The World's Advance

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UNDERGROUND CONCRETE IRRIGATION SYSTEM

The concrete underground irrigating system is the latest thing for watering citrus groves of Southern California. After years of experiment grove owners declare that the new system is the final word so far as this irrigating business is concerned.

The new irrigation system consists of a pressure box and a series of small stations, one of which is placed at the head of each row of trees. In size the pressure box is 4½ feet high, 3½ feet long and 2⅓ feet wide, outside measurements. Inside it is about eight feet deep, being sunk a trifle less than four feet in order that the water main may be reached. In this box there are two compartments, the water entering in one side, then passing

At the Left: The Pressure Box of the New Concrete Irrigation System. Above: One of the Concrete Stations with Connecting Pipes.

through the water gauge at the center of the top of the partition and out the other side into the pipes of the irrigating system. This water gauge in the partition is exactly a foot square and in this way the feet-hours of water used are measured, doing away with an expensive meter.

From the box the water runs through the eight-inch main of the system to the stations. These underground pipes and the stations are of cement. The station is round and has a wall two inches thick. Around the station are six openings with their private shut-off caps, while at the bottom of the station there is a "turn-off" valve. Six ditches are made between each two rows, and the water from three openings in the stations at the head of the two rows running alongside is accommodated by the six ditches. This system is as much as possible "out of the way" and makes the irrigating of these groves comparatively simple, yet very effective.

A NEW TRENCH-DIGGING MACHINE

A machine that does the work of scores of laborers has lately come into use for making trenches and ditches. The new traction ditcher requires but two operatives and its adjustments are so numerous that it seems to be possessed of human intelligence, as one watches it in operation.

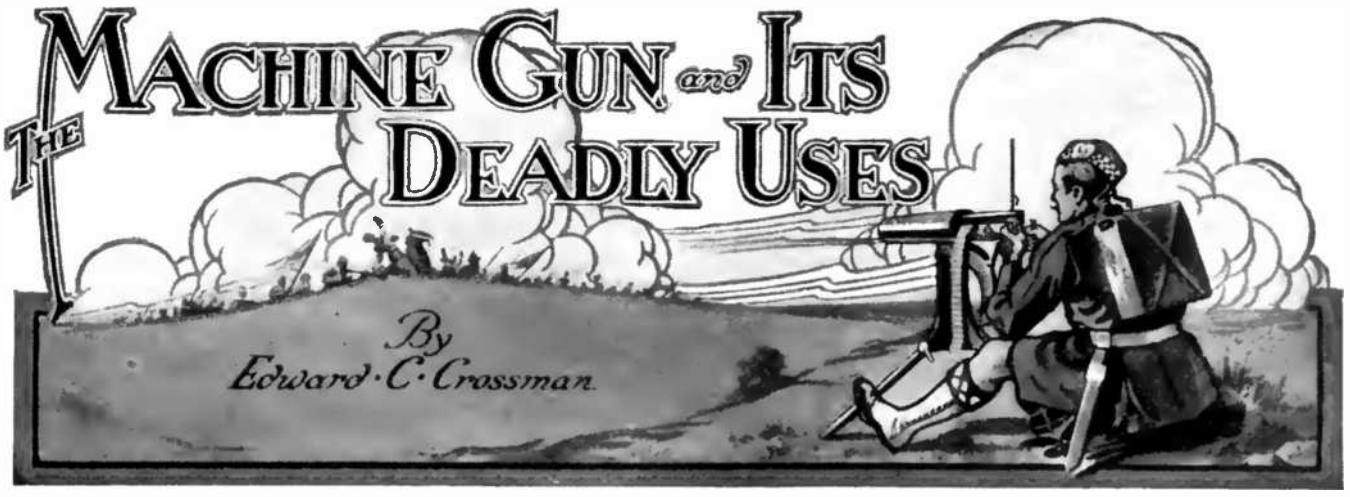
A New Trench-Digging Machine that Operates at the Rate of Four Feet of Trench Five Feet Deep and Two Feet Wide Per Minute.

The ditching machine is self-propelled; steam furnishing the motive power. The excavating is done by means of a large wheel with scoop pockets at the contact points. A derrick regulates the depth at which the wheel excavates. All the manipulation is under the control of one man, the only other helper being the fireman. As the pockets invert they deposit the dirt on an endless belt, where it is conveyed a short distance from the trench. The machine will excavate a ditch or trench at the rate of four feet per minute, making it five feet deep and two wide.

GROOMING HORSES BY ELECTRICITY

The Park Department of New York City has inaugurated an innovation in the grooming of its horses. Instead of using curry combs in the usual manner, they are now being employed in connection with a vacuum cleaner. Thus not only is the horse groomed properly, but the dust, scale and dandruff are thoroughly removed from the animal's coat and deposited in the receptacle of the suction cleaner. Aside from the grooming being more thorough, it is said that a great saving in time is effected, a man using the vacuum cleaner being able to care for several times the number of horses he formerly could curry in the old way.

The Machine Gun and Its Deadly Uses



By Edward C. Crossman

SHOOTING at the rate of six hundred rounds per minute, the machine gun is considered by many the most effective of modern weapons. It has done much to eliminate the old-time dash and vividness of warfare, rendering battles of today a matter of science in man-killing.

JUDGING by the titles of some of the photographs printed about the country on the war subject, the machine gun is an unknown animal to most of our newsgatherers. They apply the term indiscriminately to real machine guns, and to coast defense ordnance and field artillery and mountain batteries. It is like the term "marine," which every newspaper man insists on hanging around the neck of very obvious blue-jackets shown in photographs and other illustrations.

Gun Kick Put to Work

A machine gun, as the term is used in military parlance, is an automatic rifle actuated by its own recoil and firing continuously as long as its belt or clips hold out and the trigger is held back. In some models, such as the Benet-Mercie, the simple turn of a knob converts the arm to a self-loading rifle in which the recoil does the work of ejecting empty case and inserting a new one, but does not fire it. With this adjustment the operator has to press the trigger for each shot, just as with the many types of self-loading pistols and rifles and shotguns now on the market.

In its own province, however, the machine gun does all the work so long as it is kept supplied with ammunition. The recoil of the cartridge, or the work of the powder gases, taken from the barrel at a little gas-port, functions the extracting and cocking and loading mechanism, and again fires the gun when the breech is closed. The operator has merely to keep the gun on the mark. The gun crew keep the hungry monster supplied with belts or clips filled with cartridges.

The rate of fire of such a gun is tremendous. By the sound one can grasp the meaning of 600 shots a minute, the number that such a gun can squirt out if worked to a maximum speed and kept filled. The sound of such a gun is practically that of a pneumatic riveter working on a steel frame building—when the riveter is working very fast.

Contrary to some beliefs, the gun is rarely used for long stretches of shots

—uninterrupted volleys of perhaps a full minute's duration. In rare circumstances this might be done, such as troops in close order charging close at hand, offering therefore a large mark and every inducement to shoot quickly while the shooting is still possible.

The cartridge is almost invariably the same cartridge used in the infantry rifles of that army. The reason is obvious—ammunition supply is simplified and the guns can be fed from any infantry reserve store.

Constant Firing and Diminished Accuracy

As all modern military cartridges develop considerable recoil, a string of shots from the gun will jar it off the mark and necessitate relaying it again. This is true even with the heavy 150-pound gun and tripod of the Vickers-Maxim, formerly used in the American service, and now readopted after careful trials against the Benet-Mercie.

The fact that the constant pounding of the powerful cartridges jars the gun off the mark, necessitates firing a machine gun in short bursts of shots, perhaps 15 or 20 at a time say for two or three seconds, then a pause while the pointer relays the sights, then another burst, and so on.

This is quite apparent even at short range. The writer, firing a Benet-Mercie some years ago at 20 yards, let go one burst of shots that numbered about 35. At this 60-foot distance the three-score bullets made a narrow slit in the paper, little wider than a bullet, but seven inches from top to bottom. The last shots fired were the highest, of course. At 1000 yards this would have meant missing the mark 30 feet or so with the last shots, outside of all other causes.

Unhappily one cannot gallop up to a gun of this sort that is out of ammunition, hurl a bandolier or two in its maw just as said bandoliers came off an infantryman's back, and then start its chatter. They require special containers, clips of 60 rounds, belts or something of the sort, from which the feed mechanism can pluck or drive the cartridge.

The present American machine gun, the Benet, uses long, flat brass clips holding 60 rounds of the regular sharp-pointed infantry ammunition. The end of the clip—held horizontally—is slipped into the gun, and then the monster bites the cartridges out as it forces the clip across from side to side and finally throws it out. The Colt and the Vickers-Maxim use a woven belt, not unlike those generally employed for carrying cartridges. These hold 250 rounds each and are filled by a little device called a belt-filler.

Both the present gun and the two just mentioned are accompanied by a number of thousand rounds of ammunition, packed ready for use in these containers.

One of the Most Characteristic Machine Guns Employed In the Present European War Is That of the Belgian Army, Mounted On a Light, Two-Wheeled Carriage and Drawn by Dogs.

No Army In the War Has Made Better Use of the Machine Gun Than the German Army. Both On the French and Russian Fronts the Germans are Amply Supplied With Machine Guns That Serve to Shatter and Discourage Many an Attack by Their Opponents.

The Benet gun is very light, weighing around 30 lbs.—well within the capacity of anyone's strength when it is to be moved about. It has no tripod, but has a short, adjustable rest at the butt that is used by the pointer, who lies prone behind the gun, and a pair of short legs near the muzzle.

Where Lightness is a Drawback

The very lightness and handiness of the Benet gun constitute an objection in that the recoil promptly gets the gun off the mark. The Vickers, now readopted for the American service, is mounted on a heavy tripod, and the gun itself is quite heavy, this outfit totaling about 100 lbs. The pointer sits on a little seat on the tripod, helping to hold it steady against the throb of the firing. This gun is cooled by a waterjacket surrounding the barrel, while the Benet and Colt are air-cooled.

The Benet is furnished with a pair of spare barrels, which are to be inserted in the gun every few hundred shots, letting the fired barrel cool off in the interval. The changing of barrels requires but a moment's work.

Machine Gun Fire vs. Rifle Fire

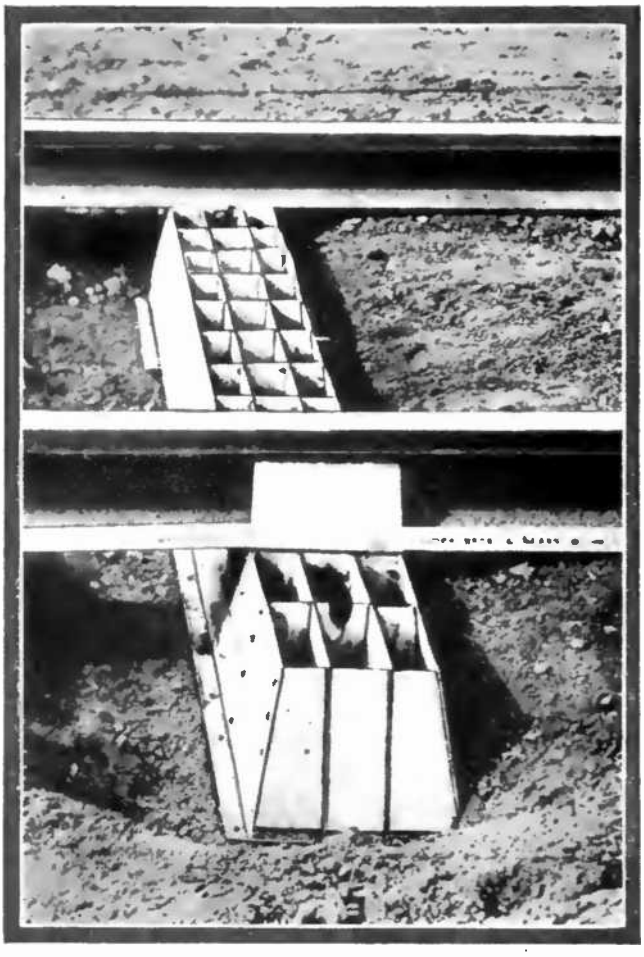
Queerly enough, tests made years ago at the School of Musketry at Monterey by the American army developed that the machine gun, in the hands of skilled crews, is more accurate at the very long ranges than infantry fire. Shot for shot, the Vickers gun firing 600 rounds from 2000 yards down to 1000, beat a body of 50 expert riflemen firing the same number of rounds. On a skirmish target of 89 figures of men, the machine gun inflicted 39 hits on 29 targets, out of the 600 rounds. The infantrymen inflicted 20 hits on 17 targets in the same number of shots. One of the ranges was unknown, the distance not told either to machine gun crew or to the infantry.

On a huge collective target of 176 figures, the machine gun fired 400 rounds, from 2,000 down to 1,200 yards, making 89 hits on 65 figures. The infantry made 74 hits on 52 figures.

In the time used at the firing points in both preparation and firing, the infantry and gun ran about the same, but the machine gun used a far larger portion of the time at the firing points, in actual firing, thus showing that it could be brought into action promptly and lost no time in reducing jams and trouble.

The weak point of the machine gun is its liability to jams. Trained men recognize the trouble, however it may occur, but untrained men may have a gun jam from defective cartridge, wet belt, ruptured cartridge case, or other cause and be unable, through their unfamiliarity with the gun, to reduce it promptly.

In the American service, every regiment is accompanied by four machine guns and their accessories. The guns and the ammunition, packed in wooden cases, are carried on pack-mules.



If the Claims of the Inventor Prove True, This Steel Tie Will Eliminate Railroad Wrecks Due to Defective Rails.

STEEL TIE TO PREVENT WRECKS?

A steel railroad tie has recently been perfected which the inventor claims will do away with a large percentage of railroad wrecks. The new tie absolutely prevents rail spreading, the most frequent cause of wrecks, and on account of its peculiar surface it makes an excellent cattle guard also. For the same reason, human trespassers would have a difficult time following a railroad track on which these ties were used, and consequently the yearly death rate of 5000 persons from that cause would be greatly diminished.

Careful tests of the new ties on a railroad in Oklahoma show that they have wearing properties at least five times as great as wooden ties. No spikes are necessary, and for the reason that they are self-gauging, the working gang can be decreased to one-half its usual size. In large quantities the steel ties represent a saving to the railroad of $320 per track mile.

A strong argument in favor of the new tie is that the enormous depletion of the American forests could be checked to a large extent.

AN IMPROVISED MOTOR ROAD SCRAPER

Instead of discarding as worthless a number of old road scrapers and buying new ones, the street department of a western city conceived the idea of removing the front wheels of the scrapers, attaching a pinion to the forward part of the frames and using them as trailers on the new motor trucks that the city purchased.

Thus rigged the scrapers can be used for either earth removal work or in snow removal. The powerful motor trucks can attain a speed and a hauling strength that was impossible with the horse-drawn scrapers in their original shape.

As snow and ice removers the old scrapers are more than paying for themselves, while the wear and tear on the trucks is not as much as if they were working under a load.

OPERATING TABLE FOR HORSES

In Boston's new animal hospital, the most modern in the country, there has been installed a special operating table for horses. The table itself has the form of a tipping rack, which can be moved from a vertical position to a horizontal position.

By the proper arrangement of straps, blocks and tackle, the horse can be firmly fastened to the table while in its vertical position. As the table is swung into its horizontal position by means of a geared crank, the animal is slowly lifted off its feet and finally is stretched out in a horizontal position, ready for the veterinary surgeon. When the operation upon the animal is complete and it is still under the anesthetic, the table top and the horse are removed to a room carpeted with tan-bark. There the straps are loosed and the animal placed on the soft floor to remain until it recovers its senses.

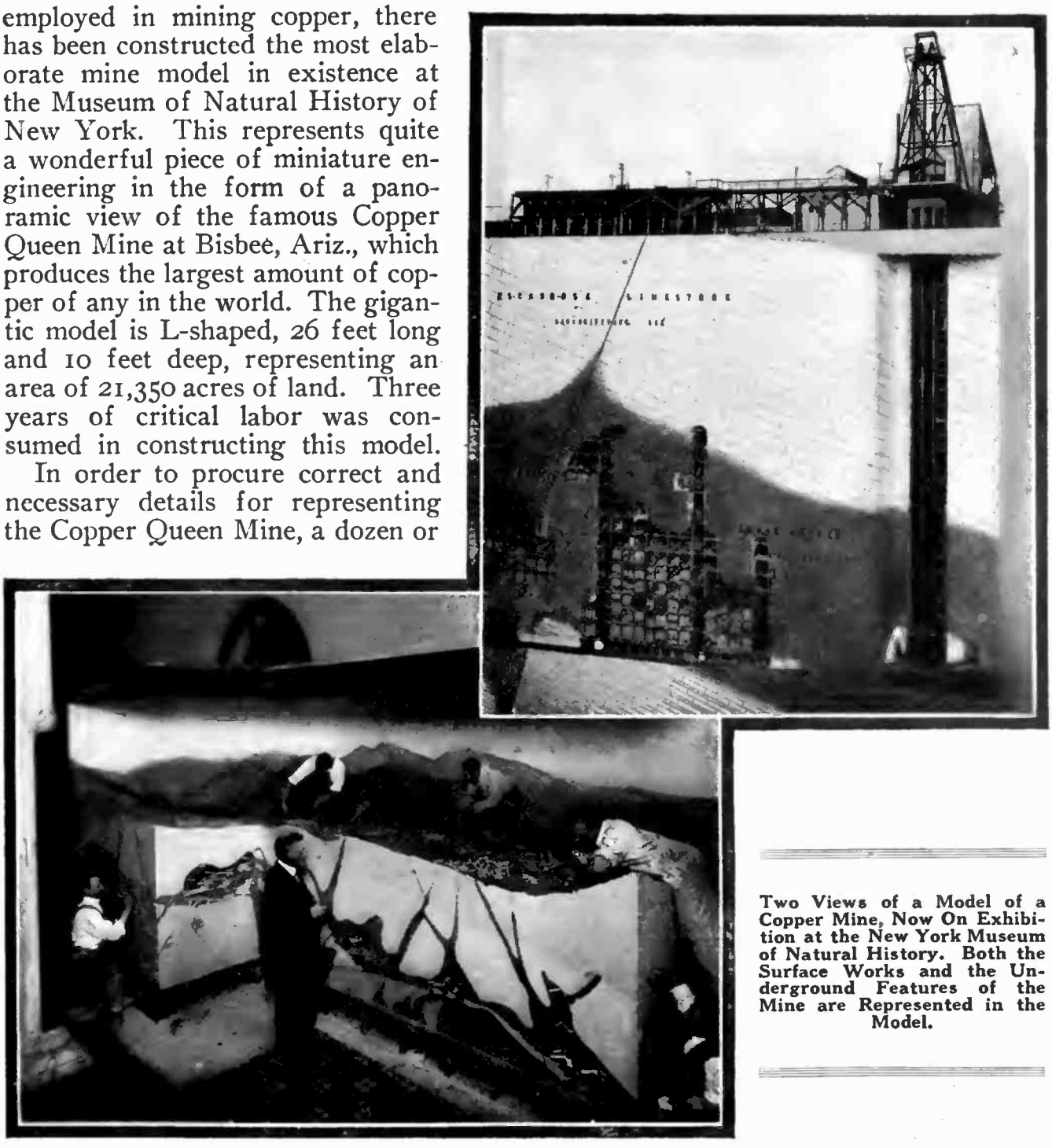
A WONDERFUL MODEL OF A COPPER MINE

THE copper industry and its methods of production are of exceptional interest just now, owing to the demand for this metal occasioned by the European war, as well as its extensive use in the commercial world for many purposes.

To illustrate the modern methods employed in mining copper, there has been constructed the most elaborate mine model in existence at the Museum of Natural History of New York. This represents quite a wonderful piece of miniature engineering in the form of a panoramic view of the famous Copper Queen Mine at Bisbee, Ariz., which produces the largest amount of copper of any in the world. The gigantic model is L-shaped, 26 feet long and 10 feet deep, representing an area of 21,350 acres of land. Three years of critical labor was consumed in constructing this model.

In order to procure correct and necessary details for representing the Copper Queen Mine, a dozen or more trained and skilled artisans, such as mining engineers, draughtsmen, map makers, painters, photographers, geologists and others spent many weeks at the mine obtaining data.

On the surface of the model there are represented more than one thousand dwelling houses, buildings, small structures and shaft houses, besides numerous railroad tracks, locomotives, cars, loading bins and other objects. These are made of brass, with the exception of the dwelling houses, which are of cardboard. To add realism to the model there has been painted a background of the surrounding hills made by a well-known



Two Views of a Model of a Copper Mine, Now On Exhibition at the New York Museum of Natural History. Both the Surface Works and the Underground Features of the Mine are Represented in the Model.

painter. The model is constructed on a scale of 24 feet to the inch.

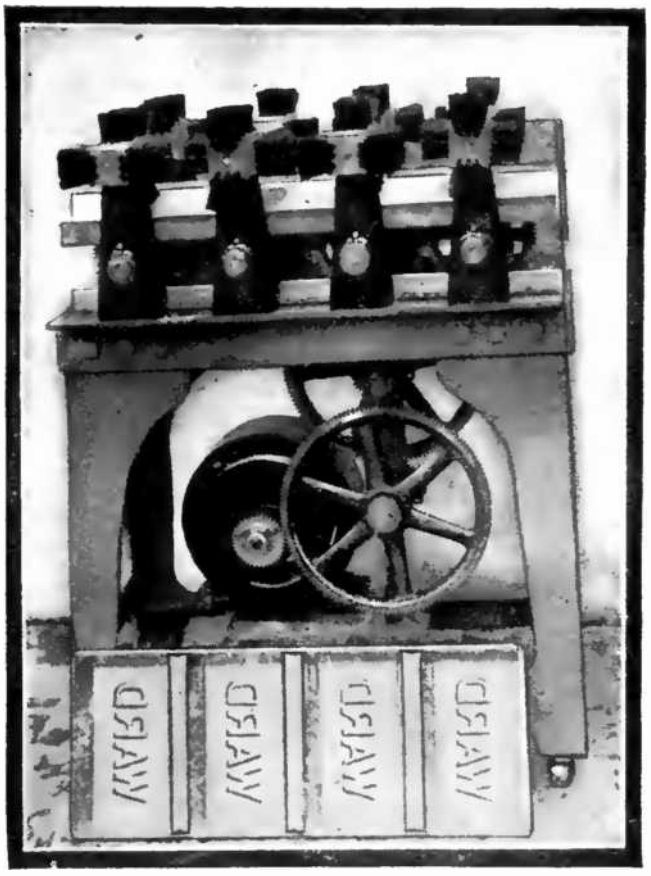
The sides of the model have been used to give the geological section along several vertical planes from 4,100 feet above the sea up to 5,900 feet on the Queen Hill. One of the interesting features of the model is the representation of a bit of the underground workings of the mine, showing tunnels, slopes, raises, shafts and various kinds of machinery, constructed to scale and inserted in their proper positions.

The yearly output of the big Copper Queen Mine is 75,203,813 pounds of copper. The model was built at the cost of $25,000 and presented to the Museum of Natural History through the generosity of James W. Douglass.

A TEAM OF TURTLES—SLOW BUT SURE

Of all strange teams, Master Rex Bassler, of Darien, Wis., probably has the strangest. He is here seen driving a team of eight turtles that were caught by his father, who makes a business of catching turtles. Blocks were placed in front of them to make them stand still long enough to take the photograph. Rex says his team is slow but sure. However, when he grows older he will likely want a speedier team than these turtles.

A Team of Eight Turtles Affords a Slow But Sure Means of Locomotion.



Two Thousand Bread Pans Can Be Cleaned and Greased Every Hour by Means of This Machine.

SCOURS AND GREASES BREAD PANS

Two thousand bread pans can be cleaned and greased in an hour by a newly invented electrical machine. The pans are scoured with stiff brushes and the grease applied with soft ones. One operator only is required.

Provision is made for the use of either direct or belt-driven motors, and either direct or alternating current will do. The machine is mounted on casters, so that it can be moved about easily.

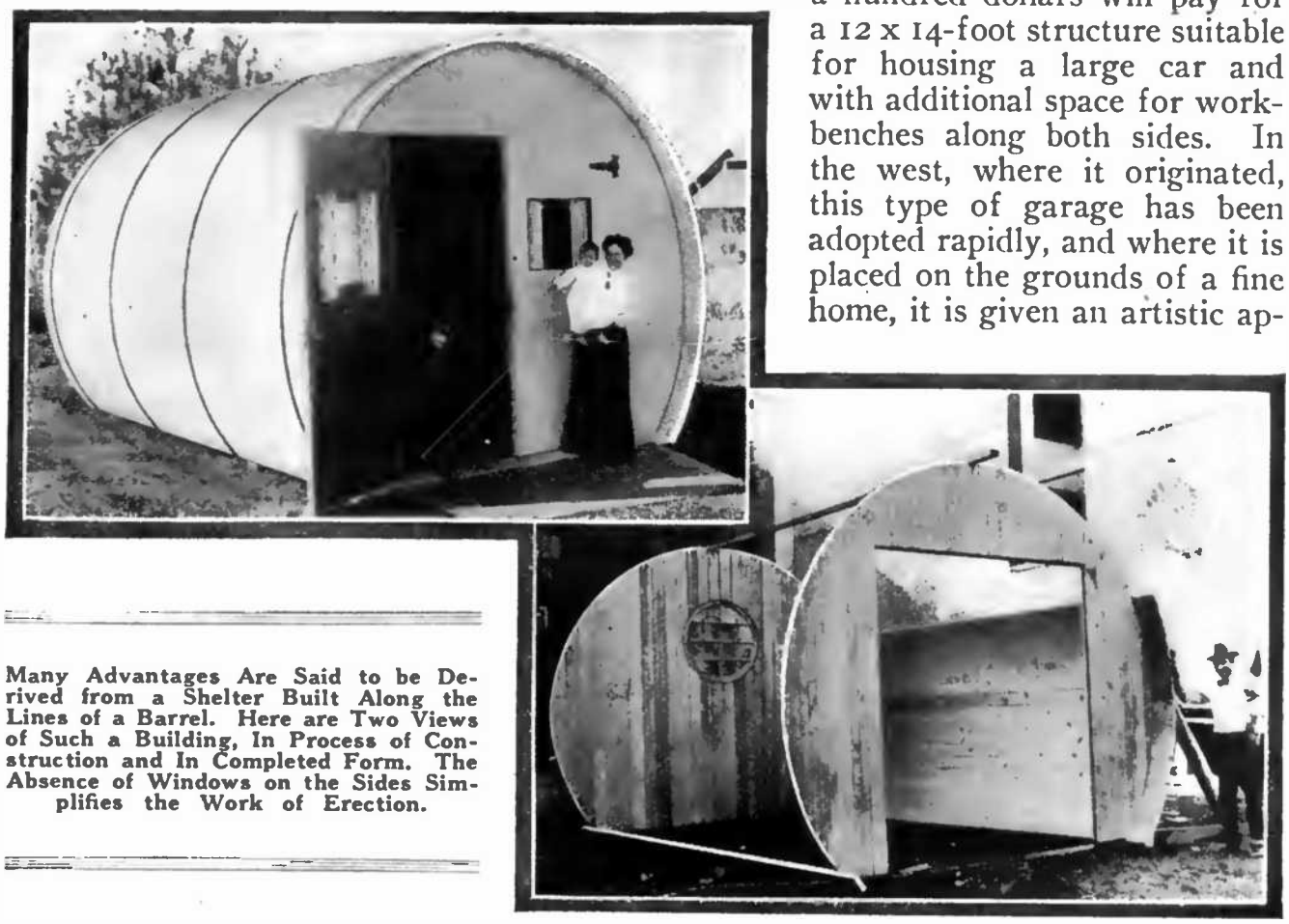
A recent electrical invention is in the form of a latch for automobile doors that opens when a push-button is pressed. It is said to overcome some of the inconveniences of the usual hand-operated automobile door latches. Obviously, it is far easier to press a button than to tug at a stiff latch.

HOUSES THAT ARE BUILT LIKE BARRELS

Building small portable structures such as garages, summer houses, boat houses and the like in the shape of a barrel is a new idea in construction that has many advantages, perhaps the foremost of which is its readiness of assembling and dismantling.

The floor of this type of portable house is laid on light foundations. The ends are set up and the sides are placed around them like staves and secured by means of four large hoops of heavy iron. All the lumber is two inches thick and fits snugly by tongue and groove, so that no nails are required; only a few bolts being necessary to hold the structure together. The ends are units, with the doors and windows separate. There are no windows at the sides, which adds greatly to the ease of assembling. The result is that in an hour an unskilled workman can set up such a building; its dismantling being accomplished in even shorter time. It is said that children can do the simple work of assembling, as the parts are light to handle and easily fitted together. When dismantled a wagon will carry one of these houses in one load.

Following these lines of construction, a garage has been built by a Spokane designer, who found that it was adapted to many other purposes, such as bunk houses for mining camps and storage sheds for grain, as it is absolutely weather-tight when given a few coats of paint. No additional roofing is required over the staves. The low cost of a building of this sound and lasting construction is another valuable feature. About a hundred dollars will pay for a 12 x 14-foot structure suitable for housing a large car and with additional space for workbenches along both sides. In the west, where it originated, this type of garage has been adopted rapidly, and where it is placed on the grounds of a fine home, it is given an artistic appearance by the addition of a pergola in front and a few vines.



Many Advantages Are Said to be Derived from a Shelter Built Along the Lines of a Barrel. Here are Two Views of Such a Building, In Process of Construction and In Completed Form. The Absence of Windows on the Sides Simplifies the Work of Erection.

HOUSE MOVED ON A BOAT

That navigation should be included in the education of a house-mover was demonstrated recently in Chicago by a real estate dealer. This man saved several hundred dollars and many days of time by loading a house bodily on pontoons and barges, and towed it a distance of more than three miles along the shore of Lake Michigan to its new location.

The house in question was found unsalable in its former location, and accordingly the owner desired to move it to another property of his. However, he found that it would cost more to move the house three miles by land than it would be worth when he got it moved. He, therefore, decided to move it by water, as he figured that he could save money by so doing. In order to get the house onto the barges and scows on which it was to be moved, it was necessary to build a pontoon bridge. This operation had to be repeated when, an hour after the start was made, the house hove to the offshore side where it was intended to be landed. Fortunately, there were no squalls or other weather disturbances to interfere with the work, which required less than seven hours. The loading required three hours, the towing one hour, and the unloading about three hours. The expense of moving was $1,000, and the house owner estimates that in its present location he will have no difficulty in selling it for $6,000. This idea might well be taken advantage of by others under similar circumstances.

Moving a House by Means of a Large Scow Results in a Time and Monetary Saving if the Dwelling Is Located Near a Waterfront.

IT TAKES ONE-HORSEPOWER TO CLIMB STAIRS

To lift 550 pounds one foot in one second requires what is known as one horsepower. Similarly, a horsepower is able to raise twice that weight one foot in twice the time, or one-half foot in just that time. Moreover, it can raise half 550 pounds one foot in half a second, or two feet in a second, and so on. Therefore, when we lift one-fourth of that weight, 137½ pounds, four feet in one second, we are exerting one horsepower.

Accordingly, when a person who weighs 137½ pounds runs upstairs at the rate of four feet a second, he is exerting the equivalent of one horsepower. For a man weighing twice that much, 275 pounds, it would be necessary to climb at the rate of only two feet per second to exert a horsepower. It is possible to do much more.

As a matter of fact, a horse often exerts many times one horsepower of energy. The average horse can draw a wagon up a hill where a ten-horsepower engine with the same load would fail. A horsepower does not represent the greatest momentary strength of the average horse, but is a measure of the power which he can exert continuously.

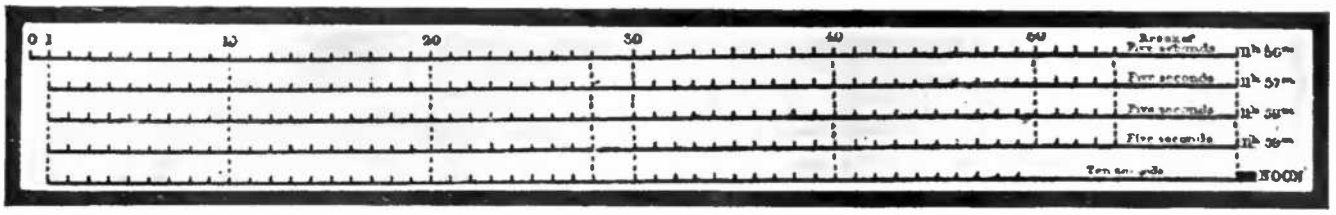
CATCHING FISH WITH ELECTRIC LIGHTS

Three White River fishermen of Mount Vernon, Ill., have a plan which has been very helpful to them this winter in catching fish.

They constructed an equipment for lighting the water under the ice and which attracted hundreds of fish to the place. These eagerly bit at the bait dropped to them on hooks. The catches were unusually large.

The arrangement for lighting the water consisted of eight dry cells, to which an electric light was attached and dropped into the water. The wire was heavily insulated to prevent the leakage of the current.

A conservative estimate places the total number of electric lighting companies serving the public in this country at five thousand or more.



Diagrammatic Illustration of How the Time Signals Are Sent Out by the Transmitting Clock at the Washington Observatory.

WHEN IT IS NOON AT WASHINGTON

EVERY day exactly at noon a copper time ball, three feet in diameter, on the roof of the State, War and Navy Building at Washington, D. C., falls from the top of a ten-foot pole into a receiving cup, where the air forming a cushion permits it to land almost without noise. About five minutes before noon an employee of the Navy Department hoists the ball by hand. At 11:55 the transmitting clock at the United States Naval Observatory, several miles distant, which, between 11:30 and 12 o'clock, is accurately adjusted to indicate the correct time, begins to beat the seconds automatically, leaving out the 29, 55, 56, 57, 58 and 59th seconds until the last minute before noon, when the 29 and 50 to 59th seconds are omitted. The beating of these seconds is indicated by a distinct click at the ball. During the last 10-second interval, when there is no signal passing over the wire, switches in the State, War and Navy building are thrown in, connecting the mechanism which automatically drops the time ball. When the next beat, indicating exact noon, passes over the wire, the releasing lever allows the ball to drop. The accompanying diagram shows the scheme followed in sending out signals.

The Time Ball On the State, War and Navy Building In Washington, D. C.

These time signals sent out by the United States Naval Observatory are automatically repeated by the Naval Radio Station at Arlington, Va., across the Potomac from Washington. Anyone having the proper wireless receiving equipment, which is not expensive, may receive them.

INCREASING USE OF ELECTRIC DRIERS IN SHINING SHOES

Bootblacks are coming to appreciate the use of electric driers more and more. It is especially in the shining of russet shoes that the electric drier is most appreciated, for the usual method of drying the shoes with a palm leaf fan or newspaper is a long and tedious process. Many electric driers are made especially for shoe shining purposes and are fitted with a supporting arm that serves to hold the drier to the foot rest. While one shoe is being dried, the bootblack can be working on the other shoe.

The Government built more than two thousand miles of trail and three thousand miles of telephone line on the national forests in 1914.

In Order to Carry On the Work of Erecting a Building During the Winter, a Cleveland Contractor Used a Large Tent.

ERECTING A BUILDING UNDER A TENT

What is considered a novelty in the building line was the erection of a factory building under a tent. This was rendered necessary because of the intense cold prevailing at the time.

When fire destroyed a part of the factory of an electrical manufacturing company of Cleveland, Ohio, it became necessary for the management to provide at once facilities at the new plant then under construction in an outlying district. Three buildings had already been completed at the new location, including the power plant, the smokestack of which is seen protruding through the tent in the accompanying illustration.

The contract for the new building called for the building to be ready for occupancy not later than February 1, and required the contractor to guarantee the masonry against the effects of freezing. Excavation for foundations was begun January 10, and on January 27 the building was turned over to the owners. Here is how this remarkable feat was accomplished:

The contractor paid $1,000 for the use of a tent for thirty days, with the understanding that the company was to raise it when requested and maintain it in the proper condition. While the lower 10-foot section of the walls was being laid, the sidewalls of the tent reached the ground. The tent was then raised to permit the building to be finished. A workshop was provided for carpenters and other mechanics under the part of the tent that was not raised, shown at the left in the view. Steam was brought to the building under construction from the power plant and carried through numerous pipes placed against the walls of the building on the inside.

At the time the photograph reproduced on this page was taken, the temperature outside the tent was 10 degrees below zero. Not only did the tent prevent any possible damage to the masonry through freezing, but it also served to protect the workmen from the cold and thus made their task a far more pleasant one.

TOY ENGINE 80 YEARS OLD

An ingenious toy steam engine, designed along lines now obsolete, shows the kind of work that boys of 16 could

A Toy Steam Engine Constructed Eighty Years Ago With Crude Tools.

do eighty years ago. The boy was an apprentice in a Boston machine shop and built the engine unassisted during his spare moments. It was exhibited at the Mechanics' Fair in 1837, and was awarded a diploma and a silver medal.

The engine is of the old "steeple" type, and is about 14 inches high. The fly-wheel is a mechanical puzzle, as it is built up of wrought iron with tapering spokes which fit into a weedless rim. It is probable that the spokes were bent before they were put in place and straightened afterwards.

The piston, cylinder heads, valve glands, steam chest, etc., have no packing but were ground carefully so that they were steam-tight. The threads cut on the bolts are of an unusual pitch, the use of which was discontinued by machinists many years ago. All of the work of the engine was done on a 16-inch lathe, of the crude type used in those days

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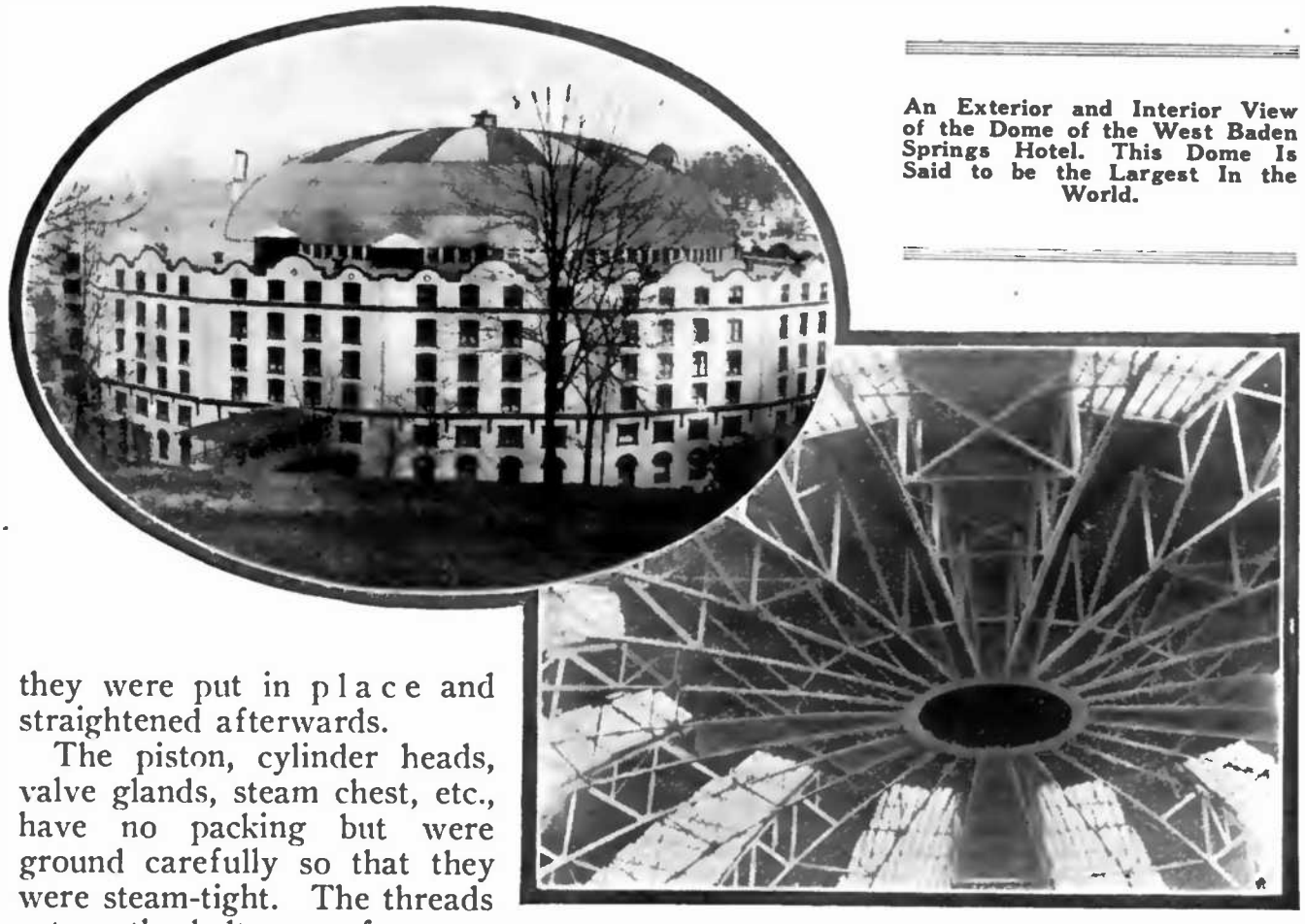
From good authority it is gathered that Germany's two great electrical manufacturers, the Allgemeine Gesellschaft and the Siemens & Halske Company did a gross business last year of about $170,000,000. Much of the goods produced by these companies was purchased by European buyers.

THE LARGEST DOME IN THE WORLD

What is said to be the largest dome in the world forms part of the West Baden Springs hotel in Indiana, surpassing those of Petrograd (St. Petersburg), Russia, and Washington, D. C.

The floor space of the hotel covered over by the dome is 200 feet in diameter and contains 62,832 square feet. The dome is constructed entirely of steel and glass, and has no central supports. Its construction was such a large undertaking that only one contractor bid on it.



An Exterior and Interior View of the Dome of the West Baden Springs Hotel. This Dome Is Said to be the Largest In the World.

So great is the vibration of the building that the dome is held in place securely by putting the lower ends of the roof trusses in shoes and on rollers. By going to the top floor of the hotel on a windy day, one can feel the movement of the rollers inside the shoes, which will show how inadvisable it would have been to permanently fasten the dome.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, write us and state your reasons.

ELECTRIC INCUBATOR HATCHES GERMS

Great strides have been made in the scientific study of bacteria during the past few years through the culture of bacilli in incubators. Microbes in large numbers lend themselves to microscopic study a great deal more readily than do small, unhealthy groups.

Bacteria incubators heated by gas have been employed in the majority of laboratories, but the recent invention of an electrically heated incubator, having several important advantages, will probably displace the old type entirely.

An Electrically Heated Incubator for the Culture of Bacilli. The Heat Is Automatically Maintained at Any Desired Temperature.

The new incubator was brought out in a laboratory in Salt Lake City. Its chief advantage is a heating arrangement which maintains the temperature at a constant point. Electric heating coils are placed in the top of the incubator, and the temperature regulated by a thermostat. When the temperature varies from a given point, the thermostat moves a delicately balanced lever arm which increases or decreases the current.

A variation of one-tenth of a degree will affect the thermostat and cause the circuits to be changed until the correct temperature is again reached.

The incubator consists of a double-walled box with an air space between the walls. The interior can be viewed by means of a miniature electric lamp which is controlled by a small button. The current consumption of the electric incubator is about 25 watts per hour.

FIFTH BIENNIAL ELECTRICAL SHOW

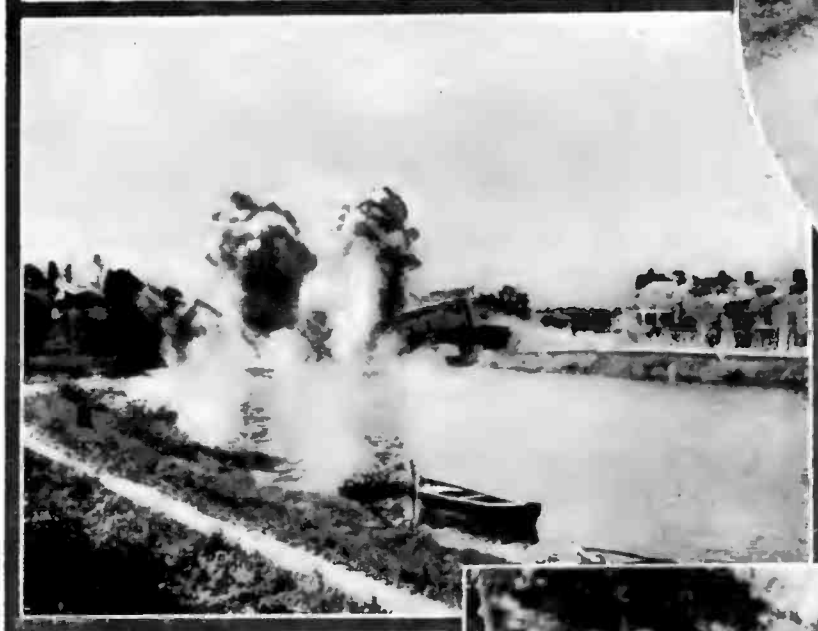
On April 8, 9 and 10 the fifth biennial electrical show will be held at the University of Illinois. This biennial event is under the auspices of the Electrical Engineering Society of the College of Engineering. The electrical shows given in the past have all been the events of the year, and this year the show promises to outlive its motto, "Bigger and Better." Twenty-five thousand square feet of floor space are available, and three-fourths of this was assigned by March 1. The electrical manufacturers are giving their unqualified support, and over fifty concerns will be represented by exhibits and each exhibit will be fully explained by capable men. The remaining booths will display local and student exhibits. Among the students' exhibits are electrical freaks of all kinds. Also an electrical fountain, café with a cabaret, and miniature Panama Canal will be the last words in artistic and interesting exhibits.

A conservative estimate of attendance based on past records has been set at eight thousand. With each admission the management will distribute free a beautiful forty-page souvenir program well worth keeping.

The admission price will be correspondingly low as the quality of exhibits will be high. Such a combination assures the hearty support of the public, and as a result, the success of the show is assured.

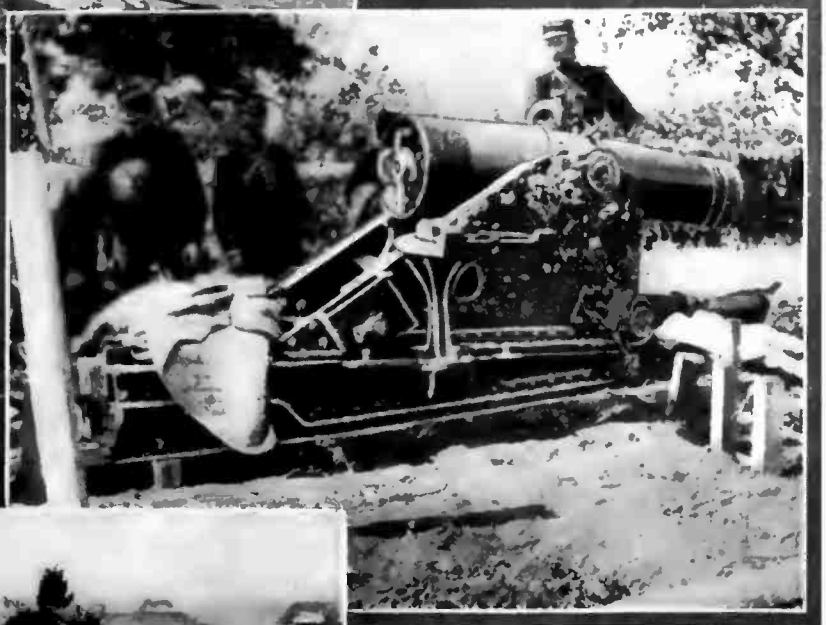
STRIKING FEATURES OF MODERN WARFARE

A French lookout in an advanced position along the French line of trenches. This one-man trench is connected to those in the rear by a passageway.



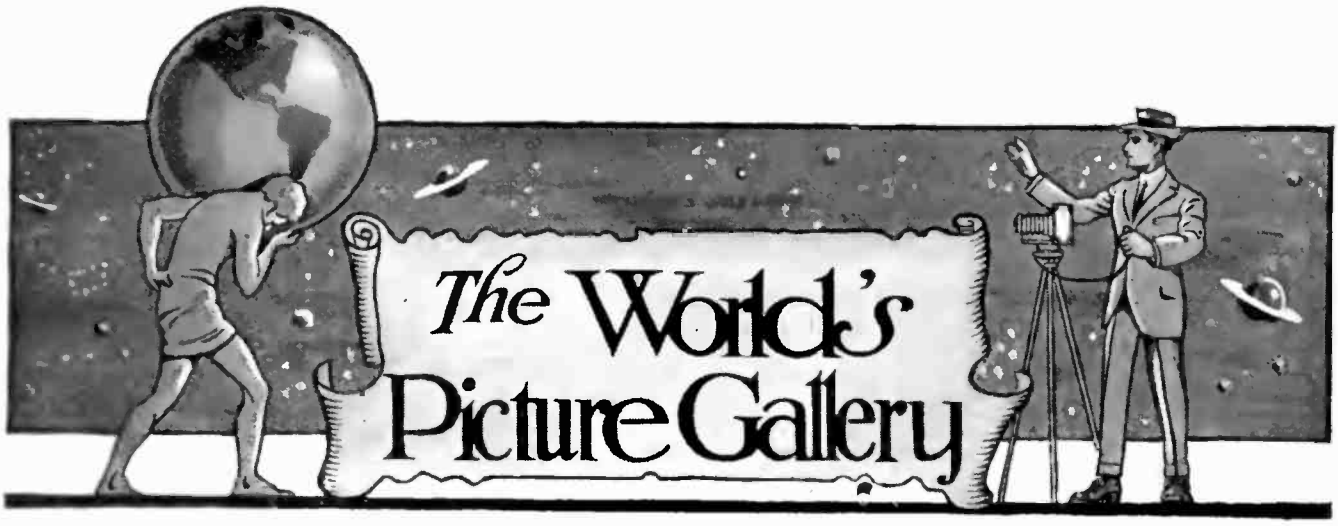
A bridge blown up by the Germans during a recent retreat in France.

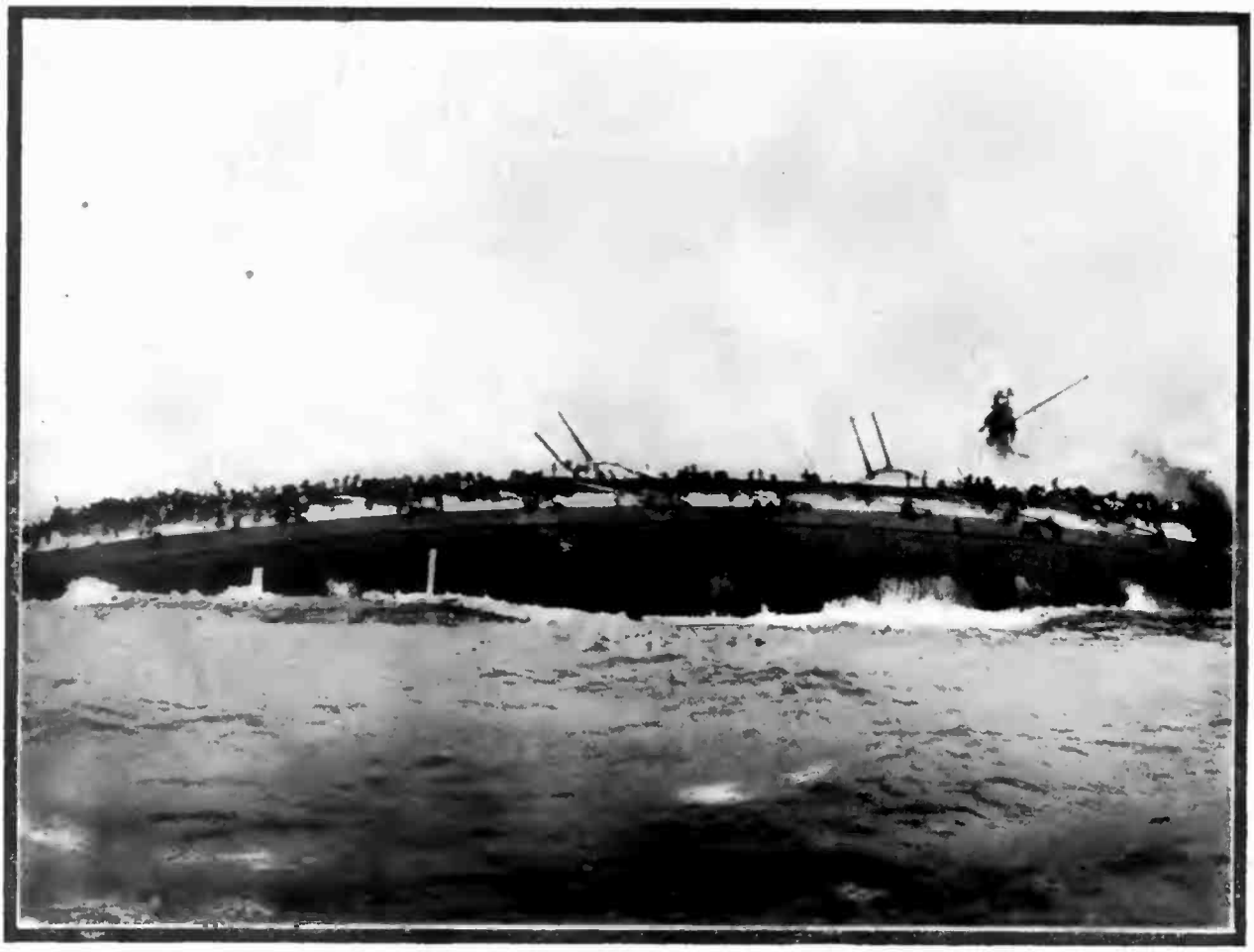
A French fourteen-inch field piece recently turned out by the Creusot Works and now on the firing line. These pieces are being made in large numbers and are intended to reply to the German heavy artillery.



Remarkable view of German and Austrian soldiers intrenched in Galicia. Here may be seen the wonderful system of intrenchments necessitated by modern warfare; the trenches being dug one in back of the other and connected by cross trenches.

Photos. Copyrighted International News Service.





THIS remarkable view of the German battleship "Bluecher," just after being torpedoed by a British destroyer during the North Sea naval battle, was photographed by an officer on board the "Arethusa." The crew of this ill-fated battleship that was battered by the gun fire of the British squadron and afterwards sent to the bottom by two torpedoes, may be seen clinging to the up-turned side of the hull.

THE PANAMA-PACIFIC EXPOSITION AT NIGHT

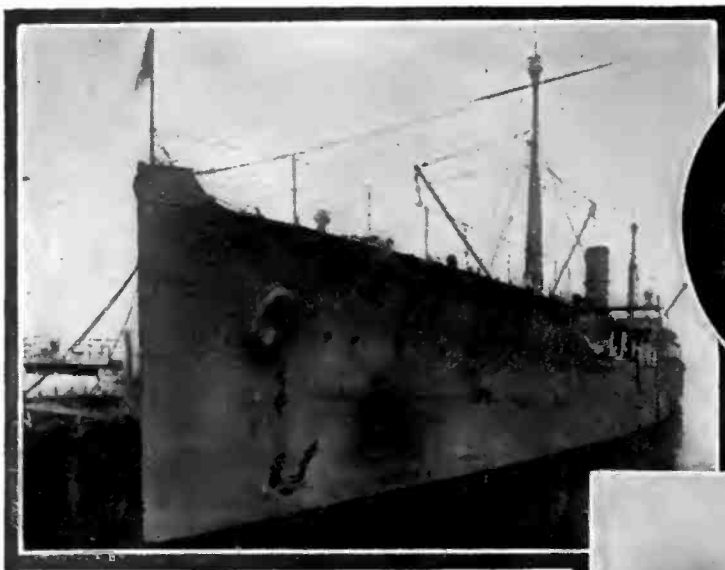
A nocturnal view of the entrance to the Court of Flowers, with numerous searchlights playing on the statues adorning the buildings. The still waters of the lagoon in the foreground act as a perfect mirror, adding further beauty to the illumination effect.

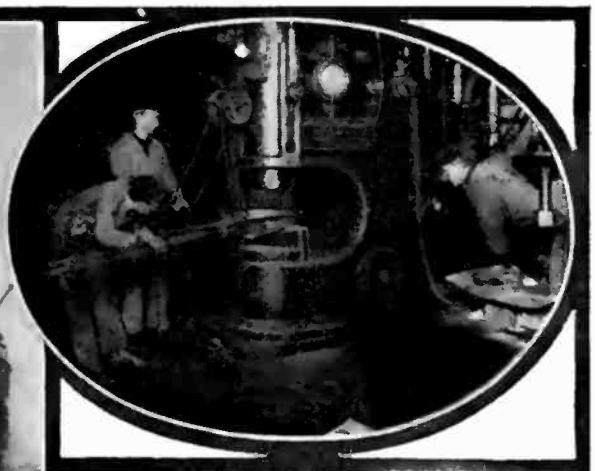
The Horticultural Building is one of the most handsome of the many structures on the Exposition grounds. It is surmounted by a glass-covered dome, on top of which is a bowl of flowers in full bloom. The bowl measures over one hundred feet in diameter.

An idea of the crowds attending the Exposition may be gained from this view, which has been taken from the Tower of Jewels, looking towards the main entrance to the grounds. In the background is seen the Fountain of Energy.

Photos. by Rockwell Feature Service.

REPAIR SHIP "VESTAL" OF THE U. S. NAVY





The United States repair ship "Vestal," which is said to be the best equipped vessel of its kind in the world. It has a complement of two hundred first-class sailor-mechanics and accompanies the Atlantic Fleet on all long cruises.

In the Upper View: A corner of the forging room on board the repair ship. Below: Repairing the range finders of the Battleship "Georgia," on the deck of the "Vestal."

Above: Electricians at work in the electrical shop on board the "Vestal." At the right: A scene in the foundry room, showing the men at work pouring molten metal into a mould.

VIEWS OF TURKISH CITIES NOW BEING ATTACKED

A panoramic view of the Turkish city of Smyrna in Asia Minor, overlooking the Aegean Sea. Simultaneously with the bombardment of the Dardanelle fortifications, this city is being attacked by another fleet of the Allied powers.

A view of the city of Constantinople and a bridge that joins the European and Asiatic portion of the metropolis. Constantinople, the capital of Turkey, is the goal of the Allied fleet that is bombarding the Dardanelle defenses.

A scene along the waterfront of Constantinople. This city has a population of about one and a quarter million people. The waterways leading to it are strongly fortified and mined, and the task before the attacking fleets is a colossal one.

Photos. Copyrighted International News Service.

GLIMPSES OF THE WAR-RIDDEN EUROPEAN COUNTRIES

A statue crowning a church in a Belgian city was struck by a German shell yet remained partly suspended in mid-air. The inhabitants of the stricken city regard the incident as a miracle, since the statue has a highly religous significance.

A German field telephone central near Warsaw, Poland.

A flashlight view of a French battery in action during a nocturnal engagement.

Sir Thomas Lipton's steam yacht, the "Erin," passing through the Corinth Canal in Greece on its way to Servia, with Red Cross nurses and doctors. Servia has suffered heavily in the European war, and before the coming of this aid the country was badly in need of medical supplies.

FROM SNOW BOUND POLAND TO EGYPTIAN DESERTS

A German dentist treating the teeth of a soldier in the trenches in Russian Poland during a lull in the fighting.

One of the French biplanes that took part in the recent bomb-dropping raids along the Belgian coast.

A group of Uhlans shooting from saddles at their Russian foes in Poland. Their lances are temporarily stuck in the ground while they are using their rifles.

An Australian camp hospital in Egypt, not far away from the pyramids. The tent contains fifteen beds, all of which were occupied at the time the photograph was taken.

A typical winter scene of a battlefield in northern France at the present time. In the snow may be seen the bodies of dead horses.

Photos. Copyrighted International News Service.

HERE AND THERE WITH THE FIGHTING MEN

Australian artillery in Egypt returning to camp after a Battle.

According to tradition, this historic column marks the life of the Turkish government. The Turks believe that when it falls, through any cause, the Turkish government will also crumble.

A French Chasseurs Alpine climbing the side of a steep hill.

German soldiers reading official bulletins that have been tacked on the trunk of the tree. These bulletins are said to contain the news from all parts of the world and are published by the military authorities.

BRITISH SUBMARINES; FRENCH AND DUTCH SOLDIERS

A fleet of British submarines at Gosport, England.

On the alert in the French trenches: Soldiers in their trenches during a spirited engagement on the Argonne front. It will be noted that every man is keenly alert and interested in what is taking place in front of his position.

An observation tower used by the Dutch artillery. This view was taken during the recent manoeuvers of the Dutch army on the Belgian and German frontiers.

With the passing away of street vendors, Paris officials are making phonograph records of their cries.

Alba Honeywell, who sold the first copy of "Uncle Tom's Cabin" in 1852. He is now 93 years old, yet is active.

One of the oddest catches on record in southern California is the weird looking sea monster shown here. It is a hammer-head shark.

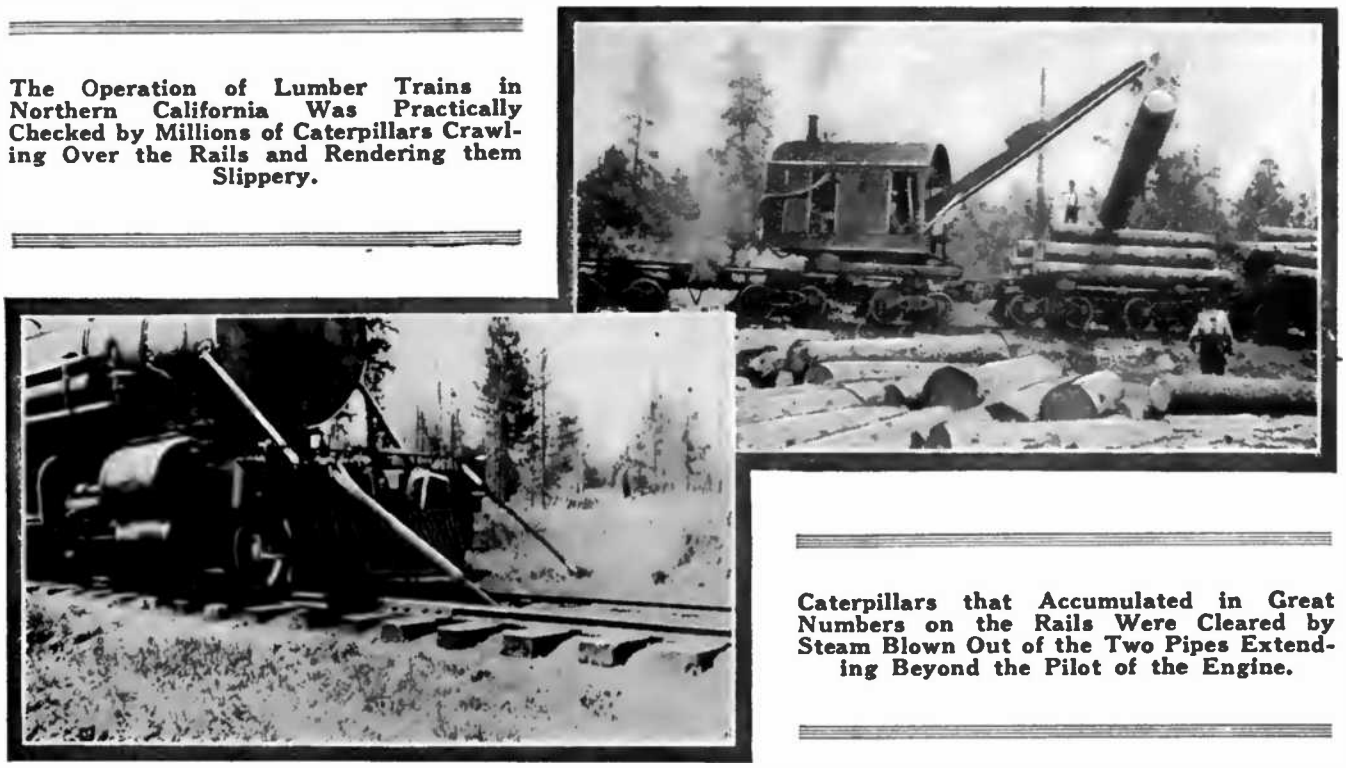
A photographer recently succeeded in printing a photograph of President Wilson on an apple. The film negative was glued to the apple while it was still green and left for 3 weeks.

CLEANING CATERPILLARS FROM RAILROAD TRACKS

An ingenious method was recently used to clear the caterpillars that swarmed over a railroad right-of-way in such vast numbers as to seriously impede traffic.

The trouble occurred in the lumber regions of northern California, which are served by the McCloud River Railroad, and the pest developed into a positive danger to traffic. Besides, the caterpillars cleaned out everything green from the countryside and made life uncomfortable for the men in the lumber camps. The countless millions of crawlers seemed to find the rails a very convenient track, for they would follow them until the passing of a train would crush them into a slippery mass. Of course, this made it almost impossible for the locomotive to proceed with safety, and the first methods of combatting the caterpillars were quite ineffectual. Cresol was sprinkled over the tracks and ties, but the chemical seemed to please the insects and they came in greater numbers than ever; sand on the rails did no good, and the expedient of stationing a couple of men on the cowcatcher to sweep off the pests, merely resulted in crushing the soft bodies. The plan of digging ditches had been tried out with success about the lumber camps, as the steep sides of a shallow trench were an effective check, but that would have been exceedingly costly for many miles of right-of-way, and would be a slow method of getting results.

The solution to the difficulty was found when Master Mechanic John Kennedy attached a little device of his own to a locomotive and it worked like a charm. Pipes were connected to the boiler and extended to a point ahead of the cowcatcher close to each rail. Live steam was shot through the pipes as required, and the caterpillars were blown far from the rails and killed by the heat, leaving the tracks clean for traffic. The device is simple and cheap in construction, but it saved thousands of dollars in ditching, and possibly saved trains from accidents on the slippery tracks.



The Operation of Lumber Trains in Northern California Was Practically Checked by Millions of Caterpillars Crawling Over the Rails and Rendering them Slippery.

Caterpillars that Accumulated in Great Numbers on the Rails Were Cleared by Steam Blown Out of the Two Pipes Extending Beyond the Pilot of the Engine.

U-SHAPED PIPE OVERCOMES EXPANSION AND CONTRACTION

A simple method for taking up the expansion and contraction in a long pipe line for steam is in use at an Arizona mine. A large U-shaped bend is made in the pipe, and this is supported by iron posts which are connected with the pipe

Expansion and Contraction, as Well as Vibration, May be Taken Care of by a Loop in the Piping.

in such a way as to allow the pipe to move freely in contracting and expanding. This method also reduces the vibration, which is very hard on the pipe joints and in time causes leakage.

Another system consists in bending the pipe in a large circle, which has an advantage over the U-shaped bend in needing only one support.

EXPERT WORK IN LOCOMOTIVE MODEL

What is probably the most complete miniature model of the latest Atlantic type locomotive in the world has been constructed by a Boston stationary engineer.

The model, which is 44 inches long and weighs 80 pounds, rests on a 3½-inch gauge track and is capable of attaining a speed of nearly five miles per hour. The chief feature of the model is the complete equipment of air brakes and pumps, something that has never before been attempted in model locomotive building. Many locomotive engineers contended that such a small air-pumping equipment could not be built, but after several attempts the constructor succeeded in making an exact model of large pumps capable of pumping 12 pounds of air. It is 3½ inches high and has a cylinder 13/16ths of an inch in diameter with a ¾-inch stroke. The equipment of automatic couplers and leaf springs, equalized in the large engines, are the other features of this exceptional model.

The boiler of the engine carries 40 pounds of steam to the square inch with charcoal as the fuel. It has 24 square inches of grate surface and contains twenty ⅜-inch brass tubes each 12 inches long, making a total heating surface of about 2½ square feet. The steam cylinder of the model is 1¼ by 1½ inches in size with a bore of 15/16ths of an inch and a stroke of 1¼ inches.

CURIOUS STREET CAR FOR TOURISTS

A highly embellished street car is offered by an electric traction company of Montreal, Canada, for the entertainment of tourists to that city.

The seats are arranged step-wise, and around them passes a brightly gilded railing. Across the top of the car, brilliant electric arches are placed, which herald the tourists' approach for a long distance.

The seats are not unlike those of a theatre, the rows being placed one higher than the other to permit unobstructed view to passengers.

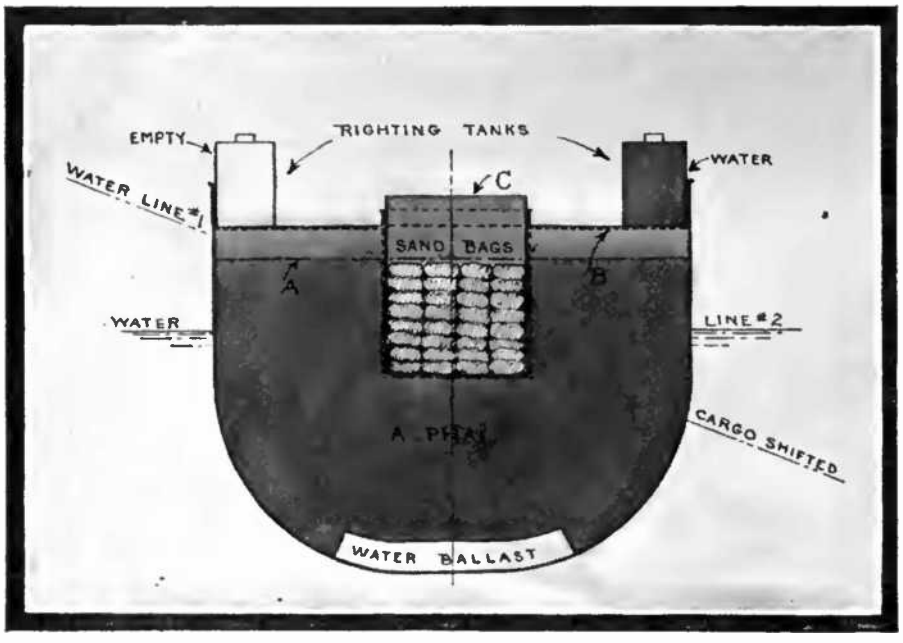
Tourists in Montreal Can Make a Sight-Seeing Trip About the City in a Special Street Car.

THE dread of a shifting cargo is one that is second only to the peril of fire or a damaged hull below the water line. The problem of handling the ship in such an emergency is one worthy of the keenest thought of the brightest mind on board ship. In this article the author relates in detail how a shifting cargo of asphalt was handled with the result that not only was the ship brought safely to port, but the entire cargo was saved as well.

NOT many months ago the following brief notice appeared in the daily press: "The steam collier *Turret Hill* has sunk owing to the shifting of her cargo. The chief engineer, who was picked up by a passing steamship, said that the vessel turned turtle, heeling over so rapidly that there was no chance to launch the boats."

Next to the peril of fire or the menace of a damaged hull below waterline, seamen have a deep dread of a shifting cargo, and for good reason, as the foregoing news item makes plain. The story we have to tell is about another vessel that survived a kindred hazard, even though she rolled over on one side so far that the thundering waves dumped tons of blue water upon her defenseless deck and came precious near to capsizing her.

The Danish steamer *Berlin,* loaded with asphalt, set out from Trinidad for New York under seemingly promising conditions. She circled about the West Indies and then turned northward along our coast in the helpful sweep of the Gulf Stream. Shortly after this she encountered a severe gale that raged for days. This did not disturb her stolid Scandinavian crew, and the steamer held her own although her engines were hard put to it and her boilers over greedy for the dwindling coal in her bunkers. Days slipped by with only moderate progress, and the supplies of food and



Showing How a Plunger Was Let Down Into the Shifting Cargo of Asphalt to Raise the Latter Up to the Level of the Deck. A Shows Level of the Fluid Asphalt After the Vessel was Righted; B, the level of the Asphalt After the Steadying Tank C Was Loaded and Sunk Into the Cargo Hatch.

fuel wasted while the destination remained still hundreds of miles off.

However, there was no immediate cause for alarm and the *Berlin* worked her way north of Bermuda without mishap. Then the unexpected happened. Three great seas hit her in rapid succession, shaking her violently from stem to stern and rolling her lee scuppers well under water. The last wave flooded her deck, worked its way back into the ocean with fearful slowness, and left the steamer permanently heeled over even after the water had escaped! What had happened? Why, her cargo had shifted, and put the ship in a predicament that promised to make it easy for her to turn turtle if three more seas of like magnitude should assail her. It was a situation calling for the promptest kind of action and the best of seamanship. But why had the cargo shifted? It had seemed stable enough when dumped into the hold.

Owing to the head winds of the storm, the *Berlin* had lingered for days in the warm waters of the Gulf Stream, and that heat had been sufficient to penetrate into the entire mass of the crude asphalt and to make it semi-fluid. When those three seas hit the vessel they set the cargo surging, and this weight was enough to tear from its fastenings at one end the metal bulkhead that divided the hold into two lengthwise compartments. Naturally, the stuff flowed to the lower side of the *Berlin* as she heeled under the attack of those giant waves, but could not return to the normal position because the loosened bulkhead, like an opened door, swung to again when the ship lurched to right herself — the weight of the plastic cargo shutting the passage by which it had entered from the adjoining compartment.

By dint of desperate work and twenty-four hours of unceasing toil, the captain and his crew managed to get the upper edge of the ruptured partition back into place and secured by means of heavy wire rope. During that period of awful suspense, the skipper's wife, also a Dane, steered the ship without relief, and so exposed was her station that it was necessary to lash her to the wheel. But the remedy to the bulkhead was only a partial one, because it was impossible to fasten the lower edge which continued to flap like a valve as the ship rolled from side to side. This movement was akin to the action of a pump and sufficient to raise the asphalt in one half of the hold to a level four feet higher than that in the flanking compartment. Thus, hour by hour, increased the *Berlin's* list.

To offset this, the engineer managed to shift to the bunkers on the high side forty tons of coal, and in this manner and for a time he helped to offset the increasing heel. But, unfortunately, that coal had to be burned, and there was just enough of it to get the freighter into the nearest American port—the little harbor lying behind the sheltering sandy arm of Cape Lookout, North Carolina. The ship did not get there an hour too soon as it was, and for more than a day there had not been an ounce of food aboard for the exhausted crew. But once there, the question of getting her thence to New

York was something to be settled by the underwriters and the vessel's agent. Here is where the resourceful genius of an ex-naval officer saved the day and, incidentally, showed how a minimum of effort would put the vessel on an even keel and make it safe for her to proceed under her own steam to her destination. This emphasizes the advantage of a technical training and the flexibility of mathematics when mastered and properly applied.

The salvage company was asked to remove from the *Berlin* a thousand tons of that troublesome asphaltum. This meant digging the stuff out and the employing of men especially trained in handling this sticky material. At best, this might have called for weeks of work. These thousand tons were to be placed in another vessel which was to be towed

In the Oval: Loading the Sand Bag Ballast On a Barge In Order to Transport It to the Steamer. Below: How the Righting Tanks Were Built Quickly Upon the Deck of the Steamer "Berlin."

back to New York. As a business proposition it was not an inviting one, and the expert of the wrecking company wondered if some other solution were not possible, and for aid in his dilemma he turned to Mr. R. H. Robinson who, before he resigned from the navy, had made himself famous by designing the first of our modern dreadnoughts.

Mr. Robinson spent about ten minutes in figuring and then declared it would not be necessary to remove a pound of the *Berlin's* cargo in order to restore her to the upright. By placing 130-odd tons of water ballast on the high side of the open deck, in a long tank to be quickly built of wood, he declared that this weight would be ample to get the ship back on an even keel despite the bulk of the three thousand tons of asphalt in her hold. A little more mathematics, and it was made plain that the needful tank could be built and made ready to hold water inside of four days. So far, the problem of restoring the equilibrium of the *Berlin* was solved, but the ship would have to make the rest of her run in the open sea, and what would happen if she encountered another storm? What was to keep the asphalt from shifting again? The stuff did not entirely fill the hold. The cargo space was like a partly-filled bottle.

Mr. Robinson had disposed of one difficulty and he was ready with an answer for this new one. He knew that he could steady the asphalt only by making it fill the entire hold, but how was he to raise its level without dumping something in to crowd the stuff upward? That something would have to be heavy enough to sink and might add complexity to the situation when the bitumen was finally removed in New York. The hold, because of the overlying steel deck, was virtually a great metallic flask, and the neck was the deep-throated cargo hatch. For this opening, Mr. Robinson proposed a rectangular tank of wood which could be rapidly built and so fashioned that it would be a snug fit yet free to move up and down like a pump plunger. You see what is coming, don't you?

By loading this tank with bags of sand it was so weighted that it would sink into the asphaltum to just the required depth to bring the level of the latter up against the underside of the covering deck. In this manner the cargo was steadied just like the contents of a filled bottle. But it would not do to transfer this pressure to the underside of the deck with all its force if the freighter should roll in a heavy sea. It was necessary to have a safety valve, so to speak, to absorb or to permit this pressure to expend itself otherwise and harmlessly. It was for this reason that the plunger or "displacing tank" was free to move up and down; the upward movement representing the harmful energy that otherwise would possibly rupture the confining deck and expose the vessel to the danger of inundation and, perhaps, certain sinking.

All of this work was done at Cape Lookout in three days after the little salvage steamer *Forward* arrived there. The only thing that threatened to cause a hitch was the lack of available sand bags, and there were not enough of these to be had in that part of North Carolina within a radius of hundreds of miles. The salvors wanted them and wanted them quickly. They were called for by wireless, and inside of three hours were on their way to Beaufort—the nearest port just inside of Cape Lookout. But how do you think they were dispatched? This shows us another side of the necessary resourcefulness of the wrecking business.

The bags were "personally conducted" to save time—expressing would have been too slow. And the gunny sacks were packed in a number of big trunks bought for the purpose. These were not of the latest make, but they had a dazzling amount of shining metal by way of external finish. Their number suggested a honeymoon. While they were on their way, a message was sent to Goldsboro from Beaufort announcing that a belated groom was coming down with his bride's trousseau—the bride being supposedly at Beaufort. The station master was asked to relay the trunks at the transfer point with all speed and was thanked in advance for his courtesy. When the resplendent baggage reached Beaufort in good time it was decorated with streamers of white ribbon at every point where bows could be fastened!

The station master and his friends at Goldsboro had thus responded with Southern gallantry. This good will towards the imagined bride saved precious time in getting the freighter ready for sea, but it was probably well that the ship left before the railroad people got wind of the true nature of that fictitious trousseau!

Above: "The Last Wave Flooded Her Deck, Worked Its Way Back Into the Ocean With Fearful Slowness and Left the Steamer Permanently Heeled Over Even After the Water Had Escaped."
In the Oval: Testing the Little Pump That Controlled the Water In the Righting Tanks.

Instead of taking weeks and spending a great deal of money in the undertaking, the entire work, from the time the salvage steamer headed south from New York until she returned to her home port convoying the *Berlin,* was a matter of a trifle over ten days. The freighter made the trip under her own steam. But for the readiness of Mr. Robinson and his training in the navy, the helping of the listed cargo craft would have been a routine salvage job and a long one. As it was, thanks to his resourcefulness, a novel way was evolved for meeting a similar problem in the future. Time always has meant money in the hustling world of business, and time saved is

money saved now more than ever. The calling of the wrecker in the past has been largely a rough-and-ready enterprise with not overmuch of science or technical skill in its ways of working. What Mr. Robinson accomplished shows how splendid is the opportunity for the technically trained man and the engineer in a field hitherto somewhat neglected, to apply their knowledge.

QUARTER OF A CENTURY PROGRESS IN BRIDGE DESIGN

The accompanying illustration is of particular interest in that it shows the progress that has been made in bridge building during the last twenty-five years.

Each of the bridges shown carries two tracks of the New York Central Railroad, formerly the Lake Shore, over the Cattaraugus Creek, near Irvington, N. Y. When the smaller bridge was built in 1889 it was thought ample in strength to take care of the traffic for many years. It would not be in service today but for the fact that bridge engineers twenty-five years ago put more than twice as much steel in the bridge to carry each ton than they do today. The larger bridge, built about two decades after, differs noticeably from the smaller structure in stiffness. This is due as much to its riveted connections as to its heavier members. In the old bridge, the joints or connections are made up of eye-bars joined together with pins, considered a good practice a generation ago. The very fast traffic of today requires rigid, well-detailed connections.

A Graphic Illustration of the Changes Wrought During a Period of Twenty-Five Years In the Design of Bridges.

The old bridge is 24 feet 6 inches high and 29 feet wide between truss centers. The new bridge is 37 feet high, or half again as high as the old one, and 31 feet wide. The span of either bridge is the same.

SUIT CASE AS AN AUTOMATIC THIEF

Recently a man was arrested at the San Diego Exposition on suspicion, in connection with the disappearance of many tools from the buildings and concessions. He had been observed about the buildings frequently, with a suit case in his hand, but no one remembered having seen him pick up any tools or open the suit case. Upon searching it was found that he had quite a collection of tools in the suitcase, which he had gathered during the afternoon. The method was a very clever one, as he had gone to a large amount of trouble and expense to make an automatic thief out of his suit case. He had cut a sort of trap door in the bottom of the case, and had arranged a claw which opened and then closed about the tools and other objects, lifting them up into the interior of the suit case. These claws were operated by a spring connected with the handle of the case. Walking up to the place where a tool was lying on the ground or floor, he innocently set the suit case down on top of the tool, and his action naturally enough attracted no curiosity or suspicion. Then when he picked the case up he pressed the spring in the handle and the tool was seized and placed inside, after which he walked safely away.

Introducing Scientific Apparatus in Photoplay

THEODORE WHARTON, collaborating with his brother Leopold in the production of "The Exploits of Elaine," has some very interesting things to say of the scientific apparatus used in the different episodes. Mr. Wharton, in the first place, emphasizes the fact that the various remarkable mechanisms shown are not the product of the studio workshop, but the genuine article, in one instance at least the only one ever produced and tremendously costly.

"For instance," says Mr. Wharton, "we are now using in the making of the eleventh episode an apparatus called the 'telegraphone,' which is the only one ever made, and which represents the expenditure of millions of dollars though the actual mechanical cost would not exceed two or three thousand. The large sum first mentioned has been expended in the experiments which have been brought to a successful conclusion in the machine, which has been kindly loaned to us for a few days by the manufacturers. Briefly, this is what the apparatus will do: You call up a man in Seattle on the 'long distance' from New York. He is away, but yet you may speak into the 'phone what you wish to tell him, and on his return by placing the receiver to his ear he will get your message and in your own voice, too.

"Again, in the tenth episode, we use the 'electric resuscitator' which recently was used for the first time on a girl who had been pronounced dead by a number of able physicians, and yet was brought back to life a half hour later by this remarkable device. This machine, which is truly almost supernatural in its powers, was invented by Dr. Leduc of the Nantes Ecole de Médécine in France. The apparatus is so new and such a rarity that we found it very difficult to secure one for our picture.

"Another new and remarkable invention we have used is the 'vocaphone,' which projects the voice of the user of it so that it may be heard a long distance from the receiver at the other end.

"No, we are not faking any scientific apparatus in 'The Exploits of Elaine.' We don't have to. The inventors of these different remarkable machines voluntarily offer us the use of their devices, feeling that the use of them in a motion picture of the tremendous circulation of this film cannot help but bring new and valuable publicity."

BIG SERIAL FEATURE IS COMPLETED

The last instalment of the "Master Key" serial produced under the direction of Robert Leonard, the Rex director, has recently been completed.

Owing to the inclemency of the weather along the southern Californian coast, which has meant the loss of so

much valuable time to the motion picture people, the company has been working day and night in the indoor studio at Universal City in an effort to keep up with their releases. On several occasions, tons of dirt have been hauled in and dumped upon the floor of the interior studio that a counterfeit of the outdoors might be made inside within range of the big electric lamps. This has, of course, meant great loss of time with the result that the company has had to work as many as seventy-four hours at one stretch without stopping except for meals.

CONVALESCENT SOLDIERS AS MOTION PICTURE ACTORS.

One instance of how European motion picture producers are utilizing the present war in their films is presented in the accompanying illustration. The two men seen above the trench in the view are both British soldiers who were wounded in the battle of Mons, Belgium. They are spending their time during convalescence by taking part in the production of a war film in a London suburb.

These soldiers make excellent actors in war photoplays, for they lend to the picture a realistic and accurate atmosphere that is so difficult to obtain with ordinary actors.

FIFTY MOVING PICTURE SHOWS GIVEN DAILY AT THE EXPOSITION.

To illustrate great industries of many kinds, forty to fifty motion picture shows are being given every day in the various exhibit palaces of the Panama Pacific Exposition. Among these the Government uses the cinema to illustrate educational methods, the American Telephone and Telegraph Company to show how calls are handled, and many manufacturing processes are also shown.

Photo. Janet M. Cummings.

British Soldiers Who Have Been Wounded on European Battlefields, Taking Part in a Photoplay While Convalescing.

THE factories of Pathé Freres produce in round numbers 2,000 miles of finished film daily. In fifteen years the profits of the company have increased more than 1,000 per cent. Painstaking thoroughness has blazed the trail of the Pathé rooster to the remotest parts of the world.

WHEN the war broke out, nearly every workman in the Vincennes factory of Pathé Freres was conscripted for service in the French Army. Women operatives were hastily recruited for the vacant places, and put through a rapid-fire course of training; whereupon the true nervous passion of French temperament broke to the surface, the rippling product was forged out, the reels boxed, crated and sent hustling on their way to the thousand parts of the world.

Then the Germans swooped down towards Paris from the North. Vincennes was in constant fear of destruction—of a fate like unfortunate Rheims. The thunder of the Krupps rolled out to the feverishly busy film factory where two shifts were urging the machinery at a twenty-four-hour-a-day clip. But the work was pushed unheedingly. It might have been that the few hundred women bent more comfortably over their tasks when finally the rumble of the guns tapered off to a murmur, and the invaders, driven back and back, crawled over the line again into Belgium.

There was nothing melodramatic in the bravery of these women—these *ouvrieres*—their attitude was simply one of calm patriotism. They realized that their Louis, their Jacques, their Henris were off up there fighting desperately for them; and when the thunder of the Krupps was loudest and closest, the women merely rolled up their sleeves a little higher and turned out celluloid film faster than ever.

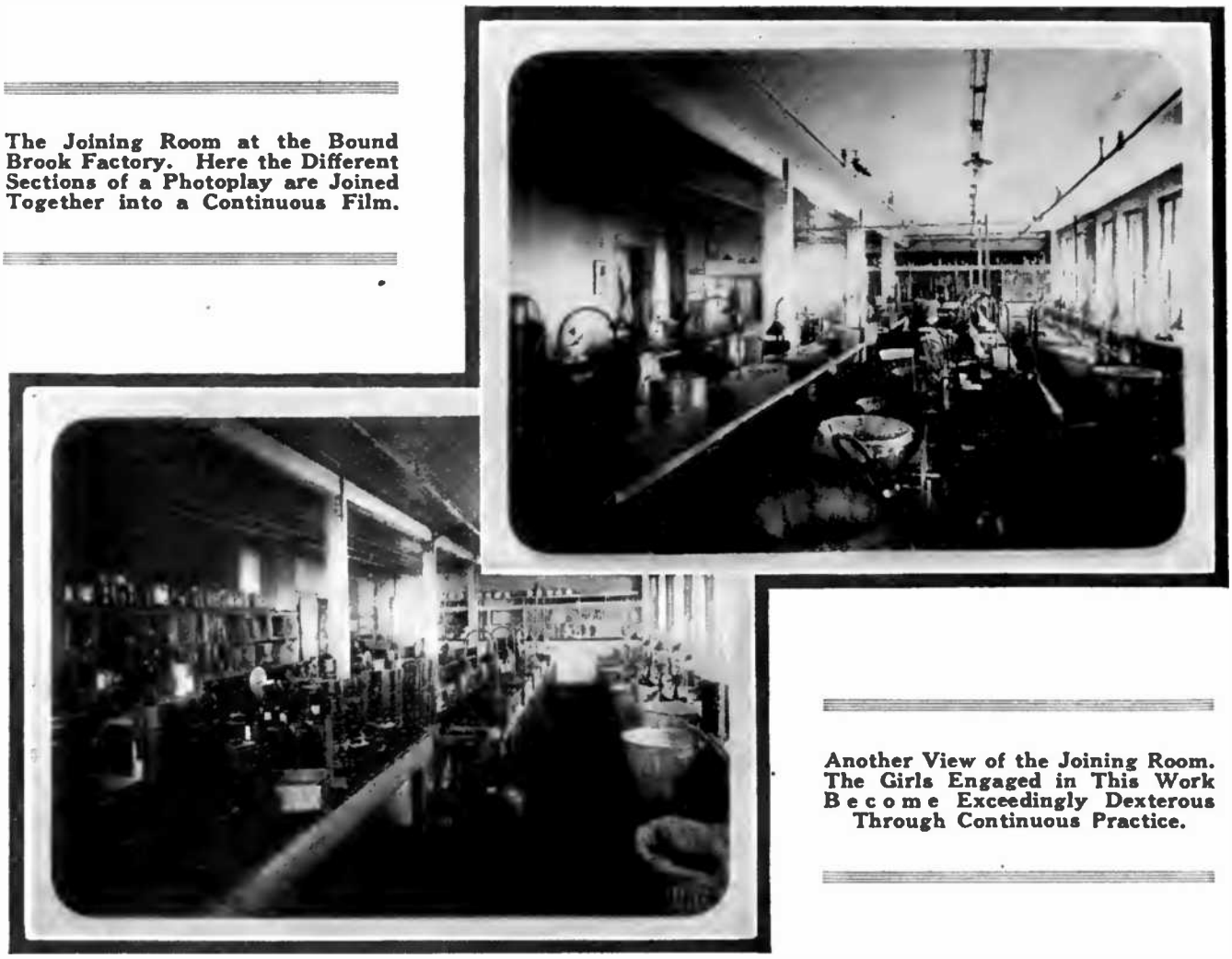
Which Explains the Rooster

This act and this attitude are typical of the French, and would be ascribed by the French as *"avoir du culot,"* or pluckiness, as we would call it. Thereby, in addition to increasing our respect for the French people, a long-standing question is also cleared up; just what symbol is the Pathé rooster supposed to convey? The answer comes as a matter of common sense; the dapper little bird, legs astride, beak agape in a lusty crow, stands for gameness and pluckiness, not to say cocksureness.

When the Pathé rooster came over to America a great many years ago, his cocksure ardor was dampened almost to the melting point. Notwithstanding the

fact that American audiences at first were delighted with anything that moved, however imperfectly, across a screen, they very shortly began to demand something far better—a picture that told a story—not merely the insipid view, for instance, of a railroad train crawling wearily into a station.

The Pathé Brothers concentrated every energy to conjure up something—for it seemed that magic would certainly be needed—that would satisfy the exacting Americans. Rough and tumble comedies were the first experiment; then along came a succession of badly acted dramas and garish melodramas. Eventually the groove was found in movies which were actually made in America. Since then, the popularity of "Made in America" Pathé pictures has swept the country.



The Joining Room at the Bound Brook Factory. Here the Different Sections of a Photoplay are Joined Together into a Continuous Film.

Another View of the Joining Room. The Girls Engaged in This Work Become Exceedingly Dexterous Through Continuous Practice.

The Iron Hand Felt Here

The unobtrusiveness of the Pathé manufactory at Bound Brook, N. J., where all of the American Pathé films come from, offers a sharp contrast to the glamor attached to the name—and to the rooster. If you are on the alert, you glimpse as they flash past, a group of uninteresting buildings sprawled out over a fenced-in portion of meadow land equalling in area an ordinary city block. In the front is a square, red brick building, and tucked behind it in decreasing order of height are a series of wooden structures.

I do not mean to disparage the Pathé factory in any sense; French factories are consistently plain and uninteresting—but from the outside only—and the Bound Brook factory is quite typical. It has the atmosphere of France, and a large number of the people at work there are French-speaking. In fact, as I was to learn later, eight or ten French Reservists, *chasseurs à pied,* who were employed there, went to France immediately on the outbreak of the war.

The gate keeper, who guards the entrance, has hardly scraped a speaking

acquaintance with our language as yet. While I was waiting in the little guard-house by the gate for the *directeur* to put in an appearance, a bell rang sharply somewhere in the interior of the main building. Immediately, the numerous exit doors flew open, and the occupants, two or three hundred men and girls, poured out into the yard. This, I was informed, in a mixture of very bad English and very good French, was a fire drill. It is a compulsory performance and takes place at frequent intervals at Bound Brook. The system is so fine that the entire factory can be emptied in less than one minute. Several years ago a workman was lost in a bad fire and since that time an organized fire drill has been held unforewarned at weekly intervals.

With the growing adoption of the new Pathé non-burnable film, the fire hazard will be reduced to a fraction of its former importance. Just as soon as the stock of explosive film now on hand is consumed, the non-inflammable type will be used exclusively. Film is now stocked in a building isolated from the rest like a dynamite shack. It is carefully guarded against fire, and numerous signs convey to the potential offender the warning, *No Smoking!*

A Battery of Projecting Machines Operated by Women Who Inspect Finished Film Before It is Allowed to Leave the Factory. Imperfect Film Is Destroyed.

A Corner in the Perforating Room. This Room is Ordinarily Darkened, the Only Light Being from Ruby Lamps. Here the Raw Film is Perforated.

Reducing the Personal Equation

To the unpracticed eye of the visitor, the net result of a trip through any of the up-to-date moving picture manufactories is just about the same. A film must go through certain prescribed stages in its career from the blank yellow ribbon in the canister to the finished, vitalized reel crated for shipment. Although the Pathé factory is no particular exception to this rule, many of the incidents in a film's career are quite unique in themselves. For instance, the business of developing, which is carried out in most factories by a painstaking process of laboriously dipping clumsy "racks" of film in untidy tanks of solu-

tions, at Bound Brook is done by a complex machine so perfect as to almost entirely disregard the human element. It comprises, in brief, a formidable mass of slender upright glass tubes reaching almost to the ceiling of a high room, gleaming whirling cogs and chains, with here and there a flash of a slowly-moving film.

The new Pathé developing machine is a triumph. Its results are as certain as the foreknown sum of a column of figures. From start to finish the development of a film of average length consumes about forty-five minutes; 10,000 feet of finished film are turned out in an hour.

Behind a walled-in space to the right was the dark-room. "In there," explained my guide, "the films are put through the various stages of development and fixing. The first thing we do with a new film is to test it with the developers. We adjust the solutions in the cylinders through which it must run so that the results will be absolutely uniform."

He led the way up a flight of steel steps into the intricacies of the purring mechanism. All around us were the open tops of the long, slim tubes into which the endless strip of film was passing, down and down until the bottom was reached, and around a sprocket wheel from which the film turned and ascended.

"The films leave the developing and fixing cylinders in the dark-room, pass out through the little aperture in the wall, and are thoroughly washed and stained here." He indicated the nearest group of tubes in and out of which a gleaming film was slowly weaving.

"When the film is thoroughly rinsed and stained whatever color is desired, it passes through a number of glass cases in which a stream of air, slightly warmed, is circulated. By the time it emerges from the last section it is quite dry. It is wound automatically upon a reel and is then sent out to the polishing machines."

We visited a room nearby where the film is polished and buffed. Several girls were busily sewing rough cloth tufts upon belts which were attached to machines.

"We take great pains in handling films for the sake of cleanness and clearness. Projecting machines nowadays are so perfect that the slightest defect—a watermark, for instance—shows up on the screen in a way we can't afford. All of the girls who handle the film are compelled to wear cotton gloves—an order we put into effect just a few weeks ago."

The Firing Line

One of the most interesting places in the entire Bound Brook *usine* is the testing room, where the finished pictures are projected and examined for defects. A battery of a dozen moving picture projectors forms a veritable "firing line." In the "trenches"—behind each machine—a keen-eyed girl operative watches the picture as it is flashed on the white wall opposite. A copy of the New York, the first, edition of a Pathé News was being rushed through each of the dozen cameras. In one view, we saw a noted statesman, prominent in "grape juice circles," in the act of pompously descending the steps of a famous mansion in Washington. From another lens issued, in grim parade, a contingent of French soldiers en route from Paris to the front. Still another picture, from Detroit, illustrated an embarrassed Great Man, with an uneasy smile, who had done something wonderful or other for humanity.

Occasionally, a girl would stop her machine, scrutinize the image of a portion of film that she suspected of defection, and if her suspicions were confirmed, she would clip out that portion from the rest of the film.

"Every inch of the twenty-five miles of film we turn out each day is thoroughly inspected in this way," the *directeur* was saying. "Our great boast is thoroughness; it is the keynote to our organization."

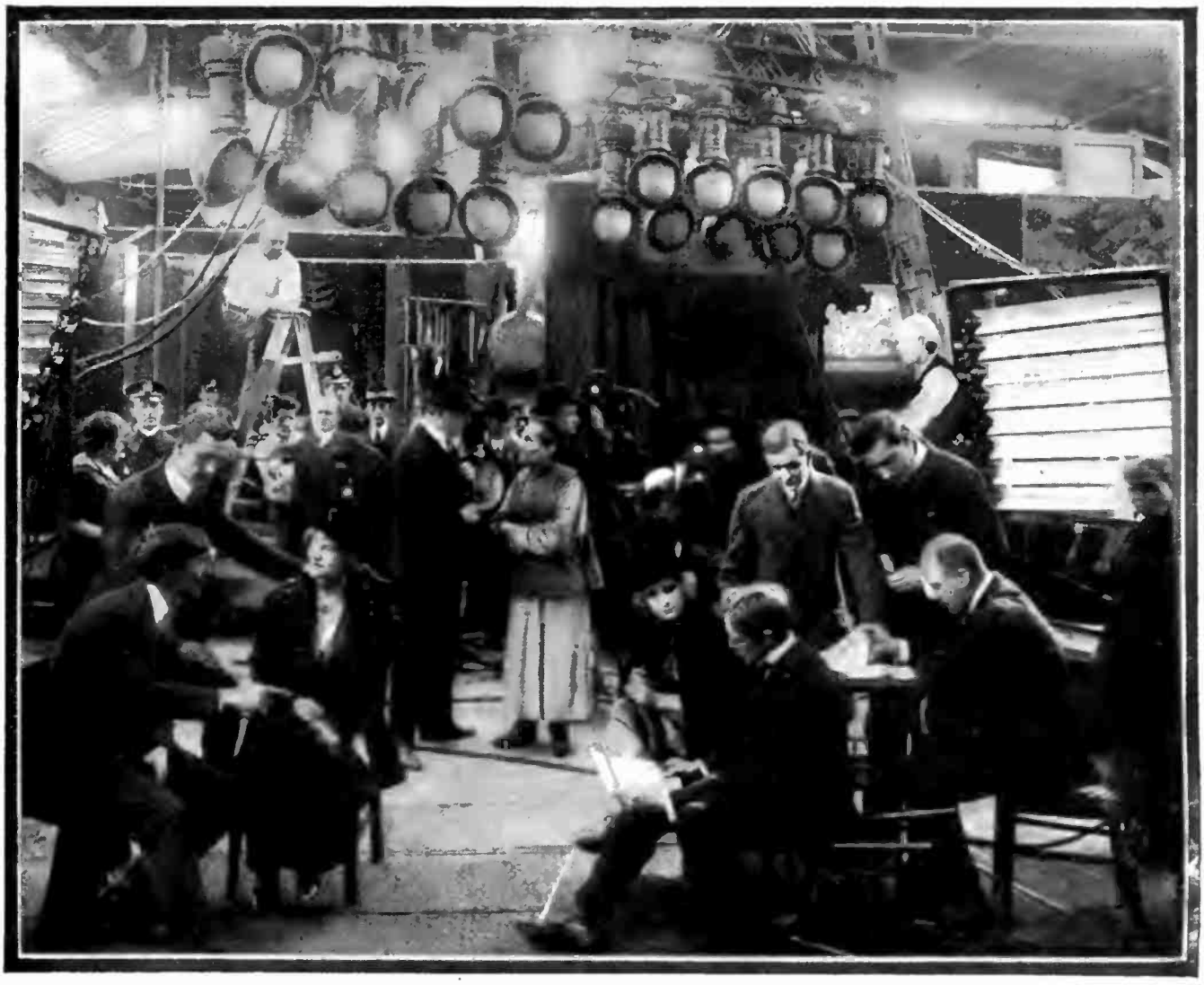
Thoroughness in another sense illustrates the universality of Pathé Freres. Titles and sub-captions of films are printed not only in English but in French, Italian, Spanish and German. From the home factory at Vincennes, films go out

in nearly every language of the world—even Japanese and Chinese.

Girding the World with Celluloid

Across the Hudson River in Jersey City, the American Pathé studio is located—hardly more than fifteen minutes by subway and tube from Times Square. This closeness to New York offers a peculiar advantage to a moving picture producer—the availability of Broadway dramatic stars. As a matter of fact, a star can quite readily perform before the Pathé camera every morning, and get back to his "legitimate stage" in plenty of time for the matinee.

It is rather difficult to believe that the quiet, gray studio is really the birthplace of the world-kindling "Adventures of Pauline" and the equally thrilling "Exploits of Elaine." Yes, indeed, we saw Miss Pearl White in action! In the original, she loved and hated just as attractively as she has done on a blank screen before thousands of admiring audiences. Moreover, she is even prettier off the screen than on, and she has an engaging way of making fun of the whole business between pictures!



A Glimpse of the Activities in the Jersey City Studio, Showing the Lighting Equipment. In the View May Be Seen Several of the Leading Characters in the Famous Serial, "The Exploits of Elaine."

The serial film "The Exploits of Elaine" is being produced by Theodore Wharton and his brother Leopold. The film is of quite an unusual nature, since it introduces new scientific inventions in a thrilling manner.

Leopold Wharton, the Pathé director, who is, perhaps, not so well known as his leading lady, can, when inspired, be accurately compared with a caged lion. Unlike most directors, he does not swear

— much — and he exercises a wonderful control over his little troupe.

In a separate part of the studio building are located, besides the executive offices—for this is the brain center of the American Pathé genus—the Pathé Daily editorial rooms. These rooms have the true atmosphere of a metropolitan daily; telegraphs are clicking incessantly from all parts of the world, and reporters and camera men are continually dashing in and out. From the time the negatives come in from France, Africa, Japan—all over the earth—they do not pause an instant until they are clicking off the miles on a fast mail train to some distant exhibitor.

The Machine Shop of the Pathe Factory at Bound Brook, N. J.

Pathé camera men are stationed in all parts of the world where anything of unusual interest is likely to happen. They form the intricate network of veins which tap the news sources of the uttermost parts —and by a like system of capillary arteries, the news is disseminated over the world.

The aggregate production of the Pathé factories is 300,000 meters, or nearly 2,000 miles, of finished film per day. From 1900 to 1914, the net yield of the organization increased from 472,000 francs ($94,400) to 8,433,000 francs $1,686,000) —a growth of considerably more than 1,000 per cent.

Painstaking attention to details is partly responsible for the success of Pathé Freres—the rooster sums up the rest of the explanation in his attitude.

ELIMINATING THE SUB-TITLES IN FILMS

"Road o' Strife," the Lubin serial by Emmett Campbell Hall, release of which begins April 5, embodies a number of novel and new features, one of the most important of which is the maintenance of illusion to an extraordinary degree. This is largely accomplished by means of a new idea in captions conceived by Mr. Hall and ingeniously worked by Director John Ince.

As it is generally admitted that the caption or sub-title is the greatest crudity and most jarring defect in the photoplay, the "Road o' Strife" idea will be of paramount interest to the entire industry.

"For several years," says Mr. Hall, "I have been trying to get away from trite and banal captions. Finally it occurred to me that the key to the problem was the dialogue caption and the judicious use of screen letters and clippings, though this would necessitate the elimination of the drop-curtain caption, and entail a complete change in the established methods of photoplay construction. I have endeavored in 'Road o' Strife' to demonstrate the possibilities of my theory. In the fifteen reels composing the serial, there is but one title—'A Week Later'—which is not a speech by a character, and the single exception was for a particular purpose.

"To get the effect desired, it was necessary to devise a method whereby the words could be conveyed to the mind of

the spectator without his consciously reading them—in other words, in such manner that he would subconsciously assimilate the thought or fact to be conveyed. If we are looking at a person, and that person begins to speak, *we do not cease to see the speaker*—the eyes do not suddenly go out of business while the ears perform their offices, but just that, in effect, has been the demand made upon the picture spectator to kindly go blind to the action while his eyes perform the functions of his ears and transmit a thought to the brain.

"To maintain a proper illusion, the spectator must be tricked into unconsciously using his eyes for his ears, and to accomplish this he must still be permitted to *think* that he is devoting his attention exclusively to the action. It is accomplished with utmost simplicity and yet so effectually as to produce almost the effect of audible speech by continuing the action while the necessary caption is being shown. The caption will be read without consciousness—the method of conveying the message to the brain not being noted. This is what we have done in 'Road o' Strife,' and we believe that we have proven our theories correct. No one form has been followed—every caption has been carefully considered and brought on and taken out in accordance with its individual characteristics; some dissolve in and dissolve out, others appear abruptly and slowly fade, while still others merely flash on and instantly disappear, as a sharp, explosive 'No!' seems to do. We have undertaken to visually approximate sound effects."

Mr. Hall is entitled to no little credit for introducing this new idea. It has long been known and admitted that the prevailing caption system in photoplays was exceedingly crude and unsatisfactory.

NEW DAYLIGHT STUDIO OF THE LUBIN FORCES

The biggest artificial light studio in the country was informally opened at the Lubin ranch in Betzwood, Pa., when Director Edgar Jones recently began the making of a series of three-reel pictures there. This is the third big studio to be built at the ranch during the past few years. The new studio, which has just been completed, is equipped with every modern scientific appliance for the making of photoplays. The Lubin engineers have been working for many months on the big studio, and the system of artificial lighting has been so designed and arranged as to permit the ultimate taking of natural color motion pictures there.

Extensive improvements and additions have also been made to the laboratories at the ranch. These laboratories, declared by experts to be the best in the country, are very busy places these days, and a great deal of scientific work is being carried on there by Mr. Lubin and his corps of assistants.

MOTION PICTURES WITH A MACHINE SHOP BACKGROUND.

To secure new themes and backgrounds for motion pictures, the producing companies occasionally resort to stories that require a machine shop set-

A Scene from a Photoplay in Which an Actual Machine Shop Was Used.

ting. In the accompanying illustration is an example of such a film, the setting being that of a completely equipped machine shop. The scene is taken from the Thanhouser-Mutual film entitled "On the Brink of the Abyss," featuring Frank Farrington. The scenes in which the machinery is shown were posed in the machine shop of the Thanhouser studio at New Rochelle, N. Y.

TAKING MOTION PICTURES ON A RACING AUTOMOBILE.

In the accompanying illustration is shown how motion pictures are taken of passengers and driver on a high-speed automobile. In this instance a special wooden platform has been built in front of the car to hold the camera-man and director, as well as the camera. At the extreme right appears D. W. Griffith, the well-known director. The scene is being taken for the Majestic-Mutual film entitled, "The Mother and the Law," featuring Mae Marsh who is sitting on the floor of the automobile.

Wooden Platform Fastened to a Racing Automobile, in Order to Hold the Camera, Operator and Director.

POCKET WIRELESS SET IN A PHOTOPLAY

In the third instalment of "The Black Box," the Universal serial film that is attracting much attention at present, there is introduced a pocket wireless apparatus that is used by a detective who figures prominently throughout the story. Aside from this idea, the detective also employs a form of telephone that permits him to see persons who are talking to him over the line.

DYNAMITING A HISTORIC BRIDGE

In the presence of fully three thousand people the Lubin Company recently dynamited the historical bridge across the Chester River at Upland, Pa., as a climax for a three-reel drama entitled "On Bitter Creek," produced under the direction of Edgar Jones.

The bridge was about one hundred years old and was located opposite a colony of old houses in one of which William Penn was a frequent visitor. Of late years the bridge, through old age, had become unsafe and the township authorities decided to have it demolished and build a modern structure across the river. The Lubin Company secured permission to do the actual destroying and wrote a story around the destroying of the bridge, as well as in keeping with the character of the surrounding country.

The actual blowing up of the bridge was in itself a very thrilling climax. No one knew exactly what the old structure would do when the large quantity of dynamite stowed in it was detonated. The ten camera men intrenched themselves in and behind all forms of barricades for protection, while two motor-driven cameras were stationed close to the bridge. At the word of the director the structure was rent apart with a terrific report.

If you enjoy THE WORLD'S ADVANCE, tell others.

Another example of the extremes to which American photoplay producers will go in their endeavors to have the utmost realism in their films, is presented in the above view. Here is seen a typical street of Tangiers, a city of Morocco, erected at Universal City, California, and used for staging several of the scenes in the serial film "Terence O'Rourke."

AEROPLANE BATTLE ENACTED IN FILM

While the war-locked nations of Europe have succeeded in preventing camera men from taking battle scenes on the continent, they have not been able to check the ingenuity of the American photoplay manager in perfecting replicas of battle scenes that in some cases are so startlingly realistic as to challenge the criticism of military experts.

An aeroplane battle in the clouds, during which a woman aviator hurls a bomb and destroys the enemy's plane, is the latest of spectacular and sensational realism that the studios have attempted and which is now in course of preparation by the 101 Bison company.

The enemy is seen coming into range. The two planes exchange shots and soon a fusilade is fired from both machines. The enemy is seen just about to escape when the heroine hurls a bomb from her plane. It strikes the enemy's machine, which catches fire and drops to the ground.

It has been learned with great regret that Frank Stites, the aviator taking part in the production of this photoplay, fell to the ground in his biplane while making a scene and was killed.

HUNTING FOR A CRAFT SUITABLE FOR PHOTOPLAY

Captain Wilbert Melville, manager of the Western Lubin Company at Los Angeles, Cal., has been scouring the entire coast in his yacht, "The Lucero," in an effort to locate a schooner of especial type and design to be used for a variety of scenes in the big three-reel production which he is making. While there are numerous schooners of all classes plying up and down the Pacific coast, so par-

ticular is Captain Melville, and so desirous is he to secure one of just the right type, that he has had considerable trouble in locating one suitable to the needs of the production.

SECURING PHOTOPLAY PLOTS FROM MAGAZINES

It is not an unusual occurrence for a motion picture director or even the scenario editors to refer to mechanical magazines for ideas in producing films. Recently, Director McGill, of the New York Reliance-Mutual Company, received several suggestions for a mechanical picture he had in mind by reading a copy of MODERN MECHANICS for March. In the accompanying illustration appears Director Lawrence B. McGill sitting in the center of the group.

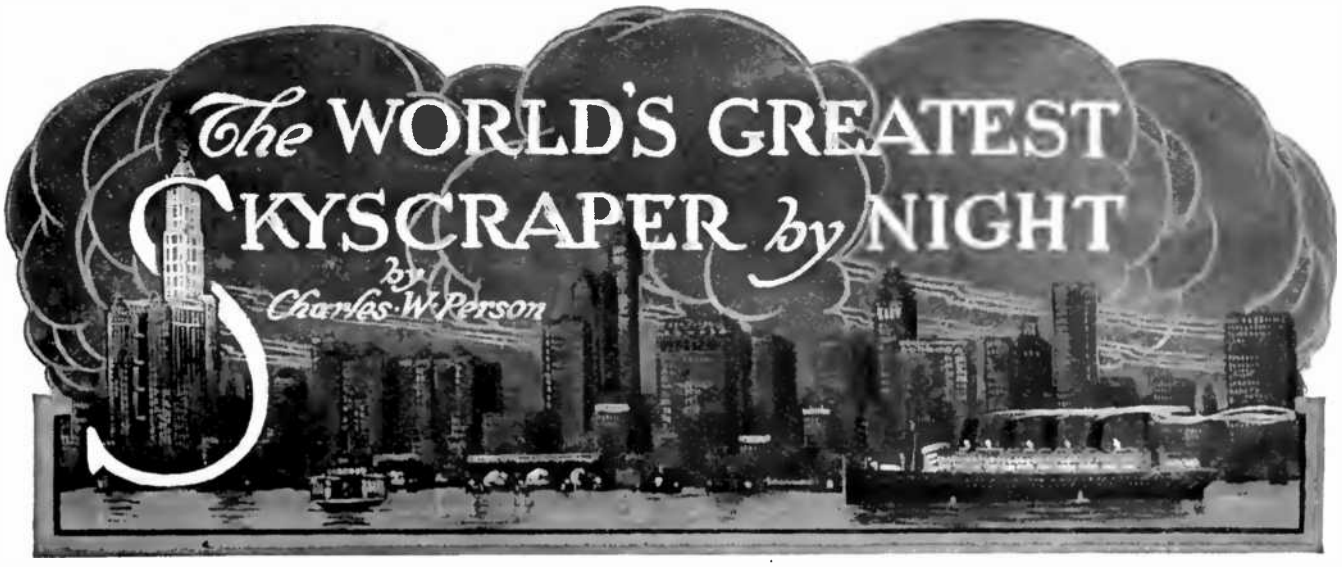
Director Lawrence B. McGill and His Company, Comprising the New York Reliance-Mutual Company.

THE WHITE PLAGUE DEPICTED IN FILMS

The Imp company is now at work on a three-reel film which, when released, is expected to create a sensation. The film deals with the ravages of tuberculosis and will be enacted by an all-star cast. The company plans to visit various cities in the East, where the scenes will be laid in factories which illustrate ideal sanitary conditions, and also in "sweatshops" and condemned loft buildings where the plague flourishes. The feature will be entitled "Every Town," and will be original in both theme and execution. Aside from presenting an interesting story, it will possess an educational value as well.

A large force of carpenters, mechanics and plasterers have been busy the past several days at the Lubin Western Studio erecting an Algerian village. Several of the regular dressing room buildings have been transformed into Algerian structures and a number of temporary ones built, in order to have a complete Algerian street to be used in a big Algerian feature which is to start immediately.

Los Angeles, Cal., is the hub of the motion picture industry, over 80 per cent of the American photoplays being produced in that city and its immediate vicinity.



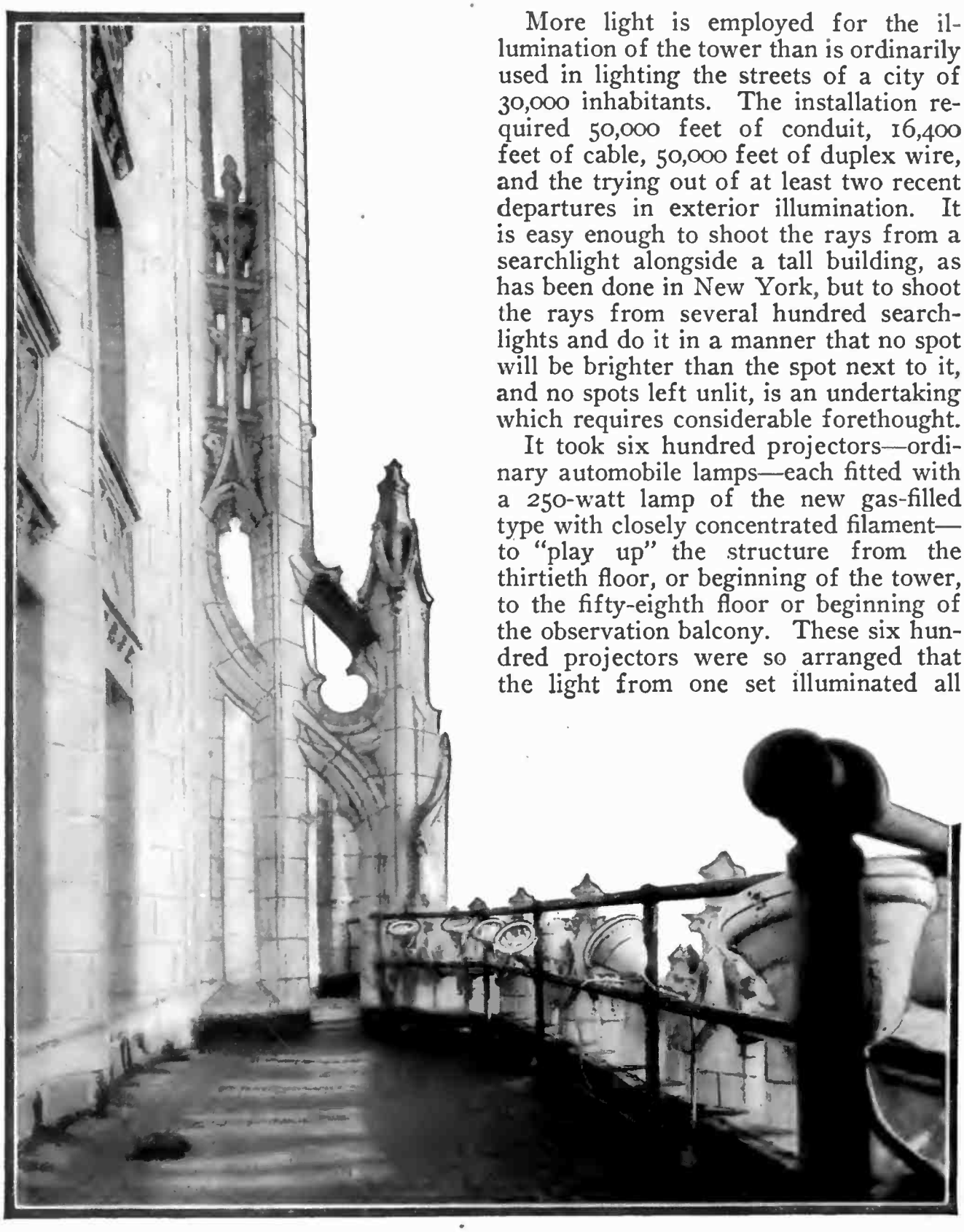
IT requires as much current to illuminate the tower of the world's tallest building as is ordinarily used in lighting the streets of a city of 30,000 inhabitants. Each night this edifice stands out against the black sky as a mighty and luminous crystal hanging from the clouds—a spectacle that leaves a permanent impression in the memory of all who witness it.

JOHN WANAMAKER and H. J. Heinz met once in a Paris hotel. After they were introduced Mr. Wanamaker remarked, "Oh, yes, you are the man who has that big sign on Broadway." This incident was very amusing to Mr. Heinz, who said it was the best evidence he had ever had of his wisdom in spending $20,000 for a single electrical display advertising the "57 varieties." He explained afterward that he had been told of that sign in seven foreign countries and twenty-six states of the Union.

Simultaneous with the blowing of whistles and the ringing of bells in New York City as a welcome to the new year, thirty floors, comprising the tower of the world's tallest building, the Woolworth Building, burst forth from the black night one giant shaft of uniform light crowned with a great scintillating jewel. When the switches were put into action throwing approximately twelve million candle power of light on the tower, the greatest permanent lighting spectacle in the world was inaugurated.

If a little piece of blue sky worth $20,000 a year rent to H. J. Heinz brings mention of it to his ears in seven foreign countries and twenty-six states, what will the advertising power of the Woolworth Building be when there is nothing in existence to approach the tower as a wonderful sight by daytime, and now an even more wonderful sight by night? All the other lighting spectacles of the metropolis fade before it. It rivets the attention and fairly burns its story into the memory of every one who glances upward in wonderment.

At first thought one might be led to believe that lighting thirty stories of masonry isn't such a mighty task after all. It all depends on the architecture, of course, and there is no office building in the world with as lavish an exterior as the Woolworth. To bring out in bold relief its hidden recesses, its balconies, its pent houses, mansard roof, observation tower and crow's nest or lantern a



These Projectors are on the Balcony of the Twenty-seventh Floor of the Woolworth Building. They Throw their Beams of Light as Far as the Forty-Third Floor of the Tower.

More light is employed for the illumination of the tower than is ordinarily used in lighting the streets of a city of 30,000 inhabitants. The installation required 50,000 feet of conduit, 16,400 feet of cable, 50,000 feet of duplex wire, and the trying out of at least two recent departures in exterior illumination. It is easy enough to shoot the rays from a searchlight alongside a tall building, as has been done in New York, but to shoot the rays from several hundred searchlights and do it in a manner that no spot will be brighter than the spot next to it, and no spots left unlit, is an undertaking which requires considerable forethought.

It took six hundred projectors—ordinary automobile lamps—each fitted with a 250-watt lamp of the new gas-filled type with closely concentrated filament—to "play up" the structure from the thirtieth floor, or beginning of the tower, to the fifty-eighth floor or beginning of the observation balcony. These six hundred projectors were so arranged that the light from one set illuminated all four sides by shooting directly upward, and light from another set of projectors shooting directly downward to fill in any spaces not "hit" by the light thrown up. It was the purpose of the engineers to

force of over forty experienced electricians not only had to face imminent danger, but they had to spread many miles of wire and do the hardest kind of figuring.

make the source of light itself invisible, and when they came to figure out a method of hiding the rays from the lamps which shot down alongside the building they had a hard task. However,

The following method of distributing the projectors was used: To light the west side of the tower a number of lights were placed on the north and south wings of the pent houses at the thirtieth

The Woolworth Building at Night, Showing the Wonderful Effect of the Electric Illumination. The Tower Is Illuminated by Six Hundred Automobile Lamps, Each Containing a 250-Watt Bulb of the Gas-Filled Type. The Lamps Are Cleverly Concealed and the Illumination of the Tower Walls Is Absolutely Uniform.

by a complicated system of screening they solved the problem, and now anyone looking upward cannot detect the source of light.

floor. These lights shot up their rays as far as the forty-third floor. From the gabled roofs at the thirtieth floor projectors were placed which illuminated

the north and south side of the tower as far as the forty-third floor. The east side of the tower had to be lighted from projectors placed on a narrow balcony opposite the twenty-seventh floor. All these projectors were employed to shoot light upward, so at the forty-third floor a similar set of projectors was placed which shot their rays downward to bring into prominence any spot not touched by the lights from the thirtieth floor.

Looking upward from the forty-third and forty-ninth floors one can see lights focused up as far as the fifty-third floor, which is the beginning of the mansard roof. On the four teurells opposite the fifty-fourth floor another series of projectors play upon the observation balcony at the fifty-eighth floor, which is just exactly 750 feet above Broadway. The most novel feature of the installation is two stories above—the sixtieth story—which is called the crow's nest or lantern. It has been enclosed with diffusing glass and within the lantern itself, which is a very small affair and is 792 feet, one inch, above the street level. In this lamp are placed over twenty powerful lamps totaling forty-five thousand candle-power. An automatic dimmer connected with these lamps continually alters their intensity in an irregular cycle. The glass surface of the lantern forms a deep red glow no brighter than the adjacent gilded structure, and again it flares to a bright white light of fifty times this intensity.

Viewed from a distance, the great tower, with the source of light hid and its thirty-floor foundation inky-black, appears as a mighty crystal hanging from the clouds. There is more light concentrated in the crow's nest alone than is used for the searchlights on some of our men-of-war. As a thing of beauty the tower lighted by night brings out in fullest splendor all the architectural detail. An afternoon's sun playing on the tower brings out its beauty to remarkable advantage, but twelve million candle-power of light directed so that its source is hidden from view accomplishes a result that even Old Sol himself has to admit is a bit out of the ordinary.

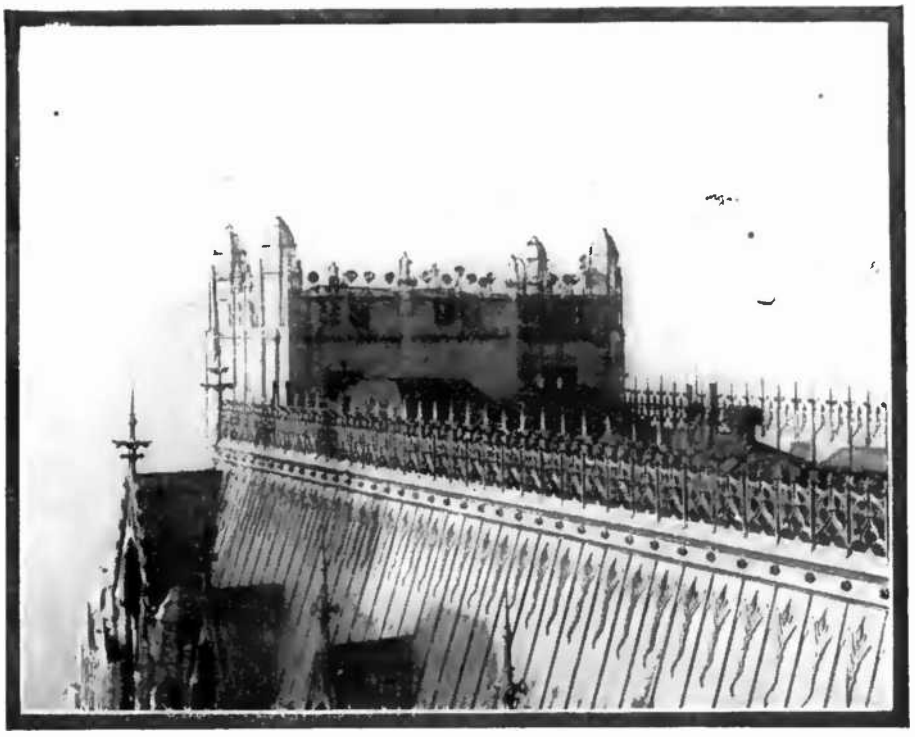
The Electricians who Placed the Electric Lamps and Ran the Conduit had a Perilous Task Before them, Often Working on Uncertain Footholds Many Hundred Feet Above the Street.

One great authority in the electric sign business expressed, as near as words can express it, the significance of the electric sign:

"It is forceful advertising when you put an isolated, distinctive bulletin before half a million people—all readers—in a single night. That is extraordinary circula-

tion. But when the announcement is so towering, so dominating, that it burns its story into the memory of each reader, its influence is so great that even circulation is secondary."

The illumination of gigantic skyscrapers by electricity is in reality nothing more than the electric sign idea on a scale of great magnitude. There is perhaps no American town of any consequence that cannot boast of several electric signs of attractive design and great advertising value, greeting the passers-by on the main thoroughfares at night. And it is especially in the smallest towns where the streets are not too well illuminated that the blaze of an electric sign is most conspicuous.



The West Side of the Woolworth Tower as Far Up as the Forty-third Floor is Lighted by Four Projectors Placed on the North and South Wings of the Pent House at the Thirtieth Floor. The South Pent House is Shown Here.

But what about building illumination. Does it pay? Evidently Mr. F. W. Woolworth thinks it does.

DAYLIGHT SIGNAL LAMPS ON ELECTRIC RAILWAYS

The use of signal lamps for daytime signaling on electric railroads as well as for night signals, thus dispensing with semaphores and operating mechanisms, has been the subject of extensive experiments and study lately.

The recent introduction of hooded lamps and the development of the lenses and artificial backgrounds has gone a long way in placing this simple equipment far ahead of the old-style moving mechanisms and semaphore movements over the face of a stationary light.

The first signal system based on scientific principles, for both day and night service, was on the Brooklyn Bridge in 1907. The signals had 5-inch lenses, giving both red and green indications and were equipped with 10-inch hoods. These lights were not equipped with any artificial background. Behind the lenses were mounted 16 c.p. lamps. These proved only partly satisfactory and from then until 1911 there were but few attempts made to use lights for daytime signaling.

In 1912 the use of deeper hoods, artificial backgrounds and the strong white light of the tungsten lamps so improved the signal as to provide the first long range indications under the most severe daylight conditions.

The latest development of this phase of railroad signaling is the successful installation and operation of over 50 miles of these signals on the system of the Indiana Union Traction Company. These signals have 40-watt lamps and 8-inch hoods, and in daytime the signal indications can be read clearly at 3500 feet and at night over 2.5 miles.

One important feature in the use of the daylight lamps, that conclusively at-

tests their value, is the correct reading of the indication. Even the small 15-watt lamps with 8-inch lenses can be read at about 2000 feet under ordinary conditions of daylight.

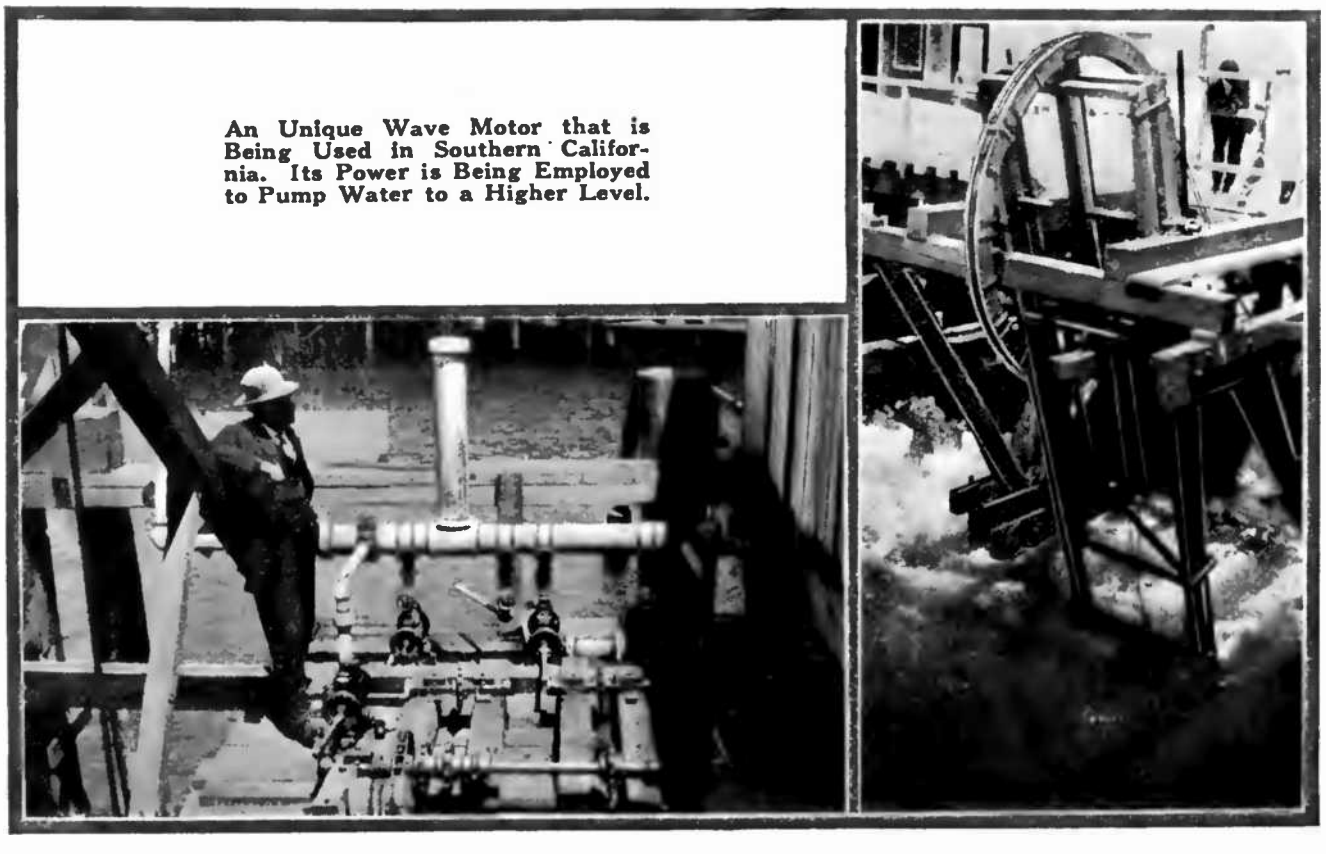
The difference in first cost of the installation and the less cost of operation recommend their use in all the modern equipments and they are being fast adopted to replace the older and more costly equipment on many of the large interurban electric lines throughout the country.

POWER PRODUCED BY THE FORCE OF THE WAVES

The great wasteful force of the waves as seen along the Pacific Ocean has set a large number of inventors to the task of claiming this great power and making it do their will. The result is that a dozen or more different types of wave motor are being tried out from time to time with more or less success. One of these inventions is installed at Venice, Cal., and with it the sea water is pumped to a height of forty feet.

A wooden wheel ten feet in diameter is suspended by a wooden framework built out over the water from the pier about twenty feet. From the wheel to about two feet below the surface of the water extend two heavy timbers which are connected with a wooden plane placed to receive the full force of the waves.

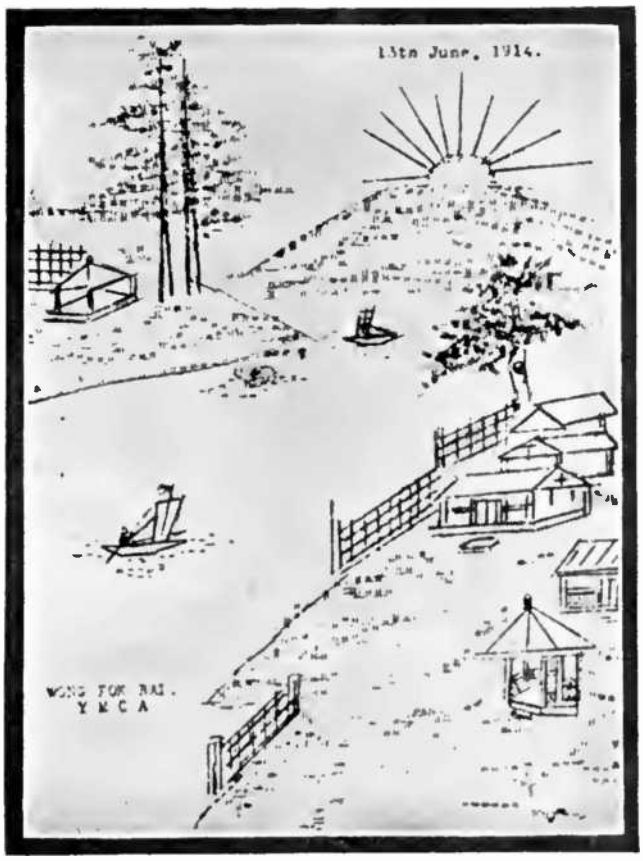
The plane is driven shoreward violently by the incoming breakers and just as forcibly driven back by the receding waves. This force revolves the large wheel and is transmitted to the four pumps by means of steel wire cables, and the water is carried upward forty feet through a three-inch pipe. To generate electricity they plan to pump this water into a storage tank, allowing it to run through a turbine.



An Unique Wave Motor that is Being Used in Southern California. Its Power is Being Employed to Pump Water to a Higher Level.

MAKING LANDSCAPES ON A TYPEWRITER.

Wong Fok Bai, a Chinese boy of Shanghai, won to American ways of living and thinking by the Y. M. C. A. of Shanghai, is an artist on the typewriter. He is not only a rapid and accurate typist, but he is also proficient in type-drawn landscapes. One of his type-drawings, "A Chinese River at Sunrise," was



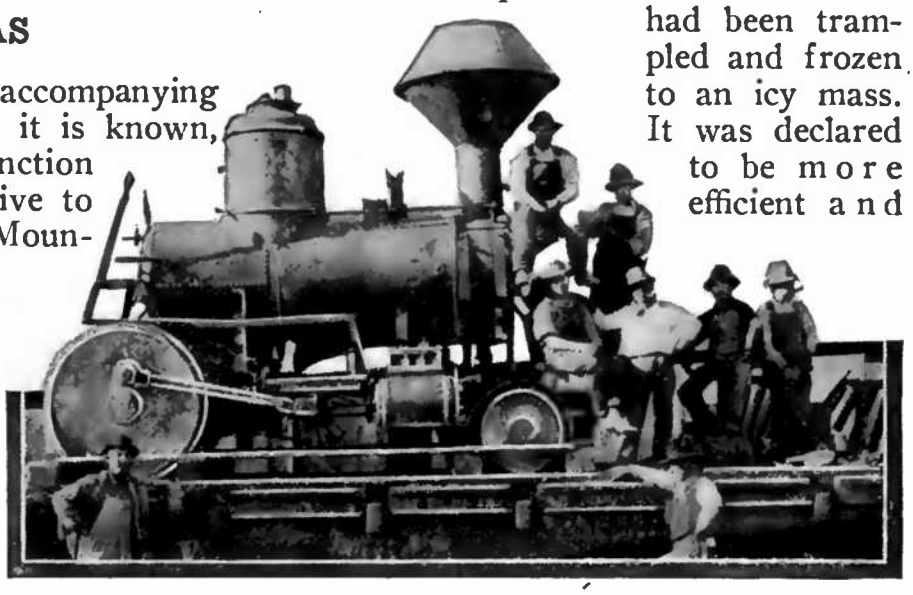
A Landscape Picture Made on the Typewriter by a Young Chinaman.

recently submitted to a leading typewriter manufacturing company in the United States and was pronounced the most excellent type-drawing ever submitted to the company.

Wong is nineteen years old and expects to come to the United States as a student in a year or so.

THE FIRST LOCOMOTIVE OVER THE SIERRAS

The engine shown in the accompanying illustration, Old No. 4 as it is known, built in 1865, has the distinction of being the first locomotive to cross the Sierra Nevada Mountains. For forty years an uninteresting junk heap, this engine has at last been rescued from a life of oblivion and restored to its original dress in order to be an interesting feature of the railroad exhibits at the Panama-Pacific Exposition. The old locomotive is of the wood-burning variety, with a diamond-shaped funnel, typical of the locomotives of that time.



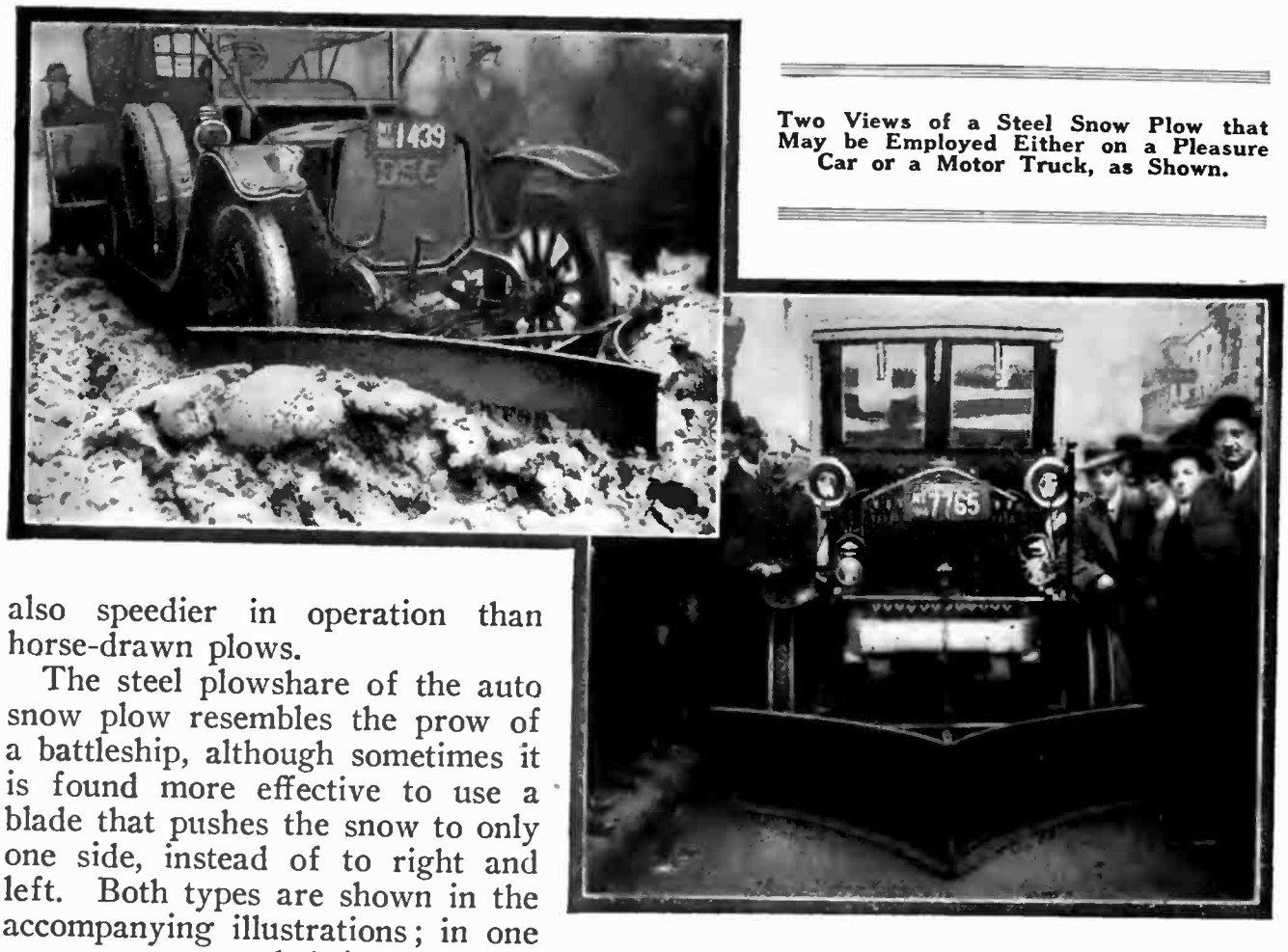
An Old Time Engine that has the Distinction of Being the First Locomotive to Cross the Sierra Nevada Mountains.

REMOVING HEAVY SNOW DRIFTS WITH AUTOMOBILE PLOW

Still another use has been found for the automobile, this time as the power behind the snow plow. The cleaning of the city streets after a heavy snowfall has always been one of the biggest problems to confront the municipal officials, as the work must be done thoroughly and, before all, speedily. The use of large numbers of men with shovels is by no means an economical and reliable method, and yet heretofore it has been the only available means of the street department.

Now a plow has been devised which is fitted in front of a motor car or truck; the power required varying according to the heaviness of the snowfall and the amount of traffic which has beaten it solid. Both for city streets and country roads, the new invention has been tried out and proven a success. In New York county, drifts of 18 inches depth have been handled with ease by this plow on a standard automobile, and in one case the road had been practically impassable for three weeks, yet the hard-packed obstruction was cleared away in three hours.

In New York City the street commission gave the device a trial and it received the indorsement of officials, although it was severely tested on streets that were hard packed with old snow that had been trampled and frozen to an icy mass. It was declared to be more efficient and



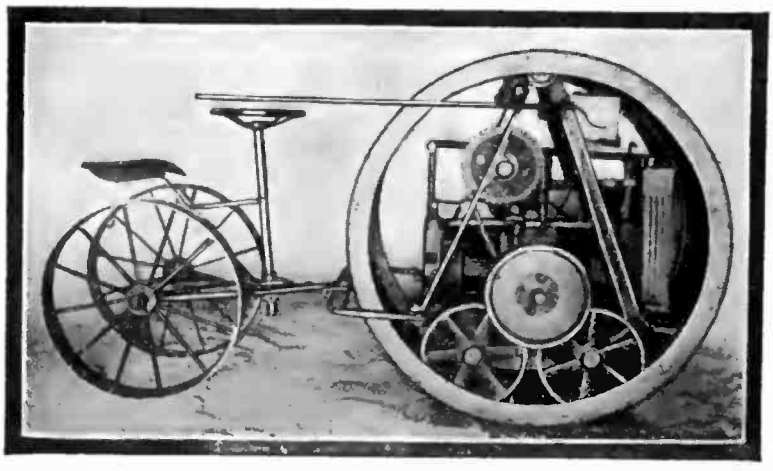
Two Views of a Steel Snow Plow that May be Employed Either on a Pleasure Car or a Motor Truck, as Shown.

also speedier in operation than horse-drawn plows.

The steel plowshare of the auto snow plow resembles the prow of a battleship, although sometimes it is found more effective to use a blade that pushes the snow to only one side, instead of to right and left. Both types are shown in the accompanying illustrations; in one case a motor truck being used, while in the other a pleasure car supplies the motive power.

GASOLINE ENGINE OF NOVEL DESIGN FOR TRACTION PURPOSES

One of the most peculiar designs of farm tractors is that of a small gasoline engine which runs on the inside surface of a big wheel and thereby moves the tractor over the surface of the ground. Its operative principle may be compared to a squirrel in a revolving cage, climbing the sides to get exercise. The engine is cranked like most motors and possesses a good-sized balance wheel and other familiar automobile devices. From 12 to 15 horsepower is developed by the engine and it can be used with all forms of farming implements, such as a plow, harrow or cultivator. It can even be hitched between the shafts of a buggy and, when highly geared, will roll its owner about.



A Gasoline Traction Engine in Which the Application of Power is Very Unusual.

When the tractor is placed on the market the diameter of the cylinder will be about four feet. This will reduce the present weight of the experimental model, which is 1,600 pounds. The price of the machine when marketed will be about $300.00, or the price of a good team of farm horses.

It is said that Russia has a total of 137 electric central stations serving nearly 15,000,000 people.

MECHANICAL MAN of the MERCHANT MARINE

By Walter S. Hiatt

THE inauguration of an American Merchant Marine opens up a new and important field of endeavor for the trained electrical and mechanical men of this country. The average American is prone to regard the man who goes to sea as a sailor and it is probable that but few of us realize the opportunity presented by the modern steamship for trained mechanicians. In this timely article the author offers a suggestion worthy of note by the wide-awake mechanic and electrician.

CONSIDER 20,213 marine engineers! Put that number in your head and then read on. The placing of ships under the American flag has a big import to the man ashore with an engine room training and a technical education. These several hundred ships being registered for foreign trade mean not only that the merchants of the United States will get better freight and selling facilities, that the shipping industry will get the money that formerly went into foreign pockets. These ships mean that a good many thousand more jobs will be open to the American who wants to go to sea as an officer, oiler or electrician in the engine room. Formerly these jobs have been held by foreigners; now the best of them will have to be held by American citizens.

The engine room of a ship is an unknown quantity to the average American. He has been educated to believe that the only man who goes to sea is a sailor. In the modern steamship, the contrary is true. The majority of any ship's crew is below decks. The fate of the able seaman is indelibly attached to the ship of sail, and the fate of the ship of sail is told in these figures: During the past year, the shipyards of the United States turned out but 73 sail vessels, as against 1,003 of steam; while in the year 1910, 127 sail vessels were built as against 936 steamers. The records of every nation of the world duplicate this decrease in sailing ships.

In other words, while there will always be room for the seaman, his rôle is no longer the paramount one aboard ship, from the point of view of numbers. In the early 'forties, when Dana voyaged in the little freight brig *Pilgrim* and later wrote his "Two Years Before the Mast," the crew of fourteen, save two, were actively engaged in working the ship.

Now consider a steam freighter of today. Take the *Panama,* of the American-Hawaiian line. Her crew consists of 39 men—rather lower than the average because she burns oil instead of coal. The largest number of men, namely, 17,

The Engineer Works on the Level—Sea Level—Below Decks, Out of Sight of the Passengers.

in any one department, are found with the engineer—one chief engineer, three assistant engineers, one deck engineer, three oilers, three water tenders, three firemen and three wipers.

When it comes to passenger vessels, the number of men in the engineer's department is simply enormous. On a 12,000-ton vessel like the *St. Paul,* of the American Line, there is a crew of 400. Other than the two wireless men, there are 167 in the engineer's department of which number 22 are officers, cadets and electricians.

But what about that number —20,213? This is the number of engineers employed in the water transportation of the United States, in lake, river and coast-wise vessels only. Are these jobs held right now by Americans? Hardly. Of natives there are 10,526, and the rest are largely foreigners who have come over here to get a good job. So far has the average American stayed from the water that he doesn't know about the good jobs already found for him right at home.

What will be the chance for the American engineer with hundreds of ships operating under the American flag? Already some 200 ships have been newly draped with the red-white-and-blue banner, and others will follow. These ships must carry, by law, after two years, American officers on the bridge and in the engine room. Watch officers, they are called. In addition, they must carry cadets; that is, young fellows who want to learn the business of going to sea.

The wages paid engineers and assistants make such jobs attractive. A chief engineer under the American scale of wages on a good ship averages one hundred and fifty dollars. The sum may rise above or fall below that, according to the ship.

What makes this business of going to sea attractive, in particular for the engineer, is that if he decides after all he would rather stay ashore his original training makes him able to hold down the shore job, and his rough-and-ready work at sea has made him all the more valuable ashore. I recall the case of an engineer of the *Ulstermore,* a Johnston line ship that ran from Baltimore to

A Passenger Ship at Sea. How Quickly She Does Her Work!

Liverpool. The engineer of that ship was a tall, brawny Scot, and he knew his job from stem to stern. The ship met a January hurricane while in mid-Atlantic, and the plunging of the ship, throwing the propeller out of water every two minutes, wound up by jerking one of the blades loose. Of course, that blade dropped off and there was the ship stopped in a bad storm with the waves rolling over her and dashing into the funnels. Well, that engineer decided he would keep that ship going. He man-

A Marine Engineer with a Shore Job at Panama. Here is Seen One of the Electric Towing Locomotives that Haul the Steamers Through the Locks of the Canal.

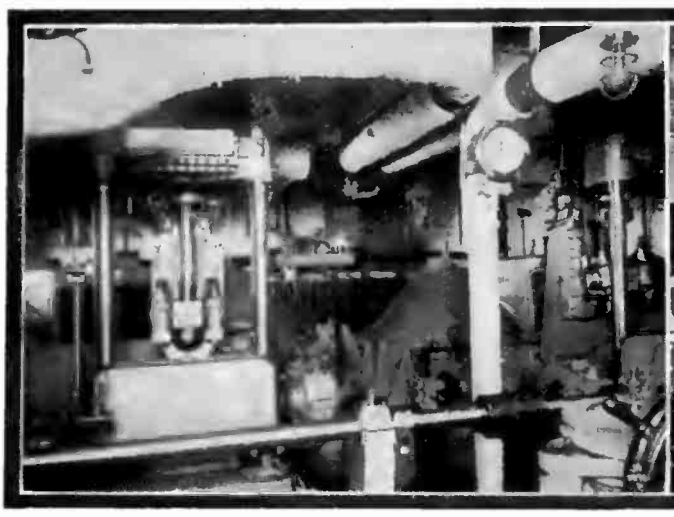
aged to turn the engine over so slowly while the propeller was out of the water that the remaining blades did their work without being jerked off in their turn. He stayed at the job three days and three nights, until the sea quieted down.

When that ship got into Liverpool, that engineer was taken off the ship by the owners and given a crack job as marine superintendent.

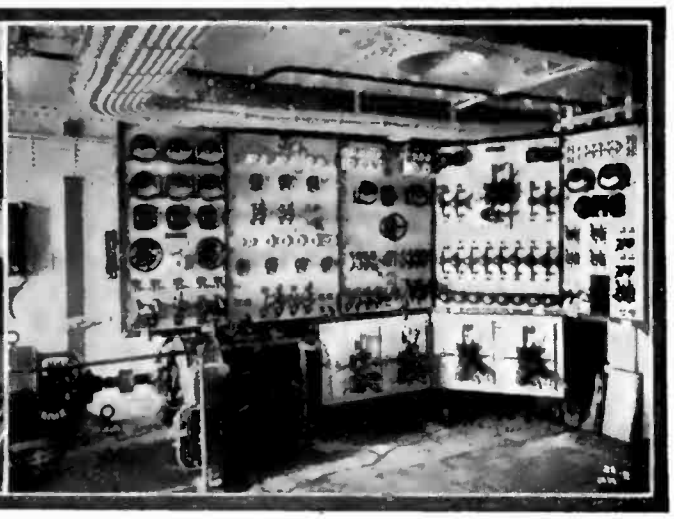
So it's a rule that works both ways. The man who has already learned his trade ashore can easily pass the examination which will entitle him to a marine license. In every big customs port of the United States—New Orleans, Chicago, San Francisco, New York—an examination for a license may be taken for the asking. The United States Department of Commerce issues a pamphlet giving the qualifications required to be shown in the examination. To get the marine license, the applicant must have had three years' experience on a steamer, or else he must offer evidence of training with stationary engines, graduation from a mechanical engineering school or training in marine construction works.

Taken all in all, this business of going to sea is healthy; it rounds a man out, gives him the horizon that comes with a little travel, let's him see how other fellows work in other places, and the pay is worth while, considering that food and lodging always go with the humblest of sea jobs.

The inauguration of the American Merchant Marine at this time is most opportune. The European war and



Rudder Machinery of a Liner. It is Part of an Engineer's Work to Attend to this Equipment.



The Dynamo Room of a Large Passenger Steamer. Here the Electrician is Much in Demand.

other factors have caused serious business depression in most industries, with the result that there is considerable unemployment. Until general business conditions improve—and the prospects are said to be uncertain and not overencouraging—it is very probable that unemployment will continue to confront many in the mechanical trades. But the possibilities of work on board the steamers of the American Merchant Marine just now offer an opportunity for employment to the more ambitious men.

CITY STREET MAY SLIDE INTO RIVER

Occupants of the office buildings on the main street of Edmonton, Canada, are facing a strange calamity, for the street, which is built along the steep bank of the Saskatchewan, threatens to slide into the river.

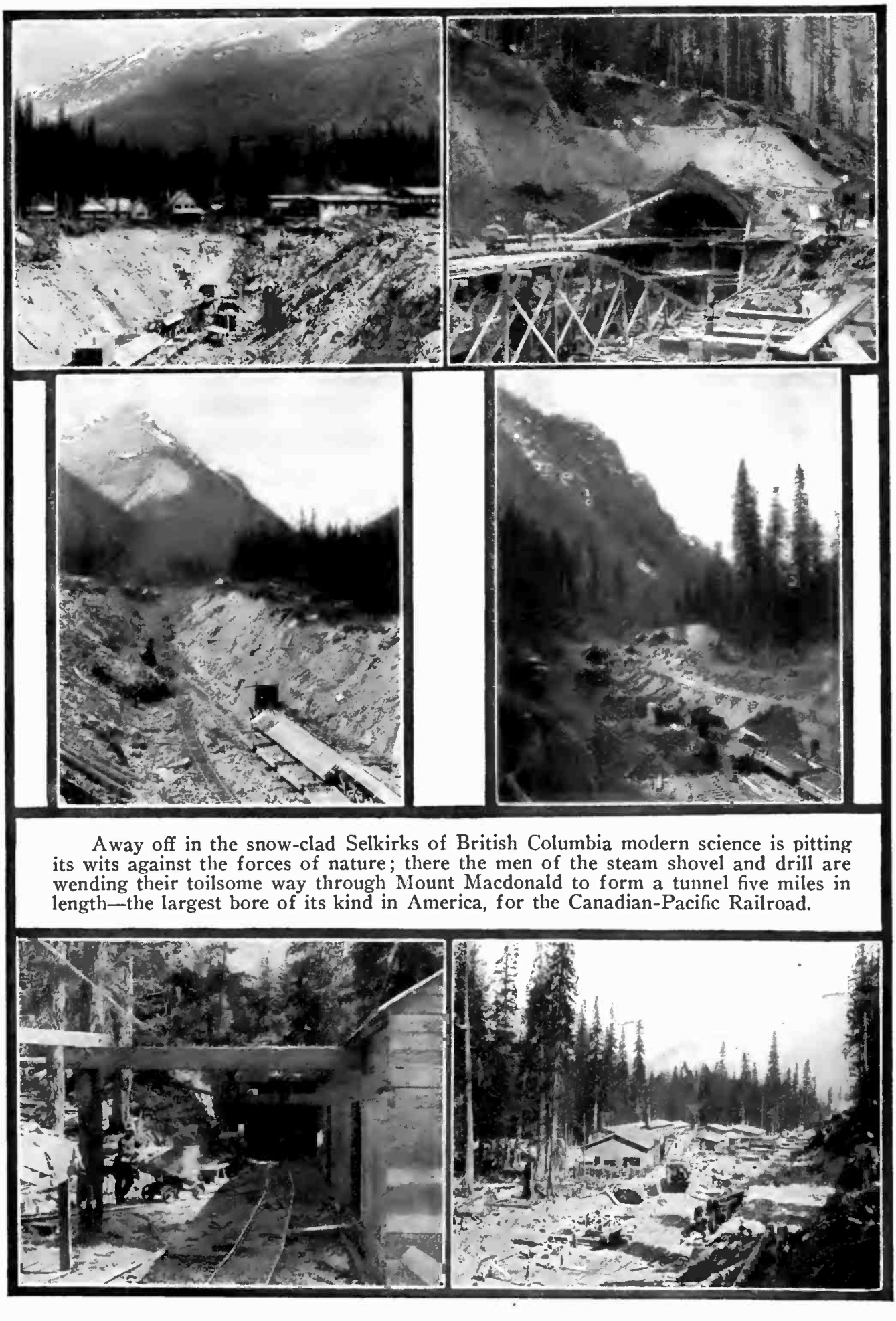
Larger and more substantial buildings have been put up in recent years to meet the increasing demand of the western Canadian wheat industry, with the result that the countless tons of stone and brick used in their construction are putting an enormous pressure on the insecure earth foundation.

Some time ago the earth showed a tendency to sink toward the river, and, in fact, a noticeable movement was observed at several points. Notwithstanding the war burden which Canada is forced to carry, an appropriation of $5,000 has already been made for the purpose of stopping the slide.

Landslides have Carried Away Most of the Main Street of Edmonton, Canada, and are Now Threatening Buildings.

At least 25 per cent. of the larch timber over large areas in eastern Oregon has been killed or weakened by mistletoe, and the forest service is taking steps to combat this troublesome pest.

AMERICA'S LONGEST TUNNEL



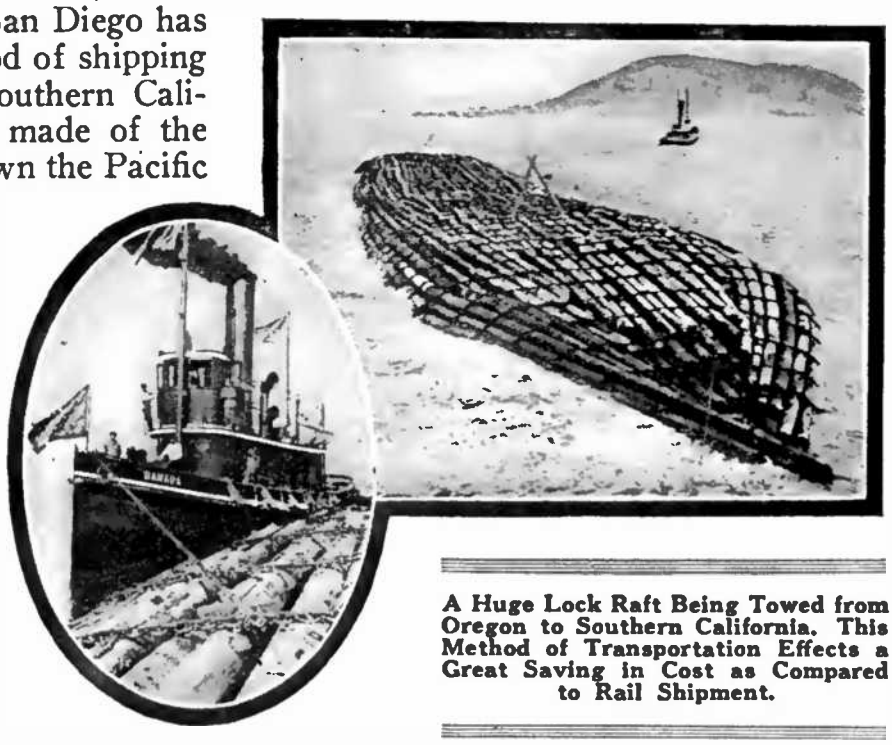
Away off in the snow-clad Selkirks of British Columbia modern science is pitting its wits against the forces of nature; there the men of the steam shovel and drill are wending their toilsome way through Mount Macdonald to form a tunnel five miles in length—the largest bore of its kind in America, for the Canadian-Pacific Railroad.

OCEAN-GOING LOG RAFTS

To compete successfully with the high-priced timber of the Southwest, a resourceful log importer of San Diego has adopted an ingenious method of shipping lumber from Oregon to Southern California. Gigantic rafts are made of the logs, and they are towed down the Pacific Coast behind small steamers.

The rafts are cigar-shaped and average 700 feet in length, 30 feet in depth and 70 feet across. Two-thirds of the raft is under water. The chains on a single raft weigh 115 tons and cost $10,000.

The first sea-going log boom made its thousand-mile trip eight years ago, and since then twenty-nine of the huge rafts have followed that course. An average of five rafts a year are now towed to San Diego. This year, one raft was compelled to turn back on account of the bad weather.

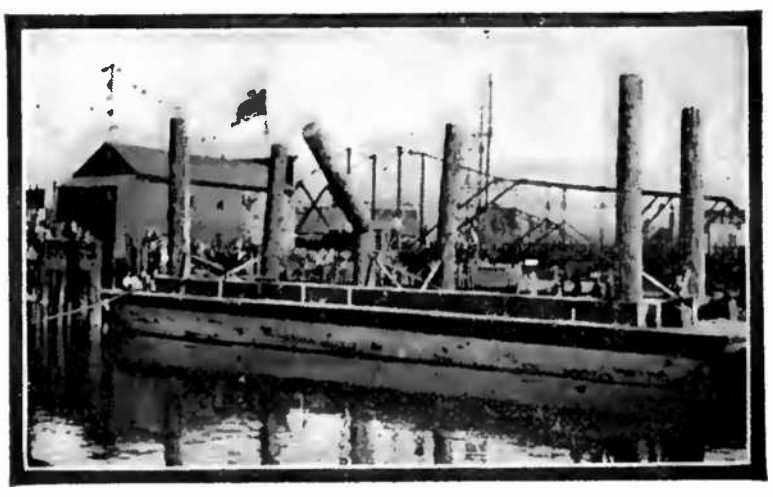


A Huge Lock Raft Being Towed from Oregon to Southern California. This Method of Transportation Effects a Great Saving in Cost as Compared to Rail Shipment.

TREE FELLING CONTESTS

Contests in tree-felling, as they are generally called in the northwest, have many elements of the picturesque, with the lithe figures of the saw-men swinging in perfect rhythm on the seemingly precarious footing of their spring-boards; the stately trunks bending, swaying ever so lightly, and suddenly toppling to a fall in their absolutely predestined position. The skill, the swiftness, the sureness of the attack appeal.

The trunks illustrated were forty-four inches in diameter, and the records of the prize-winning teams were seven minutes, fifty-six seconds, and eight minutes, respectively.



Tree-Felling Contests are Intensely Interesting and Contain in No Little Measure the Element of Excitement.

SOCIETY ELECTRIFIED

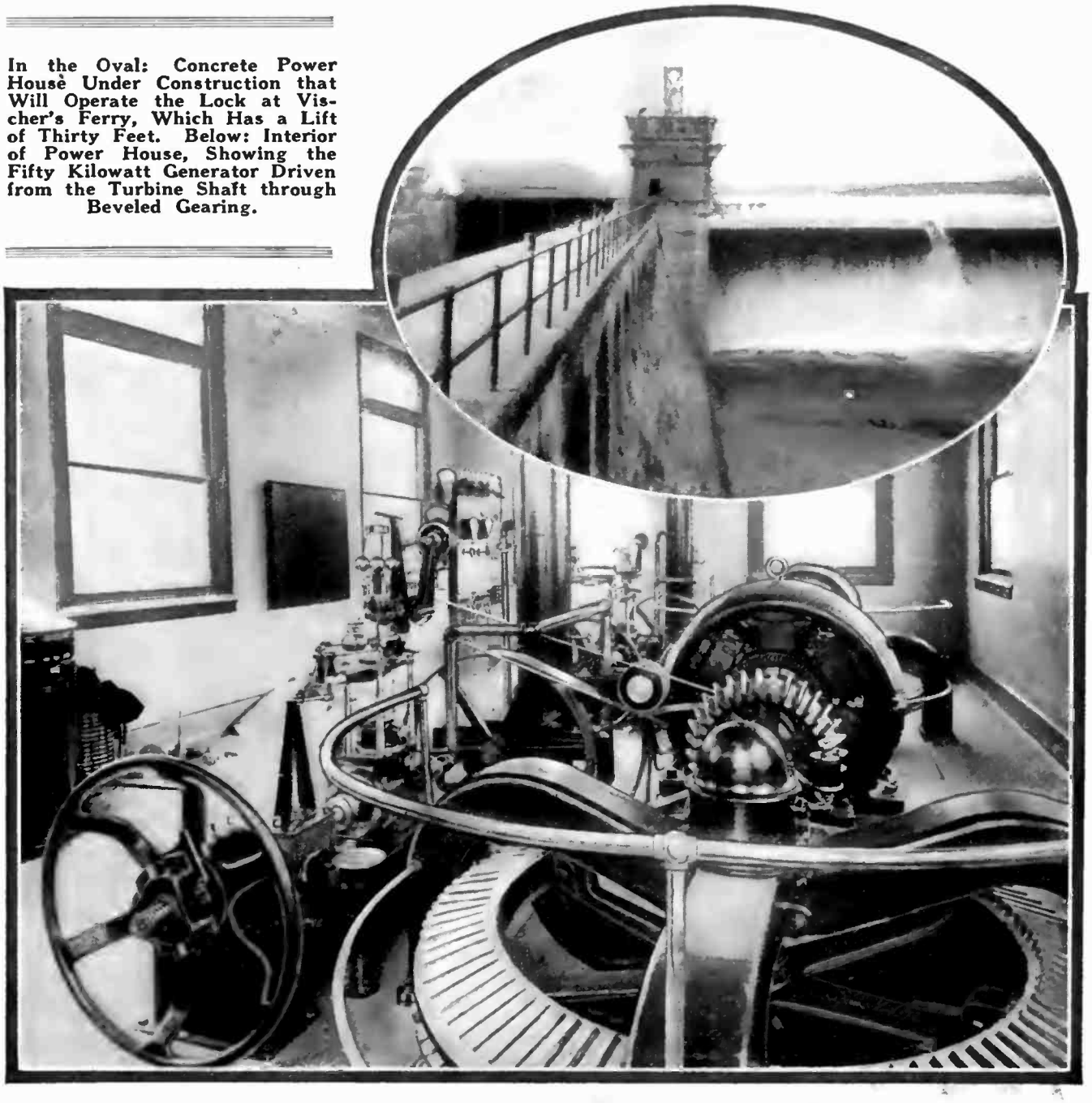
A new and popular social event is the Electric Wedding, held on the first anniversary of the marriage, after which the old order is carried out in its usual sequence, or the first is omitted and the others celebrated in the accustomed order. Such things as lamps, clocks, cigar-lighters and electroliers for the living-room, the library and the bedroom, and percolators, chafing dishes, toasters, stoves, irons, etc., for the kitchen and dining room, cause the bride to rejoice at this innovation. The various finishes obtainable for these conveniences, nickel, brass, bronze or some glazed composition, make it possible to have the gifts in harmony with the other furnishings of the home.

ELECTRIC LOCKS OF THE NEW YORK BARGE CANAL

The entire fifty-seven locks of New York's great barge canal system, now nearing completion, will be operated by electric power. For this purpose the state is building thirty-three hydro-electric power stations, ten gasoline-electric plants and three sub-stations. From the big power plant at Crescent Dam, current will be supplied for operating five near-by locks which have an aggregate lift of 169 feet. In most other cases each lock will have its own individual power plant, the energy being obtained from the fall of water in the canal at that point.

The power houses are uniform in size and architecture. They are about 20 by 30 feet in plan and 20 feet high. The walls and floors are of reinforced concrete and the roofs are of tile. Each power house is equipped with a three-ton electric crane. Four 100-watt tungsten lamps are provided for illumination at night.

The hydro-electric stations are equipped with two units, each consisting of a 50-kilowatt generator driven by a 100 horse-power water turbine. Direct current is furnished at 250 volts. The gasoline plants are driven by two engines designed to operate at a speed of 650 revolutions per minute.



In the Oval: Concrete Power House Under Construction that Will Operate the Lock at Vischer's Ferry, Which Has a Lift of Thirty Feet. Below: Interior of Power House, Showing the Fifty Kilowatt Generator Driven from the Turbine Shaft through Beveled Gearing.

The locks are 45 feet wide, with 12 feet of water on the sills. They have a usable length of 311 feet and will accommodate two barges of 1500 tons capacity. They are of massive concrete construction. The gates are of the mitering type, constructed of steel plates and beams. The locks and approaches will be lighted at night by a dozen or more magnetite arc lamps.

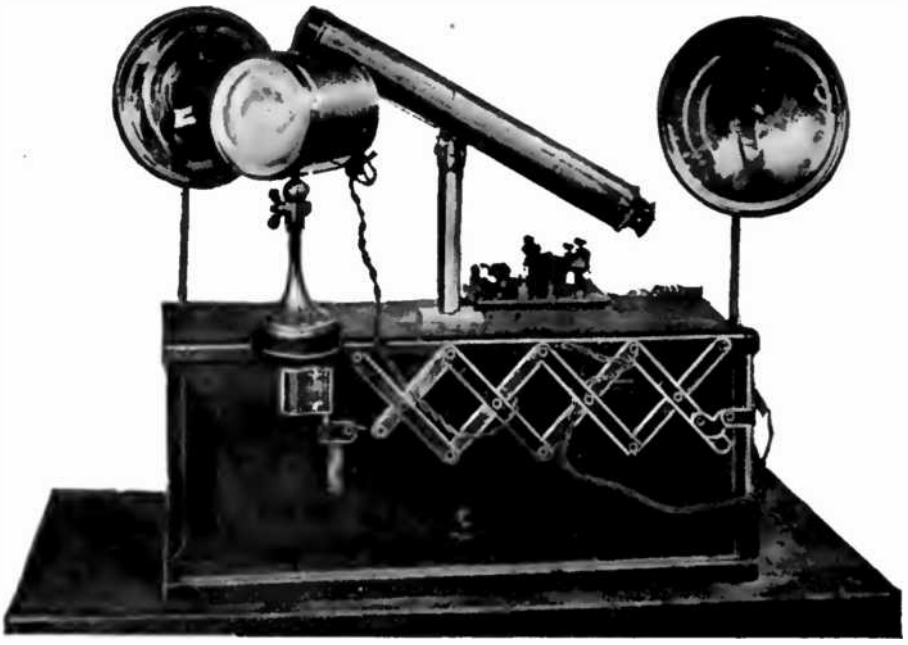
Each lock gate will be opened and closed by a steel spar actuated by a seven horsepower motor set in a recess in the lock wall. The valves which control the culverts for filling and emptying the lock chamber will be raised and lowered by motors of three horsepower. The machinery is all controlled by master switches located on operating stands at each end of the lock. Automatic signals and limit switches serve to prevent confusion or accidents. All the motors are designed to be fireproof and waterproof.

An electric capstan is placed at each end of the lock to assist boats in entering and leaving the chamber. The capstan has a 20 horsepower motor designed to exert a pull of 8000 pounds at a speed of 60 feet per minute. A telephone system will connect the several locks. The entire equipment has been designed especially for the barge canal, and it is expected to prove highly efficient in actual service.

NEW SIGNALING SYSTEM COMBINES WIRELESS AND HELIOGRAPH

A wireless equipment and heliograph signaling apparatus are combined in a new signaling system devised by a New Yorker.

A portable apparatus of this type makes it possible to signal between rapidly traveling railroad trains, trains and signal towers, and between ships at sea. It includes the usual wireless apparatus, with the ordinary antenna erected on the engine cab, ship or tower, as the case may be, for the transmission of signals. Signals by means of light waves are transmitted through the agency of a reflector of concave form, fitted with an electric bulb at its center. The lamp within the focus of the reflector gives a beam of light that can be intermittently flashed for giving a passing station a private message, under the control of a switch. Either one of the antennæ of the apparatus may be rendered operative at will for either wireless or flashlight signaling.



Portable Apparatus that Permits of Signaling by Wireless and Heliograph Between Moving Railroad Trains and Signal Towers.

American manufacturers of electrical devices would do well to consider carefully Siberia as a possible field for their wares. In that country the development of electricity is now taking place, and there is an increasing field for electrical devices.

A FACTORY THAT GOES TO MARKET

by Frank Hepburn Crawford

IN eliminating transportation expenses and loss of time, a firm manufacturing pavement blocks recently conceived and put into commission a plant mounted on railroad cars, enabling the machinery to turn out the product at the spot where it is to be used. The idea is quite unusual—and it might be adopted by other manufacturers.

AN asphalt block manufacturing plant equipped to go after business in the most literal sense of the word is one recently designed by a pavement company and first put into practical operation at New Castle, Pennsylvania, during the present year. Every unit of this plant—from the steam power outfit to the 96,000-pound hydraulic press—is built on freight cars.

The plant as at present operated is mounted on eleven cars, two of them being specially constructed steel flat cars of 150,000 pounds capacity each, with only 3 feet 2 inches from rail to floor, in order to provide proper clearance for their unique load when the factory is in transit.

The power unit consists of five marine type Seabury safety boilers and a 250 h.p. three-cylinder compound marine type engine. To those familiar with New York harbor craft it will be of interest to know that one of these boilers was formerly in the private yacht *Vamoose,* which a few years ago was the speediest craft in American waters.

The plant's stone crushing unit requires one of the specially built 150,000 pounds capacity cars. In addition to the elevating and carrying equipment, it consists of two sets of 36 by 16 inch crushing rolls weighing fourteen tons each, and two 12-foot cylindrical screens weighing six tons each, screening to a 3/16-inch diameter. The crushed stone is automatically carried from the screens to a specially built vertical type stone heater where it is raised to a temperature of about 330° Fahrenheit. It is then conveyed automatically to a double shaft pug mill of 31 cubic feet capacity into which are also fed the filler and cementing materials.

These ingredients when thoroughly mixed at the proper temperatures are elevated by a skip car to the press, which is operated on a hydraulic principle and consists of a multiple mould turret, weighing five and one-half tons, where

The Asphalt Cement Manufacturing Unit of the Plant Alone Requires Four Cars for its Transportation.

the process of filling, pressing and ejecting are carried on simultaneously. This press unit requires the second 150,000 pounds capacity car. Each block is here given three degrees of compression, the possible ultimate compression being three hundred tons to a 60-inch surface, or 10,000 pounds to the square inch. The blocks are then automatically transferred into conveyor belts which carry them through one hundred and fifty feet of cold water, and from the end of the belts they are loaded direct on cars for shipment, an average day and night run being 25,000 finished blocks 5 by 12 inches by 2 to 3 inches thick, depending upon the traffic to which they are to be subjected, and weighing from 11 to 16 pounds each, depending upon the thickness.

The factory on wheels manufactures its own asphaltic cement from imported natural Trinidad asphalt, and its own petroleum product fluxing material. The asphaltic cement manufacturing unit requires four cars, and includes two boilers, two compressors and four tanks, the largest of which is 25′ long, 13′ high and 9′ wide. The asphalt steam refining tank contains about 7,000 feet—considerably more than a mile—of 1¼-inch extra heavy electrically-welded pipe. The finished cement is drawn off by gravity from one of these tanks into a small blow tank and is then forced by compressed air about sixty feet through a 6-inch line into another receptacle from which it is drawn for the purpose of making blocks.

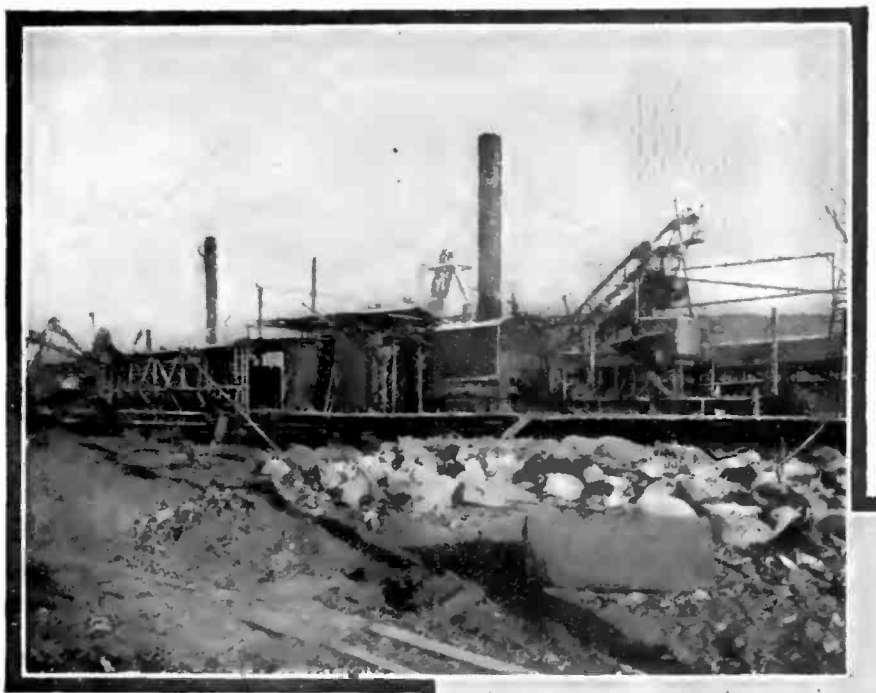
A thirty-six-foot box car is utilized for the machine shop. In this car are lathes, shaper, grinder, drill presses, an oxy-acetylene welding outfit—in fact, all the machine tools required for ordinary construction and repair work. With its dozens of countershafts and pulleys and belts and cones and the surprising diversity of its equipment, it is a marvel of compactness and not the least interest-

By means of Conveyor Belts on this Long Car, the Finished Blocks are Carried Through 150 Feet of Cold Water.

ing feature of this unusual manufacturing establishment.

Another thirty-six-foot box car serves as a store room for the thousands of pipe fittings, bolts, nuts, screws, taps, drills, wrenches and general supplies which are kept in perfect order and as readily accessible as on the shelves and racks of a hardware store.

The device for testing the blocks made at this plant is noteworthy. It consists of a specially constructed rattler, or rotatable drum, mounted on a shaft, the inner periphery of which is paved with one square yard of blocks to be tested. The entire apparatus is enclosed in an insulated box, in the interior of which are separate coils of pipes for reducing or raising the temperature of the box. By means of an ice machine the temperature is first reduced to 8° below freezing, at which point it is kept for one hour. There are then introduced one dozen cast iron cubes aggregating 50 pounds in weight and the drum is next revolved 10,000 revolutions at 37 r.p.m. Before the blocks are set in the drum they are weighed and after the 10,000 revolutions they are taken out and weighed again. The difference in the two weights represents the loss in pounds per square yard by the pounding and abrasive action of the sharp-cornered iron cubes.



A Section of the Portable Manufacturing Plant that is Now Mounted on Eleven Cars.

Limestone Crusher on its Specially Built 150,000 Pound Capacity Steel Car.

Exactly the same process is next carried out with a fresh set of blocks; only in this instance, by means of steam, the temperature of the interior of the box is raised to 90° Fahrenheit. This test represents what experience shows to be the equivalent of ten years of traffic wear on a busy street and determines whether the blocks are up to the standard specifi-

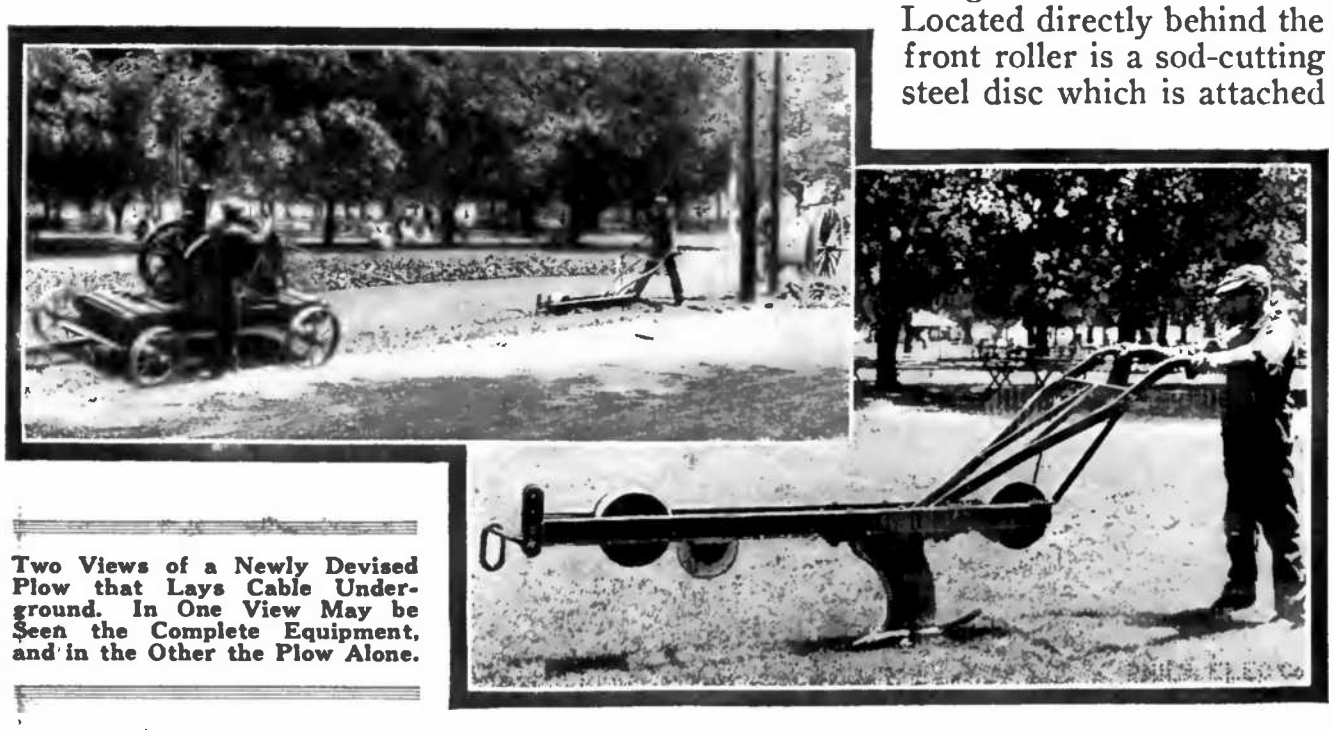
cation which this factory sets for its product.

With a complete plant built on freight cars and capable of being moved from city to city, and a skilled corps of workmen to operate it, the production of paving blocks can readily be accomplished at any point where street improvements are contemplated on a scale sufficiently large to warrant the expense of moving and the subsequent reassembling of the plant.

It is believed that this mobile factory is unique in its conception, and it is of more than ordinary interest in view of the unusual engineering skill required to accommodate the mechanical necessities of a potentially profitable plant to the limitations of freight car dimensions and railroad traffic regulations.

PLOW LAYS CABLE UNDERGROUND

In a great many cities it is necessary to lay electric light and telephone cables underground. To do this by manual labor or by placing the cables in conduits is a very expensive undertaking and constitutes one of the biggest items of cost in the maintenance and construction departments of public service companies.



Two Views of a Newly Devised Plow that Lays Cable Underground. In One View May be Seen the Complete Equipment, and in the Other the Plow Alone.

To overcome a portion of this expense a public service company in Philadelphia has developed within its own shops a special plow that cuts a deep groove in the ground and lays the cable at the same time. The machine does not throw out any earth, and after the cable is under the ground all that is necessary to complete the work is tamping.

The plow is drawn by a cable attached to a drum that is driven by a gasoline engine mounted on a small truck; the cable being supported by the usual large reel. Two wide rollers are mounted between two channel frames, and these rollers support the plow as it travels along the earth's surface. Located directly behind the front roller is a sod-cutting steel disc which is attached to the underside of the channel bars. The cable itself is securely fastened to the point of the plow and as it digs down into the earth it buries the cable with it. As a time and labor saver it is one of the best of recent inventions in the field of telephone and electric cable work.

The International Electrical Congress will be held at the Panama-Pacific International Exposition from September 20 to 25, 1915.

DEFEATING THE SUBMARINE BLOCKADE

How the Much-Discussed English Channel Tunnel Would be of Great Value at Present for Military and Peaceful Purposes

By Ernest Busenbark

"I THINK that the existence of a tunnel (under the English Channel) would be a great inducement to France to invade England." Thus spoke Lord Wolseley before the House of Parliament in 1881.

The thirty-four years intervening between that time and the present have witnessed a rapprochement between England and France which reached its climax when these two countries became allies in the combat with Germany. The unfavorable attitude of the British towards an under-channel tunnel has become less obdurate, if not entirely favorable. The German submarine blockade has emphasized the need for such a tunnel, since military supplies, food, merchandise, and even soldiers could then be transported between France and England without danger or possibility of interference. Furthermore, it would permit of greater mobility to the Allied army. For instance, practically all the men of the British army could be concentrated in France, yet at a moment's notice they could be brought back to England and sent to any point of the island in case of threatened invasion by the Teutons. Under the present conditions England is obliged to keep an army at home as a precaution against eventualities.

Let us consider the question from another point of view—from a peaceful standpoint, since the war is only a temporary condition. It is well known by travelers that the English Channel is one of the roughest stretches of water to travel across in a steamer. Were it not for the thirty odd miles separating England and France, it would be possible to travel between Paris and London in a shorter time and the trip would be a more pleasant one. It would bring England and France into still closer relationship, since such a tunnel, offering through train service between the two countries, would encourage natives of one country to visit the other. In brief, it would make England part of the mainland yet would not jeopardize her military advantage of being surrounded by water.

The English Channel project is not a new one. It dates back more than one hundred years. In almost every decade since 1802, at the time when engineer Mathieu laid before Napoleon a project for a tunnel under the channel, the plan has been resuscitated, revived temporarily then hastily shelved because of the strenuous objections raised.

In 1872 a company capitalized at $400,000 was formed under the direction of economist Chevalier to make necessary researches and plans for the tunnel. One-quarter of the shares were taken over by the Rothschild brothers and one-half by the North Railroad Company. The tunnel company asked no subsidy from the French government, but pledged itself to carry out the preparatory work—at least to the extent of its capital. Negotiations with the authorities opened at once and in 1875 the necessary charter was granted; the tunnel being bored from the French side was to meet another section starting from the English coast.

The preparatory work was carried out and the general observations made were deemed very encouraging. Under M. Ludovic Breton, shafts and galleries were sunk near Calais at Sangatte to 55.20 meters below sea level. In 1883 this gallery was 1839.63 meters in length, about 156 meters of it having been dug by hand. The conclusion from the initial survey was that the tunnel project could easily be carried out, since it would go through what is known as "Rouen Chalk," which is quite soft, yet impervious to water. The chalk forms the bed of the channel down for a good distance.

It was planned to construct two cylin-

drical tunnels of 5.50 meters in diameter each, spaced 15 meters apart; the sections to be connected by cross galleries at convenient intervals. The total mileage of the railroad track—figuring on the basis of one track in each tube—was estimated at from 50 to 60 kilometers. The total cost was placed at approximately $50,000,000.

Sir John Hawkshaw and Engineer Brunlees first brought up the proposition in England in 1869 and it received favorable attention, but the Franco-Prussian war broke out shortly afterwards and the discussion stopped.

The tunnel project again came up in 1872 and a company was formed which succeeded in securing from Parliament about the same privileges as had been granted to the French company. However, their concession was allowed to expire without anything having been accomplished.

The South Eastern Railway then took up the subject in conjunction with the French Company. Work was begun near Dover at Shakespeare's Cliff and was well under way when a distrust for the plan took root and it became the subject of lively discussions in Parliament. The more conservative element feared that it could not be successfully defended against invasion in time of war; that it would result in a large loss of trade to London shopkeepers, and the increased travel between England and France would tend to a greater assimilation of continental characteristics, to the detriment of English individuality. Discussions pro and con became so spirited that Parliament finally appointed a committee to investigate and report upon the plan. The opinions of the Committee were evenly divided: Some of the members were in favor of it and submitted ideas for protecting the tunnel against invasion by means of mines, by flooding, and by the construction of a fortress which would overlook the tunnel entrance. But in the debates that followed it was practically overthrown single handed by the speech of Lord Wolseley, an excerpt of which follows:

"Surely John Bull will not endanger his birth-right, his liberty, his property, in fact all that man can hold most dear, whether he be a patriot or merely a selfish cosmopolitan, whether this subject be regarded from a sentimental or from a material point of view, simply in order that men and women may cross to and fro between England and France without running the risk of sea sickness. Even now, when protected by our 'silver streak' we suffer from periodical panics which are as injurious to trade as they are undignified; this tunnel would render their recurrence much more frequent, thereby increasing the loss they occasion. The night does not follow the day more surely than will a vastly increased annual military expenditure follow upon the construction of a tunnel. Are we to be taxed additionally for these new military assessments in order to save a certain number of travelers and tourists of all nations from sea sickness?"

Work was stopped at once, but there was so much fear that it would still be carried on secretly that a guard, with surveyor's chain, was appointed to see that it did not continue.

In France hope was not given up and plans were made that would allay the fears of the most timid. Starting from either end a 5-span bridge would run into the sea for about one mile, connecting with the tunnel. At this point huge elevators would take the trains down 62.5 meters, to the rail level. At the first alarm, the bridge approach and connecting entrance to the tunnel could be destroyed with a few shots, so that invasion from that source would be impossible. A variation of this plan was to construct a viaduct, circling the cliff of Cape Blanc Nez in France and Shakespeare's Cliff in England, which trains would have to pass in descending the slope to the tunnel. Shore batteries guarding the viaducts at either end would absolutely remove the possibility of its use in time of war.

Since 1880 the tunnel proposition has been brought up several times; once in 1906 and again in April of last year, but the British War Office and Admiralty have succeeded each time in putting a damper on it.

Today France and England stand united more firmly than ever before. No longer does England fear a French invasion. Fear has given away to firm friendship, and the result of this war has already been to unite the two countries, making their interests and sentiments common.

WHAT A KILOWATT HOUR WILL DO

MANY who use electricity for power or illumination puzzle over bills for current consumed, and, not being familiar with the meaning of technical terms, they give it up in despair and pay without protest, although secretly nursing a feeling that they are perhaps being cheated through their ignorance of such terms as watts, kilowatts, amperes and volts.

What is a kilowatt hour of electricity and what will it do? Kilo comes from a Greek word which means one thousand, and kilowatt is one thousand watts of electricity. But what is a watt? The word watt comes from James Watt, the Scotch inventor, and it means the practical working unit of electromotive force of one volt when the flow of the current is one ampere. Expressed in figures it equals 0.00134 horsepower or 0.737 foot-pounds per second. A kilowatt thus represents just one thousand times this power.

A kilowatt hour means the continuance of this force for one hour. A kilowatt hour of electricity will perform many wonders that few realize, while its expression in ordinary terms may help to illustrate it better to the lay mind than technical words.

For instance, a kilowatt hour of electricity will carry you three miles in an electric automobile, or it will carry you up thirty times from the bottom of a shaft 80 feet deep.

It will keep your coffee warm at the breakfast table every day for a week, or run your sewing machine for 21 hours.

It will keep your breakfast warm for five hours or run a small ventilating fan for 21 hours, or a large one for six hours.

It will cook 15 chops in 15 minutes, or boil nine kettles of water, each holding two pints of water.

It will warm all the beds in your house by means of a warming pad for two weeks, or give you heat in your bedroom for an hour while you are dressing or undressing in very cold weather.

It will keep four ordinary irons hot while in use for an hour, or keep you warm in bed for an hour.

It will give you three Turkish bath lights, or run an electric piano for ten hours.

It will lift three and a half tons 75 feet in four minutes or pump 100 gallons of water to a height of 25 feet.

It will run a plate polishing machine for 21 hours or fill and cork 250 dozen pint bottles.

It will supply all the air required by an ordinary church organ for one average service, or run an electric clock for ten years.

It will light 3,000 cigars or iron 30 silk hats.

It will knead eight sacks of flour into dough or run a mechanical sieve for two hours.

It will warm your shaving water every morning for a month or warm curling tongs every day in the year for three minutes and twice on Sunday.

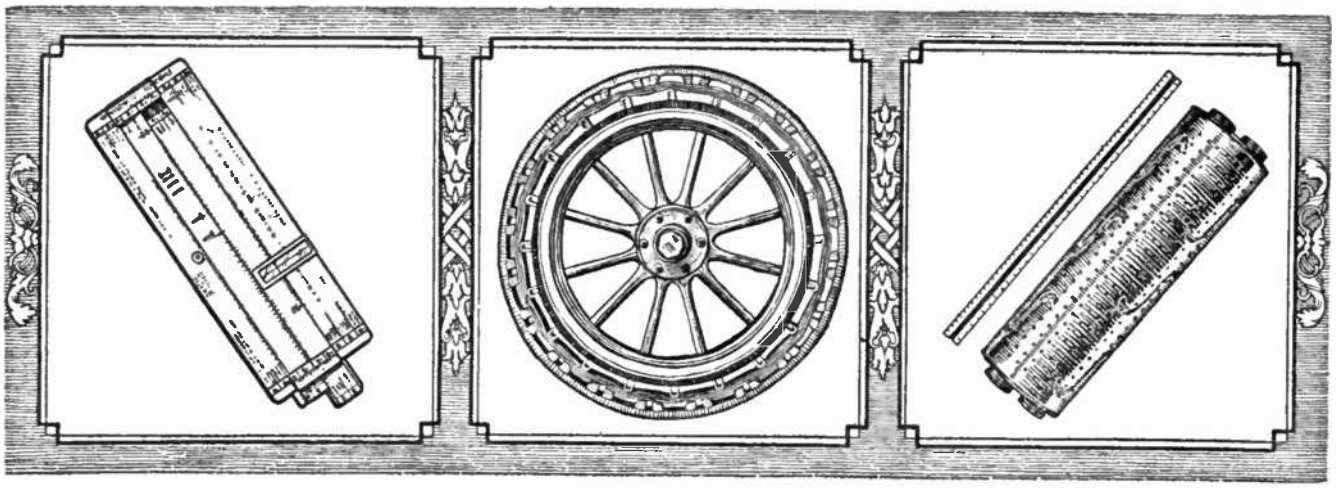
It will operate a machine long enough to clip five horses or another to clean 75 pairs of shoes by machinery.

It will drive machinery long enough to clean 5,000 knives or saw 300 feet of deal timber.

It will keep your feet warm for five hours in ordinary cold winter weather.

After one has read this list of things that can be accomplished with one kilowatt hour of electricity it is his own fault if he does not have a pretty practical idea of what the term means when translated into common language. Figuring at the usual rate of 10 cents per kilowatt hour, it is not a difficult matter to estimate approximately the cost of various tasks.

If you enjoy this magazine, tell your friends; if not, tell us. Why not hand this copy to someone else when you have read it through?



Slide Rule Computes Concrete. Flexible Tire. A Heater for Muffs.

RECENT AND IMPROVED DEVICES

Slide-Rule Computes Concrete

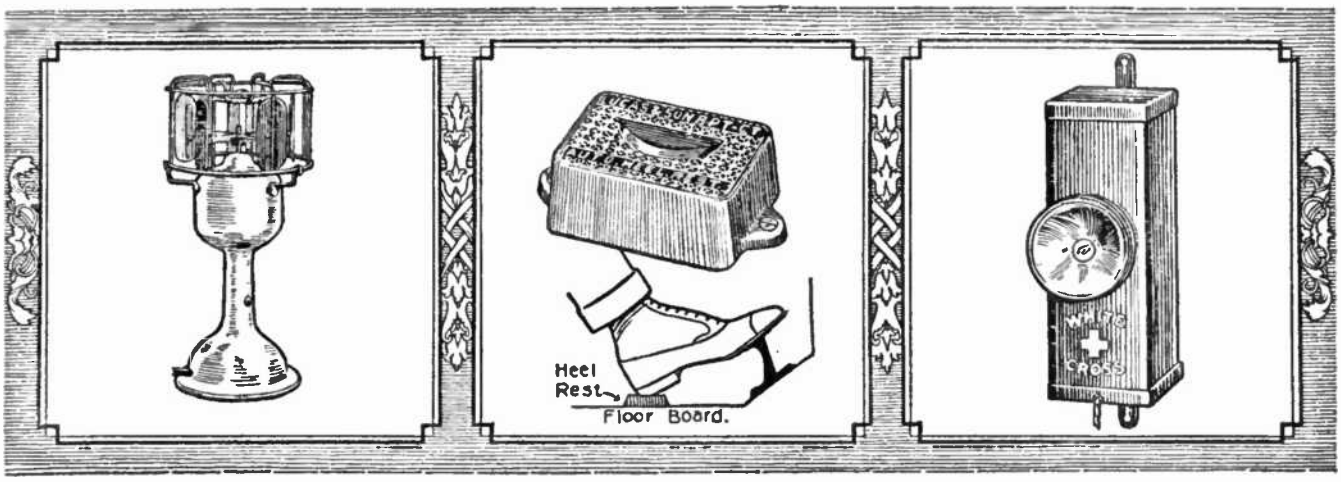
A slide-rule for quickly calculating reinforced concrete beams, girders and slabs has been devised. Its range is very wide, as it will calculate instantly any span from six inches to seventy feet, any load from ten pounds to fifty tons, any shape or size of rod, round or square, as well as any "mix" of concrete or any stress in the steel. Months of labor involving thousands of calculations were necessary in designing this rule, principally on account of the fact that seven to nine factors are involved. It is very compact, weighing about four ounces. The material used is hard fibre; the dimensions are 4 by 10 by 3/16 inches.

Flexible Tire

Since the rapid advance of the price of rubber automobile tires within the last few years, countless inventors have been working on the idea of perfecting some sort of tire which would not involve inflated rubber, or the pneumatic type, and the incurred shortness of life and the unpleasantness of punctures. One of the most ingenious examples of the new "mechanical tires" and one said to possess high resiliency and a surprisingly long life, embodies several pliable non-elastic bands under tension, separated by aluminum blocks. It will be readily seen that resiliency does not result from a pneumatic principle or from rubber compounds, as is usually the case. On account of the square edge, anti-skid properties are secured without the use of chains. By means of an adjusting arrangement the tire can be made harder or softer, to suit individual comfort. The new tire has been approved by the Royal Automobile Club of Great Britain, and it has passed the anti-skid test of Scotland Yard.

A Heater for Muffs

Whether or not the new fad of small muffs with their consequent decrease in warmth has stimulated the demand for muff warmers, the fact remains that a manufacturer has brought out a very small but decidedly efficient heater which, among other uses, is intended to be carried in the muff or pocket for warming the hands in extreme cold weather. It consists of a tinned iron case 4½ in. long partly covered with velvet. A paper covered cartridge is ignited and inserted, and it smoulders slowly for several hours, maintaining a constant temperature. No smoke or smell is produced owing to the peculiar composition of the fuel used. Moreover, the smouldering spark is not extinguished even when it is tightly screwed down in the case. Naturally, this heat giver may be used without risk of fire.



Horizontal Table Fan. Heel Rest for Pedals. Battery Porch Lamp.

The heater is made in various sizes, ranging from a tiny pocket case to an automobile foot warmer, which gives as much heat as a small stove.

Horizontal Table Fan

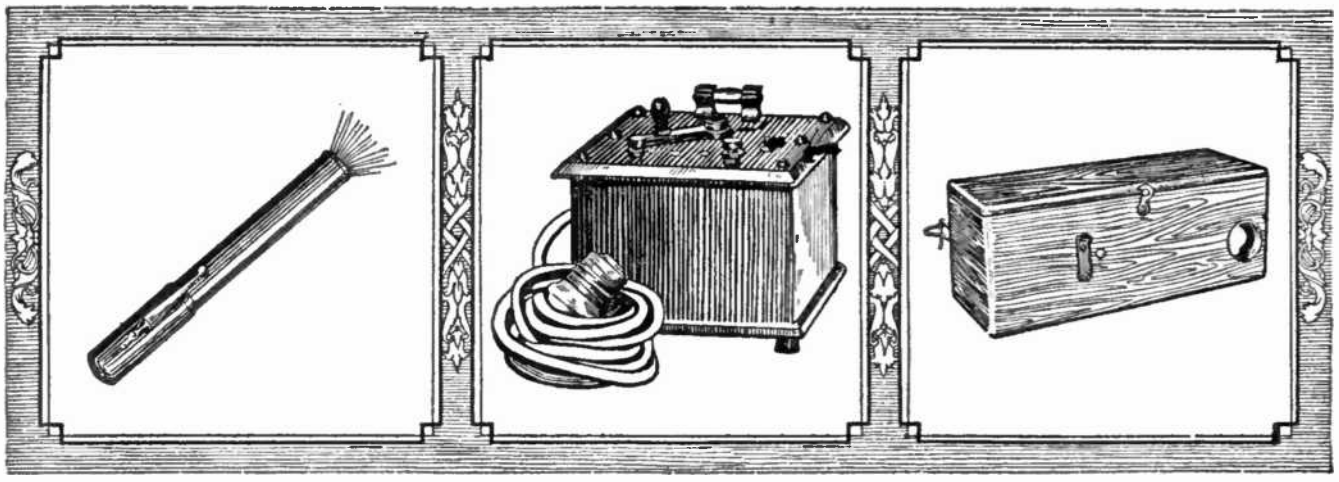
A somewhat radical departure in table fans is one in which the motor is upright and the fan wheel is arranged like the paddle wheel of a steamboat. A much greater artistic effect is secured in this design than in the ordinary propeller-like fan. The wheel is enclosed for protection in a small cage. The horizontal table fan is finished in white enamel and nickel plate to harmonize with the table linen, silver, china and cut glass. It is ornamental enough to be used for a center piece in warm weather. The air is distributed evenly around the table and at a sufficiently high elevation to prevent chilling of warm foods.

Heel Rest for Pedals

All sorts of provisions for the absolute comfort of the motorist seem to be the prevailing order nowadays. One of the latest creations is a small aluminum block to be placed under the heel to prevent its slipping and the foot becoming tired when a clutch or accelerator pedal is used. The heel of the shoe fits into an appropriate hollow in the face of the rest. The auto heel rests, as they are called, are made in various heights for adaption to all sorts of pedals. Small flanges project out from the bottom with screw holes, so that the rest can be fastened easily to the floor of the car. An added feature of the auto heel rest is that the life of the rubber car flooring is considerably lengthened, as sharp heels pressed against the floor by the weight of the pedal will wear holes quicker than anything else.

Battery Porch Lamp

The recent increased efficiency of the miniature tungsten lamp has resulted in the opening of a new field of activity for the prosaic dry battery. One of the most useful combinations of the battery and the new lamp is found in a recently introduced ceiling and porch light. The battery is contained in a weather and fireproof case, on the front of which is a reflector and the lamp. A cord hangs from a hole in the bottom and is connected to a switch on the inside, so that it operates on the same principle practically as the chain socket. Metal strips are soldered to the back and provided with screw holes for hanging the lamp. With a fresh battery the lamp will burn continuously for about forty hours, or if used intermittently, from six to twelve months. Although the lamp is designed for use on porches principally, it may also prove handy in dark corners and closets.



A Fountain Pen Flashlight. Safety Fuse on Toy Transformer. Electric Rain Alarm.

A Fountain Pen Flashlight.

The limits of compactness and ingenuity of design in pocket flashlights have been attained in a flashlight which looks exactly like a large-sized fountain pen. By pressing the clip by means of which the "fountain pen light" is held in the pocket, the light can be flashed. The light can be flashed or burned continuously as desired, and laid down while burning, so that the hands are free to work. A tungsten battery supplies the necessary current. The weight of the fountain pen light is 1½ oz. It is 5¾ in. long and ¾ in. in diameter.

Safety Fuse on Toy Transformers

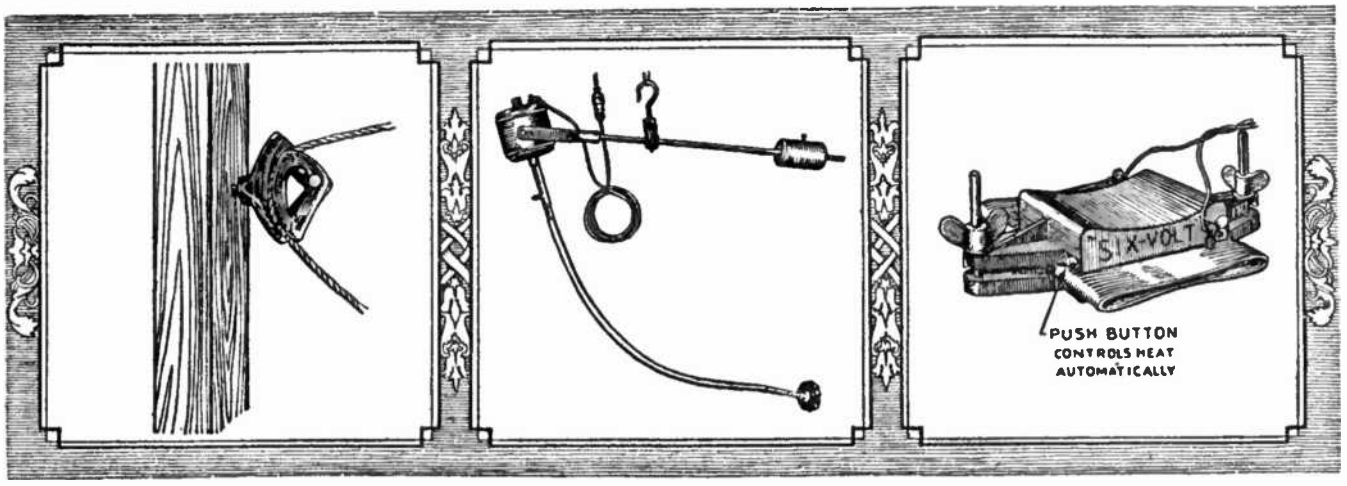
If a miniature train, operated by a toy transformer, should jump the track, a short circuit is usually caused, and if the circuit is not immediately opened, the transformer coils or the house fuses may be blown out. A new feature embodied in toy transformers has been introduced by a Detroit manufacturer. His transformers, which are of the lever-control design, are equipped with a small, low voltage fuse in the secondary or low voltage windings. In case of a short circuit, this fuse will be blown, thus protecting both the transformer coils and the house fuses. Inasmuch as the fuse is of the standard six-volt auto type, it can be readily replaced when burned out.

Electric Rain Alarm

Falling rain is likely at any time to drive into a room and damage the floor, wallpaper and furnishings. A Chicago manufacturer has devised an electric rain alarm which will give warning as soon as rain in any quantity falls into the room. The device consists of a box containing a battery, a buzzer, a small electric light, and a switching arrangement that holds what the makers call a "Raino-disc." The box is put on the window sill at night when the window is left open for ventilating purposes. The falling rain drops on the disc, switches on the current, and throws both light and buzzer into circuit. The buzzer awakens the sleeper, and the light shows which window needs attention. The latest form of this device has the raino-disc on top of the box instead of at the back. This new arrangement arouses the sleeper only when the rain is actually driving into the room thus avoiding false alarms.

Ingenious Clothes Line Clamp

A clothes line clamp which will hold the line securely claims superiority over most existing types, because it is constructed strongly enough to withstand the most severe strains which the clothes line itself is subjected to. The rope runs in a groove between a stationary fixture, which is attached by means of a long screw to the post, and a self-adjusting clamping device. When the rope is



Ingenious Clothesline Clamp. Electric Buffer Has Flexible Adjustment. Vulcanizer for Tires.

pulled tight the clamp presses tightly against it, thereby preventing slipping. Provision is made in the construction for the use of ropes of various sizes. Several coats of enamel make the clamp practically waterproof, so that it will withstand severe weathering.

Electric Buffer Has Flexible Adjustment

The ordinary hand buffer or grinder has several disadvantages to the workman engaged in a delicate task. A small motor on the axle of which a buffing wheel or grinder is placed is cumbersome and unwieldy. A new electric buffer and grinder has been brought out which eliminates these disadvantages. The motor is pivoted on a long rod, at the opposite end of which is an adjustable weight. In the center of the rod a hook is placed by means of which the apparatus is suspended from the ceiling. A long flexible shaft leads from the axle of the motor to the buffer, grinder or drill which is used. The workman is merely required to turn on the current by means of a snap socket, and he can devote his entire attention to his work. The speed of this grinder is 3400 r.p.m.

Vulcanizer for Tires

A vulcanizer which will operate successfully on the current from the storage battery of a touring car should appeal to the motorist who likes to do things himself. The "six-volt" automatic electric vulcanizer, as it is called, will do the work of vulcanizing a tire equally as well as the high voltage or the cumbersome gas heated type. Burned or overcured tubes or cases are impossible with this vulcanizer, as the electric current is controlled automatically by a device which increases or decreases the current flow and maintains the temperature constantly at the correct point. The simplicity of operation is one of the most commendable features of the "six-volt" vulcanizer. When the electrical connection is made to the battery a button is pressed and the current flows through the heating coils until the desired temperature is obtained, when the thermostat automatically opens the circuit. This vulcanizer will repair inner tubes and casings up to five inches in diameter.

A Newark inventor has recently brought out a wireless set that can be carried about in a hand-satchel. It weighs but eight pounds complete, and during recent tests it transmitted messages twenty-one miles and received signals over three hundred miles, although the inventor claims that it can be used to transmit messages over three hundred miles under proper conditions. The mechanism proper is enclosed in a case measuring 5 by 8 by 14 inches.

A USEFUL REVOLVING MIRROR FOR THE ELECTRICAL LABORATORY

By William H. Dettman.

A revolving mirror, such as is described here, will prove an instrument of considerable interest to the experimenter who is working with manometric flames, the alternating current oscillograph and condenser discharges. For determining the existence or extent of arcing in the spark gap, wireless operators will find it extremely useful.

The construction of a revolving mirror is not difficult. A wooden base 8½" long, 7" wide and ¾" thick should first be procured. It is indicated by *B* in Fig. 1. Two uprights or standards, *A*, made of wood or rubber, should have the following dimensions: ¾" thick, 4" high and a width tapering from 3" at the bottom to 2" at the top. Three inches from the lower end of each standard, a ⅜" hole should be drilled to allow the shaft *S* to project through. Two bearings, *C*, Fig. 3, should be made from 3/16" x 9/16" brass strip. These should be fastened to the standards by means of two ¾" round headed wood screws, the ¼" hole in *C* being in alignment with the ⅜" hole in *A*, as shown in the diagrams.

The shaft, *S*, shown in Fig. 3, should be made from a ⅜" steel or brass rod, 8" long, the ends of which are turned down in a lathe to a diameter of ¼". At one end, the length of the turned portion should be 2¾", and at the other end, ½". The rod adjacent to the turned parts should be threaded for ½" to fit a ⅜" hexagonal nut.

The ends *M*, of the mirror frame, should be made from mahogany or white pine according to the dimensions given in Fig. 3. In the exact center of each square a ⅜" hole should be bored. These pieces must be made carefully, otherwise the revolutions will not be uniform. Two square pieces, 4" on a side, indicated by *T* in the drawing, should be cut from the same kind of wood being used in the squares, *M*. They are intended to hold the squares, *M*, together. They should be fastened with 1" flat head wood screws to the edges of *M*. The screw heads should be countersunk. This will result in the ends of the mirror frame being 4" square, while before they measured only 3½"x4". In fact, the frame will take on the appearance of a cube with two open faces 4" square. Eight pieces of brass or aluminum 1/32" thick should be cut and bent to conform with the dimensions of *D*, in Fig. 3 3/16" holes should be drilled as shown in the drawing.

Four pieces of glass mirror, 4" x 4"+*d*" (the value of *d* being the thickness of the glass), should be obtained from an art store. The value of *d* may vary between ⅛" and 3/32", but not beyond those limits. The mirrors should be held to the cubical frame by angle pieces *D*, which are fastened to the ends *M* by ½" round head brass screws. This is shown in Figs. 1 and 2. The mirrors should be fastened to the frame in such a way that the longitudinal edge of each one screens

the remaining edge of the consecutive one. This will be clearly understood if the drawing *Z* of Fig. 3 is consulted.

The metal and wooden parts of the mirror, as well as the base and standards, should be given several coats of black shellac.

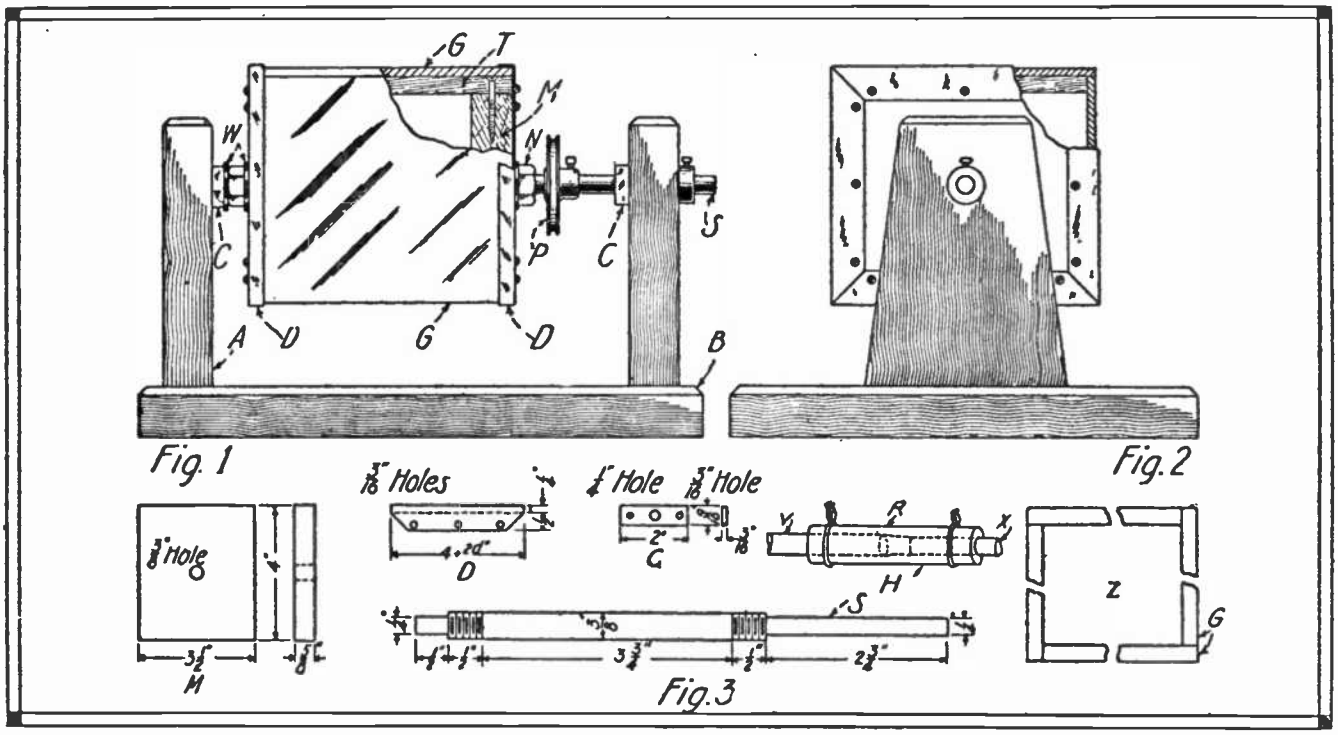
To assemble, the shaft *S* should be passed through the 3/8" holes in the ends, *M*, and a 3/8" iron washer slipped over each end after the hexagonal nuts, *N*, are in place. A pulley, *P*, about 1½" in diameter with a bore of 1¼" should be placed on the end of the shaft and fixed by means of a small set-screw.

Before mounting the mirror on the base it should be balanced by placing the two ends of the shaft on two horizontal knife edges. If the box is ill-balanced, several 3/16" holes should be drilled in the ends, *M*, and filled with lead. An accurate balance, however, is not essential unless the mirror is to be revolved at a high speed.

The mirror should be mounted on the base by means of the two standards, *A*. End play of the shaft can be eliminated by adjusting the washers, *W*.

When the mirror is employed in connection with manometric flame experiments, the shaft should be vertical. An electric motor provides the steadiest power, and its speed can be easily made variable.

In conjunction with an alternating current oscillograph, the motor must be of the synchronous type, so that synchronism is obtained with the mirror. This condition can be arrived at by mounting the motor and the mirror with shafts in alignment and nearly touching. If the shafts are of the same diameter, a short piece of rubber tube should be forced on each end, as shown by *H* in Fig. 3. *V* represents the motor shaft, *X* the mirror shaft, and *R* the tubing. If the shafts are not of the same diameter, the tubing must be large enough to fit the larger one. Rubber tape should be wrapped around the smaller shaft until a diameter equal to the larger one is obtained.

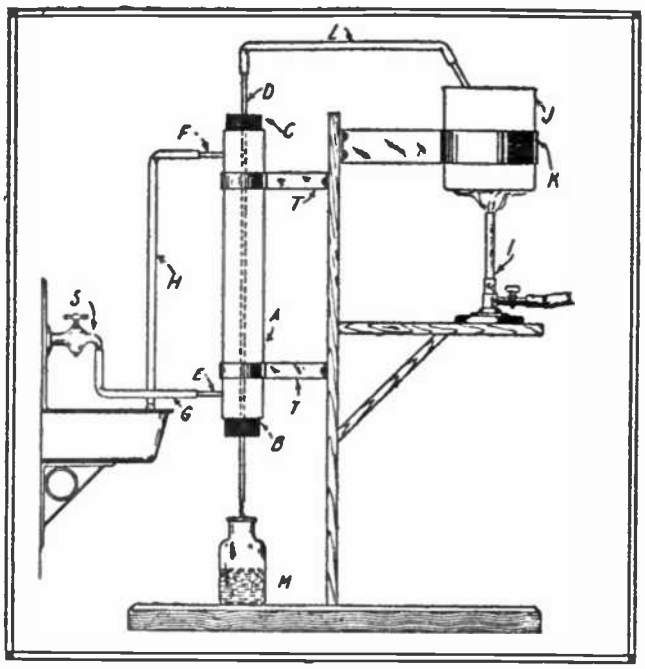


To Soften Paper for Tubes

Paper or cardboard tubes for use in loose couplers, etc., can be made if the cardboard is first softened. Two good ways to soften stiff cardboard are, first, draw the board across a broom handle which is nailed to the end of a work bench, so that a couple of feet project out; second, dip the pasteboard in warm water until the proper consistency is obtained.

Contributed by

CHARLES REYNOLDS.



A Still for the Chemist's Laboratory

Accurate chemistry demands pure materials, and considering the quantities in which water is used, an abundant supply of chemically pure water is indispensable. Distilled water is the purest obtainable, and a still of some sort should form part of the equipment of every well-fitted laboratory. In the accompanying drawing a distilling equipment is shown which can be constructed quite easily and cheaply.

A section of galvanized spouting, 18″ long and 2½″ in diameter, should be procured. Both ends of this tube should be closed with wooden stoppers, *B* and *C*, 2″ thick. Through the centre of both stoppers, holes should be bored to admit the passage, snugly, of ¼″ iron pipe. The iron pipe, *D*, 28″ in length, should be passed through the stoppers so that the ends of tube *A* are equally distant from the ends of the smaller one. A ¼″ hole should be bored ½″ in from either end of *A*, and over them soldered 1½″ sections of ¼″ tube, *E* and *F* for the cold water circulation.

The condenser should be fastened in an upright position by iron bands, *TT*, similar to *K*, to a strong board. Hydrant water should be passed from the faucet, *S*, through the rubber hose, *G*, into *A*. When the tube is filled, water escapes at *F* by way of *H* to the sink.

A large bunsen burner, *I*, should be placed under a gallon tank, *J*, from which a spigot leads. A rubber tube, *L*, should be used to connect this spigot to pipe *D*.

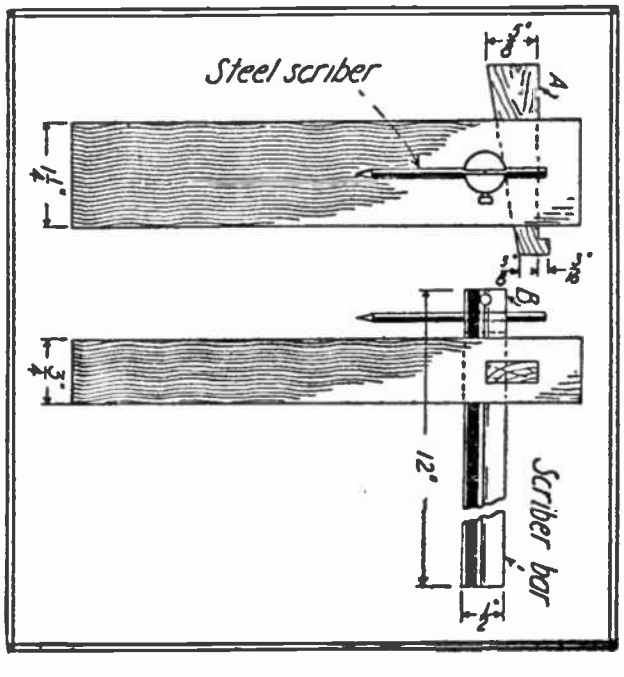
When the undistilled water in the tank is heated, steam arises, which passes through the tube *L* into tube *D*. The running water in the outer jacket cools and condenses the steam into water which drips down into the receptacle *M*. For very accurate results, such, for instance, as are desired in quantitative analyses, the water should be distilled several times.

Contributed by WM. WARTHEN.

Unique Distance-Marking Gauge

For gauging lines on a plane surface, the ordinary marking gauge answers very well, but if the necessity arises to gauge a line parallel to an edge, and between the gauging line and the gauging point a raised portion exists, the ordinary gauge is useless. To overcome this difficulty, the distance gauge shown in the accompanying drawings was devised, and with it, a line may be gauged on the inside of the bottom of a drawer, parallel to any of its sides. As the scriber bar is round, it can be swung in either direction and clamped, so that points can be reached that would be impossible by any other method.

The stock should be made of hard wood, bored to receive the scriber bar. The scriber bar should be ½″ in diameter and twelve inches in length. The



clamping device should be made of hard wood, 5/8" wide, 1/4" thick and 2 5/8" in length. It should be wedge shaped, with a projection on the small end which allows the clamping pin to be inserted when the scriber bar is removed, but when the scriber bar is inserted, the pin is held in place.

The scriber can be made from a discarded round file, and is held in place in the same manner as in the ordinary marking gauge.

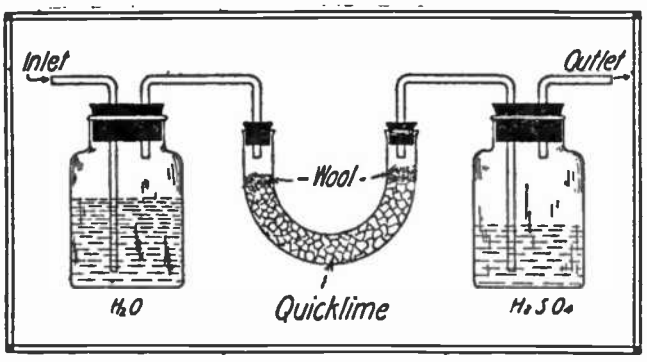
The main advantage of this type of distance gauge, or "Monkey Gauge," as it is called, is that it may be adjusted to any distance by using only one hand, thereby allowing the other hand to be free.

Contributed by

F. B. FALKNER.

A Gas Drier for Chemistry

Experiments in chemistry often require some form of apparatus which will



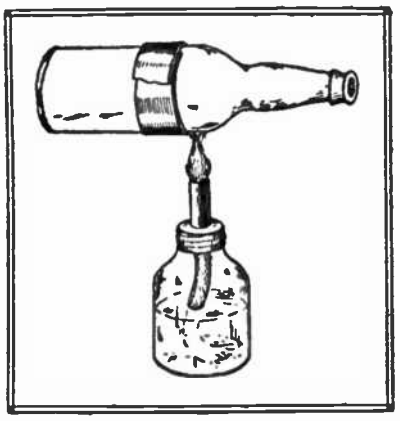
dry gases. Ordinary drying "set ups" are often dangerous, due to the generation of an explosive gas, and to obviate the possibility of an explosion a somewhat more complicated drier than is ordinarily used, should be employed. The outlet tube from the gas generator should be attached to a bent glass tube, marked "inlet" in the drawing, which leads into a bottle of water. From the wash bottle, another tube should lead to a U-tube into which is packed quicklime with a small tuft of wool placed at either end. From the U-tube the gas passes into a bottle filled with sulphuric acid. This arrangement results in clean, dry gas with no possibilities of an explosion.

Contributed by

W. S. ZEHRUNG.

Cutting Tops from Bottles

The top of a bottle or fruit jar can be cut off very easily by wrapping a strip of moistened asbestos just below the section to be removed, holding it over the flame of an alcohol lamp and rotating it constantly. When the glass has become quite hot, the bottle should be plunged into the water, neck down, and the glass will split off evenly near the line of the wet asbestos.



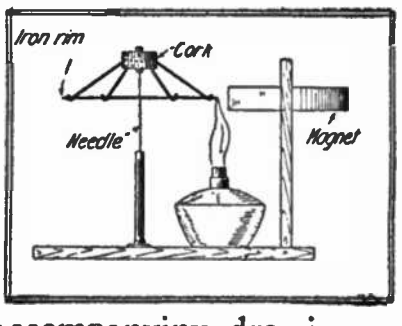
Contributed by

C. H. PATTERSON.

An Interesting Experiment in Magnetism.

The action of this motor depends altogether upon the heat rendering the iron of the rotor non-magnetic, and the attractive force of the magnet for the coolest part of the rotor. Inasmuch as the torque is small, the friction must be very slight, and for that reason the rotor should be of small size—not over about three inches in diameter—as light as possible, trued and well balanced.

The rotor may be made by using a cork for the hub, in the center of which is a bearing, made by drilling a small hole into the end of a piece of hard non-magnetic metal, such as brass. The hole in the bearing fits over the end of a needle, which may be supported as shown in the accompanyiny drawing.



The spokes must be made from some non-magnetic metal, and they should be of as small a size as will rigidly support

the rim, so as to conserve as much heat as possible on the rim. Copper, brass or aluminum may be used. They should be held in place by sharpening one end of each and pushing it well into the cork. The other ends should be bent into a small hook to hold the rim securely in place.

The rim of the rotor is made from soft iron wire, not larger than No. 24, and for good results should be as nearly perfectly round as possible. The ends may be secured by filing the inside of one of the hooks flat and then squaring the ends of the rim, and "butt ending" them in this hook, or they may be welded electrically.

The magnet is so placed that one of its poles acts upon that point of the rim directly over the flame shown in the figure. Any non-sooting flame may be used. An alcohol lamp is excellent and should be so placed that the rim is in its hottest part near the point of the flame.

Upon the action of the rim heated by the flame reaching a bright red heat, it is rendered non-magnetic, and another part of the rim is drawn into the flame, to be heated.

A little experimenting may be necessary in order to determine the exact position of the magnet at which the best results are obtained.

The fact that the iron becomes non-magnetic under the action of heat is possibly caused by the heat accelerating the molecular motion within the iron and thus not only destroying the induced magnetic force, but rendering that part of the rim non-magnetic.

Contributed by

CHAS. E. MULLIN.

A SIMPLE WATER MOTOR

By Ray F. Kuns

There are many uses to which a good water wheel may be put, among them the operating of dynamos, washing machines, emery grinders, jig saws, small lathes and other light machinery. It is a cheap and reliable form of power. The ingenious worker will find much pleasure in the construction of this motor as well as in its use.

CASE: The box or case is made up from any wood which may be at hand, the kind does not matter particularly. Needless to say the joints should be closefitting. The used water is allowed to escape by falling into the sink through the bottom, which is left entirely open for this purpose. In case it is desired to use the motor where there is no sink or waste pipe, the sides of the case should be left as long as the legs and the bottom closed tightly; a drain pipe being attached to take away the water.

Either screws or nails are used in assembling the case. Leaky joints, if encountered, may be remedied by tacking strips of tin over them. Paint inside as well as out.

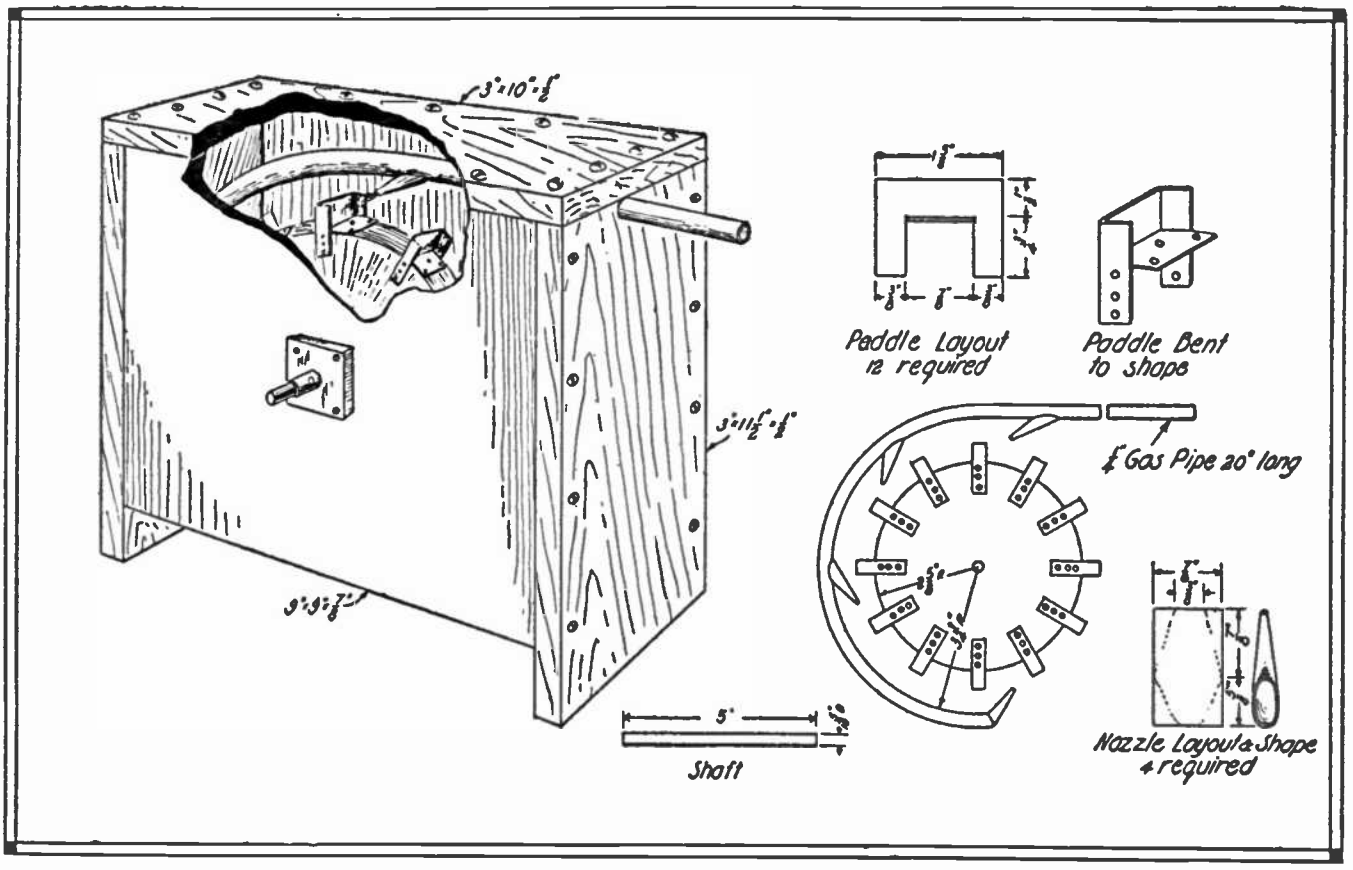
WHEEL: This is made from a piece of 7/8" lumber. If a lathe is available turn up the wheel on it, otherwise lay off with dividers and work to line.

To prevent the wood wheel from warping, the sides are covered with discs of tin which are soldered to a strip of the same metal covering the edge. This excludes all moisture from the wood as well as materially strengthening the wheel.

Drill the hole through the center of the wheel with the 5/16" bit, being careful to have the work exact.

SHAFT: Cold rolled steel is best for this part, but in case it is not available, brass or iron rod may be used. Place the shaft in the wheel and solder securely in place. The shaft should be long enough for a pulley on each side of the case.

PADDLES: These are best made from heavy tin, as it is easily soldered. Note



layout on drawing. Cut and bend these to shape after which they may be tacked in position on the wheel with small brads. When all are in position, solder the edges.

BEARINGS: Tack a piece of tin 2" square over the center of each side of the case. Drill a 7/16" hole in the center of each of these pieces and on through the side of the case. Enlarge the inside ends of these holes until they are at least ½" in diameter and come back almost to the tin. This is to prevent the bearings binding in case the sides of the case warp.

A piece of 7/16" brass tubing of No. 16 gauge and 1¼" long is now placed in each side of the case. The inside diameter of this tubing will be found very near 5/16". If it is a little tight for the shaft, first drive it on with a hammer and then lay on the anvil and pound it as it is turned. This will soon stretch the brass tubing sufficiently.

Assemble case temporarily, seeing that the wheel is in the center of it when the bearings are soldered to the tin. Drill oil holes when the case is taken apart for further work.

NOZZLES: To increase the power of the motor four nozzles are used instead of one. First bend up a piece of gas pipe as suggested in the drawing, after which the holes for the nozzles are laid off and drilled with the ¼" bit. If no drill is at hand, these holes may be filed to size.

Next lay out the tin for the nozzles and cut on the dotted line. Bend these to shape, soldering them at the joint. When the nozzles are finished they may be soldered over the holes in the gas pipe. The opening in the end of the nozzle should be just ⅛". File the pipe clean and tin it before attempting to solder on the nozzles.

Place the pipe in the case around the wheel, making sure that the paddles just clear each nozzle. Wire it in position at the top and back to hold it securely.

FAUCET CONNECTION: Wire a short piece of ½" hose on the open end of the gas pipe. Secure the other end of the hose to the faucet by means of a screw connection, the two parts of which may be secured at the hardware store. If the faucet already has a threaded end, the inside part of the connection will be unnecessary, but if the faucet has a plain opening this part may be soldered to it.

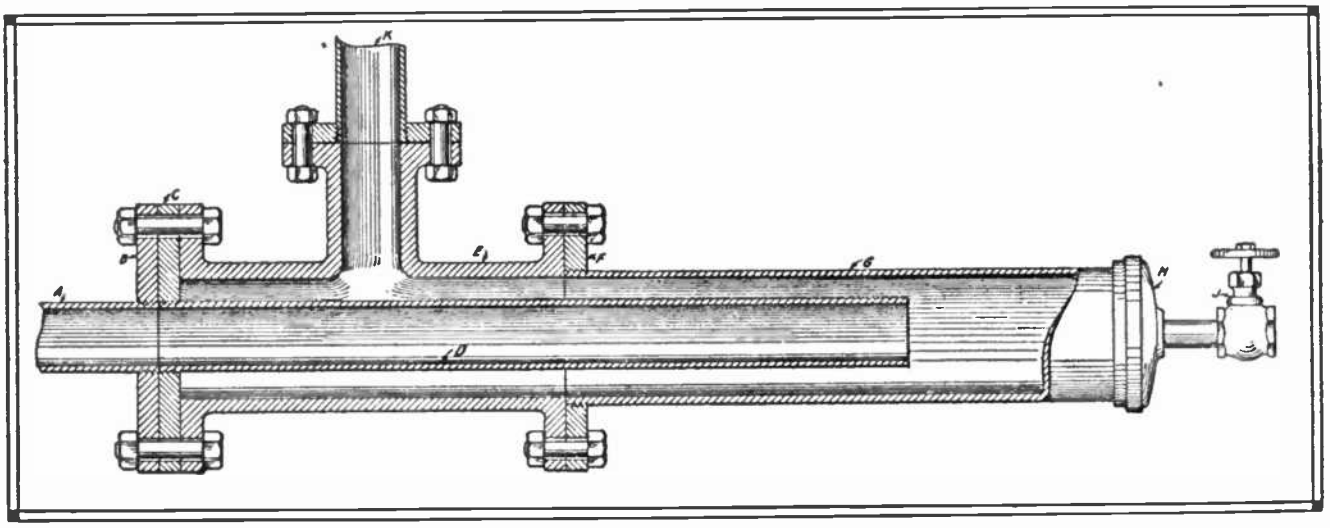
When the wheel is working well the

pulley may be fastened in place and turned true while the motor is running. This is a very simple operation. A rest is provided for the chisel, just as in lathe work, and in a little while the pulley can be finished up neat and true, either with a flat, crowned or grooved face. The pulley should be made from wood or babbitt metal and of a size to suit the individual requirements of the builder.

BELTS: Round belts may often be secured from old sewing machines or made by drawing a square strip of leather through a leather punch or drill hole. Flat belts can be made from bicycle tape by winding several layers of it around the pulleys, thus having the belt endless.

Steam Separator from Pipe Fittings

The object of a steam separator is to remove the condensed steam or water from the pipe line and to permit the live steam to pass on unimpeded. In the drawing is shown the details of a very practical steam separator which can be made at little cost from standard pipe fittings.



Pipe *A* is the main line pipe leading to the device and threaded into the flange *B* which is in turn bolted to the end of a tee *E* but separated from the tee by a second flange of similar size *C* carrying an extension of the main line pipe *A*. The extension is lettered *D*. The tee *E* must be large enough to accommodate the area of the pipe *D* figured from the outside plus the area of the main line or a little larger. The side outlet is to be of the same size as the main steam line. The pipe and flange *F* and *G* are to be of the same size as the tee. The cap *H* is to be fitted with a drip valve *J*.

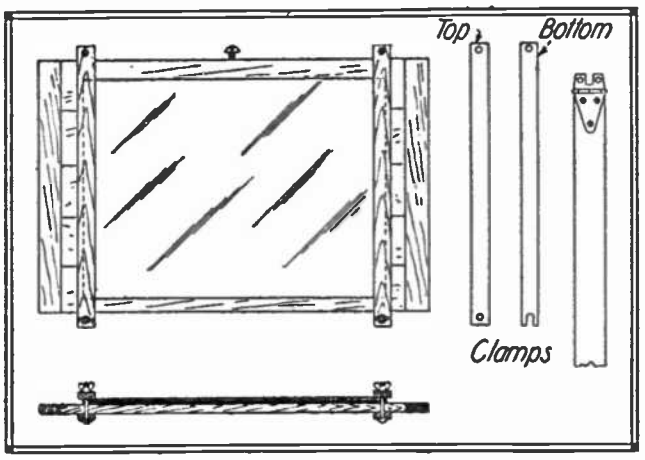
The steam enters through pipe *D* and after leaving this pipe it turns upward to outlet *K* leaving all water to drop to the bottom of separator to be drained through the valve.

The use of a separator of this kind in connection with a steam radiator will prevent the annoying rattle and bang of the "water hammer" by preventing water from entering the radiator.

Contributed by
HARRY A. SCHREIBER.

Printing Attachment for Drawing Boards

For the amateur draughtsman to whom hand printing is still a difficult art, a printing attachment for his drawing board will be of considerable help. Clamps should be made of yellow pine strips 1" x 2" of a length sufficient to outreach the length of the drawing board by about 1". They should be held together by ¼" bolts of suitable length, fitted with wing nuts for quick adjustment. A blanket of light felt should be placed upon the board to compensate for any ir-



regularities that may be present, and to prevent the breakage of the sheet of glass that is used.

Contributed by

V. A. BLOXHOLM.

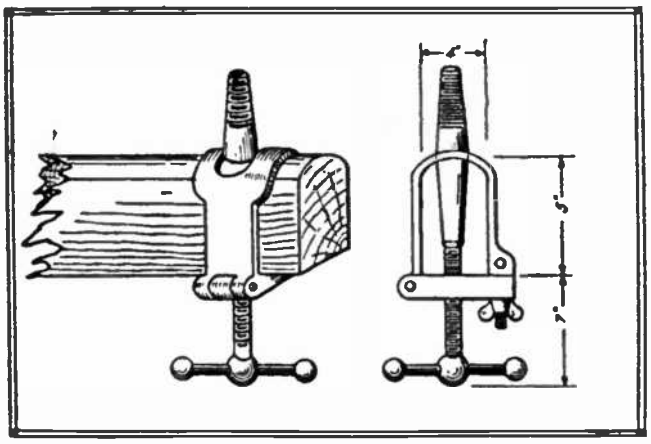
To Remove Insulator Pins

The experienced lineman knows the difficulty of removing insulator pins that have become useless either by being burned off or by the thread having become worn down to a point where it will no longer hold the insulator. The conventional method of hammering the old pin out frequently results in damage to the other insulators on the cross arm.

In the illustration is shown a simple but very effective little tool to assist in the removal of such pins. The construction is shown clearly in the drawing and the reader will note that the device consists merely of a U-shaped band with a pivoted yoke carrying a long screw with a substantial handle on its end. The U piece is slipped over the pin and cross arm as shown, the yoke secured and the handle turned so that the screw forces the pin up and out of the cross arm.

Contributed by

F. W. M.



Non-spilling Flux Bottle

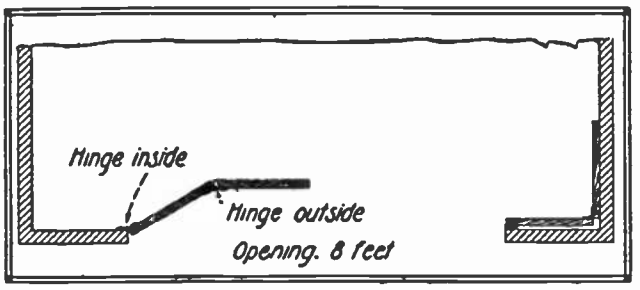
If a wad of cotton batting, large enough to absorb the liquid, is placed in a soldering flux bottle, the constant danger of the bottle tipping and spilling out its contents is easily prevented. The flux should be applied to the joint with a small brush. Plenty of liquid is taken up by the brush from the soaked batting.

Contributed by

J. G. LUNDHOLM.

Collapsible Garage Door

Small garages do not afford enough space, ordinarily, for sliding doors or even swinging doors of the usual type. By the use of a folding or collapsible door, which swings and folds up out of the way in the corner, the difficulty can



be gotten around nicely. The first sections should be hinged to the door jamb, and the second hinged to the outer edges of these.

Contributed by

MERT. MARSILLIOT.

Black Ink

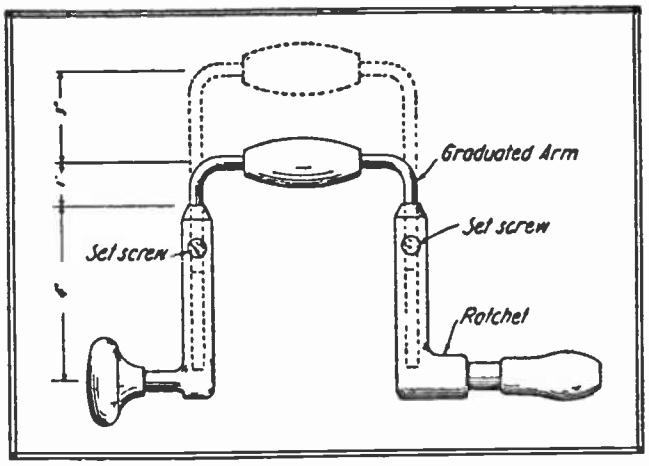
Two and four-tenths grams of logwood extract should be mixed with one hundred cubic centimeters of distilled water. Heat should be applied until the substance is dissolved. After it is cooled, potassium chromate should be added until the desired shade is obtained. Too small an amount results in a purplish blue, while too much causes a dead black. From 2 to 3 c. c. are usually sufficient. A little gum arabic or gelatine may be dissolved in the solution to give it "body." If this is done the solution should be filtered through silk.

Contributed by

W. S. ZEHRUNG.

Adjustable Handle for Brace

The illustration shows a bit brace made with an adjustable handle so arranged that the length of handle, or in other words the leverage, can be changed to suit the conditions of the work at



hand. This tool will be found exceedingly useful to the building trade.

While the illustration shows the brace as made with a special casting or forging, the ordinary brace could easily be altered through the exercise of a little ingenuity to combine the advantages of that shown in the drawing. The section of the handle frame inserted into the sockets should, of course, be square in order that the brace may be firm when in use.

Contributed by

WM. J. ALBIN.

How To Cement Glass

Two good formulæ for cements to mend glass are given below:

Pulverized glass	10 parts
Powdered fluorspar	20 parts
Soluble silicate of soda	60 parts

Both glass and fluorspar must be in the finest powder. The mixture should be made by quick stirring and must be used at once.

For mending valuable articles in glass: A strong solution of gelatine to which is added for every five parts of gelatine one part of acid chromate of lime in solution. This mixture becomes insoluble in water under the action of light. The surfaces to be cemented should be covered as evenly as possible with this liquid, pressed firmly together, tied with string or cord and the glass exposed to sunlight for several hours. Boiling water has no effect on this cement and the fracture can scarcely be recognized.

Contributed by

HARRY C. BOYER.

Frosted Glass

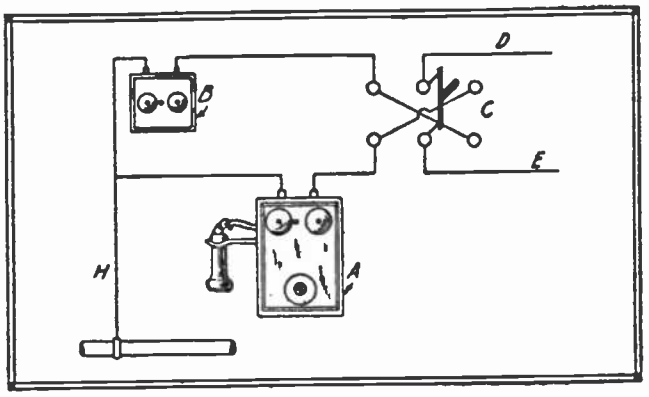
Glass can be treated chemically so that it will have the same appearance and do the same work as ground glass. Ninety grains of gum sardarac and twenty grains of gum mastic should be dissolved in two ounces of ether. One ounce of benzole should be added afterwards. It is essential that the benzole be quite fresh. The solution should be poured quickly and evenly over the surface to be frosted.

Contributed by

GEO. W. GREENE.

A Private Telephone Line

By the use of a double-pole double-throw knife switch, the complicated circuits of the usual private telephone line are eliminated. As indicated in the diagram of connections, *A* is the telephone, *B* is a call bell, *C* is a D. P. D. T. switch, *D* is the party line of the local telephone company, *E* is the private line and *H* is



the ground wire. When the switch is thrown to the right, the telephone is connected in the party line circuit, and the extra bell of the party line will ring. Reversing the switch throws the telephone on the private line, and the party line bell is also connected to ring.

Contributed by

C. L. CHRISSINGER.

SEWAGE DISPOSAL FOR COUNTRY HOMES

By H. W. Young.

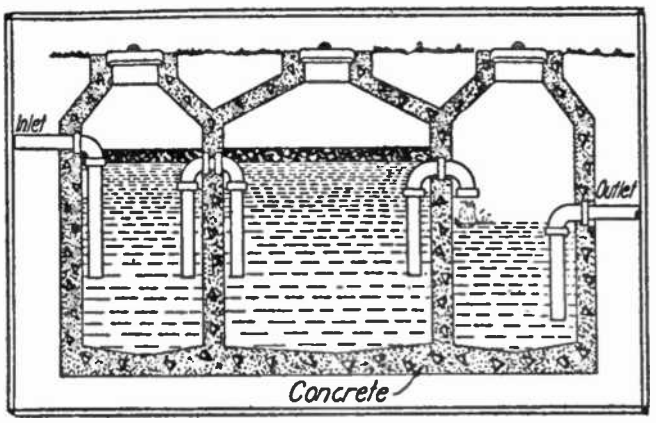
Scientists have proved by experiments that sewage will become purified and rendered entirely harmless if allowed to remain in a tank where a certain sort of "friendly bacteria" eat up or destroy all poisonous matter. Indeed, this method is employed on an extensive scale in the sewage disposal plants of large cities.

As an adjunct to the water supply systems which many farmers and owners of summer homes are now installing, it is desirable that some form of sewage disposal be installed also.

A cheap yet effective "septic tank" or receptacle is shown in the diagram. The receptacle may be located at any convenient point, but not beside an open well. The inlet pipe should be three to four inches in diameter, laid below the freezing line. The walls of the tank should be of concrete four to five inches in thickness, and one, two or three compartments may be provided. The depth below the inlet pipe should be five to ten feet, and the first compartment large enough to contain 24 hours' accumulation of sewage.

One compartment is sufficient for ordinary family use, but two are better as the bacteria have more chance to consume the solid matter and purify the liquids before they leave the tanks.

Three compartments should be constructed for hotels, country clubs, etc., and where only one or two are used the outlets should be put in as shown. The outlet may be conducted to a low point or may be carried only a short distance



to a filter bed. A pit measuring four feet square and six to seven feet deep filled with gravel, crushed stone or cinders will make a good filter. The filter bed is only necessary where the ground is very heavy black soil or clay, too solid to allow the liquids to escape. Any plumber will understand how to put in the necessary traps in order to prevent poisonous gases from entering the house from the sewer pipes.

To Insulate Small Punchings

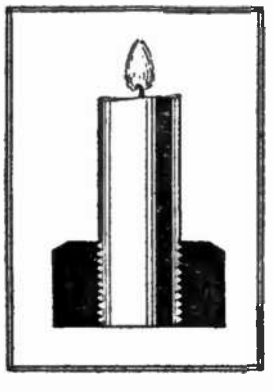
Small punchings for motor armatures or other electrical apparatus can be insulated quickly and easily by dropping them into a bottle containing shellac. They should be stirred thoroughly so that they are entirely covered, and removed and strung on a thread in the open air. When they are partly dried, the line should be shaken in order to remove the surplus liquid. For best results, the shellac should have the consistency of thin oil.

Contributed by

CLARENCE H. ANDERSON.

Ingenious Candlestick

An ingenious substitute for the untidy method of sticking a burning candle to a shelf or ledge by melted wax, is to screw the candle into a heavy burr. Such an improvised candlestick prevents upsetting, and the candle can burn down and out without danger of fire.



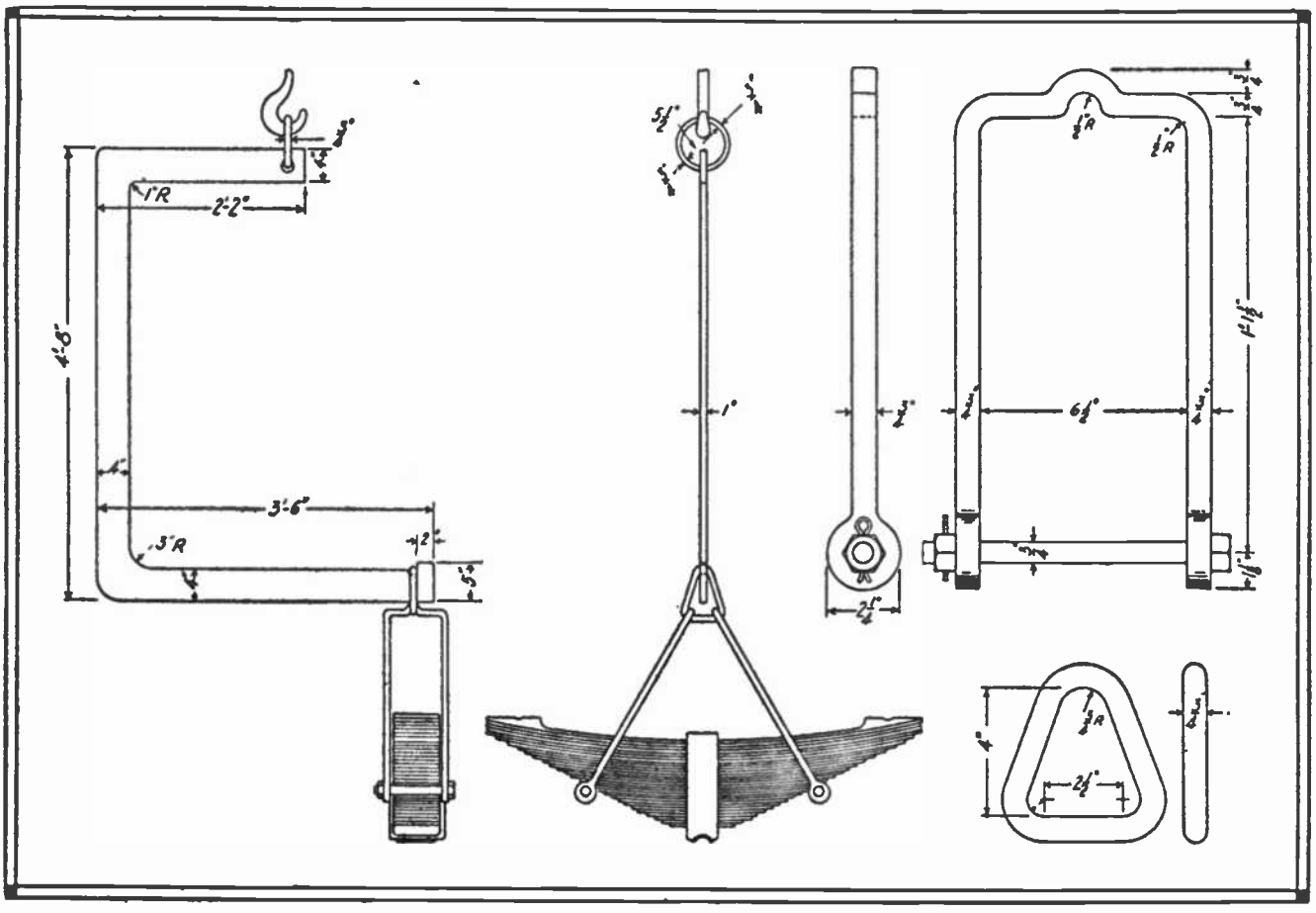
Contributed by

J. E. LUNDSTROM.

Lifting Machine for Locomotive Springs

Although a machine for lifting the springs of a locomotive in place will probably not fall within the scope of interest of most of our readers, the idea in itself is novel and original, and may suggest applications to commoner use.

A crane or air hoist is attached to two hangers which are placed under the spring. They terminate at the upper end in a triangle of iron rod or steel, at the apex of which is attached a long bar with a hook at the other end. This hook



fits in a ring which is hung upon the crane hook. The various parts are shown in detail in the accompanying drawing.

Contributed by

JOSEPH K. LONG.

For Fountain Pen Users

If the threaded piece of a fountain pen is lightly greased with vaseline, the parts will unscrew more easily, and the ink cannot leak out.

Contributed by

GEORGE W. GREENE.

Removing Stains of All Sorts

Almost any stain can be removed in some way. A few remedies for common stains are given below.

Acid stains may be removed in almost all cases by ammonium hydroxide, commonly known as household ammonia. An aqueous solution of baking soda may also be used.

As for analine dyes, an aqueous solution of sodium sulphite will immediately remove the stains of most analine dyes from the hands.

Ink stains and iron rust may be removed by a concentrated solution of pyro phosphate of soda or oxalic acid. The latter should only be used on white cloth.

Mildew can be taken off with a weak solution of chloride of lime or calcium oxychloride and exposure to sunlight.

Silver nitrate and chemical ink stains can be removed by using a solution of bichloride of mercury. *This substance is very poisonous and should be handled carefully.* In the case of fresh stains a weak solution of potassium cyanide produces good results. Like the other, however, it is a dangerous poison and should be used with caution.

Paint stains may be taken out with carbon disulphide, chloroform, or spirits of turpentine. Care should be taken that none of these substances is brought near an open flame.

Tar stains can be removed by first applying olive oil freely. When the tar is soft, turpentine, naphtha and benzine should be applied successively. Strong alcohol will usually remove these stains as well as those of beeswax, resin, and the like.

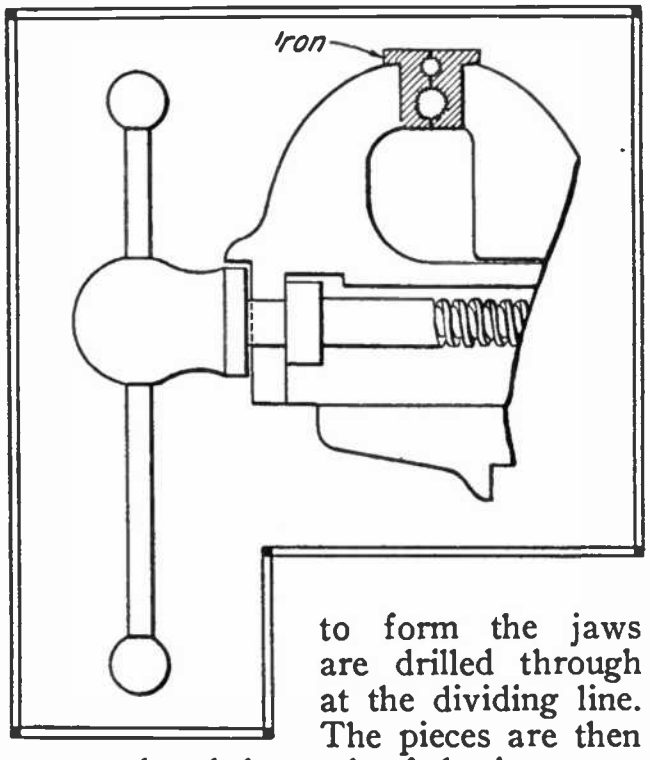
All of these stain removers should be applied carefully and when liquids are used a blotter should be handy for the purpose of absorbing the surplus solution.

Contributed by

W. S. ZEHRUNG.

Pipe Vise

The illustration offers a suggestion for a simple attachment in the form of special jaws by means of which any bench vise may be adapted to take pipe in various sizes. The attachment may be made from a pair of iron castings or planed up from pieces of steel. When the general form has been secured, the two sections are gripped together in a pair of clamps and the holes which are



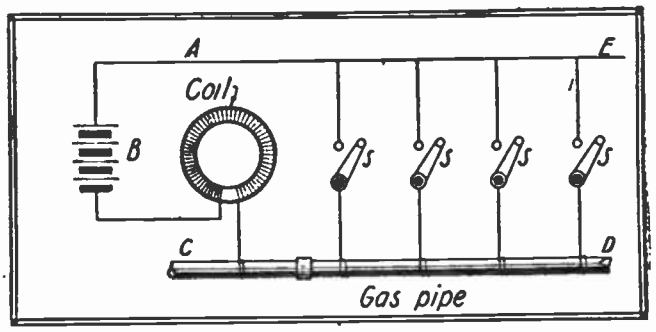
to form the jaws are drilled through at the dividing line. The pieces are then separated and the teeth of the jaws may be filed in the faces. The scheme of having two holes in each pair of jaws lessens the number of sets required, but it prevents the firm grip obtainable with but one hole placed in the center of the attachment.

Contributed by

FRANK HARAZIM.

A Multiple Electric Gas Lighter

Lighting the bunsen burners along a laboratory table by electricity saves both time and matches, and the cost is com-



paratively low. A small inductance coil of the "make-and-break" type and a set of either wet or dry batteries are required. The coil consists of an iron ring 4" or 5" in diameter around which is wrapped 500 turns of No. 25 D. C. C. magnet wire. From the batteries, *B*, one wire, *AE*, should be run. The gas pipe, *D*, will suffice for the return circuit. Short wires should be connected from *CD* and *AE* and lead above the gas jet. Switches, *S*, should be inserted to prevent short circuits.

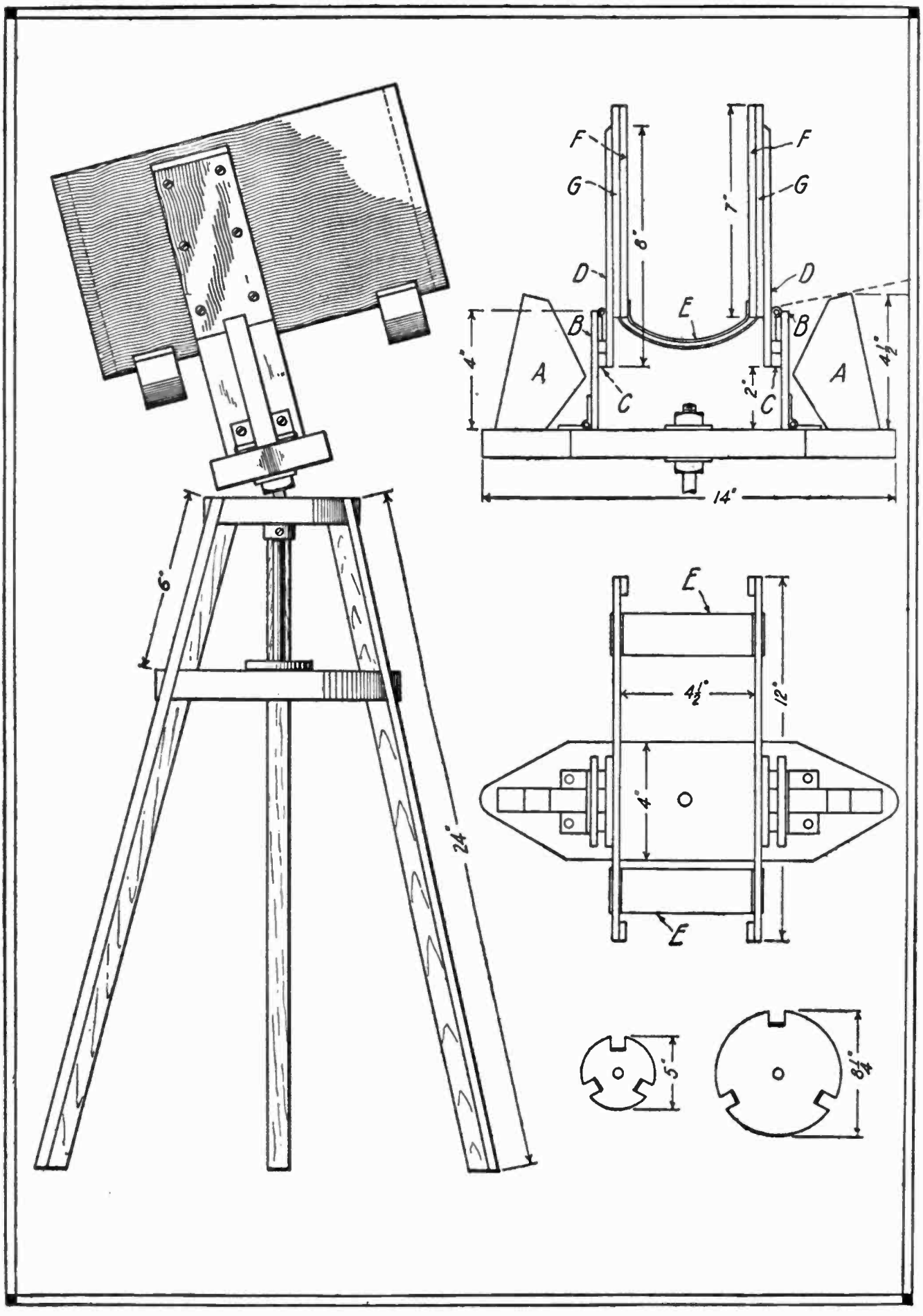
Contributed by

HIRAM W. EDWARDS.

Dictionary Holder

A dictionary holder that requires no springs and can be made of odds and ends about the workshop is shown in the accompanying drawings. The dimensions given are for a dictionary of the standard size, 4½"x8"x11". If a dictionary thicker than 4½" is used, it will be necessary to place the hinged supporting pieces farther apart than shown in the drawings.

Slots should be cut in the boards which are to cover the sides of the dictionary, and bands or tapes, *E*, for supporting the book should be passed through the slots



and sewn together so that they will hang down loosely and fit the binding.

As shown in the end view, the odd-shaped pieces, *AA,* are higher than the

hinged pieces *BB*, so that when the book casing is open, it will rest in a sloping position on the pieces *AA*, as indicated by the dotted lines. It should be noted that the small pieces *CC*, are of a thickness equal to that of the folded hinges and nailed or glued across the ends of pieces marked *DD*.

A bolt, ½" in diameter and of sufficient length that 8½" remain after the head and square shoulder are cut off, should be obtained. The sharp edges made by cutting the bolt should be rounded off with a file. At the point at which the thread ends, the bolt should be bent at an angle in order that the book-casing will be supported in a sloping position as shown in the side elevation. Two nuts and two washers are required. The bolt should be held in a vise, and the first or lower nut screwed tight at the end of the thread. The lower end of the bolt enters and turns in a hole in a small circular piece nailed to the lower 8¼" plate.

An iron collar having a set-screw is fitted to the bolt beneath the 5" top plate of the tripod. This arrangement is not necessary, however, if care is taken in lifting the book-holder by grasping the tripod rather than the book-casing.

An ornamental button may be turned to cover the upper nut of the bolt, if desired.

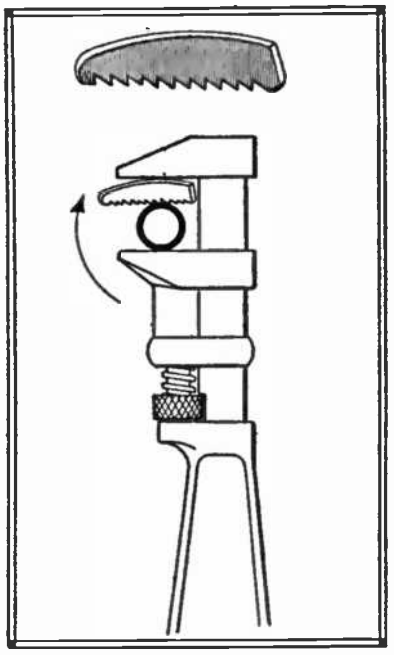
Contributed by

C. H. PATTERSON.

A Vest Pocket Pipe Wrench

Mechanics do not ordinarily have sufficient call for a pipe wrench to require one as a part of their regular kit; yet, occasionally, a demand is made in the form of a pipe that must be tightened, or a stubbon rod that cannot be turned, by the ordinary monkey wrench. A supplement for a monkey wrench which will serve it for tightening pipes and rods is shown in the accompanying illustration. It consists of a small bar of steel 1½" long, ¾" wide and ⅜" thick. The back should be curved so that it will be self-adjusting. The face, which is straight, should be cut with saw tooth notches across the entire width, and hardened.

To use the improvised pipe wrench the notched piece should be inserted in the monkey wrench between the jaws, not quite touching the shank. The wrench should be opened far enough to admit the pipe which rests opposite the "hump" on the attachment. Turning the wrench in the direction of the arrow will cause the pipe to roll in toward the shank and allow the teeth to gain a secure hold. This arrangement will tighten a right-hand thread, while the same pipe can be loosened by placing the attachment on the lower jaw of the wrench and turning the handle in the opposite direction. The attachment will fit practically any sized wrench, and it is adapted to a wide range of diameters.



Contributed by

W. H. SARGENT.

Pewter Color in Brass

A color closely resembling pewter may be given to brass by boiling the article in a cream of tartar solution to which has been added a small amount of chloride of tin.

Contributed by

HARRY C. BOYER.

To Repair Old Carpet Sweeper

When an old carpet sweeper refuses to work, an examination will often show that it can be repaired quite easily.

If the rubber tires of the wheels are loose, they should be removed, soaked for several hours in boiling water and dried. This will contract them, so that they fit tightly. Thick shellac should be used to cement them.

The drive pulley which is usually an integral part of the brush spindle, may be worn down to such an extent that the rubber wheels do not bear upon it. It should be whittled down to the size of the spindle. Next, a block of tough wood in which a hole is bored to fit the spindle, turned in a lathe or whittled round to the right size, is glued on the spindle.

If the machine still refuses to work, although the brush revolves, the trouble probably lies in the fact that the brushes have been worn down to such an extent that they do not touch the carpet. In this case, the screws in the bearings at the end of the brush should be taken out, and the brush lowered about ¼ inch. If some of the brushes or bristles have come out, they can be replaced from an old hair brush.

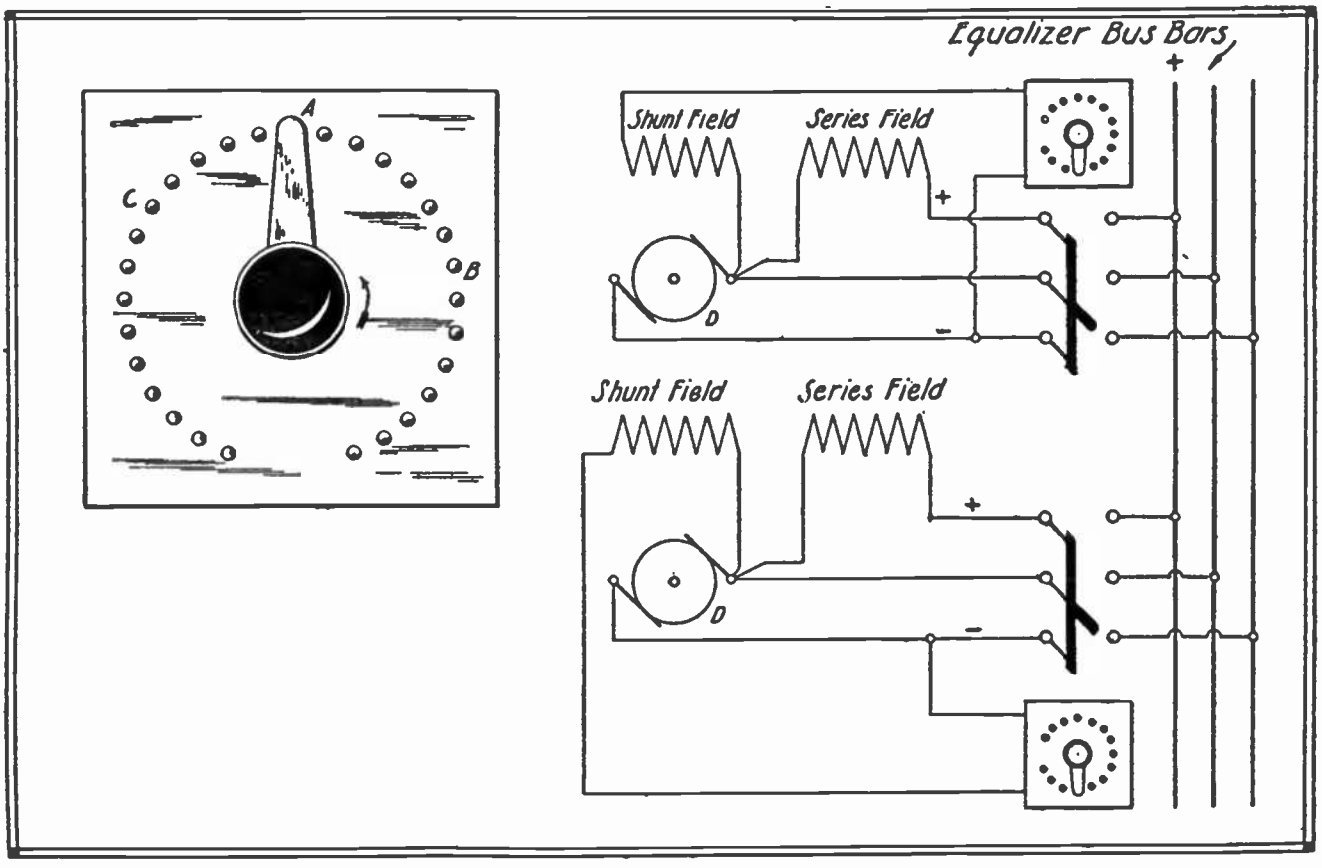
Contributed by WM. C. HOUGHTON.

RESISTANCE OF CONDUCTORS AT DIFFERENT TEMPERATURES

By William Morton

The writer noted with interest the article in the February number of this magazine by J. H. Blakey entitled "Electrical Resistance at Low Temperatures," and submits herewith a little proof of the theory advanced.

In the power house with which the writer is connected are two 250-K. W. motor-generator sets of the synchronous type, with the generators connected in parallel; that is, both sets are pulling on the same load. The motors are running on 4000-volt, 3-phase current and the compound-wound generators deliver 110 volts at no load while the full load voltage is 125 (direct current). The current supplied by the generators is used by 110-volt motors and lamps, and in order to maintain the voltage, the latter is adjusted to 115 volts at the



power house and the machines are balanced so as to deliver that potential with the aid of the rheostats indicated in the sketch.

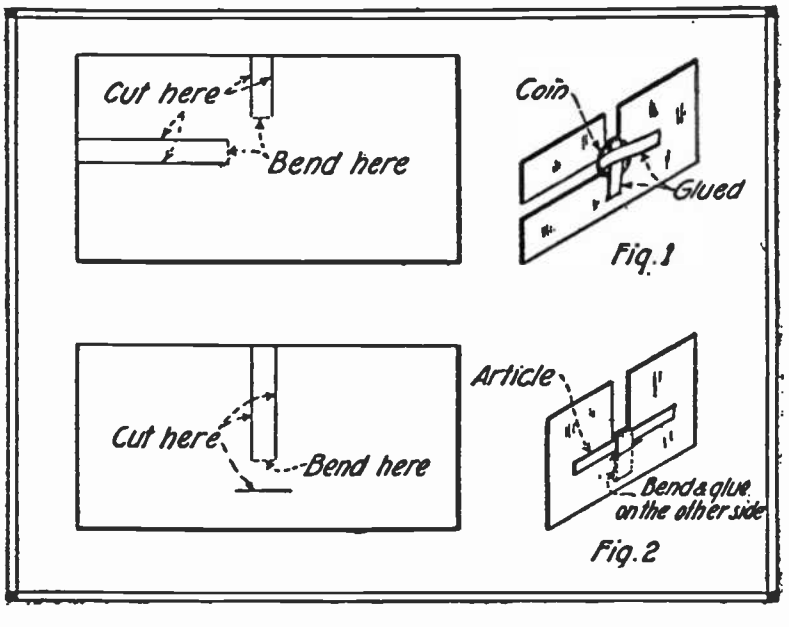
During the cold weather (the temperature dropped to zero outside) the heating system failed for two nights and in starting the machines each morning it was found that with all the resistance in circuit, the voltage was 120, while the same point on the rheostat, had the resistance been warm or of normal temperature, would have cut the voltage down to 100. As the rheostats heated up with the current, the voltage gradually lowered and after about 30 minutes the voltage was 115 and ten minutes later the rheostats had to be moved to their balanced point.

A further test was made in which No. 1 machine was started and run on full load, the voltage being just as described. In 40 minutes No. 2 machine was started and thrown in, together with No. 1, on full load with the result that the voltage of each was 120 with No. 1 rheostat (warm) as shown at *C* and No. 2 rheostat (cold) as shown at *B;* the difference in points on the two rheostats proving necessary in order to equalize the load between the two. In half an hour the two machines were perfectly normal and the voltage of each was 115 with the rheostat lever at *A*. When the operation of the heating system was resumed on the following day the trouble disappeared entirely.

While the above seems to be a practical illustration of the effects of low temperatures on the resistance of metals, still the writer is of the opinion, based on experiments, that the resistance of the liquid in a water rheostat decreases with an increase of temperature instead of *vice versa,* as in the case of the metallic resistance.

To Mail Coins

Two suggestions for mailing coins and other articles too heavy to permit of their being placed loosely in an envelope, are given in the illustrations. Both mailers involve the use of a minimum amount of cardboard which is first cut exactly to fit into the envelope. Fig. 1 shows the coin mailer and Fig. 2 the card to take an article of some length. If so desired, several holding strips can be cut in the same card. If no paste is available, the ends of the strips may be held with pins.



Money mailed in the manner described is not liable to be lost.

Contributed by

N. G. NEAR.

Written Stereopticon Slides

During one of the recent elections, a newspaper editor, who wished to give the returns to the crowds by means of a stereopticon, found that there were no blank slides in the office. Various substitutes were tried without much success until the following plan was hit upon.

A sheet of celluloid was purchased from a carriage builder and cut into pieces 3x4 inches in size. On either side of the piece of celluloid was placed a sheet of the softest carbon paper obtainable, and the three sheets were inserted in the typewriter. The election returns were then typed, and the results were very satisfactory. The carbons made a

clear impression on the transparent celluloid, and the resultant view on the screen was quite readable.

When the returns had been seen by all those in the street below, the printed celluloid was removed from the stereopticon frame and cleaned with a damp cloth. In this way one piece of celluloid could be used repeatedly. A good way to mount the celluloid when it is put in the projecting machine is to place it between two pieces of glass, fastened together with a hinge made of adhesive plaster, such as can be obtained from any druggist.

Contributed by

CHARLES M. STEWART.

An Emergency Radiator

The following experience with a broken auto-truck radiator, and the emergency radiator which was substituted, will be of interest to motorists.

The writer, while driving a motor-truck, met with an accident which caused the radiator to leak so badly that it would not hold enough water to cool the engine. No repair shops were convenient, so an old whiskey barrel, which was handy, was placed in the truck behind the seat, and a ¾-inch hole bored near the bottom. A piece of ordinary garden hose was driven into the hole and connected to the intake water pipe of the engine. Another section of hose was run from the discharge to the top of the barrel. With this makeshift repair, a run of twenty miles was made with the engine quite cool.

Contributed by

J. C. WOODMAN.

Ingenious Dark Room Lamp

A good substitute for a ruby lamp for a dark room can be made by dipping an electric light bulb into red analine dye which is thoroughly mixed with gelatine and water. The light should be turned on, as the heat quickens drying.

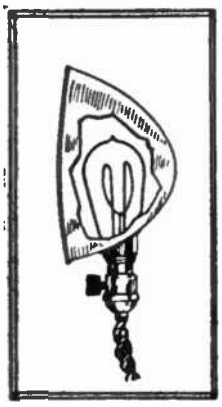
Contributed by

RUSSELL WALDO.

Substitute for Hot Water Bottle

A very simple substitute for a hot water bottle is suggested by a Californian doctor. It involves the use of an electric light bulb and ordinary metal reflector. The open front of the reflector should be closed by means of a piece of tin. When this is to be used it should be slipped into a flannel bag to prevent contact of the metal with the skin.

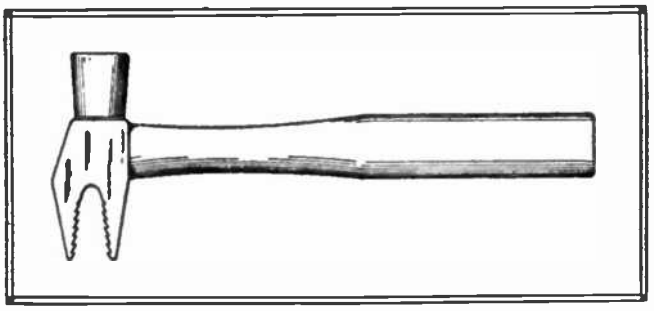
If moisture as well as heat is wanted a wet cloth placed between the skin and the box may be used. This little device is not heavy and has the advantage of maintaining a uniform heat for any length of time desired.



Since there is a possibility of excessive heat being given out by the lamp, care should be exercised. A lamp may be placed in series to cut down the heat.

A Wrench and Hammer Combined

An unique and decidedly handy tool for the man-about-the house is shown in



the accompanying illustration. By the use of a broad angle in which the saw-tooth notches are cut, the tool may be used as a pipe wrench adapted to a fairly wide range of diameters.

Contributions to this department will be paid for at space rates, with a minimum of $1.00 per idea.

A HANDY CANOE LAMP

By Earl C. Swetman

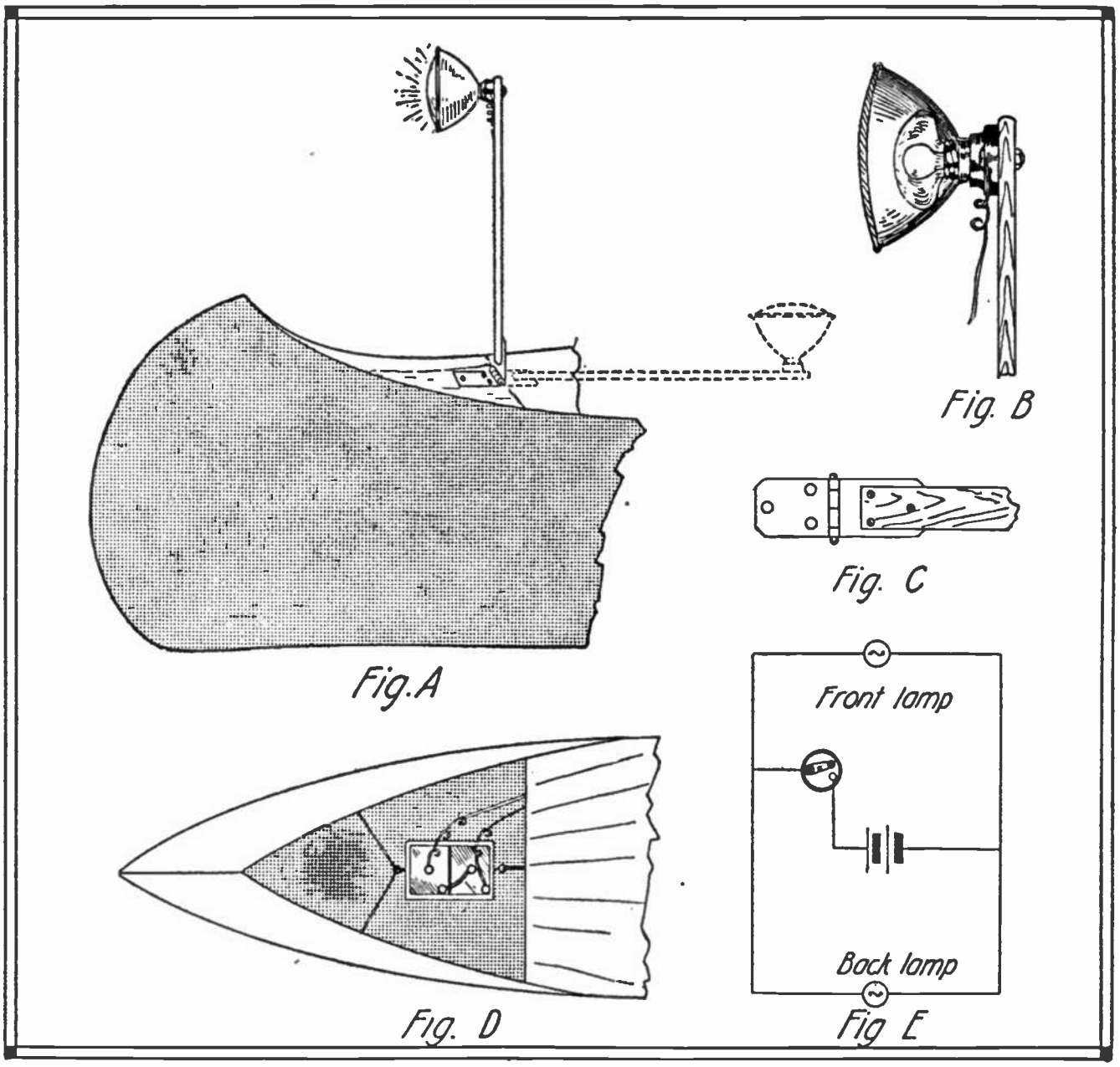
It is rather an exceptional thing to see a canoe carrying lights after dark, although it is just as advisable to show lights from a canoe as from a larger craft. Lights displayed on a canoe serve as a means of protection from being run down by motorboats rather than as a warning to other craft. It is largely a matter of safety, although the convenience of having a light is an inducement in itself.

A novel and simple way of installing electric lights on small craft is to have them so arranged that they may be elevated to a conspicuous position when required, and lowered to a safe and out-of-the-way position when the canoe is put on the rack. The two positions are shown at *A* in the accompanying drawing. This is done by using an ordinary brass clasp about 5 inches long. One-half of the clasp is screwed to the deck, close to the bow or stern, and to the other half is screwed the flat, wooden stick, which supports the light, as shown at *C*.

The canoe lamp is shown assembled at *B*. It consists of a miniature receptacle, a small reflector and a miniature lamp, all of which may be bought at any electrical supply shop. A three-volt lamp, with a good reflector, is sufficient for the purpose and gives a surprisingly brilliant light. The wires from the lamp can be run down the sides of the supporting arm, and through small holes in the deck, to the battery. Wire of No. 20 or 22 gauge is a good size to use.

One of these lights may be erected on each end of the canoe, and controlled by a switch under the rear seat or wherever desired. In order to save the batteries as much as possible, the lights need be used only when necessary, and turned off when no other boats are near.

The battery for the lamp is placed under the front deck, since the bow is usually out of the water anyway and the cells are best placed there to distribute the weight. They are suspended as shown at *D*, in a very rigid manner. With this arrangement the cells are always kept dry, for should water get into the bottom, they are above it, and when the canoe is turned over and the water runs down on the under side of the deck, the battery is still above the water. The three wires that run from one end of the canoe to the other must be kept dry, and it is advisable to run them through rubber or brass tubing along the keel or under the gunwale. The wiring diagram is shown at *E*, in which it will be noticed that both lights are controlled by the same switch, while two cells of the battery are placed in series.



Various Details of the Electric Canoe Lamp, as Well as a Wiring Diagram for the Connections If Two Lamps Are Used.

The one commendable feature of the electric canoe lamp described is that it in no way interferes with the usual handling of the canoe. When the craft is placed on its rack, there are no projecting parts nor is there anything to fall out. The weight of the entire outfit is insignificant.

PANAMA-PACIFIC EXPOSITION NOTES

PERHAPS the largest exhibit at the Panama-Pacific International Exposition is that installed by the Federal Government. It is scattered about in the eight main exhibit palaces and includes practically every branch of work taken up by the many departmental bureaus.

In the Palace of Mines and Metallurgy there is a section devoted to radium-bearing ores. Here the visitor will see a small building about ten by fifteen feet in size, the walls of which are sheathed with corrugated iron. The one entrance to this structure is presided over by a guard who permits the inno-

cent looking person to enter therein so that he may view five specks of radium salts. The interior is painted a dead black and one small red light serves to give the necessary illumination. Along one wall are five booths and across each booth is a shelf in which the speck of radium salts is incased. A magnifying glass is mounted above the radium to enable the observer to obtain a more detailed view of the radio action of the metallic salts under observation. To the observer the crystals are outlined by a white scintillating light which in appearance resembles an electric brush discharge, while the circumambient region glows with a phosphorescent and aurora borealis effect.

The visitor from New York City will wish to linger at the exhibit of the Pacific Telephone and Telegraph Company in the Palace of Liberal Arts. Upon entering an elaborately furnished room he will be politely ushered to a seat. At 4:30 p. m. a lecturer steps to the front, the room is darkened, the motion picture projector is started and an illustrated talk is given on the principles of the telephone exchange and facts about the new trans-continental telephone line. There is a pair of head receivers hung on the back of each seat and at 5:00 p. m. (8:00 p. m. in New York), the lecturer announces that "We will now ring up New York. Place the receivers over your ears and listen," says he. So we clamp the receivers on our head, but hear nothing. "Sometimes there is a delay in making the connection," he continues, "but we usually get them in a few seconds."

In less than a minute we hear the click-click of telegraph sounders amid a conglomeration of voices and then with a final click we "get" New York. "Hello San Francisco. This is New York. Greetings!" says the man in his New York office, whose voice is reproduced so loud and clear that we can understand with the receivers held three feet from our ears. The electric fans are shut off to diminish the noise and the voice from New York continues, "It is a very cold day here," and then reads some news items of the day. He next places a phonograph before the transmitter and for several minutes we are treated to a musical selection. Now comes another click and the spell is broken. Possibly our own impressions are best portrayed by the lady from the country who exclaims as she leaves the room, "My, ain't it wonderful!"

An interesting exhibit in the Palace of Machinery is a 500 H. P. Diesel oil-engine coupled to a 250KW 220V D. C. generator. The engine bears a sign which reads: "At noon Feb. 20th, 1915, President Wilson started this engine by wireless from Washington." The radio-telegraph relay which served to start the fountains and open the doors of the various palaces also actuated a secondary relay which operated a valve controlling the compressed air used to start the engine. The current generated is used by other exhibitors.

The Aurora Borealis has a dangerous competitor in the form of a two and one-half billion candle power electric scintillator which plays its colored shafts of light upon the cloud and fog banks or upon smoke and steam clouds when the former do not exist. This scintillator consists of a battery of forty-eight thirty-six-inch projectors operated by a force of marines who have been trained especially for this duty. The men are divided into sections and squads so that the projectors may be operated in a systematic manner for producing various combination and color effects. A large locomotive stationed nearby generates the necessary steam to be used in the absence of clouds, while hundreds of four- to ten-inch bombs are sent aloft to add to the effect. Red, blue, orange and green disks are placed before the projectors. When these forty-eight magnificent colored shafts of light are played upon the clouds, the visitor is lost in admiration at the beauty and grandeur of this artificial aurora borealis.

The quantities of ammunition consumed and the cost involved in conducting a modern naval fight are stupendous. As an example it is said that the cost of firing all the guns of the big British battleship *Queen Elizabeth* for one hour would be well in excess of $1,000,000.


The Summer Cottage Completed

A CRAFTSMAN SUMMER COTTAGE

Describing a Summer Dwelling that May Be Constructed by the Average Handy Man at Low Cost.*

By Ralph F. Windoes
Instructor of Manual Training, Davenport High School, Davenport, Ia

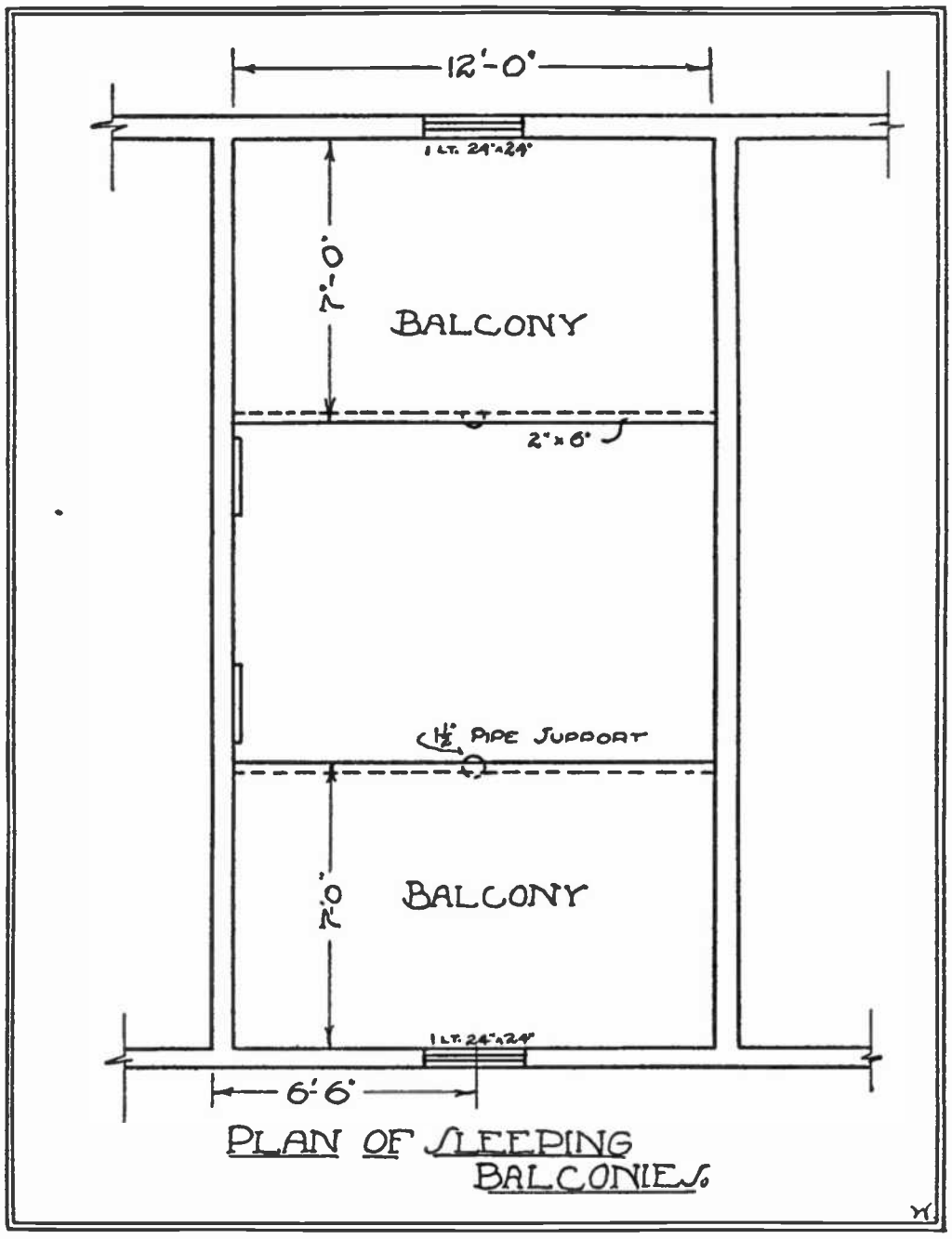
Illustrations from drawings made by the author

WITH the coming of the springtime our good craftsman finds it an effort to stay in his little crafts-shop and construct those useful things that have held and interested him through the long months of winter. The spirit of the springtide—the lure of the woodland with its visions of cool glens and shimmering lakes—enters into the little shop where it entices our craftsman to put aside his tools and go out of doors. Those of us who are human—and all good craftsmen are—have felt this "call of the wild" with its pull to the waters, and we have longed to build us a little summer home where we might spend a few weeks of each year, at least, in the healthy companionship of nature.

But, unluckily, the cost of such a home has made it impossible for a great many of us. We have not the ability, or at least we think that we have not, to build one ourselves, and to have one constructed for us, with the high cost of labor, land and materials, makes it prohibitive.

So, with these things in mind, the writer has endeavored to evolve a little cottage of good design—and comfortable, and in this, and in subsequent articles, he will tell our craftsman exactly how to build the cottage. So fully will the explanations be given that any boy with just his manual training school experience, and any home craftsman who can hammer and saw with a little accuracy, will find no difficulties to surmount if he cares to tackle it. Its cost should not amount to much over $250 for material—this varying according to locality, grade of materials purchased, distance from a railway station, etc. As for the land, he may buy a lot outright or he may rent a spot for a given number of years, with the option of buying it at any time. As an investment, few will pay a higher rate of interest. If he has put, let us say, $400 into it—and this should be ample fully equipped—he should be able to rent it for ten weeks of the summer at $15 a week, and have it for his own use two or three weeks

*This article is the first of a series on the construction of the summer cottage. Additional details will be given in the instalments that will follow regularly in forthcoming issues of THE WORLD'S ADVANCE.



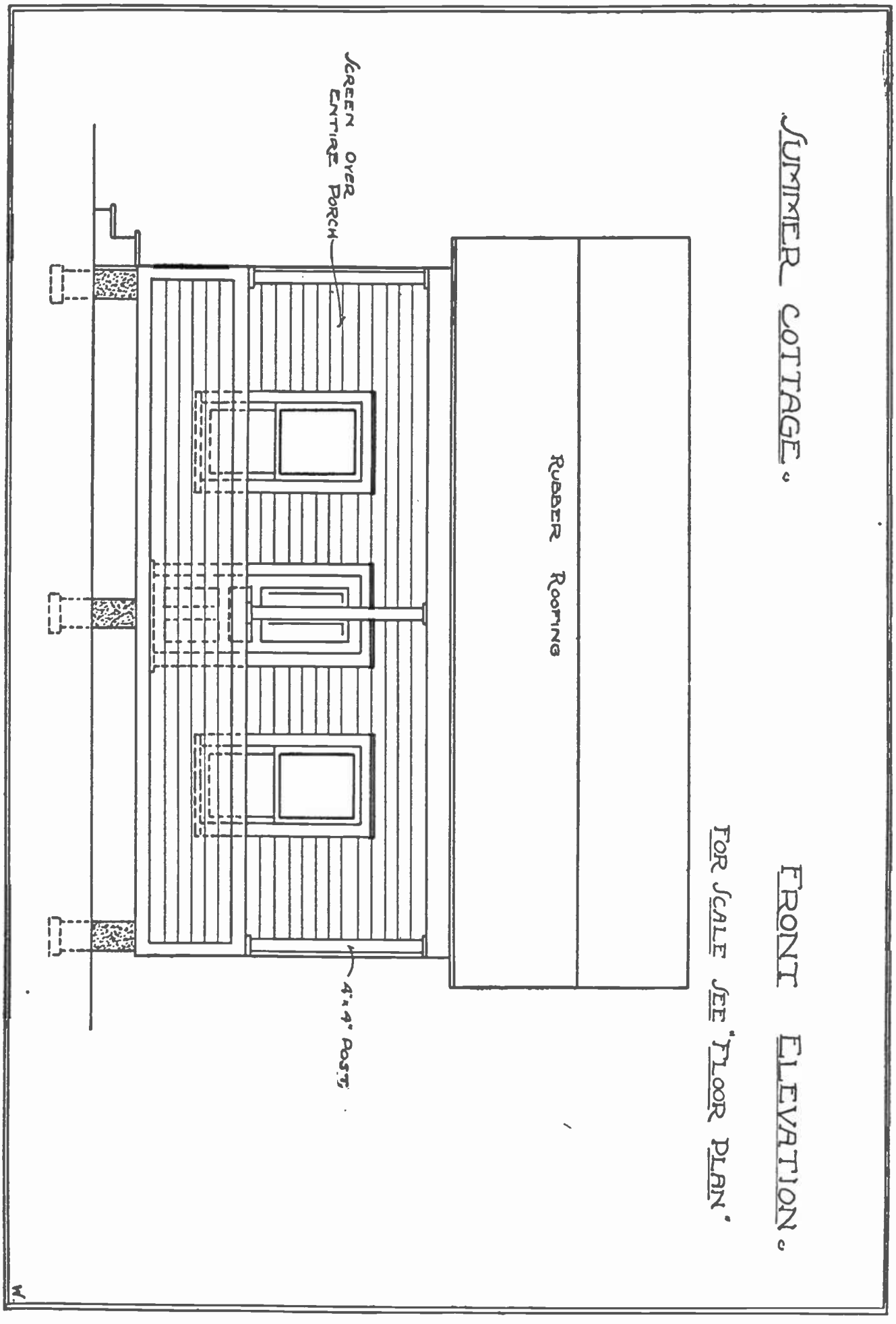
PLAN OF SLEEPING BALCONIES

besides. In three seasons, it would actually pay for itself. (This figure is based on rents obtained for cottages of this kind at the inland resorts of Michigan.)

The cottage shown in the sketch is similar to that owned by Mr. George S. Waite and built at Comstock, Mich., upon the banks of the Kalamazoo River. It was put up entirely by manual training school students from Kalamazoo under the supervision of Mr. Waite, and from plans designed by the author.

As a careful study of the plans will reveal, it is a wonderful combination of comfort and utility. The large, screened-in porch overlooking the river is the favorite lounging place. It can be used to dine upon, and it offers ample space for cots, if used as a sleeping porch. The living room, as seen on the floor plan, is 12 feet wide and 23 feet long — a large, comfortable, well-lighted room. At each end, and raised a good distance from the floor, are the sleeping balconies. These are curtained off to the height of 7 feet and 6 inches, which effectually cuts off any view to or from them when in use, and they are reached by the means of ladders. Each balcony can easily accommodate four sleepers, and with cots placed beneath them, and also curtained off, a total of ten or twelve people can easily and comfortably be accommodated in the little cottage. The combination kitchen and dining-room, perfectly arranged, completes the plan of the cottage.

An approximate bill of material follows. This has been compiled with great care and, providing full measure is given by the dealer, will fully cover every item needed. The prices given are reliable at the present time in the middle west for the grade of material itemized. If No. 1 stock is ordered, the price will advance about 25 per cent. It is possible to purchase second-hand lumber and millwork, and if the craftsman keeps on the lookout for such, he will be able to cut his expense account down to a considerable extent.


SUMMER COTTAGE.
FRONT ELEVATION.
FOR SCALE SEE "FLOOR PLAN."
SCREEN OVER ENTIRE PORCH
RUBBER ROOFING
4"x4" POSTS

BILL OF LUMBER

NUMBER OF PIECES	SIZE OF PIECES	DESCRIPTION	FEET	PRICE PER M	TOTAL AMT.
38	2" x 6" x 12' 0"	Sills and joists, No. 2 Yellow Pine...	456	$18.25	$ 8.32
20	2" x 6" x 14' 0"	Sills, girders and balcony headers, No. 2 Yellow Pine.....	280	18.25	5.11
8	2" x 6" x 24' 0"	Sills and double joists, No. 2 Yel. Pine	192	21.50	4.13
2	2" x 10" x 24' 0"	Porch headers, No. 2 Yellow Pine....	80	24.75	1.98
8	2" x 4" x 24' 0"	Plates, No. 2 Yellow Pine.....	128	25.00	3.20
32	2" x 4" x 18' 0"	Studs and Rafters, No. 2 Yellow Pine	384	22.75	8.73
45	2" x 4" x 16' 0"	Studs and window headers, No. 2 Yellow Pine.....	473	19.25	9.10
6	2" x 4" x 14' 0"	Studs, No. 2 Yellow Pine.....	54	19.25	1.05
20	2" x 4" x 12' 0"	Studs, No. 2 Yellow Pine.....	160	20.50	3.28
26	2" x 4" x 10' 0"	Rafters, No. 2 Yellow Pine.....	182	21.00	3.82
25	2" x 4" x 8' 0"	Porch studs and balcony joists, No. 2 Yellow Pine.....	125	18.25	2.28
	4"	No. 2 Yellow Pine Flooring for entire floor	1,230	18.50	22.75
	4"	No. 2 Yellow Pine Flooring for roof	1,560	18.50	28.86
	4"	No. 2 Yellow Pine Flooring for balcony floors.....	210	18.50	3.88
	6"	No. 2 Yellow Pine Drop Siding.....	1,952	20.80	40.60
30 ft.	¾" x ¾" ¼-rnd.	Yellow Pine.....	.....	½c ft.	.15
140 lin. ft.	1" x 8"	No. 2 Yellow Pine for frieze.....	.....	19.70	2.75
154 lin. ft.	1" x 6"	No. 2 Yellow Pine for water table....	.....	14.80	2.27
172 lin. ft.	1" x 5"	No. 2 Yellow Pine for casing..	.....	13.30	2.28
96 lin. ft.	1" x 10"	No. 2 Yellow Pine for porch seat.....	.....	26.50	2.54
		Total Cost of Lumber.....			$157.08

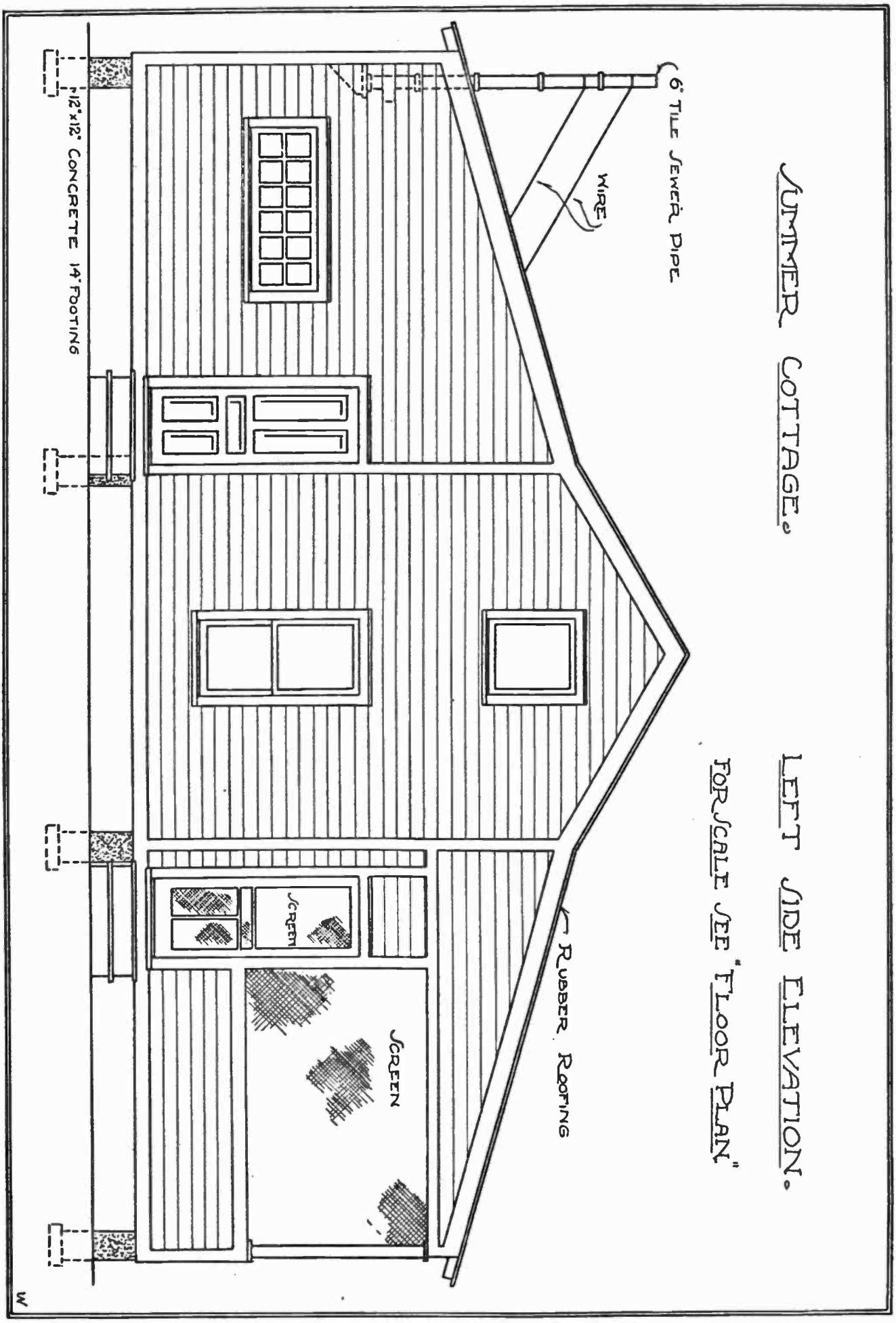
MILLWORK

4 only B grade door frames for 3'0" x 7'0" doors @ $1.80	$7.20
3 only 5-panel painted doors 1⅜" x 3'0" x 7'0" @ $1.60	4.80
1 only Black Wire Screen door 3'0" x 7'0" @ $1.85.....	1.85
4 only B grade window frames opening 2'8" x 5'6" @ $1.25	5.00
4 only 2-light check rail windows 28" x 30" @ $1.32	5.28
3 only B grade window frames for single sash 5'8" x 2'4" @ $1.25.....	3.75
3 only 12-lt. single sash glass 8" x 10" sash 5'8" x 2'4" @ $2.85	8.55
2 only B grade frames for attic sash opening 2'4" x 2'5" @ $1.10	2.20
2 only Attic sash glass 24" x 24" @ 0.86.....	1.72
Total Cost of Millwork.....	$40.35

HARDWARE AND MISCELLANEOUS ITEMS

312 ft. screen wire cloth, black @ 2c square foot.....	$6.24
1560 sq. ft. rubber roofing @ $1.25 roll of 108 sq.ft. (15 rls.)	18.75
4 lengths 6" vitrified sewer tile @ 20c each.....	.80
1 only T-branch of 6" vitrified tile @ 40c each.....	.40
7 sacks Portland Cement @ 40c sack.....	2.80
1 kitchen steel sink 18" x 36" @ 1.50.....	1.50
1 pr. cast iron sink brackets 18" @ 35c pair.....	.35
1 cypress sink drip board @ 55c.....	.55
1 Pitcher spout pump 3" bore, 1¼" pipe @ $1.08.....	1.08
1 1¼ pipe drive point @ 86c.....	.86

(Continued over leaf.)


SUMMER COTTAGE.
LEFT SIDE ELEVATION.
FOR SCALE SEE "FLOOR PLAN"
6" TILE SEWER PIPE
WIRE
12"x12" CONCRETE 14" FOOTING
RUBBER ROOFING
SCREEN
SCREEN

HARDWARE AND MISCELLANEOUS ITEMS—Continued

20 feet 1¼" pipe @ 6c per foot for pump	1.20
10 feet lead pipe for sink drain @ 13c foot	1.30
20 feet 1¼" pipe to carry sink drain away from cottage @ 6c	1.20
1 only 1¼" coupling to attach drive point to pump pipe @ 6c	.06
1 only drive cap for 1¼" pipe @ 12c each	.12
2 pieces 1½" iron pipe 9' long @ 10c foot for balcony supports	1.80
2 pcs. 1½" pipe 10' long @ 10c foot for balcony hand-rails	2.00
2 pcs. 1½" pipe 3' long @ 10c foot for balcony hand-rails	.60
8 only floor plates for 1½" pipe @ 5c each	.40
2 90 degree elbows for 1½" pipe @ 12c each	.24
5 pair butt hinges for single sash windows @ 10c pair	.50
5 transom catches for single sash windows @ 15c each	.75
16 window spring bolts @ 1c each	.16
3 pair loose pin butt hinges, 3½" x 3½" @ 14c pair	.42
3 lock sets @ 43c each	1.29
1 complete screen door set, hinges, pull, spring, and hook @ 15c	.15
150 lbs. 8d common wire nails (1½ kegs) @ $2.03 keg	3.05
20 lbs. 16d. common wire nails @ 4c lb	.80
5 lbs. 4d wire finish nails @ 5c lb	.25
2 gals. mixed paint for primer @ $1.25 gal	2.50
1 gal. boiled linseed oil @ 75c gal	.75
2½ gals. mixed body color @ $1.25 gal	3.13
1 gal. mixed paint for trimming @ $1.25 gal	1.25
1 qt. sash paint @ 35c	.35
1 pt. white shellac @ 36c	.36
1 gal. porch floor paint @ $1.80 gal	1.80
Total Cost of Hardware	$59.76

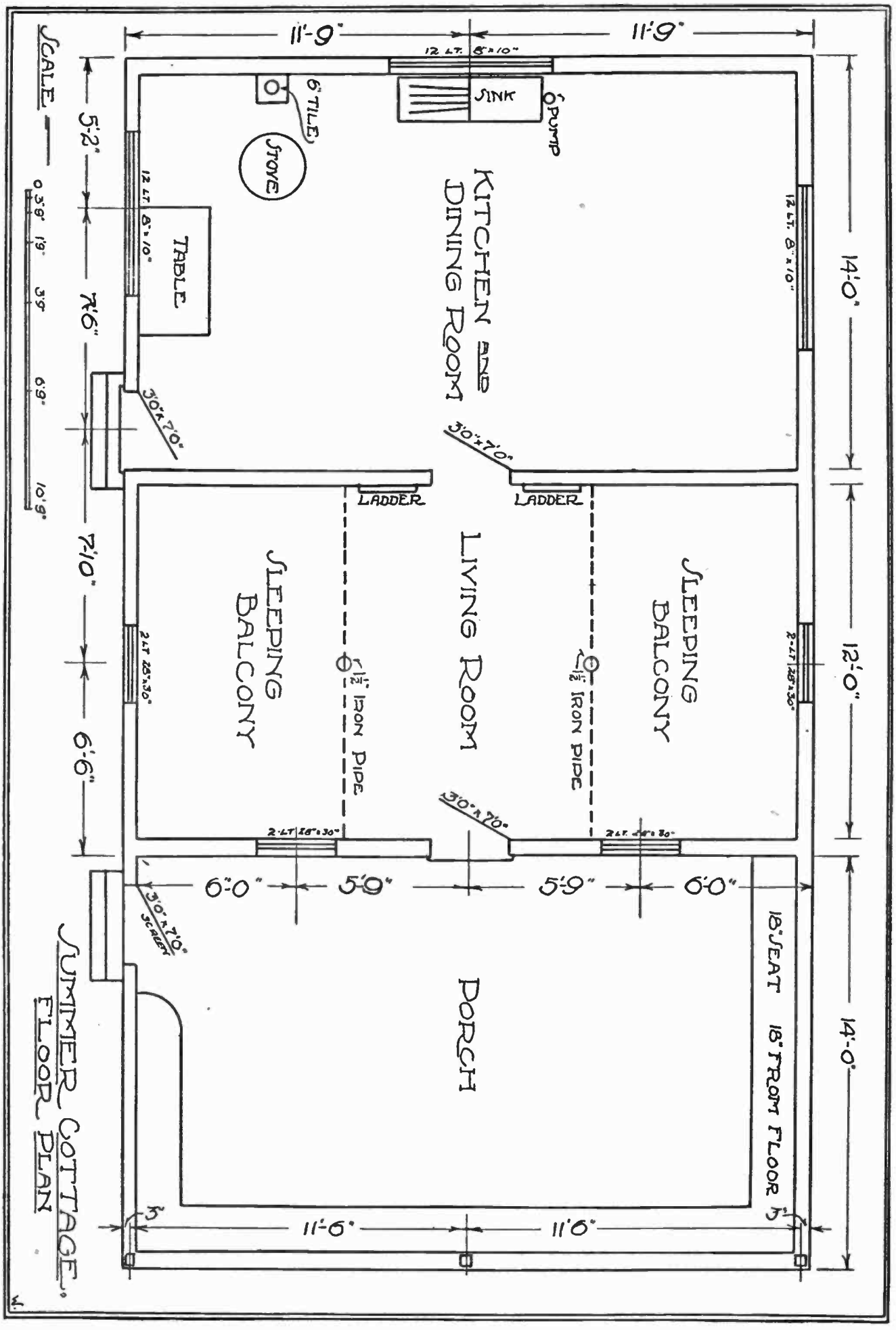
RECAPITULATION

Cost of Lumber	$157.08
Cost of Millwork	40.35
Cost of Hardware and Miscellaneous Items	59.76
Total Cost of Cottage	$257.19

This total cost is based on new materials throughout, and is figured very completely. It can be shaved below the $200 mark by cutting out some of the apparent luxuries. For instance, a cheap grade of sheathing may be used on the roof instead of the matched flooring, but this is not a good practice where rubber roofing is used; the single sash twelve-light windows and frames will need to be made to order, as they are not stock sizes. The builder may change their size to some stock size if he cares to, which will cut down their cost a little. The screening may be omitted and put on later, and only one coat of paint over the primer may be used the first year, but both of these things add so much to the comfort and beauty of the cottage that they are strongly recommended.

No color is given for the paint, but a gray is advised for the priming coat, and two shades of green for the body and trim. Of course, the sash paint will be black.

Before ordering any material, we would advise the craftsman to study over the bills and the plans, and become very familiar with every item and its use. A great help to those who are unfamiliar with the terms and names employed will be found in the catalogues that may be had upon request from the large mill-


11'-9"
11'-9"
12 LT. 8"x10"
SINK
PUMP
6" TILE
STOVE
12 LT. 8"x10"
TABLE
14'-0"
5'-2"
7'6"
3'0"x7'0"
KITCHEN AND DINING ROOM
3'0"x7'0"
LADDER
LADDER
7'10"
SLEEPING BALCONY
1½" IRON PIPE
LIVING ROOM
1½" IRON PIPE
SLEEPING BALCONY
2 LT 28"x30"
2 LT 28"x30"
12'-0"
6'6"
3'0"x7'0"
6'-0"
5'9"
5'9"
6'-0"
3'0"x7'0" SCREEN
PORCH
18" SEAT 18" FROM FLOOR
14'-0"
5"
11'-6"
11'-6"
5"
SCALE
0 3'9" 1'9" 3'9" 6'9" 10'9"
SUMMER COTTAGE.
FLOOR PLAN

work supply houses located all over the country.

It is understood, of course, that the craftsman has his own tool kit, but in the next instalment of this series we will itemize the tools needed together with instructions for the beginning of the cottage.

THE TWO-SPEED INDUCTION MOTOR

ONE of the greatest objections to induction motors has always been the lack of economical speed control. Of quite recent date a two-speed motor has been introduced into the electrical field for application to such shop machinery as may require different speeds. The speeds above, below and intermediate to both speeds of the motor, required on such machines as wheel lathes, shapers, etc., are obtained by shifting the gearing of the machine itself.

In appearance and mechanical design this motor resembles any other squirrel cage induction motor, the rotor being identical. A very marked difference, however, is found in the end connections of the winding of the stator element, that is, by merely throwing a switch the number of poles in the stator winding is doubled, thereby decreasing the speed by one-half.

It will be recalled that the synchronous speed of any alternating current motor, in revolutions per second, is equal to the frequency or the cycles per second divided by the number of pairs of poles, so that by doubling the number of poles the speed is decreased one-half.

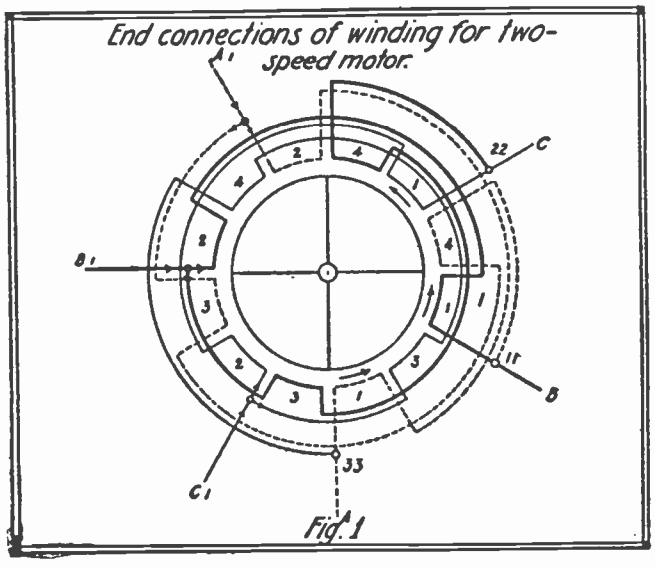


Fig. 1

For motors having two speeds, for example, 900 and 1800 revolutions per minute, the number of poles in the stator corresponding to these two speeds is eight and four, respectively, with the frequency of the supply being sixty cycles per second.

Fig. 1 shows the end connections that are used with the 900 and 1800 R. P. M., 60 cycle, three-phase motor. The quartered circle within the center part of the diagram represents the four poles set up in the stator winding. The three phases are represented by heavy, dotted and light lines, each quarter or pole being composed of three phases, each phase in numbers 1-2-3-4, etc.

No special auto-starter is required in the connection of the motor, but a special four pole, double throw switch, shown in part C, Fig. 2, having thirteen points, is needed and placed between the motor and the auto-starter.

It will be noted that when the switch is closed in the upper position one blade short-circuits the three leads connected to the bottom of it, these three jumpers being put on at the time of installation.

When the machine is set for low-speed operation the switch is thrown to the down position and the leads from the motor marked *A, B* and *C,* Fig. 1, are connected to the respective leads from the switch marked in a similar manner and to the line through the auto-starter, while the leads from the motor marked *A1, B1 and C1* are open.

From Fig. 1 it is seen that at a given instant the direction of flow of the current in each phase winding of each pole is the same. For example, by tracing the *A* phase through, beginning at *A,* each

group of coils marked 1-2-3-4 are placed to form positive or north poles, the negative or south poles being of a consequent formation. Accordingly, when the switch is thrown for low speed, or the higher-number-of-poles position, four positive or north poles and four negative poles, known as consequent poles, are produced.

The end of the *A* phase winding ends at the beginning of *B* phase and is marked 11; the end of the *B* phase winding ends at the beginning of the *C* phase winding and is marked 22; the end of the *C* phase winding ends at the beginning of the *A* phase and is marked 33, thus forming a delta connection as shown in part *a*, Fig. 2.

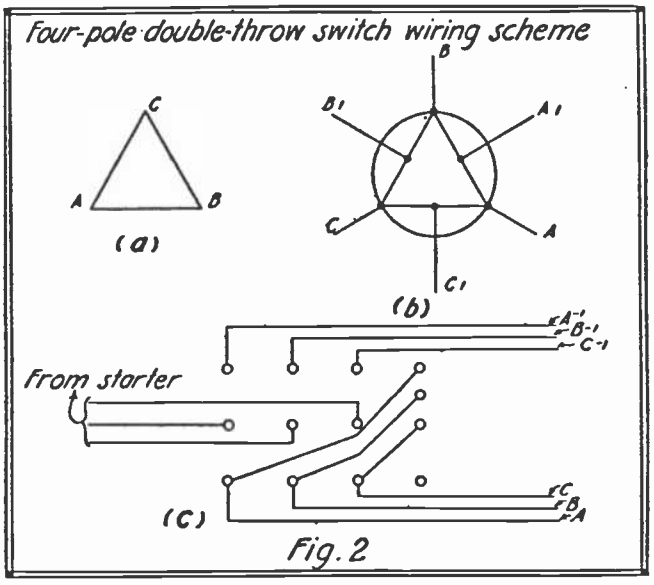
Referring to Fig. 1, when the four pole switch is thrown to the up or the high speed position, the leads *A*1, *B*1 and *C*1, from the motor, are connected through similarly marked leads of the switch, thence through the auto-starter to the line and the motor leads *A*, *B* and *C* are short-circuited.

Again referring to the diagram and tracing the path of current through any phase, for example, the *a* phase, we begin at *A*1 and find that the current goes both ways, thus forming two negative poles, 2-1, and two poles, 3-4.

The other phases, *B* and *C*, may be traced in the same manner, thus when the switch is thrown to the position for the higher speed or the lower number of poles, the windings are connected so that alternate north and south poles are produced.

With this connection, the switch being up, the leads *A*, *B* and *C* are short-circuited as shown in part *b* of Fig. 2; the circle representing the short-circuit. The circuits are split and fed both ways from the points *A*1, *B*1 and *C*1, thus forming a parallel star connected winding.

Upon first thought it would seem to be the same to connect *A*, *B* and *C* in the place of *A*1, *B*1 and *C*1 at the switch. However, this is an error as has been shown. Although the motor will operate with either connection, the magnetic flux will not be evenly distributed when the motor is running at the high speed with the reversed connection, which will be verified by following out the connections in the reversed manner mentioned.—J. H. WICKMAN.



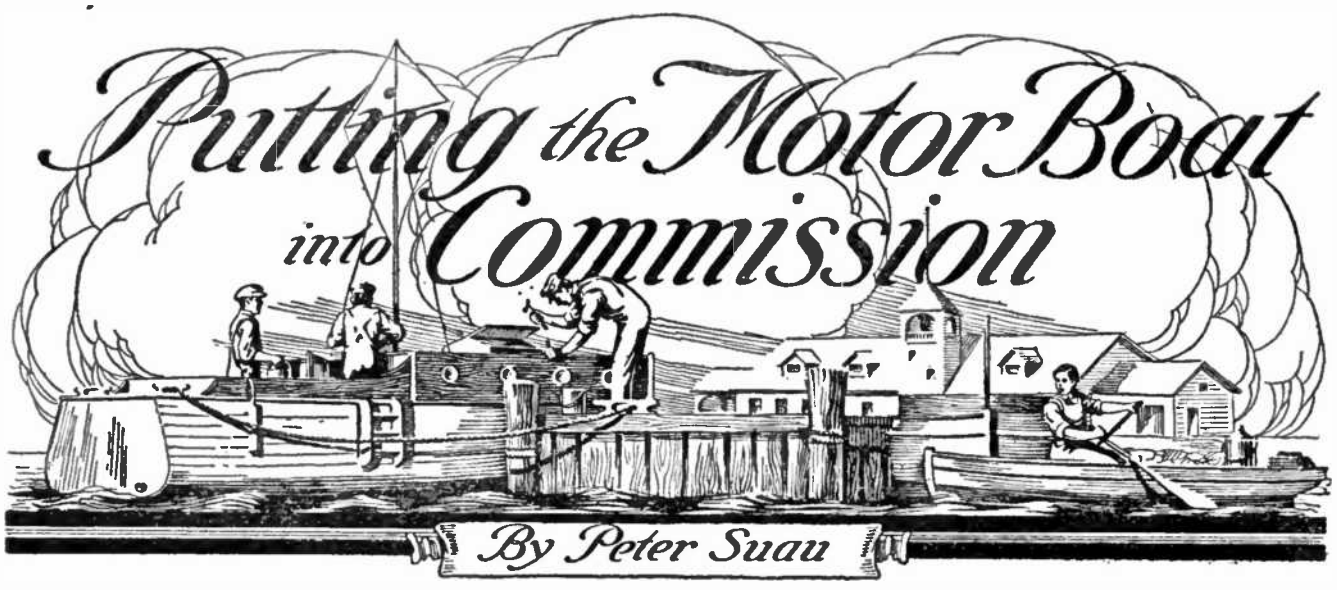
NEW RADIO STATIONS AT CANAL ENTRANCES

According to a recent issue of the *Canal Record*, the following facts are gathered concerning the powerful wireless stations that are being erected in the Canal Zone by the Government.

An antenna has been strung between the new steel masts of the Colon radio station and a series of receiving tests has been in progress. All of the equipment of the plant is ready for use and the towers are completed with the exception of the final riveting. It is expected to have the new plant in full operation upon the receipt of the new spreaders, specially designed of monel metal.

For the Balboa station, the erection of the first of the two steel towers was begun on February 17. These towers will be like those at Colon, self-supporting, 300 feet high, and set 600 feet apart. The apparatus for the Balboa station has been installed complete and is ready for use upon the completion of the towers and antenna.

Upon the completion of the new plants, the old equipment in use at the respective stations will be dismantled. Parts of it have been found available for use in the new plants.



THE work of putting the motor boat in commission is a pleasant task for the motor boat enthusiast. There are two ways of accomplishing the task—the right and the wrong. The right way may be a little more difficult, and, at times, slightly more expensive, but in the end it proves to be the most economical. The work of putting the motor boat into commission can be divided into three distinct tasks:

First—Overhauling the engine.

Second—Refinishing the outside of the boat and doing the necessary inside painting for the average boat of, say, 22 to 28 feet, whether cabin or open boat.

Third—Finishing the bright woodwork—the varnished wood.

For the work under the second and third headings, the tools required would be about as follows:

A putty knife of good quality; one or two scrapers; a small and a large paint brush and a varnish brush.

These brushes should be of good quality. While the paint brushes do not have to be of the very best quality, at least the varnish brush should be of a kind the bristles of which will not fall out. These are practically the only implements required, and the materials will follow later.

Overhauling the Engine

As different gasoline motors vary to a great extent, it is quite impossible to give a standard rule for the overhauling. If the motor boat enthusiast be inexperienced in engine work and there is any serious trouble with his engine, it would be well to secure the services of a good mechanic, who should be watched while working. Thus the beginner will gain some idea as to how work of this character should be accomplished.

We will, however, take it for granted that the boat has been put away in the fall with the engine in reasonably good running order. Before launching in the spring, no matter how well the engine ran last year, all bolts and cotter pins should be gone over to see that they are all tight, firmly holding the engine parts in proper position.

There are two distinct types of motors to contend with—one the two-cycle motor, the other the four-cycle. As a general thing, small, single-cylinder motors are of the two-cycle type. The larger motors of two or more cylinders are about evenly divided, and as they increase in size the proportion of the four-cycle type increases.

All that is required for the general overhauling of the two-cycle motor is to see that all bolts are tight and the different parts are in their proper positions. A cup or two of kerosene run through each cylinder before launching will tend to loosen up the cylinder rings, and make the starting of the engine easier.

The four-cycle type of engine, no mat-

ter how well its operation was during the previous season, will require to have its valves ground. For the uninitiated it may be added that the valve is at one side of the engine where the mixture of gasoline vapor and air enters the cylinder, and is known as the "intake valve." On the other side of the engine another somewhat similar valve is found, which is designated as the "exhaust valve." There is a set of valves for each cylinder of an engine.

If the motor boat owner cannot, with reasonable certainty, remove these valves, it would be advisable to secure someone's assistance who is acquainted with the type of motor in question. To remove the valves of most motors it requires a tool known to the trade as a "valve lifter." This tool compresses the valve spring and permits the removing of the proper pin, thus releasing the valve from its seat.

The valves have beveled faces which rest against a beveled seat, making perfect contact, or at least reasonably so, in order that the compression of the engine is not lost when the valve is closed. The valves should be taken out and thoroughly cleaned, and a good grinding compound secured. Such compounds can be obtained at any garage or automobile supply store in two grades—medium, rough and smooth.

Upon examination of the valves it will be noted that the intake ones are practically clean, whereas the exhaust valves are pitted. To grind the exhaust valves, take a small quantity of the rough grade of grinding compound and smear it over the beveled surface of the valve; then take a screw-driver and insert it in the slit in the valve head and turn it backwards and forwards, lifting the valve at short intervals and changing its position. This grinds the surfaces evenly and does not give any extending portion of the beveled surface of the valve head a chance to grind its way into the seat. After this has been done for some little while it will be noticed that the pitted surfaces are gradually being ground out. When they are fully ground away, the beveled surface of the valve and the beveled seat upon which the head sets should show a reasonably smooth surface. It is then time to use the finer grade of grinding compound to smooth them off.

It is well to state at this point that since the grinding compounds usually contain more or less emery, the valve and the valve seat must be cleaned thoroughly before the engine is in any way operated, since if any emery should enter the cylinders in any quantity it would ruin the engine beyond repair. To ascertain if the grinding of the valve is perfect, give the valve seat a thin coat of colored paint and drop the valve head into place, but do not turn it in any way. Remove the valve and examine it carefully. If the beveled surface on the valve head is equally covered on all sides with the paint, the contact between it and its seat is perfect. Any portions that are not coated with paint indicate that there are spaces between the valve and its seat, and obviously will allow leakage when the engine is running. Under these conditions, clean all the color off and proceed as at first until the valve sets correctly.

If the engine is in a boat of the cabin type, the wiring to the spark plugs is probably in good condition. However, should the engine be in an open boat it is advisable to rewire the engine. If the grade of wire required is not known, it is wise to take a sample of the different

Finishing the Bright Woodwork of a Motor Boat Is a Comparatively Simple and Inexpensive Task.

sizes when purchasing the new wire. If the engine be of a complicated type, that is, of two or more cylinders, all wiring should be followed from the spark plug to its source and tagged or designated by some mark, so that when removed it can be replaced correctly.

Refinishing the Outside of the Boat and Painting the Inside

The materials required for the refinishing of the outside of the boat and the inside painting for salt water use are as follows:

Putty, white lead, white French zinc, linseed oil, turpentine, drier and selected coloring matter for the paint, red lead, copper paint, oxalic acid, varnish remover and varnish.

Sandpaper in a coarse, or No. 2, grade, and a finer grade, such as No. 0. For the rough work, steel wool of a grade equal to the No. 2 sandpaper may be used, perhaps with better results.

The outer portion of the boat, aside from the bright woodwork, should be sand-papered thoroughly with the No. 2 grade of sand paper, or rubbed with the steel wool, until the surface is smooth. Then, with a putty knife, examine all the seams in the boat to see that the last year's putty is not loose. Any loosened putty should be removed. Where the putty is cracked but is held securely in place, do not take it out, since the planking of the boat when once in the water will swell up and close these cracks.

Spots will be found where the seams have contracted and pushed the putty out. At these places cut with the putty knife until level with the planking. The next operation should be to take a small quantity of white lead paint mixed as follows:

Take a clean can and, with the putty knife, remove, say, a pound of white lead from the white lead pot and put it in the can. Pour in enough turpentine to make a thick, heavy paste. Then add linseed oil, mixing the paste with a clean stick until the paint runs off the end of the stick in a rather heavy stream. If too thick the paint will run very sluggishly; if too thin it will drop like water. A happy medium must be struck.

For a pint of white lead paint about an ounce or two of dryer will be sufficient for the purpose to which this paint is going to be put. It is advisable to mix paint at least three or four days in advance of the time when it is going to be used, as this gives the ingredients an opportunity of becoming thoroughly mixed.

The paint being ready, the small paint brush now comes into use. Wherever the putty has been removed, paint the seam thoroughly; by this is meant on the two surfaces at right angles with the outside of the planking. After this has been done the paint should be allowed to dry for at least two or three days. The seams are then ready to receive the putty. The putty, in itself, is not adaptable to boat use and accordingly a mixture should be made as follows:

Take a clean piece of board and with the putty knive remove from the pail a quantity of putty and place it on the board. Then take a quantity of the pure white lead and mix thoroughly with the putty. The proportions should be about 15 to 20 per cent. of white lead to 80 per cent. of putty.

When thoroughly mixed, the prepared putty should be of a consistency that can be kneaded in the hand without sticking to the fingers. If too much white lead is introduced the mixture will stick to the hands.

When the mixture has been well worked up and the white lead thoroughly mixed in, putty the seams as follows: The putty is forced into the seam with the putty knife; the person doing this work being careful to see that the seam is entirely filled with putty up to the level of the planking. Otherwise when the mixture sets it will sink inwards, making a hollow seam which is very homely in the finished boat. When the puttying is completed, at least three or four days should intervene before the first coat of paint is applied.

It is peculiar, but nevertheless so, that copper paint will not adhere to white lead paint. If the white lead paint goes below the water-line and the copper paint is put on over it, experience has taught that before the boat has been many days in the water the paint will start to come off. It is, therefore, advisable to put a coat of the copper, or bottom paint, on first.

Copper paint is secured ready mixed.

The brown copper paint is the best, as it repels any marine growth. This grade of copper paint costs from $2.25 to $2.75 per gallon. Upon opening the can the paint should be thoroughly mixed with a stick, as the copper in the liquid settles on the bottom very rapidly. Copper paint applied to the bottom of the boat will usually dry hard in about six hours. However, before applying the copper paint, any metal work below the surface, such as the skeg and the rudder which very often are of iron, should be given a coat of red lead paint. The copper adheres readily to the red lead paint, which may be made as follows:

If the Varnish on a Boat is in Poor Condition, It is Better to Remove It Entirely and Then Refinish.

Pour about a pint of linseed oil in a can and then drop in the red lead powder while stirring. Sixteen ounces of linseed oil will take at least a pound or slightly more of red lead before it has the proper body for painting. This also requires a small quantity of drier, of which two ounces will be sufficient.

If the red lead paint when applied and while drying becomes streaky it is because there has not been a sufficient amount of the red lead powder used in making the liquid. This can only be remedied by giving the metal parts in question another coat. The painting above the water line may then proceed.

We will take it for granted that the boat is painted white above the water line. Paint for this purpose can be mixed for obtaining two distinct finishes: One, a high gloss; the other, a dead matte finish. To secure these different mixtures proceed as follows:

FOR THE HIGH GLOSS.

Place in a can about 3 to 4 pounds of white lead and one pound of white French zinc. Pour in turpentine of sufficient quantity to make a heavy paste, and then thin out with linseed oil to the same consistency as explained before. Next add half a tumbler full of the drier. This paint should be stirred continually for at least half to three-quarters of an hour in order to secure the proper homogeneous mixture.

If this paint has been mixed in a paint pail that had white paint in it before, it is advisable to strain the mixture through a piece of cheesecloth into a clean pail so that the paint will be absolutely free from any skins.

Apply the paint with even strokes running lengthwise, and do not remove the brush abruptly from the planking, as this will leave marks which, when the paint is dry, will show. After the first coat has been applied it should be allowed to stand for at least 36 to 48 hours to dry hard. Then proceed to look over the surface of the paint to see if there are any dents, or if the seams have any holes in the putty. If any blemishes of this character are found, fill to the surface with the white lead putty. The white lead putty must be permitted to dry hard before the next operation can take place. After it has dried hard go over the surface lightly with the No. 0 sandpaper, then apply the second coat of white paint. At this stage of the work the surface of the planking should be perfectly smooth and the seams should not show through. By this is meant that from the water line to the top of the boat the planking should appear as one solid piece. Two coats of good paint should be sufficient. If, however, there are any marks, proceed as before with the putty and sandpaper, and give a third coat.

TO SECURE THE DEAD MATTE FINISH.

Take 60 per cent. white lead, 40 per cent. of white French zinc. Thin out to the consistency required for easy painting, as explained before, with turpentine. *Do not put in any drier.* If the quantity of paint mixed is a gallon at one time add about one-half pint of linseed oil.

Proceed to paint as in the other instance. If any of the white paint has run below the water line, remove it with the putty knife or sandpaper and proceed with the second coat of copper paint. The French zinc used in the white paint is intended to keep the paint white. Ordinarily, white lead paint will turn yellow if it is not mixed with a sufficient quantity of the zinc. It should be mentioned here that the linseed oil for white paint should be of the bleached type. For colored paints this is not necessary, the ordinary raw linseed oil being quite satisfactory.

For cockpit floors, the mixture of the paint is slightly different. The white lead is mixed into a heavy paste with turpentine to which is added equal parts of a fair quality varnish and linseed oil, finally including any desired ground color and oil until the desired shade is secured. If the paint is too thick, add more of the varnish and linseed oil. To this paint add drier. As will be noted from the foregoing, the drier varies according to the quantity of paint being prepared, but it is at all times a very small portion of the mixture—about two ounces to the pint. This mixture comprises a paint that is more durable for floor purposes than those in which the varnish is left out. It might be added that an excellent coloring matter for this purpose is raw sienna. It gives a light, yellowish buff tint, which is very popular and shows dirt less than many other shades of paint. This paint can be used to advantage for the outside top of a cabin cruiser, as well as for all floorings and decks. For inside woodwork in a cabin type of boat where white paint is used, the same mixture as used on the outside planking will be found excellent. It is, however, better to use the gloss finish paint, as the one that produces the matte surface is not so adaptable for inside work.

Finishing the Bright Woodwork

The condition of the bright woodwork has a great deal to do with the procedure of finishing. If the wood has been well taken care of it is practically a simple matter to renew its finish without great difficulty, whereas if the varnish has been allowed to wear off in the preceding season it will probably require total refinishing.

We will take up the first condition, *i. e.,* the woodwork in fairly good condition.

The first step is to scrub the woodwork thoroughly with hot water and soap, then go over it with a bleach. The bleach is made up as follows:

Take, for instance, an ordinary quart bottle and fill it about three-quarters full with plain water. Add oxalic acid until the solution becomes saturated; *i. e.,* when the oxalic acid settles at the bottom of the bottle and the water will not take up any greater quantity than it has already taken.

Spread the bleach thoroughly over the woodwork and allow it to dry. This solution will not in any way attack the old varnish, but it will bleach the wood where it is uncovered. About 24 hours will suffice for the bleaching process. Following this the bleach should be thoroughly washed with a solution of half water and half ordinary vinegar. When thoroughly dry go over the work lightly with a very fine grade of sandpaper. If the sandpaper is coarse it will scratch the varnish that is already on the woodwork, which will show through when the new varnish is applied.

The foregoing accomplished, the varnishing can now proceed. This should be well worked out with the brush. Varnishing should be done only during dry, clear weather.

If the finish of the workwork is in a very poor condition, the old varnish will have to be entirely removed. To remove it proceed as follows:

Cover a small patch of the woodwork with a varnish remover, which practically takes effect immediately, and follow with the scraper. When the woodwork has been entirely gone over and the old varnish removed, it should be stained, provided a stain was used before.

These stains are obtained ready mixed. If, however, the wood is in the natural state, such as oak or mahogany, it is preferable to finish it without stain. When the old varnish has been removed from the natural wood and no stains are used, the bleaching process with the oxalic acid is resorted to as in the other instance. When the woodwork is thoroughly washed and dried it should be gone over with a rag or piece of cotton that is saturated with linseed oil. Before the linseed oil has dried thoroughly, sandpaper with No. 0 sandpaper. This acts as a filler, making a better surface for the varnish, and is, in every way, better than a ready prepared filler, as it takes greater labor to refinish the woodwork again, even when the regular filler has been used. Permit the oil to dry for at least 24 hours, and then wipe off clean with a cloth and proceed to varnish. For all outside decks and woodwork which are exposed to the elements, at least three coats of varnish should be given, and then one coat once a month during the season.

Possessing a Fair Ability in Handling Tools and a Liberal Amount of Spare Time, There Is No Reason Why the Average Boat Owner Should Not Do His Own Repairing.

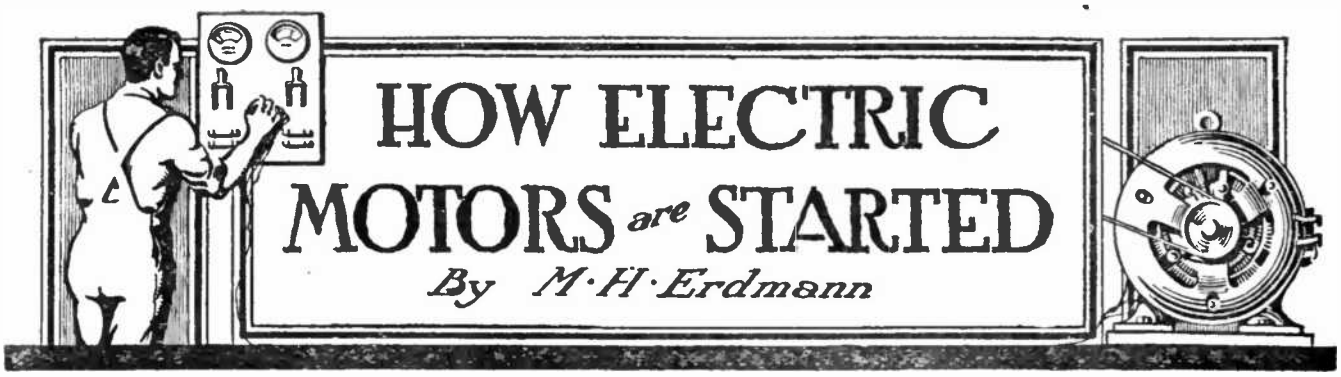
In purchasing spar varnish be sure that it is the very best procurable. This spar varnish will cost in the neighborhood of $4.50 per gallon.

Do not add anything to the varnish in the way of turpentine or other paint mixtures, as they will spoil the varnish. In handling the can do not shake it, as this causes air bubbles in the varnish which will spoil the finish when applied to the wood. If, by accident, a can of varnish should be shaken, it must be allowed to stand until all the air bubbles have disappeared.

NEW NITROGEN-TUNGSTEN STREET LIGHTS A SUCCESS IN SEATTLE

There are probably fifty cities in America which lay individual claim to being "The Best Lighted City in America." Seattle, Wash., however, really has well-founded claims to the distinction. Seattle is the first city to exploit the new nitrogen filled, low voltage tungsten lamp for street lighting, and by an ingenious and effective method of diffusion the streets are flooded to all points with the genial glow. These lamps have the highest efficiency of any practical street lamp yet devised, and, due to their satisfactory behavior, the Government has selected them as a means for illuminating all of the locks at the Panama Canal.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, tell us.



HOW ELECTRIC MOTORS are STARTED

By M·H·Erdmann

STARTERS of various kinds were described in the first part of this article, which appeared in the April issue of THE WORLD'S ADVANCE. The second part of the discussion follows:

True and absolute current limit acceleration can only be secured by the use of the series wound accelerating switch; *i. e.*, a switch whose operating coil is so wound as to adapt itself for connection in series with the motor to be accelerated. There are two types of such switches on the market at present, both of which operate upon similar principles. The general schematic arrangement of one of these types of switches is shown in Fig. 6. The winding *I* is carried by a brass tube within which the core *E* is free to reciprocate vertically. The upper end of this core carries a non-magnetic stud to which is attached a copper contact plate *G*, adapted to make contact with a pair of contact brushes *H* when the switch is closed. The lower end of the core is reduced in cross section and forms a stem *F*, which meets the body of the core to form a shoulder. The stem *F* passes into a hollow adjustable plug *C* which is of magnetic material. The winding of the switch is enclosed and protected by a semi-cylindrical iron casing *A*, which also constitutes the return member of the magnetic circuit. The upper member of the frame or case *A* is provided with a plug or polepiece *B* of magnetic material. When the current flows through the winding *I*, magnetic flux passes between the plug *B* and the upper face of the core *E*. Substantially all of this flux is normal to the face of the core *E* and is effective in producing a magnetic pull tending to close the switch. At the lower end of the core, however, the flux has two paths. One of these is from the horizontal portion of the frame *A*, into the sleeve or hollow plug *C*, and from the upper face of this sleeve through an air gap into the shoulder on the core. This portion of the flux takes a direction practically normal to the face on the shoulder of the core and produces a magnetic pull which tends to move the core downwards, or, in other words, tends to prevent actuation of the switch. Through the second path at the lower end of the core a portion of the flux passes directly into the stem or extension *F* in a direction at right angles to the direction of motion, and this portion of the flux is therefore not effective in producing a pull on the core in a vertical direction. The total flux divides between these two paths inversely as their reluctance. With a small current in the winding *I* substantially all of the flux passes directly into the extension *F*, this path being of much less reluctance than the path including the air gap. The extension *F*, however, is of restricted cross section and as the magnetic force is increased the reluctance of this path increases and more and more of the flux is crowded into the air gap.

The core *E* is then acted upon by two forces: one, the magnetic pull at its upper end which tends to close the switch; and the other made up of the weight of the moving parts plus the downward magnetic pull at the shoulder on the plunger. When the current is below a certain critical value the upward pull is greater than the downward pull plus the weight of the moving parts and the switch will close. When the current is above this critical value the downward pull plus the weight of the moving parts, predominates and the switch cannot close.

The critical point below which the switch will close and above which it will "lock out" is adjusted by screwing the adjustable plug *C* in or out, which adjusts the lower air gap. This has the effect of altering the reluctance in the path, including the air gap with respect to the reluctance of the path through the stem or extension *F*. Screwing in the plug and thereby shortening the air gap has the effect of decreasing the value of the current at which the switch will lock out, while increasing the air gap has the effect of increasing the value of the current at which the switch will lock out.

A simple form of automatic starter employing series wound switches to obtain current limit acceleration and used in connection with a compound wound motor, is shown in Fig. 7. The starting resistance *R* is proportioned so as to allow only 150 per cent. of full load current to flow through the motor when it is in circuit immediately after the

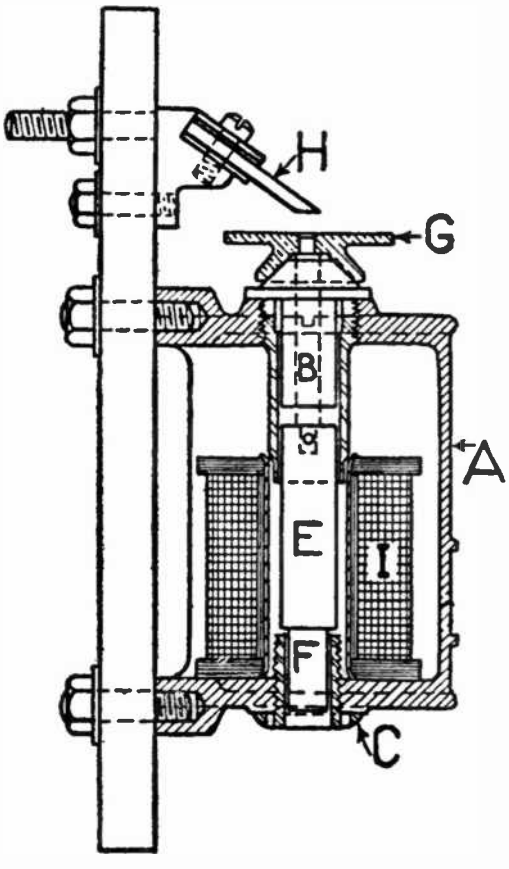


Fig. 6.—Plunger Mechanism of an Automatic Motor Starter.

knife switch *K* is closed to start the motor. This current will lock out the accelerating switch S_1. As the motor gains in speed, the current drawn from the line will decrease until the value is reached at which S_1 will close, short cir-

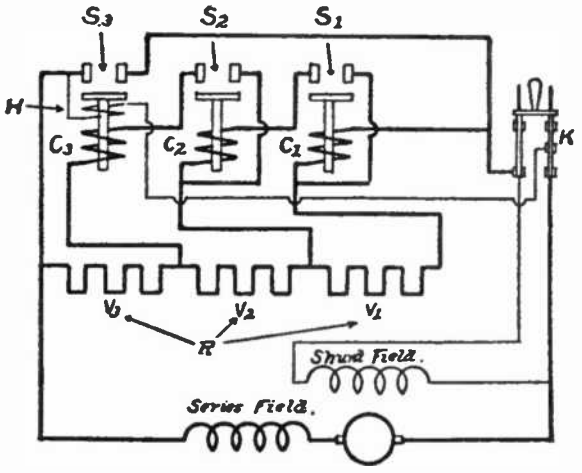


Fig. 7.—A Simple Form of Automatic Starter Employing Series Wound Switches.

cuiting the first section of resistance V_1 and at the same time energizing the operating coil of S_2. This will cause a sufficient rise in current to lock out S_2. Then as the current decreases again it will reach the value at which S_2 will close, cutting out a second section of resistance and energizing the operating coil of S_3. When S_3 closes the motor is connected directly across the line and is receiving full voltage at its terminals.

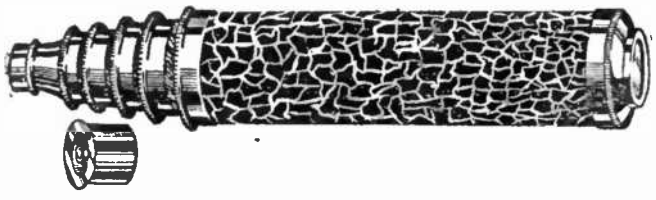
In addition to the regular operating coil, S_3 is also equipped with a shunt wound holding coil *H*, which is supplied with voltage equal to the counter electromotive force of the armature, and which is designed to hold the plunger of S_3 up when it is once in the closed position. The magnetic flux produced by this coil is sufficient to hold S_3 closed, but not enough to close it until the current in its operating coil has dropped to the value for which the switch is adjusted. When the knife switch *K* is opened to stop the motor it opens the circuit to the shunt holding coil, which, in turn, allows S_3 to open immediately, making it possible to close *K* again to accelerate the motor before the armature has come to rest. If this provision were not made the starter would be very undesirable in case it should ever be required to accelerate the motor prior to the armature coming to a dead stop, for with S_3 in the closed position and the motor running at a low

rate of speed, if *K* were closed it would connect full line voltage across the motor's terminals and the result would be either a blown fuse or a collection of fireworks around the commutator.

In conclusion, it might be well to add that all the different general types of automatic motor starters described in this paper can be equipped with shunt contactor switches for starting and stopping from remote points by means of push buttons, float switches or other auxiliary devices. When the shunt contactor is used, provision can also be made for overload protection while the motor is running.

TELESCOPE WITH IMPROVED FEATURES

When we consider that it was early in the seventeenth century that Galileo constructed his first telescope, it would seem that every possible improvement should have been made before the dawn of the twentieth century. Yet as late as February 24, 1914, a United States patent was granted to Franklin B. Warner and assigned to Kirtland Bros. & Company,



Improved Telescope and Special Solar Eye Piece.

of New York, for a new and improved multi-focal telescope.

The improved telescope is arranged to permit of the convenient use of interchangeable objective lenses of more or less magnifying power with different focal lengths, and to allow changing the length of the tubes to correspond to the focal length of each respective objective lens. The instrument is so constructed that the tubes are firm and rigid, and held in alignment at all times.

The multi-focal telescope invention is protected by four very broad claims. Probably the greatest feature of the invention is that the user is enabled to take better advantage of distances and the conditions of light and atmosphere. The telescope is sold with two objective lenses, one for medium range with murky atmosphere, and the other for long range in a clear, rarified atmosphere. Despite its many advantages, the telescope is sold at a very moderate price.

Mr. Warner was granted a patent combination dust cap and solar eye-piece on April 24, 1906. The object of this invention, as its name implies, is to protect the eye-piece end of the telescope from dust and dirt when not in use, and to provide a mount with a dark lens for sun observations. The dust cap solar eye-piece is supplied with the multi-focal telescopes.

With the telescope, eclipses of the sun and moon can be observed with interest. and even sun spots may be seen under favorable conditions. On a farm or ranch of even small size this telescope would pay its cost many times over. In these days of the airship and the aeroplane a new use for the telescope has developed, hence, the person on land needs a telescope to see the ships in air sail by no less than he who dwells by the sea.

ELECTRIC RAILROADS IN THE UNITED STATES

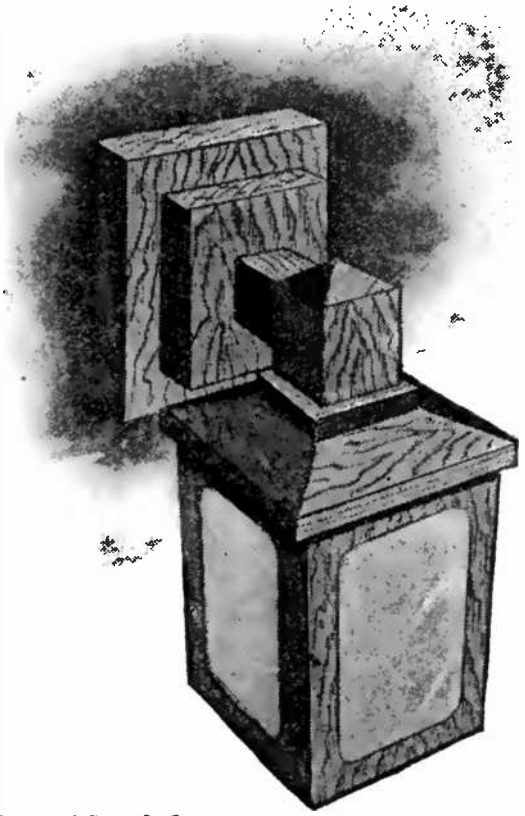
In 1912 there were 1,260 electric street railway systems in the United States employing a total of 282,461 men and representing an investment of $4,708,568,141. So complete is the network of electric railways in this country that today one can travel from Boston to Chicago with only a few miles of steam travel where there are gaps yet to be filled.

Anyone knowing who the amateurs "IE" or "PWR" are and where they are located, will confer a great favor by reporting the information to John M. Clayton, 1301 Welch St., Little Rock, Ark.

A Lantern for the Porch

THE project offered in this article will serve either as a lantern for the porch or as a wall bracket of unpretentious but withal pleasing design. If it is put to the latter use the severe side panels may be displaced by others bearing some quaint device sketched upon the wood and cut out by means of the scroll saw. The panel for the porch light is purposely made severe in order that a house number may be painted upon the class. A more artistic piece of work may be made of the lantern if the number is cut directly from the thin wood of the panel and made to form a part of the design itself.

The simple construction of the lantern may be noted with a glance at the drawings in Fig. 1. The lantern proper is composed of four side panels of thin wood fastened together with beveled corners and strengthened by means of the top and bottom frame and corner posts. The dimensions of the lantern as a whole may be determined by using the scale reproduced with the drawings in this figure, cutting it out with a knife.



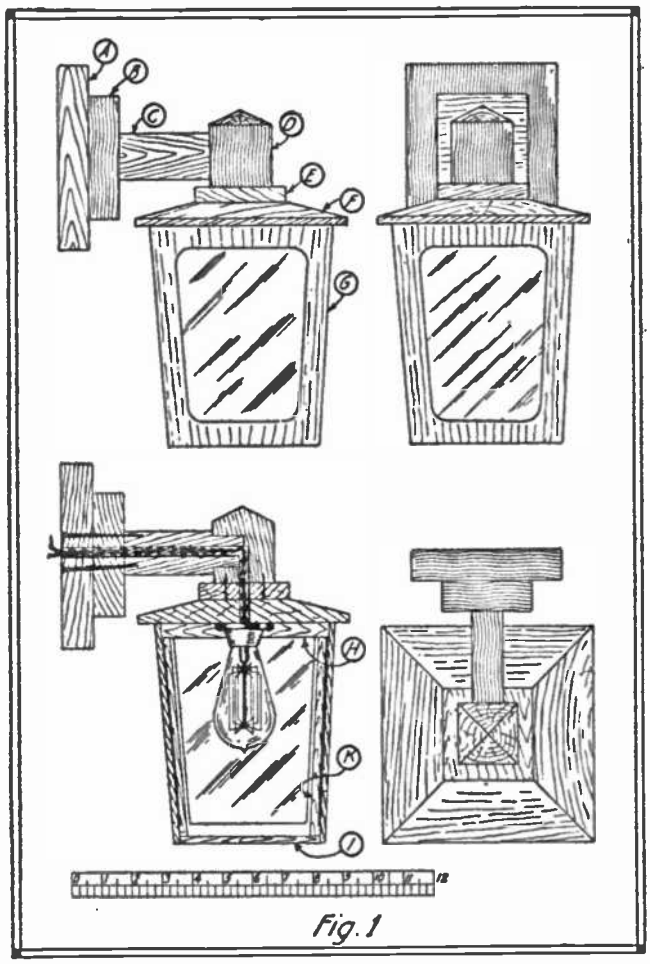
View of Porch Lamp as It Appears When Completed.

For the dimensioned details, the reader is referred to Fig. 2, in which are given the sizes of the various pieces and the number of each required. The bill of materials to be given to the lumber mill is as follows:

(*A*)	1	piece wood	1″ × 5″ × 5½″
(*B*)	1	" "	1″ × 3″ × 4″
(*C*)	1	" "	1″ × 1½″ × 4″
(*D*)	1	" "	2″ × 2″ × 2½″
(*E*)	1	" "	½″ × 3″ × 3″
(*F*)	1	" "	¾″ × 7″ × 7″
(*G*)	4	pieces "	¼″ × 6″ × 7¼″
(*H*)	4	" "	½″ × ½″ × 5½″
(*I*)	4	" "	¼″ × ¼″ × 4½″
(*K*)	4	" "	¼″ × ¼″ × 6½″

For outside duty, mahogany will be found the most serviceable and for the small quantity of wood required the cost will not be prohibitive. If the lantern is to be used indoors, the wood may be of oak or in fact any wood which harmonizes nicely with the interior decorations.

The first operations, in the event that the lumber has been ordered cut to size and sanded at the mill, will be to make the mortise and tenon joint between the arm *C* and the block *D* after the latter has been pointed at top. The joint should be a good fit and the pieces left separate until after the holes have been drilled and the twin wire passed through. Prior to drilling the holes, the block *B* should be centered upon and

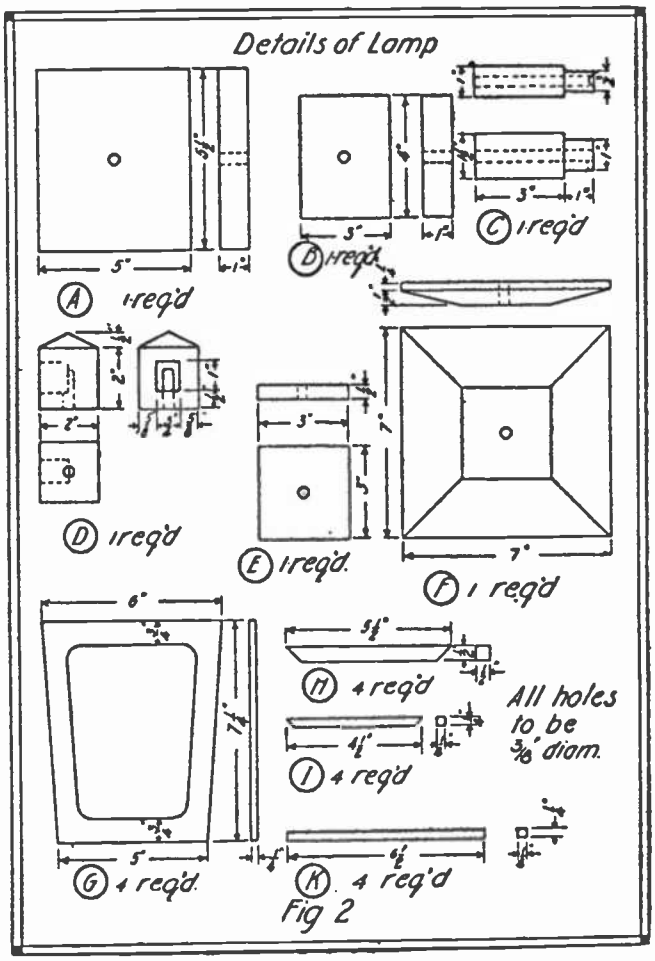


Various Views of Porch Lamp, Showing the Assembly of the Parts.

nailed to the block *A* with a very thin layer of glue between. The arm *C* is then secured to *B* by means of two slender wood screws passing through the two blocks as shown in the sectional view in Fig. 1. The hole may then be drilled through the two blocks and the arm. The bevel may next be cut upon the lantern top *F*. The block *E* is nailed and glued to the post *D* and then the top of the lantern secured to this combination by means of nails and glue. The hole may next be drilled through the lantern top, the block, and the post. The post and arm are still left separate.

The side panels having been prepared and the edges beveled at 45 degrees, the body of the lantern may be assembled. The first operation is to nail the four pieces *H* to the lantern top. The lower frame composed of the pieces *I* is to be assembled independently with glue and nails. The side panels *G* may then be fitted to the top of the lantern and the lower frame, nails being located cautiously at the mitered corners. The fitting of the corner posts *K* to strengthen the body of the lamp brings us to the point where the arm and post *C* and *D* may be fitted together. A piece of incandescent lamp cord of suitable length is bared at its ends and the wire gripped under the lugs of a lamp receptacle. The wire is then passed through the hole in the post and the receptacle drawn up tightly against the inside of the lantern top, where it is secured with screws. The wire is then passed through the hole in the arm *C* before the latter is secured to the post. The application of glue to the mortise and tenon and the bringing of the two snugly together completes the assembly. The reason for holding these two parts separate until the wire has been passed through is, of course, apparent to the reader; it would manifestly be impossible to bring the wire around the corner otherwise.

The glass may be milk white or colored art glass as the builder's preference dictates. The former is in better taste for



Parts of the Porch Lamp with Their Respective Dimensions.

the porch and in such an event an exceedingly pleasing combination is secured if the entire woodwork of the lantern be painted a dead black. If the natural color of the wood is desired, the woodwork should be treated to several coats of good spar varnish both inside and out of the lantern. The greatest problem is to protect the wood from the action of the weather and the best protection is afforded through the liberal application of good waterproof varnish.

INDIGO — AN INDUSTRY THAT WAS KILLED IN A NIGHT

Up to a decade or thereabouts ago one of the most important of tropical industries was the raising and manufacture of indigo for use as a dye. Then, suddenly and without warning, came the news of the discovery of aniline dyes, by which, through inexpensive processes, coloring mediums could be manufactured from coal tar and benzole which answered all the purposes of indigo at a fraction of its cost. This discovery was like a bomb thrown into the midst of the indigo industry, for, as far as their future usefulness was concerned, the plants engaged in the manufacture of that hitherto valuable commodity might just as well have been dynamited. To-day, even in Central America and India where it was most active, it is practically as though the indigo industry never existed.

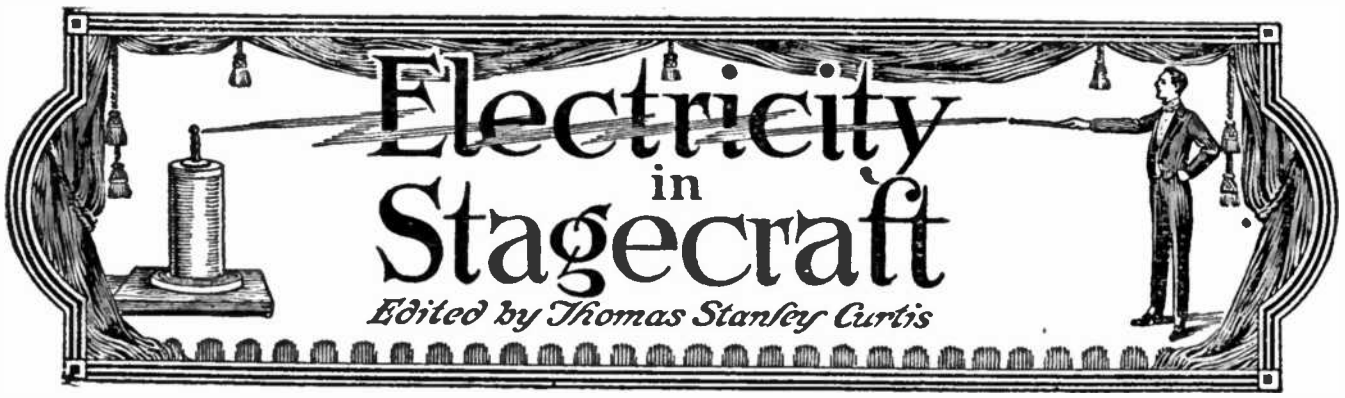
In the light of the passing of the indigo industry, those who are interested in the production, manufacture and sale of rubber are asking themselves and each other if that industry will not be the next one to fall before the inflexible scythe of science. The world production of rubber at the present time, between the wild and the plantation product, is about 90,000 tons, worth anywhere from $150,000,000 to $175,000,000. The investments in the industry must foot up to over a billion dollars. With rubber at one dollar a pound, there is a huge profit in it for the planter, and it is hardly likely ever to go much below that price as long as it comes from the juice of a tree. The area planted to rubber trees would be tremendously increased but for the fear that the discovery of a practicable process of making synthetic rubber at a low price will be discovered. (Such a process has, in fact, been discovered in Germany, but though the ingredients —corn, common salt and lime—are very cheap, the elaboration is still so expensive that the finished product is more costly than natural rubber.) It takes a lot of courage for men to put several millions into a project with the full knowledge that any day may bring news of an invention that will make them paupers at a single stroke. Synthetic rubber at ten or fifteen cents a pound does not sound nearly so remarkable as a score of scientific inventions that have been announced within the year, and few indeed are the optimists among the rubber men who do not feel in the bottoms of their hearts that it is coming.

TELEPHONE PROGRESS IN THE UNITED STATES

The recent completion of the transcontinental telephone line has been the result of a steady progress in long-distance telephonic transmission. The following chronological table is interesting.

Year.	Terminals.	Miles.
1876	Boston-Cambridge	2
1882	Boston-Providence	45
1884	New York-Boston	235
1892	New York-Chicago	900
1911	New York-Denver	2100
1913	New York-Salt Lake City	2600
1915	New York-San Francisco	3400

America, the country that gave birth to the telephone, leads the entire world in the extensive use of this means of communication.



Preparing the Lecture*

NOT the least important feature of the work in hand is the preparation of a suitable explanatory lecture to accompany the experiments which are to be performed with the apparatus described in past articles. Upon the snap and vigor of the lecture depend in a large measure the successful presentation of the offering. It is safe to assume that the day of the electrical fakir is past—no longer can the smooth-tongued performer claim some supernatural power which enables him to take through his body enormous voltages which would prove fatal to the average mortal. The lecturer of this type is as much a thing of the past as is the old-time magician who makes claim to some occult power rather than to sleight-of-hand or mechanical ingenuity to accomplish his tricks. The electrical entertainer of today must bear in mind that in the past five years the education of the general public along the lines of electricity and science has advanced in an astonishing degree, and to offer his experiments under the guise of a wizard is not only to insult the intelligence of his audience, but to stamp himself as an absurd charlatan as well. Just as the modern prestidigitator credits his quickness of hand, so should the electrical entertainer give credit to modern science for his ability to perform the startling experiments he offers.

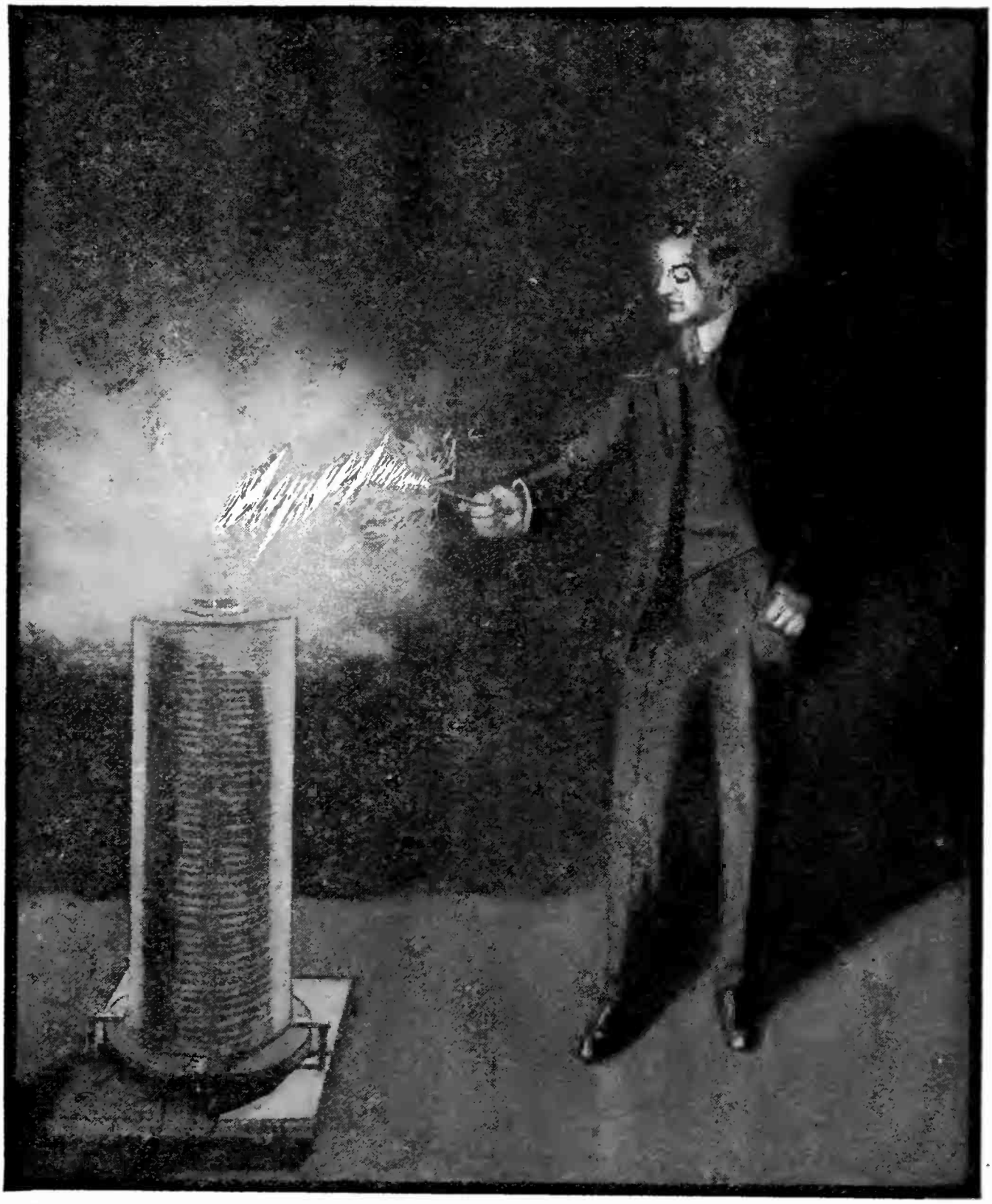
The class of audience catered to should also bear careful consideration. The style of talk favored by the intelligent and well-read Chautauqua assembly would be hopelessly out of place in even a high-class vaudeville theatre. This is not due to the lesser degree of intelligence to be found in the theatre audience so much as to the fact that such an audience demands to be shown rather than told. The experiments must speak for themselves and any lecture accompanying their presentation must be more in the nature of an explanatory "chatter" rather than a discourse on the theory and scientific reasons for the phenomena demonstrated. With the typical lecture audience, on the other hand, the explanatory remarks may be more comprehensive in nature, as such an audience comes to listen and be instructed, as well as to see and be entertained. At the same time the performer must not lose sight of the fact that many of the people in even a scholarly audience are totally unfamiliar with even the fundamentals of electricity except in a vague way, and his discourse should therefore be interspersed with frequent analogies in everyday life in order that the terms and phrases used may be clearly comprehended.

A clever touch of comedy is of almost inestimable value; for the theatre audience it should be of the "slap-stick" variety, while for the lecture assembly it should be genteel or even subtle in nature. As an illustration of the former style of

*This article is one of a series that has appeared regularly in past issues of *Modern Mechanics* and THE WORLD'S ADVANCE since September, 1914. Previous instalments have covered the construction of the apparatus referred to in this issue. Back numbers may be secured at 15 cents per copy while the supply lasts.

comedy, the writer has seen many a mediocre electrical act carried through to a riotous curtain simply because a more cultured audience would have resulted in a few disdainful smiles.

The performer should beware of a



The Theatre Audience Demands to Be Shown Rather Than Told; the Experiments Must Speak for Themselves.

handful of boys from the audience were knocked off their feet supposedly through contact with a wire. The same bit of comedy presented for the approval of a lengthy introduction in either of the two cases. For the theatre, the opening remarks should be exceedingly brief and

(*Continued on page* 695)

Electricity in Horticulture
Edited by Thomas Stanley Curtis

Plant Culture by High Frequency Current

Part III. Construction of the Spark Gap

PERHAPS no one portion of the high frequency current apparatus is more likely to give trouble and to require frequent attention than is the spark gap across which the condenser discharges. The discharge is accompanied by heating effects which are in themselves troublesome, and while the ordinary stationary form of gap may give satisfactory service for a time at least, still its successful operation is hindered, as the sparking surfaces become heated and pitted. The gap to be described has proved its value in actual practice and, while it may appear to be unnecessarily complex in design, still the many points of advantage are only brought out through the construction of a substantial and more or less massive affair.

With reference to the side elevation and plan views in Fig. 1, the gap consists of two 8-inch discs of zinc arranged to rotate in opposite directions at a fairly rapid rate of speed. The rotation serves the double purpose of always presenting a fresh sparking surface, and therefore a cool one, to the point of discharge, and in establishing a strong current of air directly upward and between the sparking surfaces, due to the surface friction of the periphery of the discs. The effect of this current of air is to assist in the wiping out of any arc which may form during the discharge.

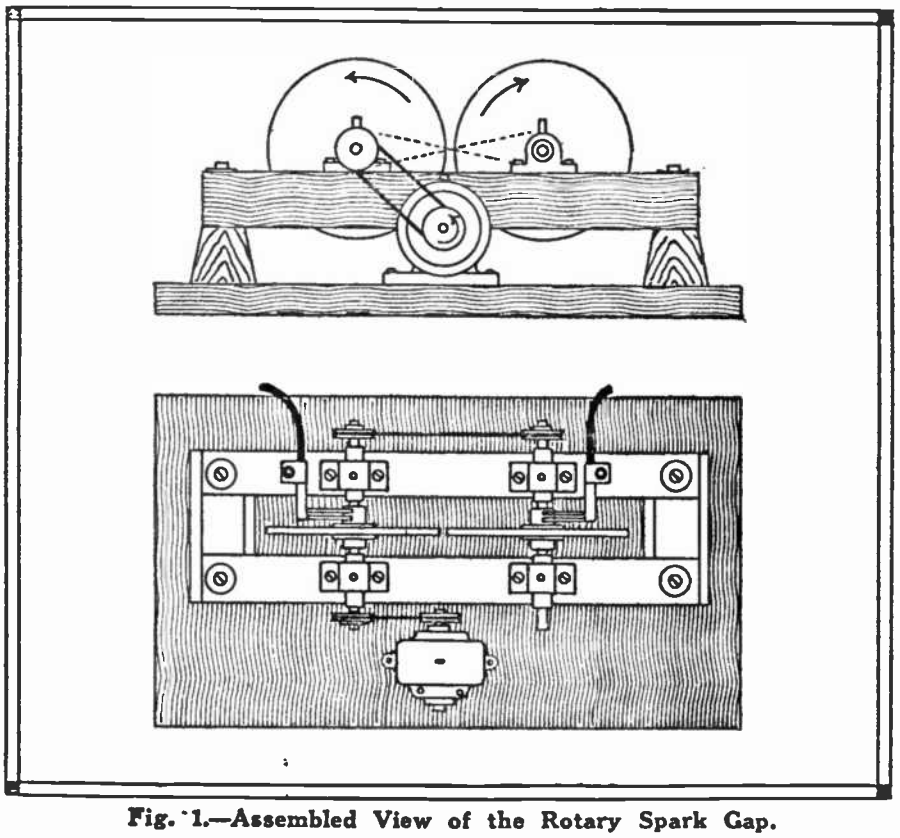


Fig. 1.—Assembled View of the Rotary Spark Gap.

The discs are mounted upon a substantial framework and base of dry wood which has been painted with or preferably boiled in paraffin wax. The discs are mounted upon shafts of ½-inch steel and secured to the latter by means

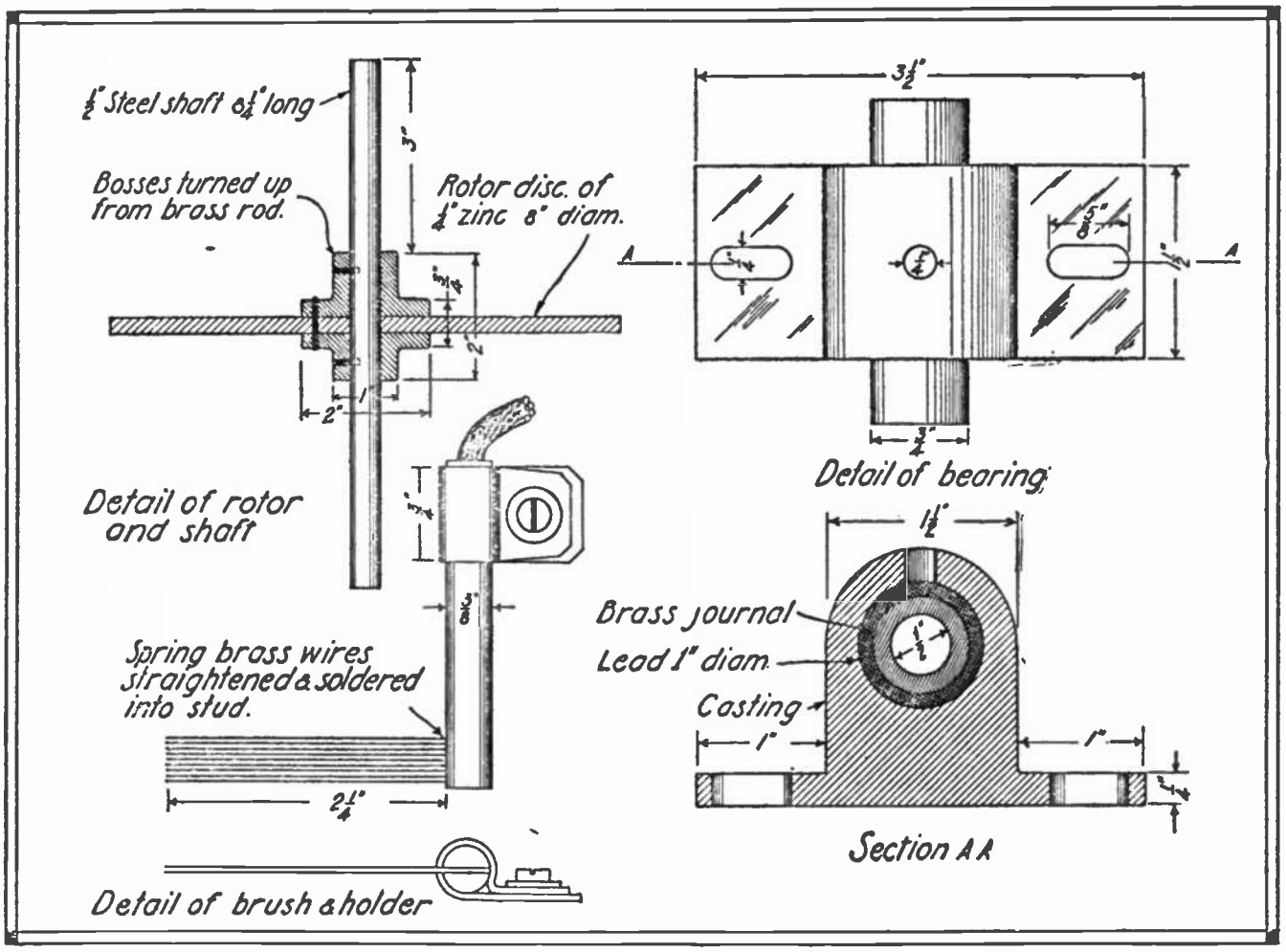


Fig. 2.—Details of Parts of the Rotary Spark Gap, Showing Method of Construction.

of brass bosses turned up and drilled to a snug fit on the shaft. When the final assembling has been done the bosses are pinned to the shaft and to the disc, thus insuring the permanency of the construction. The final operation is to take a finishing cut off the periphery of each disc with the shaft held between centers in the lathe.

The details of the bearings are given in the enlarged drawings, Fig. 2. The reader will note that the bearing proper is a journal of brass tubing reamed to fit the shaft nicely. The bearing support is a casting with a hole cored through it to take the journal. Slots in the feet of the bearings permit the distance between the discs to be varied.

When the various parts have been finished, the bearings are located on the framework as shown in the plan drawing and the journals slipped over the shafts. A piece of cardboard is then forced over each end of each journal after the latter has been propped up inside the bearing with bits of wood. Melted lead is then poured into the opening at the top of the bearing and when cold it will hold the journals in perfect alignment with the shaft. The bearings may then be removed and a small hole drilled down through the lead and brass to afford a passage for oil to the shaft. The addition of an oil cup stuffed with a wick completes the bearings, which may be replaced on the frame.

The shafts are belted together with rubber belting crossed to make the discs turn in opposite directions. The driving is accomplished by means of an electric motor belted to a pulley on one shaft.

The current is conducted to the discs through wire or gauze brushes bearing upon the smooth bosses, as shown in the plan view in Fig. 1. The details of the brush holder are to be seen in Fig. 2.

The discs should rotate freely and quietly when the motor is started. If the oil cups are properly fitted, the gap should be capable of an all-day run without trouble developing. The adjustment of the gap will be considered in due time, when the instructions are given for the operation of the completed apparatus.

Practical Electro Therapy

Edited by Thomas Stanley Curtis

High Frequency Apparatus*

IN the last article we learned that the alternating current, after entering the apparatus within the instrument case, is transformed or stepped up in voltage to a value perhaps hundreds of times as high as that at which it entered the instrument. This voltage would prove dangerous or fatal under certain circumstances if it were applied to the body of a patient in its existing state. Before it can be used, therefore, it must be converted to a current of very high frequency, *i. e.*, one which changes its direction of flow hundreds of thousands or perhaps even a million times per second. The astonishing characteristic of such a current is that it may be applied to the human body in quantities which would prove fatal if the current were of the commercial frequency.

THE CONDENSER AND OSCILLATORY CIRCUIT.

Tracing the course of the high potential current as it leaves the secondary of the transformer, we find that it passes into a device called a condenser. This piece of apparatus consists of a number of sheets of tinfoil separated by plates of mica or glass. The foil sheets are supplied with lugs projecting alternately first from one side and then from the other as the foil and mica plates are assembled. The alternate lugs are soldered together on each side and to these joints the wires from the transformer are fastened. Passing from the condenser we find the current flows through the primary of another transformer, but one without an iron core, and finally across a spark gap and back to the condenser.

The condenser acts as a reservoir for the current, which stores up as a charge on the plates until the tension becomes so great that the current leaps across the spark gap in a crashing discharge. This discharge is not composed of a single spark, as appearances would seem to indicate, but it comprises many separate discharges which surge back and forth across the gap with a motion which may be likened to that of a swinging pendulum. When the energy is finally spent the discharge would naturally cease, but during all this time the condenser is again replenishing its supply from the high voltage terminals of the transformer and as soon as one discharge has died away, there is another charge ready to take its place. All of this happens perhaps in the ten thousandth part of a second or less.

The oscillatory discharge of the condenser across the gap sets up a current of very high frequency in the circuit, which includes the primary of a second transformer in it, as previously explained. Obviously, therefore, it is only necessary to place within this primary a secondary coil having a suitable number of turns of wire in order to obtain a high frequency current of any desired potential. There is no electrical connection between the two in the case of certain forms of apparatus and, owing to the fact that nothing but a current of high frequency would induce another current in the secondary of this transformer—due to the absence of an iron

*This article is the third of a series on high frequency apparatus. The first article appearing in the March issue of MODERN MECHANICS is a general description of a portable high frequency outfit which is described in detail in this and succeeding articles.

core—there is no danger whatever of the patient receiving a shock of low frequency current from the secondary terminals. While this safeguard is not employed in other forms of medical high frequency apparatus, still the method used is quite as effective, and its principle will be taken up in a future article. The aim at present is to cover but one method at a time in order to prevent possible confusion.

The generation of the high frequency current having been explained, the method of adapting it to the various electrodes and their uses will be taken up in the next article.

PREPARING THE LECTURE

(*Continued from page* 691)

"straight from the shoulder," for an audience of this nature is ever impatient for something to happen and the quicker the action throughout the better the reception. If the lecturer is endowed with an unusually commanding presence, which invariably combines the gift of wit or humor, he may carry the action with his own magnetic personality; but for the individual who is not gifted in this manner, the rapid-fire style is safer and less likely to subject him to the disconcerting ridicule of an unruly gallery crowd.

The introductory remarks should be quickly followed up with an impressive experiment; this is to at once arrest the attention and whet the appetite for better things to come. After the successful completion of this one experiment, the performer has, in a large measure, gained the confidence of his people, and in consequence, they will be the more ready to listen to his further remarks. At this point may come the real introduction to the entertainment to follow. The experiments should be placed on the programme in logical order and every effort made to so arrange them that there shall be no wait whatever between the successive demonstrating. This feature will receive attention at length in the next article, however, for space will not permit of justice to it in the present instalment.

The mediocre experiments should be interspersed with the spectacular and startling ones, and invariably the climax should consist of the one experiment that proves to be the masterpiece. It is not always possible to determine just which one from among the number may properly lay claim to this title and this is where the value of "trying it on the dog" comes in. As a matter of fact the final rehearsals of the performance should be before a real audience and a critical one at that, for only in this way can the production be whipped into shape.

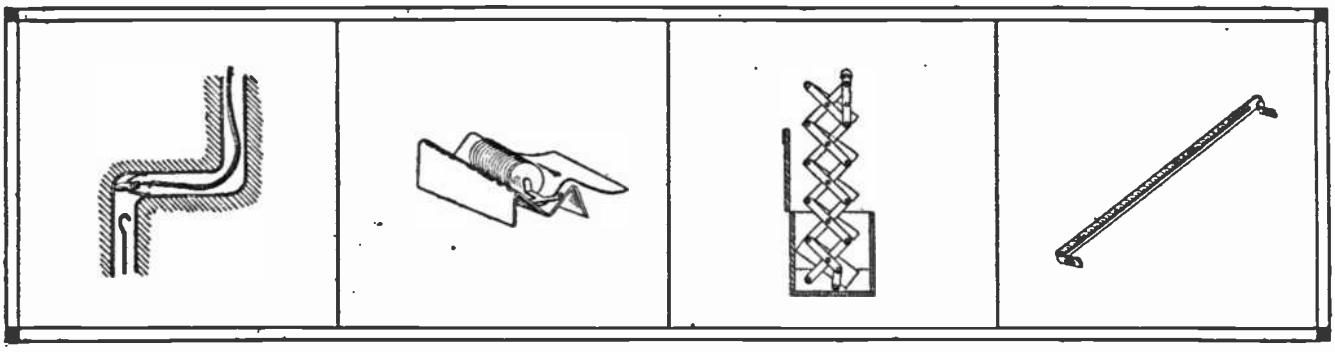
In the next article the author will suggest an effective programme and later articles will carry the reader through the performance of the experiments.

LOCATING BULLETS BY MEANS OF ELECTRICITY

Bullets are now being located by electricity by means of a novel method recently described in the *British Medical Journal.* Briefly, it consists in the use of a telephone, similar to those used in wireless telegraphy. To one end of the telephone wire is attached a small piece of platinum which is placed upon the patient's skin which has previously been moistened with salt water. The other end is in the form of a disinfected thread of silver and is attached to the surgeon's instruments. The instant the instrument strikes the tissue in which the bullet is located, a rattle is heard in the receivers. This method is said to be more practical than the present X-ray one.

WIRELESS CLUB NEWS

The Editors of THE WORLD'S ADVANCE are at all times pleased to hear from wireless organizations throughout the country. Clubs and associations are urged to write in regarding their work. Notices will be published whenever space permits.



Recent Novel Patents

For Wire Fishing

To fish wires through crooked pipes, a Connecticut inventor has brought out a device consisting of a hollow metal body, slotted upon the sides, a plug which fits in it, and wings projecting through the slots and pressing against the walls of the pipe by means of small springs. The wings are intended to prevent the wire from bending back, while their construction, as can be readily seen in the sketch, adapts them for turns.

Coin Wrapper

A patent has been granted to an Ohio inventor on an automatic coin wrapping machine of unique design. It consists of an open, inclined, V-shaped groove and a metal finger for holding the coins in position. Wrapping paper is placed in the groove, under the pile of coins. Great quickness in wrapping coins is claimed to be the outstanding feature of this invention.

Odd Tool Box

An unique tool box containing a number of tool trays mounted on a collapsible lattice framework is the subject of a patent granted to a Pennsylvania inventor. Although the tool box is no larger than the ordinary tool boxes in general use, yet it can be opened and its various trays will form a convenient stand.

A Drawing Board Attachment

A rigid ruling strip of substantial length and provided at its opposite ends with small slotted arms, by which it is attached to a drawing board, is the subject of a patent granted recently to a Chicago inventor. One of the arms is flexible so that the rule can be moved longitudinally without causing the strip to move up and down, thereby causing errors in the drawing.

Pouch for Holding Fruit

The patent office has granted rights to a Washington inventor for a fruit holder consisting of a pouch shaped member to conform to the outline of the palm of the hand, with an open mouth at its forward end. The pouch is fastened to the hand of the user by means of straps about the thumb, little finger and the wrist.

Incandescent Lamp Protector

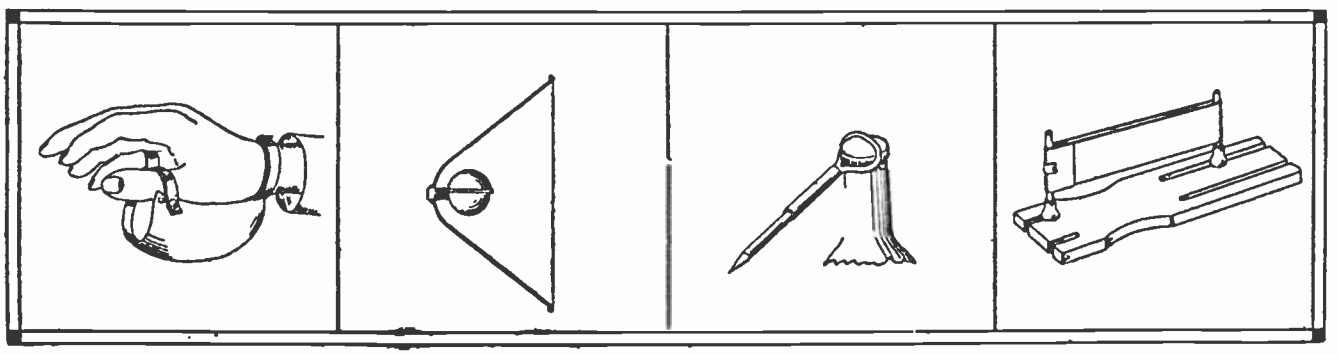
In order to prevent the dangerous glare of automobile headlights, a cup-shaped covering for the incandescent lamp has been invented by a man in Connecticut. According to the patent granted, an elastic arrangement holds the protecting cup in place so that it may be easily attached or detached. Thus any automobile lamp may be prevented from blinding the drivers in passing cars.

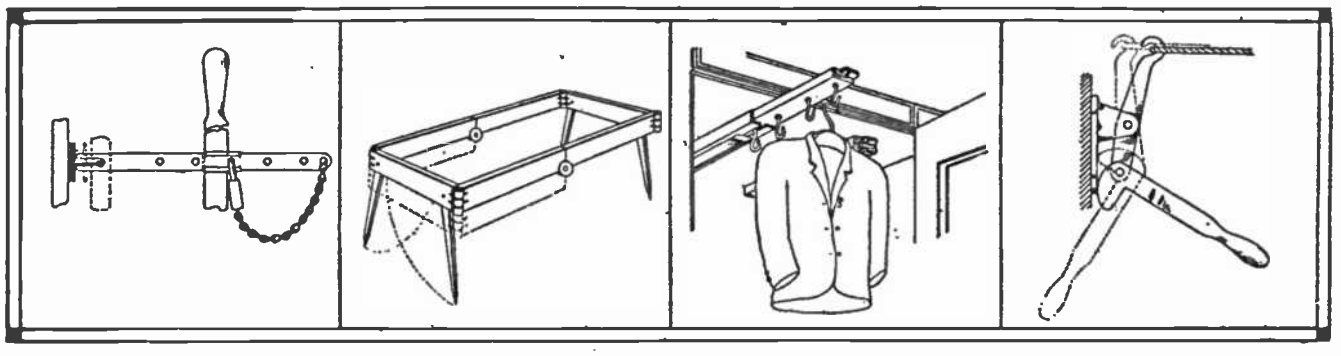
A Bottle Opener

Something out of the ordinary in a bottle-opening tool comprises the grounds upon which a patent has been granted to a Philadelphia inventor. This bottle opener consists of the usual flared wire top, fitted with a hollow, tubular handle. Into this tube a pencil or rod of some sort is inserted and used as the lever. The advantage gained in this bottle opener is compactness, and, if it is fitted on a pencil, it is always handy.

Holder for Photographic Films

An adjustable holder for photographic films is the subject of a patent recently issued to an inventor of New York. It consists of a baseboard made of some stiff material and cut with slots by means of which upright posts, which hold the film, are moved forward and backward to accommodate a film of any length. The film is wound about these posts and held in place by a clip. An unique feature of this film holder is a provision incorporated in the construction of one of the posts, whereby it may be locked automatically in any adjusted position to the baseboard.





A Lock for Automobiles

A locking device designed to prevent the stealing of automobiles is the subject of a patent recently granted to an inventor in Virginia. It is quite simple in structure, consisting of a padlock and chain that serve to lock one of the operating levers of the automobile so that it cannot be moved, thereby preventing the car from being run. A long flat bar, having holes bored through it at intervals, is attached at one end to the body of the car. A slide attached to the lever is moved along the bar until one of the holes in the bar is opposite a hole of the same size in the slide. Through these holes the curved rod of the padlock is passed.

Folding Table

Folding tables of all sorts have been granted patents, but the idea as worked out by a New York inventor has several ingenious features which deserve attention. Altogether, this table folds at ten different places. The four corners are hinged, and pivots at the center of the two long sides permit still another fold. The legs are pivoted also in order that they may be drawn up out of the way.

A Clothes Hanger

A New York inventor, evidently of the impression that there have not been enough clothes hangers invented, has been granted a patent on a new clothes hanging idea. This hanger embodies a sliding rack on which hooks are fastened for suspending clothes hangers of various sorts. The rack slides into a rectangular tube which serves as a runway, so that the clothes on the hooks can be pushed back out of sight into the closet. The runway has a slot cut along the bottom for admitting the passage of the clothes hooks. A semi-circular metal strap is fastened at the top and outer end of the rack, so that it can be pulled out easily and the clothes made accessible.

A Line Stretcher

An instrument for stretching lines and possessing several good features has been patented by a Chicagoan. It comprises a fixed bracket provided with screw holes by means of which it is attached to a post or other support, and a lever having at its upper end a hook for attaching the line, and at the lower end a pivot on which turns a cam controlled by a handle. When the handle is pushed down, a high leverage results and the line is tightened.

A Cigar Press

Cigars must be pressed to conform to the dimensions of a standardized box, and to accomplish this object an Illinois inventor has devised a mechanism for which a patent has recently been issued. It consists of a stationary base, ends and back. Along the edge of the back a linear scale is engraved for measuring the thickness of the compressed pile of cigars. The cigars are placed under a board between one end and a movable block. A rack push bar secured to this block, or partition, pushes against the cigars, pressing them to the desired shape.

A Case for Chewing Gum

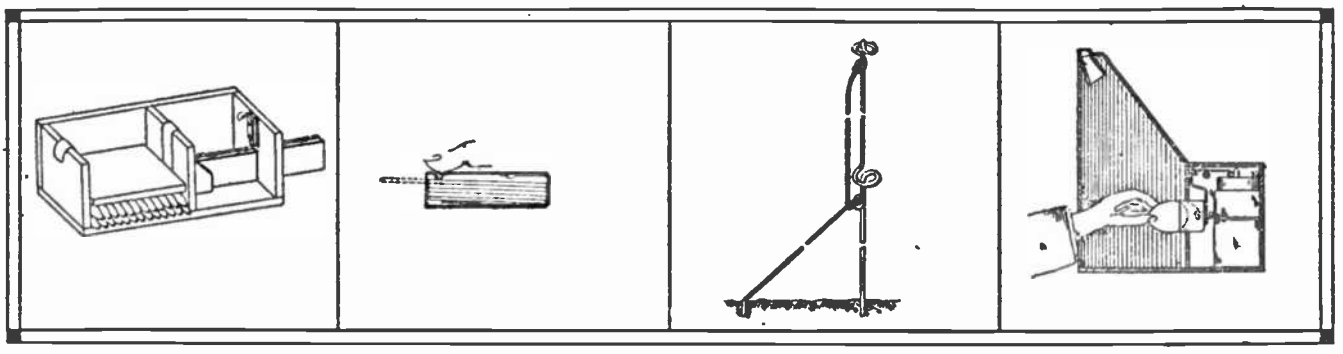
Among the many patents issued recently on mechanical devices comes the refreshing idea from a Kansas inventor of a case that may be used for holding chewing gum, tickets or other similar articles. The chewing gum holder consists of a closed case with a slot at the forward end and a pivoted cog projecting through the top. A spring pressing upward at the bottom of the case forces the sticks of gum against this cog, and when it is turned by the movement of a finger, a stick of gum or ticket—whichever the case may contain—slides out of the slot.

Support for Plants

Among the patents granted recently, a device invented by a man in Texas has well founded claims to novelty and originality. It consists, in brief, of a long wire in which there are several loops or curls. Its purpose is to support growing plants. The rod is intended to be thrust into the earth deep enough so that it will remain erect, notwithstanding the weight which the growing plant places upon it. As a supplementary support another rod, or a number of them, is attached to the upright one at an angle of about 45 degrees and forced into the earth several inches.

An Egg Tester

A novel idea for testing the freshness of eggs has been patented by a man in Missouri. A metal case with a sleeved hole in front, through which the egg is inserted, contains the testing mechanism. The egg is placed in a movable receptacle in the back of which is inserted a miniature electric lamp. At the top of the case is an eye piece through which the egg is viewed. When the light is turned on and the egg is in place, the freshness is determined by the quality of its glow.



Questions and Answers

This department will appear regularly in THE WORLD'S ADVANCE, subject to following regulations: The questions must be legibly written with typewriter or in ink, on one side of the sheet. Each question must be definite and cover but one point of the subject under consideration, although a letter can contain more than one question. On the 10th of the second month preceding the date of issue of the magazine, all the questions on hand will be considered and those which are put in the most intelligent manner and of widest general interest will be selected for publication in such issue, the number being governed by the space available. All other questions will be returned to the writers with a statement of the price for which they will be answered by letter. Return postage must be enclosed with each letter containing questions, and the letters must be addressed to the Questions and Answers Department and contain nothing relative to other departments of the magazine.

LIGHTNING PROTECTION.

In reply to the many requests we receive for information relating to protection from lightning we will offer the following suggestions: All aerials must be protected. It is not merely obeying the regulations, but it is very desirous for the operator's own personal safety. There is very little danger from lightning if the aerial is properly protected, but it is very dangerous to be near one if it is not well grounded during a thunder storm. We have been in the station when the aerial was struck and have observed several other aerials after the bolt had passed. In almost every case there was no damage. The flash of lightning is usually severe and the noise loud, but no damage is done to surrounding property. Frequently insulators are punctured or spreaders splintered, but otherwise the damage is negligible. It would be interesting if amateurs would write to us what happened when their aerial was struck and the extent of damage done, if any, also the type of ground used. Merely burying a copper kettle under the surface will not be sufficient. A pipe driven down at least ten feet should be employed. The better the ground the safer the station will be. The regulations require No. 4 copper wire to connect the aerial to the ground. This should be strongly adhered to. A 100 ampere switch is required, no voltage being specified. If the station has a transmitting set it is best to use a 600-volt switch, so as to prevent the antenna current from jumping across the switch into the ground when the transmitter is being used.

SELENIUM CELL.

(28) C. F. Estwick, Rochester, N. Y., asks:

Q. 1.—Where or how can I obtain a selenium cell which will operate automatically to turn on electric lights in the evening when it begins to get dark and turn them off again in the morning as soon as it becomes light?

Q. 2.—Will this device operate satisfactorily on alternating current at commercial frequencies?

Q. 3.—Will the device work satisfactorily out of doors, in a suitable housing, where it would be subject to variations in temperature due to extreme weather conditions?

A.—It is unfortunate that there should be such a wide misunderstanding of the possibilities of the selenium cell. At its best it is but an experimental device and has not yet been developed so that it is sufficiently reliable and inexpensive to be of commercial importance. In the dark the resistance of selenium is very high, but when a strong beam of light falls on it the resistance is greatly reduced. To use such a cell some form of sensitive relay must be employed, then, of course, the circuit may be closed for direct or alternating current, as the case may be. It has been suggested to use such a cell for turning on lights by having the relay make the circuit when the magnets are de-energized, that is, when the cell is in the dark. In this manner lights could be turned on at night, but as previously mentioned such a scheme is not commercially practicable. A time switch would be about as cheap and infinitely more reliable.

MEANING OF "DYNAMO" AND "MOTOR."

(22) H. N. G., Philadelphia, Pa., asks:

Q. 1.—What is the difference between a motor and a dynamo?

A. 1.—We presume you might have used the word "generator" instead of "dynamo." At present the latter word is largely regarded as generic, that is, as applying to both uses of the machine. It is certain that in many cases, say at a factory, up to a certain stage of the construction, perhaps even when finished, there is no indication as to whether a given machine is to be used as a generator or motor. Even in the testing previous to shipment, the

machine may be tried in both ways. The final distinction comes only when the particular connections are made. If the machine is to be used as a shunt generator, say for charging storage batteries, a high resistance rheostat would be put into the field circuit. If it were to be used as a shunt motor, a low resistance rheostat would be put into the armature circuit; and if for variable speeds, a rheostat might also be used in the field circuit. A series motor is common for street car propulsion, but with the exception of their use for series street lighting, series generators are not often used. A compound wound generator is a very common sort, especially for railway generating stations. When such a machine, say in smaller size, is used as a motor, the terminals of the series coils should ordinarily be reversed, else they destroy the magnetism established by the shunt circuit. In general, the differences between the two are in the use rather than the construction. As a generator a somewhat higher speed than that realized with the motor is required. This allows for overcoming the various internal losses. The motor draws energy for these purposes from the supply circuit.

WINDING FOR A. C. MOTOR.

(30) A. S. B., Great Falls, Mont., asks:

Q. 1.—What size of wire should be used for winding the little alternating current motor described on page 79 of the July magazine, when the supply is at 60 cycles?

A. 1.—It would be permissible, and perhaps advisable, to use the No. 18 as described for the 30-cycle circuit. The article plainly states, however, that less turns be used. We would advise you to put on one size larger, but getting as many turns as the space permitted. One point of importance is not mentioned in the article, and that is to insulate the bolts that hold the laminations. Further, they should be of brass rather than of iron. Recognition of this detail will reduce the heating of the motor.

ARMATURE WINDING.

(31) W. E. VanB., Edgar, Neb., asks:

Q. 1.—What size and quantity of wire to use for an armature 1⅞" in diameter, 3" long, having 12 slots, each 5/16" dia., to adapt it for operating a jump-spark ignition coil? There are two permanent magnets.

A. 1.—As you do not state the present winding, or in what respects it now fails to operate, we cannot advise you as closely as desirable. It is certain that with the adjunct of an induction coil you can use dynamo current quite as readily as that from a battery. We advise you to use No. 22 double cotton-covered magnet wire, perhaps requiring ¼ lb. Get as many wires per slot as possible, each half-winding occupying one-half the slot, as is doubtless familiar to you.

REMAGNETIZING PERMANENT MAGNETS.

(32) J. B., Baltimore, Md., asks:

Q. 1.—How can I re-energize permanent magnets?

A. 1.—Find someone who has a 110-volt motor, bridge the magnets, one at a time, across the poles. This is to be done with the field excited, but the armature not running. If the starting rheostat does not in itself permit this condition, remove one of the brushes or slip a piece of paper between it and the commutator.

TOY ALTERNATING CURRENT MOTOR.

(33) B. F., Kittanning, Pa., asks:

Q. 1.—What would be suitable dimensions and winding for a toy alternating current generator, say to give 6 volts and 4 amperes, at 60 cycles? A machine with 6 poles is preferred, therefore permitting a speed of 1200.

A. 1.—Such a machine is almost too small to build, for a somewhat larger one would be just as easy. Years ago there were a number of 6-pole fan motors on the market, notably those of "Emerson" make. If through some dealer in electrical supplies or through some firm that repairs motors you could get one of these field magnets, it would be ideal for your purposes. Of course, you will have to excite the field magnet from some direct current source, and as you have not decided upon that we cannot advise you as to the size of wire or number of turns. The armature of the fan motor would be of no service, for you require one with at least 12 slots, using two adjacent slots for a coil. 24 slots would also answer, winding two coils per pole, one inside the other. For your proposed machine we would recommend an armature about 2½" in diameter and 1" long, axially, wound with No. 20 wire. We shall be glad to advise you more definitely just as soon as you have found out what materials are available.

FIGURING THE INPUT.

(34) E. W. S., San Francisco, Cal., asks:

Q. 1.—How to compute the watts in an electrical circuit when the volts and amperes are known, as, for instance, the input of a transformer?

A. 1.—Differing from the direct current case, the value of the watts cannot be determined merely by multiplying the number of volts and amperes. While methods involving the use of either three voltmeters or three ammeters can be adopted, they are by no means available for your purposes, and you should have recourse to an indicating wattmeter.

RADIO SECTION

Devoted to the Encouragement of Amateurs and Experimenters in the Field of Radio Communication.

THE TEST BUZZER AND ITS USES

Describing in Detail the Various Applications of an Electric Buzzer in Testing Receiving Apparatus.

By E. E. Bucher
Instructing Engineer, Marconi Wireless Telegraph Company of America

SINCE the advent of commercial wireless telegraphy, the simple bell buzzer has achieved a position of dignity and importance. No longer does this device alone adorn the wall of the butler's pantry and perhaps advise the presence of the unwelcome gas bill collector, but it becomes as well an invaluable asset to the radio experimenter for the preadjustment of a detector or the calibration of an oscillatory circuit.

At the time when self-restoring detectors were introduced into the art of radio telegraphy, necessitating the use of head telephones for recording purposes, it became apparent that there should be at hand some feeble source of high-frequency electrical oscillations for adjustment of the receiving detector to the maximum degree of sensitiveness; and it was early discovered that when any portion of a buzzer circuit (in operation) was placed in an inductive relation to the windings of a detector circuit, a faithful reproduction of the note of a genuine radio transmitter was effected.

It has, in some instances, been so thoroughly instilled in the mind of the junior experimenter that a high or perhaps well-nigh disastrous potential is required to radiate energy from an oscillatory circuit, that he does not at once grasp the fact that the desired results may be obtained even when the circuit is set into excitation by a feeble source of energy, such as two or three volts of battery current.

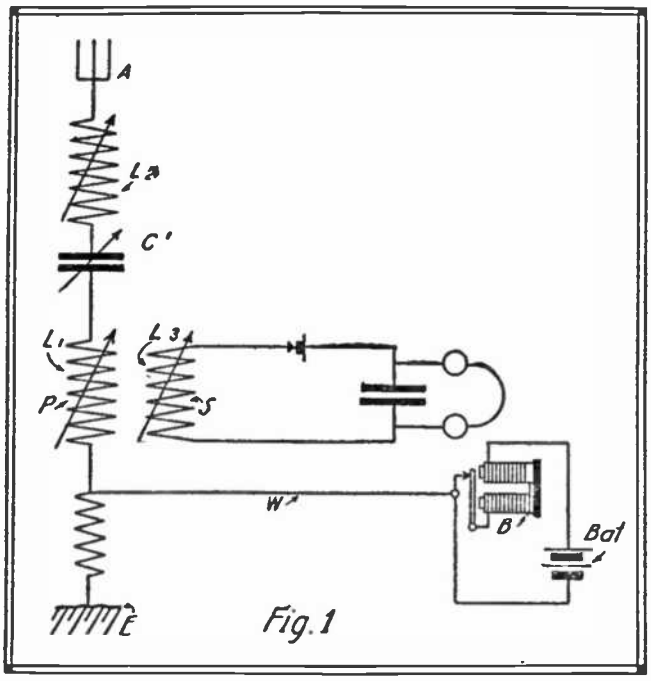
However, one fact cannot be denied; the amateur station minus this buzzer testing equipment is working at a distinct disadvantage and it behooves the owner to at once educate himself into its daily use.

For the benefit of experimenters of this class the writer will describe four distinct methods for employing the bell buzzer in connection with one or two cells of battery as a source of charging potential for excitation purposes, viz.:

(1) The plain buzzer excitation circuit.
(2) The aperiodic buzzer excitation circuit.
(3) The highly damped buzzer excitation circuit.
(4) The feebly damped or timed buzzer excitation circuit.

THE PLAIN BUZZER EXCITATION CIRCUIT.

In this, the first-named method, the buzzer is simply employed to locate the most sensitive spot on a detector of the crystalline type. It is most effective when employed as shown in Fig. 1. A small piece of insulated bell wire, *W*,



Wiring Diagram for a Buzzer Test Set Used in Finding Sensitive Spots of Crystal Detectors.

is connected to the stationary platinum electrode of the vibrator and then extended to and wrapped about the earth lead of the receiving tuner.

If the crystal to be adjusted is of the silicon or perikon type, it is quite sufficient that the lead be wound about the earth lead, but when carborundum is the detecting element, the wire may have to be bared and direct metallic connection made. The point of best adjustment is readily obtained; the buzzer being set into operation and various points on the crystal tried out until the maximum response in the head telephone circuit is attained.

The action of this device is as follows: When the buzzer is set in vibration—by means of a small battery current—an extra potential due to counter-electromotive force is set up in the windings and manifested as a spark at the platinum contacts. The wire extended from the stationary platinum electrode becomes one side of an open circuit oscillator, the windings of the buzzer the opposite side, which is charged by the extra potential and discharged at its own period of vibration, emitting highly damped, feeble oscillations of extremely short wave length.

The pulses of energy flowing in the extended wire act inductively on the aerial circuit, setting up in it similar pulses, which are again transferred to the detector circuit, wherein they are made audible. If desired, the extended wire *W* may be wrapped around some portion of the detector circuit winding in place of the earth lead.

Buzzers employed in work of this nature should emit a high-pitched note. It is now possible to purchase on the open market several makes having this characteristic.

A buzzer of any type may be adjusted for a high note if the platinum electrode of the soft iron armature is removed from the spring and fastened directly to the armature. There is the added advantage in this reconstruction that the buzzer is practically noiseless in operation.

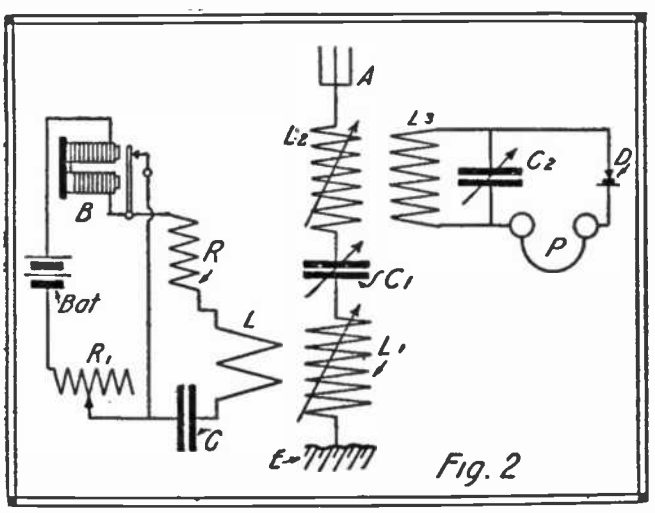
THE APERIODIC BUZZER.

The aperiodic buzzer excitation circuit is often used to give impulse excitation to a radio-telegraphic circuit upon which measurements are to be made.

A particular application of it is shown in Fig. 2, where the aerial circuit of a receiving set *L* 1, *C* 1, *L* 2, is to be calibrated.

An ordinary buzzer *B* has an aperiodic discharge circuit, *R*, *L*, *C*, shunted across the contacts of the vibrator.

The condenser *C* is charged by the counter-electromotive force of the buzzer windings, but the discharge through *L* and *R* is non-oscillatory owing to the resistance *R*. Thus the pulses of energy flowing through *L* may act inductively upon one or two turns of wire in the earth circuit, thereby charging the aerial system, which in turn discharges at its



Hook-up for Connecting Buzzer in Order to Give Impulse Excitation to a Receiving Set.

own frequency, as determined by the values of inductance and capacity employed.

Next a wavemeter, comprising the inductance coil *L* 3, the variable condenser *C* 2, the detector *D* and the head telephones *P*, is placed in inductive relation to some portion of the antenna system, being coupled as loosely as possible.

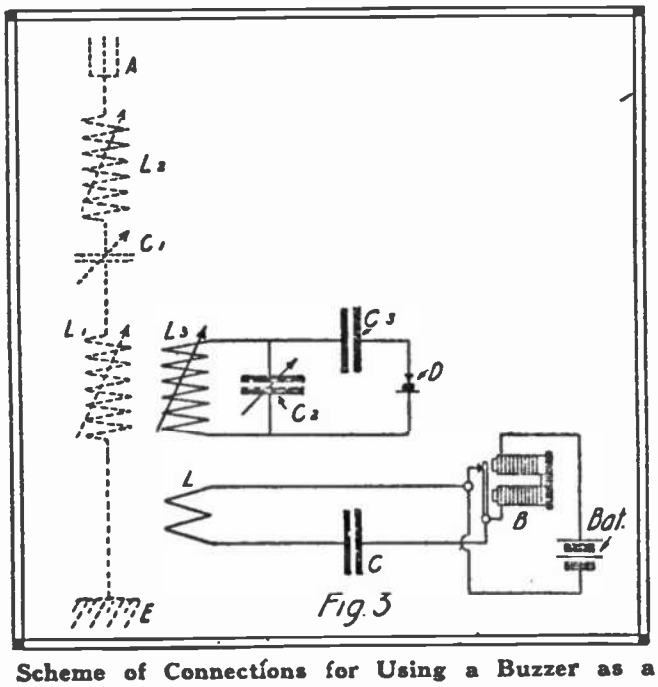
The buzzer being set into operation, the capacity of the wavemeter condenser is then altered until a maximum of response is heard in the head telephones; from which, of course, the wave length is directly obtained.

A number of settings of the aerial tuning inductance *L* 2, the short wave condenser *C* 1, and the primary winding *L* 1 may be made and the corresponding readings obtained on the wavemeter can then be tabulated or plotted in the form of a curve for future reference.

During the test the single turn of wire, *L*, should always be coupled as loosely with *L* 1 as is consistent with the strength of signals. The condenser *C* may have a value of about 0.004 microfarads and the resistance *R*, 600 to 900 ohms.

THE HIGHLY DAMPED BUZZER.

For simply finding the sensitive spot on a crystal, the so-called highly damped buzzer excitation circuit is of value.



Scheme of Connections for Using a Buzzer as a Generator of Highly Damped Waves.

In Fig. 3, *L* 1, *C* 1, *L* 2 constitute the antenna circuit of a receiving set, while the coil *L* 3 is the secondary winding connected to the detector *D*, etc. The test buzzer is represented at *B*, the battery at *Bat*. The vibrator of the buzzer is shunted by the condenser *C* and the single turn of wire *L*. The condenser *C* has a considerable value of capacity, say 1 or 2 microfarads.

When the buzzer is set into vibration, the circuit *LC* becomes charged by the counter-electromotive force of the windings, but the discharge of *C* is in the form of highly damped electrical oscillations, owing to the preponderance of capacity and the absence of any considerable value of inductance.

Regardless of the wave length to which the local detector circuit may be adjusted, it will be set into excitation by the testing circuit, and hence the best point on the crystal for rectification is readily located. Care should be taken to have the coil *L* in inductive relation to the *used* turns of *L* 3.

A number of receiving sets furnished to the United States Navy have been fitted with test buzzers of this type.

THE TUNED BUZZER TESTING CIRCUIT.

Of the methods described, the tuned buzzer testing circuit is the most desirable, and it is positively indispensable to the amateur experimenter who owns a wavemeter, for it not only serves the purpose of adjusting the receiving detector, but also permits the circuits of the entire receiving tuner to be preadjusted to the maximum degree of efficiency.

The complete circuits are shown in Fig. 4. As usual, the circuits of a receiving tuner are indicated by the variable elements of the antenna circuit *L* 2, *C* 1, *L* 1, *L* 4; the local detector circuit by *L* 3, *C* 2, *C* 3, *D* and *P*.

The wavemeter *LC* is set into excitation by the buzzer *B* in connection with the battery *Bat*, and thus becomes a miniature transmitting set, emitting oscillations of feeble damping.

It will be observed that, in order to complete the circuit, the battery current for the operation of the buzzer flows through the coil of the wavemeter *L*.

When the vibrator is in operation the rise and fall of the lines of force about *L* cause the condenser *C* to become charged, which in turn discharges through *L* at a frequency corresponding to whatever values of *L* and *C* may be used.

It is important, in order that the counter-electromotive force of the buzzer windings may be absorbed, that the magnets be shunted by a condenser of large capacity, say 1 microfarad, or this condenser may be conveniently replaced by a non-inductive resistance of about 100 ohms.

For preadjustment of the entire receiving tuner the method is as follows:

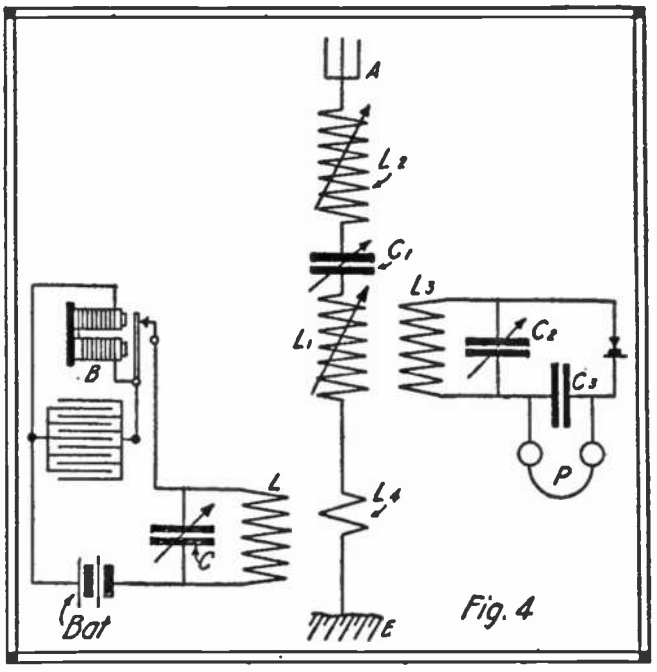
First, the secondary circuit of the receiving tuner *L* 3 is rather tightly coupled to the primary winding *L* 1, the condenser *C* 2 being set at the zero position. The coil of the wavemeter *L* is coupled to a single turn of wire, *L* 4, included in series with the antenna system.

With the buzzer in operation, high frequency electrical oscillations of a definite period traverse the wavemeter circuit and are then transferred by electromagnetic induction to the aerial circuit. These oscillations will have maximum intensity when the aerial circuit has the same value of wave length as the wavemeter. This condition is attained when the adjustable elements *L* 2, *C* 1, *L* are altered in value until a maximum response is secured in the head telephones.

The signals will have still greater strength when the local detector circuit *L* 3, *C* 2, is in resonance with the aerial circuit; this being accomplished when the values of these two elements are altered as necessary.

Resonance having been obtained, the detector may now be adjusted for sensitiveness, and, to do this most effectively, the coil *L* should be coupled as loosely as possible to *L* 4. Further trials at the detector are made until the maximum possible strength of signals is obtained.

It may be of interest to note here the relative sensitivity of certain of the various detectors. For instance, the writer finds that when silicon, perikon or cerusite detectors are employed the coil *L* must generally be within an inch or two



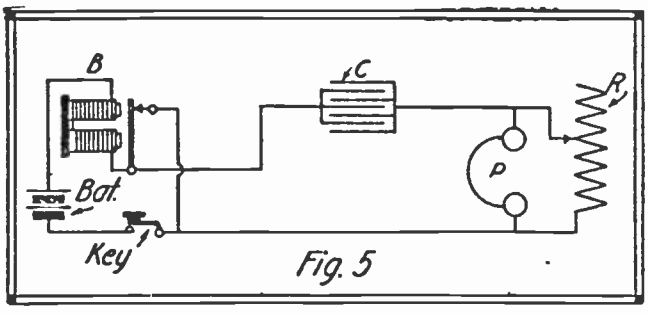
Connections for a Buzzer that Permits of Emitting Oscillations of Any Desired Wave Length.

of the coil *L* 4, but when a triple valve amplifier is the detecting element the entire wavemeter must be removed to a point fifteen or twenty feet away from the complete apparatus.

It will readily be seen why this method is preferable for the preadjustment of a receiving set, for when the receiving system is excited as a whole in this manner, account is taken of the degree of coupling between the primary and secondary windings, and accordingly the correct adjustment for the reception of signals of maximum intensity is given.

It should not be forgotten that the wavemeter must have such values as to be within the range of the set to be calibrated, and if satisfactory results are not obtained it may be due to the lack of proportion between the circuits.

A minimum value of battery current should always be employed for the operation of the buzzer. It might therefore be advisable to include a small battery rheostat in the circuit as indicated in the drawing. Should it be desired to calibrate the secondary winding alone, the antenna circuit may be disconnected and the coil of the wavemeter *L* placed in inductive relation to the secondary winding *L* 3. The constants of that circuit may then be varied and the corresponding wave lengths noted on the wavemeter where maximum response is secured.



Connections for a Simple Buzzer Practicing Set That May be Used in Learning the Codes.

Last, but by no means least, we may mention the use of the buzzer for instruction in the telegraph codes. As a learner's practice device it has no equal. A diagram of connections is shown in Fig. 5, where an ordinary buzzer, *B*, is connected to the battery, *Bat*, in connection with the telegraph key, *K*. The circuit containing the telephones, *P*, the condensers, *C*, and the battery rheostat, *R*, is shunted across the contacts of the vibrator.

The key being closed and the buzzer properly adjusted, a high-pitched note is produced which may be regulated to imitate any type of radio-telegraph spark transmitter in use today.

For "fulness" of tone the condenser *C* should have a capacity of the order of 2 microfarads, and the rheostat R a maximum value of resistance of about 10 ohms.

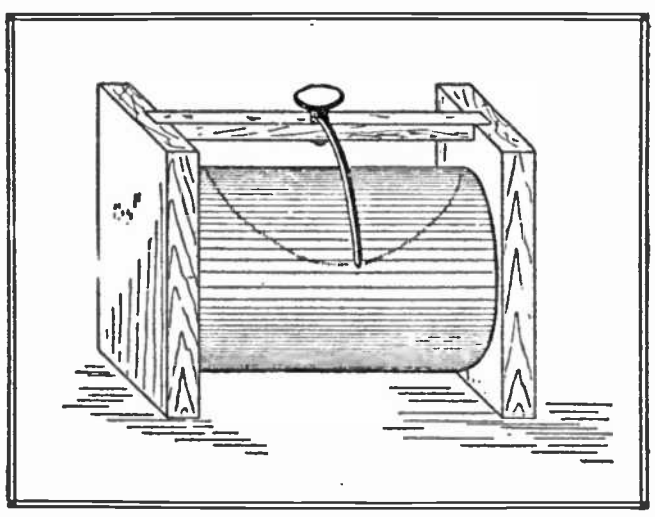
The use of the reheostat *R* will soon become obvious, because sufficient energy is released from the condenser *C* to operate several hundred head telephone receivers and, of course, in a single telephone without the rheostat the sounds would be of unbearable intensity.

Finally, the writer finds that there is some misunderstanding as to the number of interruptions which can be obtained per second by a buzzer. Certain high-pitched buzzers constructed particularly for radio-telegraph apparatus will give a frequency of vibration of from 1000 to 2000 per second.

A RAPID ACTION SLIDER

In the accompanying sketch is shown a type of slider that can be used advantageously on tuning coils of average length and large diameter.

In the center of the slider bar of a tuning coil bore a hole of a suitable diameter to pass an 8/32 machine screw.



This Simple Arrangement Permits of Greater Ease and Rapidity in Tuning.

Then take a piece of phosphor-bronze or springy brass strip of about one-half the length of the tuning coil. At one end bore a hole through the strip to hold it on the screw that passes up through the hole in the slider bar, by means of two nuts. Bend the other end of the spring and round it off so that it will slide over the wire without binding. Place a suitable knob on the end of the screw and the slider is complete.

Such a slider as described in the foregoing is far simpler to adjust, a mere turning to the right or left being all that is necessary.—NATHAN WOLPERT.

NEWARK RADIO CLUB

The Newark Radio Club has recently been organized by young men residing in and near Newark. All amateurs in the vicinity who are interested in radio telegraphy are urged to join the association. Communications should be addressed to the secretary, David S. Cohen, 369 Morris Avenue, Newark, N. J.

AMATEUR WIRELESS STATIONS

THE STATIONS AND APPARATUS IN THE ABOVE VIEWS ARE AS FOLLOWS: (1) Wireless Station of Paul Robillard, New London, Conn. (2) Wireless Station of J. D. Haig, Merchantville, N. J. (3) Receiving and Sending Set of H. Corcell Stuart, St. Johnsbury, Vt. (4) Experimental Apparatus of Dale Laughlin, Sioux City, Iowa. (5) Wireless Station of Edmond B. Carr, Springfield, Ill.

An Efficient Transmitting Condenser

By C. L. Sears

THE average glass plate condenser does not give good service since losses due to brushing are great. A glass plate condenser immersed in a good grade of transformer oil, using copper foil or sheet, has been found to be nearly as good as a compressed air condenser, without the high cost and bulky appearance of the latter.

The condenser described in this article will be found suitable for any ordinary amateur set up to one kilowatt when using a wave length of 200 meters. The variable and adjustable feature will be appreciated if one desires to use the full power at all different adjustments of the oscillation transformer. Very often a transmitting outfit using a one kilowatt transformer will not give an antenna reading of more than 2½ to 3 amperes, due to the incorrect capacity of the condenser, which does not absorb full power; whereas, if the condenser were the correct size it would take the full power and the antenna would show 5 to 6 amperes on the hot-wire ammeter.

The condenser about to be described has a very wide range, namely, from approximately .00005 to .0199 mfds., and consists of one variable portion with a maximum of .00342 mfds., and an adjustable portion of three units: One of .00206 mfds., one of .00412 and one of .0103 mfds. The variable portion is made after the manner of a receiving variable condenser of the rotary plate type with the exception that it is somewhat larger and uses transformer oil as a dielectric instead of air.

It is particularly in wireless telephone work that this condenser will be found very useful, since it possesses the variable feature combined with high insulation that is proof against break-downs.

In Fig. 1 are shown the various parts of the variable condenser. The plates (see *A* and *B*) are cut from 1/16 inch aluminum or copper sheets to the sizes given. Twenty of the plates shown at *A* and nineteen like *B* are required. After being cut to size and drilled out as shown, the plates should be made perfectly flat by hammering them with a leather mallet. Two pieces for connection should be made as shown at *J* and *K*. The piece *K* is drilled for the same sized holes as the stationary plates, *A*, while the piece *J* is merely a flat strip.

The dimensions for the washers are given at *C* and *D*, cut from round brass rod. There are required 18 like *C*, cut from ¾-inch round rod, and 57 like *D*, cut from ½-inch round rod, all 5/16 inches long. Also while making these washers there should be cut three pieces 1 inch long, ½-inch diameter, and threaded for 10-32; six pieces ¼-inch long and ½-inch diameter, threaded for 10-32; one piece 1 5/32 inches long, ¾-inch diameter, threaded for 14-20; one piece 13/32-inch long, ¾-inch diameter, threaded for 14-20; and one piece ¼-inch long, ¾-inch diameter, threaded for 14-20. These last pieces will serve to hold the various parts together.

The rods for holding the plates comprise three pieces of 3/16-inch round brass rod, *E*, threaded for 10-32, and one piece of ¼-inch round rod 11½ inches, and threaded for 14-20, as shown.

The handle for turning the rotary plates is shown at *G* and is made from ¾-inch black fiber and drilled half-way through the center with a 3/16-inch drill and tapped out with a 14-20 thread. The pointer is made from a short piece of No. 12 aluminum wire driven in the handle, the end being flattened and cut to a spear head form with a pair of shears. The part shown at *H* is used as a bearing for the handle and is made from 1-inch round brass rod, threaded for 14-20.

The scale or dial, *I*, is made about 6 inches in diameter and a trifle more than a semi-circle. If the maker has not a set of numbering dies, the dial may be etched with nitric acid by first coating it with melted beeswax and scratching through. A small quantity of acid is then placed in the scratches. When etched deep enough the acid may be washed off with

ammonia, and by heating the plate the wax may be wiped off with a rag and the plate can be polished and lacquered.

A piece of ¾-inch black fiber should be made the same size as the plate shown at *A*, except that the center should not be cut out and it should be about 1 inch greater than a semi-circle. Through the center is drilled a ¼-inch hole. This is to be used to hold the plates in their proper places at the bottom of the jar. This completes the variable condenser.

In the adjustable portion of the condenser, the glass used for separation consists of 22 pieces cut from old photographic plates that have been thoroughly cleaned. The glass plates should measure 8 by 14 inches and be ⅛-inch thick. Double strength clear window glass, free from flaws, may be used although not so good; also, the capacity would be reduced about 25 per cent.

The condenser electrodes are made as shown at *A*, Fig 2, and are cut from copper foil or thin, soft copper sheet. The condenser is built up as shown at *B*, Fig. 2, and connected as shown at *C*. The sections are as follows:

First section, *C*, 1 and 2 plates.
Second section, *B*, 2 and 3 plates.
Third section, *A*, 5 and 6 plates.

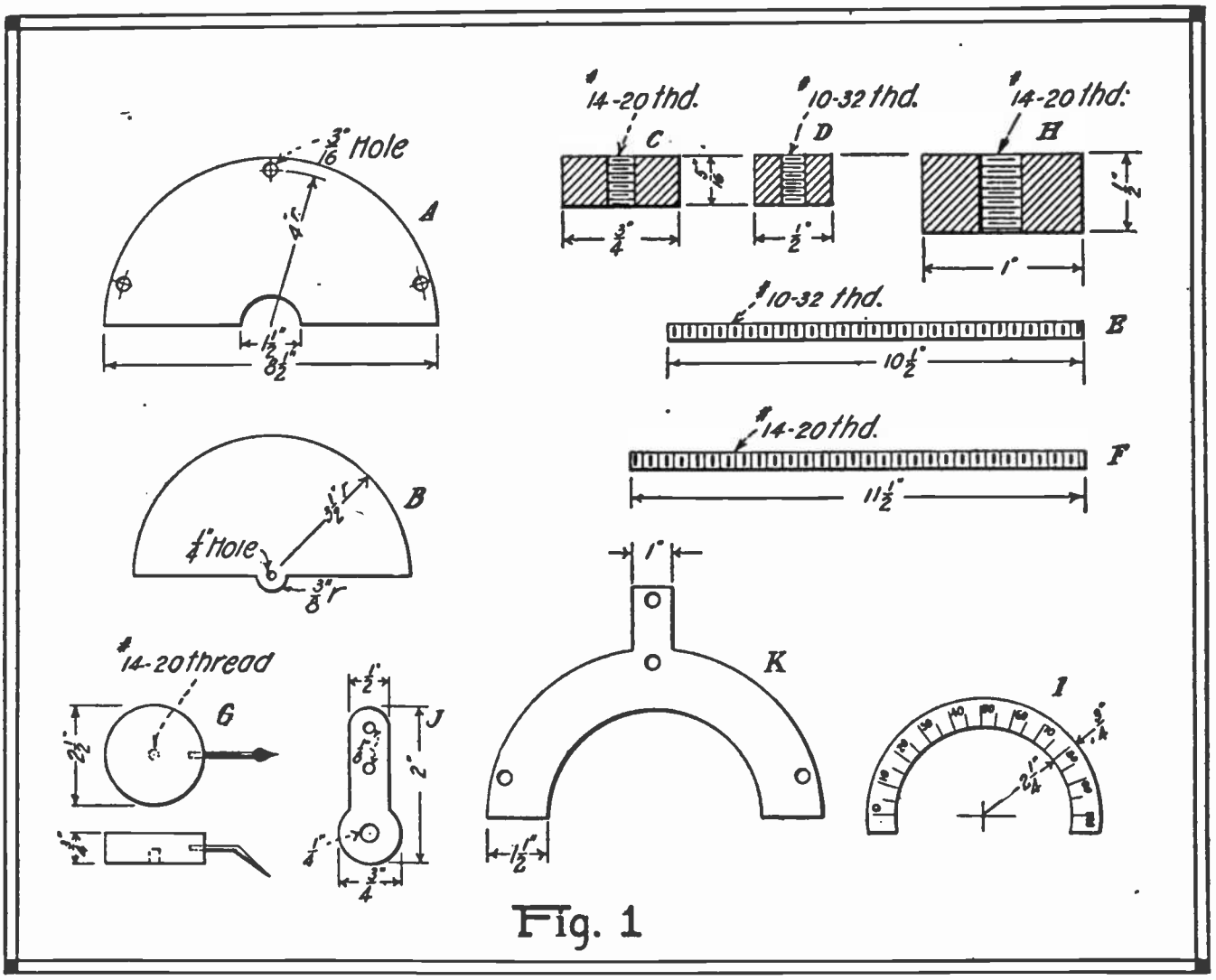


Fig. 1

Various Parts of the Transmitting Condenser, Including Stationary and Rotary Plates, Washers, Rods, Handles, Dial, Connecting Piece and Base Plate.

There should be two pieces of glass set between each section for better insulation of the electrode leads or tabs. After the condenser has been built up as shown, it should be tightly wrapped with some flat cotton or silk tape.

In Fig. 3, the switches for throwing in the various sections of the condenser are shown. These consist of six small 15-ampere baby knife switches of the S. P. S.T. type, removed from their porcelain bases, and two copper strips drilled as shown at *D*. There should also be in-

cluded two heavy "quad" style binding posts. The size of the holes through which the switch posts pass in the strip are not given, as they will vary according to the make of the switch used. The smaller holes for the wood screws should be about ⅛-inch to accommodate a No. 4 round head brass wood screw.

Two battery jars, 9 inches in diameter and 15 inches high will also be needed to hold the oil, as it is practically impossible to make a wooden box oil-tight.

The condenser may be mounted in two different ways, either making two separate units or as one piece of apparatus. A box to hold the two jars may be made of walnut, mahogany or oak, the most suitable stock being about ⅞ inches thick. Walnut and mahogany are the best insulators, but oak is easier to finish.

If made of ⅞-inch stock the box will require:

2 pieces ⅞" x 12" x 21½"
2 " ⅞" x 15¼" x 20½"
2 " ⅞" x 9¼" x 15¼"

This will give a box 9¼x15¼x18¾ inches inside, and will allow for square-end corners as shown at *A*, Fig. 4. The box should be put together with 1½-inch flat head brass screws. If of oak the box should be given a coat of filler and then waxed. It may also be stained if desired. If made of mahogany or walnut it should be varnished and then rubbed down to a piano finish with pumice stone and water, and finally with rotten stone and oil.

The condenser is now ready for assembling, but before starting on this work, the front and top of the box should be taken off.

The three pieces that are 1 inch long and ½-inch diameter, threaded 10-32, should be screwed down on the long threaded end of the 3/16-inch rods until 1⅛ inches of rod sticks through the other end. The stationary plates are then placed on the rod with the separating washers between, beginning with a plate and ending with a plate. The whole is tightly held

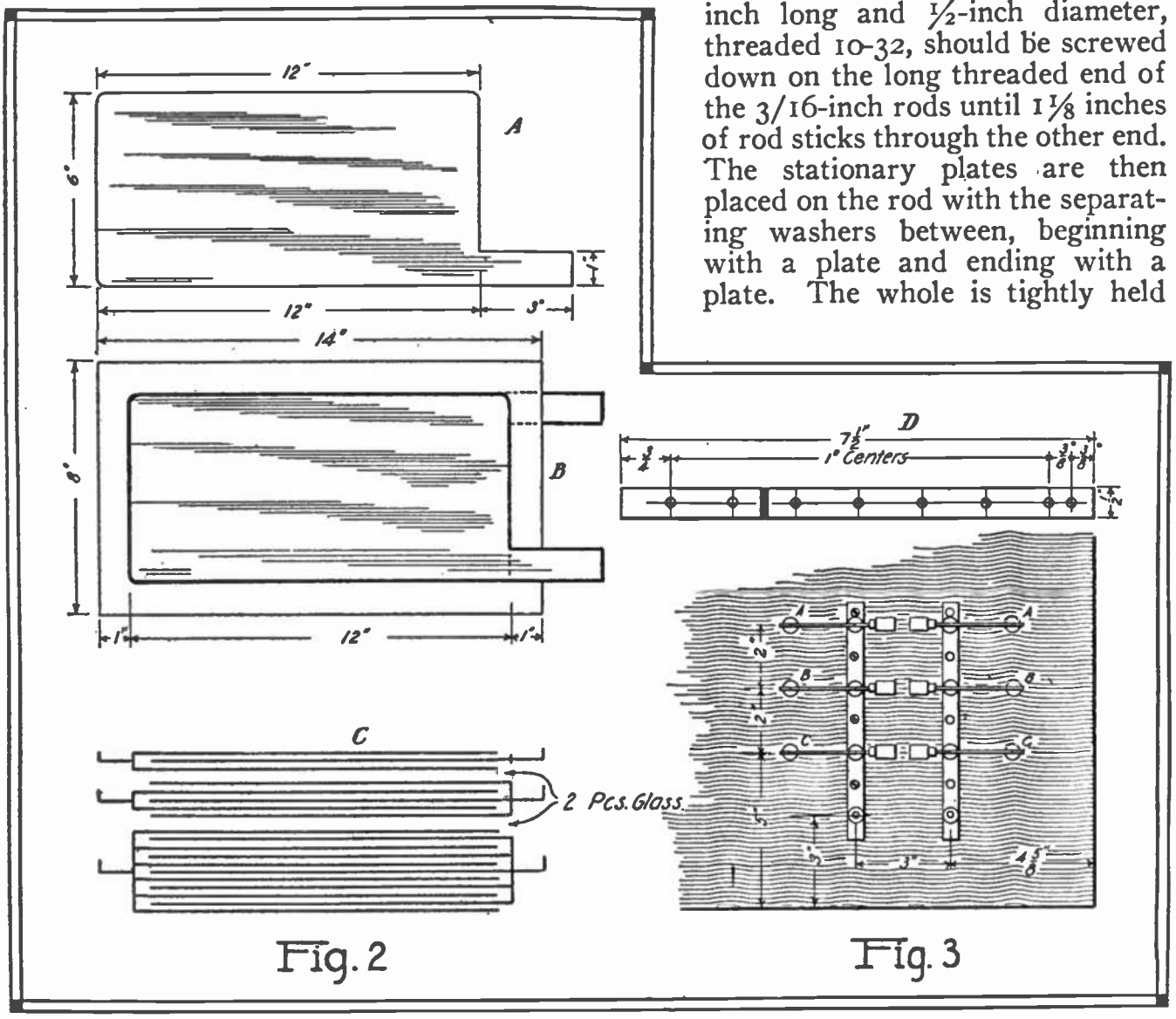


Fig. 2 Fig. 3

The Fixed Condenser Member of the Transmitting Condenser, Showing the Arrangement of the Units and the Switch Construction.

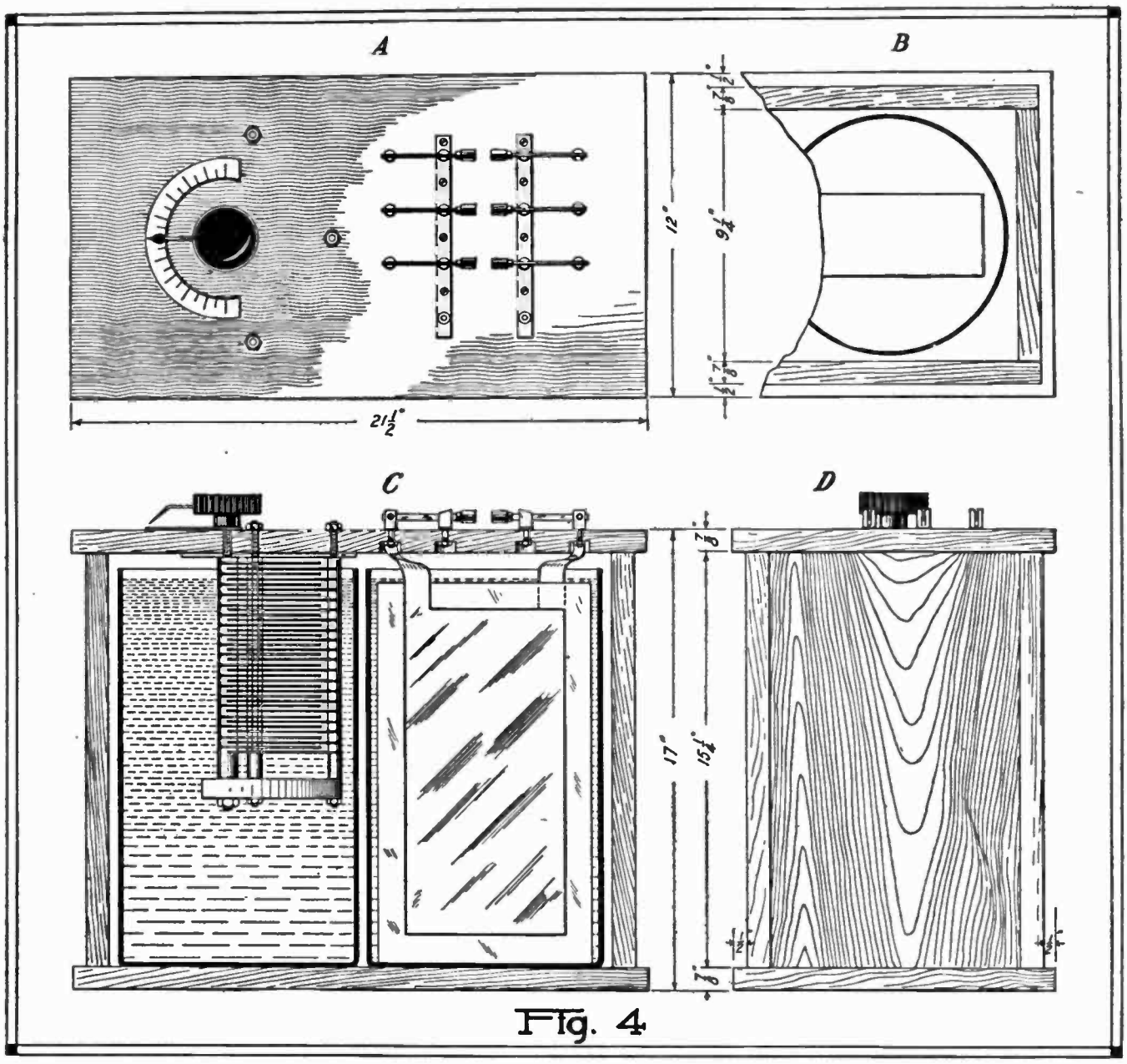


Fig. 4

Views of the Complete Transmitting Condenser which May be Used to Good Advantage in Wireless Telephone Work.

together with a ¼-inch brass nut threaded for 10-32.

The ¾-inch diameter piece, 1 5/32 inches long and threaded 14-20, should be screwed on the long thread end of the ¼-inch rod. On this rod are assembled the movable or *B* plates, starting and ending with a plate and using the ¾-inch washers as separators. The whole is tightened by screwing on the 13/32-inch, ¾-inch diameter, 14-20 piece. The upper end—the long threaded end—should protrude through the 1 5/32 inch ¾-inch nut about 1⅝ inches.

The black fiber piece ¾-inch thick should then be placed on the lower end of the fixed plates and clamped in position with the other three ¼-inch long, ½-inch diameter pieces, one on each 3/16-inch rod, and the ¼-inch, ¾-inch diameter piece put on the end of the ¼-inch rod and then soldered in place so that the rotary plates turn easily in the fiber. The pieces *J* and *K* should then be slipped over the upper end rods; the piece *K* over the fixed plate rods and the piece *J* over the upper end of the rotary plate rod, so that when tightened against the inner part of the box top they may be used for connecting the variable section to the two quad binding posts on the copper strips (see Fig. 3) by means of flat copper tape.

The fixed plates may be fastened to the top of the box by boring three holes as shown in Fig. 4 at *A* and *C*, and plac-

ing three finishing nuts on the rods; the rotary plate rod being placed through the box top also and the bearing *H*, Fig 1, screwed down with the handle over it. The dial may be put in position with about five small ¼-inch round head brass screws.

The parts shown in Fig. 3, should then be mounted on the other end of the box tops and the connections from units *A*, *B* and *C* (Fig 2-C) made to posts *AA*, *BB* and *CC*, shown in Fig. 3.

The jars should then be placed in the box and the top of the box put in place, thus at the same time lowering the variable and adjustable sections into the jars. The front of the box should not be put on until the jars have been filled to within ½ inch of the top with transformer oil, about 3⅛ gallons being required for this purpose. The oil should be put in with the aid of a funnel and about two feet of rubber hose.

The range of the condenser using the variable section only at a maximum is as follows:

Calling the 1 and 2-plate section of .00206 mfd. "*C*."

Calling the 2 and 3-plate section of .00412 mfd. "*B*."

Calling the 5 and 6-plate section of .01030 mfd. "*A*."

Calling the variable section of .00342 mfd. "*V*."

$C.$ = .00206 mfds.
$V.$ = .00342 "
$B.$ = .00412 "
$C + V.$ = .00548 "
$B + C.$ = .00619 "
$B + V.$ = .00754 "
$B + C + V.$ = .00950 "
$A.$ = .01030 "
$A + C.$ = .01236 "
$A + V.$ = .01372 "
$A + B.$ = .01415 "
$A + C + V.$ = .01578 "
$A + B + C.$ = .01648 "
$A + B + V.$ = .01784 "
$A + B + C + V.$ = .01990 "

As V. is only considered a maximum value, it can be seen that many values between those here given can be obtained by either reducing V's value, by rotating the plates, or by substituting it for C and reducing below C's value.

HOW RADIO WAVES TRAVEL THROUGH THE EARTH

PROFESSOR MARCHANT, the English physicist, recently wrote in the London *Electrician* that unless two sets of wireless waves—which travel through the earth as well as through the air—are really one, there would be serious "back flaring" of the secondary waves.

Dr. Fleming, another British engineer, also used the expression "waves due to surface electricity propagated in or through the earth."

Now comes Professor G. W. O'Howe, who seeks to disprove that electro-magnetic waves can go through the material of which the earth's crust is composed and then to give rise at a distant point of the earth's surface to phenomena which have usually been assumed to be entirely due to radio-waves that have travelled through the atmosphere and the outside space.

He says the earth's crust merely acts as an imperfect conductor to the radio-wave currents with which such waves must be associated if they are to travel around the earth and not pass off into space.

The specific capacity of induction and resistance in ohms for the cubic centimeter for sea water, fresh water, damp earth and dry earth, are all known, so the values can be obtained for the high frequencies employed in radio-telegraphy.

Professor Howe's conclusions after a detailed investigation are these: He found that a wave in the earth itself cannot persist far beyond the surface for any great distance unless it travels through the crust and is at the same time continuously supplied with energy from the main wave in the atmosphere above.

Long distance transmission, according to experiments between the Arlington Station and such large scout ships as the *Salem,* cannot be due to waves through the earth or the sea.

The current received at a great distance, when it is calculated upon the assumption of a perfectly conducting earth and an un-ionized atmosphere, is shown to be much smaller than that actually found by Dr. Austin. This is the basis for the theory of reflection of radio-waves by refraction due to ionization of the upper and outer layers of the rarified atmosphere.

The effect of the curvature of the earth in long-distance radio-telegraphy has been investigated by many mathematicians, notably Poincaré, Hurlbutt, Cohen, March, Meholson, and Sommerfeld. W. Von Rybczynskii, at work under Professor Sommerfeld of Munich, has just published a severe and correct arraignment of Poincaré's and Nicholson's results on the ground that their approximations were such as to lead to large errors.

They assume a perfectly spherical earth and a perfect conductor surrounded by perfect insulation. None of these assumptions is correct, hence their solution for practical wireless telegraphy is useless.

NEW POCKET RADIO SET

At frequent intervals we hear of someone picking up signals with a pocket radio set attached to an ordinary umbrella held in the hand for an antenna. But the particulars concerning the precise type of apparatus used are for the greater part rather vague.

In the illustration is shown the appearance of a complete receiving set which for compactness seems to be all that may be desired. The set comprises a head band and receiver attached to a small cylindrical case not much larger than a good sized pill box. In the latter may be found a detector, fixed condenser and tuning coil of diminutive size. The variation of the inductance of the tuning coil

A Pocket Wireless Set Containing a Tuning Coil and Crystal Detector.

is accomplished by means of an instrument switch bearing upon contact points connected with the turns of the winding.

Notwithstanding its extreme compactness, the set appears to be decidedly practical in design and the various parts are arranged so as to provide a unit of great convenience in operation and, it would seem, of an efficiency commensurate with its field of application. The set should prove of not a little value to the camper or boy scout in the field, or in any case where a light and extremely portable outfit is essential.

CENTRAL RADIO ASSOCIATION

The recently organized Central Radio Association is enjoying a healthy increase in membership, and the secretary reports that the association is now represented in twenty-four States. The primary object of the association is to further the acquaintance among the amateur operators residing in the States lying between the Rocky Mountains and the Ohio River.

There is no entrance fee in the asso-

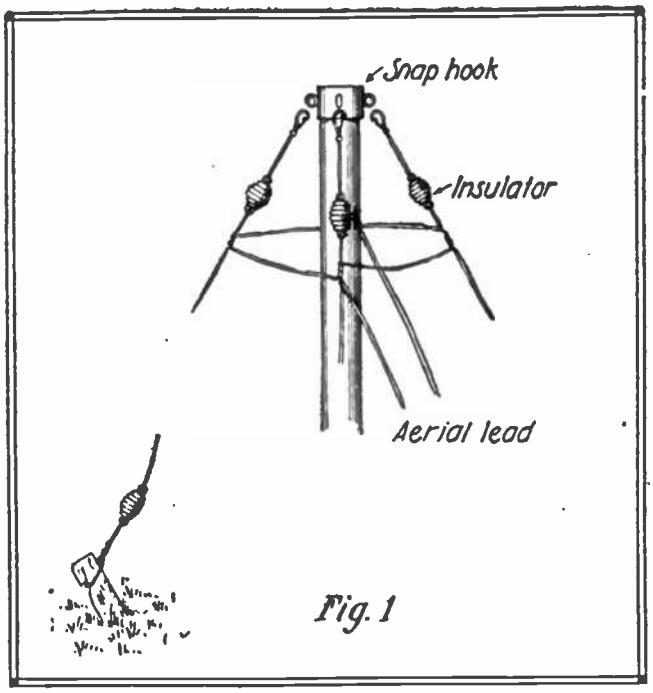
ciation and all amateurs or clubs of amateurs in the district are invited to join. The secretary of the association, H. B. Williams, Chanute, Kansas, will be glad to forward application blanks to those who are interested.

NOTES ON PORTABLE WIRELESS SETS

THERE is nothing that will afford more real interest for the wireless enthusiast than the possession of a really efficient portable outfit, and likewise there is nothing that will tax his ingenuity more than designing the same.

It is obvious that in the construction of a portable set a great number of problems arise which are not met with in a permanent station. Primarily, the equipment must be light, rugged, compact and, at the same time, efficient. The containing case should be comparatively small, and the antenna system and source of power for the transmitter should be packed in such a manner that a minimum of time and labor is consumed in setting up the apparatus.

All of these features are combined to a marvelous degree in the field radio set used by the U. S. Army. This outfit, of course, incorporates some apparatus that is beyond the average experimenter's means, but there are several features that can be profitably patterned after in any amateur equipment. Many descriptions of such portable sets have appeared in past issues of this and other periodicals.



Method of Attaching Aerial Wires to the Top of a Portable Wireless Mast.

But to return to the construction of an amateur portable outfit. The first question that arises is the design of the antenna system. The type of aerial used is determined largely by the nature of the work the set is intended to perform. If the station is to be set up at a camp, a more or less permanent aerial can usually be erected. The construction of a horizontal aerial is, of course, advisable where practicable, but a slanting one suspended from a tree or flag-pole and with the lead brought in from the lower end is very serviceable. However, in most instances, a "take-down" mast constructed in six foot sections with metal connecting sleeves is the only practical solution. For use with such a mast, an "umbrella" aerial is preferable to all other kinds, because it has no directional effect and the wires themselves form the guys for the pole. Each strand is terminated at both extremities by a ball insulator, and all the top ends are soldered at intervals to a lead which is brought down to the instruments. Provision is made at the lower ends of the wires for securing them to stakes, and the upper ends are terminated by snap hooks, which can be quickly fastened into rings on the top mast section. When the outfit is taken down, the antenna wires are detached from the poles and stakes, and each one rolled up separately; the top ends remaining connected to the lead-in and enabling the aerial to be erected without loss of time. The sketch shows the scheme clearly.

An efficient ground connection is of as much, if not more, importance than a good aerial, and presents a more difficult

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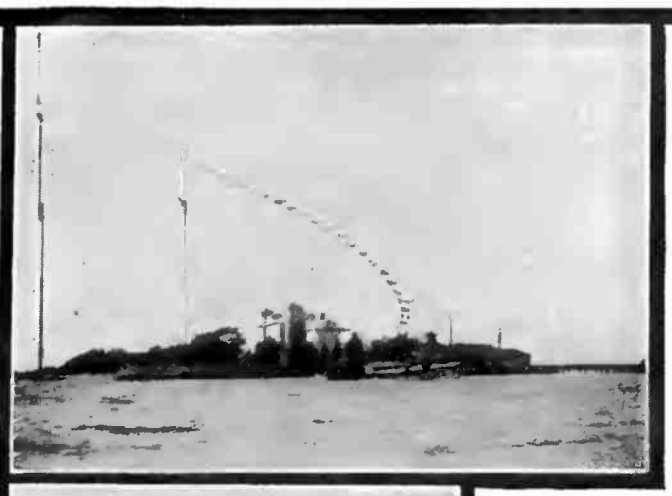
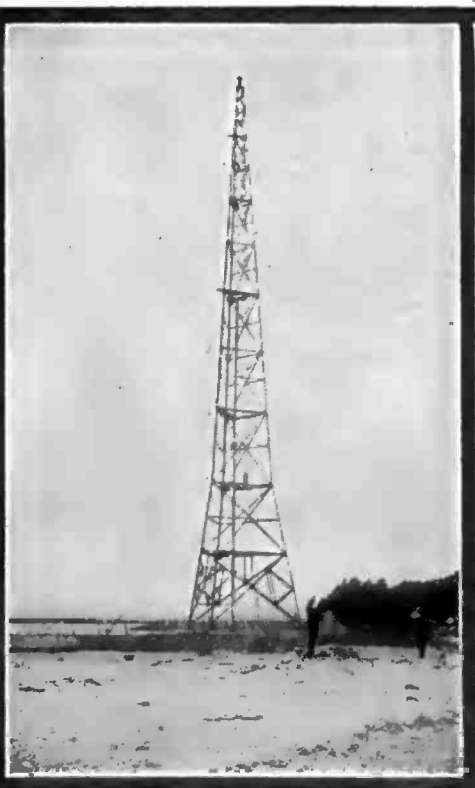
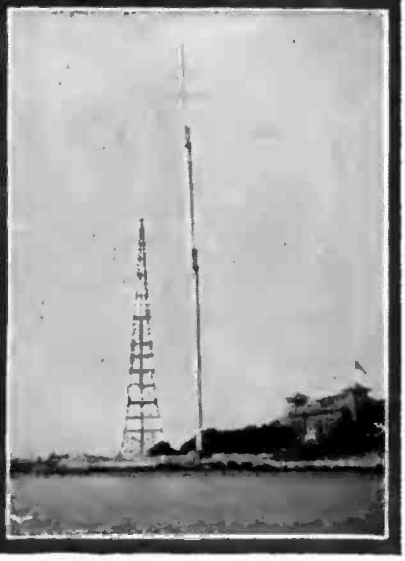




Various Views of the Beaufort, N. C., Station Before the Erection of the Steel Tower, and as It Appears To-day.

THE BEAUFORT STATION



The above views show the former wooden masts used at the Beaufort, N. C., wireless station and the present steel masts. The Beaufort station is situated on Piever's Island and belongs to the Navy. Some three years ago the wooden mast fell and crashed through the roof of the building housing the U. S. laboratory, in a ninety-mile gale. Since that time the wooden mast has been replaced by a three-sided steel tower resting on a concrete foundation.

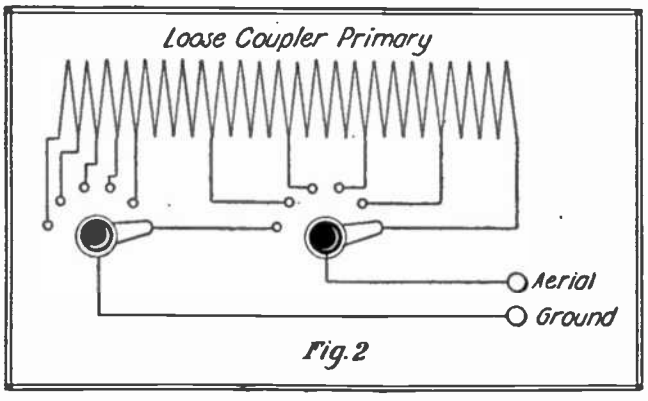
problem. A generous sized piece of sheet zinc solves the problem if the set is to be erected near a creek or well, but this does not include the majority of cases. If the station is designed for use in all locations and under any conditions, any sort of attempt at a direct ground connection is likely to be unsatisfactory. With this idea in view, a "counterpoise" may be used in the form of several lengths of rubber insulated copper wire, which are laid out on the ground radially from the mast and all connected at the center to the ground lead. A number of lengths, equal to the number of aerial strands, of wire such as is ordinarily used for light current transmission, will serve the purpose. In this scheme, there is no positive ground connection, but a condenser effect is produced. Such a "ground" has been found to operate very satisfactorily and has the advantage of being conveniently portable.

The elaborateness of the receiving set naturally varies according to whether the portable outfit is to be equipped for both sending and receiving or only the latter. In any case, the tuning device should by all means be of the loose-coupled type with switch adjustment on both coils. The primary inductance should be variable by not more than two turns at a step for accurate tuning, which can be accomplished with a small number of contact points by the double switch arrangement shown in Fig. 2. The right-hand knob varies the inductance in large steps, and the adjustment is then perfected with the left-hand knob, which controls a number of turns in all equal to the number of turns included between two contact points on the first switch. This connection gives the fineness of adjustment of the time-honored slider, with none of the poor contact resulting therefrom.

The United States radio pack set uses a zincite-bornite detector, but the common little silicon type is probably best suited to the amateur's purpose. For practical work the use of a good, sensitive pair of at least 1,000 ohm 'phones is imperative.

The remainder of the apparatus may be essentially of the usual permanent station type, but contained in a compact unit. A sensitive receiving outfit will go a long way towards overcoming some of the unavoidable handicaps resulting from the limited antenna system.

The greatest difficulty encountered in the transmitting set is the obtaining of an efficient source of power for the transformer or coil. The U. S. Army sets employ "take-down" 500 cycle generators run by hand power applied to two large cranks. The little alternator is a marvel of efficiency, but far beyond the average experimenter's pocketbook, leaving him the sole choice of batteries. The next best, then, is probably a good storage battery, carried in a separate case and provided with a flexible lead so that it can be rapidly connected to the transmitting apparatus of the portable set.



Simple Form of Tuning Apparatus That May Be Used to Good Advantage in a Portable Wireless Set.

The direct current power will make some sort of interrupter necessary, which at best is a more or less troublesome piece of apparatus. A spark coil having a vibrator with ample sized platinum contacts will usually work satisfactorily, but if more power is used on an open core transformer, the construction of an independent magnetic vibrator is advisable.

The design of the secondary circuits should make up for some of the inadequacies of the antenna and power source. The most efficient gap to use is probably a small one of the quenched type, which will prove efficient despite its "mushy" tone caused by the conditions. A series gap with large sparking surfaces is the next best solution, unless the resourceful amateur devises some way to use a rotary gap advantageously under the unfavor-

able circumstances. The closed oscillating circuit should be loose coupled to the open radiating circuit to prevent any undesirable "back induction" between the two. To save space, the secondary may be closely wound of small strip, so that it can be slid entirely inside the primary spiral, which accordingly should be of broad strip and large diameter, the whole being placed in the lid of the case.

A "break-in system" with a gap in the ground lead will save the space of a switch and increase the rapidity of sending and receiving signals.

The arrangement of the instruments, packing for transportation and other similar features are important details that can only be satisfactorily determined for any one set, however, by the owner himself.—M. K. ZINN.

The Marconi Station at Belmar, N. J.

WIRELESS messages can now be flashed from New Jersey to London. With this feat accomplished, we see the completion of one of the links of the wireless girdle of the world by the Marconi Company: From New Jersey to London, from London to Egypt, from Egypt to India, from India to Yokohama, from Yokohama to Honolulu and from Honolulu to San Francisco. Messages will soon be flashing both day and night in their course around the earth. The two stations in this country and the one in Honolulu were erected by the Marconi Company at a cost of a million and a half dollars, and are said to be larger and more powerful than any other wireless stations in the world.

The stations for the Atlantic side of America have been built in New Jersey; the receiving half being in Belmar and the transmitting portion in New Brunswick, although both parts will be controlled at Belmar by the use of a telegraph line, working the high-power transmitting keys at the sending station in New Brunswick through automatic relays. Thus, all the operating will be done at the receiving station, while the actual energy will be emitted from the transmitting station at New Brunswick, about twenty miles distant.

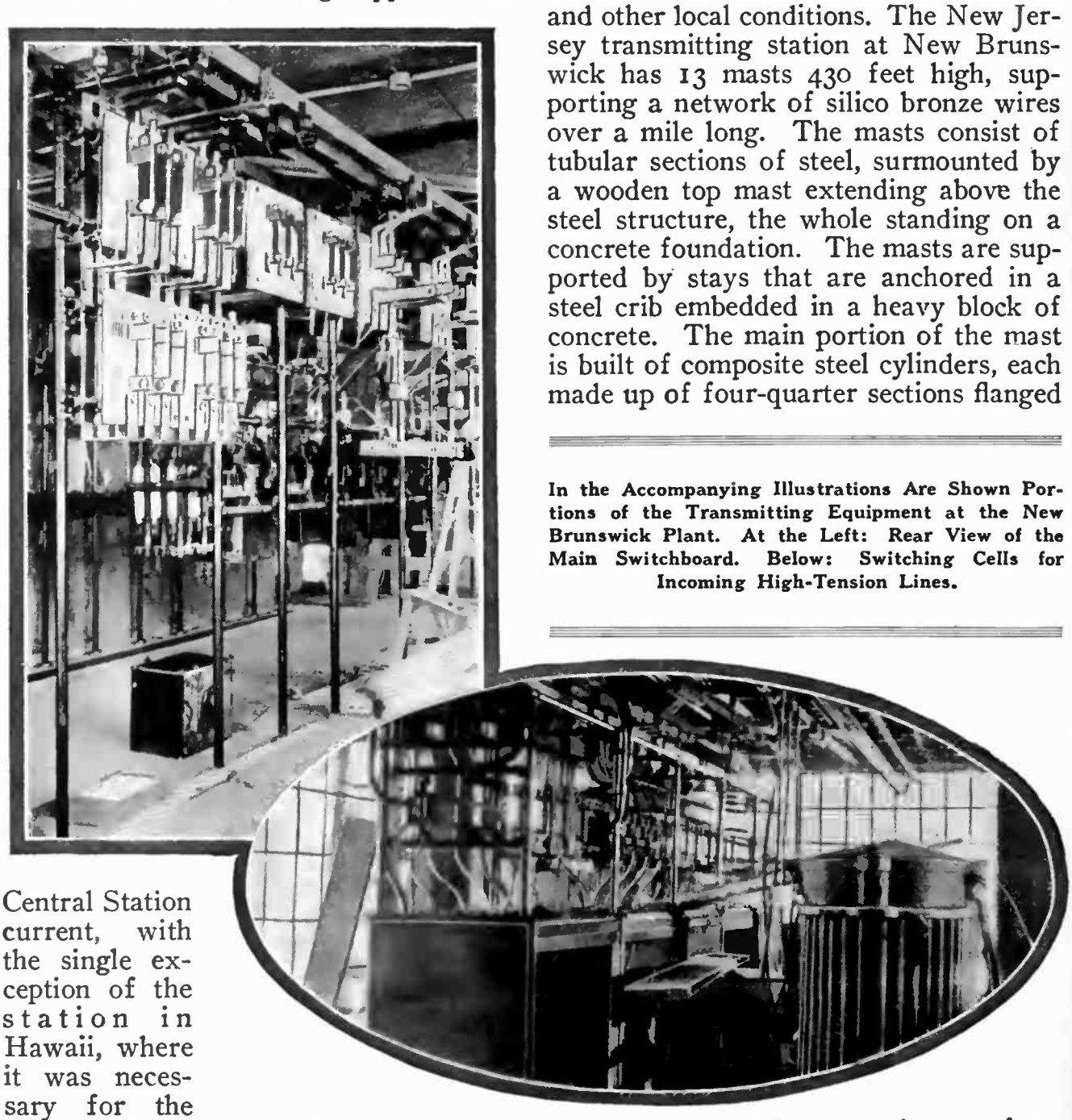
The company is using high speed automatic transmitters of a synchronous rotary discharger type of 300 kilowatt rating, with a capacity of about 100 words a minute. In addition to using high speed automatic transmitters, the receiving will also be done automatically and the messages will be taken down on a dictaphone, at the same time giving a permanent record of all communications.

The actual sending distance is 3000 miles and the length of time required to send a signal across the ocean is slightly less than one-fiftieth of a second. Messages are handled normally at Belmar, both outgoing and incoming, all Western Union telegraph stations acting as feeders for Trans-Atlantic Marconigrams over land wire connections from New York to Belmar. At Belmar the messages are fed to automatic machines, which, by means of auxiliary circuits, operate the discharger and hence the aerial at New Brunswick, where the actual sending impulse is released. The incoming wireless signal, on the other hand, is read directly at the Belmar aerial. Belmar is tuned in harmony with the sending station in England, but out of harmony with New Brunswick or its own sending impulse. Similarly, the receiving station in England is in harmony with New Brunswick but out of harmony with its own transmitted wave; the reason being, of course, to permit each receiving station to hear signals from across the ocean through the simultaneous disturbances of its own sending.

The current used for sending the messages from the New Brunswick towers is supplied by the Public Service Electric Company from their sub-stations in New Brunswick. A direct line from the

sub-station to the Marconi plant—a distance of four miles—furnishes electricity at 2400 volts, 60 cycles. At the Marconi station it passes through transformers and is boosted to 100,000 volts and 19,000 cycles at the aerial. The total equipment of the station is 650 horsepower, normal rating.

It is interesting to note that all the wireless stations are being supplied with Central Station current, with the single exception of the station in Hawaii, where it was necessary for the Marconi Company to build a power plant of their own in which were installed three 500-kilowatt steam-driven turbines.



In the Accompanying Illustrations Are Shown Portions of the Transmitting Equipment at the New Brunswick Plant. At the Left: Rear View of the Main Switchboard. Below: Switching Cells for Incoming High-Tension Lines.

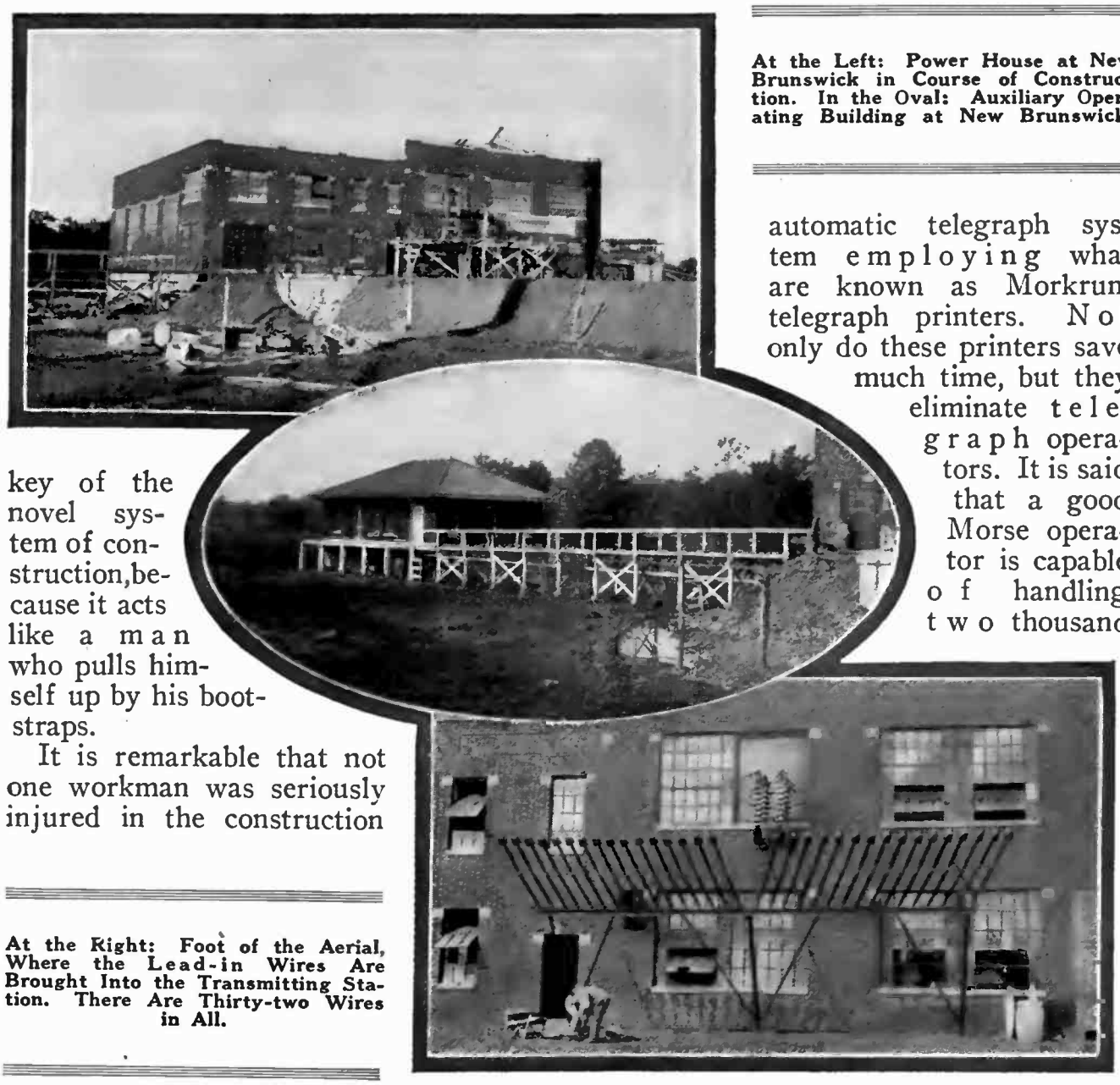
Work on the New Jersey stations was started in May of 1913 and completed July, 1914. It is estimated that 28,000 tons of heavy material was used in the construction of the transmitting half of the station, and that 26 tons of imported glass was used in the tanks of the condenser at the New Brunswick plant.

An interesting feature is the construction of the iron masts which hold the aerial wires. The towers that the other stations in the world-girdling chain use differ in length and number according to the wave length employed, the distance over which transmission is desired and other local conditions. The New Jersey transmitting station at New Brunswick has 13 masts 430 feet high, supporting a network of silico bronze wires over a mile long. The masts consist of tubular sections of steel, surmounted by a wooden top mast extending above the steel structure, the whole standing on a concrete foundation. The masts are supported by stays that are anchored in a steel crib embedded in a heavy block of concrete. The main portion of the mast is built of composite steel cylinders, each made up of four-quarter sections flanged vertically and bolted together to form the cylinder. This method of construction enabled the rapid erecting of the masts, which are small in diameter compared to their height and offer little resistance to the wind. A single mast consists of sixteen cylinders 15 feet long, one tapering section 10 feet long and then

follow fifteen cylinders 10 feet long, making the total height of steel work 400 feet, and above this raises the top mast of 30 feet. The wooden top mast is the key of the novel system of construction, because it acts like a man who pulls himself up by his bootstraps.

It is remarkable that not one workman was seriously injured in the construction of the New Jersey stations, although the construction of the masts had no precedent even for the engineers.

There are 12,000 feet of exceptionally high tensile strength wire rope, made of even strands of seven wires each, used to stay each mast. Each stay wire is broken up into a number of short lengths by porcelain insulators to prevent absorption of energy by the wires, which would occur if any length was long enough to have the period of vibration similar to the wave length of the sending station.



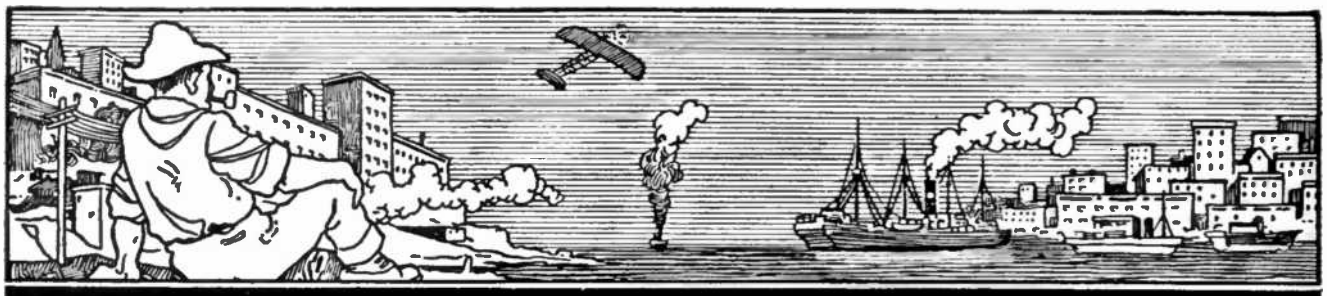
At the Left: Power House at New Brunswick in Course of Construction. In the Oval: Auxiliary Operating Building at New Brunswick.

At the Right: Foot of the Aerial, Where the Lead-in Wires Are Brought Into the Transmitting Station. There Are Thirty-two Wires in All.

AUTOMATIC TELEGRAPHY.

The Associated Press has just installed in the New York editorial rooms an automatic telegraph system employing what are known as Morkrum telegraph printers. Not only do these printers save much time, but they eliminate telegraph operators. It is said that a good Morse operator is capable of handling two thousand words, while the Morkrum machines will handle no less than three thousand. Briefly, it may be stated that the Morkrum system employs a paper tape that is perforated on a machine resembling a typewriter. Messages are printed at the receiving end of a roll of paper, in such a form as to be read by anyone. In newspaper offices a system of this kind is bound to prove a great time saver.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, tell us.



What the World is Doing

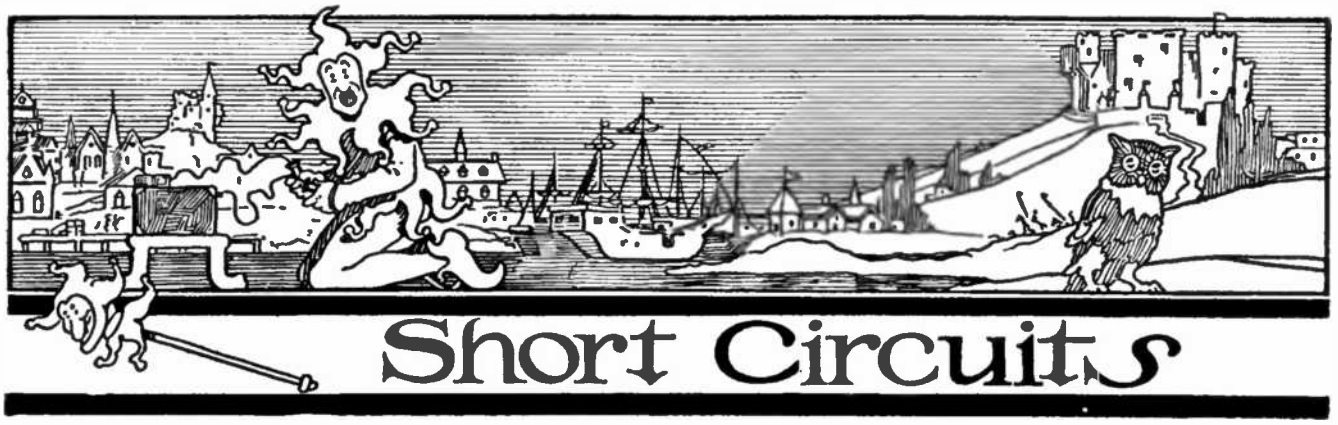
"JUST what field do you cover and how do you aim to do it—in other words, what is the policy of your magazine?" is the question asked the editors almost daily by the uninitiated. And a natural question it is, for the policy which is meeting with universal approbation among our readers, both new and old, is too young and perhaps too radical to be perceived at first glance.

Our answer is invariably in the nature of a comparison with other magazines purporting to be in our own field; there are some excellent publications which tell the reader all that is going on in the world of electricity and mechanics and there are others that tell, in highly technical language, how the results are accomplished. The aim of THE WORLD'S ADVANCE is to tell the everyday man not only what is going on, but *how it is done,* and this in terms so simple that he can readily comprehend the plan. The object of this is to enable the multitude to profit by the experience and ingenuity of perhaps a few bright men.

The articles in the magazine are never so long as to be wearisome, but neither are they so curtailed as to merely whet the appetite of the reader, leaving him with his curiosity wholesomely aroused but totally unsatisfied. In editing the manuscript the irrelevant matter is invariably weeded out and lengthy dissertations that may possibly have the merit of verbosity—if merit it is—find no place in our columns. The length of the "newsy" portion of the article is governed solely by the story the author has to tell, without regard for the number of pages consumed; and, when the interesting facts of the matter are told as a matter of news, we take enough additional space to tell the reader how the trick was done.

Perhaps the casual reader will say, "That sounds very well, but now back it up." To this we suggest that the skeptic turn to any feature article in this or any other number. Take, for example, Mr. Skerrett's offering on page 603 of the present number; in this article the author tells of the ever-present danger of a shifting cargo in a ship at sea. He shows how an accident of this kind may happen on a freighter laden with a valuable cargo and perhaps result in the loss of the lives of the crew and the entire cargo as well. As the reader follows the story, which is replete with interest in itself, he will note that the exact method of procedure by means of which the cargo was righted and the vessel brought safely to port is related in minute detail. Perhaps the radio amateur or the handy-man-about-house will say, "Of what earthly use can it be for me to learn how to right a shifting cargo in a ship at sea?" To this we say let the reader not lose sight of the fact that the value of any piece of knowledge lies not in the concrete application which served to illustrate the plan but in the elementary principle involved. For example, we learn in school that there is such a thing as capillary attraction. How many of us remember ten years later that we ever heard of such a thing in the physics class? And yet when we go to pour a liquid out of a tumbler and into a bottle without the aid of a funnel we are likely to spill the liquid unless we utilize that simple physical principle, capillary attraction. If we place the handle of a spoon, a piece of wire, or a glass rod at the edge of the tumbler the liquid will pass down the rod and into the small neck of the bottle without a drop being spilled. The formidable sounding capillary attraction causes the liquid to cling to the rod as it passes into the bottle.

The homely illustration thus afforded may serve to suggest that any easy way of surmounting a difficulty, no matter how foreign it may seem to our own walk in life, is worthy of note if we but comprehend the simple principle involved. In Mr. Skerrett's article we learn that a shifting, mushy cargo of semi-fluid asphalt was prevented from surging about and acting as a battering ram on the interior of a vessel merely by letting down a simple weighted plunger into the center of the mass and thus causing the level of the latter to rise until it reached the under side of the deck.



"He who puts his hand to the plow," screamed the cross-roads orator, "must not turn back."

"What is he to do when he gets to the end of a furrow?" asked the auditor in the blue jeans overalls.—*Christian Register.*

Restaurateur—Anything the matter with the chowder, sir?

Guest—Oh, no. I was merely wondering how in the world you ever discovered so many things cheaper than clams to put in it.—*Judge.*

Financier—That is not the same tale that you told me a few days ago.

Beggar—No, sir. But you didn't believe that one.—*London Mail.*

"Why are you moping there, Dick?"

"I've no one to play with."

"Well, go and fetch Freddie, next door."

"Oh, I played with him yesterday, and I don't suppose he's well enough to come out yet."—*London Opinion.*

Wife—I've noticed an odd thing, John. When you go to light the gas in the next room you invariably take two matches.

Hub—Yes, my dear; I long ago discovered that if you carry one match it will go out, while if you carry two it won't.—*Boston Transcript.*

"Yes, I tried the experiment of an office girl instead of an office boy. She didn't whistle or smoke, but she failed to please the office force."

"Why was that?"

"She could never learn to go out and get the correct score."—*Kansas City Journal.*

"Have you any parts of an automobile that you don't want?"

"I have an old tire. What's the idea?"

"You know how our grandmothers used to make crazy quilts for the needy?"

"Yes."

"On the same principle I am trying to assemble an automobile for a poor woman who has none."—*Louisville Courier-Journal.*

Mr. Benham—Why did that woman keep you standing at the door for half an hour?

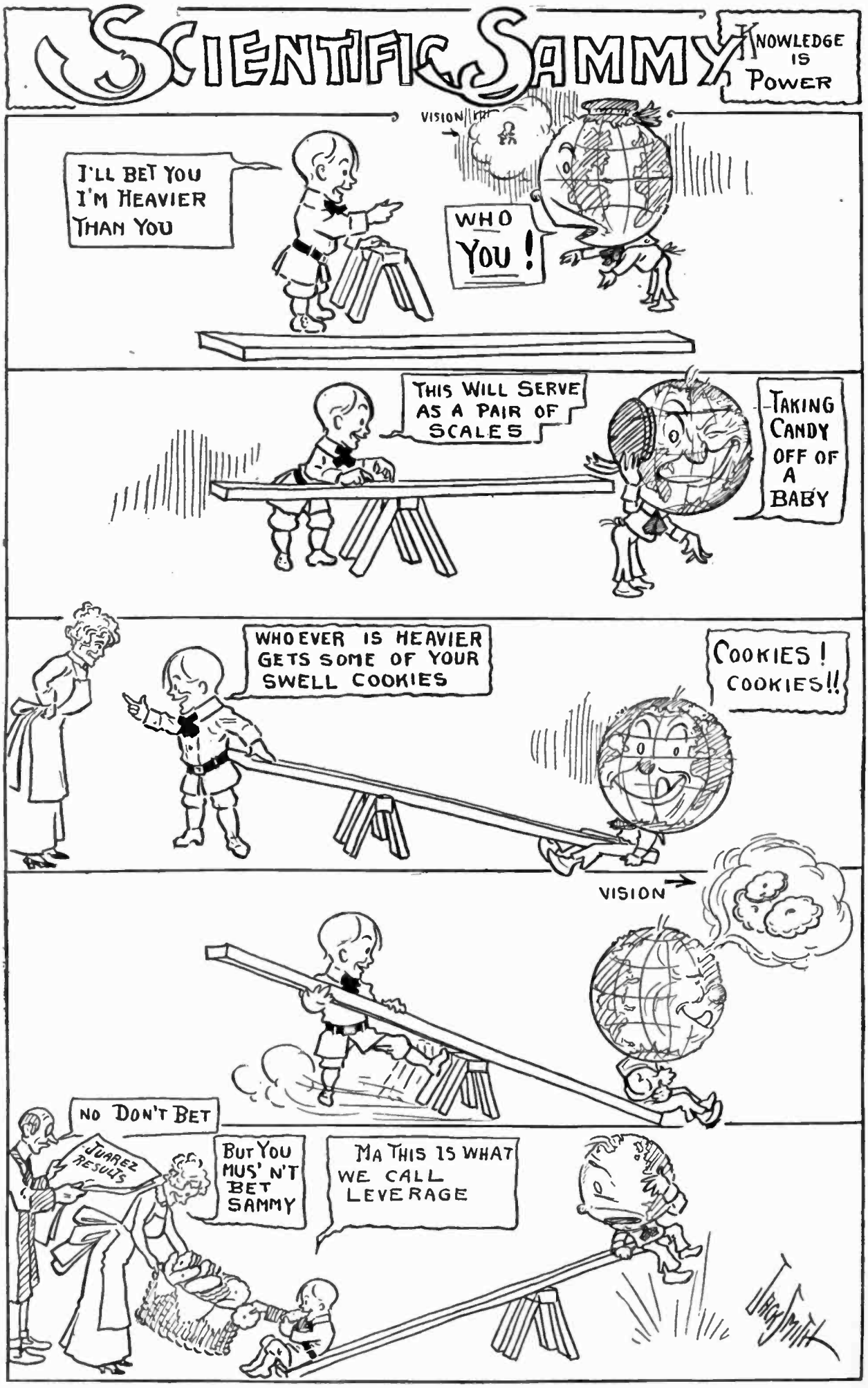
His Talkative Wife—She said she hadn't time to come in.—*Pearson's Weekly.*

"How did that blackhander come to be taken redhanded."

"Because he was a green hand."—*Chicago Post.*

Teacher—Tommy, where is Mexico?

Tommy—On page 10 of the jography, miss.—*Red Hen.*


SCIENTIFIC SAMMY
KNOWLEDGE IS POWER
I'LL BET YOU I'M HEAVIER THAN YOU
VISION
WHO YOU!
THIS WILL SERVE AS A PAIR OF SCALES
TAKING CANDY OFF OF A BABY
WHOEVER IS HEAVIER GETS SOME OF YOUR SWELL COOKIES
COOKIES! COOKIES!!
VISION
NO DON'T BET
JUAREZ RESULTS
BUT YOU MUS' N'T BET SAMMY
MA THIS IS WHAT WE CALL LEVERAGE