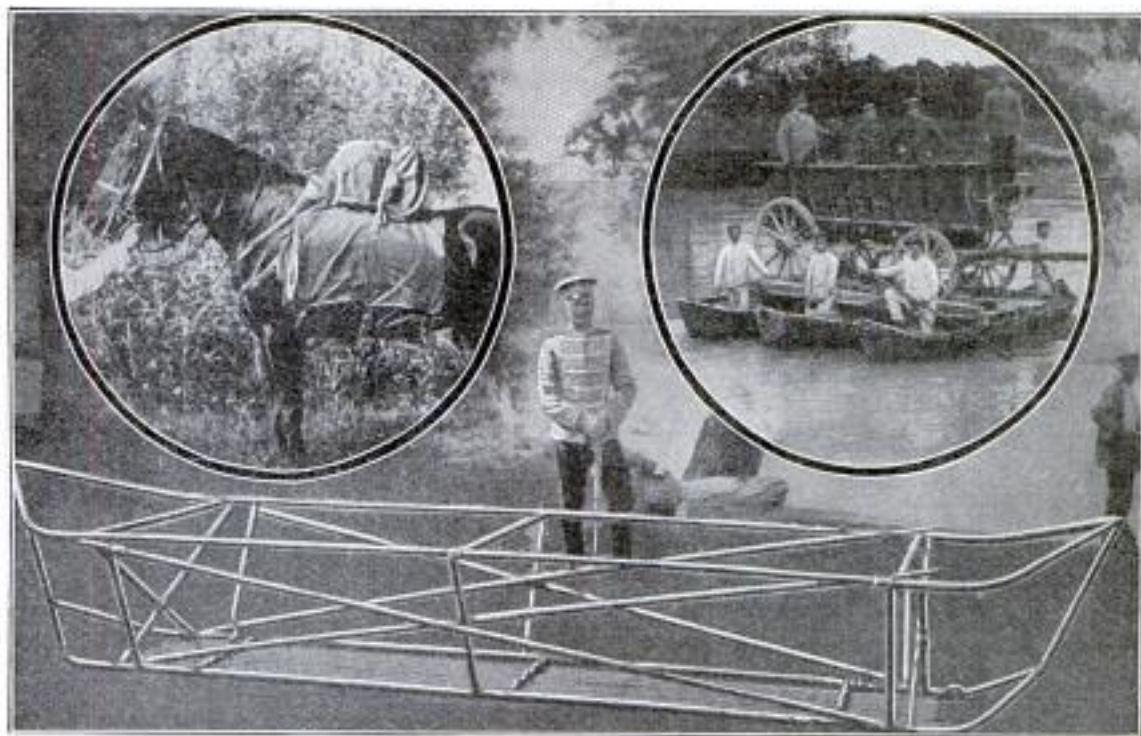
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POPULAR MECHANICS

Vol. 10.

MAY, 1908.

No. 5.



German Military Folding Boats

CANVAS FOLDING BOATS TO TRANSPORT ARMIES ACROSS RIVERS

Probably one of the most important and interesting inventions recently added to the equipment of the German army is a canvas folding boat, the skeleton of which is formed of cavalry lances. From 12 to 16 lances are necessary to make one boat, and three or four more are used as oars. The latter are made by fastening pieces of wood, covered with oilcloth, to the ends. The task of putting the boats together is so simple that six men can complete the feat in 4 minutes. A water-tight sailcloth is stretched on the lances and tied in place.

The lances are, of course, carried by the cavalry regiments in the German army, not as skeletons for boats, but as weapons of warfare. The canvas is folded into small, light bundles, and carried on the horses' backs behind the saddles. The boats have a wonderful capacity when their lightness is taken into consideration. Each will carry 16 soldiers with equipments, or 2 tons of anything compact enough to be placed in them. The possibilities of the boats seem to be endless. By placing two of them together and running boards across, horses and field guns can be

transported over narrow but otherwise unsurpassable waterways. By forming a long chain of them and proceeding in the same manner a bridge is made on which almost an entire army can be transported across a river. Airtight compartments prevent the boats from sinking in case the sailcloth is perforated by bullets from the enemy's guns.

The boats are not to be confounded in any way with the steel pontoons which form part of the equipment of all modern armies. Their disadvantages are obvious, as they require special wagons and horses to transport them from one point to another, and are subject to the conditions of the country over which the armies are passing. The canvas boats can be used at any point accessible to saddle horses, which is practically everywhere, while wooded or rocky lands, and the absence of roads, necessitates great hardships and loss of valuable time in getting the steel pontoons to the position desired.

As in everything concerning the efficiency of the German army, the Kaiser has taken a personal interest in the tests with these boats, and has given orders to continue experiments. The arrangement by which the lances are so quickly put together to form the skeleton frames has not been fully explained, as the army officials wish to keep it secret to a certain extent.

KNITS BIG FLAG FOR THE NAVY

While lying on a cot in the hospital at Tacoma, Wash., L. L. Martin, who had his legs broken in 22 places in a street car accident, knitted a mammoth American flag in red, white and blue yarn, which he intends to present to Admiral Evans while the fleet is at San Francisco. He was taught knitting while living on a farm many years ago.

The naval hospital ship "Relief" was put in commission at the Mare Island Navy Yard on February 1.



HIGHEST CONCRETE POLE IN THE WORLD

This reinforced concrete pole, towering its frail looking peak 150 ft. into the air, is the highest in the world, and was built horizontally on the ground and erected in one piece. Instead of being frail, it weighs 45 tons and tapers from 31 in. at the base to 10 in. at the top. Its setting base is 10 ft. square and 10 ft. deep. The pole is one of two erected to carry telephone wires over the ship canal at St. Catharines, Ont.

PERMITS FOR USE OF ALCOHOL

Manufacturers using less than 50 gal. of completely denatured alcohol per month are not required to secure a permit. Those

using more than that amount per month must secure a permit from the collector of internal revenue of the district in which the business is located.

COMBINED MOVING PICTURE AND TALKING MACHINE

A device, which is practically nothing more than a combination of the graphophone horn now in use and a



Pictures and Music

projecting lantern with moving picture rolls, has been invented for the purpose of giving the thousands of owners of talking-machines the added pleasure of having their records illustrated with appropriate scenes, or views of the singers and monologue artists themselves. Pictures and music are

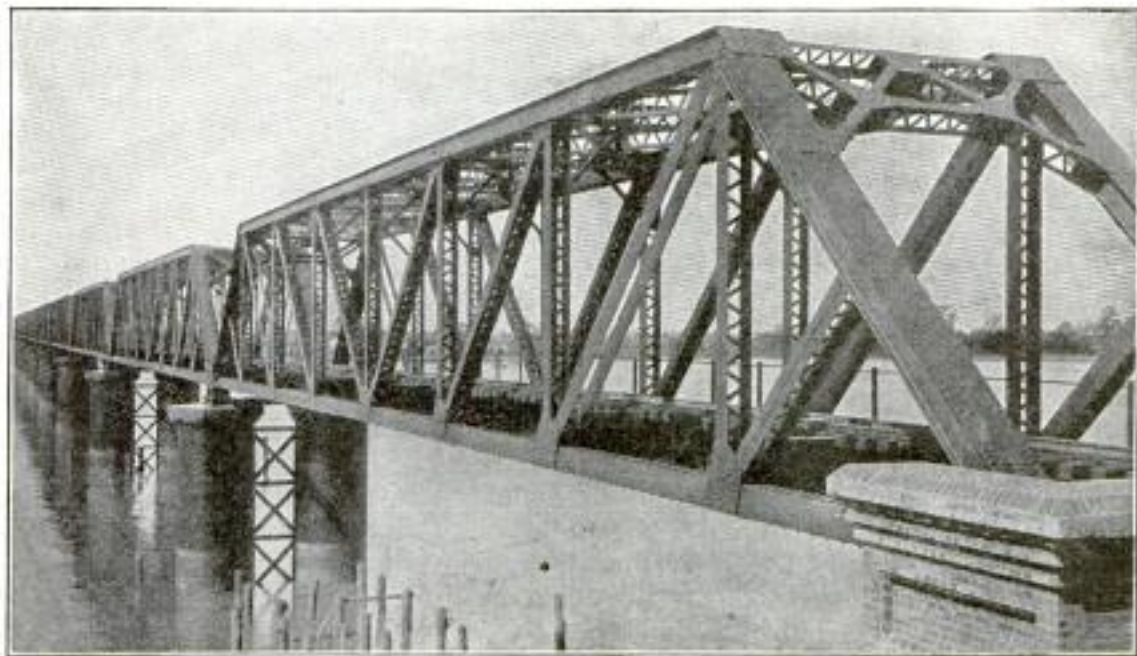
turned on simultaneously and work together, the pictures being projected through the same horn that projects the sound.

The device can be quickly connected to any make of talking-machine by the simple turning of a screw. The lantern, fitted with a Welsbach light, is then attached to a gas jet, a sheet is hung across one side of a room, and everything is ready to commence operation.

BRIDGE BUILT BY NATIVES OF BURMA

The most important and longest of the many bridges constructed in building the 121-mile extension of the Burma railways, which brings the seaport of Maulmain into direct connection with Rangoon, the capital of Southern Burma, is the one over the Sittang river.

Its total length is 1,760 ft., and it is composed of 11 spans of steel 160 ft. long, supported on pairs of cast-iron cylinders, each 10 ft. in diameter and filled with concrete. These cylinders were floated down the river into position and sunk according to the usual method in India, which is to dredge out the earth from inside the cylinder



New Bridge Linking Capital of Southern Burma with Port of Maulmain

and to allow it to sink with its own weight. The cylinders are built up as their bottoms sink into the bed of the river, and then are filled with concrete.

The whole of the labor of the engineering work was done by men known as Bombay Khallassies (sailors). They are experts at any work involving the use of ropes and pulleys in dangerous positions. The riveting was done by natives imported from India.



PICTURE OF FALLING CHURCH TOWER

The illustration shows the wrecking of the Lutheran church at Butler, Ind. The building was erected in 1860 and, having been condemned as unsafe, was torn down to make place for a new one.

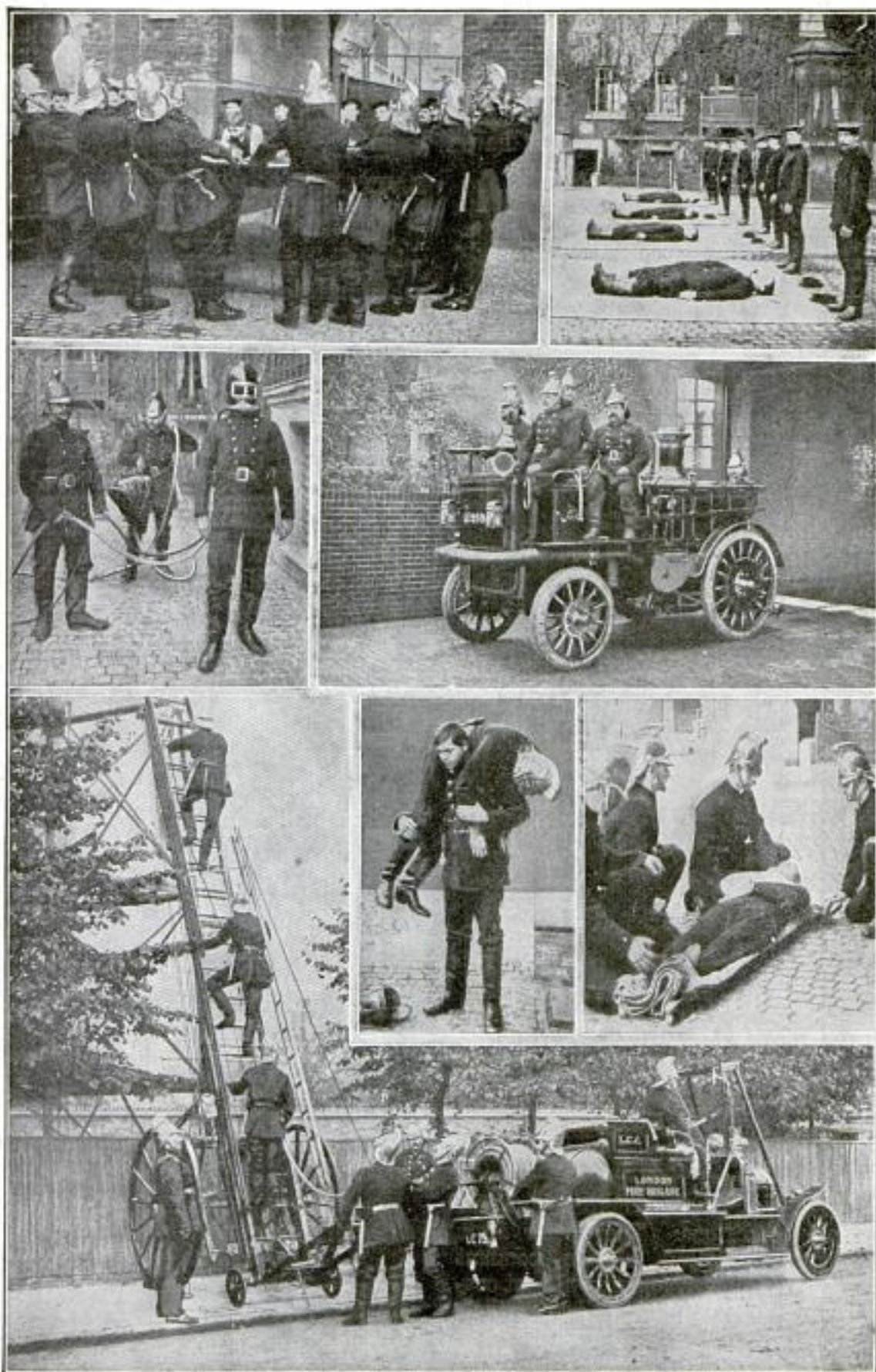
The photograph is somewhat unusual, the camera having caught the falling tower after it had been well started on its fall.—Photo by C. A. Newman.

LONDON'S FIRE DEPARTMENT IN THE MAKING

Not long ago Americans spoke of the English fire-fighting brigades with derision, and many stories were told of the elaborate toilets necessary, and the proverbial slowness of even the companies of the big metropolitan cities in responding to an alarm. Such slowness has not been evident for some time, if it ever did exist, and if the firemen always look natty and immaculate it is because of the elaborate toilets made after and not before the fire. Today London's fire-fighters are on a par with the best in the world, and far in advance in more than one feature.

An aspirant for the position of fireman has not only to qualify in muscular, but in mental and moral fitness for duty, and, as a probationer, undergo a three months' course of study before acceptance. This instruction, although partially theoretical, is chiefly outdoors and severely practical. At the headquarters station even the older firemen can be seen at any time of the day gravely scaling the headquarters buildings, laboriously trundling fire escapes, directing streams of water into an improvised cistern, practicing life-saving by carrying companions off imaginary flaming windows, and jumping from third-story windows into tarpaulin sheets.

Among the more recent additions to the fire-fighting appliances are the motor-driven fire-escape standards, engines, and ladder trucks, and the smoke helmet, with its connecting air-tubes and bellows. This somewhat resembles the helmet of a driver and three men are necessary for each equipment. One gropes his way through the smoke, protected by the helmet, while the second handles his air-tubes from the outside, and the third works the bellows.



The Training of a London Fireman

FORCING A PREMATURE OPENING OF PINE CONES

In raising millions of trees for planting on the mountains of southern California the government experts have



Five Acres of Pine Cones

been confronted by some peculiar problems. Among these is the opening of the cones of certain species of pine to obtain the seeds. One in particular, the "knob cone," will not open for a hundred years after maturity under normal conditions. They grow from the trunks instead of the pendant branches and are frequently almost covered by the growing bark before their opening time comes. These are placed in an oven and heated for days. Ordinary conifers are opened by the sun, the experts having hit upon the expedi-

ent of setting them upon sand, usually against a sunny hillside. The illustration shows a section of a 5-acre field of these in San Bernardino county from which the seeds will soon begin to drop.

BATTLE BETWEEN OWL AND RABBIT CAUSES TWO FIRES

A large horned owl with a struggling rabbit in its claws flew against two high tension electric power wires near Redding, Cal., recently, and made a short circuit, which was responsible for two disastrous fires and serious injury to one man. The short circuit was made possible by the owl striking one wire and the rabbit becoming tangled up in another and lower one. Both were instantly electrocuted, but hung in a charred mass to the wires.

One fire totally destroyed the hoisting works at the White Oaks mines near Shasta, and the second occurred in the Redding hotel. A young man at the mine who attempted to telephone news of the fire was badly shocked and burned the moment he touched the telephone, the line being in contact with the short-circuited wires.

A BLAST FURNACE EXPLOSION

To obtain a photograph of a furnace explosion is a rare occurrence. Every-



The Exploding Furnace

one is generally looking for a safer occupation than setting up a camera.

This particular furnace had been giving trouble all morning, and an explosion was expected almost any moment. Permission was obtained from the superintendent to make a snapshot, and a suitable place to set up the camera was advised.

A rumbling noise, caused by the falling of the stock, which had been hanging, gave the desired warning to the photographer, and the next instant the explosion occurred and was successfully taken by the camera.



Austrian Mountain Railway

RAILWAY RUNS UP A PRECIPICE

The Virglbahn cable railway up the side of a mountain in the Southern Tyrol, Austria, now holds the record of being the steepest railway in the world, with a grade of fully 70 per cent at its upper end and an average grade of 66 per cent. In the run of 945 ft. the grade rises 640 ft.

The road construction is comparatively light as the cars are small and the breaking stress on the tracks much less than usual on the same type of

railway. The experiments in automatic vacuum braking made on the 70 per cent grade showed that cars freed from the cable could be stopped without shock within a distance of but 4 ft.

The illustration shows one of the cars over the 78-ft. viaduct, located a little over one-third the way up the side of the precipice. The cars seat 30 passengers. The road and equipment cost \$100,000 or about \$1,000 per running foot.

How the Foreign Army of Invasion, Foreign Born and Children of Foreign Born, Line Up



Great Britain and
Canada, 9,146,565

Germany,
6,846,674

Russia and Poland,
1,373,447

Italy,
713,121

Oriental,
190,318

TARGET PRACTICE IN THE NAVY

Graphic Pen Picture by an American Gun-Pointer

Of all the various arts that form the basis of modern naval warfare there is none so important as that of target practice. Straight shooting is the crucial test of modern sea fights. Other things being equal, the fleet that can make the most hits in the shortest time is the one that will surely win. Even as in prehistoric times the victorious cave-dwellers were those who could throw their volleys of stones swiftest and hardest, so today our mighty armadas are worse than useless unless their ability to "sink, burn and destroy" is at least equal to their opponent's.

Like everything else, proficiency in target practice is only attained after long and arduous training. Our navy is fortunate in having a system of instruction that has been demonstrated by actual results to be unequalled by any other nation on earth. Much is due also to the quick intelligence of the men and the natural taking to fire-arms of all descriptions that is one of the distinguishing characteristics of Americans in general. A few glances into the inner workings of our training system may prove of interest.

Down on the western coast of Mexico lies the sheltered and secluded harbor of Magdalena Bay. Secure from the prying curiosity of foreigners, it is an ideal spot for the training ground of a mighty fleet. For the last two months its broad waters have been studded with hundreds of shot-torn targets, and its cactus-covered mountains have resounded to the roar of thousands of projectiles.

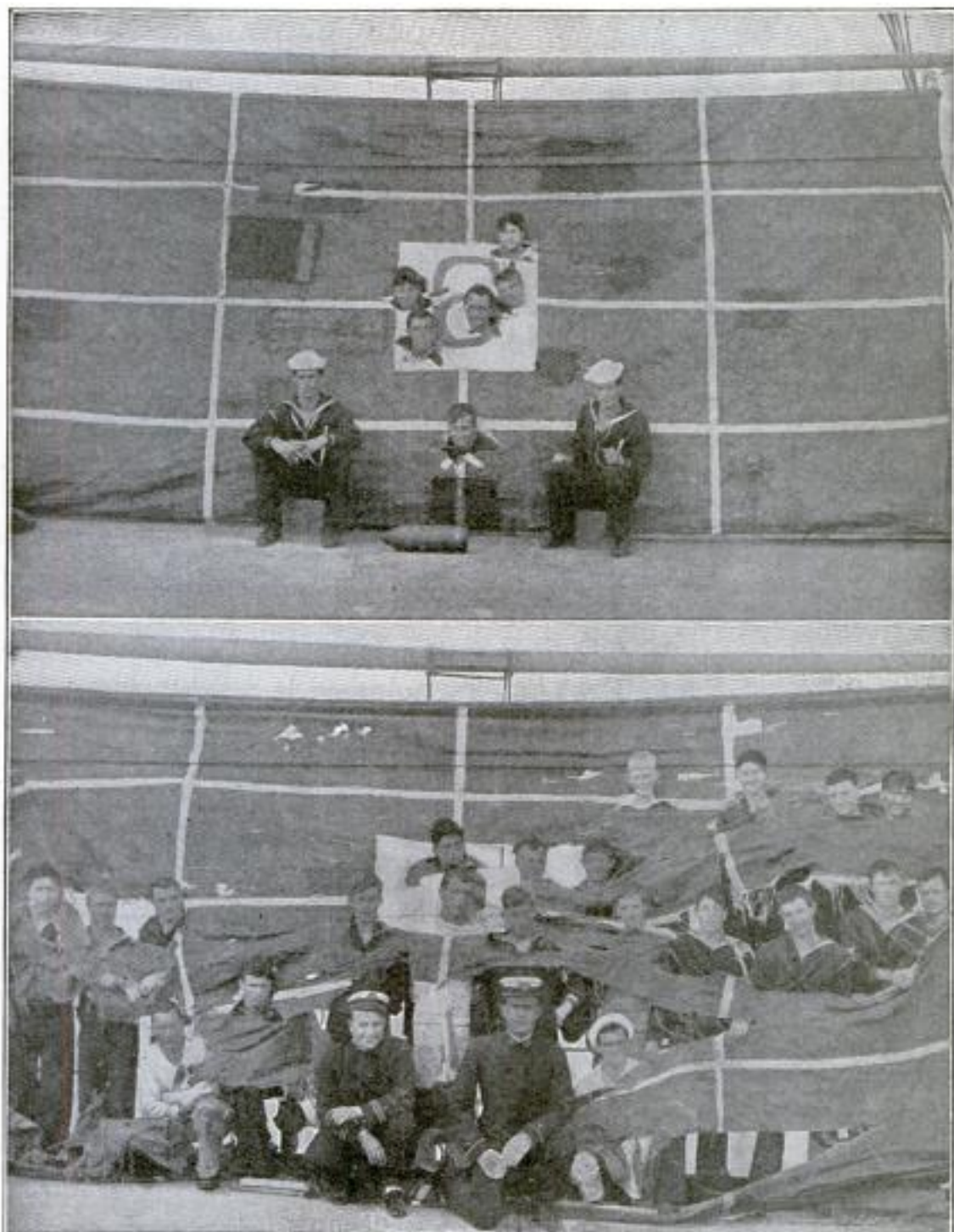
The harbor is divided into four well-defined areas, at safe intervals from each other, which form the ranges. Here, in every hour of the twenty-four, warships may be seen steaming to and fro across the targets, vomiting forth a ceaseless hail of steel under the burning rays of the tropical sun, or picking up their marks by night, through the help of their high-power electric searchlights.

For weeks and months before the ships go on the range preparations are being made for the coming ordeal. Guns are taken apart, piece by piece and screw by screw, carefully overhauled, and put together again only when keyed up to their highest pitch of perfection. All day long the "ping-pong" and sub-calibres punctuate the silence, and the loading machine is surrounded by its devotees. Later comes calibration and bore-sighting, when the sights are carefully adjusted to the fraction of a fraction, and the preliminaries are over, leaving all hands eager for the real work to come.

At length the eventful day dawns and a trial run is made over the range to ascertain the necessary number of revolutions, turning angles, etc., and we are ready to begin. The warning whistle blows, the red flag goes up, and almost simultaneously the deck trembles under your feet and a mighty roar announces that the ball has begun. Up on deck the excitement is intense. Half the crew have field glasses trained on the target and each shot is followed with breathless interest, calling forth a murmur of admiration or a groan of sympathy. Feeling runs keen between rival divisions and large sums of money frequently change hands after all is over and done with.

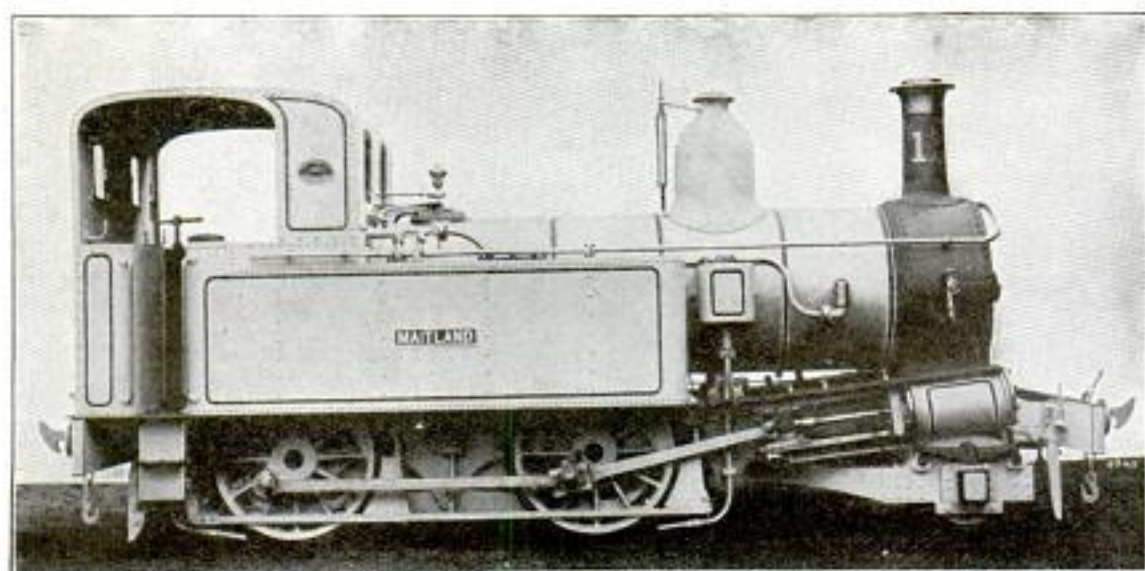
Again the whistle blows, the flag falls, and the bugles sound "cease fire." The umpire comes forward with his report: "Number six, 6-inch gun, sir—12 rounds, 12 hits, one minute. Splendid shooting, sir—a record, I think." The gun pointer, by the way, is a mere boy in his teens, that a year or two ago could not have told the breech mechanism from the muzzle.

Again the warning whistle blows. This time it is the monster turret guns and all hands hastily provide themselves with cotton wool ear-plugs. The gun's



UPPER TARGET—Result of 6-in. Gun Fire: 6 Shots, 6 Hits; 5 of which were Bull's Eyes. LOWER TARGET—10-in. Gun Fire: 14 Shots, 13 Hits. The Gun Crews who did the Shooting

crew are already packed into the turret with just room enough to work and not a superfluous inch to spare. Boom! The ship reels under the shock like a wounded lion, but there is no "scamped" work in Uncle Sam's ships and nothing breaks, except, perhaps, a few glasses in the ward-room. A mighty column of water springs up in front of the target, followed a second later by another and another miles apart. "A hit!" "A hit!" "And right through the center of the target, too!" "Good for the first division!" Shot follows shot in rapid succession until the score reads: "Fourteen rounds, 13 hits, and the last one so close that it was a shame not to count it."



Small Passenger Locomotive, Isle of Man Railway

But now the shades of night are beginning to fall and we draw off for an interval of hard-earned repose. Under the magic influence of realized hopes the sternest of division officers unbends and holds an informal reception in his room, which all the gun's crew attend, to celebrate the occasion.

Supper and a hurried smoke and the fun begins anew. This time it is the wicked little 3-inch barkers, which are designed to make things exceedingly warm for torpedo boats and destroyers. As these "wasps of the sea" would probably attack at night, we do our firing at night with a view of getting as near to the real conditions as possible. As we steam rapidly past the targets two broad green pencils of fire stab the gloom and the guns sing merrily to the tune of 20 hits a minute. The shells are specially designed and are luminous and a quick eye can follow the "tracer" from the moment it leaves the gun to the moment of impact.

Last of all comes the three-pounders and machine guns, the latter spreading destruction at the rate of 600 rounds to the minute. At short ranges they squirt lead like a hose, carrying certain death to any living thing within the radius of their fire.

At last the final shot is fired, almost regretfully, and we fall back again to the normal routine. The poor old ship has been sadly neglected during the conflict and much cleaning and scraping is necessary to put things "ship-shape and Bristol fashion."

After the conclusion of the record practice the most skillful of the pointers are rewarded by liberal additions to their pay and all of the guns' crews share in the prize money. The captain also marks his appreciation by granting extra privileges to all, and every one is happy in the knowledge that if we are not at the top of the list we are very close to it at least.

If some of the shore-going people who decry all naval expenditure could only see the fleet at work in Magdalena Bay they would speedily alter their views. The United States navy is the greatest guarantee of peace that we have ever had, but it must be kept so by unremitting drill and sleepless vigilance. Some day the navy may have to decide the fate of the Nation, where arbitration committees and peace conferences are unknown. Under such conditions a pair of well-pointed 12-inch guns are the finest arbitrators in the world—especially when they are pointed by the American gun pointer—the unquestioned champion marksman of the world today.

CORPSE STEERS BOBSLEIGH DOWN MOUNTAIN SIDE

With his hands still remaining on the steering wheel, but his head fallen forward on his breast, a man named Derchen died of heart disease while steering a bobsleigh on which himself and three companions were shooting down the steep course which runs for 3 miles between Leysin and Sepey, Switzerland. Two of the steep descents had been made when Derchen was seen to relax, but none of his companions could get past him to the steering wheel, so the mad flight continued through Sepey at lightning speed. The bobsleigh at last dashed into a fountain, seriously injuring the three live men and mutilating the corpse.

MARKET QUOTATION INDICATOR

An electric quotation indicator has been placed over the blackboards in the Minneapolis Chamber of Commerce for the purpose of posting the changes of the market as rapidly as they occur. The woodwork of the indicator is 64 in. in diameter and about 12 in. deep. The month posted (indicating the wheat, of course, not the date) and the last digit of the ruling market price appear in the circular white face of the indicator, the fractions being posted in the square white spaces cut in the rim. Inasmuch as all dealers know the market price within 10 cents, it has been considered



"September Wheat 117 $\frac{3}{8}$ "

unnecessary to post any except the last digit and the fraction. The posting illustrated reads "September 117 $\frac{3}{8}$."



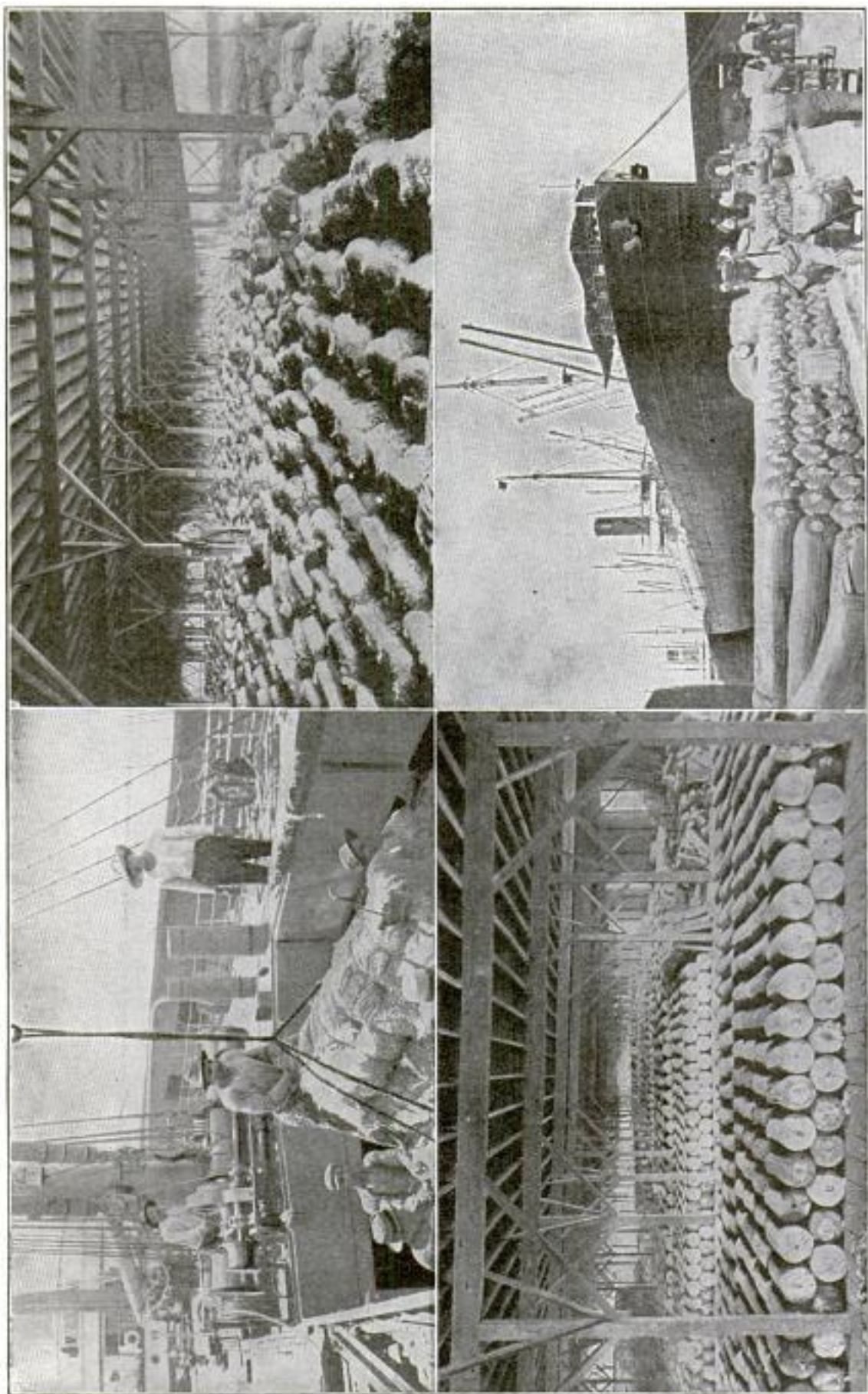
HOUSE MOVING IN THE FRENCH CONGO

House moving is an easy task among the Lakas, a tribe living near the Lagone river in the French Congo, Africa. This tribe, which is one of the most superb examples of the savage black race, lives in conical shaped huts constructed of plaits of tough straw. When a change in location is desired, both the women and the men put their shoulders to the task and carry the roofs of their homes to the new site, sometimes many miles distant. The circular walls of the huts are rebuilt.

FIRST-AID-TO-INJURED KITS IN KAISER'S CARRIAGES

The recent attacks upon rulers have induced the German Kaiser to place in all carriages used by himself and members of his family a complete first-aid-to-the-wounded kit. This consists of two rubber bandages, a rubber tube and two antiseptic bandages. In addition to these, his adjutants and all members of the household wear suspenders that can be used at a moment's notice as bandages.

The latest expression in the word crop of 1908 is "notel." It was first used in Cincinnati and means a person who has no telephone.



SHIPPING COTTON ABROAD

The shipment to Europe each year of the hundreds of thousands of tons of cotton is in itself a great industry. Millions of dollars are invested in warehouses, docks and steamers. Not only our own but large quantities of Mexican cotton find outlet through American gulf ports. The illustrations on the opposite page give a graphic idea of the magnitude of the business. Figure 1 shows a slip of three bales loading into a steamer. It takes two days to load a ship. Figure 2 is a dock warehouse containing 10,000 square bales of cotton awaiting shipment, all under one roof. Figure 3 is also a dock warehouse, containing 5,000 round bales of cotton. The round bales are formed in a machine which winds the cotton into a package weighing several hundred pounds and as hard as a post. In this shape it is more easily handled, as it can be rolled like a barrel, and it also packs closely in a ship's hold. In Fig. 4 some of the round bales are on the dock, with two big ocean freighters waiting to take on cargo.

WALNUT CLEANER PROPELLED BY WATER WHEEL

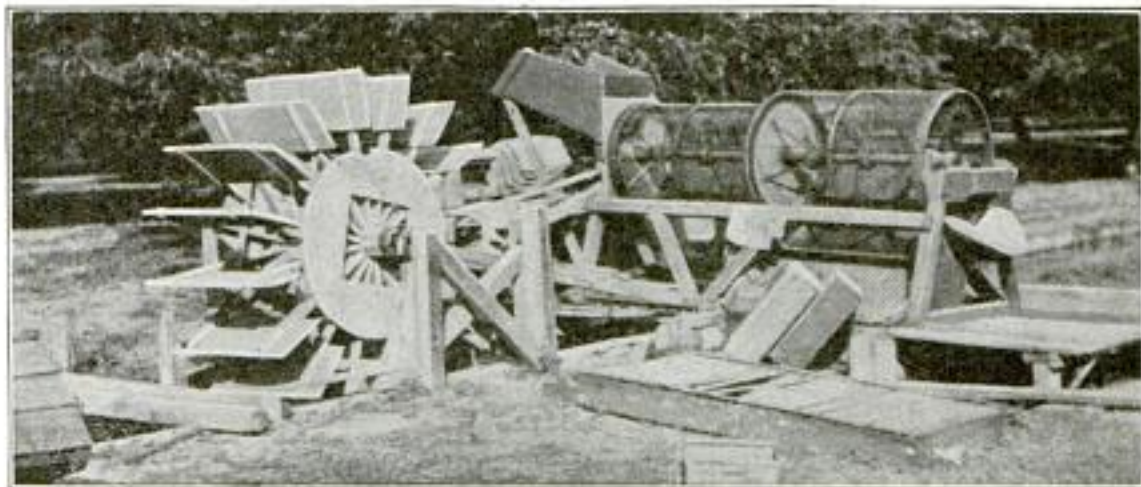
The large quantities of English walnuts grown in California are cleaned and sorted in rotary screens, many of which are propelled by water wheels placed in the irrigating flumes. The



The Zakka Khels, a warlike tribe of India are in rebellion. They are armed with Martini Henry rifles and are sharpshooters. Their favorite method is to avoid an open engagement, and to pick off the British soldiers by "sniping." This they do from lofty and inaccessible rocks.—Courtesy London Illustrated News.

nuts are fed into the hopper at the left and after tumbling around in the smaller screen until cleaned are next whirled into the large screen for sorting. This is done by gradually withdrawing the white circular disc.

The new armored cruiser, "North Carolina," averaged 22.48 nautical miles an hour in her 4-mile speed trial.



A California Device for Cleaning Walnuts



Ostriches Exercising on Snow Covered Ground

OSTRICHES THRIVING IN SNOW

One of the most remarkable feats of acclimating animals has just been accomplished by Hagenbeck, one of the best known animal dealers in the world, who has among his other possessions a large ostrich farm. As shown in the illustration, these great birds are running around on snow-covered ground, and seem to enjoy it, a circumstance which has astonished German scientists.

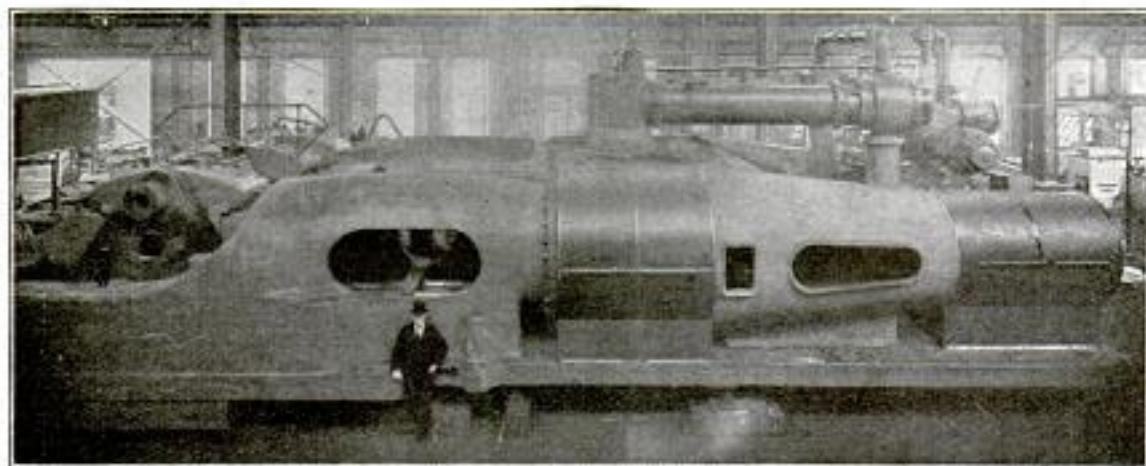
Ostriches are very sensitive to climatic changes and as a rule will not live long if brought to cold countries. Yet the ingenious German exposed them to the cold winter weather near Hamburg at a time when the conditions were worse and the snow heavier than in many years. The birds are kept in a thriving condition by giving them constant exercise when in the open air, a

dry resting place, and sufficient nourishing food. Under these conditions the birds grow an extra thick and valuable covering of feathers.

LARGEST STEAM ENGINE IN THE WORLD

The 25,000-hp. rolling-mill engine installed in the Sharon, Pa., plant of the Carnegie Steel Company, is the largest steam engine in the world and weighs 550 tons without foundation plates and flywheel. It is a horizontal twin-tandem engine, with one cylinder 42 in. in diameter and the other 70 in. in diameter. It operates at a speed of from 150 to 200 revolutions per minute.

Being used to operate the rolls in a steel mill, it has to be quickly reversed at the end of each run, and for this



25,000-Hp. Rolling Mill Engine

Courtesy Allis-Chalmers Co.

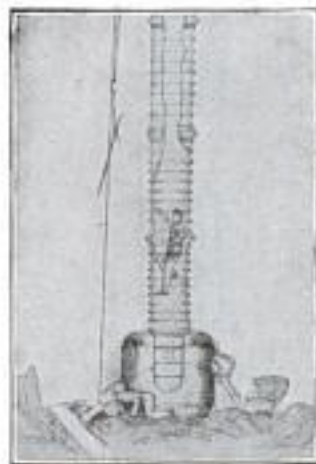
purpose the reversing mechanism is run by a small independent engine. Another small engine is used in operating the steam throttle valves, all of these units being under the control of the one engineer.

FIREMEN FOR SCHOOLS

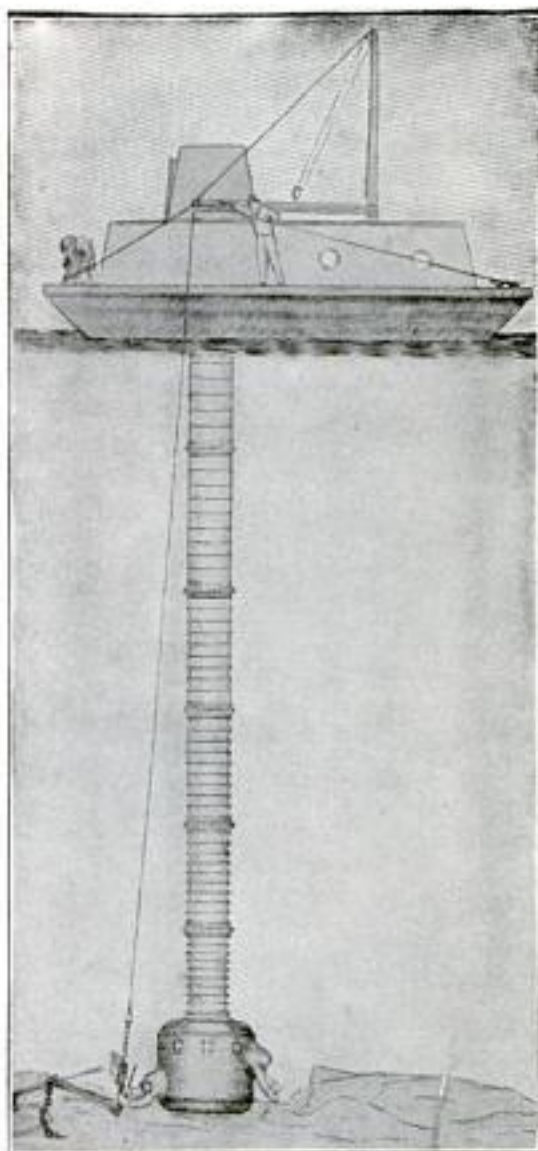
The Woman's Christian Temperance Union of Washington, D. C., has requested the District commissioners to have a fireman stationed in each school building during school hours. The Union maintains that if the stationing of firemen in the Washington theaters is a safeguard for theater-goers, the school children should have the same protection.

TUBE-CAISSON DIVING APPARATUS

A diving apparatus in which any person, whether skilled or unskilled, can descend and make personal examinations and explorations under water, has been invented by an eastern man, and is now in active operation in the James river.



This apparatus is a perpendicular tube-caisson, automatically submersible to any depth, affording an open air shaft to the surface in which an ordinary individual can descend and ascend at will. At the bottom of the shaft is an operating chamber which can be floated over the water-bed's surface, or be rested on the bottom. This chamber has a number of glass observation ports through which the operator can direct his movements. Objects can be handled by means of arm-sleeve extensions into which the arms are thrust as into the sleeve of a coat with gloves attached. Material is raised



"The Tube Telescopes"

or lowered by means of a lifting device on the outside of the tube. No compressed air is necessary and the operator only has to look upward to see the sky. The tube is collapsible and extends or telescopes with the motion of the vessel without affecting the position of the operating chamber.

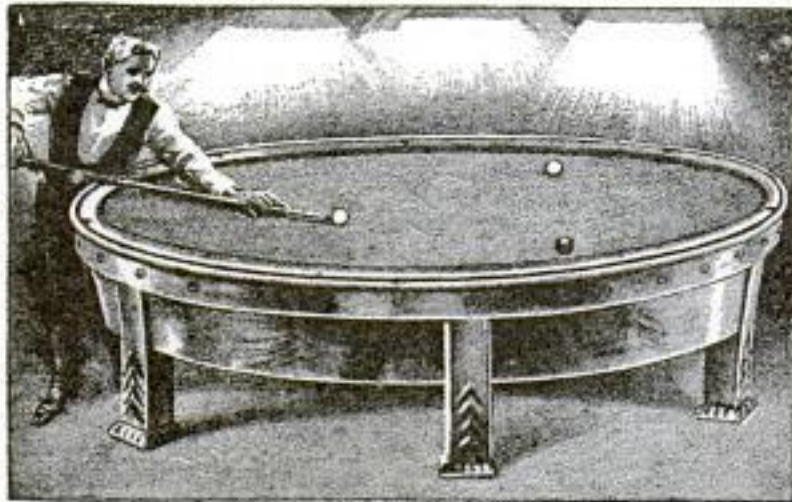
AIRSHIPS FOR U. S. NAVY

Following the lead of the War Department in calling for bids to secure practical airships for use in the army, the Navy Department is making plans for the application of aerial navigation as an adjunct to the navy. It is stated in Washington that Rear Admiral Evans expects to be furnished with either

an aeroplane or aeronat for experimental purposes before the fleet leaves the Pacific coast.

CHAMPIONS PLAY ON OVAL BILLIARD TABLE

Although the first oval billiard table made its appearance some time ago and gained an almost instant popularity in some parts of the world, very few of them have come into general use in this country. The new arrangement of cushions made many famous billiard shots much easier, and many more much harder, necessitating a new and thorough study of angles in which the cue ball had to be played and cushioned to make a successful carom.



Oval Billiard Table

FLOWING GAS AND SALT WATER WELL RUINS FARMS

The flowing well shown in this illustration has ruined nearly 400 acres of farm land near Mobile, Ala., during the past three years, and successfully combated every attempt to shut it off.



"Cannot be Suppressed"

The volume of water looks like the product of an ordinary artesian well, but on the contrary is salt water polluted with natural gas. Brought into contact with fire it belches a volume of flame strong enough to illuminate everything near it. In an attempt to bore for oil, the salt water and natural gas were struck at a depth of 400 ft.

WIRELESS CALLS AID TO BURNING VESSELS

Prompt action with the wireless telegraph prevented what might have been a serious panic when a fire broke out during the night on the freight deck of the Fall River line steamer, "Providence," while bound from Providence to New York. More than 300 passengers were asleep when the fire was discovered, and the captain, fearing a panic, sent a wireless call to the "Richard Peck," of the same line, which was known to be somewhere in the vicinity, although not sighted.

The call was promptly answered and the passengers quietly transferred. When freed of the care of the passengers, the entire crew of the "Providence" gave their attention to the fire and soon had the blaze extinguished.

Braking an automobile by means of the engine instead of with the regular set of brakes is at times particularly desirable, according to many automobile manufacturers.

BUILDING AIRSHIPS AND FLYING-MACHINES

By G. H. Curtiss, President G. H. Curtiss Mfg. Co., Hammondsport, N. Y.

PART I

[Editor's Note—Mr. Curtiss, who has been invited to write this series of articles, is not only himself a progressive and successful aviator, but has combined the scientific construction of the flying-machine with the scientific construction of the gas engines used for aerial propulsion. He thus combines in an unusual degree the theory of flight with the practical experience of a manufacturer.]

The term airship, generally speaking, is applied to dirigible balloons, while the heavier-than-air classes are more commonly spoken of as flying-machines. The flying-machine, or aéronef, is divided into three classes: Aeroplanes, which consist of one or more horizontal planes designed to soar into the air by being propelled forward at an incline; the helicopter, in which the ascensive force is secured by the use of vertical screws, or propellers; and the orthopter, or wing-beating machine.

In this chapter we will endeavor to describe the most simple and practical form of dirigible balloons, while the other types will be taken up in successive issues.

How to Build a Dirigible Balloon

The ascensive power of a dirigible or other balloon is secured by the use of gas contained in a large envelope of oiled fabric or rubber-coated cloth. For the dirigible balloon where the bulk of the gas bag is an important consideration, the use of hydrogen gas, which has the greatest ascensive power, is desirable; 1,000 cu. ft. of hydrogen gas will lift about 65 lb.

In building an airship, it is well to first determine the weight of the frame, propellers, engine, controlling mechanism and operator; then build, or purchase, the gas bag, of proper dimensions and sufficient capacity to lift the desired weight, together with a reasonable amount of ballast, which in a one-man outfit should be about 50 lb. Experience has taught us that a 7-hp. engine driving a suitable propeller will furnish sufficient pull to drive a one-

man airship as fast as it can be readily controlled. Taking this as a basis, let us proceed to enumerate what our requirements and their respective weights will be: An engine of this power in the form of a 2-cylinder air-cooled motor will be the most desirable. This will weigh, with all appurtenances, about 100 lb., the engine alone only weighing 50 lb. From this it will be seen that in securing an engine we must not consider simply the catalog weight of the engine, which seldom includes the ignition system, oil or gasoline tanks, mufflers, etc. Placing the weight of an operator at 175 lb., frame 60 lb., propeller and shaft 40 lb., rudder, drag rope and ballast 100 lb., we have a total weight of 375 lb. Add 80 lb. for the weight of the gas bag and its suspension, and we have 455 lb., which divided by 65 gives us 7,000 cu. ft. of gas required to lift the machine.

It is apparent that an elongated balloon will pass through the air with much less resistance than a spherical balloon. We will, therefore, adopt a form in which the length is about four times the diameter. A diameter of 15 ft. and a total length of 60 ft. gives us the desired cubic capacity. With this in mind, it is evident that a frame of considerable length must be constructed in order to support this long gas bag for the greater part of its length. This frame should be 40 ft. in length and can be constructed of spruce in the form of a triangle and properly guyed with wires at a weight of about 1½ lb. per foot. The illustration, Fig. 1, shows the proper form and method of construction. The frame should be in the form of a triangle measuring about 3 ft. on a side. The length of the spruce sticks would be approximately 16 ft. These sections can then be butted and spliced together by short pieces, lapped on underneath, and fastened by bolting and

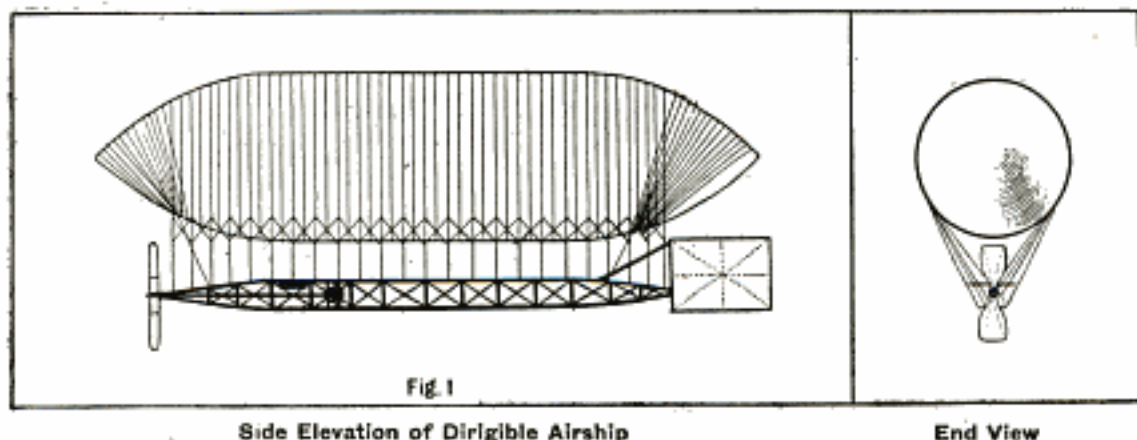
lashing. Lashing is one of the best ways of making the joint of two or more pieces on an airship.

The frame is hung underneath the balloon by attaching it to the netting on either side by light-weight linen cords, as shown in the sketch. The longitudinal sticks of the frame should be triangular in form, while the cross sticks should be square.

The engine should be mounted at about one-third the length of the frame from the forward end, and the power transmitted to the propeller shaft by the use of a heavy bicycle or motorcycle chain. The propeller shaft should be made of $1\frac{1}{4}$ -in. 16-gauge tubing, supported by about five bearings and fitted

work being of bamboo. The rudder, Fig. 3, is controlled by an endless cord running through a pulley in front of the operator, so that he can get hold of it with either hand.

To build the gas bag is perhaps the most difficult part of the construction and requires the most skill. The builder must, after determining the size of his bag, divide it into three sections: the forward taper, the straight cylinder, and the rear taper. The cylinder is composed of straight strips of equal length, while for the tapered ends the silk must be cut in the form of a triangle, with the sides cut on a slight curve. This can be secured by hanging the silk on the wall and attaching silk



Side Elevation of Dirigible Airship

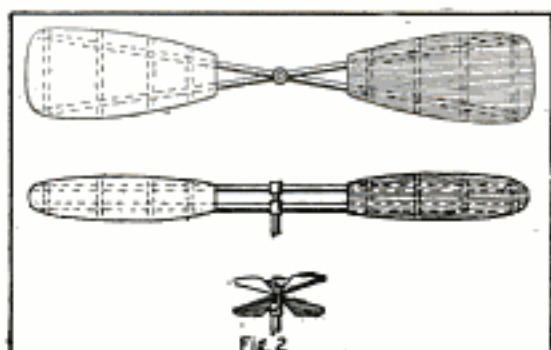
End View

with a thrust for taking the pull of the propeller.

The propeller, Fig. 2, would be 10 ft. in diameter, with an equal pitch. The pitch can be secured by fitting the braces which hold the arms of the propeller to the shaft at an angle of 20 degrees from each other. The arms for the propeller should be made of hickory or ash, and the canvas covering tacked on over light $\frac{1}{4}$ in. by $1\frac{1}{2}$ -in. slats mortised into these arms. The blade at its widest place should be 2 ft. For convenience in removing or replacing, in case of accident, the propeller should be made up separately from the shaft and attached to the shaft by two $\frac{1}{4}$ -in. tapered pins. The rudder should contain about 50 sq. ft. of surface and be braced in the manner shown in the sketch. It is preferable to cover this rudder with silk, the wood-

cord from end to end, marking the silk as the cord hangs. This will give a good form. All of the seams run lengthwise. There is no strain on the silk when inflated in a properly fitting net.

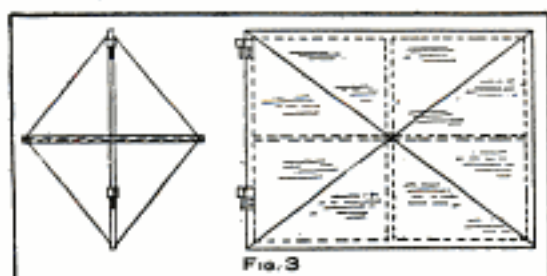
While cotton fabric may be used, silk is by far the better. If properly treated it will last indefinitely. It is much stronger and lighter than other fabric. The first operation in building the balloon is to oil the material. The fabric should be cut in lengths and treated with linseed oil. The oil can best be applied by dipping in a large vessel or tub. The strips should then be hung by one end in a large room, of moderate temperature. This first coat of oil should dry in three or four days, although in some climates it takes considerably longer. After the strips of silk are given one coat of oil and thor-



Details of Propeller

oughly dried they may be cut to the proper shape to form the cylinder and cone-shaped ends of the gas bag.

The seams should run lengthwise, and each lap should be double stitched. After all of the silk has been sewed up, a manhole of about 15 in. in diameter should be made in the center, and a small neck, 6 in. in diameter, a little to the rear of the manhole, fitted for inflation. The balloon should then be blown up with air from a centrifugal blower, and a coat of oil put on by brush from the outside. A strip should be oiled the entire length and the balloon rolled over slowly and another strip oiled, etc., until the entire surface is covered. It may then be turned inside out, through the manhole, and the process repeated. After it has been given a sufficient number of coats to make it airtight, powdered soapstone, or French chalk, should be sprinkled over the entire surface inside and out, to prevent sticking. Care must be taken that expansion shall not occur from change of temperature and burst the bag.



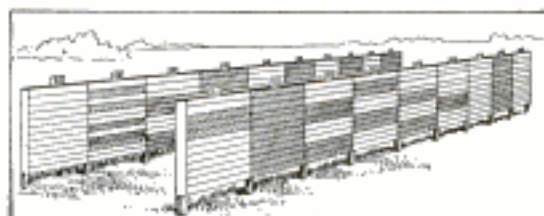
Details of Rudder

The framework is suspended from the balloon by linen cords attached to a square mesh of Irish linen net, as shown in the illustration, Fig. 1.

The net should be carefully adjusted over the bag before filling is commenced. After the balloon is fully inflated, the framework may be placed beneath it and the suspension cords attached, the rudder and propellers fitted on, and the machine is ready for a flight.

PAINT TEST FENCES

Paint test fences have been erected at the North Dakota Agricultural College, at the Carnegie Institute in Pittsburgh, Pa., and at Atlantic City, N. J., for the purpose of comparing the effect of weather on paints under the varying climatic conditions of these widely separated localities. The illustration shows



Courtesy Modern Painter

The Test Fences

the test paint fences erected in North Dakota. The same paint formulas had been used in each locality.

REVENUE CUTTERS AS LIFE-SAVERS

The importance of the revenue cutter service as a means for saving lives along the American coasts is daily becoming more apparent to congress, with the result that there is a disposition to increase the size of the revenue fleet. With this in view, the U. S. gunboat "Vicksburg" is to be turned over to the Treasury department's navy and put into service on the Pacific coast. The revenue cutters, "Mohawk" and the "Thetis" have made an enviable record in the work of rescuing sailors from shipwrecked vessels.

To make a surface to paint on copper apply to the metal a solution of copper sulphate to which is added a little nitric acid.

POPULAR MECHANICS

TWO GREAT HISTORICAL BELLS



Great Bell of Moscow, "Czar Kolokol"

When Christianity was young it was a popular belief that demons, frightened by the sound of bells calling Christians to prayer, would flee away, and consequently bells were not only used as a summons but as a precaution.

The great bell of Moscow, "Czar Kolokol" (Emperor of Bells), is by far the largest bell in the world. It weighs about 492,800 lb., and its cost in bell material was fully \$340,000, to which more than \$1,000,000 was added in precious jewels, plates, etc. It is 19 ft. high and 19 ft. in diameter, and was cast by order of Empress Anne in the year 1733. The bell was originally suspended from beams, which, being destroyed by fire, let it drop to the ground.

The great bell of China weighs 120,000 lb., and is 14 ft. in height and 12 ft. in diameter. The Chinese bells are struck with wooden mallets instead of iron clappers.

The program of the Russian Admiralty, which includes a big fleet of battleships, the last of which is to be completed in 1917, calls for an expenditure of \$1,078,000,000.



Courtesy Meneely Bell Co.
Great Bell of China

SUFFRAGETTES FLY KITE

One of the latest devices of the English suffragettes to draw the attention of the members of Parliament is a kite, from which hangs a banner inscribed "Vote for Women." The kite is kept flying over the houses of Parliament from daylight to dusk.

FRENCH 16-CYLINDER MOTOR

Among the new inventions shown at the last automobile exhibit in Paris was the Pengot, a 2-cycle, 16-cylinder motor of exceptional interest. The largest American automobile engine in gen-



16-Cylinder Auto Engine

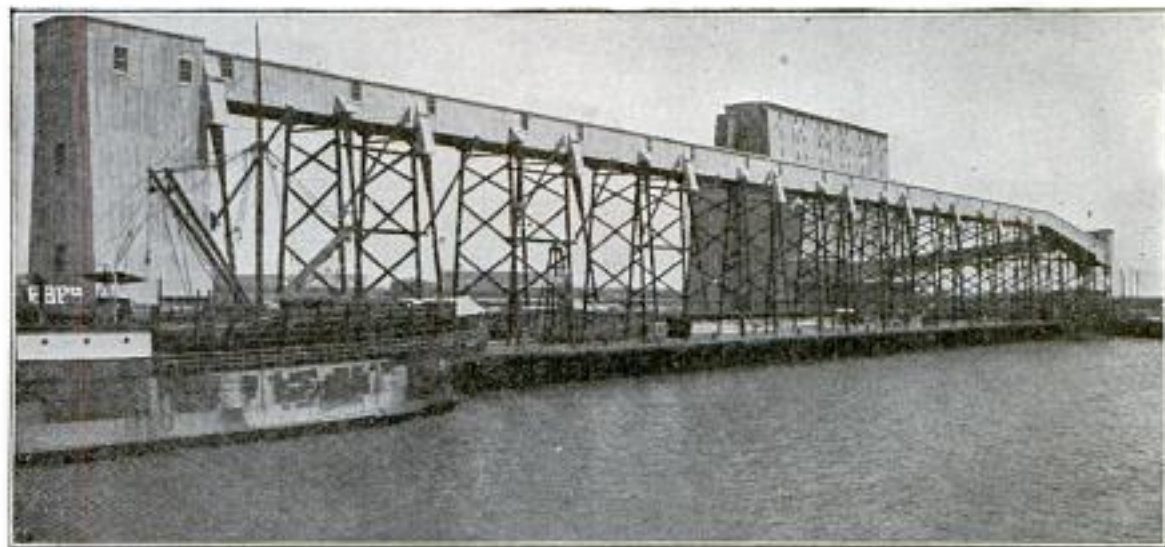
eral use has only 6 cylinders, although 8-cylinder motors are being used to some extent on motorcycles.

DOCTOR SUMMONED TO PATIENTS BY PIGEONS

In the small village of Skowhegan, Maine, where telephones are few and far between, the extraordinary idea of a pigeon messenger service has been successfully carried out by the village doctor, who by this method receives an almost instant call when any of his regular patrons become ill. He first trained 50 carrier pigeons and then gave them to as many regular customers. The moment any member of a family having one of these pigeons becomes ill, the bird is liberated and the doctor does the rest.

GRAIN LOADED AT GULF OF MEXICO PORT

Of a type somewhat different from the chutes used at northern ports for loading grain into ships, this immense structure is typical of the seaports of the southern states. The great number of chutes suspended from the runway, 19 in all, make it possible to load two or three ocean steamships at the same time.



Several Steamers Can Load Here at One Time

SERVING MEALS ON A BIG SCALE

At a recent municipal celebration in Covina, Cal., in which a barbecue was given to mark the advent of an electric railway, coffee was served from an



Capacity 5,000 Cups

urn holding 250 gal. or 5,000 cups; beans were cooked in a pot holding 200 gal., and 12 steers and twice as many sheep and porkers were roasted to a turn in a 44-ft. trench.

The giant coffee pot stood 9 ft. high and was the largest ever made. It was heated over a roaring coal fire,

and during the feast was twice emptied, thousands drinking from it for the novelty as well as for its excellent brew. The huge bean pot was patterned after an original in Boston. The steaming meat was eaten by 15,000 people.

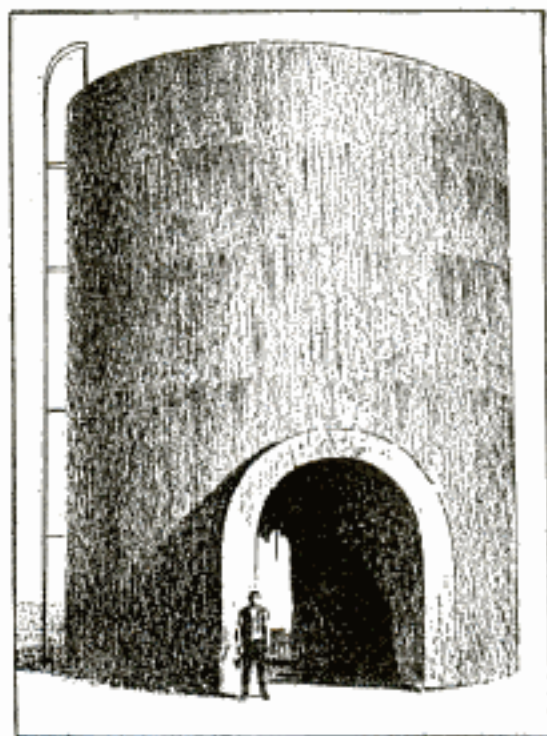
"OLD GLORY" RE-ARRANGED

By order of the war department, the field or union of the national flag in use in the army will, after July 4, 1908,



Official After July 4, 1908

consist of 46 stars in 6 rows, the first, third, fourth and sixth rows to have 8 stars, and the second and fifth rows 7 stars each. This arrangement leaves



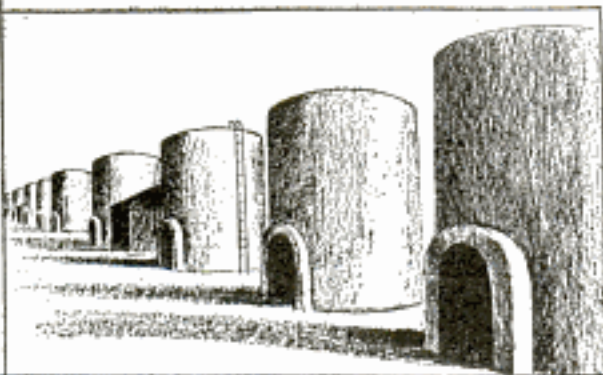
space for an additional star in two of the six rows, so that the next time a state is made the field of "Old Glory" will not have to be materially re-arranged.

CONCRETE BINS FOR STORAGE OF FILTRATION SAND

An important and absolutely new feature of the immense filtration plant at Washington, D. C., which in itself is a concrete city covering more than 29 acres, are the massive concrete sand bins, 29 in number, which form a part of the sand washing system.

These bins are used for the storage of sand after it has been washed and before it is returned to the filter beds. From the washer the sand is carried, suspended in water, through pipes and into the bins. The proportion usually flowing in is four parts water and one part sand. The sand sinks to the bottom and the water accumulates until the bin is half full. At this level the water overflows through a pipe, and continues to overflow until the sand reaches the outlet. The gate at the first outlet is then closed, and the process is repeated by the use of a second outlet near the top of the bin. Each bin holds 250 cu. yd. of sand.

The bins are of massive construction and tower 32 ft. into the air. The diameter, outside measurement, is 23 ft. 6 in., and at the top the outside wall is 9 in. thick. They are supported on circular concrete foundations, carried below the frost line. Their great weight, to which is added the weight of



Immense Sand Washing Bins—Washington Filter System

the wet sand, is carried partially on the outside wall and partially upon three circular arches. These arches intersect at the center of the structure, and leave a space underneath large enough for a 2-horse cart to enter. At the intersection of the arches there is a heavily constructed gate, through which the clean sand is allowed to pour into the wagons. From the wagons the sand is dumped through manholes upon revolving chutes, which scatter it quite evenly over the surface of the filter. At other filters, where there are no concrete sand bins the washed sand is heaped up in the courts and must be shoveled into

the wagons by hand before it can be taken back to the filters.

At the Washington plant the dirty sand is also handled in the easiest manner possible. Laborers scrape it up from the surface of the filters and throw it into ejectors, whence it is forced by water pressure through a series of hose and pipes into the sand washers in the courts.

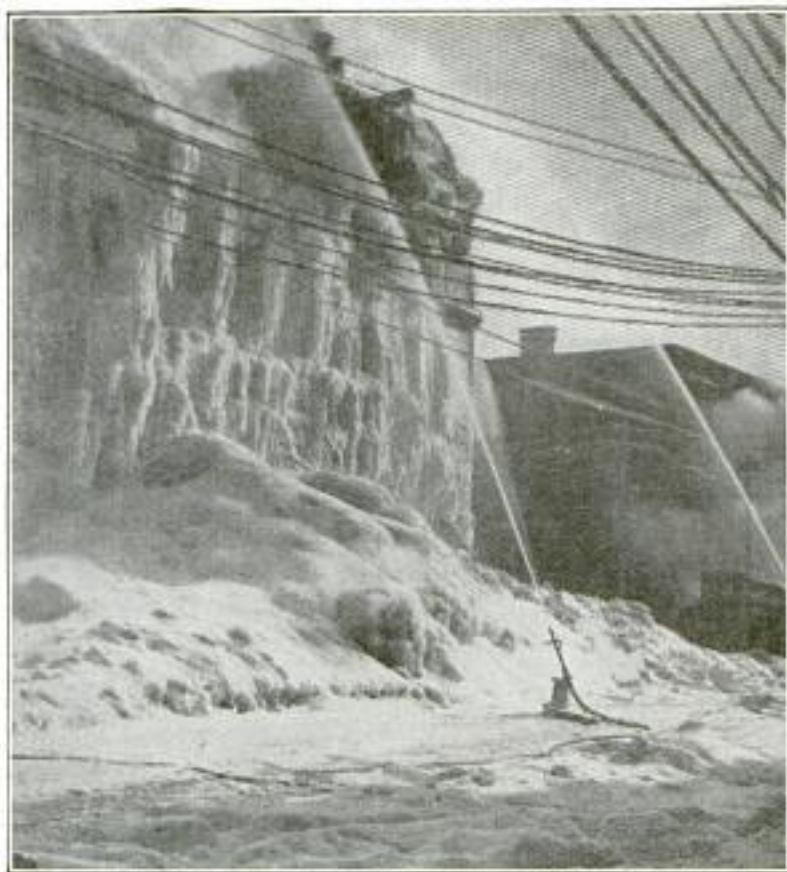
The 29 bins cost \$60,800, but this expenditure has been justified. The average cost of handling a cubic yard of sand by this system is about 42 cents, while the cost at other plants runs from \$1.38 to \$1.70.

BUILDING BURNS 78 DAYS SUR- ROUNDED BY WALL OF ICE

Surrounded by an immense wall of ice, 8 by 10 ft. thick, a fire in a 5-story building in Troy, N. Y., filled with bales of cotton waste, defied the efforts of the fire department to extinguish it for 78 days, and on the last day took a combined force of 15 streams of water to quench the flames.

The fire started on one of the coldest nights of a winter month, and the dense smoke soon drove the firemen to a respectful distance. Almost as rapidly as the water struck the building it froze into a solid mass, surrounding the heart of the fire with an almost impassable barrier. The amount of water soaked up by the waste caused the building to collapse. For 41 days several engine companies, assisted by volunteers, threw incessant streams of water on the great mountain of waste and debris, but as this only coated the ruins

with more ice the fight was ineffectual. At times the fire beneath caused the ice to collapse and sheets of flame burst



78 Days Required to Subdue This Fire

through, filling the surrounding district with smoke and driving workers

from adjacent buildings. It was seemingly impossible to remove the bales of waste frozen together under tons of bricks by usual means. Dynamite was not experimented with. The fire burned fitfully for 78 days until warm weather came, and on the last day blazed up again almost as fiercely as on the first night. The photograph was taken on the sixteenth day.

TENTS USED AS UNIFORMS DURING THE DAY

By Frank H. Gotsche

A Californian inventor has devised an interesting shelter tent, the canvas covering of which can be divided into sections and worn as a garment or uniform during the day. Adapted for the use of troops, hunters and campers in general, the uniform, or poncho, as it is called, somewhat resembles the uniforms sometimes worn by the soldiers of oriental countries.

The illustrations show a hunter wearing a poncho, and two different sized tents ready for occupation. The first is 8 ft. high and 11½ ft. in diameter, and is made of 5 ponchos. The second is made of 4 ponchos and is 8½ ft. high and 9 ft. in diameter.

When using a tent section as a poncho, the arms are passed through the connected edges between the buttons, and a piece of cord, or a belt, is fastened around the waist. The wearer thus has the free use of his arms and the garment fits with sufficient closeness for comfort and protection from the weather.

The tent in position has a triangular shape, with as many triangles as there are ponchos. The main support is a center pole, around the top of which is placed a ring. The shape of the poncho-sections admits of any number be-

ing used in the construction of a single tent, so that it can be made as large or as small as desired.

BERLIN ASPHALT WASHING MACHINE

A movement is on foot among property owners in Berlin, Germany, to have this motor-propelled asphalt washing machine take the place of the ordinary street sprinkler, which always leaves an asphalt pavement swimming in water and in an utterly unsuitable condition for immediate usage.

This machine sprinkles, cleans and immediately dries the asphalt, so that it can be used at once by other vehicles, without the certainty of spattering water and mud in every direction, and



Poncho Tent Can Be Worn

the less frequent but more serious danger of skidding. The water consumption is small, every drop being utilized, and then washed into the gutters by

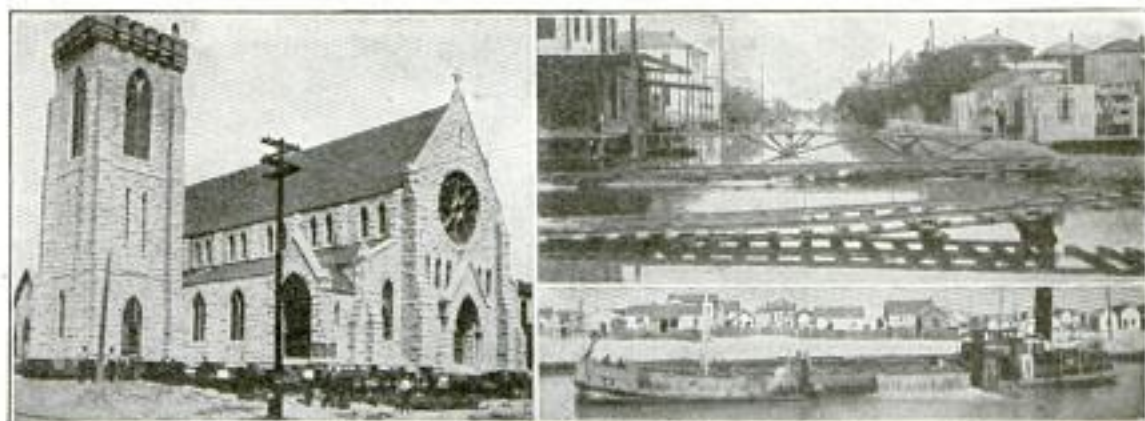


Asphalt Washing Motor in Operation

the rotating rubber roller at the rear. The machine is driven by electric batteries located over the front trucks. Two 4-hp. motors are mounted on the front wheels.

bay, and the sand, rising inch by inch, creeps up around the stilts until the buildings are again on a solid foundation.

One of the accompanying illustra-



Raising Church 12 Ft.

Temporary Bridges—Sand Dredge

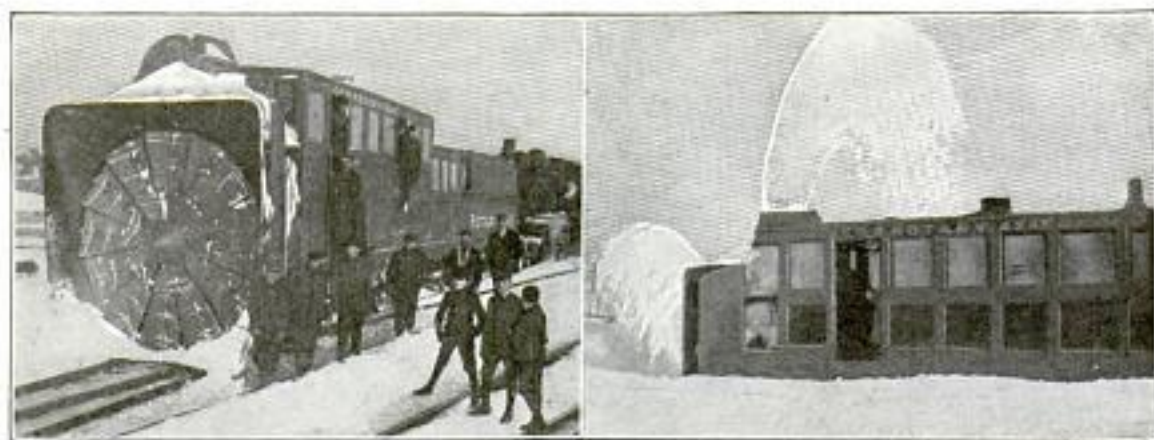
DELUGING GALVESTON WITH SAND AND WATER

The remarkable manner in which the grade of Galveston, Texas, is being raised 15 feet, to protect it against another possible tidal wave, is intensely interesting. Section by section the southern city is being deluged with sand and water, and houses, churches and business places are being raised on stilts. The water runs back into the

tions shows the end of a dredge discharge pipe belching a deluge of sand and water 10 ft. high into the streets. Another photograph shows a large stone church being jacked up to the new level, and still another the condition of a street with street car tracks raised, and foot bridges for pedestrians. The water seen in the street is slowly finding its way back to the canal and thence to the bay, leaving its burden of sand behind. The vessel in the canal is a hopper dredge loading sand.



Night and Day These Geysers Pile Up Sand



A Front View

Plow in Action

ROTARY SNOW PLOW IN CANADA

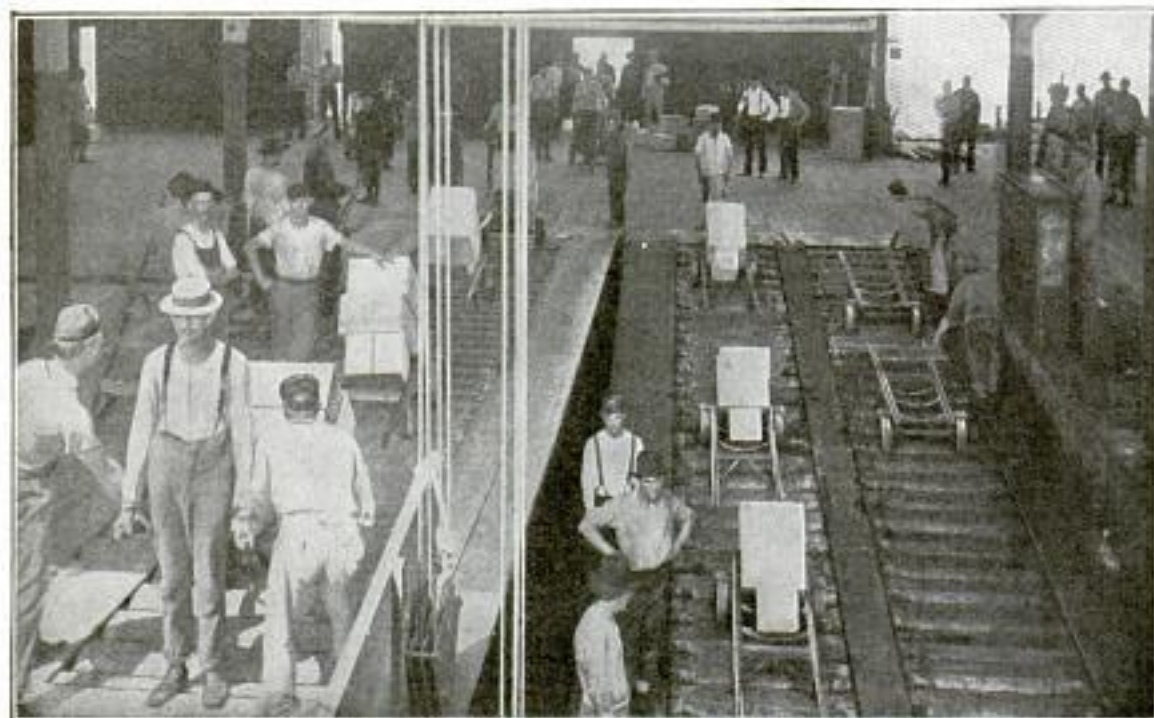
Fighting the immense snow drifts that blockade the railroad lines in the Canadian north and northwest every winter is a task that taxes the ingenuity of railway officials and the staying powers of the many corps of snow fighters on whose shoulders rests the responsibility of keeping the lines clear.

These illustrations show one of the rotary plows of the Canadian Pacific Railway, which all winter long burrowed through 25-ft. drifts in northern

Ontario. One illustration shows the circular blades of the plow at rest after a severe combat, and the other the plow in action, catching up the snow and sending it through the chute at the top. The snow is thrown in this manner a distance of from 50 to 100 ft., according to the depth of the drift.

UNLOADING PACKAGE FREIGHTERS

In unloading package freighters it is impossible to do the work with suction funnels or clam shell buckets as is the case with bulk freighters. The pack-



The Men, Trucks and Freight Ride on Moving Platforms

ages are lifted from the hold to the different decks by pulleys and placed on trucks. The trucks are wheeled onto steam or electric conveyers which carry them up the incline to the freight sheds. The same method is used in loading. Heavy weights attached to the ends of the conveyers make it possible to raise or lower them as the ship rises out of the water in the process of unloading or sinks lower when loading. The conveyers are really moving sidewalks upon which the loaded trucks and men are carried.

U. S. "CHESTER" MAKES GREAT SPEED RECORD

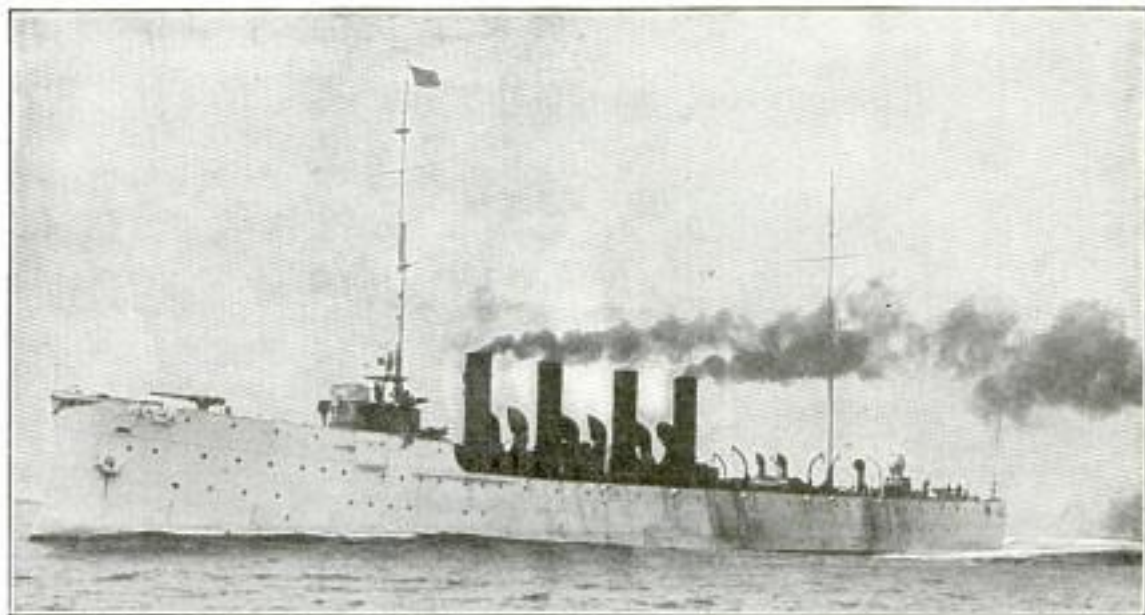
The United States scout cruiser "Chester" has broken the speed record for cruisers with a speed of 26.52 knots,

the enemy in times of trouble. Her battery consists of two 5-in. guns, six 4-in. guns, and two 21-in. submerged torpedo tubes. Her length is 423 ft., 2 in., and breadth 46 ft., 8 in. The contract called for 27½ miles an hour, 3 miles less than she has succeeded in accomplishing. The indicated horsepower of her main turbines is 16,000. Her two sister ships are the "Salem" and "Birmingham," both building at Quincy, Mass.

HOW MINES ARE SALTED

The ways and means by which mines are salted and disposed of to unsuspecting purchasers are sometimes difficult of detection, even by experienced mining engineers.

On this subject Howard W. Dubois



The United States Scout Cruiser "Chester"

or 30½ land miles an hour, made in her speed trials off Bath, Maine, where she was constructed. Equipped with turbine engines, she has proven herself one of the fastest war vessels in the world, and has won the honor of being the fastest craft in the United States navy with the exception of the torpedo boat destroyers.

The "Chester" is one of the three vessels authorized by Congress to act as scout cruisers and keep in touch with

says, "Salting may take place in the mine itself previous to examination, but this method involves considerable expense. The cheapest and easiest method used is to salt the engineer's samples, and the salting, so to speak, of the engineer himself for a favorable report is often possible by the financial inducements which can be offered, in comparison with which the ordinary examination fee would look small.

"The books of mines are often fixed

to show good mill returns, whereas operations have been carried on at a loss, and cases have been known where gold ore has been purchased at twice its real value, both for salting purposes and to give a good product to the mine."

Precious metal mines are those mostly selected for the salter's art, but cases have been known where attempts have been made to salt iron mines. It requires the greatest vigilance on the part of an examining engineer to make sure he has not been salted at one of the many opportunities presented.

FRAUDS IN WEIGHTS

A lump of damp putty stuck to the under side of the pan of a scale is one of the many ways by which dishonest



A Lump of Damp Putty on Scale Pan

dealers cheat their customers out of from one to four ounces to the pound of the goods they are purchasing. The

lump of wet putty lies on a ledge back of the counter and is deftly attached to the bottom of the pan as it is placed on the scales.

THE STRENGTH OF THE BRITISH NAVY

Speaking in the British house of lords, Lord Tweedmouth, first lord of the admiralty, said Great Britain's three warships of the "Temeraire" type were superior to the "Dreadnaught" type, and the three warships of the "St. Vincent" type would be a still greater improvement. He also stated that in the spring of 1911 Great Britain would have three squadrons of four ships such as the "St. Vincent" type, and that it would be safe to say all the powers of the world combined would not be able to put an equal squadron on the sea.

CONCRETE TERRACE WALLS

Reinforced concrete terrace walls, with an "L" foot, have been constructed at Ocean Front, Long Beach, Cal., to make possible a beautiful terraced lawn down the front of a 60-ft. bluff. Without the "foot," or inward facing, it would have been necessary to build the walls several feet thick, instead of only 10 in., as the dirt which covers this inner facing keeps the walls from being tumbled over into the water.



The Concrete Wall Along the 60-Ft. Bluff

HORRIBLE HOLOCAUSTS UNNECESSARY

The Mechanical World Provides Safeguards if Humanity Will Avail Itself of Them

Ever so often, and that often has been occurring more frequently than ever during the past few years, some awful holocaust takes place which wipes out of existence a hundred or more lives because of carelessness or neglect in the providing of adequate means of escape and the keeping of such means in proper condition.

As often as such disasters occur the civilized world rouses itself to frantic action; school commissioners, far and near, visit the school buildings under their jurisdiction and find dangerous conditions; the building commissioners of municipalities hurry from building to building demanding a fire escape here and less inflammable material there. A veritable crusade is launched, and nations, states and municipalities are shaken.

Mothers send their children to school next day with dread, adults shiver with apprehension in the theaters.

All this sudden impetus to better existing conditions is to be praised, but the price humanity pays for such a lesson is overwhelming. Why not the impetus without the lesson? But that has to do with human nature, not with mechanics. The mechanical world has provided means to safeguard humanity and it now remains for humanity to avail itself of the opportunity.

In the first place, every state should pass a law, and rigorously enforce it, that every school or building in which men, women, and especially children, congregate should be constructed as nearly fireproof as constructive ingenuity makes possible. Not only this, but other laws should be passed dealing with the duties to be imposed upon men

who have charge of such buildings, making neglect of duty and the obstructing of exits by locked doors, or other means, a prison offense. The building specifications of towns and cities and the rules laid down by boards of education are not sufficient to grapple with the problem.

The first and greatest safeguard is



Safety Stairs 35 Ft. from Building

fireproof construction. With walls constructed of stone, concrete or brick, steel stairways, steel window sills and frames, floors and ceilings of reinforced concrete and fireproof tile, expanded metal lath, desks and seats with cast-iron standards, a vagrant blaze would find very little to feed upon. Such construction will undoubtedly become universal in the near future, but as yet only a few of the metropolitan cities seem to realize its importance.

On school buildings of the usual construction, with wooden floors, paneling and stairways, the fire escapes should be the best obtainable, be accessible from every room, and reach completely to the ground.

The fire escape on the Central school building of Sterling, Ill., which, by the way, was constructed some time before the lesson, is worthy of serious study



Suggested Plan of Emergency Exits—One from Each First-Floor Room

on the part of every city in the country. It consists of a wide steel platform on a level with the second story of the building, and at least 35 ft. out from the wall, supported by a number of steel posts. From this to the ground are wide steel stairways down which four rows of children can walk. Two passages or runways connect the platform with two specially constructed doors opening into rooms on the second floor, and stairways connect the platform and the third floor. In emptying the building the children come down the upper stairways in two columns, two abreast. Two columns turn to the right and two to the left, going down the lower stairways four abreast.

Another type of fire-escape, which is being installed on many metropolitan school buildings, is the spiral-chute. In exterior appearance it looks like a steel cylinder or drum standing up alongside the wall. Its interior is a spiral chute or slide. The children, stepping into it by an entrance on each floor, slide feet first down the chute until



Fire Escape Ladders and Platforms for Each Floor, on Four Sides of Building

they reach the bottom, where they are gently tossed out on the ground. The chute is usually about 9 ft. in diameter. Experiments have proved that it is a safe and quick means of emptying a building and that there is no possible chance of the children becoming clogged in the descent.

Among other plans proposed is the building of outside exits to all the rooms on the first floor, so that the children in these rooms can, in case of fire, leave the building without using the halls. This would give the children rushing down the stairs from the upper floors an unobstructed passage.

Still another plan is the construction of a steel platform entirely around the building at each of the upper floors, making the fire-escape stairs accessible from every window.

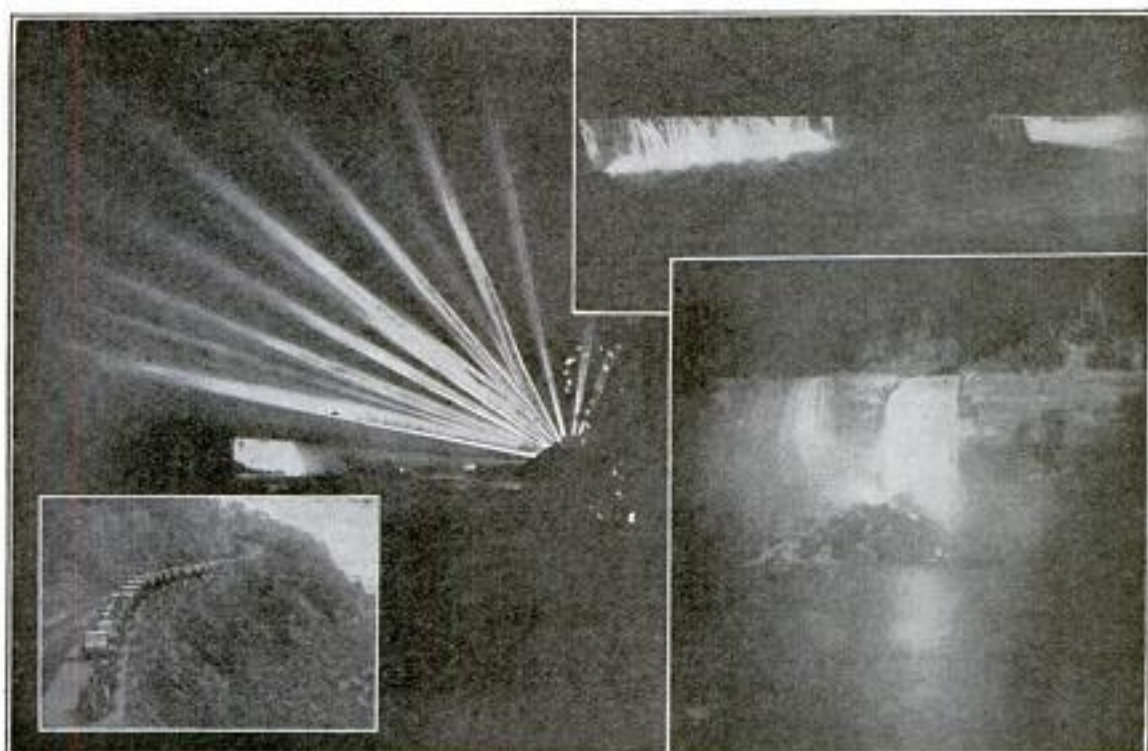
The question of finance is one of the leading factors in opposition to expensive improvement, especially in smaller cities and towns, but the strongest opposing factor is the class of men who do not consider such improvements absolutely necessary because the children in their community have gone to school for 50 or 100 years without a disaster. "Such holocausts only occur once in a long time," they argue, "and the probability that out of all the schools in the country the next might occur here is far fetched." If the probability were more apparent these same men would undoubtedly be the first to demand the necessary changes, but they do not duly take into consideration the fact that it is the unexpected that always happens.

BURNING NATURAL GAS AND SLACK

Low grade bituminous slack, when burnt in conjunction with a small amount of natural gas, makes smokeless combustion possible. The natural gas introduces an excess of oxygen and the heat necessary to ignite the volatile gases of the slack. The slack is burned on plain stationary grates and

the gas is introduced through five small jets in the side walls of the fire-box, so that the gas flames play over the entire fuel bed. This grade of coal costs only a little over \$1 per ton.

Sometimes precious stones have blemishes which are removed by burning in sand and iron filings. White spots on rubies and black spots on diamonds are removed in this manner.



Weird Night Effect at Niagara Falls

Copyrighted, 1907, by B. H. Norris

HOW JEWELS ARE FAKED

The making of false gems and the doctoring of others which are real, but slightly blemished, has become a profession so widespread that in some countries the workers of entire towns do nothing else.

Artificial rubies are sold in every city, large or small, in the civilized world. The method of manufacturing them is simple. A small crystal of silicate of alumina, colored by bichromate of potash, is rotated at a high speed, and under a high temperature. It is then nursed with minute particles of natural ruby, which adhere and become melted onto the center cone. With care and patience a large head can thus be built up from which the ruby is afterward cut.

It is said that almost every pink topaz now on the market has been "pinked," as the topaz, although it occurs in many colors, is rarely pink.

ILLUMINATING NIAGARA FALLS

The illuminating effects obtained at Niagara Falls, under the rays of the three powerful batteries of searchlights which were given an experimental test during the month of September, 1907, were so beautiful that steps have been taken for the permanent installation of a series of batteries just twice as strong, at an approximate cost of \$40,000.

The three batteries used in the trial will be part of the permanent installation, and were composed of twenty-six 30-in. and eleven 18-in. reflectors. All the effects were controlled from battery No. 1, the sub-division into three batteries being for the purpose of securing a wide sweep over both the cataracts, with a rising and plunging light. When the permanent installation is completed this summer the combined searchlights will give approximately 2,000,000 cp.

CHINESE ALUMINUM AERONAT

China, not to be outdone by the powers, has entered the friendly strife for airship supremacy with an aluminum aeronat, or dirigible balloon. Its inventor, Tse Tsan Tai, has been working out his idea since 1894.

The Chinese inventor not only believes that aluminum is indispensable, but that dirigible balloons should depend upon their fan-propellers for advancing, receding, ascending and descending, and that the cigar-shaped balloon should only be used as a safety buoy. Consequently, besides bow and stern propellers, the "China" is provided with three powerful deck propellers, regulated by clock work. Instead of being steered by exposed horizontal and perpendicular rudders, it is controlled by concealed steel wings which can be ejected from either side of the ship's stern by pressing an electric button.

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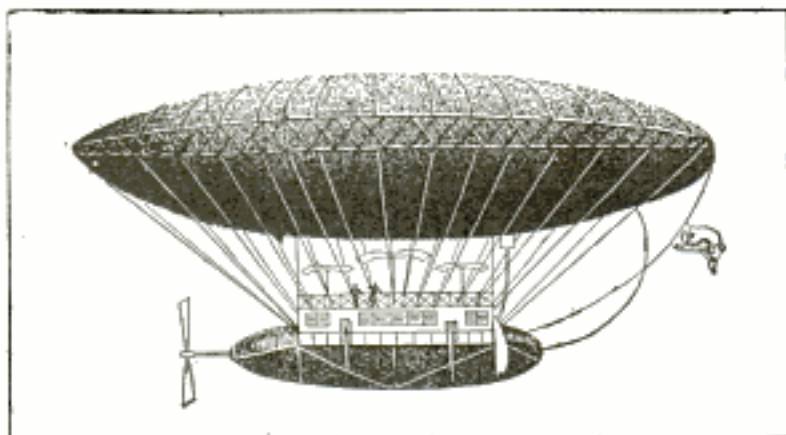
**"BATTLE FLEET" TO CIRCLE
GLOBE**

When the "battle fleet" steamed into Magdalena bay on March 12, practically ending the history-making cruise of over 13,000 miles begun less than three months before, the naval experts of the world marveled at the feat of seamanship that brought the fleet into harbor three days ahead of its schedule without a ship being in the slightest way disabled.

The acclaim, not only of the people of this country, but of other countries as well, filled the fleet's cup of joy brimming, and all drank of it, from "Fighting Bob" to the most inconsequential though far from humble Jackie; but a perfect tidal wave of joy engulfed the fleet two days later when the message was received from Washington announcing that the ships would

leave San Francisco on July 6 to circle the world.

After target practice at Magdalena bay the fleet left for San Francisco, where it will arrive about May 5, making stops at San Diego, Los Angeles, Santa Barbara and Santa Cruz. The fact that but two months is to be allowed between the arrival of the fleet at San Francisco and its departure for



the Far East is the best proof that no serious repairs are necessary to any of the ships. Even this short time for repairs will be cut down by the excursion of the fleet to Puget Sound to give the people of the North Pacific coast an opportunity to see the ships.

On the trip around the globe the vessels will first touch at Hawaii, where they will coal. From there they will go to Samoa, and thence to Melbourne and Sidney at the invitation of the Australian government and the British ambassador. Leaving Australia, the fleet will proceed to Manila, and while in the Philippines the annual fall target practice will be held.

As soon as the news reached Japan that the fleet was to proceed around the world the emperor of the island kingdom expressed his desire to have it visit Japanese waters. Accordingly Baron Takahira, the Japanese ambassador, presented the invitation, couched in the most cordial terms. The same was considered by President Roosevelt and his cabinet and accepted. China will also be visited. The fleet will return to the United States by way of the Suez canal, reaching the Atlantic seaboard again about March 1, 1909.

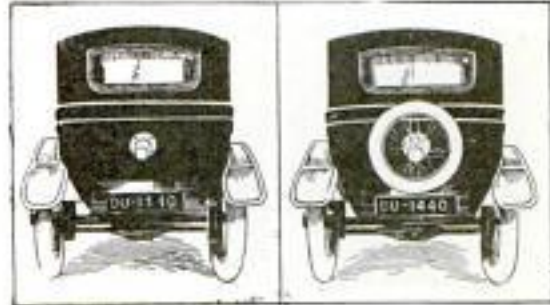
One interesting feature was the fact that on the last half of the great cruise more miles per ton of coal were obtained than on the first half, owing to the increased efficiency which goes hand in hand with added experience. It was the efficiency of the boilers that struck the French admiralty with amazement. One of the greatest troubles in the French navy is the predominance of boiler accidents, whether the cruise be a long or a short one. In consequence the head of the French admiralty has advised a study of American boilers, a number of which are now being manufactured in France.

The wisdom of the cruise is now conceded by even those alarmists who had visions of wars as a result. Quite the contrary effect is being produced, and the ocular demonstration of ability and power which the fleet is demonstrating to peoples having only vague ideas of what this country really is, will result in greater respect and enlarged business relations.

The British government will issue postage stamps with a black border for sale to people in mourning.

CARRYING A SPARE AUTOMOBILE WHEEL

One way of carrying a spare automobile wheel is shown in this illustration. A holder, or dummy hub, made of aluminum and weighing under 4 lb.,



"Hub" Holder for Tire

is fastened to the back of the automobile. This holder, being an exact imitation of the wheel hubs, keeps dust and water out of the interior of the spare wheel, thus insuring an easy change.

Brigadier General Allen, who has charge of army aeronautics, has had a number of the smaller and older spherical balloons of the war department patched up for use in target practice.



Many of the through trains in Europe have a Hospital Compartment, as shown in the above illustration.

THE TROUBLES OF THE TROUBLE HUNTER

Amusing Solutions of Serious Difficulties—Why Pumps, Air Compressors and Gas Engines Sometimes Don't Operate

By C. F. Carter

When a man buys an engine or a pump or a machine of any sort he naturally expects it to do the work required of it. In ninety-nine cases out of a hundred the work will be done faithfully enough provided the engine or the machine is treated fairly. But if there is anything on earth which insists with inflexible pertinacity upon getting a square deal it is a bit of machinery.

Unfortunately, abused engines and machines cannot talk to explain their troubles; they can only strike. The owner, however, does enough talking for both sides when anything goes wrong. Never by any chance does he take any blame to himself. All that is saved for the builders of the offending property. If the tolls are not too high they get it by telephone. Otherwise the down-trodden sufferer sends by mail a choice lot of compliments that have been studied up in advance for just such a contingency.

All this is so thoroughly understood and accepted as a fundamental part of the business that large engine builders and machinery houses have special men called "trouble hunters," who are detailed to stand up and take this abuse and then proceed to the scene of the difficulty and take some more. When the trouble hunter points out the fault, which is very often due to some absurd



oversight or neglect on the part of the operator, then comes the real explosion. Anybody who imagines that a man will gracefully acknowledge to a stranger that he has made—well, a mistake, doesn't understand human nature, that's all.

There was a millionaire on upper Fifth Avenue in New York who bought a pump driven by an electric motor to force water to the top floor of his magnificent mansion, the pressure in the mains being insufficient. The pump was installed by one of the largest and best known concerns in the trade and was left in good working order.

But the very next day there came a call over the telephone for the manager of the pump company. In torrid tones as became an outraged millionaire the purchaser of the pump announced that it was no good, that the builders of it were no good, that the men who installed it were no good; that he, the millionaire, had been deceived and defrauded. He demanded that the pump be removed immediately and his money refunded.

The trouble hunter was hustled into an automobile and directed to interpret the speed law liberally. When he reached the millionaire's palace what do you suppose he found?

Why, the butler had opened a switch on the wire which supplied the pump motor the evening before and had forgotten to close it again in the morning. The moment the current was turned on the motor started up, the pump resumed its duties and the millionaire was able to take his bath. But did he scold the butler for a blundering blockhead for causing all the trouble? Not at all: he only insisted with greater vehemence that the pump must be removed and only countermanded the order when the trouble hunter made a show of complying with his demand.

A leading company recently sold a pump to a New York restaurant keeper who had a basement below the sewer level and so was obliged to use mechanical means to lift sewage from a sump into the sewer. The restaurant man said he could install the pump for less money than the manufacturers were willing to accept for the service, so it was delivered on the sidewalk, the price was duly paid and the incident was considered closed.



But a few days later there came a call on the telephone; not in the haughty intonation of an aristocrat, but the plaintive wail of a tradesman in distress. The pump would not work, the basement was flooded and ruin threatened the restaurant. Wouldn't they please, for goodness' sake, send somebody right up to see what was wrong?

The trouble hunter hurried to the restaurant. The place was flooded exactly as reported; he could see that at a glance. When the basement was bailed out so that he could get at the pump it did not take more than two minutes to find out what was wrong.

The pump had been shipped with a blind gasket over the delivery pipe to keep out the dirt in transit, as is customary. The plumber whom the frugal restaurant keeper had engaged to install the pump at reduced rates had not thought it necessary to remove this blind gasket when he made the connection with the discharge pipe. Of course the pump could not force water through the gasket.

The Brooklyn Power Company bought a large circulating pump for a condenser, but couldn't make it work. It took a pretty long search for the trouble hunter to make out what was wrong. It was the tide.

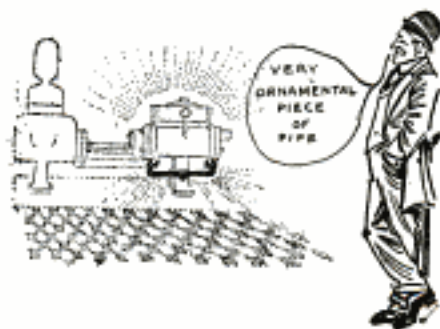
Yes, there could be no doubt that it was the tide. Because, if the tide had not persisted in rising and falling in Gowanus Canal it would not have been necessary to put in a check valve to protect the pump, which was below high tide level, from back pressure. Quite inadvertently the employes who put in the check valve arranged it so that it entirely stopped water from reaching the suction pipe at all.

Equally brilliant was the feat performed in behalf of the purchaser of a very fine feed pump which was to be installed in an engine room which was something of a show place. The buyer of this pump contemplated the drip cocks on either end of the cylinder long and earnestly before he hit upon a plan to keep the greasy water from them off his beautifully tiled engine room floor.

The solution was some daintily burnished brass pipe leading from each drip cock to a T midway between them, the trunk of which was to be connected with the sewer. But when the job was done the pump absolutely refused to make a stroke. After tinkering and studying for some days in vain efforts to make the costly pump go, the owner in despair sent for the trouble hunter.

The pump was found to be in perfect order, all the connections were properly made, and there really seemed to be no reason why the obstinate pump should not do the work required of it until the pretty brass tubes from the drip cocks were examined.

Then it was discovered that the genius who had attended to this job, instead of running the tubes to the T according to specifications, had improved upon the original plan by run-



ning them through the T so as to form an unbroken pipe leading from one end of the cylinder to the other. When steam was turned on the pressure in both ends of the cylinder was perfectly balanced through this connection and the piston could not move any more than a man can lift himself by his bootstraps.

The trouble hunters for another company are able to earn their salaries through the singular predilection of the purchasers of centrifugal pumps for putting them up with the suction end where the delivery end should be and the delivery end where the suction ought to go.

Sometimes, though, the trouble is a little more serious. A Western concern sold a Corliss driven air compressor of 2,000 cu. ft. capacity to a western customer. It was set up and started in operation to the entire satisfaction of buyer and seller. After the compressor had been in operation about a month the manufacturers were notified that it failed to regulate and was working in a very unsatisfactory manner. An expert was requested to come and look into the matter at once.

The trouble hunter found everything in perfect order so far as appearances went, but the regulation certainly was poor and the air pressure varied greatly without apparent cause. The compressor was carefully watched all day without result. Upon closing down in the evening the valve gear was examined, but the cause of the trouble could not be found. Next day's search was equally fruitless.

As a forlorn hope the air regulator was taken apart and examined. Nothing could be found upon minute examination that could have caused any trouble. Yet strange to say when the regulator had been re-assembled the compressor ran with perfect regulation as if it were working for a prize. The trouble hunter looked wise and said nothing, though he went home mystified.

Two months later he was called back again by a repetition of the former trouble. This time before taking the governor apart a most painstaking investigation was made. It was found at last that the air cylinder of the governor, which was connected with the receiver by a quarter-inch pipe, had a leak at the joint, which was made with a cap, so minute that the air blowing through it was not noticed. Yet the quarter-inch pipe not being large enough to take care of the leak without a reduction in pressure, any change in pressure in the receiver did not have its proper effect on the air cylinder of the governor. When this minute leak was stopped the compressor worked satisfactorily and has given no further trouble.

But it is the gas or gasoline engine that forms the basis for the most spectacular language among purchasers. This is not due to the innate depravity of the gas engine, but rather to the fact that it is a new thing and the buyer can therefore exercise more ingenuity in letting it get out of order than he would feel justified in using in the case of more familiar mechanism.

It seems to be a common impression among the buyers of the smaller sizes of gas and gasoline engines that they very nearly approach perpetual motion and that they do not require any attention at all. The result of this impression is that the engines do not receive the very small amount of attention they do require. Surprisingly few owners and operators of gas and gasoline engines know the principle upon which their engines operate. Consequently they are unable to make any adjustment if the engine should go wrong. All this makes work for the trouble hunter.

Last spring a New Englander purchased a 25-hp. gasoline engine. It was carefully set up according to printed instructions and upon trying it out for the first time it ran so beautifully that the enthusiastic owner sent a glowing message to the New York manager, congratulating the builders upon their superb product and himself upon being the fortunate possessor of so fine an engine.

But the very next night the New York manager received another message of an entirely different tone. It said the engine would not work at all and urgently requested that an expert be sent at once to see what the matter was. Realizing that the matter was important, since the engine was the principal source of power for lights and water supply in a small village, the manager, by losing the greater part of a night's rest, succeeded in running down a grumbling and protesting man and getting him off on a mail train at 3 o'clock in the morning.

The trouble hunter rode in a day coach without breakfast or lunch, but with frequent changes of cars to make up for the omission, until 2 o'clock in the afternoon. Then he had a nice drive of eight miles over a rough country road to reach the village. He was not surprised to find the owner of the new engine rather inclined to say cutting things about gasoline engines in general and this special make of gasoline engines in particular. Any one who had bought an engine which refused to work the second day after it was set up might feel justified in growing sarcastic at the expense of the builders.

The trouble hunter looked things over and tried to start the engine. It wouldn't go. Then he went outside and took off the cover of the gasoline tank, a galvanized iron affair enclosed in a rough wooden box sunk in the ground.

"Why, you have no gasoline here," he said.

"Oh, yes I have. I put in sixty gallons day before yesterday and only ran the engine a few hours. There's plenty of gasoline."

"But there isn't a drop. Try putting some gasoline in and see if the engine doesn't work."

Upon examination it was found that the carpenter who had boxed up the tank had driven an eight-penny nail into the bottom of the tank and on discovering the mishap had pulled the nail out without plugging up the hole. Of course, the gasoline soon leaked out. The engine ran all right as soon as it was supplied with fuel.

Was the New Englander grateful for the service rendered? Well, no one would have thought so who saw the saucy letter he wrote in reply to a bill for the traveling expenses and time of the trouble hunter. He refused to pay the bill, saying the engine company, which, by the way, had had nothing whatever to do with the installation of the engine, was entirely responsible for its failure to work.

Another tale of trouble with a municipal gas engine had that happy ending which is deemed so essential by theatrical managers. This particular engine was sold to the municipality of a Western town instead of an individual. It was wanted to run the town electric lighting plant.

Being a municipal deal the mayor and board of aldermen naturally wanted to avail themselves of every possible opportunity for patronage by employing local talent to install the engine. The offer of the selling company to send an erecting engineer to set up the engine was declined with thanks. A local gas engine expert, with the requisite pull, obtained the contract for erecting the municipal engine.

It was late in the summer when the engine was delivered. The home talent pattered and tinkered over the job of erecting until late in October. Then he gave it up and announced that the engine would not work at all. It had been built wrong.

Here was a pretty how-d'ye-do. The mayor and most of the aldermen and other functionaries were up for re-election on the strength of their progressive



record in procuring electric lights for the town. If the story should leak out that they had bought a gold brick in the form of an engine that would not run they would all be slaughtered at the polls beyond all hope of political resurrection.

An agonized appeal was wired to the engine builders. The star trouble hunter was rushed to the scene as fast as limited trains could carry him. He arrived on the day before election.

The home talent, it was found, ignoring the fact that the engine had been set up and tested in the shop, had felt it incumbent upon him to take it entirely apart. He did a splendid job of dismantling, but when it came to putting the engine together again he found himself in the predicament of the Irishman who took his Waterbury watch to pieces: there were more wheels than he could find room for. He did not follow printed instructions and he made no attempt to match the gears on the intermediate shaft though they were plainly marked. The result was that he put the engine entirely out of time.

It required just twenty minutes by the clock for the trouble hunter to get the engine operating perfectly. That night, the eve of election, the town was illuminated for the first time by the new electric lights; and next day the mayor and his entire ticket were triumphantly elected.

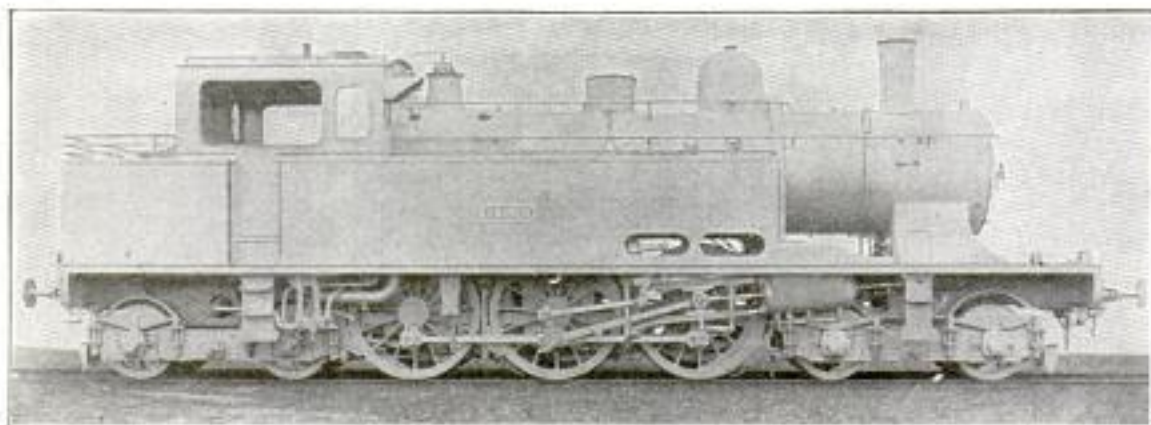
Election night the trouble hunter, who had been detained by an insistent hospitality that was not to be denied, was given a dinner by the grateful town officials which was declared by the local press to be the most sumptuous banquet ever spread in that fair city. All the cigars and liquid refreshments in town, seemingly, were urged upon his acceptance, and he was even pressed to buy some lots at reduced rates in order that he might come and make his home among them.



ILLINOIS COAL KEEPS BEST UNDER WATER

According to experiments made by Prof. S. W. Parr, of the University of Illinois, the soft coal mined in that state keeps best when stored under water. His tests showed that the coal

completely submerged in water and kept submerged until about to be used lost nothing in heat value, while coal kept in exposed places lost from 2 to 10 per cent. The deterioration of coal kept dry and under cover was practically the same as when kept in the open air.



Compound Locomotive—Alsace-Lorraine Ry.

LEARNING HOW TO FLY

By L. J. Lesh

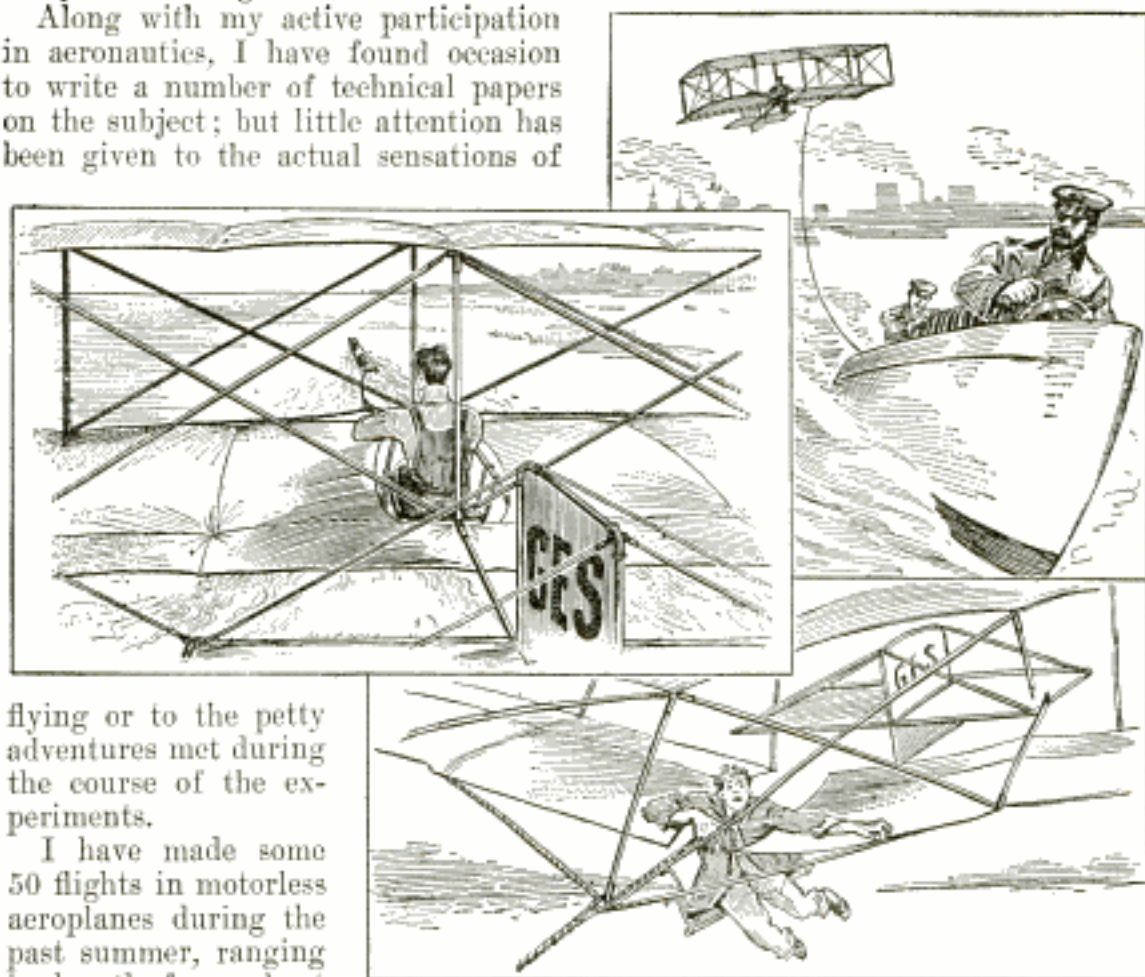
[Editor's Note—The author, who has not yet reached his 18th birthday, is a former Chicago boy, but has spent the past year in Montreal. The illustrations in this article are from his own sketches.]

Apart from the scientific interest which attaches to experiments in flying, this kind of work presents some sensational features which are of interest to the public at large.

Along with my active participation in aeronautics, I have found occasion to write a number of technical papers on the subject; but little attention has been given to the actual sensations of

Two incidents stand out in the year's work as being particularly interesting and exciting. The first of these occurred during the longest flight (6 miles), which was made over the River St. Lawrence in tow of a motor boat, and the second happened during my shortest flight (100 ft.), which was ended by a smash-up in mid-air.

The flight above the river was undertaken in hopes that the aviator would



flying or to the petty adventures met during the course of the experiments.

I have made some 50 flights in motorless aeroplanes during the past summer, ranging in length from about 100 ft. to 6 miles, the prime object of the tests being to acquire skill and confidence while in the air. The method of experiment was to raise the machine in the manner of a kite, by pulling it through the air with a towing rope fastened to the flyer by means of a bridle. When the experiment was carried on over land, a fast horse supplied the necessary pull on the cable, and during a flight over water, a motor boat was used with good results.

remain suspended long enough to learn something of the balance and steering of the machine as well as get over his "air-fright."

The machine rose prettily from a high concrete wharf at Montreal, Canada, and flew straight downstream for about 3 miles without any untoward incident. The aviator had just begun to congratulate himself on the performance of the flyer and to wish that the motor boat had taken on enough

gasoline to go clear to Quebec (128 miles), when he got his first taste of the dangers of the air.

One of the ropes holding the small seat with which he had equipped the machine, broke and left him hanging by one arm, with the choice of either retying the rope or negotiating a 60-ft. drop to the water. After a good deal of trouble he succeeded in fixing the seat and convincing the men in the boat that everything was all right.

This state of things did not last long, however, for a little later one of the other ropes holding the seat broke, and after some more gymnastics (physical and verbal) the aviator gave up the flight in disgust, coming down in the middle of the river about 6 miles from the start and three-fourths of a mile from the nearest land. The men in the boat (they were Frenchmen) made frantic efforts to do something after the descent, and finally succeeded in getting the aviator out of the water, unhurt, and in breaking the machine to pieces.

After this experience the writer decided to continue his experiments over land, and accordingly rebuilt the old model, making a few alterations in design and method of operation.

This machine made one flight of about 100 ft. and lasting five seconds; but into it was crowded for his special benefit all the worst sensations that one might expect to meet with during a lifetime of aerial travel.

The towing power was supplied by a horse, and as there happened to be a high wind on the day of the flight, the machine rose very rapidly and plunged so violently that the aviator was unable to keep it on an even keel.

At an unfortunate moment the horse looked around to see what he was pulling, and evidently came to the conclusion that he was being pursued and had a right to look after his own interests. He bolted immediately on coming to this decision, and the increased pull was more than the light framework and wires of the aeroplane could stand.

It folded together like a jack-knife

and plunged to the ground. Every stick and wire of the frame snapped, but the aviator was so fortunate as to come out of the accident unhurt. It was a tremendous bump, though, and taught him a lesson he will not forget.

MANICURING ELEPHANT'S FOOT

Accustomed to the dry climate of the Indies, the elephants imported to temperate and rainy countries are subject to many diseases of the flesh and skin to which the veterinary surgeons of national and municipal zoological gardens are compelled to give the closest watch. The smallest scratch on the sole of an elephant's foot is apt to become serious, unless immediately treated with



Trimming His Nails

an antiseptic, and the horned substance of the feet, not being exposed to the wear produced by roaming through a wilderness, grows in captivity as rapidly as the finger nails of a human being. The illustration shows a veterinary surgeon trimming these nails or horned substances with a chisel and mallet.

BALED SNOW WITH HAY BALER

An industrious Illinois man spent his pleasure hours during the winter pressing snow into bales with an ordinary hay press and stacking the finished product in an improvised ice house for use next summer, if it can be kept that long. On account of its porosity, however, baled snow is far from being equal to good ice.



Superstition, mostly as a fad, but in many cases serious, has struck the autoist in the form of a figure-head mascot fastened to the automobile bonnet. In many instances this conceit is ironical as well as funny, and finds expression in the guise of a nickel or brass policeman with stop watch in hand, or gesticulating "stop!" One of the best examples is a grinning red devil, and another is a crowing barnyard fowl. Both of these would be appropriate on a machine driven by a speed maniac; the first to express disregard for all consequences, and the second disdain of the slower and more cautious drivers passed on the roadway. A more serious example is a figure of St. Christopher, the traveler's saint, mounted on Queen Margherita of Italy's automobile. The figures are made of nickel or brass, plated and colored.

AERIAL NAVIGATION TERMS

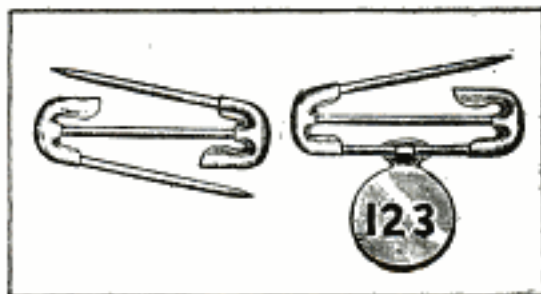
The Permanent Aeronautic Commission has adopted the following terms to be used in properly distinguishing the various types of aerial machines and the operators of each.

Any machine without a gas vessel or bag is to be called an "Aeronef," and this type is further to be divided into three sub-divisions, called Helicopters, Aeroplanes, and Orthopters. The first is an aeronef, relying on one or more propellers for its suspension and progress through the air; the second is an aeronef in which suspension in the air is more particularly assured by one or more planes, and the third is an aeronef sustained and propelled by beating wings.

The term aviator is to be employed as defining the operator of any of these types. Aeronaut will be applied only to the pilot of an aerostat or aeronat. The aerostat is a common balloon, floating along with the wind, and the aeronat is a dirigible balloon.

LAUNDRY CLOTHES TAG

One of the simplest methods used by laundries to mark the clothing and household linen of one family, so that the separate pieces will not lose their identity when mixed with articles of at



least half a hundred other families, is the pin and marking tag shown in this illustration. The pins are made thin enough to pass through the ironing machine without injury to machine or garment, and can be used on any unstarched article from a fine lace handkerchief to a pair of overalls. Attached to the pins are aluminum discs or linen tapes bearing numbers or letters.



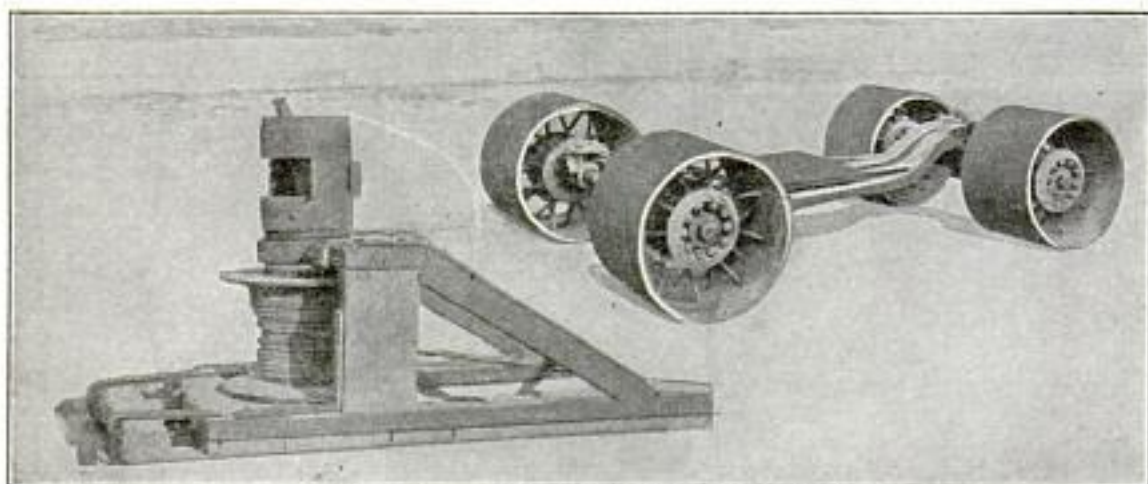
Some of the Record Tags

HOUSE MOVING IN THE WEST-ERN STATES

In the western states, where mushroom growth is the most prevalent and buildings have to be torn down or removed, to be replaced by more substantial structures, the comparatively light

CHEAP AND EFFECTIVE WATER WHEEL PUMP

After 20 years of service this water wheel, 7 ft. in diameter, is still pumping water at Palm Springs in the Colorado desert. During that time it has received no attention or repairs, except



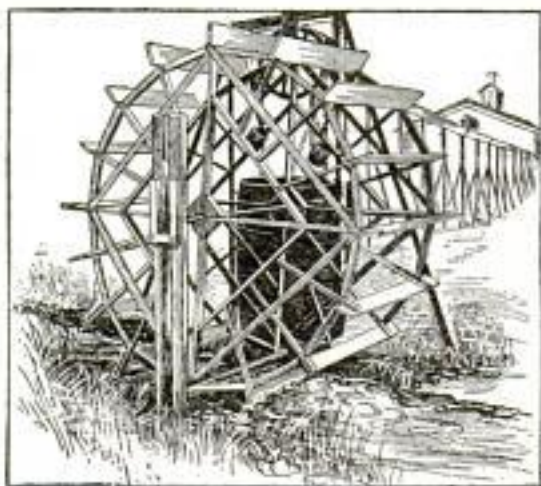
Windlass and Truck Used for Moving Houses

frame buildings are moved on the truck shown in this illustration. After jacking up the building and putting timbers under same, two common wagon trucks are placed under the two rear corners, and the moving truck under the front part, in the center. The frame of the truck is made of steel rails. The wheels have roller bearings and all the spokes are set at an angle of 45 deg. Its carrying capacity is 30 tons.

The house-moving windlass, also used in the west, is quite as novel as the truck. It is made of a piece of 12-in. seamless steel tubing, with cast-iron flanges and strengthening pieces riveted on to the top. Steel cable is used instead of chains and steel rail skids instead of wooden ones, as is usual in the east.

Steam was successfully used recently in quenching an oil fire at Petersville, Pa. There are about 30 oil wells in the vicinity of the town, and when one of them caught fire the burning oil flowed through the streets, says the Practical Engineer. Steam was raised in the boilers of the oil rigs and the inhabitants used it to put out the fire.

the addition of new buckets. It operates in a flume 28 in. wide, with but a slight current and no dam or drop of the stream. The cost of the wheel was probably less than \$5, as it consists almost wholly of common lath and pieces of clap-boards. The shaft is of $\frac{3}{4}$ -in. gas pipe, to which is fitted two pieces of grooved scantlings. Around this makeshift of a hub are fitted the spokes. On the further side are six cups made of old corn or tomato cans cut in half, with top bent inward. These cups



Cost \$5; Used 20 Years

pick up the water and drop it into a trough, from which it runs through pipes to a barn some distance away.

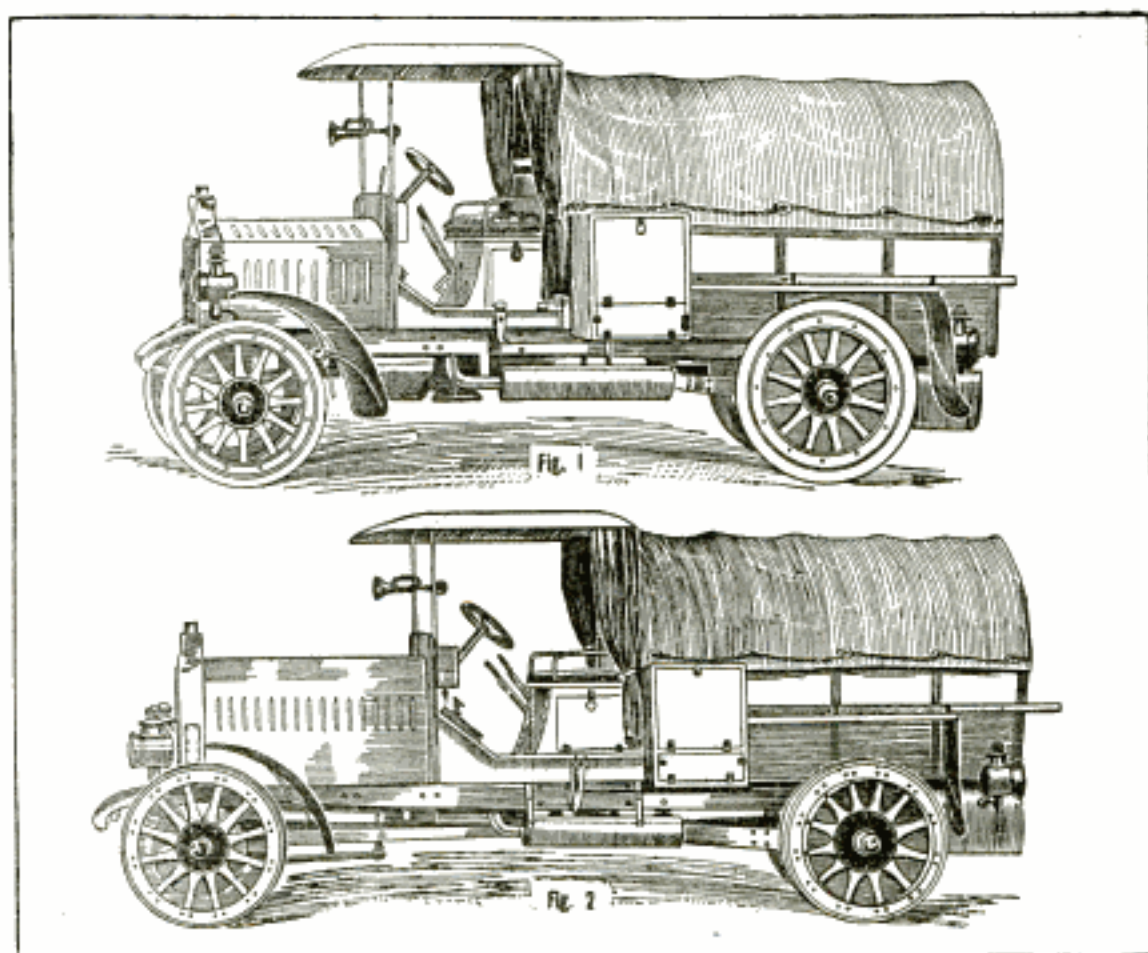
AUTOMOBILE WAGON-TRAINS FOR GERMAN ARMY

By Georg Jacoby, Berlin

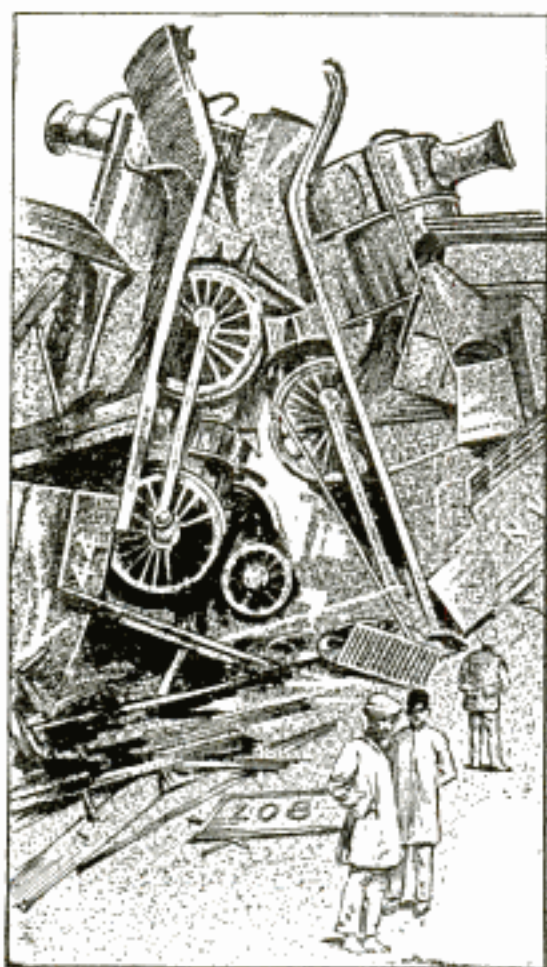
Germany has undoubtedly equipped its army with more power-driven vehicles than any other three countries. Almost every type of serviceable machine, from healthy-looking fighting automobiles, armed with rapid-fire guns, to motorcycles, has found a place of usefulness, and new types are being added to the list every day. The "Verkehrstruppen," which is a corps formed for no other purpose than to experiment and recommend means of transportation, has just added a number of new automobiles for transportation purposes which are entirely up-to-date and present many interesting features.

These are six 45-hp., 4-cylinder machines; two 60-hp., 6-cylinder machines and a much speedier and smaller (Fig. 1) 25-hp. machine. The latter is to be used to carry soldiers and parcels quickly from one place to another. It can also pull a trailer at a speed of 15½ miles an hour.

The 45-hp. machines are strongly built and have a capacity of 2½ tons. Their own weight is 7,000 lb. Each of these machines pulls three trailers, with a combined weight of 4 tons, at a speed of 11 miles an hour. The power is transmitted by a cone clutch and speed changing gear. The rear wheels are driven by sprocket wheels and chain. Four speeds are possible ahead, and one reverse. As these cars are subject to rough service they are fitted with steel tires. Chain caulkins are provided for bad roads, and ice caulks for slippery ground. The latter can be screwed into the wheels.



Serviceable Machines Used by the German Army



The two engines shown in the illustration look in a way like two wild animals of the jungle reared up on their haunches and clasped in a bitter death struggle. It was a death struggle, and the result was 20 people killed and many more injured. The collision occurred near Ludhiana, India.

The two 60-hp. machines (Fig. 2) weigh over 4 tons, and are capable of hauling four trailers with a combined weight of nearly 7 tons. Their chassis and wheels are extremely strong and built for extraordinarily rough service. They can run over plowed fields and sandy roads and on grades which would be impossible for horses. In order to cope with such conditions all four wheels are connected with the engine; those in the rear in the usual way, while a longitudinal shaft transmits the power by conical wheels to the front wheels. Thus grades up to 50 per cent can be overcome.

Especially of interest is the fact that all machines are provided with searchlights, and also with axes, boards, hoes and windlasses for very steep grades

and ditches. A rope is fastened to a tree or stake and the motor winds the trucks up over any obstacle. Before acceptance the machines were inspected by the Kaiser and found highly satisfactory.

ACROSS SIBERIA IN ELEVEN DAYS

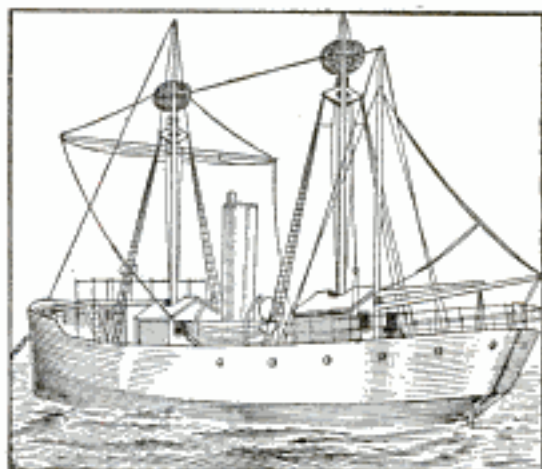
Siberia, with an area half again as large as Europe, with its enormous rivers, timber wealth, extensive deposits of metal and of coal, and in the southern section over 1,000 miles of fertile land, is not altogether the prison house of Russian political convicts that popular impression has made it. It is a land of immense possibilities slowly awakening at the insistent knocking of the civilization that in the future will knit together its great expanses with many railways such as the famous Trans-Siberian railway.

The trains on this railway leave Moscow three times a week, and with only one change of cars, at Irkutsk, reaches Vladivostock, on the Pacific, a distance of 5,527 miles, after a little over 11 days. These trains are made up of a baggage, a dining, one first-class and two second-class cars, which have eight staterooms each. The staterooms in the first-class cars accommodate two persons and in the second-class cars four persons. One part of the dining car, which may be used for reading or writing, is provided with a library of Russian and French books. Both first and second-class passengers are allowed in the dining car. For the 11 days' trip it costs \$145 first class and \$95 second class.

The traveler from London reaches Japan via Siberia 12 days earlier than by the Suez canal, and this time can be made much shorter, as the average speed of the trains is only 20 miles an hour. The stops made are long and frequent, and the trains are scheduled to be under way only 21 out of every 24 hours. On some days the train's schedule calls for stops which aggregate 9 hours out of the 24.

LIGHTSHIP ON WAY TO PACIFIC

Traveling under its own motive power and manned by a crew of about 20 men, this small lightship is following in the wake of the battleship fleet around South America. It was built at the government yard at Tompkinsville, Staten Island, and will be sta-



Lightship on Way to Pacific

tioned off the Californian coast as a beacon to mariners who seek to reach San Francisco.

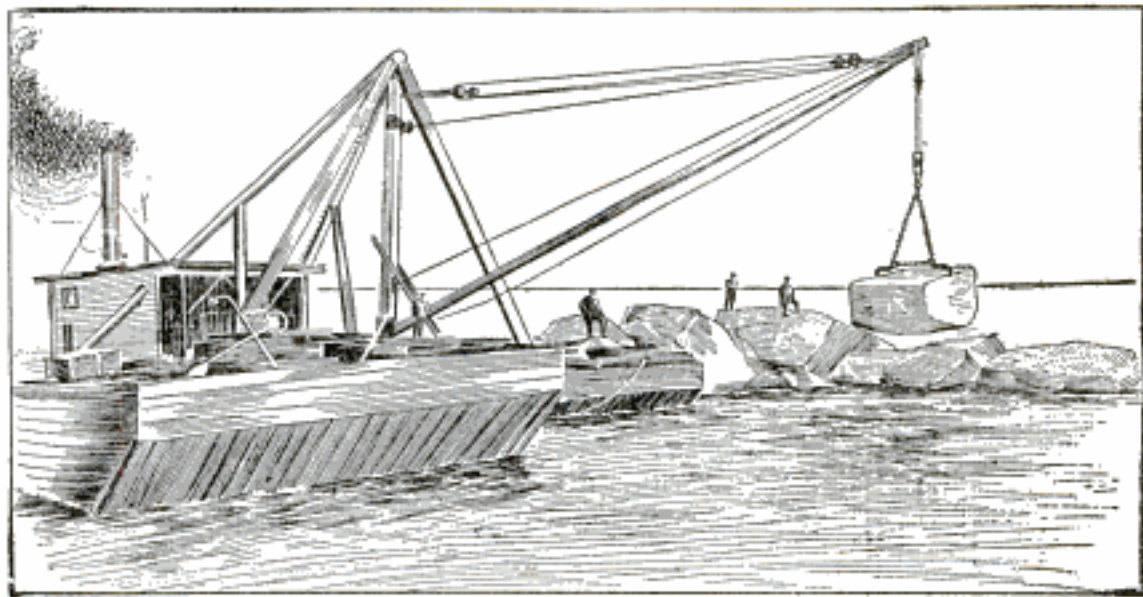
The cruiser "Yankton," which was detached from Admiral Evans' fleet to search for American sailors, supposed to be lost on Indefatigable Island, returned to the fleet without finding any trace of them.

DIVERSIONS OF AEROCAB TRANSPORTATION

This is a London artist's conception of an aerocab. Drop me at such or such a place, is the command received by a genuine cab driver when his passenger wishes to stop, and the same command has just been given by the thoughtless passenger of the aerocab.

BUILDING ROCK JETTIES

In building the Galveston jetties rock is transported by rail from long distances and loaded onto barges. The barges are towed to the scene of operation where a derrick barge swings them into position. These great blocks of stone weigh several tons each.

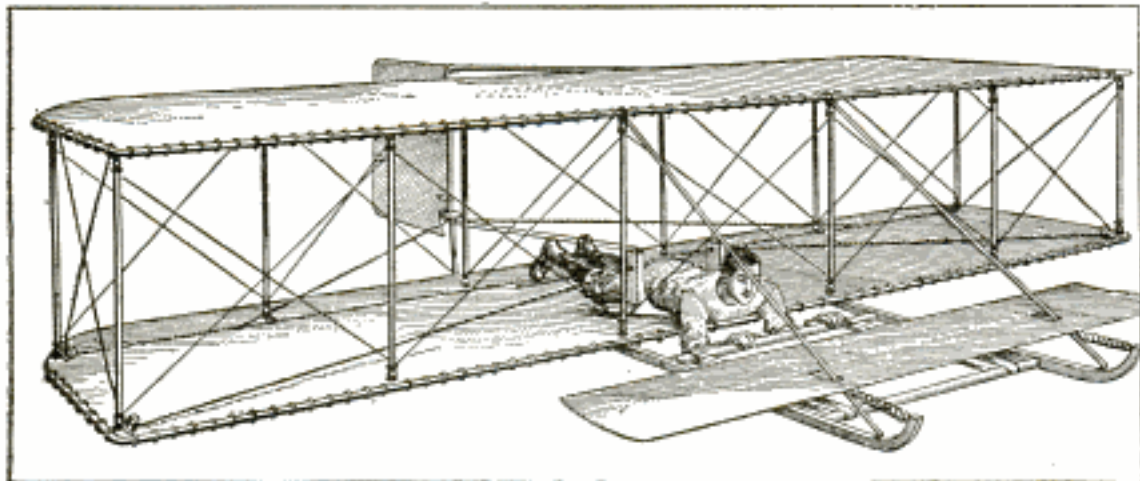


WRIGHT BROS.' AEROPLANE A PUZZLE

The secrecy regarding the Wright Bros.' aeroplane (sold to England)

SANITARY CIGAR-ROLLING TABLE

The cigar table shown in this illustration embodies many sanitary feat-



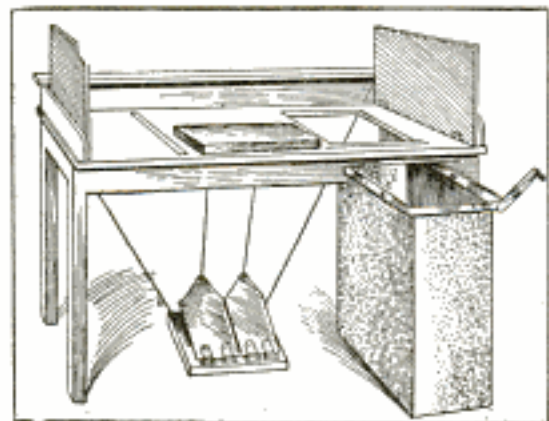
Wright Bros.' Aeroplane—From Patent Office Drawing

caused many American aeronauts to be skeptical of its success. The recent application for an English patent gives some idea of the machine.

From this application it seems that the motion of the wings that keep the flying-machine progressing through the air can be effected by the hands and legs of the operator, or may be supplied by a motor. The machine is sustained by the reactions which result from thin surfaces of wings moved horizontally, almost edgewise, through the air, inclined at a slight angle to the plane of the machine's progression, either by the application of power or by the force of gravity.

The wings are made of cloth stretched on a light frame of wood and wire, and are connected with each other through ball-and-socket joints by 12 upright standards which can both bend and twist. The front horizontal rudder is stationary, and when the rear edge is raised or lowered the machine moves up or down at the will of the operator, who lies prone on the lower wing surface. The body of the operator rests on a movable cradle, and with the motion of his legs he imparts motion to the wings. The machine, as illustrated (drawing made from English patent papers), indicates a very limited use.

ures. The filler box is made of galvanized iron and holds enough tobacco for a day's work. The top of the box is covered by a tight-fitting rubber covered cloth, which opens and closes by means of a pedal, and a similar arrangement is provided for the binders and wrappers. The filler box has a false bottom, which is raised by a



Sanitary Cigar-Rolling Table

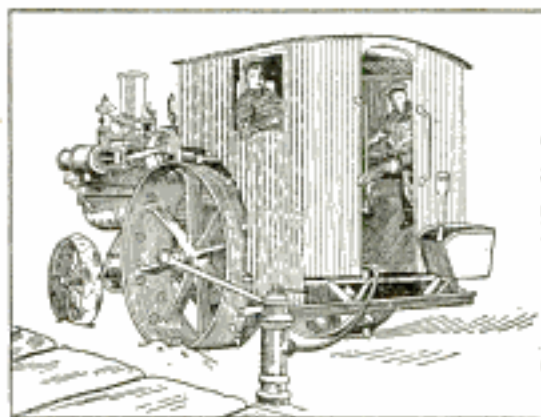
crank as the tobacco is used, keeping the supply even with the top of the table.

Sticky varnish put on furniture by cheap workmen may be remedied by first placing on shellac varnish and then follow with a coat of copal varnish.

SHOP NOTES

Thawing Out Hydrants and Mains

During an increased spell of cold weather a number of water mains and hydrants were frozen in our city and could not be used in case of fire. The accompanying sketch shows how I fitted my road roller with a pair of narrow faced front wheels and with spikes in the rear rollers so I could drive it from one hydrant to another. One end of a hose was connected to a steam pipe inside the cab and the other end run into the stand pipe of the hydrant. The work was accomplished quick and with



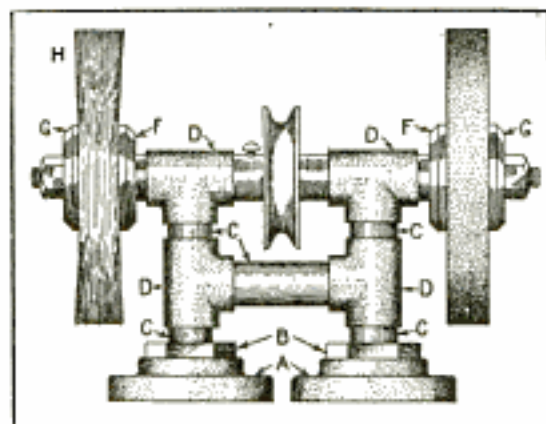
Thawing City Hydrants

success.—Contributed by Wm. B. Barker, Onaway, Mich.

How to Make a Buffer and Grinder Stand

This stand is an improvement on one described in a recent number of Popular Mechanics. The advantage of having two bases or feet is that it makes a more substantial and rigid frame and can be used for quite heavy work.

The materials necessary for making a buffer and grinder like the one shown in sketch are two pipe flanges, A; two bushings, B; four $\frac{1}{2}$ -in. tees, D; five $\frac{1}{2}$ -in. nipples, C; two collars, F; two

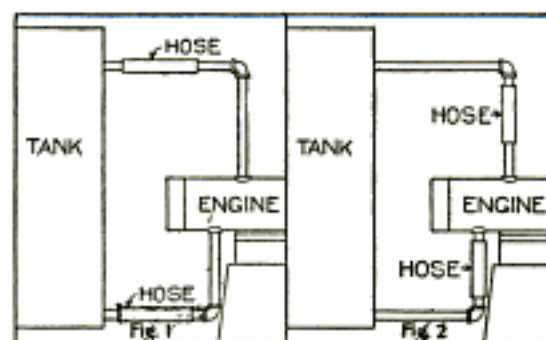


Home-Made Buffer

washers, G; a number of cloth discs for the buffer, H; an emery wheel; a short piece of $\frac{1}{2}$ -in. shafting; a pulley and babbitt for bearings. Apply a solution of sal ammoniac to the threads when putting together, which will cause them to rust and make a rigid joint. By using two bases or feet instead of one the whole machine will be more solid and will not "wobble" when running at high speed for heavy work.—Contributed by R. Q. Dalton, Chicago.

Water Tank Connections for a Gasoline Engine

The ordinary method of connecting a cooling water tank to a gasoline engine is shown in Fig. 1. When pipe is connected in this manner the hose will soon crack and become loose,

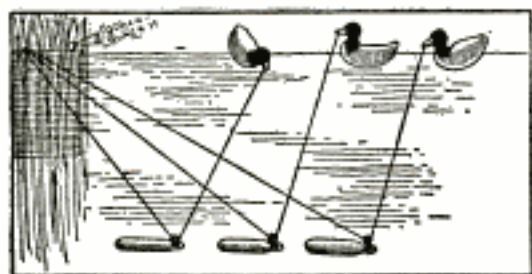


Improved Hose Connection

caused by the vibration of the engine. Make the connections as shown in Fig. 2 and the hose will last indefinitely.—Contributed by Ora S. Harms, Fennimore, Wis.

Making Decoy Ducks Appear Like Life

During the spring and fall months of the year many hunters use decoy ducks to assist them in calling the wild

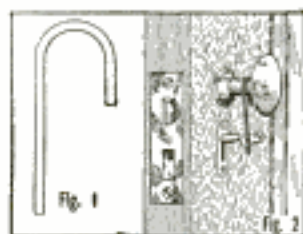


Life-Like Decoys

game to a lake or river. To attract the game the decoy ducks must appear as life-like as possible. This can be done by running a cord from your boat or hiding place through a small pulley, which is attached to a window weight sunk in the water, and fastened to the bill of a decoy. By pulling the cord the decoy will appear to dive and with a duck call the flying game will be attracted to the spot.—Contributed by Walter Short, Council Bluffs, Iowa.

A Door Key Holder

Bend a piece of heavy wire in the shape as shown in Fig. 1 and place the hook part over the shank of the knob as in Fig. 2. The other end is slipped through the open part in the handle of the key. When a door is locked from the inside and the device applied, it will not only keep other keys from being inserted from the outside, but will also prevent the



key from being turned with instruments.

How to Babbitt a Main Bearing

Occasionally a main bearing of an engine needs rebabbiting, and while it is not a difficult job, it may, nevertheless give considerable trouble if one does not know very well how to proceed. Sometimes, if the box is in four quarters, it may be taken to a machine shop and the work done there, but it must often be poured on the engine by the engineer. A large Corliss engine, located in a place where there was no machine shop, needed repairs and the main bearing rebabbited. This was accomplished by chipping out all the old babbitt and placing the bottom box back into position. The crank-shaft was leveled and supported by a jack. Another jack was placed against the crank, pressing it tightly against the side of the bearing. The bottom box



Rebabbiting Main Bearings

was then poured, taken out, the edge trimmed off the babbitt and then replaced. The quarter-boxes were then placed in position and separated from the bottom box by thin cardboard in order to prevent the babbitt from adhering to the bottom box. They were then poured, taken out, trimmed and replaced. Wooden liners of the required thickness were put in and the top box poured.

All boxes were then taken out, oil-grooves cut in them and scraped, says a correspondent of The Practical Engineer. The oil grooves were cut as shown in the sketch with a half-round gauge or chisel, and the edges were beveled to a half-inch. This method insures a good distribution of the oil

over the bearing. The top box had no oil grooves cut in it, the edges only being beveled, as this box is not supposed to bear heavily on the shaft.

How to Use Old Dry Batteries

Cut out the bottom of the dry battery and clean thoroughly. Punch three or four holes with a nail or pointed instrument near the top of the cell. These holes will allow the air to escape when the battery is set in the solution. Make a 5-oz. solution of sal ammoniac and place it in a jar which should be a trifle larger than the dry battery. Set the battery prepared as above in this solution and you will have a good battery.—Contributed by M. K. Orton.



Nail Keg Strainer for a Suction Pipe

A duplex pump was used for pumping pond water for flushing out a deep well and washing away the clay cut out by the casing as it was forced downward. The water seemed to be sufficiently clean and free from any material that would catch in the valves, so no strainer was used on the suction pipe.

The pump ran smoothly for a few days, then one side refused to deliver water, says a correspondent of Power.

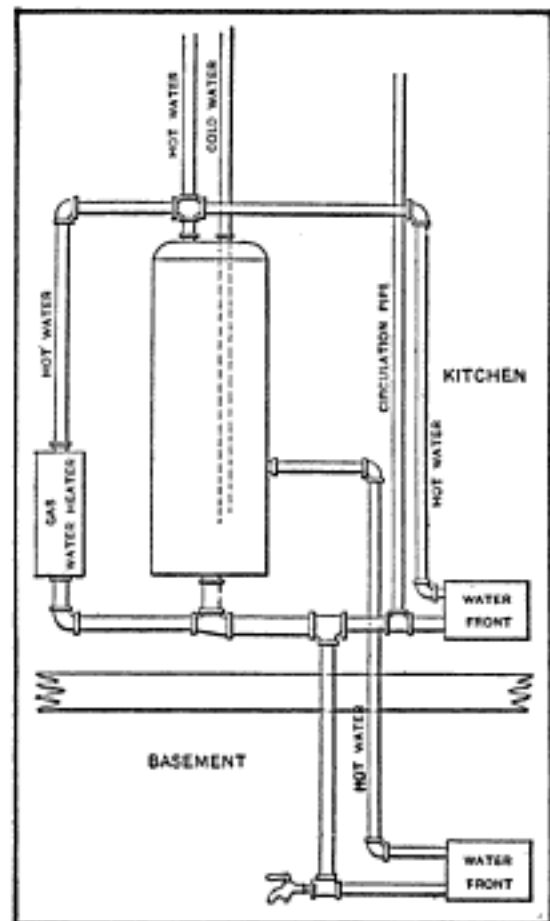
On examining the valves it was found that a horse bridle had been drawn up through the suction pipe and had caught under the valve. To avoid a

repetition of such an occurrence, a strainer made from a nail keg was placed on the end of the suction pipe.

In making, the hoops on one end of the keg were loosened to remove the head, in which a hole was cut large enough to fit around the suction pipe, on the end of which was screwed a coupling to prevent the strainer coming off. The head was then split in half to permit of its being placed above the coupling. A number of 1-in. holes were bored in the keg as shown in the sketch. The keg was then placed in position over the pipe and the hoops tightened.

How to Connect Two Water Fronts

The piping from the range boiler should be 1 in. in diameter for the supply to the two water fronts, and instead of the water having to pass through both of the water fronts,



Details of Connections

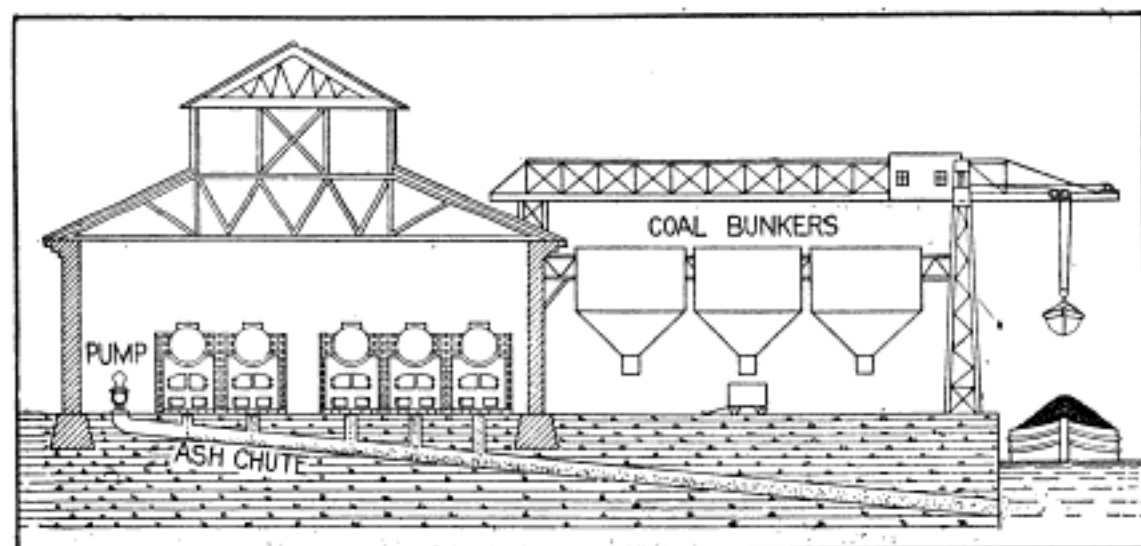
whether they are both in use or not, this 1-in. pipe is connected to a reducing tee, so that either water front can be supplied, says *The Metal Worker*. The hot water pipe from the basement water front is connected into the boiler in the usual way, while the hot water pipe from the kitchen water front is connected into the hot water service pipe as shown in the illustration. The arrangement of piping thus brings the circulation pipe so that it can deliver water to either of the water fronts.

Novel Method of Supplying a Plant with Fuel and Removing Ashes

A certain plant is located within 200 ft. of a river bank from which it is supplied with coal brought in barges,

end to the discharge of a large pump. When the time comes to hustle out the ashes, which is every six hours, the coal wheeler pulls out the ashes with a large hoe and the pump is started. It requires but a short time to remove the ashes.

When the plant was built, the steam digger was erected first, and all the sand used in the construction of the plant was taken from the river bottom. The ash-sluciceway was led to a point over this hole, the supposition being that the ashes would drop into it, when they could be removed to scows by the digger. The hole filled up all right, but not with ashes, and where they go is a mystery. Sometime afterward a boat's crew took several soundings and no trace of ashes could be found.



Removing Ashes from a Boiler Room with Water

unloaded with a steam digger and hoisted to a belt conveyer, which transfers the coal to large bunkers. The bunkers are elevated, fitted with chutes from which the coal is taken in the hand cars holding one ton, to the boiler room, where it is shoveled by hand from the cars onto the grates, says a correspondent of *The Practical Engineer*.

A cast-iron sluiceway, round and open at the top, runs along the top of the ash-pits, the opening being on the level with the bottom of the pits. One end connects with the river directly beneath the steam digger and the other

The Proper Care of Show Cases

A great many glass show cases are ruined each year from the lack of proper attention. Small cracks appear, caused by heat or contact with hard, heavy bodies, and if these cracks are not at once attended to they soon spread. Cracks may be kept from spreading by making a short scratch at right angles with a diamond or glass cutter, says the *Sporting Goods Dealer*. A case should set perfectly level on the floor, especially the new all-glass variety. Use a solution of 1 oz. of white

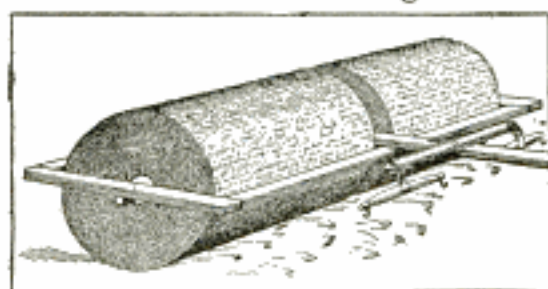
wax dissolved in a pint of pure turpentine to remove scratches. For cleaning the glass, a good method is to use 1 oz. of whiting, 1 oz. alcohol and 1 oz. of water of ammonia in a pint of water. Apply with a soft cloth, allow to dry and then wipe off.

Roof Shingles

Shingles are usually 16 in. long, and a bundle of them is 20 in. wide and contains 24 courses in the thickness at each end. A bundle of shingles will lay a course 80 ft. long. When shingles are exposed 4 in. to the weather 1,000 will cover 107 sq. ft.; 5 in., 132 sq. ft.; 6 in., 160 sq. ft.

How to Use Wire Fence Rolls for a Land Roller

Common woven wire fence that is sold in rolls of 40 rd. and 48 in. high can be used to construct a land roller and when the land is rolled the wire, which is good as new, may be used for fencing. Two of these rolls are used in making this roller. Wooden blocks are fitted and inserted in each end of the rolls. Holes are bored in the center of these blocks and a long rod run



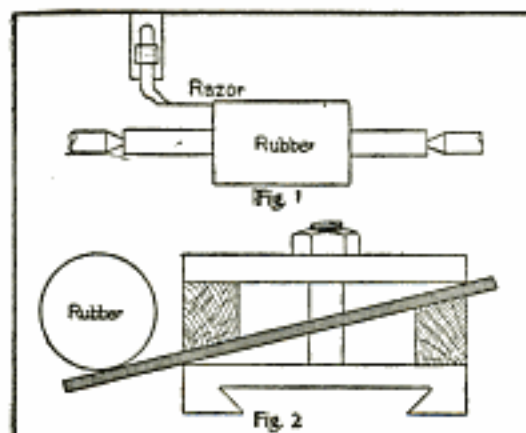
Wire Fence Used as Roller

through the holes which is used as an axle. This rod is attached at each end, and in the middle between the rolls, to a wood frame. A tongue is fastened to the frame which completes the roller. The outside end of the woven wire should be securely tied with wire to the under layers so that it will not unroll when in use.

Ores containing gold, silver and copper have been found in the Culebra cut of the Panama canal.

How to Turn Rubber

Bend the handle of an old razor at right angles with the blade and mount it in a holder as shown in Fig. 1. This will make one of the best tools to turn rubber the quickest, says American Ma-



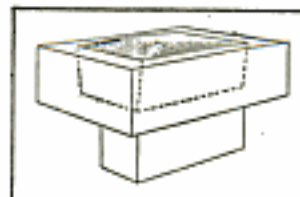
Turning Rubber

chinit. When using this tool care should be taken to bring the blade just a little below the center. In setting the tool for cutting, measure from the mandrel or the spindle that the rubber is being turned on.

Fig. 2 shows a way of turning a rubber roller when there is not sufficient stock for a cut. Use a sharp file fastened in the tool post as shown. Anyone having any difficulties with turning rubber will soon get over them by adopting these methods.

A Babbitt Riveting Block

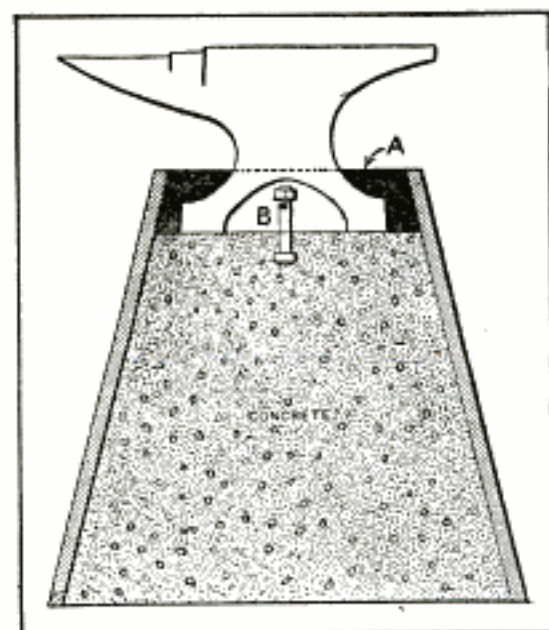
Those who have had experience in hunting up new pieces of babbitt or lead every time they wanted to use a soft block for riveting will appreciate the device here illustrated. A pattern is made from which any number of castings can be molded. The lug on the bottom makes it convenient to hold in the vise. The hollow top is poured full of babbitt (or lead), thus forming a soft anvil that lasts much longer than a plain piece of babbitt, as



it is supported on all sides by hard metal which prevents the mushroom effect, says Machinery. When the babbitt gets so battered up that it cannot be used longer, the block is held in a flame until the babbitt melts, and then it is poured again. This scheme will save time and babbitt.

How to Make a Concrete Anvil Block

The tapering cast-iron box is filled to within 2 in. of its top with concrete. Wood will do as well as cast iron for the form, only that the cast iron may



Concrete Anvil Block

remain in position. On each side of the anvil is imbedded a bolt and nut, B. The space above the concrete is filled with melted lead, A, which holds the anvil rigidly in place, says the American Blacksmith, also deadening its sound to a marked degree.

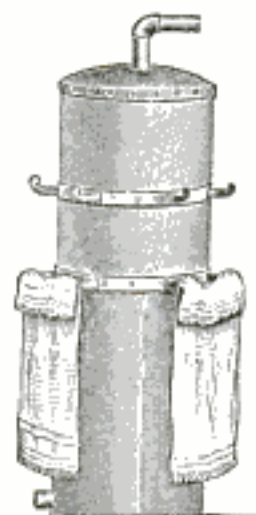
To Protect Corncrib from Rats

When building a cornerib set it on posts which are placed part way in the earth. About 22 in. of each post should extend above the ground. On this part of each post place a tile which

is 2 ft. long. The tile will settle down enough to allow the crib to rest on the posts. Rats cannot climb up the smooth tile.

Towel Hanger for Kitchen Boilers

The heat from the kitchen hot water tank can be used to excellent advantage for drying dish towels and other cloths used in the kitchen by the use of the hanger shown in this illustration. It is made of a thin strip of metal from which extend seven or eight arms or hooks on which articles can be hung. The clasps of the rim are so notched as to be easily adjusted to any sized boiler.



How to Make Drop Black

Drop black, also called Frankfort black, takes its name from the German town in which it was first manufactured, and is called drop black on account of the shape in which it is prepared for sale. It is made from a variety of materials of organic character, such as vine twigs, peach stones, hop vine, bone shavings, ivory cuttings, etc. They are calcined in a closed vessel until they are thoroughly charred, says Railway Master Mechanic. The black thus obtained is ground as fine as possible with water, the mass is next lixivated to free it from soluble matters, and then dried. It is then mixed with a little glue water and made up into small pear-shaped drops for sale. Drop black is of fine texture, varying in hue from bluish black to reddish black, which is due to the different materials of which it is made. Vegetable matters yield a black of a bluish hue and animal matters a grayish hue.

Drop black owes its color to carbon, the amount of which varies in different samples. The following is an analysis sample of drop black:

	Per cent.
Water	2.333
Carbon	65.742
Mineral matter	31.925

The mineral matter contained phosphate of lime, an evidence of the use of bones in the composition.

How to Mend Plaster Casts

In mending plaster casts I have tried everything, shellac included, with very poor results, until one day I tried oxy phosphate of zinc, a cement used by dentists for filling, and have never had a failure in any case. The cement should be made thin and then the edges of the broken parts brought firmly together and held in place for a few minutes.—Contributed by J. Robbins, D. M. D., Salem, Mass.

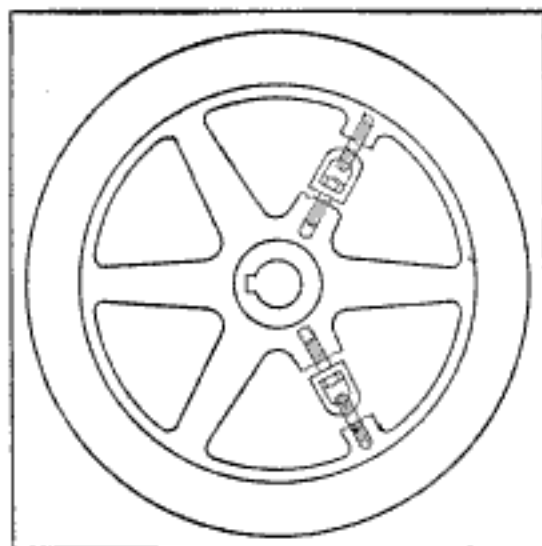
Home-Made Door Holder

A very simple and easy-to-make door holder that will not scratch the floor and will always keep the edge of the door clean was designed by a correspondent of *Woodworkers' Review*. Secure a piece of old sheathing, or any old boards around the job, about 8½ ft. long. About 1½ ft. from one end of this board fasten to a small cleat a perpendicular piece 2 ft. 4 in. long and run another piece over the top of this at an angle projecting over about 3 in., as shown in Fig. 1. In this piece that

angles, cut a notch the thickness of the door and nail it at the top and bottom. Two cleats are nailed across the board, one about 6 in. from the upright and the other the same distance from the end of the board. Fig. 2 shows the top view and Fig. 3 how it may be used to hold the door in an inclined position.

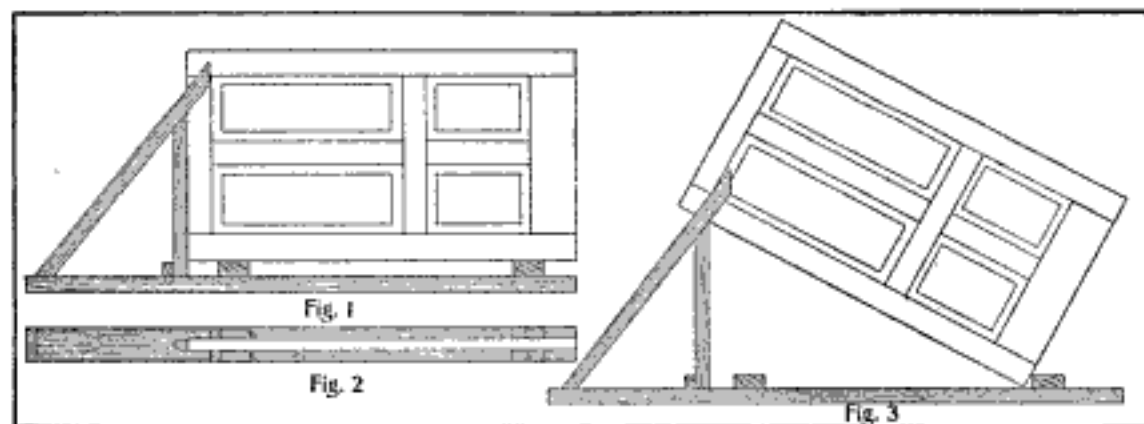
Repairing a Broken Fly-Wheel

Two spokes were broken in a fly-wheel on a steel plate shear by the



An Odd Repair

carelessness of an overhead cranesman in a steel mill. As there were no spare wheels on hand, the mechanic in charge tapped a 1½-in. hole in the ends of both broken spokes, says a correspondent of the *National Engineer*. Into the outer end he screwed a stud having a right and left hand thread. Into the

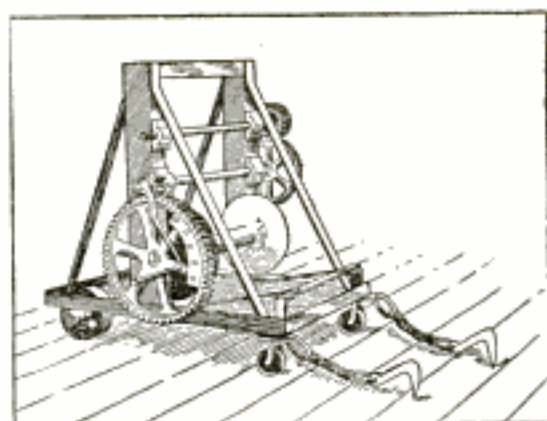


Door Holder That Will Not Scratch the Door

end nearest the axle he screwed an ordinary tap bolt, first slipping it through one side of the turn-buckle which was made as shown in sketch. Any tension could be maintained by this arrangement up to the breaking strength of the rod.

A Portable Crab

The accompanying sketch shows the construction of a portable crab for plat-



Portable Crab

form and warehouse purposes. It is made entirely of iron and steel, with the exception of three pieces of wood. It has double gearing of which the first is 6 to 1 and the second 20 to 1, giving a pull of 4 tons on a single line with a man turning each crank. The second crank can be thrown out of gear when using only the first. This will make a handy outfit for loading and unloading heavy articles to and from freight cars or about the warehouse.

How to Clean Copper Plates

When copper plates are stained with verdigris, which prevents their amalgamating with and saving the gold, the plates can be cleaned in the following manner: Thoroughly scrub the plates with fine sand and water, using a coarse gunny sack or scrub brush. Wash off the sand and scrub thoroughly with a solution consisting of 1 part of oil of vitriol and 4 parts of water, says

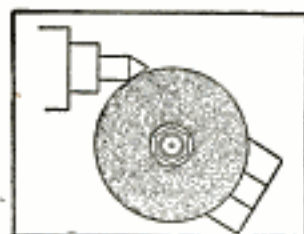
Western Machinery. The acid disintegrates the verdigris, dissolving the oxide of copper, and leaves the plate clean, when it will readily amalgamate with the mercury without the use of cyanide solution, except the acid solution should have been made stronger than herein prescribed, in which instance the plate should be washed off with water, and then dressed with a solution of cyanide as usual.

The formation of verdigris on the plates can be stopped by plating them with silver amalgam, after cleaning as before mentioned, exactly the same as mercury, leaving the plates thoroughly coated with silver, whereby they become more effective for catching gold and silver, and will operate better than plates which have been electro-plated with silver.

Turning Hard Lathe Centers with a Carborundum Tool

The center on my lathe was in bad shape and I had a rush job where a $\frac{1}{2}$ -in. mandrel must be used, and as we had no center grinder, apparently the only way possible was to anneal and re-turn the center, says a correspondent of American Machinist. A happy thought struck me to use a carborundum wheel we had—No. 40 grain. Taking out the tool post, I bolted the wheel flatwise in its place on top of the compound rest and swung it around to 60 deg., as shown in the sketch. Running the belt on the highest speed cone, I fed the wheel back and forth along the center, using the cross-feed screw to force the wheel in. In this manner the center was fitted up in good shape quickly; in fact, better than it would be after turning and hardening, as it usually springs some in that process.

Owners of small shops who have no grinder or cannot afford to own one will find this method a good substitute.



When through with the grinding a polish may be given by using a piece of fine emery cloth placed over a file with a little oil.

A Novel Sack Truck

The illustration shows an idea in sack trucks for the mill, which is a product of a German miller of Breslau. Three huge sacks full of grain or flour may be pushed around the mill, and by



Handy Sack Truck

an ingenious contrivance shown, a sack can be lifted onto one's shoulders without the help of anyone.

How to Keep Slag Back in Ladle

An extra man is always required for each ladle when taking off a heat to keep the slag and dross



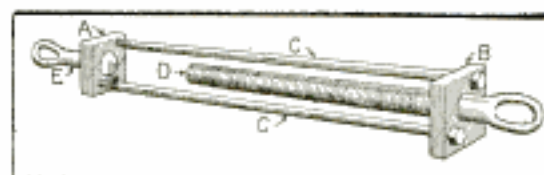
back from the pouring stream of molten metal. Make a hole or a spout in the side of the ladle as shown in the sketch and the part of the ladle

above the hole will not permit the dross to pass out with the flow of metal.

A round file may be used as a reamer by inserting it in the hole to be reamed and turning to the right instead of to the left. By doing so the file will not bind and excellent work will result.

How to Make a Long Turnbuckle

A hole is drilled in the center of two square plates of metal which may be of any size suitable for the work at hand. These two plates of metal are represented by A and B in the sketch. Two smaller holes are drilled in opposite corners of both plates, A and B,



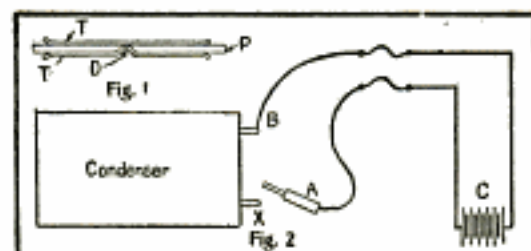
Making a Long Turnbuckle

and the ones in B are tapped to receive the threads of the long bolts, C C. A long screw bolt D is made with an eye in one end and is inserted through the center hole in B and fitted with a nut on the back side of the plate. Another eye piece is inserted through the center hole in plate A and a head riveted on the back side. When in position the nut on the back side of the plate B is turned to take up the slack.

How to Clear a Short-Circuited Condenser

The accompanying diagram shows how to apply the electric current to a condenser that may have become short-circuited by the tinfoil, through a defect in the paper insulation, making a contact one sheet with the other, as shown in Fig. 1.

Connect the contact point, A, Fig. 2, to one side of the source of current and the wire, B, to the other side, connecting this wire to the condenser as shown. Then by means of attaching the con-



Cleaning out a Condenser

tact point, A, to the condenser terminal, X, you will succeed in burning out the short-circuited portion of the condenser, says Telephony. Be sure to insert a fuse wire between the contact point and the source of current, which will blow out at about five amperes, and it is well to simply make passing contacts between A and X until you have observed that the short-circuited portion has been cleared. C represents the source of electric current, which may

be the regular 20 or 40-volt storage battery or it may be a 110-volt lighting circuit. Either system will serve so long as it is a source of direct current.

In Fig. 1 is shown the tinfoil, T, and the paper insulation, P. D shows the defect in the paper where the tinfoil has forced itself through in contact with another sheet. It is this contact point which is burnt out when you "flash" the condenser in the manner described.

How to Construct a Small Brass Furnace

The blacksmith, particularly the one who has put a metal working lathe in his shop, frequently feels the need of some means to obtain small castings quickly. If the shop is located in the vicinity of a foundry, the problem is simple, but when the nearest melting shop is miles away, then the question of repairs becomes a serious and expensive one. There is a way by which the smith in a remote region may obtain permanent relief. It is by putting in a small brass furnace and the accessories of a foundry sufficient to make small patterns, mold them in sand and cast in brass.

There are a great many places in repair work where a brass casting can be made to replace a broken steel one, and there are many other places where brass construction is far better than iron, although perhaps more costly. Some-

times cost cannot be considered where repairs must be made in a hurry.

Figure 1 represents a form of crucible usually employed for containing brass during the melting process. These crucibles can be obtained of any size, from 1-oz. capacity to large enough to hold 300 lb. of metal.

Different sizes of tongs will be required to fit crucibles of varying capacity, but as a foundry seldom uses more than one or two sizes of crucible, the assortment of tong sizes need not be an elaborate one. These are clamped over the crucible whenever it is necessary to move the crucible, either for putting in more coal, for replacing the crucible in a vertical position in the fire, or for removing it when the brass is ready to be poured into the molds. To pour the metal out of the crucible, a bar may be put through the tongs just above the crucible and held by two men, while another man tips down the crucible by means of the top end of the tongs, using them as a lever fulcrumed over the bar. In this manner the contents of the crucible may be poured at will. In regular foundries the tongs are removed from the crucible after the latter has been taken from the furnace and set on the ground over one of the ladle handles shown in Fig. 2. Then the tongs are removed, the ladle handle lifted into place to take the weight of the crucible and contents, which then

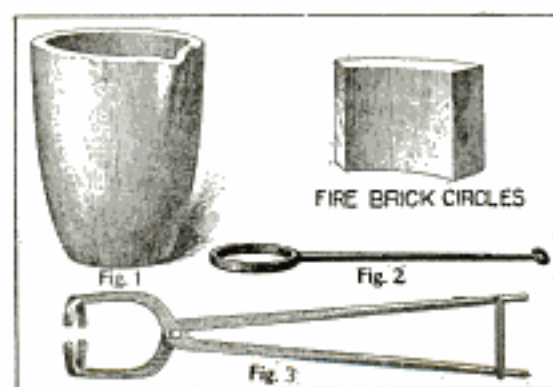
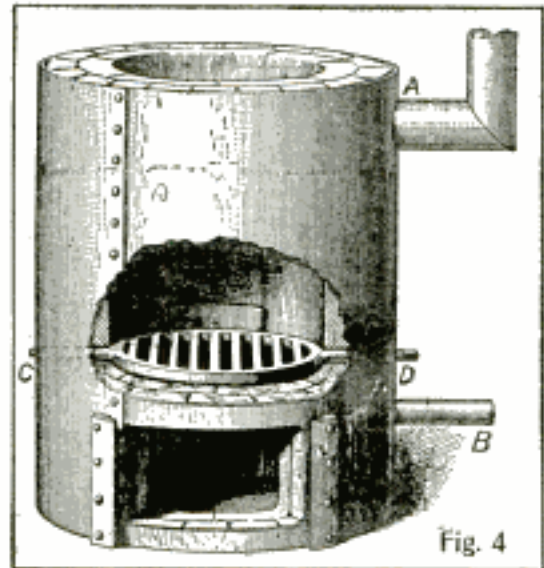


Fig. 1—Crucible for Melting. Fig. 2—Ladle Handle for Crucible. Fig. 3—Crucible Tongs

may be treated as if it were an ordinary ladle, and the molds poured by one man instead of three. The tongs are made as shown in Fig. 3.

To make a brass furnace for occasional use, procure a piece of sheet iron, 3 ft. wide and 8 ft. long. Bend this up in a cylinder and rivet together as shown in Fig. 4. Cut opening for the smoke pipe, A, the grate stems, C and D, for the ash door and for the air pipe, B. Also rivet on slides each side of the ash door in order that the air supply entering under the grate may be controlled by means of a sheet metal slide fitted over the ash opening instead of a door, and for the purpose of closing that opening entirely in case of necessity. The forge blower is connected direct to the air pipe, B, and used in case the chimney fails to give the necessary degree of heat.

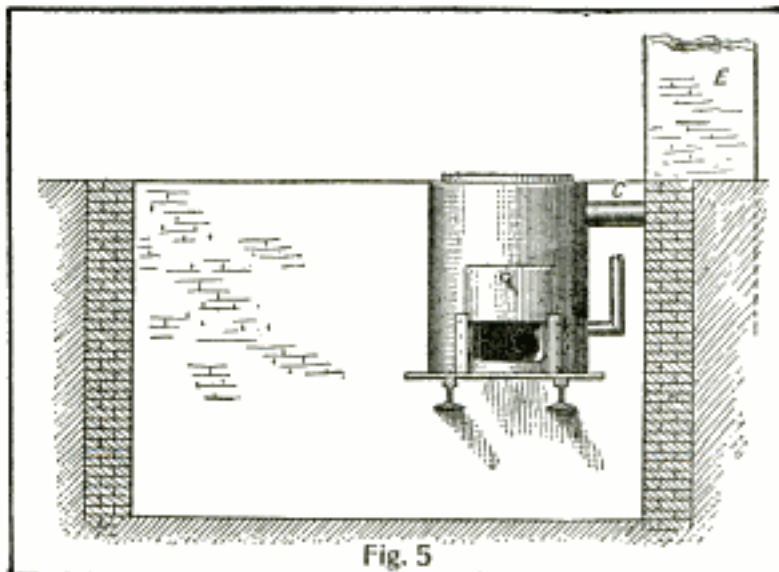
The grate may be taken from any coal stove which will yield the proper size. The grate is held in position both by the stems, C and D, which bear in the iron shell, and by the bearings of the stems in the brick lining of the furnace. The fire pot is lined with fire



Small Brass Melting Furnace

be 18 in. inside and 24 in. outside diameter. This will leave 3 in. all around inside the shell for a course of common bricks set on end and laid flat against the shell, the whole to be set with fire clay.

By having the working floor level with the top of the furnace it is easier to lower the crucibles into place, also to remove them from the furnace when under heat, says a correspondent of the Blacksmith and Wheelwright. The furnace should be placed in a pit excavated in the floor of the shop, as shown in Fig. 5, the furnace being supported on two pieces of railroad iron placed across the pit. The smoke pipe, C, is led away to a flue, E, which should be at least 30 ft. high to give the necessary draft. Were it not for the possibility that a blast might be required on account of poor coal, or some other reason,



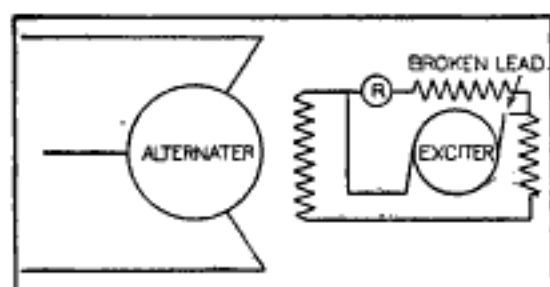
Furnace Arranged in a Pit

then the ash door and slide might be dispensed with, together with the bottom plate between the furnace and the rails. In this case the ash and clinkers would fall directly to the floor of the pit through the space between the rails.

brick circles. These circles are carried in stock by manufacturers of fire brick, and are known simply as "brass furnace circles." If a brick of this kind 7 in. high and 3 in. thick is used it will take seven to make a circle, which will

The Reversal of a Generator Field

An interesting field reversal occurred in a power plant consisting of a 440-volt, 150-kw., belted three-phase generator, with a 6-kw., four-pole, 125-volt belted exciter. A few minutes before "shutting down time" the alternator lost its field. A hurried examination showed that the negative exciter lead was broken at the brush-holder, also that three of the pole pieces were north pole, and one south. The lead, when found, lay across the frame, ap-



Reversal of Generator Field

parently having dropped there when it broke, but without grounding. After the broken lead had been repaired, a short-circuit test with a telephone receiver showed the circuit between the two armatures clear.

The machines were then started up, but the exciter "picked up" the wrong way, says a correspondent of the *Electric Journal*. The only direct-current apparatus available was a couple of dry batteries which the engineer explained, as he brought them out, were about exhausted. These were applied to the series field of the exciter. They would reverse the field in the air-gap, but as soon as they were disconnected the residual field still showed the wrong polarity. The batteries were then applied to the shunt field. The field in the air-gap was apparently neutral while the batteries were attached. This suggested a possible solution of the trouble. The batteries were connected in the shunt field circuit and then the machine was started with all the resistance in the rheostat cut out. After a few seconds the machine began to pick up in the right direction and was then ready to run.

The accompanying diagram shows the cause of the field reversal. When the field circuit of the alternator was broken it discharged through the shunt field of the exciter, the direction of the current being opposite to the normal.

A Concrete Pipe Joint

A novel method of connecting concrete pipe by means of an impervious and strong joint is described in the *Engineering News*. In the many instances in which cast concrete pipe has been used it has generally been found extremely difficult to form a joint which is at once watertight and strong enough to bear the weight of the earth filling, but the present process seems to solve both problems.

The pipes are cast in lengths of about 3 ft. The end faces of each pipe are provided with a groove having a triangular or semi-circular section, this groove being larger at the lower part of the pipe where the thickness is greater. These faces are provided with shoulders, to prevent a vertical movement of the pipes, when being set. At the crown of the pipes, semi-circular openings are provided, which form round holes in the top of the pipe when the two sections are joined. The joint is effected by first putting the adjacent sections together, the shoulders interlocked, and pouring hot asphalt through the circular opening on top until the entire groove is filled with asphalt. This filling of asphalt rapidly hardens so that in a very short time the earth fill can be replaced in the ditch. The small amount of asphalt which may leak through the inside of the joint may be chipped off as soon as it hardens.

A copper coating may be applied to brass for laying-out purposes in the same manner as used on iron or steel. The entire surface is covered with cast-iron dust, while the brass is still wet with the solution. Brush off the cast-iron dust, and the surface will have a nice copper coating.

How to Set Up and Operate Pumps

The suction and discharge pipes should, under no circumstances, be of smaller diameter than indicated by pump connections. When long pipes are used it is necessary to increase the size to allow for friction. Use as few elbows, tees and valves as possible, says the Practical Engineer. Lay suction line with a uniform grade from the pump to the source of supply, and be sure to avoid air pockets. The greatest care must be taken to make the suction line absolutely airtight, as a very small leak will supply the pump with enough air so that little or no water can be obtained.

A foot valve is also desirable if its location is such that the suction pipe can be drained in cold weather. The valve will insure quick starting of the pump by keeping the suction pipe filled with water. Hot water cannot well be lifted by suction, as its vapors tend to destroy the necessary vacuum. Therefore, hot water should be arranged to flow to the pump, and this applies also to thick liquids. Keep the stuffing boxes evenly packed, but do not screw them down tight, and give the pump reasonable attention.

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Linemen's Pole Brace for Boring Holes

This brace and bit is intended for boring holes in the tops of poles after

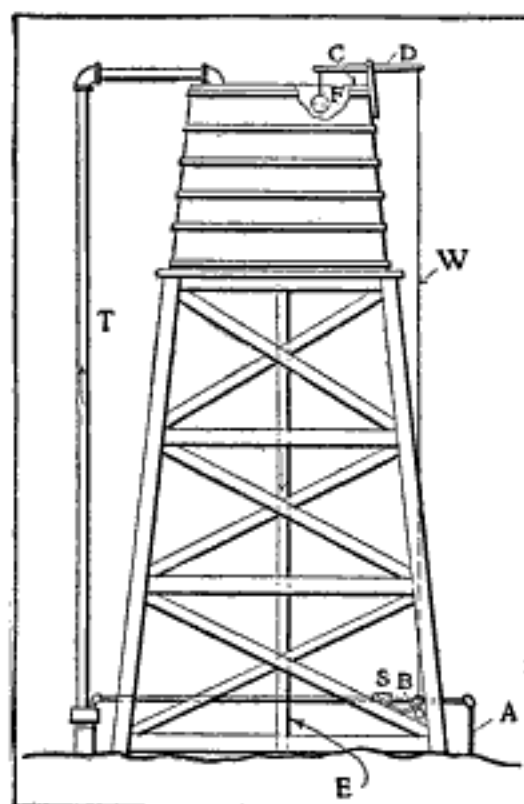


Brace for Boring Pole Tops

they have been set. In operating the brace the left hand grasps the center knob and steadies it, while the end or crank knob is turned with the right hand. In this way the lineman is not obliged to lean out from the pole and danger of falling is lessened.

Air-Lift Regulator for Water Tanks

In our plant we have an air-lift supplying water to a tank which is situated some distance from the engine room, and consequently could not be



Automatic Tank Regulator

easily regulated therefrom, says a correspondent of Power. The demand on the tank was intermittent, and it was essential that the tank should neither go empty or overflow. The regulator shown in the accompanying sketch was devised and installed.

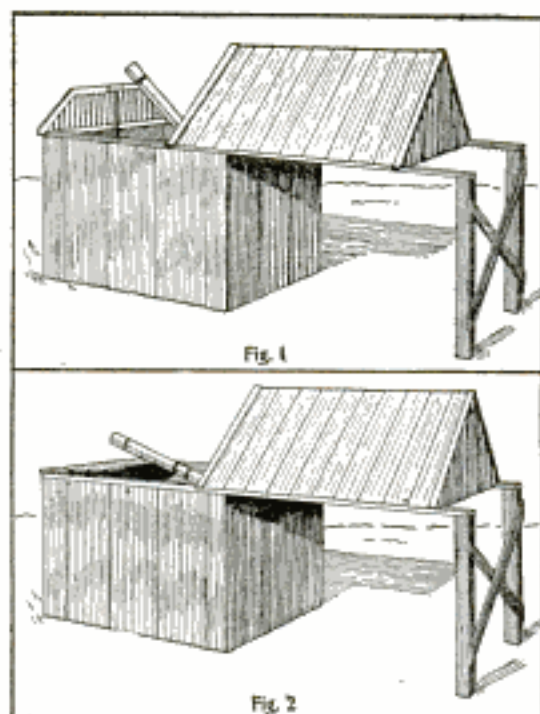
A stop-cock, S, with a bell crank lever attached to the plug, is placed in the air pipe, A. From this lever a wire, W, is connected to a walking-beam, D, from the opposite end of which a float, F, is suspended. The stop-cock and float were adjusted so that when the water was 3 in. from the top of the tank the stop-cock was just closed. As soon as the water fell in the tank the stop-cock was opened, admitting the air to the lift.

This device kept the water within 2 in. of a fixed point excepting, of course, when the air supply was shut off. The

walking-beam, D, has a stop, C, on which to rest when the tank is emptied. The weight, B, is used as a counter-balance for the float and to keep a tension on the wires.

A Wood and Iron Telescope House

The accompanying illustrations show the construction of a house used for a telescope in England that is made by using a frame of wood over which is placed corrugated iron as a covering. The roof is placed on small rollers and can be moved clear of the house, giving an entire opening for the telescope,



Observatory Without Dome

says the English Mechanic. Fig. 2 shows the gable turned down to clear the way to view the horizon.

How to Wash Automobile Tires

The best method of washing automobile tires consists of passing a damp sponge, or a well-wrung cloth, around the covers. In this way all grit and dirt can be effectively removed, and the condition of the rubber readily seen. The washing should be done with the smallest possible quantity of water to prevent permeation of moisture to the

inside of the covers. Many motorists are in the habit of washing the bodies of the cars with kerosene and water, and for removing mud and dust from the varnish the mixture is very satisfactory. But such a method should never be employed for the cleansing of tires, says Automobile Topics. If rubber comes in contact with kerosene for any length of time it will become swollen, disintegrated and will crumble in the hand. If moisture is allowed to enter the cover it will very soon begin the destruction of the canvas linings, besides rusting the rims, and rusty rims will ruin the covers.

Nickel Plating Without Electric Current

A light coat of nickel may be deposited upon brass and copper articles without the use of the electric current. The deposit is hardly sufficient to stand heavy buffing, but it may be lightly treated without cutting through.

A solution is made up as follows:

Water	gal. 1
Double Nickel Salts.....	oz. 8
Sal-ammoniac	oz. 8

The salts are dissolved in the water, and the whole is then heated nearly to boiling, says the Brass World. The brass or copper articles are immersed in the solution and some pieces of aluminum are placed in it so that they come in contact with the brass or copper. The aluminum may be in the form of sheet scrap or granulated. A few pieces only are necessary.

Gas is given off from the aluminum and within a minute the article will become covered with a white coat of nickel. In a few minutes a fairly heavy deposit will have been produced.

The nickel deposit is not quite as white as that obtained by electro-deposition from a good nickel solution, but it is the equal of an ordinary grade. It has a dark shade resembling the nickel obtained in an alkaline plating solution.

Leather washers smeared with soap will not leak gasoline.

How to Mount Large Bells in Towers

(By Courtesy of Meneely Bell Co.)

The bell-chamber should not be placed any higher in the tower than is necessary in order to bring the position of the bell, when mounted, just above the level of the tops of the surrounding houses. This room should be especially arranged to permit the free egress of the sound. It must be tightly sealed directly above the tops of the windows, which should be as wide and open as possible, and extend almost to the floor, in order that the bell, when at rest, may have its mouth above the level of their base. The floor beneath the bell must be tightly closed.

It is usual to construct the tower in such a manner that the bell can be readily hoisted to its position through openings on the inside. Since, however, it is frequently necessary to raise the bell on the outside, the accompanying cut, together with the following instructions, shows an easy way of getting a bell into its place.

First a strong beam is projected at an elevated angle, from the top of a window in the bell-chamber, and securely fastened. The tackle is attached to the end of this beam and the power is applied either from within the tower, or by running the rope to the ground and through a stationary pulley, where it may be drawn upon by any number of men, a team of horses, or a mechanical apparatus. When the bell has been raised to a sufficient height, it can be drawn into the tower by the guide rope or a small tackle. Prior to the hoisting of the bell, the frame should be raised and placed so that it has a firm and level bearing. The wheel should also be raised before the bell and placed upon the proper side of the tower, ready for attachment. It will be noticed that the wheel must necessarily be placed upon the side of the frame opposite to that upon which the tolling hammer is to be attached. When the bell is mounted the standards should have small, wooden braces set up against

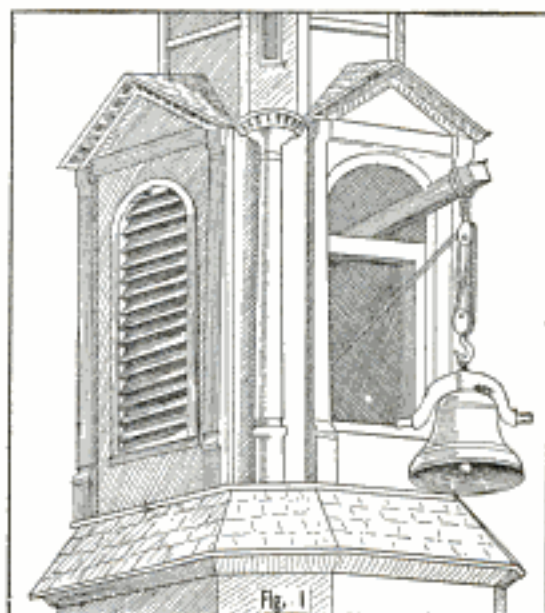


Fig. 1
Mounting Large Bells

them, sidewise and bearing against the wall of the tower at the intersection of the floor, so as to prevent any fracture or straining in that direction. The clapper bolt should be well oiled when inserted and the key opened at the end, to prevent its falling out.

The rope is attached in the manner shown in Fig. 2. Whenever the weight of the bell permits, it is usual to let the rope pass down through sheaves, directly under the center of the wheel, by which arrangement the bell can be swung completely over, without disarranging the rope. In case of bells of heavy weight, since any additional friction would materially increase the labor of ringing, it is usual to let the rope fall in a direct line from the outer portion of the wheel and pass through the floor, without the use of sheaves.

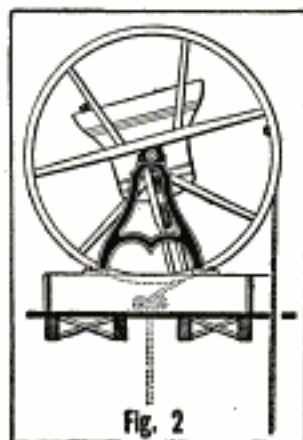


Fig. 2

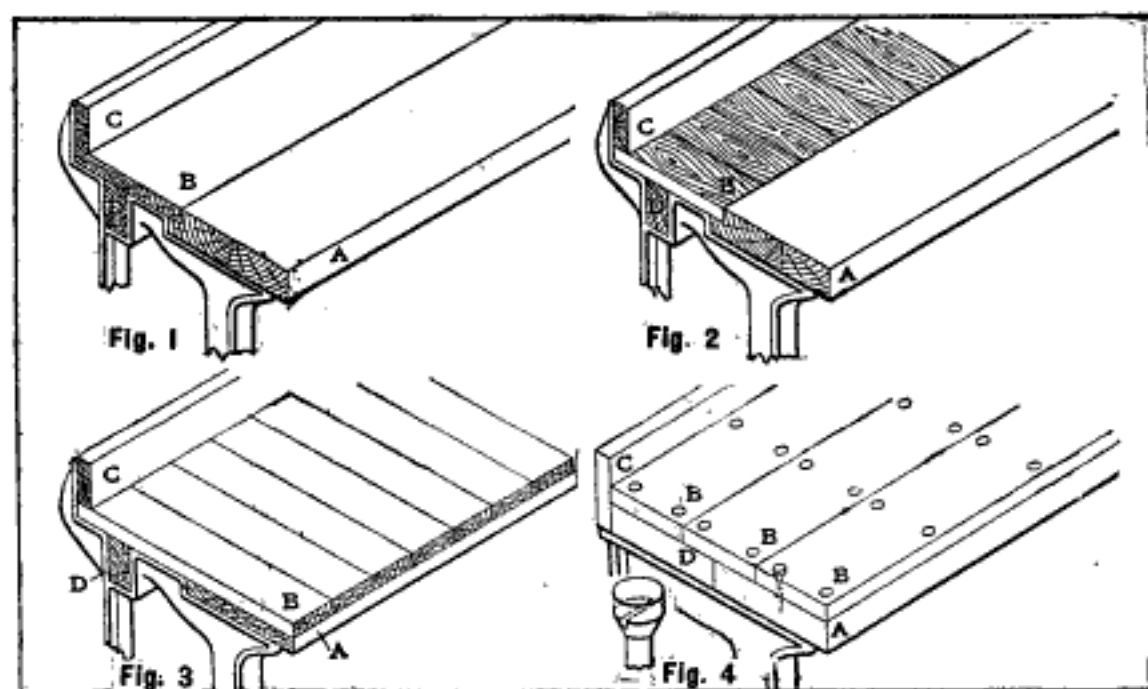
Some Designs of Work Benches

The average shop needs a bench that is rigid; that will stand chipping and filing; that can be used in testing work on a surface plate or in handling jigs and fixtures; that will not splinter badly nor yet injure a tool should it happen to drop onto it. For the tool-maker the cast-iron bench top has many advantages, but both the bench and the tool are very liable to be marred by dropping the tool on it, so that for general use we must rely on wood as a material for this purpose.

or 8 ft., give the back board a stiffness that is unknown where they are simply laid flush and not rabbeted and the stringer is absent.

All cracks are more or less a nuisance in bench work, but in this case any shrinkage can be taken up by wedging against the iron support of the board C and the edge of the back board, B.

Another style bench with the same leg is shown in Fig. 2. Here the front plank, A, and the board, C, are the same as before, but instead of having one back board, this part of the bench is made up of narrow strips as



Various Styles of Work Benches

Steam pipes have taken the place of stoves and the best place for them is on the wall back of the bench, says the American Machinist. This will not allow us to brace up the bench against the wall. A cast-iron bench leg is now used, as shown in Fig. 1, which will permit the bench to stand far enough away from the wall to allow a passage way for the heat from the pipes. Figure 1 also shows the back board, B, rabbeted to the plank A, which supports it all along the front edge, and it is also supported by the stringer D, which runs the whole length of the bench. These supports, in addition to the cross bearing of the legs every 6

B, fitting into the rabbet in plank A and supported by the stringer D as before. These narrow boards can be either tongue and grooved hardwood flooring, or can be square edges, as preferred; in either case any shrinkage can be taken up by forcing the boards together.

A cheaper form of bench is shown in Fig. 3, where the heavy planking is entirely dispensed with and the boards B run the full width of the bench as shown. Running along the front, underneath the main boards, is a soft plank, A, which supports the edge of the bench where the most work comes, and under the back is the 2 by

6-in. stringer as before. Here, too, the boards can be either notched or square edge, each having its advocates; the objection against the tongue and groove being that the edges are apt to split off from heavy articles dropping on them. An advantage claimed for the boards running this way is that the work going on or off the bench is always in the direction of the grain of the wood and that fewer splints are formed on that account. In Fig. 2 or 3 any local wear can be remedied by replacing the worn board with a new one.

Still another style of bench is shown in Fig. 4 and one which is designed to be serviceable and have a long life without so much regard to first cost as some shops must exercise. The bench leg is flat on top, the first layer of maple planks, A and D, and on top, narrower boards of the same material. These are fastened with long wood screws, holes being countersunk and plugged as shown.

Calking Pipe Joints

A method recently introduced of making lead joints for gas and water pipes is claimed to possess a number of advantages over the old ways. Formerly joints for gas and water pipes were made by first putting in strands of hemp yarn and filling the remaining space with molten lead. After cooling this would require calking and when finished only a part of the lead would be holding the joint. In making the joints in this manner it is necessary to have the pipes dry or else a poor joint will be made; there is also danger of accidents from the blowing of the hot metal. If the yarn is not properly calked the lead will enter the pipe and form an obstruction for the water or gas.

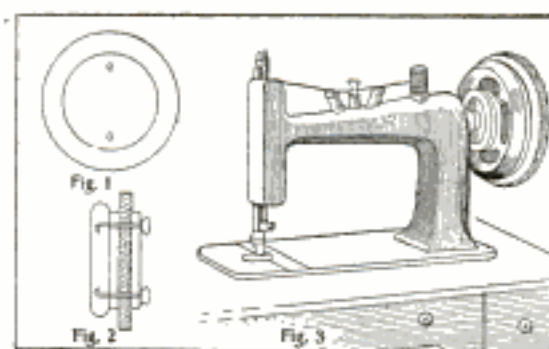
The new method of making the joint, it is claimed, avoids all the disadvantages above mentioned and has other advantages of its own. In this newer method a patent "lead wool" is used, and this consists of fine threads

of the purest virgin lead cut by patent machinery, and in such a way that it will weld together when hammered, says Light. The patent lead wool is set out in strands formed of a sufficient number of threads, each strand weighing about a pound and being about 3 ft. long.

After the introduction of the usual hemp or yarn (not tarred), this strand of "lead wool" is twisted until it fits the space in the socket. It is then well calked, and this calking is repeated with each turn of the lead wool until the socket is filled and the whole of the lead wool is tightly pressed into a dense mass of lead, whereby not only a safe and efficient packing is obtained over the entire depth of the socket, but the joint is capable of withstanding a much greater pressure than the joint made in the ordinary manner.

Home-Made Buffing Wheel

The family sewing machine may be put into useful service when not needed for sewing purposes by making a buff-

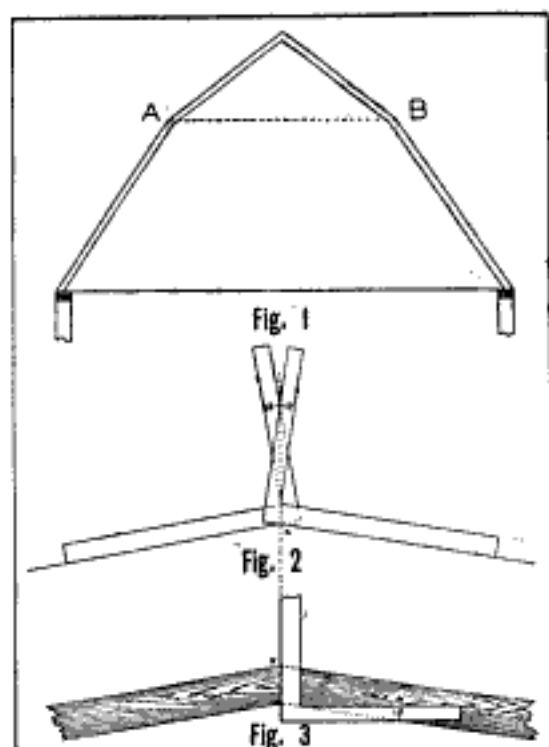


Polishing with Sewing Machine

ing wheel and attaching it to the small hand or fly-wheel. Two pieces of wood are made circular about the same size in diameter as the wheel. Several layers of cloth are placed between these wood discs and trimmed in a circle larger than the discs as shown in Fig. 2. These wood discs, together with the cloth, are clamped to the wheel with two bolts which are made hooked on one end and a thumb nut on the other. The buffing wheel can be attached and removed quickly. Figure 3 shows the wheel in position.

How to Join Gambrel Roof Rafters

A cut for the proper angle in rafters to make a gambrel roof shown at AB, Fig. 1, is made at the bisecting line



Finding Angle on Rafters for Gambrel Roof

formed by the angle of the rafters, which may be easily found by laying off a diagram and bisecting with a compass, or it may be found with the square direct, as shown in Fig. 2, by taking, say 12, on the tongue of each square as a pivot point and with the blades fitted to the angle formed by the rafters, says the American Carpenter and Builder. The intersecting point on the blade will show the figures to use that number. The blade will give the cut, as shown in Fig. 3.

Points on Tempering Well Drill Bits

When a bit is plunged into the water, it should be moved up and down, or else the molecular tension above and below the water line will be so different that the bit will be liable to break in the same way as glass when hot water

is poured on it. The bit should never be heated in the incandescent cinders of a fire, as that will decarbonize and render the cutting edge worthless. The bit should be heated a few inches back from the edge, and should not remain in the fire longer than necessary to secure the cherry-red color, says the Drill Hole. Immediately after removing the bit from the fire it should be plunged in water for a moment to partially cool it, and then should be rubbed on a stone to remove the outside scale in order that the colors may be easily distinguished. The colors should advance parallel to the cutting edge; and if in any case they are observed to do otherwise, that portion of the bit to which they are advancing most rapidly should be held in water. Frequently it is necessary to plunge the bit in water several times to obtain the proper parallelism before the final cooling; if the bit were cooled when the colors were not parallel to its cutting edge, but crossed it, the cutting edge would likely be too soft in one place and too brittle in another.

The drill bits are more serviceable when tempered in thick oil or coal tar than when tempered in water. It is presumed that this is due to the water rapidly chilling the thin parts and the skin of thick parts thus producing uneven hardness in the bit while oil or tar cools the bit more gradually and thereby renders it more tough. If it is found that a certain bit should be dipped in water when it has a blue color, it should be dipped in oil when it has a purple color; in other words, to produce the same degree of hardness with oil that has been obtained by water, the bit should be dipped in oil when it has the color that precedes the one that it has when dipped in water. In nearly all cases steel is made tougher and more uniform when tempered in oil than when tempered in water.

A drawing may be cleaned by rubbing it with bread crumbs. This will remove dirt and finger marks, leaving the paper white and clean.



Amateur Mechanics



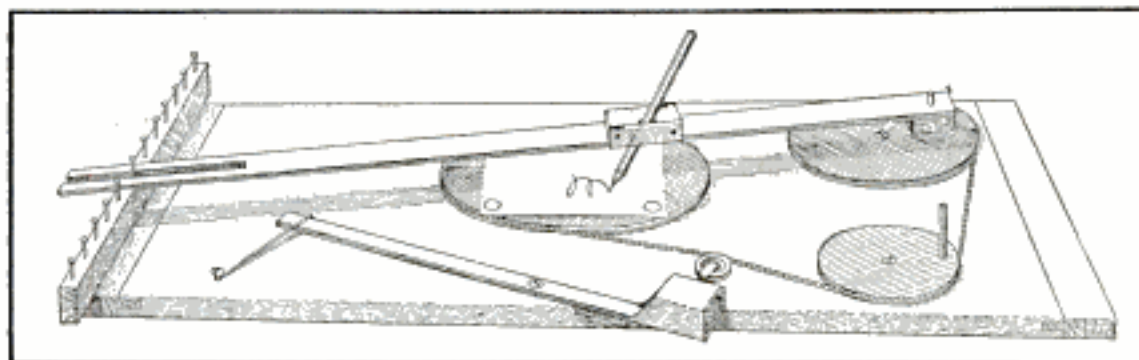
How to Make a Wondergraph

By F. E. Tuck

An exceedingly interesting machine is the so-called wondergraph. It is easy and cheap to make and will furnish both entertainment and instruction for young and old. It is a drawing machine and the variety of designs it will produce, all symmetrical and ornamental, and some wonderfully complicated, is almost without limit. Figure 1 represents diagrammatically the machine shown in the sketch. This is the easiest to make and gives fully as great a variety of results as any one of them.

grooved block attached to the ruler. A strip of wood, MN, is fastened to one end of the board. This strip is made just high enough to keep the ruler parallel with the face of the table, and a row of small nails are driven part way in its upper edge. Anyone of these nails may be used to hold the other end of the ruler in position as shown in the sketch. If the wheels are not true, a belt tightener, B, may be attached and held against the belt by a spring or rubber band.

After the apparatus is adjusted so it will run smoothly, fasten a piece of drawing paper to the table with a couple of thumb tacks, adjust the pen

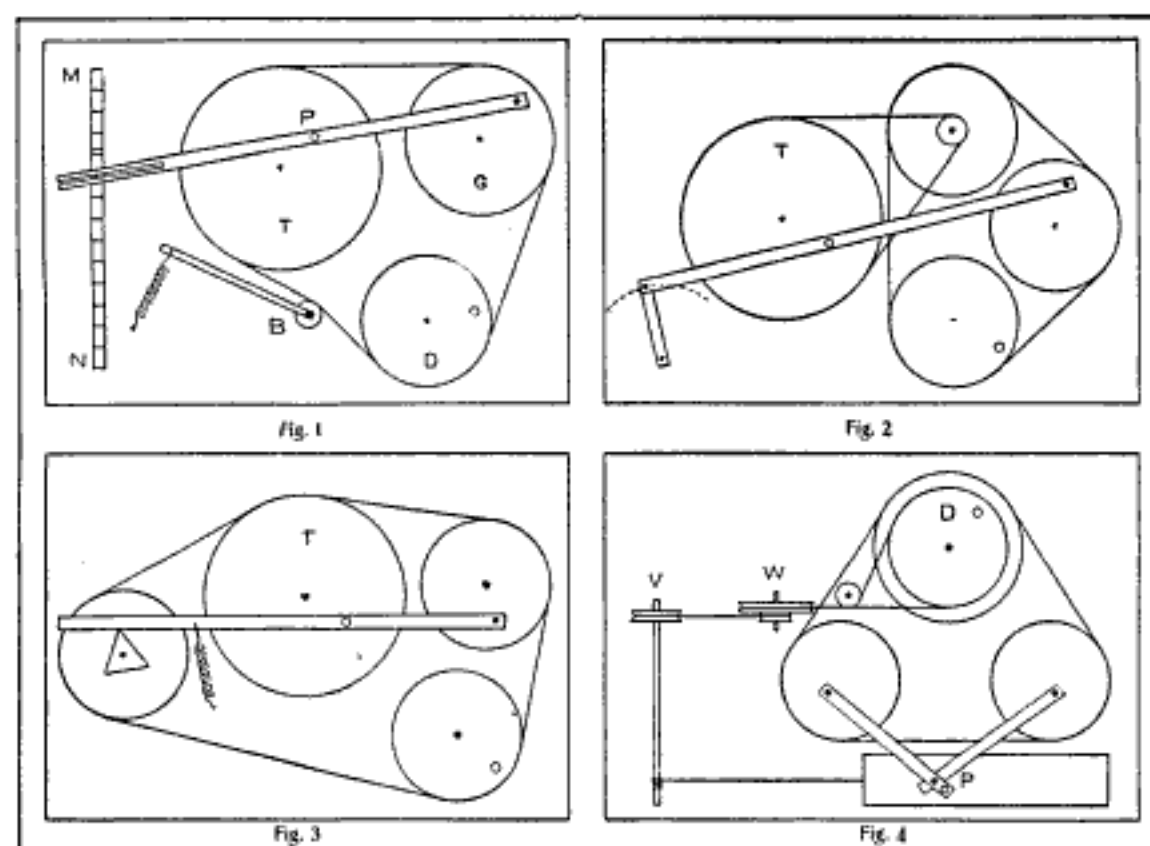


An Easily Made Wondergraph

To a piece of wide board or a discarded box bottom, three grooved circular discs are fastened with screws so as to revolve freely about the centers. They may be sawed from pieces of thin board or, better still, for about 15 cents three of the plaques so generally used in burnt wood work may be obtained. Use the largest one for the revolving table, T. G is the guide wheel and D the driver with attached handle. Secure a piece of a 36-in. ruler, which can be obtained from any furniture dealer, and nail a small block, about 1 in. thick, to one end and drill a hole through both the ruler and the block and by means of a wooden peg, pivot them to the face of the guide wheel. A fountain pen or pencil is placed at P and held securely by rubber bands in a

so that it rests lightly on the paper and turn the drive wheel. You will be surprised and delighted at the results. The accompanying designs were made with a very crude combination of pulleys and belts such as described.

The dimensions of the wondergraph may vary. The larger designs in the illustration were made on a table 8 in. in diameter which was driven by a guide wheel 6 in. in diameter. The size of the driver has no effect on the form or dimensions of the design, but a change in almost any other part of the machine has a marked effect on the results obtained. If the pen holder is made so that it may be fastened at various positions along the ruler, and the guide wheel have holes drilled through it at different distances from the center



Diagrams Showing Construction of Wondergraphs

to hold the peg attaching the ruler, these two adjustments, together with the one for changing the other end of the ruler by the rows of nails, will make a very great number of combinations possible. Even a slight change will greatly modify a figure or give an entirely new one. Designs may be changed by simply twisting the belt, thus reversing the direction of the table.

If an arm be fastened to the ruler at right angles to it, containing three or four grooves to hold the pen, still different figures will be obtained. A novel effect is made by fastening two pens to this arm at the same time, one filled with red ink and the other with black ink. The designs will be quite dissimilar and may be one traced over the other or one within the other according to the relative position of the pens.

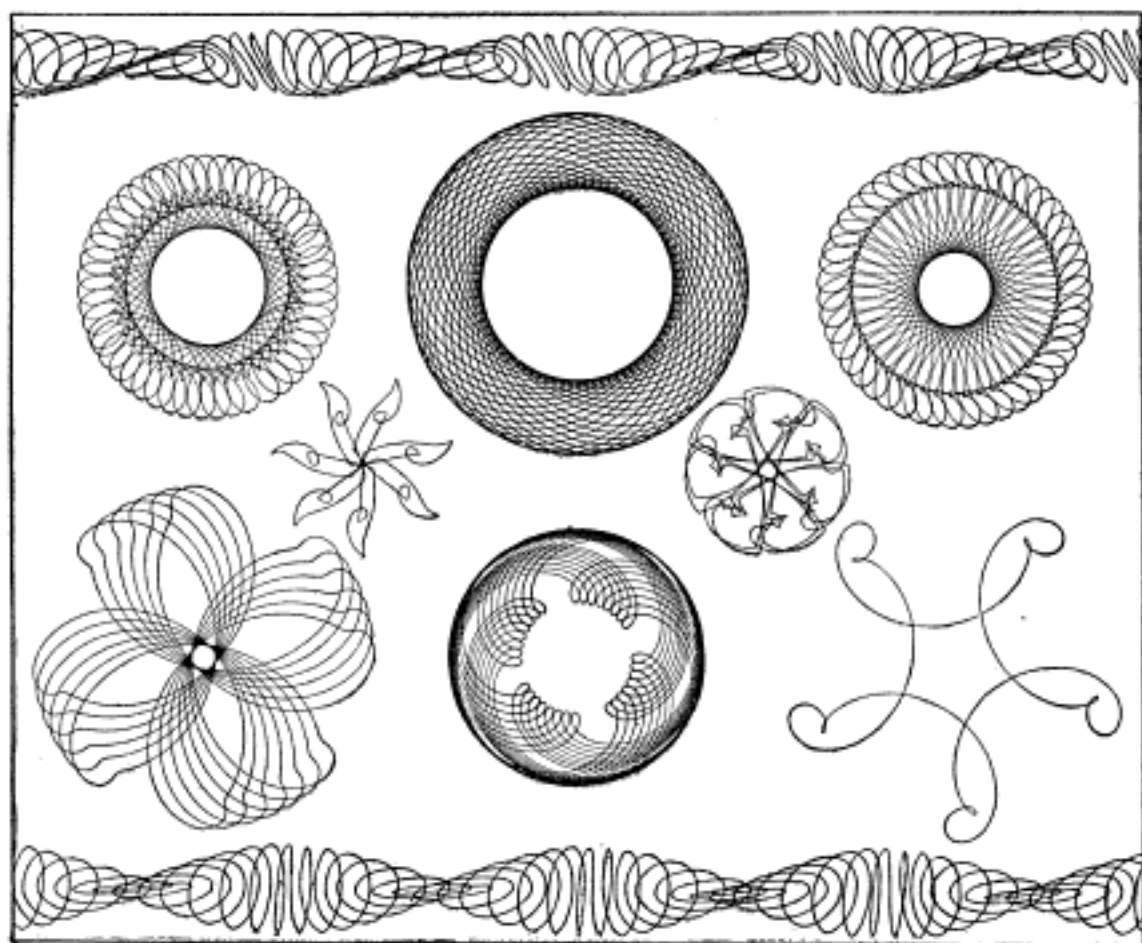
Again change the size of the guide wheel and note the effect. If the diameter of the table is a multiple of that of the guide wheel, a complete figure of few lobes will result as shown by the one design in the lower right-hand corner of the illustration. With

a very flexible belt tightener an elliptical guide wheel may be used. The axis may be taken at one of the foci or at the intersection of the axis of the ellipse.

The most complicated adjustment is to mount the table on the face of another disc, table and disc revolving in opposite directions. It will go through a long series of changes without completing any figure and then will repeat itself. The diameters may be made to vary from the fraction of an inch to as large a diameter as the size of the table permits. The designs given here were originally traced on drawing paper 6 in. square.

Remarkable and complex as are the curves produced in this manner, yet they are but the results obtained by combining simultaneously two simple motions as may be shown in the following manner: Hold the table stationary and the pen will trace an oval. But if the guide wheel is secured in a fixed position and the table is revolved a circle will be the result.

So much for the machine shown in



Specimen Scrolls Made on the Wondergraph

Fig. 1. The number of the modifications of this simple contrivance is limited only by the ingenuity of the maker. Fig. 2 speaks for itself. One end of the ruler is fastened in such a way as to have a to-and-fro motion over the arc of a circle and the speed of the table is geared down by the addition of another wheel with a small pulley attached. This will give many new designs. In Fig. 3 the end of the ruler is held by a rubber band against the edge of a thin triangular piece of wood which is attached to the face of the fourth wheel. By substituting other plain figures for the triangle, or outlining them with small finishing nails, many curious modifications such as are shown by the two smallest designs in the illustrations may be obtained. It is necessary, if symmetrical designs are to be made, that the fourth wheel and the guide wheel have the same diameter.

In Fig. 4, V and W are vertical wheels which may be successfully con-

nected with the double horizontal drive wheel if the pulley between the two has a wide flange and is set at the proper angle. A long strip of paper is given a uniform rectilinear motion as the string attached to it is wound around the axle, V. The pen, P, has a motion compounded of two simultaneous motions at right angles to each other given by the two guide wheels. Designs such as shown as a border at the top and bottom of the illustration are obtained in this way. If the vertical wheels are disconnected and the paper fastened in place the well known Lissajou's curves are obtained. These curves may be traced by various methods, but this arrangement is about the simplest of them all. The design in this case will change as the ratio of the diameters of the two guide wheels are changed.

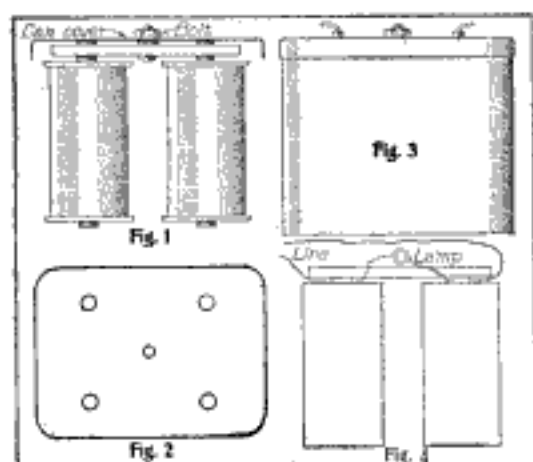
These are only a few of the many adjustments that are possible. Frequently some new device will give a figure which is apparently like one ob-

tained in some other way, yet, if you will watch the way in which the two are commenced and developed into the complete design you will find they are formed quite differently.

The average boy will take delight in making a wondergraph and in inventing the many improvements that are sure to suggest themselves to him. At all events it will not be time thrown away, for, simple as the contrivance is, it will arouse latent energies which may develop along more useful lines in maturer years.

How to Make a 110-Volt Transformer

Secure two magnets from a telephone bell, or a set of magnets wound for 2,000 ohms. Mount them on a bar of brass or steel as shown in Fig. 1. Get an empty cocoa can and clean it good to remove all particles of cocoa and punch five holes in the cover, as shown in Fig. 2. The middle hole is to be used to fasten the cover to the brass bar with a bolt. The other four holes are for the wire terminals. A piece of rubber tubing must be placed over the wire terminals before inserting them in the holes. Fill the can with crude oil, or with any kind of oil except kero-



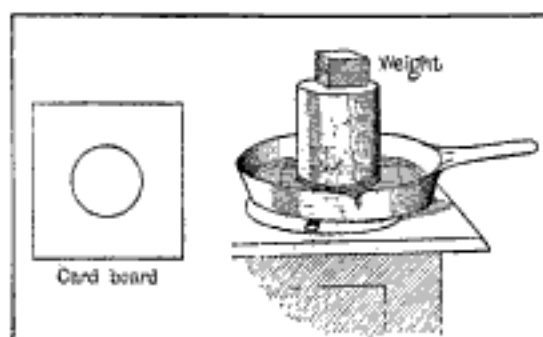
Parts of the Transformer

sene oil, and immerse the magnets in it by fitting the cover on tight (Fig. 3). The connections are made as shown in the diagram, Fig. 5. This device may be used on 110-volt current for electro-

plating and small battery lamps, provided the magnets are wound with wire no larger than No. 40.—Contributed by C. M. Rubsan, Muskogee, Okla.

Experiment with a Vacuum

Take any kitchen utensil used for frying purposes—an ordinary skillet, or spider, works best—having a smooth



Experimental Apparatus

inner bottom surface, and turn in water to the depth of $\frac{1}{2}$ in. Cut a piece of cardboard circular to fit the bottom of the spider and make a hole in the center 4 in. in diameter. The hole will need to correspond to the size of the can used. It should be 1 in. less in diameter than that of the can. Place this cardboard in the bottom of the spider under the water. A 2-qt. syrup can or pail renders the best demonstration, although good results may be obtained from the use of an ordinary tomato can. The edge of the can must have no indentations, so it will fit perfectly tight all around on the cardboard. Place the can bottom side up and evenly over the hole in the cardboard. Put a sufficient weight on the can to prevent it moving on the cardboard, but not too heavy, say, 1 lb.

Place the spider with its adjusted contents upon a heated stove. Soon the inverted can will begin to agitate. When this agitation finally ceases remove the spider from the stove, being careful not to move the can, and if the quickest results are desired, apply snow, ice or cold water to the surface of the can until the sides begin to flatten.

The spider with its entire contents

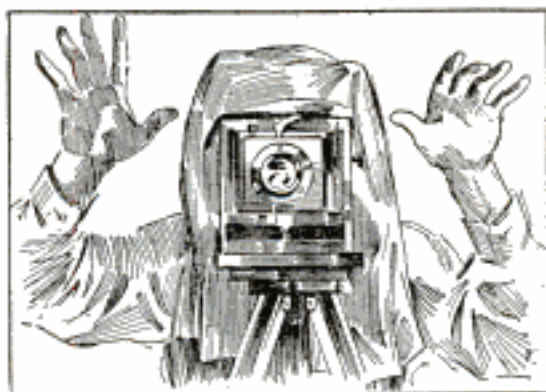
may now be lifted by taking hold of the can. When the vacuum is complete the sides of the can will suddenly collapse, and sometimes, with a considerable report, jump from the spider.

The cause of the foregoing phenomenon is that the circular hole in the cardboard admits direct heat from the surface of the spider. This heat causes the air in the can to expand, which is allowed to escape by agitation, the water and the cardboard acting as a valve to prevent its re-entrance. When the enclosed air is expelled by the heat and a vacuum is formed by the cooling, the above results are obtained as described.—Contributed by N. J. McLean.

The Making of Freak Photographs

An experiment that is interesting and one that can be varied at the pleasure of the operator, is the taking of his own picture. The effect secured, as shown in the accompanying sketch, reproduced in pen and ink from a photograph, is that made by the photographer himself. At first it seems impossible to secure such a picture, but when told that a mirror was used the process is then known to be a simple one.

The mirror is set in such a way as to allow the camera and operator, when standing directly in front of it, to be



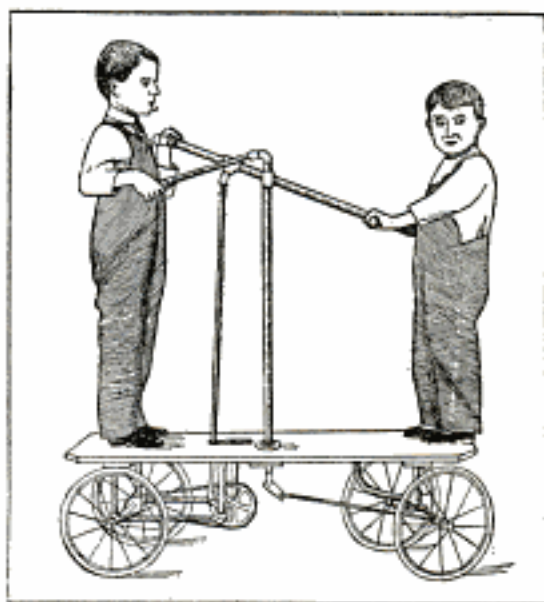
Photographing the Photographer

in a rather strong light. The camera is focused, shutter set and plate holder made ready. The focusing cloth is thrown over your head, the position

taken as shown, and the exposure made by the pressure of the teeth on the bulb while held between them.

Hand Car Made of Pipe and Fittings

Although apparently complicated, the construction of the miniature hand car shown in the accompanying illus-



Boy's Hand Car

tration is very simple. With a few exceptions all the parts are short lengths of pipe and common tees, elbows and nipples.

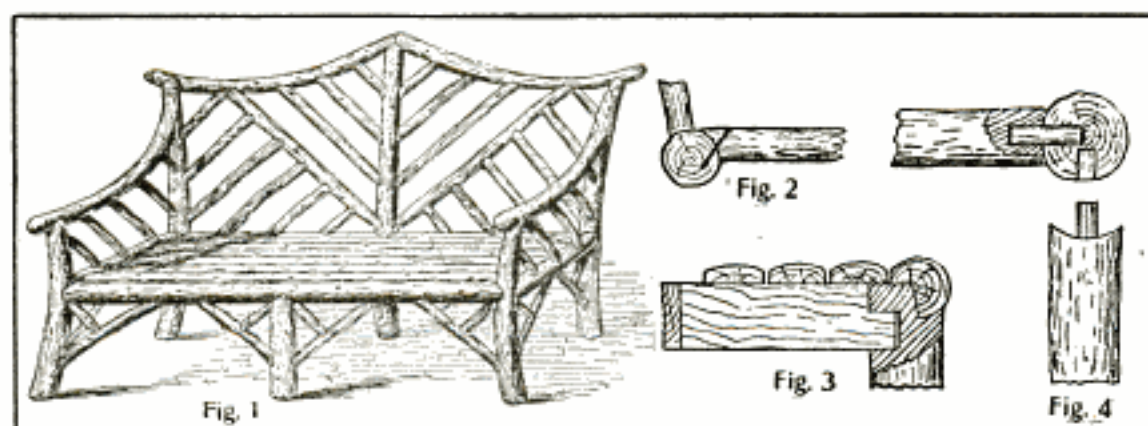
The wheels were manufactured for use on a baby carriage. The sprocket wheel and chain were taken from a discarded bicycle, which was also drawn upon for the cork handle used on the steering lever. The floor is made of 1-in. white pine, 14 in. wide and 48 in. long, to which are bolted ordinary flanges to hold the framing and the propelling and steering apparatus together. The axles were made from $\frac{3}{8}$ -in. shafting. The fifth wheel consists of two small flanges working on the face surfaces. These flanges and the auxiliary steering rod are connected to the axles by means of holes stamped in the piece of sheet iron which encases the axle. The sheet iron was first properly stamped and then bent around the axle. The levers for propelling and steering the car work in fulcrums made

for use in lever valves. The turned wooden handles by which these levers are operated were inserted through holes drilled in the connecting tees. The working joint for the steering and hand levers consists of a $\frac{1}{2}$ by $\frac{3}{4}$ by $\frac{3}{8}$ -in. tee, a $\frac{1}{2}$ by $\frac{3}{8}$ -in. cross and a piece of rod threaded on both ends and screwed into the tee. The cross is reamed and, with the rod, forms a bearing.

The operation of this little hand car is very similar in principle to that of the ordinary tricycle, says Domestic Engineering. The machine can be propelled as fast as a boy can run. It responds readily to the slightest movement of the steering lever.

to the front rail and also connected to the back post by a bearer, 4 in. deep by $1\frac{1}{2}$ in. thick. This bearer is tenoned to the back post.

Fig. 3 shows a sectional view of the bearer joint to front leg, and also the half-round seat battens resting on the bearer, also showing them with their edges planed. It is advisable to have a space between the edges of each batten, say about $\frac{1}{8}$ in., to allow rain-water to drain. The ends of the seat battens are pared away to fit the transverse rails neatly as shown in Fig. 2. The struts for the post range in diameter from $1\frac{1}{2}$ in. to 2 in. The ends of the struts are pared to fit the posts and



Rustic Seat and Details of Construction

How to Make a Rustic Seat

The rustic settee illustrated in Fig. 1 may be made 6 ft. long, which will accommodate four average-sized persons. It is not advisable to exceed this length, as then it would look out of proportion, says the Wood-Worker. Select the material for the posts, and for preference branches that are slightly curved, as shown in the sketch. The front posts are about $3\frac{1}{2}$ in. in diameter by 2 ft. 4 in. long. The back posts are 3 ft. 4 in. high, while the center post is 3 ft. 8 in. in height. The longitudinal and transverse rails are about 3 in. in diameter and their ends are pared away to fit the post to which they are connected by 1-in. diameter dowels. This method is shown in Fig. 4. The dowel holes are bored at a distance of 1 ft. $2\frac{1}{2}$ in. up from the lower ends of posts. The front center leg is partially halved

rails, and are then secured with two or three brads at each end.

Select curved pieces, about $2\frac{1}{2}$ in. in diameter, for the arm rests and back rails; while the diagonally placed filling may be about 2 in. in diameter. Start with the shortest lengths, cutting them longer than required, as the paring necessary to fit them to the rails and posts shortens them a little. Brad them in position as they are fitted, and try to arrange them at regular intervals.



Motorists that suffer with cold hands while driving their cars may have relief by using a steering wheel that is provided with electric heat. An English invention describes a steering wheel with a core that carries two electrically heated coils insulated one from the other and from the outer rim.

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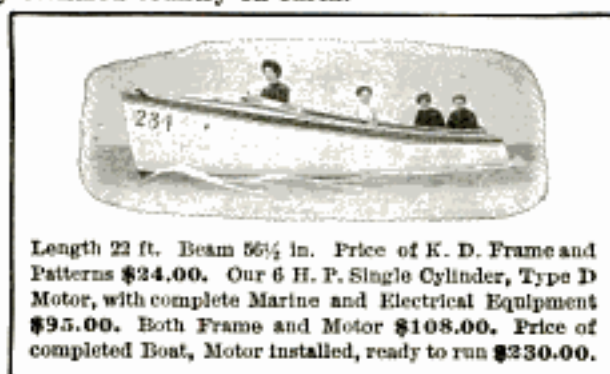
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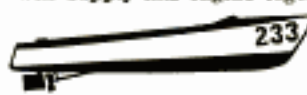
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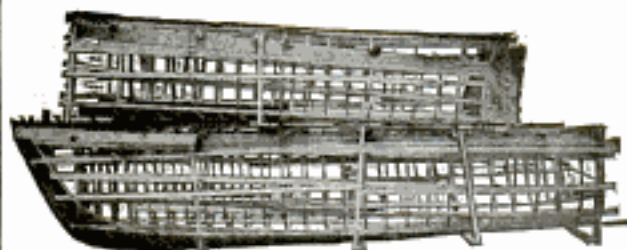


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TREE SWALLOWED TOMBSTONE.—While cutting down a large wild-cherry tree in a cemetery near Crawfordsville, Ind., it was found that the tree had enveloped a marble tombstone 2 ft. in height and about 14 in. in width. The tree was 4 ft. in diameter at the base and for many years had attracted attention by its size.



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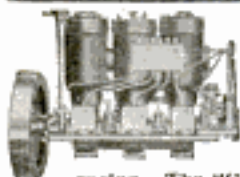


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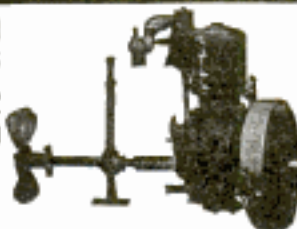
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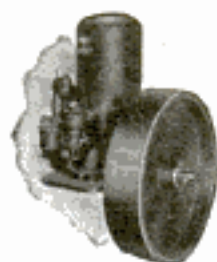
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TO COMPEL VESSELS TO CARRY BREECHES BUOY.—Owing to numerous wrecks under conditions which often make it impossible for the life-saving stations to give material aid, a bill is being prepared in the department of commerce and labor which will require all sea-going American vessels to be equipped with a self-anchoring line carrying a projectile and the means for projecting it. Several devices of this character are in use and a vessel so provided may establish communication with land independent of aid from shore. Equipped with a device similar to the breeches buoy a stranded vessel can land its crew and passengers with some degree of safety. In many instances a strong adverse wind makes it impossible for the mortar equipment of a life-saving crew to throw a line over a stranded ship. This same wind would naturally assist in the shooting of a line from the ship to the shore.

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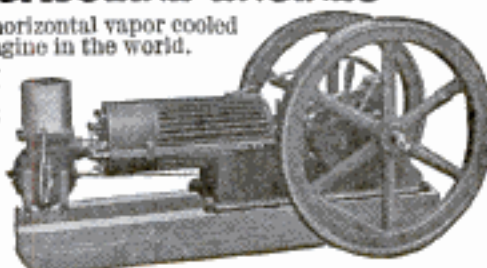
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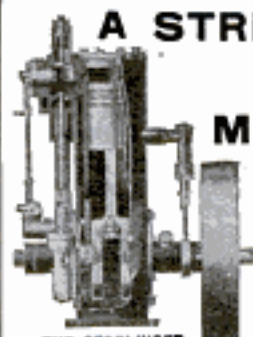
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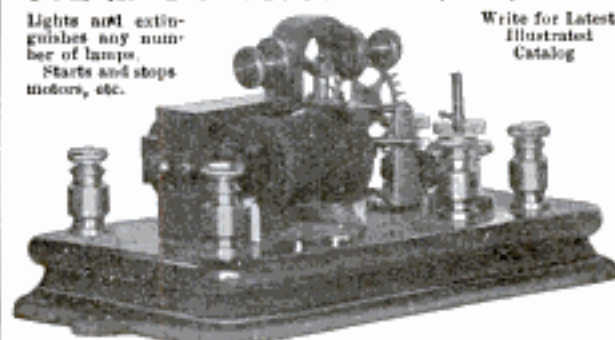
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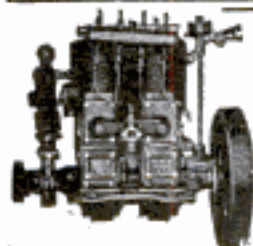
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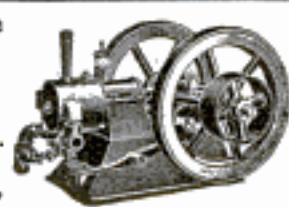
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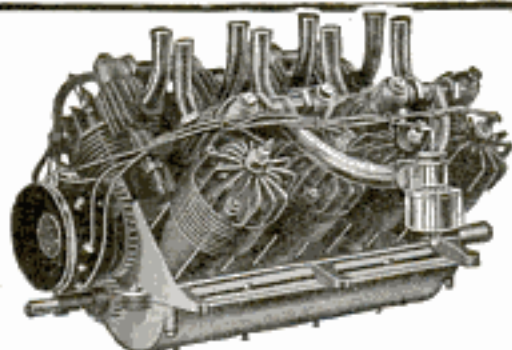
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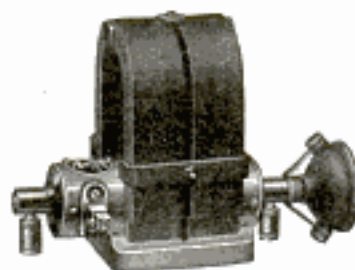


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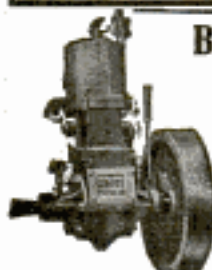
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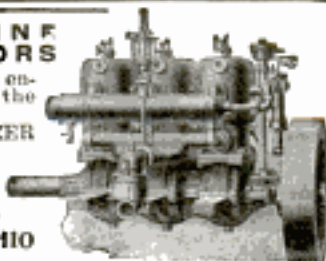
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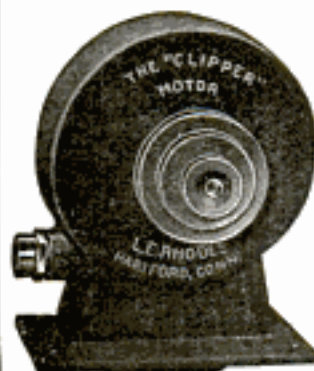
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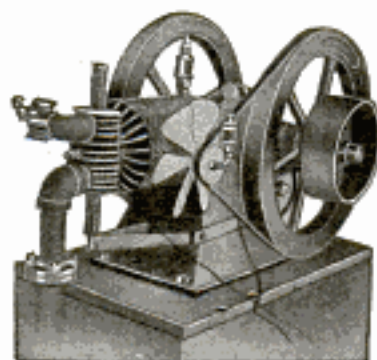
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ELECTRICITY DIRECT FROM FUEL.—Dr. Waldemar Jungner, a Swedish inventor, has invented a process by which electricity is produced from fuel without the medium of rotating power machinery. The details are not as yet disclosed, because of patents pending, and the only information given of the construction is that Dr. Jungner has discovered a gas which he stores under pressure in closed vessels and then allows to escape slowly into an electrolyte, where it is ionized under combination with the oxygen of the air. The electro charge is led away by suitable conductors. In this process the electrolyte increases in volume and overflows, while the active gas is again extracted therefrom by the heat from any kind of fuel.

The inventor claims that he is able to produce electric energy from fuel with an efficiency superior to the ordinary method with boilers, engines and dynamos.

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Write or call on us at once for particulars of our personal test on deposit offer. At the same time we will mail or give you our free booklet and a list of prominent and well satisfied users of the Electrophone in Chicago and elsewhere, whose word has weight, and who will gladly endorse our statements and answer inquiries. Physicians cordially invited to investigate. Address or call (call if you can).—

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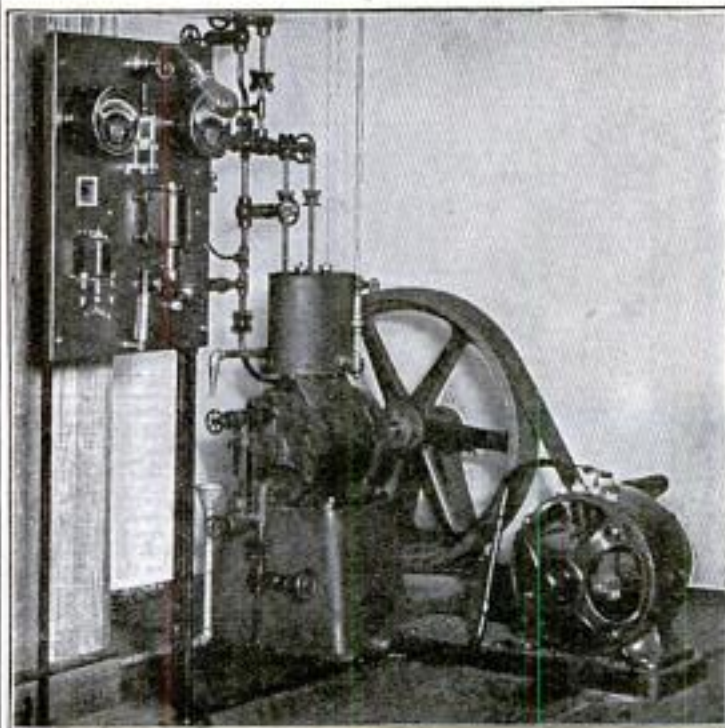
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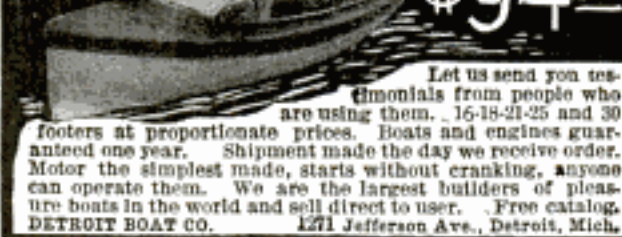


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BALL GAME ARRANGED BY WIRELESS.—One of the most novel uses ever made of the wireless telegraph was the arranging of a ball game while many miles out at sea. The baseball players of the Twenty-fourth Infantry, aboard the transport "Sherman," en route to Honolulu, desired a game with some Honolulu ball team on the afternoon the ship was to make that port. While still a couple of hundred miles out the wireless apparatus was brought into play and all details for a game were arranged. Within an hour after the transport arrived at Honolulu the game was in progress, watched by several thousand people.

THE PARTY LINE TELEPHONE.—The telephone solicitor referred to by an exchange in the following was "on to his job" and a judge of human nature as well:

"Do I want a party line?" snapped Mrs. Harker, with much emphasis. "No, indeed! Why, the idea! I wouldn't think of having one."

"Don't blame you, madam," replied the telephone solicitor, with a sly wink at the milkman. "Party lines are very embarrassing. When you go to the telephone to call up some one you are likely to hear Mrs. A. telling Mrs. B. all the latest gossip of the neighborhood. Then you will hear the butcher telling Mrs. Z. how much she owes and what he is going to do if she doesn't pay him."

"Gracious!"

"Not only that, but you can hear just what Miss K. says to her beau during lunch hour and what old man Smith is telling the pretty widow down in the apartment house and—but what is the use of wasting time? You don't want a party line. They are too embarrassing. Good-day, madam, I—"

But Mrs. Harker had him by the arm. "Come right back," she said, firmly, "and take my order for a party line. What if it is embarrassing? We all have to stand embarrassments sometimes."—Telephony.



TAT'S GRIT SOAP

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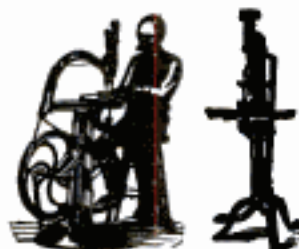
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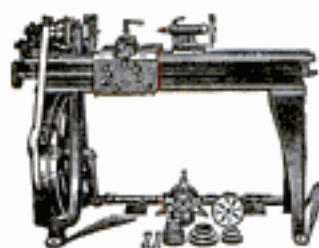


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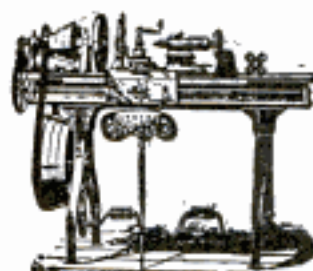
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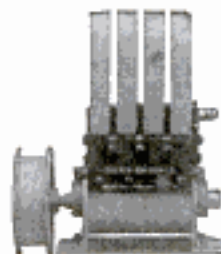
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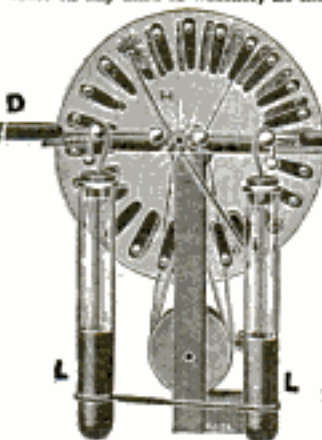
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"Naw, I got a sheep ranch, my neighbor, he got a cattle ranch an' another got a hog ranch, but I tank a man be a tarnation fool to start a monkey ranch in dis part of de country."

BICYCLE PRODUCTION.—It is refreshing to learn that at least one important industry has not been under depression during the past quarter of a year. It may occasion some surprise when it is stated that reference is made to bicycle production, for the average reader might

(Continued on page 114.)

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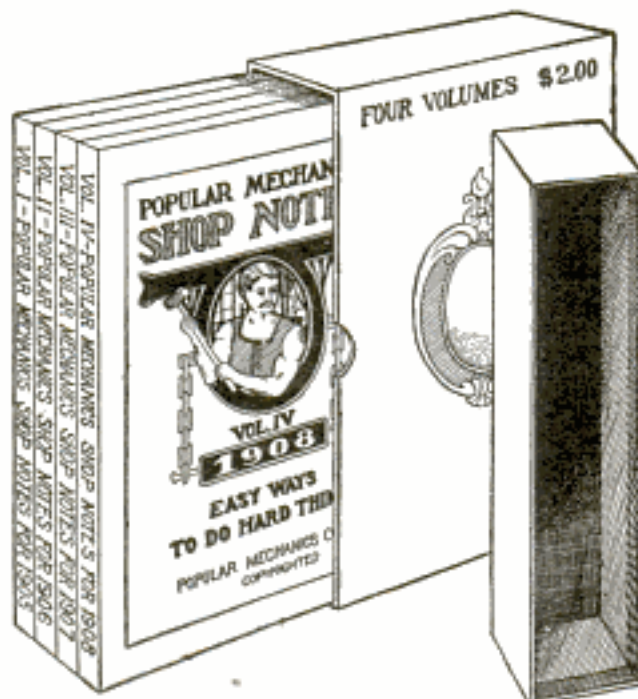
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(Concluded from Page 112)

not be inclined to put that industry in the "important" class.

Yet for more than a year the press of the country has found the revival of the bicycle an interesting piece of news, and, taking the sporting features of cycling into account, the newspapers are now carrying almost as much matter concerning the wheel as they did some ten years ago.

In commenting on the new conditions the Saturday Evening Post says: "When the bicycle ceased to be a fad there were still a good many people who believed that its popularity would revive later. Nevertheless, the sport of riding the wheel seemed to be pretty dead, the collapse being at its worst in 1901. In 1904 only 250,000 bicycles were manufactured in this country. But in 1907 the number rose to 750,000, and during the present year no fewer than 1,250,000 new wheels will be turned out in American factories.

"The bicycle dealers say that men who have not ridden for years are dropping in every day to purchase wheels. One says that he is tired of riding on street cars and holding onto the strap. Another declares that he does not feel as well as he did when he rode a wheel every day. A third has decided that he misses the fun he used to have when a bicycle was always ready to take him anywhere. Besides, walking is a laborious method of locomotion, comparatively."

The general public might not be inclined to regard the new bicycle era as an assured fact, were it not true that the conditions in the United States have their counterpart in Canada, while Europe, especially Great Britain, seems almost wheel-mad again.

The fact should be kept in mind that apart from any revival along general lines, which might be classed as a swing of the pendulum toward fad days, it is more than probable that the recent hard times have played an important part in the extensive winter use of the bicycle, which is to be noted throughout the country.



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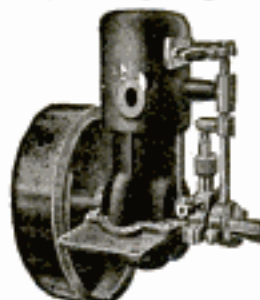
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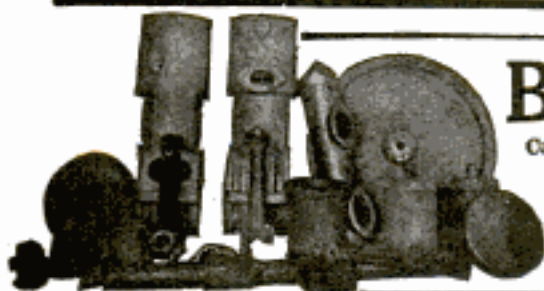


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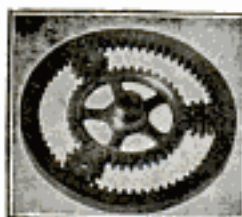
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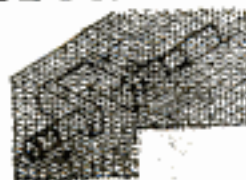
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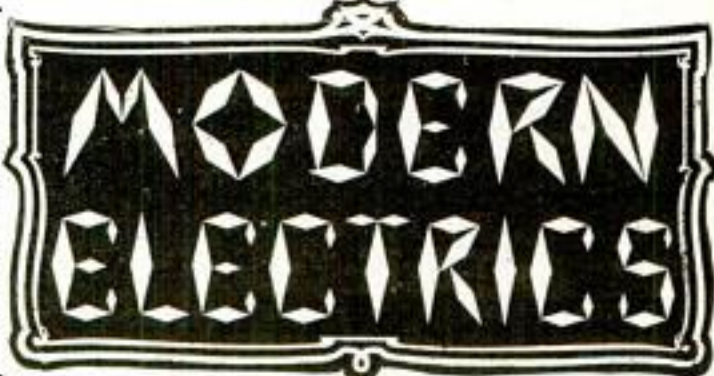
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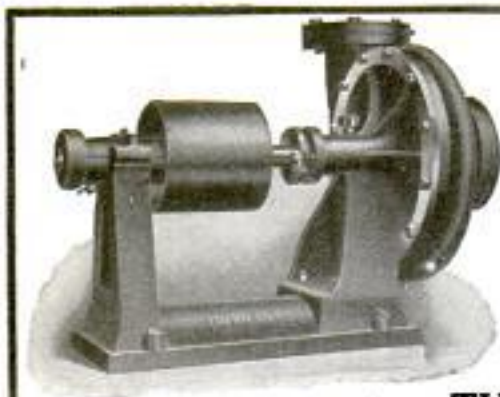
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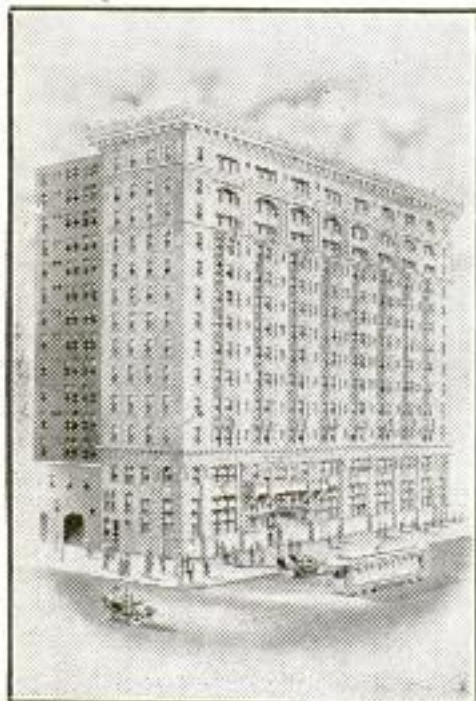
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(Continued on Page 124.)

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(Concluded from Page 122)

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(Continued on Page 126)



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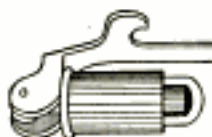
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(Continued from Page 124)

they are possessed of itching palms, and this exposure will probably confirm this notion in the minds of a lot of people who associate graft with everything governmental, be it federal, state or municipal. As a matter of history, this is the first time a Patent Office Examiner has been shown to be venal in the performance of his duties, a record that compares favorably with the Christian ministry or the judiciary of our country.

THE BRITISH PATENT LAWS.—Recent changes in the patent laws of Great Britain are of considerable interest to American inventors who obtain patents in that country. Under these amendments to the law, the British Patent Office now makes a careful investigation to determine whether the invention on which a patent is asked for is new. This investigation extends to applications for patents which when granted would bear an earlier date than the case under investigation. The examination does not, however, extend to foreign patents as is the practice in the United States and in Germany. If the invention is found to be anticipated by a prior application in Great Britain the patent is refused.

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(Continued on Page 128)

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such opposition is malicious the authorities may award costs against the opposer.

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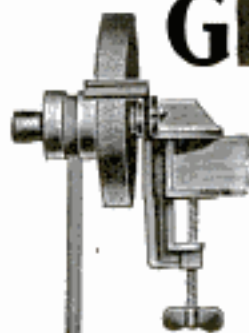
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Policeman Grace saw the automobile going at a 60-mile
clip and started in pursuit. As the crossing was
approached the gates descended and the chauffeur plunged
down his brakes and caromed off into the ditch and up
against the embankment less than 5 yd. from the tracks.
Grace saw his danger too late and his machine struck the
gates just as the express flashed by. He was thrown com-
pletely over it, clearing the smokestack of the engine by
about 3 ft., and landing on the other side only slightly
hurt.

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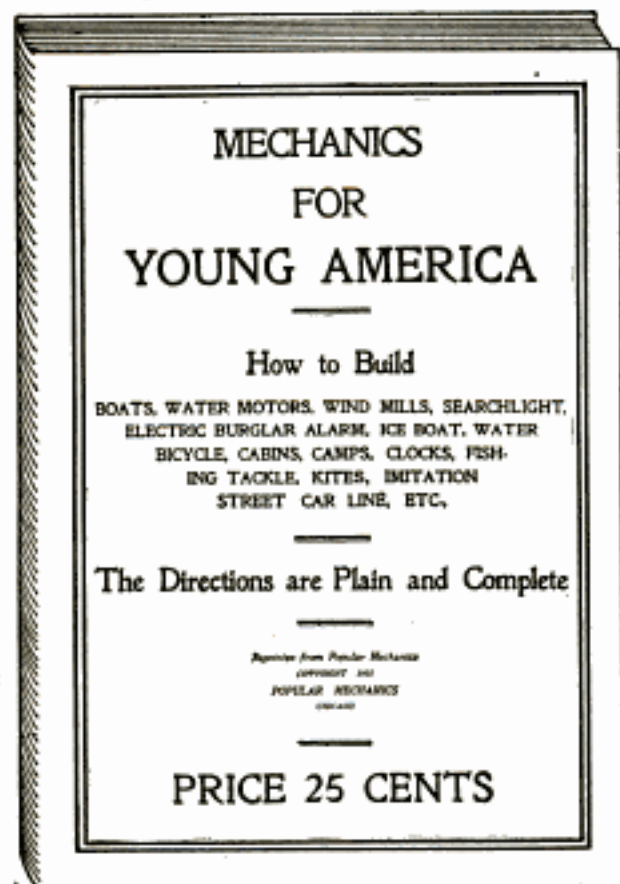
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SCHOOLS IN THE ISTHMIAN CANAL ZONE.—The work of educating the new generation in the Isthmian canal zone is progressing with great rapidity. There are at present 11 schools for white children and 17 schools for colored children, the former being taught by 24 teachers and the latter by 20. The enrollment of white children is 517 and of colored children 1,250.

PECULIAR ACCIDENT.—A motorman on the Winona Interurban Railway was seriously injured recently by being struck by a rock while driving his car under a viaduct over which the New York-Chicago 18-hour train of the Pennsylvania road was passing. The suction created by the train picked up a stone weighing nearly a pound and drove it through the glass vestibule, striking the motorman on the head.

METROPOLITAN TOWER TO BE 683 FT. HIGH.—A revision of the plans for the uncompleted tower of the Metropolitan Life Insurance building in New York calls for an addition of 25 ft., and a lookout about 675 ft. above the curbing. When completed the tower will be 70 ft. higher than the Singer building tower, and there will be but one structure in the world of greater height—the Eiffel tower, in Paris.

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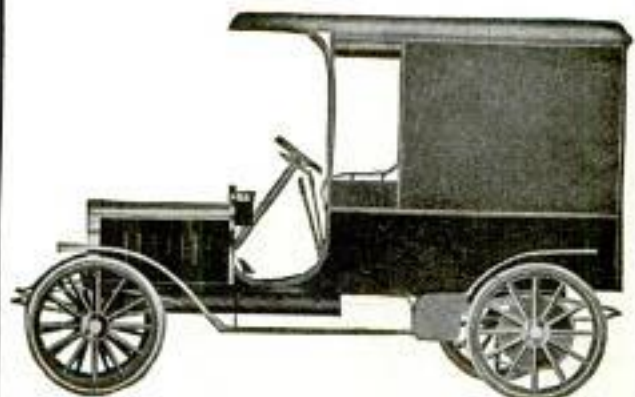
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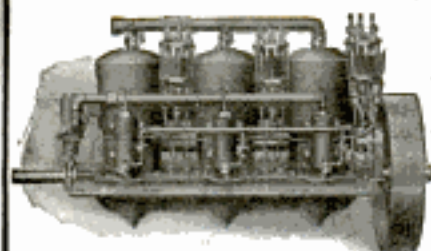
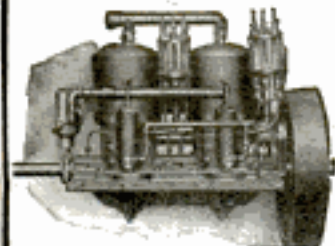
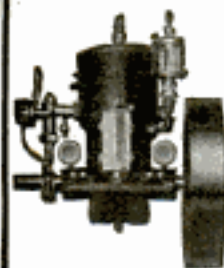
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A NOTEWORTHY PERFORMANCE.—In our April issue we showed an illustration of the speed boat "General," 39 ft. 10 in. over all, with a beam of 4 ft. 2 in., equipped with a 40-60-hp. marine motor.

At the recent motor boat races at Palm Beach, Fla., as much a classic among American regattas, as the Henley Regatta in England, the "General" made an extraordinary showing in winning six cups. Inasmuch as another entrant was considered to be the fastest motor boat in the world, the "General" has now taken first place, having attained a speed of almost 30 miles per hour.

The possibilities of the gasoline engine for marine work are being exemplified every day in all manner of pleasure, racing and commercial craft, and the different governments of the world are taking up this motive power for their torpedo fleets. It is safe to say that motor boating is today entering upon a phase comparable to the automobile craze of two years ago.

ASKED FIREMAN FOR CARD.—A small blaze appeared behind the wainscoting of one of the rooms in the New York mansion of the Misses Sands. Not wishing the luxurious furnishings of the house ruined by an unnecessary deluge of water, Miss Anne Sands summoned one fireman by telephone. When he arrived at the mansion he was asked for his card, and when he pushed by the butler in his eagerness to get at the fire he was reminded that he should wipe his feet before entering the reception room.

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STANDARD OIL MAKES BUTTER OUT OF KEROSENE.—One of the larger Standard Oil tankers called a few days ago with each of its sixteen reservoirs full, and the commander took along two complete lines of samples of all the by-products of petroleum, which now number forty-four. These will be placed on exhibition in various capitals of Europe. It is something wonderful to contemplate, this manufacture from the refuse of common crude oil, rock oil, Seneca oil, or any other name you please to call it, of forty-four highly important and immensely valuable commercial and medical articles, toilet preparations, foods, and so forth and so on; and at the same time have the refined oil left! The by-products are worth more than the oil; yet only a few years ago all this refuse was dumped far out in the ocean, a whole fleet of scows being employed for the purpose at great cost. No scows now from the Hook! Here is a miracle of evolution.

Before the Standard Oil chemists began to discover that there were millions in the by-products of petroleum the company had buried a vast fortune in filling up the marshes and shallows about Constable Hook with the refuse from the tanks. It was making land out of mush. Iron dump carts were driven up to the tanks and the hot, tarlike sediment was poured in and hauled away to the filling. There is no estimating the number of cubic yards thus wasted, but it runs into the millions. It is said now that negotiations are pending for a resurrection of these fillings. "The property covers several acres," said one of the interested parties, "and is as rich as a gold mine. Every cubic foot is valuable. Unfortunately, the stuff dumped at sea is not recoverable."

One of the very late by-products of petroleum is butter. It is far superior to most of the cheap so-called butter that is sold in corner groceries, and a good deal better than oleomargarine. I had the experience of eating some the other day without knowing what it was, and thought it most excellent. I assume it is vaseline prepared in a buttery way. Nothing simpler or easier. What next? Will wonders never cease?—N. Y. Press.

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AMERICAN MAGAZINES IN CANADA.—About a year ago the Canadian government raised the postage rate on American periodicals to an extent which forced most publishers to advance their subscription rates 50 cents a year to readers in that country. This was done to give the publishers in England a positive advantage, of which they were not slow to take advantage. The rule, however, proved very unpopular to the thousands of readers who could not get what they wanted in the English journals, and to Canadian newsdealers who find their business greatly impaired. The Canadian Bookseller and Newsagent, a leading organ of the trade, says:

"The favors which British publishers are receiving under the new cheap postal rates upon British periodicals, etc., sent into Canada, is not an altogether unmixed blessing. British publishers are rejoicing at the change and their exports to this country are said to have increased 100 per cent. It would make us all feel pleased to think of the increased advantage thus afforded our kin in the old land were it not that the affair has some of the characteristics of a boomerang and is raising a cry among the newsdealers and booksellers of Canada, who begin to see that the long end of the stick is the one they are carrying. British publishers seeing a large increase in their subscriptions in Canada have concluded that it would be a paying proposition to establish subscription agents on the spot. Agents of this class send their subscriptions direct to the head office and the publications are sent to subscribers direct through the mail. Cheap postal rates make this possible and the Canadian newsdealers and booksellers, who are the best fitted concerns for handling subscriptions en bloc, are done out of the business entirely. The sting of the business is in the tail. If it were simply a question of competition and the newsdealers and booksellers were losing only what business they could not obtain against fair competition there would not be much complaint to make. But that is just what is not the case. The cheap postal rates enjoyed by British publishers are rendered possible by the payment of heavy mail subsidies, coming from the pockets of Canadian taxpayers. The newsdealers and booksellers as a body contribute their share to the subsidies and if figured out it would be found to be more than a negligible quantity. It is quite enough

in fact to make the newsdealers and booksellers feel that they are not receiving justice. They are paying for the advantages which enable their British friends to take away their business and do them a permanent injury.

"The establishment of trade preferences and disabilities of all kinds makes it necessary that old conditions be changed and in the process of change someone must suffer a temporary discomfiture. A well devised trade preference, however, should involve the minimum of financial disturbance and injury to those who are unfortunate enough to be the sufferers, and it should, above all things, be so arranged if possible that whatever injury is inflicted will be but temporary at most. The change in the postal laws works out results which are contrary to these and other canons of economic fiscal alterations. The disadvantage is heavily centered upon one body—the Canadian newsdealers and booksellers—the burden makes every promise of being a continuous and constantly increasing one, and it is to be borne largely by those who are providing the means for affording an economic preference to the very parties who turn out to be their competitors. The newsdealers pay in the long run, under the new arrangement, the salaries and commissions of the new army of subscription agents who are already overrunning the country and provide, also, an increased profit for the publishing houses who it was expected would have been doing their Canadian business through them instead of the agents."

The attitude of the Canadian government is surprising, being as it is, a step backward, for in these days the tendency and effort of all progressive countries is to reduce the postage rates and increase and improve the service. The Canadian postal department shows a profit balance each year, hence the excuse of a money loss in handling American journals has not even that excuse. The sane, sensible, business solution of the matter would be to allow American publishers to enter at Canadian offices as second class matter, to be distributed from there under the same rates as now paid by Canadian papers. This would in turn permit the distributing news companies and the newsdealers to remain at pound rates, and while the publishers on this side would be paying double pound rates, it would be nothing like the unnecessary burden now imposed.

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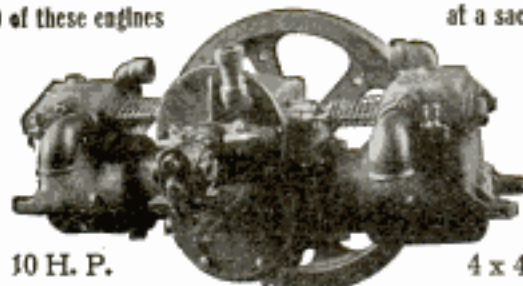
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