The WORLD'S ADVANCE

Vol. 30 APRIL, 1915 No. 4

An Opening Word

WITH this issue the magazine greets its readers under its new name THE WORLD'S ADVANCE—a title truly significant of the contents.

As recent editorials have pointed out, the policy evolved during the past eight months is now firmly established and it will in no way be altered by the change in name.

Under the new title, the Editors will endeavor to present all that is new, interesting and useful in the fields of electricity, mechanics, science and invention and, furthermore, to present this material in a form that shall render it not only intensely interesting but instructive and of practical value as well.

THE EDITORS

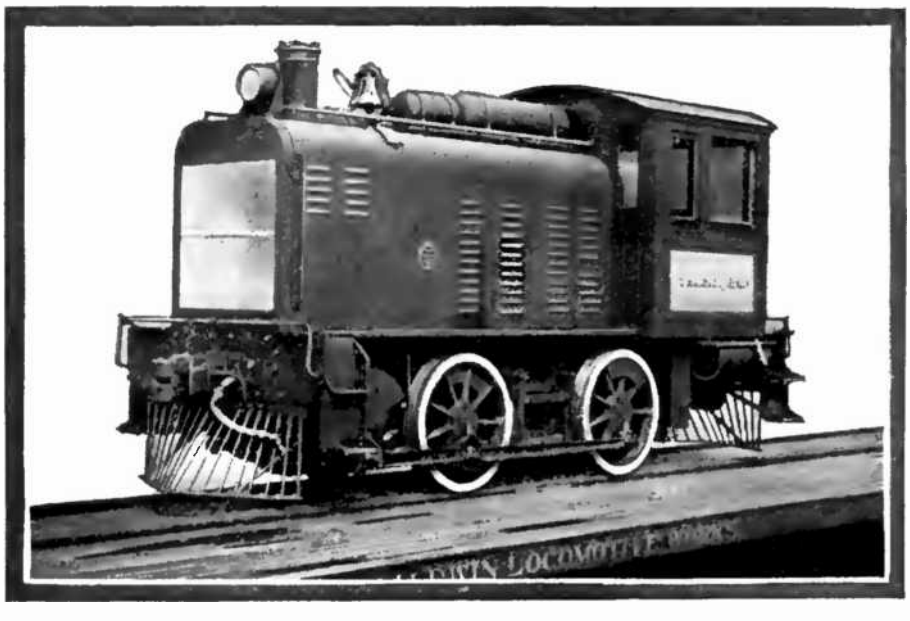
THE FIVE ICES

Experiments in the Massachusetts Institute of Technology have shown that water can be made to solidify into five different kinds of ice, each of which at certain temperatures and pressures changes from one into another with explosive violence. One kind, "ice-2," requires a very low temperature and great pressure to keep it from exploding into ordinary ice. Another kind will stay frozen at summer heat, provided it is kept under a pressure of 20,000 atmospheres. In nature such great pressures exist only in company with very high temperatures, and it is therefore entirely possible that some of these kinds of ice never existed until they were created in the experimenter's hydraulic press.

AN INTERNAL COMBUSTION LOCOMOTIVE

One of the oldest and largest locomotive shops in this country has recently turned out an industrial engine of radically new design. The locomotive, which is illustrated in the accompanying view, uses for its propelling power an internal combustion engine.

The new type of locomotive is equipped with a four-cylinder, water-cooled engine which is especially designed to stand heavy service conditions. It will burn either gasoline or kerosene and is equipped with a self-starter system similar to those used on most gasoline automobiles of today. An electric generator which is driven by the crank shaft of the engine through suitable gearing, supplies current for the self-starter and furnishes the necessary current to the electric headlight and other lights.



A Type of Locomotive That Is Designed Along the Same Lines As an Automobile. Its Tractive Power Is Developed by a Four-cylinder Engine That Uses Either Gasoline or Kerosene for Fuel.

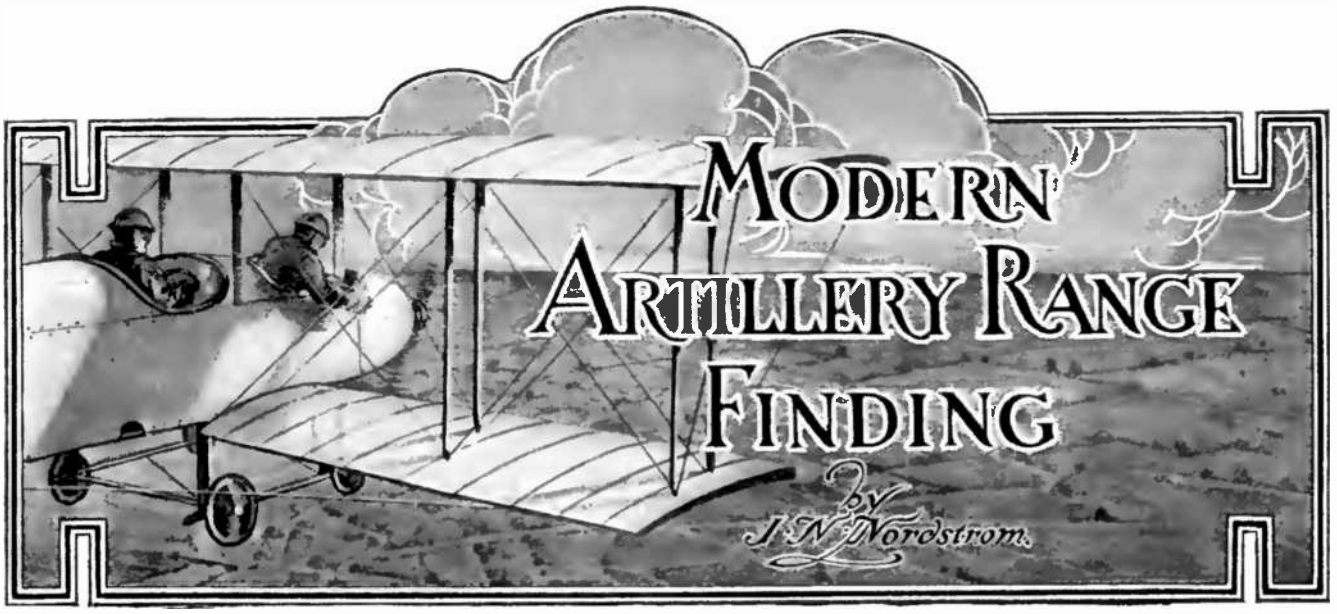
WOOD AND REINFORCED CONCRETE

It has been found that under certain conditions wood is a good substitute for the iron rods used to strengthen concrete beams. Cement combines as well with wood as with iron, and the cement coating effectively protects the wood from decay. It is believed that by using nine per cent. of pitch-pine for reinforcement, it is possible to make a concrete beam as strong as one that is reinforced in the ordinary way with one per cent. of steel.

EXPLODING MINES BY WIRELESS

From France came news a few months ago of success in the art of exploding ocean mines by wireless impulses, but the news was received with suspicion. Now we have an official report by United States Consul Benj. F. Chase, of Leghorn, Italy, that he personally witnessed two successful explosions of mines in the bay by wireless impulse. He states that Manrico Compare, the inventor, operated the mines at a distance of 2,500 feet, with many intervening obstructions.

There are strong probabilities that the wireless controlled mine will still make its appearance in the present European war.



THE firing of modern artillery pieces is no longer a mere matter of sighting. Guns are now placed behind a hill or mound and are not visible to the enemy; the indirect method of firing being employed. The range is determined by observers situated at vantage points on the ground, in balloons, or hovering over the enemy's lines in an aeroplane.

ARTILLERY is playing an all-important rôle in the great European war. On the Western front, where the Germans face the Belgian, English and French armies, a battle in the open is the exception rather than the rule. For the last few months both sides have entrenched themselves and long-range artillery duels have been practically the only evidence that a war is being fought. Occasionally the soldiers come out of their trenches and dug-outs in order to assault opposing trenches and thus gain ground; but generally speaking the war in the Western theatre has resolved itself into a continuous siege with the slaughter confined largely to artillery fire.

In order that artillery prove effective, it is obvious that the fire must be accurate. And no fact could more significantly illustrate the deadly accuracy of modern artillery than the recent statement of a medical authority that over 70 per cent. of all the wounds inflicted in the present war are due to shrapnel or shell fragments. But what has made such accuracy possible?

The prime requisite of accurate artillery fire is a suitable observation point from which the fire of the guns can be directed. As a general rule the directing and checking of the fire is made from a position as near the enemy's lines as possible.

One method of observing and directing artillery fire and which has been used with remarkable success is that of employing a captive balloon. The observer in the basket of the balloon has an unobstructed view over the lines of the enemy and, by means of a telephone line connecting to the different batteries, can tell the gunners the range as well as correct the fire of the guns after the bombardment has begun. However, it is not always possible to use an observation balloon, since it presents an

excellent target to the fire of the enemy, as well as to the bombs of hostile aeroplanes. Neither is it always possible to reconnoiter by cavalry patrols. In such instances the only remaining means of observation is the aeroplane.

Photography and Range Finding

Adverse conditions prevailing particularly on the battlefields of Flanders made it necessary for the Germans to employ the aeroplane for establishing their artillery range. Great success has attended the use of photographs taken from aeroplanes as a rapid means of finding exact ranges. From such sources of information as are available, the procedure for obtaining ranges as employed by the German army is as follows:

An aviator is sent aloft with an observer and the aircraft is guided over the enemy's lines in search of the guns. As soon as these are discovered, the observer trains the camera below in such a manner as to include on the photographic plate either a church spire, a barn, a solitary tree, a windmill or some other conspicuous object, as well as his own battery for which he is securing the range. Immediately after taking the photograph the aviator returns to the German lines and lands near the batteries. The photographic plate is rapidly developed and prints are made on bromide paper and sent to the officer in command of the guns. These prints appear as regular maps in relief, the trenches being indicated by bright lines and the cut-outs for the gun positions appearing as light squares in contrast to the darker, undisturbed earth. The calculation of the range is then resolved into a simple mathematical problem.

Referring to the accompanying diagram: One side of the triangle represents the distance from the German battery to the visible auxiliary point and can be determined by distance measurement. The auxiliary point is in the form of some conspicuous object which the observer has included in the photograph and which is within unobstructed view of the German lines. The second side of the triangle is a line drawn from

the same visible point to the enemy's battery. The length of this line is easily obtained by multiplying the photographic distance by the scale of the photograph; the latter being determined from the first two points. Two sides and two angles of the triangle being known, the range can be figured quite accurately. Although this range finding appears to be a painstaking task, it is considered necessary by the Germans because of the superiority of their mortar artillery. The object is not only the temporary silencing of the opposing battery, but the complete destruction of the guns and the annihilation of their crews.

Deadliness of Modern Artillery

The most destructive shell used by the Germans in conjunction with their mortar batteries is an explosive projectile which, when dropped down on hostile batteries from a considerable height, destroys both guns and men within a wide radius. As an example of accurate observing and destructive mortar fire, the siege of Antwerp stands preëminent. During the bombardment every gun turret on Fort Lierre was hit singly by shells from the powerful 42-centimeter howitzers. At Fort Waelhem the Austro-Hungarian 30.5-centimeter guns were equally successful; while at a certain section of the defences the 21-centimeter siege guns dismantled gun after gun comprising the open battery of the main fortifications.

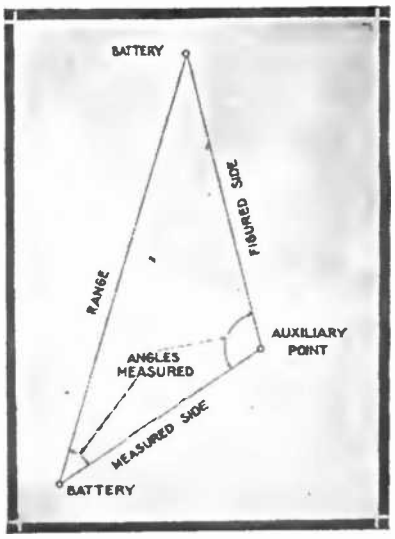
The long ranges over which artillery duels are conducted—often beyond the scope of natural vision—have rendered the aeroplane an indispensable factor in this branch of warfare.

The art of hiding or disfiguring the guns makes observations from an aeroplane a very difficult and ofttimes unreliable expedient, especially from the great heights at which the aviators are compelled to fly in avoiding undue risk from rifle and artillery fire. As a rule, the aviator or observer cannot determine the exact position of a battery until he sees the fire from the guns. In order to corroborate an observation flight as well as check the details of an observer's re-

port, numerous photographs are usually taken. These are immediately developed and printed upon landing. The photographs, in conjunction with the report of the observer, are invaluable to the general staff.

Great Skill and Steady Nerves

It is not a simple matter to take photographs from an aeroplane in full flight. It is more than a matter of pointing the camera downward over the side of the aircraft and pressing a bulb. Vibration in all parts of an aeroplane fitted with a powerful motor compels the observer to stand upright in taking a photograph, in order to eliminate the vibration as much as possible and secure sharp definition on the negative plate. The arms must not rest on any part of the airship and, in this trying position, the observer must hold the camera over the side of the fuselage, focus the camera and take the photograph. Great skill and steady nerves are obviously essential. Accurate observations can only be made at a height not exceeding 4,000 feet, while photographs taken at altitudes of from 2,000 to 3,000 feet are considerably enlarged to be of use. The hostile artillery and rifle fire is quite effective to heights of 5,000 feet, so it is little wonder that aeroplanes are shot down daily in performing their scouting work and taking photographs for range finding.



Method Employed for Determining Artillery Range.

Of the many brave deeds called for in modern warfare, perhaps none is more trying and more deserving of praise than those of the aviator and his passenger in the performance of their all-important duties. And in many instances it is due to them that the artillery fire is accurate and effective, resulting in the attainment of important gains or even great victories for their armies.

A LIGHT TO TRAP MOTHS

The beet ranches of Southern California are protected from the ravages of the night-flying moths, mostly cutworm moths, by a novel light trap which is set up in the fields; a single trap capturing from 1,500 to 7,000 moths in a single night. One company near Oxford has eight such traps in use and during the past season the results were equal to the highest expectations.

The device is of reasonably simple construction, being a powerful light enclosed in a glass globe and suspended over a shallow galvanized iron pan containing oil. The insects, flying against the globe, fall into the pan and perish in great numbers. As a large proportion of the moths are females, carrying great quantities of eggs, the results of a season's catch can easily mount high in the millions. The light is furnished by acetylene gas, a tank being set below the frame carrying the tank, though an electric light has been used with equal success.

This Light Attracts Many Moths to Their Doom in the Tank That Surrounds It.

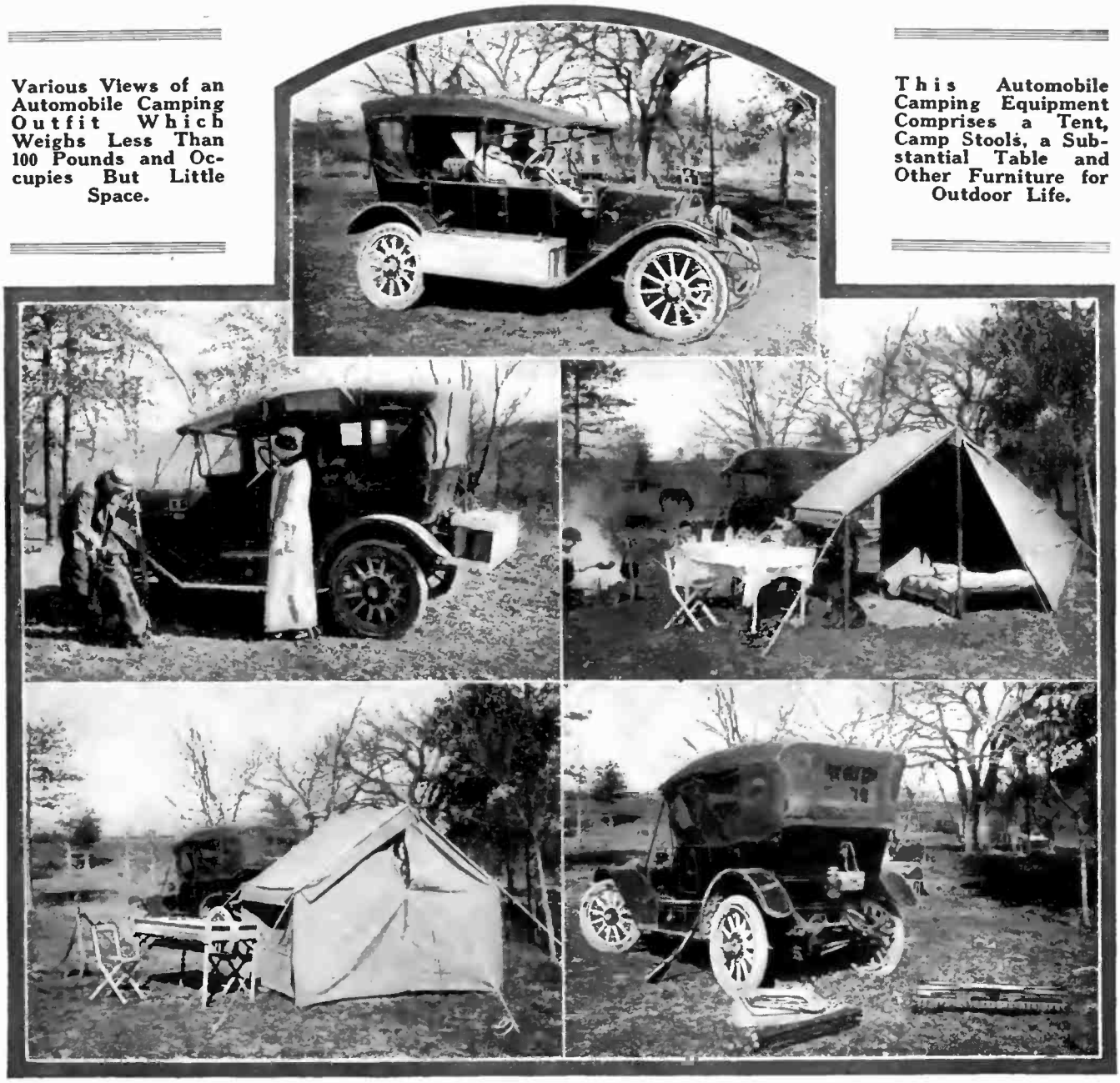
A CAMPING OUTFIT FOR MOTORISTS.

Of the many new devices for motorists that are constantly making their appearance on the market, perhaps none is more interesting than a camping outfit that has been invented by a Westerner. The outfit consists of a tent of suitable size to accommodate the motorists, a folding bed measuring four feet wide by six feet six inches long, and two folding camp stools. The bed is so constructed that it will not sag, even when holding a person of great weight. The tent is fitted with a sunshade that can be extended several feet from the tent proper. The bed can be folded and placed in a case fitted with legs and which may be converted into a substantial table finished in fumed oak and held together with steel parts. So strong is this table that it has been tested and is claimed to have withstood the most severe storm when securely braced.

The entire camping outfit packs into a case measuring 10 by 18 by 49 inches and can be readily placed on any automobile, weighing but 100 pounds.

Various Views of an Automobile Camping Outfit Which Weighs Less Than 100 Pounds and Occupies But Little Space.

This Automobile Camping Equipment Comprises a Tent, Camp Stools, a Substantial Table and Other Furniture for Outdoor Life.



SAFEGUARDING THE BANKS OF A RIVER

One of the big tasks the Government has undertaken in its fight to control the rebellious Mississippi river is the repairing of its banks. These are constantly subjected to the terrific wearing and tearing process of the great volume of water

rushing to the Gulf of Mexico. The soft dirt banks are being cut away at an alarming rate in many places and the Government barges are kept constantly at work during the summer and fall months.

One means of stopping the inroads of the river into nearby farms is the use of huge mattresses of willows which are sunk alongside the bank, weighed down with stone. The mattresses are made on board the barges and when completed are shoved into the water with the aid of machinery. The accompanying illustration shows workmen about to shove a big willow tree mattress over the side of the barge.

To Prevent River Banks From Being Washed Away, Mattresses of Willows Are Used.

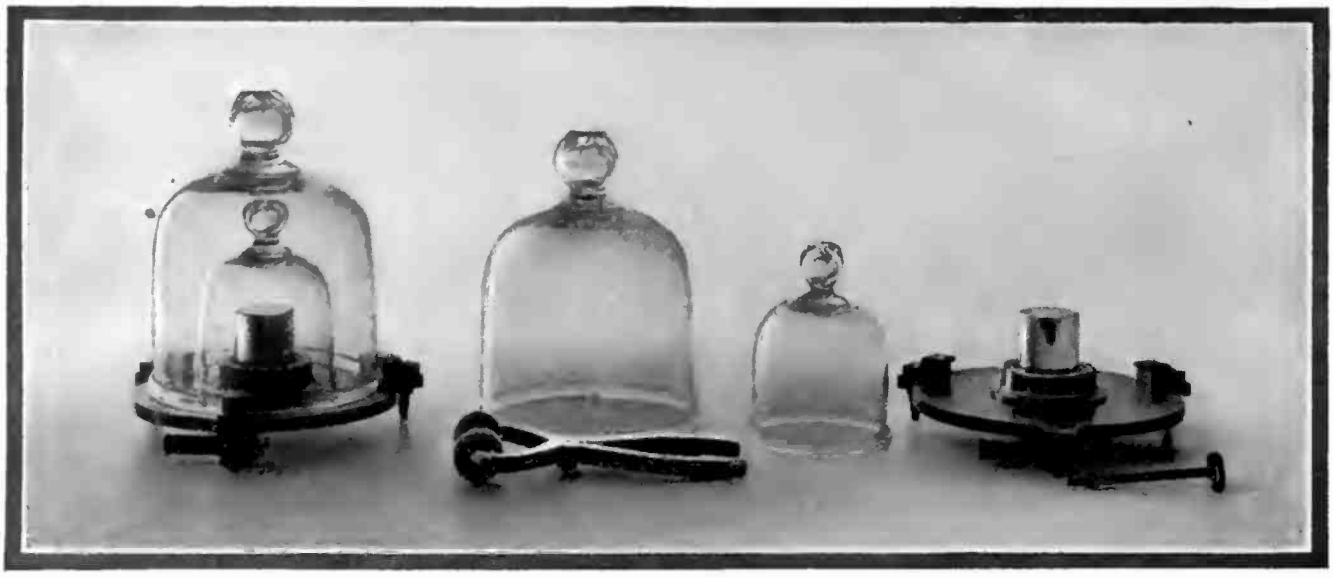
USES OF ALUMINUM FOIL

It appears that the use of aluminum foil has greatly increased in recent years, owing to the success of long and expensive experiments that have much reduced the cost of manufacture. The rolling process requires six stages, the last of which produces a full sixteen ten-thousandths of an inch in thickness. In order to obtain the very thinnest foil, the workmen lay several sheets together and either roll or beat them like goldleaf. Aluminum foil is now frequently used instead of tin-foil for wrapping such articles as cheese, candy and tobacco. It is also used in the Government printing office in place of gold-leaf for lettering on bound volumes of Government reports.

Aluminum foil is used to some extent in the condensers employed for wireless.

THE UNITED STATES PROTOTYPE KILOGRAM

In a vault at the Bureau of Standards in Washington, D. C., is carefully kept a kilogram weight that serves as the standard for the American pound weight.

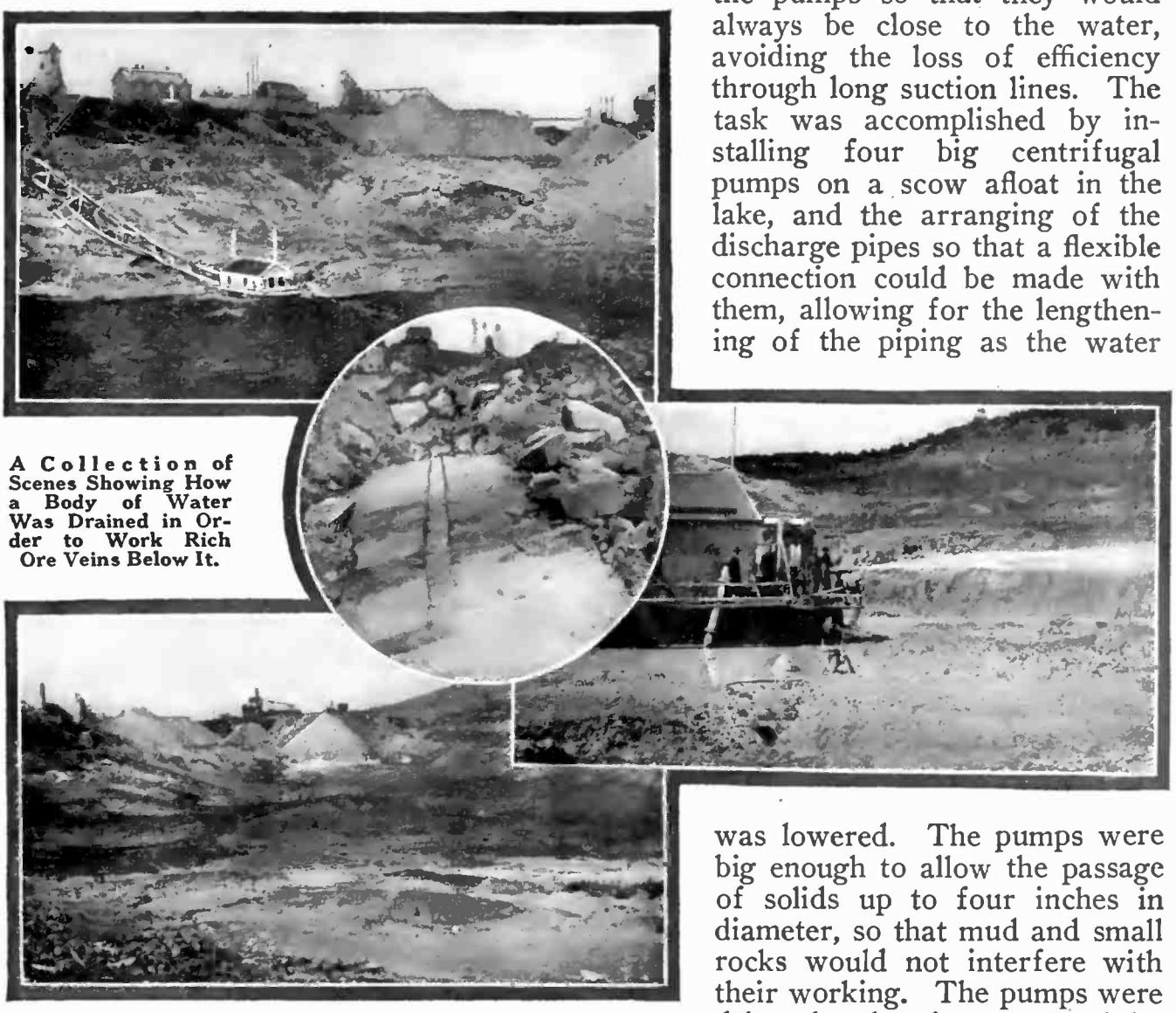


The Kilogram Weight That Serves as the Standard for the American Pound Weight, Kept in a Vault at the Bureau of Standards, Washington, D. C.

It is the equal of 2.2046 pounds avoirdupois; the standard pound being equal to a slight fraction more than half of a kilogram.

ELIMINATING A LAKE

A lake was in the way; it interfered with the industrial development of the surrounding district. The engineers in charge calmly pumped the water out and dried it up. Little things like natural lakes cannot presume to stand in the way of dividends, and this one was simply eliminated.



A Collection of Scenes Showing How a Body of Water Was Drained in Order to Work Rich Ore Veins Below It.

The body of water in question was Kerr Lake, formerly situated in the midst of the mining district of Cobalt, in Ontario, Canada. It had an area of 30 acres and contained about 400,000,000 gallons of water. The reason for its elimination was that there are a large number of rich veins of silver ore traversing the district, which it pays to work right up to the surface. That could not be done under a large body of water, and calculations proved it cheaper to dispose of the water than to lose the valuable ore. Besides, there was a strong probability that other veins could be found if an opportunity existed to examine the surface—a probability that was fully justified after the operation had been concluded.

The problems were a little difficult, for some means had to be found to locate the pumps so that they would always be close to the water, avoiding the loss of efficiency through long suction lines. The task was accomplished by installing four big centrifugal pumps on a scow afloat in the lake, and the arranging of the discharge pipes so that a flexible connection could be made with them, allowing for the lengthening of the piping as the water was lowered. The pumps were big enough to allow the passage of solids up to four inches in diameter, so that mud and small rocks would not interfere with their working. The pumps were driven by electric power and delivered the water into a 20-inch pipe which conveyed the water to another lake about half a mile away. Two 250-hp. motors operated the four pumps.

The pumps removed the water at the rate of 6000 gallons per minute for 38 working days. At first the clear water was taken out very rapidly, but when the bottom was neared, a mass of semi-

liquid mud had to be handled. A stream of water under pressure was used to wash the mud into the pump intake.

Several rich and important veins of rich silver ore were uncovered after the pumps had done their work, some of them containing ore worth nearly two thousand dollars a ton.

A "MOONSHINE" STILL IN CHINA

On the outskirts of Shanghai, China, is a "Moonshine" still, very closely resembling the form of stills used in some parts of Kentucky for making illicit whiskey.

Chinese "Moonshine," or *Samshu,* as it is called, is a pale liquid made by distilling rice water. It somewhat resembles the Japanese drink, *Saké,* which is drunk while hot. The manufacturing process of *Samshu* is as follows:

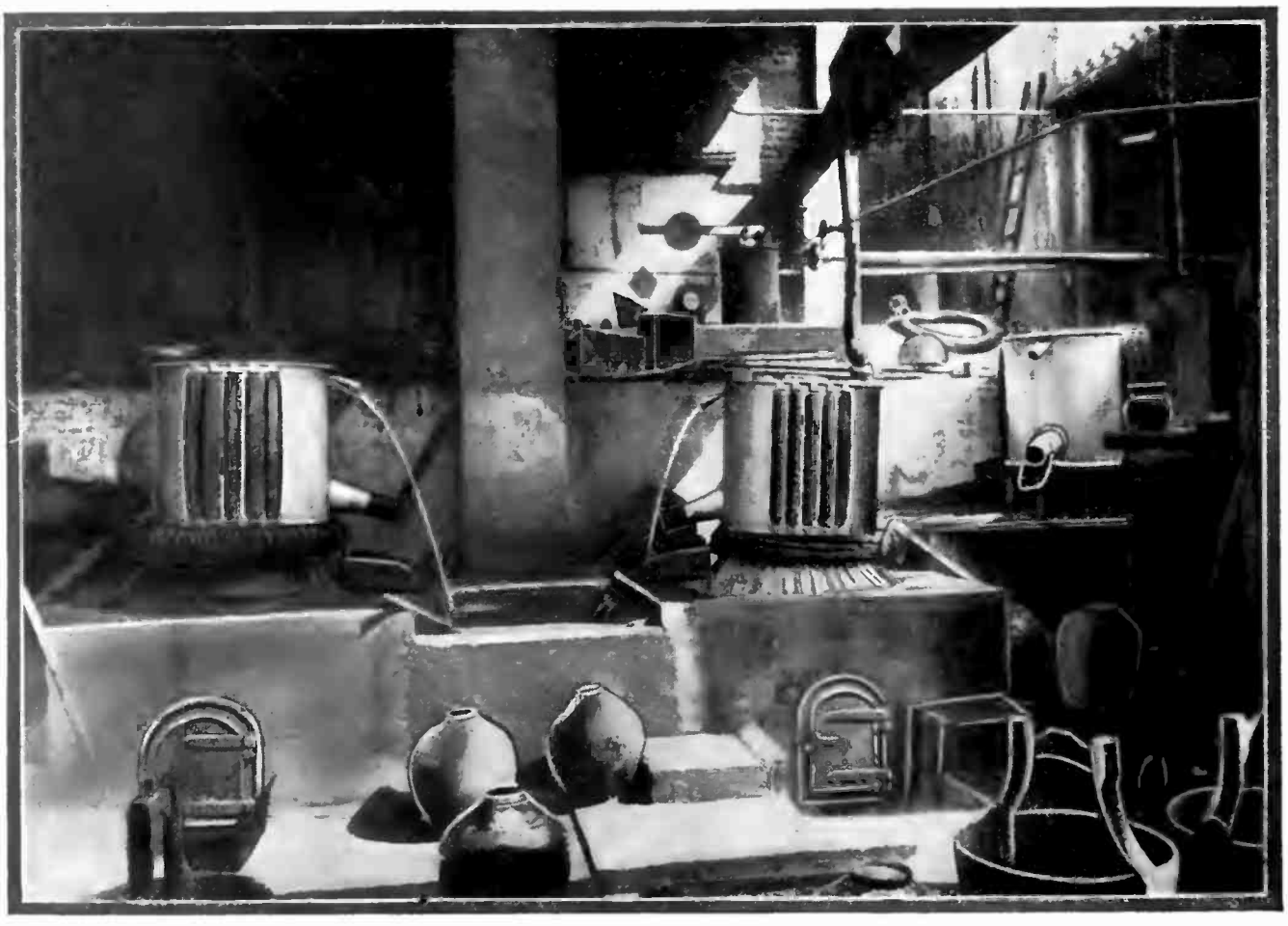
Large brass boilers in which are placed condensing coils are partly filled with rice water and mounted upon a small brick oven in which is burned charcoal. The heat vaporizes the alcoholic *Samshu* and it is condensed and drawn off at frequent intervals.

Samshu has a peculiar oriental odor and flavor, offensive to a foreigner, but quite popular with the native population. It is sold only in native stores and costs somewhat less than one cent per glass.

THE PHONOSCOPE

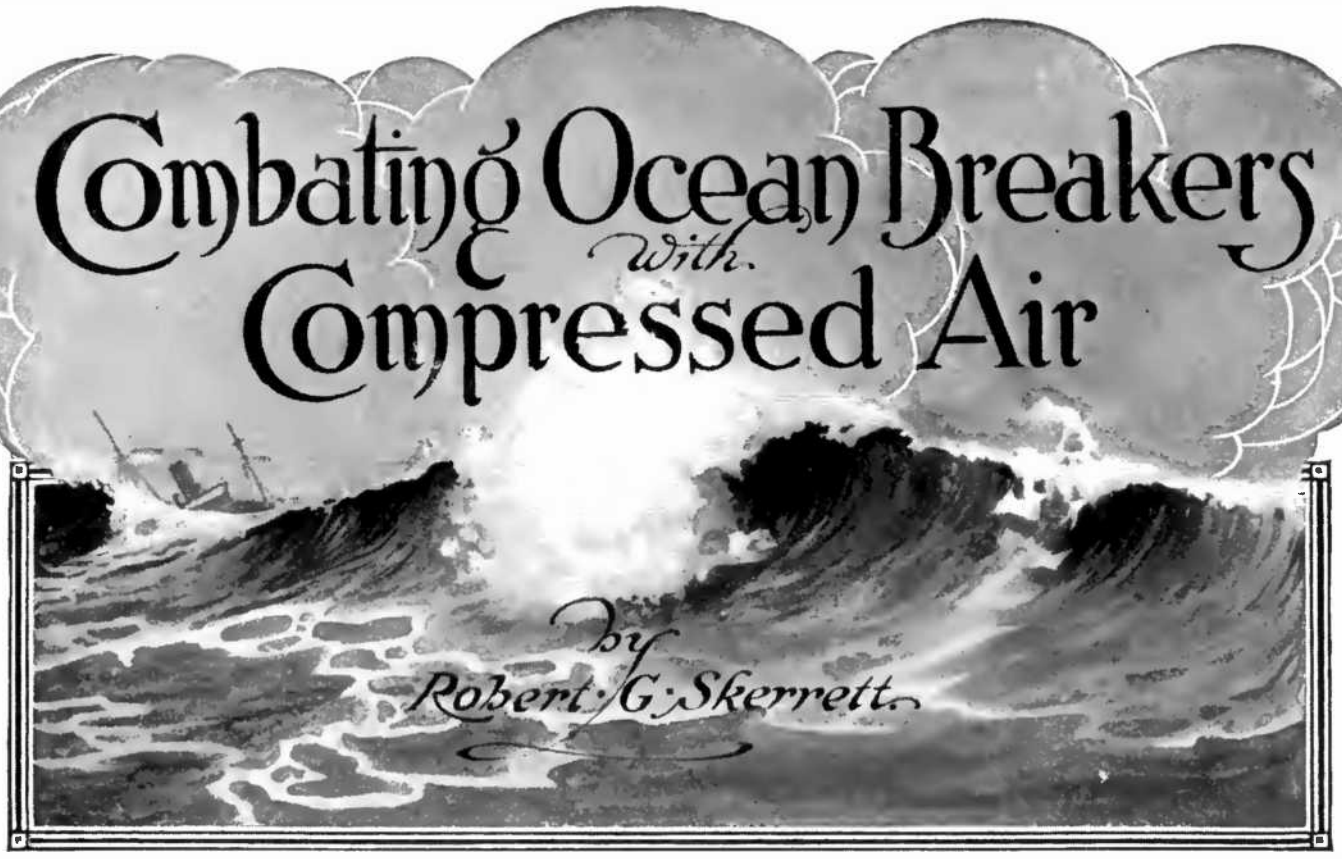
From far away India comes a report that a Professor Albe of Lahore has invented a machine that he calls the "Phonoscope," the use of which enables the totally deaf to perceive sounds by means of the eye. The machine can be used in conjunction with either speech or music.

No details of the "Phonoscope" are yet available, although it is surmised that it employs photography in some form or other. In the past, motion pictures have been taken of the effect of different sounds, particularly in conjunction with telephony and wireless telephony, and the new invention may be similar.



A Complete Distilling Outfit Used by the Chinese for the Making of "Samshu," a Popular Oriental Beverage

Combating Ocean Breakers with Compressed Air



by Robert G. Skerrett

EACH year certain sections of our coasts are ravaged by heavy seas with a resultant loss of property. Massive breakwaters of concrete, steel and stone are often powerless in the face of the huge breakers. At last a solution has been found in the form of a pneumatic breakwater; numberless air bubbles shattering the waves and robbing them of their power.

AFTER fourteen years of experimental and practical work, Philip Brasher, a young engineer graduate of Princeton University, declares that he has the only feasible means of eventually protecting the sandy stretches of our Atlantic seaboard from the erosive action of storm waves. Particularly, he offers his apparatus to meet the present pressing need of certain portions of the New Jersey littoral.

As most of us know, bulkheads and jetties of heavy pilings and stout planking—some of them steadied by rock ballast—have been the ordinary mediums by which the beach engineer has sought to arrest or check the greedy inroads of the storm-aroused Atlantic. These, in many cases, have been constructed without regard to cost, and yet they have been battered into kindling by the awful blows of the angry breakers stirred up by southeast gales. Worse than this, adjacent territory has been cut into and undermined, tumbling one after another expensive cottages and hotels right into the swirling waters. A remedy and an effective one is urgently needed if further destruction is to be arrested. Indeed, vital topographical changes may be wrought if lasting bulwarks are not reared soon. But what sort of barriers will suffice short of prohibitively expensive breakwaters? Mr. Brasher says he

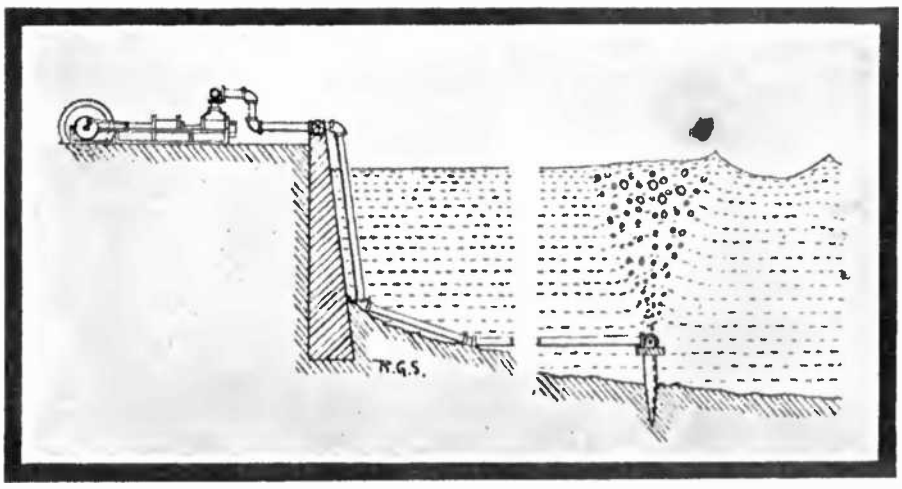
can furnish a fitting remedy by employing compressed air.

As he puts it, "My air breakwater is based upon the demonstrated scientific fact that air bubbles, rising from a considerable depth, will completely destroy the form of the waves and reduce their height to a point where they are no longer capable of doing damage.

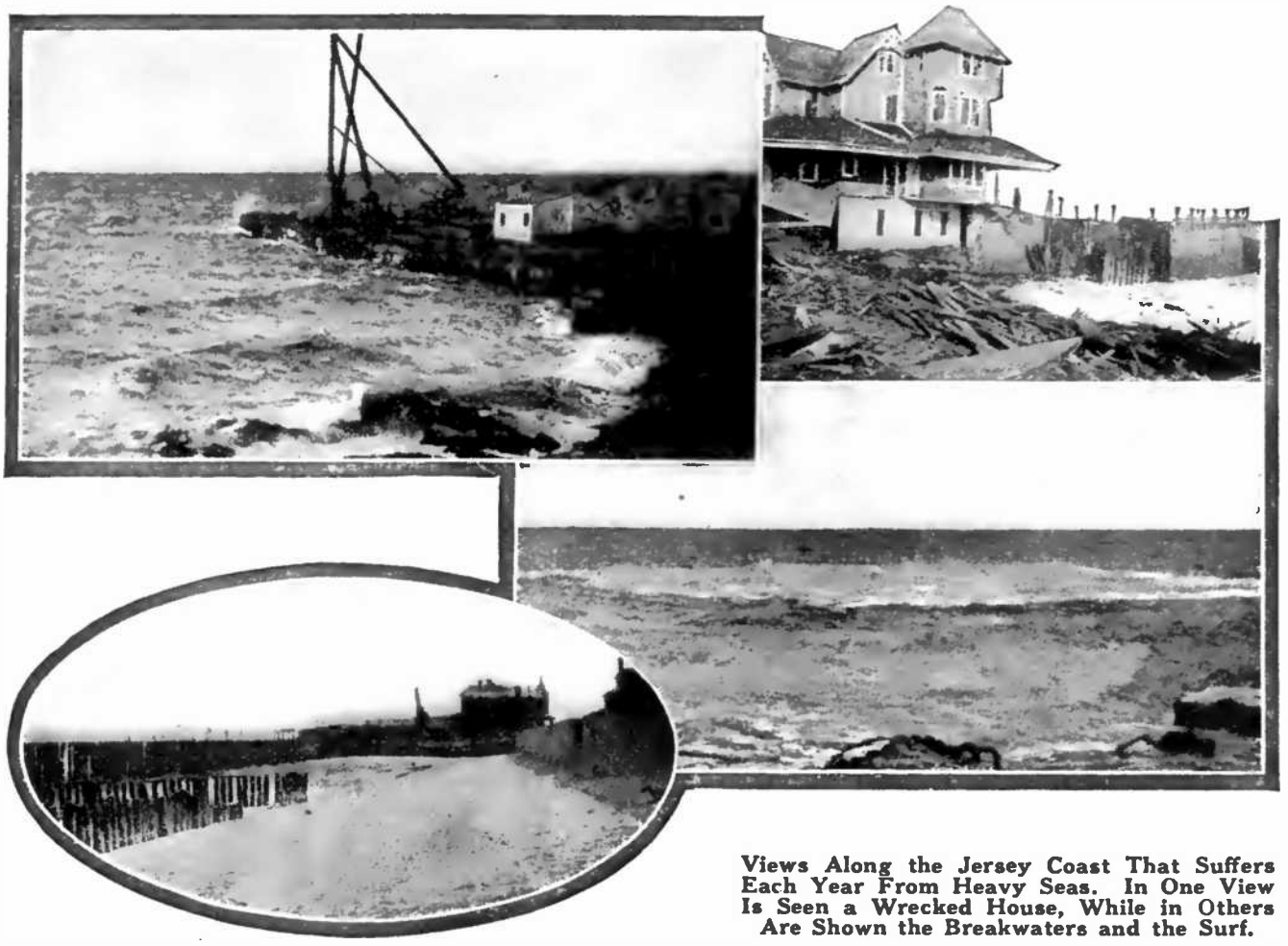
"What gives a wave its power and what is its mode of travel? There is only one time at which a wave is really dangerous to anything substantial, and that is just as it is curling to break. It is then undergoing a change from what is called an oscillatory wave—or one whose particles merely oscillate—to a wave of transmission, *i. e.,* one whose particles *travel* along in a certain direction. At that particular time, the momentum attained by the tons of water, elevated to whatever height it may be, and falling from that height, is practically irresistible. So that if it be possible to cause a wave to break before striking any object to be protected, the capacity of the wave to do harm is destroyed and it becomes merely a bubbling mass which looks rough but is really harmless.

"Wave motion is described as the transference of energy by vibration. In other words, each particle of the wave merely vibrates and the motion is carried forward by the impact of the vibrating particles. Therefore, if this vibratory impulse can be broken up or arrested, then waves can be halted and their further propagation stopped. That is exactly what I accomplish by utilizing a barrier or blanket of air bubbles mounting surfaceward from a suitably perforated conduit lying on the ocean bed and squarely across the path of the advancing seas. These bubbles, expanding as they approach the surface, disrupt the water and force widely apart the very particles which must be in intimate contact in order to facilitate the transmission of the wave forming vibrations. With intervening air gaps this is quite out of the question, and, therefore, I am thus enabled to break up billows provided I can deal with them before they have started to tumble over and have become breakers."

An instance will explain the practical application of his ingenious invention and will give the details of one of Mr. Brasher's installations. To use the inventor's own words: "I installed a plant for a quarry on Cape Ann, Massachusetts, where the shipping pier was exposed to the sea. The company had great difficulty in loading their barges except when the sea was nearly calm. I ran a pipe along the edge of the pier and down into the water at the outer end, and thence along the bottom oceanward for a distance of a hundred feet. At that point, another pipe, four inches in diameter and perforated at suitable intervals, was connected to the first conduit at right angles. The perforated pipe was three hundred feet long and lay at an average depth of forty feet upon a very rocky bottom. When the compressed air was turned on the discharge rose from the sea-bed in a wide bubbling zone that smothered all oncoming waves, and effectually protected the end of the pier so that barges could lie there in security and load without difficulty. The air consumption was three cubic feet per minute per linear foot of perforated pipe, that is to say, nine hundred cubic feet in that interval, at a pressure of twenty pounds per square inch. This impulse was all that was



Working Diagram of the Principle Employed by Philip Brasher in His Pneumatic Breakwater.



Views Along the Jersey Coast That Suffers Each Year From Heavy Seas. In One View Is Seen a Wrecked House, While in Others Are Shown the Breakwaters and the Surf.

needed to overcome the pressure of the hydrostatic head of forty feet."

The inventor states that his breakwater will be of service under the following conditions, which convey some idea as to its remarkable range of applications:

"Dredges can be kept working in the most exposed places during the roughest weather. The erection of permanent breakwaters, piers, lighthouses and dams may be continued steadily, no matter what the weather conditions. Half completed structures may be protected until finished. Lightships can ride out the roughest gale in an artificial lagoon of calm sea. Stranded vessels can be protected from the pounding of the waves until floated."

WATCH KEPT RUNNING BY FOOTFALLS OF OWNER

Councilman Schmidt, of San Diego, is the proud possessor of the only watch in the world which winds itself. He bought it forty years ago in Kansas, and it was so old then that he could not find out when it was made. It was a square French time-piece, having been made at some far off-date in Loire, France, and it is so arranged that a lever oscillates with every footstep the owner takes, thus keeping the spring tightened. It is the only watch on record, according to New York experts, which winds itself by the jar in walking. It keeps perfectly accurate time in spite of its peculiarities of construction, and has worn out several good cases. At present it is encased in a new gold case. A key is provided for emergencies, so that if the owner should be ill or have to refrain from walking for several days, the owner can wind the watch.

If you enjoy THE WORLD'S ADVANCE, please tell your friends. If you do not, write us your reasons and suggestions.

A Three-Wheeled Tractor That Is Proving Highly Successful in Different Fields of Application. Here It Is Seen Drawing a Snow Plow.

AUTOMOBILE TRACTOR OF NEW DESIGN

In Chicago there is being used at the present time a tractor of new design. It is a three-wheeled vehicle and is sufficiently powerful to haul from fifteen to twenty trailers made especially for use with the tractor.

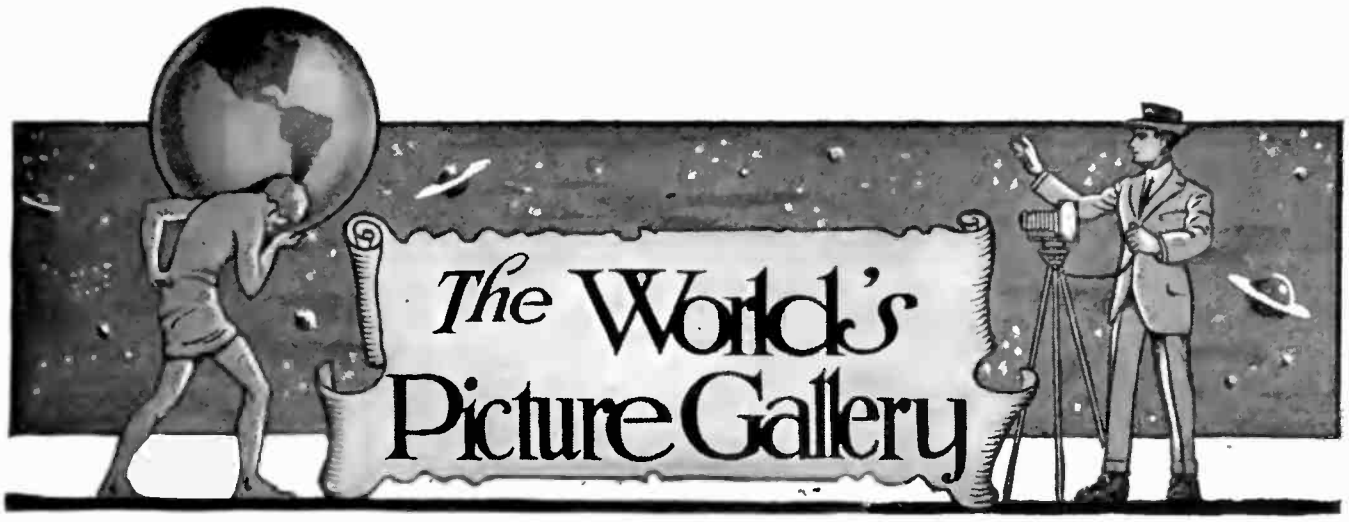
The new tractor is equipped with a four-cylinder water-cooled motor located in the rear of the machine instead of at the front as is usual. The two wheels at the rear are driven by the engine and propel the vehicle, while the wheel at the front is used for steering.

INTERESTING BRICK WALL

On one of the side streets of San Diego, California, may be seen the amusing and amazing spectacle of a small red brick house completely stuccoed with bits of broken crockery, glassware, china and porcelain; while in nearly regular patterns larger pieces of Japanese decorative china and vases, beer bottles, plates of old blue china and chunks of dark brown and green sewer tile, vie with glass tumblers, steins and earthenware jugs and jars for vividness of color and design, all forming a part of the most brilliant and dazzling display of exterior house decoration that has yet been seen. This queer house is the home of an eccentric Englishman who takes delight in the wonder and curiosity of his neighbors and the passers-by. They view with undisguised wonder the pile of barrels filled with pieces of once-treasured china and glass, now waiting his pleasure in prospective addition to the already alarming assortment of vari-colored decorations. The foundation-piers are of varied structure also, one side of the house being supported by massive looking walls of cobble-stones, while the other rests on piles of glazed tile. The chimney, too,

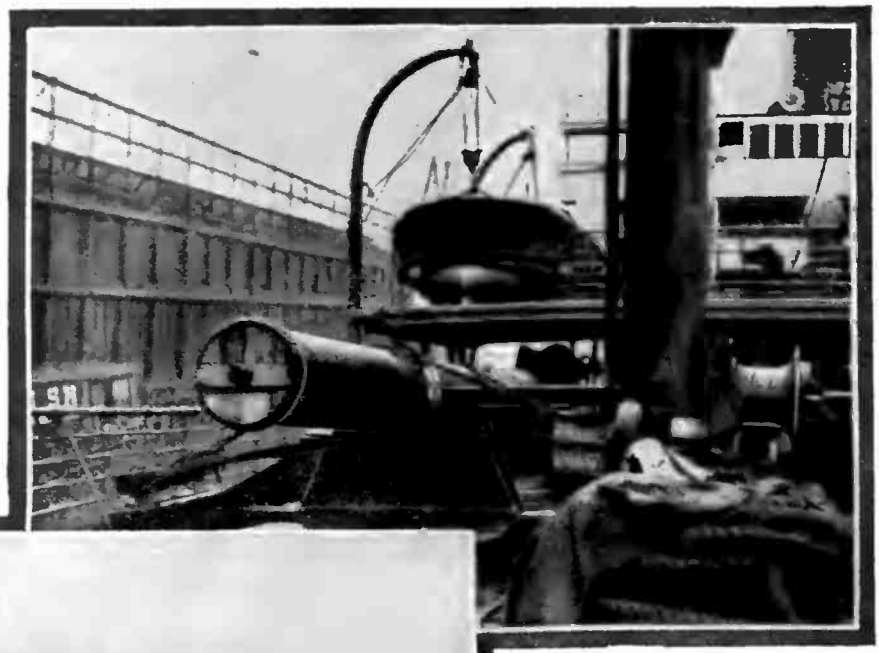
One of the Sights of a Californian City Is the Brick Wall of a House That Is Studded With Broken Crockery, Glassware and Porcelain.

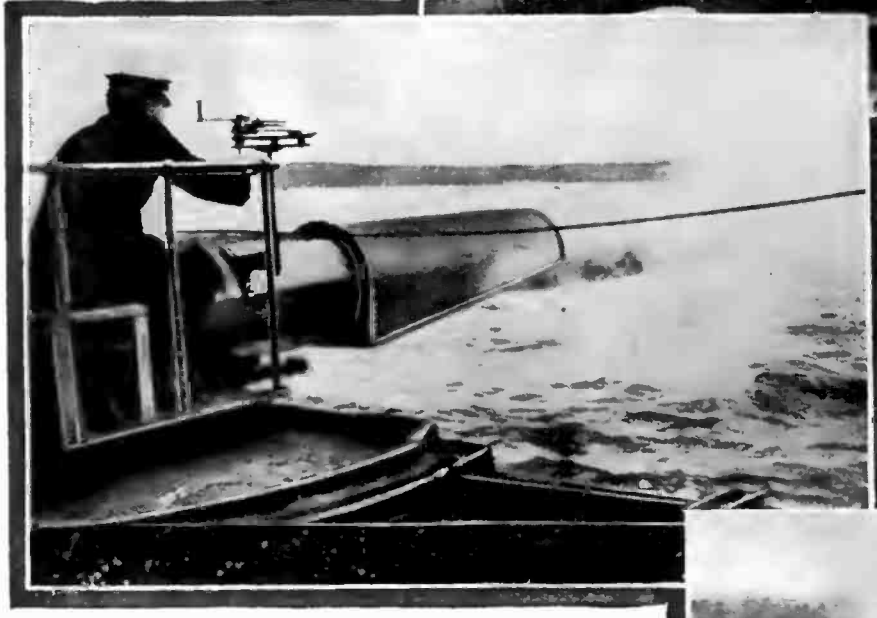
which is on the rear side of the house, is a peculiar one, since the red bricks are interspersed with white glazed ones, set in the most bewildering crazy-quilt patterns imaginable. Evidently the owner and designer of the dwelling does not believe in monotony of house decoration.



A night view of the Panama-Pacific International Exposition now being held at San Francisco. The conspicuous structure appearing in this view is the Tower of Jewels--a mass of glass jewels of many different colors and extreme brilliancy. The numerous searchlights form an important part of the illumination effects.

One of the sixteen-inch guns recently shipped to England on board the S. S. "Transylvania." This view shows how these massive pieces of ordnance were lashed to the deck of the liner.





At the Left: A torpedo leaving the torpedo tube of a British destroyer. Below: A Canadian despatch rider firing his rifle while traveling at thirty miles an hour.

Below: A German sentry in Poland.

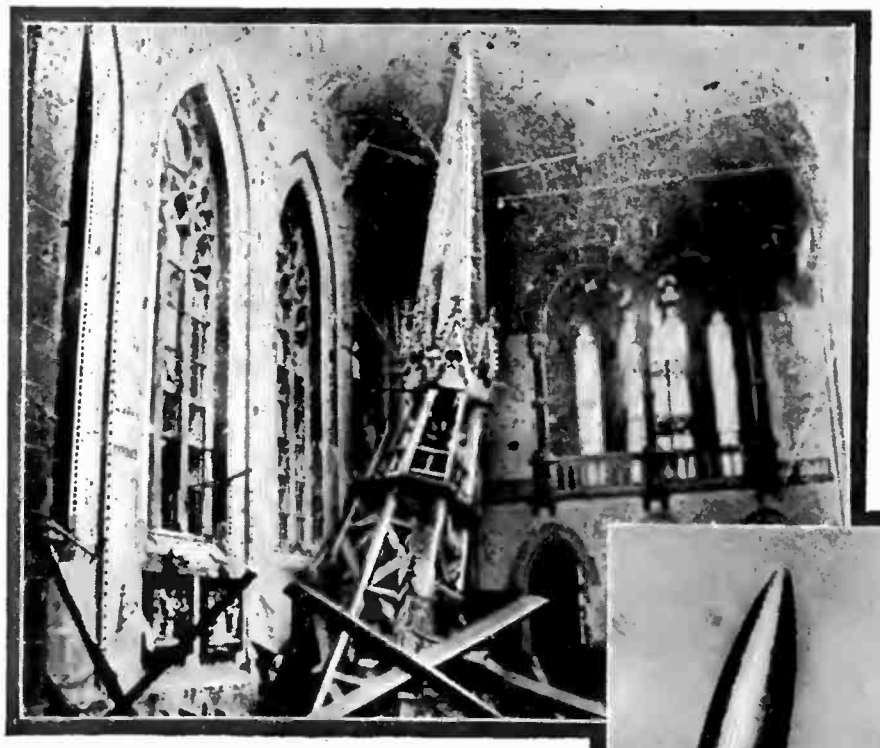
Photos. Copyrighted International News Service.

The toll of war: A battlefield on the western front after a severe engagement in which the German infantry charged across a field with heavy losses.

A French officer's living quarters on the battle line in France. Owing to the necessity of digging themselves in, the German, English, French and Belgian soldiers are obliged to withstand many hardships through lack of proper shelter. This particular shelter is considered a palace by the soldiers —and there are very few as comfortable.

Even the Red Cross ambulances are obliged to stop when challenged by a sentry and the chauffeur must show his credentials.

Photos. Copyrighted International News Service.



The interior of a French church near Bethune, which was wrecked by a German shell. The shell in crashing through the roof of the church carried the steeple along with it.

The accompanying illustration shows a cartridge clip and cartridges such as used in the French military rifle. A German bullet has passed through the four cartridges, yet through some freak of fortune they have failed to explode. The soldier who was carrying this clip was not injured.

A woman and her children who were evicted from their home through lack of funds, the husband having enlisted as a soldier. The landlord has been harshly criticised by the local citizens.

An Austrian battery shelling a Russian position in Galicia. The mountainous nature of this territory, together with the heavy snowfalls and intense cold, has made the fighting there replete with hardships.

How Switzerland guards her neutrality and is prepared for war: Swiss soldiers in the Alps carrying snow to make trenches.

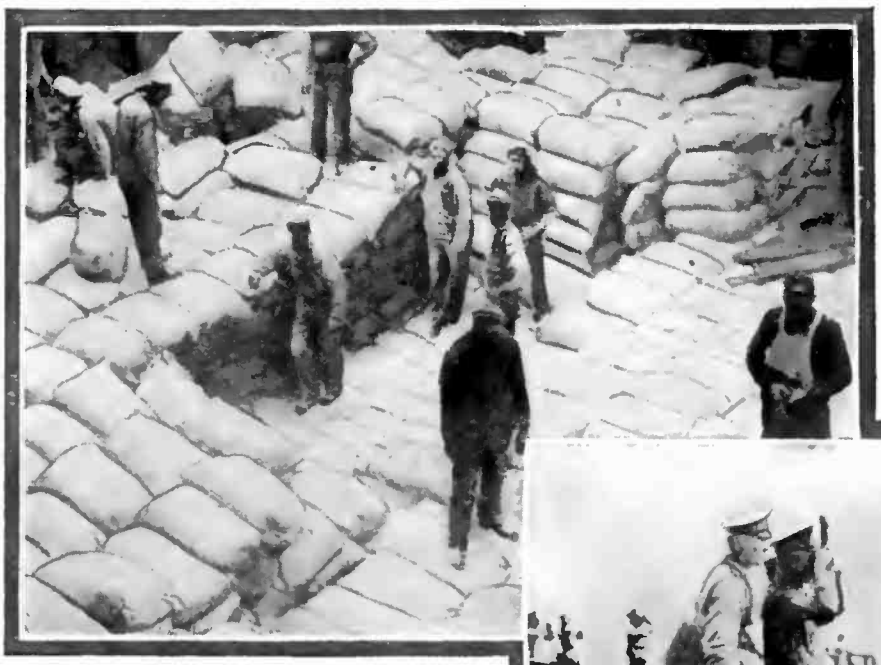
In the heavy snows of Poland the Germans have been obliged to use rough sleighs, such as the one herewith illustrated, for the transportation of their wounded to the hospitals.

Photos. Copyrighted International News Service.

The army of English women in the making. Above: The army marching through the streets of London. At the left: A member of the Women's Volunteer Reserve dressed in the regular uniform and with the equipment pack on her back.

Members of the Women's Volunteer Reserve receiving a lesson in telegraphy. The object of the organization is to train women in first aid work, cooking, riding, driving, care of horses, and marksmanship.

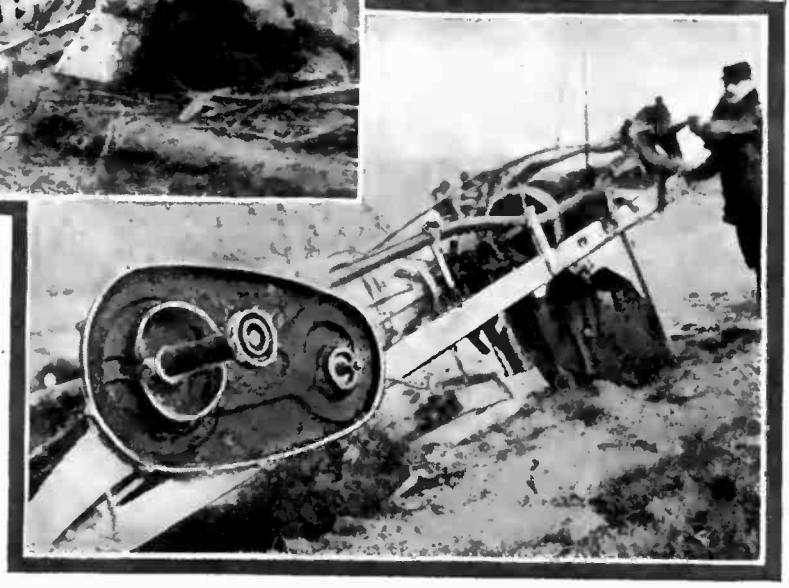
Photos. Copyrighted International News Service.



A cargo of flour and wheat in the hold of the S. S. "Baxstan," at the docks of the Bush Terminal, Brooklyn, just before the vessel sailed for Liverpool with a big cargo of foodstuff.

Russian officers observing the effect of shellfire in Galicia, during an engagement with the Austrian forces. Both armies are using light field artillery because of the rugged nature of the country.

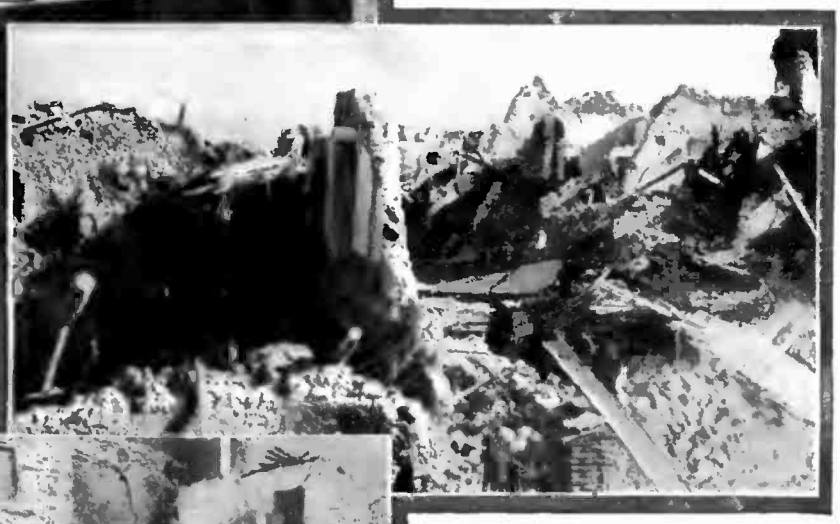
French heavy artillery shelling Steinbach in Alsace. It will be noted that in a spirit of humor the artillerymen have painted German names on their guns.



The remains of one of the motor transport wagons of the Allies after being struck by a German shell. Every movable part of the machine has disappeared, leaving only the bare framework.

Photos. Copyrighted International News Service.

Italian soldiers issuing tickets for soup to the homeless people of Sora, Italy. The Italian Government immediately after the earthquake was confronted with the problem of nourishing and housing the unfortunate inhabitants of the affected communities.



A scene among the wreckage of an Italian town after the earthquake.

Soldiers excavating among the ruins in the town of Sora in search of earthquake victims. About one hundred persons were buried in the debris caused by the earthquake.

Removing the dead from the earthquake ruins at Sora, Italy. In this town the loss in property and lives was very heavy.

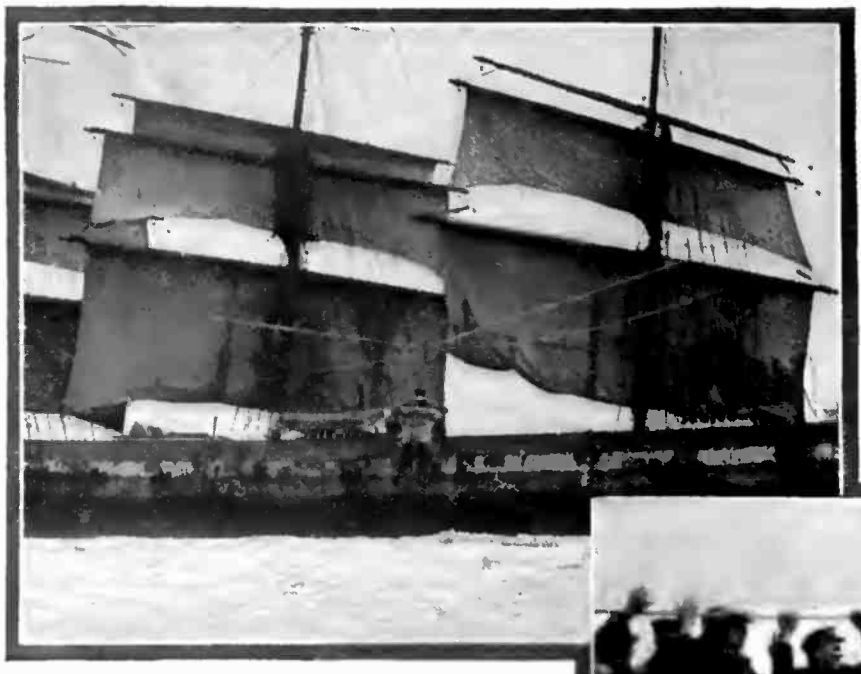
Photos. Copyrighted International News Service.

An idea of the work entailed in registering prisoners in the present war is presented in this picture. Here is seen a portion of the card index files kept by the German War Office for registering the German soldiers that have been captured by their enemies.

The new Maine memorial at the Arlington Cemetery, Washington, D. C. The monument was dedicated on February 15th. The base consists of a new turret, while the fighting mast is one taken from the ill-fated warship that was blown up in Havana harbor a short time prior to the Spanish-American war.

A school scene in the section of Alsace now occupied by the French forces. In this view a French soldier is seen teaching the children how to speak and write French.

Photos. Underwood & Underwood and Janet M. Cummings.



The four-masted sailing vessel "Hougomount" that was recently driven ashore in a storm off Fire Island, New York. In this view is seen a member of the crew being brought ashore by means of a breeches buoy.

A member of the crew of the "Hougomount" brought to shore in a breeches buoy.

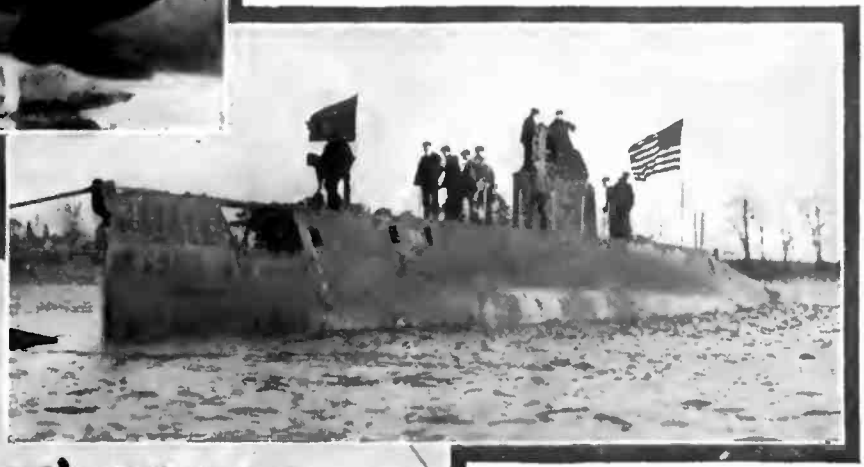
Another view of the life saving corps at Fire Island rescuing the crew of the sailing vessel.

A view of the "Hougomount" that was driven ashore during a storm, showing its close proximity to the beach. The sailing vessel was in danger of being pounded to pieces by the heavy breakers.

Photos. Copyrighted International News Service.

Awarding twenty $10.00 and $5.00 gold pieces to the gun crew of the "Georgia" that won the target practice off the Virginia Capes.

E. A. Darowsky, the best shot in the U. S. navy. This gunner made three hits out of twelve shots in one minute and forty-six seconds with the 12-inch gun on which he is sitting, at 2,000 yards. He is the first gun pointer of the "Georgia" and is 18 years old. He hails from Bayonne, N. J.

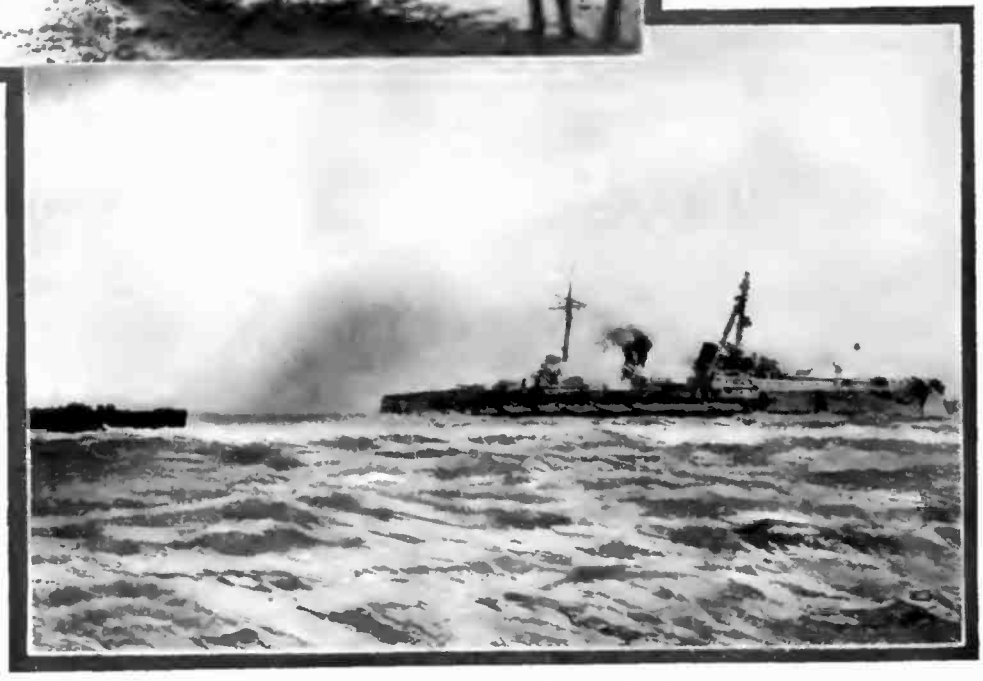


Below: Gunners of the "Georgia."

Above: The U. S. submarine boat "L-1" recently launched at the Fore River shipbuilding yards, Quincy, Mass. This craft is the largest submarine boat now in the American navy.

After the big naval engagement between the German and British fleets off Falkland Islands, in the South Atlantic: In the foreground may be seen numerous sailors from the sunken German warships waiting to be rescued. The battleship in the background is Admiral Sturdee's flagship "Invincible."

A French dirigible airship leaving its shed for a flight. The French army is equipped with quite a number of dirigible balloons of the flexible type, but thus far they have not been used for actual military activities of note.



The German battle cruiser "Bluecher" about to capsize and sink to the bottom after being torpedoed by the destroyer seen at the left. This battleship was lost during the fight between the German and British fleets in the North Sea. Dreadnaughts partook in this engagement.

Photos. Copyrighted International News Service.

MAKING WAR ON CARDBOARD SOLDIERS

An unique method of preparing the members of the National Guard for war, especially for night attacks, has been invented by Capt. John J. Richards of Providence, R. I.

Capt. Richards and his men of Troop B are getting about as near to real warfare as is possible without danger to themselves. The "enemy" is represented by cardboard targets set up in various spots throughout a wood and on several roads. The cavalrymen are then given commands to charge at various distances. A lively action with plenty of firing follows. After each attack has been worked out to the satisfaction of the commanding officer, the holes in the "foe" are covered with paper and the targets are used again.

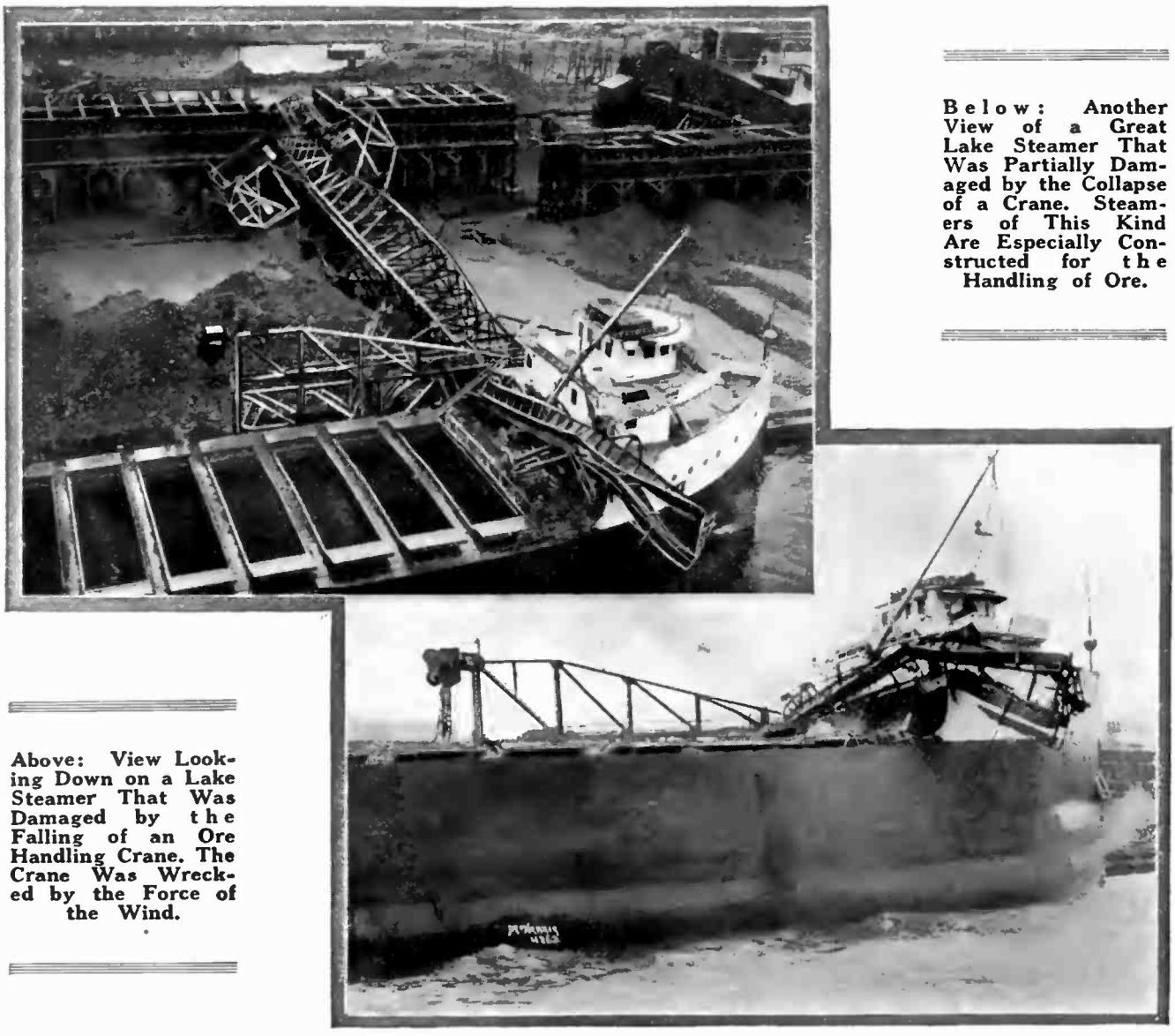
The targets, which are cut from large sheets of cardboard, have aroused keen interest among the army officials of Rhode Island. They are the exact size of a man and each is painted to represent a soldier in uniform. From a distance it is said that the targets cannot be distinguished from human beings. Real bullets are used in the fighting; the practice being accordingly of a practical nature and not of the imaginary or theoretical sort as is usually the case.

Cardboard Targets That Are Being Used by Members of the Rhode Island National Guard for Target Practice.

THE WIND'S HARVEST

When an engineer builds a steel structure he is usually pretty careful to make liberal allowances for all the stresses to which it may be subjected, building it strong enough to resist every strain that can be imagined as acting on it. Resistance to the wind is one of the things

always figured upon, but sometimes the wind is stronger than the engineer imagines. Such a case is shown in the accompanying reproductions, which show an ore dock at Duluth that was wrecked by a high wind. Ore is brought to the Duluth steel works from the Michigan and Minnesota mines in large steamships built especially for such carriage, and to make unloading rapid and cheap, these steel docks are built so that an arm reaches over the vessel and an excavator dips into the cargo and carries a loadful to the ore pile. This one was built a little too weak, with the result that the wind completely wrecked it, as well as inflicted considerable damage on the steamer. The Duluth winds are by no means zephyrs of spring, as attested by this incident and many others of a similar character.

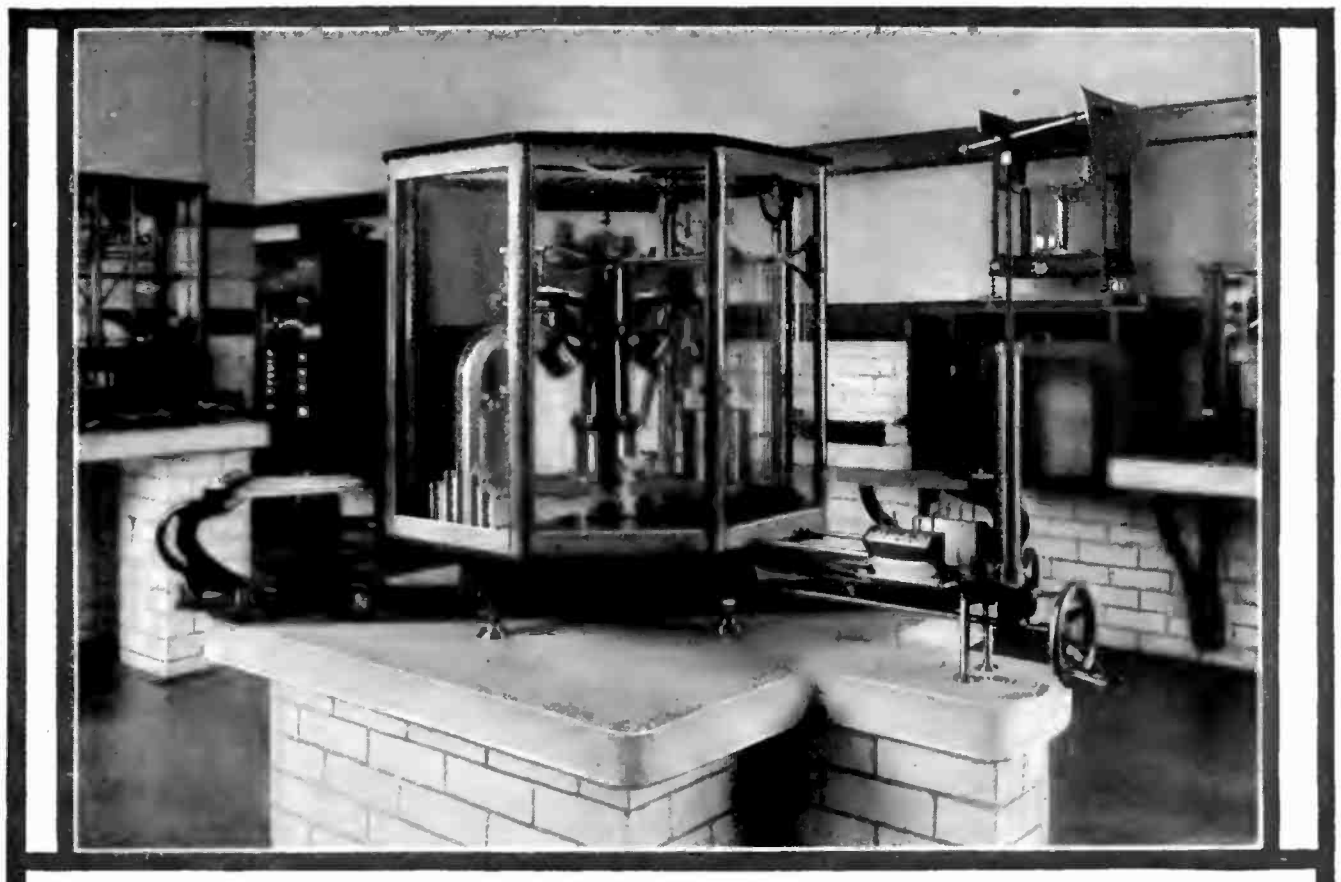


Below: Another View of a Great Lake Steamer That Was Partially Damaged by the Collapse of a Crane. Steamers of This Kind Are Especially Constructed for the Handling of Ore.

Above: View Looking Down on a Lake Steamer That Was Damaged by the Falling of an Ore Handling Crane. The Crane Was Wrecked by the Force of the Wind.

NEON GAS IN ILLUMINATION WORK

The rarefied atmospheric gas known as neon, which was first isolated in 1898 by fractional distillation of liquid air, has been successfully used in electric lighting. If a mild electric current passes through a tube that contains a minute quantity of neon, it produces a golden light that is soft and agreeable to the eyes, and makes the objects it illuminates stand out with remarkable clearness. The neon tubes require less current than the mercury-vapor lamp and give out less heat than any other form of electric light. Moreover, the electric current disintegrates the gas very slowly; the tubes will produce light for from eight hundred to one thousand light hours without being renewed.



This Weighing Machine, Which Is Used in the Laboratory of the Bureau of Standards, Is Said to Be One of the Most Accurate in the World.

A WEIGHING MACHINE OF GREAT PRECISION.

One of the most accurate weighing machines in the world is that used in the laboratory of the Bureau of Standards in Washington, D. C. This machine was designed especially for the work of the Government. There are only four others of a similar kind in the world. The weights are adjusted on the scales by the wheel that appears at the right of the machine which is shown in the accompanying illustration. The scale is intended for the testing of 50-pound weights, yet it possesses such great accuracy that a fly's wing can be weighed with precision.

NOVEL IDEAS DISPLAYED AT INVENTORS' SHOW

A vast amount of ingenuity was recently presented in the form of many inventions on exhibit at the national inventors show held in New York City.

One of the inventions which aroused much interest was a bumper or fender for automobiles. According to the manufacturer of the fender, the device is a "veritable breastwork when in danger of collision; the only bumper in the world that protects the car, child or adult occupant, stops the car and does its true work when other efforts fail."

Another invention that interested automobilists in particular was a device for dimming headlights. Numerous other similar devices for accomplishing the same results were displayed. An array of special lenses and attachments for headlights, enabling the throwing of a beam of light on the road and not into the eyes of oncoming chauffeurs, also attracted much attention.

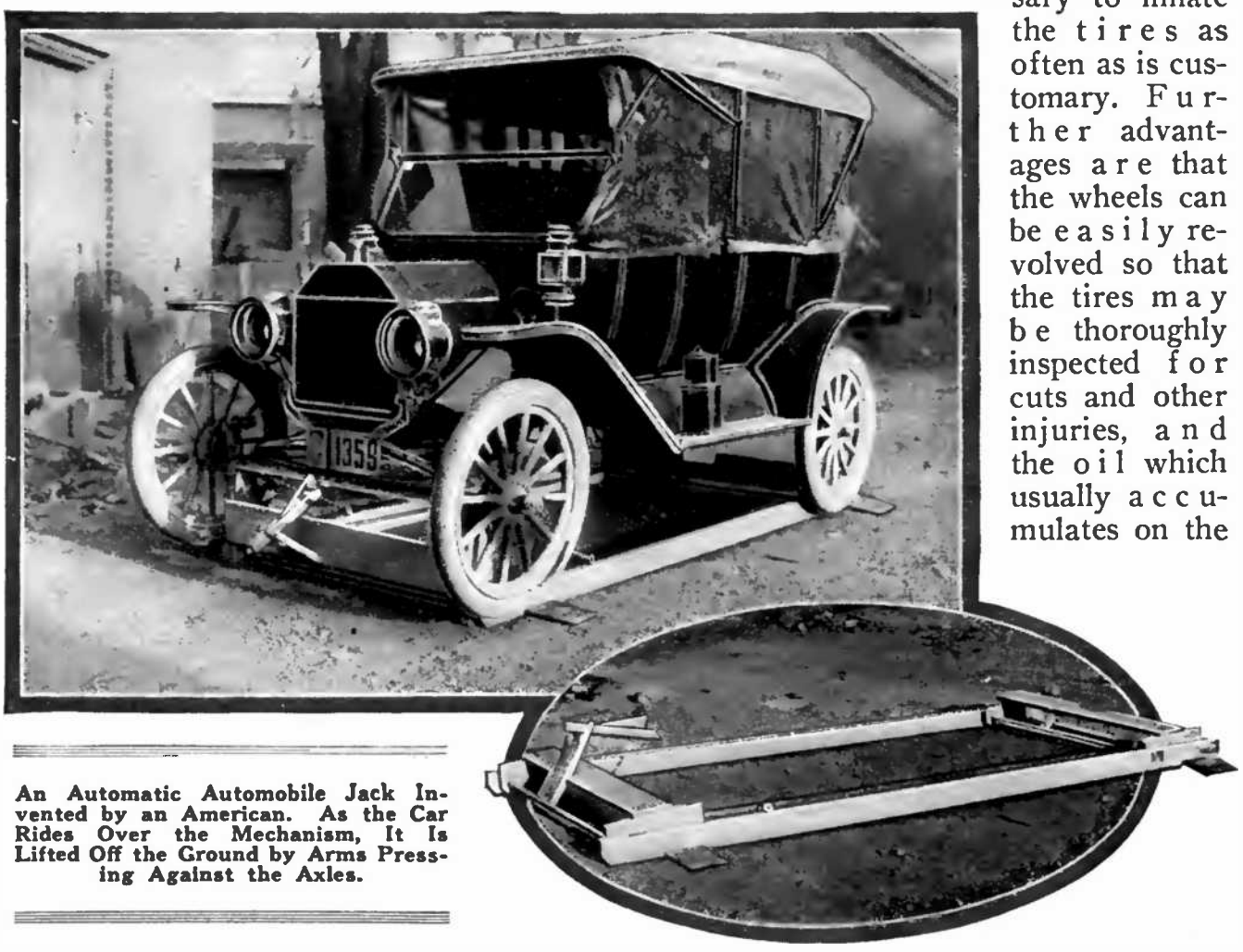
Then there was a life-saving buoy. According to the inventor, one carload of these buoys would have saved the life of everyone on board the *Titanic*. The new buoy consists of a chamber in which three persons can sit; a lid being screwed on over their heads, while a weighed tail serves to keep the buoy up-

right. The occupants have fresh air, light, rations, water and means of signaling to passing ships. All one needs is a deck of cards as well as some chips to rob a shipwreck of all its terrors.

One inventor demonstrated a portable fence made in sections. With his fence, enclosures such as paddocks, pig pens and fields can be enclosed with little trouble and practically no tools.

AN AUTOMATIC AUTOMOBILE JACK.

Among the recent automobile inventions is an automatic automobile jack the purpose of which is to lift a car from the floor of a garage. By thus relieving the tires of the weight of the automobile, two advantages are gained: Firstly, the tires last longer, and secondly, it is not necessary to inflate the tires as often as is customary. Further advantages are that the wheels can be easily revolved so that the tires may be thoroughly inspected for cuts and other injuries, and the oil which usually accumulates on the floor of garages is prevented from reaching and rotting the rubber of the tires.



An Automatic Automobile Jack Invented by an American. As the Car Rides Over the Mechanism, It Is Lifted Off the Ground by Arms Pressing Against the Axles.

The mechanism of the automatic jack is quite simple. Four standards are arranged so as to lay flat when not in use. When an automobile is run onto the jack, the front axle passes over the rear standards and travels forward until it engages a projecting arm. This arm is so connected with the standards that they are all lifted by the forward motion of the arm and move upward directly beneath the axles of the automobile. In this manner the momentum of the car causes it to lift itself. In order to protect the automobile from possible danger,

Women inventors vied with the men inventors at the show. One representative of the fair sex was demonstrating a self-threading needle for hand sewing and sewing machines. Another woman showed a little device that resembled a whistle but in reality proved to be a medicinal inhaler possessing many striking advantages.

The *Queen Elizabeth,* one of England's latest dreadnoughts, carries 15-inch guns that are capable of firing a one-ton projectile 30 miles. These guns have been used in bombarding the Dardanelle Forts.

small casters are placed under the front of the mechanism so that should an automobile come in violent contact with the projecting arm, the car and jack will slide slightly forward.

DISMANTLING A MOTORCYCLE TO BUILD A MOTOR BOB-SLED

At the beginning of the winter three young men of Fort Wayne, Ind., decided to make the most of the cold weather and snow. They dismantled a twin-cylinder motorcycle and mounted the engine at the front of a bob-sled which they made, while the rear wheel of the motorcycle was placed between the two sleds and driven by the engine through the chain transmission. An automobile steering wheel completed the motor bob-sled.

On a level highway it is said that the sled has made speeds in excess of 50 miles per hour. The nine-horsepower motorcycle engine can carry the three passengers of the bob-sled over city streets and country roads with ease.

This motor-bob is very similar in design to that which was described in the January issue of MODERN MECHANICS.

A ONE HORSEPOWER MOTOR THAT FITS THE VEST POCKET

At the national inventors' show recently held in the Grand Central Palace, New York, one of the principal attractions was a motor which, while not larger than an ordinary watch, produced one horsepower at a speed of about 3,000 revolutions per minute.

The tiny motor employs two gyroscopes that are operated by compressed air, steam or gasoline, and give the piston two impulses per revolution. During the show hundreds of persons had the decidedly novel sensation of holding between their thumb and forefinger a motor that was developing one horsepower.

SUBMARINE VENTILATION

The recent sinking of British submarine *A-7* with the loss of all on board has stimulated invention. One of the difficulties in such disasters is to locate the sunken vessel before the air supply in the submarine gives out. The use of compressed oxygen or of sodium peroxide which releases oxygen when wet and

The Engine of a Motorcycle Being Put to Good Use During the Wintertime When the Roads Are Not Favorable to Motorcycling.

By Means of the Glass Covered Solar Heater Placed Over the Side Entrance of This Home, Warm Water Is Secured for Washing an Automobile. The Heat of the Sun Is Utilized for This Purpose.

in turn absorbs all the carbon dioxide generated by the crew, is an excellent safeguard, but the best seems to be the recent invention of Albert Lamy of Havre. A hollow globe is connected with the hull of the submarine in such a way that it can easily be detached in case of accident. The globe then rises to the surface, carrying a hawser. This makes it possible for the rescue crew to pull a flexible tube to the surface and pump through it the needed fresh air. In addition, the floating cylinder indicates to rescuers the position of the sunken submarine.

SUN'S RAYS HEAT WATER FOR WASHING AUTOMOBILES

Warm water to wash a motor car can be supplied by solar heat for about eight months of the year in the east, and all the year round in the south and southwest. In California many garages are equipped with devices similar to the one on top of the structure shown in the accompanying view, and not only is plenty of water of almost boiling heat secured for the cleansing of the car, but a sufficient quantity for bathing and other domestic purposes is supplied with no cost beyond that of the installation of the outfit. The solar heater consists of a pipe coil in a glass covered, insulated box, piped from the water supply and through the heater to the hot water taps. As warm water is far better than cold water for the paint and varnish of the machine, the device is worthy of the consideration of car owners.

WIRELESS COMMUNICATION WITHOUT AERIALS

A wireless society at Tuft's College, Medford, Mass., is at present experimenting with transmitting and receiving apparatus used in conjunction with aerials placed on the ground. According to reports, it is gathered that the aerials in these experiments consist of wires laid hurriedly on the ground, without the use of supports. The best results have been secured with the receiving wire laid in the direction of the transmitting station.

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

To Teach Salesmanship by Motion Pictures

By Charles Alma Byers

PREPARATIONS have been completed to open a department in the Polytechnic High School at Los Angeles, Cal., to teach salesmanship with motion pictures. The course will be inaugurated at the coming school season and will be under the supervision of Prof. George M. Wessells, lecturer of the commercial efficiency course at the school. Two reels of films have been made, showing the right and wrong ways of salesmanship, and under the expense of the Retail Dry Goods Merchants' Association of that city, the films have recently been given a series of exhibitions not only in Los Angeles, but also in several other cities along the Pacific Coast.

It is a well-known fact that a very large percentage of the boys and girls who go through the elementary and high schools immediately enter some form of employment that requires a knowledge of salesmanship. Heretofore they have been compelled to take up such work without any special training, and therefore, being thus handicapped, the wages they were forced to accept were very low, resulting in the employer often being quite severely criticised. In fact, this phase of the question has probably had much to do with the agitation that has recently become quite general over the matter of compelling department stores to establish a certain minimum wage scale. It shall be the object of this department, with the use of motion pictures, to promote greater salesmanship efficiency and thereby enable the boy or girl to demand a higher wage.

The films were made in Los Angeles stores and portray salesmanship in all lines. First is shown the slipshod manner of the inexperienced salesman and then follows an illustration of how the sale should be properly consummated. They also teach courtesy on the part of the employee, and, in fact, everything else that has a bearing on good salesmanship.

Although the department will be especially intended for all school students who wish to fit themselves for this kind of work, it will be open to every one, regardless of age. And, of course, it will be absolutely free to all. It is claimed to be the only effort yet made to teach salesmanship with motion pictures.

A NEW PROCESS FOR MOTION PICTURE PHOTOGRAPHY

William Foster, superintendent of the Universal West Coast laboratories, announces that his process of colored pho-

A Panoramic View of the Beautiful Buildings at the Entrance to Universal City Where the Motion About 15,000 Inhabitants and Covers an Area of 800 Acres. It

tography, upon which he has been working for the past nine months, is now perfected and that a single reel subject will shortly be produced in which his invention will be given its first demonstration.

The coloring of the picture will take place in the negative and will be printed on the positive just as the regular black and whites are printed. Universal contemplates releasing the first of the new colored dramas in March.

REMARKABLE PHOTOGRAPHIC FEAT

A remarkable double exposure is one of the striking features of "Mother Hulda," the pretentious fairy story production in the Mutual program by Thomas H. Ince. In the picture a great grove of trees slowly disappears, while in its place grows an army of soldiers. Without a cut-back the soldiers advance.

VACANT SEAT INDICATOR FOR PICTURE SHOWS

Patrons of the movies will welcome a newly perfected device that is to be used in moving picture theatres to automatically indicate the positions of all vacant seats. This indicator is formed by a considerable number of small incandescent lamps, contained in a suitable casing, mounted just within the theatre entrance. The lamps are arranged in rows exactly corresponding to the rows of seats, and the rows are combined to form sections between which are provided spaces representing the aisles. Each lamp represents a certain seat, the number of which it illuminates, and at the end of each row of lamps there is provided an illuminated letter identifying the row. The rows of seats are to be similarly identified by letters formed upon glass discs set in the floors of the aisles and electrically illuminated from beneath.

The lamps are all included in separate electric circuits, and the circuit of each lamp includes also a switch mounted beneath the seat which the lamp represents. These switches are acted upon by springs that tend to maintain them open, and further tend to hold the seats slightly raised. When a person occupies any seat, however, it is at once displaced to its proper horizontal position, and the underlying switch is closed.

Thus the indicator lamp representing any seat will remain lit as long as the seat is vacant, but will go out as someone occupies the seat. When movie fans enter a theatre equipped with this device, they will have merely to glance at the indicator lamps to know at once where they may find the best unoccupied seats.

It is probable that the picture show proprietors will be quick to adopt this invention, since it will furnish them with an automatic usher at an expense

Pictures Released Under Numerous Brands Are Produced. This Industrial Community Comprises Has Been Built Solely for the Purpose of Producing Motion Pictures.

much less than would be required for the salary of a real usher. Also it will bring all of the seats into use when the theatre is full of people, keeping them from standing unnecessarily in the aisles.

OFFICIAL OPENING OF UNIVERSAL CITY

One of California's newest cities that is distinctive because of its peculiar mission will enter the field with an exposition during the coming months. The exact date of the official opening is March 15, 1915. The name of the new entrant is Universal City—sometimes known as the "Chameleon City."

Only one industry is pursued in this city which has about 15,000 inhabitants and covers an area of 800 acres, and that is the making of moving pictures. Every man, every animal and every structure is employed in the making of photoplays.

The founder of this strange town is the Universal Film Manufacturing Company. They have installed in this municipality all the latest wrinkles known to motion picture making. They have erected entire villages within this city and have created many odd and strange things that will prove a revelation to its many visitors.

The company is inviting persons going to the Panama-Pacific Exposition to stop over at Los Angeles and visit Universal City. Many big spectacles will be produced for the visitors.

ENORMOUS STAGE ERECTED AT INCEVILLE

That the demand for the productions furnished the Mutual program by Thomas H. Ince is increasing is shown by the erection of a large extension to the already mammoth stage at the Inceville studios. As soon as the great director learned that the stage as then constituted was too small to accommodate the full staff of directors at one and the same time, he ordered the addition. The stage now measures 200 feet by 75, and there is available space sufficient for staging a dozen different scenes simultaneously, while the entire area can be used for staging the biggest single set possible in motion photography today.

BUILDING A SPANISH COLONY FOR THE "MOVIES."

In order to secure Spanish backgrounds for his photoplays, George W. Terwilliger, the Lubin director and writer who is now in St. Augustine, Fla., with a special company of players headed by Ormi Hawley and Earl Metcalfe, is building an old Spanish quarter on the site of the ancient historic buildings that were destroyed by fire last year. The massive coquina walls, arches, windows and doorways of the old buildings are fairly intact, and the Lubin director and his assistants are including these in the new buildings and streets. Not only will the rebuilt Spanish quarter

offer excellent backgrounds for Lubin photoplays, but it will also serve to beautify the city of St. Augustine.

SECURING ANTIQUE FURNITURE FOR A MOTION PICTURE

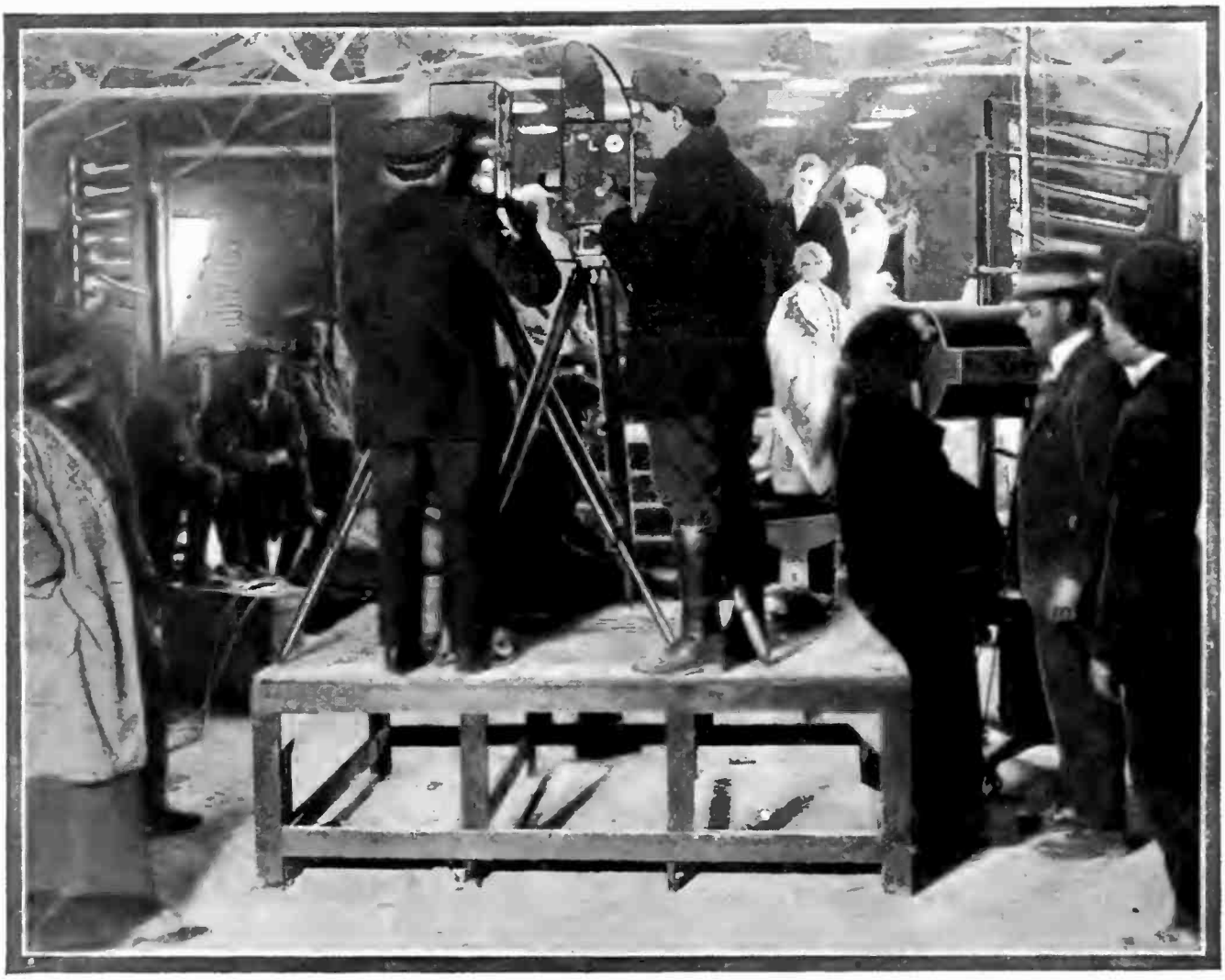
Harry Myers and Rosemary Theby took a day off recently to secure antique Jacobean furniture to dress the wonderful set reproduced in "Cards Never Lie," a two reel Victor drama.

The Victor director and his leading woman roamed Fourth avenue, New York, all morning, then spent the afternoon in curio shops along upper Third avenue and in the higher priced period furniture shops off Fifth avenue.

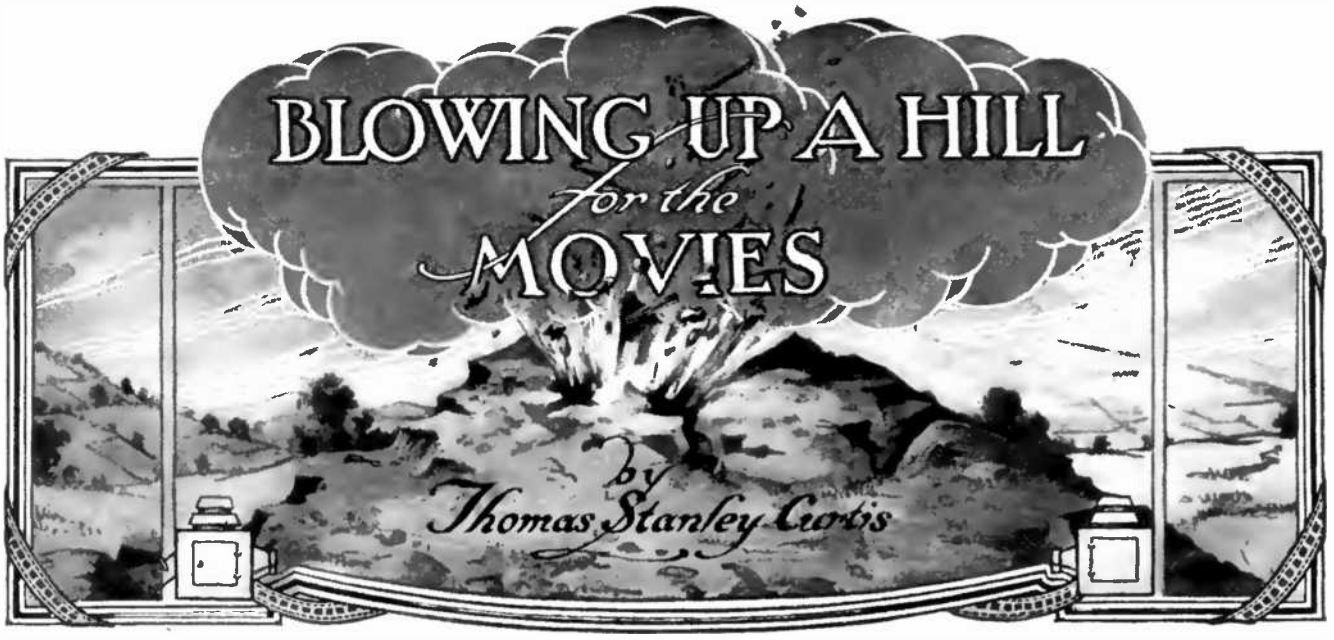
Three van loads of wonderful furniture, all in the Jacobean period, backed up before the Victor studios that night and were filmed the next day.

This is another instance of the expense and trouble the directors will go to in their efforts to secure utmost realism.

FILMING "THE MASTER KEY" SERIAL



In the above view are seen two photographers at work taking pictures of a scene for "The Master Key" serial. The setting in this case is of an oriental character and has been staged in the new indoor studio building just completed at Universal City. The system of artificial lighting comprises three different types of electric lamps—powerful incandescent lamps placed above the set, mercury-vapor tubes located on the sides of the set, and arc lamps mounted on transportable stands.



REALISM in motion pictures is considered a necessity by American producers. Expense and trouble never stand as obstacles in securing the thrillers that go to make a successful photoplay. Here is a typical instance; a carefully constructed house, as well as a hill on which it stood, being blown up for one scene lasting on the screen but a fraction of a minute.

THE signs of what promised to be an ideally crisp, clear day greeted us as we piled into the big touring car purring softly in front of the Thanhouser studio; the kind of day that gladdens the heart of the cameraman as he looks through the studio windows—and which makes him want to throw up his job after he has been out in the cold for hours, as with freezing fingers, he awaits the director's welcome signal, "Camera!"

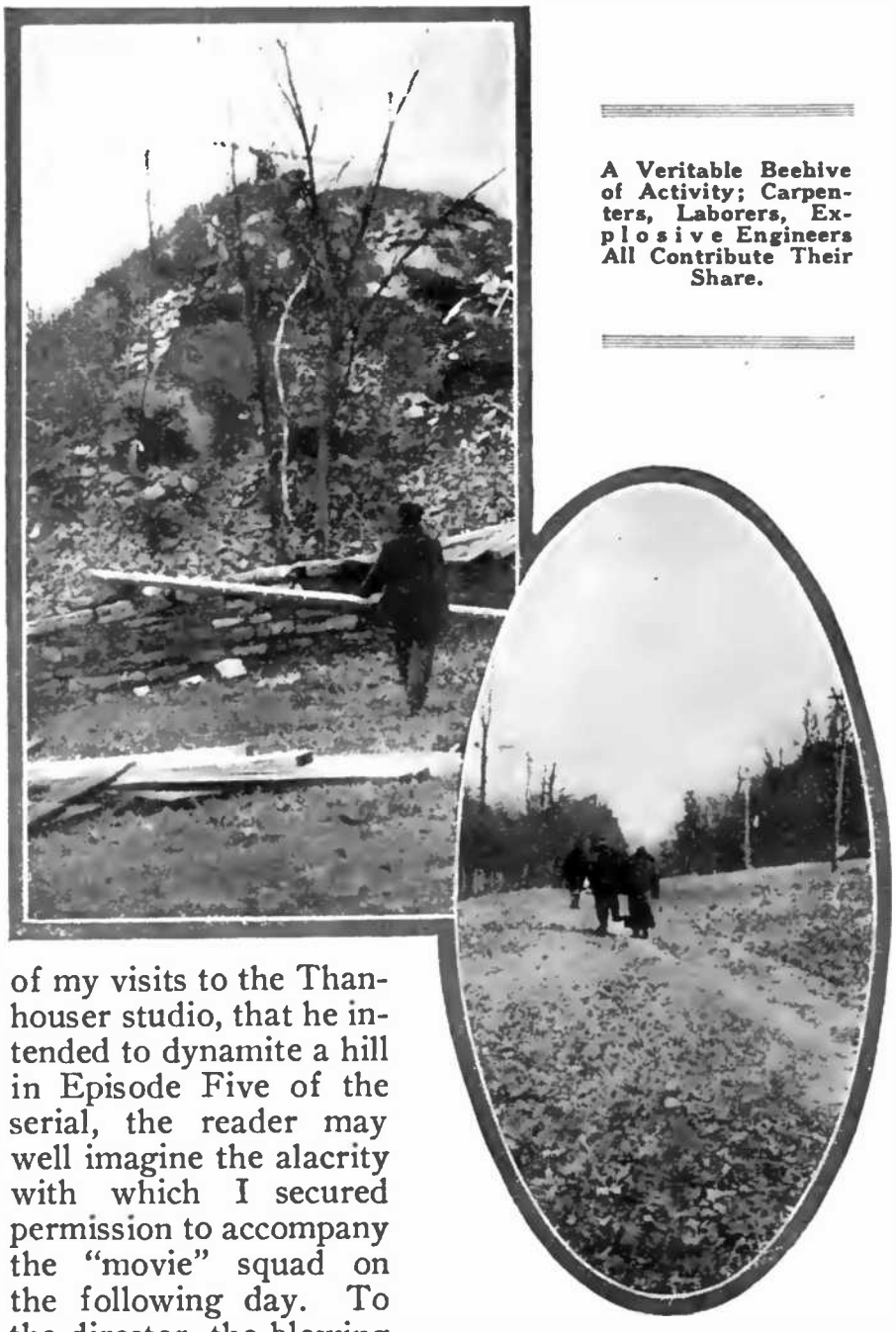
As we bowled along over the beautiful Mt. Vernon hills, snugly ensconced within a warm covering of fur robes, the inevitable impression of the layman persisted in forming itself in my mind—"pretty soft," as modern slang has it. We see, almost daily, a motor car full of the "movie" folk, smiles on their faces, speeding along, eager to contribute their little bit to the mirror of life, and we are obsessed with the idea that theirs must be a life of never-ending pleasure.

A fairly broad acquaintance among these interesting people and numerous visits to the studios had served to convince me, in a measure, that with the pleasures come many hardships; but it was not until I availed myself of the opportunity to be one of them for a day that I sensed a full appreciation of what it means to be a "movie" man in the field. For downright pluck and gameness, these exponents of the silent drama take the prize. My apologies to the reader for the digression, but I could not resist the temptation to pay a little tribute to these people who suffer untold hardships and who, as a part of their daily work, expose themselves to all manner of bodily risks, and all this to satisfy the increasing demands of an amusement-loving public.

But, as its title implies, this story concerns the staging and photographing of a difficult and spectacular scene, rather

than the vicissitudes of the "movie" actor and actress; it therefore behooves us to return to the theme lest we be accused of wandering off at a tangent.

For many months I had cherished a desire to witness the production of one of the sensational films of the "thriller" variety and when the director of the "Zudora" serial remarked, during one



A Veritable Beehive of Activity; Carpenters, Laborers, Explosive Engineers All Contribute Their Share.

of my visits to the Thanhouser studio, that he intended to dynamite a hill in Episode Five of the serial, the reader may well imagine the alacrity with which I secured permission to accompany the "movie" squad on the following day. To the director, the blowing up of a hill seemed a mere trifle and small wonder for, to a man who sends perfectly good motor cars over cliffs and runs freight trains into expresses, all as a matter of perhaps weekly diet, the detonation of a few dozen sticks of dynamite in a hillside and under a house, would scarcely cause the flicker of an eyelash. To me, however, the episode appeared to be quite an undertaking. The feeling of keen anticipation of exciting times to come was therefore much in evidence as our car neared the spot in a secluded section of Mt. Vernon where the scene was to be staged.

A Scene of Intensive Activity

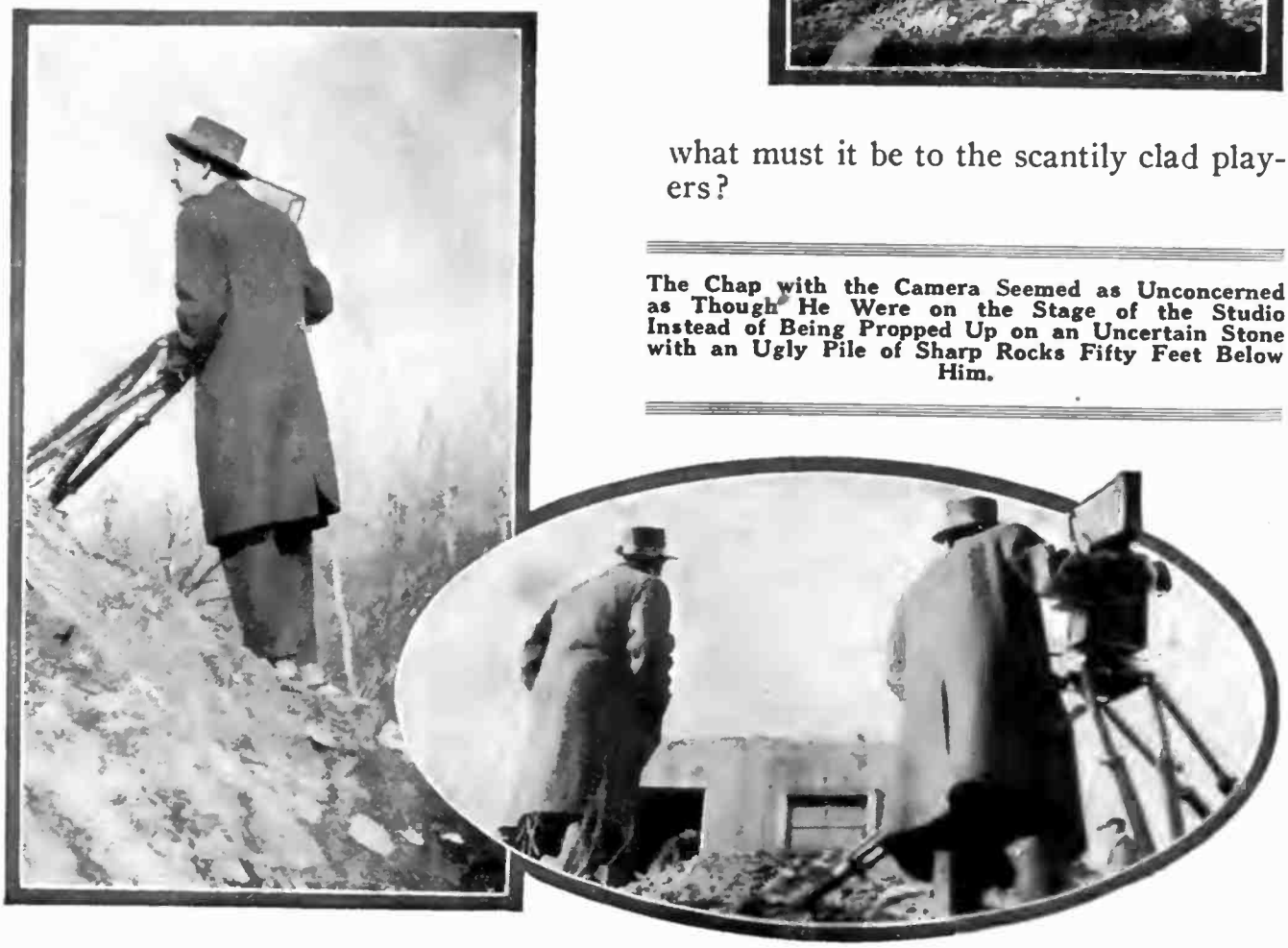
Our arrival at the location disclosed a veritable beehive of activity; carpenters and their helpers rushing lumber up the hill and as rapidly converting it into a small building of very substantial construction; laborers digging great holes in the side of the hill in which the explosive was to be placed; and, overlooking all with a stern and, as it seemed to me, disapproving eye, the city inspector, who seemed to be here, there and everywhere. As a matter of fact, Mr. Inspector was not to be blamed for his very obvious misgivings for, judging from the serious way in which each man carried out his work, and withal, the air of tense excitement, one might have suspected the existence of a conspiracy to blow up the best part of Westchester County!

The "movie" actor in the field is a trained woodsman; so I had been told. I believed it when I saw the business-like way in which our squad set about finding a sheltered spot for the campfire and believed it some more when I toasted my frozen extremities at the selfsame fire many times during that bitterly cold day.

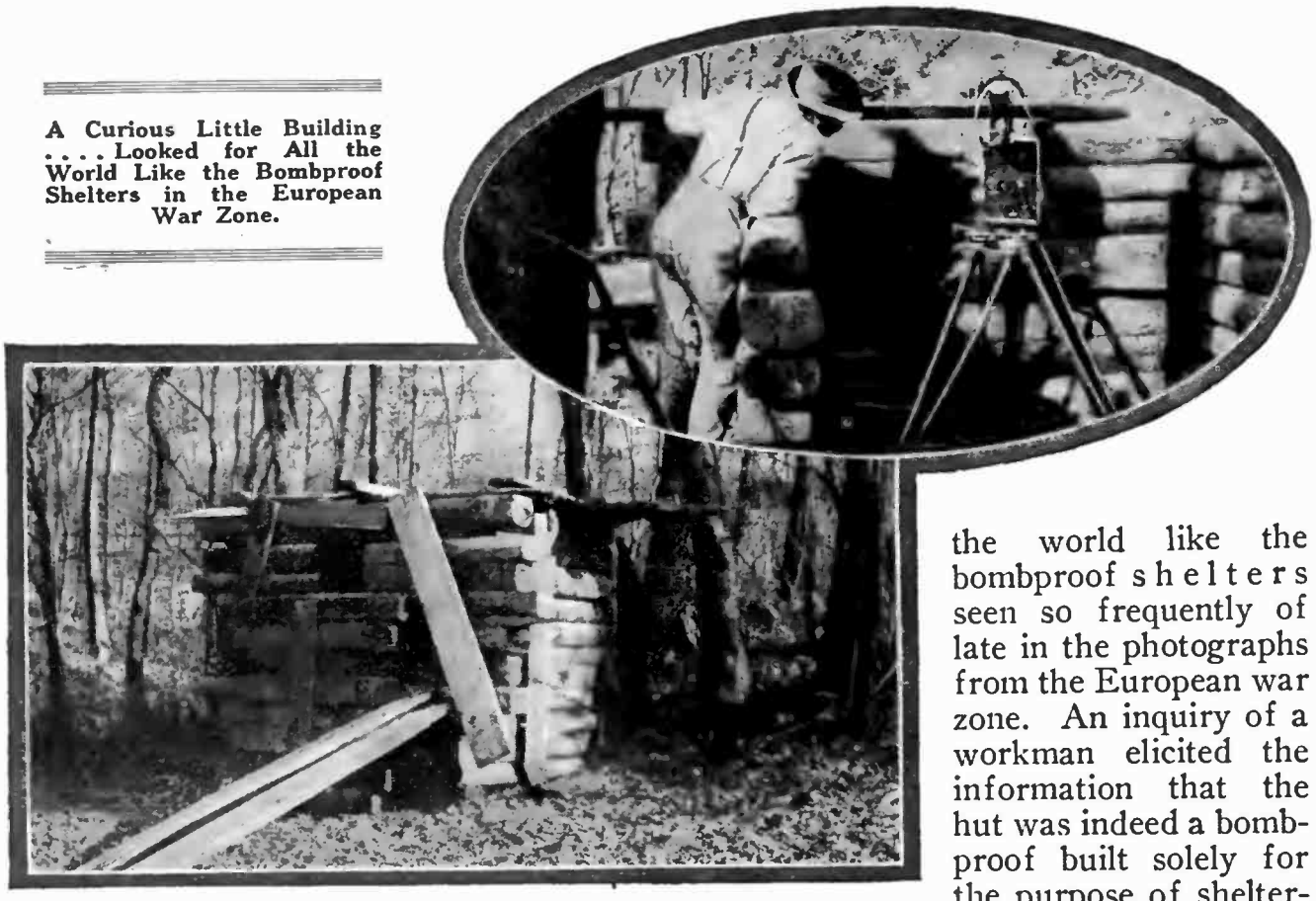
Within the first hour I had decided that the life of the picture folk was not all honey and roses. The warm fur robes

cease to be warm and Jack Frost has a most provoking tendency to sneak in at the cracks. Even a race to the top of the hill and an undignified slide down its nether side proves ineffectual and in desperation, the smoke of the campfire is braved for the sake of its grateful warmth—which toasts one's face while his back freezes. If the day in the field proves such a hardship to the visitor, what must it be to the scantily clad players?

Laborers Digging Great Holes in the Side of the Hill in Which the Explosive Was to Be Placed.



The Chap with the Camera Seemed as Unconcerned as Though He Were on the Stage of the Studio Instead of Being Propped Up on an Uncertain Stone with an Ugly Pile of Sharp Rocks Fifty Feet Below Him.



A Curious Little Building .... Looked for All the World Like the Bombproof Shelters in the European War Zone.

A Bombproof for the Cameraman

The first tour of inspection revealed a curious little building in process of construction at the foot of the hill. The front and side walls a double thickness of railroad ties, the structure looked for all the world like the bombproof shelters seen so frequently of late in the photographs from the European war zone. An inquiry of a workman elicited the information that the hut was indeed a bombproof built solely for the purpose of sheltering the camerman whose cheerful duty it was to photograph the hill as it shot skyward not a hundred feet distant. The responsibility placed upon the hut may well be imagined when the reader learns that the country for half a mile around the hill was cleared of visitors prior to the explosion.

The Movie Actor in the Field Is a Trained Woodsman. His First Act on Arriving at the Location Is to Select a Sheltered Spot for the Company Campfire.

In this connection it is interesting to note the subterfuges to which the motion picture companies have to resort in order to prevent the gathering of an undesirable "audience." The news of a spectacular "movie stunt" spreads like wildfire throughout the neighborhood of the location, even though the latter be miles from the nearest house. In the present instance, so quickly had the news spread that it was necessary to place an announcement in the local paper giving a date a day or so later than that on which the pictures were to be taken. A

deeply disappointed crowd undoubtedly awaited results or else turned away in disgust a few days later; but such measures are imperative if accidents are to be avoided.

Filming Under Difficulties

Leaving the bombproof structure, my attention was directed to the top of the hill. The "house of mystery" had been completed by this time and a scene was being rehearsed. A sprint up the hill disclosed the cameraman in process of being let down from above, the camera in his arms and his feet searching for a foothold in the hillside. A friendly rock at last provided the desired accommodation and the heavy tripod was planted. The chap with the camera seemed as unconcerned as though he were standing on the stage of the studio instead of being propped up on an uncertain stone with an ugly pile of sharp rocks at the foot of the hill some fifty feet below him. But the man who would grind the crank while several dozen sticks of dynamite were being exploded within a hundred feet of him would not mind such a mere trifle as the risk of a fifty-foot tumble onto a pile of rocks.

Glancing downward from the cameraman's viewpoint, the hill seemed alive with workmen placing stick after stick of dynamite in the holes on all sides and leading the connecting wires to the blasting machine; certainly this was no place for a nervous man!

An Enormous Cloud of Smoke, Flying Stones, Timbers and Sand Shoots Skyward, and Within Thirty Seconds the Work of Dozens of Men at a Cost of Thousands of Dollars, Goes Up in Smoke.

Ready for the Blast

The scenes at the summit of the hill were finished at last; the "house of mystery" had contributed its little bit to the story of Zudora and all was in readiness for the explosion.

Actors and visitors scamper for the friendly shelter of a wood half a mile

distant; the wires are brought down the hill to the blasting machine and, for a few minutes, absolute silence reigns as George Weber, the cameraman takes his post in the bombproof.

Just to cheer Friend George, Mr. City Inspector peeks through the opening in the log-hut and whispers "My boy, you have just one chance in a hundred to come out of this in a healthy condition." Weber answers merely with an inscrutable grin and shrug of his shoulders and calmly resumes his focusing adjustments.

When the signal is about to be given, a shout is heard and one of the laborers is seen running toward the hill, waving his arms in frantic warning. A glance at the hill reveals a venturesome lad, who has managed to slip past the guard at the rear, leisurely examining the house of mystery, under the floor of which is planted enough explosive to blow it to atoms! While it is doubtful if the youthful investigator understood the precise nature of his danger, he, nevertheless, knew for certain that he was on unhealthy ground, for, within an astonishingly few seconds, we saw him roll down the hill and vanish in a small cloud of dust across the adjacent fields.

This bit of excitement past, and a diligent search for other curious visitors brought to completion, the director gives the word to clear the deck for action.

The signal given, the cameraman begins to turn and the handle of the blasting machine is raised and depressed. An enormous cloud of smoke, flying stones, timbers and sand shoots skyward, followed by a resounding boom; and within a space of thirty seconds the work of dozens of men at a cost of thousands of dollars, goes up in smoke. The scene itself, for which all this preparation had been made, occupied but a few feet of film in the finished reel.

A dash for the spot after the explosion and we find the cameraman calmly packing up his paraphernalia just as though he had finished for the day after taking a series of the most prosaic subjects imaginable.

DICTATING CORRESPONDENCE BY TELEPHONE

The management of a shop which is engaged in turning out all kinds of typewritten form letters, circulars, etc., and which furnishes a stenographic service to the public, has introduced what is called a 'phone letter service. Persons practically any distance away may call a stenographer on the telephone, dictate a letter and have it immediately typed as the dictation proceeds, signed with a statement of how received, and posted for the next outgoing mail, all at a comparatively small cost. Special form letter heads are used for this purpose. Many business men have been saved much time by this service. The accompanying illustration shows a girl at her typewriter taking 'phone letters, wearing a telephone headband.

Typist Writing a Letter Which Is Being Dictated to Her Over the Telephone Wires.

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

A Storage Battery Tractor Being Employed to Haul Loaded Trailers About a Dock.

A STORAGE BATTERY TRACTOR

One of the latest phases of storage battery application is in the form of a compact tractor intended for hauling flat trucks to and from different departments of large plants or factories, or on steamship docks and in railroad terminals.

The storage battery tractor possesses one distinct advantage over previous vehicles of this kind that were designed to carry the goods instead of hauling loaded trailers, and that is in the reduced initial cost and the low maintenance costs, since there are a fewer number of machines required. While the trailer trucks are being unloaded, the tractor can be hauling other trailers that are ready for a journey.

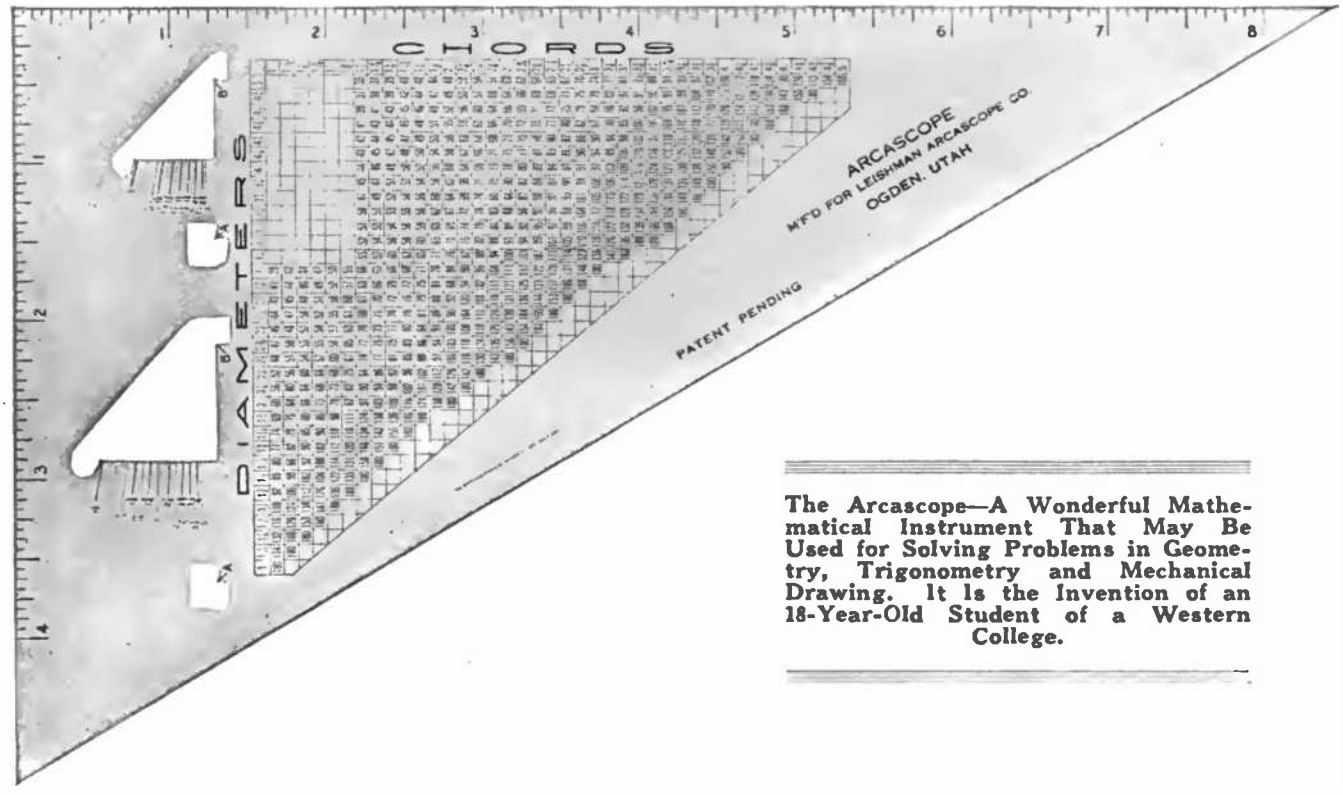
The new storage battery tractor is a three-wheeled vehicle with the power applied on the two rear wheels. The front wheel is used for steering purposes. The tractive power is furnished by a motor operating on storage batteries. An electrical controller permits of four speeds ahead and two reverse, while suitable brakes are provided for the slowing and stopping of the tractor. It weighs about 1,900 pounds and has a maximum speed of eight miles per hour with the average load.

A NEWLY INVENTED MATHEMATICAL INSTRUMENT

A combination rule and triangle that will solve mathematical problems in trigonometry, geometry and mechanical drawing, and which is simple and inexpensive, is the invention of an 18-year-

old boy, Leroy J. Leishman, of Ogden, Utah.

The new device, which the inventor calls the Arcascope, has been attracting a great deal of attention among teachers of higher mathematics in the schools and colleges of the Rocky Mountain states. So valuable do they consider it that it has been adopted in a number of schools.



The Arcascope—A Wonderful Mathematical Instrument That May Be Used for Solving Problems in Geometry, Trigonometry and Mechanical Drawing. It Is the Invention of an 18-Year-Old Student of a Western College.

Students of geometry and trigonometry must include a triangle and a rule in their equipment. The Arcascope is a combination of the two and is small enough to be carried in the pocket. It is triangular in shape, with an eight-inch base and angles of 90, 60 and 30 degrees. The rule extends along two sides. With the possible exception of the sliding rule, the Arcascope is said to be the most compact mathematical instrument ever evolved.

The instrument, in addition to its usefulness as a rule and triangle, will indicate the diameter of a circle when only the arc is given. It will also give quickly the number of degrees in the arc. Given a right triangle, with one side and two angles or two sides and one angle known, it will give all remaining angles and sides the same as though they were carefully worked out by trigonometry. By dividing scalene triangles into right angles as is done in trigonometry, the Arcascope will solve unknown values concerning these. It can be also used to divide circles for mechanical drawings and will work out any practical problem that makes use of the foregoing described principles. Another use to which it can be put is that of determining the distance to an inaccessible point by laying off lines and measuring angles.

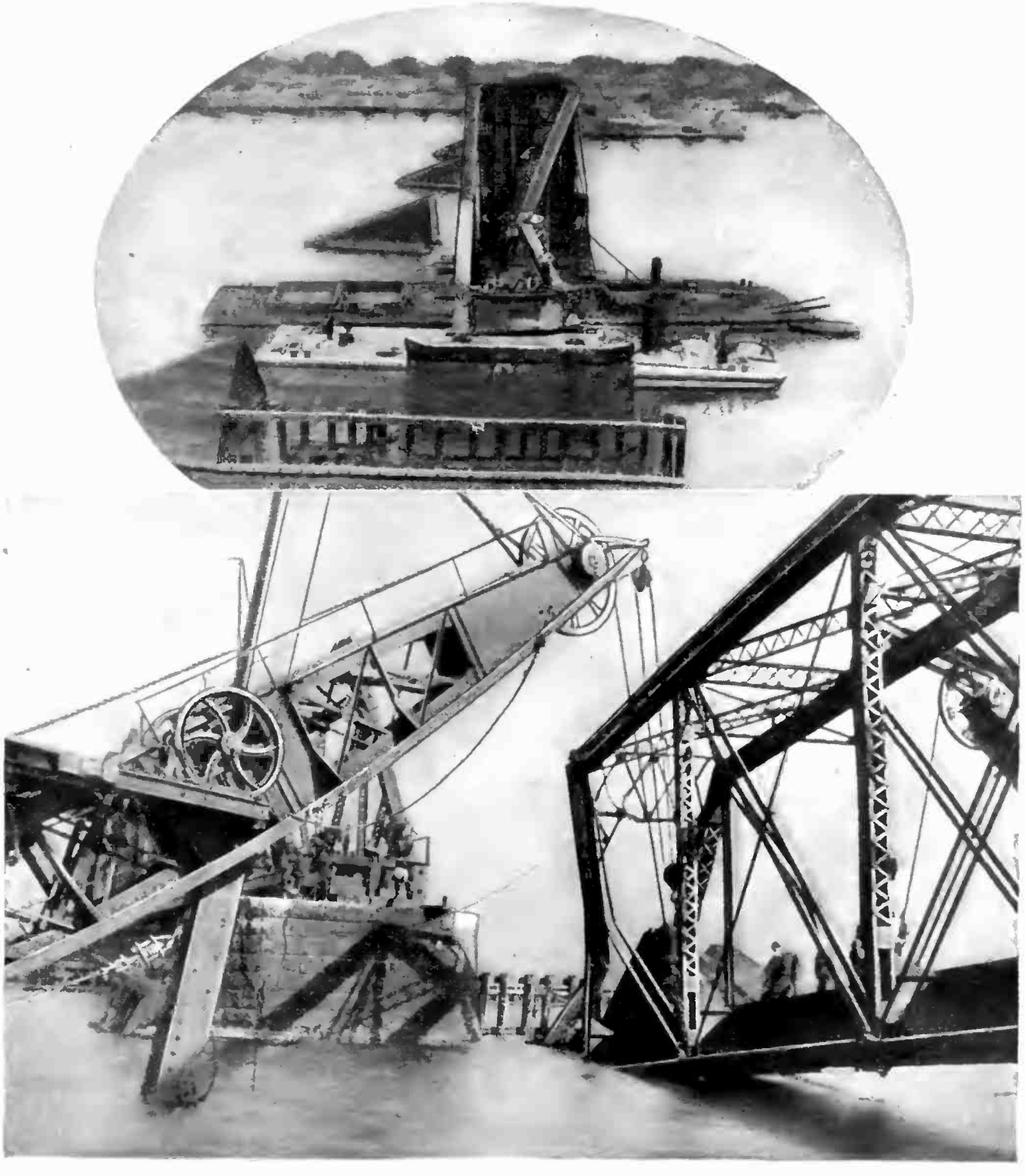
EMERGENCY REPAIRS ON A WRECKED RAILROAD BRIDGE.

The force with which some river barges move is shown by the fate of one of the spans of a Maumee river railroad bridge, which was swept off its foundation and submerged to a depth of twelve feet. Had it not been for some old piling near the ice breaker of the bridge, the span would have been completely submerged.

The problem of lifting the span weighing 210 tons back on to its foundation was solved by the use of two dredges, each having a lifting capacity of 85 tons. While being raised, a flat scow was slipped under the span near one end and,

through the sinking of the scow by blocking it up and pumping out all the water, a second scow was placed directly under the end. The dredges were used to steady the span while it was being raised. At last it was raised sufficiently high to permit of its being slid back on to the masonry foundation. False work was then driven under the span until such time when the damaged steel parts could be replaced.

The foregoing is but a typical example of the many problems that confront railroad engineers. In most instances they display great skill in repairing bridges and other sections of the right-of-way in the minimum space of time to re-establish train service.



Two Views of a Remarkable Piece of Repairing by Railroad Engineers. The Span of the Bridge, Which Was Pushed Off Its Masonry Foundations, Was Put Back Into Place by Means of Two Steam Dredges and Two Old Scows.

A COLLECTION OF SCENES OF THE RECENT SUBWAY FIRE.

Photos. Copyrighted International News Service

Firemen Rescuing Passengers from the Smoke Filled Subway During the Fire That Occurred on January 6th and Which Was Caused by a Short Circuit of a Feeder Cable. In One of the Views Is Shown the Pulmotor in Use.

To Facilitate the Rescue Work, the Sidewalk Grating Over the Subway Tracks Was Removed to Permit of Access to and From the Stalled Trains. Ambulances Were Waiting to Remove Injured Persons Requiring Medical Assistance

THIS is the age of practical men—men who can do things. Schools in different parts of the country are now entering a new era in education; they are encouraging the boys to experiment, as well as make different things themselves. They are pioneers in the learn-by-doing method of instruction.

"THE men who do things worth while are in constant demand," says Supt. R. J. Condon of Cincinnati's public schools; "they will be needed more so in the future than now," he added.

This is why hundreds of boys and young men in Cincinnati are being taught how to do things themselves and not wait until someone tells them how to do it. In a hundred different ways all these boys are working out problems for themselves and accomplishing things just by thinking out the methods unaided.

There is Gordon Fox in the manual training department of one school fixing a new handle on his mother's butcher knife. Some mothers would throw such a knife away and buy a new one, but not so with Mrs. Fox, for Gordon has been taught to repair many things about the house through his training at school. He has been taught to think out for himself how to do things and then proceed and do them. Another boy of the same school brought a porch rocking chair to school to be mended. It needed a new rocker. An oak board at the school supplied just the kind of wood necessary to make a perfectly good rocking chair out of the old one.

This is the way many boys are using their brains and learning how to do things in the mechanical line. But many others are entering the field of research. They are working out problems in chemistry and solving for themselves in the laboratories just what makes plants grow. They are also trying to determine if plants breathe through their leaves and how this is accomplished in winter when no leaves are present. The microscope is opening up new fields for some. The boys are seeing with their own eyes the things which heretofore they learned only from textbooks. They can answer a dozen different questions on a subject because they have learned from self-instruction and observation. It is not possible to trip them up on the perplexing question of how the spider stretches his web across a street, for through observation and a little thinking they solved the problem themselves.

School boys, at least most of them, are always in need of "pin money." To get this necessary cash the boys manufacture many useful articles which find a ready sale. There is one school that has a standing contract for sleds of a type that only its boys know how to

Here Is Little Oscar Kleinschmidt, a Western Union Messenger One Week, During Which He Meets Business Men, and a Student the Following Week. He Is a Member of the Continuation Classes.

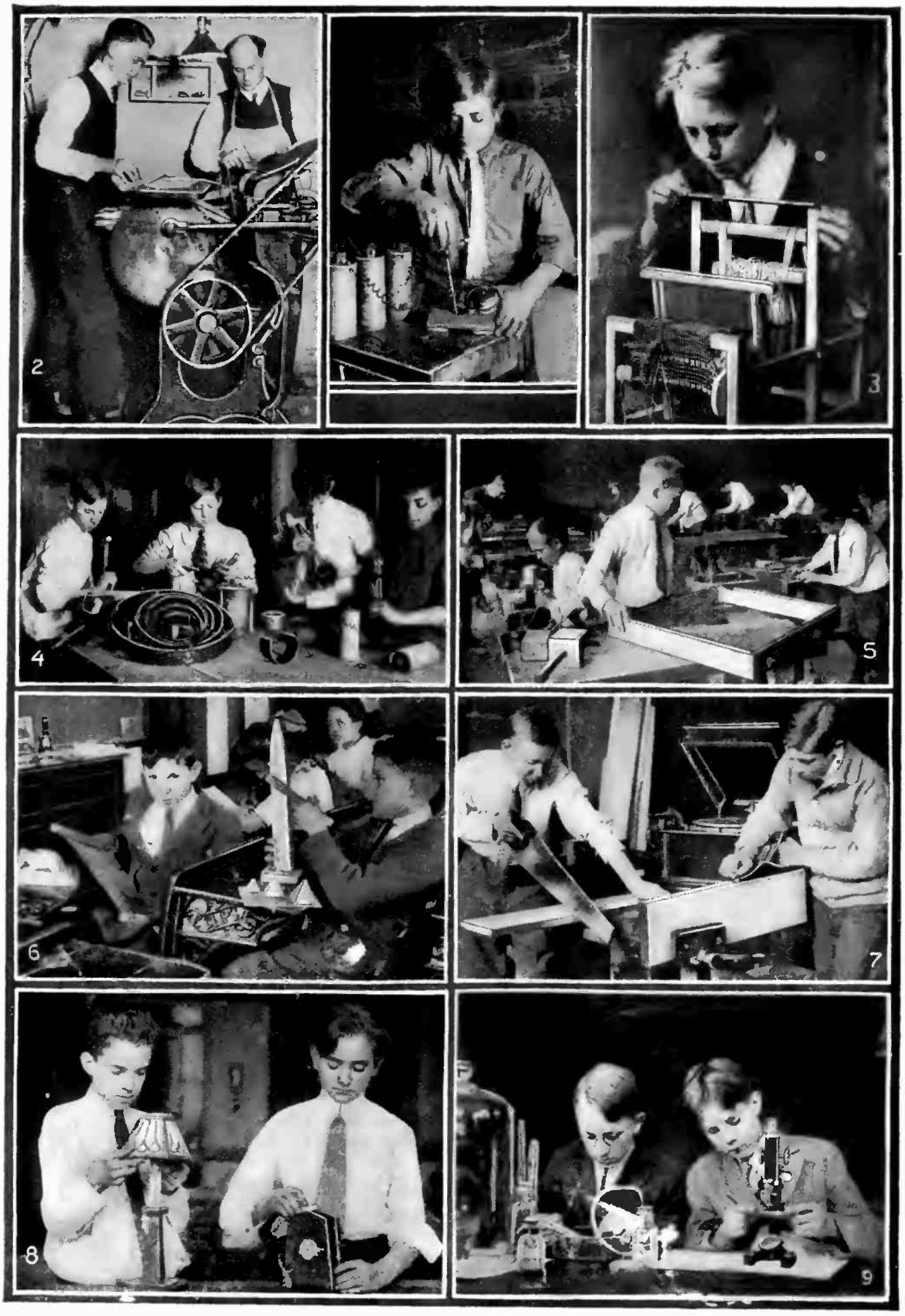
make the parts and put properly together.

Several boys of a Cincinnati school have formed a company, each boy being allowed to acquire certificates of stock according to his industrious abilities. The company manufactures bric-a-brac, lamps, desk inkstands and many other little useful and fancy articles which are eagerly bought up wholesale by various Cincinnati stores. One mother having a boy interested in such work made a purchase at a down-town store one day of a fancy little desk paper weight. She took it home to show her boy how easily he could make some just like it. He examined it carefully for a moment, then turned it over and showed her the company's trade-mark on the bottom. It was a product of this boy's company, at school.

THE VIEWS ON OPPOSITE PAGE ARE: (1) A Student Repairing an Electric Bell. (2) A Student Printing School Announcements on One of the School Presses. (3) A Working Model of a Belgian Loom. (4) A Group of Students Taking Various Things Apart to Find Out How They Work. (5) A Class in Furniture Making. (6) Making a "Dry" Egyptian History Lesson Interesting. (7) Students Making a Phonograph Cabinet — Incidentally Saving the School $25. (8) Two Members of the Boys' Company That Supplies Novelties to Cincinnati Stores. (9) Studying Chemistry and Botany Side by Side.

In order that ancient history studied at another school be more interesting to the classes, the boys are being called upon to furnish the necessary interest in conjunction with lessons about Egypt. Instead of just reading about the pyramids, for instance, boy sculptors are making miniature models of them out of potter's clay and shaping the curious objects of the race as if they were the real articles made some thousands of years ago.

"Boys are not particularly interested in text books which simply tell them things," said one of the teachers. "They become intensely interested, though, if they can work out the things they read about into real objects, or accomplish something as a result of reading that book. A lesson learned that way is



The Various Activities of the Boy Students of the Cincinnati Public Schools. The Boys Are Being Largely Taught By the Learn-By-Doing Method.

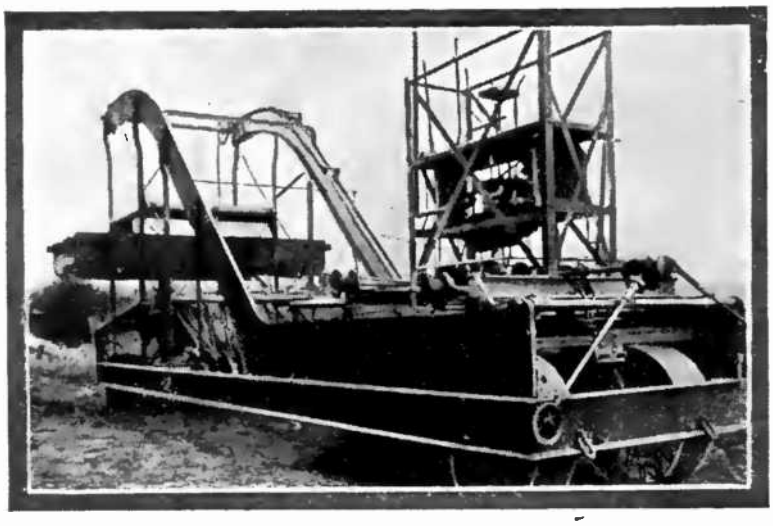
never forgotten," concluded the teacher.

Boy-mind-building, as this new method is known in the schools, is not only making leaders out of hundreds of boys, but it is also making alert students; difficult problems, history and geography lessons are solved much more readily by these young men who are being trained to think and do things, than by those boys who lack the mind-building training. That the training is making valuable men out of these boys may be gleaned from the fact that, when one of these students is forced to leave school at an early age and seek employment, his employer invariably places him on the continuation plan, that is, the boy works a week then goes to school a week, yet he is paid for full time.

It may be considered a certainty that other cities will soon follow the example set by the Cincinnati schools. The value of teaching boys by actual experience has long been known, although, curiously enough, not applied in schools to any great extent.

NEW MACHINE PLOWS AND HANDLES DIRT

In the accompanying illustration is shown a new machine that is designed for handling dirt to be used for grading, as well as loading dirt into dump-wagons. The principal parts of the machine are a gang plow and scraper. There are seven plows that plow an equal number of furrows measuring from six to twelve inches in depth. The scoop handles two cubic yards at each load. The motive power for the machine is furnished by a large traction engine that is equipped with a winding drum. The cable on this winding drum at its free end is attached to a suitable form of anchor which is placed a considerable distance ahead of the machine, in the direction that it is to travel. As the winding drum turns, the cable is wound on and the vehicle is pulled forward. No power is applied to the wheels for the tractive effort.



A Machine That Plows a Field and Deposits the Dirt Into Wagons.

The machine handles a complete load of dirt in twenty seconds and it is said that it will average from 800 to 1,000 loads per day; the dirt being dumped into the usual wagons.

THE SIMPLON TUNNEL

The Simplon Tunnel is the longest tunnel not merely in Europe but in the world, its exact length, inclusive of the two short curves at either end, being 12 miles 537 yards. For about fifty years before its piercing, engineers had been speculating as to the possibility of such an undertaking. By 1898 work was actually begun, and the whole tunnel was ready for traffic by May 19th, 1906. The cost amounted to 2,940,000 pounds, or about $14,700,000.

The north portal of the Simplon is about one mile from Brigue Station, in Switzerland, and the south portal about half a mile from Iselle, in Italy, the frontier being crossed in the tunnel itself. More than half of the tunnel is in Italian territory.

The Simplon is the lowest great Alpine tunnel, the highest elevation reached by it being only 2,313 feet. It was originally built with a double gallery, con-

nected by cross shafts every 220 yards, the two galleries being 56 feet apart. One gallery alone was at first finished, and only a single track laid. The second gallery, however, will soon be completed and ready for traffic.

During the construction of the Simplon the workmen suffered intensely from heat, owing to the number of hot springs tapped and to the temperature of the rock. The thermometer at times rose to 127° Fahrenheit, and the arrangements for ventilation by means of the continual introduction of fresh air proved insufficient, so that the air had to be cooled in advance of the boring party by being sprayed with ice cold water.

The enormous weight and stupendous pressure of the mountain overhead was sufficient to distort the strongest wooden beams and warp the most solid iron supports.

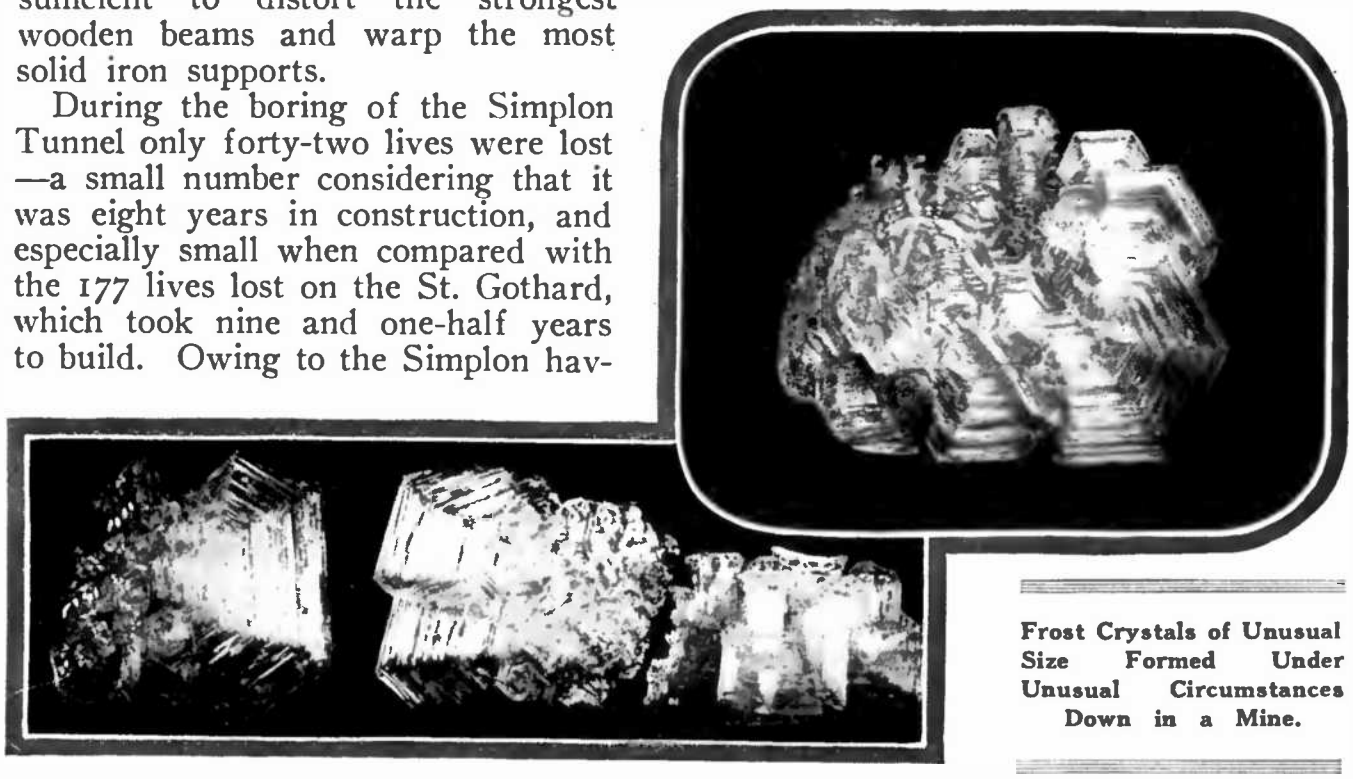
During the boring of the Simplon Tunnel only forty-two lives were lost —a small number considering that it was eight years in construction, and especially small when compared with the 177 lives lost on the St. Gothard, which took nine and one-half years to build. Owing to the Simplon having been begun after considerable experience of great Alpine tunnels had been acquired, it was far more rapidly constructed than any of its predecessors.

The traction in the tunnel is electric, trains taking from twenty to twenty-five minutes to pass through.

Half way through the tunnel, at a point where there are 7,000 feet of mountain overhead, a station has been built, not for passengers but for signaling purposes, two railway officials being constantly kept there. At this station, also, a slow train can be shunted on to a siding, in order to allow an express to pass. So well supplied is the Simplon Tunnel with fresh air that the men in the central station can remain on duty for eight consecutive hours without feeling any ill effects.

HIGHLY DEVELOPED FROST CRYSTALS

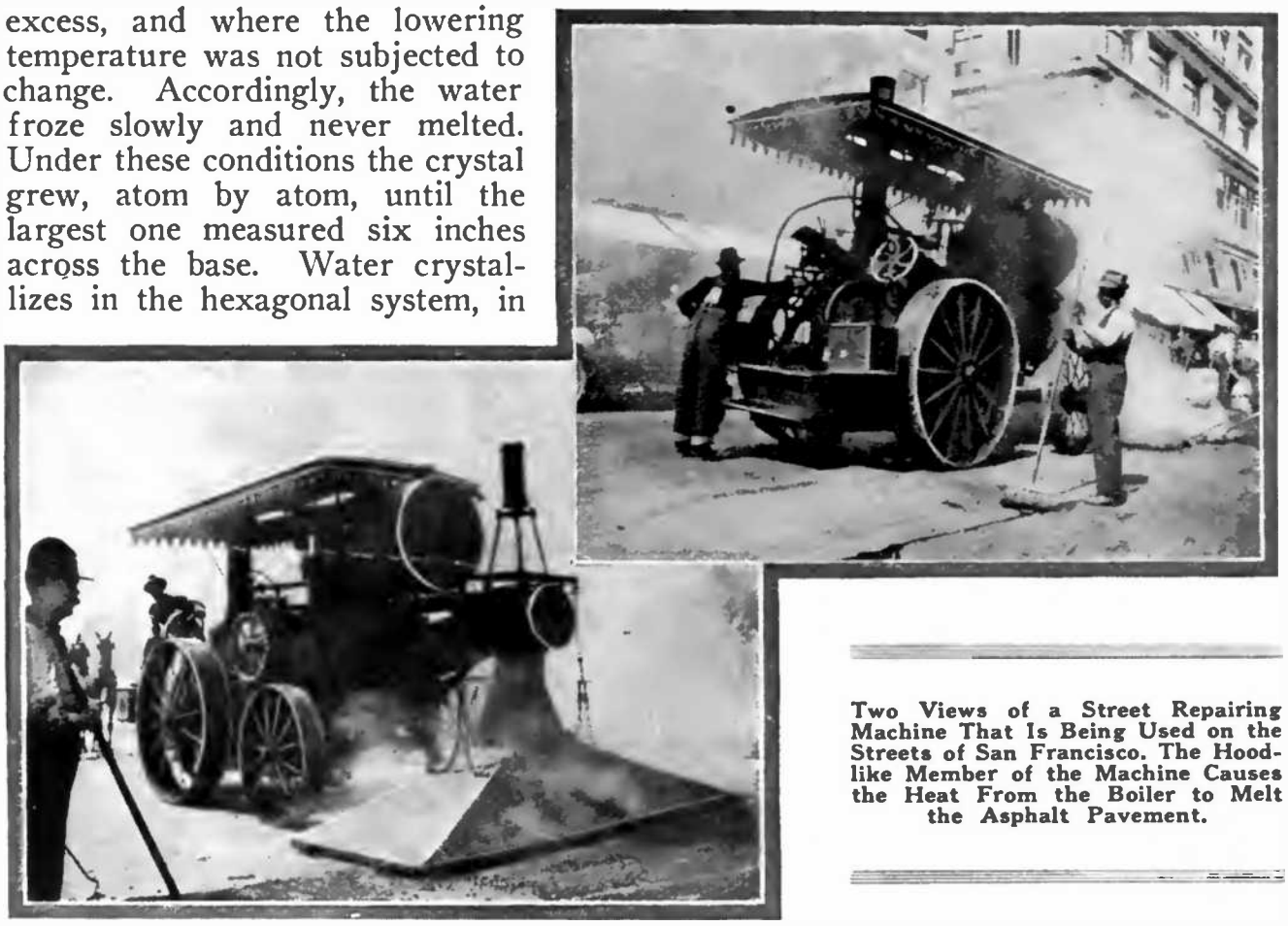
The accompanying illustrations show frost crystals formed under conditions which have permitted them to grow to sizes quite unusual in ordinary life. Tiny crystals of snow and ice are common enough, but their size, usually microscopic, has prevented most people from becoming familiar with their wonderful variety and extreme beauty. Each flake of snow is a complex structure built up upon a basis of a geometrical figure, perfectly symmetrical and adorned with multiplications and changes upon the parent figure. Sometimes they can be seen, especially when the flake is large and is caught upon a piece of black cloth, but one must be earnest in searching before the snow melts and a drop of water takes its place.



Frost Crystals of Unusual Size Formed Under Unusual Circumstances Down in a Mine.

The large crystals shown in the illustrations were formed deep down in a mine where the moisture was not in great

excess, and where the lowering temperature was not subjected to change. Accordingly, the water froze slowly and never melted. Under these conditions the crystal grew, atom by atom, until the largest one measured six inches across the base. Water crystallizes in the hexagonal system, in which there are four axial planes of symmetry. The beautiful regularity of the six sides are to be seen in the illustrations.



Two Views of a Street Repairing Machine That Is Being Used on the Streets of San Francisco. The Hood-like Member of the Machine Causes the Heat From the Boiler to Melt the Asphalt Pavement.

A NEW STREET-REPAIRING MACHINE

The two accompanying views show a new machine that is being used in San Francisco, Calif., for the purpose of taking up asphalt pavement. Its operation is quite a contrast to the usual and laborious method of pick and crowbar.

In general appearance the machine is very similar to a steam roller, although it is not near as heavy and travels at a much slower speed. The fuel used in driving the machine is crude oil. When the vehicle is in motion the chimney in the rear is used for furnishing the draft. On the other hand, when the machine is working, the draft is shut off in the chimney and is forced instead through the funnel at the front by means of a jet of steam. After three or four minutes the flames that have been forced under the funnel, melt or soften the asphalt so that it can be scraped into piles with saw-toothed hoes. The new asphalt is then laid down and rolled out.

By the use of the new machine two to four blocks of street pavement a day can be torn up and relaid, according to the amount of traffic there is on the street.

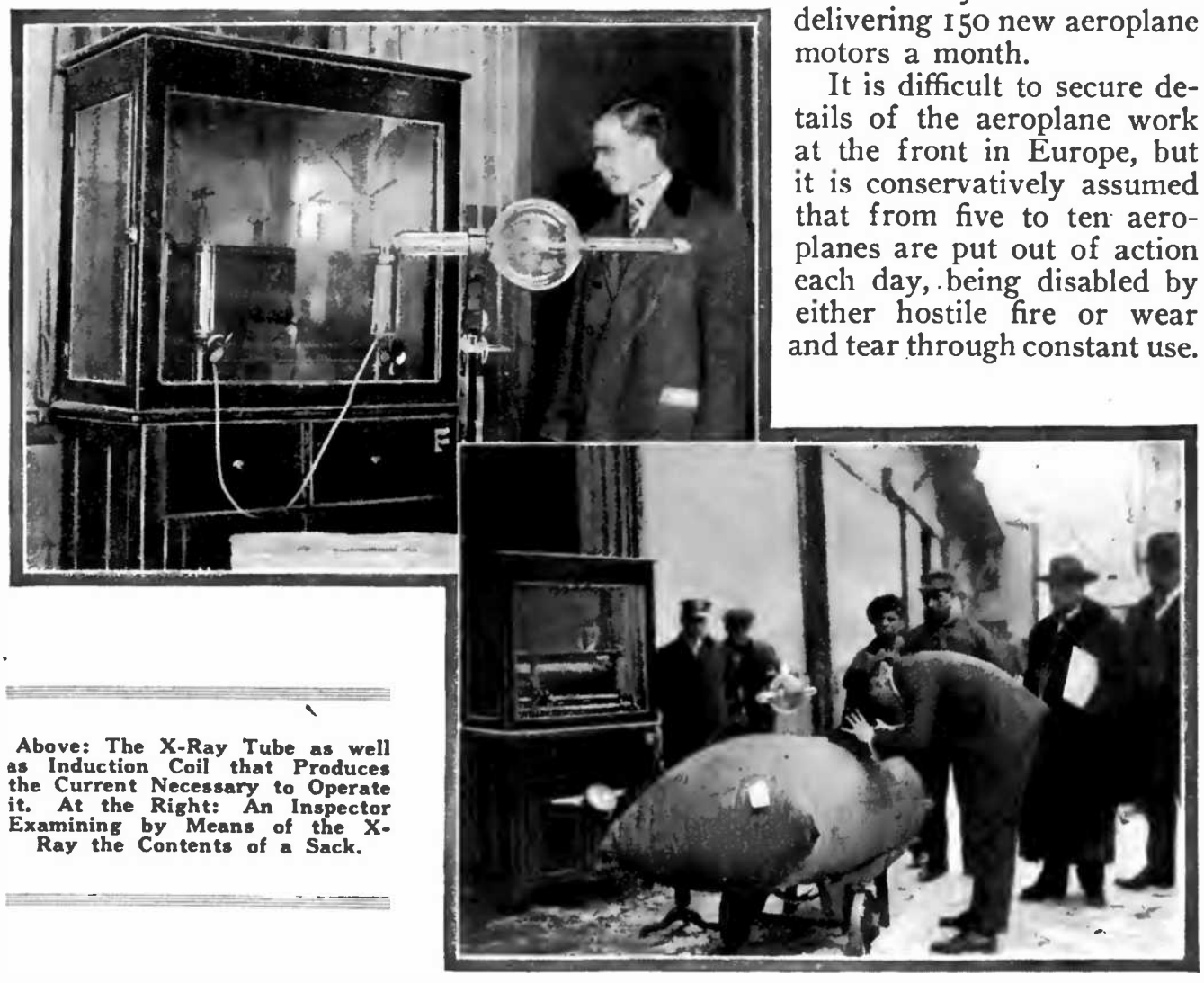
POWER OF AUTO CLOSES WATER MAINS

Through the invention of a New York man, the power of an automobile is now used to open and close big water valves. All manual labor is dispensed with, and the time required has been reduced to a few minutes where formerly from one to two hours' time was necessary.

The new equipment consists of an arrangement that is placed over the manhole in the street. This arrangement is connected by suitable shafting to the rear wheel of an automobile. The automobile wheel is jacked up from the ground. The shaft connection is so constructed that it may be adjusted and clamped on any sized automobile wheel.

USING THE X-RAY TO EXAMINE SHIPMENTS TO EUROPE

An X-ray apparatus is now being used to examine all bulky shipments exported to the fighting countries of Europe through the port of Boston. In this manner any attempt to conceal contraband articles in bales of cotton or similar packages is frustrated. By using the X-ray it is possible for the inspectors to examine boxes, bundles and bales without the necessity of opening them, not only effecting a great saving in time, but also causing the inspection to be more thorough.



Above: The X-Ray Tube as well as Induction Coil that Produces the Current Necessary to Operate it. At the Right: An Inspector Examining by Means of the X-Ray the Contents of a Sack.

The latest available statistics indicate that there are 14,152 telegraph stations in England. Last year's telegraphic business amounted to 87,000,000 messages. The telegraph lines in England are owned and controlled by the Government.

MILITARY SERVICE RAPIDLY WEARS OUT AEROPLANES

The life of aeroplane motors in use is not over 350 hours, and to assure this much of them they must be taken apart, cleaned and remounted every 50 hours, according to the experience of French aviators since the war began. Since the cost of one of the motors, when ordered in lots of 100, is 15,000 francs (about $3,000) each, the expense is a heavy one. One factory near Paris is delivering 150 new aeroplane motors a month.

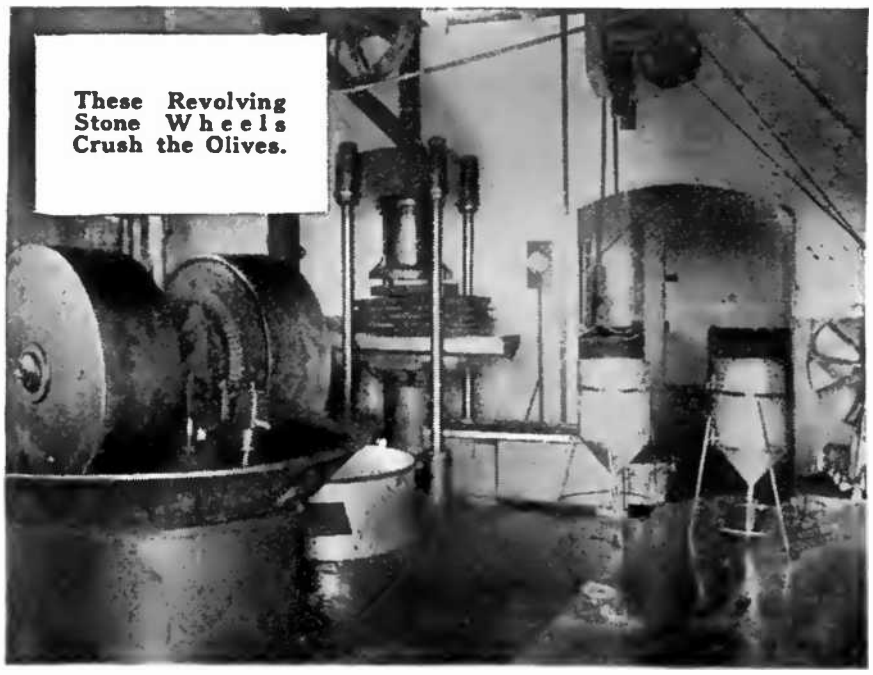
It is difficult to secure details of the aeroplane work at the front in Europe, but it is conservatively assumed that from five to ten aeroplanes are put out of action each day, being disabled by either hostile fire or wear and tear through constant use.

The military aviation schools are training many hundreds of young aviators, so that there is a constant renewal of the human material at the front, while factories are working day and night to steadily increase the number of aeroplanes in action. Although the cost of maintaining the aeroplane fleets is high, it is comparatively insignificant compared to the money expended for other purpose, notably the cost of ammunition and that of food.

The Making of Olive Products

By Charles Alma Byers

OLIVES have been grown in the United States, almost exclusively in California, for one hundred and forty-five years, but only during the last few years has their culture assumed anything like the proportions of an important industry. The crop now yields an annual income of more than two and a quarter million dollars.



These Revolving Stone Wheels Crush the Olives.

The slow development in the industry has been due mainly to the rather crude and expensive methods in vogue for a long time for preparing the olives for the market. Recently, however, a great deal of attention has been given to this matter, and at present the packing companies of California are far in advance, in methods and machinery, of the olive-growing countries of Europe. At the same time our methods are far more sanitary. During the last ten years, according to government statistics, the output has increased nearly 400 per cent.

The two varieties of olives principally grown in California are the Mission and the Manzanillo, the former being the more popular. Both are used for either oil or pickling purposes. The ones used for pickling must be larger, and these are usually produced on the better land or where fewer trees are planted to the acre. About 60 per cent. of the crop is used for making olive oil.

The first quality of oil is pressed from fruit which is firm yet ripe enough to allow the pit to be squeezed out without carrying with it any of the flesh. When gathered, the olives are spread on drying trays which are then piled up with an air space between so as to dry them out. The olives when drying lose sometimes as much as half the weight of the fruit as taken from the tree. When they feel spongy and greasy they are taken to the mill where they are crushed, usually in a stone trough in

Spreading Out Olives on Trays in Order to Dry Them.

which a big stone member revolves on its edge in the manner of a heavy wheel. After the fruit has been crushed it is put in bags of linen or other suitable coarse material and subjected to tremendous pressure. The resultant fluid is run into settling tanks, where the oil and water separate. The oil, rising to the top, is drawn off. It is still further purified by being pressed through filters of cotton batting; then again through druggist's filtering paper, after which it is ready for bottling.

The process is quite slow, but the oil is absolutely free from any sediment or matter which would cause it to ferment or become rancid. It has taken about ninety days to do this. Every minute of the time the product has been under the constant care of experts and has not been allowed to come in contact with anything which is not scrupulously clean or sanitary.

As the Olives Move by on a Continuous Belt, the Women Sort Them According to Size.

For pickling, olives are gathered in four stages of ripeness: First, green; second, when just beginning to take on a reddish cast; third, ripe, or just when they have become black; fourth, dead ripe. Fruit which has become dead ripe is considered best of all, but it requires extreme care to preserve it and therefore very little of it reaches the market.

The bitter principle must, in each case, be extracted before the olives are edible. This is accomplished in two ways—the lye treatment and the water process. In curing by the water process, which is the one most used in California, the fruit is put into vats or barrels and covered with fresh water which is either changed daily or kept flowing constantly. It takes from thirty to sixty days or more, according to conditions. After the bitter part, due largely to potash, is eliminated, weak brine is put on the fruit—strong brine would cause it to shrivel. After about a week this is poured off and a stronger brine, in which it remains for two or three weeks, is used. The olives are now ready for the market.

Olives Placed in Large Vats for Extracting the Bitter Principle.

In 1912 the United States consumed olive products to the value of more than $11,000,000, of which only a little more than one-fifth was produced in this country. American olives are also grown in Arizona,

SUCCESSFUL FARMING IN A CAVE

A CAVE in the heart of the Ozark Mountains of Missouri is the unusual spot chosen for a farm by a tired citizen of St. Louis. This odd agricultural venture is no longer a matter of speculation, for the farmer is successfully raising mushrooms, rhubarb and celery, while his profits, bigger than those of his neighbors above ground, are unaffected by drought, cold and other destructive climatic phenomena.

Robert Smith, of St. Louis, was one of the first captivated by the "back to nature" movement twelve years ago. While looking about for a farm in the western part of his home state, Mr. Smith found an attractive 26 acre stretch, beneath part of which lay Fisher's Cave, a large subterranean opening that still bore the claw imprints of the bears which formerly hibernated there. Remembering the profitable use made of caves by the mushroom growers of southern France, the erstwhile St. Louisan determined to test the productiveness of his acquisition.

Preparations for the experiment were simple. He first constructed a 25-foot flat bottomed boat, for his only practicable access was by a small river running through the cave. Then, while his neighbors were digging up weeds and clearing brushwood from their lands, Farmer Smith had to uproot and haul away the stalagmites and stalactites—the salty deposits left by the incessant dripping of water during many centuries. Except for a clayey substance, ochre, which covered part of the walls, the cavern floor was bare limestone, so that the final preliminary activity was to spread a quantity of soil and manure over the ground for planting.

Mushrooms are peculiarly suitable for such a project as the cave farm. The spawn is secured in bricks that are broken up and scattered over the floor surface. From a single mulching and with almost no care, the farmer can harvest a new crop of marketable mushrooms every day for three months. Allowing a brief period for the fungus to attain its full size, Mr. Smith can readily plant spawn three times each year. From this promising start the subterranean agriculturist turned naturally to rhubarb and celery. These are planted above ground, but are later transplanted in the cave. The underground ripening causes an unusually rapid growth; the rhubarb gaining on the average an inch a day in length.

The beginning which Mr. Smith has made with his cave farm shows the brilliant possibilities of this form of intensive cultivation. Besides the crops which the Missouri farmer is now producing regularly, the cave, with its fixed quantity of moisture and its temperature which never varies from 60°, is better than a man-made cold storage house for keeping vegetables fresh indefinitely. So quickly did this condition become evident that all the farmers within a radius of twenty miles now store their sweet potatoes in the cave for periods as long as two years to secure a favorable market.

ELECTRICALLY EQUIPPED KITCHEN

It is only natural for those who have not investigated the cost of cooking by electricity to dismiss the proposition by saying that it is too expensive and that only families of wealth can afford such luxury. Yet, in Tulare County, California, there are 175 consumers on the local company's system using current for cooking and heating.

There is a kitchen in one of the residences in Visalia which is merely a sample of a number of similar installations that have been made in Tulare County. The family using this equipment consists of two people, and they do all of their cooking and heat the kitchen with electricity, in addition to using it for lighting purposes.

At the Top: The Underground River That Flows Through the Cave in Which Is Situated a Farm. In the Oval: The Entrance to the Underground Farm. Below: A Portion of the Subterranean Farm, Devoted to Mushroom Culture.

ELECTROPLATING OF PALLADIUM BY NEW PROCESS

Palladium is now used for the plating of fine instruments in preference to silver, on account of the fact that it is harder and also because it does not tarnish. The bath usually employed is that of Pilet and Carry, of Besançon, France, composed of chloride of palladium, phosphate of ammonium and phosphate of soda. A small quantity of benzoic acid is added to the bath; this, according to the inventors, serving to increase the whiteness of the deposit.

The palladium plating bath is prepared as follows: Take one-quarter of an ounce of palladium in the form of thin leaf and cut it up into small pieces. Place them in a flask and add one ounce and a quarter of strong muriatic acid and an ounce of nitric acid. Heat gently until the palladium dissolves, and pour into an evaporating dish. Evaporate until a pasty brown-black residue is obtained. Now add sufficient soft or distilled water to dissolve the paste, which will produce a dark brown solution.

Wrecking an Elevator by Means of a Cleverly Placed Dynamite Charge.

Now make a solution of half an ounce of ammonium phosphate in 8 ounces of water. Warm and add to the first solution. To this add 8 ounces of phosphate of soda dissolved in two quarts of water. Boil until the solution is clear and all smell of ammonia has disappeared. If it is desired to whiten the deposit, add one-quarter of an ounce benzoic acid. The foregoing accomplished, add one quart of water, which will bring the total amount to about one gallon.

The solution may be used cold, but it is preferable to warm it to about 120° F. A good coating will require from 5 to 10 minutes in the bath, and it may be deposited on brass, copper, iron or steel. Use a carbon or a platinum anode. If the carbon from an old dry battery is used, soak first in hot water to remove the sal-ammoniac. A current of 2 volts is sufficient. Use a porcelain dish, a glass or enameled vessel to hold the solution.

REMARKABLE DYNAMITE BLAST

In the accompanying illustration is seen an elevator shaft 165 feet high being destroyed by a dynamite blast. The railroad authorities recently found it necessary to make way for extensive yards at Phillipsburg, N. J., and accordingly decided to wreck the elevator as well as the old iron furnace shown at the left that was built as far back as 1849.

FORESTRY NOTES

Lodgepole pine, one of the principal trees of the Rocky Mountains, makes good strong wrapping paper and pulp board.

Recent sales by the Government totaling 126,000,000 feet of saw timber in the Olympic national forest, in western Washington, mark the opening of this hitherto inaccessible storehouse of timber, estimated to contain a stand of 33,000,000,000 board feet.

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 the pest.

DESIGNING WARSHIP HULLS by EXPERIMENT

By Robert Hunt Moulton

ON the water of the Model Experiment Basin at the Washington Navy Yard, each new vessel of the United States navy is tested before construction by means of a toy reproduction possessing the exact lines and proportions of the large craft's plan. Costly errors in warship construction are thus eliminated. And often a great saving in cost is effected through the knowledge gained in the tests.

YOU have taken a patriotic pride in the speed performances of American fighting ships, and if you have followed these showings closely you have no doubt been impressed with the steady advance made. Each year naval vessels have shown consistent improvement in speed, seaworthiness and engineering economy, but have you ever paused to ask how these results are primarily made possible? This is the direct fruit of the model experimental basin.

The model tank, as it is generally called for brevity's sake, is the establishment in which small models of prospective ships are made and tried on a reduced scale. When Congress was asked to appropriate money for the plant which is now an interesting and important department of the navy yard at Washington, the proposition was looked upon as involving an expensive toy. Since then, however, the work done there preliminary to the building of warships has represented a saving of many hundreds of thousands of dollars, besides insuring the designed performance of the man-of-war.

This is another example of the old rule of thumb being supplanted by the certainties of science. Without going too far into the history of things, it is sufficient to know that an Englishman, Dr. William Froude, discovered back in the '70s that there was a comparable relation between the power required to draw a small model through the water and the motive energy needed to propel a big craft of similar form. The principle which he discovered later became known as Froude's law, or the law of comparison. His studies were first made with miniatures and then verified by the towing of a large vessel formed on identical lines.

Within the last twenty years there have been created and developed many vessels of novel types and the results obtained would have been virtually out of the question but for the model tank. Millions of dollars would have been wasted in blind groping instead of ob-

taining positive assurance of what the finished vessel would do before a single cent was spent in her building.

All of the models tested at Washington are of a uniform length of twenty feet, and the purpose of making them so large is to reduce the possible error in translating the performance figures of the model into those of the full sized vessel. These models are made of wood and are fashioned in a machine especially designed for this work.

Next, the model is painted and carefully varnished, in order to obtain a very smooth surface; and with this done various waterlines are marked upon the white paint, so that instantaneous photographs taken during the towing tests will show just how and where the waves and the hollows produced by the miniature boat in motion are developed.

When the model is ready it is carried to the basin and there loaded in the balancing tank with bags of shot until it has the right weight or displacement and proper trim or poise upon the water. With this done it is ready to be attached to the towing carriage and tested.

The towing carriage is a sort of mobile bridge which straddles the main tank. It is driven by electricity, the different speeds being under very nice control. Upon the towing carriage are all of the operative switches and measuring instruments, as well as the recording mechanism which marks the speed of the model and its pull or resistance when drawn through the water. The aim is to obtain a ship form which will show the least pull or resistance at the desired maximum velocity. The actual speed of the model is a mathematical ratio of the relation between this miniature and the full sized ship, and therefore the model does not travel fast, if you consider what the big craft will really do.

The towing basin is 370 feet long and 43 feet wide, and the maximum speed of the carriage is relatively far in excess of the probable speeds of anything but freak craft.

After a model of satisfactory form has been developed and tested, then comes the further task of making the figures of the trials applicable to the battleship which is to be built.

Now there is just one part of this work which does not follow Froude's law of comparison. This is the factor of the friction set up between the water and the wetted surface of the vessel's underbody. This resistance follows a law of its own and it is necessary to tow another model which consists of a thin plate just as long as the small craft and with a submerged surface exactly equal to that of the model.

From these two tests, that of the plane and that of the model, the designer has the information he wants and this information covers various trials over a wide range of speeds, so that the naval architect knows both the maximum and the cruising speeds at which the vessel can be propelled most economically. The cruising speed is an important one, because it is at this rate of travel that ships of war go most of the time. Full speed is really a battle reserve or something to be called for only when urgency demands. In this particular, fighting ships differ radically from the ocean greyhound of commerce.

But don't think that the naval designer has an easy task even with the model tank at his disposal. The speed trials of the full sized ships are not less important to him because they give him a check upon his model work. This check is very necessary inasmuch as it enables the designer to bridge over the gap between his model and the real vessel year by year with more exactness.

The builder of the hull structure, the naval architect or naval constructor, has only a share in the final product. The naval engineer must take up the problem where his brother ends. That is to say, the engineer knows just what energy his propellers must exert effectively against the water in order to force the ship along at her several speeds. He, too, must work from the outside of the ship inward up to a point.

The position of the propeller in relation to the hull and the very form of the propeller must be suited to the particular craft in question. These can be tried in miniature in association with the model for the determination of some data, but after that the engineer must

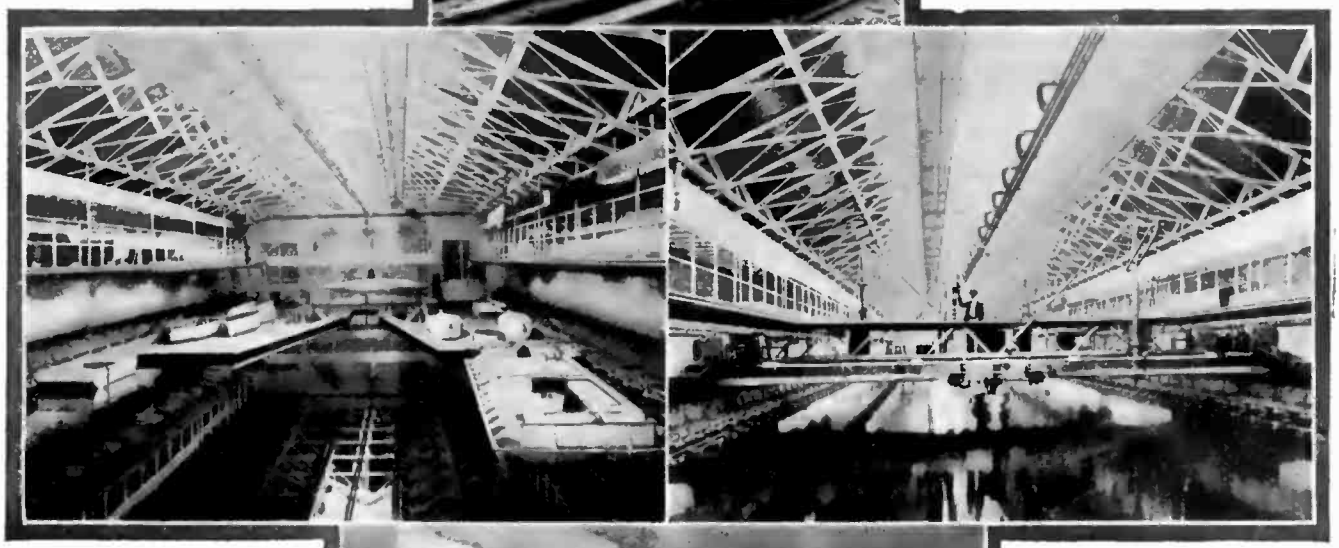
draw upon experience and his carefully tabulated records of other performances.

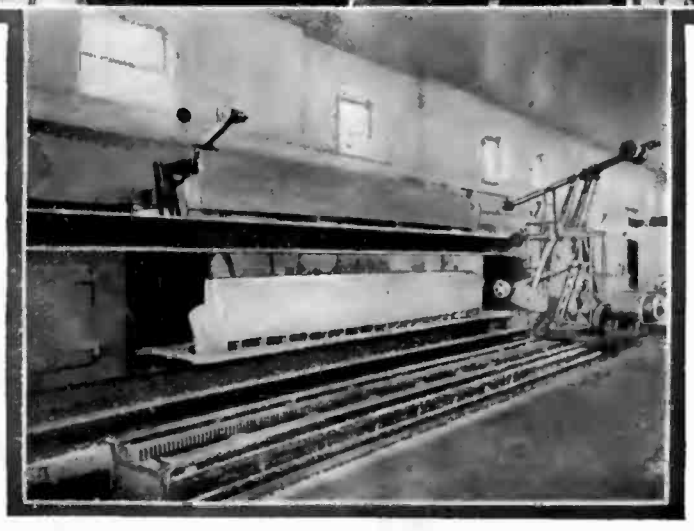
The average annual expenditures for the maintenance of the model basin at Washington are under $25,000, and this is a trifling sum compared with the savings which have been effected through careful designing. In the case of the three scout cruisers *Birmingham*, *Chester* and *Salem*, by merely lengthening their hulls it was found possible to save in those three ships a combined total of 17,000 horse-power over that required for the original design. Figured at $60 a horse-power this represented an economy of machinery cost amounting to $1,020,000.

The model experimental basin is no longer looked upon as an investment of doubtful value; every first class naval power has one of these establishments, and like that at Washington most of them lend their aid to the merchant marine as well. Such is the development of the experiments of Dr. William Froude.

At the Right: A Close-up View of Part of the Machine That Is Used for Modeling the Miniature Hull.

Below: The Electric Towing Carriage in Motion With a Model Hull Attached to It for Testing Purposes.





Above: One End of the Test Basin Showing a Number of Miniature Hulls to Be Tested.

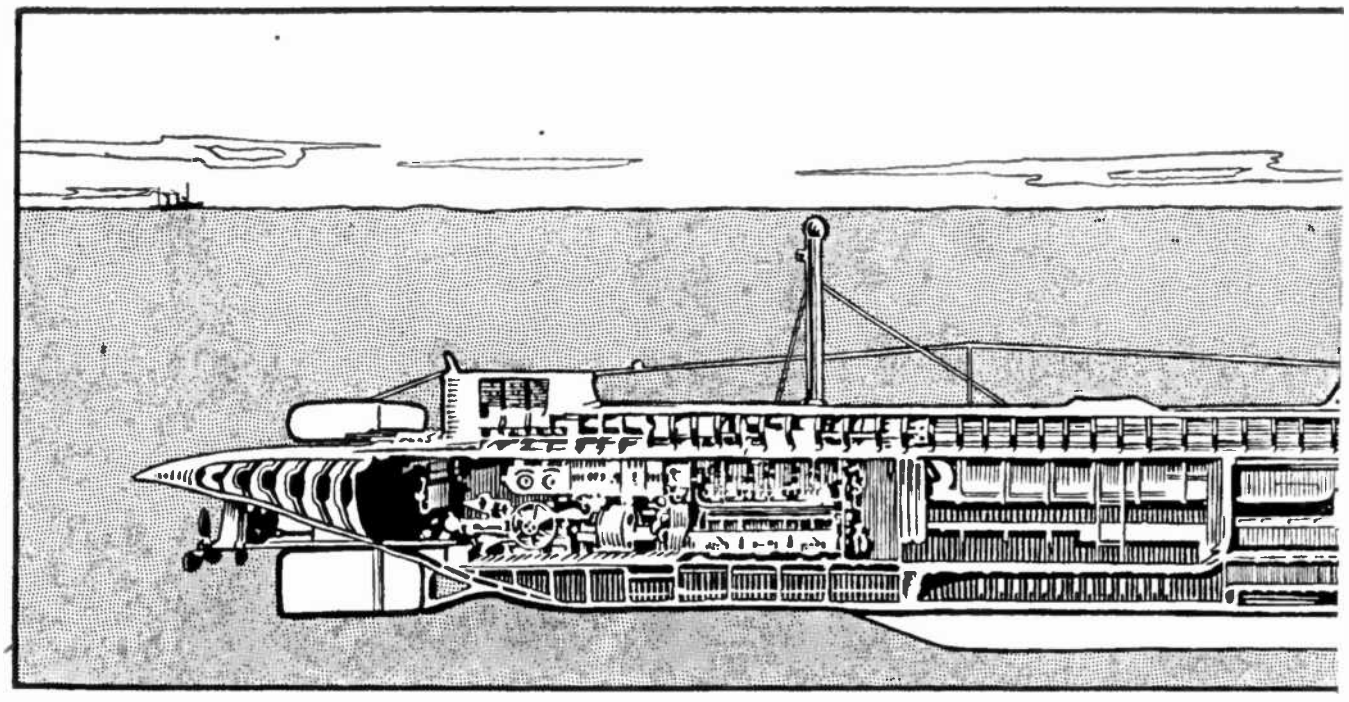
At the Left: Another View of the Machine That Makes the Hulls. The "Former" Is Below and the Model Above.

GERMAN SUBMARINES AND THE WAR

THE partisans of the submarine torpedo boat have been very much encouraged by the manner in which these under-water craft have made good in the present war. True, they have not worked all the wonders in naval combats that have been so confidently prophesied by their designers, but it must be borne in mind that this order of torpedo boat is still in its extreme youth; yet, when conditions favor its operations, it is capable of dealing a death blow to the mightiest of dreadnoughts.

Although much has been said of the dire work of the "U" boats of the German under-water flotilla, it is necessary in all fairness to give credit to the rival British craft for setting the offensive pace. It was British submarines that made their way to the Bay of Heligoland and lured the German cruisers out from under the protecting sweep of the formidable guns mounted on the island of that name. But the presence of the British subaqueous torpedo craft served then to bestir the Kaiser's "U" boats to vengeful activity, and they have been destructively busy at intervals ever since. The most amazing feature of these performances on the part of the German under-water flotilla has been the sureness of their attack and their capacity to operate at extremely long distances from their bases.

Strange as it may seem, it was not so many years ago that the great German naval organizer, Admiral von Tirpitz, vigorously opposed the building of submarines, and yet to-day he is putting these very craft to the most telling service. The truth of it is, he was strategist enough to wait until other nations had paid the price of developmental work, and then, with certain engineering difficulties surmounted, he saw to it that every mark spent by his government should make for the effective strength of the navy. But his change of heart was hastened by revelations which came during the grand naval manœuvres in the autumn of 1912.

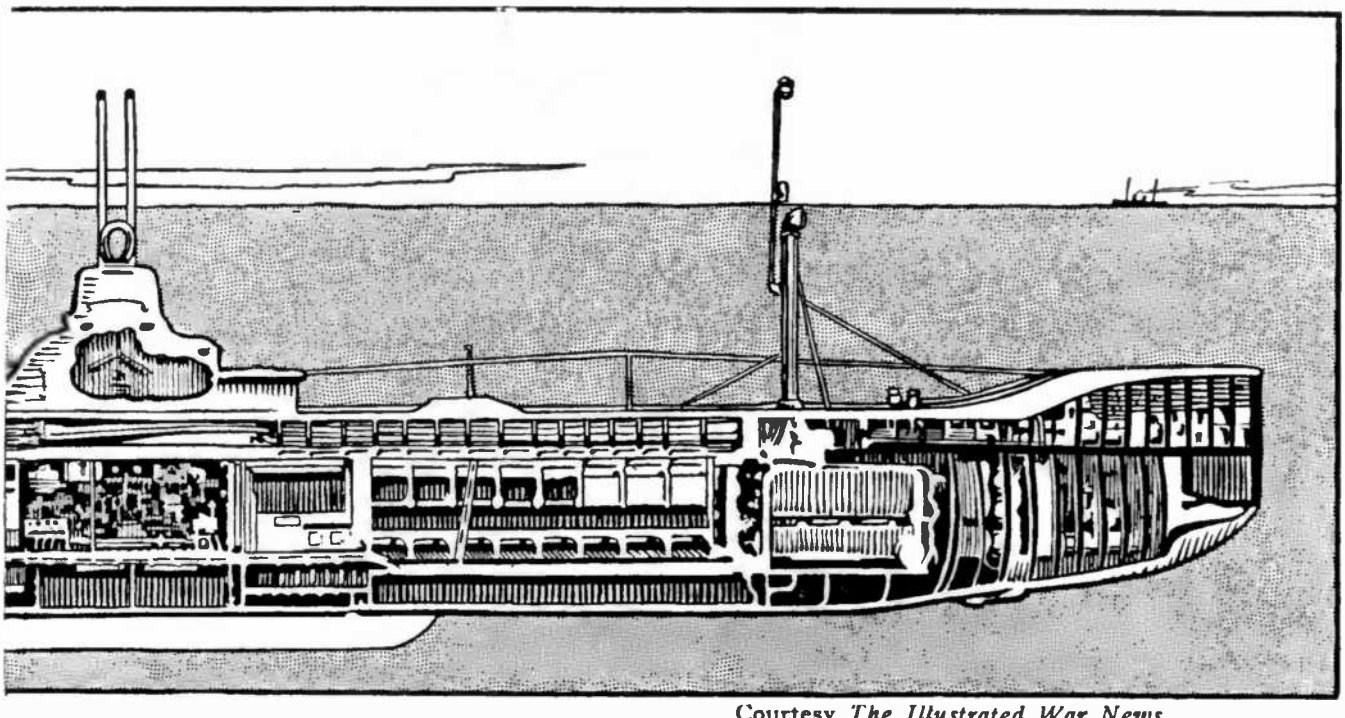


A Cross-Sectional View of a German Submarine Boat of Most Recent Design. A Craft of This Kind Equipped With Four Torpedo Tubes and Two 14-Pounder Quick-Firers, and Carries a Crew of Probably Electric Motors and Gasoline Engines; Ventilator, Escape Hatch and Men's Quarters; Captain's Cabin; Escape Hatch, and Ventilator and Torpedo Tubes. Along the Bottom of the Submarine in Their Relative

In those operations, the under-water craft performed in an unexpectedly brilliant fashion, and their behavior opened the eyes of the Kaiser's naval experts. The fine seafaring qualities of the "U" boats and the ease with which they succeeded on several occasions in surpris-

ing and "torpedoing" certain of the big ships duly impressed the admiralty officials present at the war game. The boats were able to manœuvre with great precision when totally submerged, and were so handled that they came to the surface at exactly the right distance from the ship to be attacked—this range seldom exceeding 400 yards! This meant certainty of hitting with an actual torpedo.

Again, the North Sea prior to the war had been the favorite field for exercise, and the submarines were frequently sent from the mainland to Heligoland and back when the sea conditions were calculated to try both the boats and their crews to the utmost. Now here is an item that explains still better why the "U" boats have scored as they have. A rival naval expert tells the story. "One day towards the close of the manœuvre period the weather was bad, so bad, in fact, that the smaller destroyers were unable to do their part in the programme and had to run for shelter. A division of big cruisers belonging to the 'blockading fleet' were patrolling some twenty miles off shore and keeping a sharp watch for one of the opposing battle-cruisers which was expected to make a dash for the open sea. In view of the boisterous weather no one gave a moment's thought to torpedo attack, and a good many people on those cruisers got the surprise of their lives when half a dozen submarines bobbed up so close to them that torpedoes could not miss, and made the ominous signal that all four ships concerned were torpedoed. This was not an isolated case during that interval of mimic warfare; and the Germans found the submarines to be less dependent on mother craft than the ordinary surface torpedo vessels, and much less liable to mechanical breakdowns. No wonder that the German submarines have done so well in actual conflict."



Courtesy *The Illustrated War News.*

Has a Displacement of About 900 Tons, a Surface Speed of 18 Knots and 12 Knots Submerged, Is 30 Officers and Men. Briefly, the Sections of the Vessel From Left to Right Are: Engine Room, With Conning Tower, Periscope and Central Operating Department; Officers' Quarters; Torpedo Room and Order Are: Lubricating Oil Tanks, Storage Batteries in Two Separate Compartments, and Oil Storage.

There has recently been demonstrated at Ilion, N. Y., by a well-known typewriter company an electrical typewriter which, it is claimed, will revolutionize the transmission of messages over telegraph wires. The demonstration showed how an operator writing on one machine would simultaneously cause another similar machine to write at a remote place. A speed of 60 words per minute was easily obtainable.

HOW AN INVENTOR SECURED CAPITAL

An inventor of limited means who had not sufficient time to devote to capitalizing his invention secured funds by this odd method: A working model of the invention was loaded upon a push cart and wheeled to a vacant lot in in the center of the city. It was possible, as a rule, to get permission from the foreman of a building job to leave the model near the sidewalk for a day or two with no other charge than one or more cigars. The model carried a brief description and the owner's name and address, together with a statement that capital was needed to float the device. Meanwhile the inventor was able to go about his daily work that brought in a living while waiting for funds to promote the device. The results are said to be successful and it was certainly an inexpensive advertising campaign.

A Western Inventor Secured Financial Aid by Displaying His Idea to Passers-by.

ELECTRICITY CARRIED THROUGH WATER STREAMS.

In several instances firemen have been shocked by electric currents passing through a stream of water issuing from a hose. It appears that the current passes from a live conductor on which the stream is being directed, through the water to the ground. Upon holding the brass nozzle at the end of the hose, the firemen are apt to receive an electric shock.

The experiments of an Italian by the name of Ugo Tartaglini, described in *La Scienza per Tutti,* are of exceptional interest since they indicate the amount of current flowing through a stream under different conditions. In one test a stream of water from a hose fitted with a nozzle measuring 15 millimeters in diameter was played on a trolley wire carrying a direct current of 525 volts. At 2.2 metres distant a voltmeter attached to the nozzle on one side and grounded at the other registered 20 volts. At 65 centimeters away it registered 70 volts, while at 20 centimeters a voltage of 210 was indicated. Since the average man can stand a current of 50 volts without serious shock, it follows that a fireman can hold the nozzle of a hose five or six feet away from the wires without danger.

Mr. Tartaglini also has experimented in conjunction with alternating current lines, one of these carrying a current of 2300 volts and the other 4600 volts. In both instances a voltmeter did not indicate a passage of current through the stream of water, although the experimenter states that a slight shock could be felt by placing one's hand in the stream.

Chemical extinguishers are the most dangerous form of fire fighting equipment around live wires. With such an extinguisher Mr. Tartaglini noted a current of 1500 volts passing through a stream of water when the nozzle of the hose was placed at 225 millimeters from a wire carrying 2050 volts.

News print paper has been made by the forest service laboratory from 24 different woods, and several compare favorably with standard spruce pulp paper. The great quantities of wood pulp that are being used constantly for newspapers and magazines make it imperative to find substitutes for spruce pulp.

THE cooking of food by means of electricity is a commercial proposition. In order to make it a success, it is necessary to point out the advantages it has over other methods. These advantages may appeal sufficiently to the housewife to give it a trial. The next thing to prove will be its general cheapness. Competition is the keynote of activity in all fields of effort, and the gas companies have carried on so successfully a campaign in the introduction and use of gas for cooking and heating that, in the majority of homes, the use of electricity for that purpose would seem a novelty. The same campaign must be carried on on behalf of the use of electricity. The electric stove is no novelty in the West, in the kitchen, at least. In the East it is gaining ground every year. By its means the housewife benefits in the following manner: First, there is no waste heat, consequently she works in a cool kitchen. Second, absolute cleanliness is possible at all times. Third, labor is reduced to a minimum because an electric stove is always ready. Fourth, with no flame, there is perfect safety. Fifth, the character of the stove permits of more time for social duties. Summing up, therefore, it is evident that an electric stove is safer, hygienically superior, socially more acceptable, and from a labor standpoint a time-saver, as compared with a coal or gas stove. Without dirt, ashes, gases or smell it constitutes an ideal addition to a clean and well kept household. As no oxygen is consumed by it, the air of a home is purer. As it is small, no kitchen is crowded by its use. As it is scientific in construction and operation, it means that the housewife can predetermine results with laboratory-like exactitude in roasting, baking or stewing. Consequently, the phrase "You can cook by the clock" is justified by its use. As the kitchen is really a laboratory in which foods are prepared to excite appetite and induce digestion, it is a splendid thing to realize that the electric stove, the highest scientific product of the age in that field, can be installed to reduce all kitchen operations to a dependable basis. This in itself is a great advantage. The empirical laws that have hitherto prevailed in the culinary art need prevail no longer. One of the greatest sources of failure in baking has been a questionable oven temperature. With the electric stove this cause disappears. With its disappearance the doubts concerning results go too. A housewife prepares her dough according to exact recipes and can feel certain with a guaranteed and regulated temperature that cake or bread will emerge "done." It means working in a modern, sanitary way—the science of housekeeping realized.

THE UNIT OF THE STOVE OR HEATER—The heating unit is a disc, within which is the heating device. The heating is obtained by means of an inoxidizable high resistance wire. This wire is wound around an insulating body, or enameled, or embedded in a non-conducting substance, or otherwise prepared to act as an element of the heat-

ing system. Frequently a steel disc is employed within which the heating element is sealed. The element is brought as near to the side which is to emit the heat as possible. The other side of the disc, that which is not used for heating, is supposed to be provided with a "dead air space." In disc stoves, which are merely steel discs supported on legs, the device is used for heating similarly to single plate gas stoves. As the under part would radiate heat equally with the upper were this not obviated, the air space is provided below. Four-legged units of an oblong form are on the market, constituting electric stoves with appliances. For instance, two tops—a grid used for toasting, and an aluminum griddle plate used for baking griddle cakes; or inverted for frying purposes. It is provided with a cake turner which also forms a handle for the stove and attains a cooking temperature in from three to five minutes after current is turned on. The high resistance wire heated by the flow of current produces a certain number of heat units a minute and if this heat is not radiated wastefully, it can be utilized for the purpose in view most economically.

ELECTRIC WATER HEATING—For instance it may be, and often is, necessary to know the amount of time required to heat a certain quantity of water by means of a certain number of watts. To accomplish this the following formula is needed, giving the minutes required for a certain number of gallons or pounds of water:—

Electric Cooking Has Many Advantages, But One of the Principal Ones is that "You Can Cook by the Clock."

(For gallons of water)—

$$\text{Minutes} = \frac{146 \times \text{gallons} \times (Th - Tc)}{\text{watts} \times \text{per cent. efficiency}}$$

where Tc = temperature of water cold.
where Th = temperature of water hot.

Allowing an average efficiency for electric cooking devices of from 80 to 95 per cent. or about 85 for all cases would give a definite figure for the formula. In a specific case of one gallon of water to be heated from 40° Fahr. to boiling point or 212° Fahr., about a kettle full of water in all, with a wattage of 2000, the calculation shows the following:—

$$\text{Time} = \frac{146 \times 1 \text{ gal.} \times (210° - 40°)}{2000 \times .85}$$

$$\text{Time} = \frac{146 \times 172}{1700} = \frac{25112}{1700} = 14.7 \text{ minutes}$$

In other words, it will take nearly 15 minutes to boil 1 gallon of water with 2 kilowatts according to this calculation, the efficiency of the cooker being 85 per cent. If the quantity of water is reduced to one-half a gallon, the time required with the same power would be 7 minutes. If the power is reduced to one-half, the time required to heat one-half a gallon of water from 40° to 212° Fahr. would still be 15 minutes.

In cooking, the boiling and stewing processes are similar to those of boiling water, the exception being that the amount of fluid is less. In boiling potatoes or making soup there is a similarity to that of boiling water in the tea kettle. The calculation shows that the time reduces, and therefore the cost in proportion, to the reduction in the quantity of water. For instance, with one gallon of water and 1000 watts the time in minutes required to bring it to a boil is:—

With 1 gallon—

$$\text{Minutes} = 29.4 = \frac{146 \times 1 \times 172}{1000 \times .85} = 4 \text{ quarts}$$

With ½ gallon—

$$\text{Minutes} = 14.7 = \frac{146 \times ½ \times 172}{1000 \times .85} = 2 \text{ quarts}$$

With ¼ gallon—

$$\text{Minutes} = 7.35 = \frac{146 \times ¼ \times 172}{1000 \times .85} = 1 \text{ quart}$$

Even a quart of fluid is rather excessive for certain forms of cooking, but assuming it is not, it is evident that a kilowatt need only be used for 7 minutes to reach boiling point. After that point has been reached, a reduced heat will be all that is necessary. The same formula is used for pounds of water instead of gallons, but the coefficient 146 is reduced to 17.5, as for instance:—

(For pounds of water)—

$$\text{Minutes} = \frac{17.5 \times \text{pounds} \times (T - T)}{\text{watts} \times \text{per cent. efficiency}}$$

In a case of 10 pounds of water raised from 40° to 212° Fahr. and 1000 watts used, the time would be, with an .85 efficiency as before:—

$$\text{Time} = \frac{17.5 \times 10 \times 172}{1000 \times .85} = \frac{30100}{850} = 35 \text{ minutes}$$

With 5 pounds of water the time would be one-half or about 18 minutes. In summer the water is warmer when drawn from the faucet than in winter. The gain would be about 20° Fahr. in this respect. According to the last calculation, 1 pound of water would heat up in about 3.5 minutes with the application of 1000 watts. At the rate of 10 cents per kilowatt hour, it would cost about one-seventeenth of 10 cents or .6 cent per pound of the water boiled.

To get the watts required to heat a certain volume of water in a given time in minutes, the device having a certain efficiency, the following transposed form of the formula is required:—

$$\text{Watts} = \frac{146 \times \text{gals} \times (T - T}{\text{minutes} \times \text{per cent. efficiency}}$$

If we wish to heat two quarts of water and take ten minutes doing it, bringing it to the boiling point, the power required will be as follows, the "½" meaning two quarts or ½ gal.:—

The Character of Electric Cooking Permits of More Time for Social Activities.

$$\text{Power} = \frac{146 \times ½ \times (212° - 40°)}{10 \times .85} = \frac{12556}{850} = 1477 \text{ watts}$$

According to these figures it will take about 1.5 kilowatts for 10 minutes to heat ½ gal. or two quarts of water to the boiling point. At 10 cents per kilowatt hour, it will take 1½ kilowatts for 1/6 of an hour. This will mean 1/6 of 15 cents or 2.5 cents cost. As the efficiency of a heating device is really a measure of its non-radiative power, it is evident that the less the radiation, the less the wasted heat and the higher the efficiency. The higher the efficiency the less the cost in service. The radiation is dependent upon the construction and the surface of the electric heating utensil. The greater the surface, the greater the radiation; and the less the surface, the less the heat wasted. The facts are as follows:—

(a) For polished nickel or copper vessels the loss is 1 watt per 250 square inches per degree Fahr. rise.

(b) For tarnished copper, iron or dull surfaces the loss is 1 watt per 150 to 175 square inches per degree Fahr. rise.

ELECTRIC COOKING RANGES — The commercial fact to be ascertained is the cost of cooking by an electric range. In one which is well equipped, there is a separate switch for an 8-inch stove, a switch for a 6-inch stove, a switch for the oven, a switch used in changing from oven to broiler, another switch for a 6-inch stove and a final switch for a broiler and toaster. It is always economy to turn the heat on full until the stove or oven or broiler is hot. After the cooking begins the medium or low heat may be used to continue the operation, but it is not economy to use them at first. In electric ranges the best practice is to use vessels that lock on, as by this means the heat is not wasted as with ordinary utensils. Another practice is to have three degrees of heat governed by a controlling switch. This aids in the use of a heat suited to the cooking and is obviously otherwise economical. The cost, as given by one large manufacturer of electric ranges, is from 3 to 5 cents a day per person. In places where special rates are given to those installing cooking or heating devices, the cost would be less. It seems likely that with the more extensive use of electric ranges, central stations will give special rates for the reason that this would add to the day load, a time when the call is least for power for lighting. In the case of one particular range, from whose operation data is supplied as to the cost of cooking various meals, the total watt consumption, with every receptacle in use, is 3775 watts. The parts of the range and the individual watt consumption of each part is given, as well as the capacity of the vessels adapted to this particular type.

Electric Cooking Stands for the Minimum of Help in the Household.

		Costs.
(1)	Oven, 12 inches deep, 11.5 inches high inside, takes 1,300 watts at 10 cents per K.W. hour.....	.13
(2)	Broiler, 9 × 12 inches, with griddle top, takes 1,300 watts at 10 cents per K.W. hour.....	.13
(3)	Disc stove, 8 inches in diameter, takes 735 watts at 10 cents per K.W. hour	.073
(4)	Disc stove, 6 inches in diameter, takes 440 watts at 10 cents per K.W. hour	.044

In addition to these heating devices of the range proper, a 3 pint blazer, a 3 pint double broiler, a 5 quart vegetable boiler and a 4 quart tea kettle completed the equipment. A meal for six persons was cooked and a record kept of the time, kilowatts, cost and manner of handling the heat. The bill of fare included a breakfast, a dinner, a supper and a less expensive dinner. As an ocular demonstration of this kind means more than theoretical conclusions regarding the same, the menu and its electrical costs are given in full.

ELECTRICAL COST OF COOKING MEALS FOR SIX PERSONS—It is supposed that in the electric stove and devices used, heat insulation methods are employed. If water is evaporated into steam at atmospheric pressure, an extra allowance of 0.285 of a kilowatt hour per pound is necessary in calculations. It is also to be understood that the efficiency of heating varies from 50 per cent. with external heaters to 95 per cent. under the best conditions of internal immersed heaters. An average efficiency for polished nickel or copper vessels, covered, using immersion heaters, is about 85 per cent. With these conditions fulfilled, experiments have shown that the costs given in the table that follows may be relied upon as representing the power consumption for four meals.

The table appearing on the opposite page is of exceptional interest to everyone interested in electric cooking. It depicts in a concise manner just what may be done with electric current and at what cost. The table also states the type of electric heating utensil to employ for cooking the various kinds of food. Cost of cooking other food requiring approximately equal time may be estimated.

MEALS FOR SIX PERSONS COOKED ON AN ELECTRIC RANGE

Food.	Quantity.	Operation.	Utensil.	Use High Heat Before Cooking.	Use High Heat.	Use Medium Heat.	Use Low Heat.	Leave with Heat Off.	Total Time of Cooking.	Kilowatt-hours.	Cost of Cooking for 6 persons at 3c. per K.W. Hr.
				Run Heaters as Follows							
				Min.	Min.	Min.	Min.	Min.	Min.		Cents.
Breakfast.											
Oatmeal	1 cup meal	Steaming	Double boiler	20	—	25	—	5	30	0.26	¾
Broiled ham	1½ pounds	Broiling	Broiler	5	8	—	—	3	11	0.28	¾
Sauté potatoes	6 cold	Frying	8" pan	8	12	—	—	3	15	0.24	¾
Cream muffins	12 in pan	Baking	Oven	30	10	5	—	5	20	0.93	2¾
			Total								5
Dinner.											
Cream spinach soup	2 qts.	Boiling	6" blazer	—	47	18	—	—	65	0.43	1¼
Roast beef	4 pounds	Roasting	Oven	—	63	17	—	—	80	2.29	6¾
Cottage pudding	1 pan	Baking	Oven with beef	30	10	10	—	5	25	0.32	1
Mashed potatoes	2 pounds	Boiling	6" double boiler base	10	12	25	—	—	37	0.28	¾
Squash	3 pounds	Boiling	Veg. boiler	3	15	30	—	—	45	0.54	1¾
			Total								4½
Supper.											
Egg salad	6 eggs	Boiling	6" double boiler	—	10	—	15	—	25	.22	¾
Dressing	——	Boiling	6" double boiler	10	—	7	—	3	10	.22	¾
Raised biscuits	1 dozen	Baked	Oven	30	10	10	—	5	25	1.02	3
Layer cake	2 layers	Baked	Oven with biscuits	30	10	5	—	—	15	0.28	1
Stewed prunes	1 pound	Stewing	6" blazer	—	30	10	—	—	40	0.24	¾
			Total								5½
A Less Expensive Dinner.											
Lamb chops	10 chops	Broiled	Broiler	—	35	20	—	—	55	0.36	1
String beans	2 quarts	Boiled	6" double boiler	25	3	92	—	—	95	1.11	3¼
Steamed pudding	1 lb. 4 oz.	In mold	8" vegetable boiler	—	12	—	—	—	6	0.07	¼
Lyonnaise potatoes	6 cold	Fried	8" fry pan	6	10	—	—	3	13	0.35	1
			Total								5½

Average cost per day for each person at these rates, 2⅓ cents.

As these figures are taken from the records of one of the largest manufacturers of electric cooking devices in this country they are authentic on the basis given. The fact that an allowance of only 3 cents per kilowatt hour is given does not alter the relative costs of cooking different viands. It is evident that

practicality, cleanliness, celerity and results are all embodied in this system. Special rates for electric stoves would necessitate a special meter attached to them for this purpose. The widespread use of them in the East would mean a suitable change in their cost as well as an agreeable charge for current. Considering the labor saved, the actual cost of electric cooking is even lower than that given.

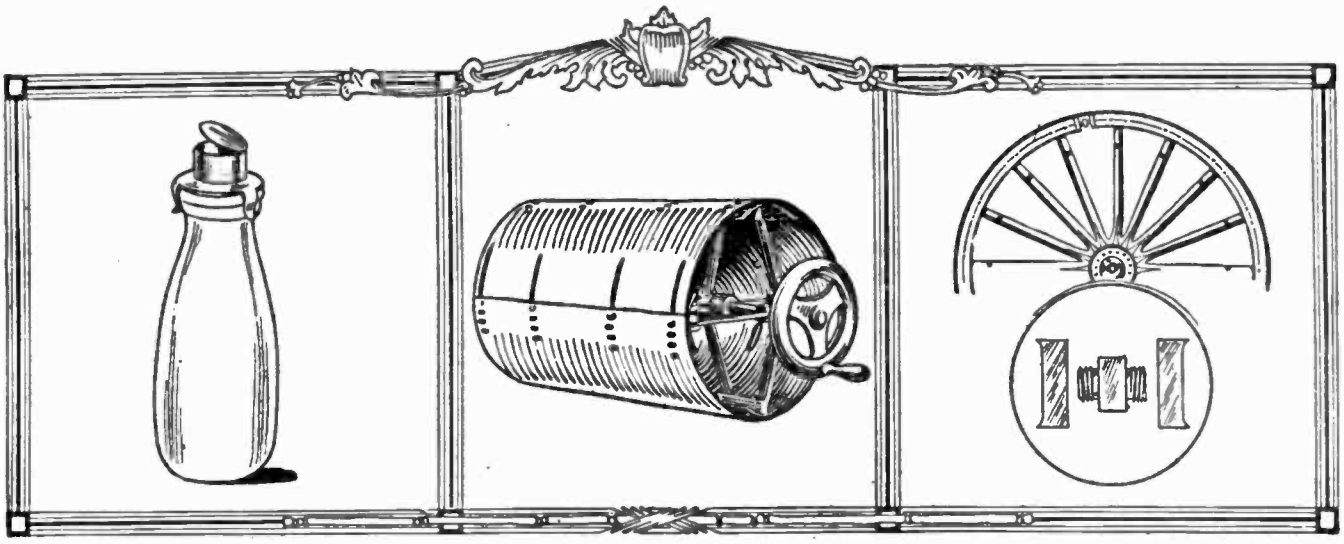
LUMINOUS AND AIR-HEATER RADIATORS—Luminous radiators simply consist of electric lamps of the incandescent type set into a metal frame of convenient shape. They are placed anywhere in the house or set into the fireplace. The wattages they consume vary from 500 to 750 to 1000. This type is employed because the light efficiency of incandescent lamps of the carbon filament type is less than 5 per cent. The rest of the electrical energy is transformed into heat. Consequently more than 95 per cent. of the power is utilized as required in this manner. Air-heater radiators on the other hand, of the general type in use in electric cars, divided up into 500-watt heating elements, two to six of which are used in each heater, range from 1000, 1500, 2000, 2500 to 3000 watts apiece. Car heating in winter costs about 2.25 cents per hour or 40.5 cents per car day of 18 hours. It has been stated that tests of Boston cars of two doors, 12 windows, and 850 cubic feet of space can be raised 25 degrees Fahr. in severe weather with an expenditure of 2.5 kilowatts. On this basis, room warming by electricity, would not represent so severe a test. According to Houston and Kennelly, in the case of the Vaudeville Theatre, in London, England, about 16 heaters are employed; four large portable ones with attachments at the center and sides, and twelve around the walls. The energy consumption is 300 watts for the smaller, and 1200 watts for the larger of the heaters, about 11.4 kilowatts in total. The temperature of the auditorium is raised 20° Fahr. by them. The price charged is 8 cents per kilowatt hour, the cost of heating 72 cents per hour, and to warm the theatre for 4 hours, it costs $2.88. From these figures, it is evident that with twice as many heaters, and a 3-cent per kilowatt hour rate, the cost would be less.

In those cases where labor is employed to operate machinery, it is necessary to subtract this cost from that of the electric power consumed, if by the introduction of that power the labor is not needed. In the case of electric heaters as that of gas heaters, labor is at a minimum. No attendance is required, there is no coal stove, no dirt or ashes. In the gas stove the air is vitiated and the danger of asphyxiation is ever present. The electric heater obviates all these risks, and, therefore, by the ordinary laws of progress is destined to supplant its predecessors. By the same inevitable logic, the electric range will create a revolution in the domestic sphere of the feminine world. It is a perfect instrument and of ideal construction. By its means, labor is reduced and comfort increased so greatly that, unless women value their labor very lightly, the electric range is by far the cheapest addition to the home.

ELECTRIC POWER PLANT IN PALESTINE

Even in Palestine, where living is almost as primitive now as a thousand years ago, electricity has been introduced. There is now one electric plant belonging to the agricultural colony Rishon-LeZion, where the famous carmel wine is made. The colony was founded some thirty years ago by penniless refugees from Russia.

The Rishon-LeZion colony is now equipped with the most modern machinery for the making of wine. Most of the machinery, as well as the illumination of the colony, depends on electric current from a power plant situated within the colony and said to be the only one in the Holy Land.



Sanitary Milk Bottle Cover. Collapsible Concrete Form. Steel Tire Tightener.

RECENT AND IMPROVED DEVICES

Sanitary Milk Bottle Cover

The serious menace of unsanitary milk containers has long been recognized, and of late years many steps have been taken to prevent the inoculation of milk with typhoid germs through the introduction of various devices to close the milk containers. The paper disc cover was one of the first destined to come into widespread use, and so far as it goes, this cover admirably fulfills its purpose. There is still danger of contamination, however, after the milk bottle has been opened in the home; a fly, for instance, may enter the neck of the bottle and leave enough typhoid bacteria to cause an epidemic in the family.

To further safeguard the users of milk, the device shown in the illustration has been put on the market. It consists of a combined bottle-opener, cover and pouring spout. The point of one of the spring prongs is sharpened in order that it may be inserted through the paper bottle cover, thus making it a simple matter to remove the latter. The metal prongs are then pressed down over the neck of the bottle which is immediately provided with a tightly fitting cover with a hinged lid.

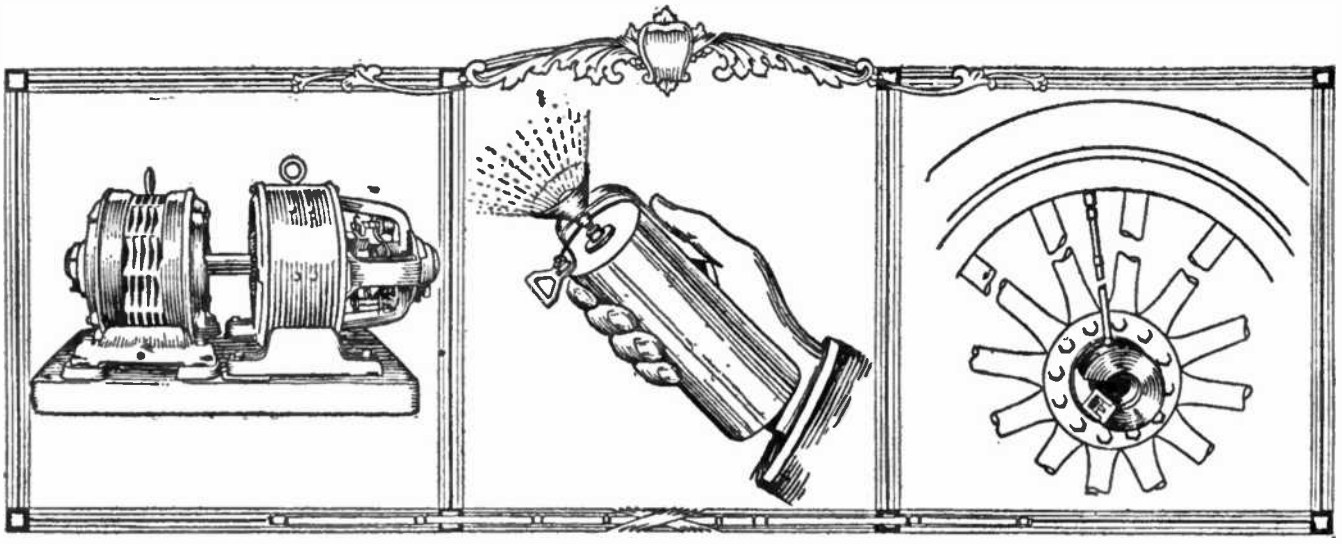
If you enjoy this magazine, tell others; if not, tell us.

Collapsible Concrete Form

A collapsible mold adapted to be used as a form in the construction of concrete culverts is now being prepared for the trade. The device is made of four pieces of sheet steel so curved that when joined at the sides an affair of cylindrical shape is formed. Running horizontally through the cylinder is a piece of pipe into which is screwed a suitable rod having a hand-wheel at the other end. To the pipe and to the rod are fastened respectively four sets and one set of arms. With a forward turning of the hand-wheel, the rod is screwed further into the pipe, which causes all of the arms to spread apart and press against the sides of the form, increasing its diameter. A reverse turning of the wheel draws the arms together and lessens the diameter of the mold. In construction work the form is embedded in a mass of soft concrete, which, when sufficiently "set," permits of the backward turning of the wheel, decreasing the diameter of the mold and making possible its easy withdrawal from the structure.

Steel Tire Tightener

To be able to fit a steel tire tightly to a wooden wagon wheel without shrinking and perhaps dishing the wheel, has long been the aim of wagon builders, but this



Generator for Picture Arcs. Dry Battery Lamp Attachment. Auto Tire Inflator.

feat has not been easy of accomplishment in the past. Now along comes an inventor with a most ingenious and practical tightener to be inserted in the wheel in place of a small section of wooden felly, which is removed with a handsaw where two sections of felly unite. The tightener consists of three pieces, as shown in the illustration; two blocks similar to square nuts, with the edges burred over to grip the felly, and a central piece having a threaded projection on either side to engage the holes in the nuts. As one projection bears a left hand and the other a right hand thread, it is obvious that by turning the central piece the nuts will be spread apart, thus serving to tighten the wheel against the inside of the tire.

Generator for Motion Picture Arcs

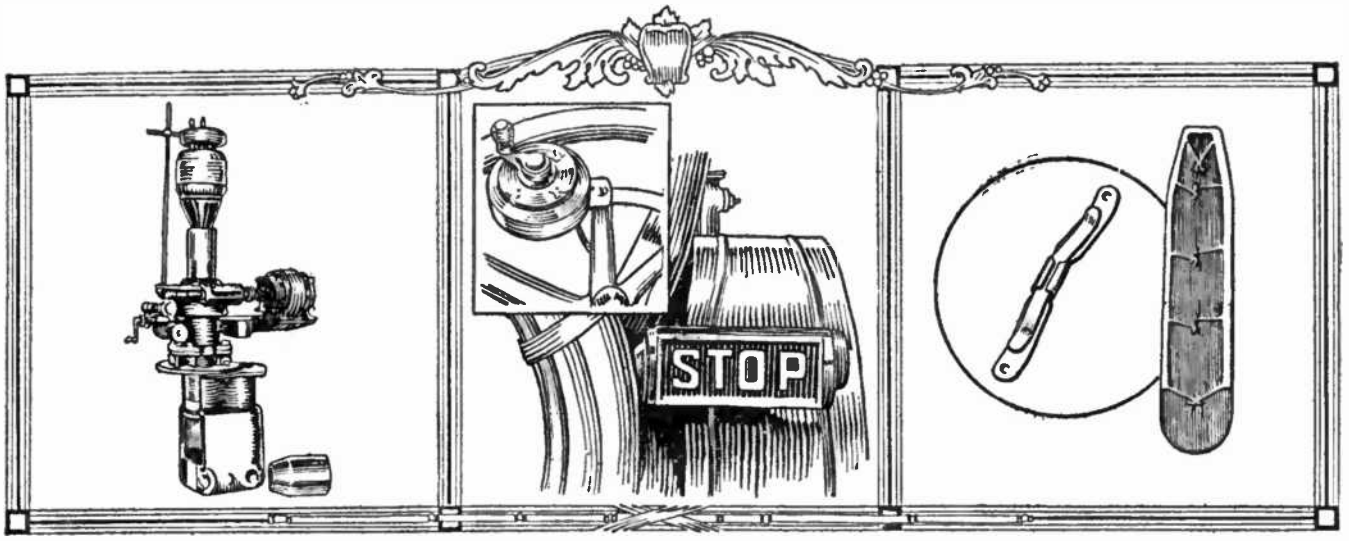
The motion picture operator who has had experience with both alternating and direct currents in connection with his projection arc lamp will be quick to express an opinion that the former type of current is an unmitigated nuisance; the alternating current arc emits a nerve-racking buzz and it seems to have a fiendish tendency to travel around to the rear of the carbons and away from the condensing lens which transmits the brilliant rays to the projector. The direct current arc, on the other hand, is perfectly quiet and a marvel of steadiness providing the carbons are fed at proper intervals. Furthermore, the direct current arc delivers at least fifty per cent. more useful light to the condenser than does the alternating current with an equal reading of the ammeter.

The increasing prevalence of alternating current illuminating systems of late years has made it difficult for motion picture theatres to obtain direct current for the arc lamps without the use of costly and sometimes unreliable generating plants. To meet the naturally large demand for a means of direct current supply, the motor-generator set shown in the illustration has been introduced.

Dry Battery Lamp Attachment

Another lamp attachment for the standard dry battery! Seemingly there is no end to them. The writer of these columns has selected one after the other, each having some advantage in point of cheapness, simplicity or general utility over the others, and still they come.

Simplicity is certainly the greatest claim of the attachment illustrated on this page. The device is a stamping of sheet metal to which is attached the reflector and miniature socket. In the end of the stamping is a hole which permits the attachment to be hung on a hook or,



Portable Cylinder Grinder. Auto Traffic Signal. Ironing Board Cover

if desired, the battery may be laid on its side when the attachment prevents rolling. The circuit is made by pressing the extension of the stamping with the thumb, thus bringing the central terminal of the lamp base into contact with the carbon terminal of the battery.

Auto Tire Inflator

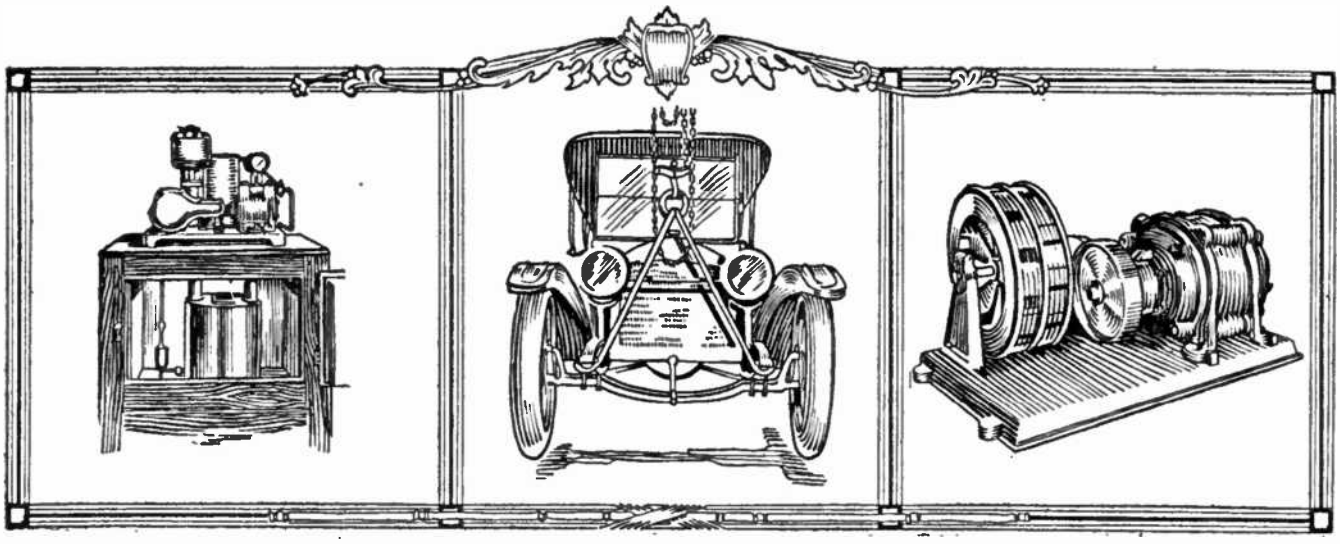
No longer is it necessary for the autoist to stop his machine along the hot and dusty road to pump up his tires—an annoying job at best even though a motor pump of some kind be used. The device illustrated herewith provides a continuous connection between the tire and a motor-driven pump attached to the chassis of the car. It is thus possible to inflate the tires even while the car is running and without having to do more than start the pump. The ingenious feature of the device is found in the rotary joint at the hub of the wheel by means of which the air is delivered to the moving wheel.

Portable Cylinder Grinder

After an internal combustion engine has been operated under full load for a long time, the bore of the cylinder tends to take an elliptical shape; the increased friction of the piston against the wall of the cylinder at every working stroke being responsible for this condition. Heretofore the remedies for this condition have all been expensive and have necessitated a considerable delay. The option has been to buy new cylinders, pistons and rings; to have some machine shop bore out the cylinders in a lathe—at best an expensive and uncertain job; to use adjustable reamers which seldom work with any degree of accuracy; and, fourth, to return the cylinders to the motor factory to be ground out on the elaborate machines used in the original manufacture. The latter method is recognized as the right one, but it entails the expense and delay of shipment to the distant factory and return.

The need for a portable grinder that could be installed in the up-to-date garage repair shop has been recognized for some time, and the want appears to have been filled by the machine illustrated on this page. This device is so designed that it may be applied to any motor cylinder regardless of its size, and, at a remarkably low operating cost, grind out the cylinder quickly and accurately. The machine is operated by two small electric motors which may be driven by current taken from a lamp socket. The grinder should prove a boon to the autoist through the agency of the garage man, who will have a new and profitable field opened up before him in the event that he installs one of the machines.

The latest model touring cars have electric lamps for illuminating the tonneau; these being set flush in the back of the front seats.



Ice Machine for the Home. Automobile Jack. Motor-Driven Alarm Siren.

Auto Traffic Signal

No longer is it necessary to hold out the hand as a crude and frequently misleading signal to the man behind when driving the car. With the rapid development of automobile accessories of all kinds it was inevitable that a device should be produced to render unnecessary this dangerously ambiguous form of signaling. The device illustrated herewith appears to fill the bill in every particular, affording, as it does, an effective means of showing the driver in the rear whether the machine is to stop or turn to the right or left.

The control is electrical and a small controller on the steering wheel of the car serves to operate the signal. The signal is plainly to be seen by either day or night. At night the signal remains dark on blank, but is automatically illuminated on "stop," "right," or "left." The operator is immediately notified of the operation of the signal by a small bell attached to the signal case, as well as the signal flashed to drivers in the rear.

Ironing Board Cover and Clamps

A simple device recently introduced on the market renders it unnecessary to sew, pin or tack the cover to the ironing board as in the yesterdays. The complete device consists of a properly cut and hemmed cover, fitted with tapes for attachment, and a set of five cleats which are attached to the under side of the ironing board. In use the cover is held to the board by drawing up the tapes and securing them to the cleats as the illustration shows. The convenience of the arrangement, to say nothing of the advantage of being able to draw the covering taut in a few seconds' time, should commend it to every housewife.

Ice Machine for the Home

The demand for modern conveniences in the home has been met with sanitary plumbing, electric lighting and heating, the vacuum cleaner, electric washer, and other time and labor-saving devices. Automatic machinery of every description has been perfected as a means of adding comfort and security to the home, all of which has done much to emancipate the housewife from the former drudgery. But with all of this progress, one of the most vitally important of all of the household appliances appears to have been somewhat neglected up to the present time—the refrigerating system. It is true that ice boxes have been vastly improved in recent years and much has been done to prevent the inevitable dampness of the ice box from exerting its deteriorating influence upon the foodstuffs in the refrigerator. Present-day knowledge, however, tells us that ice refrigeration is wrong in principle as compared

with the more up-to-date system in which a low temperature is produced by other means.

The appearance on the market of a refrigerating machine designed expressly for use in the home, and combining every desired feature of simplicity, low cost, and safety, is therefore of great interest in the field of new devices. Unlike most other machines of this nature, this outfit does not employ ammonia, sulphur-dioxide, or carbon-dioxide as its freezing agent. While the precise nature of the agent used is not disclosed by the manufacturer, still it is said to have some remarkable properties, among which may be noted a freedom from dangerous and unpleasant fumes. A further feature of safety is found in the comparatively low pressure employed in the machine—from sixteen to twenty pounds.

The machine is quite automatic in its operation, which is controlled by a thermostat, while the motive power is supplied preferably by an electric motor, unless another source of power is at hand and is more convenient under the circumstances.

Automobile Jack

When the garageman wishes to remove the wheels, springs or axles from a car, he usually has an uncertain, and, to say the least, annoying task before him. The conventional form of jack placed beneath the edge of the car body at four points will do the trick, but these jacks at times have a most provoking tendency to slip sidewise, frequently resulting in a loss of time and temper, to say nothing of possible damage to the car if it is let fall to the floor when, perhaps, two or more wheels have been removed. The device shown in the illustration is designed to do the work of the jacks quickly and with a maximum of safety. It consists merely of a pair of iron rods with hooks in their ends and joined to the end of a chain which is part of a block and fall, with automatic check, attached to the ceiling of the garage. One of the contrivances at the back and one at the front of the car will enable the workman to lift the car bodily from the floor.

Motor-Driven Alarm Siren

The value of the siren as a fire alarm signal has long been recognized, but the failure of a number of these devices at the crucial moment, due to a lack of sufficient air pressure at the time, has resulted in their having acquired a reputation for unreliability. To prevent the possibility of such failures and still to retain the desirable alarm-sounding qualities of this form of whistle, a motor-driven siren has been placed upon the market. It is so arranged that by opening and closing the motor switch at short intervals the pitch of the emitted note can be quickly changed and the true siren effect produced. The device is admirably adapted to use in plants where steam has previously been the motive power, but where electricity has superseded the steam.

The alarm should prove excellent for small towns having volunteer fire departments where it is necessary to give a general alarm whenever a fire breaks out. By placing the siren on top of a building not far from the local telephone exchange, the control switch for the alarm may be placed within reach of the telephone operator, who can immediately start the siren in operation when an alarm is given by telephone. Other switches at convenient points in the town would expedite the sounding of the alarm. This ease of remote control is an important feature of the device.

Motion Pictures Are Used to Record Plant's Growth.

An apparatus invented by Professor W. C. Stevens and L. M. Peace, of Kansas University, is being used to take motion pictures of growing plants. The rate at which the pictures are taken is varied with the growth of the plant, some plants growing more rapidly than others, and many plants growing faster at certain stages of their development than at other periods of their life. Moving pictures are thus being used in still another educational field — incidentally proving a source of amusement as well as instruction.

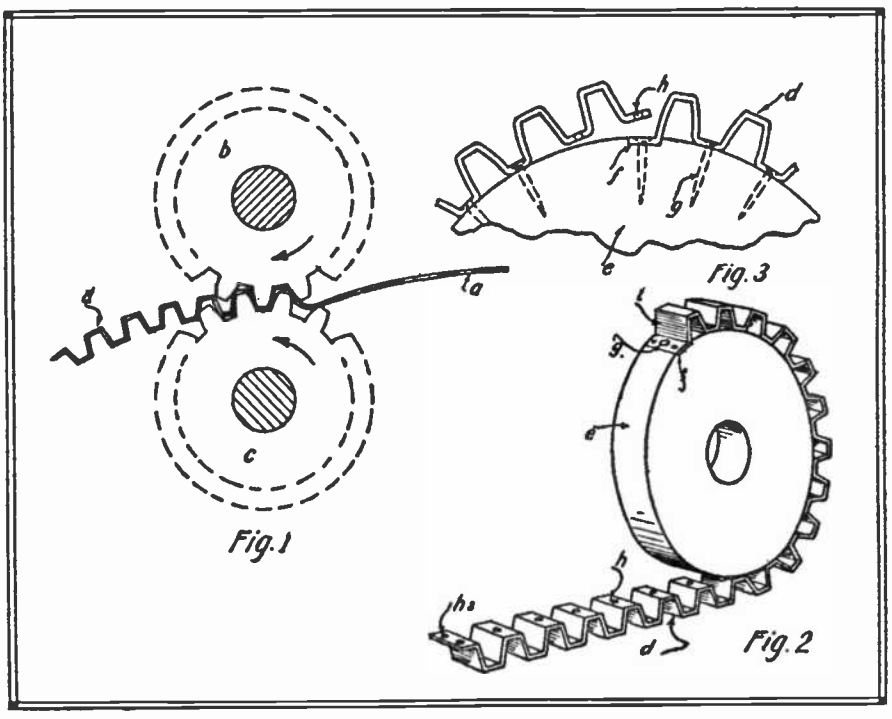
Gears for Models and Toys

As a solution to the problem of making gears for wooden models of inventions, toys or light experimental work, the following description of the accompanying sketches is a very simple and efficient way out of the difficulty. And this construction will be found superior to the plain, circular wooden discs—which many inventors use and in which they depend upon friction—as it insures a positive movement and will transmit considerable power.

Cut tin or other thin metal into strips *a* equal to the width of the gear desired and run it between any gears *b* and *c* with small teeth, found on some convenient machine, thus forming the teeth as shown at *d*. Then turn up the wooden disc *e* to a diameter equal to the tooth-bottom diameter of the gear to be made, less twice the thickness of the metal used. Make the holes *h* with a small brad before attaching the teeth to the disc. Next make the recess *f* in the disc equal in depth to one thickness of the metal; this is necessary because when attaching the final end the lap would otherwise interfere with tooth clearance. The side *i* of the first tooth should be lengthened slightly before attaching to allow for the recess *f*. Use small flat head brads *g* between each tooth.

Contributed by

R. N. VANBUSKIRK.

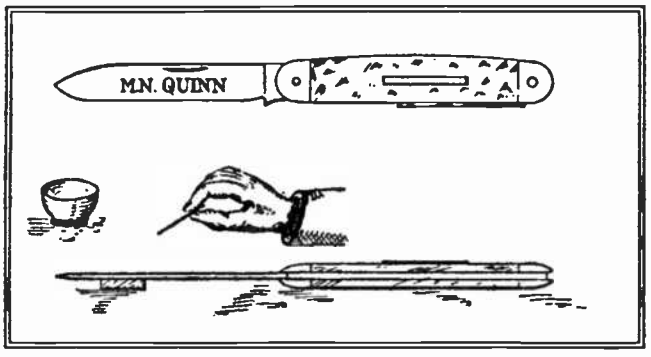


Etching a Knife Blade

The blade of a knife or other tool may be marked with the owner's name by means of a simple etching process which may be carried out in the following manner: Prepare the blade by cleaning thoroughly, making sure that it is free from grease, and then cover both sides thoroughly with asphaltum paint or varnish. After this has dried for eight or ten hours, take a metallic instrument having a sharp point and scratch the name or other marking through the asphaltum and down to the blade just as you wish it to appear when finished. Apply a second coat of asphaltum around the edges of the lettering, but be careful not to let it cover any of the scratched places. Allow the second coat to dry thoroughly and you are ready for the etching.

To prepare the fluid, mix one part of nitric acid with two parts of

water in a small glass or cup, taking care to add the acid to the water and not the reverse. Lay the knife down with the



blade supported in as nearly a level position as possible with the lettered side up. With a straw or toothpick, transfer to the blade a few drops of the acid—just enough to cover the scratched portions of the blade. As the acid bubbles away, add a few drops more. Examine the etching occasionally, and when sufficient depth has been gained, rinse off the acid and remove the asphaltum with a rag wet with turpentine. The blade should then be thoroughly washed with soap and hot water. The letters will show very distinctly, and once placed, they cannot be removed except by very deep grinding.

Contributed by

MANLY N. QUINN.

Refinishing Old Floors

A soft wood floor, such as Georgia pine, which has become rough and blackened from hard use and little care, can be refinished and made as good as new. The work does not require professional skill, but can be done by any able-bodied man at a slight expense and with a moderate amount of labor.

The first operation is to plane off the rough, blackened surface till the clear grained wood beneath appears. The final finishing cut should leave the surface clean, bright, smooth and level, which is accomplished by setting the blade to take a thin shaving. The baseboard moulding should be removed to secure the best results. The corners and strips along the walls which cannot be reached with the plane can be cleaned off with a cape chisel and with a scraping tool made by grinding a plane blade at a rather blunt angle. A small hand emery wheel which can be clamped to the window sill is essential, as every tool must be kept very sharp to do good work and to reduce the amount of labor.

The second operation is to sandpaper the floor until there are no plane marks left, using a coarse grade first and fine at the last.

The third operation consists in spreading on a coat of white shellac evenly, using a full stock brush about three inches wide. It is important to select a full stock brush with the bristles set in tight, so that none will pull out while in use. When the shellac is dry, polish with fine sand paper and then apply another coat. Use wood alcohol for thinning if required. When the last coat of shellac is dry apply a coat of floor wax with a soft white rag, which leaves the floor ready for use.

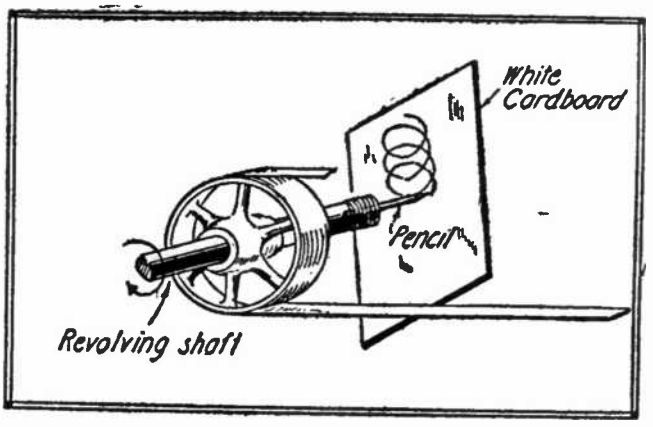
Finished in the manner described, the floor compares favorably with hardwood and in appearance it is infinitely better than the mere painting which is so common for pine floors.

Contributed by

BENJ. B. JACKSON.

Makeshift Speed Indicator

A simple method of determining the number of revolutions per minute of a shaft is to tie a pencil to the surface of



the shaft and when the latter is revolving, to pass a piece of stiff cardboard at right angles to the pencil for a fraction

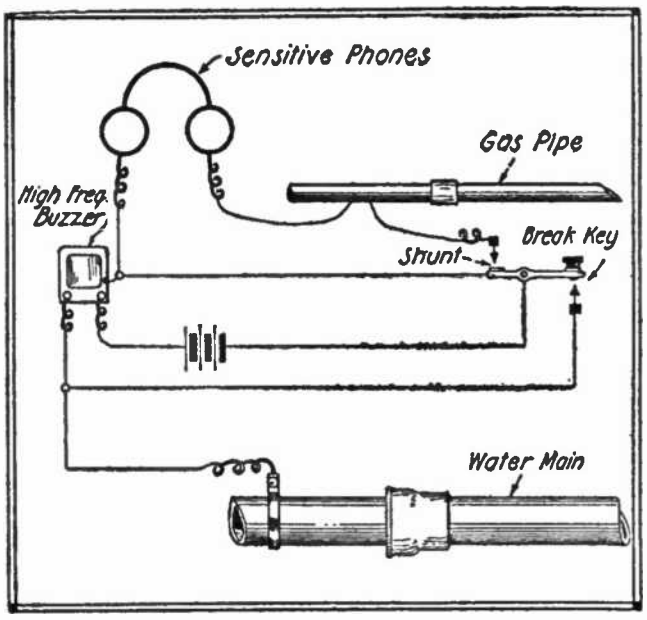
of a minute, letting the point of the pencil describe a series of circles on the cardboard. By timing the period for which the card is held to the pencil and then by counting the number of convolutions appearing on the card, the user will be able to tell immediately the number of revolutions per minute of the revolving shaft

Contributed by

JAMES MCINTYRE.

Pipe Line Telegraphy

It is sometimes possible to employ the gas and water pipes in lieu of a regular wire telegraph line in cases where the latter is impracticable. The circuit shown



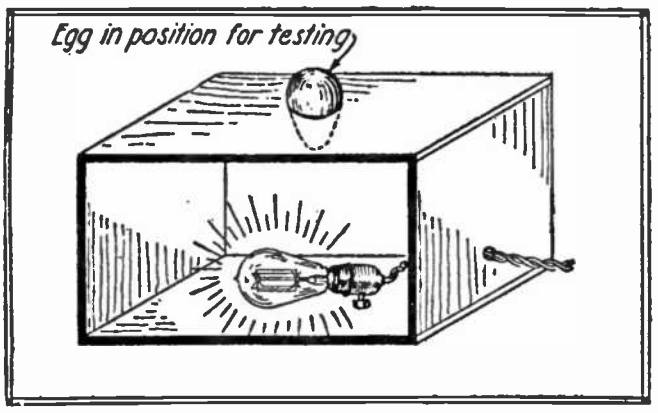
in the accompanying illustration will usually work over a distance of a block or two. The diagram shows a "break in" system in use, but this is, of course, not essential to the operation of the sets. The usual circuit can be employed as well, the gas pipe being used as the overhead wire and the water pipe as the ground.

Contributed by

IRVING FARWELL.

Electric Egg Tester

The simple device shown in the accompanying illustration will enable one to determine instantly whether or not an egg is fresh, or, indeed, its actual degree of decay in the event that it is



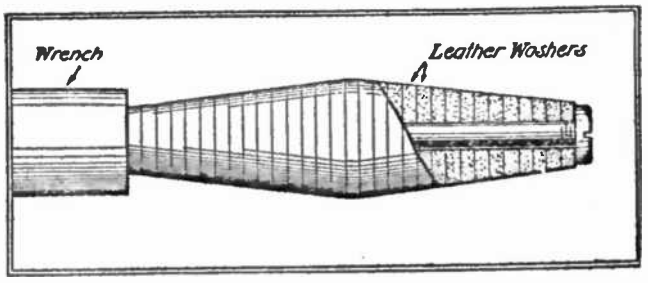
not strictly fresh. The tester comprises a small wooden box in which is mounted an incandescent lamp. In the cover of the box is a hole of a size that will permit the egg to rest in it without passing through. The tester is used either in a darkened room or with a cloth thrown over the user's head to exclude extraneous light. A strictly fresh egg will appear as a clear pink glow, while a partly decayed egg will show a dark blotch in it. After a little experience has been gained by comparisons, the user will be able to tell to a nicety just the condition of any egg placed in the tester.

Contributed by

STANLEY RADCLIFFE.

Everlasting Wrench Handle

A wrench handle of great durability and one that at the same time affords a splendid grip, can be made by slipping a series of leather washers of gradually increasing and decreasing diameter over the steel stud which passes through the wrench handle. The washers may be cut roughly to size from a strip of leather belting, punched with the correct size of hole and assembled on the stud before being cut to the finished size. A coarse rasp and a sharp knife will enable the worker quickly to shape up the handle as desired. If the washers are assembled



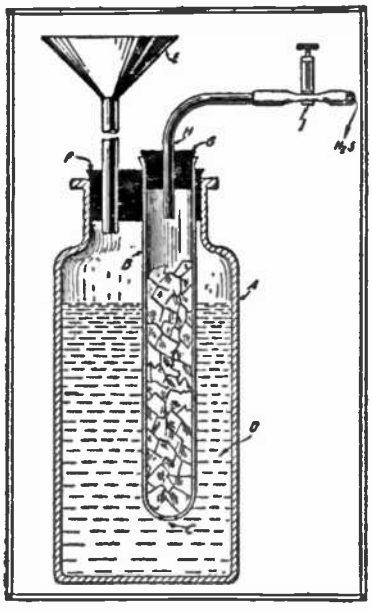
with glue before being drawn up with the nut at the end of the stud, the handle will be far more substantial.

Contributed by

HARRY J. MURPHY.

A Simple Hydrogen Sulphide Generator

In the accompanying illustration is shown a suggestion for a simple H_2S generator of great practical value in the laboratory. The generator may be described as follows: *A* is a bottle of about ½ liter capacity, *B* a six-inch test tube with a hole *C* punctured in the bottom by means of a blow pipe, *D* is the acid solution, *E* is a thistle or funnel to permit of influx or efflux of air, *F* and *G* are rubber stoppers suitably bored to receive their respective inserts, and *H* is a bent delivery tube, while *I* is a pinch-cock.



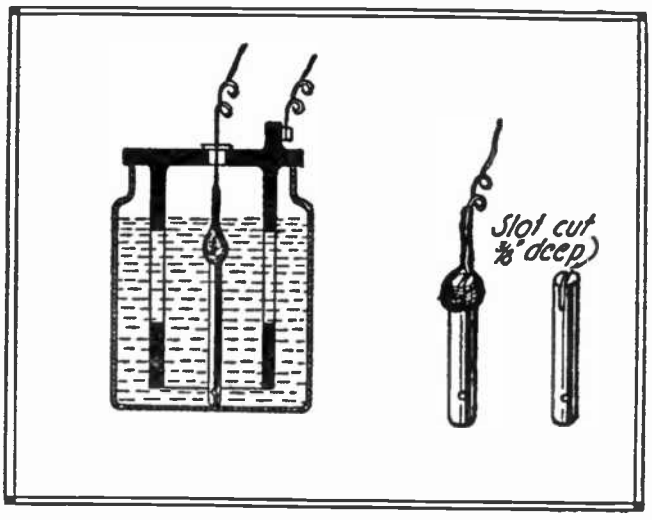
When the pinch-cock is opened the weight of the acid solution pushes part of it up and into the test tube. The acid then reacts with the iron sulphide in the tube and H_2S is evolved. If, then, the pinch-cock be closed, a pressure due to the gas is formed which pushes the acid solution out of the tube. The excess of the gas bubbles up through the acid and out through *E*.

Contributed by

FRANCIS B. COYLE.

A Method of Economizing on Battery Zincs

The contributor was recently confronted with the problem of securing continued service from a carbon cylinder battery after the zinc has been practically exhausted and at a time when it was not possible to procure new zincs without some delay. The desired result



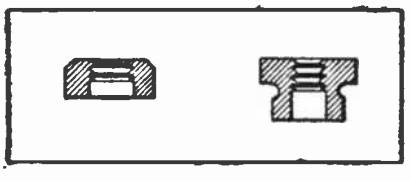
was obtained by cutting off the eaten portion of the old zinc, securing a length of insulated copper wire to the zinc, coating the union with a liberal amount of wax to prevent local action between zinc and copper wire, and finally immersing the zinc by suspending it from the wire. This plan permits of the use of the very last inch of zinc and it proved to be a very practical solution of the difficulty.

Contributed by

EDWARD M. DAVIS.

Self-Starting Nuts

A nut may be made to catch its thread quickly and easily by counterboring the under side with a hole as large as the clearance size of the screw. When such a nut is placed on the screw, the counterbored portion holds it in the proper position to catch the thread without difficulty.



If a nut, such as a knurl on a binding post, is to be removed from its screw frequently, the counterboring should be continued until there are but two full threads left. The nut may then be instantly removed and replaced.

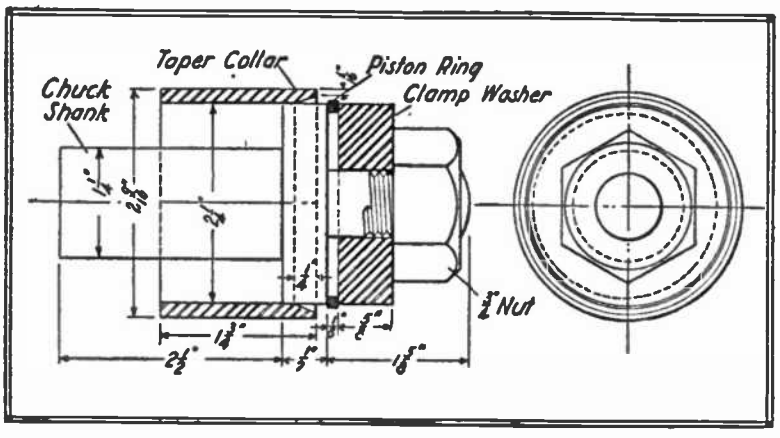
Contributed by

CLARENCE H. ANDERSON.

AIR VALVE PISTON RING CENTERING DEVICE

By W. G. Astle

Piston rings for the air valves of locomotive air compressors are made slightly eccentric and cut on the thin side to give the requisite spring to cause them to form a good, tight joint. The piston rings are made from a long ring, from which a large number may be cut. The outside of the stock sleeve is turned to a diameter larger than that finally required, and then the sleeve is offset the required amount, the inside being bored to a correspondingly larger diameter than that of the final inside diameter of the piston ring. The stock sleeve is then cut to form rings of the necessary thickness. These rings are slotted at an angle of 45 degress to form the spring allowance, and sprung together at that point. In springing the rings together, the varying radial thickness of the rings causes them, when compressed, to assume a final shape that is not a true circle, so that it is essential to take a light, final cut over the outer face in order that they will form a true fit inside the cylinder.



The object of the device shown herewith is to chuck the work so that this final truing-up may be quickly accomplished. The device consists of a main body, with a shank at one end for chucking in the lathe, and a threaded shank at the other end, over which a washer for clamping is slipped and secured in position by a ¾ inch nut. Over the main body of the device there is a closely fitting collar, the inner bore of which at the clamp washer end is tapered.

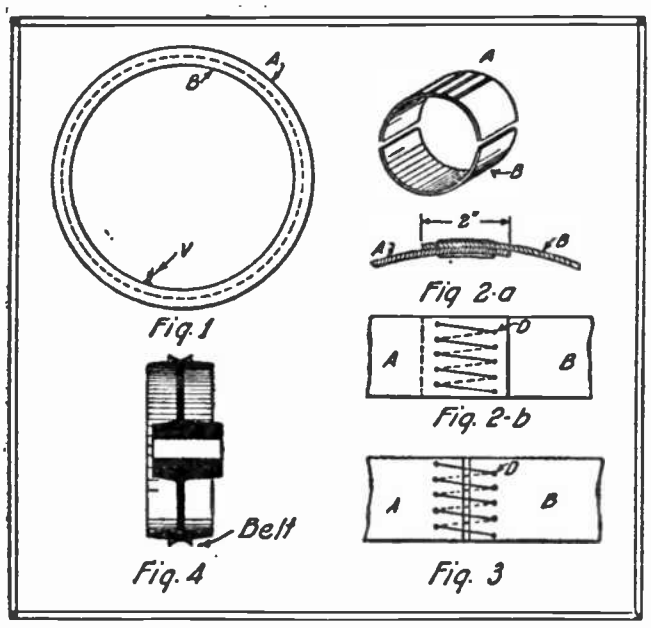
The operation is simple. The ring to be finished is placed between the main body and the clamp washer, which is loosely fitted up to the ring. Over the body the taper collar is slipped and forced over the piston ring, compressing the latter and at the same time centering it with regard to its outside diameter. When compressed to the limit the clamping nut is tightened, and the taper collar slipped off from the main body which is then chucked in the lathe by the chuck shank, and the outside of the ring trimmed down to a true circle. This tool was devised by a machinist in the shops of the Timiskaming and Northern Ontario Railway. Particularly rapid work can be accomplished with the device, and it will produce a ring that has not the same tendency to leak as an ordinary ring that has not been re-turned will have.

It is quite possible that this tool can be applied to other purposes.

Belt from Bicycle Tire

The tread of a bicycle tire, *A*, Fig. 1, makes an excellent belt for use on crowned pulleys. The tire is to be cut through the center as shown in Fig. 2a and if the length is correct, the belt needs no splicing. Should a splice be necessary in order to fit the belt to a certain machine and its driver, the joint may be made either as shown in Fig. 2b or as shown in Fig. 3. The latter is preferable if well done. Fig. 4 shows how the belt rests on the pulley.

The inside of the tire, *B*, of course, cannot be used in one continuous piece owing to the presence of the valve and



the weakness of the tire at that place if the valve stem is removed.

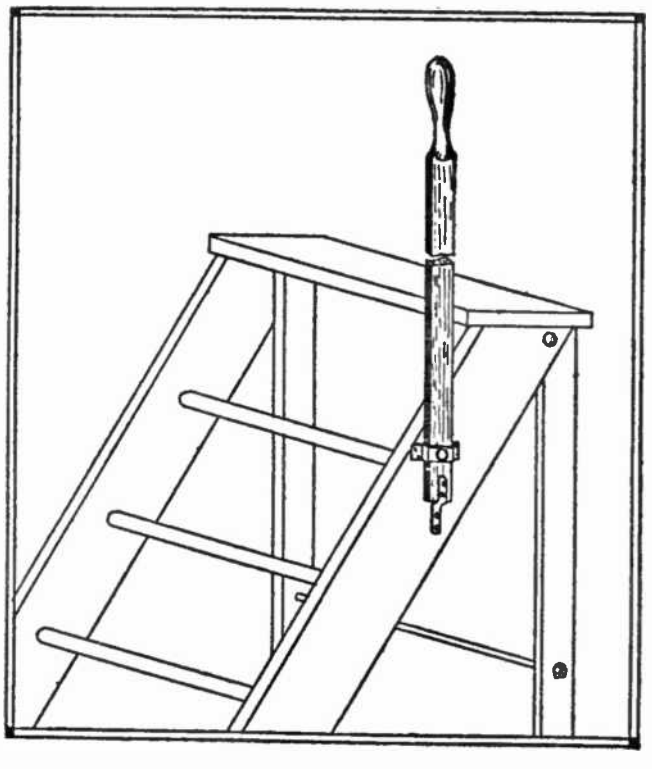
The belt should always be removed from the pulleys if the machine is to stand idle for any length of time in order that stretching may be avoided.

Contributed by

F. M. D.

Handle for Stepladder

When standing on the top step of a stepladder it is at times difficult to maintain one's equilibrium and the device shown in the illustration is intended as an aid to those who have frequently to make use of a ladder in this fashion. The device is merely a removable handle projecting upward for a few feet in order that the user may have a balancing grip upon which to hold when standing on the top step.

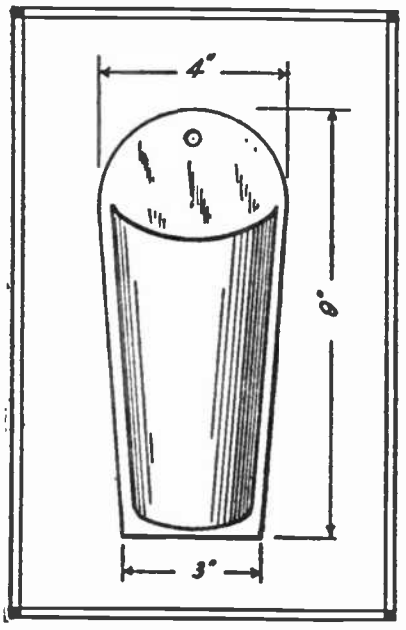


Contributed by

JACOB LIEBMAN.

Cotton Waste Holder

In a manufacturing plant of the middle west, the question of handling and preserving cotton waste has received much consideration. The waste reaches quite an amount in the average large shop, particularly if a good grade is used. For this reason as well as from the standpoint of a fire risk, the provision of a suitable receptacle at every machine and work-bench is quite justified.



The holder shown in the illustration is readily made in small quantities and, in the above-mentioned plant, its design has proven of great value. The holder consists of three pieces of tin cut to the shape and size indicated and soldered together.

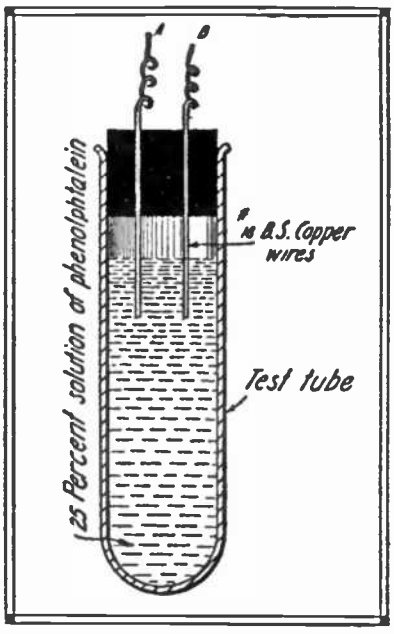
Contributed by

P. W. BLAIR.

Polarity Indicator

In the illustration is shown a simple polarity indicator which may be made by any electrical workman at a cost of a few cents. A 5/8-inch test tube is filled with a 25 per cent. solution of "phenolphtalein"

which may be obtained from any chemical house. The cork of the tube is fitted with two pieces of No. 18 copper wire and sealed in place with sealing wax; the ends of the wires projecting down into the liquid for a fraction of an inch. To use the instrument, the poles of the circuit are connected with the wires leading to the indicator and immediately a red coloration forms around that terminal, which is the positive. On removing the current and shaking the tube, the coloration disappears and the indicator is ready to be used again.

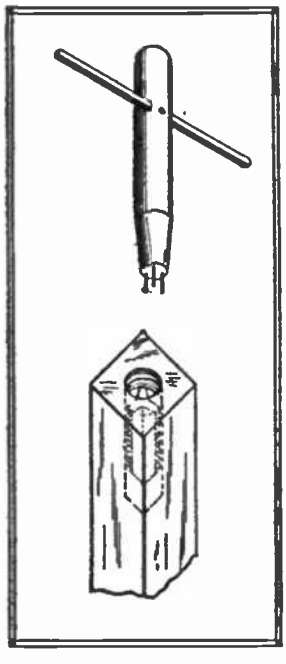


Contributed by

SAMUEL COHEN.

To Remove Broken Tap

The contributor has found the device shown in the illustration to be of great value when a tap has been broken off inside a valuable piece of work. The device consists essentially of a short length of cold rolled steel rod into the end of which are inserted three short pieces of steel needle or stiff steel wire. A handle facilitates turning the implement. Obviously the pieces of needle are so disposed that they will fit in the grooves of the broken tap in order that the latter may be removed by applying the instrument and turning backward very carefully. Should the tap be broken off in slate or some soft metal the support for the three pins may be of hard wood, in which case it is a simple matter to make the device at a moment's notice.

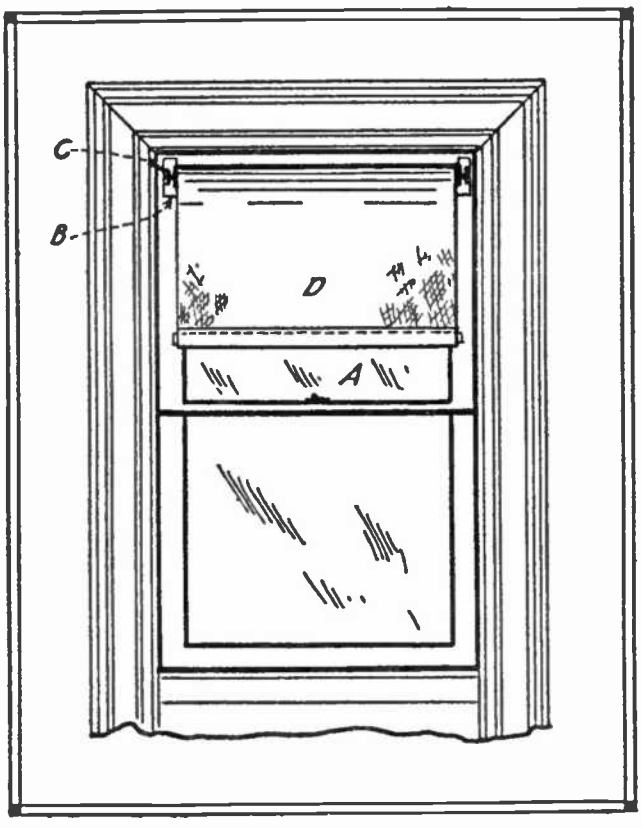


Contributed by

V. BAZIRJIAN.

A New Method of Hanging a Shade

In the illustration may be seen a novel suggestion for hanging a window shade.



Blocks of wood, *B*, 2½ inches long, one inch wide and 1½ inches thick are secured to the top of the frame of the upper sash on either side. On these blocks, the shade brackets are secured. The shade should be of a width that will fully cover the window glass, yet fit inside of the window casings.

The top window may be pulled down and the shade will come with it, permitting a free passage for the air and at the same time preventing the unpleasant flapping that is so disastrous to a shade.

Contributed by

T. D. TRICKEY.

MAKING A WOODEN CHECKER BOARD

By Alfred R. Wagstaff

The following article describes the making of a checker board which, when completed, contains 82 pieces of wood and is a beautiful piece of furniture.

The best effect may be procured by using bird's-eye maple for the light squares, and mahogany for the dark squares and outside strips, although the board can be made of light and dark gumwood and trimmed with black walnut.

The first step in the making of this checker board is to make the squares, eight strips of wood being required, four dark and four light. These should be planed and squared so as to measure ⅞ inch thick and 1½ inches wide and about 12¼ inches long. Glue them together as shown in Fig. 3, making sure to get them level.

While these are drying, the bottom can be made so that no time may be lost. Secure six pieces of ½-inch pine about 18¼ inches long and cut these 3 inches wide. Glue and clamp them securely so that they will not buckle. Now return to the checker squares and mark them off as shown by the dotted lines in Fig. 2. Saw along these lines and plane the edges so as to fit together. Then glue them together as shown in Fig. 3, turning alternate strips end for end.

When this is dry, smooth off one side and mark it X. Take the bottom and smooth off one side and fit the side of the checker square marked X. Glue this square exactly in the middle and clamp securely.

The next step is to make the veneer strips. These are cut ⅛ inch thick, 3 inches wide and about 18 inches long.

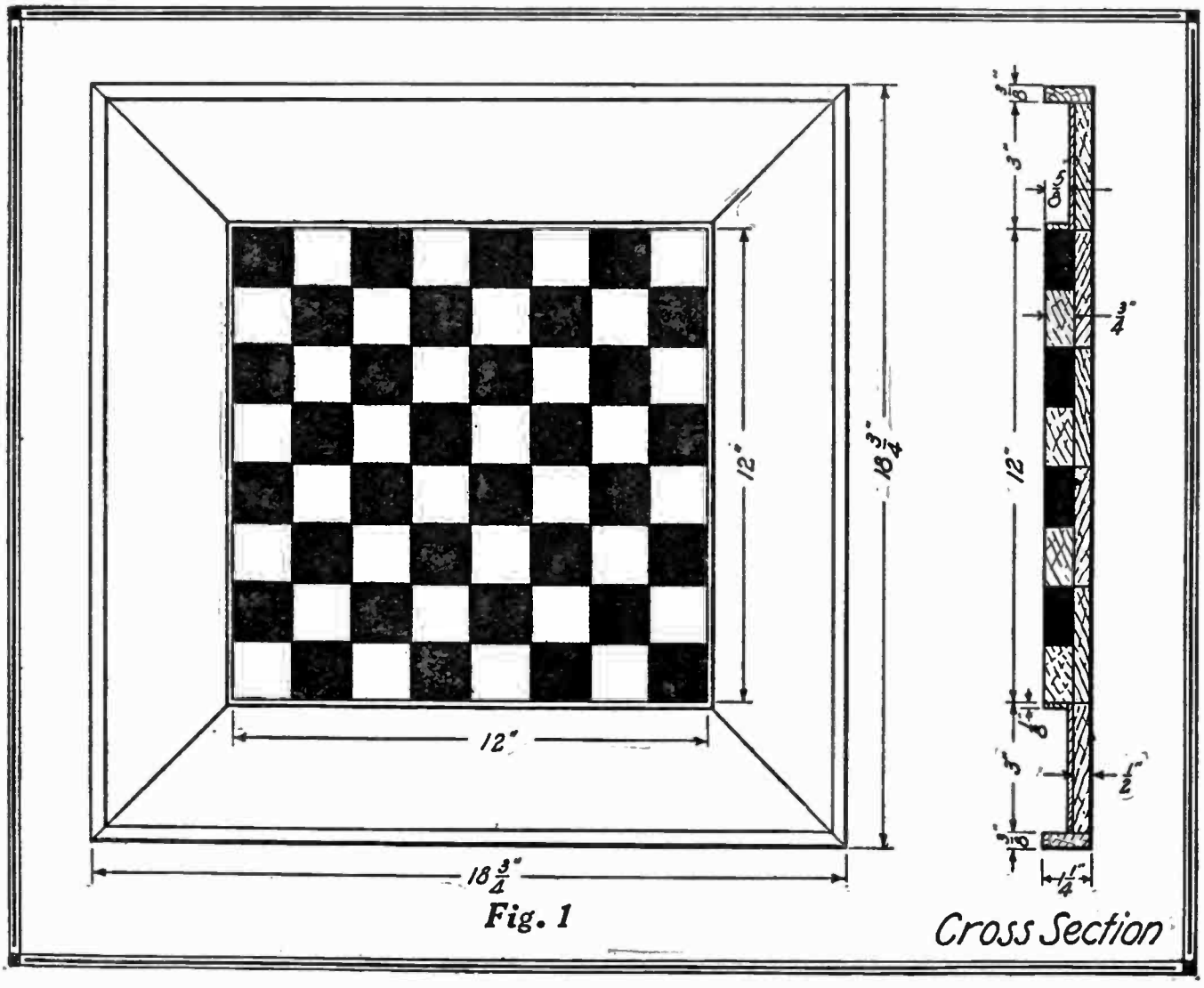


Fig. 1

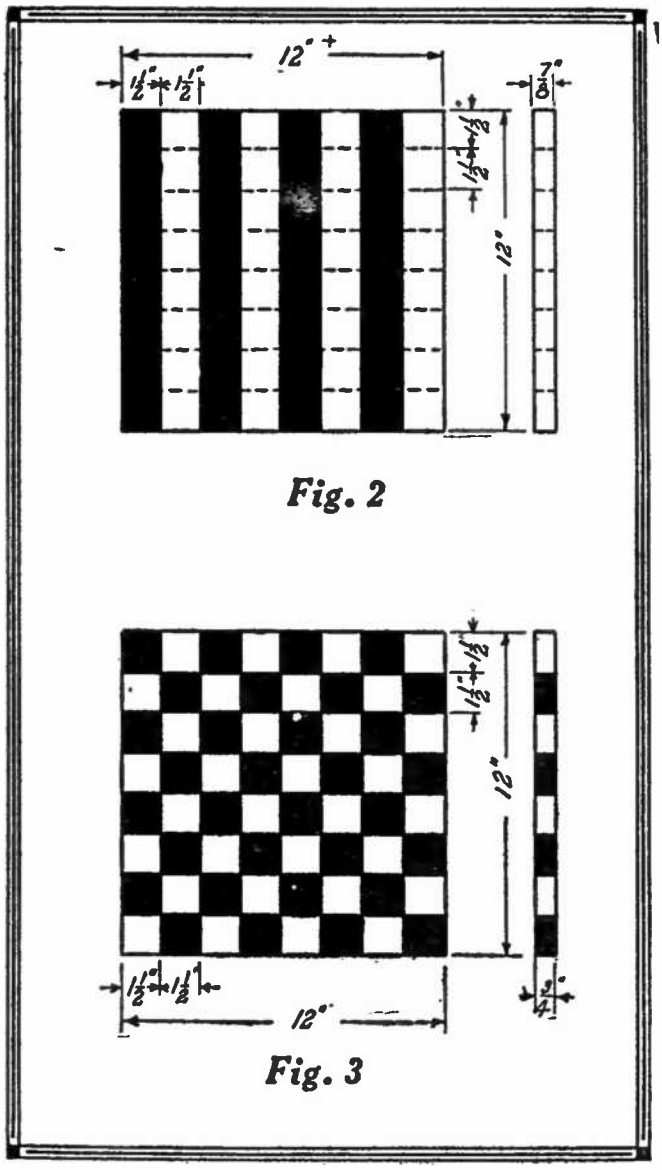


Fig. 2

Fig. 3

Fit them on the base and glue, thus forming the bottom of the tray. Now plane off the top of the squares, making them about ¾ inch thick.

Four strips of mahogany or black walnut are cut ⅛ inch thick, ⅝ inch wide and about 12¼ inches long. These are fitted and glued around the checker square as shown in Fig. 1. Cut four more strips of the same kind of wood ⅜ inch thick, 1¼ inches wide and 18¾ inches long. These are finished and nailed around the outside of the board, thus forming a trough. Give the board a good sandpapering with coarse sandpaper first, and then fine.

If the board is made of gumwood, a coat of clear filler is needed to bring out the distinction between the dark and light squares and give it a better finish. Any desired finish may be used, but a ground coat of shellac, well sandpapered and given a coat of clear varnish, makes a very fine board.

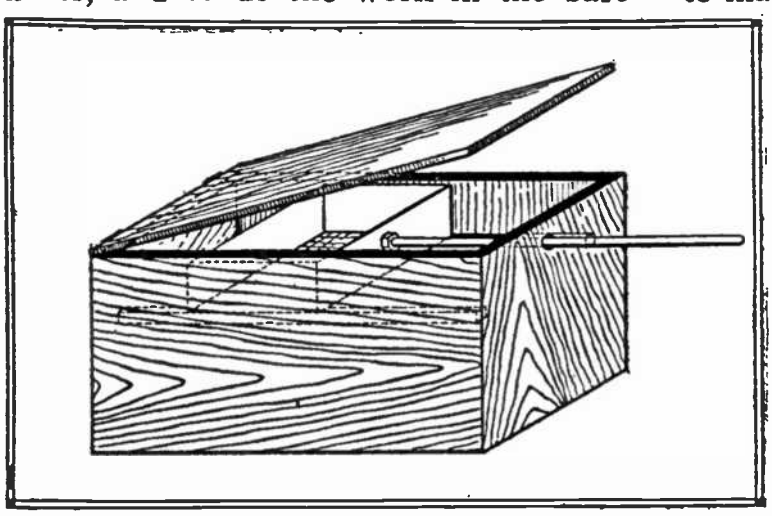
Celluloid Containers

The contributor has found celluloid to be a very useful substance in the construction of small battery jars. The sheet stock may be softened by immersing in hot water and bent to any shape desired. A solution of scraped celluloid in alcohol will form a good cement with which to join the seams.

Contributed by JAMES RITCHIE.

TO SIFT ASHES WITHOUT DUST

During the winter it is often disagreeable to go outside in the cold to sift ashes, and to do the work in the basement ordinarily results in a cloud of dust that seems to go through the house. A few minutes' work, however, will suffice to make a device that will not only lighten the labor of handling the sieve, but will at the same time prevent the obnoxious dust from floating through the atmosphere.



To make the device, take a deep box—one that will hold a week's accumulation of ashes, if possible. The box should be about as wide as the sieve. Take two boards about an inch square in section and fasten on the inside of the box to provide a track on which the sieve may slide. In one end of the box cut a hole through

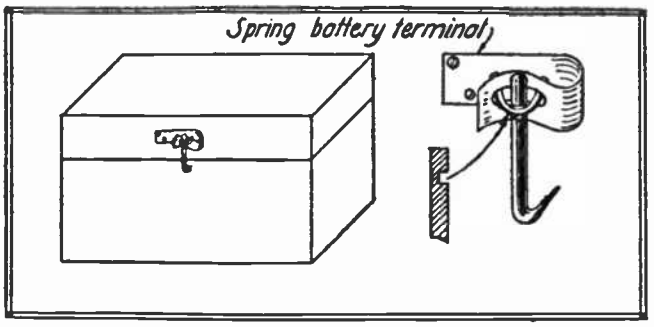
which the handle of the sieve may be inserted. Hinge a cover on the box and the device is completed.

Contributed by

E. TRABOLD.

Handy Lock

The illustration offers a suggestion for a simple but effective hasp, or fastening for a small box. The fastening is made from a headless nail having a notch near its end and a binding post of the spring clip type. The latter is secured to the



cover of the box, while the nail is driven into the side. The clip engages with the notch in the nail.

Contributed by

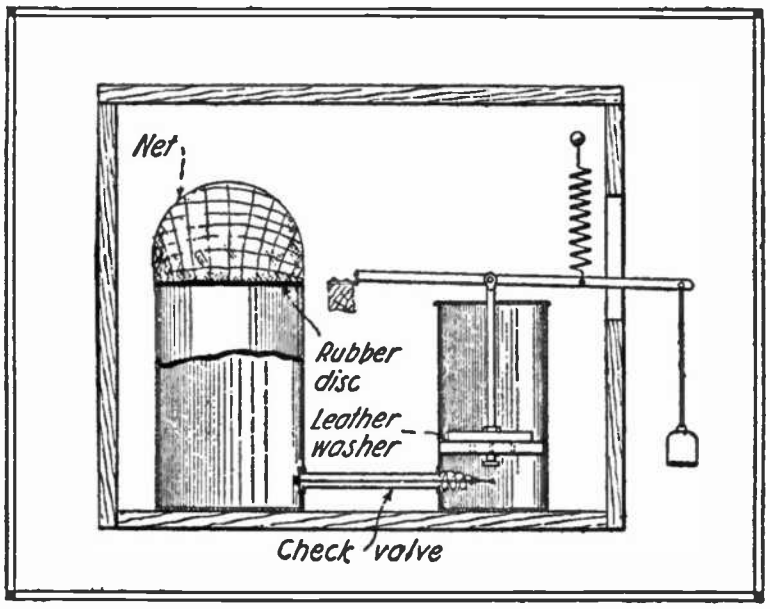
J. LIEBMAN.

A BLOWPIPE BELLOWS

By Fred. A. Berger

A serviceable, easily constructed and, withal, cheap bellows for a blowpipe is shown in the illustration. The essential features are two tin cans, one serving as the container for the air, while the other forms the pump cylinder.

The construction of the latter will first be considered. The can is of the ordinary type in which vegetables are packed. The top is removed by melting the solder, after which the inside is cleaned of any projecting bits of solder along the seam. A ½ inch hole is then drilled in the wall near the bottom for the outlet valve.



The piston is composed of two wooden discs and a leather washer. The smaller disc is permanently fastened to the piston rod which may be a long bolt. The larger disc is drilled with several holes for the air inlet, after which it is placed on the piston rod with a sliding fit. Between the two discs is placed the leather washer which should be of about the same diameter as the smaller disc. The larger disc is wound with oiled string to form a packing around its periphery and the piston is complete. The reader will see that this piston incorporates a check valve; when the piston makes its down stroke, the two wooden discs are pressed together and the leather washer seals the holes in the larger disc, while on the up stroke the discs are separated and the air passes through the openings.

The outlet valve is merely a washer fastened to the end of a long rod that passes through a tube leading from the pump to the container. A coiled spring holds the valve in a closed position on the upstroke of the pump.

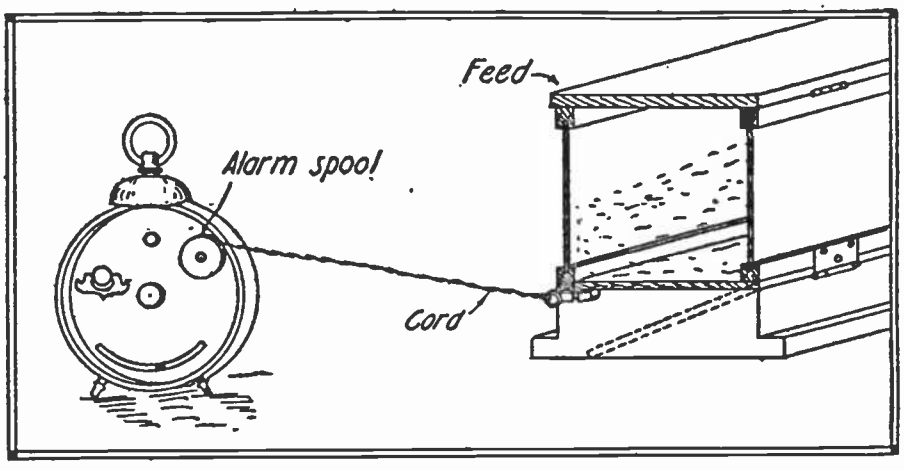
The framework and the method of actuating the piston are clearly shown in the illustration. The stirrup enables the operator to pump by foot power, leaving

his hands free to handle the blowpipe. The container for the air is a large tin can with its tin top removed and a piece of thin elastic rubber substituted. A net placed over the top will prevent the rubber from breaking should the pressure become to great. The connection for the supply piping is not shown in the sketch, but it may be made by boring a hole in the air container and soldering in place a piece of brass or copper tubing. To the latter is attached the rubber tubing.

An Automatic Horse Feeder

Anyone who has had to get up at an unearthly hour and give Dobbin his breakfast will appreciate the following suggestion.

The first step is to fasten a small spool to the alarm wind of an alarm clock. This may be accomplished in several ways, but preferably by sawing a slot in



one end and pressing it into place. The clock should now be securely braced on a conveniently arranged shelf, either with wire or by means of a small leather strap. Next, procure an empty cracker box or other suitable box and mount it upside down so that the lid swings freely on a pair of small hinges. Normally the lid is kept in place by a pin or trigger connected to the spool on the clock by a stout cord in such a manner that the spool will wind up the cord and release the grain. If convenient it would be to advantage to place the entire apparatus on the outside wall of the stall and cut a hole through just above the feed box in the manger, allowing the grain to drop out of the box into a spout conveying it to the horse. As the feed is released the alarm also sounds, and it does not take the animal long to learn its meaning.

Contributed by

AUGUSTUS SAULTIS.

A Handy Cabinet

The accompanying illustration shows a convenient way of keeping small supplies, such as rivets, brads, screws and tacks in proper order. The cabinet can be made at a small expense and it will be found to amply repay for itself in a short time by its convenience and time-saving qualities.

When the cabinet is made according to directions, the boxes can be tilted at an angle of 45 degrees without overbalancing. This feature makes it easy to see into the boxes and get out the desired articles. The boxes can also be tilted over entirely when one wishes to clean them or empty their contents into another box. With a cabinet of this kind there is no opportunity of mixing articles by having one box spill into another.

The cabinet is made preferably of cypress and measures four feet high, two feet wide (inside measurement), and six to eight inches deep. The receptacles can be made of common tin cans, the size of which may vary, although efforts should be made to secure cans of about 2¾ inches in diameter. The cans are cut afterward to two inches in height.

When the cans have been cut to the desired size, they are mounted on a base as shown in the sketch. The base can be made of No. 26 gauge galvanized iron cut to the size shown and bent at right angles at the places indicated by the dotted lines. When the base is finished it should be four inches long, a little less than three inches wide and provided with a flange on each side one-half inch wide. The hole for riveting

should be one inch from one end.

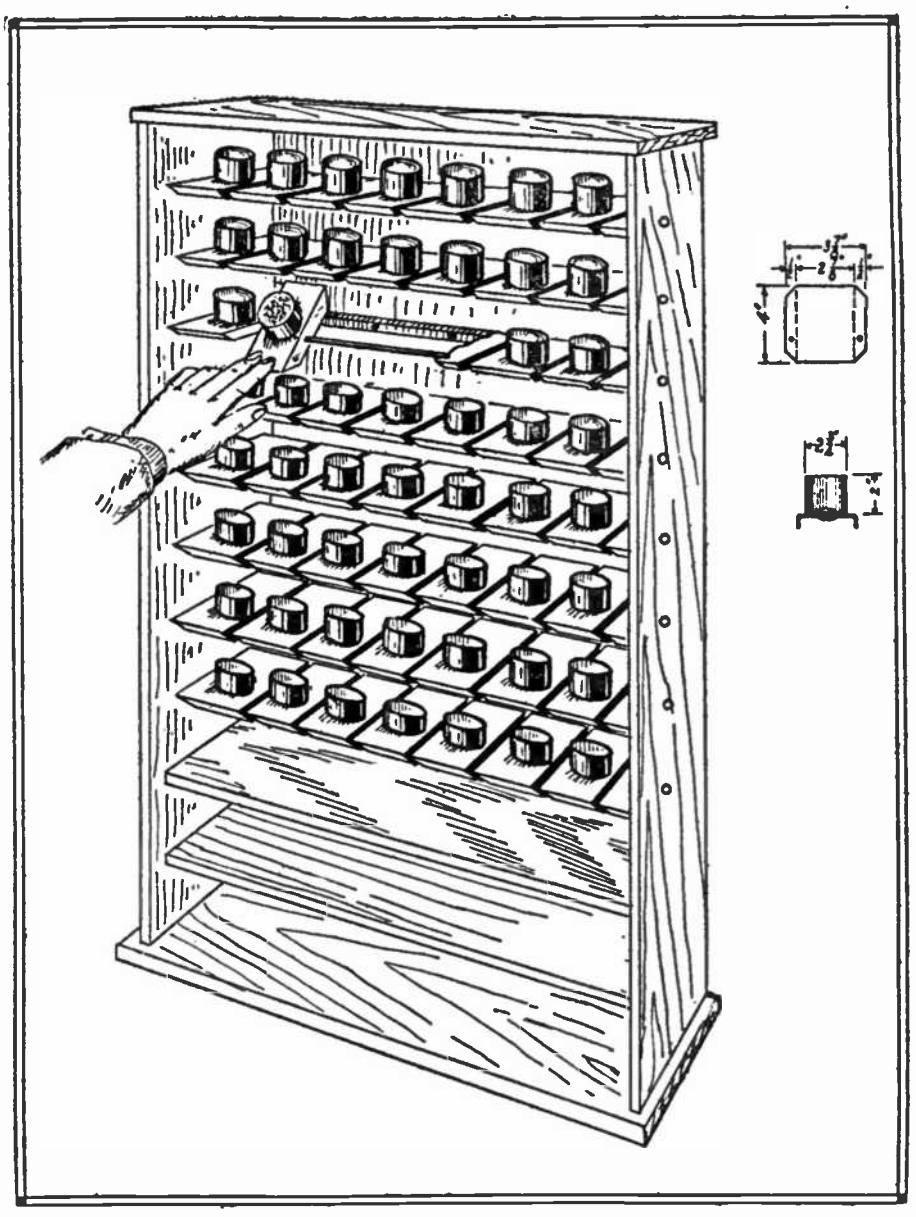
The cans are fastened to the center of the base either by riveting or soldering. Eight of these cans may be mounted in a row on a one-quarter inch rod that has been threaded at both ends so that it can be held in place by nuts. A small washer should be placed between each base on the rod in order to keep the cans from interfering with each other.

The boxes are held in their normal position by gravity, a cleat being nailed to the back of the cabinet for one end of the base to rest on. In placing the rods care should be taken to see that at least two inches is allowed between each so that the adjacent rows do not interfere with each other.

The cabinet made by the writer contained 48 boxes, while at the bottom there were placed two shelves for keeping a surplus supply of the articles.

Contributed by

J. C. LUNDHOLM.



To Cut Aluminum

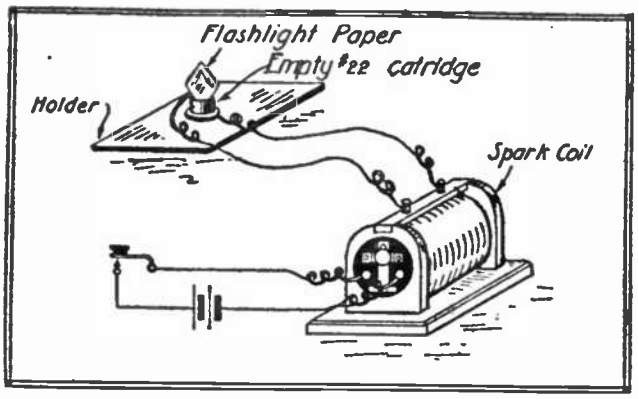
Special parts of sheet aluminum may easily be cut to any desired shape by means of what is known as a pattern maker's saw which is similar to a hand fret saw only larger and with very coarse teeth. The addition of kerosene oil in liberal quantities will greatly assist in the operation. This suggestion will be found of value to the experimenter who has tried to worry out the disc of a rotary spark gap from a piece of aluminum which, despite its softness, is at times a most difficult metal to work.

Contributed by

JAMES RITCHIE.

Electric Flashlight Ignition

When one desires to form one of a group to be photographed by flashlight and there is perhaps no assistant to ignite the flash, the suggestion offered herewith will afford a solution of the difficulty. The plan is to arrange the flash sheet and camera in the usual way and to ignite the flash by means of an electric spark produced on the pressure of the key. The necessary electrical equipment consists merely of a small spark coil, a key or button, a suitable battery and a few feet of wire. The circuit is arranged as shown in the illustration, the terminals of the coil secondary being connected with the igniter. The latter consists of an empty .22 caliber cartridge. One wire is fastened to the base of the cartridge, while the other is held with its tip projecting just inside the shell, but without touching



the latter. The flash sheet is placed with one corner resting in the cartridge and a few grains of gunpowder are placed in the latter. A pressure of the key, closing the circuit, ignites the powder, and the flame sets fire to the flash sheet. The camera shutter is, of course, open when the key is pressed.

Contributed by

FRANK A. HATFIELD.

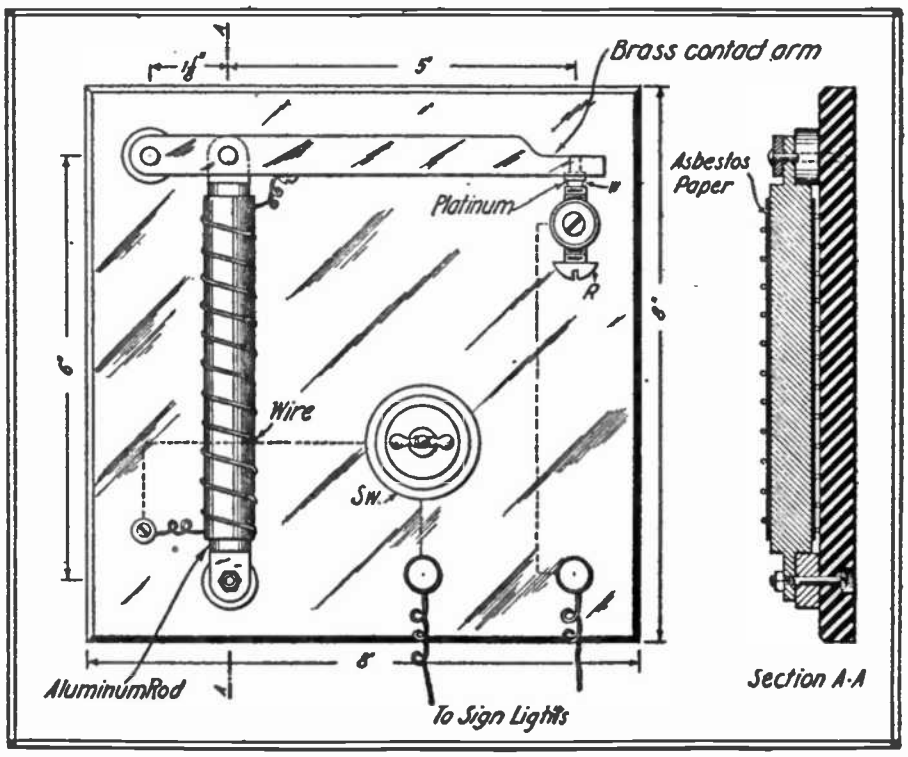
Simple Electric Sign Flasher

The accompanying sketch shows a simple and inexpensive electric sign-flashing device which the writer made several years ago for a small electric sign and which gave entire satisfaction. Its construction is obvious from the drawing. The operation of the electric sign is as follows: When the sign lights are turned on, the current passes through the German silver resistance wire, heats the aluminum rod which expands and raises the brass contact arm, breaking the circuit at *W* and darkening the sign. This cuts off the current through the resistance wire, allows the alluminum rod to cool and contract, thus pulling down the contact arm and closing the circuit at *W*, thereby illuminating the sign.

The length of time the sign is dark or is illuminated is regulated by screw *R*.

Contributed by

F. B. HAYS.



SWEDISH STEEL ELECTRIC HORN DIAPHRAGMS

It is often necessary in the course of experimental or repair work on electric horns to procure a diaphragm of special size or thickness in order to complete the horn. The price charged for new standard diaphragms is usually rather high and as a rule they will only fit one make and style of horn. In experimental work where the body of the horn is usually constructed out of material at hand, it rarely happens that any suitable diaphragm can be purchased ready made which will answer the requirements. It is therefore the purpose of this article to give a few hints on the construction of horn diaphragms in general.

The very best material from which to make the diaphragm is blue Swedish sheet steel. This steel is very tough and springy and is used by practically all of the high class horn makers. The only objection to its use by the amateur is that it is so much harder than all ordinary tools that it is very difficult to work. However, the author had no trouble in making good diaphragms by the method described herewith. In purchasing this steel, which can be bought only at a few up-to-date steel houses, the

first thing to consider is the gauge. Sheets one-fiftieth of an inch in thickness are heavy enough to make a good, substantial five-inch diaphragm. The correct thickness to use varies somewhat on different classes of horns; for instance, a mechanical horn requires a somewhat heavier diaphragm than an electrical horn. It is therefore advisable to buy two or three different gauges of steel to experiment with. Although the cost of this steel is about eighty cents a pound, five-inch diaphragms can be made at a cost of about three for ten cents.

When the proper material is at hand, it is next necessary to cut it into circular disks which can best be done with a good pair of curved tin snips. Great care should be taken not to bend the diaphragm as it is almost impossible to straighten it after cutting, but with a good pair of snips there is no need of bending it in the first place.

When the diaphragm is completely cut it is often necessary to make one or more holes in it, but as the steel is so hard it cannot be drilled even with a special high speed drill, so the best way to make the required holes is to punch them. This can be done by riveting together two flat pieces of strap steel or iron, measuring about an inch wide by one-eighth thick by several inches long, in such a manner that the diaphragm can be inserted between their flat surfaces. The next step is to drill a hole of the desired size through both pieces somewhere near their center. The diaphragm is then inserted between the two pieces and shifted about until a mark showing the location of the hole to be appears in the center of the hole drilled in the pieces of strap iron. A hard steel pin about one-thousandth of an inch less in diameter than the hole is used to cut the hole in the diaphragm; this being accomplished by placing the pin in the guiding hole in the strap iron, and giving it a quick sharp blow with a hammer. By the use of the above method and a little care, a very good diaphragm can be constructed by anyone at a fraction of the cost of a new one.

The pitch of the note produced by the horn is dependent upon the relative thickness of the diaphragm as compared with its diameter. The thicker the metal, the higher the pitch; or, with a given thickness of metal, the smaller the diameter of the diaphragm, the higher the pitch produced. With the stiffer diaphragms, however, the horn is rather more likely to become inoperative through sticking of the diaphragm and this should be taken into consideration when the tendency toward a high tone is observed.

A BOILER ROOM LOAD INDICATOR

By F. G. Matthews

The central station company that operates in Philadelphia has installed in the boiler rooms of certain of its plants indicators whereby the boiler attendants are advised graphically of the kilowatt load on the station at different periods of the day so that they can handle their fires accordingly. The arrangement comprises merely three voltmeters: one in each boiler-room and one at the switchboard operator's desk, all of which are so interconnected with a source of current and a resistance that the switchboard operator can vary the indications of the voltmeters simultaneously and at will. All of the voltmeters have scales which have been altered to read kilowatt load rather than volts. When the operator desires to telegraph the fact that a change in load has occurred he adjusts the resistance until the pilot instrument in front of him reads the number of kilowatts load then on the station. At this moment the other two instruments in the boiler rooms will indicate the same reading because of their being interconnected with and having the same calibration as the pilot instrument.

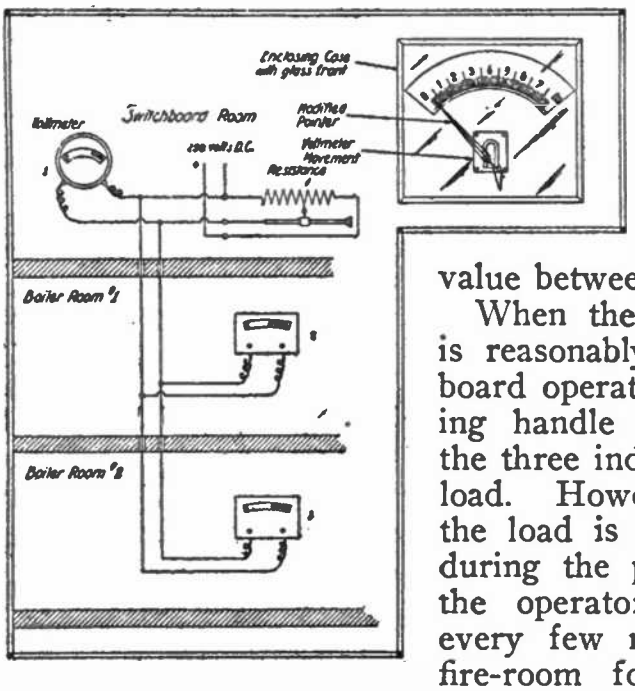
One of the boiler room indicators is shown in sketch. The circuit showing how the indicators are connected and operated is also shown.

It is of material assistance in the economical handling of a boiler plant if the stokers or firemen know the load that the plant is carrying. For example, if the

stokers see by the indicator that the load is rapidly increasing—as it sometimes does when a period of darkness due to a storm ensues, or when it becomes suddenly dark in the evening—it is obvious that more boilers must be put into service, or that those which are in service must be pushed to their maximum capacities.

Again, if the fire-room foreman sees from the position of the indicator needle that the load on the plant is decreasing, he immediately knows that he must cease heavy firing and that possibly some of the boilers should be cut out of service.

The arrangement as used by the Philadelphia company is not automatic, but is operated by the switchboard operator. In other words, the system of wiring the electrical instruments is merely an arrangement for transmitting a graphic message from the switchboard operator's gallery to the boiler room. The indicators used in the boiler room were made from Weston, D. C., station voltmeters, altered into the form shown in the sketch. The length of the pointer was increased from the usual 3 inches to 16 inches, so that the arrow end of the pointer would swing over a long scale that would be visible from any portion of the boiler room. This extension to the pointer was constructed somewhat in the form of a truss so that it would have maximum strength with minimum weight. The only portion of the original Weston meter that was retained was the movement, magnet and back board.



The scale of each indicator was divided into eight main divisions, and each one of these main divisions was divided into tenths. Assuming that each main division represents 10,000 kilowatts, the full scale deflection of the instrument would represent a load of 80,000 kilowatts on the station. Each subdivision represents a load of 1,000 kilowatts. The glass-front case enclosing each boiler room indicator was made 2 ft. 9 in. wide and 2 ft. 6 in. high.

The switchboard operator has in front of him a standard round-type direct-current voltmeter, which is indicated in the circuit, that has its scale divided from 0 to 80, and has subdivisions, each one of which represents 1,000 kilowatts.

The resistance, whereby the current through, or the voltage impressed on, the voltmeters is changed, consists of enameled wire wound on a spool.

A movable contactor is arranged to slide over the convolutions of this wire along a groove where the enamel has been removed. Thereby the contactor makes contact with the resistance wire. Electricity for the operation of the arrangement is furnished by a 250-volt storage battery used in connection with the exciter system.

It is obvious from studying the sketch that the switchboard operator can, by moving the adjusting handle *A* backwards or forwards, so regulate the voltage impressed on the three meters 1, 2 and 3, that the three meters can be made to indicate simultaneously any value between 0 and 80,000.

When the load on the station is reasonably steady the switchboard operator moves the adjusting handle occasionally so that the three indicators will show the load. However, at times when the load is changing rapidly, or during the period of peak load, the operator shifts the handle every few minutes, so that the fire-room force will always be conversant with the kilowatt load that the station is pulling.

If you have an idea for this department, why not send it in? All contributions are paid for at space rates, with a minimum of $1.00 per idea.

AN ELECTRIC ALARM CLOCK

By G. M. Heinroth

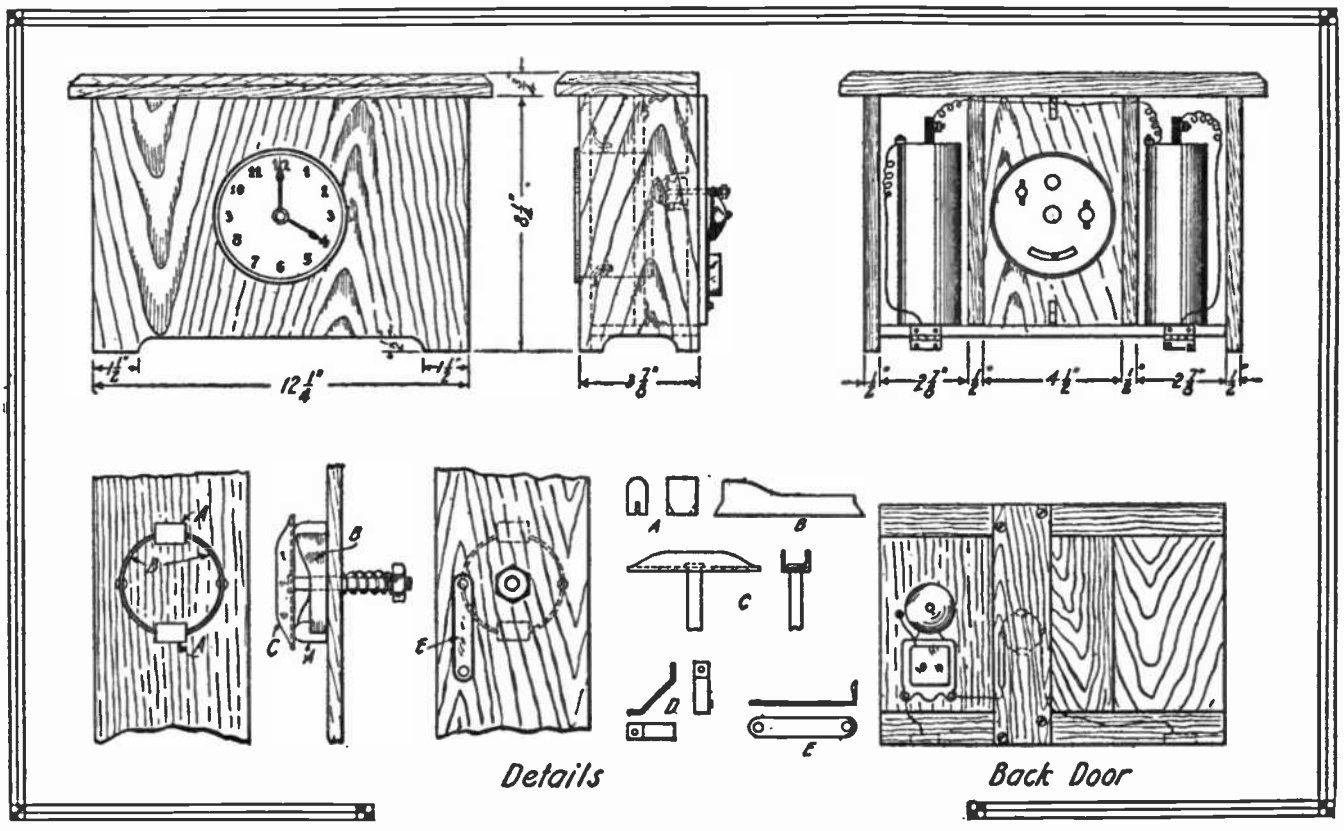
An alarm clock of pleasing design and presenting the important feature of a continuous ring after it has been started, is described in this article. The clock may be made by any handy man with simple tools, and its usefulness amply repays the small expenditure of money for materials and the time involved in the construction.

In operation, the device is merely an ordinary alarm clock so combined with an electric circuit and bell in a suitable frame or case that the winding key of the alarm clock closes a switch when the clock "goes off" and thus completes the circuit through battery and bell, making it necessary for one to arise and turn off the current in order to stop the bell from ringing.

The clock movement is prepared for fitting into the wooden case by removing the gong and its supporting rod, laying aside the latter for future reference. The appended illustrations will show the reader how the clock is fitted into the wooden case which is made of oak and nicely finished. The dimensions are, of course, given only as suggestions since the individual builder will naturally have to make his case of a size to conform with the size and shape of the clock he intends using.

For the front of the case the builder should select a good, straight-grained piece. The bottom edge is worked out as shown in the drawing. The face of the board may be smoothed up with sandpaper, the right and left hand edges mitered to form a good joint with the end pieces, and the hole cut for the face of the clock. This hole is best cut with a scroll or jig saw and for the sake of appearances it should be a good fit for the clock.

The end pieces may next be worked out and mitered to fit the front board. These pieces should be cut accurately to the same height as the front. In marking and cutting the end pieces, care should be taken to make sure that there is a right and a left side. Before fastening the ends to the front piece, the top



and bottom should be prepared as the mitered joint is not so strong as to permit of very much handling. In assembling the case, good glue should be used, and, supplementing this, slender finishing nails may be sparingly used in the mitered corners.

The clock is supported within the case by means of the angle irons shown in detail at *D* and in use by the dotted lines in the side elevation drawing of the completed clock. In locating the clock in the case, care should be taken to see that the face projects about ⅛ inch uniformly all around.

The attention is next directed to the partitions which separate the battery compartments from the clock chamber, and to the piece that fits over the rear of the clock between the two partitions. The two partitions are fastened to the backing piece and the whole then secured in place with screws in order that the clock may be removed for repairs should such be necessary at any future time. A hole is drilled through each partition near the top for the wire connecting the two battery cells to pass through.

The covering for the rear of the case is in the form of a door built up of four separate pieces. The sides are just wide enough to cover the battery compartments and about three inches less in height than the case. The difference in height is made up by a 1½ inch strip across the top and bottom, leaving the center of the clock part uncovered. The cover is hinged to the case at the bottom.

The electric bell is fastened to one side of the opening on the cover and a wire connects one terminal of the bell to one hinge. The other terminal is connected to the switch and contact device which receives attention next. This device consists of two pieces of copper, brass or tin cut to the shape shown at *B* and bent in the form of half circles which are fastened to the piece of wood that closes up the opening left in back of the clock. At the termination of each copper piece, a small block of wood or fibre cut as shown at *A* is secured to provide the insulating segment on which the contact maker may rest when the device is set. The contact maker is shown at *C* and the reader will note that it consists of a piece of metal bent up into the form of a trough which is to fit over the winding key of the clock. A stud is securely fastened to the trough and made to pass through a hole in the wooden backing piece, where it is held by means of the coiled spring and nut. The contact maker should turn without undue friction, but at the same time it should make a firm contact with the copper strips when turned off the insulating blocks. The switch is merely a short strip of metal bent up as shown at *E*, pivoted at one end and making contact with the head of a screw that terminates in a soldered joint on one of the copper strips. The second strip is connected to the hinge on the right hand side. The remainder of the connections are shown clearly in the drawing of the back of the case with cover removed.

It is understood that the height of the contact strips, the insulating blocks and the sides of the trough or contact maker are necessarily dependent upon the size of the clock movement. The idea is to have all dimensions of such a value that the trough will fit over the winding key when the device is set. When the alarm rings, however, the trough should slip into the depression in the contact strips, releasing the key in order that the latter may continue in its revolution without again bringing the contact maker into the insulated position.

The operation of the device is obvious. By letting down the back on its hinges, the clock is exposed for winding and setting and in replacing the back, it is only necessary to see that the contact maker is in a vertical position and resting on its insulators while the alarm key is in a similar position in order that it may enter the trough when the cover is closed.

Increasing use of the national forests by local farmers and settlers to supply their needs for timber is shown in the fact that small timber sales on the forests numbered 8,298 in 1914, against 6,182 the previous year.

A CRAFTSMAN LIBRARY TABLE

Describing the Construction of an Attractive Library Table, and Discussing Oak as a Cabinet Wood.

By Ralph F. Windoes,
Instructor in Manual Training, Davenport, Iowa

Illustrations from drawings made by the author.

THERE is no other article of furniture that appeals as strongly to the major of Home Craftsmen as a library table. One reason for this, perhaps, is the exorbitant price asked by dealers for such tables of good design and construction—$25.00 being the lowest, generally, of quarter-sawed oak. If the craftsman purchases carefully, he should be able to obtain the lumber and materials for the same table for $7.50 or $8.00, while the joy derived from the creation of such a piece will surely make it a worthy project for his endeavor.

As hinted above, quarter-sawed oak is the best wood to use, beyond a doubt, as its beauty of grain and markings when properly finished places it in a class by itself. It is altogether fitting, then, that we give this peer of American hardwoods a few words of discussion at this point.

There are over fifty distinct varieties of oaks in this country, which are roughly divided into two groups—the white and the red. Generally speaking, the white oak trees may be distinguished by their acorns, which ripen in one season, and their leaves, which have well rounded lobes. The acorns of the red oaks ripen in two years, and their leaves have sharp points, while the fingers of the leaves are indented again with smaller teeth. Hence, a study of the trees will enable one to readily distinguish between the two groups. But this does not assist much in deciding which is which when it comes to the cut lumber—and it is here that the craftsman finds his interest centered.

About the only way in which the lumber of the two classes can be distinguished is by a careful study of the end grain. In Fig. 1, at *A*, we see the end of a cut log with the names of the most important parts. From the center, called the *pith,* we see lines radiating toward the edges. These lines are known as *medulary,* or *pith, rays,* and cause the "flake" to appear on the surface of a board when it is quarter-sawed. Parallel to the bark we notice a series of rings, known as *annual rings,* running around the log. One of these rings is formed each year, and it is by means of them that the woods may be distinguished accurately. A careful study of Fig. 2, which is a greatly enlarged section of the

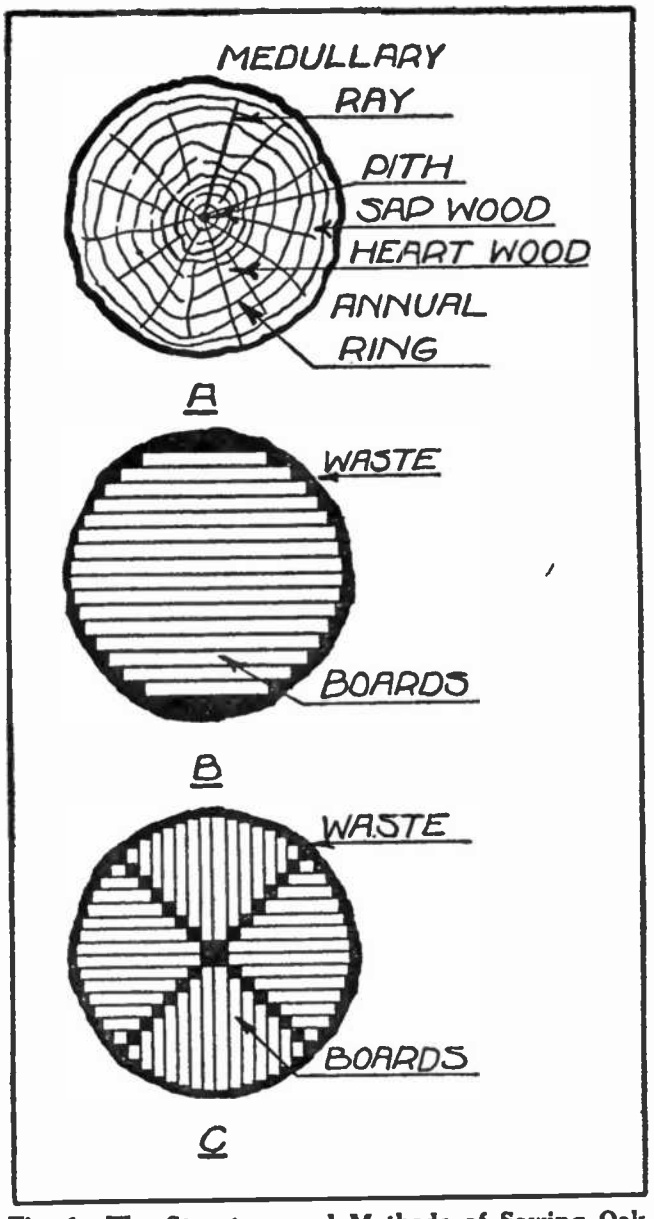


Fig. 1.—The Structure and Methods of Sawing Oak for Furniture Making.

two woods, shows each ring to be divided into two parts—large pored wood, or spring wood, and close pored wood, known as summer wood. This means that in the spring when the sap is flowing rapidly, the pores formed are large and open, but in the summer and fall, when the growth is much slower, the pores are smaller and closer together. Now these *small* pores, in the white oaks, are so numerous and closely packed together that it is almost impossible to count them, while in the red oaks they are few in number and are easily counted. Hence, by a study of the woods, they may be distinguished. Of course, you will not be able to note these pores with the naked eye, so some sort of a microscope will be necessary. One of the small pocket magnifiers, which can be purchased at a reasonable cost, will suffice, and, together with a very sharp knife or chisel with which to pare the wood so that the fibers are not broken, will comprise the necessary equipment for studying the wood.

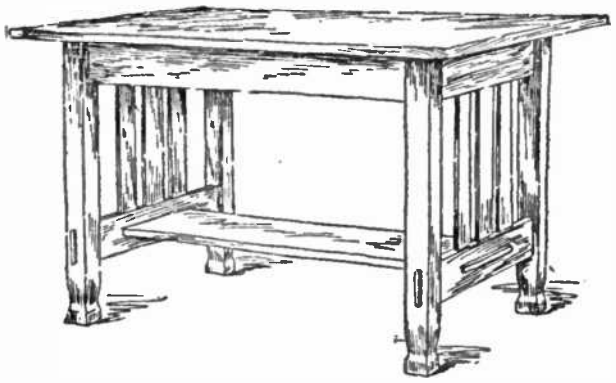
While this microscopic method is the surest way of determining various kinds of wood, lumber men almost universally group light colored oaks that work like true white oak, and call them white oak, while all other oaks are placed in the red oak group. Color, then, is one of the marks of distinction, but this cannot be relied upon, as the sap wood of some of the red oaks is lighter than the heart wood of the white. The red, as a general rule, is more elastic, but it is not as heavy or as hard as the white, which characteristics assist greatly in distinguishing between the groups.

For cabinet making, the red oak is easier to work than the white, but has a coarser grain and is more liable to shrink and warp—hence white oak is recommended for all furniture building.

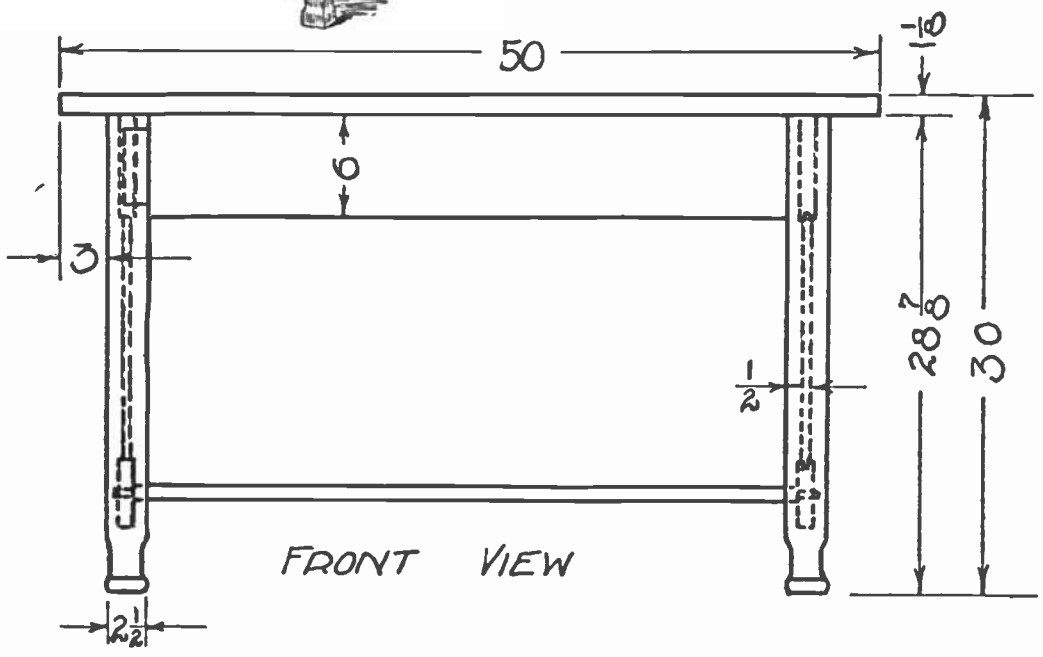
Referring again to Fig. 1, we find at *B* one method of sawing up a log so as to produce plain sawed lumber—the black portions of the drawing representing waste. At *C* is illustrated a method of cutting so as to produce quarter-sawed lumber. The log is first cut up into quarters, and then each quarter is sawed into boards so that the medullary ray may be visible on the surfaces of the boards, causing the beautiful "flake." The drawing also illustrates the amount of waste from this method of sawing, which accounts for the higher price of quartered over plain.

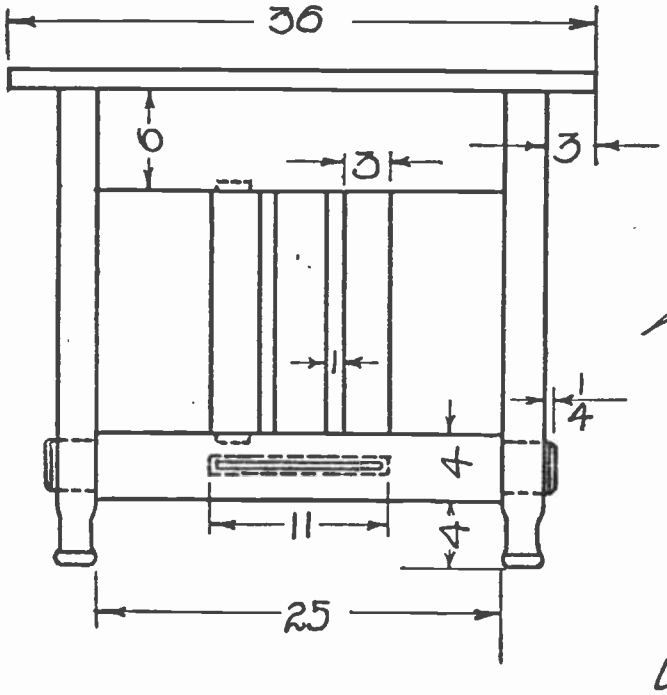
The lumber for this table should be purchased as follows, planed and sandpapered to dimension at the mill:

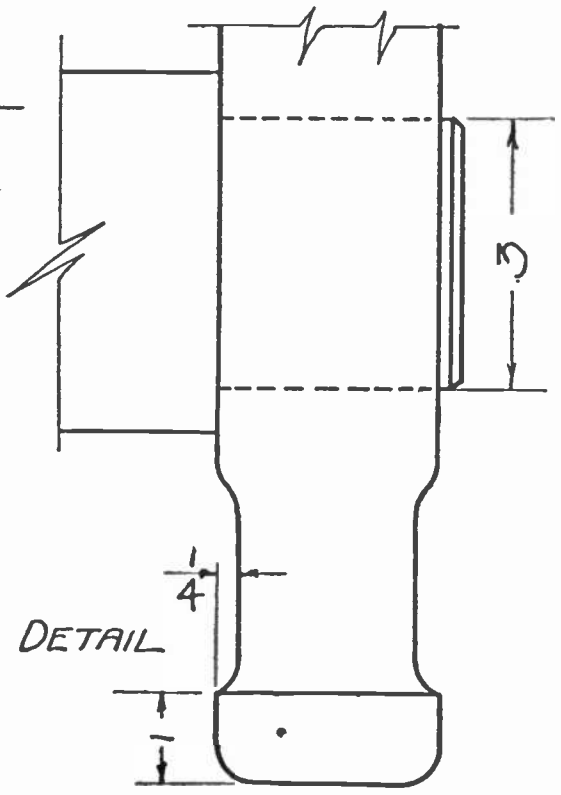
Legs, 4 pcs., 2½" x 2½" x 28⅞", plain oak.
Side rails, 2 pcs., ⅞" x 6" x 43", quarter-sawed oak.
End rails, 2 pcs., ⅞" x 6" x 29", quarter-sawed oak.
End stretchers, 2 pcs., ⅞" x 4" x 30½", quarter-sawed oak.
Shelf, 1 pc., ⅞" x 11" x 43", quarter-sawed oak.
Top, 4 pcs., 1⅛" x 9½" x 52", quarter-sawed oak.
End slats, 6 pcs., ½" x 3" x 16", quarter-sawed oak.



LIBRARY TABLE







W.

Working Details of the Library Table Described in the Accompanying Article, as Well as a View of How it Appears When Completed.

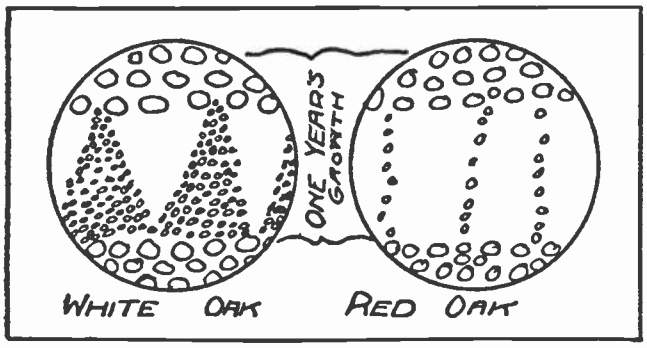


Fig. 2.—Distinguishing Marks of the Different Kinds of Oak.

Begin the construction of the table by laying out the mortises in the legs. To do this correctly, select the two poorest faces that are adjacent for your *working faces.* That is, the corner where these two faces join will be the inside corner of each leg when the table is assembled, and it is on these faces that the mortises will be layed out. Be very sure that you *check* these faces so that no mistake will be made in the work that is to follow. Mark the joints out roughly with pencil and place the four legs into position on the floor so that proper mortises face each other. While in this position, mark them on the ends Nos. 1, 2, 3 and 4, so that you will be able to place them in the correct order later on. From the *checked working faces,* lay out the work very accurately with the marking gauge, knife and try-square. Notice that there will be no mortises for side rails at the lower ends of the legs, and that the stretchers are through tenons; these joints being laid out on both sides. When carefully finished and tested, bore holes between each set of lines and chisel out the cheeks, as has been explained before in this series.* On the through tenons the holes are bored into the center from both sides and the chiseling is worked from the opposite edges. The mortises in the legs for the side and end rails are ½ inch wide, 5 inches long, and 2 inches deep.

When the mortises have all been cut, lay out and chisel the little recesses at the bottom of the legs, as illustrated in the detail. Sandpaper these carefully so that no chisel marks remain to be seen.

Next, cut the tenons on the side and end rails to fit snugly into their respective leg mortises. Be very sure that the distance between shoulders on the like pieces is exactly the same. Following these you should cut the long tenons on the stretchers. As the ends show, this work must be very carefully done or an unsightly crack will show on the faces of legs. Chamfer these stretchers a little on their ends.

Now the mortises should be layed out and cut for the end slats. They are located in the top edges of the stretchers and the bottom of the end rails. When completed, fit the slats into them and cut the mortises for the bottom shelf. These will be worked from both faces as the tenon runs through. In fitting this tenon cut the shoulder distance a little long and then pare it down to fit after the table has been clamped up dry. If all of these parts go together nicely glue the tenons and clamp to dry. The whole table may be put together at once, or the ends may be clamped singly.

After all visible glue has been removed, joint up the boards for the top. If the craftsman has not had the experience or does not care to take the time for this, he may order the top all glued up and sandpapered to dimension at the mill. Of course, this will cost him much more than the separate boards.

To joint the top you should have a 22 inch or a 24 inch jointer plane. Be sure that the bit is straight across the cutting edge—and sharp. Place the four boards in the position that you wish them to occupy when completed, and mark them so that you can tell this position as you are jointing the edges. Take one board

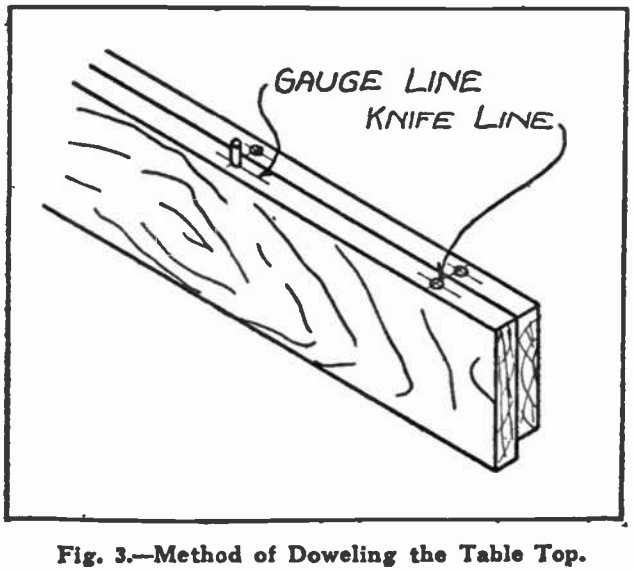


Fig. 3.—Method of Doweling the Table Top.

*See January number of MODERN MECHANICS.

and plane it as near straight and square as possible, running your plane straight with the edges of the board so that you will be sure to plane out all "hills and hollows," and not be low on the ends. When this is finished, place the board, which is to be joined to the first one, in the vise and plane this edge in the same way. If both edges have been correctly planed you may now place the first jointed edge on top of the second and no light should show through. If light is visible through the joint, mark the high spots and very carefully plane them off. Repeat this with the three joints, and you will be ready to dowel the top, as explained further on.

As suggested in Fig. 3, clamp two pieces together so that the edges which will be joined are uppermost. With the marking gauge, lay out lines in the center of each and cross these lines with the knife and try-square mark at right angles, as shown in the drawing. Where these lines cross on both pieces, the joints of crossing will be exactly opposite when the boards are put up into position.

Next bore holes at each point with a ½ inch bit, making them about 1½ inches deep. Bore them perfectly straight and of equal depth so that the pins will be interchangeable. The latter should be about 2¾ inches long and pointed a little at the ends. The pins should slip in easily into the holes and not have to be driven.

If hot glue is available and the workman has had enough experience to handle it rapidly, it is much better to use for this work than the cold, but if the latter is used, allow it to stand about fifteen minutes before clamping.

When the glue has set, scrape it off and plane the top down as nearly smooth as possible. Then scrape and sandpaper it until every rough spot in the grain has been removed and trim the edges and ends of the piece.

Fasten the top to the frame with angle irons or table top irons that can be purchased at most hardware stores. The latter are to be preferred, as they allow for expansion and contraction of the top with changes in the weather.

The finish for a table of this kind should consist of stain, filler, shellac and wax—processes that have been discussed so often in this department that they will hardly bear repetition.

EXTINGUISHING FIRE WITH SAWDUST

A SUGGESTION that an inflammable material be used to extinguish fires may excite ridicule, since the popular idea of such extinguishers refers to water, sand, carbon tetrachloride or carbon dioxide gas.

However improbable the suggestion may seem, facts to prove its practicability are at hand.

Quite recently the Stanley Works of New Britain, Conn., reported through the Manufacturer's Mutual Fire Insurance Company's office that extensive experiments conducted at their plant on extinguishing burning lacquer by the use of sawdust had been extremely successful. The insurance company could scarcely credit the report and requested that new tests be made in the presence of their experts. This request was readily granted and the tests were absolutely convincing.

Tanks were built out in the open and filled with lacquer up to six inches in depth. A stiff wind was blowing. After igniting the lacquer and letting the blaze get full headway, the sawdust was thrown evenly over the surface with a long handled snow shovel. The largest tank was 60 inches long, 30 inches wide and 16 inches deep. A representative test was one in which a two inch layer of lacquer was allowed to burn one minute and two seconds and the fire was then completely extinguished in eleven seconds by the application of only two shovels of soft wood sawdust. In order to utilize the extinguishing effect of car-

bon dioxide a mixture of ten pounds bicarbonate of soda in a bushel of sawdust was tried. A two inch layer of lacquer was allowed to blaze for one minute and eight seconds, following which it was easily extinguished with one shovel of this mixture in nine seconds. Obviously, the heat released carbon dioxide from the bicarbonate and this acted as a blanket on the flame. In fact, tongues of flame could be seen shooting out from under the layer of gas. The absence of wind indoors would doubtless give still better results.

To make the test more difficult a wooden platform five feet square was built with a two inch rim and a fire of lacquer allowed to burn on it for 45 seconds. The conflagration was extinguished with three shovels of sawdust in 53 seconds. The next test was with the same platform, attempting to extinguish the blaze with a three gallon chemical fire extinguisher, but with no better results. Had it not been for the rim of the platform the force of the stream would have spread the burning lacquer.

Motor gasoline was also used instead of lacquer in a tank 30 by 12 inches. A vigorous blaze in this was promptly extinguished with two shovels of sawdust in 12 seconds. Sand had but little effect on gasoline burning in a layer of appreciable depth, but it did fairly well when applied to gasoline burning on the ground.

The following conclusions seemed warranted by the tests:

Sawdust, spread over the surface, will readily extinguish fires in inflammable liquids such as lacquer and gasoline when contained in such moderate-sized tanks as those ordinarily used in manufacturing plants.

The efficiency of the sawdust is due to its blanketing action in floating for a time upon the surface of the liquid and excluding the oxygen of the air. The sawdust itself is not easily ignited and even so its burning embers do not reignite lacquer.

The character of the sawdust, whether hard or soft wood, common or dried, is of no importance.

When the sawdust is applied rapidly so as to put out the blaze before the sawdust has time to sink, the depth of inflammable liquid is of no importance.

Sand is not satisfactory as an extinguisher for fires in liquids contained in tanks or vats, because the sand sinks to rapidly. With a liquid burning on the ground, sand is more effective for obvious reasons. However, it is no better even then than sawdust and is heavier and more awkward to handle.

The mixture of sodium bicarbonate with sawdust is most effective because of the release of carbon dioxide which adds to the blanketing action of the sawdust.—HENRY M. HOLMES.

ELECTRICITY ON A CALIFORNIA RANCH

The simplicity and ease with which electric current can be applied to farm work, particularly when the farm is within reach of a transmission line, are exemplified on the large certified dairy farm of H. R. Timm in Solono County, Calif.

Mr. Timm's ranch has about 300 acres of alfalfa which is used for dairy cow feed. He has two silos which each hold 500 tons of ensilage, and he fills them both with green alfalfa for silage, when he is harvesting the last crop of alfalfa of the year. The green alfalfa is run through a regulation corn ensilage chopper which is operated by an electric motor.

Similarly, during haying time, Mr. Timm runs dozens of tons of alfalfa hay through the ensilage cutter and stores it in the hay barn. By chopping up the hay Mr. Timm succeeds in scoring two points of economy. The cattle eat the hay with little waste when it is chopped —they clean up all the stems—and the chopped hay goes into the barn in more compact form, giving the barn greater storage capacity.

The corn ensilage cutter is driven by a seven horse-power electric motor, and corn or alfalfa ensilage or dry hay can be chopped at the Timm dairy farm at a very reasonable cost.

A Chemical Fire Truck for a Village

By F. B. Hays

IN villages serious conflagrations often arise from small and unimportant fires that might readily be extinguished if some suitable fire-fighting equipment were at hand. In the following paragraphs the author has endeavored to give a few essential details for a chemical fire truck which not only will serve efficiently for fighting conflagration in small villages, but will also be a valuable safeguard in any factory or manufacturing plant.

In Fig. 1 is shown the fire wagon complete. The wagon is intended to be hand-drawn and may be built at a cost of about $150 by any competent blacksmith, wagon wright or carpenter. The wagon comprises a complete fire department in itself and is capable of extinguishing the average small fire.

The equipment for the fire wagon consists of the following: One nine-foot ladder; one fifteen-foot extension ladder; one thirty-gallon chemical tank; two three-gallon hand chemical extinguishers; two Pyrene extinguishers; two lan-

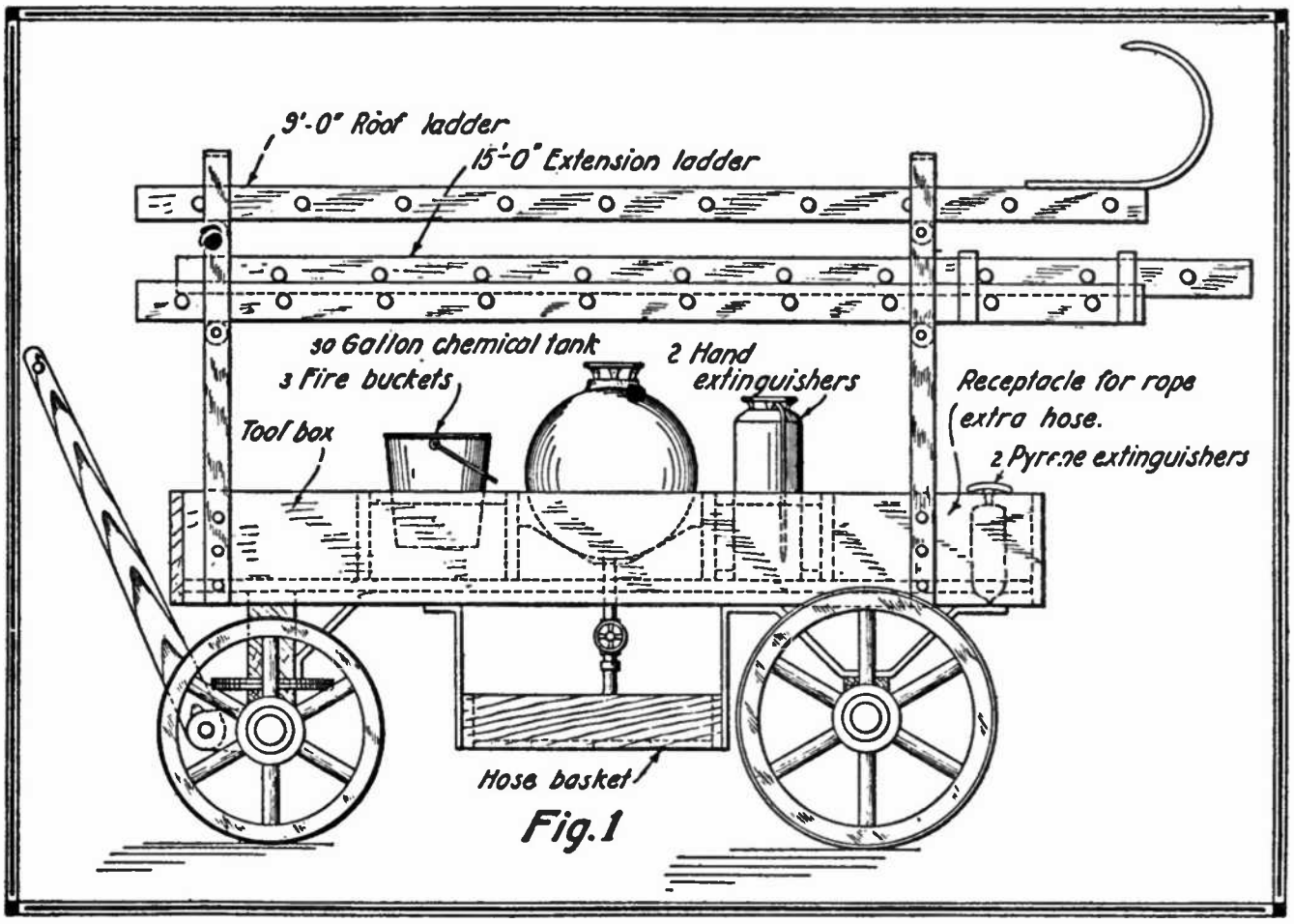


Fig. 1

The Chemical Fire Truck as it Appears When Completed. Modifications May be Made in the Equipment to Suit the Requirements of the Builder.

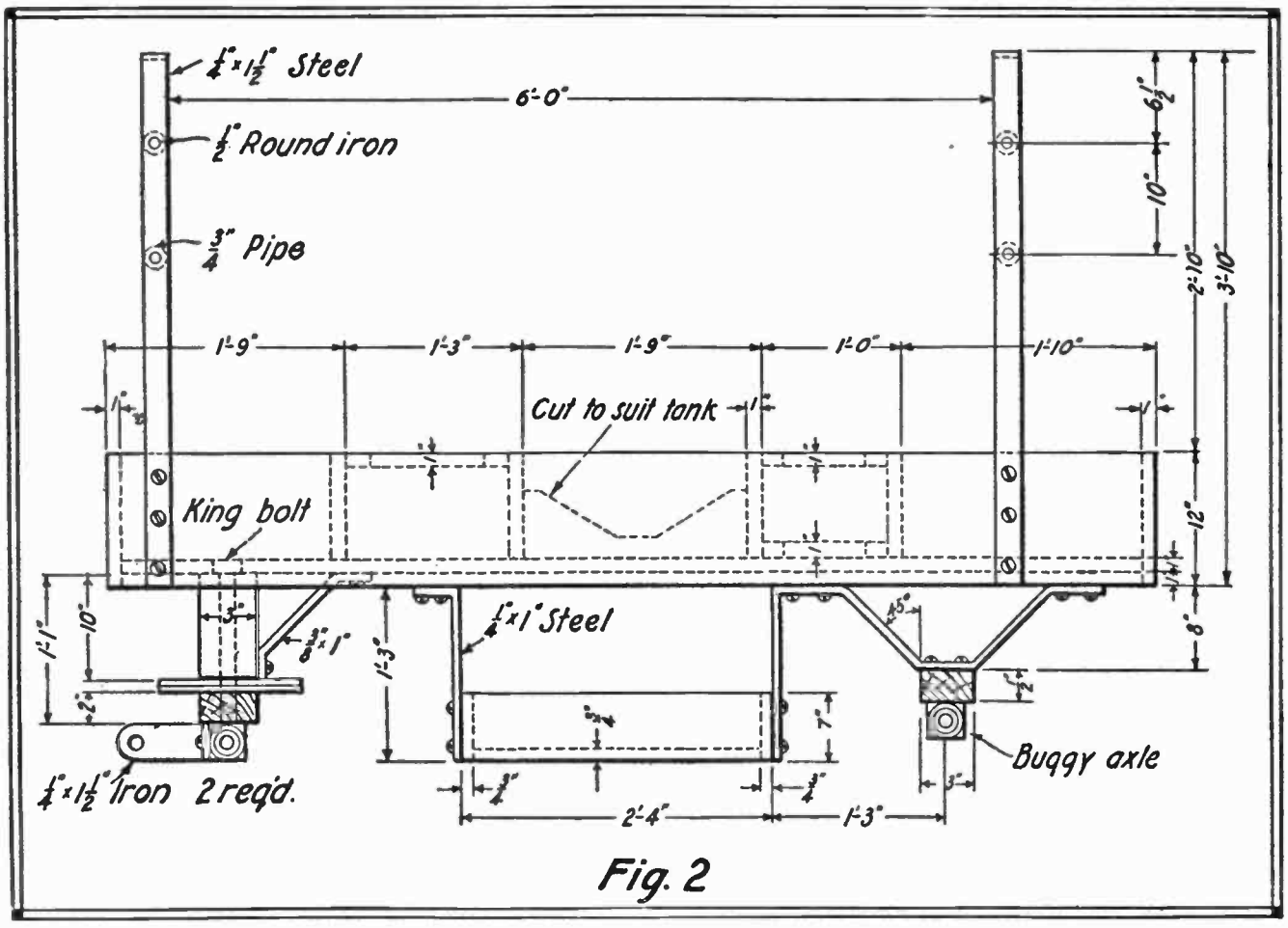


Fig. 2

Above: Side Elevation of the Framework and Truck of the Chemical Fire Engine, Showing the Necessary Woodwork and Ironwork.

Below: Top View of the Framework and Truck of the Chemical Fire Engine, Showing the Arrangement of the Holes, Compartments and Racks for Holding the Buckets and Other Equipment.

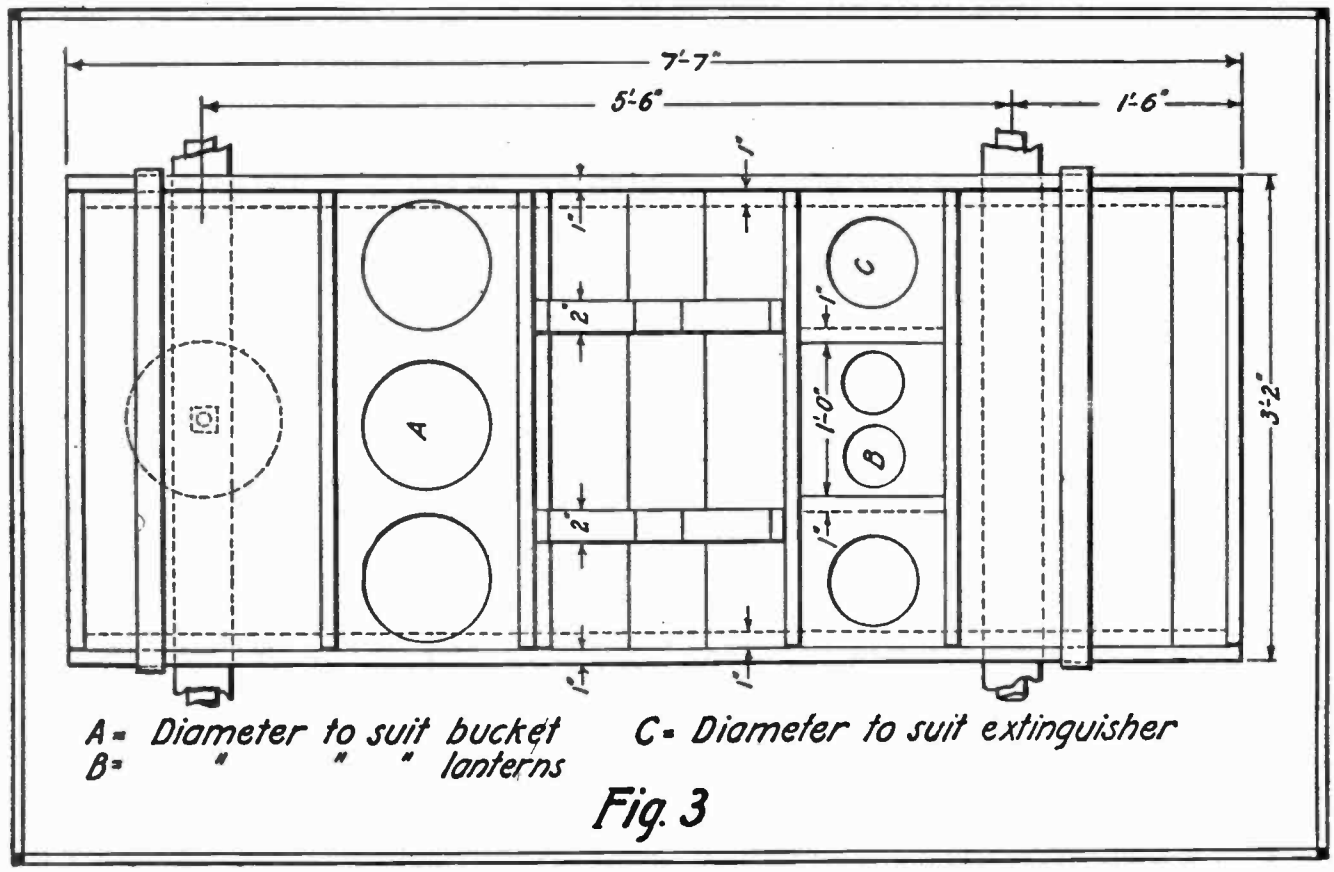
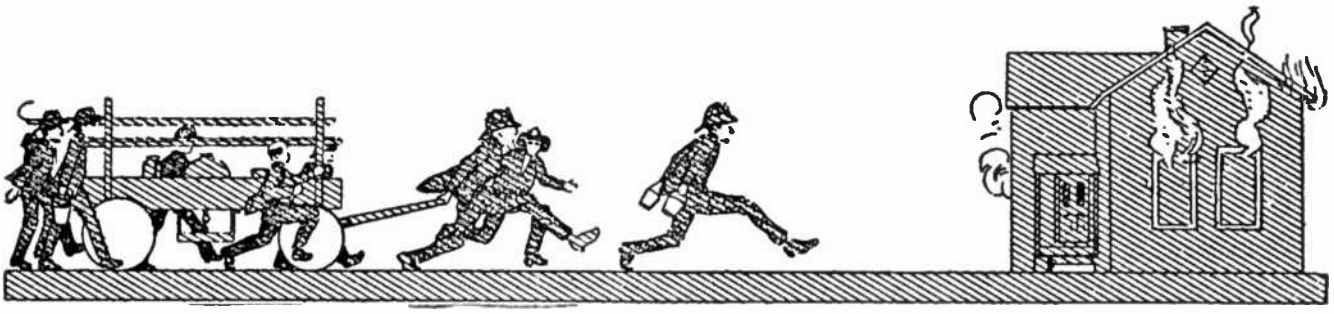


Fig. 3

terns; three three-gallon fire buckets; 250 feet of one-inch rubber covered hose; 50 feet of one-half inch hemp rope; two fire axes; one thirty-inch pinch bar; one small hay fork and one short pike hook.

The ladders, chemical tank, extinguishers, hose and other necessities can be procured through the local hardware dealer. The wheels and axles can be taken from an old buggy or cart. The wheels should be as low as possible, as indicated in Fig. 1. Figs. 2 and 3 give the dimensions and details for building the wagon.

The total weight of the fire wagon when completed should be in the neighborhood of 500 pounds and can readily be handled by one man. Aside from its uses in small villages and in factories, it will also be found a source of protection on any large farm.



USING THE X-RAY TO EXAMINE EUROPEAN SHIPMENTS

The use of the X-ray by the British government in examining a cargo of cotton consigned to Bremerhaven, Germany, on a North River dock in New York City, during Christmas week, was a sensational demonstration of the practical usefulness of this comparatively young branch of electrical science in applications outside of hospitals and surgery in which it is best known to the public.

No copper or other contraband of war was found, and the ship will be spared the detaining hand of Great Britain's traffic policemen of the high seas by virtue of the New York British consul's certificate of inspection.

The most powerful type of the Wappler radiographic machine was mounted on the shipping dock, and about every tenth bale of ten thousand was examined by a British consulate inspector stationed on the opposite side of the bale from the X-ray tube. The latter was swung a few feet from the standard on which were placed the X-ray apparatus, the rotary convertor and the step-up transformer, as well as the "inch meter" by which a convenient reading for maintaining the spark at about five inches is obtainable. The tube was applied close to the parts of the bales that were selected and brought to a platform in front of the machine. The inspector saw to it that the X-rays passed through the cotton uninterrupted by copper or other contraband; a test very similar to that of a physician searching for a bullet in a wound.

The installation of the apparatus was in charge of Prof. Davis, of Columbia University, and his assistant, Dr. Weber. A copper screen shielded the operator from possible X-ray burns while operating the switchboard on which were mounted the control and regulating devices. Provision was made to have the X-ray tube kept at a safe heat even with the constant use. A canvas screen was employed to shut off bright daylight from the whole outfit in order that the examiner's vision might not be disturbed from his scrutiny of the X-ray effects.

The initial current was 110 volts from an ordinary direct current circuit. This was converted by a rotary transformer to about 75 volts, alternating current. The high tension transformer delivered a range of 15,000 to 120,000 volts. The selector and regulating apparatus, once set, required little attention, although the current to the X-ray apparatus proper was switched on and off with each examination of a bale. The rotary transformer was about 3 kw.

BIMETALLIC ACCUMULATORS

MANY attempts have been made to produce a satisfactory form of storage cell employing other chemicals than lead plates and sulphuric acid. Thomas A. Edison performed no less than 9,000 experiments before he perfected his present type of cell.

It is of interest to note a few of the bimetallic cells that have been tried out, but which on account of many inherent defects have not been of any commercial value. However, the casual experimenter or student might find much food for thought in the description of them, because some of the cells have many good qualities which are not to be lost sight of.

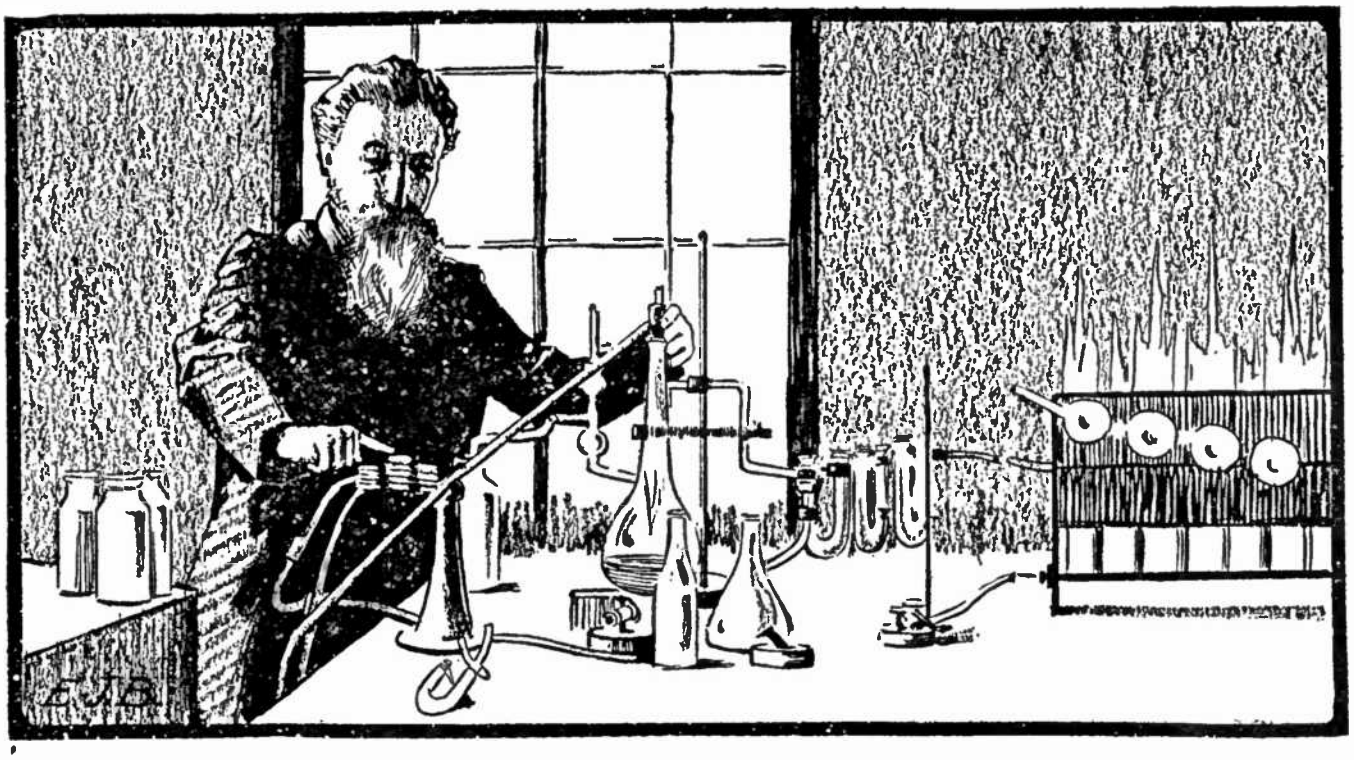
The simplest form bimetallic cell is the zinc-lead cell which employs positive plates of lead and negative plates of zinc in a solution of zinc sulphate; the action taking place during charging is the depositing of zinc upon the zinc plates and the forming of peroxide of lead upon the lead plates, the solution being decomposed into sulphuric acid. It is obvious that while the battery is charged and upon open circuit there is bound to be some local action taking place and unless the zinc is heavily amalgamated a charge will not be retained long. The E. M. F. of such a cell is quite high, about 2.5 volts, and is not very constant, ranging from 2.5 volts when fully charged to 1.5 at the end of the discharge.

A cell somewhat similar to that just mentioned is the copper-lead cell in which copper is substituted for zinc, and copper sulphate for the zinc sulphate. In this cell the local action is diminished, but the E. M. F. is considerably lower, being about 1.2 volts.

A few years ago a cell was put on the market using the same active material as the well-known Edison-Lalande primary cell, modifications being made to adapt it for use as a storage battery. It comprised a copper plate for the negative element and a thin steel plate for the positive element, in a solution of caustic soda and potassium zincate. The reactions taking place are somewhat complicated. While charging, zinc is deposited upon the steel plate and copper oxide is formed upon the copper plate; the reverse action taking place during the discharge. The E. M. F. is low, being about .75 volt. The watt output, however, is large, being about five times that of a lead cell of equal weight. The rate of discharge does not seem to effect this cell, and buckling of the plates is practically unknown. The great defect that handicaps this otherwise admirable cell is varying efficiency at different temperatures. In order to work most satisfactorily the cell must be kept at a temperature of 130 degrees Fahrenheit.

Many attempts have been made to produce a cell in which the above mentioned defects are eliminated, but these attempts have ended in failure or have been given up as impractical. Edison, however, has succeeded in producing a bimetallic cell in which the active material is peroxide of nickel for the positive plate, and finely divided iron for the negative plate. The electrolyte is a solution of caustic potash. The E. M. F. at discharge is about 1.5 volts. This type of cell has many of the good qualities of other bimetallic cells, but none of their defects. It has proven superior in many cases to the lead and sulphuric acid cell, and weight for weight it has a greater capacity and is more durable. But as the inventor himself has said, this is by no means the last word in storage batteries. In fact, he sees no reason why a cell could not be developed that would be far more efficient and durable than the present types of storage batteries now on the market, and when it does come it undoubtedly will be of the bimetallic type.—RICHARD G. WHIPPLE.

Success has followed forest planting on the sandhills of Nebraska. Jack pines planted there by the Government forest service ten years ago now have a height of over 15 feet and a 4-inch diameter.



In Practically Every Large Manufacturing Plant Where the Tempering of Steel Is an Important Factor, a Chemical Laboratory for Testing the Product Is a Paramount Necessity.

Plain Facts on Hardening Steel

By W. E. Thompson

THE hardening plants of all well systematized concerns are, without exception, equipped with some type of pyrometer for measuring the heat at which parts are to be hardened. Many concerns have all the different types at hand for checking purposes, but this is not necessary where a limited amount of work is handled. These concerns realize the value of the instruments, else they would not invest in them.

There are, however, hundreds of small shops, and some medium sized plants, that are losing a large percentage of parts, either by the development of cracks or deformations upon hardening; or having trouble with the parts after assembling due to a variation in the hardness of different lots carried through. The writer has found this to be the case many times and has also experienced considerable trouble convincing the owners that they needed a heat measuring instrument.

In one shop, making a specialty of small tools and dies, over 50 per cent. of the work was being spoiled by cracks, deformations, burning, or by reheating to unreasonable temperatures on account of failure to harden at the first trial, before the installation of a pyrometer. This loss was cut to 5 per cent. by measuring the heat. This was a case where each man did his own hardening, a gas furnace being used for heating. When the pyrometer was first installed, some of the hands were found heating straight carbon steels to a temperature of from 1800° to 2000° Fahr., and when asked their reason, stated that "the piece did not look hot enough to dip" when the gauge hand registered 1400°, (this being the heat recommended for the particular brand of steel being used). After

all hands were convinced that it was better to depend upon the meter than their own judgment, burned or improperly heated steel became only a matter of carelessness.

In another case, each man was hardening his own work in a modern gas furnace set close to the windows on the south side of the room, with only white curtains to cut down the light on bright days. Their experience had been that on some days the work would go through with little or no trouble (those days were rare), on other days the work would not harden thoroughly the first time dipped, and at other times nearly every piece would crack. Fifty per cent. of the work was being scrapped in this case also. In spite of this condition, it was six months before the firm would have a pyrometer put in. They finally had one in on trial, the loss was cut to 5 per cent., and to-day they would not attempt to harden without one.

In every place where an instrument was installed, it not only saved its cost in a short time but also made the hardening operation as easy as telling time by the clock. Faster and better work was the natural result and the strained look came off the toolmakers' faces. There is nothing more demoralizing to a tool or diemaker than to make parts over after fire cracking. It is just as reasonable to expect men to make fine tools with no measuring instruments as it is to expect them to heat steel properly without the proper temperature indicator. Poor results will be obtained in either case.

The writer has used electric, hot-blast, and sight or optical pyrometers with uniform success. Some care is needed when using an electrical instrument, to keep the electrical connections clean when the terminals of the cable connecting the thermo-couple with the meter are made of brass, as these oxidize rapidly, showing less heat at the meter than is actually produced in the furnace. These terminals should be made of copper to eliminate this trouble. Another trouble found when using the electrical pyrometer is the wearing away of that part of the tube enclosing the thermo-couple, which stays in the furnace, caused by the oxidization of the iron. When this occurs, the couple may be cut off, the ends twisted together and brazed, the enclosing tube cut off and tapped, and a new plug screwed into the end. The hot blast pyrometer gives little trouble but it is not as desirable to use for general work as the electrical method. The sight instrument is, without doubt, the most reliable meter, but requires more care in handling to prevent breakage, so is not as economical for general use as one fastened in its place permanently for that reason.

After the installation of a gas or oil furnace and a pyrometer, a set of rules, with a complete table of critical heat temperatures for all the different steels in use in the plant, should be placed within easy reading distance of the furnace. The following rules apply to any furnace used for hardening tools, dies, or other parts made of steel or high carbon steels, and should be followed to get the best results.

GENERAL RULES FOR THE USE OF THIS FURNACE

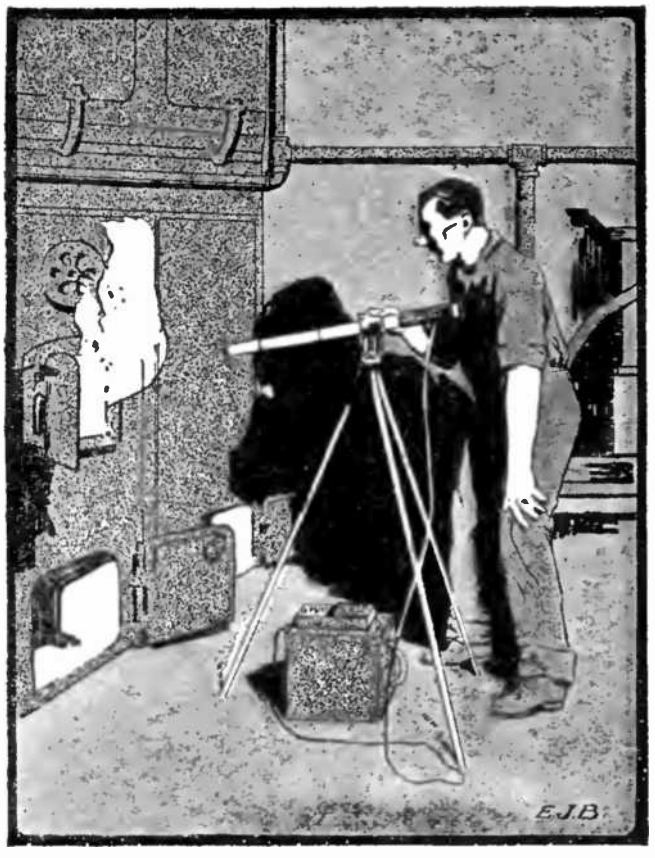
1. Do not use any cyanide or other case-hardening mixture in this furnace.
2. Do not heat any copper, brass, german silver, or other metal than iron and steel in this furnace as the fumes of such metals are injurious to steel having a high carbon content.
3. Boracic acid may be used in the smallest possible quantity to prevent the surface of steel scaling.
4. Parts to be hardened should be placed in the furnace when cold or at a temperature not exceeding 800° Fahr.
5. The full heat should not be applied when starting. Better to regulate the burners to about half blast and let the furnace heat gradually.
6. When the pyrometer registers the desired temperature, the burners should be regulated to maintain this temperature until the work is thoroughly heated.
7. Steel may be quenched in any conventional bath, but a method preferable for dies and parts liable to crack is—

   Dip the piece in clear water until all vibration ceases, then quickly into oil at 300° Fahr. The part should then be drawn to the desired temper in oil before it goes below 300° Fahr.

8. Dies or any part containing a depression in the surface should be dipped with this depression up.
9. Large pieces may be quenched in brine instead of water if preferred.
10. Prepare all work for hardening as much as possible by plugging holes unnecessary to harden.
11. Heat all steel to the proper temperature. See Table —.

A barrel of snow water, with a small percentage of salt in it, makes an excellent dip and improves with age. The use of vitriol should be discouraged—there is nothing to recommend it. Tool steel, properly heated, will harden thoroughly if quenched in clear soft water at ordinary temperature, provided enough water is supplied to cool the piece quickly. Brine is a slight aid when hardening large pieces but is not necessary. Small pieces may be dipped into cylinder oil at a temperature of 300° Fahr., and will harden as hard as necessary for all practical purposes. The danger of cracking or deforming is reduced by this dip. The temper should be drawn as usual after hardening in hot oil.

A good method to use for dipping all pieces liable to crack is that given in Rule 7. The steel is placed in the furnace cold or at a temperature not above 800° Fahr. While the work is heating, the oil drawing bath is brought up to 300° F. and kept at this temperature until after all the parts are hardened and in it. When the piece to be hardened is at the proper temperature it is dipped into the bath and held there until it can just be held in the hand under the surface of the water, it is then transferred quickly to the oil bath. When the hardening is all finished, the oil bath is raised to the desired temperature, by a thermometer, thus drawing all parts uniformly. This method reduces the chance of cracking to a minimum for the following reason: Steel, as a rule, develops cracks after it has cooled below 300° F., due to tremendous strains set up internally that are later relieved by drawing the temper, or in other words, raising the temperature of the whole piece to a point whereby these strains are equalized. The above method prevents these strains reaching a dangerous point.



The Heat of a Flame Cannot Be Determined by the Human Eye; a Pyrometer is Essential for Accurate Work.

The idea of dashing work from the fire into the bath is wrong, although a large percentage of workmen do this. It is generally well known among steel men that when a piece of steel, heated to a predetermined temperature, is taken from the furnace into the air, the surface of the steel rises suddenly to a higher temperature than the inside, then begins to fall again. With the exception of thin or very small pieces, liable to be air-cooled, the heated parts should not be dipped within one minute from the instant they leave the furnace—that is time enough for any work except very large pieces. If this policy is followed less cracking will result.

It is generally safe to dip small pieces of straight carbon steel at about 1400° F.—alloy steels at 1450°—and oil hardening steels at 1500° Fahr. Large pieces should be dipped at 25° to 50° higher.

The average workman labors under the impression that if a steel will harden at 1400° of heat, it should not be heated any higher. This is another mistaken idea. The makers, going to considerable

expense, obtain the best or critical hardening point of every grade of steel that they make and their instructions should be carefully followed, regarding the heat, to get the best results.

The hardening of small saws or very thin pieces may be accomplished by heating as usual and cooling between two comparatively large pieces of iron or copper, having their clamping faces the shape of the hardened piece, if not flat. If a large number of pieces of this kind are to be hardened, the jaws may be held by a frame and operated with the foot as in large plants, but if only a few pieces of this nature are occasionally required, the clamp irons may be handled by a helper when the hardener brings the work into place between them. When the work is hardened flat, as small saws and blades, the lower jaw is preferably laid in oil that just covers the face of the jaw. The saw is dropped flat on this face and the upper plate brought down quickly, the oil helping to absorb the heat. This is the only practical method of getting thin pieces hard and flat.

The tool steel furnace should be kept clean—this is very important. Cyanide of potassium and other case hardening mixtures not only spoil the lining of the furnace but also throw off fumes injurious to the tool steel and workmen alike.

Copper, brass or German silver should not be heated in the furnace as they also throw off fumes very injurious to high carbon steel, and the effects last even after the visible metal is removed. Sulphurous fumes are one cause of soft spots and nearly always prevent clean work.

Boracic acid is probably the best preventative of scale known for commercial use and it will not hurt the furnace if kept away from the lining. It is good practice when using the furnace to lay a piece of sheet steel on the floor of the heating chamber and the part to be heated on this plate; the boracic acid will run onto this plate which is easily cleaned.

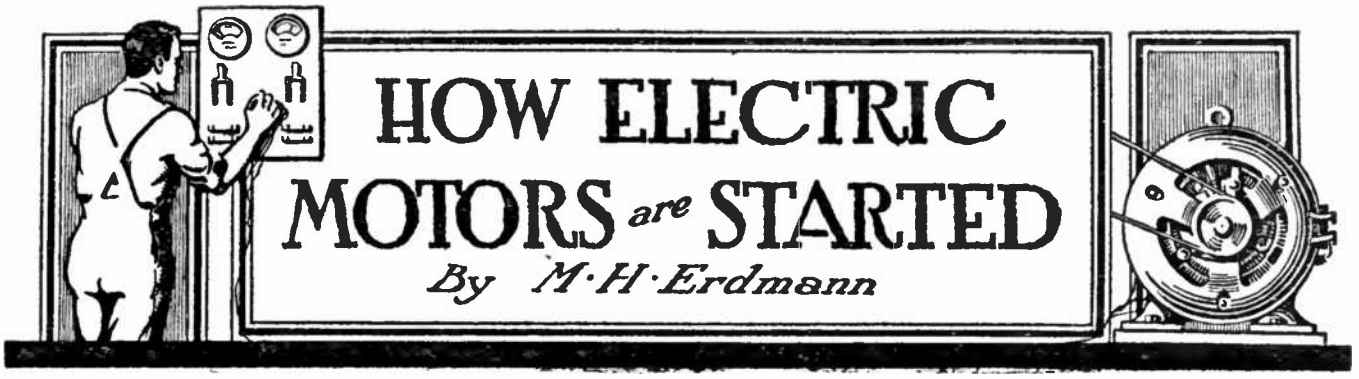
High speed steels, when intended for cutting tools, require to be hardened at a high heat, but when intended for hammering, swaging or striking dies may be hardened at about the same temperature as straight carbon steels. In either case, crystal borax used to prevent oxide forming is better than boracic acid for the protection of this kind of steel. Any borax adhering to the steel after dipping can be removed by placing the part in boiling water for a short time.

Dies and tools having a number of tapped or dowel holes should have these holes plugged with chalk or other non-burning filler. This prevents strains running across the surface strains and thus causing fractures.

In closing this article it might be well to state that although hardening is a purely mechanical operation, it is the most important of any in the making of tools and dies. The highly systematized plants appreciate this fact, and their chief hardeners are among the highest salaried executives. In the small shops, however, there is more chance to save on this operation than on any other, as, with exceptions, the owners either do not appreciate the importance of proper heat treating methods or do not know how to improve their condition. With the exception of seams in the rough steel, for which the makers are responsible, there is a reason for every crack. These troubles may be eliminated or reduced to a very low factor by a careful study and application of the information issued on this subject from time to time.

There is a way to successfully treat every case, but the application depends upon the man, or, rather, the development of his gray matter, as no set of rules ever issued will cover all cases. It is but another case where the human factor is the all-important agency in the successful performing of the work.

The forest service is co-operating with 54 railroads, mining companies, pole companies, and cities in making tests of wooden ties, timbers, poles, piling, and paving blocks which have been given preservative treatments.



HOW ELECTRIC MOTORS are STARTED

By M·H·Erdmann

TO attempt to describe in even moderately minute detail all the different types of direct current motor starters on the market today would necessitate a paper the reading of which would take up the greater part of three or four hours. In this paper, however, I shall endeavor to describe briefly the more common types that are in use and the various principles under which they operate.

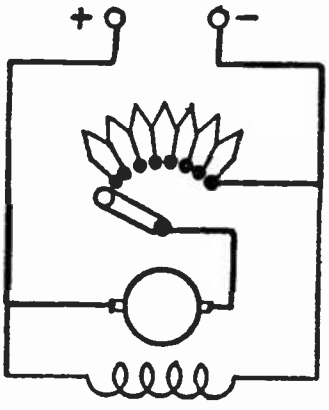


Fig. 1.—Connections for a Motor Starting Rheostat.

Wherever direct current motors of a larger horsepower than one-quarter are used it is advisable to employ some sort of a starting device to accelerate them, by means of which an external resistance in the motor circuit is gradually decreased until it is entirely cut out and the motor is receiving full line voltage at its terminals.

There are several methods of accomplishing this end, the original being to step-by-step short circuit the external or starting resistance by hand. The simplest way to do this is through the use of what is commonly known as a motor starting rheostat, a simplified connection diagram of which is shown in Fig. 1. There may, of course, be added to this starting rheostat such refinements as no-voltage release and overload protection, but the principle of operation is the same in any case. But at best this method is more or less unsatisfactory when applied to motors of say above 10 horsepower—unless a competent man is employed to start the motors—due to the fact that there always exists the tendency to accelerate them either too rapidly or too slowly. If the tendency is toward too rapid acceleration the current drawn by the motor will be excessive and either the line fuses will be blown or the motor windings will in time burn out. On the other hand, if the motor be accelerated too slowly the starting resistance, not generally being proportioned for continuous duty, will burn out. If the starting of large motors is to be done manually it is highly imperative that an ammeter be placed in the circuit and that an educated electrical man be instructed to watch the ammeter while he is accelerating the motor so that the current drawn from the line will not reach a dangerous point and that it does not flow through the starting resistance for a long enough

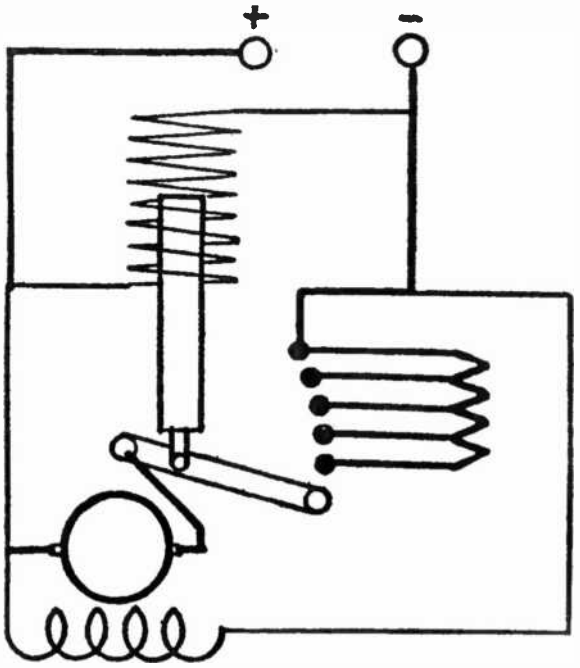


Fig. 2.—Diagrammatic Scheme of a Simple Automatic Motor Starter.

period to cause damage.

But think what such a procedure would mean in some plants where hundreds of motors are used and where a large percentage of them are each connected to an individual machine! It would mean the employment of a large corps of men whose sole duty would be to start and stop those numerous motors, in some cases many times a day. This is entirely out of the question.

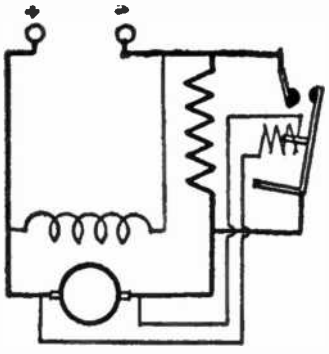


Fig. 3.—An Automatic Motor Starter Circuit.

The most expedient move, then, for the manufacturers to make is to install some type of automatic motor starting device whereby the motor under the control of each starter can be started, stopped or reversed by the mere pressing of a button or the throwing of one small handle.

When the need for an automatic starter became fully realized less than ten years ago by the manufacturers of motor controlling devices several types were developed. Among the first was what is commonly called the "dash pot" type, in which the plunger of a solenoid was mechanically connected to a pivoted arm which passed over segments on a slate base that were connected to the various taps taken off from the starting resistance. The plunger was prevented from being pulled up too rapidly by the action of the dash pot which could be adjusted to operate through a wide range of time units; *i. e.*, seconds or even minutes for very large motors having heavy loads to accelerate. See Fig. 2.

A slight departure from this type of starter is one which still makes use of the dash pot but gets away from the sliding contacts by utilizing a train of fingers to short circuit the starting resistance. These fingers are all fastened to one small shaft which is rotated through approximately twenty degrees by the action of the plunger in the dash pot. They are not rigidly fastened to the shaft but are so connected through the medium of springs that the shaft can twist slightly farther after the fingers have made contact. With such an arrangement provision can be and is made for the fingers making contact with their respective resistance tap lugs in a certain sequence. In other words, the starting resistance is cut out step-by-step.

It is a well-known fact that a pile of carbon discs or plates makes an ideal variable resistance, due to the fact that the surface contact resistance between the discs or plates varies inversely as the pressure applied. As the pressure is increased the total resistance of the pile decreases and vice versa. This principle is made use of by one of the manufacturers of motor controlling apparatus. The carbon pile resistance is connected in series with the armature of the motor exactly as would be a coil or cast-iron resistance. A dash pot is employed whose plunger operates a lever which increases the pressure on the carbon pile as the plunger pulls up. When the maximum pressure is reached an electrical circuit is established which short circuits the carbon pile and connects full line voltage across the terminals of the motor. With a starter of this type an absolutely uniform rate of current input increase to the motor is obtained by the use of the automatic starters described above.

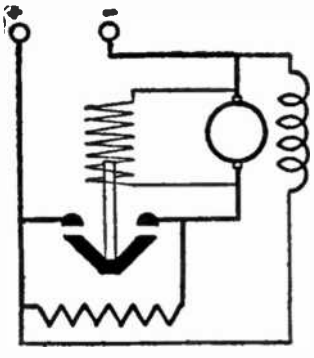


Fig. 4.—Another Automatic Motor Starter Circuit.

With a starter of this type an absolutely uniform rate of current input increase to the motor is obtained as against the step-by-step increase obtained by the use of the automatic starters described in the foregoing.

All dash pot types of starters have one very great drawback, however. This is the time element which is involved. With a certain adjustment of the dash pot the motor under the control of that starter will always be accelerated in the same amount of time no matter what the load may be. This is perfectly satisfactory

where the load to be started is always the same, but where the load is variable it is not so satisfactory. To accelerate a heavy load a longer time is necessary in order to keep the ampere input to the motor down to a safe value. Then again, when a light load is to be accelerated time is lost because the motor has time to attain full speed before the starting resistance is finally cut out.

An improvement over the dash pot type of starter is the one whose resistance cut out switches are actuated from the counter electromotive-force of the armature. As an accelerating motor increases its speed the counter electromotive force, if measured across the armature terminals, will be found to increase from zero as the speed increases, until at full speed when it is only slightly lower than the impressed voltage. Now consider a small solenoid-operated switch whose coil is so wound that it will pull the switch closed when the voltage across its terminals reaches a certain predetermined value. Then consider that this solenoid is connected across the armature of the motor and that the contacts of the switch are so connected that when the switch is closed it will short circuit a section of the starting resistance in the armature circuit of that motor. When the main line switch in the motor circuit is closed the solenoid has applied to its terminals a voltage equal to the counter electromotive force of the armature and, as the motor speeds up, this voltage increases until that value is reached at which the solenoid will pull the switch closed. In closing, the switch will short circuit the starting resistance and connect full line voltage across the terminals of the motor. See Figs. 3 and 4. If it is desired to incorporate more than one accelerating switch the coils of the following ones are so wound that they operate each at a higher voltage than the one immediately preceding it and all the coils are connected in parallel across the armature. Automatic starters employing the counter electromotive force principle have an advantage over the dash pot type in that the rate of speed increase of the motor being governed by the load and the rate of increase of the counter electromotive force being governed by the speed, it naturally follows that the time required for acceleration is automatically governed by the load. In other words, a light load is accelerated more rapidly than is a heavy one. This type of starter, however, has never been successfully applied to motors above three horsepower.

The ideal principle to utilize for accelerating direct current motors of any horsepower is what is called current limit acceleration, in which the current drawn by the motor during acceleration

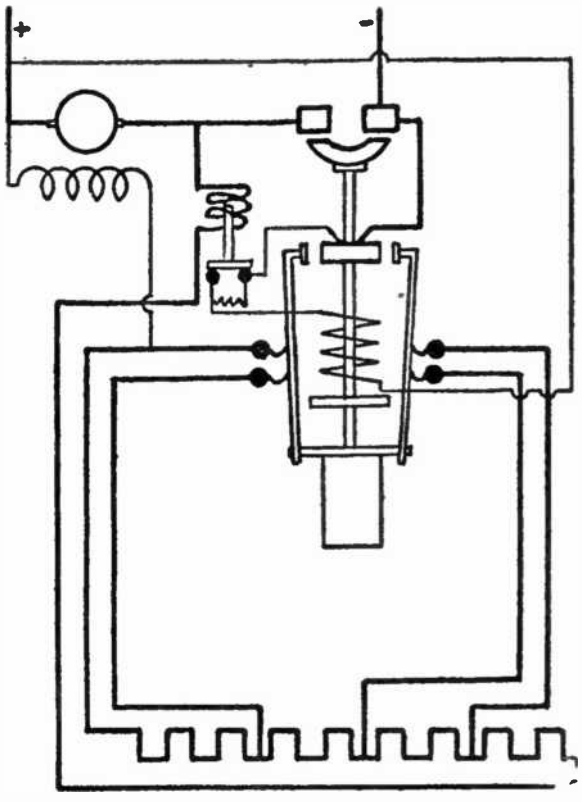


Fig. 5.—An Automatic Motor Starter Circuit in Which Current Limit Acceleration is Obtained.

automatically governs the proper length of time required to bring that motor up to full speed no matter if the load be light or heavy.

A rather unique type of automatic starter which accomplishes current limit acceleration in a way is the one shown in Fig. 5. A small series wound relay, set to raise its plunger at about 130 per cent. of the rated full load current of the motor, is connected in the armature circuit during acceleration. The lower end of the plunger is equipped with a copper disc which bridges across two studs that are connected in parallel

with a small coil of resistance. This resistance is in the circuit of the shunt wound solenoid which operates a plunger to close the resistance cut-out switches. A dash pot is used to keep this second plunger from being pulled up too rapidly. Now when power is applied to accelerate the motor the main plunger is pulled up through the action of the shunt wound solenoid and this closes the resistance cut-out switches in a predetermined sequence. But should the current input to the motor increase above 130 per cent. of the full load rating the series wound relay would raise its plunger and cause the coil resistance to be inserted in series with the shunt solenoid. This decreases the magnetic pull produced by the shunt solenoid to such a value that its plunger will not be raised any further until the motor current decreases sufficiently for the series relay to drop its plunger and cut out the resistance in series with the shunt coil. When the motor has attained its full speed and the accelerating resistance has been entirely short circuited, a curved copper brush makes contact with a pair of heavy lugs and forms a jumper around all the wires and leads of the starter, which are in the main motor circuit. Through the jig-dance action of the series relay during the acceleration of a heavy load, a sort of current limit acceleration is obtained, although it is not true current limit acceleration.

(*Concluded in the May number of* THE WORLD'S ADVANCE)

THE ROYAL ACADEMY

WHENEVER we see the words "Royal Academy" we naturally think of London. But there are four royal academies besides the British.

The Royal Academy of Arts was founded in 1768 by George III for the encouragement of painting, sculpture and designing; and Sir Joshua Reynolds, an American, was the first president.

The Royal Academy of Sciences at Copenhagen was founded by the King of Denmark in 1743. Then there is The Royal Academy of Sciences at Berlin founded by Frederick I in 1700. It is devoted to research in mathematics, physics, philosophy and history. And again there is The Royal Academy of Sciences at Stockholm founded in 1739 and now known as The Royal Swedish Academy. And still again there is The Royal Spanish Academy founded at Madrid in 1714. Its membership is limited to 24. The Imperial Academy of Sciences was founded at St. Petersburg in 1725 by Catherine I.

The French Academy was founded at Paris in 1635 by Cardinal Richelieu for the purpose of refining the French language and style. The Academy of Inscriptions and Belles Lettres (1663) and The Academy of Sciences (1666)—both founded at Paris by Colbert—and The Academy of Moral and Political Science (Paris, 1795), were merged with The French Academy and called The National Institute of France. Its membership is limited to forty, and these are known as "the forty immortals."

The others are: The Academy of Fine Arts at Paris founded in 1648, The Academy of Medicine at Paris, which is the national board of health, and The Academy of France at Rome.

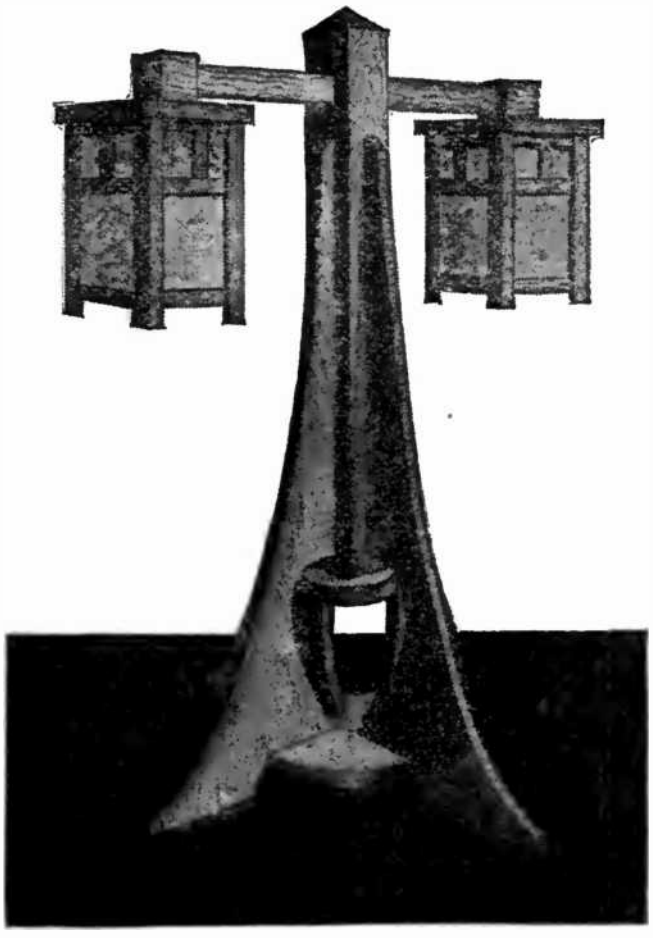
In America we have The National Academy of Design founded in New York City in 1826; and The Academy of National Sciences of Philadelphia, founded in 1812. The latter has the best natural history collection in the country. There is also The American Academy of Political and Social Science founded at Philadelphia in 1889, as well as The National Academy of Sciences founded at Washington in 1863 with a membership limited to 100; and the American Academy of Sciences and Arts founded in Boston in 1780.

(*Continued on page* 550)

A Table Lamp in Wood and Artglass

TO READERS who have followed the present articles, the design offered this month will appear exceedingly simple of construction, and so it is, for the difficult angles and complex features which, in other designs, may have made the builder wish he had four hands instead of but two, are conspicuous by their absence. The lamp presented herewith is, however, a project worthy of consideration both from the standpoint of appearance and general utility.

Following the custom established in previous articles, the complete bill of materials is given below and the wood should be ordered from the mill cut to size and sandpapered:



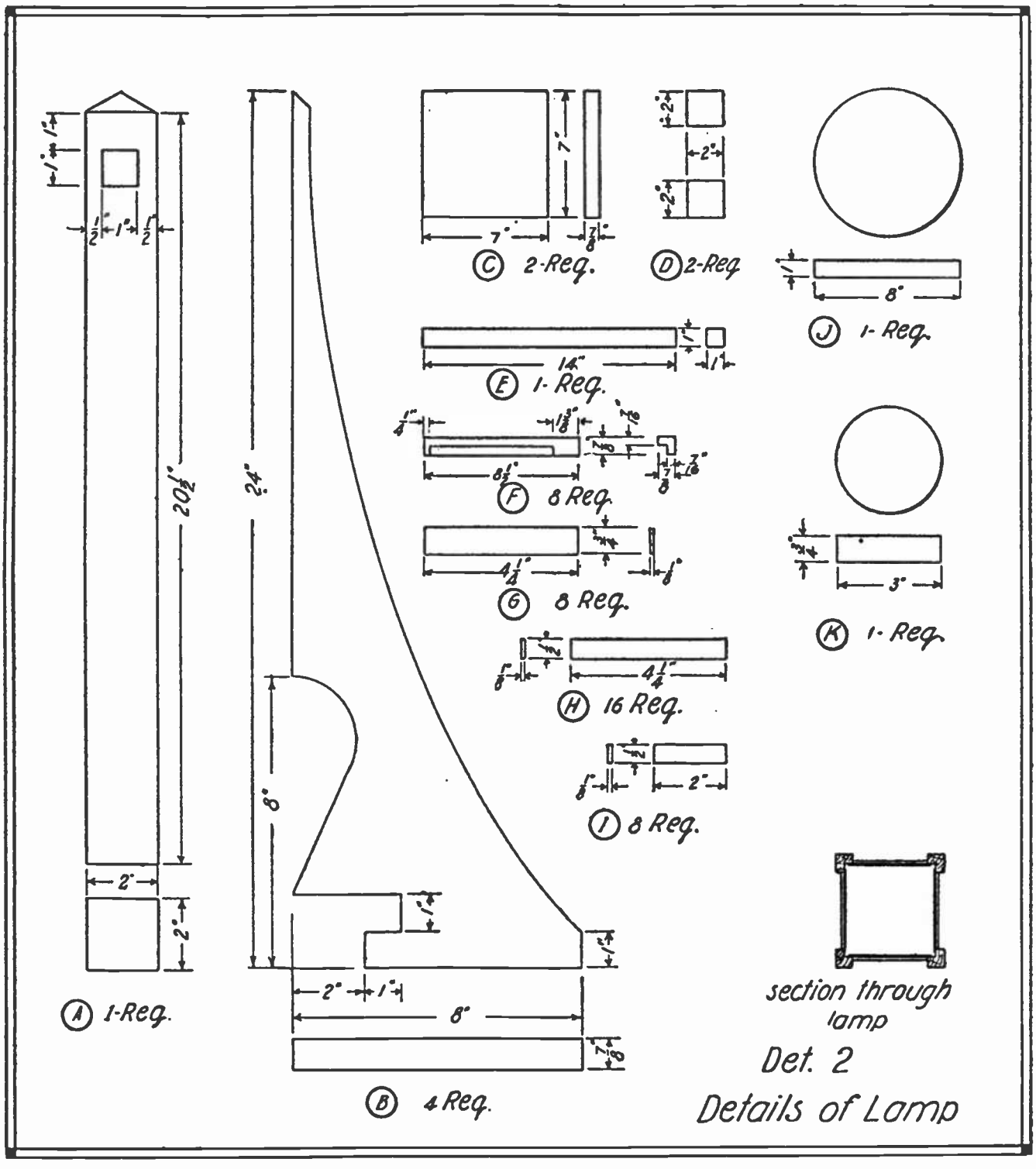
The Table Lamp Complete.

(*A*) 1-piece, 2x2x21 inch oak.
(*B*) 4-pieces, ⅞x8x24 inch oak.
(*C*) 2-pieces, ⅞x7x7 inch oak.
(*D*) 2-pieces, 2x2x2 inch oak.
(*E*) 1-piece, 1x1x14 inch oak.
(*F*) 8-pieces, ⅞x⅞x8½ inch oak.
(*G*) 8 pieces, ⅛x¾x4¼ inch oak.
(*H*) 16-pieces, ⅛x½x4¼ inch oak.
(*I*) 8-pieces, ⅛x½x2 inch oak.
(*J*) One disc, 1-inch thick by 8-inch diameter oak.
(*K*) One disc, ¾-inch thick by 3-inch diameter oak.

In addition to these, there will be required eight pieces of art glass of the desired shade to fit the sides of the lamps and two lamp receptacles to be screwed to the inside of the top of each lamp.

The construction of the lamp requires but little comment. The square hole is cut through the top of the main post *A* to pass the cross bar *E* which carries at its extremities the lamps proper. The parts of the latter are assembled in the manner shown with glue and brads. The latter should be well set and the holes filled with a paste wood filler mixed with the stain to be used on the framework of the lamp. The decorative slats *G*, *H* and *I*, are let into the corner posts and glued before the glasses are inserted.

The conductor from the electric lamps may be passed through the cross arm and down through the center post if the workman is ingenious. The trick may be done by drilling entirely through the cross bar and also through the center post with a fairly good sized bit. The flexible lampcord is then passed through the cross bar from end to end and a long steel wire with a hook bent in its

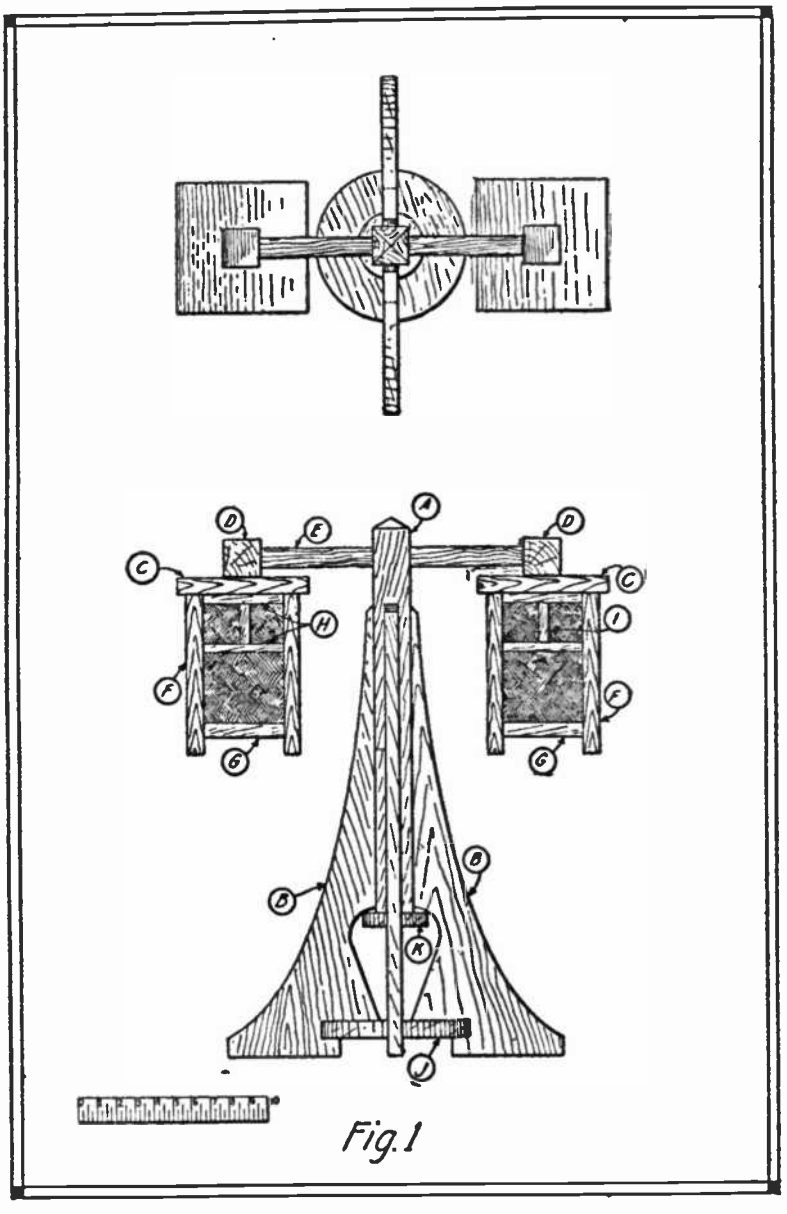


Details of Lamp Parts Showing Dimensions.

end is sent up through the center post and hooked over the cord. With the exercise of a little care and patience the cord may be drawn down through the post without injury to the insulation. The exit through the disc at the bottom of the post is a natural and graceful one and appearance of the wire is entirely inoffensive as it is led away to the wall or floor pocket.

No dimensions are given on the finished drawings of the completed lamp, but a scale is appended in order that the reader may readily take the dimension of any portion by cutting the scale from the page and using it on the drawing. In the detailed drawings, however, the reader will find each part accurately dimensioned.

The woodwork may be stained to harmonize with the decorations of the room in which the lamp is to be used.



Elevation and Plan Views of Completed Lamp.

AN UPSTAIRS SHOPPING DISTRICT

Do your shopping upstairs. That is the modern idea which has been developed in Los Angeles, Cal., where a nine-story office building is devoted almost entirely to retail stores.

The Title Guarantee Building in the heart of the shopping center was built especially for this kind of business and, although it was a decided innovation, three-quarters of the space was leased before the structure was completed. The ground floor is devoted to conventional business establishments; the mezzanine is given over to the Title Guarantee Company, and eight floors above are built with wide corridors lined on either side with plate glass store fronts that display goods quite as effectively as those on the street. One noteworthy feature is that no artificial light is required during the business hours.

Oddly enough, no attempt is made to keep the rival firms out of the proximity of their competitors. Indeed, the tendency is for certain floors to become centers for certain lines of business: thus the jewelers are on the fourth floor, the tailors on the fifth, the piano dealers on the seventh.

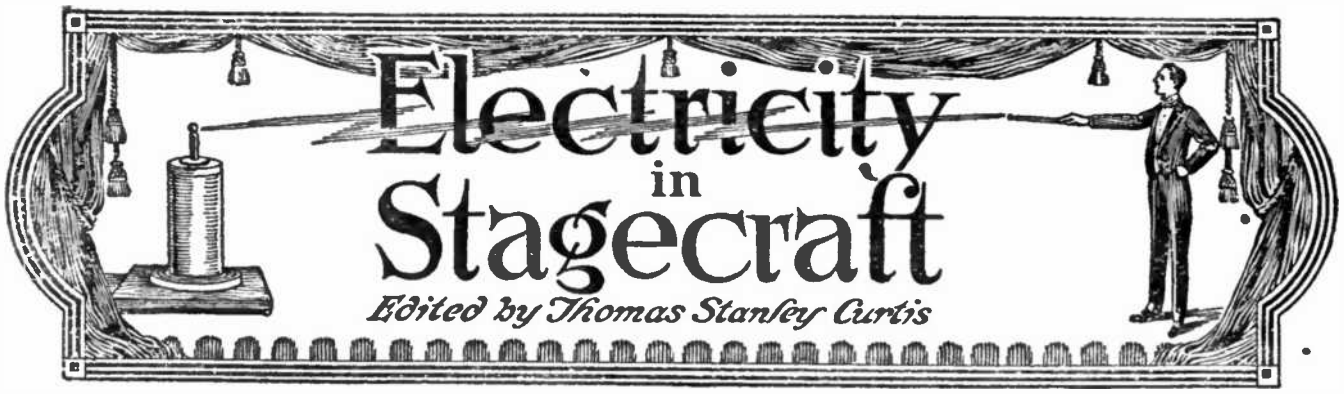
Altogether there are ninety-nine stores in this upstairs shopping section, and on the ninth floor there is additional area used as workshops for tailors, etc., so that the valuable display space can be put to best use.

The number of visitors to the building has been checked up during the year that it has been in operation, and an average of 10,000 a day is computed. The exclusive character of the business conducted there makes it especially restful after the crush of a bargain counter in the department stores, and that feature alone draws much valuable patronage.

Electric signs on the building invite attention to the novel features within, and the merchants get together and run their newspaper advertisements in a space together, thus making a better display for all. The idea will doubtless be widely copied, as it has proven highly successful.

ELECTRIC GATE OPENER

In England a gate opener, electrically-controlled from a distance, has been placed upon the market. The actuating mechanism for the gate is a spring motor which furnishes the power actually used to open the gate. The electric current, sent from a considerable distance perhaps, is used merely to release a catch which permits the gate to open under the impulse of the spring.



Experiments with the Low Voltage Transformer

IN THE last article appeared a description of the apparatus necessary to produce a current of very low voltage but of great volume. Such a current may be applied to the requirements of the popular science entertainer in a number of ways and the space available in this department will permit of but a brief outline of the many interesting experiments it is possible to produce.

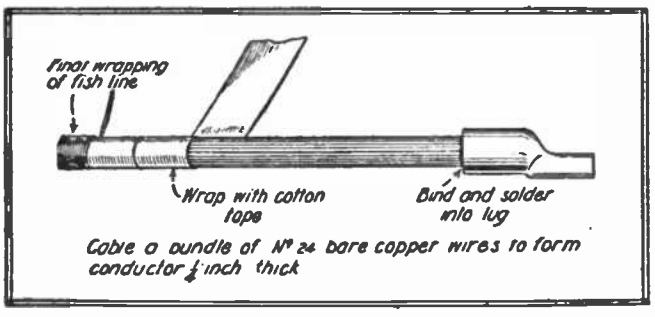


Fig. 11.—Showing Method of Insulating Cable.

As a necessary adjunct to the transformer described last month may be mentioned a pair of heavy cables to conduct the current from the secondary of the transformer to the appliances with which the experiments are to be performed. Such cable may be purchased in an electrical supply store, but it is likely to be rather too stiff for the requirements of the performer. For this reason the author suggests that the worker make his own cable, and the appended illustration (Fig. 11) shows how this may be done. A coil of No. 24 bare copper wire is cut into sufficient ten-foot lengths to make up two bundles of wire each ¼ inch in diameter when the wires are tightly bound together. The end of one bundle of wires is forced into a substantial lug and very carefully soldered to insure that a perfect electrical connection is made. This lug is then gripped in a vise and the wires are stretched individually and collectively along the bench with the ends held securely when the stretching has been done. A wrapping of cotton tape is then wound throughout the entire length of the cable starting at the end with the lug and finishing temporarily three or four inches from the other end where the tape is

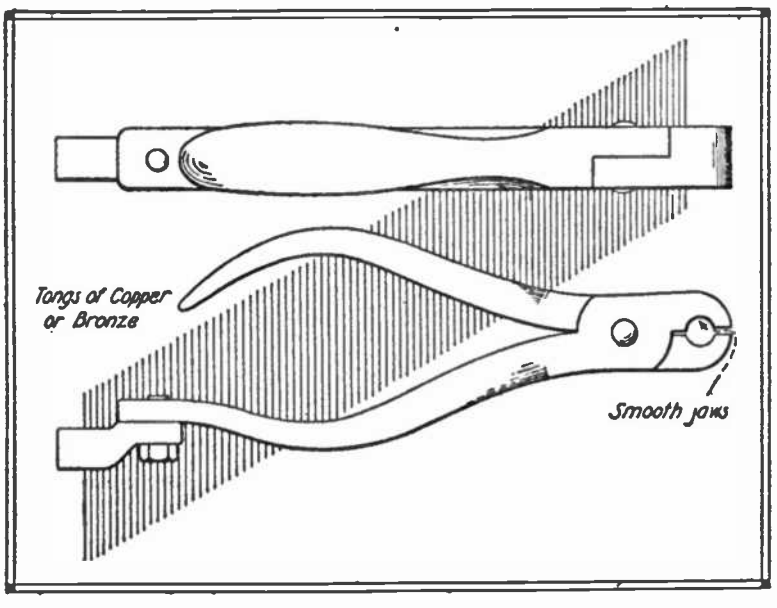


Fig. 12.—Elevation and Plan Views of Special Bronze or Copper Tongs.

bound with wire to keep it from unwinding. Again starting at the lug end, a layer of fine, hard fish line is wound around the cable and over the tape, finishing the covering of the cable. Before cutting tape and line at the finishing end the wires are to be cut off squarely and inserted into a second lug which is carefully soldered as in the case of the first one. The tape and line may then be brought up to the lug and finished off. The same process is repeated with the second bundle of wires to form a cable similar to the first.

The only other adjuncts necessary for the simpler experiments with the transformer are two pairs of tongs or clamps to which the cables are fastened. In Fig. 12 the reader will note a suggestion for a pair of tongs of suitable design, and if the worker is a fairly skilful pattern-maker he can make a pattern from which a copper or bronze casting may be made. Failing in this, he may use a dismantled pair of iron tongs or gas pliers for the patterns, making such changes as may be necessary with the aid of a bit of hard wax. The illustration is just one-half the size of the finished tongs used in the author's outfit, and it will not be safe to use a lighter weight of copper as the tongs heat up pretty well after the current has been on a few minutes. The lug of the cable is fitted to the handle of the tong, as shown in the illustration.

"The Steel Will Quickly Discolor and Become Red and Then White Hot."

Assuming that the transformer has been set up, the worker will be anxious to try it out. The tongs may be grasped with the bare hands as the voltage of the secondary is so low that practically no shock will be perceptible; however, if the performer's hands are tender or susceptible to perspiration, the handles of the tongs may be dipped in white lacquer which will be quite invisible when dry but which, at the same time, acts as an effective insulator. The tongs having been connected to the transformer secondary by means of the cables, and the 60-cycle alternating current circuit through a 30-ampere fused switch, the performer may grasp a piece of ¼-inch steel rod about two feet long in the jaws of the tongs and have an assistant turn on the primary current. The steel will quickly discolor and become gradually red and then white hot. At this stage the current should be turned off and the performer should place a pair of gloves on his hands, explaining to the audience that, as they have just seen, the current passing through his hands has no effect whatever upon him, but that the intense heat so near his hands is worse than unpleasant. The heavy gauntlet gloves in place, the experiment can be carried to the stage of white heat, at which point the steel is almost plastic and the rod can be bent easily into a

(*Continued on page* 550)

Plant Culture by High Frequency Current

Part II. Construction of the Condenser

IN the design of the condenser for our purpose, one or two primary requisites have constantly been borne in mind. The condenser is subjected to practically continuous use for several hours at a time and it is obviously essential that ample radiation surface be provided in order that the plates may remain cool. Coupled with this highly important point may be mentioned the importance of eliminating all corona or brush leakage around the edges of the tinfoil plates. These requirements are ordinarily met with in an oil immersed condenser, but the latter, to be efficient, should employ only oil as its dielectric and such a condenser presents constructional difficulties not easily conquered by the amateur workman. As the next best solution of the problem, the design for a glass plate condenser of large heat-radiating surface and of substantial construction is offered in this article.

For its construction the condenser will require 120 plates of glass 8 by 10 inches of the kind used for photographic negatives. Old plates of the latter sort may be purchased cheaply from nearly any photographer and they serve the purpose admirably. The first step is to remove the emulsion coating on each plate by soaking it in hot water and scraping with a putty knife. The plates are then to be dried thoroughly and divided into four piles of 30 plates each. The complete condenser consists of four units, of 30 plates each, connected in series mul-

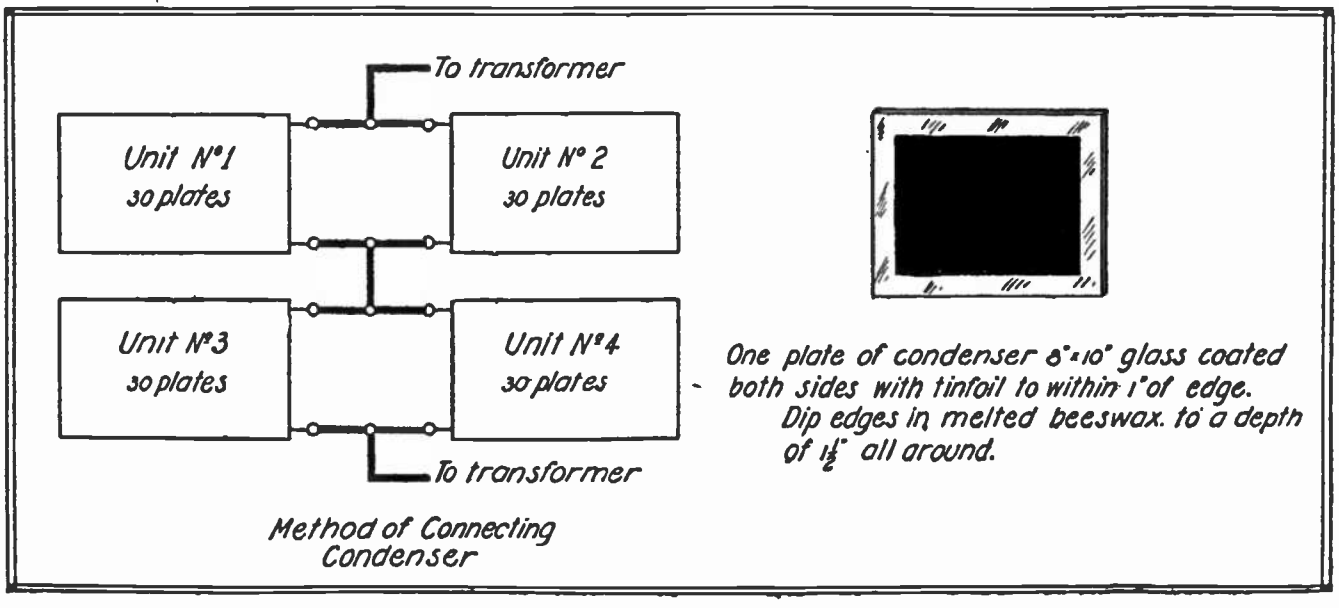


Fig. 1.—Showing Method of Connecting the Four Units of the Condenser and Also One Plate of Condenser With Tinfoil in Place.

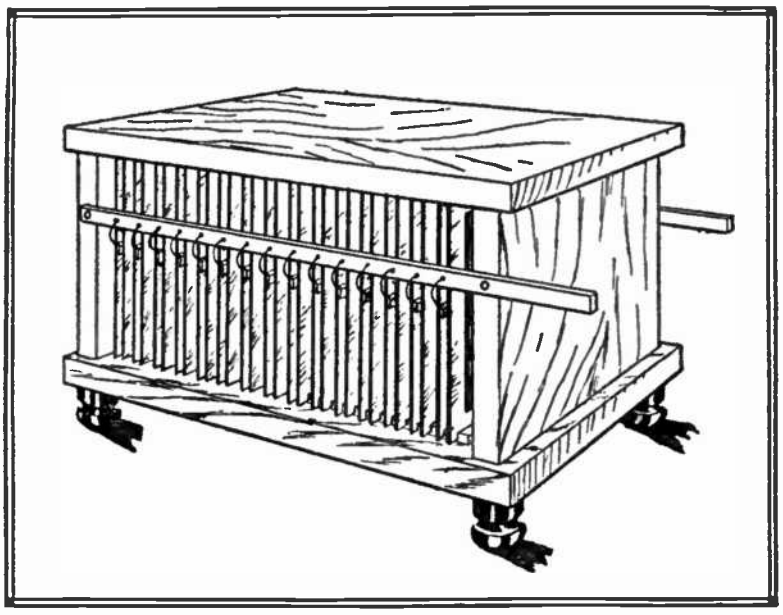


Fig. 2.—Perspective View of One Unit of the Completed Condenser.

tiple as shown in Fig. 1, and in order to make the description clearer the steps in the construction will be given for but one of the four units, which are alike in every particular.

A good grade of varnish gold size is procured and placed on the worktable with a good soft brush about an inch in width. Tinfoil of the grade used by florists may be procured in pound packages containing four or five strips of foil six inches wide and perhaps 48 inches long. The foil is to be cut up into pieces 6 by 8 inches in size, neatly flattened and separated ready to be applied to the glass plates, which should be arranged in a pile on the table. A plate is removed from the pile and given a quick, thin coating of the varnish (which dries in twenty minutes in the open air) and a sheet of foil immediately laid upon it, care being taken to see that the foil is accurately centered on the plate. The foil may be forced into smooth and close contact with the glass with the aid of a wad of cotton placed within a piece of soft cloth to make a sort of pounce or dauber. Starting at the center of the foil sheet and carrying the rubbing process toward the edges with a circular motion, the workman will be able to force the foil into what is practically absolute contact with the glass, and at the same time cause the surplus of varnish to exude from the edges.

The plate is then turned and coated on the other side in exactly the same manner; the process is repeated with each of the thirty plates in each of the four units until the 120 plates have been coated. The lot may then be laid aside to dry in a warm room for several days. When this has been accomplished, each plate is to have its edges dipped into melted beeswax to a depth of 1½ inches in order that the edge of the tinfoil on both sides may be thoroughly coated with the wax. This will quite prevent the corona or brush losses so frequently noted with glass plate condensers.

The rack in which the plates are to be mounted may next claim our attention. Its construction may be noted in Fig. 2, which gives a perspective view of the complete unit. The reader will see that the support comprises a baseboard and cover of wood separated by two end pieces. The plates slide in grooves formed by ½-inch square strips of wood nailed to the base and cover. A bar of ⅛ inch by 1 inch copper runs across from one end piece to the other on either side and affords a means of connecting the many plates in multiple. This connection is accomplished by means of the special contact leads shown in Fig. 3. These leads are merely pieces of lamp cord tipped at one end with a lug and at the other with a contact made from a piece of spring brass ribbon bent into the shape shown in the drawing. The object of the contact is to establish con-

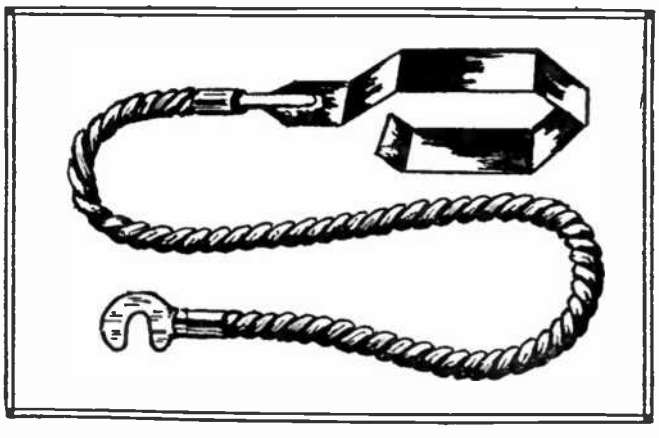


Fig. 3.—The Special Connector With Its Contact and Lug.

nection between both plates of tinfoil when the spring is inserted.

In making the connections to the bars on either side, the contacts are alternated in order that the plates may all be in multiple. That is, referring to Fig. 2, in starting to insert the contacts, on the one side the first contact spring is inserted between the first and second plate; on the other side the contact would be between the second and third; returning to the nearer side, the second contact is inserted between the third and fourth plates, and so on until all have been put in place. The contact with the first and last coatings are of course made by inserting the clip between the tinfoil and the wooden end piece, placing a small sheet of glass between the spring and the wood to prevent the metal coming into contact with the wood.

When the four units have been made as described, they are to be connected up as shown in Fig. 1, the connecting leads being strips of copper ribbon. The setting up will receive due attention, however, in a later article, when the rest of the apparatus has been described.

EXPERIMENTS WITH THE LOW VOLTAGE TRANSFORMER

(*Continued from page 547*)

U shape. A few minutes more and the steel actually burns up in the performer's hands, sending forth a shower of sparks in all directions. In order to protect the eyes and clothing from the sparks, it is well to wear a helmet and a large leather apron to completely cover the person. This dress has its psychological effect upon the audience also.

The transformer may be used to weld together two pieces of iron rod held in tongs and brought together; spot welding of sheet iron may be done if a device is built to provide sufficient pressure at the contacts; a mass of metal may be brought almost to the melting point if placed in a crucible and the terminals inserted; and, in fact, countless other experiments, many of which will suggest themselves to the possessor of the transformer, may be performed.

A most effective stage setting is one of dark purple velvet in the form of a cave-like affair. Practically all of the electrical experiments should be performed in semi-darkness in order that the effect may be striking. The fusing of copper and zinc rods held in the tongs with the stage dark makes one of the most startling experiments the author has ever beheld.

THE ROYAL ACADEMY

(*Continued from page 542*)

But why the word academy? The academy was a gymnasium in the suburbs of Athens in which Socrates and Plato taught the Greek youth who flocked to them. Socrates' discourses were of a moral nature. Hence, learned men when investigating, generally form themselves into an association and call the association an "academy."

MOTOR ROLLER SKATING THE NEW SPORT

Not long since a young New Yorker startled the natives by whizzing down a broad avenue on a pair of roller skates which appeared to be imbued with some supernatural power that made it unnecessary for the skater to move a muscle of his body. The mystery was solved when the observer noticed a tiny electric motor mounted on the rear of each skate and connected with one of the rollers by means of a small chain drive.

The storage battery furnishing the electric current for the motors was carried in a belt around the skater's waist and seemingly the weight was so slight as to be of no consequence.

Practical Electro Therapy

Edited by Thomas Stanley Curtis

High Frequency Apparatus*

IN DESCRIBING the internal construction of the high frequency coil it is thought best to divide the subject up under the several headings indicated by the various pieces of apparatus, within the case. To this end, therefore, the reader's attention is first called to

THE TRANSFORMER

The alternating current taken from the house lighting circuit at perhaps 110 volts is passed through a suitable controlling switch to the primary of the transformer. The function of this device is to change the intensity or voltage of the current from that suitable for lighting lamps to one many hundred times higher. The principle of the transformer has already been discussed in these columns, but for the benefit of the lay reader it may be said to be briefly as follows: When an alternating current is made to flow through a wire, a similar current will be produced in a second wire placed beside the first but having no connection with it. If the two wires be wound into coils and the coils placed side by side, the effect is greatly enhanced, and if a mass of laminated iron be placed within the openings in the coils the effect shows a very marked increase. This property of the alternating current is known as "induction" and the current produced in the second wire is said to be induced by that in the first. The voltage of the current induced in the second wire is in direct proportion to the ratio between the number of turns of wire in the first and second coils. Therefore, if the first coil contains one hundred turns and the second coil one thousand turns, the voltage induced in the second coil will be ten times that applied to the first. Accordingly, let us assume that in our transformer there are five hundred turns of wire in the first coil or *primary,* as it is called, and thirty-five hundred turns in the second coil or *secondary.* If we impress a voltage of 110 on the primary we shall have a voltage of thirty-five times 110 or 3850 volts at the secondary terminals.

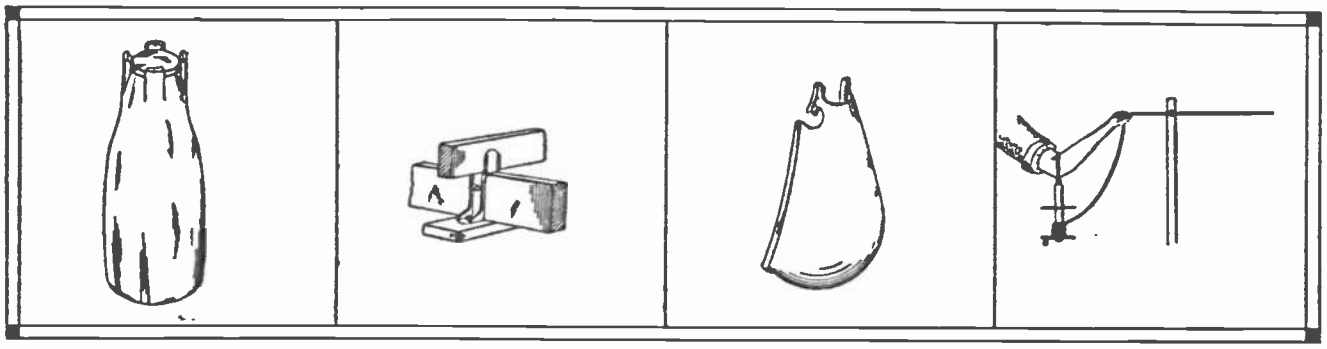
This high voltage makes it necessary to employ highly specialized methods of insulating the windings of the transformer for the tendency of the very high potential current is to leap through the air for a fraction of an inch or to tear its way through even the best of insulators unless they present sufficient resistance to its pressure.

In the next article we shall see how this high voltage is applied to the operation of the apparatus and what measures are taken to safeguard the patient from the dangerous current.

*This article is the second 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.

THREE DEVILFISH TRANSPORTED FROM HAWAIIAN ISLANDS

Three giant octopi, or Pacific devilfish, have been safely transported from Hawaii to San Francisco, where they will be on exhibit among other strange and unusual types of sea life in the Hawaiian building at the Panama-Pacific International Exposition. These sea-terrors will be carefully confined in a large tank of sea-water.



Recent Novel Patents

An Odd-Shaped Bottle

A bottle of odd design is the subject of a patent granted to an Indiana inventor. As shown in the accompanying illustration, the upper portion of the bottle is fitted with four spring members that serve to hold a stopper in the form of a cap firmly in place. It is obvious that a bottle of this kind can be readily and effectively sealed, while its opening is also a simple matter.

Clamping Device

A metal clamping device, shown in one of the sketches, is the subject of a patent secured by a Western inventor. It consists of a piece of metal made in such a form as to permit it to hold in place two pieces of wood crossing each other at right angles, and is provided with a base by which it may be screwed on another piece of wood. This clamping device should undoubtedly prove of great value in certain lines of carpentry work.

A Sanitary Breathing Shield

A member of the United States Navy is the inventor of a novel sanitary breathing shield which is illustrated in one of the accompanying illustrations. The shield consists of a framework that serves to hold the resilient material forming the shield proper. Nose clips are provided so that the shield may be readily worn without the necessity of straps or other inconvenient holding members.

Clothes-Line Reel

A clothes-line reel, comprising a rotatable spool, a shaft on which the former revolves, and an arm ring, is the invention of a Wisconsin man. The accompanying sketch illustrates the device and shows how it is actually used.

Drawing Board Support

A convenient drawing board support has been patented by a Chicago inventor and is illustrated in one of the accompanying sketches. It is so designed that it may be fastened to any table. Suitable hooks hold the bottom of the drawing board, which rests against the rear support. The angle at which the drawing board is held may be altered at will. The device is made to fold up completely so that it may be easily carried about.

A Cuspidor Lifter

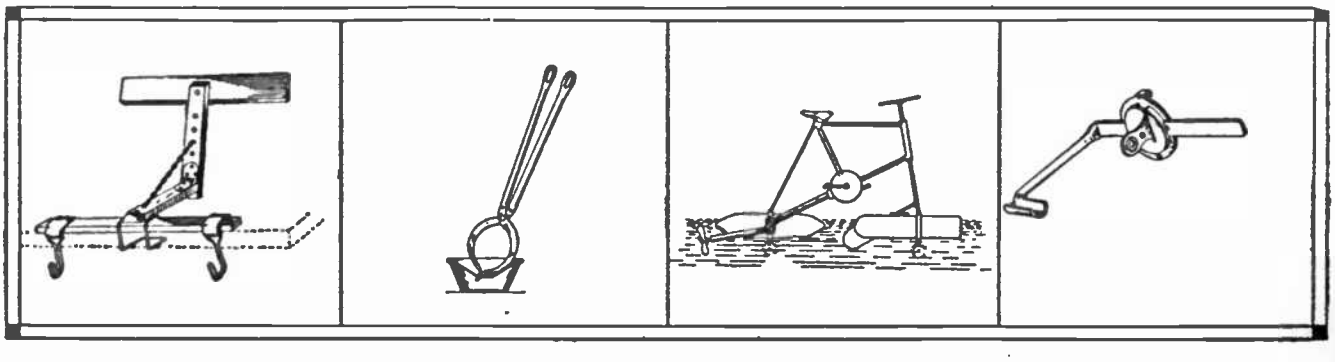
A Kansas inventor has recently been granted patent rights on a cuspidor lifter. This implement consists of two pivoted handles terminating at their lower ends in bowed jaws. According to the claims of the inventor, the jaws are inserted in the hole of a cuspidor and the latter can then be carried about and cleaned without the necessity of actually handling it as is now customary.

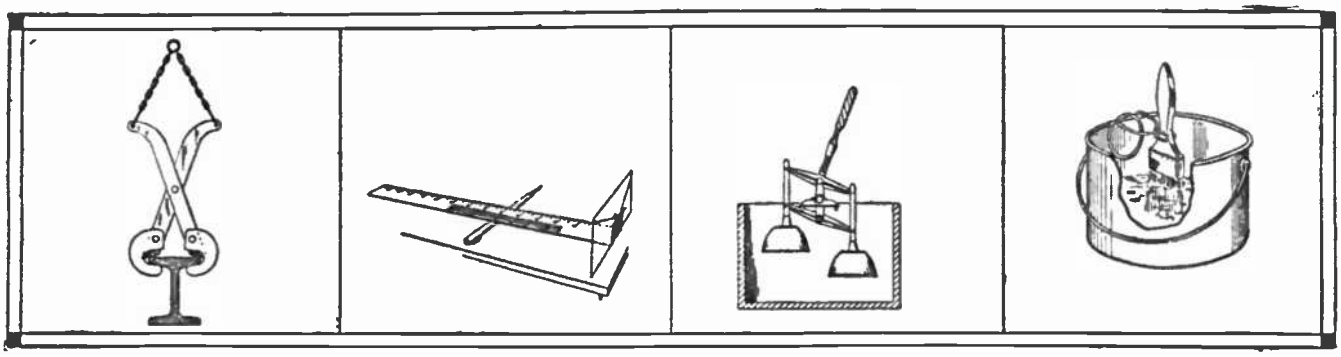
A Bicycle Boat

While numerous bicycle boats have been patented in the past, the one just patented by a Philadelphia inventor has several interesting features. His craft has the usual bicycle frame. In the rear it is fitted with two floats between which is placed a propeller driven by a shaft drive from the pedals. In the front, directly below and operated by the handle bars, is another float that is utilized to steer the water vehicle.

Improved Window Shade Bracket

A Pennsylvania inventor has just patented a combined window shade bracket and curtain pole holder that presents considerable ingenuity. As shown in the sketch, a part of the device is made to screw on the framework of a window and does not differ essentially from the usual window shade bracket. To this part of the device is fitted an arm that terminates at one end in a holder for curtain rods, the other end being bent and held in the shade holder base so as to slide either way to accommodate curtain poles of different lengths.





A Safety Beam Grip

A safety beam grip is the subject of a patent recently secured by a New York inventor. As shown in the accompanying sketch, his invention consists of a beam grip comprising two main pivoted members and two pivoted jaw pieces. The device is so designed that when the lifting power is exerted on the chain the jaws firmly grip the beam and cannot become loosened accidentally.

A Postal Scale Ruler

A Wisconsin inventor certainly deserves much credit for his exceedingly clever invention which is in the form of a combined ruler and postal scale. As shown in the sketch, his device resembles a conventional ruler with the usual markings on one edge, while on the other edge are special markings relating to the weight of mail matter in ounces. At one end of the ruler is provided an upright piece for holding a letter or other mail matter in place while it is being weighed. A round pencil is slipped under the ruler to act as the fulcrum and the ruler is then shifted along the pencil until it balances. The markings nearest to the pencil indicate the weight of the mail matter held on the end of the ruler.

A Washing Machine

A compact, hand-operated washing machine is the subject of the patent granted to a New Yorker. His machine consists essentially of a container for holding the clothes to be washed and the water, a system of levers actuated by hand power, and two bowl-shaped members that alternately plunge into the container. The lever action is so designed that the plungers work in a vertical axis. Clothes are washed in this machine by pushing the handle back and forth for a certain period of time.

Paint-Brush Holder

Nothing is more annoying than to have the handle of a paint-brush become covered with paint or varnish, caused by its slipping into the liquid or rubbing against the sides of the can or other container. To eliminate this trouble an inventor hailing from Colorado has devised a simple holder of bent wire that may be attached to any can and will hold the brush in the center of same.

Attachment for Handsaws

A Canadian inventor has recently secured patent rights on a simple attachment for handsaws that serves the purpose of blowing away sawdust as fast as it is formed while sawing through a piece of wood. Not only does this lighten the task of sawing, but it also enables the workman to see the saw cut and accordingly makes for accurate work. The device is simply a rubber bulb, fitted into the handle of the saw and equipped with a spout that points downward towards the work.

An Improved Spike

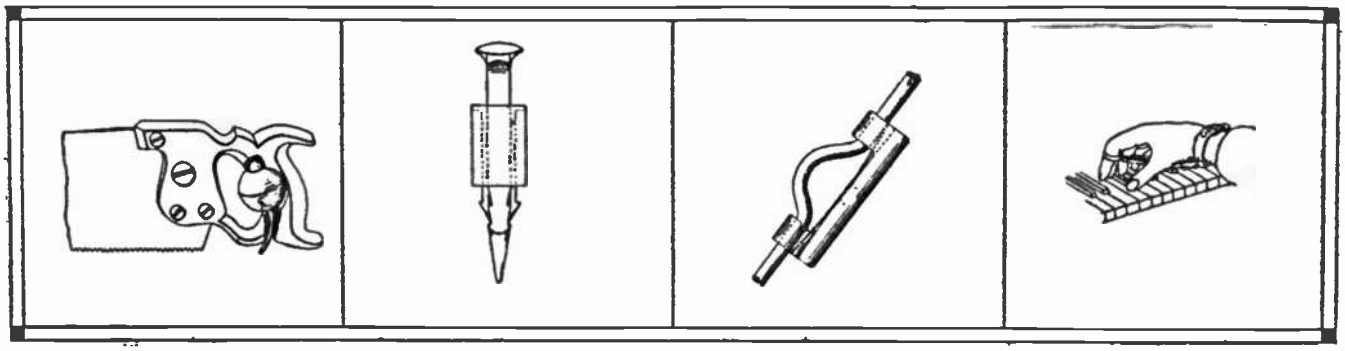
Much ingenuity is displayed in a recently patented form of spike invented by a Tennessee native. As shown in the accompanying sketch, his form of spike consists of a principal member with a barbed point, and a sliding member containing a split sleeve. The action of the spike is quite obvious if the drawing is studied. As the point is driven into a piece of wood the action is quite conventional until the spike has been driven in as far as the sliding member, successive blows causing the sliding member to move upward and the sleeve to spread out and become firmly anchored in place by means of the barbs.

Lamp Cord Adjuster

Nothing could be very much simpler than the cord adjuster recently patented by a Pennsylvania inventor and illustrated in one of the accompanying sketches. The cord adjuster consists of a piece of insulating material of the shape illustrated, as well as a spring that presses at both its ends against the lamp cord passing through the device. The cord adjuster is so designed that it can be slipped on any lamp cord without the necessity of taking off the socket or disturbing the connections in any way.

Finger Trainer for Pianists

A New York inventor has devised a novel arrangement to be worn by persons learning piano playing. The invention consists of an adjustable wrist band to which are connected by means of straps several loops that are placed around the fingers of the hand. The arrangement serves to hold the wrist and fingers in the proper position and thus trains the learner to hold his or her hand correctly.



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 wldest 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.

In reply to the many requests of our readers as to where they may obtain call books with both the United States and foreign calls, we will say that there is not published in this country a complete call book the same as the one for United States stations only. All United States calls, including those of amateur stations, are published in a call book which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for fifteen cents. The complete list of international calls may be obtained only from the International Telegraphic Union at Berne, Switzerland. The Marconi Yearbook, however, contains a reasonably complete list of international calls, and in addition a map showing the principal wireless stations of the world. This book may be obtained from our Book Department

PRIMARY CELLS.

(29) H. Frankland, New York City, asks:

Q. 1.—What is the amperage of the average wet cell and of the average dry cell?

A. 1.—The amperage which it is possible to get from a cell will depend on the resistance of the measuring device used. If an ammeter of low resistance is used the ordinary wet cell, such as is employed for bell work, will give about 5 amperes on a short circuit. Dry cells vary from 25 to 35 amperes; small flashlight cells from 5 to 10 amperes. The type S Edison caustic of soda cell will give from 30 to 35 amperes. None of these cells will stand this rate of discharge for any appreciable length of time.

Q. 2.—Is a battery of Grenet (bichromate) wet cells suitable for operating a wireless spark coil?

A. 2.—Yes.

Q. 3.—Does a multiple connection of cells increase the voltage?

A. 3.—A battery made up of cells connected in multiple would have the same voltage as a single cell, but its internal resistance would be less, and accordingly the output would be greater. A cell has a definite voltage regardless of its size. Its internal resistance, however, decreases with increase in size. The capacity in ampere-hours increases with increase in size, so that while the voltage remains the same for all sizes of the cell, the output in watt-hours will increase as the size is increased.

RADIO SET.

(23) C. M. Patch, Dubuque, Ia., writes:

Q. 1.—I am working on a one kilowatt set with an end in view of having it theoretically as well as actually correct in every detail. There are several questions of more or less technical nature pertaining to the glass plate condensers that I am working on which I desire to get advice on. Good advice is hard to get and with the knowledge and experience you have, I am sure you are in a position to help me out better than anyone else. The capacity of a transmitting condenser, designed to balance up well with the inductance of an oscillation transformer to tune to a 200 meter wave, as I understand, is determined by dividing 1,000 × the power in Kw. by the number of cycles per second × the secondary voltage, squared. In my case I have one of Clapp-Eastham's 1 Kw. type E (12,000 volt secondary) transformers to use on 110 volt, 60 cycle supply. This figures 0.00000001157 Farads. Multiplying by 1,000,000 changes it to 0.01157 M.F.

My idea is to build four units of 0.01157 M. F. capacity with a little additional capacity which I may use or not, just as is necessary. Then I will connect these four units in series multiple so as to avoid too much strain on the plates. Will ⅛-inch glass be necessary or will 1/16-inch be sufficient?

A. 1.—The 1/16 should be sufficient.

Q. 2.—Clapp-Eastham state that 12 plates coated with 6 by 8 inch pieces of tinfoil should give sufficient capacity for each unit.

Do you think that this statement is correct?

A. 2.—Yes, this will give sufficient capacity.

Q. 3.—How can I fasten the tinfoil on and what should the condenser be immersed in?

A. 3.—The condenser may be immersed in transformer oil. An excellent way to fasten the tinfoil on is as follows:

Place the plates in a moderately warm oven and heat them for five minutes; remove them and rub the surface with beeswax. The tinfoil should have rounded corners, and just before it is spread over the surface of the glass, a piece of copper ribbon should be slipped underneath, making a lug for connections. Spread the tinfoil on the other side in the same manner, and when completed paint the edges with hot beeswax. Beeswax is far superior to shellac because it does not blister like shellac. It is the blistering which causes most of the failures in plates.

Q. 4.—Can I mount the condenser on one side of a panel switch-board and use switches mounted on the other to cut in additional amounts of condenser?

A. 4.—Such a method might be permissable if it were not necessary to reduce the length of leads to an absolute minimum. The 200 meter requirement makes it necessary to use very short leads, too short in fact to permit such a convenient method of connecting up condenser plates to be used.

FIELD AND ARMATURE DATA.

(24) H. H., Helena, Mont, asks:

Q. 1.—Can a certain laminated field and a short-circuited armature be utilized for making a practical motor, say for driving a small lathe, washing machine, etc.? Outside diameter of stator sheets is 7⅝", outside diameter of rotor is 3½", both being 2" thick. There are four field poles, and rotor has 17 one-quarter inch copper rods. Motor has been rated as 3-phase, ½ h. p.

A. 1.—Unless you have been seriously mistaken as to the construction of the stator, the motor could not have been operated on a three-phase circuit, there being no way to wind four poles for such a supply. It certainly appears as an ordinary single-phase fan motor, but far from ½ h. p., say 1-10 h. p. You will not find efficient "power" motors for alternating current circuits with the definite sort of poles used for direct current machinery. You should have numerous internal slots, say not less than 24, wound in the manner clearly described in Watson's articles.

COATING IRON WITH TIN.

(25) J. E. T., Plessisville, P. Q., asks:

Q. 1.—How can a cast iron vessel be coated with tin? He states that if he can succeed in doing such work he will take a fine position, and get plenty of work.

A. 1.—We are sure that if you could find out how to do this you would indeed get a fine position—you might readily expect a million dollars for the process, but no one as yet knows how to do it.

CHANGING MOTOR WINDING.

(26) E. B., North Attleboro, Mass., asks:

Q. 1.—How to adapt a 110-volt 125-140-cycle fan motor to a 60-cycle circuit?

A. 1.—Your motor has either eight or ten poles, but for the lower frequency circuit it should have only four poles. If your motor has eight poles, you can reconnect them so as to have two adjacent poles North, the next two South, and so on, giving a partial equivalent of half the present number. The operation of the motor, however, will be uneconomical.

INTERNATIONAL SIGNAL CODE.

(27) C. V. Williams, San Jose, Calif., asks:

Q. 1.—Kindly give list of all Official Abbreviations and the International Signal Code or where same can be purchased.

A. 1.—The International Signal Code is not a set of abbreviations intended to be sent by wireless, but instead is a flag code. There are flags to represent every letter in the alphabet and words may be spelled out by means of these flags. To make transmission more rapid there are sets of abbreviations used to designate common nautical expressions. The code may be found in many nautical books and you can doubtless obtain a copy from the Government Printing Office at Washington. There is also another set of signals known as distant signals. These are formed by hoisting cones, balls and drums. As the cone has two positions there are four characters available, each of which is designated by a number. Common expressions may be formed by these symbols according to the International Code.

Q. 2.—If this list is not of the International Signal Code then please state their meaning: 6, 73, 10, 21, 121.

A. 2.—As previously mentioned there are but four characters available so we do not believe that the numbers you heard were the equivalent of the distant signals sent by radio. Perhaps what you heard were abbreviations used by some particular line. "73," of course, is the common greeting expression. We have no interpretation of the others mentioned. If, however, the numbers were the equivalent of the distant signals the only two capable of interpretation are 21 and 121. The former means "immediate assistance wanted" and the latter "I am aground." Perhaps some of our readers may have further information as to what these signals were and we would appreciate it if they would send in their opinion in order that the subject may be more fully discussed.

RADIO SECTION

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

SOLVING THE AMATEUR'S DIFFICULTIES*

Helpful Information Tending to a Better Understanding of the Radio Law and Increased Efficiency of Apparatus.

By E. E. Bucher

Instructing Engineer, Marconi Wireless Telegraph Company of America.

IN the March issue of MODERN MECHANICS there appeared the first part of this article dealing with the solving of the amateur's difficulties. Continuing the discussion:

OSCILLATION TRANSFORMERS.

It is believed by many amateurs that in order to emit a pure wave to comply with the United States regulations, it is necessary to construct an elaborate inductively coupled oscillation transformer in place of the single coil helix generally used. There can be no denial of the fact that a transformer of the former type allows rapidity of adjustment unattainable by the plain "helix," but practically the same results may be produced with the latter.

Referring to the diagram in Fig. 3, let *AB* represent an ordinary direct coupled helix. Let us say, for example, it consists of 8 turns of wire spaced ½-inch, each turn 12 inches in diameter. If the capacity of the condenser *C* is of such value that in order to obtain a wavelength of 200 meters in the closed oscillatory circuit but ½ turn or less is required between points *E* and *D* for resonance, it is evident that the mutual inductance between the closed oscillatory circuit and the antenna circuit is of small value. Therefore, the emitted wave will approach a single frequency of as pure a character as may be expected from a "loose-coupled" oscillation transformer.

Take a similar case as shown in Fig. 4. The oscillations in the antenna circuit take the path through the helix from *A* to *B*, while those in the closed circuit take the path *D* and *E*. Since the active turns of either circuit are some distance from one another, the mutual inductance is correspondingly small and, if sufficient space intervenes be-

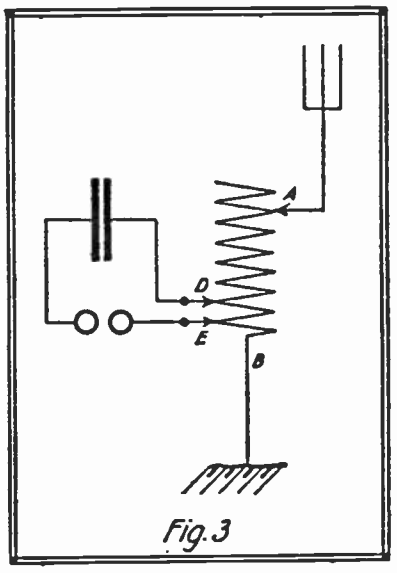


Fig. 3

Connections for an Ordinary Direct-Coupled Helix.

*The first part of this article appeared in the March issue of MODERN MECHANICS. The subjects covered in that issue were: Aerials and the Law, Transmitting Condensers, and Rotary Gaps.

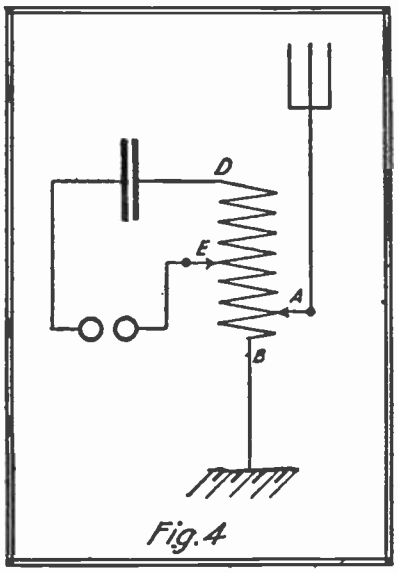
tween the active turns, a wave-length of single frequency is emitted from the antenna circuit.

It should be clear, then, that an inductively coupled oscillation transformer is not required to comply with the United States laws, and that a single coil may be employed if used in the manner shown in the preceding paragraph.

RECEIVING TUNERS.

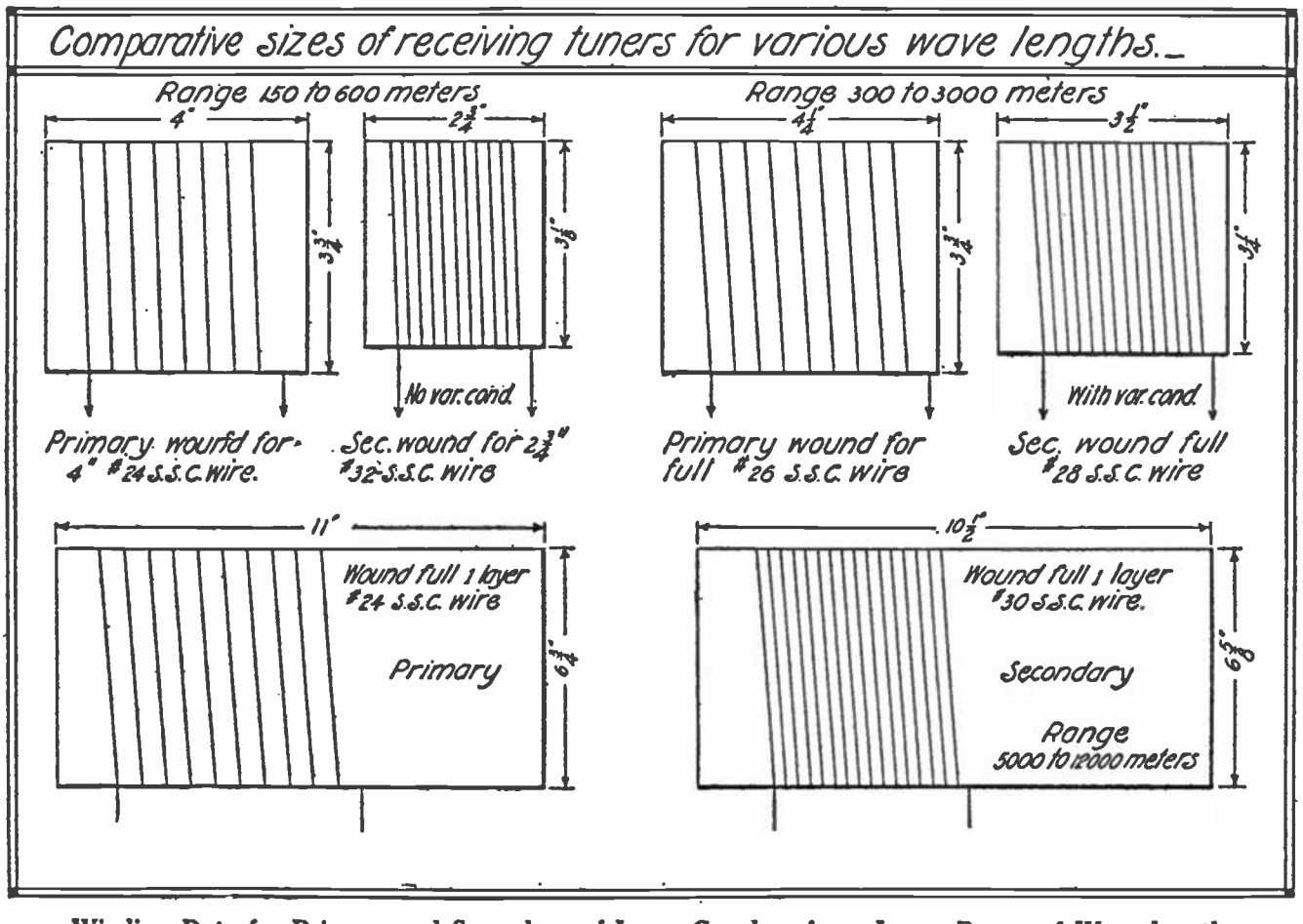
Many amateurs are in doubt concerning the proper dimensions of a receiving tuner for their work. Some attempt to build a receiving tuner having an enormously wide range of wave-lengths, making no provision for the elimination of dead-ends. If the tuner is to be used for wave-lengths up to 600 meters only, the windings can be very small indeed. For instance, a cardboard tube 3⅛ inches in diameter wound for a distance of 2¾ inches with No. 32 wire, gave a secondary winding of sufficient length to tune to wave-lengths of 600 meters. Now the size of the primary winding to correspond with this secondary winding for 600 meters cannot be definitely given, as the size of the aerial with which it is to be employed is not known.

If the progressive amateur desires to receive waves of greater length, an inductively coupled receiving tuner for tuning to wave-lengths of 3,000 meters may have the following approximate dimensions:



Another Scheme of Connections for a Helix.

The secondary winding should be 3½ inches in length and 3¼ inches in diameter, wound closely with No. 28 wire. If this winding is shunted by a condenser of 0.001 Mfds. capacity, the circuit is resonant to wave-lengths up to 3,000 meters. The primary winding for this same tuner may have a length of 4¼ inches and a diameter of 3¾ inches,



Winding Data for Primary and Secondary of Loose Couplers for a Large Range of Wave-lengths.

wound closely with No. 26 S. S. C. wire. With an antenna having a natural wave-length of about 350 meters, this winding will receive wave-lengths up to 3,000 meters. If the antenna has a natural period of 160 meters the primary winding must be proportionately increased or a loading coil added in series with the winding as described.

Amateurs who desire to receive the longer wave-lengths with a considerable degree of efficiency should erect two aerials, one of short wave-length for transmitting on the 200-meter wave and the other of greater length for the reception of signals from the high power stations.

A single wire aerial is quite sufficient for receiving, providing the wire has a fair degree of conductivity. Such an aerial for wave-lengths up to 10,000 meters should have a flat top length of at least 1,000 feet—preferably 2,000 feet—the height being decided upon by the amateur. Of course, a wire of this length is not suitable for the reception of 200-meter signals. For maximum results the short wave signals must be received on the smaller transmitting aerial.

A 200-meter aerial is fairly suitable for the reception of wave-lengths up to 3,000 meters, but for bringing in stations above this value it will be necessary to resort to a longer aerial.

Amateurs living in the open country are not required to erect an aerial especially for the reception of long wave-lengths, but instead they may use the telephone line connected to their own residence. The aerial binding-post of the receiving tuner may be connected to one side of the telephone line, the ground binding post being connected to a short wave condenser in series with the earth connection. If the series condenser is of small value—0.001 Mfds. or less—it will not interfere in any way whatsoever with conversation taking place on the telephone line, nor will the one tapping in on this line be able to hear telephonic communications. It has been found possible on an ordinary telephone line, to receive messages from high power stations at a distance of 3,000 miles. Fig. 5 illustrates the scheme of connections.

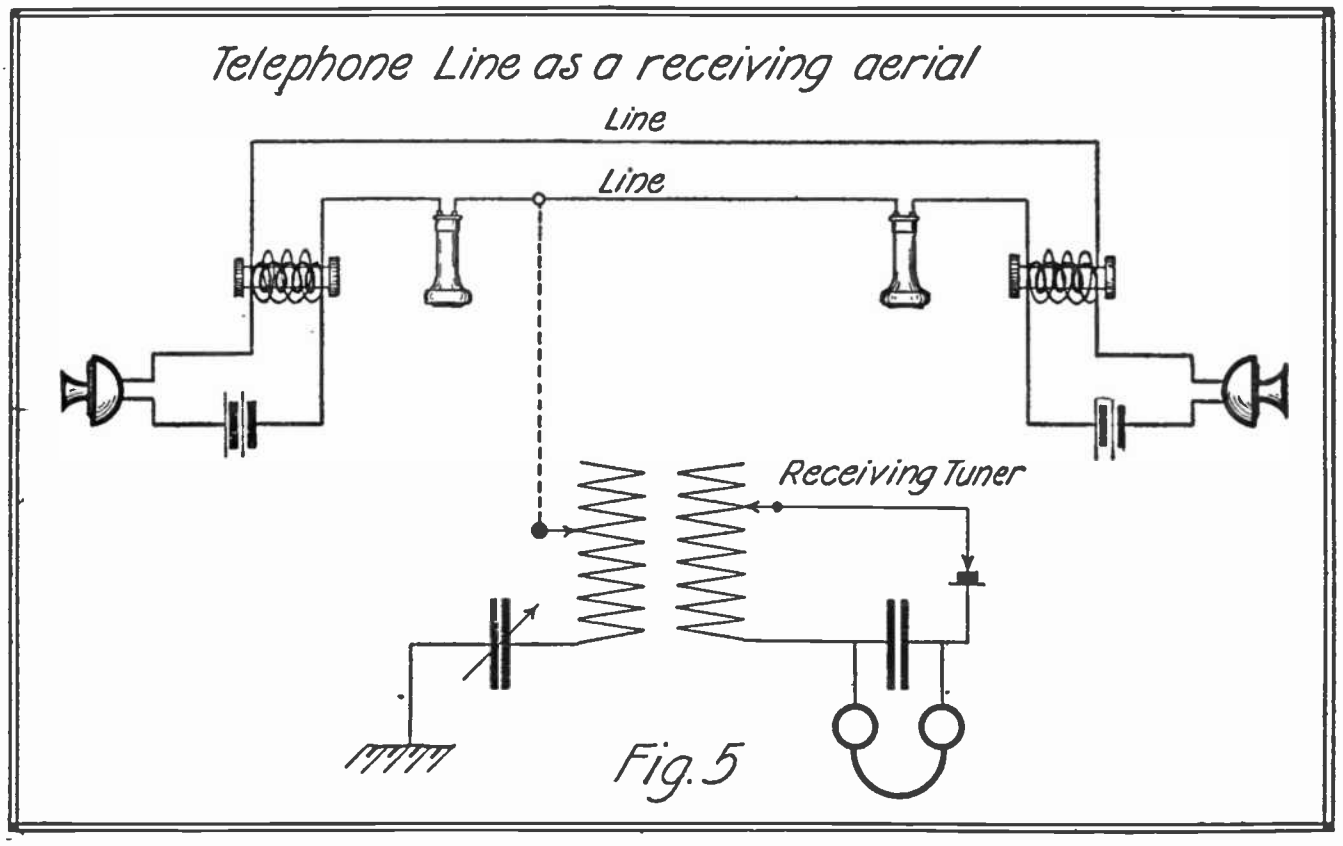
Many amateurs are interested in knowing the dimensions of a receiving tuner for very long wave-lengths and accordingly the following may be of value:

The secondary winding should be 10½ inches in length on a form 6⅝ inches in diameter, wound closely with one layer of No. 30 S. S. C. wire. When this winding is shunted by a condenser of 0.0003 Mfds. capacity it gives a wave-length value of 7,500 meters, and with a variable condenser of greater capacity it will quite readily afford adjustments to a wave-length of 10,000 or 11,000 meters. The primary of the same tuner may be 6¾ inches in diameter and 11 inches in length. It is wound closely with one layer of No. 22 or 24 S. S. C. wire. This receiving transformer should be used in connection with an aerial at least 1,000 feet in length and preferably longer.

In the dimensions of the receiving tuners as given so far, the size of wire for the secondary winding has been purposely selected for use with detectors of the crystal type. If the amateur intends to employ the audion as the receiving detector and desires to receive the maximum strength of signals with a minimum of losses due to distributed capacity, he should not hesitate to make the secondary windings of wire as small as No. 36. This affords a maximum potential which is necessary for increased strength of signals.

The audion is essentially a high resistance detector and therefore requires a considerable value of potential for the best results. If a condenser is used in shunt with the secondary winding, it should always be one of small value and its maximum capacity in no case should exceed 0.0001 Mfds.

In connection with receiving tuners, it is a fact worthy of consideration that the maximum strength of signals is obtained with practically all types of detectors when the inductance of the secondary winding predominates rather than the capacity; that is to say, when the capacity in shunt is of small value as compared to the value of the inductance for a given wave-length. On the other hand, better syntonic effects are secured



Connections for Employing a Telephone Line as a Receiving Aerial.

at the receiver when the value of the secondary inductance is small and the shunt capacity proportionately large, provided the coupling is correspondingly decreased.

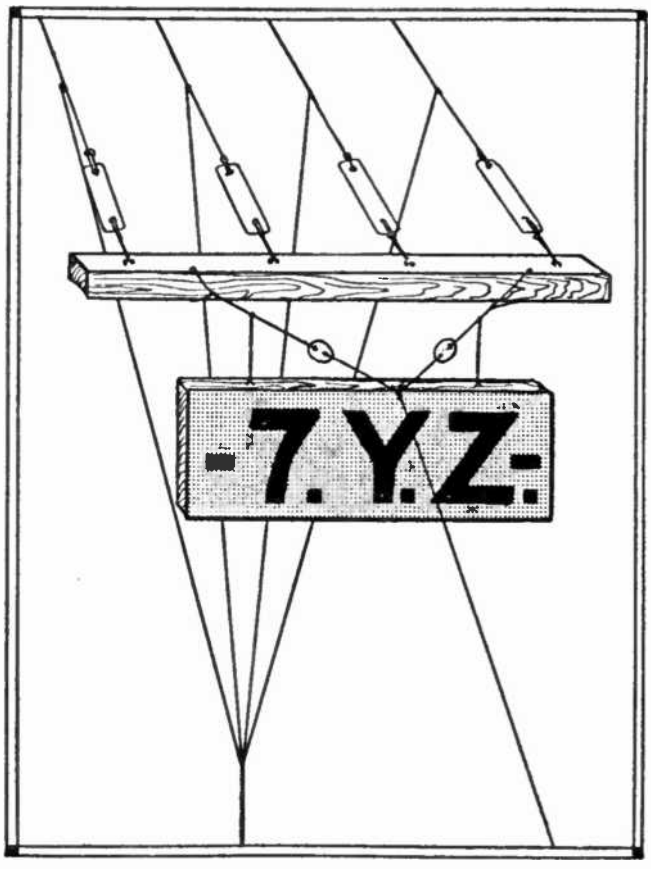
In an early issue of THE WORLD'S ADVANCE the writer will discuss testing buzzers and the testing of receiving transformers, bringing to light many new points that are not generally known.

WESTERN AMATEURS SEEK TO OPERATE THEIR INSTRUMENTS AGAIN

In the Sixth Radio District, which embraces California, Utah, Nevada, Arizona and Hawaii, the amateurs have been refused permission to either send or receive, ever since the war in Europe began. Rear-Admiral Pond of the Twelfth U. S. Naval Inspection Department, placed the ban on the wireless amateurs, much to their regret.

The Government's intention was to prevent a breach of the neutrality regulations, on the supposition that the amateurs might send information to foreign ships, California's coastline extending some seven hundred miles along the Pacific coast. The amateurs are certain they could be trusted to observe the rules of strict neutrality, and a movement has been started to induce Admiral Pond to raise the ban. The Sunset Radio Association of San Francisco, of which Walter Maynes, a licensed operator, is president, has taken the matter up and is circulating petitions throughout the entire Sixth District for the signatures of amateur operators, the intention being to present these petitions to Admiral Pond and induce him to lift the ban on amateur wireless.

The amateurs pledge themselves to a strict observance of the nation's neutrality, and hope to be placed on their honor in the matter of sending and receiving. All operators in this district are eagerly availing themselves of the opportunity to sign the petitions and thus boost the good work. These petitions may be secured by addressing either Walter Maynes, President, 207 Hugo street, San Francisco; Carroll Reed, Secretary, 1683 7th avenue, San Francisco; or Howard Lee, 1580 Grove street, San Francisco.



By Means of a Small Sign Hung On the Spreader of an Aerial, Passers-by are Informed of the Station's Call Letters.

A STATION NAME SIGN

Many times in his travels an amateur will happen to see an aerial and the question will immediately come to his mind: "Have I ever 'talked' with that fellow?" If the amateur had a means of telling who the aerial belonged to he would immediately know whether he had "talked" to its owner before.

In view of the foregoing, it would probably be a good plan for amateurs to place a sign made of either wood or metal and of about the same size as an automobile license plate on a spar of the aerial, as shown in the sketch. Not only will such a sign inform passersby as to the call of the station, but it will also prevent the aerial from turning over in a storm.—FRANK H. BROOME.

DEPRESSED ANTENNAE

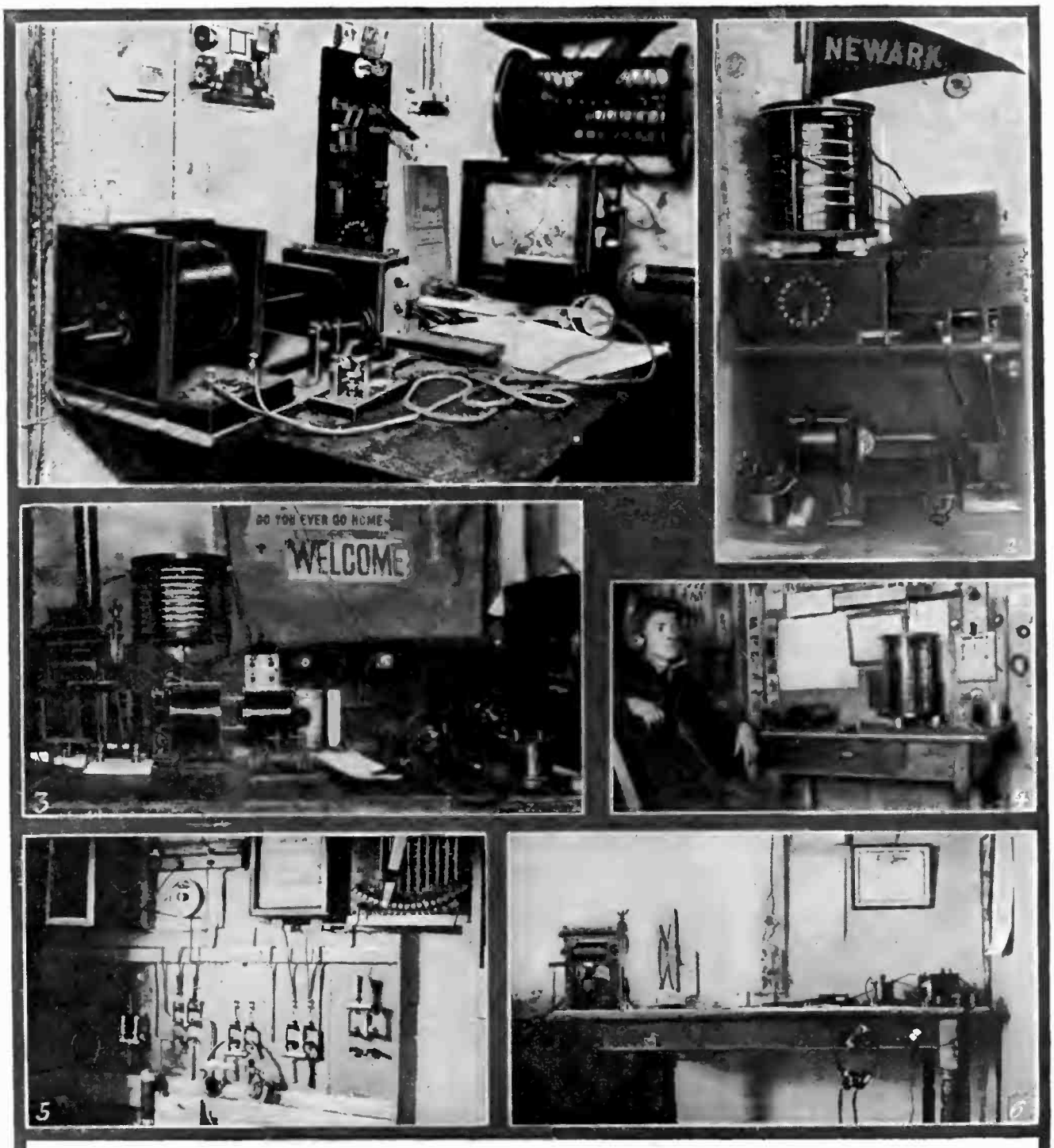
It has been found that the antenna of a wireless apparatus, although fixed only a few inches above the ground, will successfully receive radiations from a considerable distance. In a garden at St. Denis, a few miles from the center of Paris, Professor Rothé placed on posts about six inches high a copper wire that was varied in length from 50 to 115 feet. The insulation was poor, and the wire touched the grass at several points. It was not laid in the direction of Paris. Professor Rothé used a water pipe for the earth connection, and also arranged a detector, a telephone and a battery in series between the water pipe and the common terminal of the aerial and the self-induction. With this arrangement he received distinct signals from the Eiffel Tower. He used first a 400-ohm telephone and then a 150-ohm receiver shunted across a Jégou transformer. Another French experimenter had equal success, and it is predicted that on account of their cheapness and simplicity, the depressed aerials will be extensively used.—EDWIN TARRISSE.

MICA PLATE FOR ROTARY SPARK GAP

It is not necessary to use hard rubber or other expensive material for rotary spark gap discs. Sheet micanite 1/32 inch thick will be found excellent material for making rotary gap discs for powers up to ½ kw. The micanite plate should be reinforced by a heavy brass or copper ring such as is usually employed in rotary gaps. This ring prevents the mica from chipping at the edge. Micanite has one fault and that is due to its being made of mica and shellac—when it is heated the shellac melts. To avoid this trouble when employing it for a rotary gap, the transmitting key should not be pressed while the gap is standing still, since the studs would become heated and consequently cause a warping of the disc.—IRVING FARWELL.

A seaman who partook in the naval fight off the Falkland Islands between the British and German fleets, recently disclosed a few sidelights of that engagement. He states that before the fleets joined in battle, the British vessels endeavored to communicate by wireless with each other the various orders and instructions for the battle formation and succeeded despite the enemy's jamming.

AMATEUR WIRELESS STATIONS



THE STATIONS AND APPARATUS IN THE ABOVE VIEWS ARE AS FOLLOWS:

(1)—Receiving and Transmitting Apparatus of D. B. Tripp of New Bedford, Mass. Practically All of the Apparatus in This Station Has Been Made by Its Owner. (2)—Wireless Station of C. G. Howard of Newark, O. (3)—Receiving and Sending Apparatus of Peter Faber of Madison, Wis. (4)—Wireless Station of Fred F. Dennis, Fair Haven, N. J. The Receiving Apparatus Has a Range of 1,500 Miles, Day and Night. (5)—A Corner of the Experimental Laboratory of Guy A. Hunter, Port Townsend, Wash., Showing the Switches and Various Instruments. (6)—Wireless Station of James P. McQuaide, Larchmont, N. Y.

In Defence of the Flat Top Aerial

By Raymond W. Woodward, B.S.

IN the February number of MODERN MECHANICS there appeared an article entitled "The Fallacy of the Flat Top Aerial," in which it was stated that an aerial composed of wires placed one above the other would prove to be more satisfactory than the customary flat top antenna. It is the purpose of this article to show wherein the writer believes that the foregoing conclusions are erroneous and that other things being equal the flat top aerial is more suitable for wireless reception than the above mentioned type.

In the first place, if we glance at the various commercial aerials throughout the country, we will see that the majority of them are of flat top construction, and none have the wires in a vertical plane. Notable examples are practically every ship, the huge government station at Radio, Va., and the more recent high power Marconi installations. With the possible exception of the latter, it would have been mechanically simpler to have placed the wires one above the other. If such has not been done there must be ample reasons for it.

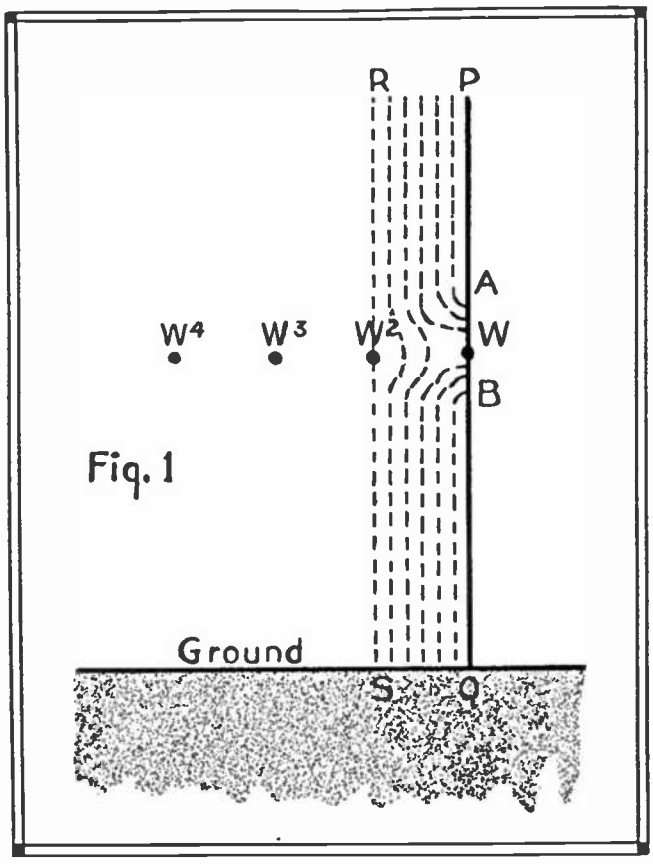


Fig. 1

A Diagrammatic View of a Wireless Wave Cutting the Wires of a Flat Top Aerial.

If the wires were placed in a vertical plane, each would be at a different height above the earth and would therefore have a different capacity. Such an arrangement would be unsymmetrical and would probably not have a fundamental wave length of definite value, as would be shown by the wave meter condenser indicating resonance over a larger range of the scale than usual. Consequently, if the aerial were used for transmitting it would be difficult to comply with the federal regulations concerning dampening—if not impossible.

As stated in the article referred to, the electromagnetic waves travel parallel to the ground; the wave front, however, is at right angles to the ground. It is generally acknowledged that the propulgation of electromagnetic waves is analogous to that of light waves. Now, it is a fundamental fact in the wave theory of light that every point in an advancing wave front acts as a new point source of light, and the same holds good for electromagnetic waves. Thus, when a wave front strikes a flat top aerial we will have a condition similar to that represented in the accompanying sketch. Here W_1, W_2, W_3, etc., are cross sections of the wires, and PQ is the wave front just as it strikes W_1. Energy will be absorbed for a short distance on either side as AB. Regarding points on AP and BQ as new sources of wave emanations, as shown by the dotted lines, the two portions of the wave will again come together, and, if the wires are properly spaced, W_2, will be cut by a solid front wave having only slightly less total energy than at W_1. This process will repeat and all the wires will receive very nearly the same amount of energy. However, if the wires are

placed too close to each other, the second wire will be in the "shadow" of the first and removing all but one strand of the aerial will then show no appreciable diminution in the strength of received signals.

The reason that a single long wire appears to give the best reception is because most amateurs base their results on long distance work, and that stations capable of transmitting over long distances do so by the aid of long wave-lengths. Since an aerial absorbs the greatest amount of energy when working at or near its fundamental wave-length the long aerial will give the best results for this work. If other wires were added of the same length as this single one, still better results would be obtained.

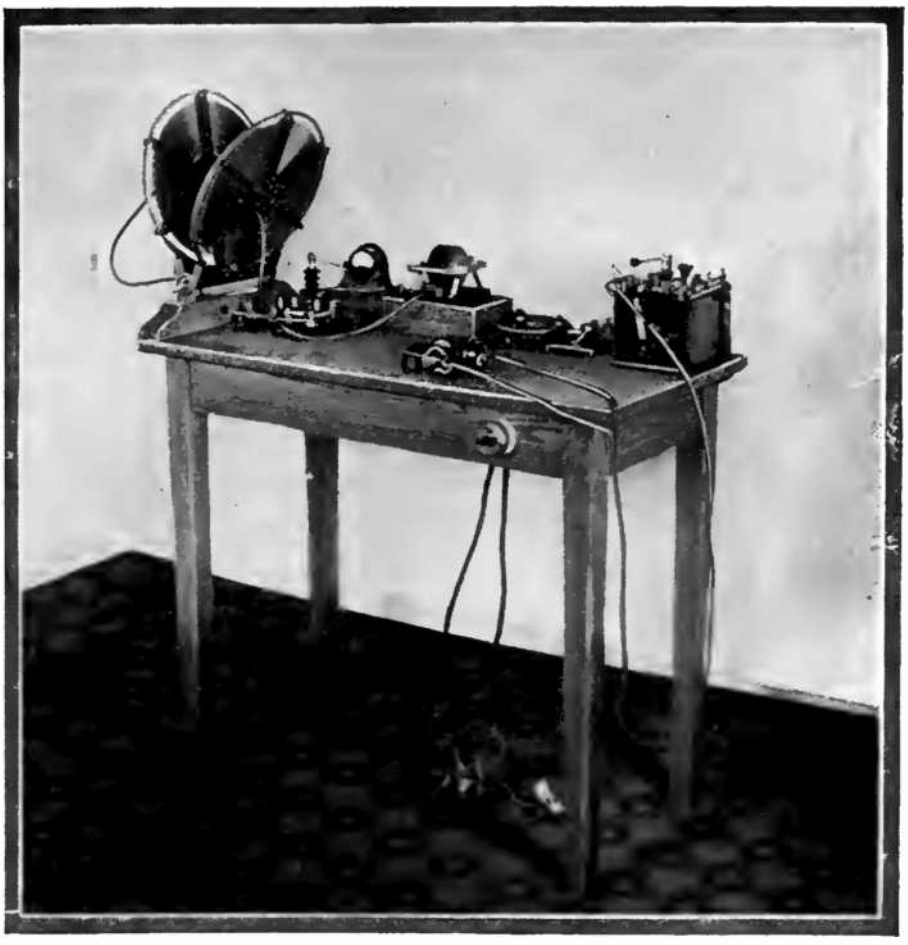
From the writer's own experience he has had the best results when the spreaders at each end of the antenna were horizontal, although at times they have accidentally become nearly vertical.

It should not be inferred from the above discussion that the flat top T or L aerial is the best type for all conditions, but it probably is for amateur use.

NEW RADIO SETS FOR COAST ARTILLERY AND HARBOR BOATS

In the accompanying illustration is shown one of the latest sets made by the United States Signal Corps and intended for use by the Coast Artillery division as well as on harbor boats.

The new sets consist of a quenched gap transmitting set and an exceedingly compact receiving outfit, both being mounted on a substantial table. The transmitter is equipped with a pan-cake type oscillation transformer that can be adjusted to secure the maximum efficiency and the sharpest tuning.



Sending and Receiving Apparatus for Coast Artillery and Harbor Boats.

A COMMENDABLE RECEIVING RECORD

The writer recently made a record which he believes worthy of notice on the part of fellow wireless amateurs. Lately, while moving his station from one location to another, the writer erected an aerial consisting of a single wire stretched from a point on a house twenty feet above the ground to a pole six feet high and fifty-four feet away, and back again to a point on the house fifteen feet above the ground. The free ends were connected together and brought to the receiving instruments comprising a standard loose coupler, a cat whisker silicon detector, rotary variable condenser, fixed condenser and a pair of receivers. On the evening of the 26th of September the writer was surprised to pick up signals from Key West (NAR) with the foregoing-described set and aerial. Since then, signals from that station have been heard three times. Any night signals can be received from NAA and WSL.

—ALLEN W. COVEN.

IOWA RADIO RELAY LEAGUE

The Iowa Radio Relay League was organized during the month of February. Amateurs in several Iowa towns have been admitted to the League, the purpose of which is to have a station in every large town in the state, placing the amateurs in communication with each other and assisting them in developing their wireless apparatus.

At the election of officers on February 4th, the following appointments were made:

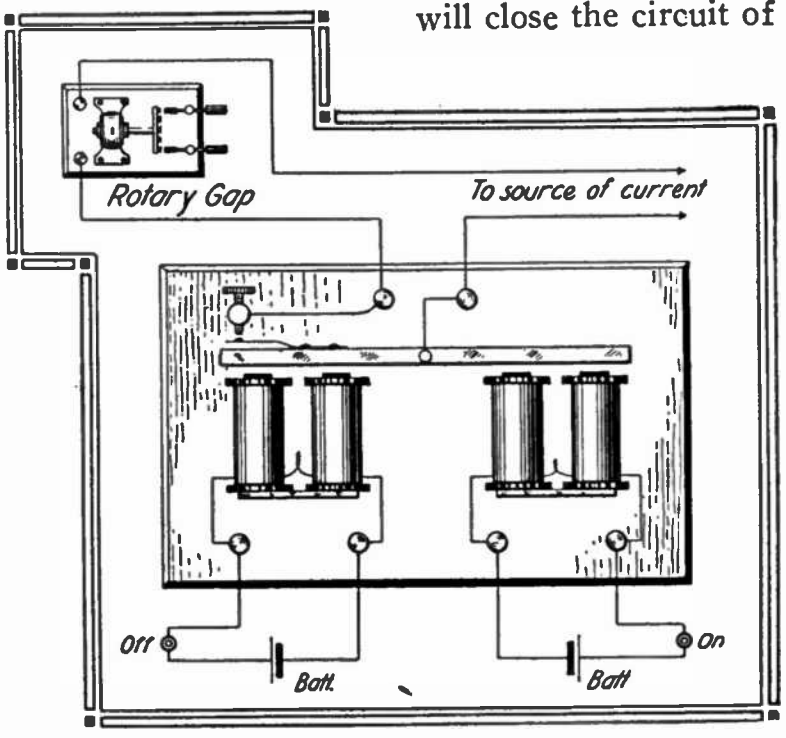
President, Chas. E. Lockwood; Vice-President, A. P. Leckington; Secretary, Kenneth Lamb; Treasurer, Francis Harbin.

Amateurs in Iowa and neighboring states wishing to join the League should correspond with Chas. E. Lockwood, 117½ Bridge Street, Waterloo, Iowa.

Amateur radio clubs and associations throughout the country are invited to send copies of their proceedings and letters telling of the experiences of members to The Radio Section of THE WORLD'S ADVANCE. Such material, when it proves available for use, will be paid for at space rates on publication.

STARTING ROTARY GAP MOTORS BY PUSH BUTTON

In many stations employing rotary gaps it may be found more convenient to employ ordinary push buttons in preference to a snap switch to start and stop the motor of the gap. By following the directions and diagram given below, a system is secured whereby two push buttons do the work.



A Simple System for Starting and Stopping a Rotary Gap by Means of Push Buttons.

To begin with, secure a piece of square iron bar of suitable size and bore a hole through its center so as to pivot it at that point. The armature should be so mounted and adjusted that when it is pulled to either side it will remain in that position. The drawing explains itself. It will be noted that when the button labeled "on" is pushed, the armature is drawn and makes the contact that closes the motor circuit. When the push button labeled "off" is pressed the bar is pulled so as to break the motor circuit. If desired, the device may be elaborated on by using another contact that will close the circuit of a magnetic break such as was described in a recent issue of *Popular Electricity and Modern Mechanics*, when the motor circuit is opened.

In the event that any difficulty is experienced through arcing at the break of the contact, a small paper and tinfoil condenser may be shunted across the contact points; if this still proves ineffectual, the two pairs of magnets may be moved closer together on the baseboard in order to increase the separation of the contact points by increasing the travel of the pivoted arm.—WILLIAM H. HALLENBECK.

Surrounded by His Numerous Wireless Instruments Both in Finished Form and Process of Development, Mr. Eugene T. Turney is Quite at Home in His Laboratory.

An Interview with Eugene T. Turney.

By Thomas Stanley Curtis

A VISIT to his laboratory and a chat with Eugene T. Turney brought to light two interesting facts which in themselves constitute what may be termed a paradox. First and foremost, Mr. Turney is an inventor and one of no mean ability; coupled with this, he is a business man. Strange as this combination may seem, ample evidence of its existence was forthcoming throughout the interview.

Mr. Turney first conducted his visitors to the little testing laboratory wherein each of his new devices tells its story, and a bright cheerful den it is. Of diminutive size, but withal, large enough, the "lab" is a picture of orderly efficiency. If the instruments in it pay a tribute to the inventive genius of the owner, no less is the systematic atmosphere of the testing room a graphic illustration of Mr. Turney's business instincts.

The editorial mind is trained to skepticism, but nevertheless it is always open to conviction. That is to say, we who hear daily—yes, almost hourly—of new achievements and devices, are prone to accept all statements with "a grain of salt" until we are shown; then we are ready to tell what we have seen with our own eyes or heard with our own ears. This, then, was our attitude as we entered the quiet little testing room.

Our attention was first called to the new Crystaloi detector which is clearly Mr. Turney's pet. This device was described several months ago in MODERN MECHANICS, but for the benefit of new readers the essentials of its construction will be reviewed briefly.

The detector appears to be an idealized form of coherer, having all of the desirable features of the latter with none of its disadvantages. The active material is in the form of a finely granu-

lated alloy held in a chamber between a sensitive crystal and a silver contact surface. The chamber forms the central

One of Mr. Turney's Latest Inventions—the Crystaloi Detector With a Special Cohering Inductance.

portion of a knurled wheel of insulating material which is mounted vertically between uprights in such a manner that it may be rotated. By turning the container, the alloy, which does not fill the chamber, is made to change its position with the result that the most sensitive point is found within a few seconds.

To sum up the active principle of the detector in the words of its inventor: "A comparatively large surface of a very sensitive mineral is brought into contact with a great many points of a very light, finely divided alloy which becomes a conductor only when traversed by high frequency oscillations."

So much for the detector itself; we had heard the story before and were ready to be shown. Accordingly the telephone receivers were brought into requisition and our surprises began. A pressure of the test buzzer key and a half-turn of the detector knob and we were ready for anything. A mere recount of the stations we heard would be of little interest and value, but it may be stated quite frankly that, judging by numbers, we did not miss many of the stations that were sending at the time. The signals were firm and clear, taking into consideration the various sources from which they came, and we do not hesitate to say that the detector proved itself to be a little marvel of convenience.

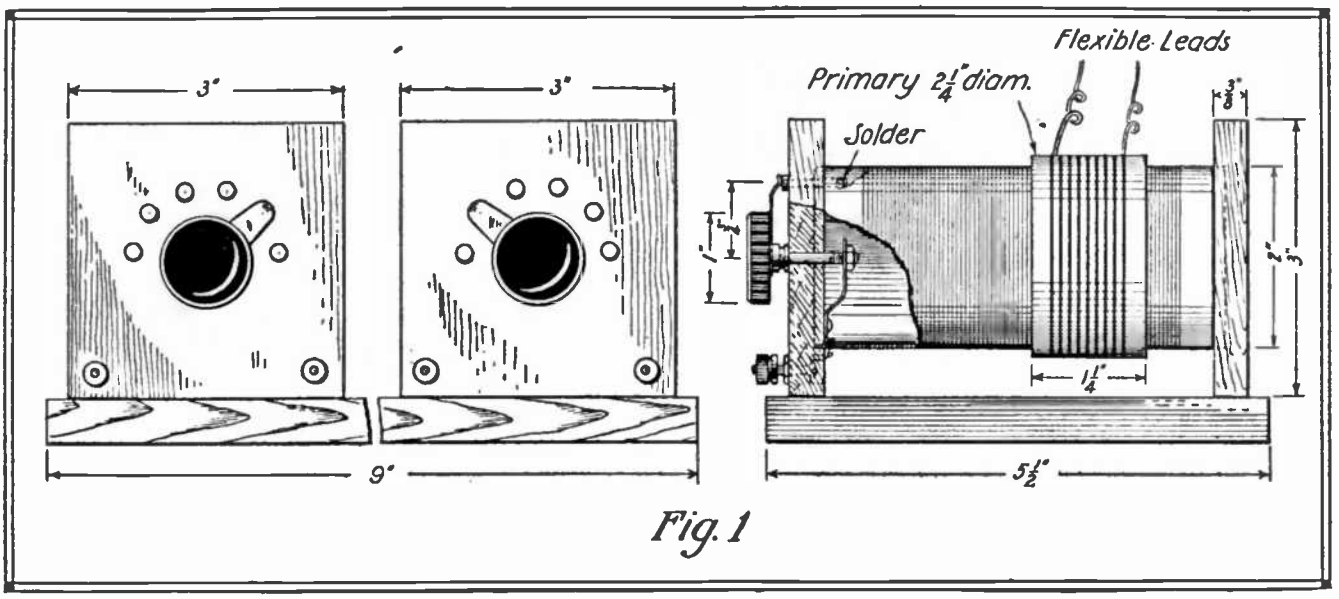
We had been listening but a few minutes when the strains of a Sousa march came to our ears, superposed upon the dots and dashes of the code; a radio telephone was in operation. A slight adjustment of the receiving transformer and we listened to an etheric band concert.

Throughout the tests, static was conspicuous by its absence. The writer shall not attempt to account for this characteristic, but the fact remains that it is marked. Mr. Turney merely states that the construction and principle of his device renders the receiving apparatus remarkably free from static interference and, without trying to explain something the inventor declined to elucidate, his visitors can heartily second the motion. As a matter of fact, there are several interesting points in connection with the action of the detector that would bear a technical explanation but for a' that, what are the odds? It works, and if the evidence of our eyes and ears is to be accepted, it works as well as the inventor claims.

Passing from the simple detector, the inventor called our attention to a new type in which is incorporated what Mr. Turney calls a cohering inductance. This inductance, when properly proportioned and connected in the circuit, causes the alloy to cohere more firmly, which reduces the internal resistance and makes the detector considerably more sensitive. In the new type, the inductance is enclosed within the base of the detector and is properly connected in the circuit.

Mr. Turney has a number of interesting devices in process of development, among which are a variable condenser of radical design and an attachment for a receiving transformer which the inventor has named an "exploring inductance."

Our visit to Mr. Turney's laboratory brought out the fact that his is but another case of the serious experimenter turned inventor and finally manufacturer. This gentleman has had the sagacity to concentrate all of his efforts on one product until he has brought it up to a state approaching perfection. Success inevitably awaits the man who follows this path, providing his product has a market and is properly exploited.

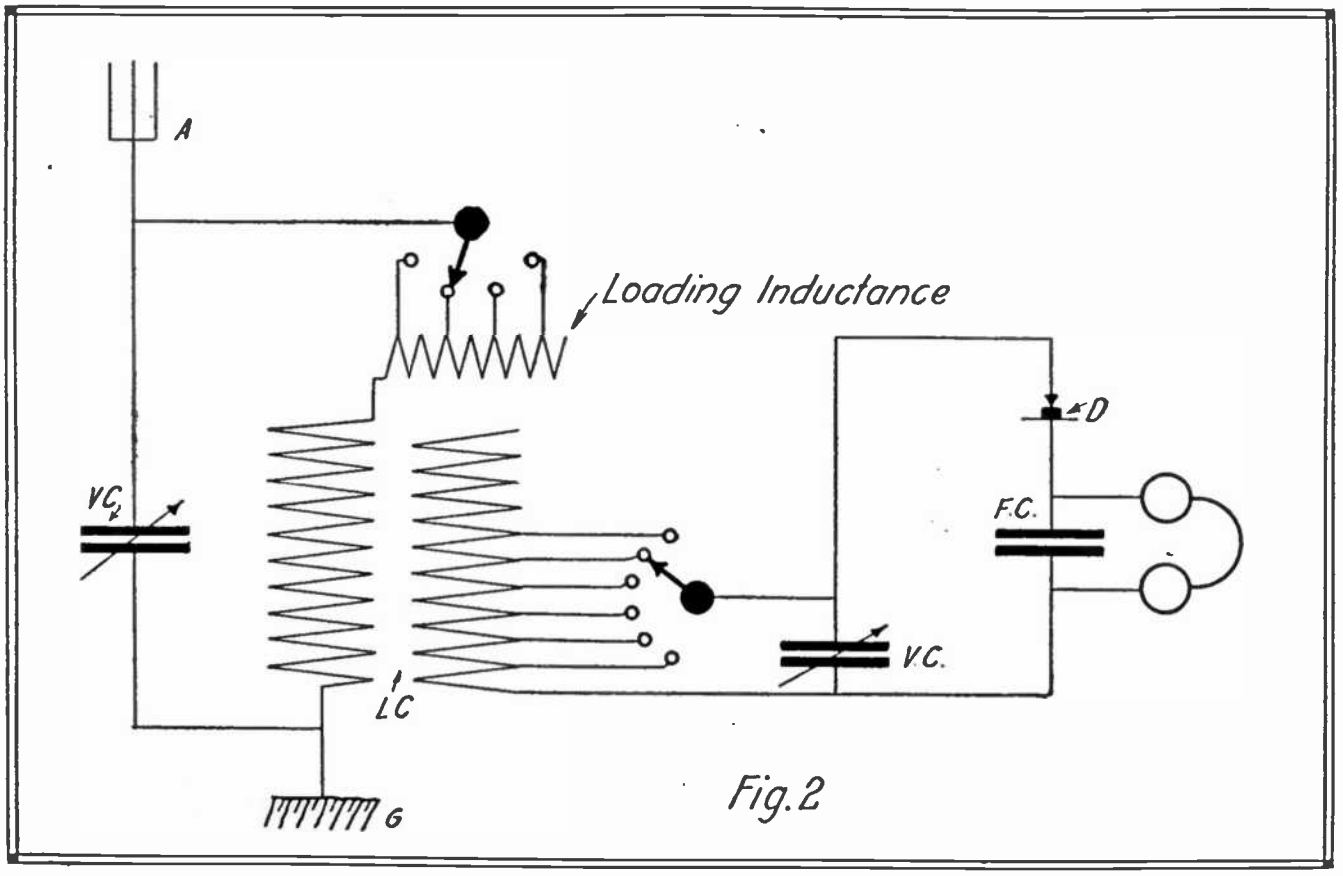


End and Side Elevations of a Small Multiple Tuner That May Be Used With Good Results for Close Tuning.

A NEW TUNING APPARATUS

BY the use of only a few turns on the primary of a receiving transformer and supplying the necessary tuning inductance with a tap loading coil, the sharpness of incoming signals is increased.

The small multiple tuner here shown makes possible more selective tuning than can be obtained with the ordinary loose-coupler. It will be noticed that the primaries have only a small number of turns. This eliminates dead end effects to some extent. There are no variations on the primaries.



Scheme of Connections for Using a Single Tuner for Receiving Wireless Messages.

The writer has found that with the ordinary loose coupler the coupling is varied very little. This is due to the fact that most all stations are tuned so that their waves have a decrement precisely the same.

Since few turns increase selectivity and since the coupling need be varied only minutely, it is possible to make a receiving transformer that is very compact and quite simple to adjust.

Now a few facts as to the construction of the tuner. The primary and secondary tubes can be made of mailing tubes. Six taps are brought from the secondary to a switch at the end of the coil. The primary consists of ten or twelve turns of No. 22 D. S. C. wire and connections are made to it by two flexible leads. Each secondary is wound with No. 28 D. S. C. wire, beginning 3/8 inches from the ends.

Two of these couplers are required to make a multiple tuner and they should be mounted on a base as shown in Fig. 1. Fig. 2 shows the connections for a single coupler, while Fig. 3 shows the hookup for a double transfer circuit that is excellent for selective tuning. Since the two coils are of only slightly different diameter, the space between them can be filled in by wrapping heavy paper or cardboard around the secondary before slipping on the primary tube. The coupling should be varied until a spot is found where all stations come in good. Then the coupling need not be changed. The use of variable condensers for sharp tuning is recommended.—IRVING FARWELL.

TESTS OF A NEW WIRELESS TELEPHONE SYSTEM.

From the Pacific Coast comes the report that a distance of 721 miles has been covered with the wireless telephone system of H. P. Dwyer, of San Francisco, Calif. Unofficial tests were conducted between Tatoosh, Cape Flattery, and the Government station at Mare Island. It is said that the conversation proved perfectly clear and understandable despite the great distance. A power of 4½ kilowatts was employed in conjunction with an aerial suspended from a 300-foot tower.

Details of the Dwyer radio telephone system are not available at the present moment, but in an early issue of THE WORLD'S ADVANCE there will appear a complete description of the system, with particular attention to the technical details, when these are disclosed by the inventor.

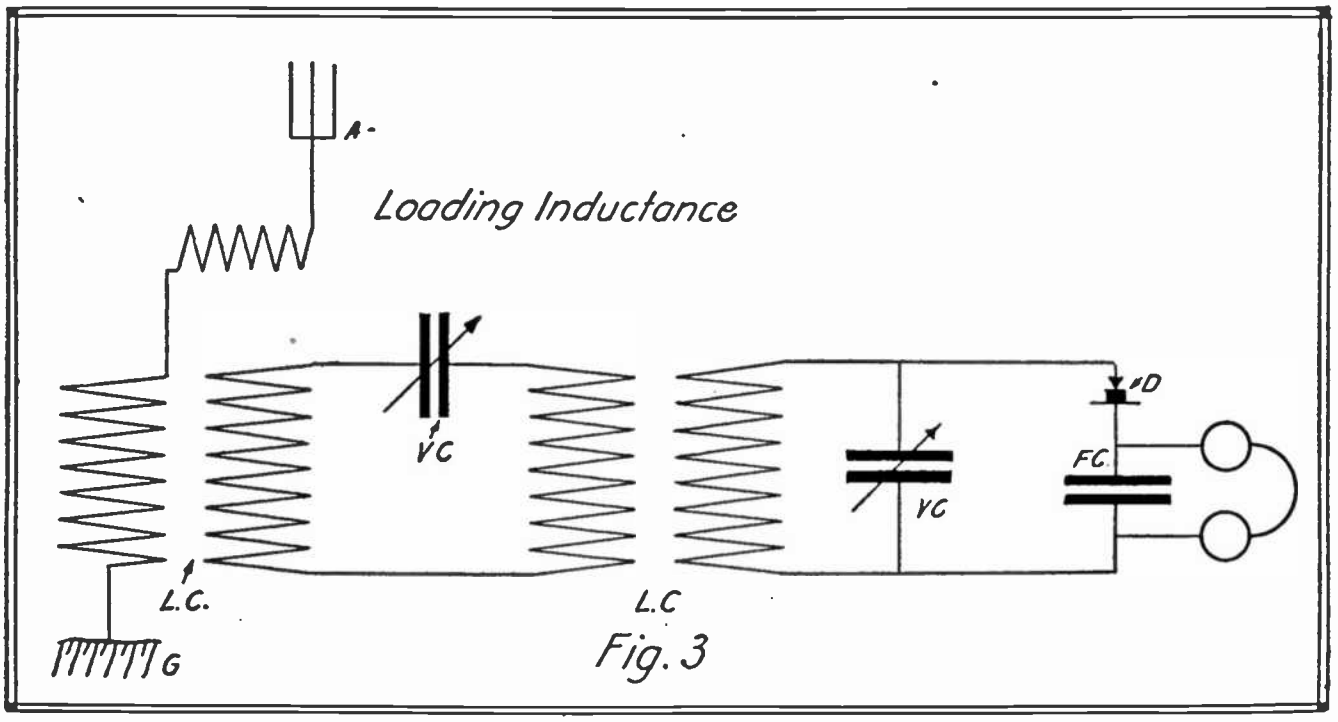


Fig. 3

Scheme of Connections for Using Two Tuners for Receiving Wireless Messages. This arrangement permits of a high order of selectivity.

CONTRARY to the prevailing opinion among those interested in wireless telegraphy and telephony that nothing new or startling is being accomplished in this field, an interview with Dr. Lee DeForest discloses several radically new ideas that are being put into practical use.

THAT nothing really new has been introduced in the field of radio communication during the last few years is the prevailing opinion among those who are closely following the development of the art. And this opinion is borne out by facts if we are to judge by the equipment used in everyday work. Modern commercial stations employ apparatus built in about the same manner as that of several years ago; although in fairness it must be admitted that in most instances the various instruments show many refinements in design. Yet nevertheless, despite all the ingenuity that may be displayed, there are few instruments or systems that can lay claim to being an absolute novelty—a something that is radically different.

I have been one of those who share the belief that no actual progress is being made in the wireless field; but after a visit to the laboratory of Dr. Lee De Forest, the well-known pioneer in this class of work, I am obliged to tender my resignation as a member of the pessimists club since I am firmly convinced that much is being accomplished along entirely new lines and that we are on the eve of many surprises.

It was a Saturday afternoon not long ago that I took advantage of the invitation extended by Dr. DeForest to visit his laboratory where he had prepared several interesting demonstrations for a party of us. We traveled up to the High Bridge station by electric train and within a short space of time found ourselves at the door of a two-story brick building, with the Doctor there waiting to greet us.

The first surprise in store for us was an exhibition of the audion amplifier. The outfit in this case comprised a large oak cabinet with a hard rubber front on which were mounted numerous switches, binding posts, adjusting handles and three amplifier bulbs. The amplifier, our host explained, is one of the outcomes of his experiments with the audion. An amplifier bulb is built along the same lines as the audion, differing only in the particular that it contains two plates instead of one. By the employment of the amplifier apparatus it is possible to magnify even the weakest electric currents many times.

"I have here an ordinary telephone receiver such as you can buy at any supply store for about fifty cents," said the Doctor, indicating a receiver of the Bell type lying on the demonstration table. "You all know what a poor microphone a receiver of this kind is. I have ac-

cordingly selected it for demonstrating to you the audion amplifier."

The telephone receiver was soon connected to the amplifier apparatus, and the Doctor announced that we could now listen to its microphonic capabilities, using the first step of the amplifier. Upon placing the receiver over a watch the ticking of its movement could be clearly heard, although not loudly. But upon throwing in the second step of the amplifier the ticking of the watch proved to be quite loud. Not alone the ticking but even the slightest touch of the fingers on the table were audible in the telephone receivers. Doctor DeForest then connected in the third or last step and bade us listen to the sensitivity of the receiver microphone. No longer did the ticking of the watch seem natural—it was far too loud to ever be considered as such. Slight taps on the table were heard in the telephone receivers as loud crashes. Even a person walking about the room caused considerable disturbance in the head band receivers.

To my query as to how many times the amplifier increased the sound produced by the receiver alone, our host replied:

"From my numerous experiments I have found the first step to amplify from six to ten times. Of course, you understand that all amplifier bulbs are not identical and some prove more sensitive than others. However, from six to ten times amplification may be expected from a single step. The second step amplifies the current of the first step from six to ten times, giving an amplification thus far of from 36 to 100. The third step increases the current of the other two steps again from six to ten times, resulting in a total amplification of 600 to 1000, depending on the efficiency of the bulbs. It is difficult for the ear to grasp the meaning of one thousand amplifications. In fact, the ear at best is a very poor judge of comparative strengths of sound. I have based my estimates of the capabilities of the amplifier on tests made with an audibility meter."

One of us inquired whether the amplifying process could be continued several more steps—or even indefinitely. The answer to this uery surprised us:

"I have tried four steps," replied the doctor, "but find the current so powerful that it paralyzes the audion bulb in the last step. By this I mean that the powerful current renders the bulb inoperative at times. Furthermore, the amplification is so great—in the neighborhood of ten thousand times—that even the slightest sounds cause a roar in the receivers. This is far from desirable and soon becomes indeed troublesome. I have therefore come to the conclusion that the three step amplifier is the practicable limit."

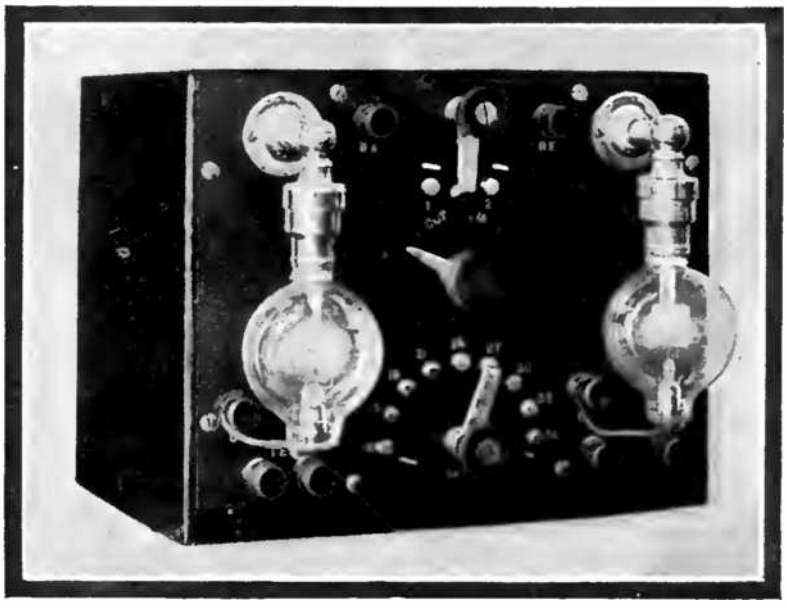
Our host then proceeded to connect up an audion receiving set with the amplifier. Two sets of telephones were placed in circuit with the apparatus; one directly to the audion set and the other to the three step amplifier. What a difference in the signals! Even the signals that sounded so faint and distant when using the audion alone came in as loud as if the stations were suddenly transported into the adjoining room, when using the amplifier. And the wonder of it all was that the amplifier did its work without any distortion of sound nor objectionable noises.

Being of a curious disposition, one by one the members of our party at different times had wandered about the laboratory, studying and drinking in with his eyes all the interesting things laying about in both finished form and in process of development. What had been the center of attraction for all of us was a huge cabinet receiving set with a hard rubber front on which were mounted numerous switches, binding posts, handles and an audion bulb. Its name plate bore the legend: "Navy Type Ultraudion Receiving Set."

Dr. DeForest intercepted us before we could ask him concerning this new center of attraction:

"That is a special receiving set which we have built for our exhibit at the Panama-Pacific International Exposition. I intend leaving for San Francisco in a few weeks' time and I shall take this set and several other outfits with me. I am going to show you several features of this set and shall also try to pick up some long distance stations for you; Hamburg or Nauen, for instance."

The Doctor explained briefly the principle of operation of the ultraudion set which, it appears, is to use the audion bulb as a generator of undamped oscillations. By means of elaborate adjustments of capacity and inductance it is possible to have the bulb generate currents of any desired frequency. Incoming signals of the undamped variety are heard in the receivers as long and short blasts of a whistle, or "beats," as they are technically termed. These beats are produced by the difference in frequency between the current generated by the audion bulb and that of the incoming waves.



The Audion Detector—One of Dr. DeForest's Inventions—Has Been the Foundation for Many of His Subsequent Devices.

Unfortunately we did not succeed in hearing any long distance signals with this set. As the Doctor explained, hunting for signals of long wave lengths with this receiving set which tunes so sharply is analogous to searching for the proverbial needle in the haystack. One man employed in the laboratory has spent much time in getting accustomed to the adjustments of the set and is able to pick up many of the European long-distance stations, as well as the stations of the Amalgamated Radio Company on the Pacific Coast. Strange as it may seem, although the Doctor is the designer of the set and is intimately familiar with every part of it, he frankly admitted that he did not have the knack of picking up stations with it.

By this time the conversation drifted to wireless telephony, since we all knew of the extensive experimenting of Doctor DeForest in this field. To add to our interest there rested on the floor of the laboratory a huge arc generator equipped with a magnetic field and a system of water cooling. Our host said that this was one of his old arcs with which he had been fairly successful, although more recently he was devoting most of his attention to radio telephone systems using a form of quenched gap and those employing an audion bulb as wave generator.

"I have succeeded in bringing to a commercial stage two forms of wireless telephone. One of these utilizes an audion bulb as the generator of the high frequency current. Of course, you probably have read of the audion as a wave generator and accordingly appreciate that thus far it is for the most part only applicable to short-distance work. But this system has the beauty of being so simple that it can be operated by almost anyone. My other system, which employs a quenched gap, can be used for greater distances and the voice carries well. With the latter type of sets it is necessary to employ a high frequency alternator.

Later, when Dr. DeForest brought us down to the large machine shop, where his commercial products are turned out, we were surprised to see the practical appearance of his wireless telephone sets. The present sets follow the general lines of conventional wall telephones and are but a trifle more complicated to operate.

"I believe that some one will succeed in talking across the Atlantic ocean without wires within five years' time," said the Doctor in reply to a query. I might even add without hesitation that it is a possible achievement today with the apparatus thus far developed. Given a sufficient sum of money with which to conduct extensive experiments and pur-

A Wireless Telephone Set That May Be Carried About in a Motorcycle Side Car Bids Fair to Become an Important Factor in Military Operations.

chase the necessary extensive equipment, I feel confident that I could talk to Europe by wireless telephone in a few months' time."

The Doctor called our attention to compact and cleverly designed wireless telegraph sets that employed a quenched gap. The workmanship was perfect and much ingenuity was displayed in designing different portions of the sets, the oscillation transformers in particular. These panel sets are entirely self-contained with the single exception of the alternator for supplying the current. We were also shown a large variety of audion receiving sets with many innovations in the way of tuning apparatus.

Suggested by the present European war there has been recently completed a wireless telephone set that may be carried about by a motorcycle equipped with a special side car. Our host told us that the set had a fair range and would probably prove more convenient than some of the existing portable radio telegraph sets now used by the belligerents. The set employs the quenched gap type of wave generator and is designed very much along the lines of a wall telephone set. The receiving set is of the audion type and, together with the transmitting equipment, forms a compact and rugged unit for work in the field.

A few more minutes of discourse and we were bidding the Doctor good-bye and making our way to the railroad station; I, for one, convinced that something new is being accomplished in the wireless field and that we are on the verge of a big step forward in this branch of communication.

AMERICAN RADIO RELAY LEAGUE STATION

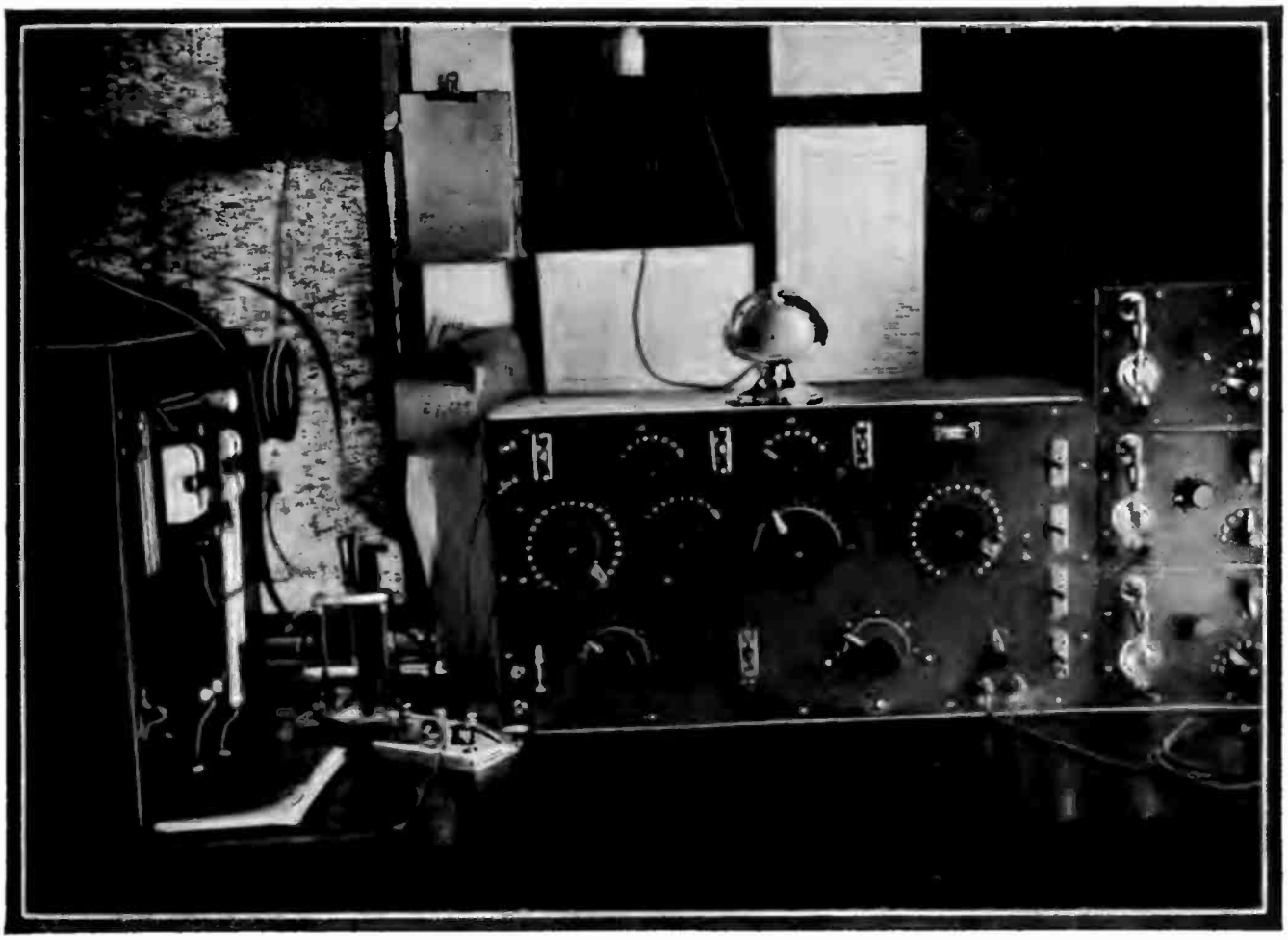
THE wireless station of George C. Cannon of New Rochelle, N. Y., which is illustrated in the above view, is a model of good design and efficiency.

In the center of the illustration may be seen the hard rubber front of the oak cabinet containing the tuning apparatus for receiving. A special loose-coupler designed by the owner is used in the receiving set, permitting of tuning for wavelengths up to 3,200 meters, while a loading coil that is used in conjunction with it and which adds inductance in both the primary and secondary circuits tunes the set up to 8,000 meters. A condenser is placed in the ground circuit to enable short wavelength signals to be received. Although a condenser is used in tuning

the secondary of the loose-coupler, but little capacity if any, is needed, because of the great inductance value of the secondary winding. In the primary circuit it is possible to tune to one turn of wire. The degree of coupling can be altered within a wide range. The detector used is an audion, together with a two-step amplifier, the different degrees of amplification being immediately secured by the manipulation of switches.

The transmitting set is of one kilowatt capacity and is placed in a polished cabinet, a portion of which appears at the left. By using a very small condenser and a high speed rotary gap—one that operates two or three times as fast as that of an ordinary set—together with close tuning and a fairly loose degree of coupling, the transmitter is capable of covering long distances on a short wavelength and with an aerial of medium height.

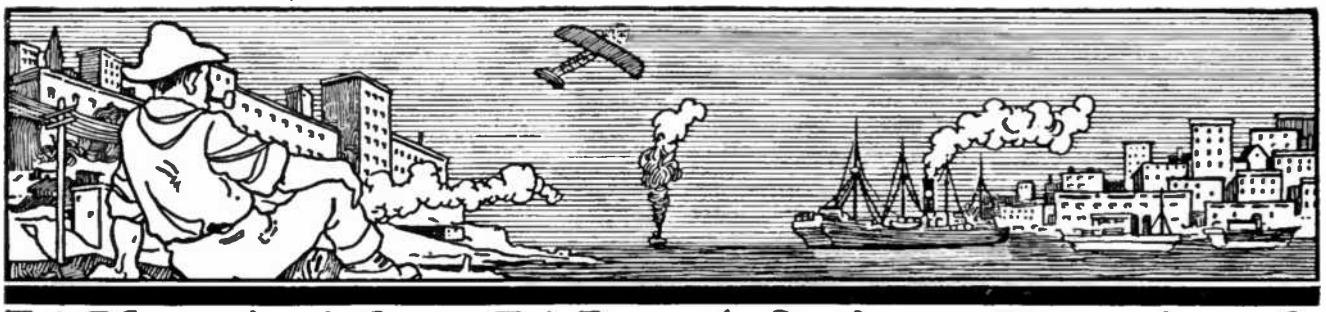
As for the efficiency of the station, Mr. Cannon states that it is possible to read signals from the Key West station when standing 15 feet away from the telephone receivers. With a loud speaking telephone the signals from Arlington can be read over 100 feet from the instrument. On the other hand, the transmitter has been tested out for eight consecutive nights with Rockland, Me., approximately 350 miles away in a direct line. Signals from the station have been copied 800 miles away on exceptional nights.



Wireless Station of George C. Cannon of New Rochelle, N. Y., One of the Stations in the American Radio Relay League Chain, Incorporates Many of the Latest Ideas in Radio Engineering.

THE FARMINGTON VALLEY RADIO CLUB

In April, 1914, the wireless society known as The Farmington Valley Radio Club was organized in the Simsbury, Ct., High School. At that time it had a membership of four. A room in the school building was given to the club for use as a wireless station, and soon after a one-quarter KW equipment was installed. Today the club has a membership of over twelve.



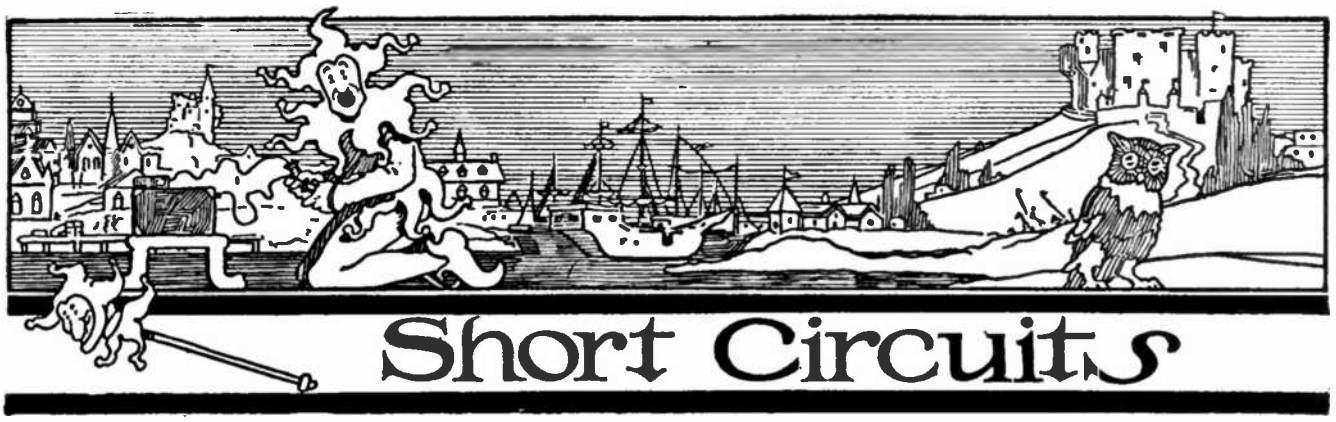
What the World is Doing

SEVERAL weeks ago a reader of this magazine wrote in stating that he and his friends had been conducting experiments with foreign and American wireless instruments, the outcome of which proved the latter to be superior in almost every way. This is not surprising to anyone familiar with the radio apparatus of European manufacturers and those of American make. The former are often more elaborate and the workmanship cannot be surpassed. But while the foreign radio apparatus may prove quite suitable for the conditions of operation existing in Europe, American operators prefer the more rugged and practical American instruments, even if the finish does not happen to be so elaborate. And these same differences are evident in most electrical apparatus. Almost invariably the American products will be found more substantial and easier to handle, while the foreign ones will present perhaps better care in the matter of finish. Since the war in Europe shut off a good portion of the goods formerly imported from the countries at war, Americans have begun to appreciate more and more the capabilities of domestic manufacturers. Previously, many of us were apt to prefer imported products to our own and this for the reason that we did not know our own products. Most of us have now come to appreciate the real meaning of the legend "Made in America" on different products, and the future will witness even greater enthusiasm in domestic manufactures.

"PRACTICAL Men in the Making" is the title of an article in this issue that is worthy of more than passing note. It affords a graphic illustration of the fact that this present age of ours is alive to the importance of making useful men of our growing boys. Time was when a man would say with perhaps a touch of disdainful pride, "Mechanical? No, I cannot even drive a nail." He may say it to-day, but there's little satisfaction in saying it when perhaps his twelve-year-old son is the proud possessor of an artcraft lamp, a piece of mission furniture, or a radio outfit made with his own hands. While his daddy looks helplessly on, the boy puts up shelves in the kitchen, repairs the household furniture, installs electric bells and changes the location of the electric lights, and makes himself generally indispensable in the home—just as he is destined to make himself indispensable in the office or factory in years of maturity. No, Friend Reader, not perhaps through being able to install lights and repair furniture, will he be a power in the business world, but because his early training has developed in him a wonderful resourcefulness—an ability to meet and conquer obstacles.

In short, the net result of the practical training given the boy of to-day is to quicken his powers of observation and analysis—to enable him to pick out the weak places in any problem set before him regardless of its nature and to equip him with a self-confidence that is backed by ability and experience.

It is gratifying to the Editors of this magazine to note that the editorial policy inaugurated eight months ago as an experiment has proved to be so thoroughly sound now that it has stood the test of time. Perhaps the strongest evidence of its soundness is given by the several educational institutions which have adopted the very same policy in their courses of instruction. What this magazine aims to do with both men and boys, the schools are doing with the younger generation; making of them practical men—men who accomplish things—in the fullest sense of the word.



He Certainly Had

The chef was interviewing the young man who had applied for work.

"Have you had any experience in the lunch business?" he asked.

"Why, I should say so," replied the energetic youth. "I've been lunching for almost 20 years."—*Lippincott's.*

It All Depends

Boss (to office boy)—If any one asks for me, I shall be back in half an hour.

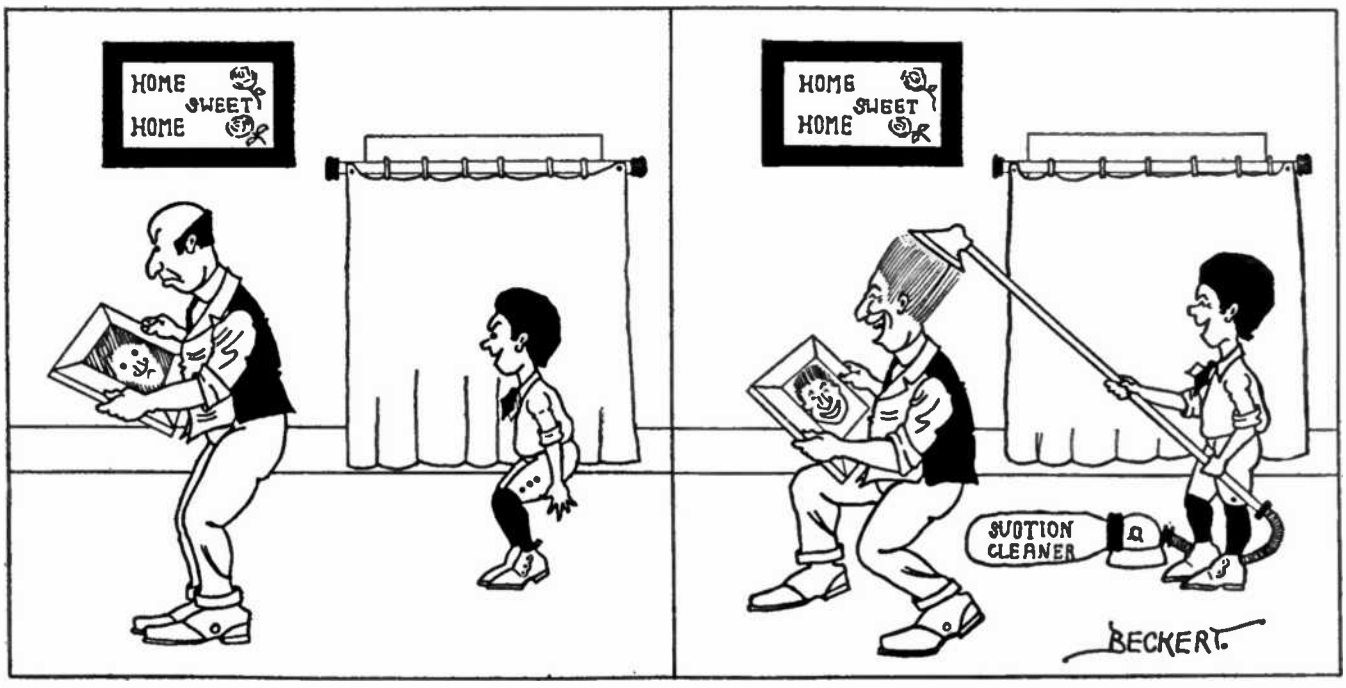
Office Boy—Yes, sir; and how soon will you be back if no one asks for you?—*Boston Transcript.*

A Clever Answer

The two oldest inhabitants were very ignorant, neither of them being able even to tell the time of day. A friend of Uncle Ben's gave him a watch, of which he was very proud. One day, before the crowd at the corner store, old Pete, being slightly jealous of such wealth and wishing to embarrass his rival, said, "Say, Ben, what time have ye got?"

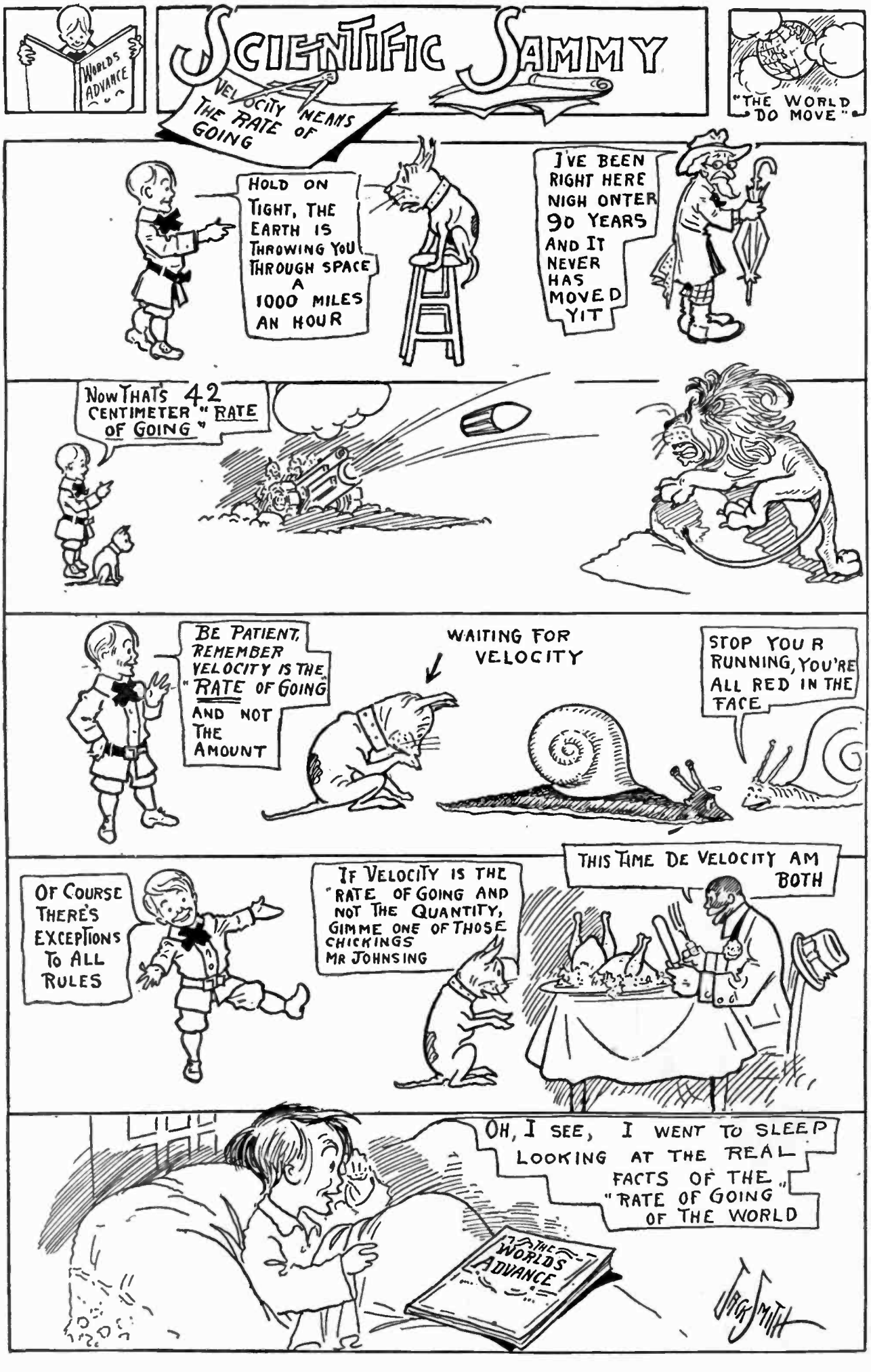
The other old fellow drew out his watch and turned its face toward his inquisitor. "There she be!" he exclaimed.

Pete was almost at a loss, but he made a magnificent effort and retorted, "Blame if she ain't!"—*Everybody's.*



Dad: Were it not for that dome of mine
My looks would sure be mighty fine!
Kid: By golly, dad! I'm not a dreamer;
I've got a scheme—the vacuum cleaner.

Dad: The suction works, hair grows like thunder,
Ingenious Gene, you are a wonder!
Kid: The world would gain, if people knew
What electricity can always do.


WORLDS ADVANCE
SCIENTIFIC SAMMY
VELOCITY MEANS THE RATE OF GOING
"THE WORLD DO MOVE"
HOLD ON TIGHT, THE EARTH IS THROWING YOU THROUGH SPACE A 1000 MILES AN HOUR
I'VE BEEN RIGHT HERE NIGH ONTER 90 YEARS AND IT NEVER HAS MOVED YIT
NOW THATS 42 CENTIMETER "RATE OF GOING"
BE PATIENT, REMEMBER VELOCITY IS THE "RATE OF GOING" AND NOT THE AMOUNT
WAITING FOR VELOCITY
STOP YOU R RUNNING, YOU'RE ALL RED IN THE FACE
OF COURSE THERE'S EXCEPTIONS TO ALL RULES
IF VELOCITY IS THE "RATE OF GOING AND NOT THE QUANTITY, GIMME ONE OF THOSE CHICKINGS MR JOHNSING
THIS TIME DE VELOCITY AM BOTH
OH, I SEE, I WENT TO SLEEP LOOKING AT THE REAL FACTS OF THE "RATE OF GOING" OF THE WORLD
THE WORLDS ADVANCE
J.R.G. SMITH