MODERN MECHANICS

In Plain English

Vol. 30 MARCH, 1915 No. 3

ANNOUNCEMENT

WE find with considerable regret that not a little confusion has arisen among our friends and readers due to the similarity of the name of our magazine with that of a contemporary publication.

However, to the reader who has followed the development of the present MODERN MECHANICS *through the many years since "The Popular Electrician" was founded back in 1890, it is superfluous to say that at no time has it been our aim either to imitate or to bask in the well-deserved prestige of any other magazine. Thoughtful readers will appreciate that the policy of our magazine is quite different from that of any other publication, even though at first glance it may resemble some others in a general way just as dozens of other magazines and newspapers are identical in make-up and style.*

MODERN MECHANICS *makes no effort to report a new device or achievement solely for its news value; the aim is rather to include in every article some feature of practical value—something that may enable someone, perhaps in a far distant land, to profit by the experience of the individual referred to in the article.*

The articles in MODERN MECHANICS *are long enough to tell the story without being so long as to seem wearisome.*

They give the reader a general review of the world's advance in electricity, mechanics, science and invention and show him not only what is being accomplished but also how it is done.

Therefore, in view of the fact that the present title does not properly cover the contents of our publication, as well as to eliminate all possible criticism, it has become essential to make another change in name. The new title will enable us to continue in every particular with the same editorial policy as heretofore, while the new name will more clearly express the contents of the magazine. Hence, commencing with the April issue, the magazine will be known as "THE WORLD'S ADVANCE."

The reader is referred to page 431 of this issue for additional comments on this subject.

The Editors.

February 15, 1915.

A DESCRIPTION of an unique type of submarine diving apparatus with which a Western inventor contemplates bringing valuable submerged wrecks to the surface.

THE successful casting of an approximately eight-foot sphere, the largest shell ever cast, so it is claimed, is a step toward the realization of the dream of ages—the recovery of the untold millions of treasure that are known to be lying at the bottom of the sea.

Within the last few months still more treasure has been sunk, and, indeed, the ships and valuable contents sent to the bottom since the outbreak of the war represent sufficient salvage to warrant the development of the new type of diving apparatus which has some of the features of the submarine and some resemblance to the diving bell, although its inventor has developed other devices that are absolutely unique.

The diving apparatus, which is the idea of a Los Angeles inventor, consists of a hollow metal shell somewhat less than eight feet in interior diameter, and designed to contain two operators and a number of mechanical devices. The shell is to be used in connection with a tender ship to which it is connected by cables supplying electrical power and permitting of telephonic communication between the men below and the tender. The electric power serves to operate a motor which in turn drives two propellers mounted on universal joints, designed for allowing a wide range of exploration while connected with the vessel above. For instance, while the general location of many treasure-bearing wrecks is known, it may be necessary to explore quite a wide radius before the hulk is found, and this is accomplished by the propellers as well as several searchlights carried by the submarine chamber.

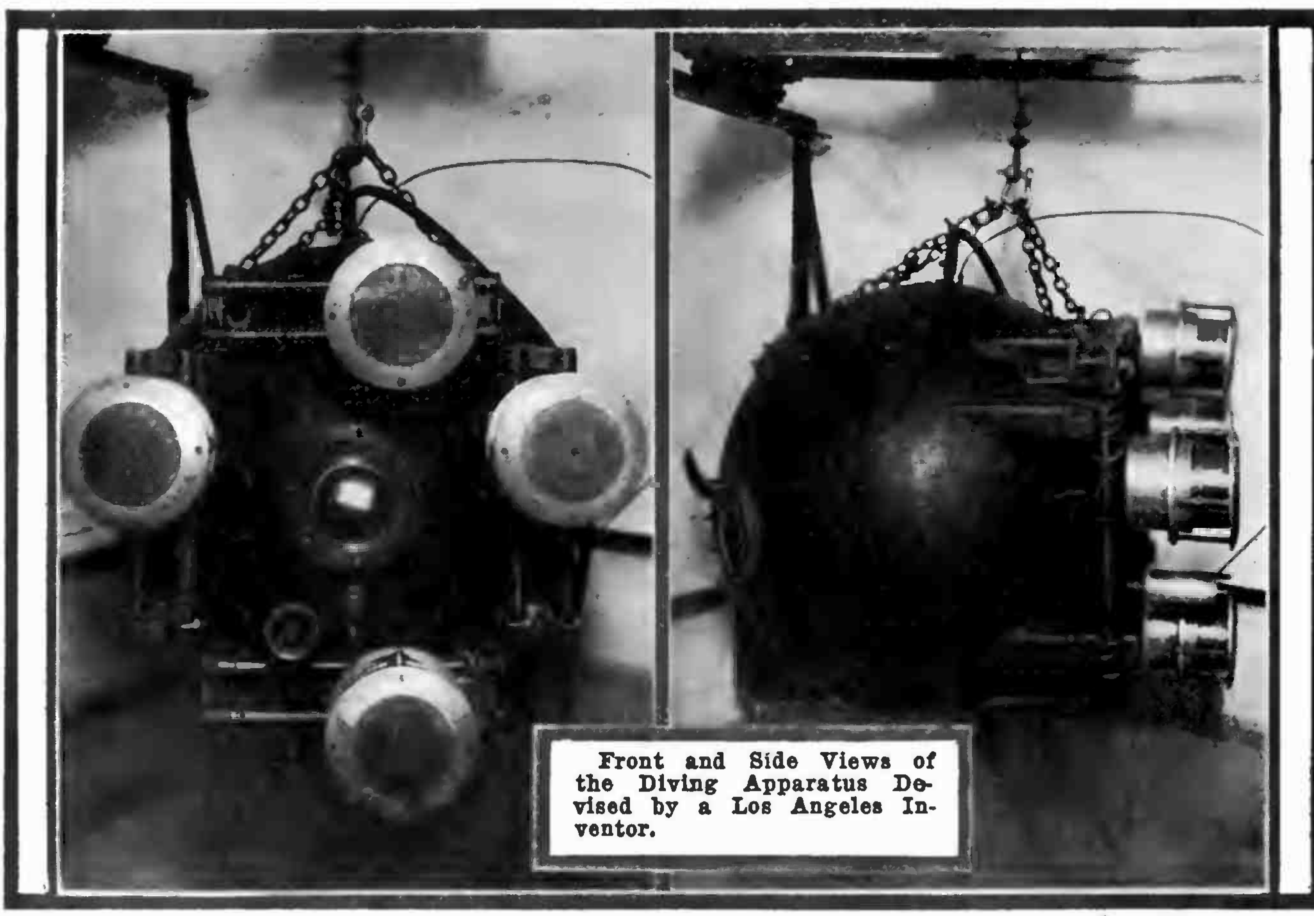
The inventor of the diving chamber has a novel method of bringing wrecks to the surface. It requires a number of pontoons, varying according to the size of the sunken ship. These are in the form of steel cylinders with corrugated walls. Each cylinder contains a small motor-driven pump. The pontoons after being filled with water are carried down to the hulk by the submarine. After being attached to the side of the wreck, the pumps empty them and their buoyancy raises the hulk to the surface.

The method of attaching the pontoons brings into operation one of the most remarkable features of the submarine device—a series of huge magnets on the submarine, which are energized by the electric current from the tender when the submarine is

Above: Pouring the Iron for Casting the Eight-Foot Round Shell to be Used for Submarine Exploration. Below: The Shell as it Appeared when the Metal had Cooled.

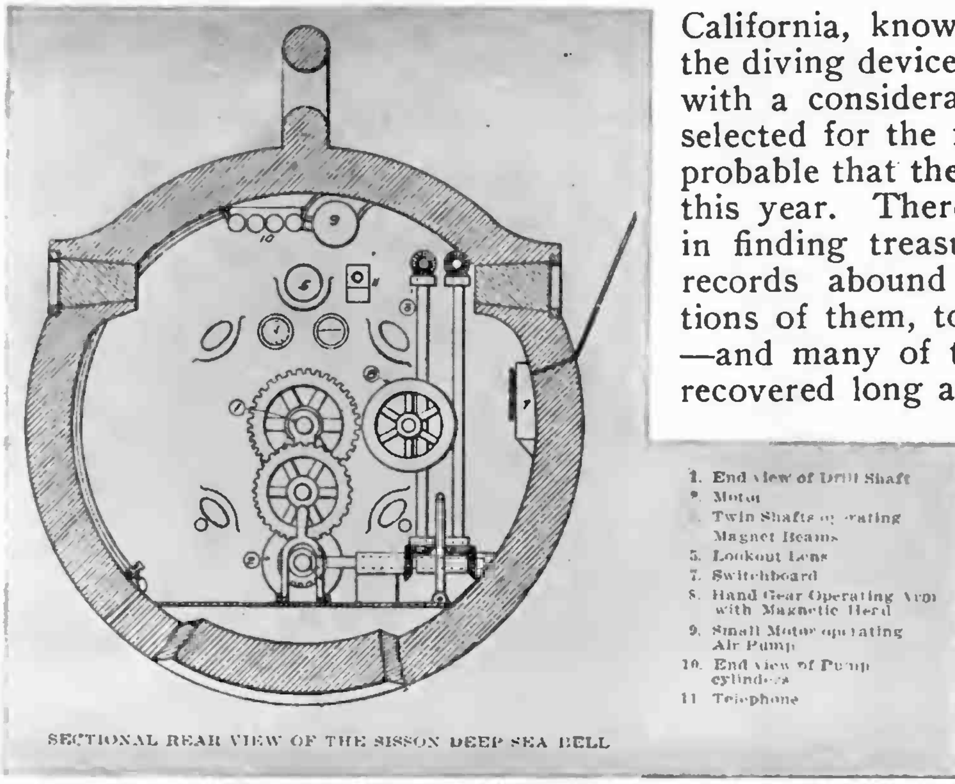
ready to operate on the hulk. The magnets hold the submarine firmly to the iron or steel plates of the wreck, while a motor-driven drill bores a hole into the side. This operation takes place after the pontoon has been set in a proper position beside the wreck. The pontoons are fitted with several steel cables on the ends of which are special hooks held upright by floats. After drilling a hole, the submarine, while still held by the magnets to the vessel's side, moves a few inches to one side; this being accomplished by a worm gear that shifts it to a given distance. Then the end of the first pontoon cable is seized by a magnetized arm and the automatically-locking hook is set in the freshly drilled hole. The submarine is then moved a short distance, another hole is drilled, and again a pontoon hook is inserted. This procedure is repeated until the wreck is firmly attached to the first pontoon.

After a pontoon has been attached to the hulk, the submarine ascends to the tender and brings down a second pontoon, repeating the operation until the hulk is surrounded by these metal cylinders. It is understood that each is connected by a power line to the tender above, so that when the time for pumping out the water arrives, each can be emptied independently, or all together, as desired. Since the submarine can keep in touch with the tender by telephone and at the same time observe the operation of the work below, it is possible to conduct the pumping in such a manner that the hulk will be floated on an even keel, by emptying some pontoons faster than others. Once at the surface, it is only a matter of towing the wreck to some convenient harbor for securing the contents, and if the vessel is not irrepairably damaged, for making it seaworthy.



Front and Side Views of the Diving Apparatus Devised by a Los Angeles Inventor.

In the case of vessels sunk in war, it may be possible in most cases to repair the ships for further service. The same possibilities are logical in cases of shipwreck occurring through striking a submerged rock. Many of the older wrecks would be of value for their contents alone, and some of them



Diagrammatic View of the Interior of the Diving Apparatus, Showing the Various Controlling Devices.

are known to carry millions of dollars worth of gold and silver coin or bullion.

A sunken vessel off the coast of California, known by the inventor of the diving device to have carried a safe with a considerable fortune, has been selected for the first venture, and it is probable that the attempt will be made this year. There will be no difficulty in finding treasure ships—official sea records abound with exact descriptions of them, together with locations—and many of them could have been recovered long ago but for the lack of efficient diving apparatus.

One of the principal mechanical difficulties, the casting of a spherical shell of the required size, has just been overcome. It is 1¼ inches thick, has a weight of six tons and is formed of a metal which is rendered malleable by a secret process, yet is sufficiently rigid to withstand the pressure of the sea to a depth of a thousand feet.

BETWEEN THE LINES LIES SAFETY

In an effort to help along the "safety first" campaign, prominent street crossings in Cincinnati have been marked off into lanes by two white lines about ten feet apart. It is in the lane thus designated that safety is found by the pedestrians, since danger of being struck by an automobile or other vehicle is eliminated. Drivers do not cross the white lines until signaled to do so by the traffic officer and people have been quick to learn that they should not attempt to cross the street outside of the white lines. At the curb "step-off" at each corner is painted the injunction "Walk Between These Lines." As the painted lines are liable to wear off, they will be replaced in the future by lines of white bricks laid in the paving which will make the lines absolutely permanent.

The White Lines Mark the Lanes through which the Pedestrians May Cross the Streets in Safety.

A Handy Watering Can for Reaching Flower Pots Placed on High Shelves.

A HANDY WATERING CAN

One of the most handy things ever devised for the watering of ferns and flowers which happen to be located upon shelves far above the reach of the ordinary person, is the little device just invented by a Californian. With this simple apparatus it is possible to eliminate all climbing and much of the regular work in the operation of plant irrigation in the modern business or home place. This little device consists of a can something like two inches in diameter and seven inches in length, to which a wire or "tipper" about an inch in length is soldered to the side about an inch from the top of the can. To this can is also soldered a wire handle, this being fastened to either side of the can, so located as to permit the can being tipped quite readily. The opposite end of this wire holder is fastened to a handle of sufficient length to reach any of the flowers that are to be watered.

FIGHTING THE MOSQUITO IN PANAMA

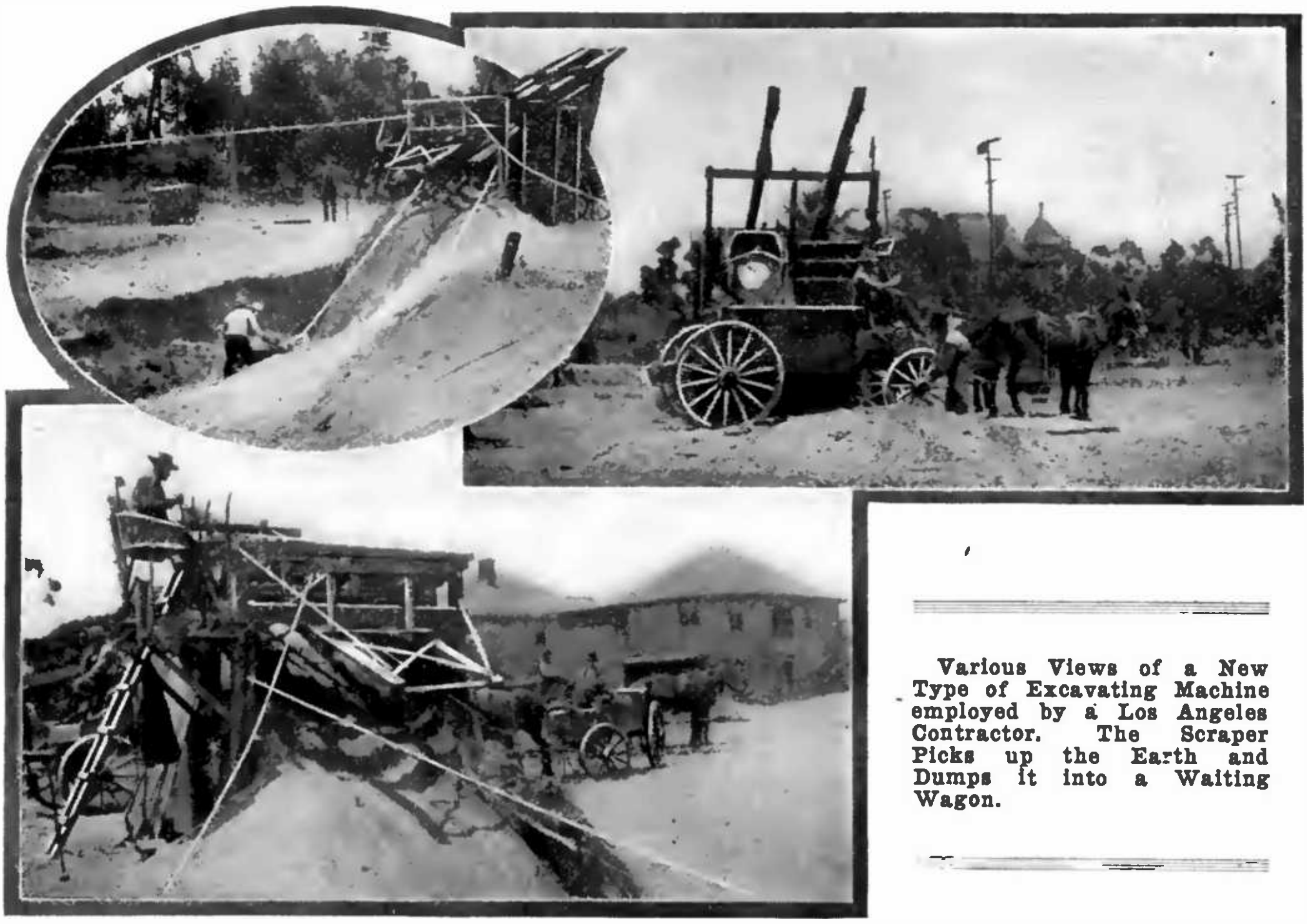
Almost as important as the work of the canal builders was that of the Sanitary Corps, whose campaigns against tropical disease made possible the accomplishment of the great task. The accompanying view shows two of the Canal Zone mosquito fighters. These men operate in pairs, one carrying the pressure tank and the other an extra supply of oil. They cover the entire Zone and it is safe to say that every pool of still water is frequently sprayed with the poisonous oil which has put such an effectual check on the breeding of disease-bearing insects.

These men are not natives of Panama. They are West Indian negroes; the zone natives having proved absolutely worthless as laborers, according to reports.

Two Mosquito Fighters in the Canal Zone, carrying their Weapons.

A NEW TYPE OF EXCAVATOR

An excavating machine in use in Los Angeles employs a novel system in making the dirt fly. It is driven by an electric motor, operated on a light and power circuit.



Various Views of a New Type of Excavating Machine employed by a Los Angeles Contractor. The Scraper Picks up the Earth and Dumps it into a Waiting Wagon.

In this new excavator the usual familiar device of a chain of buckets is discarded. Instead, one or more scrapers attached to wire cables are used, the cable being endless and so adjusted that the pull of the motor draws the full scraper to the scaffold, where it is automatically dumped into a waiting wagon, while the reverse action draws the empty scraper back to the starting point. Here a laborer is waiting for it, but his work is quite light, as he merely grasps it by the handles, steers it for a few feet until it is full of dirt, and then lets the cable draw it up the incline to the dumping place. In order to get the reverse action, it is necessary to stake out the cable around the excavation and provide pulleys for it to run on.

The operation of the new excavator is remarkably speedy, since it pulls the dirt up the slope and dumps it ten times as fast as a mule-drawn scraper could do the work. Two scrapers can be employed even more economically, for, while a laborer is required for each scraper, the motors of two can be operated by a single engineer. His duties are merely the throwing back and forth of a couple of levers.

PUMICE—NATURAL AND ARTIFICIAL

Pumice is a volcanic rock that, when ejected from the volcano, has been made porous by the sudden expansion of gas or steam imprisoned in it. Although the stone is useful in the industrial arts, especially in leather and felt work, in sculpture and stucco-work, and in polishing woods and grinding lithographic stones, the texture and hardness of it vary so much as to make it untrustworthy for exacting work. That has led to the introduction of an artificial stone, said to be better than the natural pumice. This is, or until recently was, manufactured at Bietigheim, in Germany, from sandstone and clay, combined in different ways to produce at least ten grades of pumice.

Most of the natural pumice used in the United States is imported. The value of the native supply, according to the latest available figures, was $33,439. It is obtained principally from deposits in Harlan and Lincoln counties, Nebraska.

THE WORLD'S GREATEST INLAND DRYDOCK

When the upper half of the Mississippi River was closed to navigation in November, the largest inland drydock in the world, located at Keokuk, near the big dam, was ready for use. It is of sufficient size to accommodate the largest boats and can easily care for several boats at a time of the size plying the Mississippi River.

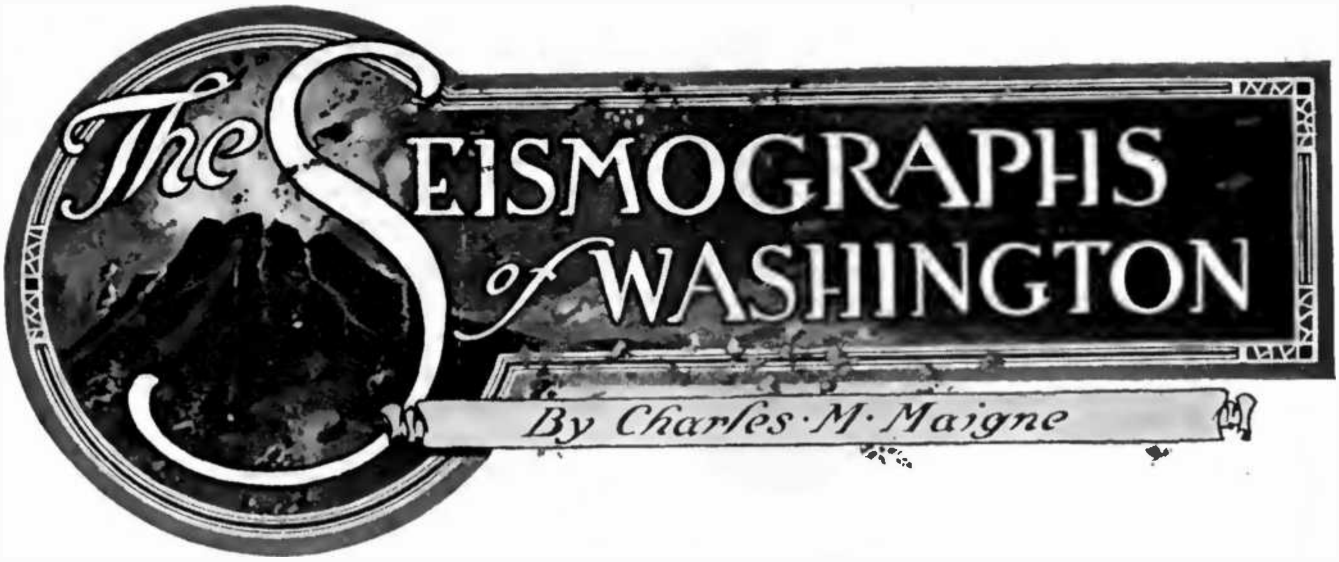
The drydock is 463 feet long and 150 feet wide. A huge travelling crane is an important feature of the big plant, as it renders possible the making of the most extensive repairs on river boats. A half dozen buildings, including the administration building, a machine shop, store houses and shops, form an important part of the drydock.

It is expected that the Keokuk drydock will prove a big boon to the navigators of the Mississippi River.

The Keokuk Drydock on the Mississippi River, Said to be the Largest Inland Drydock in the World.

BUILDING A ROAD BY DYNAMITE

Not long ago road-builders near Nevada City, California, used dynamite in building a half-mile stretch of road on the side of a hill. They placed the dynamite in vertical holes five feet deep along a line that was to mark the upper side of the road. When the dynamite exploded it blew the earth out toward the down-hill side. Little shoveling was needed. The road-builders used dynamite also to split fallen trees, and with the logs built an eight-foot corduroy road across a long stretch of swamp-land. In eight days, it seems, eight men completed the road at a cost for labor and material of $264, or 10 cents a lineal foot.



BEFORE the cable, telegraph or wireless means of communication can send the news of a volcanic eruption around the world, delicate mechanisms known as seismographs have already imparted the fact and recorded the violence of the disturbance in distant cities.

ON the stately heights of old Georgetown, overlooking the winding stretches of the Potomac, there stand the buildings and towers of Georgetown University, and in the heart of the great quadrangle, fifteen feet below the level of the ground, is a concrete and non-conducting cave jealously guarded from the tread of disturbing mankind.

In the heart of the cave, just as a nest of weird, ungainly spiders of human devising, with threads of web extending far and wide across the land, are grouped delicate contrivances of steel and brass, bronze, vulcanized rubber and platinum, as, with microscopic accuracy, seismographs which record near and distant tremors of the earth keep their ceaseless watch.

Their platinum pens, as they scratch across the sooted surface of the smoke sheet placed on the revolving drums, may tell of disturbances within the earth, valuable only to science in the study of seismology; or they may record a cataclysm in a distant land; and their faint whisperings, when amplified by the lightning flash of cable and wireless, may spell out a tale of terror, of rocking cities and falling masonry, of the horror of a sudden darkness wherein frenzied people flee blindly through debris-piled streets, amid the moans of the injured.

Twice each day, with reverend footfall, the great door of the cave is entered and the record of the preceding hours lifted from the instruments. Then it is filed with those that have gone before, and the story of its waverings is sent out to be compared with the "grams," as the completed records are called, of other stations scattered throughout the land.

Let us look at the theory of the instrument.

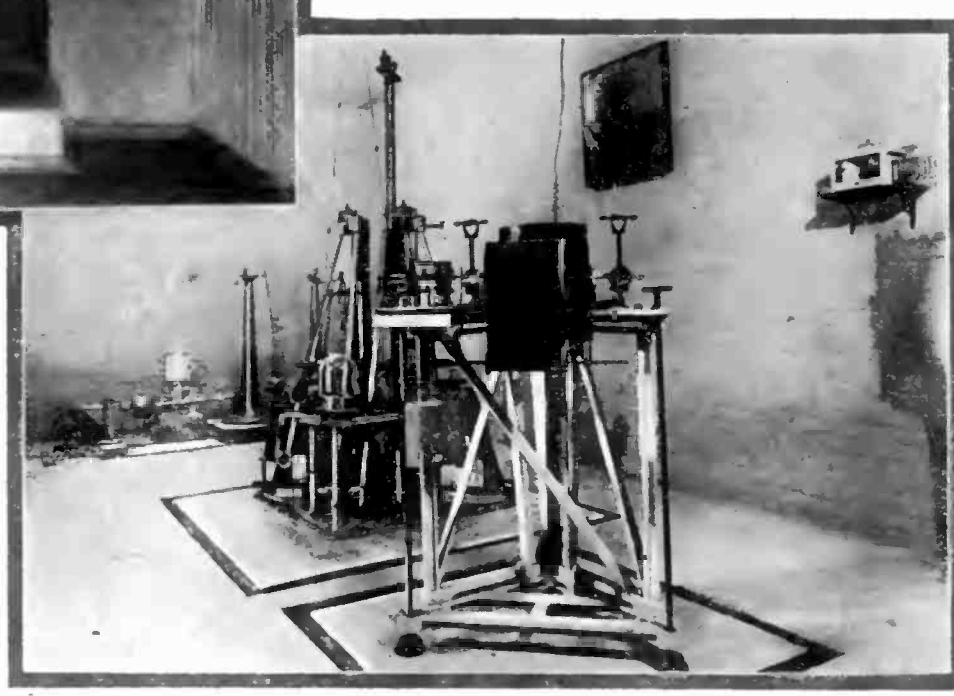
The seismograph is virtually an inverted pendulum, one end of which is practically rigid except for a complex hinge, called Cardanic, and with a mass of metal on the outstretched arm, as heavy as is consistent with the strength of the hinge. Delicately attached to the other end of the recording arm is the platinum pen, which, on the moving end of the strut, amplifies the faint movements transmitted from the rigid frame of the machine.

When the pier or support upon which the instrument rests is set in motion by the tremblings of the earthquake, the Cardanic hinge and the frame of the machine execute all the oscillations communicated to them, while the heavy mass of metal on the arm tends to keep its position.

It is the inertia of the mass which

gives it stability. Between the mass and the frame, which is more or less agitated by the faintest earth tremor, there is a relative motion and the pens trace a record of the disturbance.

That it may not remain stationary when the frame oscillates, as the tremendous relative weight must be supported, the mass is attached to the frame by two thrust rods, which meet in the center of oscillation of the mass. These rods meet at an angle of 90 degrees and thence extend to the short end of a lever, the fulcrum of which is fixed rigidly to the frame, while its long arm works against a spring. The pressure of the spring opposes the pull of gravity, acting on the mass, which is slightly displaced from the vertical position.



Above: Clocks Governing the Seismographs at Georgetown University. At the Right: The Seismographs that Stand on Concrete Piers that Reach Downward to Bed Rock.

Photos. by G. V. Buck, Washington, D. C.

Just as a pendulum the mass executes harmonic motion and will have its own definite period or beat. This may be changed at will by adjusting the leverage through which the spring acts on the mass. It is through these levers that the desired magnification on the "gram" is secured. The long arm operates one of the recording pens and hence any movement transmitted to the latter will be multiplied on the record in the ratio of the long to the short arm of the lever system.

Unless checked, strong impulses would keep the mass in motion for a considerable time, thereby obliterating or accentuating earth-tremors and falsifying the record. To prevent this, what is known as a "damping" contrivance is used. Damping tends to hold the mass in check, preventing it, to a great extent, from executing its own vibrations. The damping is accomplished by means of a piston connected by a rod to the lever system, and which moves to and fro in a cylindrical air chamber.

The resistance of the air opposes and

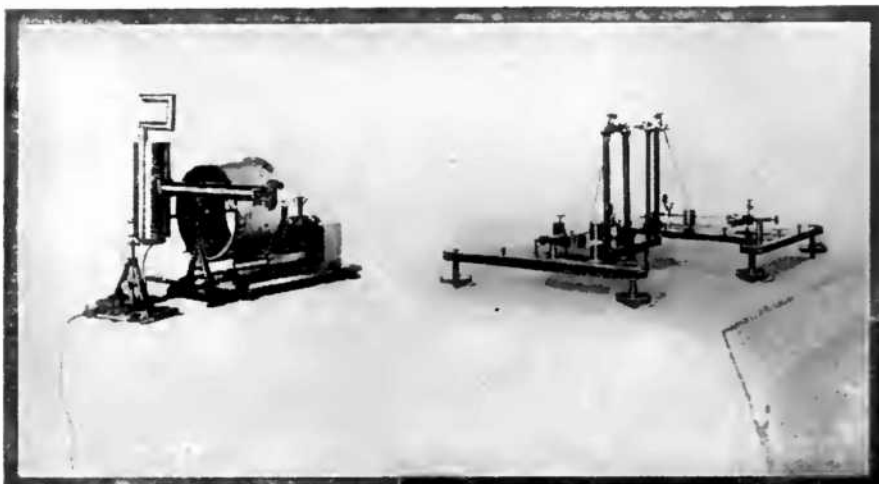
minimizes the pendulum's independent action. Through this system, the mass keeps itself from being thrown into violent swinging by earth disturbances, without losing its sensitiveness to minute tremors.

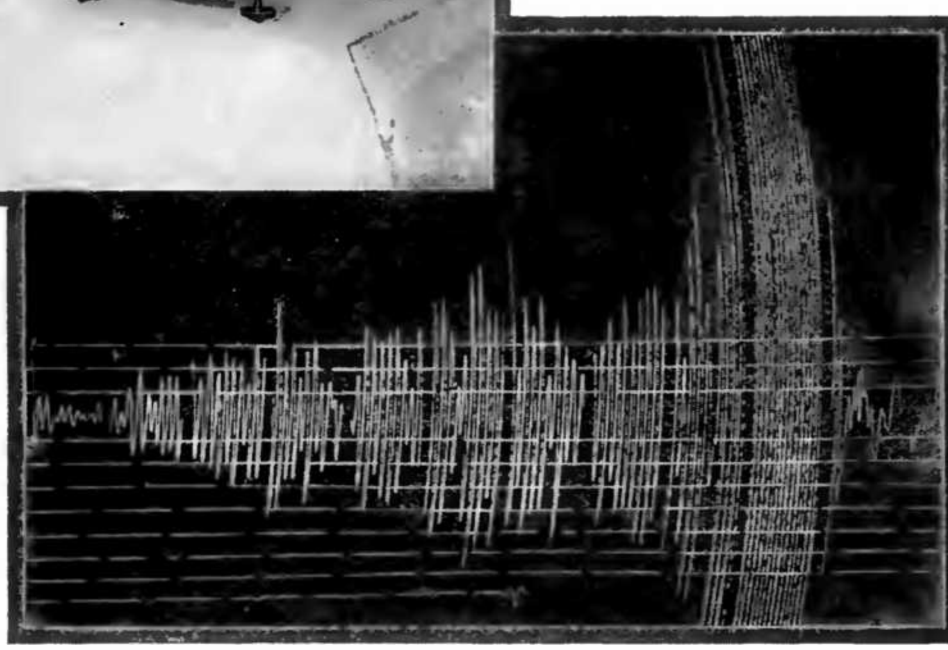
The Georgetown seismic station is under the direction of Fr. Tondorff, S.J., a young priest. He has been in charge of the station for about four years and in that time his labors have brought him into contact with leaders in science from all over the world.

Father Tondorff was asked recently if there were possibilities of science reaching the mark where an earthquake could be predicted in a certain locality. He replied that while almost anything was possible, but little advance had been made along this line.

"Each earthquake," he said, "is studied and its possible relation to other disturbances is analyzed. Much time is being given now to the periodicity, that is, the more or less regular intervals between disturbances of various intensity. Possibly some solution may be deduced from this, but it is difficult to say.

"Periodicity in earthquakes I may compare in a homely way with a somewhat similar occurrence, although very faintly. Have you ever noticed sliding snow on a roof? Some near the top will start to slide, through melting or some disturbance, and some projection will halt its progress. In a short time this will slide further, until it is checked again by some obstruction; finally, the increased weight of the snow will start it off again, and the whole mass of it will dash to the ground. We may compare the cumulative of this to the periodicity of a great earthquake," he concluded.





Above: Photographic Seismograph after Bosch, a Type that is Much More Compact than that Illustrated on the Opposite Page. At the Right: A Gram of a Violent Eruption.

The seismograph instruments are very delicate and very finely adjusted. There are four of them at the Georgetown station, one of which is a photographic seismograph, after Bosch. It photographs the seismic waves as they occur and is of great accuracy.

Another machine has been loaned from the station and is now in the frozen north with the Crocker land expedition, yet the remaining instruments are sufficient to check each other and their service to science is unceasing.

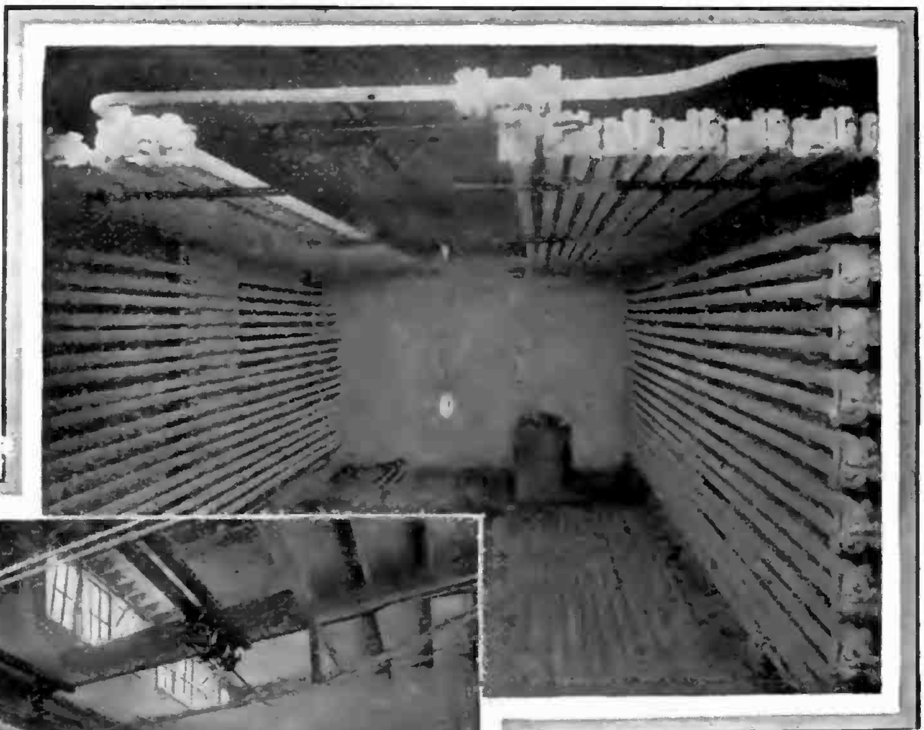
Don't fail to read the important announcement appearing on page 289 of this issue, concerning the April number.

BURNING MAHOGANY FOR FIREWOOD!

The residents of the little settlement at Jordan Valley, Oregon, have to take their choice between burning coal at $27 per ton, or mahogany wood at $18 a cord, and many of them take the mahogany. This wood is so hard that it ruins saws, and this adds to its cost as a fuel. There is a grove sixteen miles from the village, which supplies the mahogany fuel, and the people do not seem to think it is at all strange to be burning this expensive mahogany wood, so coveted for pianos and furniture. The reason for the high cost of coal in this mountain village is the fact that all freight which enters the town must be hauled up from the base of the mountain, and the charge for cartage on all commodities and merchandise of any sort is one cent a pound. The coal costs only $7 per ton at the base of the mountain, but the freight on 2,000 pounds at a penny a pound brings the cost up to $27 for every ton that reaches the summit.

AN UNUSUAL AUTOMOBILE TEST

Automobiles are constructed to be of service in all kinds of weather and great trouble is sometimes taken by manufacturers to insure maximum satisfaction at all times for the motor vehicles. For experimental purposes an Indianapolis manufacturer makes use of a cleverly devised refrigerator room wherein tests for wintry conditions can be made regardless of the natural temperature prevailing. This room is large enough for the largest car and observations can be taken of all working parts in the below-zero "weather" of the refrigerator room.



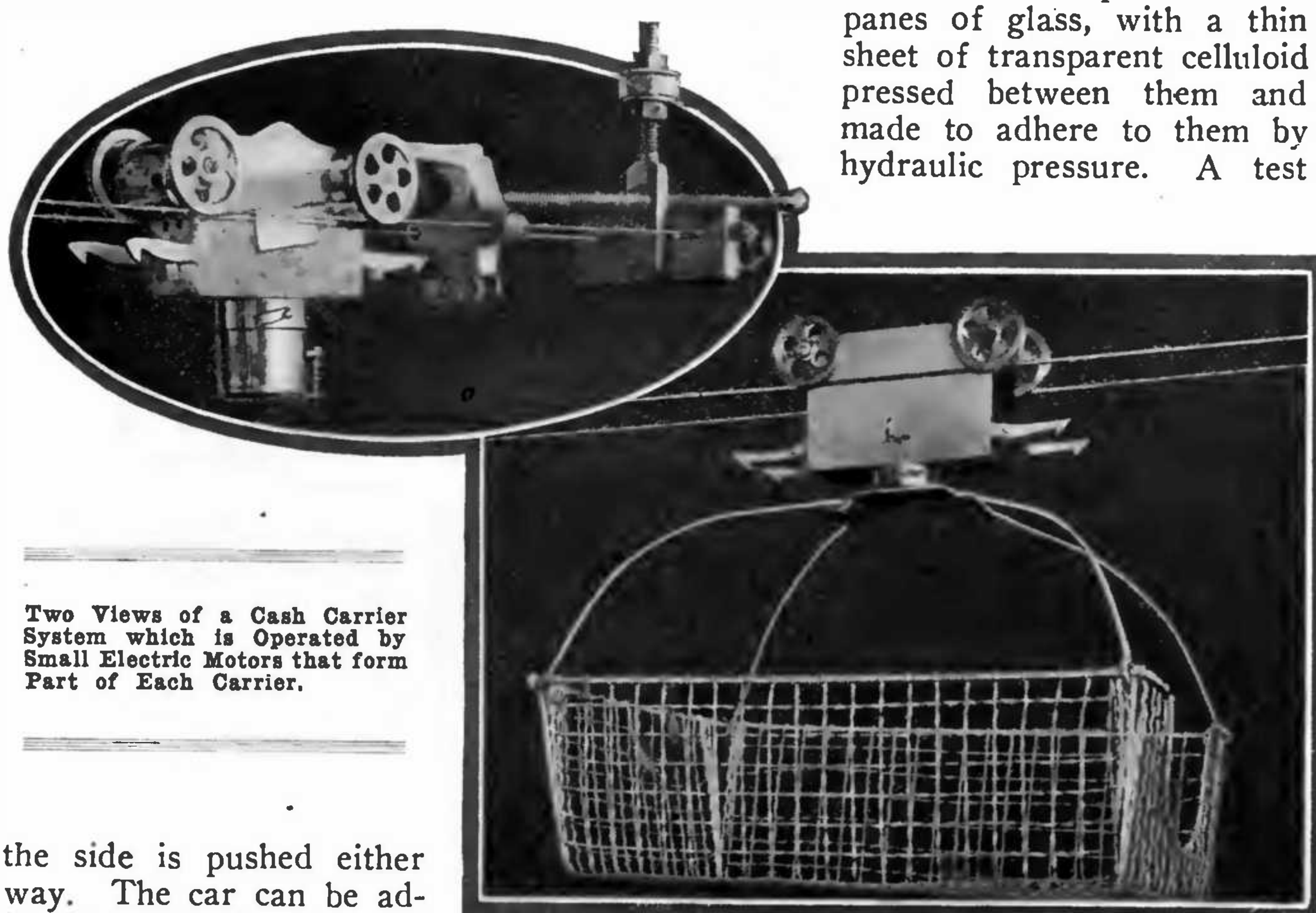
Above: The Interior of a Refrigerator Room in which an American Automobile Manufacturer Tests his Cars.

Below: Ammonia Compressor and Condenser for Generating Intense Cold in the Refrigerator Room.

ELECTRIC MOTORS REPLACE SPRING POWER IN CASH CARRIER SYSTEM

A striking innovation in cash carrier systems is presented in the invention of a Western window trimmer who has been working several years on an electric carrier to replace those operating by spring or pneumatic power.

The new cash carrier consists of a small car fitted with a miniature electric motor. To start the carrier a lever at the side is pushed either way. The car can be adjusted so that it will drop packages or messages at any point on the system and return to the starting point and stop. It will climb stiff grades and operate on a system that is circular or straight. The current for the motor of the cash carrier is supplied by a transformer, and suitable controlling devices permit of variation in the speed of the cars.



Two Views of a Cash Carrier System which is Operated by Small Electric Motors that form Part of Each Carrier.

Electric cash carriers have now been employed in a Western department store for over a year and have proven entirely satisfactory according to reports.

Don't fail to read the important announcement appearing on page 287.

THREE-PLY GLASS

It has been said that a great fortune awaits the individual who shall invent a flexible, unbreakable glass. "Armored glass," so called because it contains a netting of galvanized wire and is not easily broken into small pieces, is too heavy and too nearly opaque for most uses. There is a glass of comparatively recent invention called "three-ply." Although it is neither flexible nor unbreakable it has certain advantages over other kinds. It is composed of two panes of glass, with a thin sheet of transparent celluloid pressed between them and made to adhere to them by hydraulic pressure. A test has shown that a blow hard enough to shatter ordinary glass and to drive the pieces for some distance merely cracks the three-ply glass.

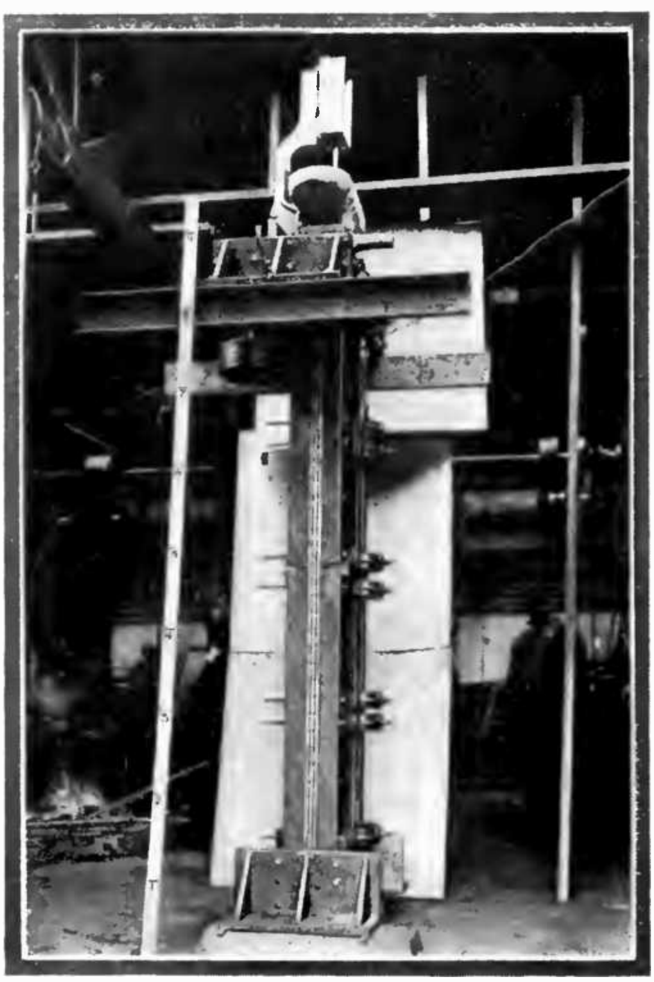
THE STOUTEST TIMBER

One of the most remarkable of the many hard woods of Australia is yate. According to some, this tree apparently furnishes the strongest timber known. Its average tensile strength is twenty-four thousand pounds to the square inch, equal to that of cast iron. Many specimens are even stronger, and one was tested up to seventeen and one-half tons to the square inch—a tensile strength equal to that of wrought iron. The tree sometimes attains a height of one hundred feet and is often more than two and one-half feet in diameter.

MAKING ENDLESS BRASS RODS BY MACHINERY

The making of brass rods has for years required a number of tedious tasks. Today, with the invention of a simple-looking machine, brass rods are turned out automatically just as long as it is fed molten brass.

A man in Newark, N. J., has had this problem under consideration and the result is the perfection of the endless rod machine that turns out brass rod at the rate of from thirty to forty feet per minute. Once the machine is started all labor is dispensed with, excepting, of course, the melters whose duty it is to supply the machine with the necessary amount of molten brass.



By Means of this Machine, Continuous Brass Tubing can be Made with No Other Attention than to Furnish the Metal.

The continuous casting machine stands somewhat over nine feet in height and at its lower extremity rests upon two concrete piers. This space is for the delivery of the brass rod from the machine.

The conventional process of manufacturing rods has been to cast molten brass into stationary molds. With the latest invention the metal is fed into the top of the machine, flows by gravity through a guiding tube into the molding bore of the machine in the center, and the completed rod comes out at the bottom. The machine is said to work equally well on common brass and leaded brass mixtures. The effect of the machine is the same as the old fashioned two-part mold. The molds are divided into sections and are carried on two co-operating chains. As the chains are set in motion the two-part mold is continuously formed.

ARE HIGH BUILDINGS EVER PLUMB?

During the construction of Boston's highest building, the new Custom House tower, the elevator builders carried up their permanent guides as fast as the steel work was in place—something which was never before attempted in any building—due, of course, to the usual inability to plumb the giant framework of a high structure sufficiently to fasten permanent elevator guides in place.

In this building, over 625 feet high, the experiment was tried and has proved a decided success, not only to the elevator builders but to the designers and erectors of so many thousand tons of giant steel columns and beams.

At the twenty-ninth story the elevator guides and the great steel frame to which they were fastened were less than three-sixteenths of an inch out of true plumb! This is truly remarkable in spite of the fact that the great tower rests on no other foundation than that made by pneumatic caissons sunk to a depth of over a hundred feet into loose mud. It is doubtful if all tall structures are as straight as was the case with the new Custom House of Boston.

A REMARKABLE ARCH

IN the ruins of St. Dominic's Church in Panama thero is an arch that is very remarkable. Although it seems impossible that this arch should remain standing after so many years, when nearly all the rest of the building is in ruins, it nevertheless still remains firm. The arch is made entirely of brick and stretches in a long span for the entire width of the church. No sane architect of today would attempt such construction. According to legend, the monks who erected the church had to build the arch three separate times; each time the supports were removed the arch would fall.

French soldiers examining the wreckage of a German monoplane that was hit by shrapnel and brought to earth. Riflemen and artillerymen have now attained a state of marksmanship where aeroplane pilots are in constant danger of being hit by rifle bullets or shrapnel.

A French family among the ruins of their home. In Galicia, western Poland, East Prussia, northeastern France, Belgium and some parts of Servia such scenes as this are quite common.

Distributing gifts to the German soldiers in Poland. As will be seen, one of the gifts is a sausage. Cigars are much in evidence as Christmas gifts among the German soldiers.

A French soldier arousing his sleeping comrade in order to share with him his Christmas box. During the Christmas holidays relatives sent many presents to the men at the front, such as wearing apparel, particularly warm socks and mufflers, tobacco, sweetmeats, etc. The Christmas holidays were duly observed on the firing line, in some instances the soldiers of both sides arranged a truce and even visited each other's trenches to exchange presents.

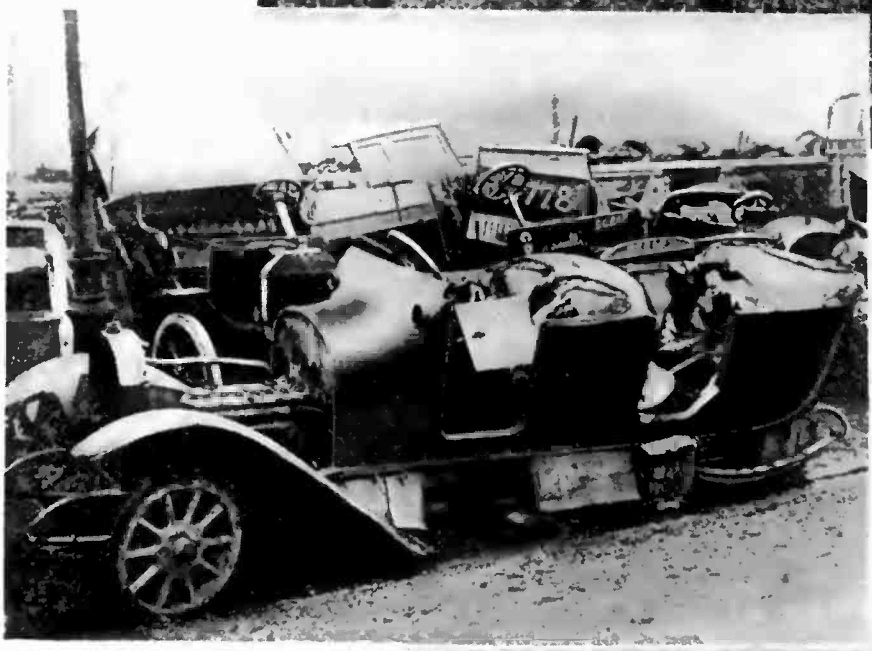
When the war was brought home to England: A view of a building that was partly wrecked as a result of German shells during the bombardment of West Hartlepool by a fleet of German warships. The inhabitants of this and other towns that were victims of the raid, on seeing the German warships approach shore took them to be British ships, since the belief existed that the German ships were securely bottled up. This accounts for the great loss of life.

A section of trenches that have recently been dug along the bluffs of the east coast of England as a precaution against any attempt at an invasion by a hostile army. The recent raid has caused the British authorities to make many defensive preparations.

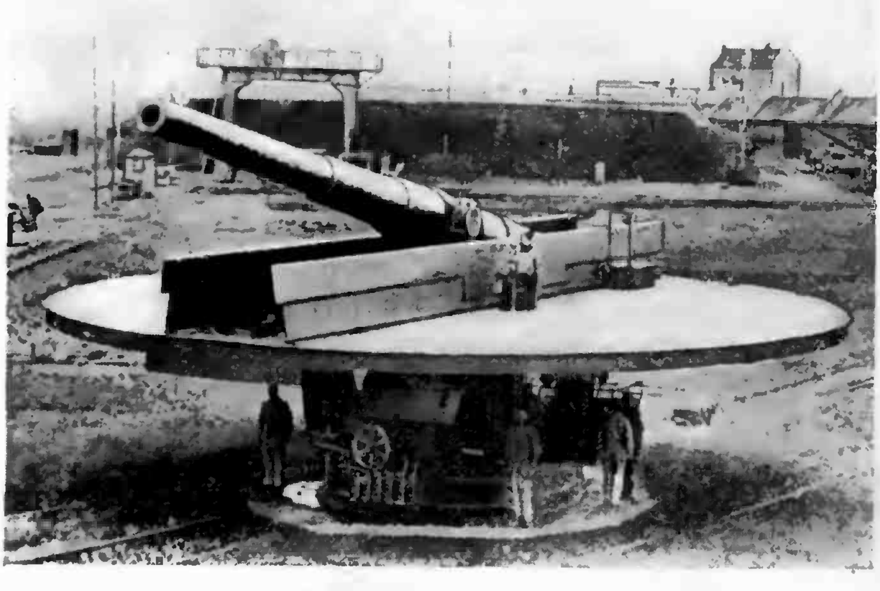
A wrecked shop in the city of Scarborough, England. It was struck by a shell from a German warship, killing the wife of the storekeeper. Many civilians were killed and wounded because of the fact that the raid was unexpected, the women and children having had no time to flee to safety.

Photos. Copyrighted International News Service.

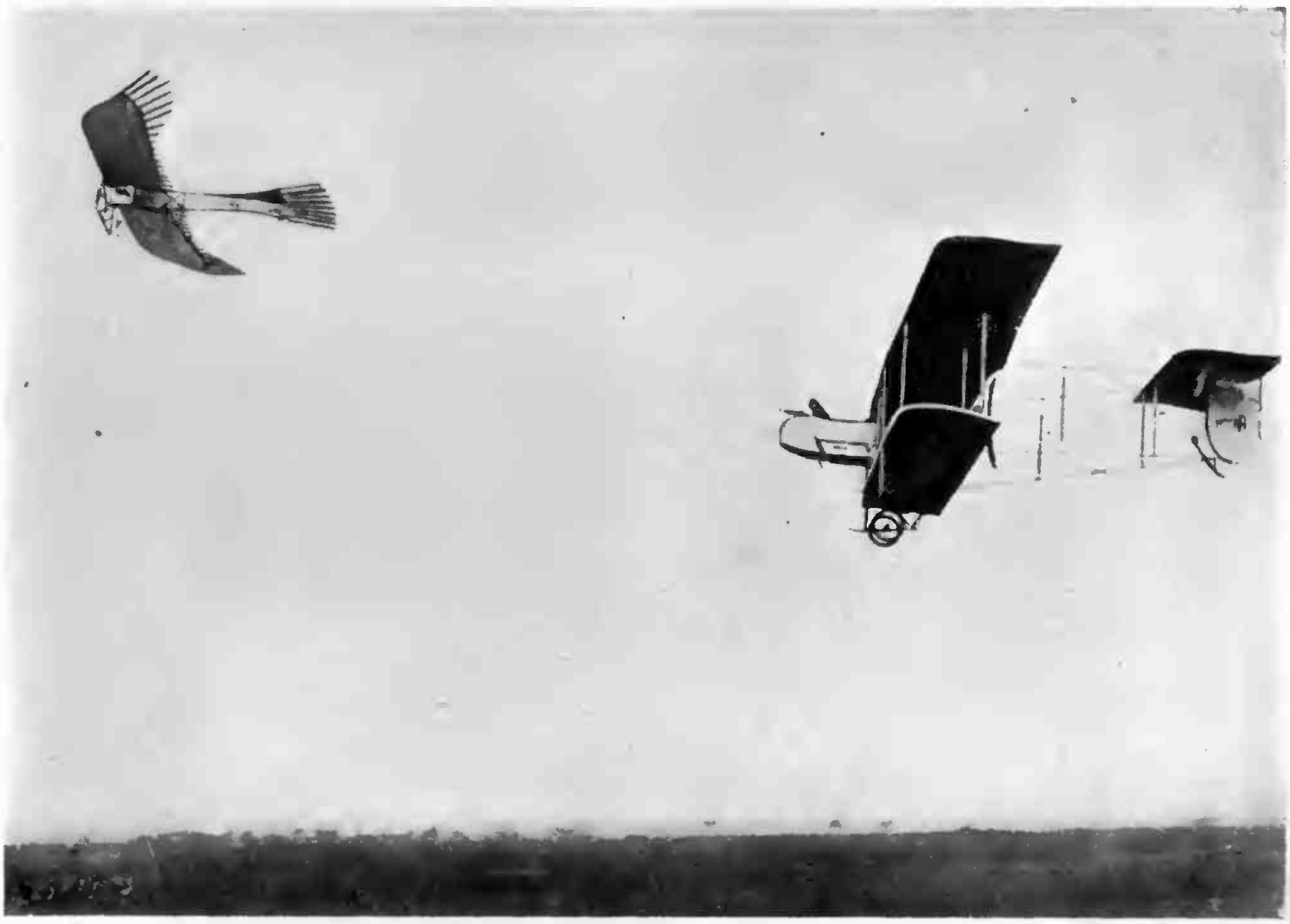
A French machine gun being placed in position. This class of weapon has proven most deadly, and it is liberally used by the German and the Allied armies. At the beginning of the great war the Germans had a marked advantage in the vast number of machine guns they possessed, but present reports state that the Allies are now equal to their opponents in this branch of equipment.



An automobile scrap heap: Most of the automobiles that have been abandoned by the Germans are in such a damaged condition as to be of no serviceable value to the French soldiers. They are accordingly brought to the scrap heap shown here.



A type of disappearing gun that is being used in some of the French forts. It will be noted that the gun can be lowered and the steel doors closed down, thus protecting the mechanism and gun crew from hostile shell fire. A gun of this type is obviously intended to be surrounded by a mass of concrete, in a very similar manner to the steel cupolas of the Liege forts. It has advantages over the steel cupolas and might perhaps withstand the bombardment of huge howitzers.



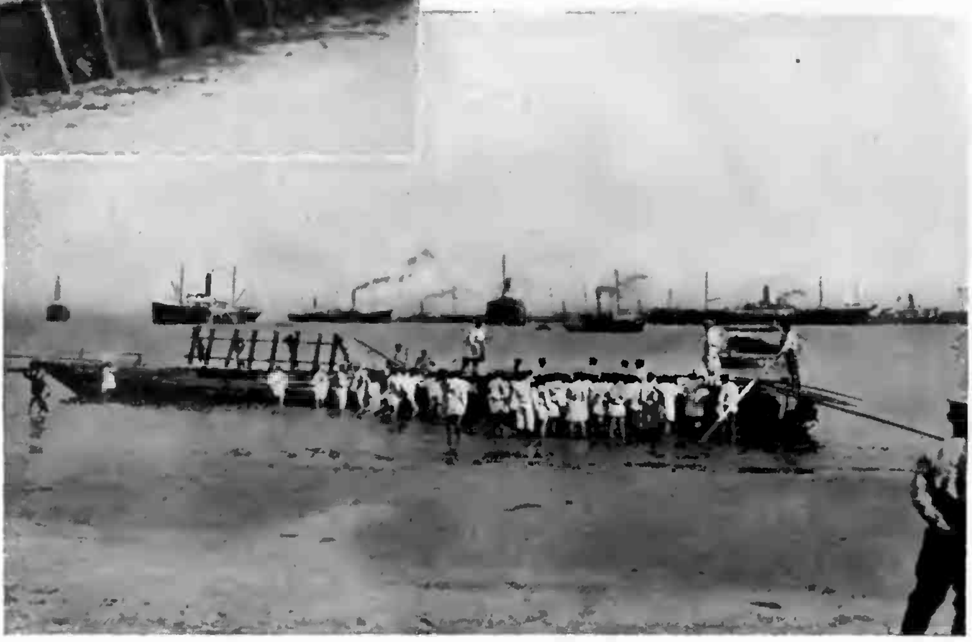
Above: A reproduction from a composite photograph showing a French biplane attacking a German Taube monoplane. While this incident was actually witnessed by a war photographer, the great speed at which the machines were travelling prevented the photographing of both together. Each machine was photographed separately.

Below: A French long-range gun in action in the Flanders section of Belgium. This type has only recently made its appearance and is intended to reply to the powerful German howitzers.

Photos. Copyrighted International News Service.

A few of the 200,000 Japs who greeted the German prisoners of war from Tsingtau upon their arrival in Tokio. With the capture of the German stronghold in China, Japan's military activities in the great war have practically ended, although the German prisoners must be held in custody until peace is arranged between the countries at war.

The lighthouse at Scarborough which was pierced by a shell from one of the German raiding ships. This structure was one of the most prominent targets selected by the German gunners. The bombardment was, according to reports, systematic, the German crews having probably laid plans beforehand as to the important points of the city that were to be bombarded.



Japanese troops landing railway iron for laying a light railway from Saoshan to the Japanese front near Tsingtau. The siege of Kiauchau was conducted with the same precision as that of Port Arthur during the Russo-Japanese war of ten years ago.

Photos. Copyrighted International News Service.

A company of French infantry marching through a sacked village in northern France on their way to the front. At many points along the battle front in France, villages have changed hands many times; in some instances a village may be occupied by the Germans in the morning, by the French in the afternoon, and again by the Germans the following morning.

French soldiers examining their Christmas boxes. This view is of particular interest because it shows the hardships that must be endured by the men in the trenches. Water often accumulates in trenches that are not provided with means of drainage, resulting in ill health to their occupants.

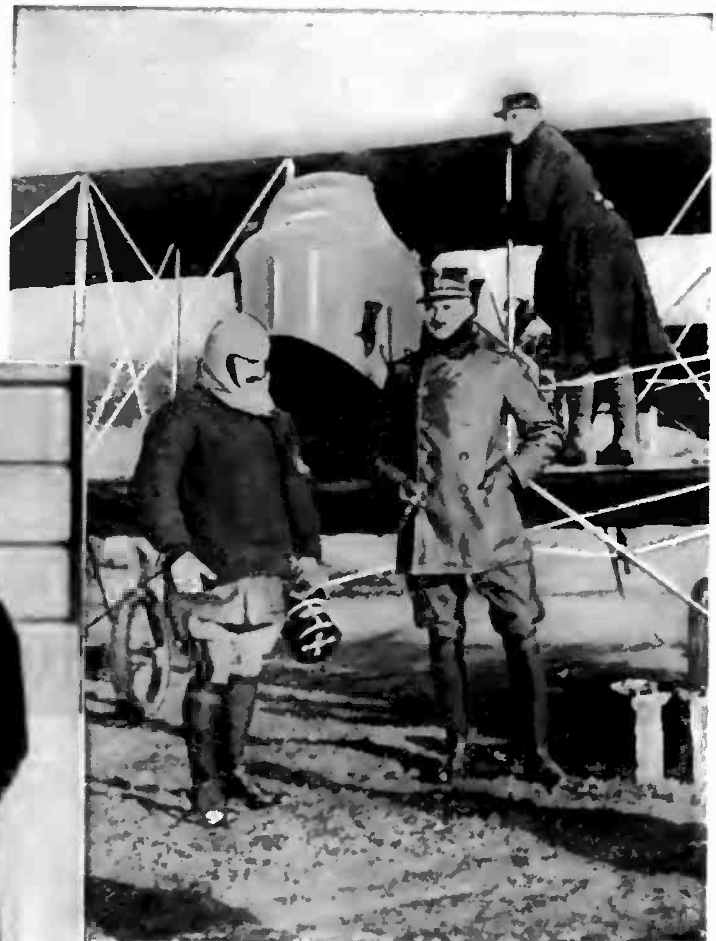
A Belgian airman handing a dispatch to a motorcycle messenger. The aeroplane has proven a valuable instrument for reconnoitering the position of the enemy, while the motorcycle has had its greatest field of usefulness in the carrying of dispatches.

After a battle: French Red Cross aides searching for the wounded. The skill and efficiency of the medical corps connected with all the armies at war have done much to reduce the toll of life.

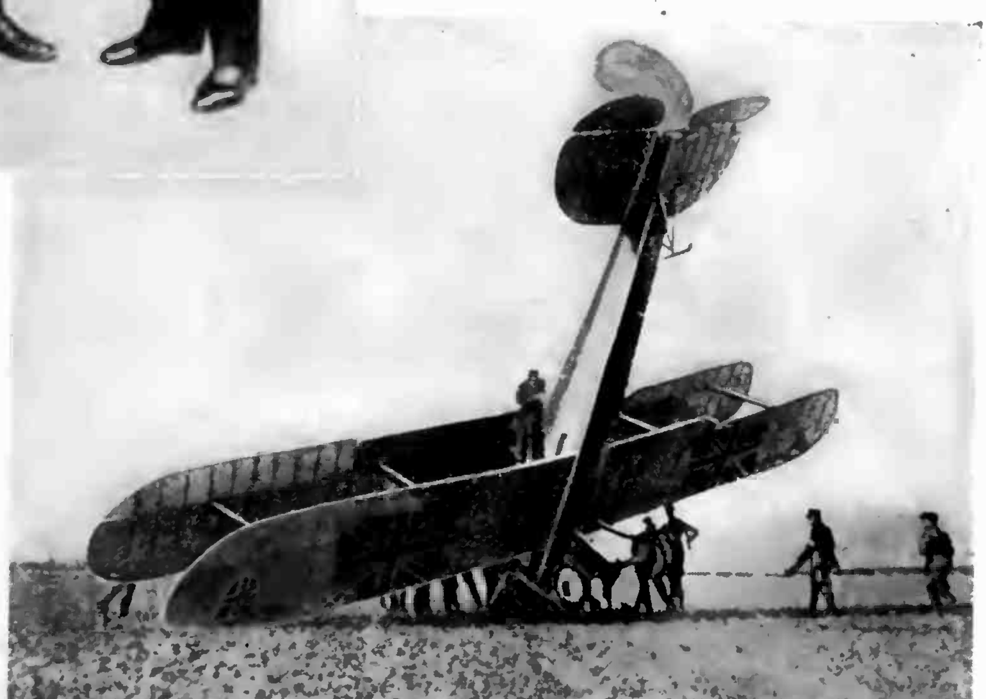
A section of the English coast trenches. These earthworks are constructed along the same lines as those on the Continent, and are provided with bomb-proof shelters and barbed wire entanglements. They are intended to withstand a bombardment by warships and repulse an attempted landing.

Austrian Infantry securely intrenched against their Russian foe. The Austrians have suffered many reverses in the present war, but in all fairness they must be admired for unflinching courage. Even after the most severe defeat, the Austrians soon reorganize their battered armies and again return to face the enemy.

Belgian aviators and one of their machines. For the most part the Belgians have been using biplanes of the Farman type, while the Germans show a preference for the monoplane type. The English and French use both types in about equal proportions.



The well-known English aviator, Claude Graham White, at the front. He is not only a famous aviator but also a designer and constructor of machines that bear his name.

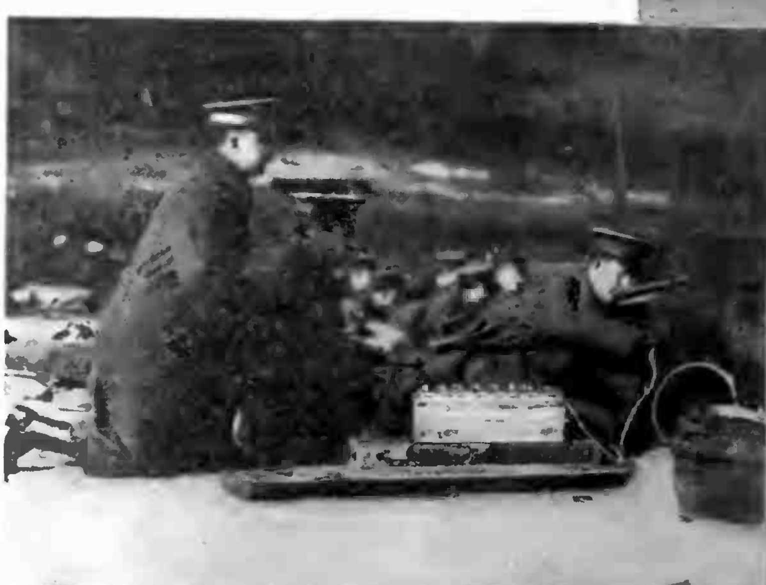


A British aeroplane that was dashed to earth at Ypres. On the underside of the planes of British airships are painted Union Jacks so as to distinguish them from German aeroplanes that are marked with black crosses.

Photos. Copyrighted International News Service.

At the Left: An explosion of the new powerful explosive invented by Lt. H. C. Woodward of the Twenty-second Regiment Engineers, N. G. N. Y.

At the right: Preparing a charge of the new explosive, Trotol-Gelatine, for the tests on land and submarine mines at Fort Wadsworth, S. I.



Above: Electric batteries which furnished the electric current for exploding the mines. At the right: The explosion of a submarine mine charged with 175 pounds of Trotol-Gelatine threw a column of water 375 feet high. The shock would have destroyed the most powerful battleship afloat.

Above: A class of German recruits receiving instructions from an army officer on the use of a rifle. At the Left: An officer in a western prison wears the coat shown for protection against firearms. It is woven of steel and somewhat resembles an ancient coat of mail. It will protect its wearer from revolver bullets fired ten feet distant.

A dwelling built by the negroes of Porto Rico in two hours' time. The shelter is made of palm leaves supported by the trunks of dead coco palms. No nails are used.

A scene during the rugby game between Leland Stanford University and the University of California. This game is the big event in Pacific Coast athletics. A crowd of 26,000 witnessed the game. This view is a very unusual one, since it has caught the "pig skin" in mid-air.

Peculiar "cabbage rocks" found along the shores of the Columbia river. The rocks on the shore are soft and are continually crumbling away, sometimes into curious shapes.

At the Right: A gusher in the oil fields near Bakersfield, Calif., recently caught fire and burned for several days before it could be extinguished. Eighty acres of ground was burned over and the huge torch was only extinguished after several days' effort, using metal plates and live steam.

Panorama view from the dome of the Festival Hall at the Panama-Pacific International Exposition. The view shows the western part of the main group of exhibit palaces. The tall Tower of Jewels, in the center, which is 435 feet high, conceals the famous Golden Gate entrance to the Bay of San Francisco. The domed structure at the left is the Palace of Horticulture. The other palaces shown, from left to right, are those of Education, Liberal Arts, Agriculture, Manufactures and Transportation. Beyond these is shown the Bay of San Francisco, with Mount Tampais and the hills of Marin County.

FACTS CONCERNING THE NEW ELEMENT CANADIUM

It was about two years ago that there was discovered what is thought to be a new noble metal which may in time have important scientific and commercial results. This metal was found by A. G. French in the Nelson mining district of British Columbia and was named canadium. It is allied to the platinum group and occurs pure in the form of grains and short crystalline rods, and also as an alloy. Assays give three ounces or less to the ton. Canadium has a brilliant white luster, and like the three noble metals, gold, silver and platinum, does not oxidize when exposed to the air. The new element is softer than platinum, and its melting-point is not only several hundred degrees lower than that of any of the platinum groups of metals, but slightly less, even, than the melting-points of gold and silver. The physical and chemical properties of the new metal will be studied by many chemical laboratories. According to one authority, canadium is the first new metal to be discovered in anything more than infinitesimal quantities since Professor Winkler isolated germanium in 1885.

A VERY ODD AUTOMOBILE ACCIDENT

The motor truck of a Los Angeles fruit rancher recently turned turtle on a high bridge when the driver lost control

A Curious Automobile Accident in Which No One was Hurt.

of the machine. Instead of making a sheer drop of fifty feet, when the machine backed off the viaduct, it turned somersault, landing upside down on the top of a water-tank. The two Japanese riding on the truck were thrown into the tank through the roof but were unhurt. The Orientals were able to swim until rescued by way of a trap door in the side of the tank. The machine was badly wrecked.

LAWN SPRINKLER OF UNUSUAL DESIGN

An unusual form of lawn sprinkler is shown in the accompanying illustration. It consists simply of a pipe capped at one end and supplied with water at the opposite end. The pipe has a row of holes through which issue streams of water. At the supply end the pipe is fitted with a valve for controlling the water, as well as a handle for turning the pipe so as to change the direction of the sprays. In one instance the sprinkler is employed in a park, the pipe being placed at the edge of a road. In the morning, before traffic commences, the pipe is turned so that the water is sprayed on the road. Later, and for the remainder of the day, the pipe is turned to direct the streams of water on the lawns. This form of sprinkler is so simple that it can be readily and cheaply made by anyone, without much trouble and with simple tools.

A Pipe With a Row of Holes being Employed to Good Advantage as a Lawn Sprinkler.

AN ELECTRIC FLOOR CLEANER

A rather unusual sight in a Chicago office building is one of the porters pushing an electric floor cleaner over the mosaic tile floor late in the evening, instead of the usual corps of women or men with scrubbing brushes or mops.

The electric floor cleaner consists of a powerful motor driving a number of brushes mounted on a suitable framework. Water and soap are supplied to the brushes as required. The reel on the truck plays out as much wire as may be necessary for connecting the motor to the nearest source of power. The equipment enables one man to clean the floors of the entire building with a considerable saving in time and expense.

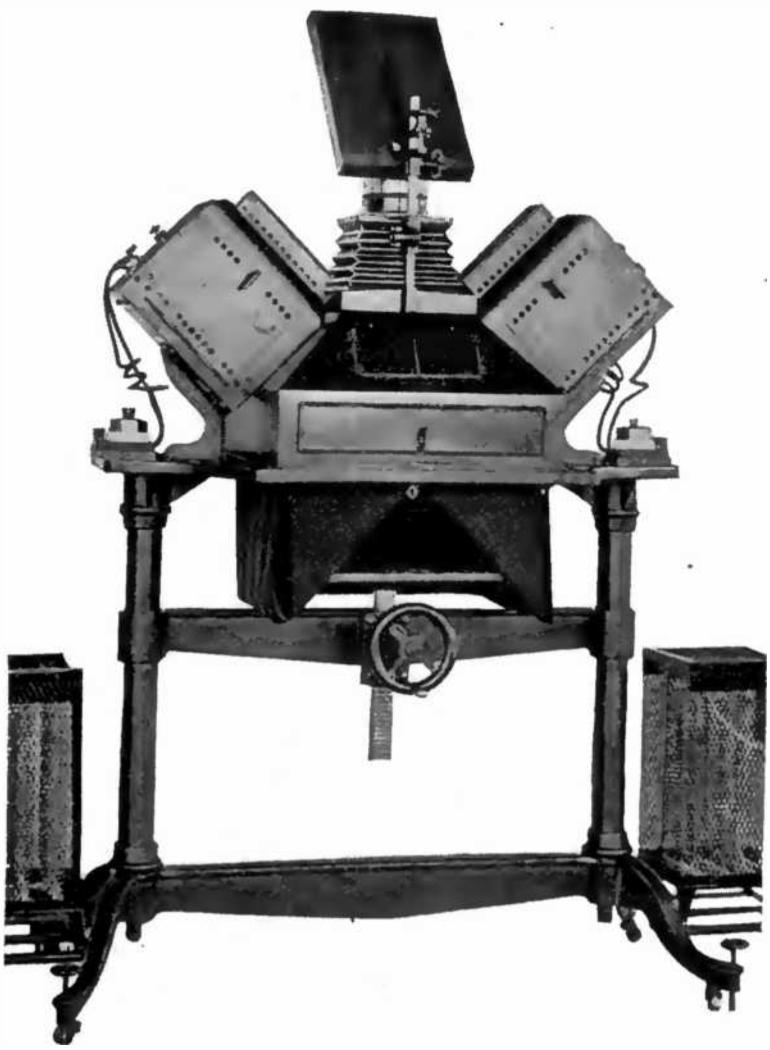
Electric Floor Cleaner Used in a Chicago Office Building.

The European war has given American electrical manufacturers an opportunity of extending their sales in foreign countries. In electrical machinery, Germany has exported more than $12,500,000 annually, $12,300,000 in incandescent lamps, and $10,400,000 in other electrical material. This amount of business, as well as that of other fighting nations, could be secured by American firms just now if properly solicited.

PROJECTION OF LARGE OPAQUE OBJECTS

While opaque projection is not new, the successful application in the case of large objects has recently been made possible by the introduction of the apparatus illustrated.

It is of interest to note that the original model was built as an experiment in response to the request for an instrument of sufficient scope to project on the screen an entire section of a cash register. So satisfactorily did the first machine operate in this connection that similar machines are now being used in educating salesmen to a more intimate knowledge of the product. An entire section of the cash register may be placed in the device and shown on the screen with the mechanism in actual operation. Large advertisements and placards may also be projected for the purposes of discussion and comparison by the salesmen present.



Large objects may be Shown with this Arc Light Projector, which was Originally Intended to Project on the Screen a View of the Entire Mechanism of a Cash Register.

It is pointed out that, in addition to these commercial uses, the new electric projector may be used to advantage in projecting full-page advertisements from large magazines, as well as photographs and engravings of any size up to twenty inches square. In educational work, too, lies some of its greatest possibilities for service, as it is especially suitable for projecting natural history subjects. All objects are clearly shown in their natural form and coloring in greatly enlarged images.

NOVEL LEAK-INDICATOR

An automatic leak indicator for ships consists of a number of small cast-iron boxes screwed to the bulkhead of each compartment and set at predetermined distances, one above another. In each box there is an electrical contrivance connected with an indicator-board either on the bridge or in some other convenient place. The board is fitted with a number of small glow lamps of different colors, and is connected with an alarm-bell. When the water rises to the level of the lowest box, it makes an electrical contact by which the lamp corresponding to the height of the bulkhead that the box indicates is lighted and so remains until the next box is reached by the water, when the second lamp is lighted. Meanwhile, the bell rings continuously until switched off.

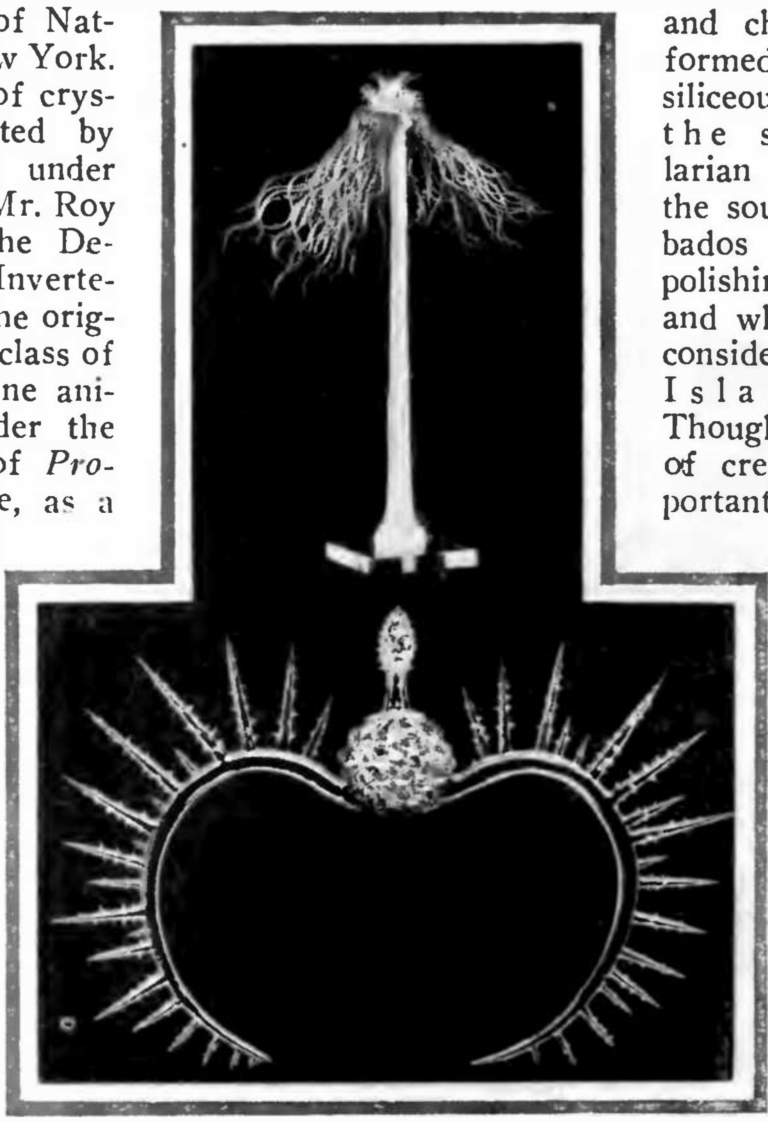
In many cities and villages the central electric station has, by way of equipment, a small transformer mounted on a wagon or sleigh and intended for the thawing out of frozen pipes. When a pipe is to be thawed, the transformer is brought up in front of the house and connected to the power wires.

Wonders of the Deep Sea in Glass

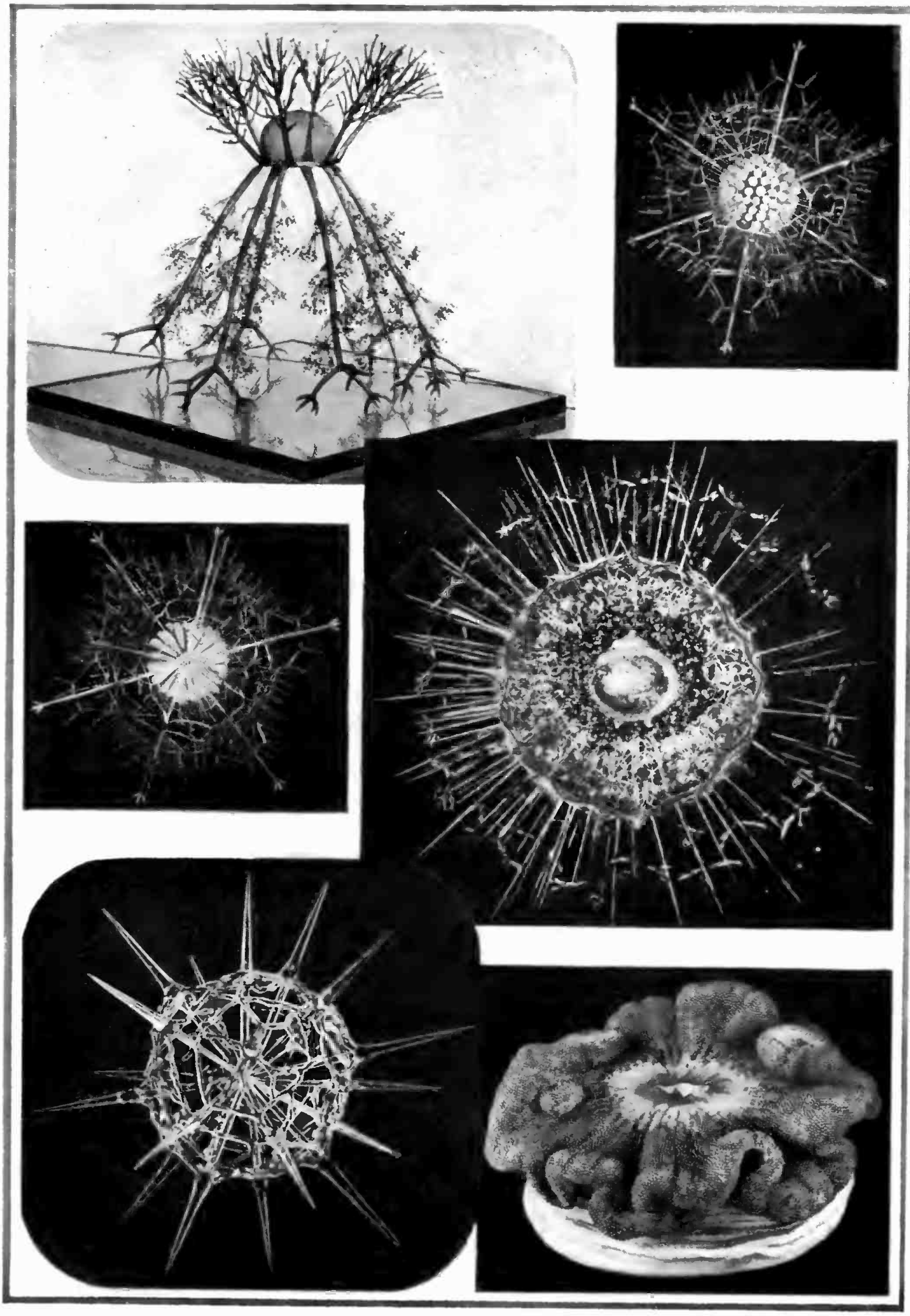
By Herbert Beardsley

THE latest and most realistic portrayal of miniature marine animals of the ocean depths—animals having wonderful and almost unbelievable forms—is by enlarged models of glass. In these beautiful and intricate models the highest development of the glass-worker's art has been combined with scientific knowledge, and the onlooker may rest assured that he is gazing at the actual wonders of the sea for the first time made visible to the naked eye.

The accompanying illustrations depict a series of the most extraordinary and unique of these elaborately made glass models recently installed in the Museum of Natural History, New York. The models are of crystal glass executed by Mr. H. Muller, under the direction of Mr. Roy W. Miner of the Department of Invertebrate Zoölogy. The originals belong to a class of microscopic marine animals known under the scientific name of *Protozoa*. They are, as a whole, considered the simplest and lowest in structure of all animals, being composed of a single cell, yet certain among them, known as the *Radiolaria* have forms of amazing complexity and great beauty. These minute one-celled animals form a group of immense importance both from a biological and economic standpoint. Swarming in countless millions in both fresh and salt water, and at times even in the bodies of other animals, they are the most abundant and most widely distributed form of life. Many of the smaller marine and fresh water creatures depend upon them for food, and among them may also be found some of the most important disease-causing parasites. The calcareous and siliceous skeletons sometimes become compacted into solid rock, and thus are of great geological and commercial importance, many extensive cliffs of limestone and chalk having been formed in this way. The siliceous skeletons form the so-called "Radiolarian ooze," which is the source of the "Barbados earth" used for polishing and grinding, and which forms no inconsiderable part of the Island of Barbados. Though this vast world of creatures is so important and surrounds us on every side, penetrating, as it were, all the interspaces between the larger forms of life, yet they are invisible to our eyes, and were it not for the compound microscope and enlarged models we would be ignorant of them except in their effects.



Two glass models of Protozoa found respectively in the Waters of the Japan Sea and off Australia.



A collection of glass models of deep sea life now on exhibition at the Museum of Natural History in New York City. Scientific knowledge, coupled with the greatest skill in glass working has made these models possible.

In graphically portraying minute animal life the glass model is of paramount value to science and education, for aside from its embodying attractiveness and artistic realism of detail, it preserves both form and color for all time, a thing heretofore impossible when employing wax or other material.

STEEL AUTO TIRE EMPLOYING PNEUMATIC PRINCIPLE

Savage, inventor of Savage arms, has invented and perfected a steel auto tire that has the same resiliency as the usual rubber tire. In fact, this new steel casing resembles nothing more than a coat of mail for use on an inner casing of the usual kind. The tire is particularly intended for use on rocky, mountainous roads where the usual rubber tire would be quickly cut to pieces. Before making this new steel casing public, the tire was tested out under most adverse circumstances in order to develop possible mechanical flaws. The structure of the tire consists of numerous small interlocking sections, combined to form a solid though flexible fabric. The tire has the same resilient properties as the average tire.

A View of the new steel tire, as well as a single section of interlocking pieces. The usual inner tube is employed, the steel pieces forming an outer covering.

ELECTRO-MAGNET AIDS RED CROSS

One of the most prominent features of the present European conflict is the amazing success of the Red Cross field corps. Considering the enormous number of men on the firing line, the fatalities are surprisingly low. This fact is due in a large part to the extensive degree in which the most improved and up-to-date surgical methods and appliances are being employed.

Advances made in surgery during the past few years are being utilized with remarkable results in the treatment of wounded soldiers. American surgeons, who have gone to the front, in particular, are performing frequent operations which, while not new to science, have been rare in the past. All this adds to medical knowledge. Through their efforts men who would otherwise be compelled to go through life, maimed and disfigured are being reconstructed physically, while at the same time those surgeons are obtaining experiences of such a varied character as would be impossible except in time of war.

Dr. Joseph Blake, of New York, at the American Ambulance Hospital, is making a new nose. Over an artificial ridge he is grafting flesh and skin from the wounded man's forearm. Surgeons at Val-de-Grace Hospital constructed a new chin of rubber, covered with a beard trimmed according to the soldier's photograph. In the American Ambulance Hospital a powerful electro-magnet is installed for removal of shrapnel, making unnecessary the long and difficult operation of probing. The X-ray apparatus is much in use for readily locating bullet wounds.

The Difficulties of Producing Films

By Ernest A. Dench

THE path of the film producer bristles with difficulties, especially when he has been refused permission to take pictures on certain sites or under certain conditions.

Some time back a certain producing company had set their mind on using Yellowstone Park and its charming scenic possibilities. They knew that cameras were not permitted to be operated therein, but this did not daunt them from attempting their object. Their apparatus was smuggled into the park and when the camera man was busy taking pictures, he was suddenly confronted by six soldiers and four mounted policemen, who arrested him and confiscated the film in the camera. They imprisoned him in the lock-up on the grounds for three days. Meantime he sent his credentials to the Secretary of State and these being proved, he was released.

In England the producer is mainly confronted by "red tape." No railroad plays are of British origin. This is due to the fact that in the early days of motion pictures the British railroad companies granted the use of a portion of their track to a film producer with fatal results. During the activities a man was killed. Since then the British railways have refused to co-operate with the cinematograph companies.

Last year the B. & C. Company—a British film firm—engaged part of a regiment of soldiers to play in "The Battle of Waterloo." Despite the fact that the army men were employed when off duty and their earnings increased the sport funds, the War Office expressed its disapproval in no small manner.

In those days when the police of England and the suffragettes were at odds, it was perhaps unwise for a large automobile party, consisting of a dozen girls dressed as suffragettes, the camera men and director, to attempt a raid on the Prime Minister's residence in Downing street, London. The police were on the warpath, however, and although explanations were forthcoming, they declined to allow the producer to obtain his much-desired realism.

Even when the motion picture company applied to the Commissioner of Works and the Prime Minister himself for official permission, they failed in their purpose.

But this state of things is not peculiar to England, for producers in other countries have similar difficulties confronting them.

In Germany no films must hold up the police or soldiers to ridicule, so when an officer of the law saw a man in policeman's attire flaunting a sword and revolver while chasing a desperate looking criminal in burlesque fashion, he promptly took both in charge. It was for the "movies," of course, but the pseudo policeman did not secure his liberty without paying a heavy fine.

On a previous occasion, just as an airship was leaving the aviation ground of the German government, an automobile dashed up and from it jumped an excited man who ran up to the occupants of the airship and begged them to stop. Before they could recover from their surprise he waved a batch of official appearing documents and boarded the car of the airship. He then ordered the flight to be started.

After the airship had proceeded a good way on its voyage, the man explained that he was playing the part of a detective in a film drama and as the firm producers could not obtain consent to board the airship by legitimate means, he had resorted to this method.

The "detective" attempted to bribe the officials, but they were so indignant at being misled in such a manner that they had him arrested on reaching *terra firma*. The unlucky actor spent the few weeks that followed in jail.

During the recess of the French parliament, a producer managed to secure permission to photograph the interior of the Palais Bourbon. But his real motive was to have his players made-up to represent the noted persons and have them act in the benches. Somehow the authorities got wind of the affair and promptly stopped the proceedings, to the dismay of the photoplayers.

STAGE IN THE OPEN FOR "DREAM" FILM

How the "dream or vision" is produced in a moving picture film is shown in this view. The fireplace is set up outdoors in order to secure a pretty landscape effect through the opening of the grate and the girl in the arm chair is supposed to be seeing herself and her lover in a mental picture. In reality, the girl in the chair with her back to the camera is not the heroine of the film, but instead she is an actress of about the same general appearance who takes her place for this scene; the leading lady being engaged in enacting the "vision." The section of film preceding this and showing the same grate with a burning log, is taken in the studio. The sudden transition from a fire on the hearth to a landscape in the grate makes a very pretty effect in the film drama.

Arrangement of a Set for producing a Vision in a Fireplace.

ACTOR HAS APPEARED IN 1,600,000 PICTURES

Director Arthur Mackley has begun work on his twenty-sixth picture for Reliance-Mutual release, in which he appears in the role of a western sheriff. The title of this picture is "Sheriff For An Hour," in which the western officer and deputies arrest a young crook who has been deceiving his mother by making her believe he was earning an honest living.

Since originating his part of sheriff, Mr. Mackley has played in almost 200 subjects, averaging 1,000 feet each, and appearing in almost half of the scenes. With sixteen pictures to each foot, his face appears in a total of 1,600,000 motion pictures.

Don't fail to read the important announcement appearing on page 289 of this issue.

Chameleon City

By Chas. W. Person

THERE'S no use trying to doubt the postulary perfection of the axiom that one never can tell. One never can!

A city is being built in the San Fernando valley—just a short trolley ride out of Los Angeles—that can be changed over night to conform to any nationality, style of architecture, color scheme or state of preservation. All the director of construction needs is a night's notice and he'll turn the town into an Illium for you, or a Rome, Athens, Paris, London, Chicago, New York or any really sizeable place you may mention.

And it won't be such a tremendous job for him, either, for this was exactly what the city was built for—to be changed over night into something radically different and changed back again with equal facility. When the plans for it were made the architects, landscape artists and engineers were told to keep this one idea uppermost—the greatest usefulness with the least amount of construction.

For that reason every building which has been put up or which is planned is designed to have a four or five fold usefulness. Every facade is of a different type of architecture and usually represents a different kind of usefulness. For instance, a shelter designed primarily for a saddlery shop and a blacksmithy has a front elevation that is in keeping with the nature of the building. From the other three angles, however, it has the appearance of a Gothic hunting lodge, military barracks, and a Wild West ranch house. In addition to this, any one of these front elevations can be changed over night to represent an entirely different kind and character of building. This idea will be carried out throughout the entire city.

You probably have guessed it by this time. The city is to be built for the express purpose of making moving pictures—the first and only city of its kind ever attempted. When completed it will accommodate 15,000 souls, and it will cost something like $2,000,000. The construction work has already progressed so far that a small settlement is standing now and being used for motion picture work. Around this the greater city will be built.

It was only after careful consideration of all the localities within a convenient radius of Los Angeles that the San Fernando valley was chosen as the site for the city. Every advantage has been taken of the remarkable configuration of the valley to bring out the variety of backgrounds and locations. There is a natural lake and lagoon which has sufficient depth and size to float any craft from an Indian canoe to an American battleship, but where natural water-ways are not found and are needed, they have been artificially constructed. There is a large force of men at present occupied in no less an undertaking than building a river bed. The idea has been to get a view of water, hill, vale and mountain scenery from the principal buildings in the unique city.

The plan of usefulness has been carried out in many particulars thus far. Viewed from one side the landscapes present a certain aspect. From the other side the character, climatic or sectional, is entirely different. This will enable a director, who under ordinary circumstances would have a certain number of good locations, to be able to construct from ten to thirty more scenes from the same locations. Every stream and gully has been spanned by bridges and here is illustrated how changeable the complexion

In the Oval: A Portion of the Huge Outdoor Stage where "Interior" Settings are Photographed; Below: The Blacksmith Shop which is Kept Busy not only in Shoeing Horses but in Making Different Objects in Iron Required in the Production of Photoplays.

Above: The Dressing Rooms for the Actors, which are Supplied with all Conveniences and Comforts. At the Right: One of the Buildings the Four Sides of which are Totally Different.

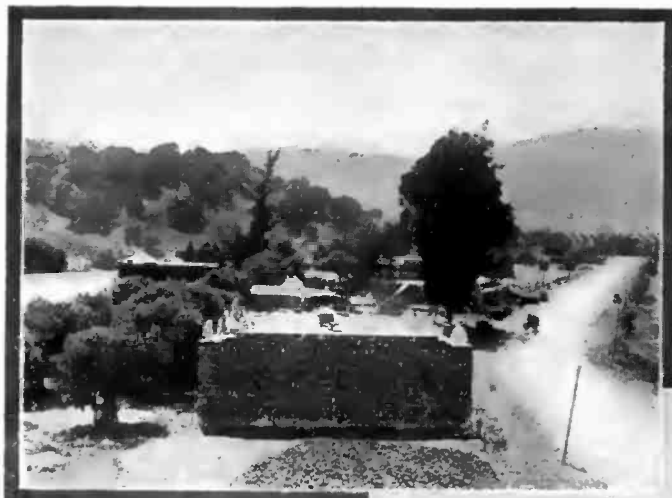
Above: The Carpenter Shop of the Chameleon City. There is no other Department of this Thriving and Hustling Community that has More Work to Accomplish than the Carpenter Shop.

of the city can be. Every bridge is so constructed that it can take on the appearance of a Japanese arch bridge, a Roman stone bridge or a steel cantilever bridge, or in fact any other kind of a bridge for which the director has need in the production of a scenario.

All the streets are to be scientifically paved and piped for gas, electricity and sewer mains. The main boulevard will be six miles long and this, taken in conjunction with other main streets and cross streets, will give an idea of the amount of work which the street department alone will have to do. The piping for water is an important item, for every building and house will be supplied with water 99 per cent. pure, fed to a reservoir from seven artesian wells at the rate of 300,000 gallons a day. The roadways of the city are peculiar in that they are being constructed in different widths and styles of top dressing, in order that the director may have a variety in the matter of road scenes.

For the convenience of both men and women actors, a club house is being built. For outdoor enjoyment, there is under construction a quarter-mile race track, with concrete grand stand and stadium in the most approved university style, and this arena can be employed for a setting in a play calling for outdoor sports, or for a number of different settings. One day, it may be necessary to use it for the Coliseum at Rome, and another day for the Olympic stadium in Greece. Some director may wish to stage a country fair there, another may wish to have it represent the Polo Grounds in New York City. It can also be used for an Indian Durbar or golf links. Just outside the stadium is a model tennis court built for utility and pleasure, combined.

There is now under construction an administration building, an exhibition theatre that can take on either the appearance of a city or country theatre at the behest of the director, barracks for the housing of a troop of cavalrymen, bunk houses for the cowboys and two hospitals and infirmaries, which will be thoroughly equipped with every modern instrument for surgical and pathological remedy. Treatment in these hospitals will be defrayed by the company, and the bungalow residences within the city will be rented to employees far below the usual rentals in the vicinity of Los Angeles.



Above: A View of a Portion of the Chameleon City with a Partly Finished Building in the Foreground. At the Right: Huts of Various Designs for Use in Photoplays.

Below: The Grand Boulevard of Universal City, Lined on Either Side by Dwellings for the Employees and the Buildings that House the Various Departments of the Big Studio.

The wardrobe department has a building of its own now. It was one of the first to be built and contains a wardrobe valued at $35,000. In addition to this the costume shops, which are nearby, are so arranged that they can turn out the designs which are required by every period of dress from the era of palm leaf girdles to the present time. Twenty electrically operated sewing machines turn out the work.

The first notable incident of the mobility of this movie city was shown in the preparation very recently of a scenario. The director knew of just the proper location for a fire and a rescue by means of a rope acting as a pendulum, but sad to relate the scene was supposed to take place in Jersey City, New Jersey, and that was three thousand miles away.

It was out of the question to take a company that distance in order to stage that one scene, and even then the city fathers of Jersey City would not have consented to the total destruction of one of their office buildings even for the edification of ten million movie fans. The only thing to do was to reconstruct the scene from buildings already standing. This was done in thirty-six hours. The result was so perfect that New Yorkers who gazed upon it in wonder were compelled to pinch themselves before they could realize they were in California and not New Jersey. The scene was then burnt to the ground, and this newest and oddest of cities, the chameleon, once more resumed its workaday color.

The great feature film, "The Clansman," which has recently been completed, required seven months for filming, following eight weeks spent in the preparation of the scenario. The cost is estimated at from $300,000 to $500,000 and more than 100,000 feet of film was taken, although it was afterwards cut to 12,000 in the finished production.

THE ECLAIR WESTERN STUDIO

In the above view is shown a portion of one of the several outdoor stages of the Eclair Studio at Tucson, Arizona. Recently, Webster Cullison, managing director of the Eclair forces, came to New York City to arrange with the Eclair and Universal officials concerning the new producing companies to be formed and the new buildings and stages that are to be erected at Tucson, as well as the necessary equipment. While in New York he made arrangements with the owners of the steamer Palatial to take twelve van loads of furniture, properties, scenery and other equipment to Tucson.

On his return trip Mr. Cullison was accompanied by 32 players who were to form the basis of several new companies. These actors and actresses were in addition to the 27 then situated at Tucson.

Relative to the transporting of the entire production force of the Eclair to Tucson and of the closing down of the Fort Lee, N. J., studios for at least the time being, Mr. Cullison stated:

"I have known for a long time that the locality in which I am at present situated is superior to almost any other in the United States and I speak from personal experience as a director in nearly every part of this country. Above other considerations, Tucson has ideal climatic conditions necessary to the best photography, where daylight is depended upon. Of course, there is no question but that the sun is superior to artificial light for photography in Tucson. During my sojourn there as managing director of the Western Eclair Company we have had about six days of bad weather."

ESCAPE OF SNAKE CAUSES LIVELY TIMES AT WESTERN STUDIO

A big snake and a gila monster almost demoralized the Komic Company at the Reliance and Majestic Mutual studios in Los Angeles during the taking of "Dizzy Joe's Career."

Eddie Dillon, while directing the production in which he played the title rôle of "Dizzy Joe," was compelled to handle a big snake while acting as a snake charmer in a circus. The animal man who furnished the snake for the picture brought a gila monster with him. During the rehearsal the animal man turned the gila monster loose.

Dillon was barefooted and had a firm grasp on the snake. When the gila monster was seen free on the studio stage there was a wild scramble on the part of the players to beat a hasty retreat. Dillon dropped the snake, stubbed his big toe and ran a splinter in his foot beating a hasty retreat.

A short time later, when the gila monster had been recaptured, it was learned that it was perfectly harmless.

HISTORICAL KNOWLEDGE OF A DIRECTOR

They recently were staging one of the big battle scenes in "The Clansman" about forty miles away from the Mutual studios in Los Angeles when there arose a dispute among the actors as to the color and kind of horse ridden by the famous Confederate commander in chief, General Robert E. Lee, when he was campaigning at the head of the Army of Northern Virginia. D. W. Griffith, the well-known director, who alone is responsible for the production of this picture, was away for the moment.

"Better stop 'taking,'" said one of the actors to the camera man, "till we telephone in and have all the facts about General Lee's horse looked up and verified."

A high powered touring car had glided up behind the group. In it sat Griffith himself.

"What's the fuss about?" he inquired. When told he smiled tolerantly. "Why, Lee's dappled gray charger, Traveler," he remarked, "is one of the three most famous horses in history. Bucephalus and Napoleon's nags were the other two, and I've got a horse as near like Traveler as possible waiting in that stable yonder. Go on with your 'take.'"

SPARROWS INTERFERE WITH PRODUCTION OF PHOTOPLAY

It happened in the big Lubin studio in Philadelphia, just as Director Barry O'Neil was getting ready to stage the big climax in the feature film "District Attorney."

"Lights," shouted O'Neil. The powerful lights dazzled the room. "Camera," yelled the director. Both camera men started to grind and the acting began. Then, down swooped the two sparrows, just grazing Miss Bernard's head. All the players did a small stampede, thinking the sparrows were bats. O'Neil had to stop the scene. A few minutes later the players began again and once again into the scene swooped the sparrows. It was indeed a test for tempers, but not nearly as great a one as when the thing happened a third time. O'Neil was forced to wait fully three-quarters of an hour while everyone in the studio, armed with various domestic weapons, helped drive out the winged interrupters.

BARTERING FOR ADMISSION TO THE MOVIES

The natives in such places as Guam, in the Philippines and the South Sea Islands transact business by bartering instead of money. And since the popularity of the motion pictures has spread to these outlying places it has been up to the picture theatre proprietors to adjust themselves to the local conditions.

In Gaum the natives idled their time away until an enterprising American opened a cinema show there. They then all suddenly went in for poultry farming. The reason for this was that ten fowls' eggs acted as an *open sesame* to the movies. As for the poor hens, they have had to work overtime.

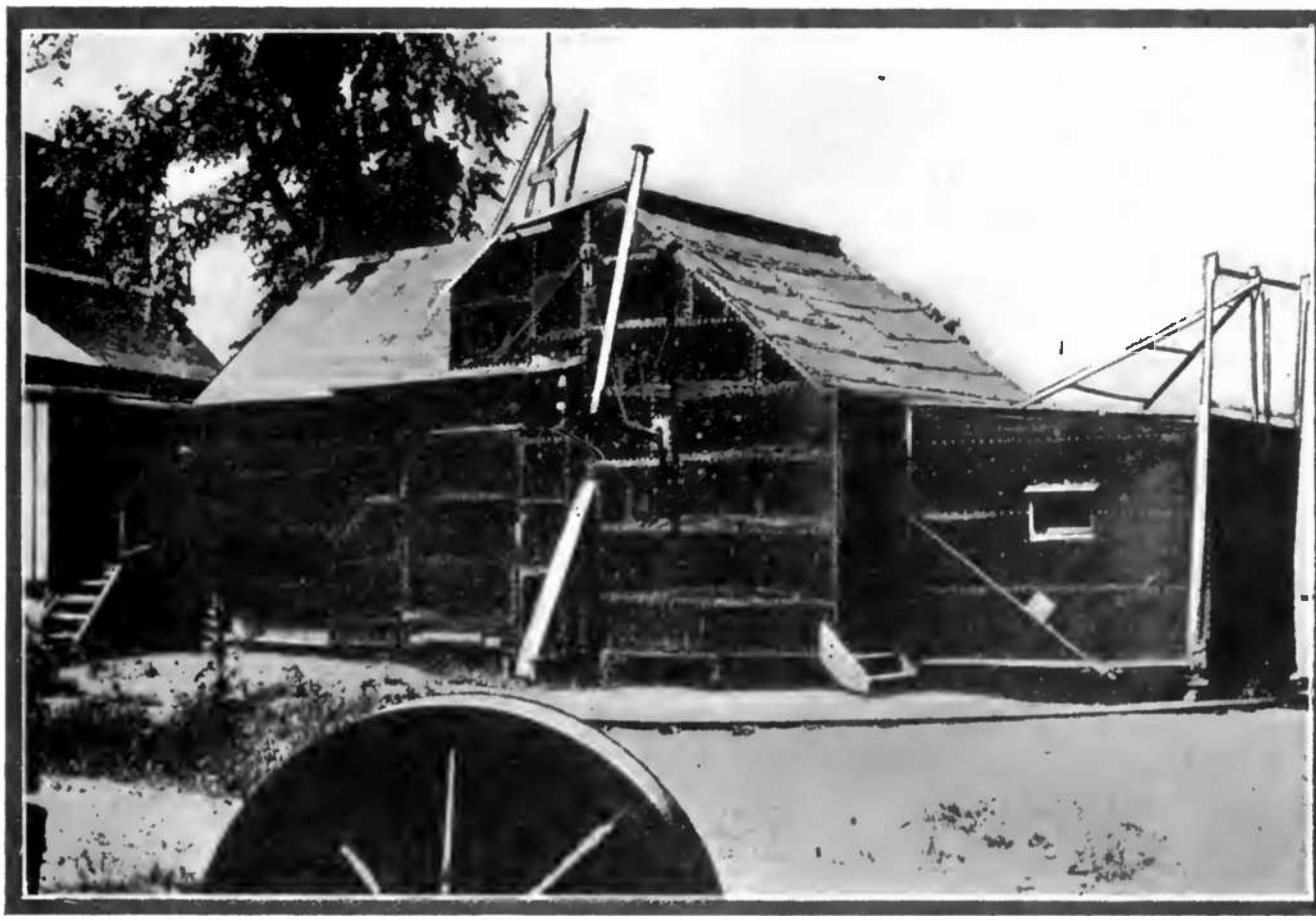
Thanks to a Frenchman, there are now three film halls in Tahiti. Being the only form of amusement it has become very popular with the Tahitan. He will barter anything to obtain admission, even to his shirt or girdle, whichever he may be wearing. Every night the entire population—totalling about 8,000—swarms to the theatres which can accommodate 3,500 altogether.

To reduce the huge crowds, the exhibitor was obliged to increase the entrance fees. It developed into such a nuisance that the Governor ordered the places to close three nights a week. On the remaining four evenings a general stampede now takes place.

It is stated that the crime pictures are having a bad effect on the natives, so it is quite likely that there will be a censor soon.

FIRST PICTURE STUDIO IN THE UNITED STATES

What is claimed to be the first motion picture studio in the United States is illustrated in the accompanying view, showing the building erected by the Edison Company in 1905. It was built on pivots so that it could be swung around to follow the sun, and on a truck so as to be transportable from place to place. The building measured about 20 by 25 feet, and was familiarly called the "Black Maria" by the members of the company.



This Building is Said to Have Been the First Motion Picture Studio in the United States. Compared to a Modern Studio it would Not Even be large Enough to Shelter a Single Setting.

"SAFETY FIRST" PREVENTS DEATH OF AN ACTOR

Everything was in readiness and the real action was about to start for one of the scenes in the Universal serial, "The Master Key," featuring a man crossing a wire cable in a suspended bucket, when someone suggested that the cable should be tested before attempting to cross it. A weight of about

300 pounds was placed in the bucket and sent on its journey. Just as it reached the section of the cable over the deepest part of the canyon there was a sharp snap, followed by the breaking of the cable and the dropping of the bucket and its weight to the bottom of the chasm. The players looked at each other in amazement. Needless to state, if Robert Leonard, the leading man, had attempted the crossing of the cable under these circumstances, he would have been dashed to death.

CLEVER RUSE SUCCEEDS IN GETTING SCENE OF BIG CROWD

Richard Stanton, actor-director of the Ince forces on the West Coast, was recently confronted with the difficult problem of securing a scene in which many persons crowd about several newsboys who are announcing an important extra. According to the story, the extra tells of the election of one of the candidates.

After considerable thought, Stanton finally decided on a somewhat novel scheme. He had several boys don the garb of newsboys and sent them out on the boardwalk at Venice, California. Meanwhile Stanton and his cameraman concealed themselves in a nearby building. The large crowds at the resort were soon startled by the cry of the boys to the effect that England had declared war on the United States. Everybody made a rush to secure a copy of the newspaper; the camera recording the excitement. After the scene was taken, Stanton made a hasty retreat in order to avoid the fury of the crowd.

CRYSTALS — THEIR MAKING, HABITS AND BEAUTY

Few persons are aware of the beauty of crystals that may be formed from ordinary household materials. In a recent Edison release appearing under the above title, a youthful chemist is shown at work in the kitchen of his home performing interesting experiments with such common substances as table salt, epson salt and other similar materials. The crystals formed by these substances are shown in highly magnified views and in their full beauty.

EXHIBITION OF THE MAKING OF MOTION PICTURES

One of the many novel features of the Panama-California Exposition to be held at San Diego will be a demonstration of how motion pictures are made.

For the sum of two dollars the visitor to the exposition will be permitted to spend an hour and a half in a typical motion picture studio. At the opening of the performance the motion picture stage will be clear. At the instruction of the professional photoplay director the stage hands will make up sets; the actors and actresses will rehearse their parts, and, finally, the camera will be brought into action to record the play. A film will then be projected on the screen to show the process of developing, drying, printing and finishing the film. Lastly, a motion picture of the scenes made will be shown.

DEATH FALL OF AVIATOR IS FILMED

Unpleasant as the subject is, nevertheless it is worthy of note that a member of Thomas H. Ince's camera staff succeeded recently in filming the actual death of an aviator. The flying man's name was Thomas Hill. After he had risen in his monoplane at Venice and attained a height of 3,000 feet and was in the act of looping the loop, one of the wings of the machine buckled, and man and machine started for the earth at almost unbelievable speed. The aviator was killed instantly. A company of Ince's players was close by at the time of the accident, and a camera man quickly focused his machine on the spectacle, while the rest of those present watched with dumb horror the tragedy so swiftly approaching its climax

How Cut Glass is Made

By F. B. Jacobs

THE average person is of the opinion that cut glass is an expensive luxury, involving an endless amount of intricate manipulation in the course of its manufacture. This, however, is far from the truth, since cut glass is comparatively inexpensive when its artistic and decorative value is considered, and the process followed in its manufacture is quite simple and easily understood.

There are, broadly speaking, two kinds of cut glass. The most expensive, cut from plain blanks, and a cheaper grade made from figured or pressed blanks. To cut from plain blanks calls for high skill on the part of the workman, who not only has to be a skilled artisan, but an expert mechanic as well, inasmuch as a slight error in the judgment of minute distances would ruin several hours and, in some cases, several days' work.

Smoothing the Rough Cuts in a Piece of Cut Glass by Means of a Revolving Grind Stone.

Figured blanks are pressed in a mold while the glass is in a molten state. The desired design is cut in the mold and is thus imparted to the blank. A figured blank looks somewhat like the imitation cut glass seen on the counters of any department store. In finishing figured blanks it is only necessary for the workman to follow the depressions left by the mold which work, needless to state, does not call for the skill required to cut from a plain blank.

It is possible, however, to finish up figured blanks with a degree of skill sufficient to deceive anyone who is not versed in the art of glass cutting. For this reason, it is a good plan for the purchaser to exercise a little caution, following the practical suggestions here given. In the first place, cut glass made from plain blanks has a substantial appearance. Again, the inside surface of open work, nappies, finger bowls, berry dishes, etc., is free from wrinkles and waves. Further, the edges of the cuts are sharp. Lastly, work cut from plain blanks rings when snapped sharply with the fingers, while a piece cut from a figured blank gives a dull tone. The difference in tone is due to the fact that different grades of glass are used in making the blanks. Perhaps the main reason why plain blanks are used by the better class of cut glass manufacturers is that their use enables them to keep their designs exclusive to a great extent. This could not be done if figured blanks were used as the designs of these are originated by the blank manufacturers and naturally they are willing to sell the same design to as many cutting shops as wish to buy.

The first step in cutting a piece of glassware is to rough out the cuts on a roughing mill. This is a revolving iron disc with a miter turned on its periphery. The cutting is done by carborundum grain mixed with water. This flows on the mill in a fine stream. Some years ago sand was used for this operation, but experience has proved that carborundum cuts about twice as fast, thereby saving valuable time. The work is held against the mill by hand, the workman being guided only by a few lines roughly painted on the glass. Great skill has to be exercised in guiding the work and, for this reason, several years of constant training is necessary before one can turn out high grade work in a rapid manner.

After the roughing operation, the cuts are smoothed as shown in the illustration. Until a few years ago, black craigleith, a stone found in Scotland, was used almost exclusively for this work. The event of the electric furnace, however, has furnished artificial abrasives that are rapidly supplanting the more expensive natural stone. These abrasives are practically pure alumina and are sold under the trade names of alundum and aloxite.

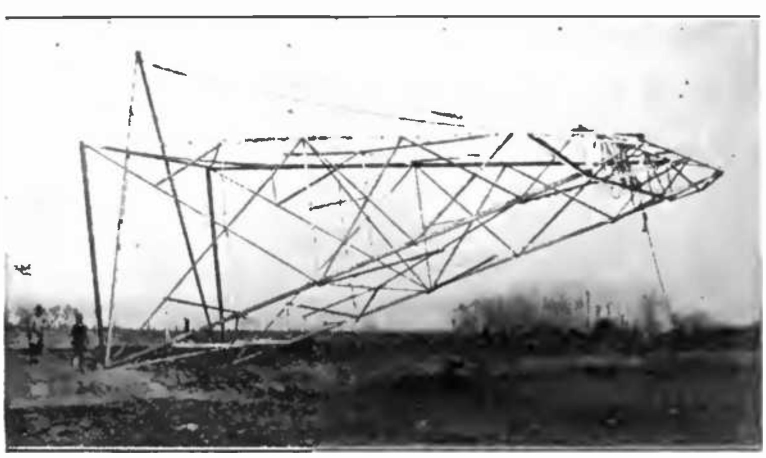
The next step is to finish and polish the cuts. This is done on a wheel made of poplar wood with its periphery turned to a miter to correspond to the cuts. The cuts are first gone over carefully with a fine powder solution having practically no abrasive qualities, after which the final polish is imparted with rouge. After washing and inspecting the ware is ready for shipment.

With the cheaper grade of ware the process is more simple. The impressions left by the mold are smoothed on an abrasive wheel, followed by a cheap finish imparted by dipping the pieces in an acid solution. This is known to the trade as "acid polish." It is seen that this method reduces production costs to a great extent, as two expensive operations are eliminated: the first roughing and the hand polishing. While acid polishing is generally associated with cheap ware, it is sometimes employed for the final finishing of high grade goods. In this case the surface of the piece is carefully coated with wax, leaving the cuts only exposed to the action of the acid. The object of the wax coating is to preserve the sharp edges on the surface.

The manufacture of cut glass is not a modern industry by any means, yet, strange to say, the work is done in the same manner that it was generations ago. The only real improvements are the substitution of carborundum for sand and artificial abrasive wheels for craigleith stones. To be sure, we might consider the acid polishing method as an improvement, as indeed it is, from the manufacturers' point of view. Its universal use by the manufacturers of the cheaper grades of goods, however, has had a tendency to lower quality.

BRINGING A TRANSMISSION TOWER INTO POSITION

This interesting view shows how a big steel transmission tower for a power line is brought into place. The structure is riveted together flat on the ground and cables are attached to it near the top. To these erection cables a team of eight or more horses can be hitched at their furthest ends. The two corners on the ground rest upon the foundations, and as the tower is swung upward, the other two corners land squarely upon the foundations prepared for them. This work is being done near Los Angeles, a city which is developing electric power at a surprising rate.



Eight or More Horses are Required to Erect a Steel Tower for Electric Cables.

A recent application of the electric current is in the form of an electrical apple wiper just placed on the market. It is said that with the aid of three men the machine will wipe one car load of apples in a day.

TELEPHONING WITHOUT WIRES

A system of telephoning without wires has been employed in German mines for some time past. Although the system cannot be considered as a wireless one inasmuch as there exists an actual conducting circuit between two stations, it possesses several novel features.

The system utilizes the pipes and rails of the mine to conduct an extremely high voltage current. The ordinary current at hand is raised to one of high tension that can readily be transmitted over piping and rails. It is said by the inventor that this high voltage current will not affect other nearby circuits nor will it produce a spark. Wireless waves do not interfere with the apparatus.

A commendable advantage of the system and indeed an obvious one is that connecting wires between stations are unnecessary. Another feature is that a general alarm may be sent to every station simultaneously in case of accident, while on the other hand the bell at each station can be operated separately through the employment of a special relay that is tuned to respond to a definite and individual signal. The instruments greatly resemble the usual wall telephone sets that are largely employed in this country. The transformer for converting low voltage current to high voltage current is an added feature. One type of instrument weighs but 20 pounds and can be installed anywhere convenient to rails or pipe lines. A pocket set that can be connected to pipes or rails for communicating with other stations, is also employed by the mine workers.

In Many German Mines a System of Wireless Telephony is Employed; the Rails and Pipes through the Mine Conveying the Current Between the Instruments.

EXTINGUISHING FIRE WITH BUBBLES

Just before the outbreak of the European war an experiment was made outside of Paris with a fire extinguisher which pours foam or bubbles over the blaze. In one experiment 16½ tons of benzine in a tank was set on fire and the foam extinguished it in a few minutes.

The new extinguisher is based upon the principle of pouring upon the blazing matter a blanket of thick foam, each bubble of which is formed of carbonic acid gas. This gas is incombustible and prevents the oxygen of the air from reaching the flames, thus suffocating the fire.

The foam that holds the gas is thick, adhesive and resists the air even when hot. It is the product of a mixture of two liquids kept separate until the moment they are to be used. The foam produced by bringing them together has a volume from eight to ten times as great as that of its generators. And the reaction that produces the foam also generates the gas. Accordingly, the increase in volume is accompanied by a corresponding decrease in density. This makes it possible to project the foam from a nozzle at a considerable distance and with much less pressure than is needed for any liquid.

The generators are two, one for each of the liquids that are to be mixed. One of these consists of: glue, one part; glucose, a half part; bicarbonate of soda, 7½ parts, and one quart of salicylic acid, to 100 parts of water. The other consists of a 10 per cent. solution of sulphate of aluminum in water. When these two liquids are mixed sulphate of soda and hydrate of aluminum result, with a profuse liberation of carbonic acid gas. The glue and glucose form the foam and the salicylic acid acts as a dehydrant.

A hand apparatus of this type was tested recently under the following circumstances: In a room was placed a dressing table, with draperies above it, while celluloid combs, soap boxes and a mirror were put on the table. To the right and left were chairs covered with muslin slips, and below was a wicker basket full of paper. Above was a window casing draped with damask curtains, lace hangings and a paper fly trap. This collection of inflammable stuff was set on fire and allowed to burn for one minute. Then the extinguisher was opened and in 25 seconds the blaze was out.

BALLOONS AID IN WEATHER FORECASTS

A number of scientists have recently used balloons in making experiments at the weather station at Avalon, Catalina Island in the Pacific Ocean, thirty miles off the Californian coast.

Two rubber balloons fastened together are used for this purpose, which, when inflated, measure about twelve feet in diameter. A small instrument known as a meteograph is sent up in a basket attached to these balloons. As they ascend and the air becomes lighter the gas expands the rubber and finally one of them bursts and the weight of the meteograph brings the other balloon slowly earthward and deposits the instrument on the ground. If the instrument falls on water its buoyancy keeps it afloat. There is a liberal reward offered for the return of these instruments, so that the weather bureau usually gets them back within a short time.

Scientists using an Instrument for Measuring the Height of the Balloons Carrying a Meteograph.

The device consists of a small aluminum cylinder blackened with camphor smoke and on which the records for humidity, altitude and temperature are traced by means of three needles. One of these instruments recorded an altitude of eighteen miles, indicating a temperature at eight miles 85 degrees below zero with little variation up to the eighteenth mile altitude. Intense cold prevails a few thousand feet above earth.

Here are some of the things sought for by these scientists:

The height of the sea breeze.
The lateral thickness of the breeze.
The thickness of the clouds.
The temperature above the clouds.

By studying the upper air currents beyond the influence of the mountains and local peculiarities the scientists hope to learn the general conditions of the great movements which produce storms and fair weather.

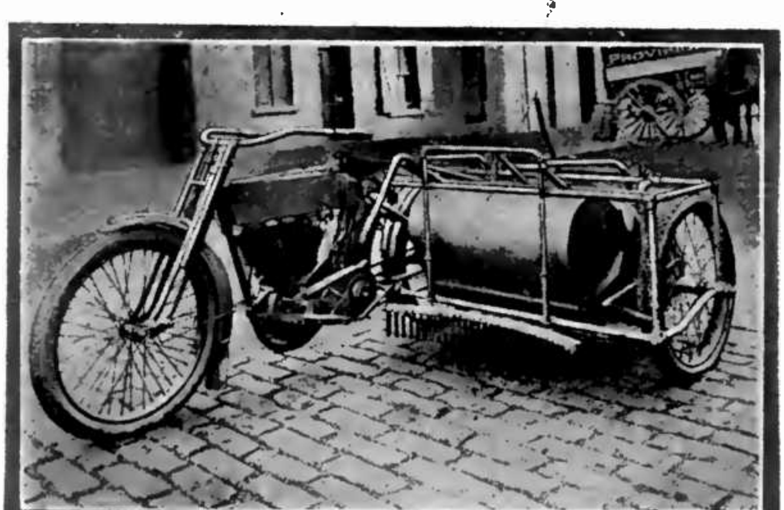
It Required Three Weeks to Scrub the Walls of this Church from Top to Bottom.

MOTORCYCLE FOR STREET CLEANING

Although originally a pleasure vehicle, the motorcycle is rapidly finding useful employment in other fields. One of the most recent applications is for street sweeping, the motorcycle being fitted with a side car as shown in the accompanying illustration. The equipment comprises a water tank for watering the streets, as well as a broom for sweeping.

The street cleaning attachment is so arranged that the levers controlling the flow of water and the pressure of the broom on the street surface can be readily reached by the motorcycle driver.

The motorcycle street cleaner is expected to prove a great boon to villages and small towns which cannot afford the larger and more costly machines used in the big cities.



A Motorcycle fitted with a Street Cleaning Attachment.

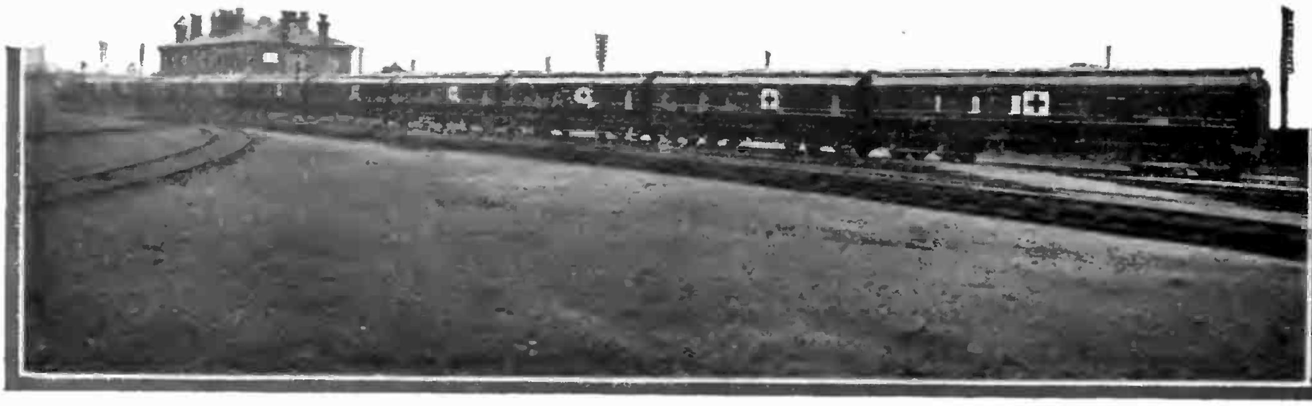
CHURCH RECEIVES A BATH

Human beings, animals and statues usually manage to get a bath quite often, but it is seldom a building receives a good "wash." Nevertheless, it was the fate of this edifice in Boston to be scrubbed from top to bottom recently and the old yellow and gray paint, which had been on for over seventy years, was washed off by a score of men, disclosing the finely laid masonry of the period of 1810.

The operation took the best part of three weeks and was watched by many thousands of interested people.

A present-day English play has for its plot a wireless installation in a chimney, which has been ridiculed. Yet recently a wireless outfit was discovered in a chimney by the Liverpool police.

A British Hospital Train



THE Midland Railway Company of England has recently supplied two military ambulance trains to the War Office. Each train comprises nine buggy vehicles and a six-wheeled kitchen carriage. The cars were all taken from regular traffic service and converted and equipped for hospital service at the railway works at Derby.

The train consists of five hospital wards, sleeping accommodation for medical officers, nursing sisters and the staff; special compartments for a pharmacy, a treatment office, provision stores, linen stores, and a store room for men's kits. All the carriages have clerestory roofs and are connected by communicating vestibules.

Each train is assembled in the following order: Sleeping and lavatory accommodation for two R. A. M. C. personnel and two medical officers; mess compartments and pantry for two medical officers and two nurses; sleeping and

Photos. Janet M. Cummings.

Sleeping quarters for the wounded, showing the arrangement of the berths. This car will accommodate twenty men.

lavatory accommodation for two nurses; kitchen carriage fitted with complete cooking range, etc.; provision stores, wash up pantry and special meat safe; mess, sleeping and lavatory accommodation for ten R. A. M. C. personnel; hospital ward for four officers and sixteen men; hospital ward for twenty men; pharmacy, treatment room, stores for clean and dirty linen; office fitted with small safe, shelves, etc.; three hospital wards for twenty men each; sleeping and lavatory accommodation for R. A. M. C. personnel, and accommodation for men's kits, etc.

The cars have been arranged with central corridors and side entrances for the easy manipulation of the British War Department's standard stretchers.

The cots used in the hospital train are of the folding type, arranged in upper and lower berths, and fitted with wire mattresses.

One of the many interesting features of the train is a water storage reservoir which contains about 1,000 gallons of sterilized water for medical use.

The floors of the cars are covered with lead and rounded off to facilitate cleansing. The treatment room in addition has the walls lined with aluminum to a height slightly over three feet. The other floors of the vehicles are covered with linoleum.

The treatment room is provided with special sliding doors to permit of the ready passing of stretchers from either end of the train. The room is provided with shelves, table, racks and cupboards. as well as water and special lighting facilities.

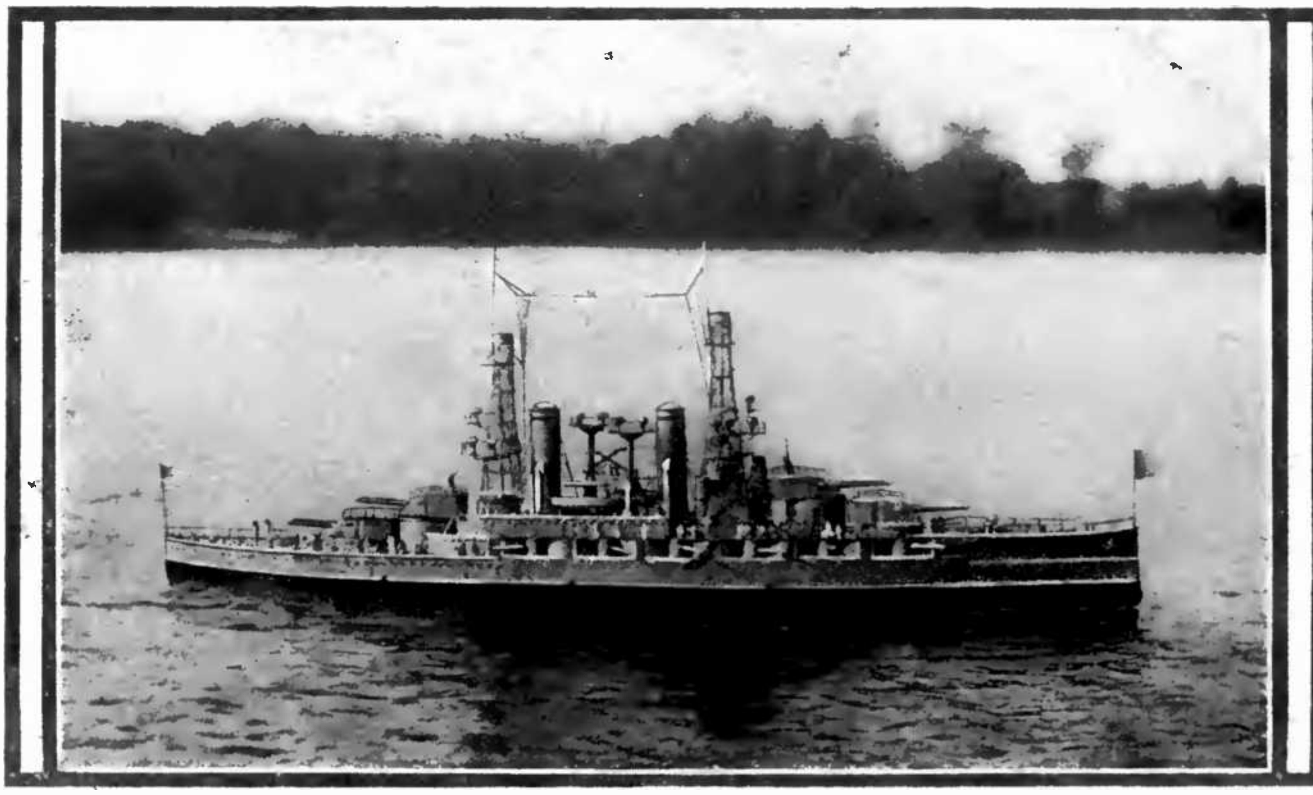
All the cars of the hospital train are efficiently heated by means of steam from the locomotive and the temperature can be adjusted to suit the needs of the medical staff.

The above views in the order shown are: Pharmacy compartment, the treatment room, and a sleeping compartment with the cots folded and the same view with the cots in position for use.

MINIATURE DREADNAUGHT THAT IS PERFECT IN EVERY DETAIL

The accompanying illustration shows the toy superdreadnaught Massachusetts, propelled by electricity. It carries a full complement of guns and is manned by dummy crew. With a trail of smoke coming from her smokestacks, her turret guns firing a broadside, sailors marching along her decks and the band playing the "American Patrol," the toy superdreadnaught Massachusetts sailed her course on the waters of Spy pond, Arlington. With her "Jack" snapping in the wind, she moved along at her full speed capacity of fourteen miles an hour.

On the shores of this expanse of water a moving picture operator trained his camera, and reporters were much in evidence. Wild excitement prevailed among the crowd of youngsters who watched the Massachusetts majestically sail into port. This toy ship is a model of its namesake of the United States navy, and is thirteen feet long. It has been constructed by a young Boston jeweler.



A model of the superdreadnaught "Massachusetts," built by a young Boston jeweler. This model is a faithful replica of its namesake, even to the minutest details.

The toy battleship is propelled by electric power. An intricate clock device causes the electric current to drive the triple propellers, fire the full complement of guns, march the dummy crew up and down the decks, raise and lower the anchors and flags, and play a phonograph. Every part of the American dreadnaught, even to the smallest detail, has been faithfully reproduced in this model.

One of the interesting features of the toy Massachusetts which is in advance of the regular warships is the installation of aeroplane guns that can be fired by the automatic arrangement.

The tiny Massachusetts is made entirely of steel. The lines of the model are as graceful as those of the speediest boats. She has a wireless outfit and fighting masts, duplicates of those on the American battleships. Other equipment includes a real wireless, searchlights, aeroplane guns, the Ardois signalling system and an automatic steering device. The main battery carries twelve miniature 14-inch guns, while the secondary battery has twelve 6-inch guns and four rapid firing guns.

There are also six torpedo tubes.

The displacement of the toy craft is 750 pounds and the draft is 9½ inches, while the speed is fully 14 knots an hour.

VANDAL ELECTRICITY INJURES PIPE LINES

Because the abutting ends of the rails of one of Seattle's street car lines were not properly bonded when laid, the current strayed into the ground, flowed along pipes and caused serious damage to them. In one case a fire main was eaten away to such an extent that the water had to be turned off, and shortly afterwards, a frame building in one of the outlying districts was burned to the ground because of the lack of water.

The stray electric currents from street car rails are, in some instances, sufficient to melt a steel file.

Several interesting tests were made with the various pipes to show the amount of damage done. One section of steel pipe, when removed from the ground, was found to have been so rotted by electrolysis that iron spikes could be readily driven into it.

The accompanying view shows one of the large steel water mains running parallel to the street railway. A copper cable was attached to the street car rail and led to a steel file. So powerful was the current which was escaping that the file, when touched to the pipe, melted and flowed like water. Seven hundred amperes was the enormous strength of this vandal current.

The old-time and familiar hand lantern of the trainmen on many railroads is fast being replaced by electric lamps. The latter are designed after the same lines as the oil lanterns, the batteries being carried in the base of the lamp.

THE GUARDED MANUFACTURE OF BANK NOTES

One of the great considerations in the manufacture of bank notes in the United States Bureau of Printing and Engraving is to guard effectively against the possibility of counterfeiting or theft.

The paper is made in a private paper plant which manufactures this particular kind for none but the Government. It is made of cotton and linen rags in which are mixed the silk threads which may easily be seen by holding a bank or treasury note to the light.

The printing and engraving process through which the paper is put is a very elaborate one and requires very complex machinery. The machinery used is so accurate and so well fortified against successful imitation as to render both the means and the product practically beyond undetectable imitation.

The ink used is made in the same building where the work is done. One large room of the building occupied by the Bureau of Printing and Engraving contains something like a dozen large paint mills which are kept busy grinding together the colors and the oil used on the presses. Only the best materials are used in the manufacture of this ink for bank notes and postage stamps.

The sheets on which currency is to be printed are counted when received. They are issued to the workman on an order from the superintendent and are charged to that workman in a pass book provided for the purpose. When the printing is done the printer makes the impressions up in books of one hundred each, with brown paper placed between them. These are delivered to a clerk and the workman is credited with their delivery on his pass book.

Some sheets may be spoiled, but all are credited to him so that his book may balance.

These impressions are counted and inspected. Spoiled ones are destroyed by properly authorized agents. The perfect ones are dried, pressed, and again inspected and counted. They are then cut and delivered for issue.

POWER DIRECT FROM THE COAL-BEDS

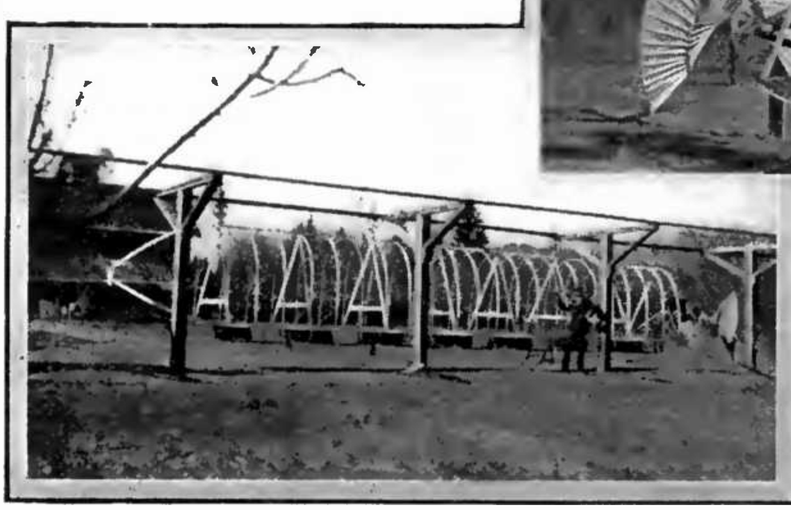
One of the foremost men of science, Sir William Ramsay, has proposed a method of getting light, heat and power from the coal-beds by converting the coal into gas at the foot of deep borings. His plan is to set the coal on fire by electricity and then to pass air and water down through the tubes to make the gas. By burning this, electric power for lighting and heating and for operating the English railways can be produced at the mouth of the borings. The only fuel that would then be needed would be oil for ships. Of course, there would be losses of power in transmission over long distances, but these would not be excessive.

AN AERIAL TROLLEY CAR

Although suspended cars have been used successfully in Germany for a number of years, many new features have been devised in the aerial trolley system at Burbank, California.

The car is torpedo shaped with a framework of steel covered with aluminum. It is fifty feet long and seats fifty-six persons. It has carried capacity load with ease.

The chief difference between this and other aerial cars is that it is driven by a six foot propeller of unusual construction, having two fan-shaped blades of sheet metal on ribs of steel tubing.



Two views of the aerial trolley car designed and constructed by a Californian inventor. The suspended vehicle is driven by a gasoline engine connected to an aerial propeller.

To serve in case of accident to the propeller and engine on the back of the car, a second propeller and motor will be placed on the front. This can only be used to double the power, if desired, or to hold back on down grades by reversing its motion.

This unique propeller is far more efficient than the kind used on aeroplanes because of its large surface. It is operated by a four cylinder 25 h.p. gas engine such as is used in automobiles. The propeller is capable of one thousand revolutions per minute and on a long stretch of track it is claimed that the car can easily make one hundred miles an hour.

The track in use at present is six hundred feet long and is built on the estate of the inventor, Mr. J. W. Fawkes. These tracks are supported on posts, some of steel and some of wood, with cross beams to correspond. This is in order to test both kinds.

The rails used are steel T beams three and a half inches broad, and three-eighths of an inch thick and scientifically trussed to prevent sagging. The car is held securely to the rail by means of four sets of grooved wheels firmly clamped both above and below the rail so that there is no danger of it jumping the track.

Another interesting point is the tilting planes to lighten the car by air pressure when it is in motion, as well as an apparatus to lower and raise the cars at the stations.

It is claimed that this trolley line is much more economical to install, costing approximately $2000 per mile and $1500 for each car. It has many advantages over the old systems, as it can be built over hills and across rough country as easily as on level stretches, the height of the track being regulated by the length of the pole. In fact, part of the Burbank system crosses a ravine by means of poles of various heights.

Mr. Fawkes is now considering the building of a double track line between Los Angeles and one of the suburban towns. For commercial purposes his idea is to have a five track system, the lower tracks for local transportation while the upper one is for a "flyer."

NEWLY INVENTED GAS TURBINE OF LIGHT WEIGHT

A gas turbine of exceptionally high power and efficiency, combined with the greatest fuel economy, has been developed by Josef Brandstetter, a young Austrian inventor living in Los Angeles. It is an exceedingly light and compact machine.

A working model of a gas turbine which possesses many promising features.

The inventor claims for the new gas turbine a number of features that should make it a factor to be reckoned with in modern power development. Great simplicity, with only one moving part, is perhaps the prime advantage, followed by the elimination of superfluous parts, making for extreme lightness. A 100 h.p. engine of this type would have a weight of only 90 pounds. The fuel cost can be reduced to 1/10 or even 1/20 of the expense for running a standard type gas engine, as it not only requires less fuel but will burn cheap crude oil. Overheating, the great difficulty to be overcome in gas turbines, has been done away with in this machine by a secret process. The inventor claims that the lightness of the engine, its simplicity of operation and absence of vibration will fit it for use in aeroplanes and motor vehicles, while its power producing qualities will make it available for large stationary engines.

Eating Through Steel with Fire

By L. R. Perry

"LIKE cutting cheese with a razor, or butter with a hot knife," is seemingly a good way in which to describe the operation of the modern method of cutting through hard metals. The marvelous work of the once wonderful high-tempered steel saw has, of late years, become dwarfed before the truly phenomenal ability of the new oxy-acetylene blow-torch. So powerful, so easy of operation, and so practical for numberless purposes is this latter process of cutting that it has become a common one, and in many places an altogether used method, having rendered obsolete former methods now considered intolerable for the same purposes.

The process itself is quite simple: Two highly compressed gases, oxygen and acetylene, are drawn from two separate tanks, conveyed through pipes and allowed to issue from the same tiny nozzle. The issuing combination is set aflame and directed against the material to be severed, which it burns or melts within a limited space, thus causing a groove or cut. So localized is the work of this wonderful flame in the hands of a

(1)—Watching a skilled operator cut through the four-inch rim of a huge cast steel wheel. (3) — Four sticks of dynamite inserted and discharged in this cast steel cylinder achieved the result shown.

(2) — Close view of workman cutting through steel rim of fly wheel.

(1)—What an ineffectual discharge of dynamite did to the hub of a big steel wheel. (2)—Another view of the same wheel after being shattered by the dynamite discharge placed at the hub. (3)—Remarkable straight fracture of the cast steel wheel at the hub, caused on the opposite side to where the dynamite was inserted. (4)—Another view of the steel wheel and its shaft. (5)—An unsuccessful attempt to shatter the wheel by a dynamite blast.

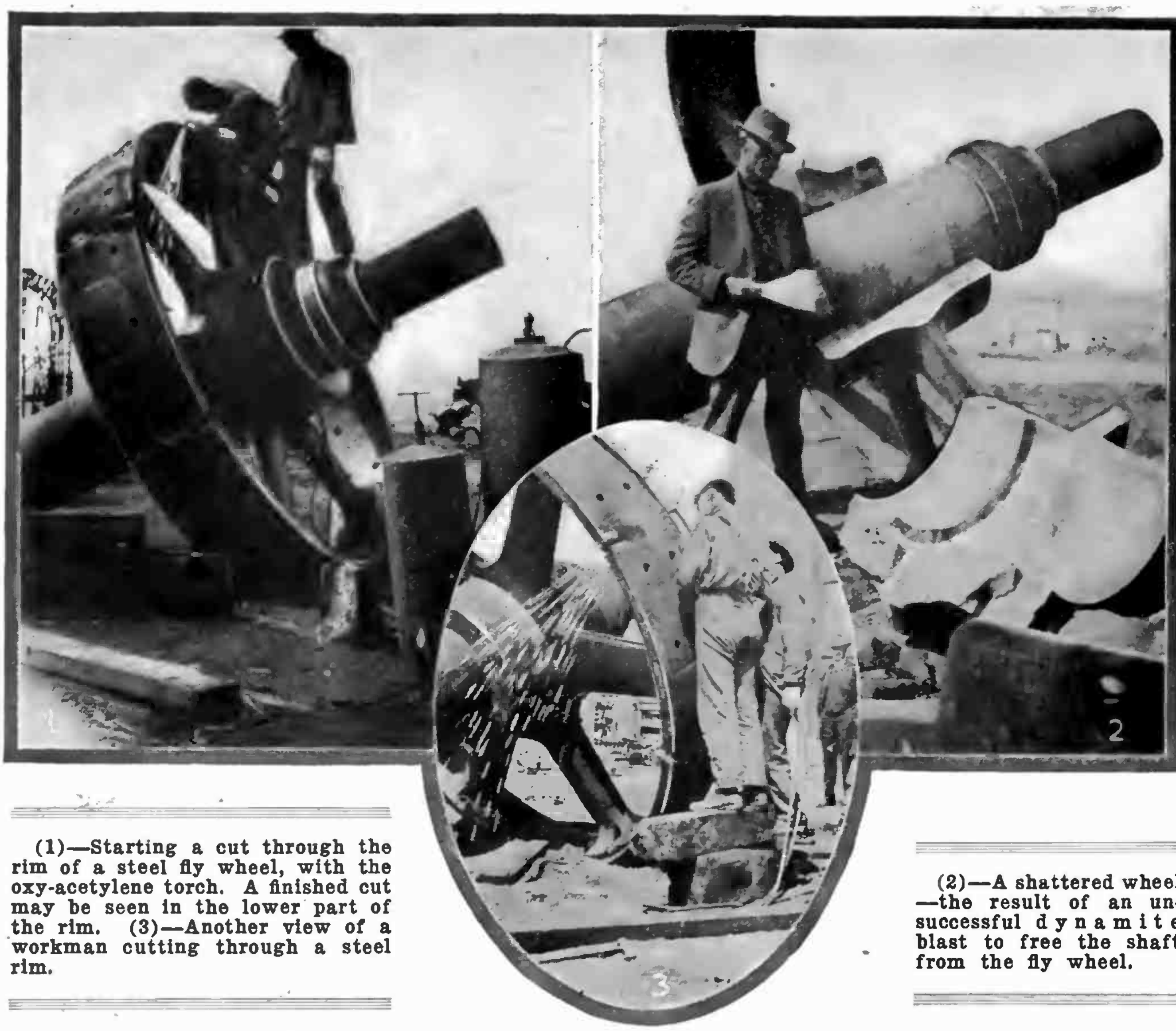
skilled operator that neat designs may be worked out or narrow slits in thick pieces of metal formed. And the ease with which the attacked metal is melted and forced away is comparable to the effect of a powerful stream of water from a hose washing away a bank of earth.

One of the chief features of the method is its portability, the apparatus often being seen nowadays on high parts of structural steel buildings where the trimming off of a girder is being accomplished in the twinkling of an eye. The reason that steel melts before the oxy-acetylene flame is because the temperature produced is several thousand degrees Fahrenheit, and steel melts in the neighborhood of 3,500 degrees.

Shopmen, too, now make a business of cutting out designs from sheets of steel, using guiding arrangements which accurately guide them over the geometrical forms of the flames.

Aluminum tanks, pipes, and other metal products for brewers' and chemical manufacturers' use are flame welded. Nickle is now being successfully handled.

Cutting tools are being made from low-carbon steel by changing the structure in the oxy-acetylene flame. Bases for oil-engines, automobile engine cylinders, boiler tubes, and ornamental iron-work are in the commercial stage of manufacture now. A still newer use is that of cleaning boiler tubes of scale by a modification of the oxy-acetylene flame, the heat being applied directly to the scale and causing it to become detached from the



(1)—Starting a cut through the rim of a steel fly wheel, with the oxy-acetylene torch. A finished cut may be seen in the lower part of the rim. (3)—Another view of a workman cutting through a steel rim.

(2)—A shattered wheel —the result of an unsuccessful dynamite blast to free the shaft from the fly wheel.

boiler by the expansion of air or moisture between it and the plate.

Welding processes have been absolutely revolutionized by the oxy-acetylene flame. Broken machinery has been put together in stronger form again without removing it from its bed; the great money and time saving advantages of the method having been instrumental in causing it to become quite popular with operators of big plants.

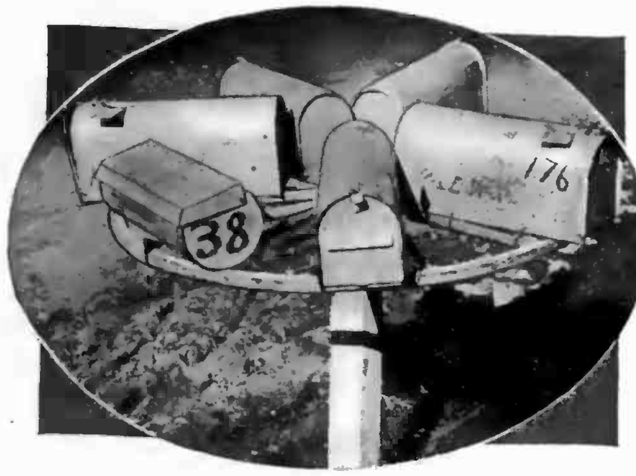
Flame welding is now said to cost but forty or fifty per cent. of riveting on the same piece of metal.

Several of the accompanying illustrations depict how dynamite was unsuccessfully employed in breaking up huge castings of electric generators relegated to the scrap heap. Holes were drilled in certain vulnerable parts of the huge castings, and dynamite inserted and exploded. The work proved slow, uncertain and ofttimes a failure. The oxy-acetylene torch was finally brought into play and the ponderous castings cut up into many sections in the minimum of time.

Plumbers, and pipe layers particularly, are now installing entire piping systems without threaded joints. Miles of pipe have been laid with far greater ease, speed and perfection by melting steel about the ends of long sections previously put together above ground in the manner described.

OLD WHEEL SERVES TO HOLD MANY MAIL BOXES

The "wheel of mail" is the very latest achievement in the way of a rural mail box holder. It consists of a regular, old-fashioned wagon wheel of the wooden spoke type, supported upon a post 2 by 6 inches in size. Out of the upper end of the post a strong iron spike extends, and over this spike the hole in the hub has been placed. Upon reaching the wheel the owner of one of the boxes has simply to turn the wheel until his own box is brought around to his side. The mail is then taken out and the owner passes on. The boxes have been so arranged upon the wheel as to maintain the wheel in a horizontal position at all times. This affair was built by a number of families whose homes were located in a short lane just off the regularly established rural mail service. Rather than have their boxes scattered at different points around the intersection of their lane and the main road, they erected this very attractive and serviceable mail box holder.



A novel use for an old cartwheel is to use it as a revolving mail box stand.

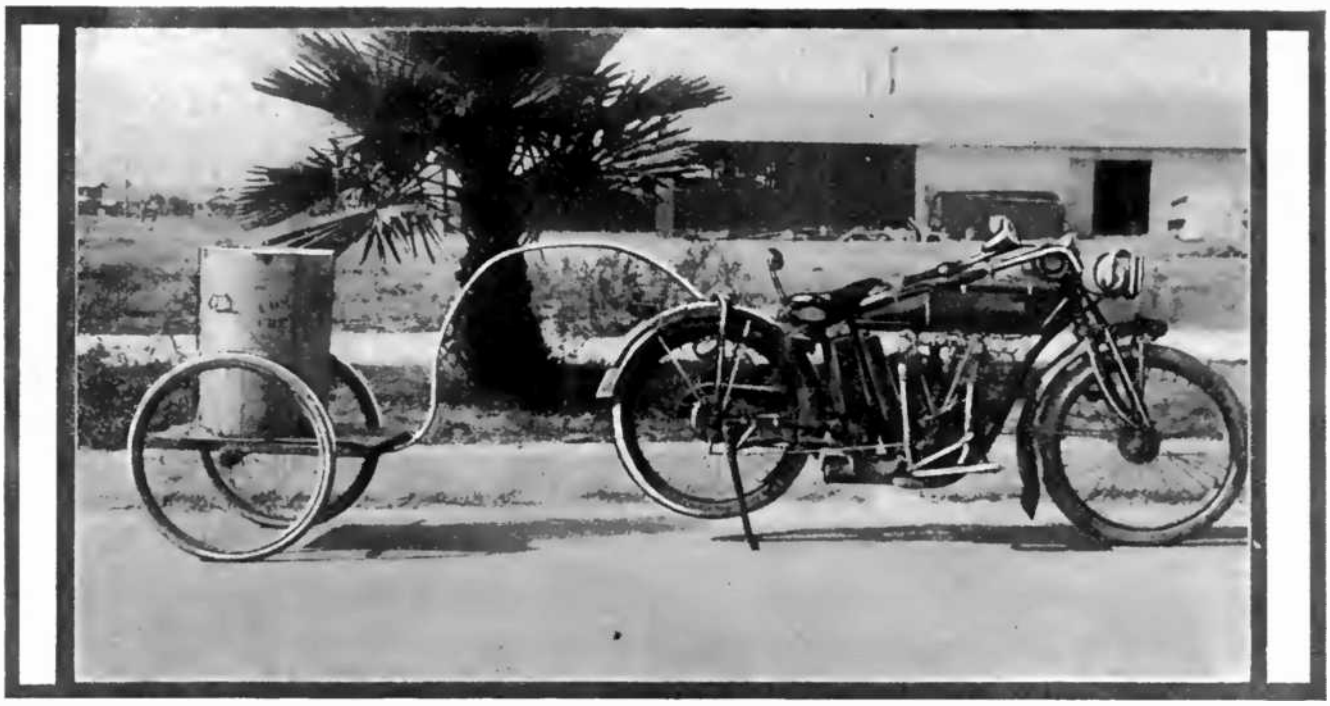
AN ELECTRICAL PICNIC DE LUXE

To show just how adaptable the electric current really is and to incidentally obviate the unpleasant task of cooking over a smoky bonfire, the employees of the Seattle Municipal Electric Company recently gave a picnic, the cooking for which was all done on the picnic grounds with electric heating utensils.

Wires were run through Woodland Park, where the festivities took place, from a near-by power line, and with the superintendent as the head chef, the meal was prepared. Beans were baked in an electric oven, and coffee was made over electric grids.

Electrical picnics are far better for the digestion than the old fashioned variety, although perhaps not so picturesque.

An electrical picnic in which the food was entirely prepared with electric devices—perhaps not as picturesque as the usual picnics, but certainly a greater success from a culinary standpoint.



By means of a light, two-wheeled cart, the motorcycle may be employed to good advantage for the delivery of merchandise.

A MOTORCYCLE TRAILER SOLVES DELIVERY PROBLEM

Using a small trailer, such as is shown in the accompanying illustration, for the transportation of ice cream pails is the idea of a Californian. This little vehicle has eliminated much of the inconvenience of delivering ice cream pails, aside from the rapidity of delivery over long distances. Originally, the motorcycle was used by its owner for the delivery of drugs and other items found in a drug store. It was accordingly a simple matter for its owner to attach the two-wheeled trailer which will accommodate one extra large keg or four medium sized kegs.

GOLD PENS

The bit of white metal seen on the under side of the point of a gold pen is sometimes platinum, but oftener iridium. Iridium is a very hard metal and a very expensive one, since it costs about four times as much as gold. The purpose of the iridium tip is, of course, to afford the pen a more durable point.

Manufacturers of gold pens obtain their gold from the assay offices in bars of pure twenty-four karat gold, which they melt and alloy with silver and copper to the degree of fineness required. Gold of fourteen karats is used in the making of the best American gold pens, that being the degree of fineness deemed most suitable for pen use; but good pens made in this country for sale in France are of eighteen karats, the French government requiring that all articles made of gold and offered for sale in that country shall be not less than eighteen karats.

The gold from which the pens are to be made is rolled and re-rolled until what was originally a thick, heavy bar of gold has been rolled into a thin gold ribbon about three feet in length by four inches in width. This gold ribbon is put into a machine that stamps out of it flat pen shapes. On the top of each of these shapes is fused the iridium point, the shapes then proceeding to a slitting machine, which cuts the slit in the pen. From this machine the pens go through another, which gives them their rounded, familiar pen form. Finally, they are ground, polished and finished, ready for use.

American gold pens are not confined to use in fountain pens. They are also made for use in regular pen holders, and have been sold in competition with those of British and English manufacture in South America, Africa, Japan, China—and wherever pens are used.

THE HARNESSING AND USE OF EXHAUST STEAM

It was in 1894 that Sir Charles Parsons showed that by means of the steam-turbine, exhaust steam from reciprocating engines could be used to produce power more economically than it had been produced before.

In 1901 Professor Rateau, of the School of Mines in Paris, discovered a method of using exhaust steam from engines that run intermittently. According to a high authority, the practical result of the development of exhaust and mixed-pressure turbines had been that, on land alone, nearly 2,000,000 horsepower of electrical energy is being generated by means of exhaust steam that had been previously wasted.

REINFORCED CONCRETE TELEPHONE POLES IN SECTIONS

A firm at Ahaheim, Cal., is manufacturing a reinforced concrete telephone and telegraph pole which can be made for sixty cents a foot and which can be enlarged or shortened any time after it is set up in the ground, without taking it down.

The poles are made by bolting and cementing cylindrical blocks together which are nine inches high. A telephone company may erect a fifteen foot pole this year and extend it to sixty feet next year by adding blocks to the top of the pole. The diameter of the blocks composing the pole vary to suit the size of the pole and the various strains to which it will be subjected.

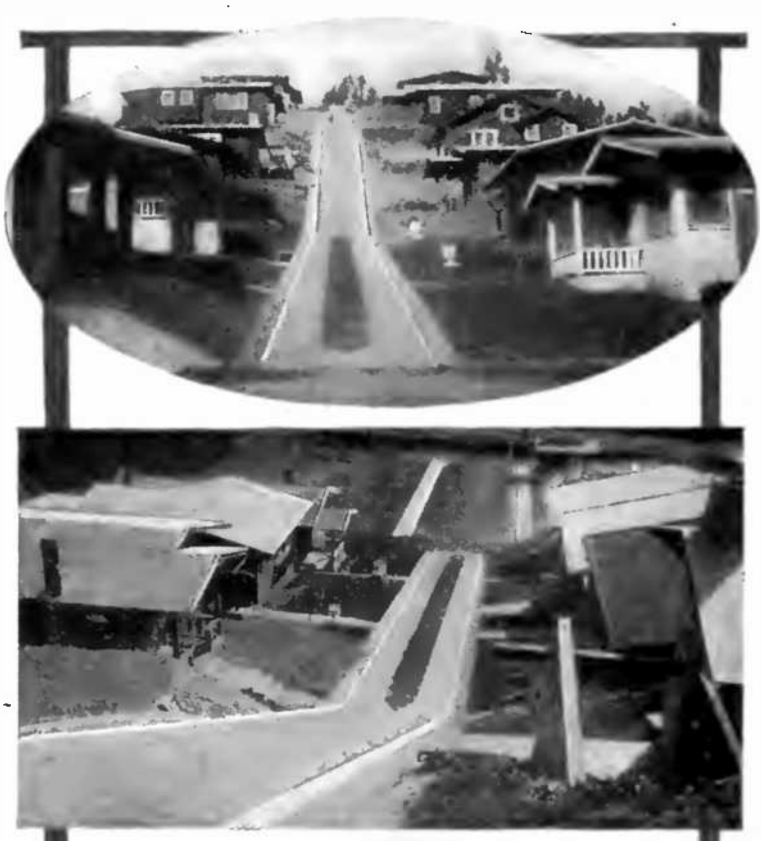
Special moulds, containing stands for the reinforcing steel bolts which run through the center of the blocks, have been made and patented by the concern making the poles. The metal moulds are arranged on a revolving wheel that can be turned to suit the convenience of the operator. This contrivance saves him unnecessary walking, both in setting up the wet concrete and in

Various views of sectional concrete poles, showing the poles in use and the apparatus by which they are manufactured with the minimum amount of labor. The poles are made up of concrete blocks bolted together. Sections may be added or removed without disturbing the base of the pole.

collecting the blocks after they are cured. The wheel is also provided with automatic sprinkling devices by which the blocks may be moistened with water while they are curing.

WORTHLESS LAND RENDERED VALUABLE BY STAIRWAY

One of the novelties in the building line in Southern California is the hillside residential section located at Edendale and shown in the accompanying illustrations. This is an example of how an apparently worthless piece of steep, hilly land may be turned into an income-producing home section. The cement stairway, or rather series of stairways, consists of four sections of steps and three stretches of inclined walks, each of which is about a hundred feet in length, the whole having a length of something like seven hundred feet, this continuing directly up the side of the hill. The pretty little bungalow homes, which range in value from $1,200 to $1,400, have been erected along either side of the cement walk. The steps are about twelve feet in width, while the walk sections consist of two cement strips four feet in width and a four-foot parking between.



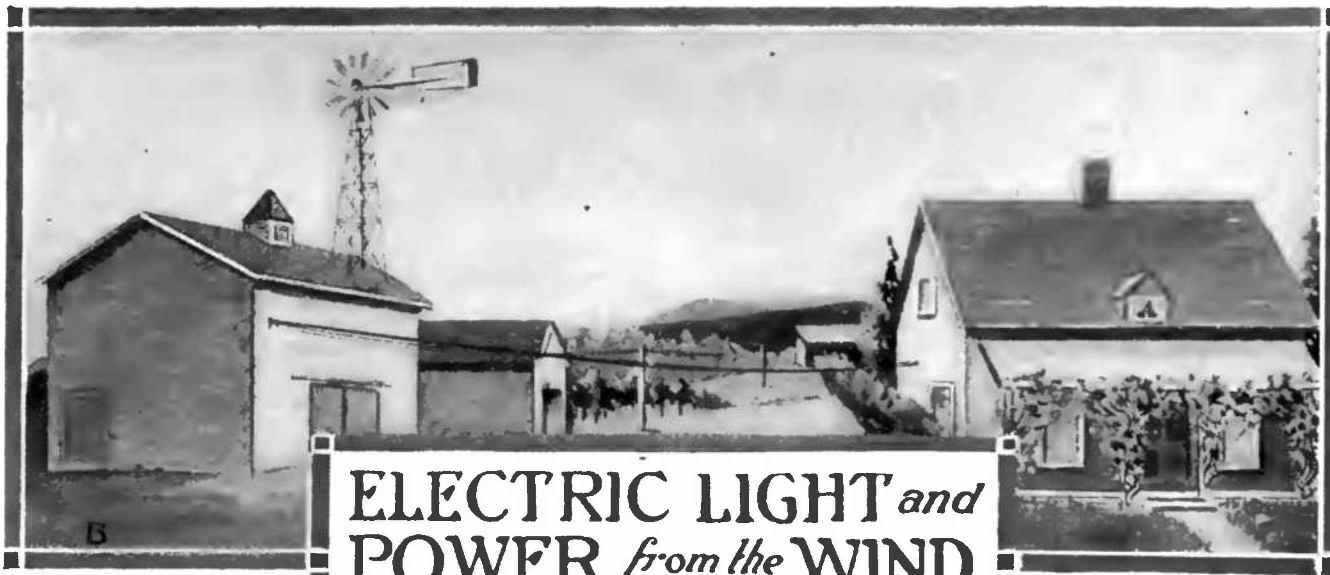
By building a concrete stairway, waste hillside land was rendered valuable.

HOT WELL INCUBATES CHICKS

A rancher in Mecca, Imperial County, California, has devised a method of turning to account the hot well upon his property by using it as an incubator. About the mouth of the flowing well he built a cement box and in this the incubator was placed with a little sand in the bottom on which the eggs are set. The receptacle is about two-thirds submerged, and the water circulates about it in such a manner that the eggs are kept at an even high temperature. The results have been unusually successful, as about 96 out of a hundred eggs are hatched.

MOLYBDENUM IN ELECTRIC LIGHTING

Not content with the improvement in the incandescent electric lamp brought about by using drawn wire filaments of tungsten instead of carbon, electrical experts are seeking an even more efficient metallic filament. It is said that molybdenum may supply the want. Molybdenum seems to be the most promising of all the so-called rare metals at all suitable for use in electric lamps. Molybdenum has rarely, if ever, been melted. Consequently, filaments of the pure or the alloyed metal could be used at a higher temperature than tungsten. That would mean better lights, for the efficiency of an electric lamp largely depends on the temperature to which the filaments can be raised. Molybdenum is a white metal, almost as malleable as iron. It can be forged while hot and worked up into thin rods, which in turn can be drawn into wire. Experts are now principally concerned with the problem whether the wire can be drawn sufficiently fine for the purpose.



ELECTRIC LIGHT and POWER from the WIND

By Robert H. Moulton

THE experiments of Mr. Forrest are of more than passing interest, offering as they do, a graphic proof that the windmill generator of electricity is an accomplished fact rather than a mere fancy.

A FEW years ago Thomas A. Edison made the prediction that in 200 years, due to the cheapening of commodities, the ordinary laborer will live as well as a man does now with $200,000 annual income. Automatic machinery and scientific agriculture will bring about this result, said Mr. Edison. Among devices for conserving power which is now more or less wasted, he mentioned the use of wind mills connected with storage batteries for laying up the energy of the winds in electrical form.

Since these statements were made the practicability of the wind mill electric generator has been thoroughly proven by at least one man, J. F. Forrest, of Poynette, Wisconsin. To a 12-foot power wind mill on his farm, Mr. Forrest has hitched a dynamo. This, in connection with a storage battery, converts and stores the energy of the wind into that of electricity. The amount thus rendered available is sufficient to light a system of 25 lamps distributed throughout the house and barn, and to operate various household and farm utilities.

After two years' experience with an unusual amount of calm weather during two summers, Mr. Forrest has at no time been without light. His power windmill is twelve feet in diameter and is geared up; that is, the vertical shaft makes five revolutions to one of the wind wheel. This shafting extends down the center of the tower and has pulleys, bevel gears and grinder rings attached to it. This windmill is used exclusively for power, as it has only the rotary motion. There is a pumping mill on a well nearby.

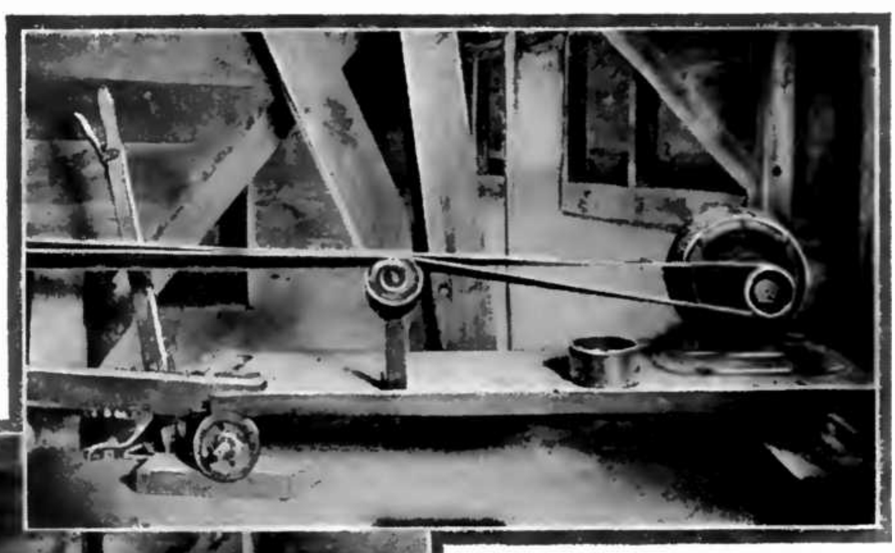
Right along in the line of economy, this windmill runs a drill press, grindstone, corn-sheller, bee hive saw, washing machine, grain elevator, feed grinder and the generator which charges the storage batteries. A power windmill, Mr. Forrest finds, will run any of these machines just as successfully as any pumping mill will run a pump.

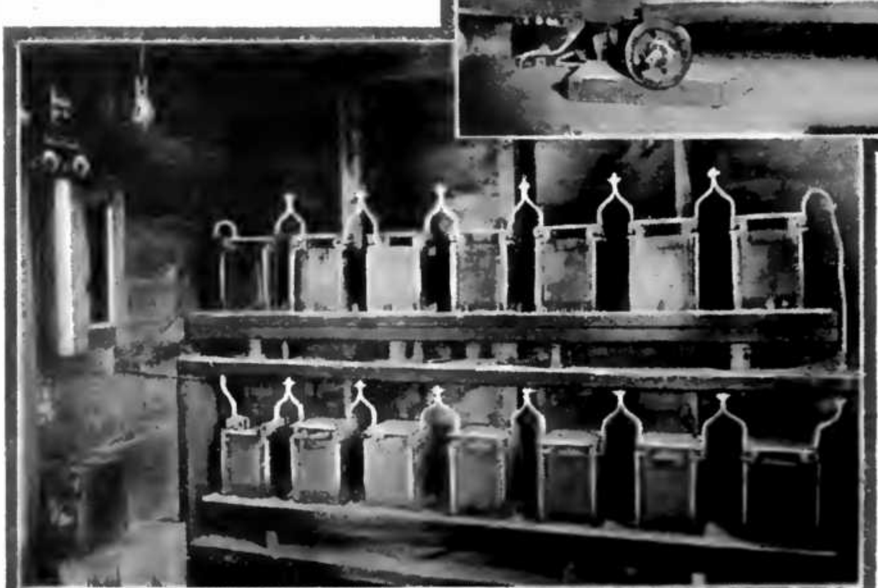
The feed grinder is of the combined foot gear type, and as the speed dies down the rings clear themselves, leaving them in a condition to start up easily when the wind again rises. There is a clutch used to start and stop the grinder automatically, and above this is a spring which, in case a nail or piece of iron gets into the grain, disconnects the grinder so that nothing will break. An elevator carries the grain into a large hopper above the grinder, and this also is started and stopped automatically. Below the grinder is room for the ground feed. The windmill works away sometimes grinding at the rate of three bags per hour.

The dynamo or generator is marked 35 volts, 6 amperes, .21 kilowatts and 450 revolutions per minute. It is run with a horizontal pulley on the upright shafting and is operated with a clutch; the belt making a quarter turn over an idle pulley, thus doing away with bevel gears. A two-inch leather belt has to be reasonably tight to prevent it from slipping, as it seems to buckle in as the speed increases. The windmill sometimes runs as high as 600 revolutions per minute. To meet these conditions Mr. Forrest finds that two different sizes of pulleys or step pulleys allow for the difference between a light and a high wind.

There is an automatic cut-in between the generator and batteries, which cuts in as the speed runs up, and drops out as the speed decreases, thus preventing the electricity from flowing back into the generator and being wasted. This cut-in, which is kept in a cabinet under lock and key, forms a very important part in a windmill driven plant and works equally well with a gasoline engine drive. There are two meters, one a volt meter and the other an ammeter, which register the rate of charge and discharge, as well as indicate if there are any lights turned on and about how many.

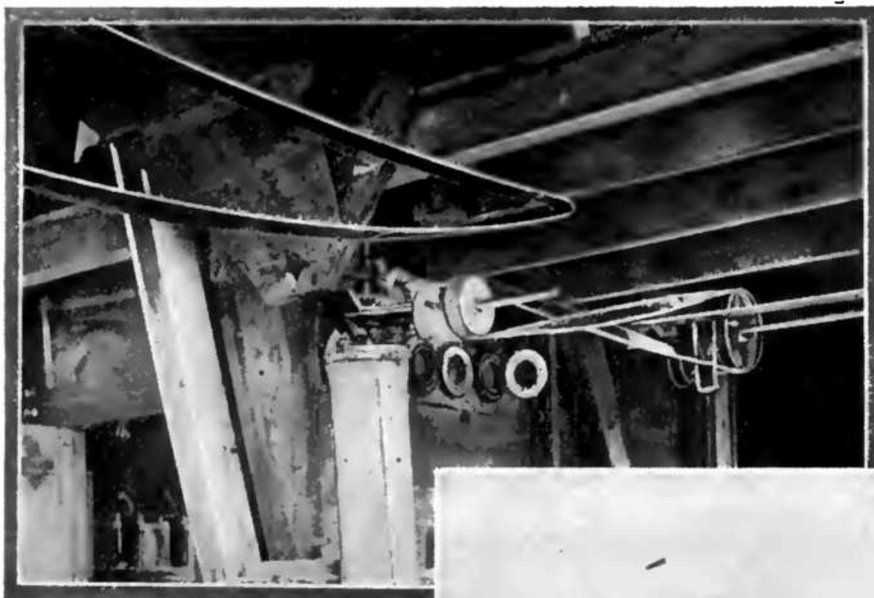
The storage battery comprises fourteen cells, each having three positive and four negative plates. Each cell gives about two volts; the entire battery furnishing current suitable for 25-volt lamps, with a capacity of 120 hours for each lamp. The cells are arranged in two rows, seven in each row. The glass jars or cells are set on sand in wooden trays and these trays are placed on shelves. The electrolyte in the cells will not freeze in a temperature 30 degrees below zero. The cells are very simple to set up and to fill





Above: The generator and the driving belt which is so arranged that the power of the windmill shaft is successfully applied to the generator pulley.

At the left: Storage cells which are employed to accumulate electric current so as to furnish a steady supply during calm.



To the left: Interior of the windmill building showing arrangement of bevel gears at the base of the windmill shaft. By means of these gears the power is transmitted to a horizontal shaft.

At the right: The buildings in which the windmill electric plant is located. The peculiar construction of the windmill tower will be noted in the picture; the framework being entirely closed in.

with electrolyte, which is diluted sulphuric acid and requires only the addition of a little distilled water to replace that which evaporates. About ten gallons of distilled water a year are used.

After purchasing three two-gallon jugs of distilled water at a drug store at 20 cents a gallon for the water and 25 cents apiece for the jugs, Mr. Forrest hit upon a novel scheme for cutting out this expense. Taking a copper kettle, he soldered a copper tube in the cover, corked up the spout, fitted a one-half inch lead pipe over the tube, and bent it so as to connect in the mouth of a jug which is set on one side of the kitchen stove or range. The kettle was then placed on the stove and filled with water, and, while the stove was being used for cooking purposes only, there was collected in a few days enough distilled water to last several months. Aside from the lubricating oil for the windmill and generator, the expense of running is practically nothing.

After two years' use Mr. Forrest finds his battery in as good condition as when he bought the cells. And the outfit is not only very durable but perfectly safe to handle. The low voltage used, which is less than one-fourth the pressure usually carried in cities, eliminates all danger from fire.

With the current costing practically nothing after the equipment is installed, Mr. Forrest's plan is to use it lavishly while the wind blows and save it during the calm. His plant cost about $250; he never studied electricity but says he merely followed directions and has no trouble at all.

According to the North Dakota Agricultural College, which has issued a bulletin on this subject, the use of a windmill for electric lighting and power purposes is possible in almost any part of the United States. A well-designed equipment, together with a 14- or 16-foot windmill, will generate enough electricity to charge a storage battery. By this means current can be used to do the pumping, washing, churning, to separate the milk, and to light a house of sufficient size to accommodate fifteen persons, as well as illuminate all stables and outbuildings necessary for a farm of 1,200 acres or more. With a storage battery it is possible to accumulate a supply of electricity sufficient to extend over periods of atmospheric quiet of from two to ten days' duration, depending upon the size of the storage battery. During periods when the wind blows continuously, as it frequently does in the Central States, electricity can be used for ironing, cooking, and many other purposes too numerous to mention.

THE SCALE REPLACES COUNTING MACHINE

A weighing machine for the counting of street car tickets now replaces even the rapid counting machines which hitherto have outrun the most nimble fingers. According to its inventor, Walter S. Smith, Columbus, O., a scale engineer, the weighing device excels the machine counter to an extent proportionately even greater than the latter outdid the old-fashioned finger and thumb.

A very accurate balance, capable of weighing a fraction of a pinhead, now used for counting tickets.

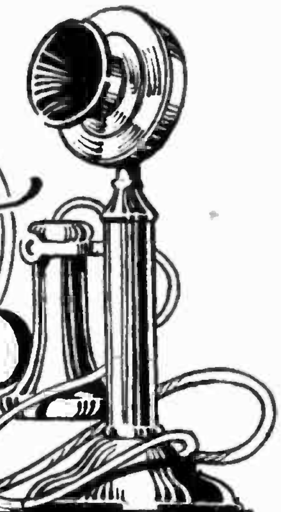
The new ticket weighing machine is simply a very finely adjusted scale. It will weigh a fraction of a pinhead. It will actually weigh one-fourth of a car ticket. Its principal parts are: a receptacle for the tickets, a scale beam, and a dial and indicator at the top. The indicator does the particularly delicate weighing after the general weight of the tickets is indicated on the beam. One-half of a ticket will cause the indicator to sway perceptibly. The face of the dial shows the number of tickets according to their weight.

The new device is being used now by the Columbus Railway & Light Company. It can weigh and count as many as 15,000 tickets at a time, and since each ticket weighs three grains, more than six pounds of tickets can be counted in a twinkling. The company collects about 300,000 a day. Formerly, seven clerks were employed to operate seven counting machines to do the daily counting. The task then consumed five hours. In marked contrast, the weighing machine, according to its inventor, does the work in almost as many minutes.

ELECTRIC STERILIZING

It is reported from Holland that there has been invented there an apparatus that sterilizes milk by electric light. It contains a mercury-vapor lamp, so arranged that a thin stream of milk may be made to flow over the surface of it. The ultra-violet rays from the light quickly destroy all bacteria in the milk. Demonstrations were first made with water containing various kinds of bacteria. The water was purified in a few minutes with but slight increase of temperature.

Telephoning from New York to San Francisco



By Austin C. Lescarboura

TO everyone connected with the telephone business in this country these words mean much: "Mr. Watson, please come here, I want you." This sentence has been made famous on two occasions: the first, when Dr. Bell, the inventor of the telephone, caused his voice to travel over some ten feet of wire and be heard by his associate, Mr. Watson, thereby proving that the telephone was a possibility; and again when Dr. Bell spoke the identical words to Mr. Watson over a line of 3,400 miles between New York and San Francisco.

On January 25th at 4 o'clock about two hundred guests of the American Telephone and Telegraph Company were gathered in a room of the telephone building in New York to participate in the formal opening of the first trans-continental line between New York and San Francisco. The honor of being the first person to formally talk over the line rightly fell to Dr. Alexander Graham Bell; the listener at the other end of the line being none other than his old-time associate, Mr. Thomas A. Watson.

"Hello, Mr. Watson, are you there?" asked Dr. Bell. His face broke out into a smile of unrestrained happiness when the voice of his associate came back over the long spans of copper. After Dr. Bell, other distinguished guests spoke over the telephone line, among them Mayor Mitchel of New York, who conversed with Mayor Rolph, Jr., of San Francisco.

Later, Dr. Bell requested as a matter of sentimental interest that a duplicate of his first telephone instrument be connected in the trans-continental circuit in place of the regular desk type of telephone which he had been using. Not only was his request complied with, but connections were made through a small coil of the wire which the inventor had used for telephoning his first complete message. Holding the rather cumbersome transmitter to his mouth, Dr. Bell shouted: "Mr. Watson, do you hear me now?" To his great amazement the reply was in the affirmative. He had been heard over 3,400 miles of wire, using one of his instruments of over forty years ago! No one was more surprised than the inventor. Regarding his crude instrument with a look of fondness and admiration, he remarked that the lines and the equipment of the present-day telephone system had reached a high state of perfection to permit of the successful use of such a crude instrument over so great a distance.

The telephone is the result of an accident. If something had not gone wrong with one of the telegraphic instruments with which Dr. Bell and Mr. Watson were experimenting, it might not exist to-day. Here, briefly, is the story:

It was during the year 1875 that Dr.

Bell, then a young man about twenty-seven years old, was conducting unceasing experiments with a system of harmonic telegraphy; his idea being that over a single telegraph line a number of messages could be sent simultaneously, using a number of transmitters sending as many currents of different periodicity and, at the receiving end, an equal number of harmonic receivers, each being affected only by the current from one of the transmitters. The harmonic receivers consisted of an electro-magnet over which was mounted a steel armature tuned to a certain musical pitch.

Dr. Bell would spend hours at a time adjusting the pitch of the receivers. He was engaged at his customary task on the afternoon of June 2, 1875, in the attic of Charles Williams' workshop at 109 Court Street, Boston. In one room were three transmitters of three different pitches, three receivers with springs tuned to the same pitches, three signaling keys and a galvanic battery. In the other room were duplicates of the receivers. All the instruments were connected to a short line running between both rooms. That afternoon Mr. Watson was in the room with the duplicate receivers.

While Dr. Bell was preparing to send some signals he was surprised to notice the vibrations of one of the receiver springs, although none of the keys had been pressed. This struck him as being remarkable and he pressed the receiver to his ear. To his great surprise he heard a faint twang that had the unmistakable timbre of one of the receiver springs. He heard the twang several times and then rushed into the room of his associate to find out what he had done.

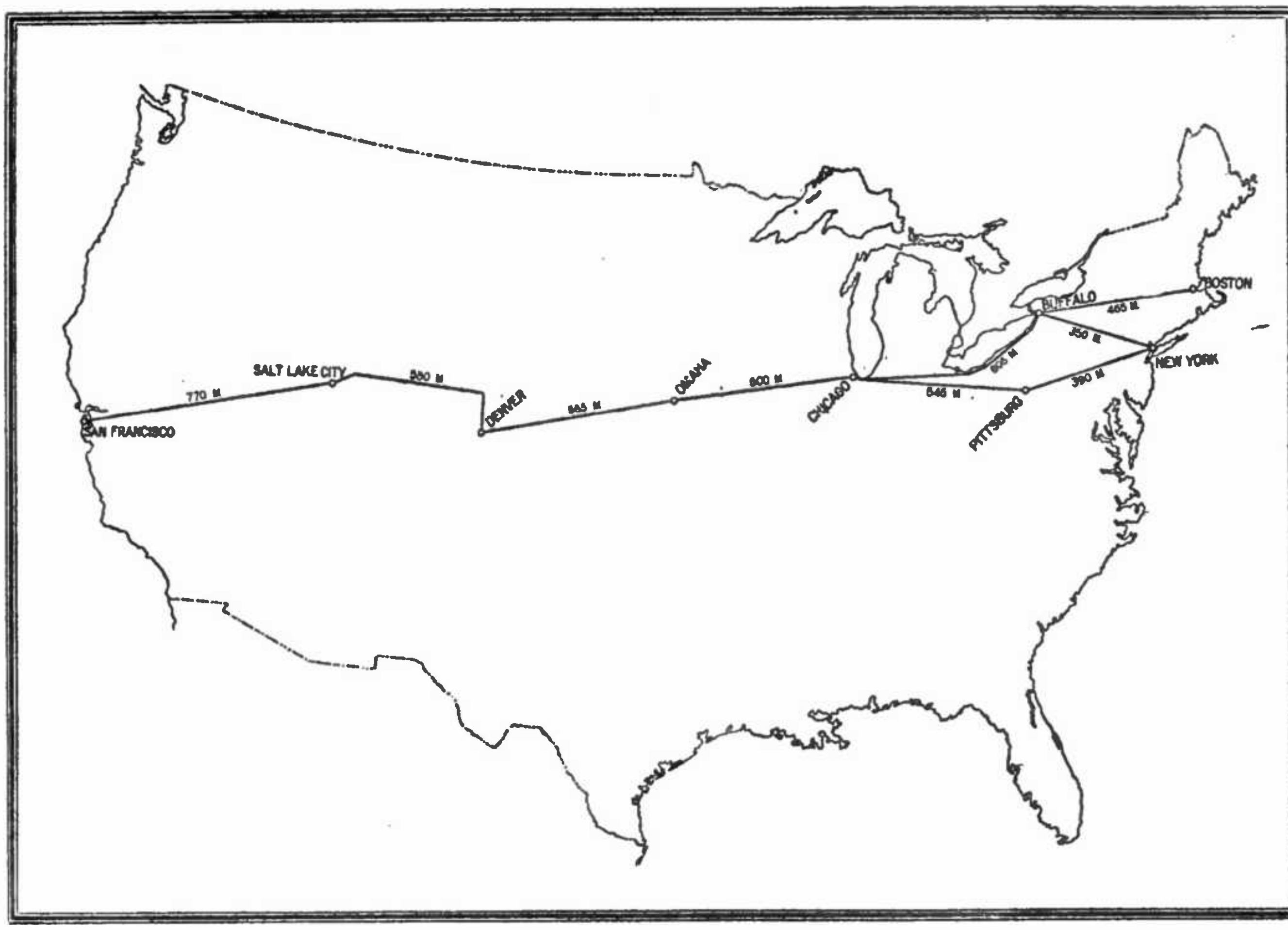
Watson in the meantime had been having troubles of his own. One of the receiver springs had become stuck and he was giving it some pretty vicious snaps when Dr. Bell rushed in excitedly. At a glance he noticed the source of the sound he had heard at the other end of the line. The sticking of the spring had answered a problem he had long thought of—a means of varying the strength of an electrical current flowing through a circuit in accordance with the fluctuations of sound waves. Dr. Bell knew that if the twang of the spring could be transmitted over the line, any other sound—even the fine modulations of the human voice—would be heard over the wire with the proper apparatus.

All afternoon Dr. Bell and Mr. Watson kept plucking springs and hearing the noise produced at the other end of the line. In the evening Dr. Bell gave his associate a sketch for the first speaking telephone. This consisted essentially of one of the harmonic receivers with a drum head attached to the free end of its spring.

The next day the instrument was ready for a test and it soon proved that Dr. Bell's theory was correct. A line was strung between the attic and the third floor of the building, since the adjoining rooms were so close together that the shouting of Dr. Bell could be heard by Watson without any apparatus. Sounds were transmitted over the line that day, although they were indistinct and the words could not be made out.

After this test followed many similar ones, interposed with many changes in the designs of the telephone apparatus. It was not until the following March, however, that the first message was received over a line in its entirety. In the meantime to avoid undesirable publicity Dr. Bell moved his apparatus to a boarding house at No. 5 Exeter Place, Boston, in which two rooms were used on the top floor for conducting the experiments. It was during the course of an evening when Mr. Watson was aiding Dr. Bell in some experiments that he heard the famous sentence issue from the receiver, "Mr. Watson, please come here, I want you." This was the first entire sentence ever transmitted by telephone—the first logical proof of the practicability of this means of communication.

To mention even briefly the various steps in the development of the telephone from that point to the present time is impossible in so limited a space. But it is well to bear in mind that a short time later Dr. Bell placed his



Route of the Trans-Continental Telephone Line from New York to San Francisco. A sound requires 1/15 Second to Travel over this Line of Approximately 3,400 Miles.

still crude invention in the hands of John J. Carty, now chief engineer of the American Telephone and Telegraph Company, who, with the aid of his vast engineering staff and that of numerous inventors, brought the telephone to its present state of development. To-day, the telephone has 130 parts, the transmitter is the 73rd type devised and the receiver the 53rd since the year 1876.

But let us return to the latest and most wonderful telephone achievement, the trans-continental telephone line.

The loading coil, the invention of Professor Pupin of Columbia University, has had an important role in the development of long distance telephony. As in the instance of other telephone equipment, this idea was taken over from the inventor and continually experimented with and improved upon by the engineers of the company. To-day, the loading coil usually measures about four or five inches in diameter as compared to the earlier types which were as big as nail kegs. The iron wire used in the loading coils must be as fine as a hair and perfectly insulated.

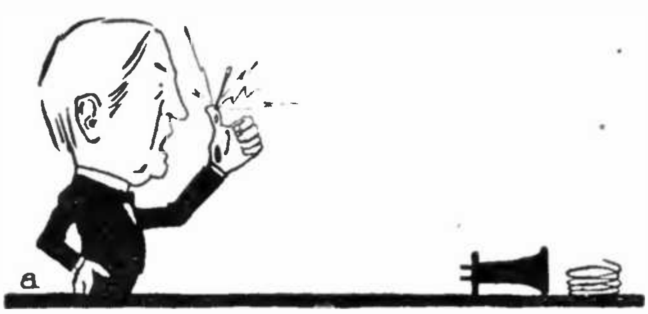
In the line between New York and San Francisco there are 3,400 miles of hard drawn No. 8 B. W. G. copper wire. There are four such wires from which are derived two physical circuits and one phantom circuit. The diameter of each wire is .165 inch. The weight of the wire is 870 pounds per circuit mile, that is to say, 435 pounds per mile for each wire, two wires being required for each circuit. The total weight of one circuit of two wires is 2,960,000 pounds or 1,480 tons. In the line itself there are 130,000 poles. As for the wire in the loading coils, it is of interest to note that in addition to the 6,800 miles of hard drawn copper forming each circuit there are 13,600 miles of fine iron wire in the loading coils. The voice travels over the 3,400 miles of line in 1/15th second, or at a rate of 56,000 miles per second.

THE average man is of the opinion that an invention requires a long and untiring period of research on the part of its inventor until he discovers his original idea. This, however, is in direct opposition to the actual facts in most great discoveries. It is often the merest incident that will suggest a revolutionizing invention. Other times it is an accident, great or small, or again it may be due to circumstances.

Inventing by Accident

By H. J. Grey

THE essential principle of the talking-machine was discovered by Thomas A. Edison as the result of an accident while experimenting with a telephone. A needle had been fixed to



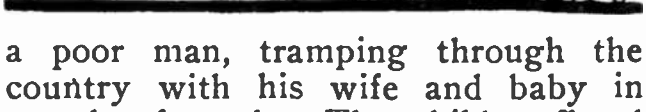
the vibrating disc of thin metal that produced the sound, and as a result of the vibration the needle was driven into the experimenter's hand. The incident set the famous inventor thinking, and a new series of experiments were devised. A roll of paper was made to rotate slowly with the needle pressing lightly upon it, while the inventer shouted "Hello" into the telephone. On reversing the paper and starting it again, it answered a very faint and distant "Hello." Since that day enormous improvements have been made, but the actual principle remains the same.

Everybody knows how Sir Isaac Newton was led to discover the force of gravity by considering the fall of an apple from a tree. History does not record, however, whether the apple hit Sir Isaac on the head or fell at this feet.

The incandescent gas mantle that is still used in so many thousands of homes, despite the more recent electric light, was also discovered accidentally.

Thirty years ago, Dr. Carl von Welsbach was conducting some researches in the color of flames containing the vapors of metals and chemical substances. Without any idea of revolutionizing the lighting of streets and houses, but merely to get a better flame for his purpose, he soaked a piece of cambric in a chemical solution and supported it over a flame of mixed gas and air. The cambric burned away and a sort of delicate skeleton of ash was left which glowed with a brilliant light. This was the first incandescent mantle, and now hundreds of thousands are sold every year.

In a sense, the homely safety pin, of which millions are in use to-day, was the result of chance. The inventor was

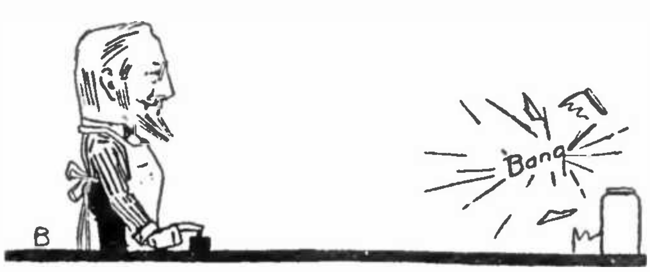


a poor man, tramping through the country with his wife and baby in search of work. The child suffered much pain from the long pins with which its clothes were fastened, and the father thought he could substitute a piece of wire that would answer the purpose as well and be much safer. And so, after one or two attempts, he bent a few inches of wire into the first safety pin that was ever made.

Wireless telegraphy is another example. Probably most people know that wireless messages are sent by means of waves of electricity that travel through space, though they may not know just how it is accomplished. Before this could be done it was necessary to know something about these electric waves. They were discovered by a German scientist through an unexpected happening in his laboratory. He had two pieces of electrical apparatus, known as Leyden jars, which were charged with electricity. One was intentionally discharged, and immediately the other one across the room discharged itself with a sharp crack and a brilliant spark.

This set the scientist thinking, and he concluded that there must have been some kind of wave, similar to light or sound, yet invisible and inaudible, passing from one jar to the other. Of course, it is a big step from this simple experiment to a present-day wireless installation on board a huge ocean greyhound, but it was the very first and necessary step in the discovery of wireless telegraphy.

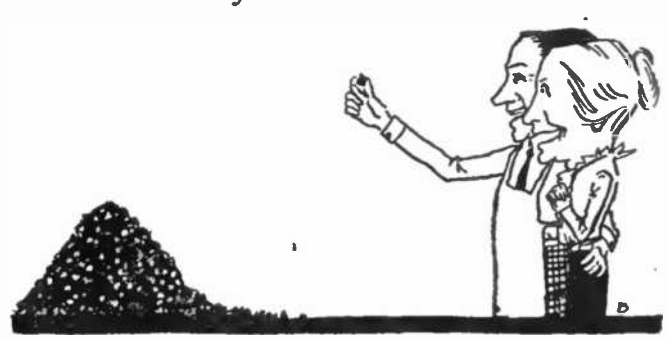
Gunpowder, though known to the Chinese for centuries, was not imported into this country from the East. It was discovered by the philosopher Bacon in the course of searching for the so-called philosopher's stone.



Thinking that this mythical substance, upon which the alchemists placed so high a value, might be made from nitre, brimstone and charcoal, a mixture of these materials was made and placed in a crucible over a fire. Of course it promptly exploded, and from this accident came gunpowder.

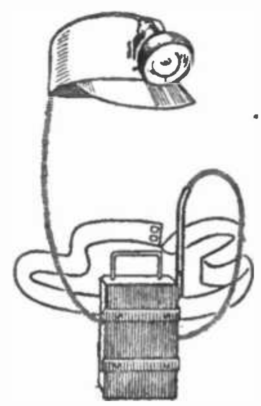
Radium has certainly aroused great interest since its discovery. It was a good many years in being discovered, but a lucky accident paved the way. Professor Becquerel allowed some crystals of a substance containing the metal uranium to remain for some time on a photographic plate. The plate was protected by the usual black paper envelope and no light could have reached it, yet on being developed it was found to have taken an impression of the crystals.

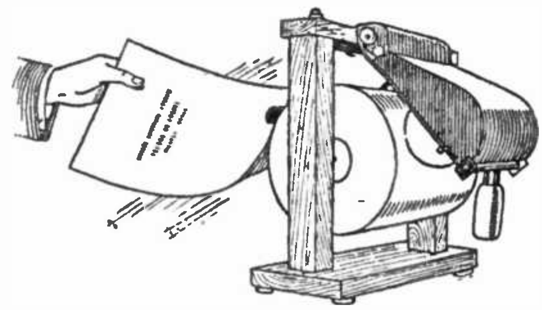
Obviously, some invisible agency was at work capable of penetrating the black paper, and after much patient labor it was found that not only the salts of uranium which photographers use but several other substances were capable of producing a similar effect. Pitchblende was one of them, a mineral containing not only uranium but the immensely valuable metal radium

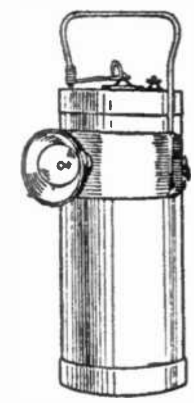


as well. Monsieur and Madame Curie, the distinguished French chemists, discovered that the waste material from pitchblende, after the uranium had been extracted, had a still more powerful effect upon the sensitive plate. They finally succeeded in obtaining a small fraction of a grain of radium from a ton or more of pitchblende waste. But that fraction of a grain was worth infinitely more than its weight in gold, and led to some of the most surprising discoveries of modern science.

There are perhaps innumerable other instances in which a mere accident resulted in a great invention. In fact, most great inventions are direct or indirect results of accidents or circumstances, although in fairness to their inventors it is but right to remember that there often exists a great gap between the fundamental discovery and its successful commercial application—a gap that stands for months or even years of untiring experimenting with, and the improving of, the original idea.







Miner's Electric Lamp. **Printer for Wrapping Paper.** **Lamp Attachment for Dry Cell.**

Recent and Improved Devices

Miner's Electric Lamp

With the dangers of fire damp explosions in mines brought to our notice by the many fatal accidents in recent years, it is not strange that at least one concern has specialized in the production of miners' safety lamps. One of the latest and most successful products in this field is shown in the accompanying illustration.

Not only is this lamp absolutely safe in an explosive atmosphere, but it is thoroughly dependable as well. In a recent test, the lamp and battery were placed under water and under these adverse conditions the lamp was burned continuously for twelve hours. At the end of this period no harmful effects could be observed as a result of the immersion. From this it is safe to conclude that the outfit could be used with entire satisfaction in the wet shafts of mines.

Printer for Wrapping Paper

The proprietors of small mercantile establishments will undoubtedly be interested in an automatic printing attachment which may be used in connection with the ordinary rolls of wrapping paper to print an advertisement as the paper is taken from the roll.

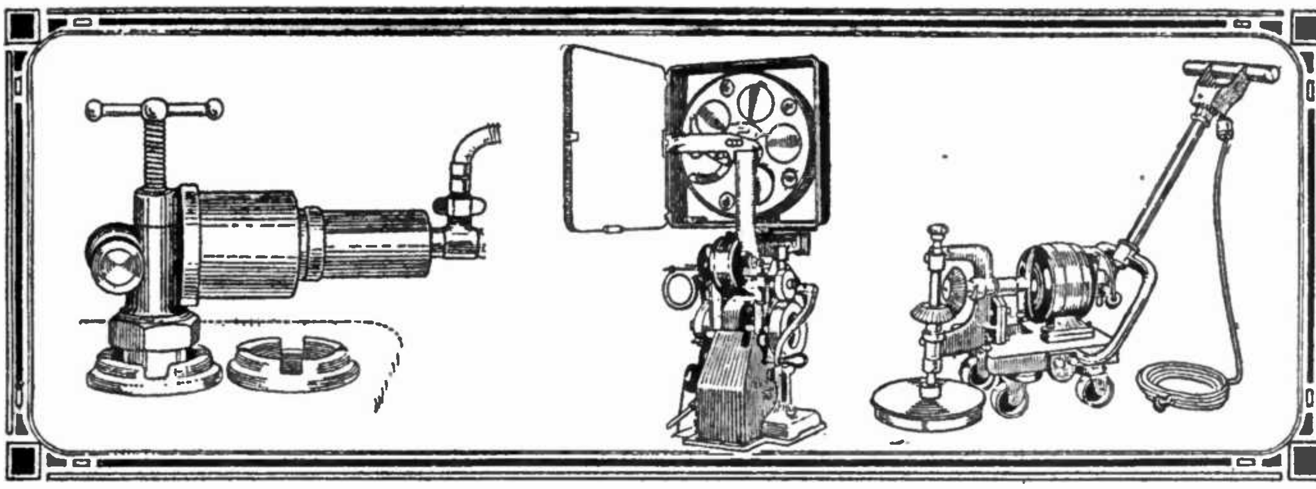
A wooden roller, having the necessary type mounted upon its face, is fastened by means of a thumbscrew on the frame of the paper roller. It is so arranged that when the paper is pulled from the roll the type roller passes over its surface, leaving the desired impression.

Lamp Attachment for Dry Cell

Still another of the various attachments for dry cells, converting the cell into an electric hand lamp or lantern, is seen illustrated herewith. The attachment comprises a handle of wire fitted into a clip of sheet metal that springs around the dry cell and which carries a reflector containing a small lamp bulb. The device is exceedingly low in price and seems to fill a long-felt want, creating a new field for the standard size of dry cell and placing a practical hand lamp within the reach of everyone.

Auto Tire Pump

A tire pump which presents many features of interest may be seen illustrated on opposite page. The pump is designed to be fastened into the cap over one of the exhaust valves of the engine, and not the least interesting point in connection with the device is the ease with which it can be set up and re-



Auto Tire Pump. **Non-Rewinding Film Reel.** **Floor Finishing Machine.**

moved. The operation of the pump piston is brought about by the compression in the engine cylinder, the expanding gases forcing the piston to the end of its cylinder at every stroke of the engine. The entire absence of mechanism likely to get out of order makes the device a valuable one for the rough and ready conditions of the road.

Non-Rewinding Film Reel.

Motion picture films, after having been run through the projecting machine, must be rewound before they can be used for the next performance. This extra handling has always been a source of annoyance and expense, to say nothing of the fire hazard involved.

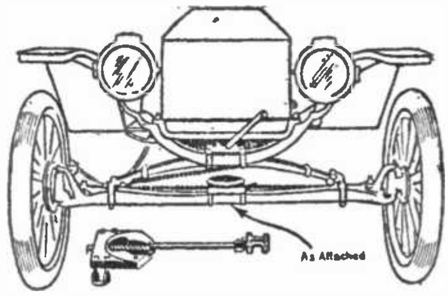
In the illustration is shown the appearance of a new device designed to make this rewinding quite unnecessary. In the design of a machine for this purpose, two problems had to be solved; the nature of the film makes it unwise to carry the band of celluloid, with its delicate emulsion face, over a sharp turn and, owing to the fact that, in a device of this nature, the film must be brought out from the center of the reel instead of from the outside, the film must be unwound by some force other than that of its own pull, since the force applied at the center of the reel has but little power to turn it.

The first condition is met by a series of arms and guides that effectually prevent the film from kinking. The second is taken care of in a most ingenious manner. The outside face of the reel is stationary, while the inside face and the spool around which the film is rolled are removable and are geared to a small electric motor through a magnetic clutch. The film passes out of the reel over a movable roller which is connected with a small switch. When the film becomes taut, the switch closes, the magnetic clutch is energized, and the reel revolved by the motor, thus loosening the film. When the film becomes sufficiently loose, the switch opens and the reel stops revolving. Thus the film is fed out at precisely the correct rate of speed.

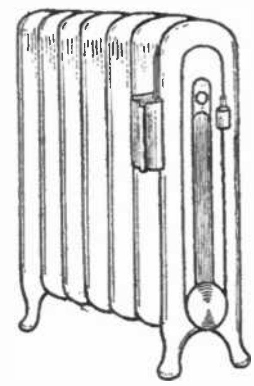
Floor Finishing Machine

With the widespread introduction of hardwood floors, many machines for automatically surfacing the wood have been offered to workmen specializing in this line. One of the most substantial of these machines is seen illustrated on this page.

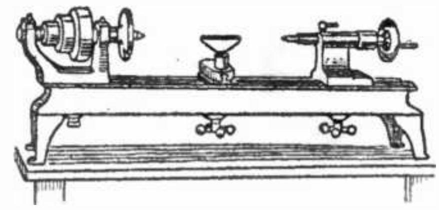
The device consists of a truck body carrying a motor and transmission mechanism which imparts motion to a grinding and polishing head fitted to a vertical shaft. Instead of the backbreaking task of going over a newly laid floor with plane and sandpaper, the present-day workman uses the new machine as one would use the lawn mower, but with far less exertion.



Safety Steering Device.



Humidifier for the Air.



Bench Speed Lathe.

Safety Steering Device

The driver of a light car not equipped with a worm steering gear knows what a problem it is to keep the car in its path when passing over sandy or muddy roads, or when one of the front wheels strikes a rut or chuck hole. The nervous tension is great and at times driving ceases to be a pleasure.

A device designed to prevent this strain is illustrated above. The device is readily added to the steering gear of any light car and, once in place, it is said to eliminate the vibration of the steering wheel when traveling on rough roads, preventing skidding in crossing tracks and in going through sand or mud, and relieving the driver of the feeling that he must keep a forced grip on the wheel. The price of the device is so low and it is so easily attached that there should be a ready field for it.

Humidifier for the Air

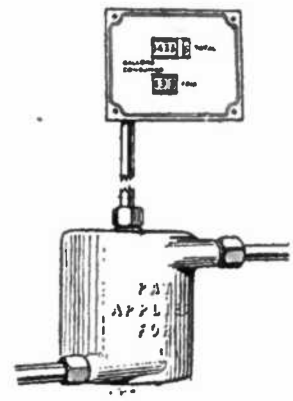
Steam heat, while ideal from many practical points of view, has its drawbacks, and not the least of these is the property of drying out the air in a room to the point where the mucous membrane of the throat begins to suffer. Many suggestions have been offered for effecting the proper supply of moisture to steam-heated air and, while all or nearly all may have some value, still it is probable that none can compare with the specially designed device shown in the illustration.

The humidifier is made of a certain kind of clay, treated by a special process which gives it the porous quality essential to its successful application in this connection. The device is hung on the steam radiator and filled with water. The porous walls of the container soon become saturated with water and liberate the moisture constantly and in just the proper quantity when the heat is turned on.

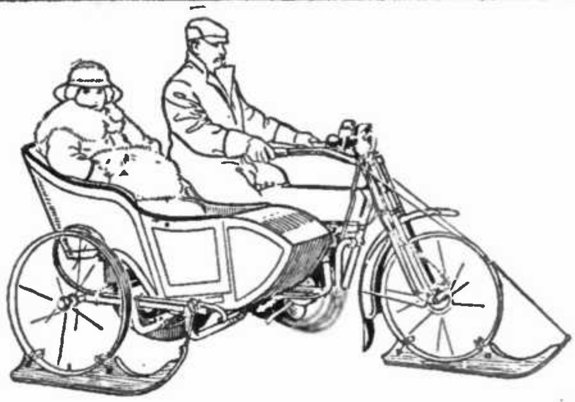
Bench Speed Lathe

The crowning ambition of the average amateur mechanic or experimenter is to own a lathe—perhaps nothing more than a polishing head with an improvised tailstock, but still a lathe. From the announcement of a New York manufacturer, it may be assumed that the home craftsman is at last to be supplied with a thoroughly practical machine at a low price. What is more, the lathe is said to be substantially built and sufficiently accurate for all ordinary work.

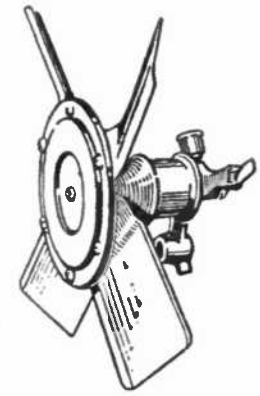
The lathe is made in two sizes, having an 8-inch swing and distances of 8 and 20 inches, respectively, between centers. The lathe has practically all of the qualifications of the best types of modern speed lathes. The spindle is hollow and the opening through the center is ½-inch. A full complement of chucks, arbors, saw tables, etc., can be obtained and for metal turning, a slide rest of simple but effective design is furnished.



Liquid Fuel Meter.



Motorcycle Sleigh.



Mechanical Auto Horn.

The lathe should find a ready field among manual training schools, shops, tool rooms, home workshops, etc.

Liquid Fuel Meter

The advent of the present-day gasoline engine, through its cheapness, simplicity and all around utility, has proven such a boon to the user of portable motive power that the mere question of its operating cost, from the standpoint of accurate measurements, has all but been overlooked. The average user of a car or motor boat knows roughly how many miles he can travel on a gallon of gasoline, but here the matter rests.

In the illustration is shown a meter designed especially for use in connection with gasoline and other engines using liquid fuel. The meter works on the principle of a water meter and in operation it is exceedingly simple. The mechanism is so designed that the meter will register correctly the consumption of fuel regardless of the rate of flow or any variation of pressure.

The illustration shows a meter of the automobile type; the case containing the mechanism is placed under the floor of the car while the dial plate is secured to the dashboard where it is clearly visible at all times.

The meter registers the consumption per trip, per day or per week, etc., accordingly as the driver desires. It also furnishes a ready means of comparison between the efficiencies of different engines working under similar conditions.

Motorcycle Sleigh

When there is a light fall of snow on the ground, a motorcycle may be operated over good roads without great difficulty, but when the flakes come down thick and fast and continue to do so for days at a time, the average motorcyclist feels that it is time to put his machine away for the winter. An ingenious resident of Galt in snowy Canada has apparently solved the problem, however, by adding runners to his machine as shown in the illustration.

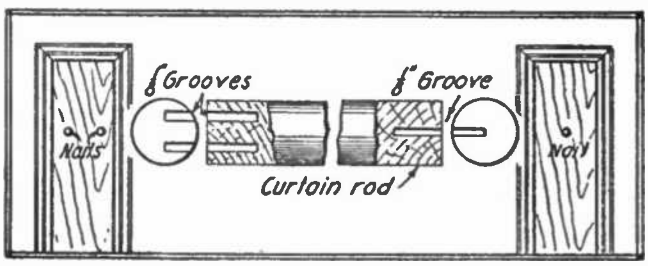
The rubber tires were taken off the front wheel of the machine and off the wheel of the side car, and runners bolted on the rims in place of the tires. The tire remains on the rear wheel of the machine for driving purposes, the runner on the front wheel making a rut in which the driving wheel can find a grip. It is claimed that the machine has traveled through a foot of snow without the slightest difficulty.

Mechanical Auto Horn

An auto horn, mechanically and not electrically operated but producing the sustained note of an electric horn, has recently made its appearance on the market. The novel feature of the horn is that it forms a part of the cooling fan on the engine. On the front of the fan is secured a diaphragm in a suitable casing, and the pressure of a button actuating a cable serves to bring the diaphragm into contact with a mechanism that sets up the vibration necessary to produce the sound.

Curtain Rod Support

A curtain rod supported in the manner shown in the illustration may be lifted off at a moment's notice when it is desired to take the curtains down. The rod is supported by three nails which fit into



grooves cut into the end grain, as shown. The rod is prepared by cutting it to a length that will make it a snug fit between the door jambs. The slots are then cut, two being placed in one end and one in the other end of the rod. Headless nails are driven in the door jamb on either side to take the slots and the support is finished.

Contributed by

AUGUST J. LOCKER.

Ground Glass Drawing Boards

A sketching board for use by the student or in the drafting room in laying out sketches, details and illustrating on a large scale, is a much desired convenience. Similar in use to the old-fashioned slate, the ground glass drawing board, painted black on one side, serves this purpose admirably.

In making the sketching board, a fine. evenly ground surface should be used to work on and the reverse side of the glass should be given two or three coats of smooth, black paint. The edges of the glass board should be squared to permit the use of the T square and triangles. Small slate pencils are the best for sketching and should be kept sharp by means of the ordinary sandpaper pad. Erasing is easily accomplished by the use of a damp sponge or cloth, thus eliminating the dust and dirt incident to art gum or other erasers used dry.

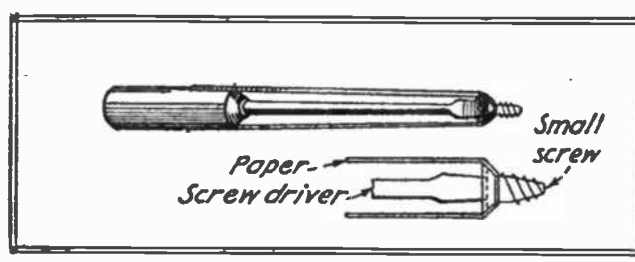
Boards up to two or three feet square need not be mounted, but for larger sizes they should be adequately supported in a flat position. The saving in paper for the student, for the school or for the drafting office is quite obvious.

Contributed by

FRANK H. JONES.

To Start a Small Screw

To start a small screw in an inaccessible place, cut a narrow strip of paper, pass the screw through the center of it and hold the screw against the blade of the driver by bringing the ends of the paper around, as shown in the illustra-



tion. After the screw is started, tear the paper away.

Contributed by

J. K. P., JR.

Cement for Handle-Bar Grips

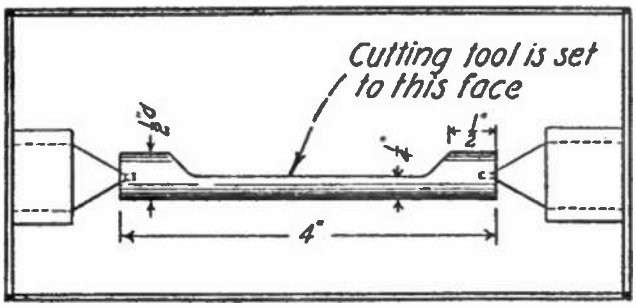
The writer has found that pure tar makes an excellent cement for fastening the grips on the handle bars of a bicycle.

Contributed by

F. GREY DALY.

Tool Centering Device

The little device shown in the illustration will enable one to quickly set the lathe tool on the dead center. The device is merely a piece of ½ inch diameter steel rod about four inches long, centered at



either end and milled down to exactly half its diameter as shown in the drawing. The rod is placed between lathe centers and the tool set to the height of the milled portion.

Contributed by

JAS. MCINTYRE.

Wire Straightener

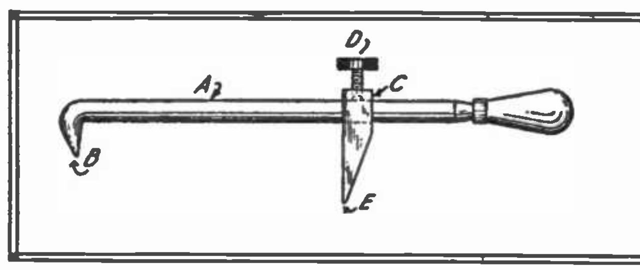
In the illustration may be seen a device for straightening wire that has been wound in a coil. The implement was made from an old turnbuckle casting having a boss on either end. In the sides of the boss, holes were drilled and tapped for the screws, *D*, which were fitted with check nuts, *C*. In the end of each screw was drilled a ⅛ inch hole, as shown in the sketch below at *E*. The turnbuckle was chucked in the lathe and the wire to be straightened passed through the spindle, on through the holes in the screws and held taut with a clamp at *A*. The screws were then drawn up tight against the wire and locked with the check nuts. The lathe was speeded up and the wire drawn out as straight as an arrow.

Contributed by

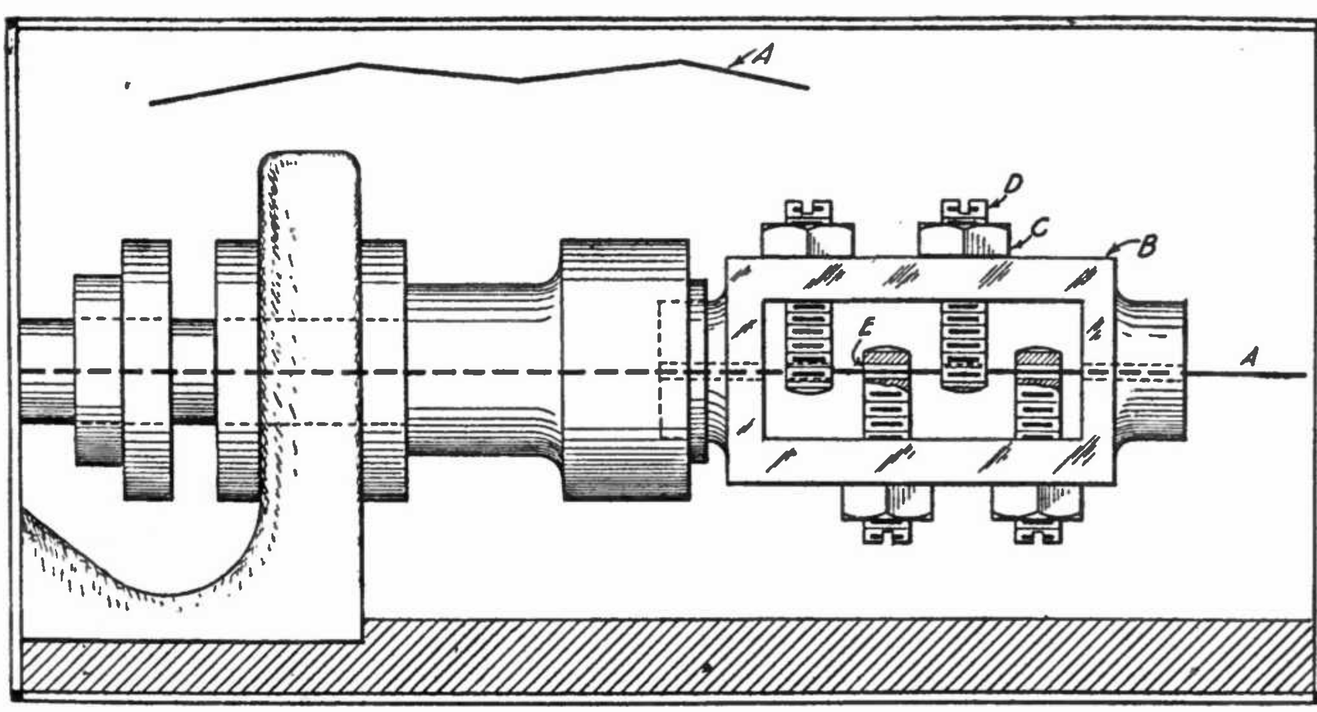
JAS. MCINTYRE.

Substantial Can Opener

A can opener capable of doing heavy service can be made in the average home workshop. The illustration shows the construction clearly. The rod *A* is of ¼ inch steel, four inches long and bent as shown at *B*. The end is sharpened to a point. The cutter *C* is of



steel ¼ inch thick, ⅜ inch wide and one inch long, sharpened to a cutting edge at *E*. A hole is drilled to pass the ¼ inch rod and in the top of the cutter another hole is drilled and tapped for the set screw *D*. A handle fitted to



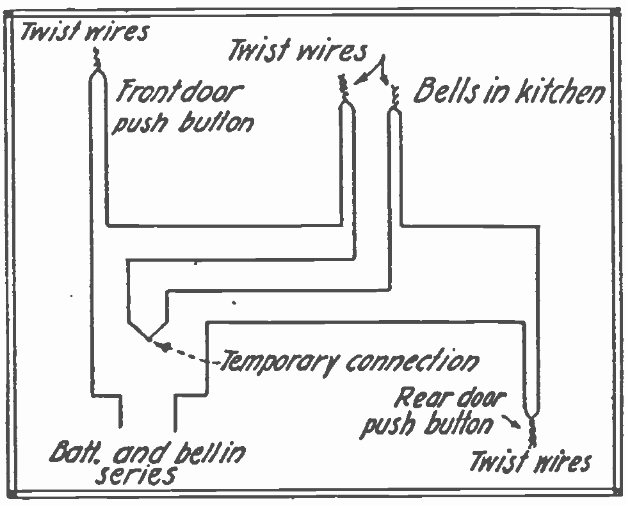
the end of the rod completes the can opener. In use, the pointed end of the rod is inserted through the top of the can, while the cutter, which has been set to the desired radius, is carried around with some pressure on the handle.

Contributed by

A. H. WAYCHOFF.

Test for Bell Circuit

In the accompanying diagram is shown a simple test for a bell circuit. At the point where the battery is to be located,



assuming that the installation is a new one, the battery and a bell are to be connected in series. Then, successively, at each point in the circuit where a push button is to be installed, the ends of the wires are to be twisted together. When the last connection is made, the bell should ring, but if it does not, it is an indication that there is a broken wire at some point in the line. In the event that the bell rings before the last connection is made, it signifies that a pair of wires is short-circuited, making it necessary to test out separately.

Contributed by

J. A. RODRIGUEZ.

A Durable Hickey

It often happens that the wireman on the job has nothing else but conduit pipe out of which to construct a pipe bender, or, to call it by its usual name, a hickey.

The thickness of the conduit wall is much less than that of standard piping and is not heavy enough for this purpose. It usually breaks right at the T where, because of the threading, it is the weakest.

If, however, a wooden plug is driven into the end of the conduit, before the T is screwed on, it will be re-enforced and capable of bearing a greater strain. Care must be taken not to force open the seam.

A hickey made in this manner is really to be preferred to one made of standard piping, because it is lighter and not so awkward to handle and less of a burden to carry from job to job.

Contributed by

JOSEPH GREOGRICH.

To Prevent Corks from Sticking

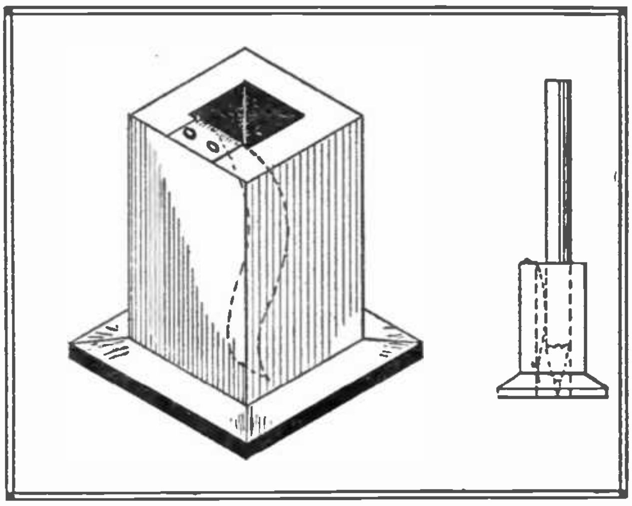
The cork in a glue or other bottle containing an adhesive may be prevented from sticking by dipping the cork in melted paraffin. The stopper is at the same time rendered more fully airtight.

Contributed by

B. W. VERNE.

Pencil Holder

A pencil holder for the workbench where pencils have a most annoying tendency to hide away, can be made from a spool with the end clipped off and a



piece of spring steel inserted as shown in the illustration. If the workman is more ambitious, he can make the holder out of a piece of square wooden stock, as shown in the larger drawing. The holder is to be nailed to the wall above the bench.

Contributed by

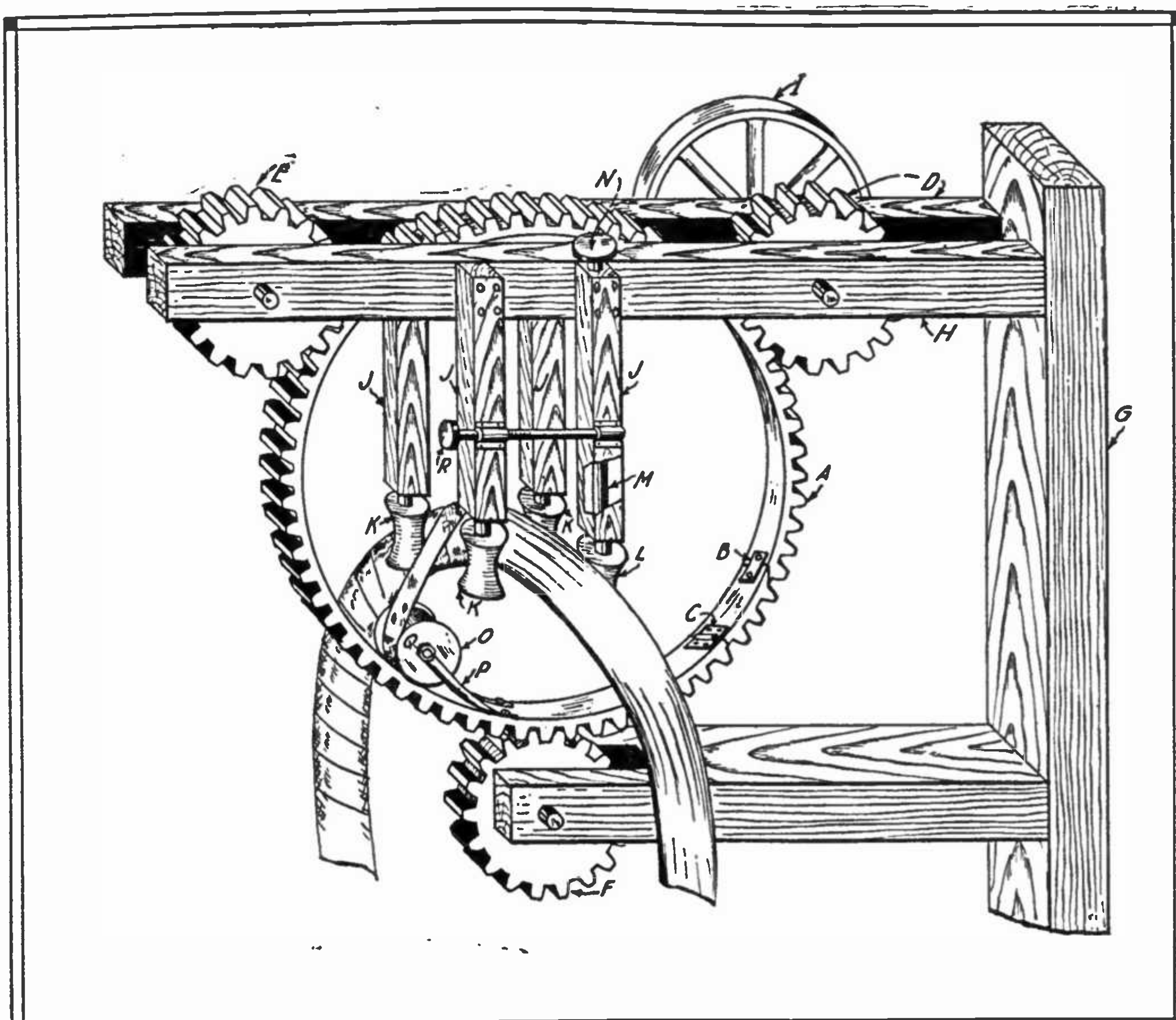
CLARENCE H. ANDERSON.

A WRAPPING MACHINE FOR AUTOMOBILE TIRES

By A. H. Waychoff

An easily constructed machine for wrapping automobile tires with cloth for retreading is shown in the accompanying illustration. An examination of the drawing will disclose the simplicity of the device which consists essentially of a large central gear, *A*, carried by three small gears, *D, E* and *F*, which are supported in a suitable framework of wood. On the inner rim of the large gear is fastened a spool carrying the cloth wrapper. The tire is supported between rollers, *K, K, K* and *L*, placed at the extremities of four wooden pieces, *J*. The roller, *L*, turns on a shaft, *M*, which passes through the wooden support, terminating in a friction pulley, *N*, resting against the edge of the large gear wheel. Obviously, when the pulley *I* is turned, the tire is fed between the rollers while the cloth wrapper is evenly and tightly wound as the gear completes its revolution.

The illustration shows the construction so clearly that but few words of explanation are necessary. It may be well to call attention to the fact that the tire is inserted through an opening made by cutting a segment from the large gear, hinging the segment as shown at *CB*. The wooden pieces, *JJ*, may be brought closer together to grip the tire



by tightening the screw, *R*. To facilitate this adjustment the piece on the left hand side should preferably be supported on a pivot rather than by four nails.

A word on dimensions may be of assistance, although the parts may be of scrap material which will, of course, vary in size with different builders. The large wheel, *A*, should be at least 18 inches in diameter and it is prepared for the present use by cutting off all the spokes close to the rim. The small wheels, *D, E* and *F,* should be about six inches in diameter and, of course, of the same pitch as the large wheel in order that the teeth may mesh. The piece *G* of the frame is of 4 by 6 inch oak about 4 feet long. The bearing supports, *H,* are of proportionate size and are secured to *G* by means of substantial lag screws. The four rollers, *K, K, K, L,* are three inches in diameter and six inches long.

A Bob-Sleigh Suggestion

Bob-sleighs usually bought or made have the rear bob fastened to the plank, as shown in Fig. 1. This construction is unsatisfactory, for when the sleigh is passing over uneven ground, especially when heavily loaded, it has no rocking action and consequently great strain is occasioned where the sleigh is fastened to the plank. Very often the bobs are broken at this point because it cannot give enough.

A much better way to connect the rear bob is to put large, strong screw-eyes into the upper and lower cross pieces, so that an iron rod can be passed through all the eyes, as shown in Fig. 3. This allows the rod to swing freely, as can be seen from Fig. 2, causing no strain. A ⅜ inch iron rod is strong enough, having holes drilled at the ends into which nails may be put to prevent the rod from slipping through the eyes, as indicated in Fig. 4.

Contributed by

E. C. SWETMAN.

Fig. 1

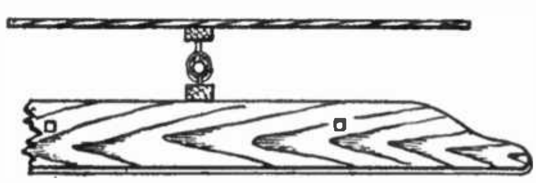


Fig. 2

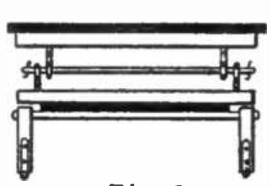


Fig. 3

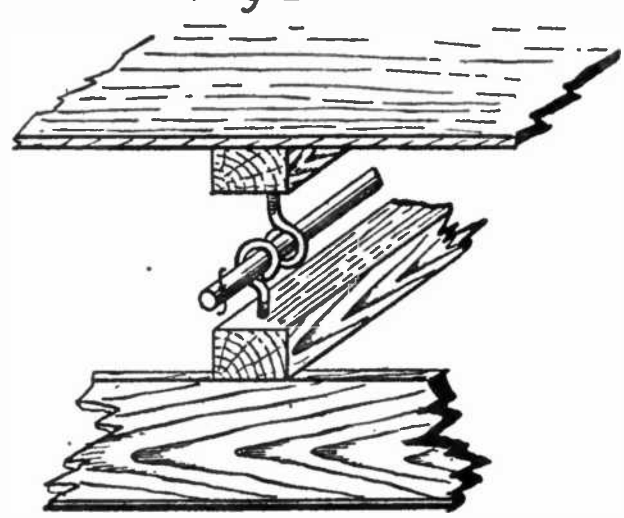


Fig. 4

Novel Air Pump

In exhausting vessels of air during the course of various experiments, it is customary to use either an air pump or an aspirator. The latter is composed of two tubes, one within the other. The outer tube is connected with the vessel to be exhausted, while through the inner tube a flow of water at comparatively high pressure is maintained. The vacuum caused by the rush of water past the tube draws the air from the vessel.

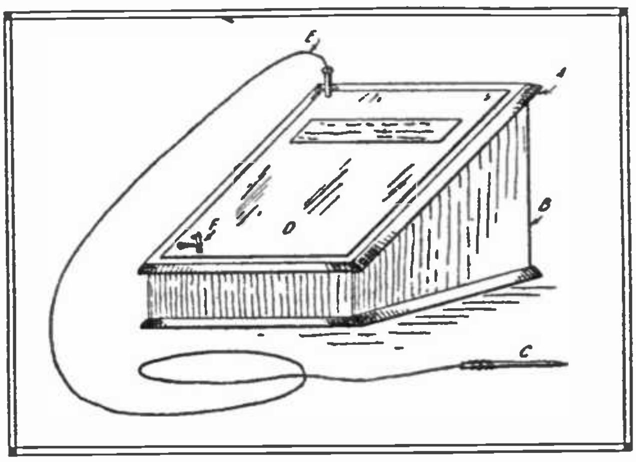
It is said that the tension of the water vapor prevents the formation of a very high vacuum with this pump. It occurred to the writer that a very high vacuum might be produced merely by using compressed air instead of water in the aspirator and this theory has been borne out by a trial.

Contributed by

JAMES ASHER.

An Electric Check Writer

A device for writing the amounts in checks, drafts and other documents wherein it is essential that the amount



shall not be changed is shown in the accompanying illustration. The device consists merely of an insulated electrode, a ground plate mounted on a sort of desk, a small spark coil and a suitable battery. The secondary of the spark coil is connected to the electrode and the ground plate. In use the check is placed upon the ground plate, the spark coil started in operation and the electrode used as a pen in writing the amount on the check. The figures appear in a series of charred perforations where the spark has passed through the paper.

The spark coil and battery are placed in the desk and a switch in one corner gives the operator the necessary means of control. The electrode is made by passing a piece of stiff wire through the center of a hard rubber rod about 3/8 inch in diameter. The connection between the electrode and the secondary of the spark coil is made with a piece of high tension automobile cable in order that the user of the device may be protected from shock. The ground plate need only be large enough to cover the space required for the writing on the check and in this manner the operator is afforded an additional protection as it is necessary to touch both the bare point of the electrode and the ground plate at the same time before a shock will be felt. If care is taken to keep the hands at least 1/2 inch from the ground plate at all times, there is no danger of shock.

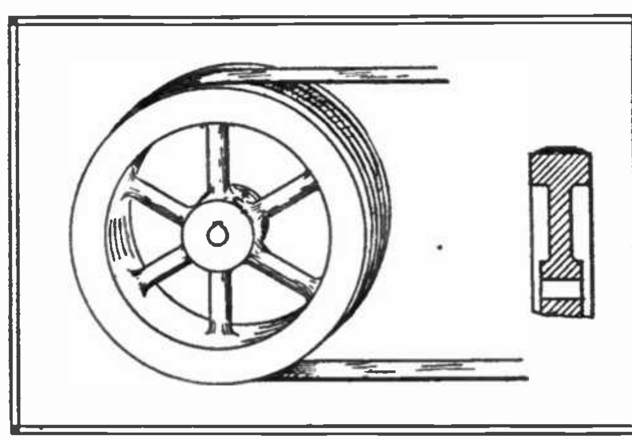
Contributed by

A. H. WAYCHOFF.

To Crown a Belt Pulley

Considerable difficulty was experienced by the writer when he attempted to belt a small dynamo to the fly wheel of the engine in a motor boat. The flat surface of the fly wheel caused the belt to fly off after two or three revolutions. After some experimenting the fly wheel was crowned in the following manner and thereafter no trouble was experienced:

Five thicknesses of ordinary electrician's tape were wound around the periphery of the fly wheel in a direction opposite to that in which the wheel turned, crowning the surface as shown in the illustration. The tape was then thor-

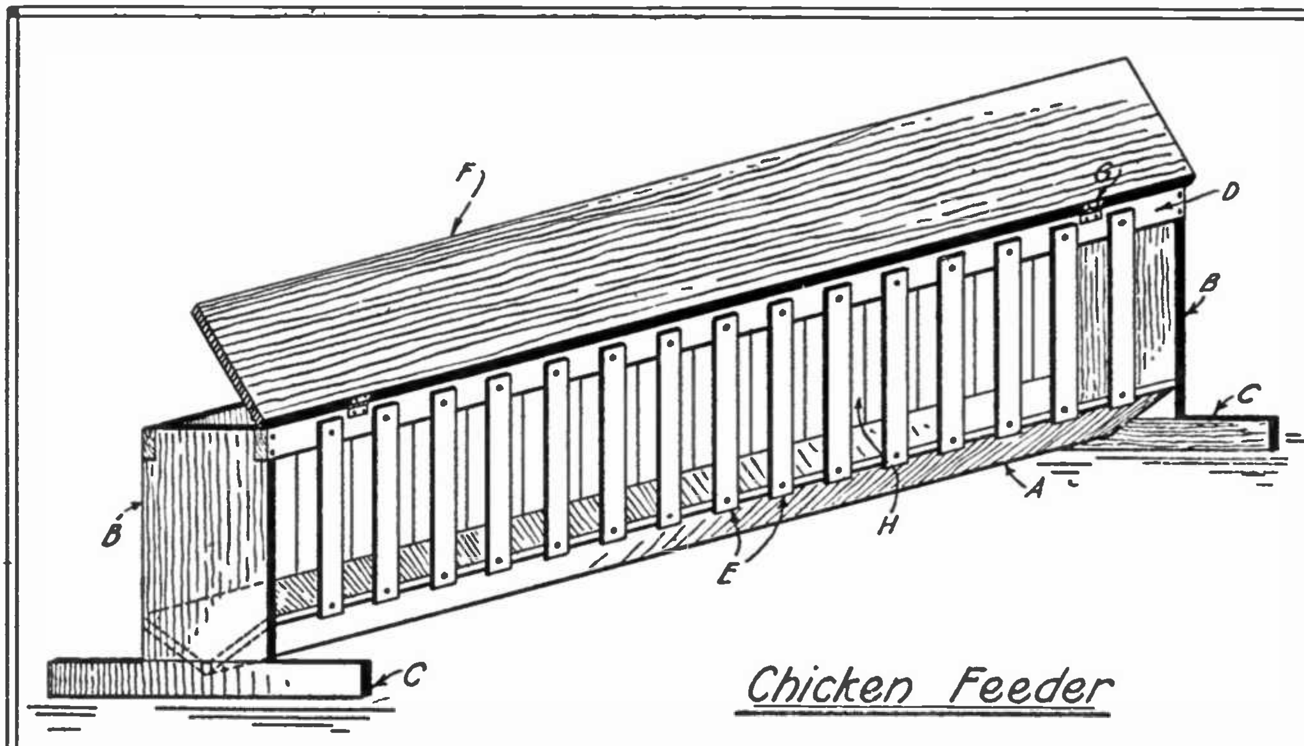


oughly shellacked and when the varnish had dried, the wheel was given a test which quickly proved the scheme to be practicable. At the end of the season the tape was found to be but slightly worn. During the entire run the belt did not once leave the fly wheel.

Contributed by

L. PHELPS.

¶ Have you an idea? Why not send it in to this department?



Chicken Feeder

A chicken feeder that will reduce the waste of feed to a minimum is shown in the illustration. The feeder is easily constructed from the following material:

(*A*) 1 piece wood 4" by 70"
(*A*) 1 piece wood 5" by 70"
(*B*) 2 pieces wood 8" by 15"
(*C*) 2 pieces wood 2" by 20"
(*D*) 2 pieces wood 2" by 72"
(*E*) 36 pieces lath ⅜" by 1½" by 12".
(*F*) 1 piece wood ⅞" by 9" by 72"
(*G*) 1 pair strap hinges 2" wide

The first step is to nail the two pieces *A A* together. The end boards, *B*, are then nailed to the trough, after which the feet, *C*, and the side rails, *D*, are placed in position. The addition of the slats, *E*, and the cover, *F*, completes the feeder.

The feed is placed in the trough and the chickens, although a bit strange at first, soon become accustomed to placing their heads between the slats to get the feed. The advantage of the feeder is that it keeps the grain off the ground where it is usually trampled and scratched into the earth, resulting in a large percentage of waste which is, of course, eliminated by the feeder.

Contributed by

P. P. Goerzen.

To Make Decalcomania Transfers

Designs may be prepared for the decalcomania transfer process by obtaining some gummed label paper from a printer and printing or lettering the design on the gummed side. The surface to which the design is to be transferred is coated with varnish and left to dry until "tacky" when touched by the finger. The transfer paper is then pressed down on the varnish and permitted to dry thoroughly, after which the back of the gummed paper is moistened with water, softening the gum and making it possible to pull the paper away, leaving the design firmly affixed to the varnish.

Contributed by A. H. Waychoff.

To Clean Mortar Off Board

A piece of wire netting, such as is used on screen doors, folded several times around a block and used as one would use sandpaper, will clean sand, mortar or other caked and gritty substances off the surface of a board that is to be planed or otherwise worked with an edge tool. The netting used in this fashion is far more efficacious than the coarsest sandpaper and it is less trying on the nerves than is a gritty piece of sandpaper rubbed over the mortar.

Contributed by Fred. W. Mueller.

A HIGH-POTENTIAL STORAGE BATTERY

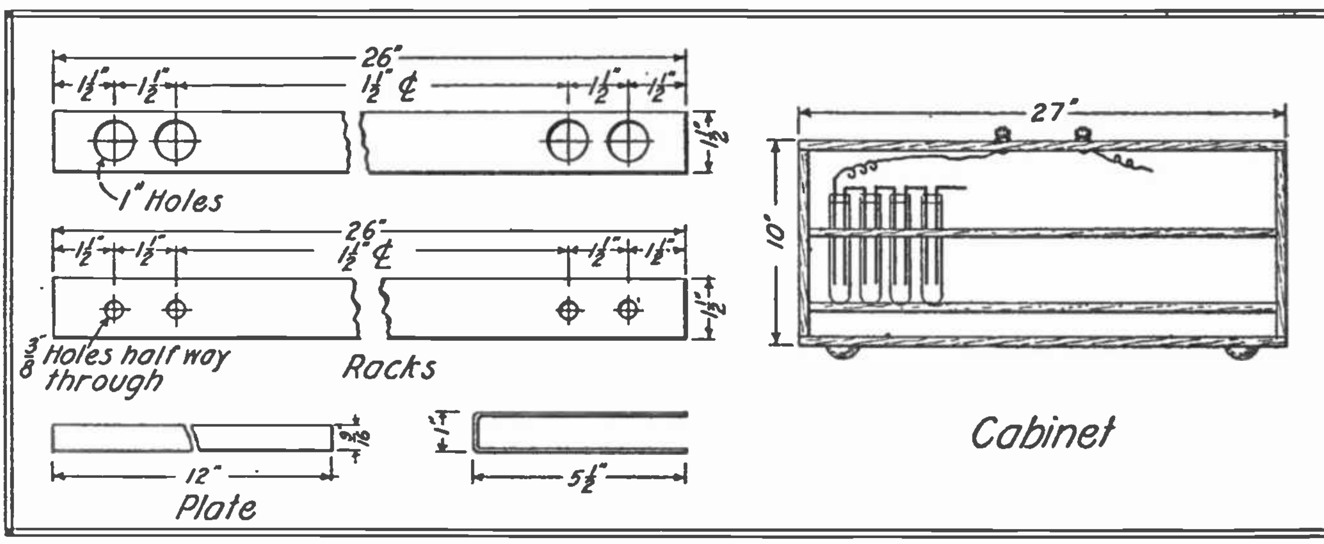
By Ray Francis Yates

Following is a description of a high-potential storage battery for laboratory use recently designed by the writer. This battery, when completed, presented rather a neat appearance and proved fairly efficient.

First, procure from a chemical supply house 48 test tubes measuring 1 inch across the mouth and 6 inches in length. From oak cut six pieces 26 by 1½ by ¼ inch. Three of the pieces are now marked and bored as shown in the sketch, each strip containing 16 holes. The remaining pieces are bored half way through with a ⅜ inch bit.

solution of sulphuric acid and water is used in the tubes, which may be filled within ½ inch from the top. The battery is charged in the ordinary way and should deliver a pressure of approximately 10 volts. The amperage is quite small after the initial charge, but increases as the battery becomes "seasoned" after repeated charging.

As a permanent fixture to the experimenter's laboratory, it can be arranged on a shelf and makes a very valuable addition. It can be made portable by arranging handles on the end and properly corking the tubes. A battery of this type



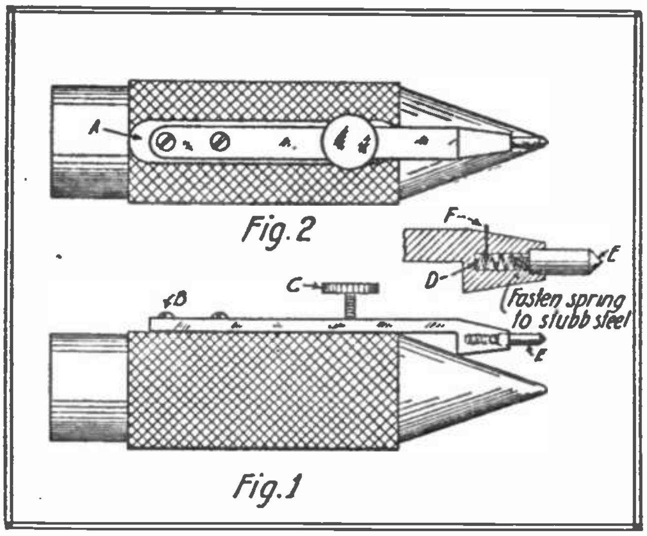
A containing cabinet is now constructed from ½ inch oak measuring overall 27 inches in length, 10 inches in height and 9½ inches in width. Brass screws should be used throughout the work to avoid the corrosive effect of the battery solution. The interior of the cabinet should be coated with lampblack or a similar acid resistant.

Cut from sheet lead 48 strips 9/16 by 12 inches and bend as shown in the drawing. The strips are placed in the tubes and the racks screwed into place. The outside of the cabinet is stained mission and two polished brass terminals mounted on the top with leads connected to them from one pole of the first and last tube. A fuse-block may be placed in the interior if desired. The usual battery can be constructed for any voltage desired by merely increasing or decreasing the number of tubes.

Spacing Center Punch

At times it is necessary to drill a number of holes a certain fixed distance apart and it is usual first to lay them out with a pair of dividers and then to mark the place for the drill with a prick punch. The spacing center punch shown in the illustration will save considerable time on a job of this kind, as it does both punching and laying out at one operation.

The simple addition of the spacing pointer to a punch of the ordinary variety makes the device. The punch hav-



ing been made or bought, is placed in the milling machine and a cut taken at *A*, Fig. 2. This forms a seat for the spacing arm *B*, which is filed up from a piece of Stubb steel. In the end of *B* is a hole to take the coiled spring which forms a cushion for the pointed plunger *E*. The spring is retained in the hole by means of the pin, *F*. The spacing arm, *B*, is to be hardened and then drawn to a spring temper after all the operations have been completed.

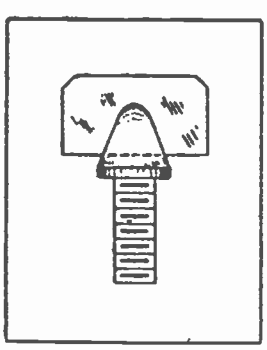
In use, the thumb screw *C* enables the operator to place the spacing point *E* at the required distance from the tip of the punch and when the latter is driven into the metal, the spacing point enters the hole against the pressure of the spring. After the first hole is spotted, the spacing point is placed in that hole ready for the next blow to be struck.

Contributed by

JAS. MCINTYRE.

Wing Set Screw

Wing set screws which may be used for a number of purposes such as replacing the lost set screw of a binding post, etc., may be made from the zinc terminal of a dry cell. The terminal is removed from the cell and a piece of brass, cut to the shape shown in the illustration, is inserted in the slot and soldered.

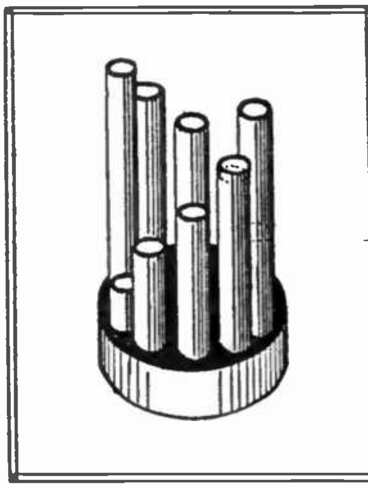


Contributed by

FRANCIS W. NUNENMACHER.

A Clarifier for Phonographs

This little device, if inserted in the horn of a phonograph, will make the sound much clearer, eliminating the disagreeable scratch to a large extent. To make the device, provide a disc of hard wood about two inches in diameter and ½ inch thick.



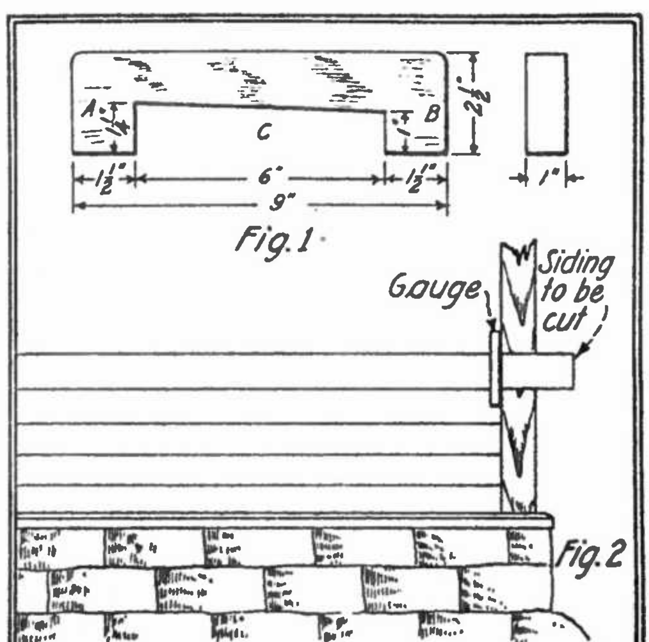
Place a rubber band around the disc and then drill a row of ⅜ inch holes around the edge as shown in the illustration. In each hole insert a piece of brass tubing, starting with a piece one inch long and making each succeeding piece ½ inch longer until five pieces are in place. Then start with another one inch piece in the opposite half of the disc and continue as before. When finished, the device is pushed down inside the horn, the rubber band on the edge of the disc holding it in place.

Contributed by

A. H. WAYCHOFF.

Marking Gauge for Siding

A marking gauge which insures an accurate fit in the corners when putting the



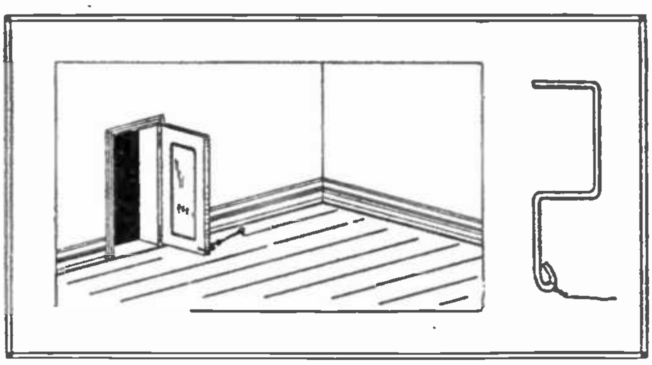
siding on a house, is readily made by the carpenter. A piece of wood is cut as shown in Fig. 1, which shows the utter simplicity of the device. In use, the parts marked *A* and *B* rest against the upright corner board of the house, allowing the piece of siding to be cut to pass through the open part *C*, as in Fig. 2. The piece is then marked with pencil or knife.

Contributed by

L. G. BURNAND.

To Hold Door Open

To hold open a swinging door, it is suggested that a wire be bent in the shape shown in the illustration, fastened to a cord, and the latter secured to the floor. When the wire is slipped over the edge of the door it will not deface the woodwork, and when the door is closed



the wire will be quite inconspicuous on the floor.

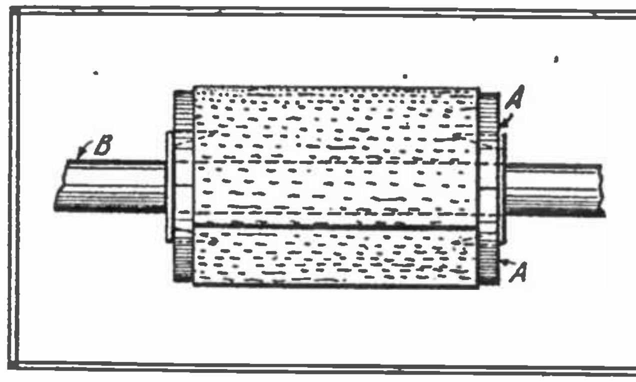
Contributed by

FRANK PHILIPPI.

Smoothing a Scored Cylinder

The scored cylinders of motorcycle engines can be made smooth by means of a properly constructed emery mandrel in the hands of a careful workman. The mandrel shown in the illustration is quickly and easily made, and in use it will be found quite satisfactory.

The mandrel is made by turning up a cylinder of wood somewhat smaller in diameter than the bore of the engine cylinder. The cylinder of wood is made in halves which are held together on the arbor by pinch dogs. Over each half of the cylinder is placed a sheet of fine emery cloth, the edges being glued down inside the joint between the halves of the cylinder. The mandrel is mounted in the lathe and revolved at high speed with the engine cylinder slipped over it and kept in motion constantly with the hands to prevent flat places from forming. The



mandrel should be kept liberally supplied with oil to prevent the emery from scratching.

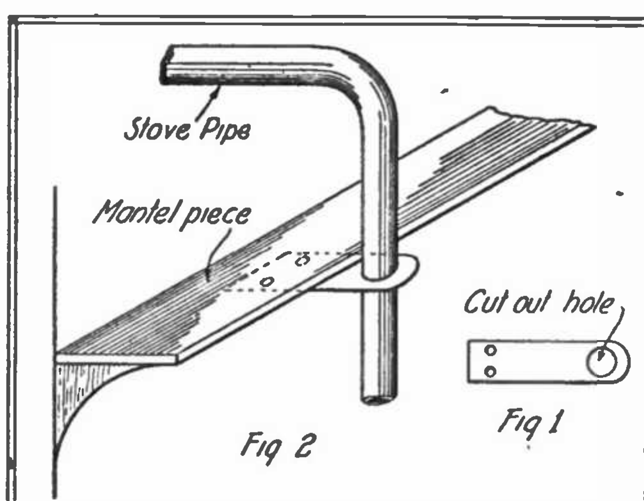
When the cylinder has been smoothed sufficiently, the oil and emery should be thoroughly cleaned out with gasoline before the cylinder is replaced on the engine. When the emery has worn off the cloth, it is only necessary to add a sprinkling of emery powder with oil as the cloth need not be renewed until it has become abraded.

Contributed by

CLARENCE H. ANDERSON.

Stove Pipe Holder

A suggestion for holding stove pipes is given herewith. The aim is to dispense with the usual wire and to put in



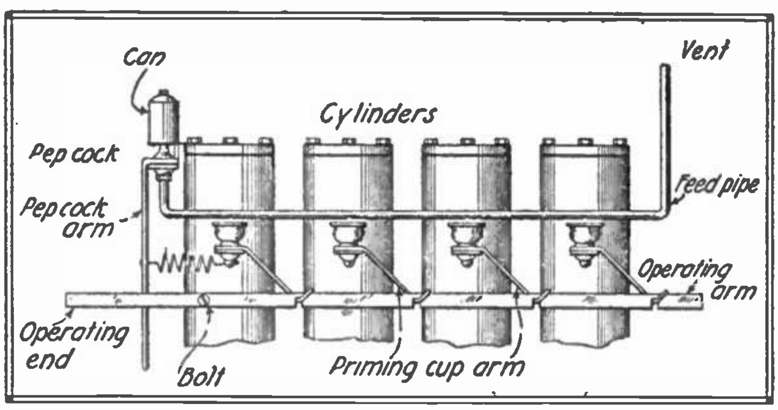
its place a holder that is neater and stronger. The holder is merely a piece of stove pipe iron cut to the shape indicated in Fig. 1 and having the holes as shown in the drawing. Fig. 2 shows the method of fastening the holder to a mantelpiece; obviously, by bending over the end containing the nail holes, the support may be fastened directly to the wall.

Contributed by

H. DROBE.

Automatically Priming a Marine Engine

A great deal of time may be saved in priming a marine engine of three or more cylinders by attaching the simple priming device here described and illustrated. To begin with, an arm made of brass rod is soldered to the handle of each priming cup, and is bent at right angles one inch from the end, An operating lever is made of a strip of brass one inch wide and long enough to extend about six inches beyond the end of the engine from which it is to be operated. Four notches are cut in this lever to a depth of ¾ inch and are made wide enough to easily slip over the ends of the arms. A piece of small copper tubing extending the length of the engine directly over the priming cups forms the feed pipe for the priming fluid. The end is bent at right angles and extends upwards to form a vent. A small can with a screw cap is fastened to the operating end of the engine with wire, and into the bottom of this is soldered a petcock into which is soldered one end of the copper tubing. A V-shaped notch is filed in the under side of the tubing directly above each cup. Another arm is bent as shown and soldered to the handle of the petcock. With all the priming cups open, the place where the petcock arm crosses the operating arm is marked. and a bolt is inserted in the lever at that place. The petcock arm is then connected with the priming cup on the first cylinder by a spring, and is kept in position by an extension of the arm which comes in contact with the bottom of the can, as shown. As the lever is pulled back, the cups are opened, thus relieving any compression left in the cylinders; when the lever is pulled back as far as it can go, the arms are reversed and the cups are closed. During this second step the bolt in the lever comes in contact with the petcock arm, thus opening the valve and causing the primer to flow into the feed pipe and into the cups. When the cups are full the lever is pushed forward, the spring causes the petcock arm to resume its normal position and the gasoline is cut off. The primer runs into the cylinders through the re-opened cups after which they are closed. Any one of the cups may be opened in the usual way as each arm will independently slip out of its notch, or all the cups may be opened with the lever without causing the gasoline to flow into the feed pipe.



Contributed by

H. H. RAYMOND.

Bending Brass Tubing

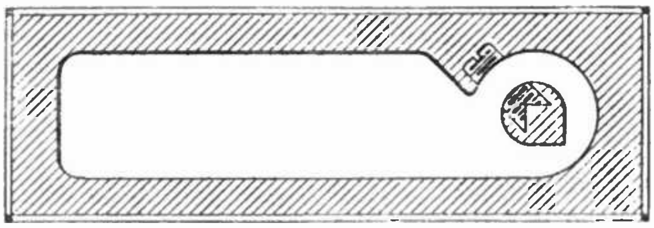
To bend brass or copper tubing without kinking or buckling the walls, fill the pipe with melted rosin and allow to cool before making the bend. When the latter operation has been completed, the rosin may be melted out by heating the tubing slightly over a Bunsen flame.

Contributed by

JACK POPPELE, JR.

Handy Tap Wrench

When tapping a hole in an inaccessible place such as close to a shoulder, it is sometimes out of the question to use an ordinary tap wrench. A wrench with a square hole in the end is the usual resort. In the illustration is shown an adjustable wrench of this type. It is made from a piece of flat, cold rolled steel, ½ inch thick, one inch wide and about four inches long, shaped as shown in the



sketch and tapped for a 3/8 inch headless setscrew. Owing to the notch cut in the end of the setscrew, it is obviously necessary to turn the latter to approximately the required distance before inserting the tap.

Contributed by

AL. MORRISON.

Hack Saw Lubricant

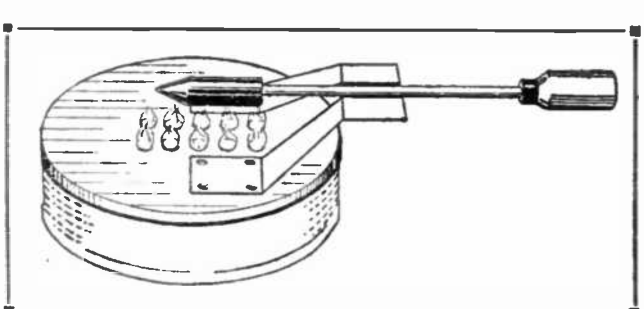
The writer has found that a lubricant composed of two parts tallow and one part graphite makes a hack saw cut faster and "sweeter." The lubricant is of great assistance in parting a stubborn piece of steel.

Contributed by

DANIEL W. SANDERSON.

Alcohol Lamp for Soldering Iron

A handy heater for small soldering irons may be made from an old shoe polish tin. The cover of the can is drilled or punched with a double row of holes and a support of heavy sheet metal is affixed as shown in the illustration. The can is filled with cotton waste and the latter saturated with alcohol. The cover is replaced and a lighted match held over the holes. The lamp will burn with a hot blue flame and a soldering iron placed on the holder will be heated quickly. If the heater is to be used in a drafty place—near an open window during hot weather, for instance—a hood may be bent up from tin and secured over the lamp.

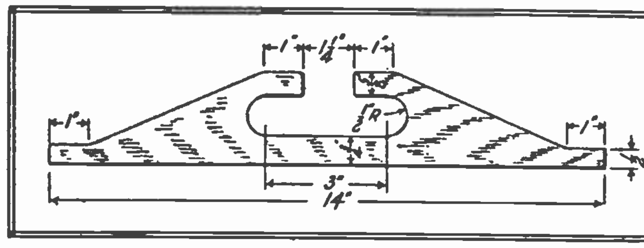


Contributed by

R. N.

A Broom Holder

A holder to keep the broom from sliding from the wall to the floor can be made with little effort. The device serves the additional purpose of offering an incentive to keep the broom in one place



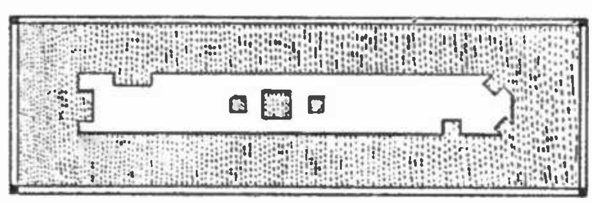
where it can be found when wanted. The illustration shows the construction clearly and no further explanation is necessary.

Contributed by

RUBEN ANDEREGG.

Handy Wrench for Lathe

In the illustration is shown a design for a very handy tool for use on a lathe. The wrench is made from a piece of 1/4 inch cold rolled steel, 1 1/4 inches wide and of proportionate length. The slots at the right hand end may be made to fit tool holders, the slots being cut at an



angle to facilitate reaching the tool. The space between is sharpened to a screwdriver wedge. The three openings in the center of the tool are for different sizes of taps and reamers, while the remaining slots are to fit the dogs used on the lathe.

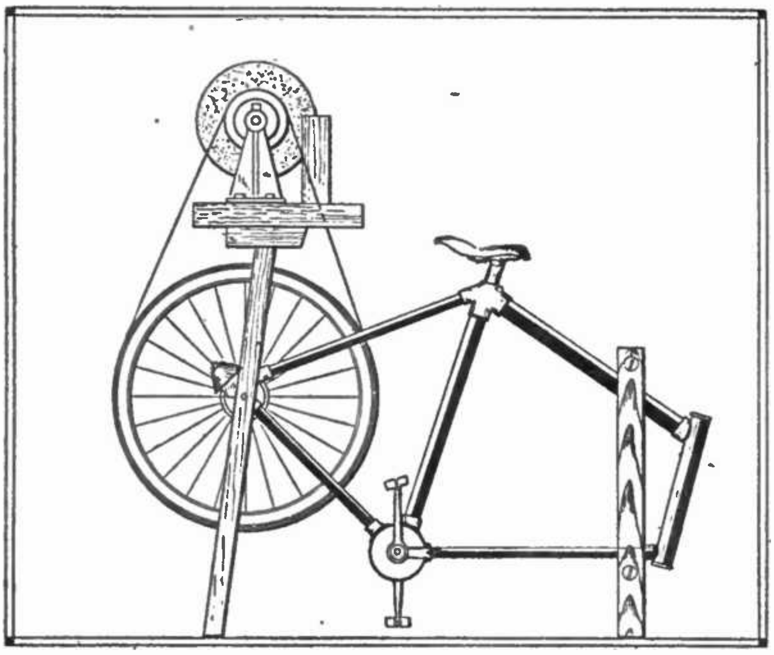
Contributed by

CLARENCE H. ANDERSON.

¶ Don't fail to read the announcement appearing on page 289.

Foot Power Emery Grinder

An emery grinder suitable for the amateur mechanic, the handy man or the small shop or farm where there is no other means of power, can be easily and cheaply built from an old bicycle.



To build the grinder a chainless bicycle without a coaster brake is preferable, although a chain bicycle could be used with a guard over the chain and sprockets. The front forks and handle bars and the rear tire are removed and the seat post turned backward. Wooden legs are carefully fitted and bolted to the frame. The tall (now front) legs are fitted with horizontal supports and the table screwed or nailed on.

The stand is a small polishing head, procurable at most city hardware stores, and the emery wheel is ¾ by 6 inches and rather coarser than those furnished with small hand grinders. In the machine built by the writer the flanges of the polishing head were only one inch in diameter and the hole in the emery wheel one inch, but a snugly fitting wooden bushing was turned up from an empty thread spool and the flanges were enlarged by putting a two-inch washer on each side of the emery wheel.

The belt is a heavy cotton line spliced together to fit taut.

A tool rest is built from ⅞ inch board and held in position by a small screw clamp.

The grinder is used almost daily by the writer for sharpening cold chisels, drills, plane irons, carpenter tools, kitchen knives, garden hoes and shovels, axes, etc., and is a big saving on files for rough filing.

The total money cost was $2.00 for the emery wheel and polishing head. The bicycle was one that was discarded and the few pieces of lumber, bolts, screws, nails and paint were picked up about the house.

Contributed by

J. HOECK.

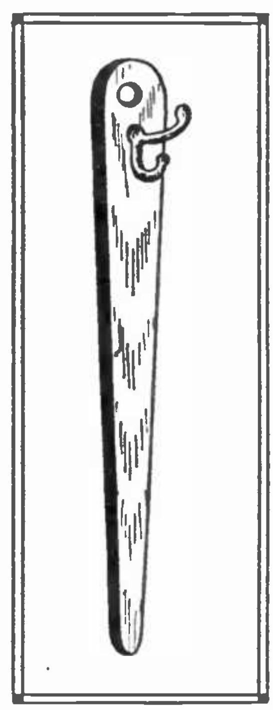
Sharpening Scissors

A pair of scissors may be sharpened by drawing the blades over the surface of a glass bottle just as though the bottle were being cut. If this operation is repeated several times, the scissors will be given a good cutting edge.

Contributed by H. DROBE.

A Coat Hanger for the Workshop

A coat hanger that will prove a boon to the workman in the shop, keeping the clothes well up and out of the way, can be made by tapering a piece of wooden strip about three feet long, boring a hole in the end and securing a coat hook near the hole. A nail is driven in the wall about 8 or 9 feet from the floor and above the workman's bench. On this nail the hanger can be placed without the necessity of climbing up on the bench.



Contributed by

L. G. BURNAND.

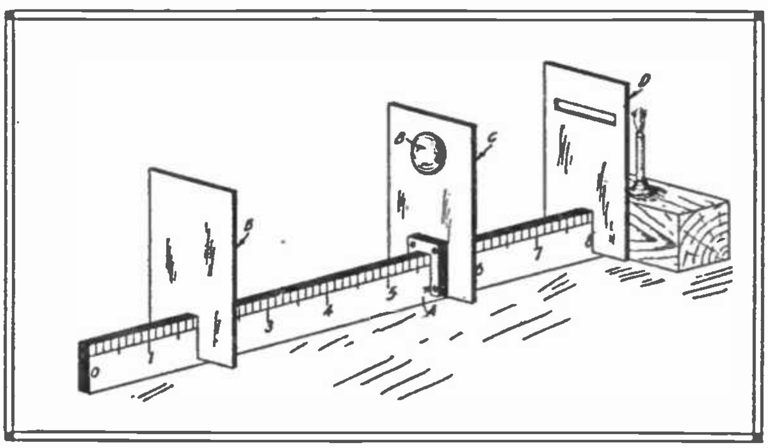
¶ One dollar will be paid for every idea accepted and published in this department.

FINDING THE FOCUS OF A LENS

By H. J. Gray

It is often a matter of importance to know the exact "focus" or "focal length" of a given lens. This applies particularly to those who use lenses in the construction of cameras, enlarging apparatus, or any other appliance for optical or photographic purposes.

Any lens that is thicker at the center than at the edge will throw an image of an object upon a screen, and will bring parallel rays of light together so as to meet in a single point of focus. Such lenses are termed convex lenses. They may be convex on both sides, or one side may be flat or even concave, but so long as the thickness is greatest in the middle they all behave in the same manner. The image or likeness of an object produced by a convex lens is called a "real image" because it can be thrown on a screen. Concave lenses, which have their thinnest part in the center, produce an image which is called a "virtual image" because it can only be seen as if apparently floating in the air and cannot be projected on a screen. The former type is by far the most common and it is with this form of lens that we have to deal in the present article.



In the illustration *A* represents a long, flat rule divided into inches and tenths of an inch. A white cardboard screen, *B,* is supported in a vertical position above this rule in any convenient manner, as well as a piece of perforated cardboard, *C,* with a lens fixed over the hole by means of wax or glue, or gripped by rubber bands, while a third sheet of cardboard, *D,* with a narrow slit cut in it at the same height as the lens, is placed at the end of the rule. This forms the object which is illuminated by a candle placed behind it. If *B* and *D* are fixed, and *C* is moved to and fro until a position is found in which a sharp image of the slit is thrown upon the screen, it will be possible to find the focal length of the lens by a very simple calculation.

Suppose the distance between the lens and the slit, or object, is 2 inches, and between the lens and the screen 5 inches. If we write u for the first distance, and v for the second, representing the focus by *f,* then we have

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

That is: $\frac{1}{2} + \frac{1}{5} = \frac{7}{10}$.

And if $\frac{1}{f} = \frac{7}{10}$, then $f = \frac{10}{7}$, or approximately 1.43 inches.

The calculation is more conveniently made, however, as follows:

Using the same letters to signify the above or any other distances found by experiment,

$$\frac{u \times v}{u + v} = f.$$

In the above example this will be:

$$\frac{2 \times 5}{2 + 5} = \text{approximately 1.43 inches.}$$

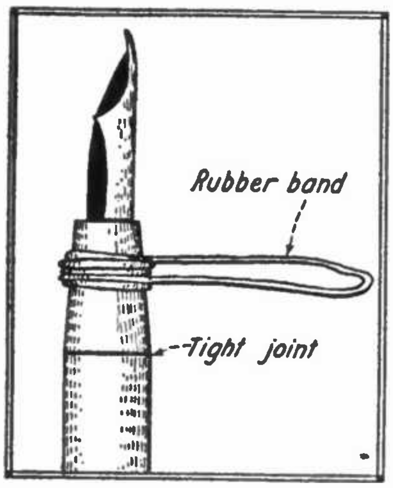
In practice, one decimal point will be found sufficient.

A yard stick may be used as the scale, fixed vertically along a plank which serves as a baseboard. The cardboard screens should be stiffened with thin wood at the back and can easily be made to slide along the scale by fixing them to small blocks of wood slotted underneath. A large hole should be made in the wooden holder that is to carry the lens. Separate cardboard screens that have holes of different sizes can be provided, and these are held in position by means of a rubber band at each end.

The slit which forms the object is best made in thin brass fixed over a larger aperture in the cardboard. Strictly speaking, distances between screen and object should be measured from the optical center of the lens, not from the surface of the glass. However, as the thickness of a lens is usually a very small fraction of its focal length, except in the case of very short focus lenses, the error due to neglecting this point is scarcely appreciable. For most purposes it is quite sufficient to know the focal length of a lens to within a tenth of an inch.

To Unscrew a Fountain Pen

To unscrew a fountain pen that has become firmly stuck together, wind a rubber band around the neck several times, keeping it tightly stretched while winding. The rubber will provide a grip that enables the user to unscrew the pen with but little difficulty.

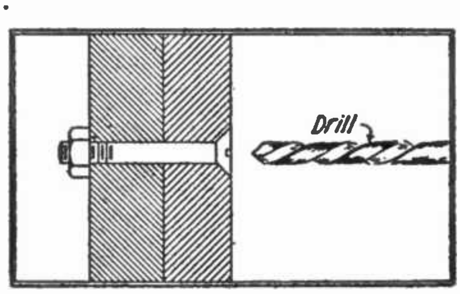


Contributed by

W. F. SCHAPHORST.

To Remove a Rusted Bolt

To remove a bolt that has rusted in place, a drill may be run through the head until the shank is reached, after which the bolt can be driven out. Obviously, the drill should be of the same size or a little larger in diameter than the shank of the screw.



Contributed by

M. L. MEYERS.

Cushion for Rubber Stamp

When using a rubber stamp, a piece of felt placed beneath the paper will greatly assist in making a uniform impression. If this cushion is used, it is not necessary to strike so heavy a blow with the stamp.

Contributed by

RUSSELL WALDO.

A Simple Chemical Glow Lamp

A phosphorescent glow lamp may be made by placing a piece of yellow phosphorus in a bottle and then pouring over the phosphorus a small quantity of olive oil heated to the boiling point. A cork placed in the bottle completes the lamp. To operate the lamp it is necessary to remove the cork letting in a small quantity of air. The phosphorus will glow brightly for some time, giving off sufficient light to enable one to find a keyhole or switch in the dark. The glow seems to fill the entire bottle.

Contributed by

R. N.

¶ Remember, the April issue of this magazine will appear under the new title THE WORLD'S ADVANCE. Read the announcement on page 289 of this number.

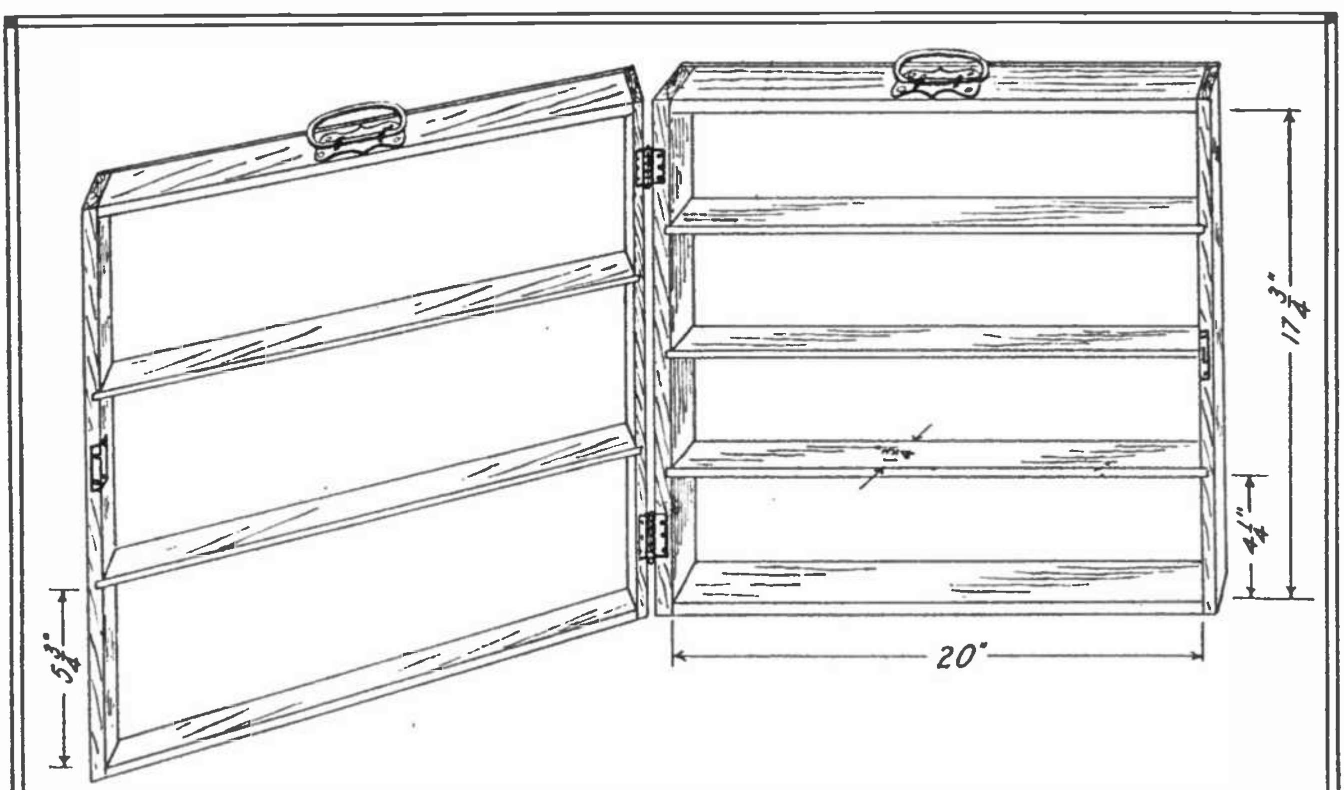
Student's Chemical Outfit

By · · E · Swetman ·

MANY students for whom chemistry has a special attraction are deprived of the pleasure of actually doing experiments because they have not access to a laboratory. The importance of experimenting while one is studying chemistry can hardly be over-estimated, for nothing can develop the powers of observation and reasoning more readily than the study of the reactions that take place before one's eyes. Experiments even of a simple nature are interesting and instructive, and serve as an aid to remembering otherwise vague reactions that would be soon forgotten.

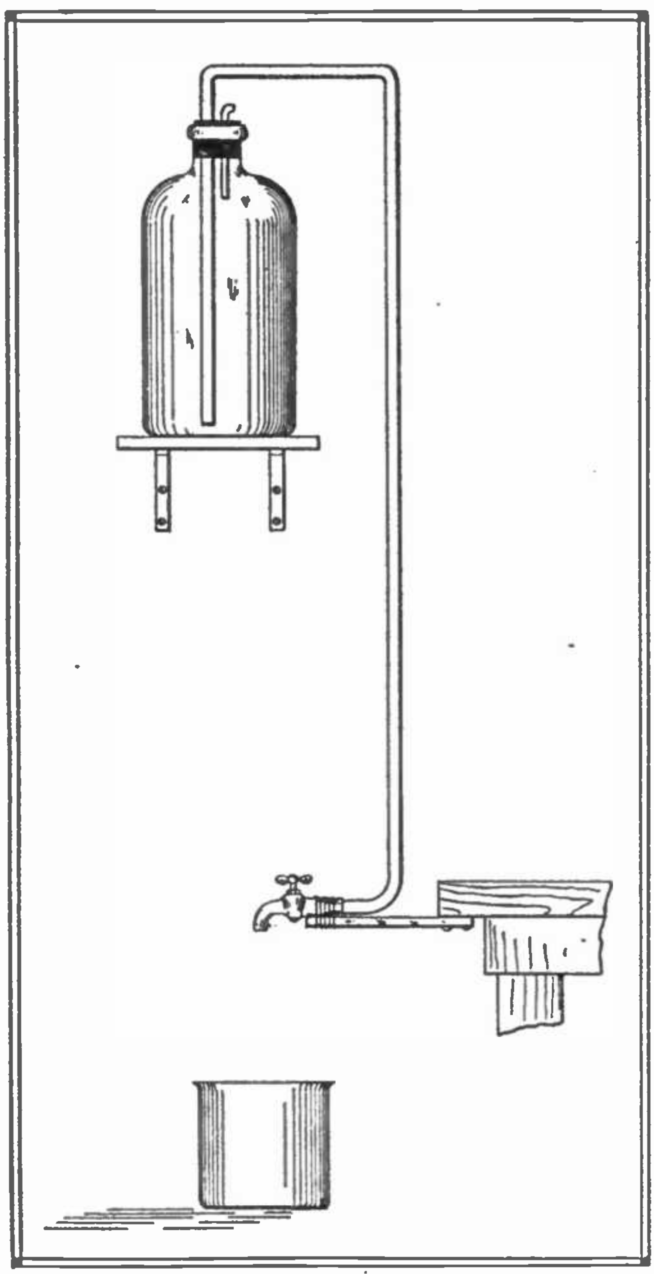
With very little expense the chemical outfit to be described can be set up, and it is amply serviceable to enable one to study all the reactions necessary for ordinary qualitative analysis. The writer had available one corner of a room, and it was accordingly necessary to set up a very compact outfit.

To begin with, a table at least three feet long is necessary. This is best covered with a sheet of moderately thick glass, for glass can always be kept clean and it is impervious to the action of chemicals used. On the table and against the wall stands the reagent case, which takes



Dimensioned Sketch of a Case for Holding the Bottles of Chemicals. Shelves Built in this Manner Facilitate the Transportation of the Outfit.

most suitably the form shown in the illustration. The frame of the case is made of half-inch material, while quarter-inch stock is used for the shelves and sides. It is provided, of course, with hinges, a lock and brass handles, and when closed presents a very neat appearance if properly finished. It has the desirable feature of being portable. The advantages of a case, such as is illustrated, over a set of open shelves on the wall, are that it can be closed and locked when not in use, thus keeping out dust and light, as well as possible meddlers. Furthermore, it is quite as portable as an ordinary suit-case. The dimensions given in the diagram were found most suitable, but can be altered for other needs. This case will hold all the chemicals required.



A "Waterworks" System to be Used by Experimenters who do not have Access to Running Water.

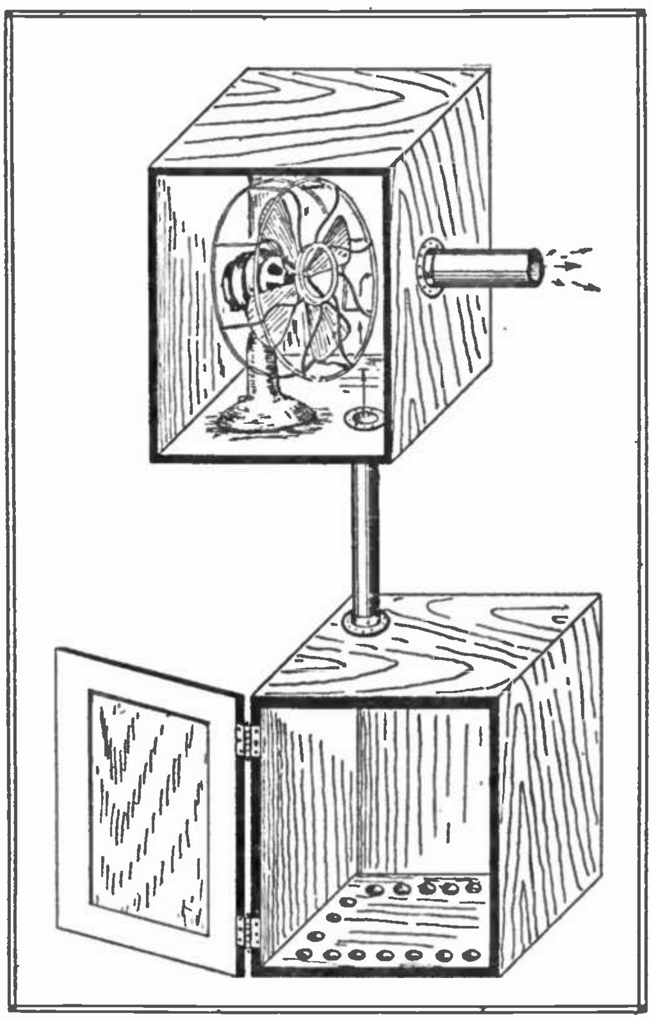
Reagents are usually bought as solids, and the solutions made therefrom as required. One side of the case is reserved for all the solid reagents; four dozen salt bottles of one or two ounce size being easily accommodated. A one-ounce bottle contains quite enough of a salt to make all the solution necessary for a course of experiments. For instance, a molar-tenth solution of cobalt chloride is all that is required, and an ounce of this salt in solid form will make considerably more than two litres of solution of this strength. The writer procured, however, three dozen one-ounce salt bottles and one dozen of two ounces capacity; the larger ones being used for the common salts, such as of copper, iron, ammonium, etc., which may be used a great deal. Square salt bottles with aluminum tops are perhaps the best, for when these are returned to the shelves after use the labels are more easily kept uniformly in front than in the case of round bottles, which is quite obvious.

The other half of the case accommodates the solutions, which are kept in glass stoppered bottles of four- and two-ounce capacity. The four-ounce bottles are used for the acids, two for each acid, to contain them both in dilute and in concentrated form. Similar bottles are supplied for the hydroxides of sodium and ammonium, ammonium sulphide, ether-alcohol, bromine water, milk of barium carbonate,—that is, the reagents most frequently used. Of course, these can be refilled easily at a nearby drug store at little cost. Smaller glass-stoppered bottles can fill up the remaining space, these containing solutions of the salts of metals being studied at the time, in order to save preparing fresh solutions constantly. Indeed, there is room in the case described for some of the metals of each group.

On the bottles should be placed paper labels of the proper size, the names of the compounds or their formulæ being written on the label in black, indelible ink. Care must be taken when pouring the acids and solutions to have the labels always on the upper side so that the drip will not run down over the label and efface the name thereon. The writer has found that, with care, paper labels are quite satisfactory and lasting.

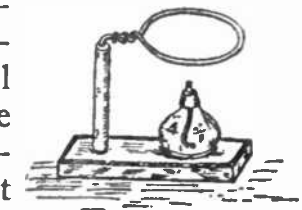
A list of reagents can be secured from any textbook on analysis, and four dozen can be selected that will fill all requirements.

The apparatus next engages attention A liberal supply of water must be at hand and when no water pipes are con-



A Fume Hood fitted with Piping and Fan Blower for Carrying away Gases.

venient, as was the case with the writer, a small "waterworks" system has to be set up. A large bottle, of from one to five gallons capacity, is supported on a shelf two or three feet above the table, and by means of some half-inch tubing the water is siphoned down to a tap secured to the end of the table. The stream of water issuing from the tap has a considerable and sufficient force for all needs. A crock is placed beneath the tap to hold waste water and solutions. A bottle of distilled water is also necessary for preparing solutions of reagents.

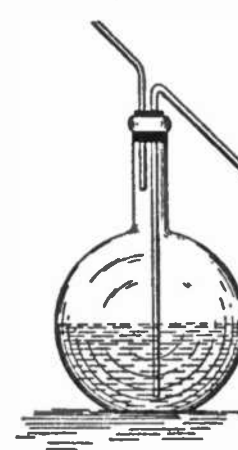


Alcohol Lamp and Stand.

If the student intends studying qualitative analysis, a small hydrogen sulphide generator is necessary, a very efficient one being described by the writer in the February issue of MODERN MECHANICS. It is suitable also for generating hydrogen or carbon dioxide.

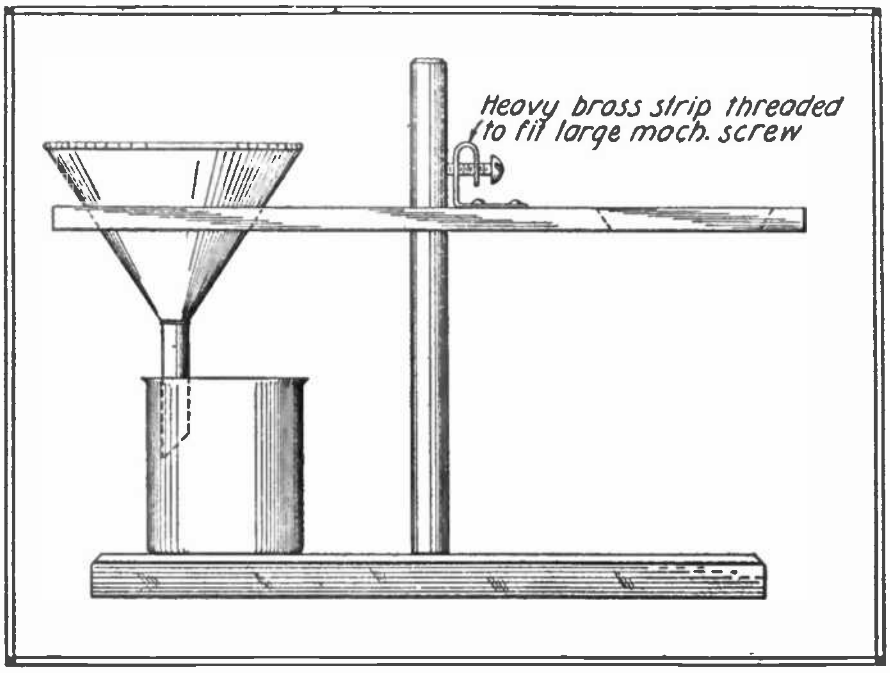
For heating and boiling solutions, if gas is not available, an alcohol lamp may be used with good results. A stand for supporting beakers over the flame is easily constructed, as shown in the illustration; heavy copper wire of about No. 10 size being used to support the wire gauze that is placed at all times between beakers and the flame, in order to distribute the heat and prevent cracking the glass.

A fume-hood is necessary to carry off vapors, fumes, and poisonous gases from boiling solutions and heated solids. One which well serves the purpose may be made of a large, tin, cracker box. The lid is made into a door by securing it to the box with small hinges. A glass window is fitted into the door for the purpose of watching the progress of operations inside. The bottom is perforated, and tin piping of about two-inch diameter leads from the top of the box to the window of the room and thence to the open air. The writer found it necessary to create a slight, forced draught, so that fumes would go through the pipe and not back out into the room. This was accomplished by enclosing a small battery fan motor in a box, just at the end of the pipe, as shown in the illustration. The sketch furnishes a clear idea of the entire fume-hood.



A Simple Wash Bottle.

A couple of test-tube racks, each with a capacity for a half-dozen six-inch test-



A Filter Stand that may be Readily Constructed with Materials Usually Found about the House.

tubes, are soon made. For washing precipitates, a liquid dispenser, known as a "wash-bottle," is necessary, and may be made with a small florence flask, a double-hole rubber stopper and some glass tubing, as shown.

A filter stand remains to be constructed. The accompanying diagram gives the clearest idea as to how this may be done.

To complete the equipment, several beakers are required, as well as filter funnel, with filter paper to fit, a porcelain evaporating dish, a small crucible, a piece of platinum wire, a pair of tongs for removing hot beakers, a glass stirring rod, and some blue, red, and violet (neutral) litmus paper.

This completes the description of a chemical experiment outfit that has proved an invaluable aid to the writer in studying qualitative reactions and has made the hours of many a long evening very profitable and intensely interesting.

NOVEL WIND INSTRUMENT DEVICE

Added possibilities for orchestral composition are revealed in a new device just perfected by Bernard Samuels, a noted European musician. Competent judges in the world of harmony on this side of the water believe his "Aerophor" will greatly advance scoring for wind instruments, by tinting future compositions with new and strangely beautiful harmonies and will also prove a blessing to the musicians themselves by saving their health and nervous energy.

It provides a means of holding a tone indefinitely, while the performer is resting his lungs. This is accomplished by foot pressure on a dust-proof bellows. A small bellows, operated by one foot, supplies the air. Connected with this is a rubber tubing which terminates in a small metal reed fastened near the mouthpiece of the instrument. Both the reed and the regular mouthpiece are held in the mouth of the musician. By a sort of stop-cock, both are controlled.

THE SIZE OF AN ATOM

In a lecture delivered last spring, Sir Oliver Lodge gave a striking illustration of the incredible minuteness of the atom. The amount of gold in sea-water, although very small, seems considerable when stated in atoms, for a single drop of sea-water contains 50,000,000 atoms of gold. That stupendous figure, however, indicates merely one-fiftieth of a grain in a ton of sea-water, and it would take 100,000,000 atoms to be visible under a microscope of the highest power.

The next issue of this magazine will appear under the new title "The World's Advance." Don't forget the name.

A HANDSOME SEWING CABINET

Describing the Construction of This Attractive Piece of Furniture, With a Few Words Concerning Mahogany as a Cabinet Wood

By Ralph F. Windoes

Illustrations from drawings made by the author.

AMONG the so-called "luxuries" that the American woman of to-day is justly demanding is a convenient place in which she may keep her sewing and her sewing supplies. Nothing will litter up a home quite as rapidly as the numerous pieces, parts and patterns that are needed in the proper performance of this household duty. Therefore, let our home craftsman consider the feelings of his over-burdened wife, mother or sister and keep her numerous sewing necessities together by making a sewing cabinet.

In our series this month we are offering a cabinet that has a great many advantages over the more "freaky" styles such as are found in our furniture stores and gift shops. In the first place, all of her pieces and supplies are kept under cover, making them almost dust proof if the drawers fit properly. The top is flat and reasonably large, 16" x 24", making it possible to cut and fit without the necessity of a separate sewing table. The drawers all pull from one side, allowing her to sit in a chair close by the cabinet and reach whatever she desires. There is ample space for all necessities, the top drawer being partitioned off for spools, shears, etc., the second left clear for miscellaneous supplies, and the two large drawers at the bottom for patterns and cloth. Finally, the appearance of the cabinet is very attractive—it might easily pass for a small serving table if left in the dining room.

The sewing cabinet requires but little stock to build, hence it is rather inexpensive. The choice of wood is left to the craftsman, though we will recommend mahogany, if it can be obtained, as it will not cost much more than quarter-sawed white oak, and the difference in price is well worth the money.

A few words concerning mahogany as a cabinet wood may not be out of place at this point, as the craftsman should have some understanding concerning all materials with which he works if he is to use them intelligently.

The only true mahogany grown in America comes from the West Indies and Central America. In addition to these localities, West Africa furnishes the mahogany supply of the world.

It is interesting to note the first use of mahogany. According to tradition, it was utilized to repair some of the ships of Sir Walter Raleigh's fleet at Trinidad, in 1597. As a furniture wood it was introduced to the world a little later in England, by a Dr. Gibbons, who had a small box made of it and a bureau. The latter attracted the attention of the Duchess of Buckingham, who begged enough wood from the doctor to have it duplicated for herself. From that day until this it has been the chosen wood of royalty and the peer among cabinet woods.

The true mahogany is a very hard wood to work and is exceedingly scarce, hence less than half of the lumber sold to-day under that name is true mahogany. Among the substitutes can be found "Columbia mahogany"—and it is in no way related to true mahogany—and "crabwood" from Guiana, the latter being the principal substitute employed at the present time by furniture makers.

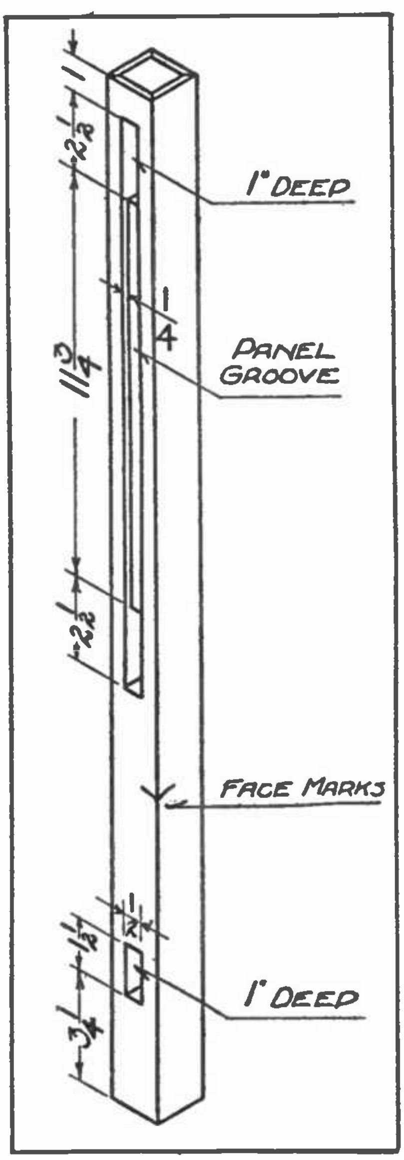


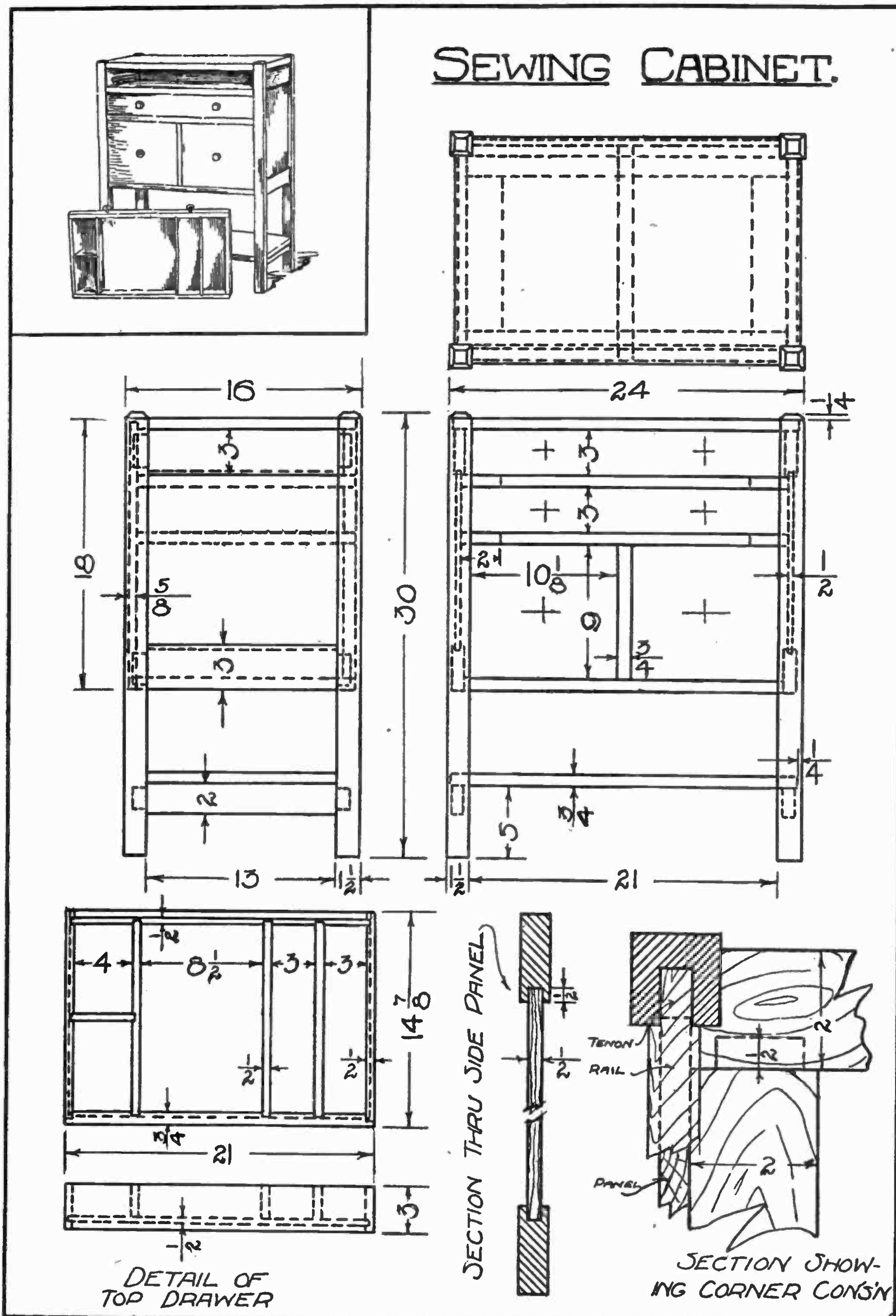
Fig. 1.—Detail of Inside Corner of Leg.

Though no true mahogany grows in the Philippines, a great deal of wood is being imported into this country and sold as mahogany. *Narra,* the best and most expensive, is used rather extensively in California. It is yellow, red, or nearly white in color, hard, readily worked, and rather coarse grained.

Red Lauan, also a Philippine mahogany, is red to reddish brown, light, rather soft, straight, coarse grained, and is sold rather extensively in this country as plain mahogany.

Of course, there are other substitutes for mahogany—a large number of them—and the craftsman must be guided more by his common sense than by the word of the dealer as to whether or not he is getting the genuine article. Obviously, if he is paying a low price he may expect a substitute, but if he is being "held up" he surely wants to receive what he is paying for. And remember, in judging mahogany, that there are two never failing tests that can be made—weight and hardness. If the wood is a rich, brownish red in color, heavy (from 45 to 65 lbs. per cubic foot) and very hard (can not be dented easily) it is probably mahogany. But if it is light (baywood, a common substitute, varies from 29 to 35 lbs. per cubic foot) and can easily be dented, it is not true mahogany, even though it is called by that name by a reliable dealer.

But let it be understood that we are not condemning all of these substitutes in the above discussion. We have seen some very beautiful pieces made from them and so colored that it was very difficult to distinguish them from the genuine article, and we will admit that it is very much easier to work up the substitute in a piece of furniture than would be the case with true mahogany; but what we do object to is the practice of selling and calling a piece "genuine mahogany" when it is a substitute, and this practice should be fought by the consumer to the last ditch. We have seen furniture—made from *prima vera,* often called "white mahogany," bought by the manufacturer for $180 per thousand—sell for "genuine Spanish mahogany" when the latter could not be obtained in the market at any price, and the customer would pay the exorbitant charge and walk away well satisfied with his bargain. He did not know that genuine mahogany had sold in the Liverpool auction rooms at $3.00 a board foot at this same time. Of course, at this price it was highly figured stuff and was cut up into very thin veneers. But the point



General Details of the Sewing Cabinet as Well as a View of this Piece of Furniture When Completed, with One of the Drawers Removed.

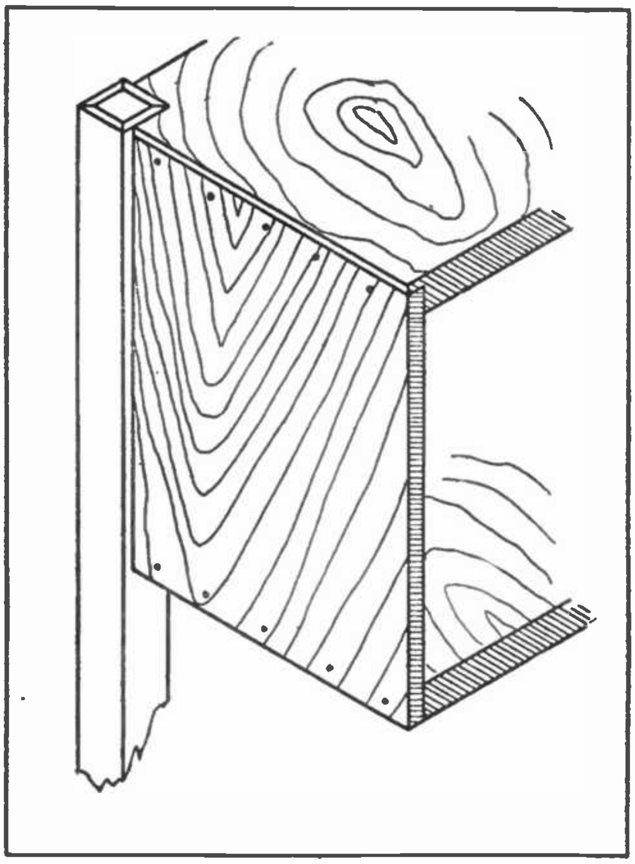


Fig. 2.—Section Through Back, Showing How it is Fastened to Top and Bottom of Cabinet.

is this—the substitute wood makes very good furniture when properly finished, never costs the dealer more than 17 or 18 cents a foot, and it should be sold in the stores at a proportionate price and under its own name. It is deception when practiced in any other way.

Let our craftsman purchase as he can —substitute or genuine—but let him see to it that he gets full value for money expended. He will need the following stock for the sewing cabinet:

Legs, 4 pcs. 1½"x1½"x30", mahogany.
Top and bottom, 2 pcs. ¾"x15½"x23¾", mahogany.
End rails, 4 pcs. ¾"x3"x15", mahogany.
Stretchers, 2 pcs. ¾"x2"x15", mahogany.
Lower shelf, 1 pc. ¾"x13"x23½", mahogany.
Drawer fronts, 2 pcs. ¾"x3"x21", mahogany.
Drawer fronts, 2 pcs. ¾"x10⅛"x9", mahogany.
Partition, 1 pc. ¾"x15½"x9", mahogany.
Fronts of frames, 2 pcs. ¾"x2"x22", mahogany.
Side panels, 2 pcs. ½"x13½"x12¼", mahogany.
Back, 1 pc. ⅝"x21½"x17¾", birch.
Backs of frames, 2 pcs. ¾"x2"x22", birch.
Sides of frames, 4 pcs. ¾"x2"x11⅞", birch.
Drawer sides, 4 pcs. ½"x3"x14⅝", birch.
Drawer backs, 2 pcs. ½"x2¼"x20½", birch.
Drawer bottoms, 2 pcs. ½"x14⅝"x20½", birch.
Drawer partitions, 3 pcs. ½"x2"x13⅝", birch.
Drawer partition, 1 pc. ½"x2"x4½", birch.
Larger drawer sides, 4 pcs. ½"x9"x14⅝", birch.
Large drawer backs, 2 pcs. ½"x8"x9⅝", birch.
Large drawer bottoms, 2 pcs. ½"x9⅝"x15⅝", birch.

The birch will stain up to a close imitation of mahogany and, if carefully applied, will finish so that it will be difficult to distinguish between the two woods. This stock should, of course, be cut to very exact dimension and should be sandpapered at the mill.

Begin the construction by cutting the mortises in the legs. A study of either the working drawing or the detail in Fig. 1 will give the necessary dimensions. Notice that the face marks, which indicate the "working faces," are on the inside corner of each leg. These will not be working faces unless they are at right angles to each other. Lay out each mortise before cutting any one of them, and place the legs in their relative position to each other to be very sure that they have been correctly layed out. Cut them very carefully and accurately according to the directions that have already been given in this series.* Notice the "panel groove" in the detail, which the side panels and the back fit into. Where the former will be placed, the groove is cut out ½" wide and ¼" deep on the inside faces of the legs between the mortises, and where the back will enter the legs, the grooves will be ⅝" wide and ¼" deep. The legs are chamfered on the top ends.

Next lay out and cut the tenons on the side rails, also rout out grooves for the top and bottom ends of the side panels, as shown in the "Section Through Side Panel" on the working drawing. The stretchers are the same length between shoulders as the side rails and should be cut accordingly.

Now assemble the sides and clamp them up dry to see that all parts fit snug. If they do, the builder may go ahead and glue them up, or he may wait until all cutting and fitting has been done. Mahogany will not shrink and swell very much, hence there will be no need to make any great allowance for this when fitting the panels.

* See January number of MODERN MECHANICS.

The next step is the building up of the two frames upon which the 3" drawers slide. On the working drawing may be seen a section showing the corner construction. The frames are made of 2" pieces, mahogany for the front strips and birch for the back and side strips. Notice in the detail given that the sides are tenoned into the front and back strips, and glued. Notice, also, that the sides rest against the panels and that the corner of each frame is cut out for each leg. This cutting must be very accurately done or a crack will be left where the front piece joins the legs.

Next, the bottom piece must be cut off and fitted between the lower side rails, as seen in the front elevation. In fitting this board and the frames, be sure that you have made allowances on the back side for the back piece. This will bring a 1/4" leg projection on the front and 7/8" leg projection on the back.

If the side sections are glued up, the builder may begin to assemble at this step. A glance at Fig. 3 will show how these pieces are put together. Beginning with the bottom board, turn the cabinet upside down and clamp this piece in its proper place. Of course, it will be necessary to place at least one of the frames in position in order to keep the legs parallel. Place one of the straight plates where it belongs and mark around it. Chisel down into the wood the depth of the plate and screw it in place. Repeat with three on each side and the bottom is secure.

Next fasten the lower shelf by screwing up into it from the under side of the stretchers, which should make the cabinet real rigid. At this step slide the back into position and fasten it at the bottom with nails or flat head screws, as shown in Fig. 2. Fit the top in place by cutting out around each leg, and rabbet it on the back edge for the back piece to fit into, as is also shown in the same sketch; but do not fasten the top at this point. Taking the lower frame, place it into position exactly 9" up from the bottom board and nail or screw into it through the back, holding it at the front edge with two angle irons, according to Fig. 3. Put the partition in place and hold it with flat head screws up through the bottom piece and down through the lower frame.

The upper frame is held in the same way as the lower, but it will be necessary to screw the angle irons into the frame before putting it into position. As its top edge will rest against the lower edge of the top rails, it will be an easy

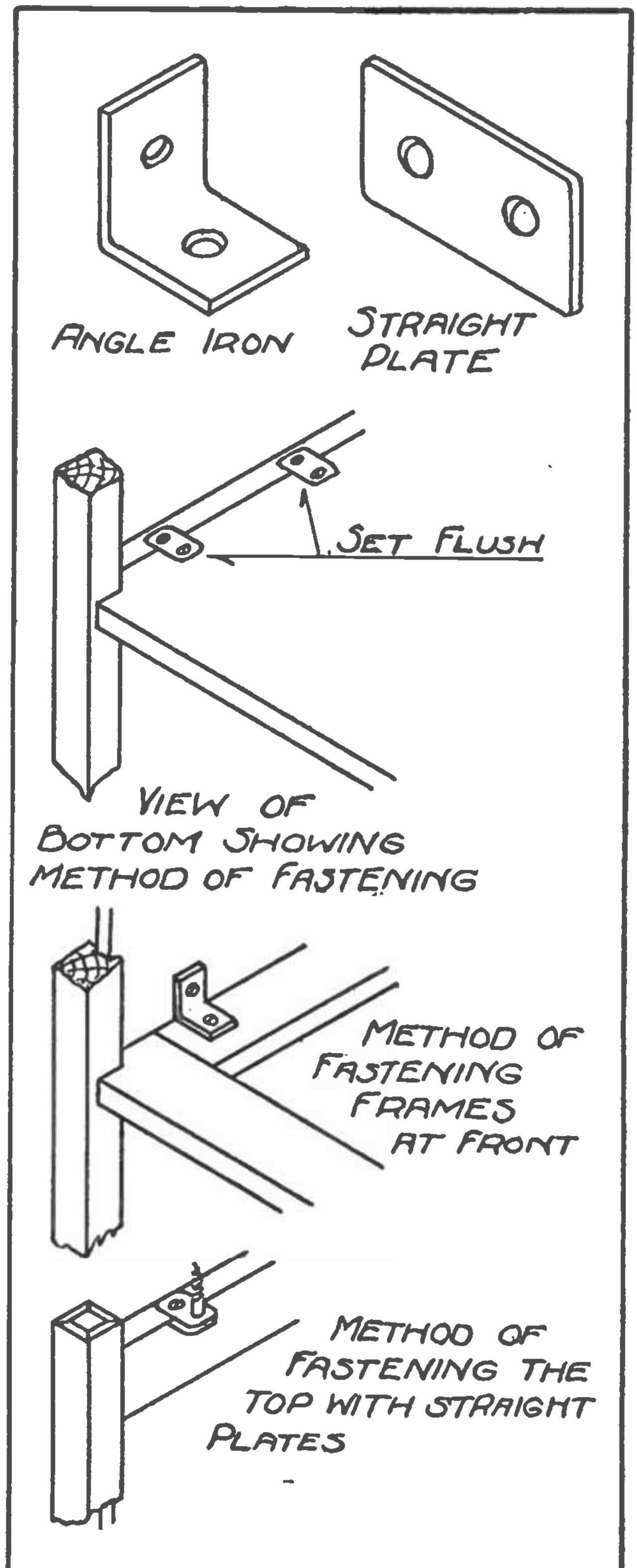


Fig. 3.—Methods of Fastening the Different Members.

matter to place it straight.

Finally, fasten the top. The nails or screws through the back will hold it on this edge, while two straight plates in each end will secure it. (See Fig. 3).

The drawers are constructed according to the detail given on the working drawing. The fronts are of mahogany and the linings of birch. The partitions are only placed in the top drawer. When fitting these into the cabinet, it will be necessary to fasten a little strip of wood along the inside faces of the rails and the side panels to build them up even with the legs and prevent the drawers from sliding in crooked.

If all of this work has been carefully done, the craftsman is ready to clean up the piece and apply the finish.

The wood must be in perfect condition, carefully sandpapered and dusted. It must also be entirely free from visible glue, oil, or grease of any kind. Obtain the dark mahogany oil stain and apply it according to the directions found upon the can as it comes from the manufacturer. Use a soft brush and be very careful not to show any brush laps. When perfectly dry, sandpaper very lightly with No. 00 sandpaper. The object in sandpapering is twofold: it smooths down the grain raised by the stain, and it throws up the high lights by removing a portion of the stain from the markings in the wood. If a second coat of stain is desired, it should be applied sparingly with a piece of cloth or waste. Next apply a *light coat* of *thin* shellac, and when this has set perfectly, sandpaper it down very carefully. The object in this shellacing is to protect the solid parts of the wood against discoloration by the filler. That is to say, the thin film of shellac does not fill the grain to any great extent, allowing full ingress of the filler where it is needed; and again it makes an impervious coating over the solid structure, preventing the wood from absorbing the filler where it is not wanted and permitting of readily removing the filler by a light sandpapering after the filler has become dry. It therefore enables a much cleaner job to be done than would be possible without the shellac coat, it overcomes the muddy or cloudy appearance that is sometimes seen, and also enhances the beauty of the finish by making more distinct contrast between the high lights and low lights. The foregoing accomplished, apply a coat of dark mahogany paste wood filler, thinned out to the consistency of thick cream. When this has lost its brightness, rub it into the grain of the wood with your fingers or a piece of leather, and wipe clean with waste or old cloth. This should fill the open grain up even with the surface of the surrounding wood, but if it does not, allow it to harden and apply another coat in the same manner. Sandpaper this a little when dry and shellac the entire piece. After a few hours, sandpaper this shellac and apply the first coat of varnish. The varnish must be the best grade of hard oil furniture varnish. Use a new fitch flowing brush, carefully brushing it over the hand to remove all dust there may be in it. Apply plenty of varnish so it may even drip off the work, then wipe off with the brush from which the extra varnish is removed on the edge of a dish. This will allow the coat to "flow" more evenly over the work. Set to dry in a dustless place, giving it all of the time the specifications call for on the can before "rubbing it down." This may be done with *very fine* worn-out sandpaper or fine steel wool. Be very careful of the edges and do not rub through the varnish in any spot. Apply a second coat of varnish in the same way as the first and, when this is perfectly set, rub it down with powdered pumice stone and water. To do this, dip a felt pad into the water and then into the pumice, lifting a sufficient amount of the latter to the work to secure a smooth, unpitted and even surface when carefully rubbed with the pad. *Be very careful of the edges* and do not rub through them. Wipe perfectly clean with a damp sponge and dry with chamois skin. This will give the dull "egg-shell" finish. If a polished surface is desired, rub this with rotten stone and oil, or rotten stone and furniture polish, to a gloss of the desired degree.

The addition of drawer pulls and casters finishes the piece.

DESIGN FOR A SMALL DYNAMO*

Description of the Construction of a 30-Watt Generator of Simple Yet Efficient Design.

By Chas. F. Fraasa, Jr.

Illustrations from drawings made by the author.

IN the February issue the main mechanical details of the construction of the 30-watt generator were covered at length. With the previously described work completed, the builder is ready to proceed with the remaining mechanical details as well as the electrical work.

For the shaft, procure a piece of ⅝-inch machine steel rod. Center the rod in the lathe and turn the ends down to 7/16-inch in diameter for a distance of 1⅞ inches. The central portion, 2¾ inches long, is turned to 9/16-inch in diameter and threaded on the ends *A* and *B*, Fig. 8, 12 threads per inch for a distance of ⅝-inch. Procure two blank hexagon nuts and tap them 9/16-inch 12 threads per inch.

The armature laminæ, Fig. 9, are made of No. 29 sheet steel. Cut enough 2½-inch discs to make a stack 1½ inches thick when tightly compressed. Cut two discs of ⅛-inch iron and clamp the sheet iron discs between them. Drill a 9/16-inch hole through the center of the stack and mount the discs on the shaft between the heavy discs. They should then be drawn tightly together in the center of the shaft by means of two hexagon nuts previously provided.

Mount the shaft in the lathe again and inscribe a 1⅞-inch circle on the ⅛-inch disc on the end of the core. This circle should then be divided into twelve equal parts, each of which locates a slot. The armature is then taken from the lathe and these points center punched and drilled clear through the core, using a 5/16-inch drill. Insert 5/16-inch bolts in these holes to prevent the tool from tearing the teeth and turn the core down to 2¼ inches in diameter. The ⅛-inch discs on the ends of the core may now be removed, since they were employed merely to facilitate the drilling and turning of the core. Replace the hexagon nuts, drawing the core tightly together in the center of the shaft, and turn the nuts off to a thickness of 3/16-inch. The slots are to be opened by a ⅛-inch cut made by placing two or three blades in a hacksaw frame, to secure the proper width of cut. The armature discs will then appear as in Fig. 9. The shaft is completed by turning it to the dimensions, Fig. 8, and threading the portion *C* for the commutator, 14 threads per inch, for a distance of ¼-inch from the end.

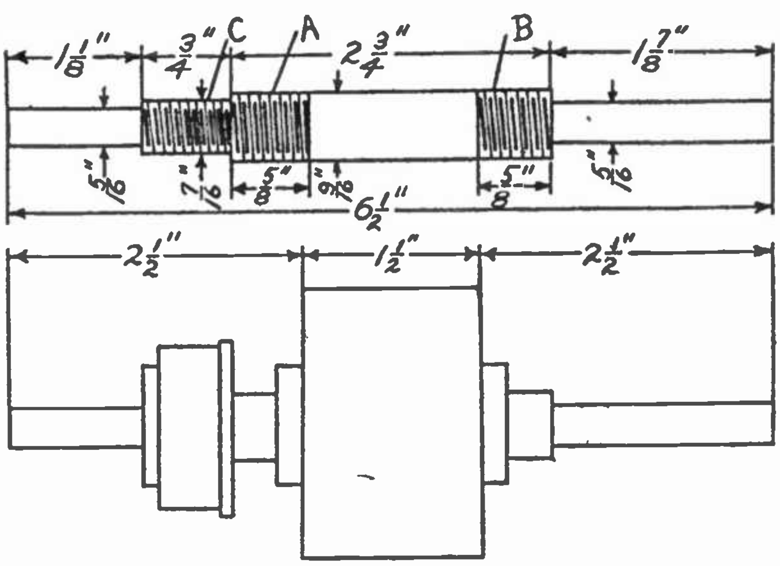


Fig. 8.—Steel Shaft for Armature.

The commutator, Fig. 10, consists of a number of copper bars *A* insulated from one-another and clamped together by the rings *B*. The bars are also insu-

* This is Part II of this article. The first part appeared in the February issue.

lated from the clamping rings. The insulation of the commutator consists of mica applied with shellac. The mica insulation is shown by the heavy lines *D* between the bars and over the rings. The nut *C* holds the clamping rings together.

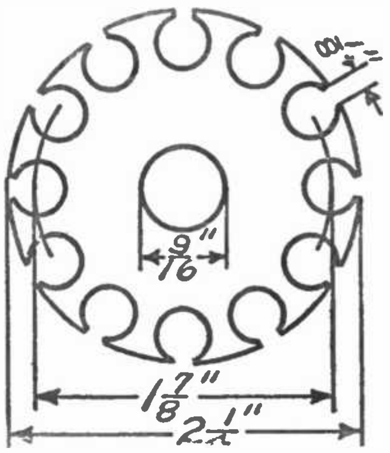


Fig. 9.—Armature Laminae of Sheet Steel.

The commutator bars are made from a copper casting or, better still, a copper forging turned to the dimensions indicated in Figs. 10 and 11. The casting is chucked and rough turned to within 1/16-inch of the finished dimensions. Then divide the circumference into 12 equal parts and with a screw slotting milling cutter, cut along these lines to within 1/16-inch of cutting through. This cut may be made with a hacksaw if no milling cutter is available, but the saw blade should be ground very thin. Then split some mica to the same thickness as the tool which made the cuts in the casting and shellac each piece liberally and place them in the slots. The commutator should then be baked and laid away to dry.

The rings, *B*, Fig. 10, are dimensioned in Fig. 11 at *A*. Two of these turned from iron or brass will be required. The nut *C*, Fig. 10, is dimensioned at *B*, Fig. 11. This is also made of iron or brass, only one being required. It should be bored out and threaded 7/16-inch 14 threads per inch.

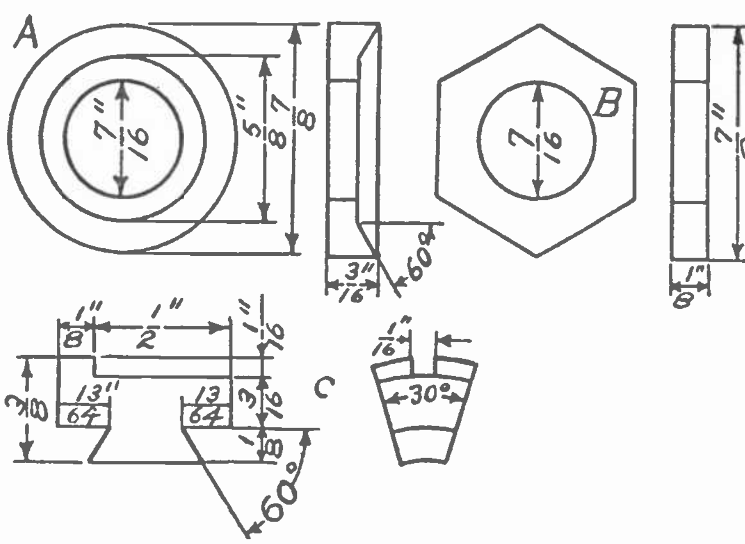


Fig. 11.—Parts of the Commutator.

Turn up a ring *A*, Fig. 12, having an internal diameter of 1⅜ inches, ⅜-inch wide, and 3/16-inch thick. Around the circumference of this ring, drill and tap twelve equally spaced holes for the ⅛-inch screws, *B*. The commutator, *C*, is then placed in this ring and the screws turned up tight against it, one screw in the middle of each segment. Chuck the commutator and bore the center out to ⅝-inch. This will cut away the copper remaining between the segments. The

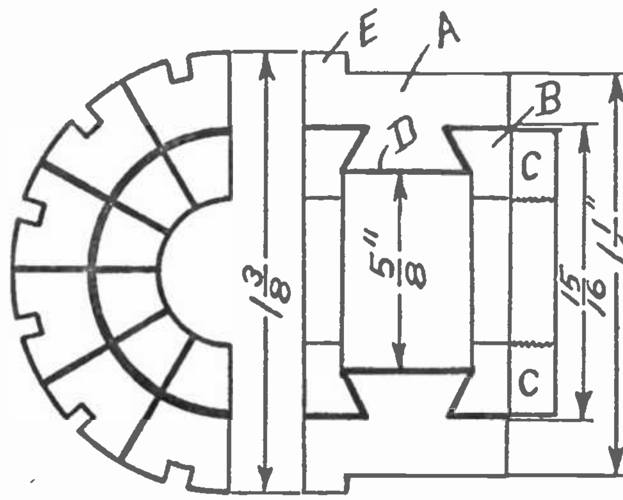


Fig. 10.—A Cross Section of the Commutator and One of its Segments.

commutator is then taken from the lathe and the flame of a blow pot directed on it to boil out the surplus shellac. The screws, *B*, Fig. 12, should then be turned up evenly around the commutator, drawing the segments together as the shellac boils out. When the shellac is boiled out, turn the commutator to the inside dimensions given in Figs. 10 and 11.

The rings, *B*, Fig. 10, should be insulated with mica before assembling the commutatcr. Split some thin mica and cover the rings with it where they come in contact with the commutator segments, using thin shellac liberally to stick it to the ring. Then slip one of the rings up against the shoulder on the shaft, wrap a 3/8-inch wide piece of mica around the shaft up against the ring, and put the commutator in place. Then put the second ring on and turn on the nut, tightening the commutator in place. Direct the flame of a blow pot on the commutator to boil the shellac out of the insulation on the rings. Tighten up the nut as the shellac boils out. Then remove the outside ring which holds the segments together and turn the commutator to the dimensions indicated in Figs. 10 and 11, leaving the ridge, *E*, Fig. 10. In the center of this ridge, on each segment, cut a 1/16-inch slot 1/16-inch deep for the connection leads from the armature.

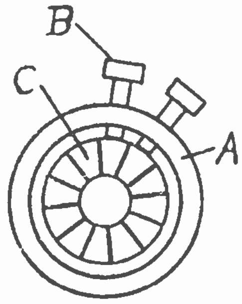


Fig. 12.—Ring for Holding Commutator.

The brush holder, Fig. 13, is finished by boring the central hole, *A*, out to 7/8-inch in diameter, and drilling the holes *B* 3/16-inch. The hole *C* is drilled and tapped for a 3/16-inch set screw. The brushes are made of three leaves of No. 24 copper or brass, *D*. The piece *E* by which the brush is mounted on the brush holder is cut from 1/16-inch sheet brass. The three leaves of the brush *D* and the piece *E* are sweated together on the end which is mounted in the holder. The leaves are free on the other end which should be shaped out to the curvature of the commutator. The brush is mounted on a 3/16-inch rod *F*, through the hole *B* in the brush holder, and clamped between the nuts *G* and *I*. The nut *I* binds the rod to the rocker arm. Where the rod passes through the rocker arm, wrap a piece of insulating material around it and place a washer of the same material under the nuts *G* and *I* to prevent grounding of the brush. When assembling the brushes be sure to test for grounds.

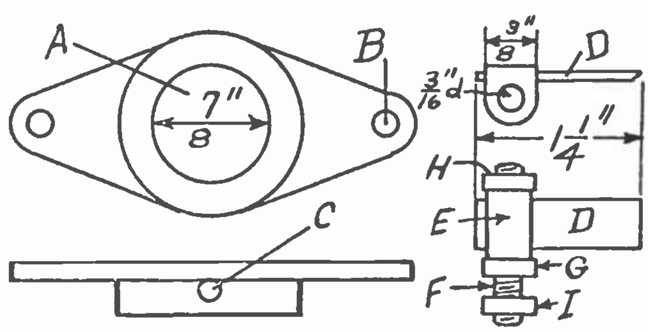


Fig. 13.—Details of Brush Holder.

Before winding the machine, it would be well to assemble the parts and see that everything runs true. Secure the field poles in place and adjust them so that the air gap is 1/32-inch all around the core on both ends. Then drill a 1/16-inch hole through the yoke ring into each pole and drive a piece of 1/16-inch steel wire into it to prevent its turning. When everything is adjusted, dismantle the machine and prepare for winding the armature and field magnet.

Wrap several layers of paper on the shaft on each side of the core, and shellac well. Cut out several discs of tough wrapping paper and stick them to the ends of the core with shellac. When this is dry, cut the paper away from over the slots and put a trough of tough wrapping paper in each slot, making it long enough to project on each end of the core for a distance of 1/8-inch, so that the wire will have no possible chance to come in contact with the core.

The armature is wound with No. 23 d. c. c. magnet wire and consists of 12 coils of 30 turns each, making 60 turns per slot, or a total of 720 conductors. The winding should be very carefully done in order to get the required number of turns in the slots. When the armature is wound, shellac well and then bake it.


Fig. 14.—Winding of the Armature.

Figs. 14 and 15 show how the armature is wound. Numbering the slots from 1 to 12 in consecutive order around the core, wind coil 1 in slots 1 and 7; leave out a loop between slots 1 and 2, and wind coil 2 in slots 2 and 8; coil 3 in slots 3 and 9; coil 4 in slots 4 and 10; coil 5 in slots 5 and 11; coil 6 in slots 6 and 12, leaving a loop between succeeding coils. The next six coils will occupy the top half of the slots already wound. Coil 7 will then be wound in the top of slots 1 and 7; coil 8 in top of slots 2 and 8; coil 9 in top of slots 3 and 9; coil 10 in top of slots 4 and 11; coil 11 in top of slots 5 and 11, and finally, coil 12 in top of slots 6 and 12.

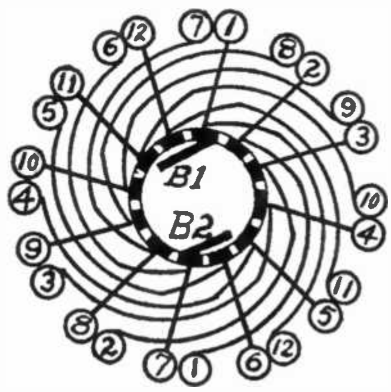


Fig. 15.—Scheme for Connecting Armature Windings to Commutator.

The connections to the commutator are made by connecting the loops between the coils to the adjacent commutator segments. The wire in the loop should have the insulation scraped off and then be driven in the slots in the end of the segment and soldered. If the coils have been properly wound, and connected, the paths through the armature should be as follows: Referring to Fig. 15, (1) B 1-12-12-11-11-10-10-9-9-8-8-7-7-B 2, and (2) B 1-1-2-2-3-3-4-4-5-5-6-6-B 2. This, together, with the winding diagram, will be useful in tracing out the winding and connections should there be any difficulty with the armature.

The shunt field winding consists of 843 turns of No. 25 s. c. c. magnet wire per pole, making a total of 1,686 turns on both poles. The wire should be wound on a spool made with a central core 1 5/16-inch in diameter, with a winding space ⅝-inch wide between the sides. Cut four saw cuts in these sides so that when the coil is wound, a tie string may be wrapped around it at four points around the coil to hold the turns in place while taping the coil.

Wind both coils in the same direction, taking care to wind the wire evenly and in layers. When the coil is wound, dip it in an insulation varnish or thin shellac, and bake it. Then wrap a layer of friction tape over each coil. The ends of the wires on each coil should have a short piece of lamp cord soldered to them for terminal connections.

After the coils have been placed on the field poles, they are connected in series with one another. The two ends of the coils are connected together, leaving the beginning of each coil for the connection leads. The connection should be such that when a direct current flows in them, it will flow in opposite directions around the two cores, making one a north and the other a south pole.

After the two coils have been connected in series, they should be connected in shunt with the armature. Fig. 16 shows the connections of the shunt type of winding. Only a portion of the current generated in the armature flows through the field winding, but the full armature voltage is impressed upon it.

The terminal binding posts are 3/16-inch rods threaded and provided with four nuts for each. The rod is passed through the yoke ring and a nut turned on each end. An additional nut is turned on each end to retain the connections. Where the terminal passes through the yoke ring, it should be well insulated by wrapping insulation around the rod and placing an insulation washer under the nuts to prevent grounding of the terminals with the yoke.

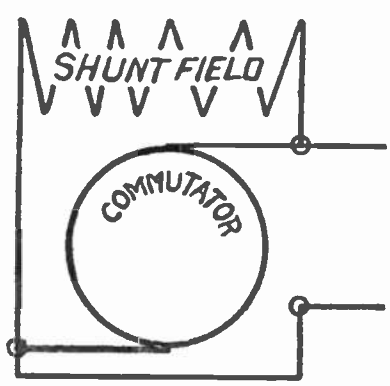


Fig. 16.—Connections for the Generator.

Before starting the machine as a generator, magnetize the magnetic circuit of the machine with a battery current. It will then retain sufficient residual magnetism to enable it to start generating. The brushes should be placed on a neutral point between the pole tips, and the machine brought up to speed. Running as a generator, the brushes should be given a little lead in the direction of rotation; as a motor, a little lead back of the direction of rotation. The output running at 2500 r.p.m. should be 15 volts

2 amperes, though 3 amperes could be carried for short intervals.

This dynamo will operate satisfactorily as a motor for furnishing motive power to toys, light machinery, window displays, etc. It is obvious that the power will not be great, but it will be found ample for most requirements usually expected of battery motors of the larger sizes.

INJURIES FROM ELECTRICITY

FOR the most part the injuries resulting from electric shocks are suffered by linemen, by workers in power houses, or by brakemen on electric railways who happen to touch the third rail. But with the increase of trolley lines in city and country and with the extension of transmission systems carrying currents of enormous voltage over long distances by means of wires strung on poles, the danger to the general public is constantly increasing.

Most of the accidents are produced by alternating currents. This is not because such currents are more dangerous than direct current, but because they are usually of higher voltage. It is not known how high the voltage must be to cause death. Much depends upon the mode of contact—whether the current passes through only a small part of the body, as when the two points of contact are in the same arm or leg, or whether it passes from one arm to the other or from the hand to the foot. A partial degree of insulation may also prevent serious consequences; for instance, when one is standing on perfectly dry ground or when the contact is made through the clothes.

An English authority on medical electricity states that it has been proved that a man with dry clothing can sit on the third rail, which carries a direct current of 550 volts, and grasp one of the other rails without receiving any shock whatever, but the experiment is not recommended to the curious.

When one has received a severe electric shock which has not been immediately fatal, he presents signs of greatly lowered vitality. He is unconscious, or semi-conscious, with almost imperceptible pulse, irregular and feeble respiration, cold, clammy skin, relaxed muscles and dilated pupils.

If he is still in contact with the live wire the muscles may be strongly contracted and it may be difficult to release him. Anyone who attempts to drag him away should have his hand protected by rubber gloves or by a dry coat folded several times, and he must see that the place where he stands is dry and that his foot is not in contact with a rail.

The treatment consists mainly in stimulation of the heart and respiration. Aromatic spirits of ammonia or some other stimulant should be given if the man can swallow, and artificial respiration should be practiced. This may be done by placing the person flat on the ground and compressing the chest firmly but gently for a few seconds and repeating sixteen or eighteen times a minute. The legs should be raised and the arms and legs rubbed in a direction toward the body. At the same time hot bottles may be applied to the body.

A NEW PROJECTILE OF ODD DESIGN

A new projectile, something between a torpedo and a shell, has been submitted for consideration to the French Minister of Marine. It glides and skims the surface of the water like a flat pebble, and has a range of nearly 10 miles. It can be fired from either a torpedo tube or a 12-inch gun, and contains a charge sufficient to destroy dreadnoughts or a breakwater. The method of firing is simple, and can be effected from a conning tower without the use of the telemeter. It is not a mere freak idea, though as yet its military value remains to be established.

What a Noise Can Do

THROUGH the starting of a fire in an oil car attached to it, a car of powder blew up.

The concussion was tremendous in the way of destruction of property, but the sound effect was still greater. The sound of that explosion traveled over three hundred miles. Entirely independent of concussion or the power of explosive force, the sound force broke farmhouse windows as far as 300 miles away; it shook dishes off of shelves and broke them; it broke immense store windows 102 miles away and even caused temporary gales of wind to rise in forests 75 and 100 miles distant from the scene of the disaster.

Napolini, an Italian scientist of some note in the latter part of the eighteenth century, claimed one evening in a conversation he was having with some friends, that with a large tuning fork and at a distance of two miles from the bells of the main Campanile of Rome, he could cause the chief bell, known as "St. Cecilia," to ring. His friends agreed to pay for the expense of the tuning fork with the understanding that if he did not succeed with the experiment, he was to pay them. If he did succeed, he was to be at no expense and all the glory was to be his.

An immense tuning fork was constructed, one of the largest ever known to man. A tuning hammer was also constructed with which to strike loudly a correct musical note on this fork. On a given night, Napolini and his friends, with the authorities of the city, gathered on a roof-top of a house which afforded an unobstructed line of sound or sound wave current to the bell of St. Cecilia. Creditable witnesses were placed at the Campanile and every legitimate precaution taken to see that no one touched the levers which controlled the six bells in this immense tower. The tuning fork was set up, and, grasping a hammer, Napolini began regularly to strike the fork. For about five minutes there was no evidence that his experiment would prove successful; but suddenly the bell of St. Cecilia began to give forth a musical response. It finally rang out so clearly that it could be heard by those on the housetop. Its companion bells gave a fainter response, but there was a clear indication of harmonious relation in musical sounds, and Napolini was upheld as to his theory that sound has an extraordinary power.

It is only within the last thirty years that the study of sound has been taken up by experts. This has been largely for the purpose of showing that every effort should be put forth to diminish sound in human life. The hum of the trolley car, the grinding of elevated trains, the useless rattling of wagons, wild screams that are uncalled for, harsh tones in the human voice, all have a serious and destructive effect on human thought, human nerves, the digestion and the value of human action in general.

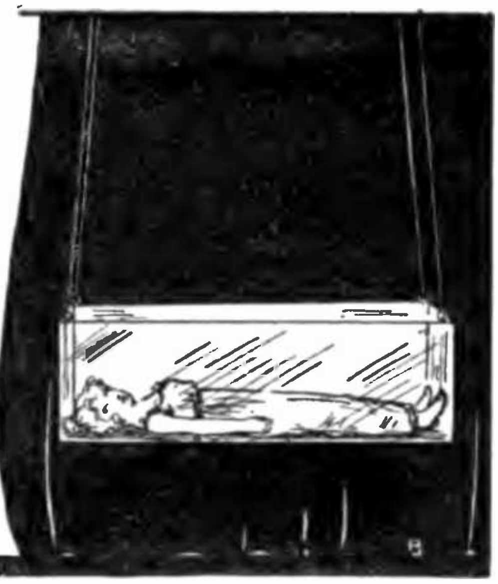
MAKING WHITE PAPER FROM BLACK

The paper of old newspapers and old books is used over again to make cardboard and coarse wrapping-paper. It is difficult, however, to produce white paper from waste printed paper. Various attempts have been made to dissolve the oily or resinous portion of the printing-inks with solutions of soap, petroleum, caustic sodas and so forth, in order to wash away the black pigment afterward. There has been invented a process for removing the ink pigment by treating the printed paper with boiling solutions of borax. The hope is expressed that this method may act as a check on the rapid deforestation of this country and avert a condition that has threatened to cause a crisis in the paper industry.

Don't fail to read the important announcement appearing on page 289 of this issue.

THE CRYSTAL COFFIN

by HEREWARD CARRINGTON



A VERY simple yet effective illusion which is often presented on the vaudeville stage is that known as the "Crystal Coffin." The trick, as it appears to the audience, is as follows:

The performer draws attention to a long, coffin-shaped box which is hanging several feet above the center of the stage and clear of the back drop and sides. The sides and ends of the coffin are of glass, so that it is possible to see through it and observe the curtain at the back of the stage. The coffin is suspended in the air by four steel chains.

The performer's assistant is now introduced—generally in the person of a beautiful and lithe young woman—and placed in the coffin. The lid is closed and the young woman can be readily seen lying in the coffin. Suddenly the magician fires a pistol several times and the audience looking through the glass coffin notices that the assistant is no longer there. In a moment or two, however, she is seen running down towards the stage from the rear of the house. She steps up on the stage and, after bowing to the stupefied audience, retires.

The secret of this clever illusion lies mainly in the construction of the box-like receptacle in which the young lady is placed. Although the coffin appears to be built wholly of glass as shown to the audience, it is not so in reality. The top and bottom of the coffin are of wood, while the sides and ends are of plate glass. But by manipulation and clever presentation, the performer can almost always leave the impression with the audience that the entire box is made of glass.

The illusion depends for its success on the top and bottom of the coffin. The top lid is so hinged that it swings outward; and underneath it is hinged, so as to swing inward, a mirror which exactly fits the under side of the wooden lid. The mirror is normally kept in place against the under side of the wooden lid by means of a spring bolt that may be released upon pressure of a spring. When the mirror falls back, it comes to a position diagonally across the crystal coffin. In the meantime, the coffin has been pulled up a little on one side by assistants in the flies, who pull the chains a certain, specified amount when the pistol is fired.

The under side of the mirror is painted so as to resemble the under side of the lid proper, to which it is attached. The under side of the lid is lined with black cloth, exactly matching the black cloth which hangs as a curtain at the rear of the stage. At a little distance and in fairly dim light, anyone looking into the coffin assumes that he is seeing through its glass sides to the rear curtain, even though it is tilted. As a matter of fact, however, the audience only sees the reflection of the under surface of the lid, which, since it matches the back drop, gives the impression that the coffin is empty and transparent.

When the mirror falls into place upon pressure of the proper spring, the rear half of the coffin is left as a hollow, triangular space, and it is here that the assistant hides. She is held there and concealed by the mirror which has fallen in front of her. The ends of the mirror would be seen were it not for the fact that two strips of wood or black paper run across the ends, apparently to make it solid, but in reality to conceal the ends. These pieces run diagonally from corner to corner.

The method of working the illusion can now be explained. When the assistant is placed in the coffin, she places her hand on the spring, ready to press it. At the moment the magician fires his pistol, she presses the spring catch and thereby causes the mirror to fall in front of her. At the same instant, the two assistants in the flies pull up the front end of the coffin in such a manner that the mirror slants at the proper angle for the view of the audience. The girl is then hidden from view and the coffin appears empty.

The girl who comes from the rear of the house is, of course, a confederate dressed exactly the same as the girl hidden in the coffin. The art of facial makeup makes the illusion complete. Such differences in appearance between the girls as there might naturally be are not perceived by the audience, since the second girl does not remain on the stage a sufficient length of time to be carefully studied. Of course, a few moments are allowed to elapse before this girl makes her appearance at the rear of the theatre, for the suspicions of the audience would be aroused if she appeared immediately after the pistol shots were fired. As it is, the audience assumes that the girl placed in the coffin has made her escape.

A NEW METAL WHICH MAY REPLACE RADIUM

Zeitschrift fur Schwachstromtechnic is the authority for the following story. If it appears improbable, as it certainly does, it must be borne in mind that we would have been equally incredulous, no doubt, if we had been given a description of the properties of radium twenty years ago.

In the mountains of Namangan, territory of Ferghana, Turkestan, there has just been discovered a new metal having powers so unusual as to surpass even those of radium. An explorer picked up a number of small pieces of metal of a dirty brown color and of great weight. He carried some of it to Moscow and there left it at a chemical laboratory for examination. The chemists made a number of experiments which gave some very surprising results. When the metal was placed in an acid it at once developed a very low temperature and caused the immediate disintegration of the glass containing vessel. When this was replaced by vessels of stone or porcelain, the result was the same. Finally an iron vessel was used; this also was reduced to powder. The chemists then tried a heavy receptacle of granite, with the result that this also was disintegrated without the production of gas or explosion of any kind, but with the same lowering of temperature. When the metal was treated with an alkali it lost twenty per cent. of its weight. Then the chemists were sent to Turkestan to get a fresh supply, which, after considerable search, they found and brought back to Moscow. Further experiments indicate that the new metal has valuable curative properties. One of the most striking observations made so far is that substances brought into contact with it invariably lose weight. Russian scientific circles are united in the belief that the world is on the eve of an enormous surprise, perhaps even greater than that produced by the discovery of radium.—J. H. Blakey.

Over the new trans-continental telephone line the voice travels from New York to San Francisco in 1/15th second, or at a rate of 56,000 miles per second. If a man could shout loud enough to be heard over that distance, the sound would take four hours to travel the 3,400 miles of air.

Making a Fac Simile Rubber Stamp

By Edward F. Hallock

FOR those who turn out duplicate letters in large quantities, a fac simile rubber stamp of the signature to be placed on the mail matter is a great convenience. The making of such a stamp is not a difficult matter and can readily be undertaken by anyone who can handle a camera and vulcanize a patch on an inner tube.

The first operation in the process of making a signature stamp is to write the signature which is to be copied. The name should be written on white Bristol board in jet black ink, preferably drawing ink, and should be half again the size of the normal signature, so that when it is photographed it will not lose too much detail. The card bearing the name is then tacked up before a camera and brought to a sharp focus on the ground glass plate, it first having been ascertained that the object is the correct distance removed from the lens to bring the name on the plate to about the normal size.

With the object sharply focused, an exposure is made on a slow plate such as is normally used for copying purposes and with a small lens aperture in order that the detail may be as sharp as can be obtained. The plate is developed in a bath that gives good contrasty negatives, a standard, slow hydrochinone developer is to be recommended, and then, to make the impression more effective, the plate is intensified in the usual manner.

The negative having been completed to the satisfaction of the operator, a process plate is prepared in the following manner: Ordinary carpenter's glue, well washed to eliminate the last trace of dust or grit, is allowed to swell in cold water until it has taken up all the water it will absorb. The glue is then melted in the usual manner in a double boiler, without the addition of any more water. It is allowed to cook for a couple of hours, in order to drive off a good portion of the moisture

The plate can be an old photographic negative or a common piece of window glass. It is cleansed and then coated with the glue, which has been skimmed to rid it of the froth which ordinarily collects on the surface of the liquid. Care should be exercised in coating the plate to make sure that a film of even thickness is applied to the plate. This can best be done by pouring a quantity of the hot glue in the center of the plate and then tilting the plate first in one direction and then the other, until the glue has reached every portion of the surface. If the tilting is carefully done, the glue can be so manipulated that it will not run over the edge. The plate should then be placed on a perfectly level surface to dry.

When the plate has dried out thoroughly, it is sensitized by immersing it in a solution of bichromate of potash in water, in the proportion of ten parts of water by weight to one of the bichromate. The plate is allowed to stay in this solution, which should be cold, of course, so as not to melt the glue, until the film has swelled to its fullest extent for the second time and then it should be placed on edge to dry in a dark place. The plate should not be allowed to remain in the liquid longer than is necessary to

swell the glue fully, for otherwise it will frill and bubble.

When the plate has dried out for the second time, it will be found that the chemical has so affected the glue that if it is exposed for a short time to the light, it will lose all power of absorbing water and swelling; and it is this effect of light on the glue that is utilized in the process of making the fac simile stamp. The plate is placed under the negative in a printing frame, just as if it were a piece of photographic paper or a lantern slide, and the frame then is placed in strong sunlight for from ten to fifteen minutes. When the plate is removed from the frame it will be found that the signature is printed on it in deep brown against the light brown color of the sensitized glue.

Development is effected by placing the glue in a cold water bath and allowing it to remain there for several hours. Upon examination it will be found that all portions of the plate, save the signature which alone was exposed to the rays of the sun, have swollen with the water absorbed. The signature then is left intaglio in the glue film and the relative height of the swelled and the unswelled portions is such that when a plaster cast is taken from the glue plate, the name stands out in bold relief to such a height that good clear prints can be taken from it.

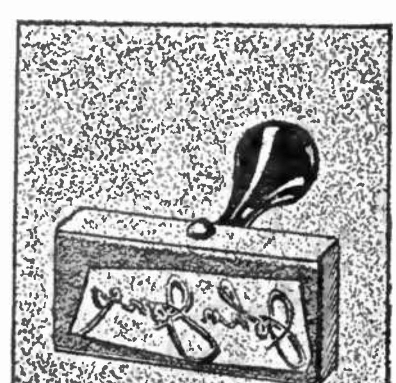
The plaster cast is very easily taken. The plaster is mixed to the consistency of cream, and then is worked into the lines representing the signature with a soft camel's hair brush; care being exercised to see that the plaster reaches the smallest crevice and that no air bubbles are allowed to remain. The plaster cast should be made sufficiently thick to give it strength so that it will not break when being handled.

When the plaster has set and hardened, which will be in about an hour or even sooner, provided a little salt has been added to the water in which it is mixed, it can easily be removed from the glue film and, as was stated before, will bear the signature in bold relief. The plaster, however, is hardly suitable to print from, so it is necessary to make another intaglio mould similar to the glue mould, but this time made from the more substantial plaster.

To do this, the face of the plaster cast is well greased with either lard or tallow in order to prevent it sticking when the soft plaster is poured against it. Care should be taken in greasing the surface to get the grease into every little space around the lettering, for otherwise trouble will ensue. The plaster for the second cast should be mixed the same as before and should be manipulated into the smallest crevices of the signature with the brush in the same manner. The second cast should be made quite thick and substantial for it will have to stand considerable pressure when it comes to vulcanizing.

When the plaster has hardened the two casts can readily be separated, provided care has been taken to see that all portions of the first cast were greased before pouring the second cast, leaving the signature complete to the last detail impressed in the second cast. It is from this cast that the rubber stamp is actually to be made.

For the purpose a small gasoline vulcanizer, such as is used by automobilists for repairing inner tubes, is necessary. Plastic or under cured rubber, some of which comes with the vulcanizer and which is used for repairing punctures in the tubes, is carefully impressed into the lines of the signature. Before doing so, however, the plaster mold should be dusted with fine graphite to prevent the rubber from sticking. The rubber,



which is soft and pliable and which comes in thin sheets, is very easily pressed into the lines, and being plastic and not resilient, it will remain there. It should be applied one layer at a time for several layers until the stamp seems to have sufficient backing. Then the plaster cast is placed in the vulcanizer with the rubber on top so that the heated plate of the device bears directly on the rubber, and the clamps are tightened as hard as possible with the hands. Tightening the clamp is important, for it forces the rubber into the smallest crevices. Then the heater is filled with gasoline in the usual manner, save that half again the quantity used for an ordinary tube patch is put in, and ignited.

The process of vulcanization is allowed to continue until the fuel has burned itself out, when the plaster cast is removed from the vulcanizer and allowed to cool. This results in the rubber being fully cured and very resilient. It is peeled from the plaster, revealing a perfect reversed impression of the written signature. The rough edges of the rubber can then be trimmed off with a penknife and the stamp glued to a block of wood fitted with a handle, ready for use.

It will be found, of course, that in the process the signature will have suffered a slight loss of detail due to the numerous transfers, but on the whole the results will be highly satisfactory.

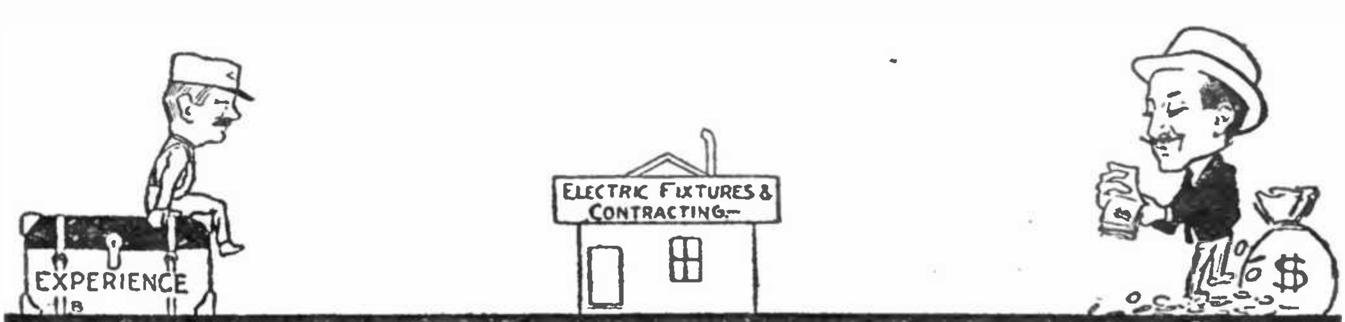
CLUES FOR THE ELECTRICAL CONTRACTOR

A MISTAKE often made is for the practical, hard working electrician to associate himself with a man of capital in order to equip and conduct an electrical contracting business, dependent wholly upon the size and general looseness of the capitalist partner's pocketbook. The sum and substance of such a combination is this: A has experience but no money, while B has money but no experience, so they combine forces. The result, in seven cases out of ten, is that the partnership is eventually dissolved leaving B short on capital and long on experience; and A is perhaps a wiser man for his experience.

Any one can place five hundred dollars with a partner of five years' experience, but it takes a thoughtful and practical business man to make a success of the combination. The chemist combines one part of oxygen with two parts of hydrogen to produce water; but if he should place these elements together in any other proportion, the result would be quite different. It is the same in the case in point. If capital and experience are not united in the one correct manner, then we cannot have success.

Then there is the question of office management. Too often so little attention is given to this important end of the business that a shop helper can guess as closely to the earning power of the company as the manager himself. We do not see this condition in a drug or a dry goods house, nor, in fact, do we find it in any line of paying enterprises.

In the ideal business, both the shop



manager and the office manager have good working ideas of each other's duties, but they never interfere with one another. The office manager can tell you at a moment's notice the amount of money expended during any given time or he can tell you the latest quotation on copper wire. The shop manager can, with equal facility, tell you how much time was spent in roughing in Mr. B's residence, or the condition of the stock room. This is truly the ideal condition, regardless of whether the company is a large one or whether the whole working force is represented by the owner.

Management as just described will succeed when work is slack and when the incompetent man closes his doors. It is the condition arrived at when the practical electrician with a certain amount of business training conducts his own shop, or when the man of experience and the man with capital combine forces in the proper manner.

Another source of destruction for the electrical contractor is the estimating department. This work unquestionably should come under the supervision of a man who is at once an experienced electrician and a shrewd business man. He must know how long it will take each and every one of his men to tape one joint; how long it will take a man to rough in a knob and tube job under the ever varying conditions of architecture; he must know personally every salesman who calls on his firm, in order to get the lowest quotations on short notice. I know men who can tell closely at a glance the cost of wiring a residence complete, but you must understand that they are men of experience who keep close watch on the time and material spent on various classes of work. They not only know that a house may be wired much more quickly when the joists and bridge work run just right, but they know how much more quickly it can be done. With the lively competition in almost every city or town, the man who guesses is going to lose out sooner or later. Get a man in your shop who does not guess but knows, and you will have an estimator who will bring profits to your door. Every means should be given him to obtain information regarding work.

If you are estimating your own jobs, you are doomed to certain failure unless you familiarize yourself with every detail connected with the business. A record should be kept of every piece of work done, showing the conditions met and the actual cost required to complete it. In this way you will be stowing away invaluable information for use at some future time. In other words, your business must be progressive. A membership in a contractors' association, a subscription to a good electrical journal and a well constituted library pertaining to electrical engineering are essential to a progressive firm.

Men are just as human as you make them. If you treat them as beasts of burden, then you can confidently expect their work to deteriorate. Help them over the rough spots and you will find them ready to put forth a little extra energy in your behalf. If you do not systematize your business as other contractors are doing you will eventually be among the losers.—J. S. Blair.

RECENT SUBSTITUTES FOR PLATINUM

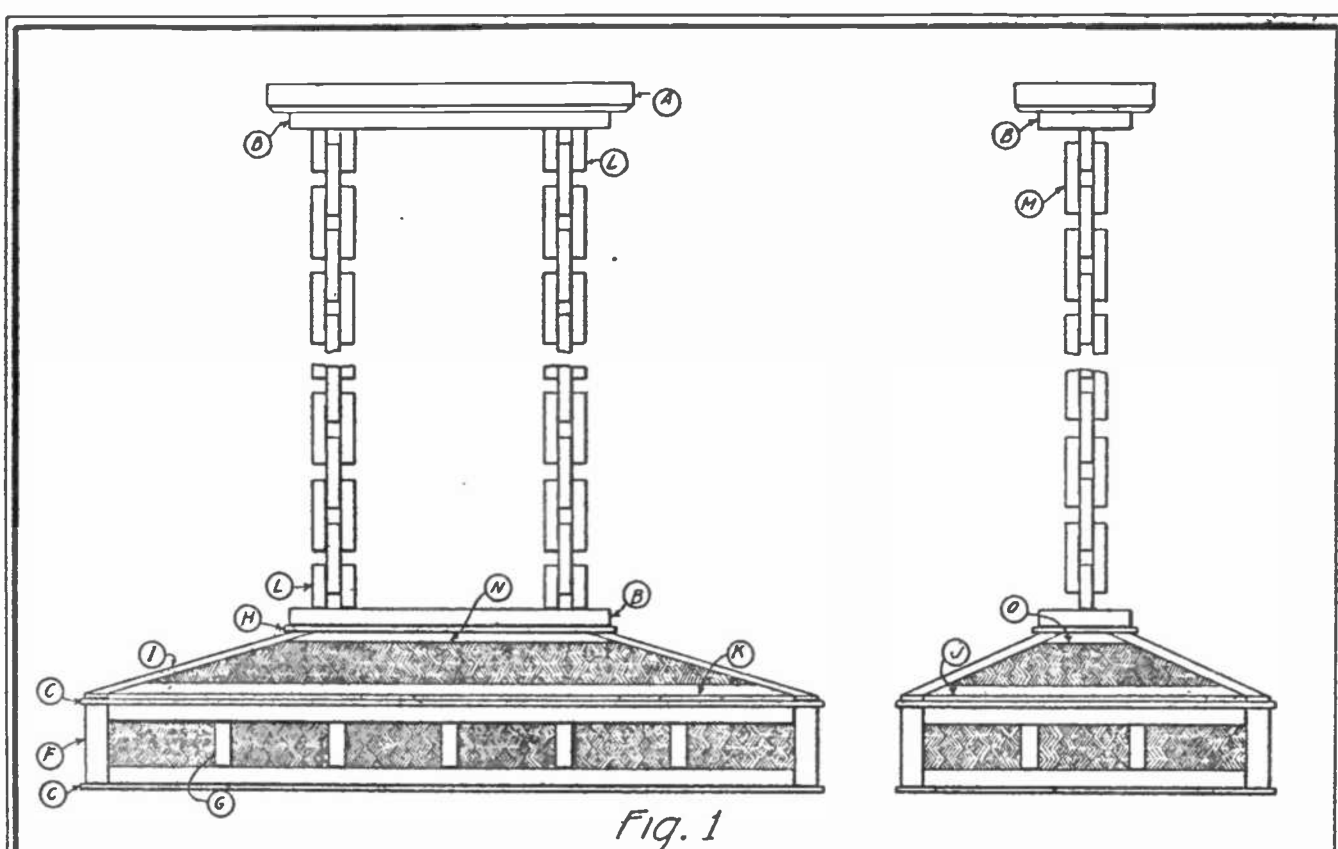
The great increase in the value of platinum during the last few years has led many investigators to seek substitutes for it. It appears that the search has been partly successful. Platinum-clad nickel-steel wire is beginning to displace platinum wire in incandescent lamps; wires of nickel alloys are now making the cheaper grades of artificial teeth; asbestos threads are taking the place of platinum wires in gas mantles; and fused quartz ware has come into general use in chemical laboratories in the place of platinum utensils. Yet the introduction of these substitutes has not affected the price of platinum; the demand for the metal seems to have steadily increased in spite of them.

A Library Dome in Wood and Art Glass

THE design offered in this article has been prepared with some misgivings on the part of the author as the project is not a simple one for the average amateur mechanic to handle The greatest care has been taken with the drawings, however, and it is hoped that by adhering closely to dimensions and then using a little ingenuity and judgment in the assembly, the builder will have but little difficulty in turning out a presentable piece of work. Certain it is that the finished article is one that will give unending satisfaction not only to its builder, but to all who have the privilege of reading beneath its genial rays. The lamps are so placed that the reader is never annoyed by having the direct rays from the filament shine in his eyes and at the same time the illumination on the book is excellent.

Referring to Fig. 1 and also to the wash drawing on the next page, the reader will note that the lamp is rectangular in form, 32 inches long, 16 inches wide, and suspended from a chain 60 inches long, or as long as may be necessary according to the height of the ceiling.

As the construction is, in general, similar to that of the lamp described in the preceding article of this series, the author will endeavor to specialize on the particularly difficult portions of the work



Side and End Views of Dome.

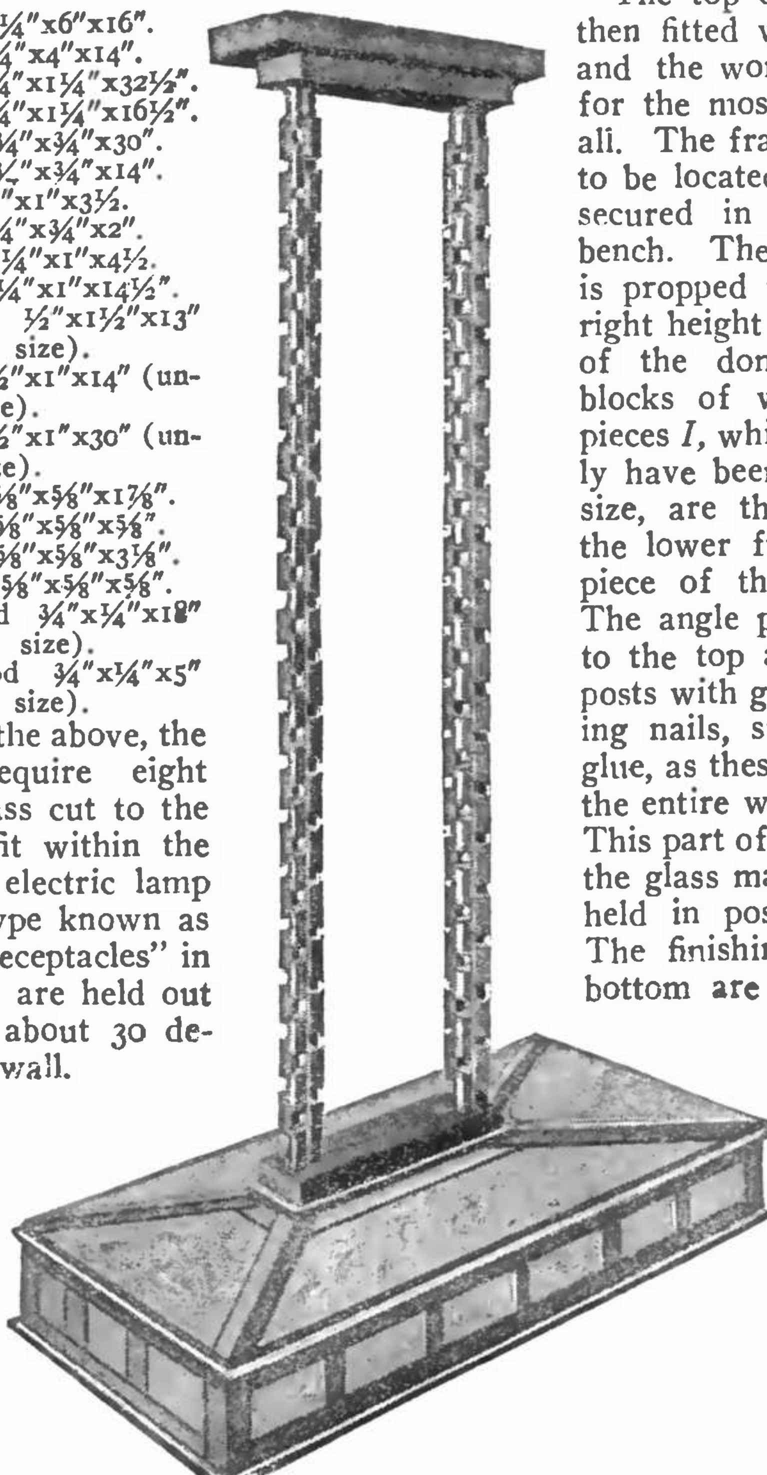
rather than give a lengthy discussion of the points covered previously in other articles.

The bill of materials, as may be noted in the drawing of the details, Fig. 2, is as follows:

(*A*) 1 pc. wood 1¼"x6"x16".
(*B*) 2 pcs. wood ¾"x4"x14".
(*C*) 4 pcs. wood ¼"x1¼"x32½".
(*C*) 4 pcs. wood ¼"x1¼"x16½".
(*D*) 4 pcs. wood ¾"x¾"x30".
(*E*) 4 pcs. wood ¾"x¾"x14".
(*F*) 4 pcs. wood 1"x1"x3½.
(*G*) 14 pcs. wood ¾"x¾"x2".
(*H*) 2 pcs. wood ¼"x1"x4½.
(*H*) 2 pcs. wood ¼"x1"x14½".
(*I*) 4 pcs. wood ½"x1½"x13" (unfinished size).
(*J*) 2 pcs. wood ½"x1"x14" (unfinished size).
(*K*) 2 pcs. wood ½"x1"x30" (unfinished size).
(*L*) 8 pcs. wood ⅝"x⅝"x1⅞".
(*L*) 4 pcs. wood ⅝"x⅝"x⅝".
(*M*) 96 pcs. wood ⅝"x⅝"x3⅛".
(*M*) 96 pcs. wood ⅝"x⅝"x⅝".
(*N*) 2 pcs. wood ¾"x¼"x18" (unfinished size).
(*O*) 2 pcs. wood ¾"x¼"x5" (unfinished size).

In addition to the above, the builder will require eight pieces of art glass cut to the proper size to fit within the frame and two electric lamp fittings of the type known as "show window receptacles" in which the lamps are held out at an angle of about 30 degrees from the wall.

The lumber is to be ordered cut to the proper sizes at the mill if the builder wishes to save himself much uninteresting labor. The angles indicated in the drawings will have to be finished by the builder as the work progresses and it is in this feature of the work that the greatest difficulty will be experienced.



The Library Dome Complete.

The frame is to be assembled by nailing the strips *C* to the corner posts *F* and then fitting in the side rails *D* with the decorative pieces *G*. This assembly can all be done with the aid of glue and slender brads. The construction must be substantial, however, as the lamp weighs quite a bit when completed.

The top of the dome *B* is then fitted with the strips *H* and the workbench prepared for the most difficult feat of all. The frame of the lamp is to be located and temporarily secured in position on the bench. The top of the dome is propped up at exactly the right height and in the center of the dome by means of blocks of wood. The angle pieces *I*, which must previously have been cut carefully to size, are then fitted, joining the lower frame and the top piece of the dome together. The angle pieces are secured to the top and to the corner posts with good, strong finishing nails, supplemented with glue, as these joints must bear the entire weight of the lamp. This part of the work finished, the glass may be inserted and held in position with brads. The finishing strips top and bottom are then put on and the dome is complete with the exception of the two receptacles which are placed as shown in Fig. 2. The wires are passed through holes in the top piece and up the chains.

For the details of the chain construction the reader is referred to Fig. 1, as well as to the parts *L* and *M* in Fig. 2. The chains are built up of separate pieces of wood securely held together with nails and glue. The length of the two chains should be

(Continued on page 407)

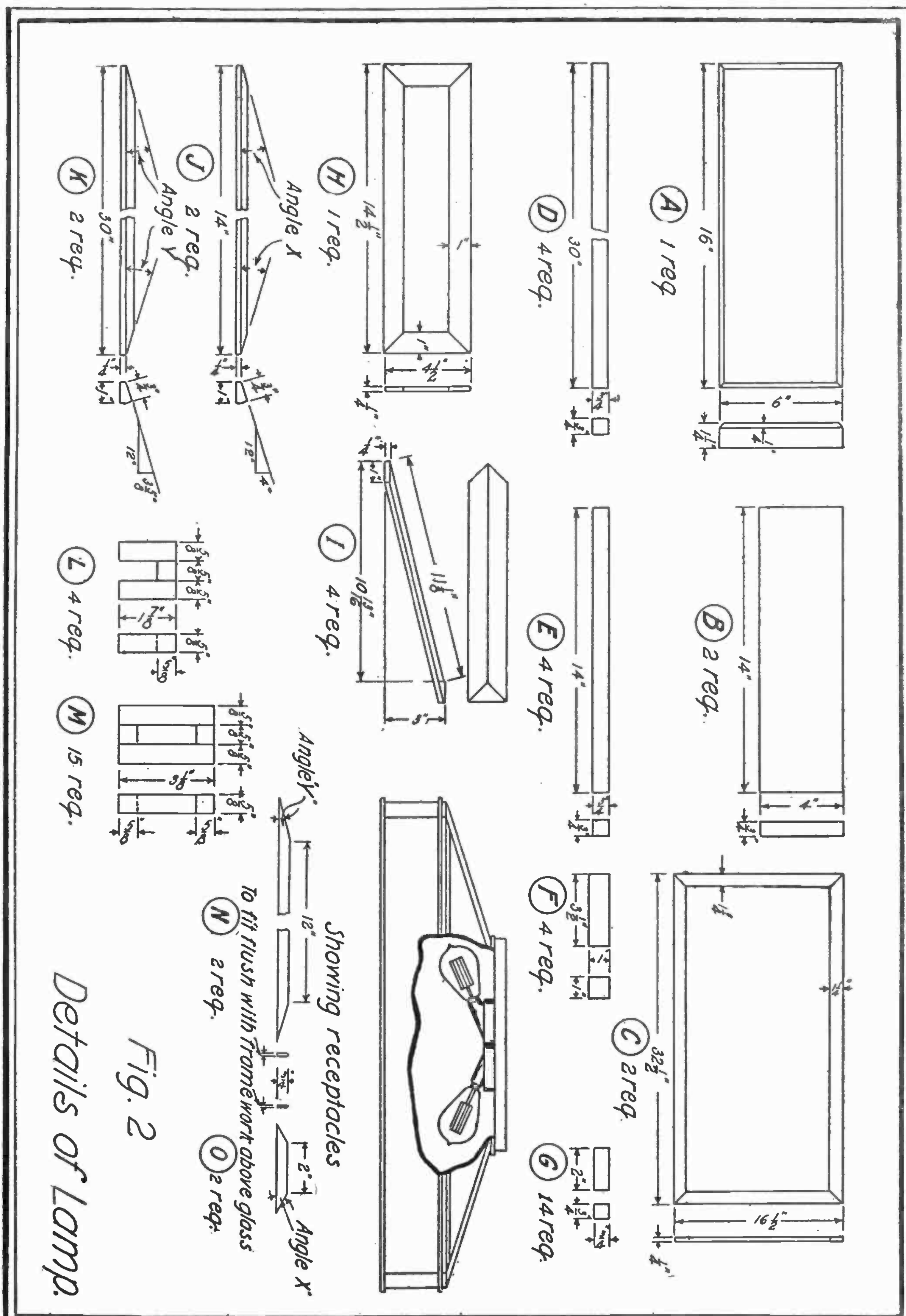
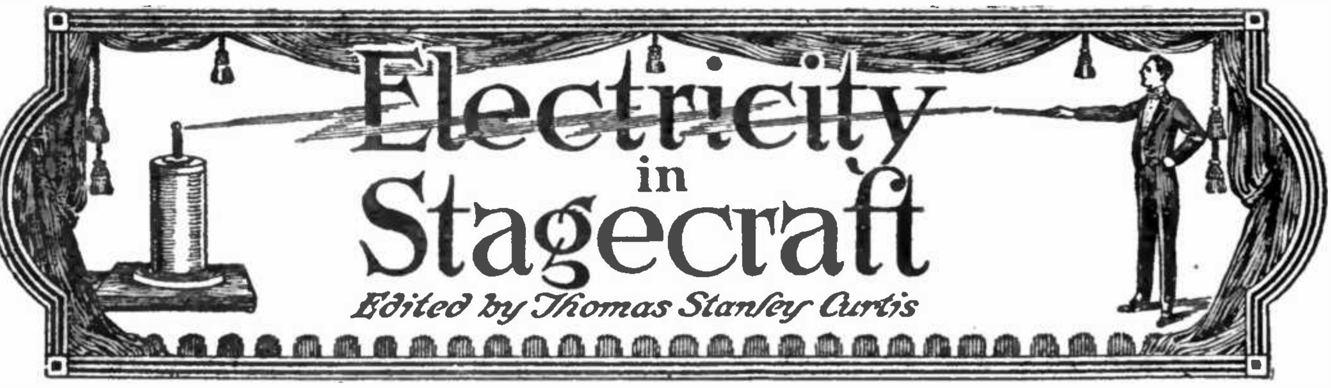


Fig. 2

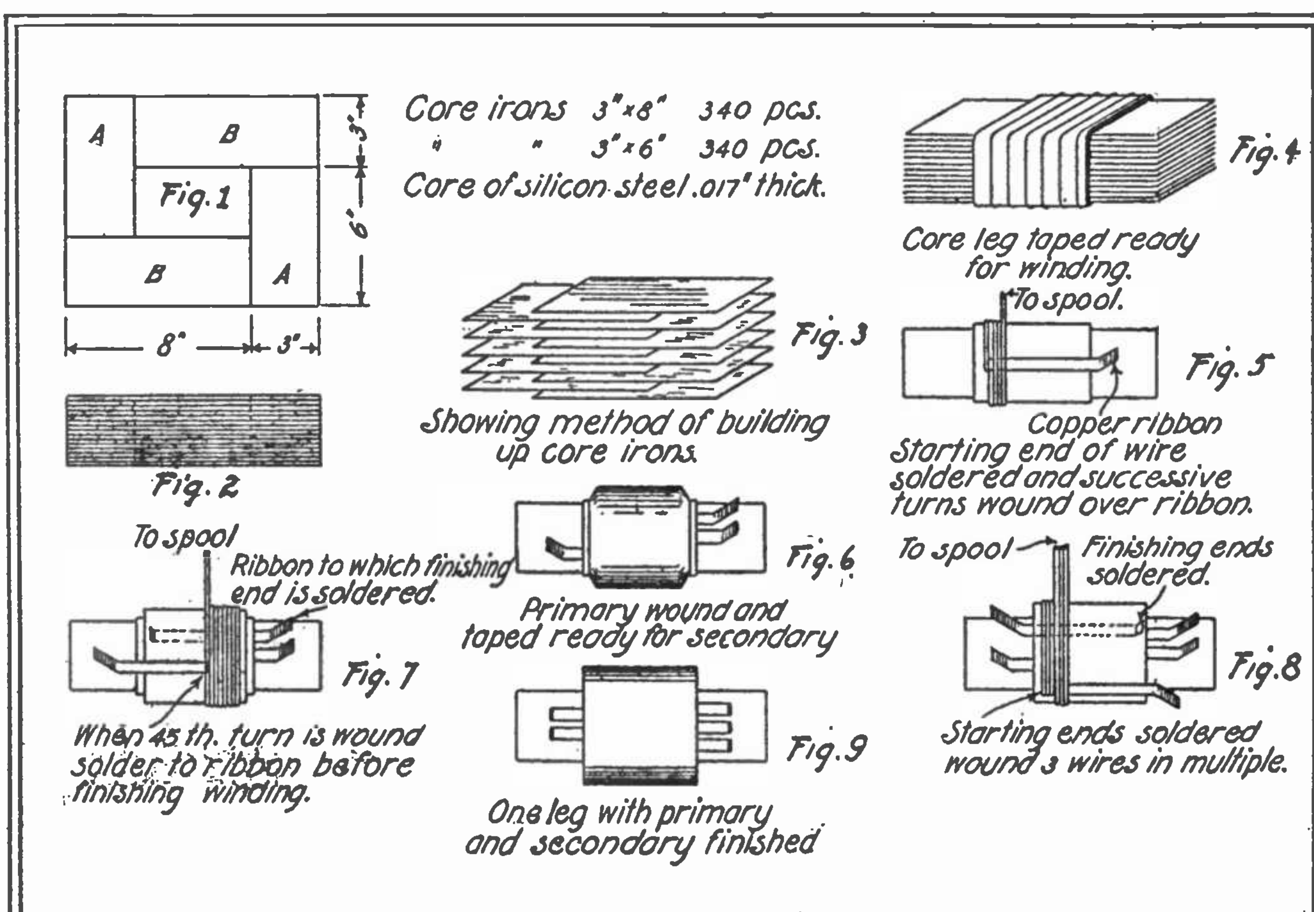
Details of Lamp.



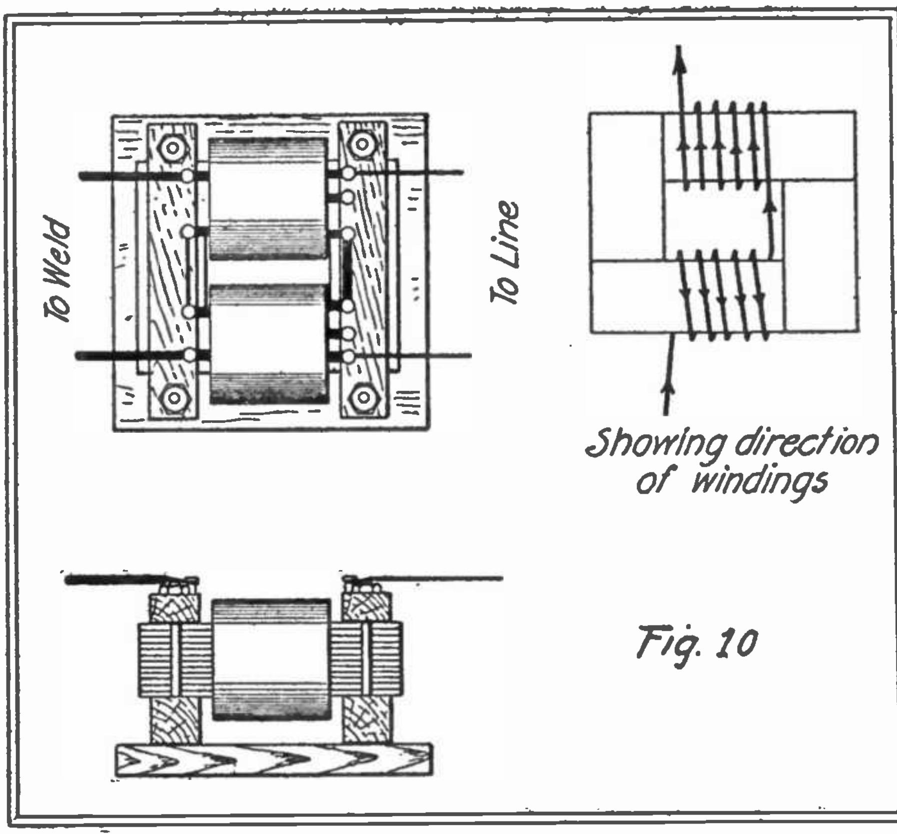
Construction of a Welding Transformer

THE feat of grasping a piece of iron wire, as thick as a pencil, between two pairs of tongs held in the hands, and causing the wire to become red and even white hot while held in that position, is a stunt which seldom fails to call forth the applause of an audience. When the experiment is conducted with the proper scenic atmosphere, the effect is materially enhanced.

In this article the reader will find the details of the construction of a low-voltage transformer admirably adapted to this purpose. The transformer can be built by the average handyman who has a smattering of electrical knowledge and who knows the value of careful work as regards insulation. In the article to follow, the design of a suitable stage setting and accessories will be described. While this experiment may readily be made one of a number grouped up into a single offering, still it is quite complete in itself and with embellishments, it may form the basis for an act of a few minutes' duration.



Constructional Details of the Welding Transformer.



View of the Welding Transformer as it Appears when Completed.

In order to make the description clearer, the various parts of the transformer will be described separately, each under its proper heading. The transformer is designed for operation on a 110-volt, 60-cycle alternating current circuit and when the load is applied, the current in the primary is approximately 26 amperes. The secondary current at 11 volts is in the neighborhood of 250 amperes and this is sufficiently large to make quite a display.

THE CORE

The core of the transformer is of laminated iron or preferably silicon steel .017 inch thick and cut into pieces as indicated in Fig. 1. From the diagram the reader will note that two sizes are required, *i. e.*, 3 by 6 inches and 3 by 8 inches, respectively, and 340 pieces of each size will be needed. The steel for the core may be obtained cut to size and ready to assemble from certain transformer manufacturers who buy the material in large quantities and cut it with a gate shear.

Fig. 3 shows how the 3 by 8 inch pieces are assembled with the ends projecting alternately three inches first on one and then on the other side. The strips are divided into two piles of 170 pieces each and each pile is then built up as shown in Fig. 3 to make two cores, each three inches thick. A generous wrapping of tape and three layers of press board make the cores ready for the windings.

PRIMARY AND SECONDARY WINDING

The secondary is wound over the primary on each leg of the transformer. For this reason the primary winding will be considered first. As mentioned before, the winding described is for use on a 110-volt circuit; if the builder desires to wind for a 220-volt circuit, he should substitute twice as many turns of a wire three sizes smaller in the primary only. The windings here mentioned are figured at but 500 circular mils per ampere, but in view of the fact that the transformer is used for only a few minutes at a time, the heating will not be excessive.

The primary consists of 120 turns in all and so arranged that 90 turns may be used if desired. The winding is of No. 9 D. C. C. magnet wire in four layers of 30 turns per layer. Two layers are wound on each leg. With reference to Fig. 5, the winding is started by soldering the end of the wire from the spool to the end of a piece of stout copper ribbon which is then insulated with a layer of paper and the winding continued over it for one layer. This prevents the annoyance of the first turn coming loose after the winding is removed from the lathe.

Over the first layer of the primary is placed a layer of press board and then the second layer of wire is wound until the 45th turn is reached. At this point a tap of copper ribbon is taken as shown in Fig. 7. Over this the winding is continued until the 90th turn is in place. This turn is soldered to the tip of a third piece of ribbon previously placed so that

(Continued on page 407)

Electricity in Horticulture

Edited by Thomas Stanley Curtis

Plant Culture by High Frequency Current

Part I. The Construction of the Transformer

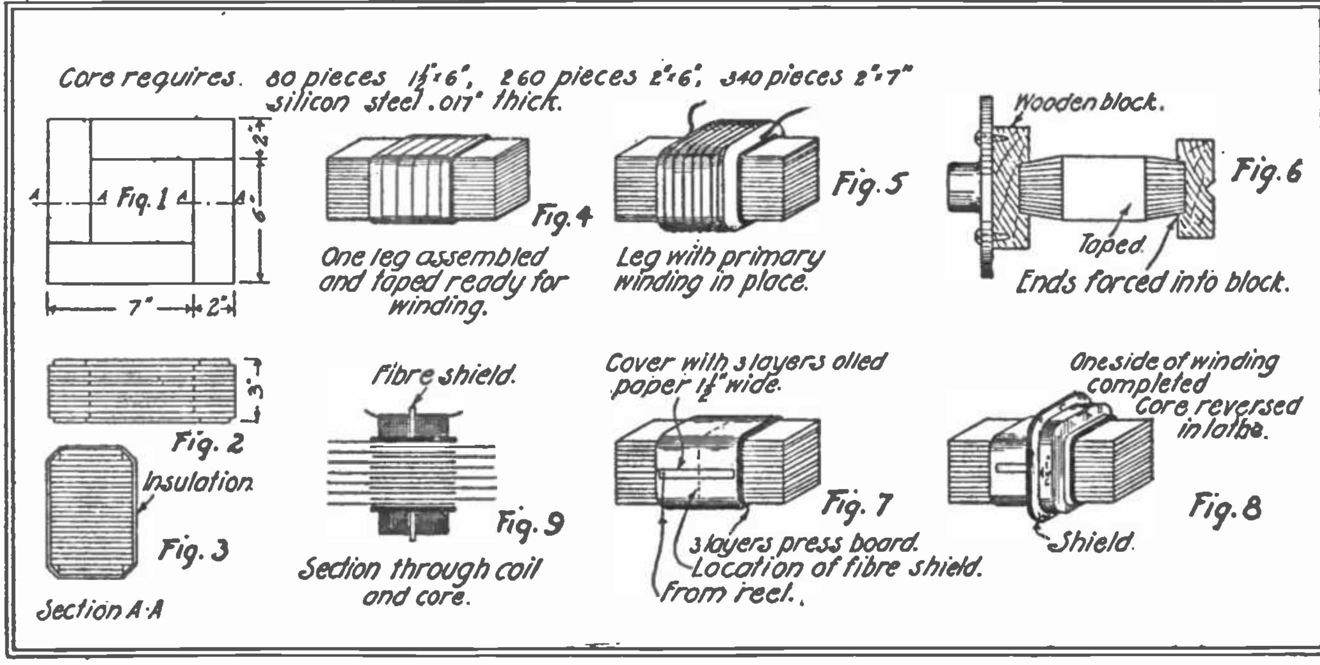
THE successful generation of an electric current at high potential and high frequency offers a problem not easy of solution, particularly if this current is to be put to practical use for long-continued periods of time. While there are several methods of producing the current, only one will be considered here as the others are deemed impractical for amateur use.

The generator to be described is designed for hard duty. The complete apparatus comprises a transformer, condenser, spark gap and an oscillation transformer. In the construction of the apparatus, a fairly complete electrical knowledge is essential. The high-voltage transformer must be carefully made and properly insulated, while the accessory apparatus requires not a little mechanical skill for its successful completion. Once constructed, however, the operation of the outfit is a simple matter and quite within reach of the average fruit or vegetable grower.

In order to simplify the explanation, the description of the transformer will be divided into sections, each bearing the proper heading.

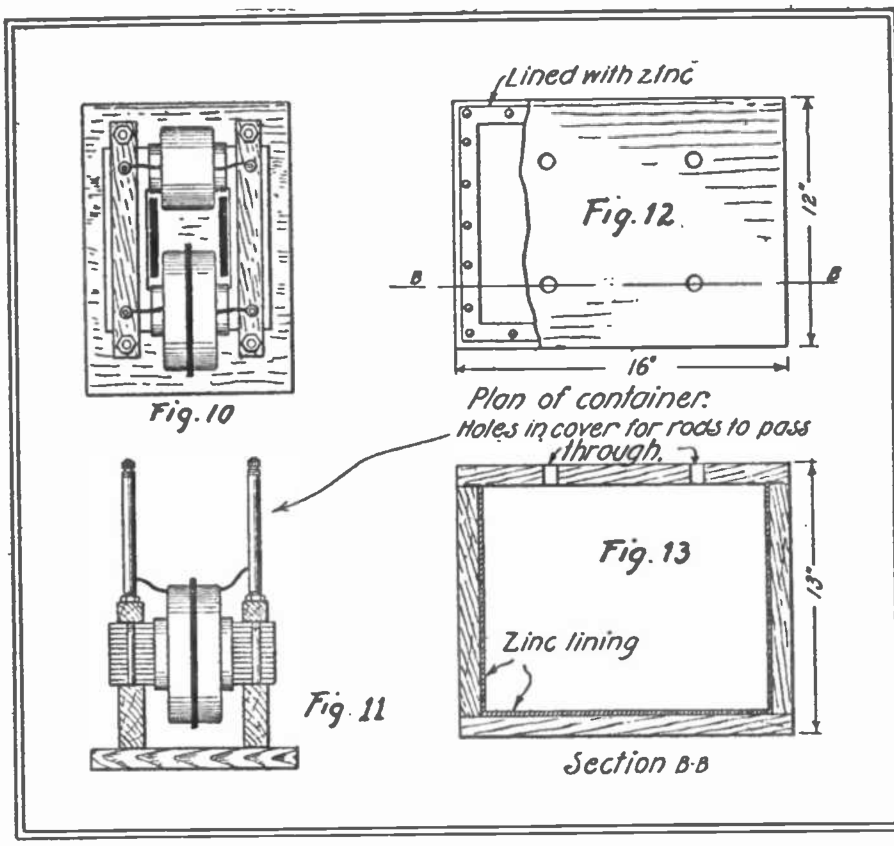
CONSTRUCTION OF THE CORE

The core is composed of thin sheet iron or preferably silicon steel which may be obtained from transformer manufacturers. The sheet metal is to be cut into strips according to the specifications given in Fig. 1. The 2 by 6 inch strips are divided into two piles of 130 pieces



Details of the Transformer.

each and these strips are assembled alternately with the ends overlapping two inches. The 1½ by 6 inch strips are next divided into four piles of twenty each and these are assembled alternately also. These packs are then to be placed above and below the assembled piles as shown in Fig. 3 to break the sharp corners. The piles are then wound tightly with tape and finally covered with several layers of pressboard, preparatory to winding the primary and secondary.



The Transformer with its Container, Complete.

WINDING THE PRIMARY AND SECONDARY

The primary is wound on one leg of the core and the secondary on the other. The two cores are then joined in a complete magnetic circuit by the end yokes as shown on Fig. 1. The primary winding consists of 125 turns of No. 10 D. C. C. copper magnet wire wound 25 turns per layer and five layers deep. Between each two layers of wire, a turn of press-board should be taken. The first and last turns of wire are held in place with loops of strong tape placed under the winding and drawn tight after the turns are in place. No shellac or other paint is used on the winding as the coils are to be immersed in oil when the transformer is completed.

The secondary winding is in two sections, each containing 4200 turns of No. 28 enameled magnet wire, making 8400 turns in all. The wire is wound in layers about an inch wide and separated by a double thickness of oiled paper between each two layers of wire. The paper should be 1½ inches wide. In Fig. 6 is shown the method of clamping the core leg in the lathe for winding.

Before starting the winding, a strip of thin copper ribbon is cemented to the insulation as shown in Fig. 7 to provide the connection between the two halves of the secondary. A strip of paper is placed over the ribbon and the winding started after the end of the wire has been soldered to the ribbon. When the first section of the secondary has been completed, the finishing end of the wire is soldered to a piece of ribbon, a few turns of paper taken over the final layer of wire, and the core leg removed from the lathe. The fibre shield which separates the two secondary sections is then slipped in place and the core replaced in the reverse direction; that is, the core is turned end-for-end in replacing it to make the blank portion of the core take the place of the wound section. The second half of the winding is then started by soldering the wire to the copper strip as before. Assuming that the lathe is turned always in the same direction, the act of reversing the core insures that the direction of the winding shall be continuous in both sections, with their starting ends connected together by means of the copper strip.

ASSEMBLING AND MOUNTING

The secondary finished, the two legs containing the windings may be stood on end and the remaining core strips inter-

(Continued on page 429)

Practical Electro Therapy

Edited by Thomas Stanley Curtis

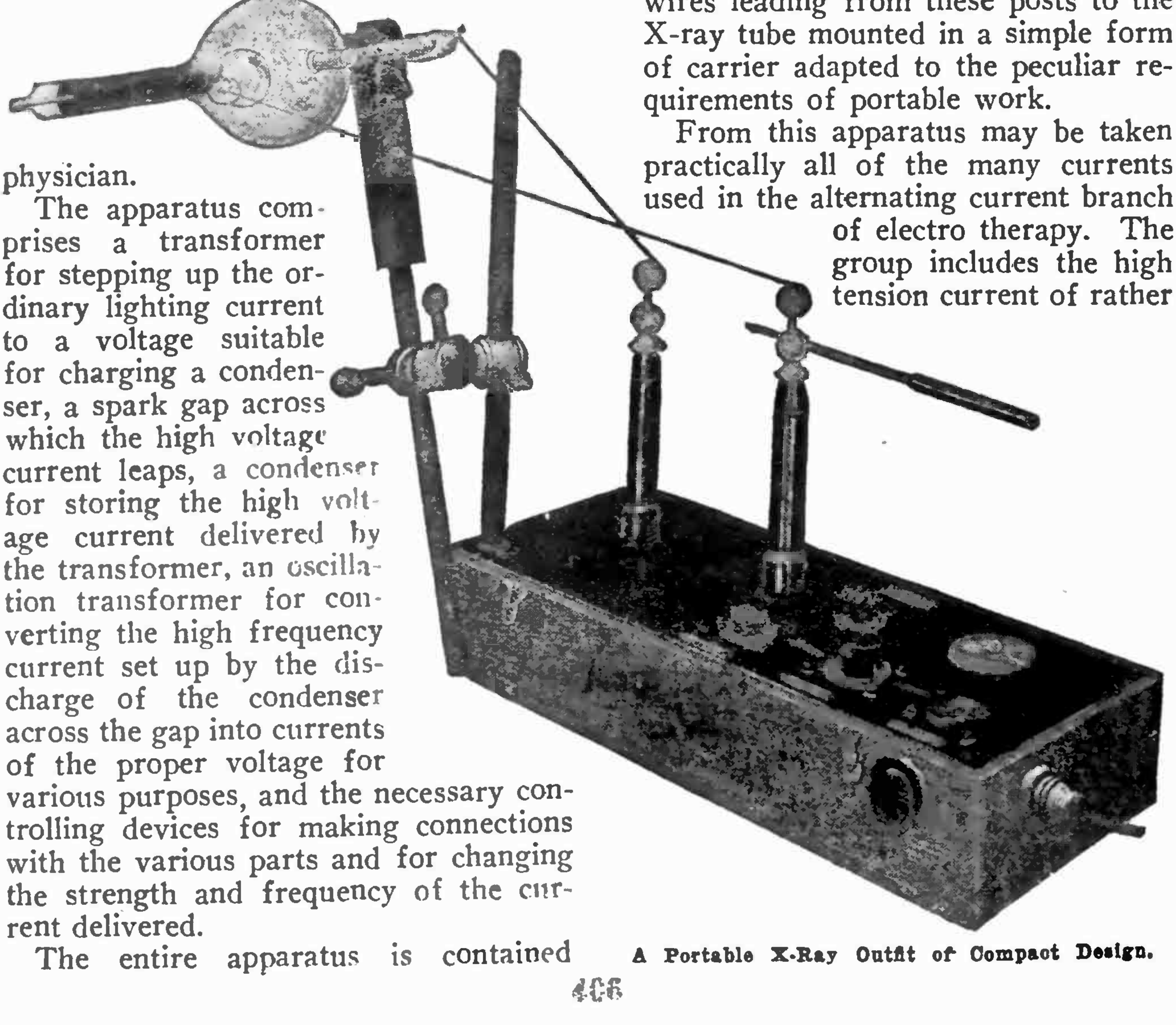
High Frequency Apparatus

IN the present article the aim will be to give a brief description of a modern high frequency outfit of the portable type. It is probable that there are more coils of this description in use than of any other form. The apparatus offers the advantage of bedside administration and it is at the same time capable of practical work in the office or operating room of the up-to-date physician.

The apparatus comprises a transformer for stepping up the ordinary lighting current to a voltage suitable for charging a condenser, a spark gap across which the high voltage current leaps, a condenser for storing the high voltage current delivered by the transformer, an oscillation transformer for converting the high frequency current set up by the discharge of the condenser across the gap into currents of the proper voltage for various purposes, and the necessary controlling devices for making connections with the various parts and for changing the strength and frequency of the current delivered.

The entire apparatus is contained within a case of oak, topped with a hard rubber cover on which the control handles are fitted. The various currents of comparatively low voltage are available through plug sockets in the hard rubber top, while the high tension current for X-ray work is taken from the terminals at the tops of the hard rubber posts which rise above the case. In the illustration may be seen the wires leading from these posts to the X-ray tube mounted in a simple form of carrier adapted to the peculiar requirements of portable work.

From this apparatus may be taken practically all of the many currents used in the alternating current branch of electro therapy. The group includes the high tension current of rather



A Portable X-Ray Outfit of Compact Design.

coarse frequency for X-ray work, high tension at very high frequency for vacuum tube treatment and the generation of ozone, medium tension at high frequency for D'Arsonval treatment in auto-condensation, low tension at high frequency for thermo-faradic effects, low tension at commercial frequency for sinusoidal effects and still lower tension for use with the cautery electrode and diagnostic lamp. In addition to the above, a hot, biting spark admirably adapted for fulgeration is obtainable, as is also the mild but penetrating current necessary for cataphoresis.

In the next article a detailed description of the component parts of this apparatus will be given and this will be followed by directions for using the apparatus to the best advantage for the various kinds of treatment.

A LIBRARY DOME IN WOOD AND GLASS

(*Continued from page* 400)

precisely the same when the assembly is finished in order that the lamp may hang properly. The leveling in the opposite direction is accomplished by the addition of small weights inside the dome.

The finish of the lamp is optional with the builder as is also the kind of wood selected. Straight-grained oak, stained to harmonize with the furnishings of the room, makes an attractive piece of work.

CONSTRUCTION OF A WELDING TRANSFORMER

(*Continued from page* 403)

the winding holds it. The same procedure is repeated with the other core leg and two layers of press board fitted ready for the secondary winding.

The secondary consists of 10 turns in all, five to each layer. The winding is composed of three No. 4 D. C. C. wires wound in multiple as shown in Fig. 8. The wire should be on three spools arranged conveniently in back of the operator who should wear canvas gloves in handling the heavy conductor. The wires will have to be tapped in place with a small wooden mallet. The starting ends are soldered to a piece of heavy copper strip, the winding done, and the finishing end secured in a similar manner. A substantial covering of press board finishes the windings after they have been liberally painted with armalac or a similar compound.

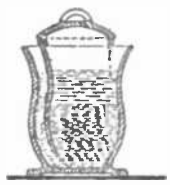
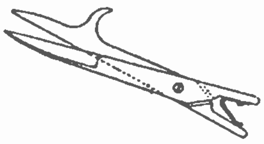
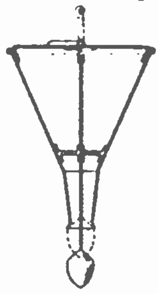
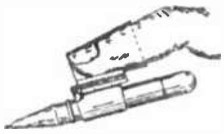
The legs with the windings on may then be set on end and the 3 by 6 inch pieces of steel interleaved in order to complete the magnetic circuit. One end of the core complete is shown in Fig. 2. A slight tapping with a light hammer will set up the irons.

THE MOUNTING

The mounting is clearly shown in Fig. 10 as is also the direction of the windings. The builder should determine this very carefully by placing the cores end to end before assembling and then noting which terminals of the windings, when connected together, will produce a continuous winding in one direction throughout.

The copper ribbon taps are soldered to No. 10 flexible stranded conductor on the primary and to three No. 4 flexible stranded cables in multiple on the secondary. The cables are led to binding posts on the primary end and massive copper bolts on the secondary. The connections between the halves of the windings are made with strips of copper insulated with tape.

The April issue of this magazine will appear under its new title, THE WORLD'S ADVANCE. Don't forget the new name when ordering your copy from the newsdealer. An announcement regarding the change of name appears on pages 289 and 430.

Recent Novel Patents

An Unique Gravy Dish

A New York inventor has patented a gravy dish of such design as to permit of pouring out fat gravy from the top of the dish or lean gravy from the bottom, at will. As shown in the accompanying illustration, which is a cross section of the dish, the device is partitioned off so that when the receptacle is tipped on one side, the gravy is drained from the bottom, while on the other side the gravy comes from the top.

Shears of New Design

Several advantages are possessed by shears made after the design of a New York inventor. The newly patented shears have blades of about the usual size as shown in the sketch; these blades being normally kept open by a powerful spring. The usual handles are dispensed with.

An Automatic Funnel

A clever idea in the way of a funnel has recently been patented by an Illinois inventor. His invention comprises a funnel that is fitted with a sliding shaft through its center, at the lower end of which is a small, wedge shaped float. The action of the funnel is this: When liquid is poured through it into a bottle or other receptacle the float will rise when the liquid reaches it and finally press against the opening in the stem of the funnel and shut off the flow of liquid. Meanwhile, an upper pivoted member, which has previously been laying in a horizontal position, is raised to an upright position and locks the float tightly in place. It also indicates that the bottle is full.

Pen and Pencil Holder

The subject of a patent recently issued to an inventor of Texas is a pen and pencil holder. This device is readily slipped over the end of a pen or pencil and is provided with a sleeve through which the index finger of the writer is passed.

A Device for Swimmers

A Maine inventor has secured patent rights on a simple attachment for swimmers. His invention is in the form of a cone-shaped fabric bag held over a metal framework and strapped to the leg of a swimmer. An attachment for each leg is necessary. The action is simple, the bag spreading out and offering a good hold on the water when the swimmer pushes his legs back, and folding up and offering practically no resistance to the forward progress when the swimmer moves his legs forward preparatory to the next stroke.

Mud Guard for Automobile Wheels

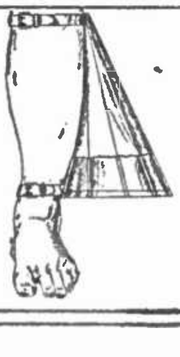
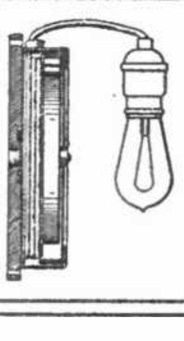
An attachment for the wheels of an automobile to prevent the splashing of mud is the object of the invention of a Rhode Island native. The attachment is in the form of a round ring of the size of the tire to which it is fastened. The ring is made of flexible material. It is said to prevent the splashing of mud which often inconveniences and aggravates pedestrians.

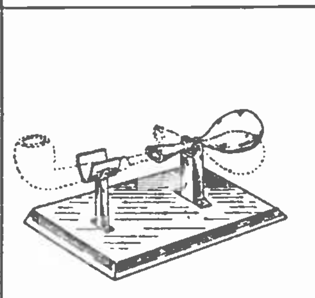
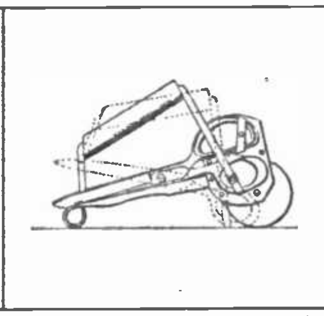
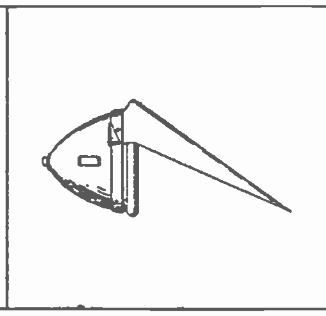
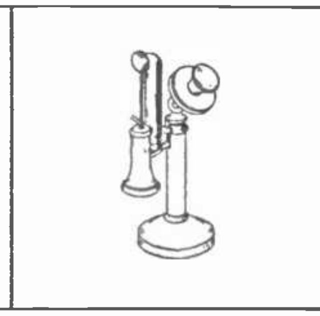
Device for Necktie

To facilitate the wearing of rings on neckties, a Maryland native has invented the simple article shown in one of the accompanying sketches. It consists of a single piece of wood or other material, tapered at one end and wedge shaped at the other. The ring to be worn is slipped down over the necktie with the device in the rear, and when it is tightly wedged, the clip member near the lower end is securely fastened to the back portion of the tie.

Handy Electric Lamp

Two Indiana inventors have jointly patented a convenient form of electric lamp and cord, the main feature of the device being that the lamp cord is always wound up on a reel by means of a spring, within a compact case when not in use. The case can be screwed on a wall and when the lamp is desired in any place, it can be carried about and the lamp cord will be fed out as fast as required.

Smoke Pipe Tester

A New York inventor has patented a smoke pipe testing arrangement which is illustrated in one of the accompanying sketches. The device is essentially comprised of a pneumatic bulb, a tapering mouthpiece for receiving the end of the pipe stem, and a suitable stand for holding the pipe. The inventor states that the device will greatly simplify the cleaning out and testing of a pipe stem and its bowl.

Attachment for Shears

A New Jersey inventor has devised a clever attachment that may be used in conjunction with any ordinary pair of shears to facilitate the cutting of goods. His attachment, illustrated in one of the accompanying sketches, when moved along by the handle causes the blades of the scissors to open and close. With this attachment a great saving in time can be effected when cutting fabrics.

Automobile Lamp Attachment

What appears to be a simple plan for eliminating the dangerous glare of automobile lamps is presented in the invention of a Westerner. As shown in one of the accompanying sketches, his invention consists of a simple hood attachment that is placed in front of an automobile head-light. The attachment is so designed that it permits the rays of light to be cast downward, yet shields them from glaring into the eyes of autoists coming in the opposite direction.

A Telephone Attachment

An inventor of Philadelphia has secured patent rights on a novel attachment for desk telephone instruments. As shown in the accompanying illustration, the attachment is in the form of a tube that is clamped to the stand and which contains a weight that is attached to the telephone receiver by means of a flexible cord. The inventor claims that this device facilitates replacing the receiver on the hook arm. The invention suggests another device that would prove very useful. Inasmuch as the cord of the receiver usually becomes twisted, an attachment might be devised that would automatically roll up the cord upon replacing the receiver on the hook arm.

Boat Propelling Mechanism

A simple paddle action for propelling boats is the subject of a patent granted recently to a Georgian inventor. By a chain drive from a gasoline engine or other suitable source of power, two paddles are alternately operated so as to give the boat a constant, forward movement.

Attachment for Pens and Pencils

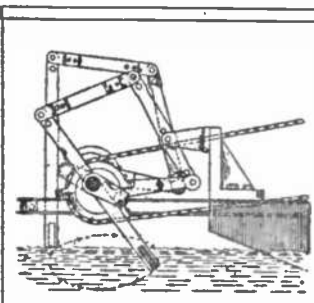
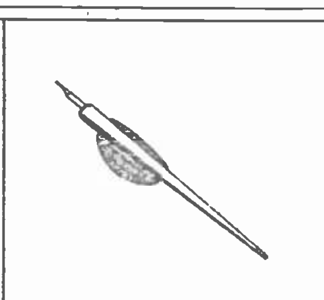
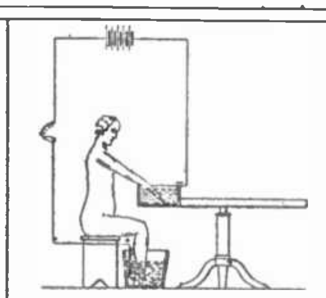
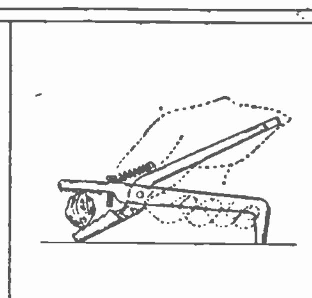
A Chicago inventor has recently patented a device for use with any pen or pencil. His invention is illustrated in one of the accompanying sketches, and it will be noted that it is in the form of a grip for the fingers of a writer. The shape of the device, combined with a weight placed in the lower portion of it, is claimed to make handwriting an easier task and far less tiring.

Extracting Metals from Human Bodies

An Englishman has secured American patent rights on a simple method of extracting metals from the human body. His plan is to have a patient place both hands in a conducting liquid contained in a suitable receptacle, and both feet in another receptacle filled with conducting liquid; electrical connection being thus established through the body. It is stated that certain metals in the body will thus be extracted and deposited on the electrode placed in the foot bath. Such a system would probably be of great aid in treating lead or copper poisoning.

An Improved Nut Cracker

A Pennsylvania inventor has secured a patent on a nut cracker of modified design. In order to facilitate the cracking of nuts, he has provided his device with a bent handle that serves to rest the cracker on the table so as to secure greater pressure. The ridges in the jaws have also been designed to give greater efficiency. One unique feature of the device is a spring for automatically opening the jaws after pressure has been removed from the handles. Another is presented in a set screw which limits the distance to which the jaws may close. Not only does the latter feature prevent the nuts from being badly smashed, as is often the case with the conventional designs of nut crackers, but it also eliminates the possibility of bruising the hand of the user should it be carelessly placed between the handles.

Questions and Answers

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

ROTARY GAP.

(15) H. W. M., Unalaska, Alaska, writes:

Q. 1.—Can you suggest any means whereby I can use a closed core transformer on a 135-volt storage battery circuit?

A. 1.—It is rather unsatisfactory to try to use a closed core transformer on interrupted direct current. If you had an electric interrupter at your disposal in which you could vary the number of interruptions per minute, you might try it with the transformer and see if your results would warrant its permanent use. We doubt if the results would be very successful.

Q. 2.—At what speed will I have to run a 32-point disk to get the tone of a 250-cycle generator?

A. 2.—950 R.P.M.

ALTERNATING CURRENT MOTOR.

(16) T. P., Hamilton, Ont., asks:

Q. 1.—In making the alternating current motor described by Leeth in the July magazine what sized wire should be used on the armature?

A. 1.—Almost any size will answer, the larger the better. The ends are merely attached together on a short-circuit, for magnetizing effect is a mátter of ampere-turns. Large wire will give fewer turns but more amperes than fine wire, but the product of the turns and amperes will be about the same.

Q. 2.—What causes the armature to revolve?

A. 2.—A complete explanation of the operation of a single phase induction motor is long and abstruse. In general, the motor is not self-starting. Only as special devices are employed is it enabled to make even a feeble start. As long as the armature is stationary it is merely a short-circuited transformer secondary. When started by hand or any other means, additional currents are induced in the armature by virtue of the dynamo action. The resultant field magnetism set up by these two currents produces a pulsating effect that somewhat resembles a two-phase motor. The explanation of the operation of two-phase and three-phase motors is readily found in most books on electrical engineering.

Q. 3.—How are the two field spools to be connected in "multiple"?

A. 3.—Each is to be an independent path for the supply currents. Ignore the existence of one of the coils, and connect the other to the supply mains. Now connect the ends of the second coil to the same points to which the first is already connected. The connection should be made in such a manner that the currents will flow in opposite directions around the two coils. This you can check by merely following the course of the winding, or testing the polarities with a magnet or compass, direct current being applied during the test, say from one or two dry cells.

INDUCTION ON BELL WIRES.

(17) E. A. D., Longport, N. Y., writes:

Q. 1.—After I send with my wireless set I notice that the electric bell starts to ring and will continue sometimes for as long as ten minutes, then stop. The trouble is removed when I ground one wire of the bell circuit. I use a ¼-kw. transformer. What causes the bell to ring, then stop?

A. 1.—The induction from the wireless set causes high voltage currents to be set up in the bell wiring. The insulation on these wires is not capable of standing such a high voltage and the result is that at some place where the two bell wires come together the insulation is charred off and a poor short circuit forms. After the bell has rung for a few minutes the bell batteries are somewhat run down and as the short circuit is not a good one there is not enough power to maintain it and the bell stops ringing. When you next start sending the high voltage induced in the wires again closes the short circuit and the bell will ring for another period. Grounding the wire stops this induced voltage in the closed circuit and there is no spark to start a short circuit.

Q. 2.—I always understood that the more ground connection you used the better. I have connected a wire fence to my regular ground and instead of improving the signals it actually weakens them.

A. 2.—The wire fence in itself is probably not well grounded and acts as a capacity ground connected direct to a metallic or earth ground and therefore as a grounded aerial in the vicinity of your regular aerial. In general, your proposition of the more ground the better is correct.

REWINDING A MOTOR.

(18) K. H. R., Oakland, Cal., asks:

Q. 1.—What changes should be made in a 1-h.p., 500-volt motor to adapt it for use as a 50-volt generator? Machine has four field poles, each wound with No. 30 d.c.c. wire. Armature has 32 slots and is wound with No. 23 wire, but commutator has 93 segments.

A. 1.—At present the four field coils are of course connected in series, but if you were to use the machine for 100 volts you could merely connect them in parallel and thereby not have to rewind them. If you desire to use the present wire, though admitting the necessity of rewinding it, you could wind two wires in parallel and finally connect the four spools in parallel with each other. If you prefer new wire and to put the four in series, use No. 21. This larger size will wind more economically than the other, so you will be able to get 10 per cent. more weight in place. The armature is evidently series wound, there being the full 32 sets of coils, three coils per slot, but one of them is left disconnected, it merely filling the space, and the remaining 31 sets furnish 93 coils and connect to the 93 segments. For your low voltage case you should seek to use the multiple winding with 32 complete sets of coils and an even number of commutator segments. By judicious solderin~ at the places where the winding connects you can bunch the segments in twos and threes, thereby getting the effect of 32 distinct groups. Still, the segments are so thin as to promise difficulty in soldering in the regular windings. If only you could insert three more segments you could wind the armature coils with three wires in parallel, and have groups of three segments of the same potential. The simplest method will be to get a 32-segment commutator and wind the armature anew with 32 coils, each consisting of No. 17 wire. The machine will be good for 20 amperes.

A. C. MOTOR ON D. C.

(19) A. R. B., San Leandro, Cal, asks:

Q. 1.—Will the alternating current motor described on page 79 of the July, 1914, magazine operate on direct currents?

A. 1.—Not as there described, but if you connect the ends of the armature winding to a 2-segment commutator, and apply brushes at the right position, it will run, but will not be suitable for a voltage much above 25.

Q. 2.—What size of wire should be put on rotor?

A. 2.—For the alternating current use it will make but little difference—its ends being merely connected together on a short-circuit. The intention was to use the same size as on the field magnet, *i. e.*, No. 18. For direct current working perhaps No. 20 would be better. For the alternating current case as described, wind 20 turns on one side of shaft and connect the ends together. Then wind a similar coil on other side and connect its ends together. Be sure you recognize that an "induction" motor was described, and in such a case it is not necessary that the rotor should have any external electrical connection.

GENERATOR WINDINGS.

(20) G. W. C., Hamilton, Ont., asks:

Q. 1.—What should be the proper winding for a bipolar dynamo having a field bore 3 1/16" in diameter and 2¼" long axially, with a 12 slot armature?

A. 1.—You will find excellent drawings and descriptions of a dynamo of almost these dimensions in Watson's "How to Make a ¼ Horse-Power Dynamo," published by the Bubier Publishing Co., Lynn, Mass. You should make the pole tips a little closer together than you have shown in sketch, and have no such extent of waste room between field spools and pole tips. Perhaps you intend to make the field in one piece. This is an attractive feature, but leads to inconvenient constructions in other points, or else reduces the possible output. You should be able to get 200 watts out of such an armature.

ARMATURE WINDING.

(21) C. F. H., Spokane, Wash., asks:

Q. 1.—What should be the armature winding for an existing 110-volt shunt motor for changing it into a 6-volt generator, field magnet being retained as it is to permit operation separately excited? It has ring armature, 4½" in diameter, 2½" wide.

A. 1.—As you give no idea of the present size of wire nor dimensions of the field magnet, we are helpless to make an explicit reply. In general you ought to be able to use present commutator, but using larger wire with fewer turns per coil. Probably the armature is of the smooth-core type, and we should judge that a single layer of No. 12 magnet wire would suffice. With more explicit information we could furnish a more precise answer.

It is not possible for this department to answer questions by mail. Persons wishing prompt answers by mail should send the regular fee of fifty cents to cover the cost of the work. If this is not sufficient, they will be advised as to the additional cost. This service is only offered to readers and the price charged often does not compensate for the time involved.

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.

LACK of understanding has, in many instances, not only placed the amateur radio-experimenter in an unsettled state of mind in regard to the requirements necessary for compliance with the United States radio laws, but it has also prevented the full realization of the benefits he should derive from his equipment.

AERIALS AND THE LAW

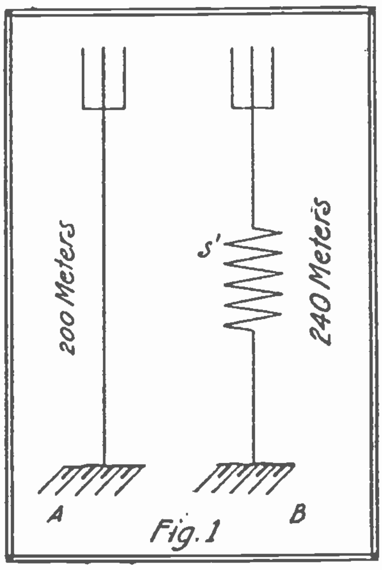
Hundreds of times the writer has been confronted with the question: "What are the proper dimensions for an aerial to have a wave-length of 200 meters in accordance with the United States regulations?" This query alone betrays a misunderstanding of the underlying principles and for that reason a few words of explanation may not be amiss. The proper answer is: To conform to the Government regulations you do not require an aerial having a natural wave-length of 200 meters, provided you intend employing an oscillation transformer to transfer energy to the aerial circuit.

It should be clear that if the aerial shown in Fig. 1 at *A* has a natural wave-length of 200 meters, and the secondary winding of the oscillation transformer *S'* is then connected in series, as shown at *B*, the emitted wave due to the added value of inductance will be considerably above 200 meters, immediately placing this station under the ban of the radio regulations. Since it is not good practice to insert a series condenser to reduce the wave-length of the antenna to 200 meters, the only remaining alternative is to so proportion the antenna at the start that when the secondary winding of the oscillation transformer is added, the wave-length of the antenna circuit will be near to a value of 200 meters.

This is by far the method to be preferred, but it often elicits disgust from the amateur when he compares his law-abiding transmitting aerial with the one he possessed before the Government authorities took a hand in the matter.

It may be well to announce here that the writer has been reliably informed that amateur stations located within the zone of interference—that is to say, so located that they may possibly interfere with the carrying on of commercial business—are expected to meet the requirements demanded from the regular com-

* This is the first part of this excellent article by Mr. Bucher. The second and concluding part, dealing with oscillation transformers, receiving tuners and other problems of the average wireless amateur, will appear in the April issue.



Wave Length of an Aerial With and Without Oscillation Transformer.

mercial stations in respect to the character and decrement of the emitted wave; while on the other hand, amateur stations located outside the zone of interference, may, upon satisfactory evidence to the Radio Inspector, be allowed to operate their equipments when the emitted wave does not fully comply with the law. Interpreted more plainly, this means that amateur transmitting stations within the zone of interference must use an oscillation transformer having a variable degree of coupling so that the least possible degree of interference is produced, whereas those stations outside the zone of interference may simply connect the spark gaps of their induction coils in series with the antenna, that is to say, use the plain aerial connection. This latter statement, however, applies more particularly to stations which were in operation when the law took effect. New stations should endeavor to meet all conditions regardless of their location.

The amateur employing an oscillation transformer must have an antenna the wavelength of which is considerably less than 200 meters, while one who is using the "plain aerial" connection should erect an aerial having a natural wave-length of 200 meters.

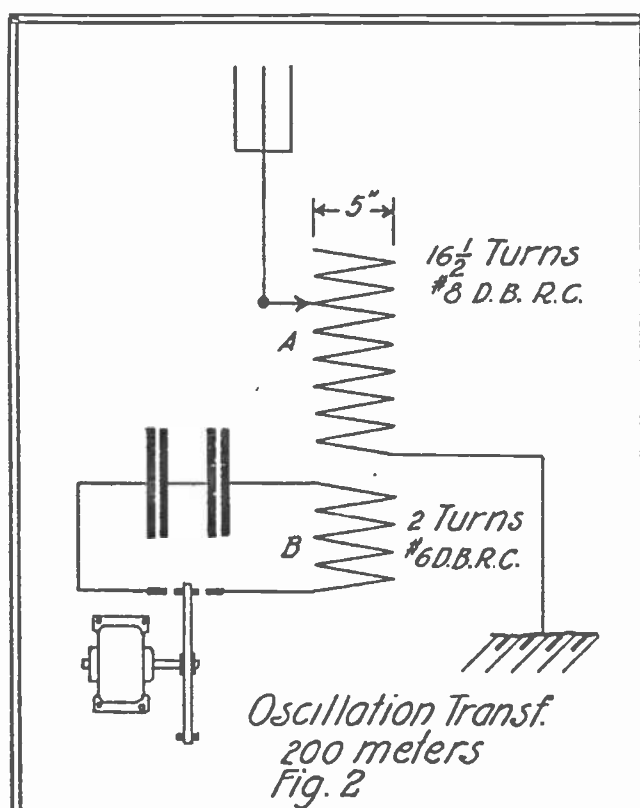
In order that an amateur's apparatus may comply with the law, data as to the proper dimensions of a 200-meter aerial may be of value. An aerial consisting of four No. 14 wires spaced two feet apart and having a height of 40 feet, with a flat top portion 50 feet in length, will have a natural wave-length very close to 160 meters. Dimensions of other aerials giving approximately the same wave-lengths are as follows:

Vertical Height.	*Flat Top Length.*
32 feet	60 feet
20 "	70 "

It is not expected that the amateurs in all sections of the country will be able to so place their aerials as to comply specifically with the foregoing-mentioned dimensions, but the measurements given may be referred to for guidance.

Supposing it is desired to raise the wave-length of an aerial from 160 to 200 meters by a coil of inductance which is to constitute the secondary winding of an oscillation transformer. It may be built in the following manner: A mandrel or any insulating support 5 inches in diameter is wound closely with 16½ turns of No. 8 D. B. R. C. wire. When this inductance is placed in series with the aerial of 160 meters as shown in Fig. 2, the wave-length of the circuit will be raised to 200 meters.

It should be thoroughly understood that the inductance coil may be used as the secondary winding of the oscillation transformer, being placed in inductive relation to primary winding *B* as in Fig. 2. The dimensions of the latter winding, *B*, will, of course, depend



Connections for an Oscillation Transformer, Condenser and Rotary Gap.

upon the value of condenser capacity in use, but as a rule it may consist of one or two turns of, say, No. 6 D. B. R. C. wire. To obtain radiation these turns are not necessarily wound tightly over the secondary turns. It will probably be found that in order to comply with the law, they may have to be placed a few inches from the secondary winding.

The amateur whose station is so situated that he is allowed to connect the spark gap directly in series with the antenna (plain aerial connection) may erect an aerial having a natural wave-length directly at 200 meters. Dimensions for such aerials are tabulated as follows:

Vertical Height.	*Flat Top Length.*
35 feet	75 feet
30 "	80 "
50 "	60 "

These dimensions are based on an aerial composed of four wires spaced two feet apart.

The writer's attention has frequently been called to the fact that many amateurs erect aerials of "freakish" design. This is generally due to the lack of space, but in many cases the antennæ are so constructed with the thought that greater radiation thereby results. The "zig-zag" type of aerial may be mentioned in this respect. It is believed that a great increase in wave-length is obtained. True enough, the wave-length of the aerial is slightly increased by "zig-zagging" due to an increase in capacity, but the inductance of such an aerial, due to the "doubling back" of the wires, is decreased and the desired improvement is only partially experienced.

Transmitting aerials should be symmetrical in design and possess uniformity of construction throughout. This seemingly is not such an important factor in receiving aerials as in transmitting aerials. It may be of interest to the amateur field to know that it has been pretty well proven through experiment that a long, narrow aerial of standard construction is far superior to that type which, in the language of certain amateurs, is "spread over an acre lot."

TRANSMITTING CONDENSERS

A problem which presents much confusion to the amateur is the proper size for a condenser for a 200-meter transmitter. It may be said that the maximum capacity that can be used in the closed oscillatory circuit of the transmitting set is 0.01 Mfds. Even with a capacity of this value, the primary inductance coil of the oscillation transformer previously described need not possess more than one or one and a half turns, which will be quite sufficient for the transfer of energy. A condenser having this value of capacity may be readily constructed in the following manner: A plate of glass ⅛-inch in thickness and with other dimensions of 14 inches by 14 inches, covered on both sides with tinfoil having dimensions of 1 inch by 12 inches, will have a capacity value of approximately 0.002 Mfds. Five of such plates connected in parallel will give the desired resultant capacity for 200 meters. If, in order to eliminate all fear of puncture due to excessive voltage, series parallel connections are to be used, twenty plates will be required—ten in parallel in each bank and the two banks connected in series. This connection will reduce the strain on the plates by one-half. Or if desired a condenser possessing the same capacity can be used instead, the dimensions being: Twenty-four or twenty-five plates of glass, 8 inches by 8 inches, covered with tinfoil 6 inches by 6 inches. When these plates are connected in parallel, the resultant capacity will be the same as the condenser decrement above, 0.01 Mfds. The size of the transformer required for this condenser will depend entirely upon the frequency and potential of the transformer and unless definite knowledge in this respect is given, no advice can be offered. However, this one example may be of help: If the transformer secondary potential is 15,000 volts and the set is employed in connection with a rotary gap having twelve points equally spaced and rotating at a speed of 3,000 R. P. M., the outfit will consume about ¾ K. W.

ROTARY GAPS

The amateur experimenter often ignores the fact that there is considerable difference between the number of interruptions of the closed oscillatory circuit produced by the rotary gap and the corresponding tone or note. He is unaware that the quality of the note depends to some extent upon the distance between the moving electrodes (on the disc) as well as the speed of the disc.

The writer once visited a certain amateur station employing a disc discharger which had 20 points on a disc 4 inches in diameter revolving at a speed of 3,000 R. P. M. Upon testing the gap the amateur was surprised to find that the note was not musical. The facts were that the moving electrodes passed the stationary electrodes so rapidly that a practically continuous spark discharge surface was presented, giving the gap no time to clear itself between the interruptions. The resultant note was no different than that obtained with the plain two-electrode stationary gap. As a remedy, the writer suggested either a larger disc with the same number of points or the same disc with a reduced number of points. Both methods were tried and a more musical note was produced.

For amateur use in connection with a ½ K. W. set, the writer suggests a rotary disc with the following dimensions: The disc should be made of black hard fibre or of Bakelite, ¼-inch in thickness and 8 inches in diameter. The disc should be fitted with eight electrodes of brass 3/16-inch in diameter. The electrodes should be slightly rounded at the tips, and placed through the disc and firmly fastened with nuts and washers. The electrodes must be of absolutely uniform length and all should project a uniform distance. The stationary electrodes should be of similar diameter, but may be fitted with cooling vanes. The disc should then be mounted on a D. C. motor having a normal speed of 2,400 R. P. M., but capable of adjustment from 2,000 to 3,000 R. P. M. For speeds below 2,400 R. P. M., a series resistance is connected in the line to the motor. For speeds above 2,400 R. P. M., a resistance coil is connected in series with the field coils of the motor. The latter resistance may consist of 16 C. P., 110-volt lamps used in parallel or in series parallel, depending upon the design of the motor.

When selecting a disc for a rotary spark gap the amateur had better assure himself that the material will stand the peripheral speed required. If in doubt, the disc had better be mounted on a high speed motor and tested at a speed somewhat in excess of that at which it is to be used, making sure to stand at a distance during the test. The writer recently witnessed a purchased rotary gap of popular make collapse at a speed of 3,400 R. P. M. The flying spark electrodes cut gashes ¾-inch in depth in hard wood and other particles wrecked a heavy plate glass window!

Where rotary gaps of the non-synchronous type are employed there should always be some means at hand for controlling the secondary voltage of the transformer, for it is invariably found that a clear note is a result of the voltage adjustment, as well as of the speed of the disc. It may also be added that in changing from a fixed spark gap to one of the rotary type the existing condenser capacity, if it was of the proper value in the first place, must invariably be reduced.

Owing to the differences in wave form of generators and transformers, also the different values of secondary voltage found in the amateur transformer, the proper condenser capacity is best determined by experiment, but in any case for a 200-meter wave it must be at least below 0.01 Mfds.

SHOCKS BY WIRELESS

At Clichy-Levallois, a suburb of Paris, some electricians received severe shocks from touching a large mass of stored telegraph-wires not connected with any system. An investigation showed that the shocks were caused by Hertzian waves sent out from the great wireless station on the Eiffel Tower, a few miles distant. By a curious accident the group of wires happened to present all the conditions of height, distance and position essential to receiving communications from the Eiffel station.

A New System of Radio Communication

By Robert G. Skerrett

FOR years the world generally looked upon Peter Cooper Hewitt's mercury-vapor lamp as the climax of the mercury-vapor arc's usefulness. But Dr. Hewitt has a restless scientific mind, and he dreamed of other applications of wide practical value. He was convinced that there were many things going on within the glowing vacuum of his lamp beside the electric current colliding with minute particles of floating mercury. And so, for sixteen years he has been patiently watching and studying this arc, and now he is ready to give to the world an entirely new development for radio communication.

Indeed, he not only promises to advance the art by tremendous strides but he reasonably assured us that wireless telephony over long distances will be within the financial reach of all of us. Let Dr. Hewitt tell the story of his remarkable invention in his own way:

"I have found that there are nearly forty different things going on inside the tube of a mercury-vapor arc, but in the beginning I thought there were scarcely more than three. It was not long after I had perfected the mercury-vapor lamp that I discovered a strikingly peculiar characteristic. In an ordinary incandescent bulb, if an alternating current be used, the current still remains alternating after passing through the filament and continuing along its path in the circuit. Now, when alternating current is fed to a mercury-vapor lamp it comes out at the opposite terminal in the form of a continuous or direct current. In other words, it is completely transformed. I wondered at this and tried to discover the reason for it. In working away at this puzzle I identified the numerous phenomena that are part of the active life of the mercury-vapor lamp. Latterly I have learned how I can make use of certain of these electrical characteristics.

"Hertzian waves are vibrations of the universal ether, and when these undulations are given sufficient energy or impulse they will travel long distances. The familiar simile of the continually-widening ripples from a stone dropped into still water is sufficiently accurate for ordinary purposes. If the original disturbance be not great enough the spreading wave-rings will diminish gradually and finally disappear before going far. Oppositely, a violent agitation of the water will produce bigger waves and stronger ones, and these will travel farther before dying out. Let us illustrate the practical application of this theory that we may see the function my apparatus will perform.

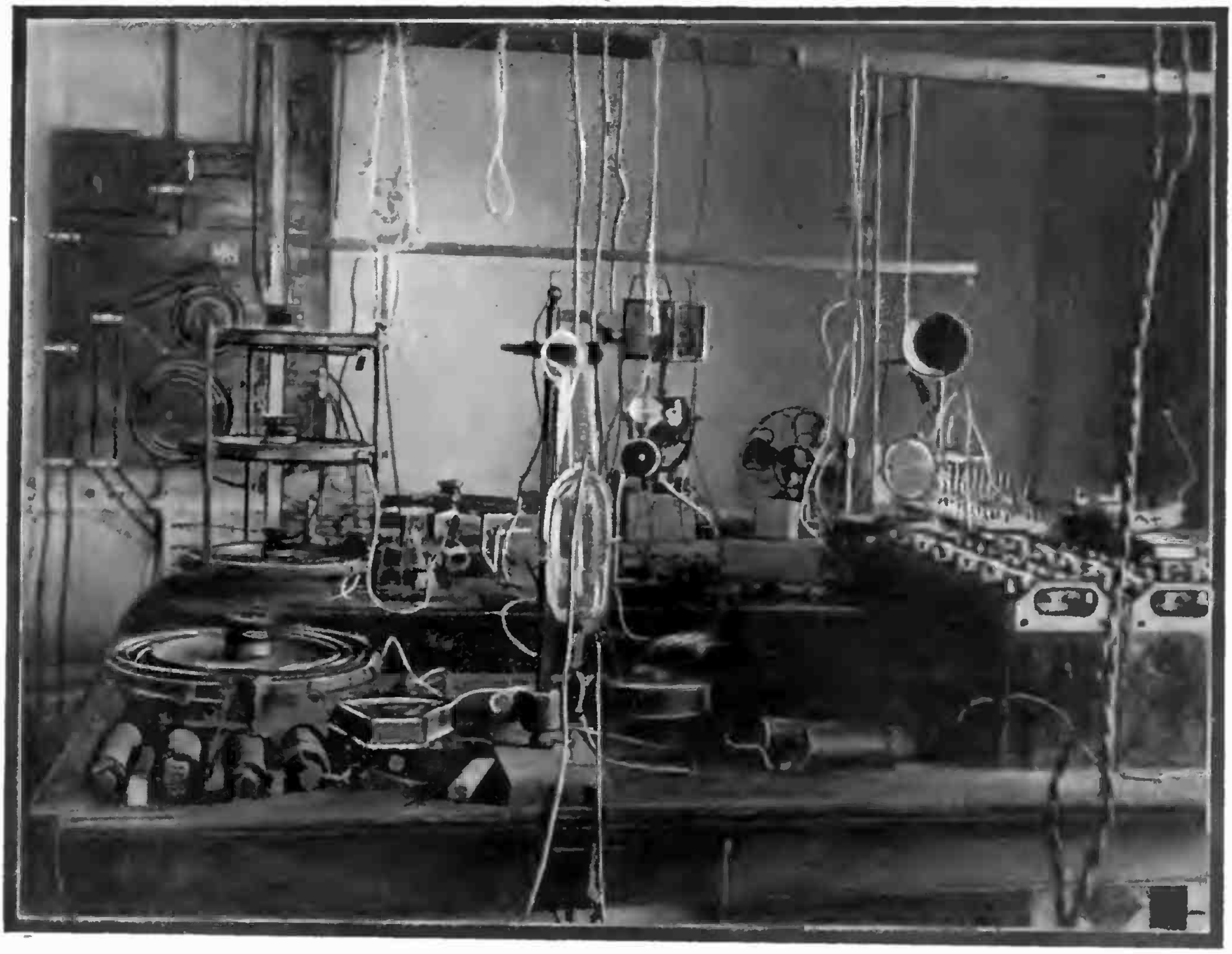
"There are in service to-day two kinds of oscillators for the production of Hertzian waves for radio communication. One, which generates a rapid series of powerful sparks at the gap of an electric circuit, is the means by which long and short wave-trains, representing the dashes and dots of a telegraphic code, are sent out through space; and the other causes a continual agitation of the ether—the dots and dashes being represented by breaks occasioned through the changing of the wave-length. That is, the receiving apparatus is tuned let us say to a wave-length of 4,100 meters and is insensitive to arriving wave-lengths 200 meters shorter. The sending operator merely works a key so as to effect this variation in the constant stream of undulations. This system was invented by Waldemar Poulsen of Denmark.

"The spark-gap oscillators are costly affairs; the big rotor for this work weighing five tons in one of the trans-Atlantic plants. It is built wellnigh as carefully as a watch and, to carry the comparison further, is pretty nearly as delicate. Constant heavy work is apt to derange it. Mechanically, the Poulsen arc is much simpler, but the difficulty lies in the fact that the carbons between which the flame is made burn out rather quickly and are expensive to replace.

Nevertheless, it is the oscillator that produces continuous waves that is most efficient. How is this?

"Returning to the simile of the water ripples, if you keep up an unceasing agitation, as with a stick, without increasing the energy employed, the little waves that otherwise would soon die out if you moved the stick once will, when you keep it in motion, cause these waves to spread and spread until they reach the other side of a good-sized pond. In wireless, the difficulty, as I have just said, lies in the producing of continuous undulations even though theoretically the thing desired. I have found out that I can get from a mercury-vapor-arc oscillator, weighing not more than two pounds, an uninterrupted flow of Hertzian waves that will reach as far as those generated by the sparking machine in which the rotor weighs quite 10,000 pounds!

"Conversely, my mercury-vapor-arc receiver will pick up any Hertzian wave, be it long or short; and in these two apparatuses I have the essentials of a successful long-distance system of wireless telephony. As you know, the telephone must be responsive to wide variations of wave-lengths or vibrations, because in common speech the different vowels and consonants vary widely in this particular. Here is where the wireless telephone and the wireless telegraph are quite unlike. My experiments have shown that my receiver will respond to any sound wave and will be equally acute to waves of such frequency that they are beyond the scope of audibility. The wonderful part of the receiver is its astonishing ruggedness, for while this form of mercury-vapor arc is exquisitely sensitive to the least ether impulse, it can withstand the shock of the current from a discharge of lightning! This



Experimental Wireless Station of Dr. Peter Cooper Hewitt in which the Mercury-Vapor Arc is Employed for Both Transmitting and Receiving Purposes.

is the natural evolution of my rectifier which changes alternating current into direct current."

An X-ray tube when working gives forth a hissing sound, and a mercury-vapor arc ordinarily does the same thing. When he first tried to adapt this apparatus to wireless, Dr. Hewitt found that his telephone receiver roared like a great conch shell. All that his ear heard was a confused din. His problem was to silence this racket, and it took him a long time and called for many experiments before success was won. The little globe in Dr. Hewitt's laboratory is not more than a foot long, and looking into it one can see the glow flutter in exact unison with the long and short sounds coming through the telephone ear-piece and representing wireless telegraph signals. By sliding a little bridge along a series of contacts, the song of the wireless alters in pitch, and this change of key really indicates the signals from a different station. In some cases, the tone is deep like the whir of a humming bird's wings or, again, as shrill as the buzz of a gnat. The point is, that by shifting his receiver key, Dr. Hewitt can shut out all signals but those of the particular station he desires to hear. This is just how he will be able to insure privacy in the working of his wireless telephone, and the range of receptivity, because of the astonishing adaptability of the mercury-vapor arc, will include the gamut described in the preceding paragraph. In short, because of its remarkable flexibility, so to speak, the mercury-vapor arc plays the part of the ordinary detector.

In order to make a conversation secret, the keynote of the sending apparatus or mercury-vapor-arc oscillator, and the resonance of the Hewitt receiving arc are attuned, and this can be accomplished by using wave-lengths higher in frequency than those of any existing commercial wireless telegraph system. In fact, Dr. Hewitt will purposely employ waves ordinarily of the inaudible class because of their greater vibratory speed. Just the same, the person speaking into the transmitter would unconsciously qualify these waves so that they would reproduce the voice after these delicately shaded impuses had been caught by the wonderfully sensitive receiving arc and amplified thereby. Understand, of course, the mercury-arc receiver is linked into the local circuit of the receiving telephone, and the effect is virtually that of controlling a relay. Because of its power to amplify the effects of the arriving waves, the Hewitt apparatus gives all of the impulse shading in the local circuit or relay needful to reproduce the sender's voice distinctly even though coming from afar. Again, the speech of the sender is made to impress itself upon the wave-forms sent abroad by means of the mercury-arc oscillator, and these identities, so to speak, travel through space, undeformed, and awaken corresponding responses in the receiver distantly removed.

Dr. Hewitt proposes that the sound signals received by his mercury-vapor arc shall be reproduced on a tape in the form of dots and dashes; in fact, he has actually done this already, and thus code messages may be preserved and deciphered at leisure. Waldemar Poulsen gave us the telephonograph, which records, in the form of magnetic charges, vocal records upon a steel wire, which can be reproduced at will. For commercial service, in connection with his own invention, Dr. Hewitt would utilize the Danish apparatus to preserve long-distance-wireless telephone conversation as well as the signals of Hertzian wave telegraphy.

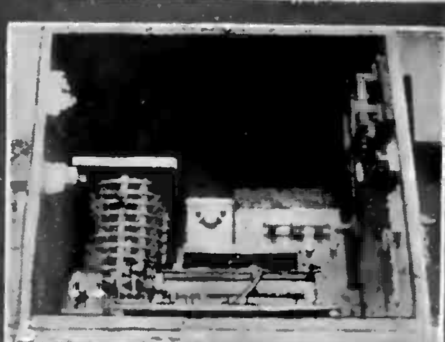
RESTORING THE SENSITIVENESS OF A GALENA DETECTOR

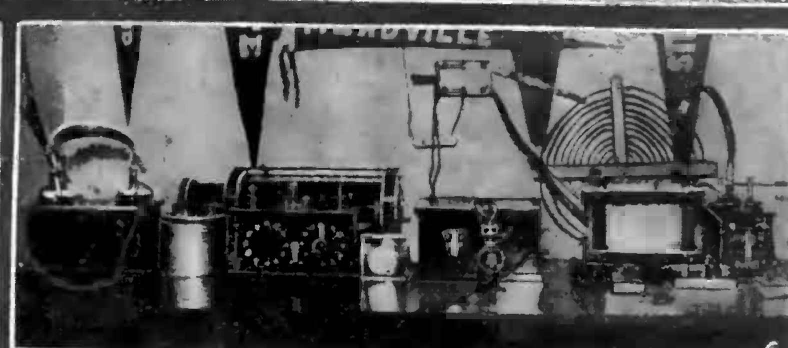
The most sensitive piece of galena employed in a detector after it has been in use some length of time is found to have lost its sensitivity, or, to use the parlance of the operators, "has gone dead." In the following is described a simple method that will enable almost any galena detector to be continually maintained at its maximum sensitivity.

As a rule, mandolin or violin string

(Continued over leaf)

AMATEUR WIRELESS STATIONS





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

(1)—(2)—Transmitting and receiving outfit of Jacob Weiss of Port Washington, L. I. (3)—Wireless station of Robert Hornibrook, Marinette, Wis. (4)—Transmitting and receiving outfit of Wesley J. Jameson, Jr., St. Paul, Minn. (5)—Portable wireless outfit of Francis X. Murphy, Gloucester, Mass. (6)—Elaborate wireless station of Vincent Brown of Meadville, Pa.

is used for making contact with the galena crystal. The operator usually places the wire in the holder and considers this part of the work completed and devoid of further attention. When the detector has lost its sensitivity to an appreciable degree, the operator immediately sets to work with a brush, soap and water, and proceeds to scrub the mineral, while all along the cause of the trouble is not with that member of the detector.

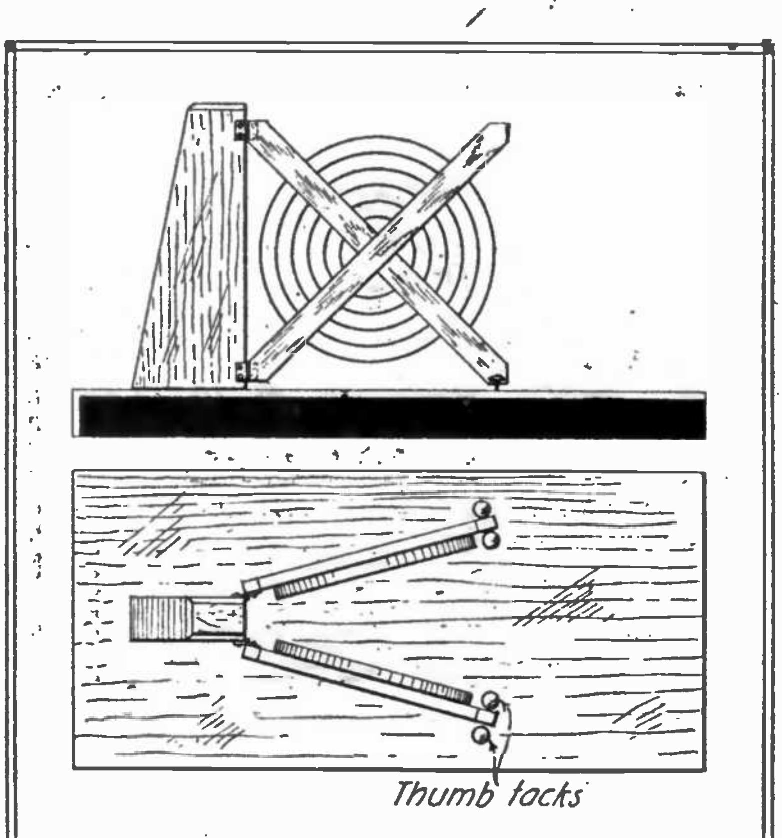
Instead of a mandolin string, which is usually hardened steel, the operator should procure a short length of stranded picture cord and pull out one of the strands which are usually of about No. 30 size. The wire is then cut at one end with a pair of scissors at a sharp angle so as to form a good point. This wire is then used in the detector; the operator finding that the efficiency of the detector is as great as ever.

The sensitivity of the galena detector can be maintained at its maximum by clipping off the end of the wire each day. Close examination of the end of the wire will indicate that it becomes tarnished in a short period of time and this has the effect of lowering the efficiency of the detector.—PAUL OARD.

INCREASING THE EFFICIENCY OF "PANCAKE" OSCILLATION TRANSFORMERS

As a result of several months' experimenting with "pancake" type oscillation transformers, the writer has arrived at the conclusion that sharper tuning and a closer positioning of the spirals can be attained if the coils are arranged in such a manner as to have the lines of force cut diagonally.

The scheme used by the author is very simple, as will be seen by the sketch. Both coils are mounted on cross pieces as shown and hinged to a wooden upright. After the spirals have been adjusted for the best results, nails or wooden pegs are driven into the wood as indicated to keep the coils in permanent adjustment.—WILLIAM H. SCHEER, JR.

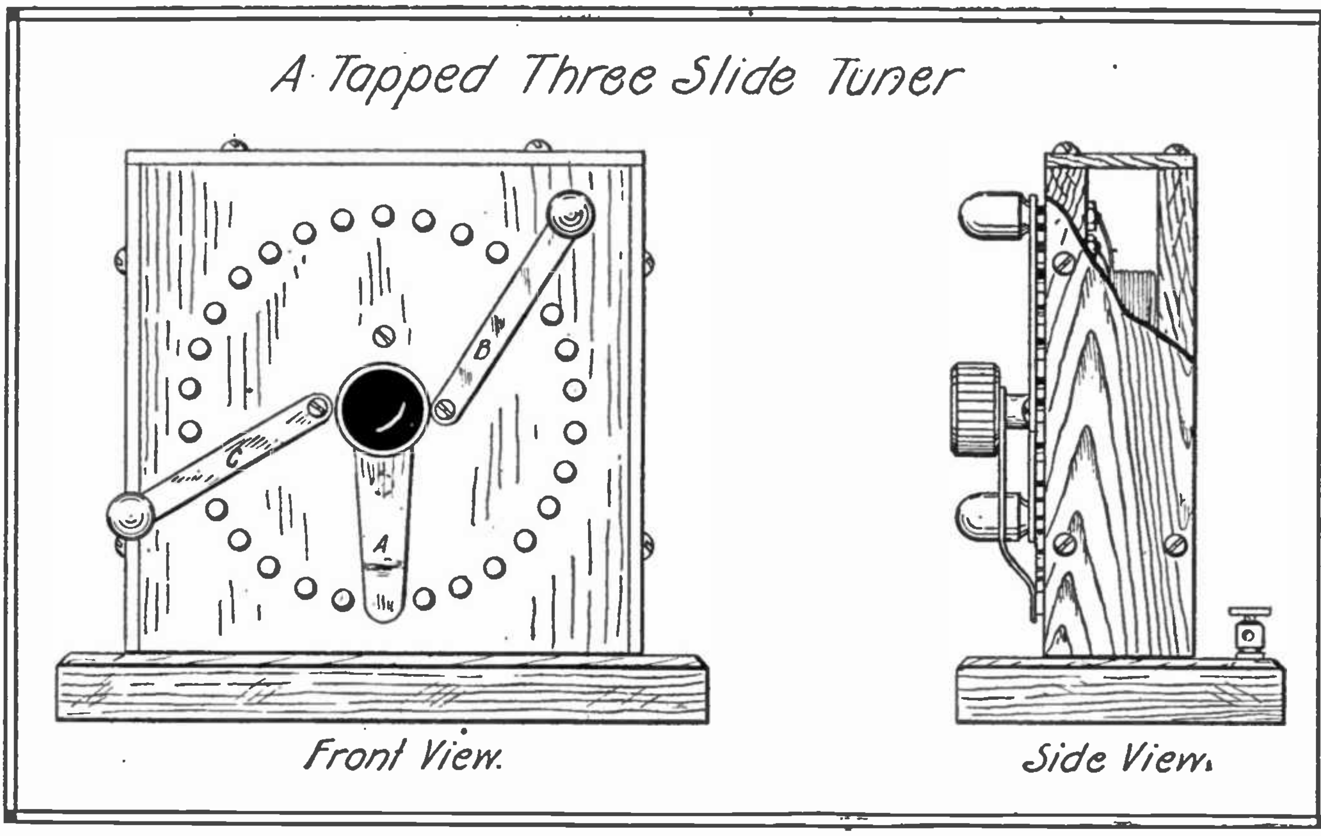


Scheme for Securing Greater Efficiency from a Pancake Type Oscillation Transformer.

A CORRECTION

Through an error the wireless station of Mr. Joseph G. Telmosse, Shawinigan Falls, Quebec, Canada, has been credited to Mr. Alfred Meuler of Oconomowoc. Wis. The view of Mr. Telmosse's station appeared on page 133 of the January issue, picture No. 2.

Don't fail to read the important announcement that appears on page 289 of this issue. It tells of the change of title as well as other facts of interest to readers. The next issue of this magazine will appear under the new title THE WORLD'S ADVANCE.



Front and Side Views of a Tapped Three-Slide Tuner as it Appears When Completed.

A TAPPED THREE-SLIDE TUNER

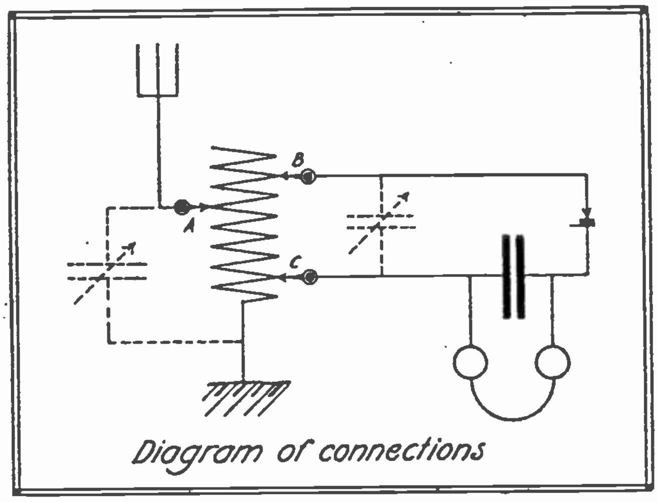
THE three-slide tuner has fallen into more or less disuse despite its many advantages, this being due to a great extent to the fact that amateurs have a keen dislike for any instruments employing sliders.

To overcome this objection, the writer has evolved a tapped tuner that retains all the advantages of the regular slider type, yet permits of greater ease in adjustment, as well as extreme compactness.

The tuner is mounted on a base measuring 6 by 8 inches, the edges being beveled to add to the appearance of the instrument. The front and back pieces measure 6 by 6 by ½ inch. The front piece is cut and drilled for 30 contact points mounted as shown in the illustration. These points are equally spaced around the circumference of a circle of 5-inch diameter. Holes are also provided for the three levers.

The foregoing accomplished, the levers are mounted in position, as shown. A knob is used on the center lever so that it can be readily turned to any desired contact, while other knobs are placed at the ends of the other two levers to facilitate adjustment. The levers are fastened at the back with nuts, these being placed in countersunk holes and connected to suitable leads. The leads are placed in slots.

The next step after mounting the switch points and levers in place is to turn a three-inch disc from ¾-inch stock. This disk is fastened between the front and back pieces by means of two long brass screws which also serve to hold the tuner together. The disk is then wound with No. 24 s. c. c. wire, the winding being as uneven as possible in order to eliminate any undesirable inductive effects which are usually encountered in layer wound tuners. A tap is taken at every eighth turn, this being found ample for comparatively close tuning. The



Wiring Diagram for the Tapped Three-Slide Tuner.

leads from the taps are brought to the contact points in proper sequence. It is advisable to solder all connections carefully in order that no loose contacts will arise later. The beginning of the winding should be attached to the contact point nearest the base.

The coil is then mounted on the base and the three leads from the levers are connected to three of the four binding posts that are placed in a row on the back of the base, while the remaining post is connected to the free end of the winding.

Thin pieces of wood may be placed at the top and sides of the tuner in order to give it a neater appearance.

In operation, the middle lever will slide over the other two levers which can be turned but a trifle more than half way. The tuner is connected into a circuit as shown in the wiring diagram, the different levers of the tuner being lettered to correspond to the sketch of the instrument.

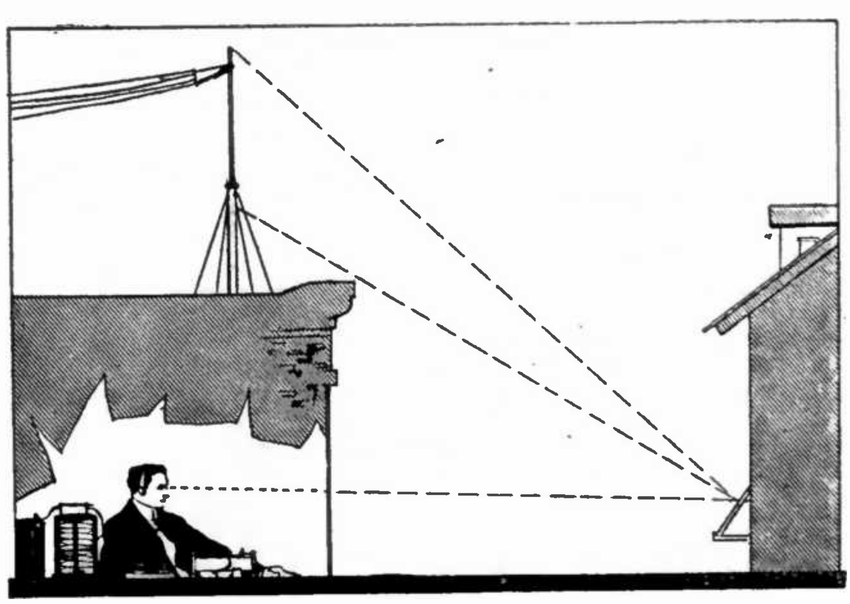
This compact tuner has a wave-length sufficiently great to hear amateurs, steamers, and most commercial stations. The signals will usually come in louder than with a loose coupler, although the selectivity is not quite as great. The additional variable condensers will, of course, lengthen the wave-length of the windings, as well as facilitate closer tuning.—THOMAS W. BENSON.

AN AERIAL SUGGESTION

Most amateurs in cities desire to keep a constant watch on their aerials in order to ascertain at any moment whether their aerial is in proper condition. Furthermore, it is often necessary to keep watch over an aerial to prevent its removal.

It is very inconvenient for anyone to be obliged to climb several flights of stairs to the roof in order to inspect an aerial. If the aerial is in front of the roof and cannot be seen from a window of the house, the following suggestion may probably be applied to good advantage:

Secure a mirror measuring about 1 x 2 feet and. after securing permission from neighbors on the opposite side of the street, erect the mirror in such a manner that it will enable a person standing at the window to secure a view of the aerial by means of the mirror's reflection. In this way it is possible to ascertain at a glance whether or not the aerial is in working order. It may also aid in catching the young wire thieves.—H. DORBE.



Without Leaving His Seat, an Amateur Operator Can See His Aerial by Means of a Simple Mirror Device.

A GIRL WIRELESS OPERATOR

ABOUT two years ago a young lady successfully applied for a position as secretary to Hiram Percy Maxim, Chairman of the American Radio Relay League. She had no knowledge of electricity and wireless, and probably no inclination for ever mastering the mysteries of either subject.

Two Views of Miss Cecil Powell and her Elaborate Receiving Set. She has Made Most of the Apparatus Herself in Order to Secure a Better Working Knowledge of the Subject.

To-day, the same young lady, Miss Cecil Powell, is an enthusiastic wireless operator and spends much of her spare time operating the wireless apparatus installed in her home. Only last October she decided to know more concerning the subject with which her work brought her into so intimate contact. She constructed in three weeks' time the greater part of her apparatus under the direction of Mr. Maxim, and thus gained a better knowledge of the subject than could have been secured through the study of books. When the apparatus was completed, she spent many a night listening to wireless signals and trying to read them. The work was slow at first, but after a while she could read a word, later, a few words and occasionally an entire sentence, and, finally, entire messages. According to Miss Powell, the learning of the code and the subsequent receiving practice was the slowest and most discouraging part of her wireless education.

When Miss Powell was recently asked whether she intended becoming a commercial wireless operator or merely had learned wireless operating as a pastime, she replied that it was only for her own amusement. She stated that it was a great source of amusement to her to listen to the conversations of others and be able to participate in them.

Miss Powell is said to be the only woman wireless operator in the state of Connecticut, the second in New England, and the fourth in the United States.

The next issue of this magazine will appear under the new title THE WORLD'S ADVANCE. There will be no alteration in the present editorial policy. Do not forget the name when ordering your copy from the newsdealer.

THERE are two extremely opposite factors that usually call for exclamations of surprise on the part of laymen being explained the mysteries of a wireless set: First, the great collection of apparatus of every conceivable description which they are led to believe is part and parcel of a wireless equipment; second, the utter simplicity of the instruments required to receive and send wireless signals through the air. And by far the admiration is greater when a simple equipment is demonstrated—and likewise the efficiency.

Simplicity—The Keynote of Efficiency

By Paul Oard

SIMPLICITY in wireless instrument construction and operation should be the keynote of every amateur's and experimenter's efforts. It seems to be the fervent desire of nine-tenths of those owning experimental stations, as soon as they have installed their sets and received a few messages, to crowd all the odds and ends they can collect on their wireless desks in an endeavor to give their station a mysterious appearance to the uninitiated.

A glance at the average amateur set will usually reveal, beside the radio set proper, an assortment about as follows: A magneto, a small shocking machine, about three extra detectors; a multitude of switches ranging from the small snap switch to the 1,500 ampere type; a telegraph sounder; a small motor, independent of the rotary gap; some "Hands off — 30,000 volts-don't-touch-me-on-pain-of-death" posters, distributed liberally around the walls; two or three coils of wire that serve no electrical purpose, and a weird collection of articles that only an experimenter can collect, from X-ray tubes to a make-and-break gas engine coil.

When the enterprising young Marconi brings in his friends, who, the chances are, couldn't tell a potentiometer from a spark plug, all this electrical display has an impressive effect upon them, and when he winds up the magneto, disturbs all the switches that he can locate, and, after putting the loose coupler through a series of gymnastics, says "Hush, here's Hong Konk talking to Moscow," they all say (and what professional operator hasn't heard this expression, as the inquisitive passengers crowd around his cabin door?) "Oh, isn't it wonderful?" When they have departed, the young hopeful muses "Funny, I can't pick up Blank, that 1 KW ought to carry at least a mile." Then begins a patient search, which, after he has unraveled all his connections and most of his temper, shows that his batteries are in dead short across his detector, and his potentiometer is on the ground circuit.

Let the experimenter thoroughly study the fundamental principles of wireless telegraphy, and in working practice resolve his set down to as little apparatus as is consistent with the best results. After settling upon his connections, the amateur should learn to use his set and not change connections until he has given the last one a thorough tryout. If this advice is followed, he will, in a short time, be obtaining from 25 to 50 per cent. better results than before. And it is well to remember that neatness goes hand in hand with efficiency. This does not mean that your apparatus must be finished in mahogany, hard rubber and silver plate, for pine, paper or fibre insulation and plain brass will do their work as well as the others, as long as proper care is exercised in the construction. Your desk need not be polished to mirror-like brightness; plain wood, finished in dead black, stands for business.

If you are an experimenter working

The Enterprising Young Marconi Brings in His Friends, Who, the Chances are, couldn't Tell a Potentiometer from a Spark Plug. All this Electrical Display has the Desired Impressive Effect Upon Them.

with the idea of finding ways and means of improving radio communication, try to have your workshop separate from your wireless set proper, and if you cannot have it in another room, at least have them on separate tables. By running leads from your main set, you can connect in your experimental set and save the trouble of disarranging your set proper.

If you are one of the many who use their wireless sets for the pleasure they can derive from it, with an aim of picking up as many stations as possible, resolve upon what you consider the best type, connect it up according to the best practice, and then learn to use it. Make your connections permanent. If your apparatus is of light construction, fasten it down to the table, so that it will not be hopping around when you adjust it.

Did you ever see a professional set with two extra detectors, each with a different mineral? Yet most amateurs have two or three extra detectors, say Galena, Silicon, Perikon, and Molybdenite. True, you will often find extra detectors on professional sets, but they are generally spares, to be used in case of breakage of the regular detector. If, in rare exceptions, another type is used, it is always of a type that is made for close work, chosen with a view toward staying powers and not toward sensitiveness. Accordingly, it is better to have one very sensitive mineral for long distance work, and, if you have a transmitting set, another mineral that will enable the use of heavy currents for close and fast work.

Keep your desk free of all unnecessary articles. Have a couple of sharpened pencils and a pad of paper always at hand. Sometimes an important message may come humming through the air when you are least prepared to receive it, and much valuable time will be lost hunting for your writing material. Have your call list where you can consult it

FROM the view point of efficiency, the simpler a wireless set is the more satisfactory will be the results. Most long distance receiving records are made with sets containing the least number of instruments and switches. Knowing how feeble are the currents that flow down to a wireless set from the aerial, it is obvious that these cannot be made to pass through an array of loading coils, loose-couplers, tuning coils, condensers and numerous switches and still retain sufficient energy to cause loud signals in the receivers.

quickly. If it is bound in book form, it is advisable to write out the stations that are within range on a sheet, so that they can be found without loss of time.

If you are manufacturing your own apparatus, try to use hard wood and fibre or hard rubber, for though soft wood and paper insulation can be made to work nicely, there is a far greater satisfaction in using apparatus that will "stay put." For instance, in California where the rarer woods are higher priced than in the Eastern states, enough mahogany for a good sized loose coupler, planed and cut to dimensions, can be obtained for 35 cents, if one goes to the right lumber yard. Surely in a case like this it would not be of advantage to use pine or ash.

Have your wireless table or desk of heavy, firm construction—a rickety affair goes a long way toward discouraging an otherwise efficient detector.

The fact that the leading wireless companies are adopting the two wire type of aerial would seem to indicate that this form is fully as efficient as the four, six and eight wire types. The amateur who is worried over his lack of wire can try this to good advantage, and he will find that if his four-wire aerial is made into a two-wire one, and doubled in length, he will have an increased efficiency in his receiving side, while his transmitting range will not be diminished. Furthermore, the two-wire aerial is easier to handle and has a neater appearance, since there are no sagging middle wires. Any amateur who has used soft copper wire knows how hard it is to keep all wires taut.

To bear out the contention that there is a great deal of "fancy work" expended on receiving sets that could be done away with, an instance may here be quoted. A standard make of loose coupler now on the market was tried out against the complete apparatus of a wireless telegraph company, the price of their apparatus running well into the hundreds of dollars, compared to a price well under the twenty-five dollar mark for the other. Tested out at distances of from 2,500 to 3,500 miles, the loose coupler, with 'phones and detector, no condensers or other apparatus of any kind, made a decidedly better showing than the other set with all its complicated apparatus and connections. On the high waves, the efficiency of the small set was still more marked.

SUBURBAN RADIO CLUB OF WASHINGTON

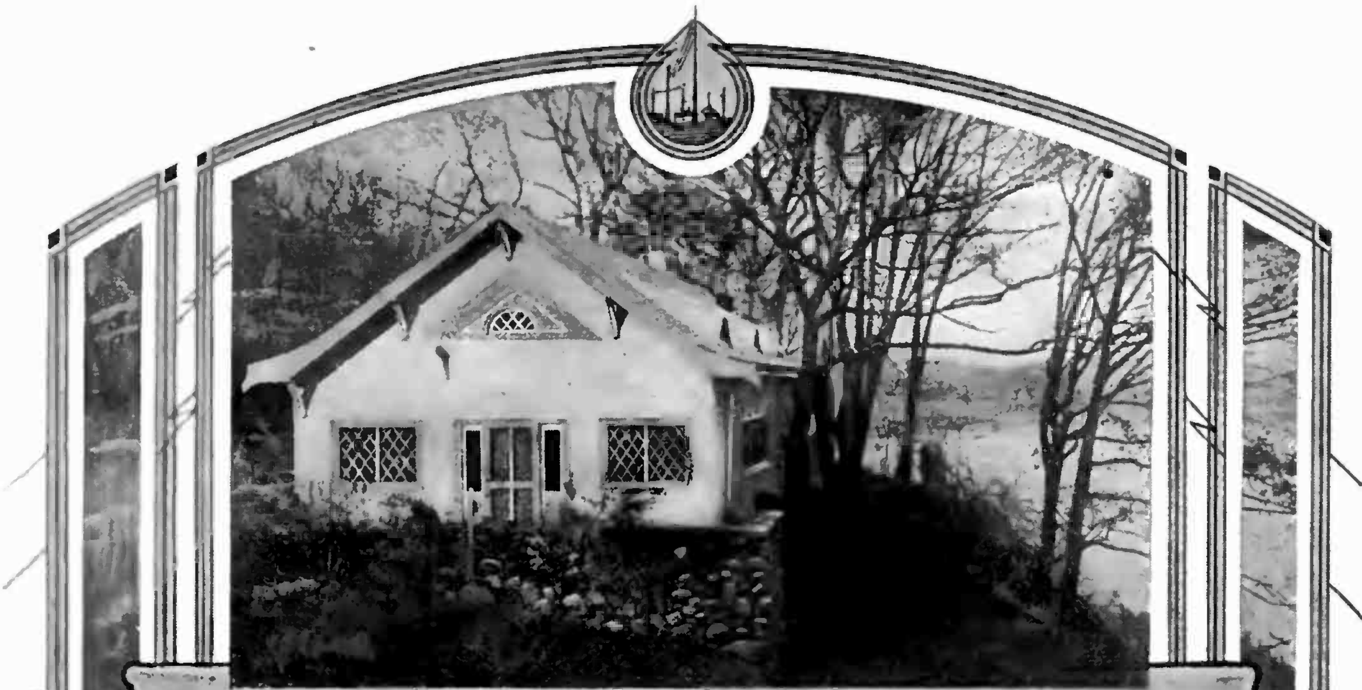
At the first meeting of the calendar year, the Suburban Radio Club of Washington held its election of officers. The results were as follows: John B. Brady, president; John V. Purssell, chief operator; George J. Rohrich, secretary and treasurer.

The club has enlarged its plans and attention is called to the fact that the membership is not limited to the suburbs of Washington, as was formerly intended, but now includes the surrounding country with Washington as its center.

One of the purposes of the club is to prevent "jamming," and this is being carried out by assigning ten minute periods to each member, at which time that member is supposed to be listening and receive any message intended for that station. This will prevent a great deal of useless calling, since everyone will know the schedule of the different stations.

Another interesting feature that is to be carried out is the encouragement of long distance sending and receiving. Special hours will be set aside for this purpose, at which time the best equipped stations will try to get in communication with distant stations. Some of the members are very well equipped in this line and they have heard amateur stations as far as 250 miles, with power input rated less than ¾ K. W. The scheme has every indication of being a success.

The club will be pleased to hear from other clubs as well as individuals, and all correspondence should be addressed to the secretary, P. O., Bethesda, Md.



Interesting Glimpses of a Famous Amateur and his Radio Laboratory.

CONTROLLING from shore a crewless motor boat by wireless on its 28-mile trip through Boston Harbor and out to sea, followed by its safe return to the starting place, is the recent accomplishment of John Hays Hammond, Jr.

His latest wireless-controlled motor boat, the *Natalia,* was built under the direction of Mr. Hammond and has

Two Views of John Hammond, Jr., Operating the Wireless-Controlled Boat from Shore. In the Center: The "Electric Dog."

Photos (C) International News Service.

proven highly successful in many trials. It is fitted with an aerial that gathers the waves sent out by the special transmitter of the inventor located on a bluff overlooking Gloucester Bay, Mass. By means of delicate detectors and relay devices the boat can be steered and run at any speed or stopped, and the various lights and searchlights, as well as other equipment, are under control of the operator at the transmitting key.

A clever application of selenium is presented in what Mr. Hammond terms "an electric dog." This is a three-wheeled vehicle driven by a motor and having at the front end two bull's-eye lenses. By holding a bright light in front of either lens, the inventor can make the vehicle follow him about. For instance, when the light is held in front of the left lens, the electric dog will turn to the left. A partition is placed between both lenses in order to prevent the light from shining through both lenses at the same time, when this is not desired.


Aerial Employed for Transmitting Waves to Motor Boat.

It has recently been announced that Mr. Hammond has completed the invention of a powerful explosive projectile. While details regarding this new invention are not plentiful or concise, it is gathered that the projectile contains an aluminum-thermic mixture which, five seconds after it leaves a siege gun, is transformed into a white hot, molten metal mass of 5,400 degrees Fahrenheit. When the projectile strikes, the liquid will set fire to any inflammable material it may encounter. And to prevent any efforts at extinguishing the conflagration, the projectile contains a separate chamber filled with hydrocyanic acid, the deadly fumes of which will prevent human beings from approaching the area in which the fire is raging. Mr. Hammond states that this new invention is particularly intended for destroying besieged towns, as well as combating dirigible balloons.

Again returning to the subject of wireless controlled craft, it is of interest to note that one of the suggested uses for this invention is in the defense of our coasts. One plan calls for a number of observation towers erected along the coasts at the most advantageous points, where a clear view of the sea can be secured. Observers in each tower could control one or more craft assigned to that portion of the coast. The wireless controlled boats could be sent out against a hostile fleet to discharge torpedoes when near enough to make a successful attack. It is said that such a scheme of coast defense would be less expensive to maintain than existing ones, and in all probabilities would be as effective, if not more so.

THE SWAN ISLAND WIRELESS STATION

One of the most interesting wireless stations in the tropics is that located on Swan Island in the Caribbean Sea. This wireless station is owned and operated by the United Fruit Company.

The Swan Island station consists of four self-supporting steel towers arranged in a rectangle measuring 300 by 600 feet. The power plant consists of two 50 H. P. Fairbanks, Morse oil engines driving two 25 K. W. 500 cycle alternators. The station covers twenty-two acres of ground, all of which is laid out in cement walks. A great portion of the station land is under cultivation. Fresh vegetables, turkeys and chickens are raised for the consumption of the station crew. The crew consists of three wireless operators, two engineers, an oiler, a cook, a messboy and three laborers, who, together with ten or twelve Grand Caymansmen who are engaged in cocoanut planting, comprise the full population of the island.

Men going to Swan Island are under contract to either remain at least eighteen months or waive the return transportation. Men remaining full time are granted return transportation to the United States via one of the Central American ports with six weeks' vacation and full pay. Some men have remained on the island two and one-half years. No women are allowed on the island.

The accommodations are said to be excellent; a cook and waiter being provided to prepare and serve the food to the operators. The men receive mail and fresh meat regularly every two weeks, and as they have a cold storage plant they are assured of fresh meat practically all of the time.

The buildings are all built of steel, sheathed with corrugated asbestos, and every man is provided with a separate room.

The United Fruit Company states that, contrary to the statements that have been published, there is no difficulty in getting men for this station, and to be assigned to it is a mark of reward for service on board ship or at other stations.

THE ELECTRIC FURNACE

Some time previous to the outbreak of the war it was reported from Germany that there had been there devised a new kind of electric furnace more durable and resistant to high temperatures than even the platinum furnace. The crucible of the German furnace it appears is wound with nickel wire and covered with a protecting jacket. For bedding the nickel wire, a pulp of kaolin, aluminum and asbestos fiber is used, and to protect the nickel from oxidation, this porous insulation layer is surrounded inside the furnace jacket with a thick layer of grains of carbon. The nickel-wire furnace will, it is claimed by the Germans, withstand a constant temperature of 1,200 degrees Centigrade, and even higher temperatures for brief periods.

PLANT CULTURE BY HIGH FREQUENCY CURRENT

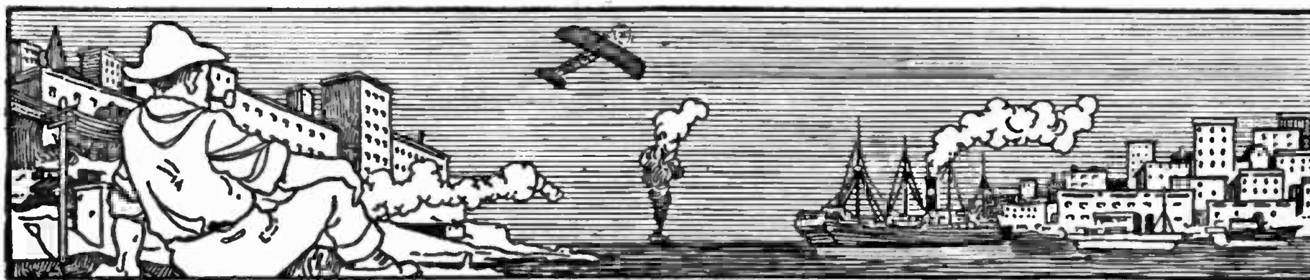
(*Continued from page* 405)

leaved in place to complete the magnetic circuit.

The reader is referred to Figs. 10 and 11 for the method of mounting the transformer. The core is gripped between clamping strips of hard wood and bolted to a base of the same material. The primary and secondary leads are conducted to upright pillars of hard rubber having a brass rod running through the centre.

The transformer is placed in a container of wood, lined with zinc as shown in Figs. 12 and 13, which give the proper dimensions. In the cover of the container are bored four holes to pass the terminal rods.

When the transformer has been placed in the case, the latter is filled with transformer oil to within an inch of the top and the cover fastened down with screws. The addition of substantial handles at the ends of the container completes the work on this portion of the apparatus.



On Polyphase Subjects

Editorial

IN the January number of this magazine appeared an editorial which stated frankly and lucidly the policy of the publication. Supplementing this statement, the Editors endeavored to explain the lines of reasoning along which they worked in evolving this policy. As a preface to the remarks which follow, the matter will be briefly reviewed herewith.

The present MODERN MECHANICS is the direct outgrowth of a number of consolidated magazines, each of which made energetic efforts to reach the goal now attained by this magazine. The first of the several publications was *The Popular Electrician*, founded in Lynn, Mass., in 1890. This magazine was later taken over by the publishers of *Electrician and Mechanic* of Boston. The same publishers gradually absorbed the several other magazines of similar type, among which were *Amateur Work* and *Building Craft*. In January, 1914, *Electrician and Mechanic* was merged with *Modern Electrics* of New York and the combined publications were called *Modern Electrics and Mechanics*.

Each of these consolidations resulted in a bigger and better magazine—a magazine more completely satisfying the wants of the readers as these wants became known. The only other magazine in a similar field was *Popular Electricity and the World's Advance* of Chicago and the logical result was reached when this magazine was combined with *Modern Electrics and Mechanics* in July, 1914, under the name of *Popular Electricity and Modern Mechanics*.

The publishers soon realized that the inordinate length of the new name placed the magazine at a disadvantage, and, after serious consideration, the first half of the title was dropped and the magazine called by its present name of *Modern Mechanics.*

Simultaneously with the appearance of the first issue under the shortened title, the publishers learned that not a little confusion had arisen among our readers due to the similarity between the title of *Modern Mechanics* with that of another magazine.

The thoughtful reader will readily understand how the name *Modern Mechanics* was adopted through a natural process of evolution; indeed, it has formed a part of practically every one of the several publications entering into its make-up. The question of possible confusion with another magazine of somewhat similar appearance but of a widely differing editorial policy was not taken into consideration.

The present magazine, after a long period of development, has reached its present splendid standing and a broader and more distinctive title can now be adopted.

However, the question of a suitable title has been a difficult one of solution, for the scope of the publication is of exceptional breadth, but we feel that we have finally definitely solved this problem.

The aim of the Editors is to give the readers a brief resumé of all that is new and interesting in the fields of electricity, mechanics, invention and science, and to incorporate in each description, some feature of practical value—something that shall give the reader an opportunity to profit by the experience of others. This policy is adopted for the benefit of the lay reader in the first half of the magazine, and the requirements of the advanced or practical man are taken care of in the remainder of the pages, wherein hundreds of hints on easy ways to accomplish difficult tasks are offered.

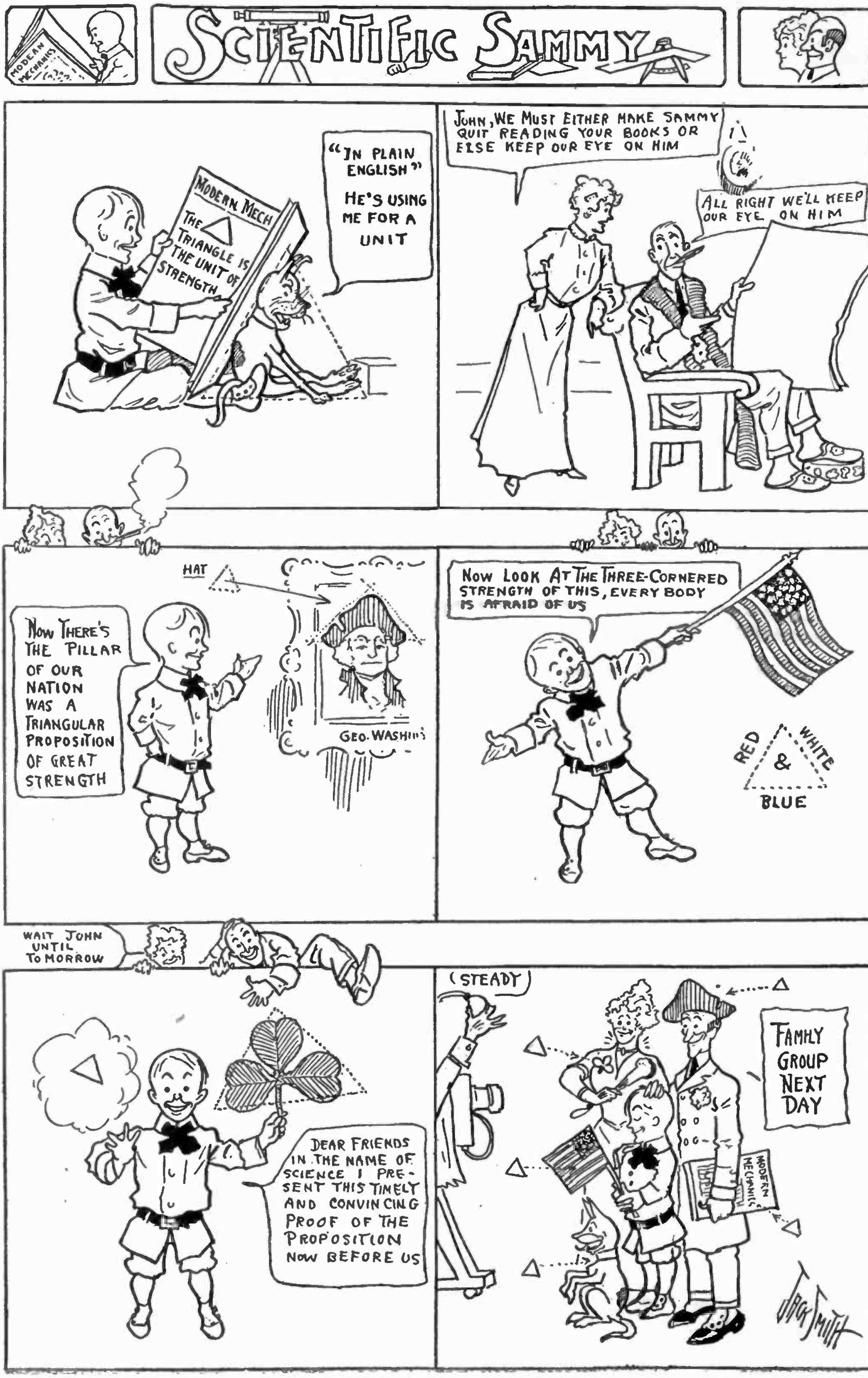
The
WORLD'S
ADVANCE
In Plain English
ELECTRICITY
MECHANICS
INVENTION
SCIENCE

Careful thought and analysis have convinced the publishers that the logical name for the magazine—the name most significant of its contents—is The World's Advance. In accordance with this decision, the title of this publication, beginning with the April number, will be:

THE WORLD'S ADVANCE.

February 15, 1915.

THE EDITORS


SCIENTIFIC SAMMY
MODERN MECHANICS
MODERN MECH
THE △ TRIANGLE IS THE UNIT OF STRENGTH
"IN PLAIN ENGLISH" HE'S USING ME FOR A UNIT
JOHN, WE MUST EITHER MAKE SAMMY QUIT READING YOUR BOOKS OR ELSE KEEP OUR EYE ON HIM
ALL RIGHT WE'LL KEEP OUR EYE ON HIM
HAT
NOW THERE'S THE PILLAR OF OUR NATION WAS A TRIANGULAR PROPOSITION OF GREAT STRENGTH
GEO. WASHI
NOW LOOK AT THE THREE-CORNERED STRENGTH OF THIS, EVERY BODY IS AFRAID OF US
RED & WHITE BLUE
WAIT JOHN UNTIL TO MORROW
DEAR FRIENDS IN THE NAME OF SCIENCE I PRESENT THIS TIMELY AND CONVINCING PROOF OF THE PROPOSITION NOW BEFORE US
(STEADY)
FAMILY GROUP NEXT DAY
MODERN MECHANICS
JACK SMITH