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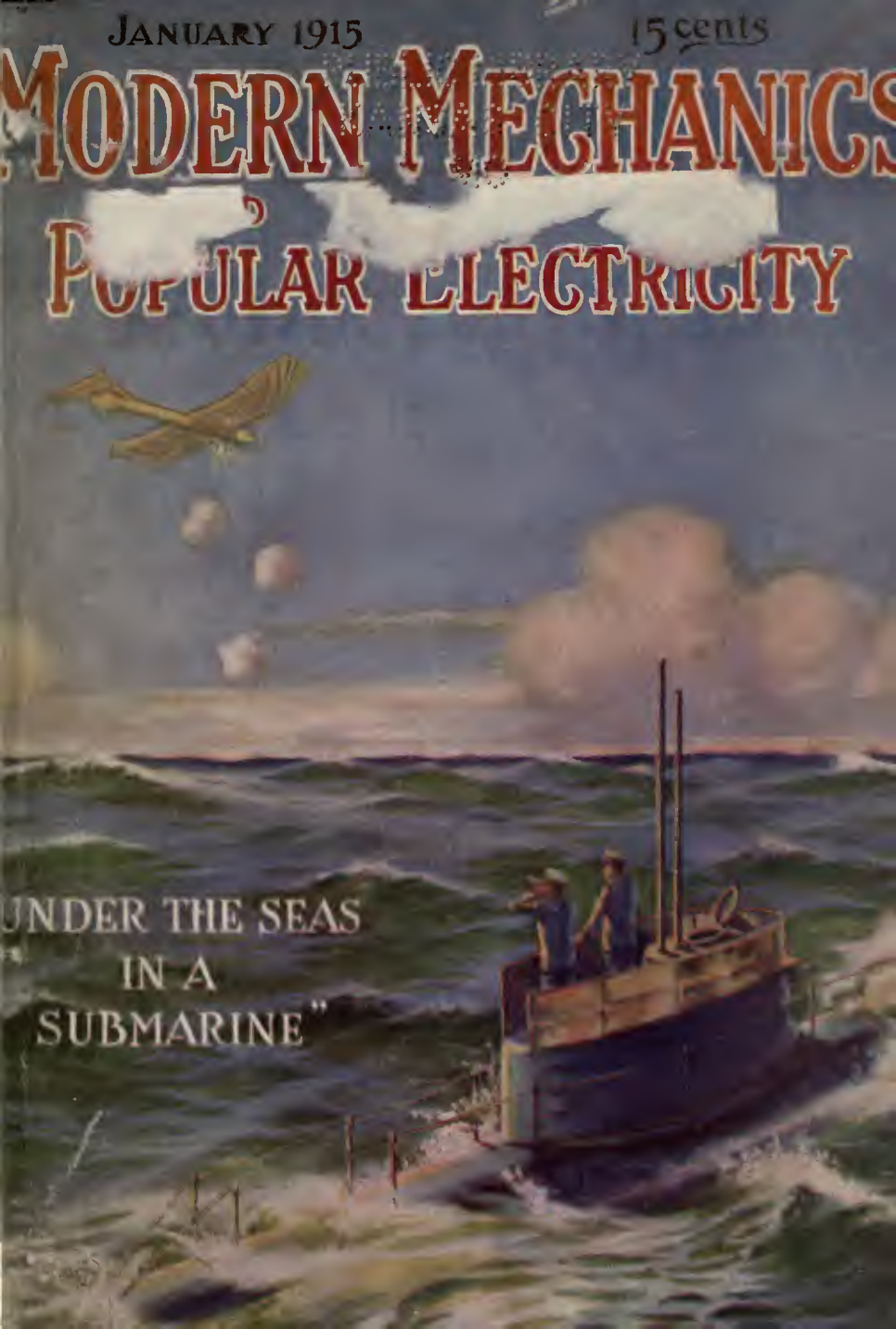

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Volume XXX. JANUARY, 1915 No. 1

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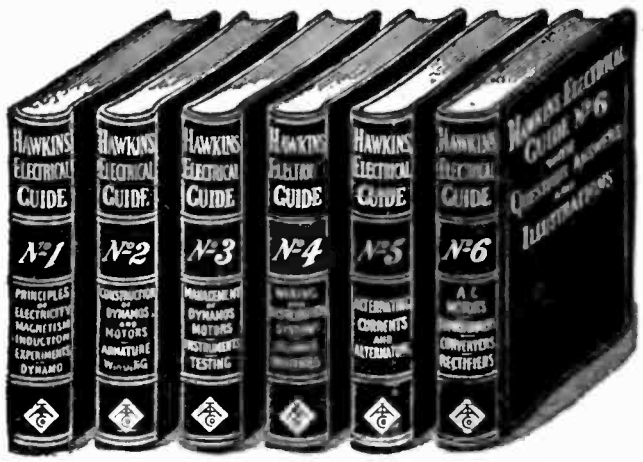

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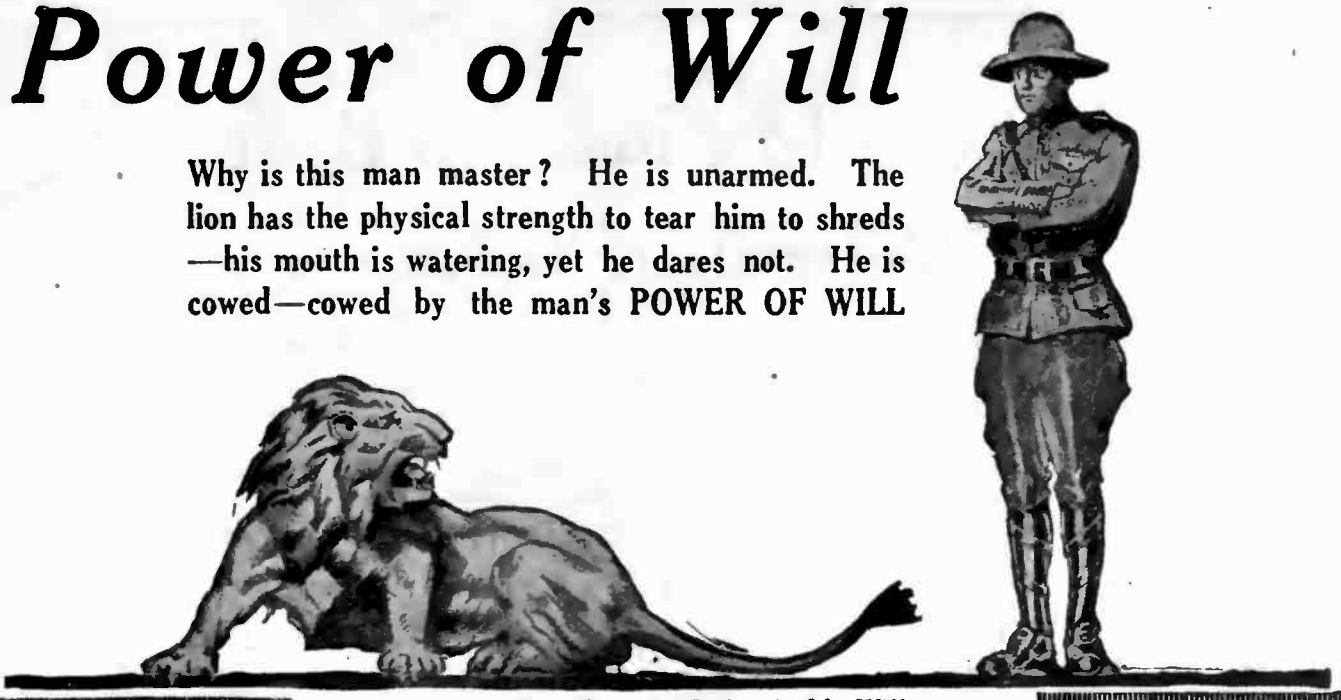

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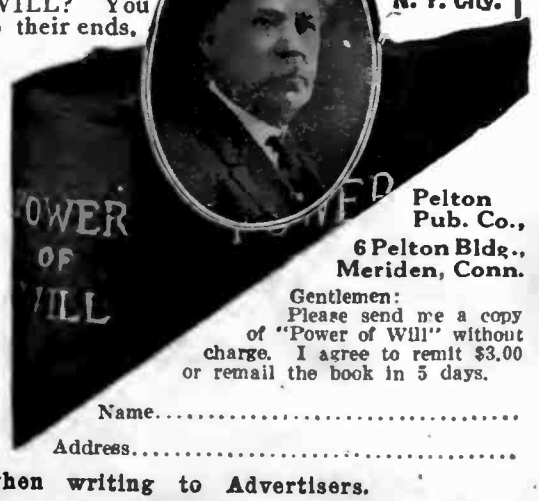

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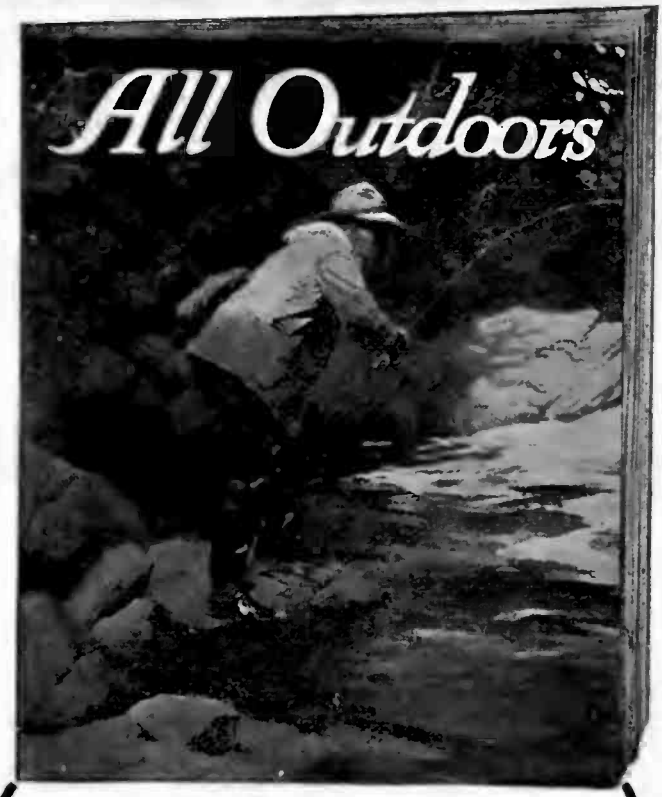

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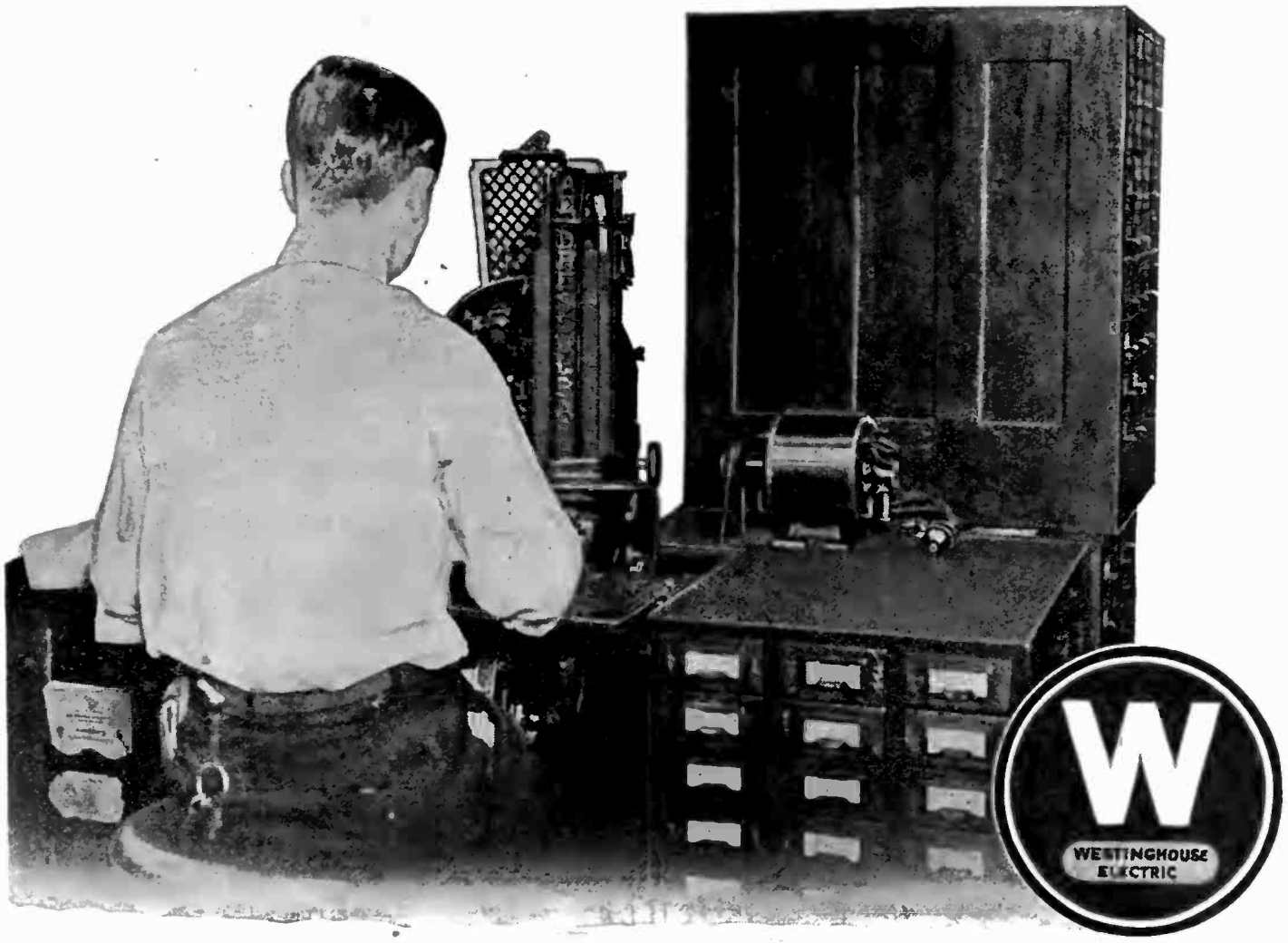

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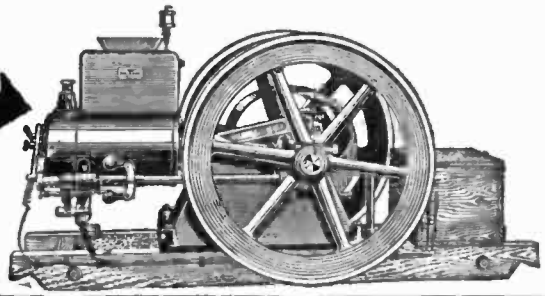

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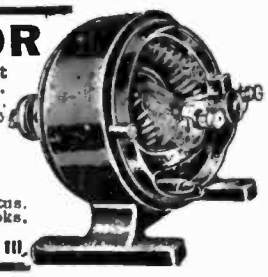

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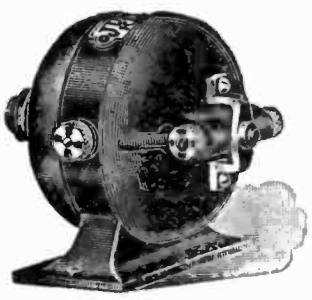

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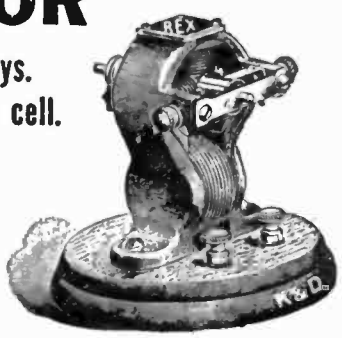

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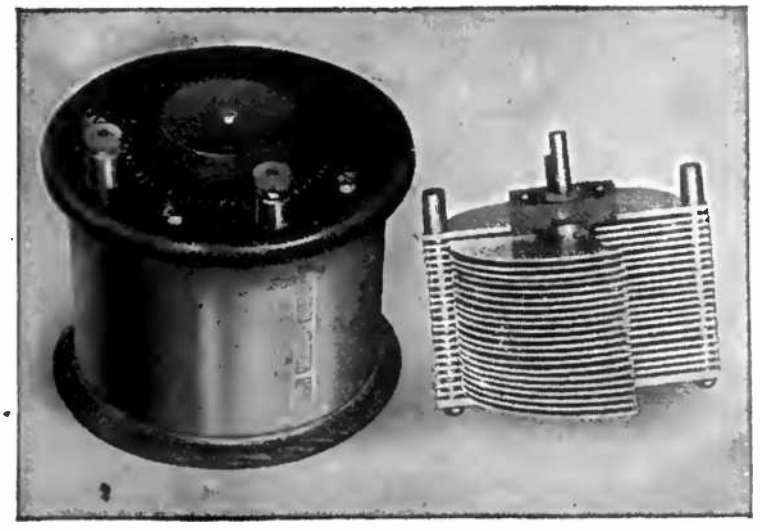

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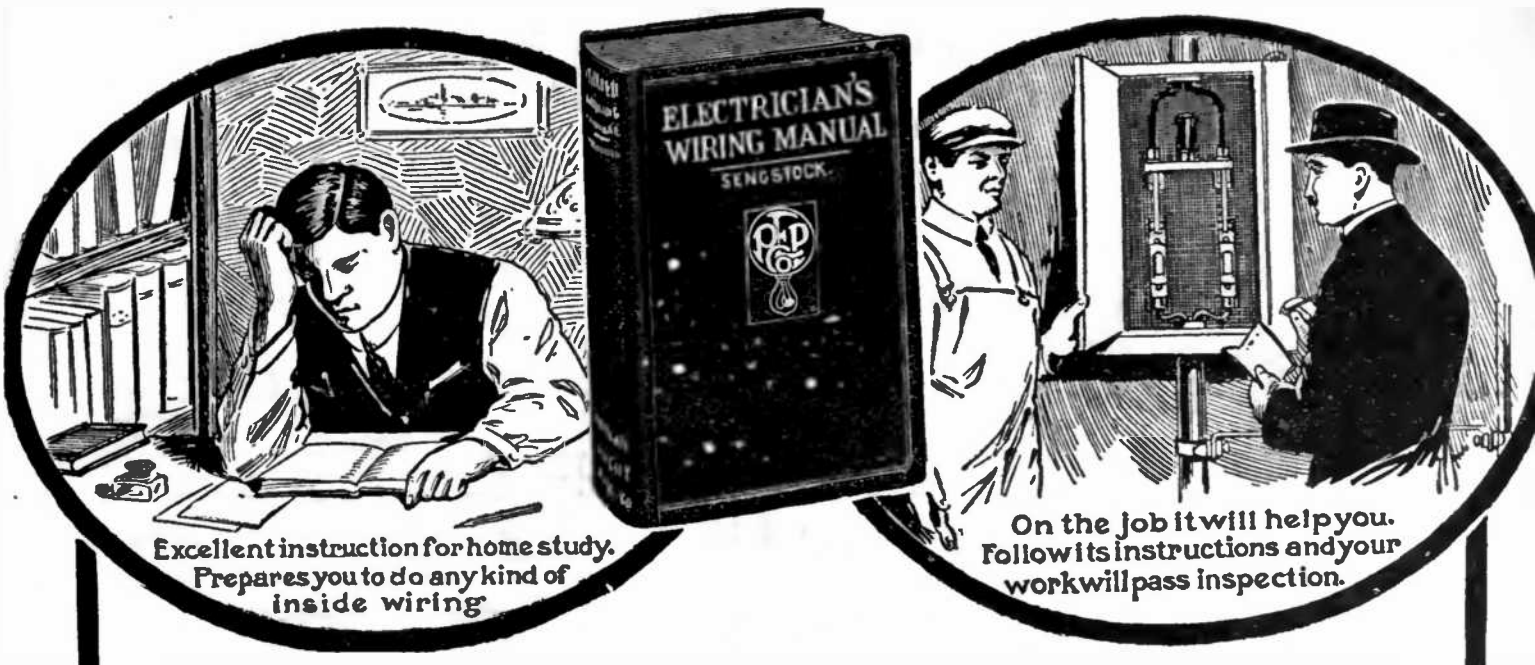

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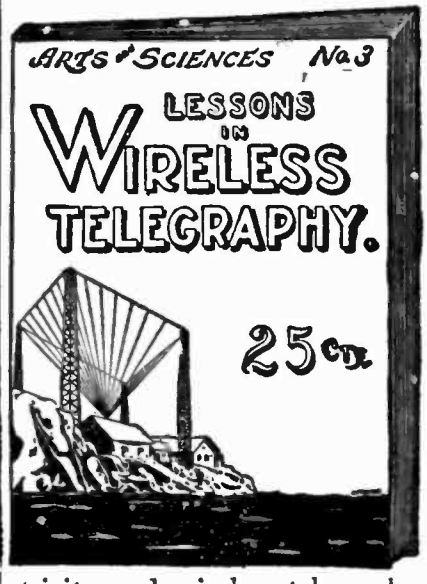

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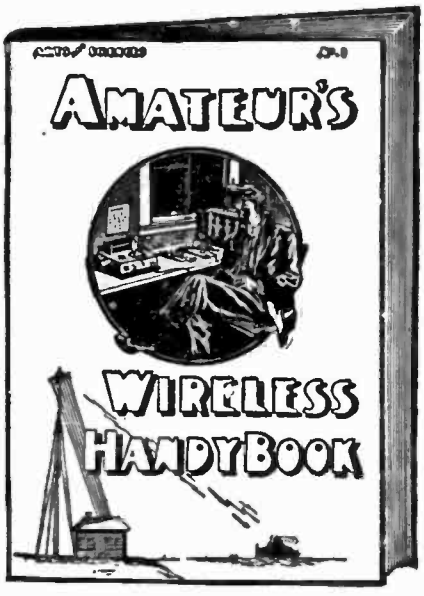

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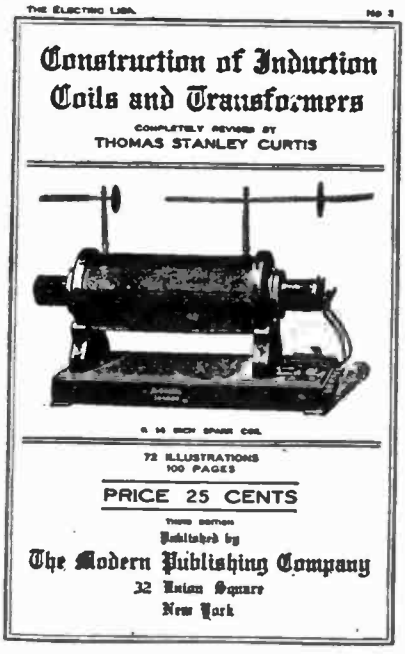

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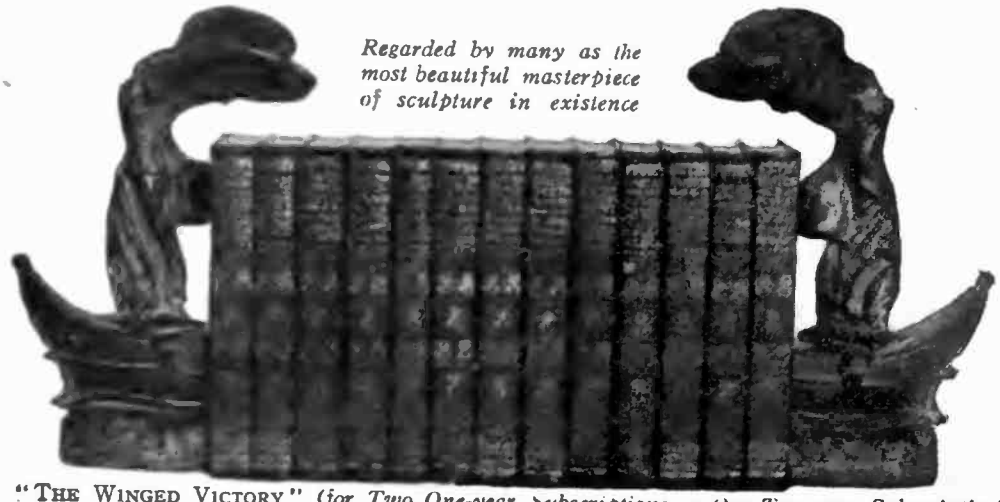

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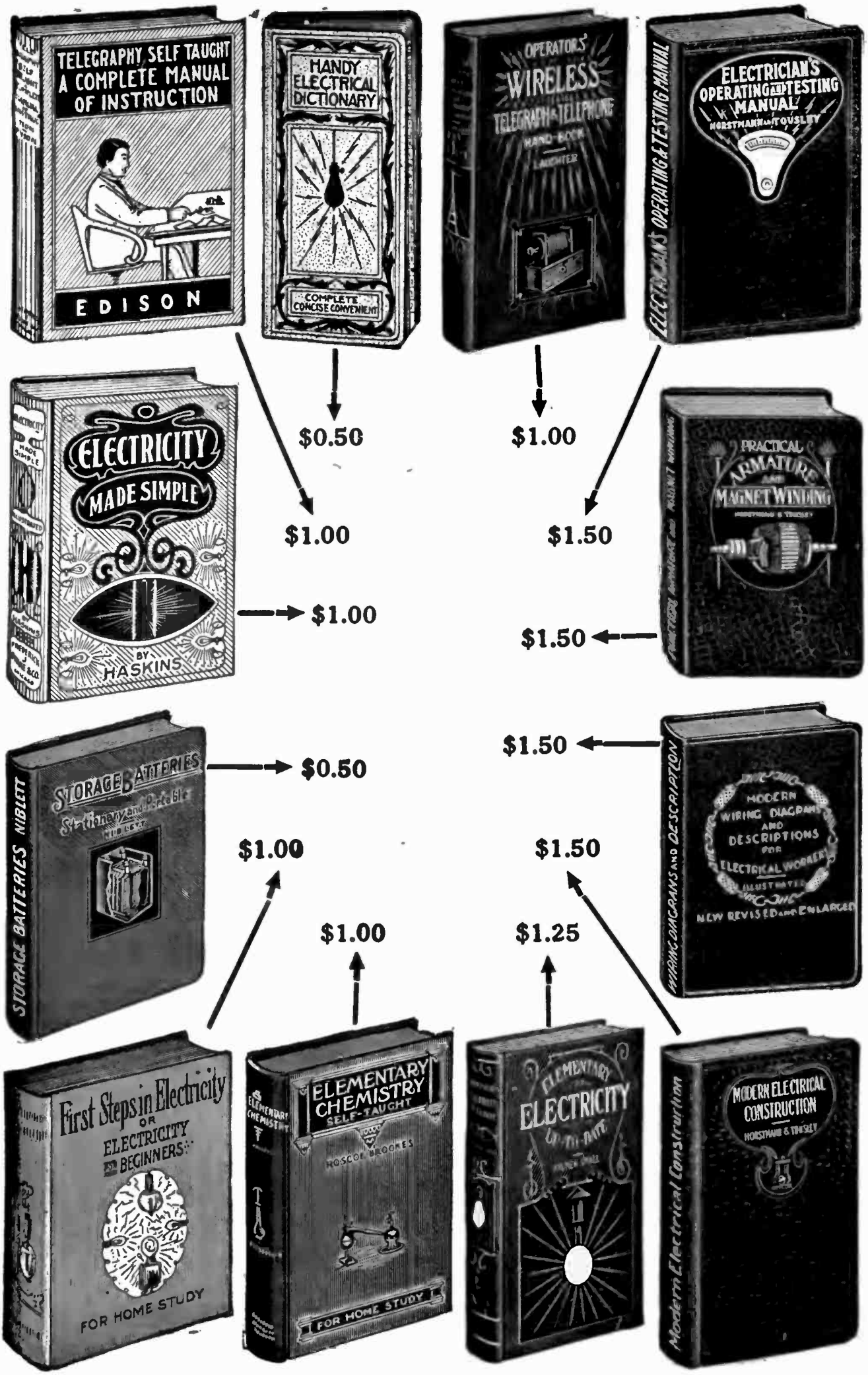

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MODERN PUBLISHING CO., 32 Union Square, New York

MODERN MECHANICS

In Plain English

Vol. 30 JANUARY, 1915 No. 1

ANNOUNCEMENT

WITH the present issue, this magazine makes its initial bow to the public under its new name, MODERN MECHANICS.

The publishers have realized for some time that the former name of "Popular Electricity and Modern Mechanics" was so long as to be unwieldly and difficult of pronunciation; hence the change. The first half of the former title is carried on the cover only of this issue in order that readers may become accustomed to the new name.

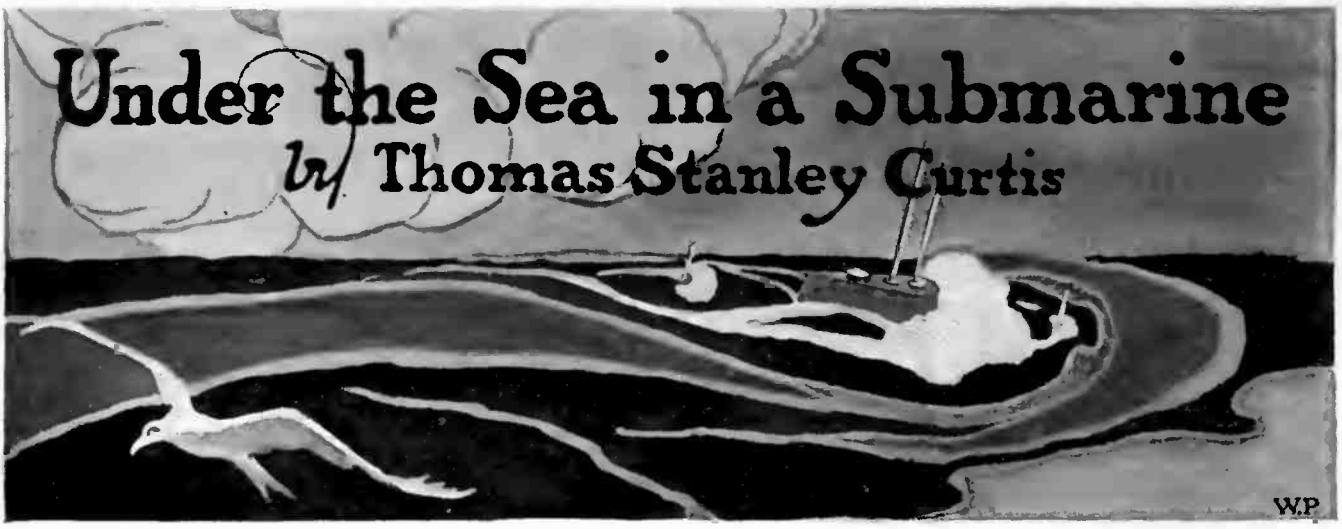
The editorial policy of the past few months will be extended into the future and the aim will be to offer the readers bright, snappy accounts of all that is new and interesting in the field of electricity, wireless, mechanics and science. The popular, highly illustrated portion comprises the first half of the editorial section, while the remainder of the magazine is devoted to practical, "how-to-make" and "how-to-do" hints of inestimable value to the handy man about the house, the electrician, the mechanic and the serious investigator.

The Editors.

December 15th, 1914.

Under the Sea in a Submarine

by Thomas Stanley Curtis

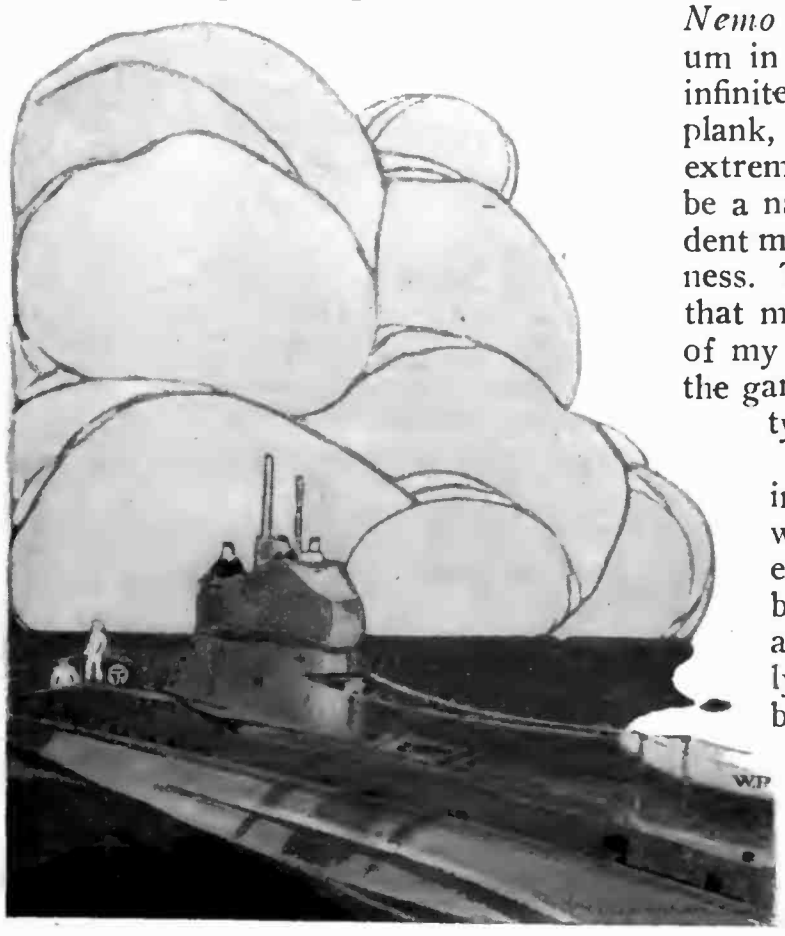


Illustrations by Waller Parker.

A tiny cockle shell of steel, manned by a handful of intrepid men; its approach unseen, unheralded; its hidden arm striking a blow that crumples the mighty dreadnaught as if of paper; such is the submarine in modern warfare. But is this wonder-craft confined, in its field of usefulness, solely to the destruction of life and property? In this story, a "landlubber" tells of the impressions received during his first and only trip on board a submarine vessel and incidentally suggests that the dream of the immortal Jules Verne is soon to be realized.

RISING above the waves, two slender tubes, each with an eye in its extremity like the lantern optic of some deep-sea fish, followed by an elongated deck-like superstructure and finally the shining whaleback of shining steel—

How the sight brought me back to the boyhood days when, with my beloved volume of "Twenty Thousand Leagues Under the Seas" I would follow, with tense nerves, the exploits of the intrepid *Captain Nemo* in his wonderful submarine vessel *The Nautilus.*



To say that I felt like a second *Captain Nemo* as I practiced a feat of equilibrium in crossing that piece of lumber of infinitesimal width, known as a gangplank, would be to handle the truth with extreme carelessness and, as this is to be a narrative of impressions, each incident must needs be related with all frankness. Therefore truth compels me to say that most of my dignity and not a little of my courage slipped over the sides of the gangplank during that walk of twenty feet from the wharf to the craft.

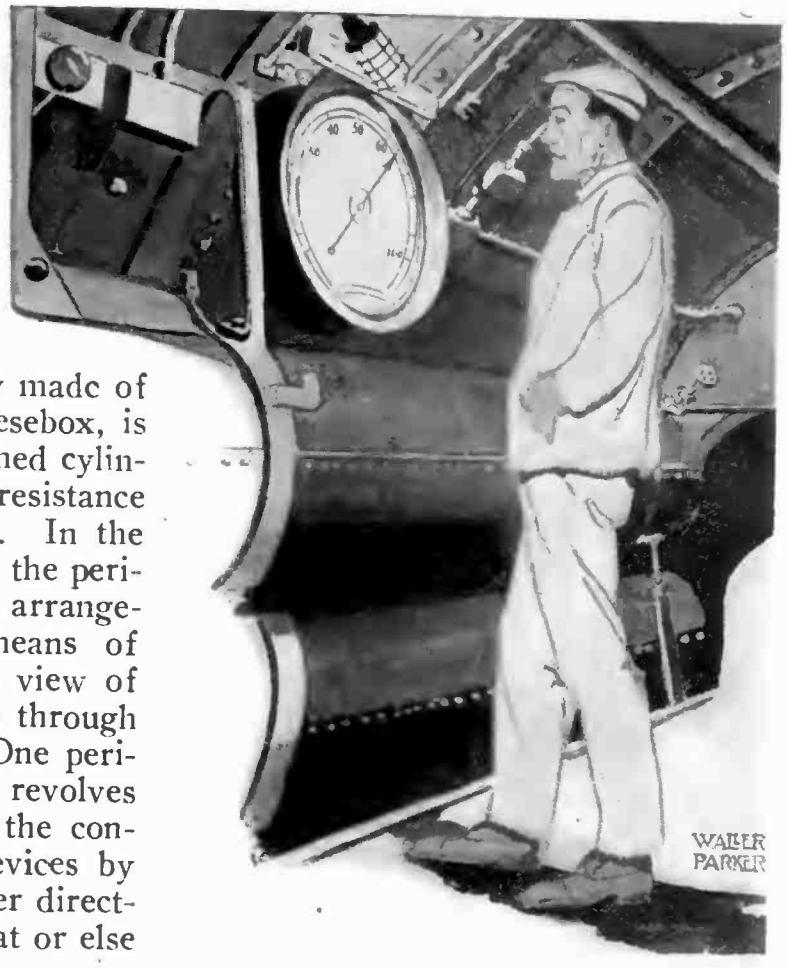
As the fiction writers say "It was in the cold, gray dawn of an early winter morning." It was cold right enough and horribly early—just before sunrise, in fact — and, as for the color tone, gray aptly describes it; gray sky, grayish-black water, gray wharf and the sinister-appearing fighting machine in dull gray, on which I had been so anxious to travel. I say "had been," for the first misgivings arose within me when I

started across that swaying gangplank (also of gray). Arriving on deck my host, in command of the submarine, attempted to counteract the effects of the gangplank incident by assuring me that I might never again reach *terra firma,* once I had started in to investigate the mysteries of submarine navigation. Perhaps he was not so brutally frank in his mode of expression as I have been—but it made little difference. I'd have taken a chance with most anything rather than go back over that gangplank.

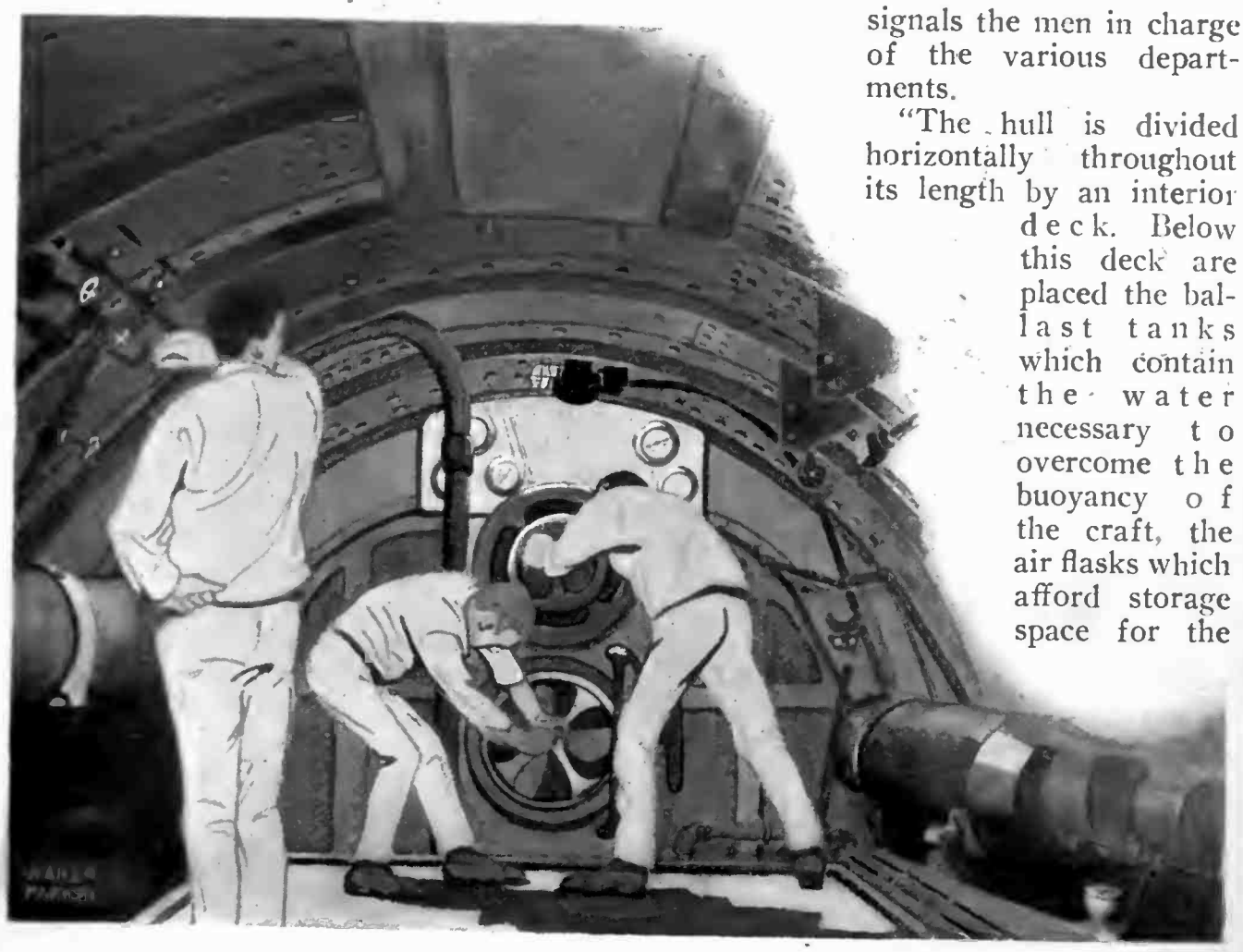
This cheerful little formality over with, I was escorted "below" via an iron ladder and through an opening which resembled the familiar manhole of our streets. Entering the operating chamber at the base of the ladder, an impression was formed which lasted throughout the entire tour of inspection; the interior of the craft presents a positively bewildering array of control levers, wheels, gauges, meters, and machines of almost every conceivable form. In fact, the craft as a whole is one compact mass of machinery—a veritable engine in itself.

Space will not permit of a detailed description of each individual department of the boat as I saw it and a general explanation in the words of the commander prior to our examination of the craft will have to suffice.

"The hull of a submarine vessel is essentially an elongated cylinder of steel, circular in cross-section and tapering to



a point or, more correctly speaking, a wedge at either end. Surmounting this cylindrical hull is a superstructure which forms a deck while the craft is running on the surface. On the central portion of the deck is the conning tower or navigating chamber in which is stationed the helmsman. This tower, originally made of a shape similar to that of a cheesebox, is now made in the form of a flattened cylinder in order that it may offer less resistance in its passage through the water. In the top of the conning tower are fixed the periscopes, slender tubes carrying an arrangement of lenses and prisms by means of which the navigator can obtain a view of the surface of the sea by looking through a device not unlike a telescope. One periscope is fixed while the other revolves through an entire circle. Inside the conning tower are the controlling devices by means of which the navigator either directly controls the operation of the boat or else signals the men in charge of the various departments.



"The hull is divided horizontally throughout its length by an interior deck. Below this deck are placed the ballast tanks which contain the water necessary to overcome the buoyancy of the craft, the air flasks which afford storage space for the

air used in emptying the ballast tanks, firing the torpedoes, and in maintaining a constant supply of fresh air for breathing purposes; the storage battery, which furnishes the electric current used in propelling the craft under water; and the oil tanks for the storage of the crude oil fuel for the Diesel engines used for surface propulsion.

"Above the deck, forward, is the torpedo room in which the torpedo tubes emerge. These tubes are cylinders of steel, communicating with the exterior of the vessel and closed at the outer end with trap doors which open automatically when the torpedoes are fired.

"Aft of the torpedo compartment is the chamber in which the torpedoes are stored and which contains the operating mechanism for handling the torpedoes.

"In the rear of this chamber is the compartment which comprises the living quarters of the crew and here as in every other section of the craft, every available inch of space is used to best advantage.

"Then we come to the engine room of the craft. This chamber contains the oil engines which drive the boat while she is running "awash" or on the surface, the various pumps for oil, water and air, the electric motors which drive the boat while submerged and which serve as generators, storing electric energy in the battery, while the boat is awash; and the various devices which cause the boat to dive and turn.

"Outside the hull, at the stern, are both horizontal and vertical rudders which control the course of the submarine through the water."

Our little tour of inspection finished, we return to the conning tower and the order is given to clear the craft for a submerged run. The lifelines and platform or bridge are taken down and stowed in a compartment of the superstructure, all hands called below and the hatches closed and sealed.

The commanding officer stations himself at the periscope and the men at their various posts. The ballast tanks are filled and the electric motor

started; the craft settling slowly on an even keel as water is admitted. Within a few minutes the deck is awash and the waves splash up past the narrow, glass-covered slit of a porthole in the conning tower to which my eyes are glued. Not a sound is heard save the gurgle of the water as it swirls around the tower and the monotonous whine of the driving motors. Finally the signal is given to dive; the horizontal rudders are tilted and I can see the yellowish-green water rise as a haze up past my peep-hole. By this time the sun is shining and I can see its beams reflected and refracted down through the water, the surface of which appears to act as a myriad of mirrors and prisms. The commander calls me and his voice has an uncanny sound. I take his place at the periscope and see a miniature motion picture of the surface of the sea in the most wonderful colors. Occasionally the craft settles in a trough between two unusually large waves and my moving picture dissolves into a blank wall of green.

We continue to dive and I go back to my porthole, through which the sea appears merely as a dense mist of deepening green. Occasionally an object, scarcely more than a shadow, passes my window and I take it for a fish that has had the temerity to venture close to this intruder of its domain.

Word is given that the "enemy" is sighted—the enemy in this case being a target of netting at which one of our torpedoes is to be fired. I am transferred from my porthole to the torpedo room, incidentally finding some difficulty in placing my feet just where they should go in the simple process of walking. Arriving in the magic chamber at last, however, I find an accommodating pipe to which I cling in a secure, if unseamanlike, position.

The breech of a torpedo tube is opened and one of the shining cylinders is slid in place. The gate is closed and, at the signal of the commanding officer, a charge of compressed air is admitted to the torpedo tube with a screaming hiss and the miniature submarine starts on its errand of destruction. The destruction in this case, however, was limited to the perforation of the target, for our torpedo carried a dummy head. The torpedo fired, we arise to the surface to note its effect.

There followed a series of manoeuvres demonstrating the mobility of the craft and more than once I marvelled at the manner in which the vessel answered every command of its navigator. Truly, it took me back once again to the *Nautilus* of fiction and as I recrossed the nervous gangplank on our return, I could not but think of the wonderful opportunity for subaqueous exploration offered by such a vessel built for this purpose rather than for warfare.

The submarine is an accomplished fact, not an experiment. It can carry a crew of twenty-five men and give them good air to breathe for days at a time though totally submerged. It can travel nearly a hundred miles under water with one charge of its battery and some three thousand miles on the surface.

It is navigable at depths of some two hundred feet and, at somewhat less than this depth, a diver can leave a "lock" in the submarine and remain in constant verbal communication with the craft by means of a telephone.

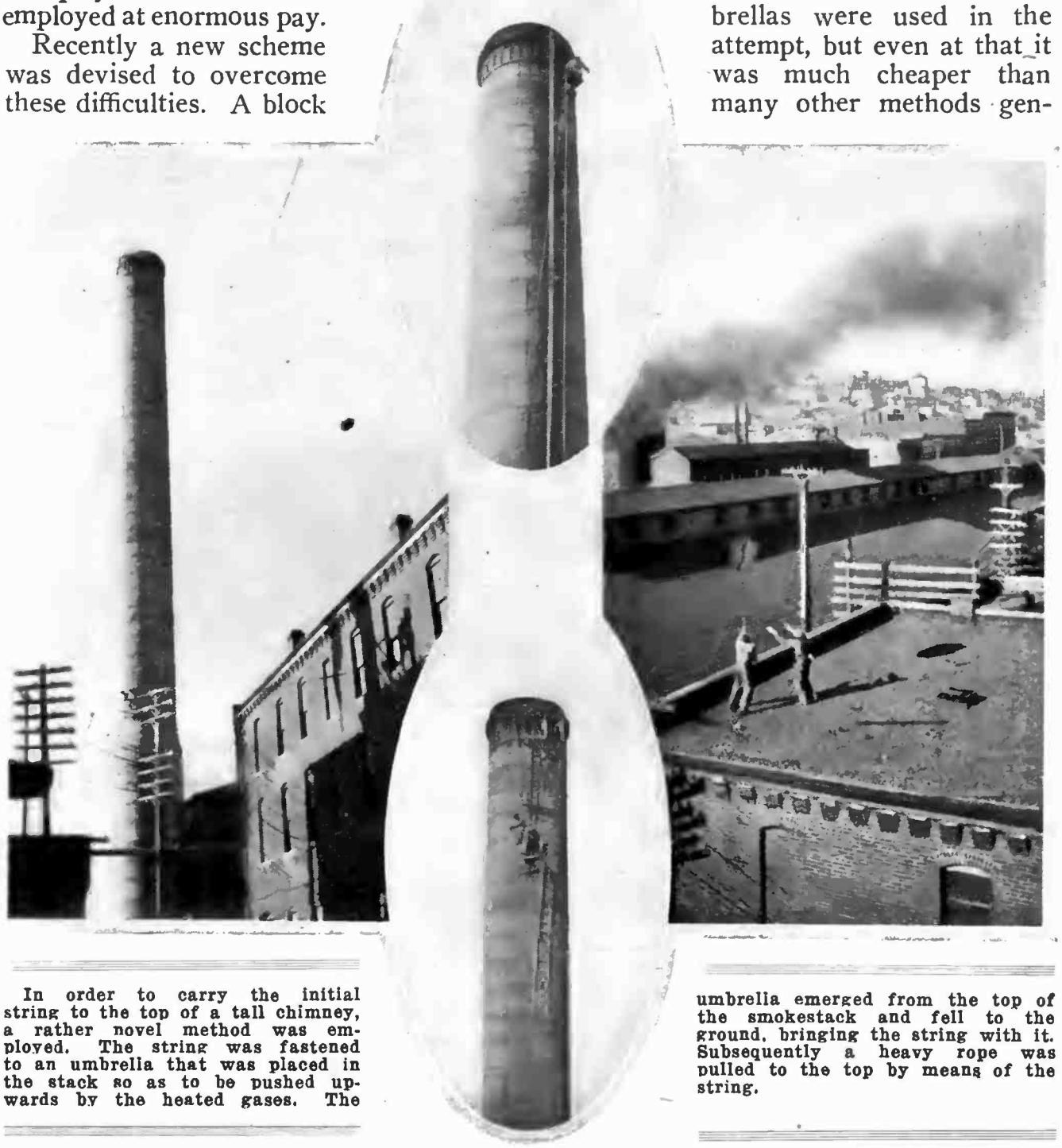
That the bottom of the sea can be explored and even photographed at a depth of sixty feet is evinced by the excellent series of photographs and motion pictures made recently by Carl L. Gregory in the Williamson Submarine Tube during a sojourn in the clear waters of the Bahamas. On this occasion, exposures were made in the one-hundredth part of a second.

With this graphic demonstration both of the practicability of the submarine vessel and of the possibility of carrying out systematic and intelligent research at the bottom of the sea, it would seem but a short step into the future when we shall have a vessel of the type depicted by Jules Verne, forecaster of the seemingly impossible—a vessel that shall carry us to the sunken coral gardens in order that we may feast our eyes on their gorgeous beauty and that may open up the portals to the vaults of untold wealth lying amid the wreckage of unfortunate ships of ages past.

AN UMBRELLA DOES UNUSUAL WORK

The hanging of large electrical signs from tall smoke-stacks and other inconvenient places has long been a source of much trouble and more expense. Steeplejacks have been employed at enormous pay.

Recently a new scheme was devised to overcome these difficulties. A block and tackle was successfully placed over the top of a very tall stack by first using an umbrella as a parachute to carry the initial string over the stack. To do this, the umbrella was pushed up through the stack far enough so that the hot gases from the furnaces caught it and carried it out over the top. It then fell downward, bringing with it a rope of small diameter. Later this rope was employed to pull a wire of proper strength over the top and then a block and tackle. By this means the large sign was strung in sections. Several umbrellas were used in the attempt, but even at that it was much cheaper than many other methods generally employed in accomplishing the same purpose.



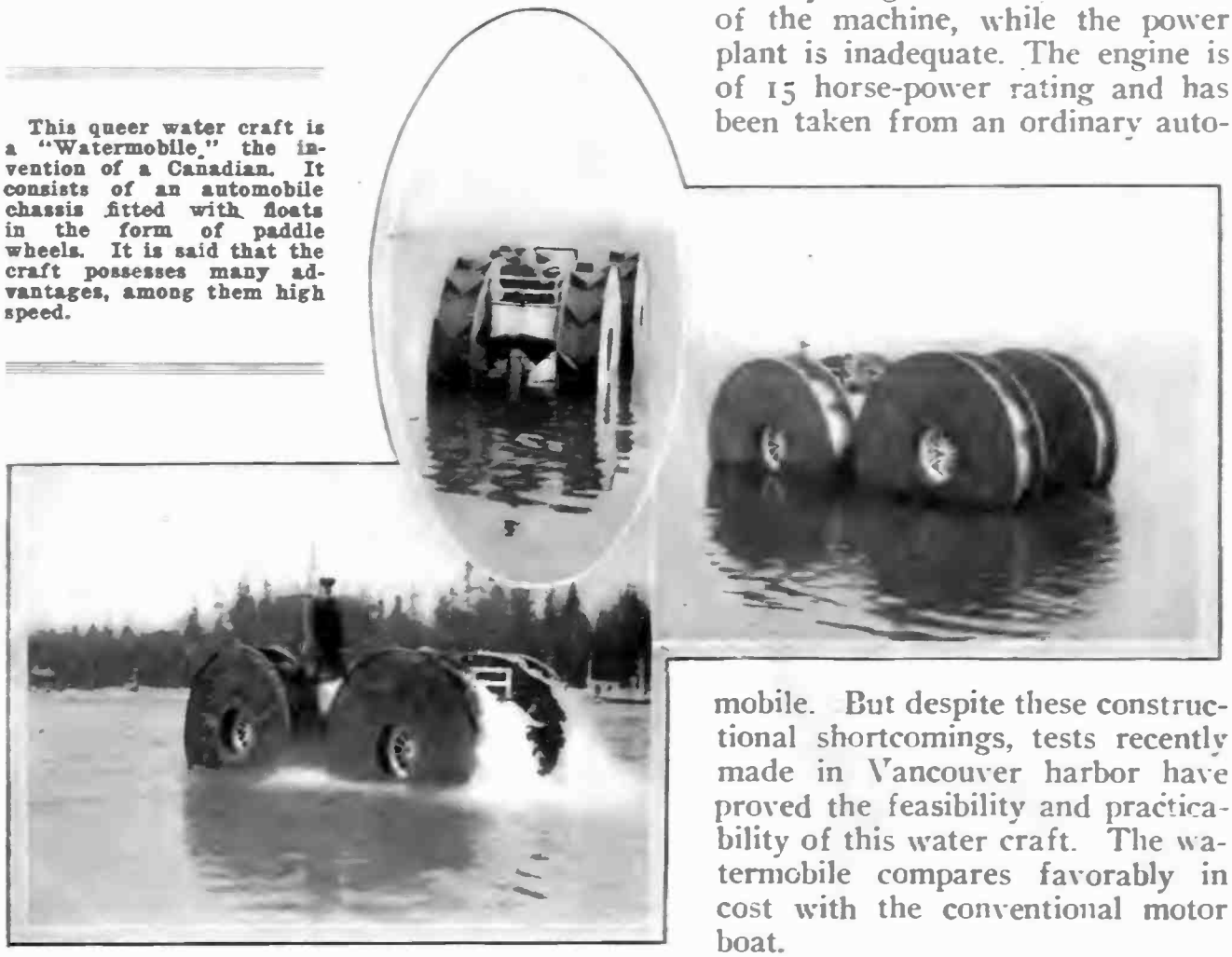
In order to carry the initial string to the top of a tall chimney, a rather novel method was employed. The string was fastened to an umbrella that was placed in the stack so as to be pushed upwards by the heated gases. The umbrella emerged from the top of the smokestack and fell to the ground, bringing the string with it. Subsequently a heavy rope was pulled to the top by means of the string.

Don't forget, the next cover of this magazine will appear as "MODERN MECHANICS."

THE WATERMOBILE

In the accompanying views is seen the "watermobile," a contrivance consisting of paddle wheels that are partially submerged and serve to give buoyancy as well as propel the vehicle. This machine is the invention of Francis W. Taylor, of Vancouver, B. C.

The demonstrating model shown in the accompanying illustrations represents the results of many years' study in an effort to cope with the greatest problem encountered in marine construction—resistance. The wheels are designed with a view of floating over the water more than of gliding through it, as in the case of ordinary hulls. The body of the car, following similar lines to the ordinary automobile chassis, is suspended from the axles of the wheels clear of the water. A special rudder contrivance is used for steering. In other respects, however, the machine conforms to the same principles as the ordinary motor car.



This queer water craft is a "Watermobile," the invention of a Canadian. It consists of an automobile chassis fitted with floats in the form of paddle wheels. It is said that the craft possesses many advantages, among them high speed.

Although in the matter of speed the inventor has not attained the results anticipated, he declares himself to be confident that the experience he has gained since the first type was placed in the water will enable him to evolve watermobiles capable of traveling considerably faster than the swiftest speed boats or hydroplanes. A hundred miles an hour is the objective of the inventor.

The model shown in the accompanying illustrations is said to have unnecessarily large wheels for the size of the machine, while the power plant is inadequate. The engine is of 15 horse-power rating and has been taken from an ordinary automobile. But despite these constructional shortcomings, tests recently made in Vancouver harbor have proved the feasibility and practicability of this water craft. The watermobile compares favorably in cost with the conventional motor boat.

KEEPING ENGLAND'S ARMY WARM

Half a million sweaters are to be ordered for the soldiers in the British army, according to reports from Philadelphia knitting mills that have been asked for estimates on 500,000 knit sweaters similar to those recently furnished to the United States army. Yarn dealers have been hastily notified to figure on the necessary prices for such a large amount of yarn as will be necessary to fill this mammoth order.

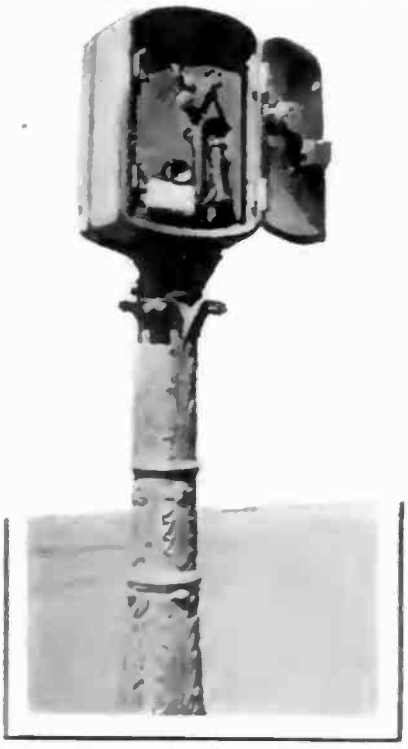
TELEPHONE BOX USED AS A MEDICINE CHEST

An odd but sensible idea is used in connection with the police telephone boxes in Los Angeles, California. Each box in the downtown district contains the necessary materials to give aid to the victims of an accident while waiting for the ambulance to arrive with doctors.

The package contains antiseptic bandages for the wounds, two antiseptic compresses of sublimate gauze in oiled paper, cambric bandages, safety pins, etc.

The police are instructed in the use of these things and it means that the bleeding from an injury is stopped with medicated materials instead of the handkerchief loaned by some passer-by—an article that is often not very clean.

The Los Angeles police surgeon, Dr. Zerfing, claims that the first dressing of any wound is the most important and if such is not cleanly done, slow healing and blood poisoning is apt to be the result.



Package of First-Aid-to-the-Injured Materials placed in Telephone Box.

He also states that the equipment of these telephone boxes is, in the end, an actual saving to the city instead of an expense, as the public hospitals are often called upon to care for these injured ones who were not properly treated in the first place, and who have accordingly contracted disease or long illness.

The highest mountain in Montana, Granite Peak, with an altitude of nearly 13,000 feet, is in the Beartooth National Forest.

Views of the Old Method of Propelling Canal Barges and the New Electric Towing Barges.

AN ELECTRIC TOWING BARGE

An electric towing barge capable of towing sixteen barges through a tunnel in 40 minutes has been recently placed in commission at the Hardcastle tunnel in England.

Formerly, the method employed for getting barges through the tunnel was rather a crude one. The men would lay on their backs on the decks of the barges and push with their feet against the wall of the tunnel. The time taken in the journey was over two hours. It was with a view to lessening the time required that the North Stafford Railway introduced the electric barge shown in the illustrations.

Don't forget, next month's cover will read "MODERN MECHANICS."

OLDEST SETTLEMENT IN THE UNITED STATES

By Albert Marple

THERE are few people more interesting as a subject for study than the native Indians of this country, and this applies particularly to the Pueblo people. The location of this peaceable tribe of Indians, now numbering about fifteen hundred, is in Arizona, in one of the hottest parts of that state. They are accustomed to the extreme warmth and they do not mind it but it is almost unbearable to the white person who may venture out near the Indians' quarters.

These Indian people have two distinct residence sections—one in the valley and one on top of a table mountain known as Acoma Mesa. The summer months are spent in the valley, where throughout that time these people till the soil and grow the produce necessary to sustain them during the winter months. There are stretches in that vast desert country where water is obtainable and it is in these sections that the Indians grow their vegetables which constitute a greater part of their food. Year after year they live in the same manner, growing their food in summer to last them during the coming winter. One of the accompanying illustrations shows one of the valley villages of these people, the homes being clustered on a smooth stretch at the foot of the hill.

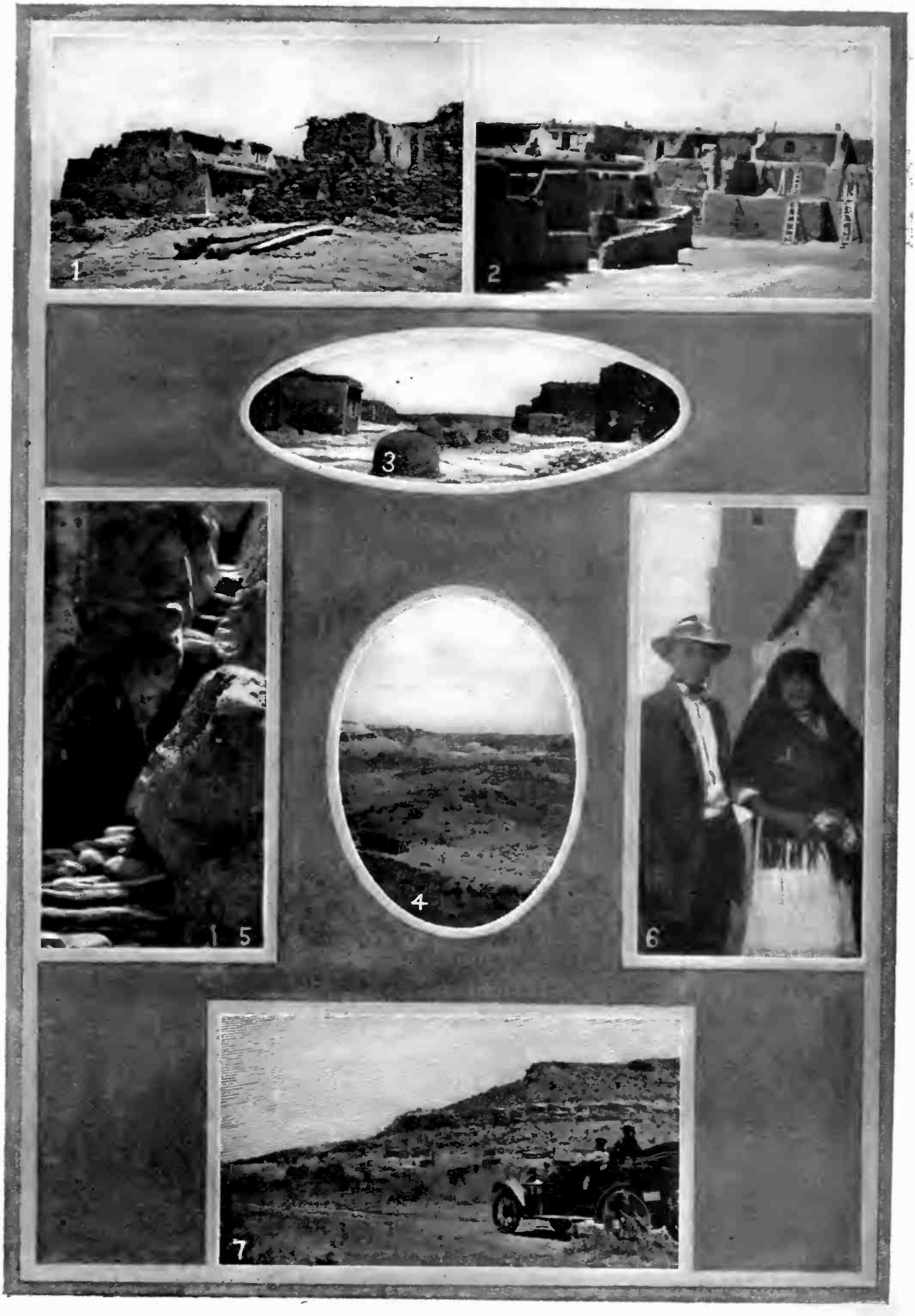
VIEWS ON OPPOSITE PAGE ARE:

(1) — Ruins of an Old Stone Church on the Mesa. In this Church the Pueblos of Several Hundred Years Ago Used to Worship; (2)—This View Shows How the Adobe Homes Are Built as High as Three Stories, as Well as How an Entrance Is Gained by Means of a Ladder; (3)—Street Scene in a Pueblo Village on Acoma Mesa; (4)—Some Idea of the Desert Country Surrounding the Pueblo Village May Be Gained by a Glance at This View; (5)—A Stone Stairway Leading Up to Acoma Mesa. The Dents in the Walls Where the Climbers Take Hand Hold Are Plainly Seen; (6)—A Pueblo Belle; (7)—Summer Houses of the Pueblo Indians in the Low Valley Where They Have Their Farms. The Adobe Huts May Be Seen Near the Foot of the Hill.

In addition to being a place of winter abode for these people, the Acoma Mesa serves as a retreat for the Indians in time of war with hostile tribes. There are only two points at which this Mesa may be approached, it being useless to endeavor to scale the sides of the smooth rock. One of these approaches is so constituted that in case of attack a huge stone may be rolled over the entrance after all of the Pueblos have reached the Mesa in safety—this barring the entrance of the foe. The other entrance, which is shown in one of the accompanying illustrations, consists of a steep stone stairway which is of such a character that at several points a single Pueblo could resist an attack of an entire tribe of hostile Indians. At these points the entrance is extremely narrow and it would be necessary for the enemy to pull himself over large rocks, during which process he could be very easily clubbed and felled by the waiting Pueblo. This stairway is so steep that it is necessary for the one who is entering the Mesa to secure fingerholds in the rocks on either side in order that he might pull himself up to the next stone. The difficulty of the ascent would make it additionally hard for the enemy to reach the Mesa. These Indians become skilled in mounting this stairway so that they reach the Mesa from the valley below with remarkable ease.

It is claimed that this is the oldest settlement of people in the United States, having been established before the arrival of Columbus in this country. It is known that this settlement existed in the 14th century, but how long before that cannot be ascertained. And a peculiar part of this village is that at the present time it is being conducted upon the exact lines that were followed in the 14th century. Upon the crumbling of an adobe hut, a new one replaces it.

Views of Oldest Settlement in the United States



The New Motorcycle Electric Headlight throws a Beam of Light Several Hundred Feet Ahead.

ELECTRIC LIGHTING FOR MOTORCYCLES

A well-known make of motorcycle has recently succeeded in developing a system of electric lighting that is proving exceedingly efficient and is reducing to no little degree the danger of night riding. The head light of this system is so powerful that it will illuminate a roadway several hundred feet in front of the motorcycle. For city riding, where ordinances prohibit the use of blinding head lights, a secondary bulb of lower candle power is provided.

A MAGNIFICENT AVIARY

In Whittier, Calif., there is an aviary that cost $700. It is private property and was built by a man whose name is W. H. Thomas. The curious thing about it is that Mr. Thomas was 91 years old at the time he put up the magnificent bird house and he did all of the work with his own hands.

From foundation to flagstaff the building is fifteen feet high and eight feet square. The four-gabled roof sets upon twelve concreted cobblestone cornerposts. Each post has a section of gas pipe through its center. The pipe is anchored in a two-foot concrete foundation. Between the corner posts there is lattice. The doorways are surrounded by scrolled ornamentations. Over each door there is a panel of artistically turned objects.

The glass windows are pebbled. Around each semi-circular window is a belt of stained windows. In the peak of each gable is a small window. A set of mechanical coo-coo birds, which Mr. Thomas devised, announce the time of day through these windows.

The structure has a gothic dome with copper roof. Along the dome of the roof runs a piece of ornamental molding with small arches. Within the arches are delicately toned brass gongs, suspended upon chains. Each passing breeze causes a musical effect to emanate from the gongs, which is a very pleasing feature of the unique edifice.

The house was built by Mr. Thomas in the idle hours of his ninety-first year to accommodate his pet canary birds, of which there are about twenty. The doors of the structure are of fine screen. They do not appear in the view since it was taken before the doors were hung. Everything estimated, the aviary cost in the neighborhood of $700. The structure is the pride of Whittier, and it is admired by everyone who chances to see it. The fame of this aviary has spread.

A Bird House built by a 91-year Old Artisan.

DAYLIGHT AND DUSK—WHICH IS WHICH?

The two illustrations shown below were exhibited in the course of a recent paper before the Illuminating Engineering Society in London by Messrs. J. S. Dow and V. H. Mackinney, with the object of showing how easily photographs can be used to deceive.

Companies interested in lighting appliances now make a special feature of photographs taken entirely by artificial light and intended to show the illumination of an interior, as it actually is. Now such photographs are a most useful weapon to the lighting engineer. But it is important to recognize that all depends on the conscientiousness of the photographer.

It is well known that photographs can be "faked" by retouching and painting the negative and the print. But it is perhaps not so well known that even without having recourse to retouching, a photograph may be caused to give an entirely misleading and false effect.

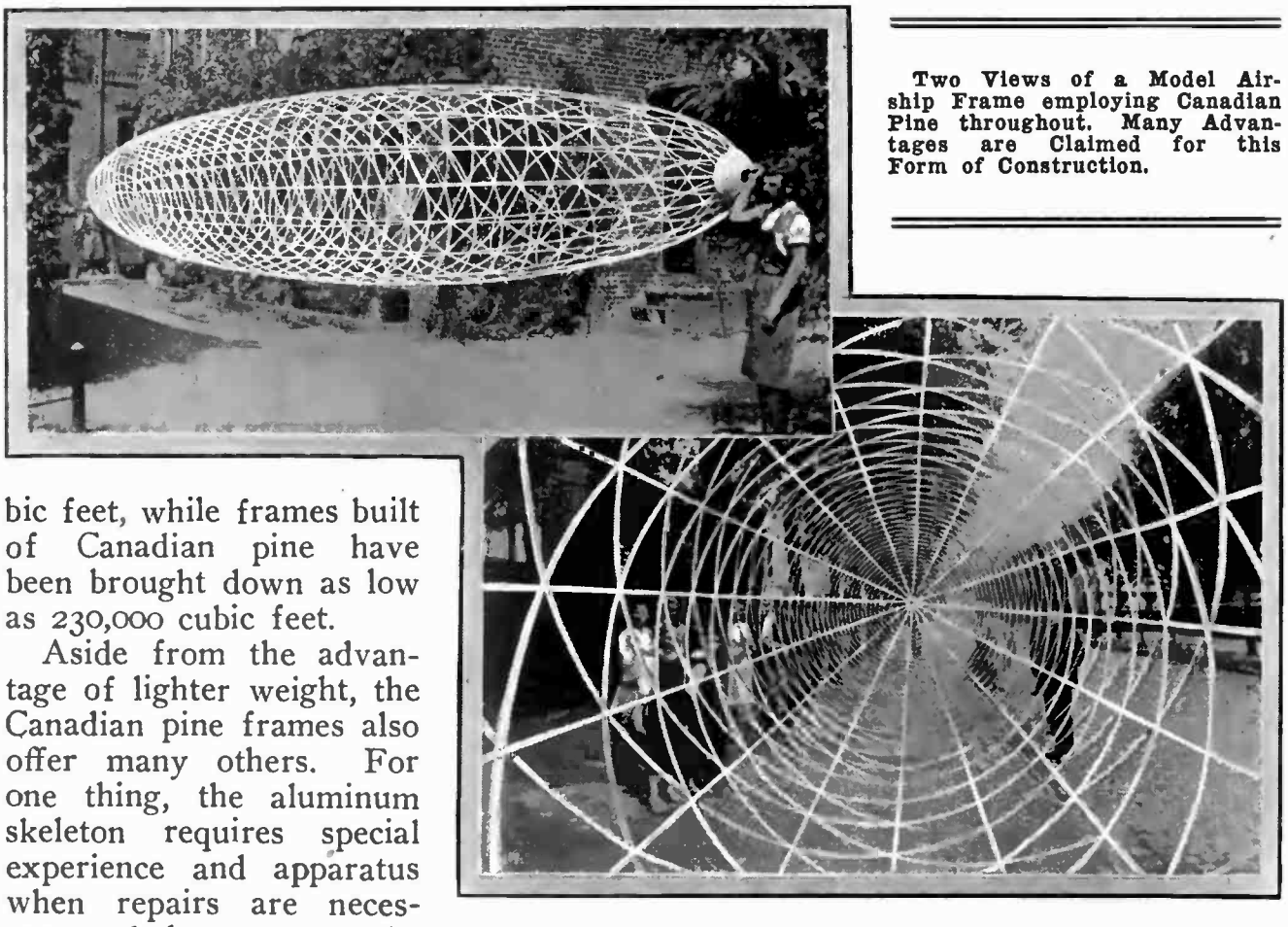
The two photographs of the house were taken respectively in full daylight and in the dusk, when the outlines of the house were barely distinguishable. *These photographs were not retouched in any way.* All that has been done is to adjust the exposure and development in the two cases with a view to producing the desired effect. Yet a casual observer could scarcely tell which of the two views was taken by daylight. It is only on closer inspection, when the shadow on the roof in the left hand view and the artificial light shining through the windows in the right hand view are seen, that one perceives which was taken by night and which by day.

NOVEL TYPE OF GERMAN AIRSHIP BUILT OF WOOD

The disasters that have overtaken several of the Zeppelin type airships of Germany have caused inventors to experiment along certain lines in an

effort to lessen the dangers with this kind of aircraft.

It has been found advantageous to employ wood instead of aluminum. After considerable experimenting one inventor has adopted Canadian pine for the framework of the dirigible. This wood is said to be one-eighth as heavy as an equal bulk of aluminum, yet it is one-third as strong. It is obvious that considerable weight can be saved by employing this wood in preference to aluminum. In its smallest size the Zeppelin type has reached 390,000 cubic feet, while frames built of Canadian pine have been brought down as low as 230,000 cubic feet.



Two Views of a Model Airship Frame employing Canadian Pine throughout. Many Advantages are Claimed for this Form of Construction.

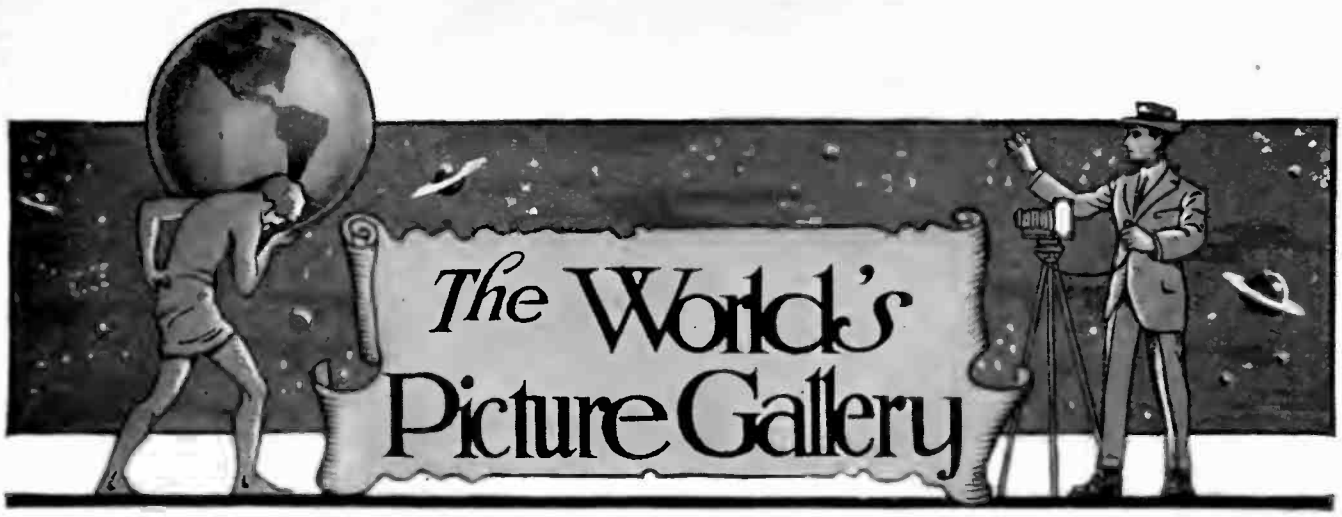
Aside from the advantage of lighter weight, the Canadian pine frames also offer many others. For one thing, the aluminum skeleton requires special experience and apparatus when repairs are necessary and these may not be available in wartime. Another feature is that the wood is coated with waterproof varnish that is insensitive to heat, cold and moisture, while in the case of aluminum the metal oxidizes. Another advantage is that the wood is more resilient and bends in such manner as to offer the least resistance to the air. Lastly, the wooden framework does not become charged with electric currents as in the instance of aluminum. Several catastrophes have been charged to the accumulation of static electricity on the aluminum envelope of the Zeppelins and the subsequent ignition of the gases as a result of a high potential spark.

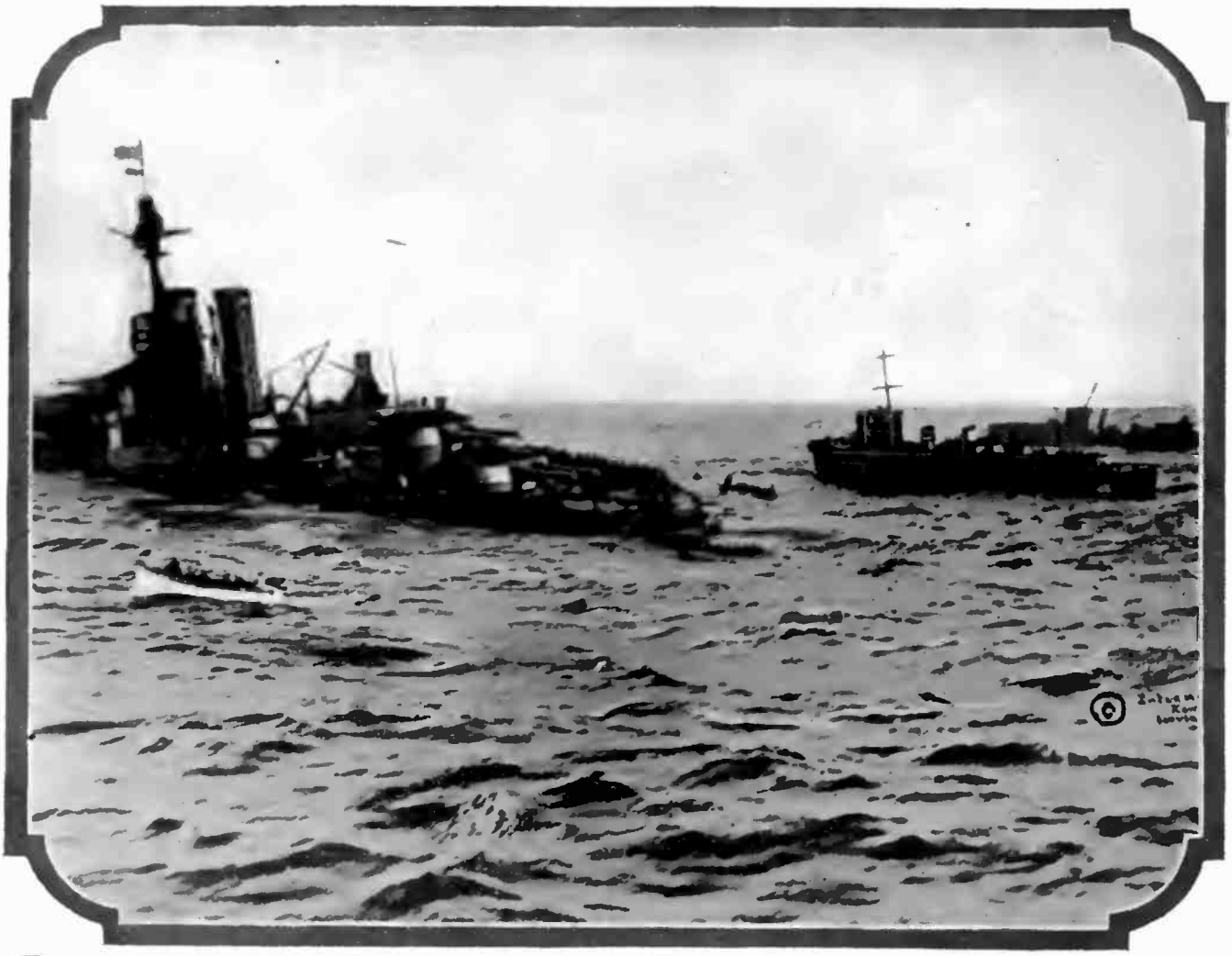
THE LAST HOME OF THE BUFFALO

The Athabasca-Mackenzie region in Canada contains many fur-bearing animals and it appears also to be the home of the last wild remnant of the American bison family. The herds of bisons, as everybody knows, are not numerous anywhere. No more so are they in the region mentioned, where, it is reported, they are being rapidly exterminated.

The Canadian musk-ox, too, inhabits this region, and in the spring, when the rivers and springs escape from the frost, great flocks of birds, including most of the migratory game birds of America, resort thither to breed.

In preparation for the coming fire season in California, 110 miles of fire lines have been built on the Sierra national forest.





THE SINKING OF THE ENGLISH DREADNAUGHT "AUDACIOUS"

In this view is seen the sinking of the "Audacious," one of the largest and most modern battleships of the British fleet. The "Audacious" was stationed off the coast of Ireland when it either struck a mine or was made the victim of a torpedo fired from a German submarine boat. There are many conflicting statements as to the cause of the catastrophe, some claiming that the dreadnaught struck a hostile mine and others that the huge battleship was the victim of a torpedo. This view was taken from the deck of the S. S. "Olympic" and shows the crew of the dreadnaught being rescued. The port deck of the stricken battleship is partly submerged and the crew can be seen gathered on the bow of the starboard side. Two torpedo boat destroyers are standing by.

Here is a striking instance of what war means. In this view may be seen the bodies of soldiers lying on the ground just as they fell. A company of French infantry was ambushed in this forest and almost every man either killed, wounded or captured by the Germans.

A French battery in action. Artillery duels along the entire battle line in France are constantly maintained.

A scene in the court room in London in which Lody, the German spy who was posing as an American citizen, securing information of British naval activities and forwarding his findings to Germany, was tried and condemned to death. This sensational case came at a time when all England was highly excited over the spy peril. Lody was shot in the tower of London by a detachment of soldiers.

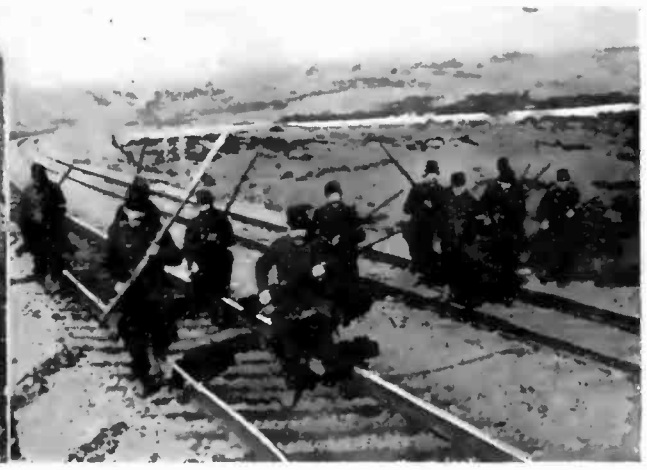
A road in Belgium. Here is seen a deserted military wagon as well as a destroyed farm house. Destruction follows in the wake of the armies.

Photos. Copyrighted International News Service.

Soldiers of the three allied armies arm in arm. Here are seen the British, Belgian and French soldiers walking together through the streets of Boulogne, France. One of the remarkable features of the war is the genial companionship that exists between the soldiers of the allied nations. Although in most instances the British troops are serlously handicapped by not knowing French, this does not prevent them from associating with the Belgian and French soldiers in every possible way. Interpreters are at hand in large numbers.

This view was taken some time ago while the Belgian army was still fighting valiantly in Belgium against the advancing Germans. A Belgian peasant woman is seen bringing walnuts to the soldiers who are resting between engagements in the trenches between Duffel and Lierre, Belgium.

At the Left: The effect of a single German shell striking a house in Rheims. This city has suffered greatly from German shell fire. Below: French outposts running to seek cover from a surprise attack of a German advance squad.



Photos. Copyrighted International News Service.

Belgian refugees sleeping outside a hut in Rosendaal, Holland. Many of the Belgians have fled to peaceful Holland and as a result the resources of that kingdom have been heavily taxed.

A battery of the famous French 75 mm. field guns in action. These guns are said to be exceedingly deadly owing to the extreme rapidity with which they can be served.

A group of British marines studying a map of northern Belgium where they are aiding the regular British army. Both English and French marines have rendered commendable service in Belgium and northern France.

Belgian soldiers operating a telephone field set. The extent to which the telephone and telegraph are employed in keeping the various commands in touch with each other and with the general staffs is astounding. A veritable network of wires is said to be in the rear of both the German and allied armies.

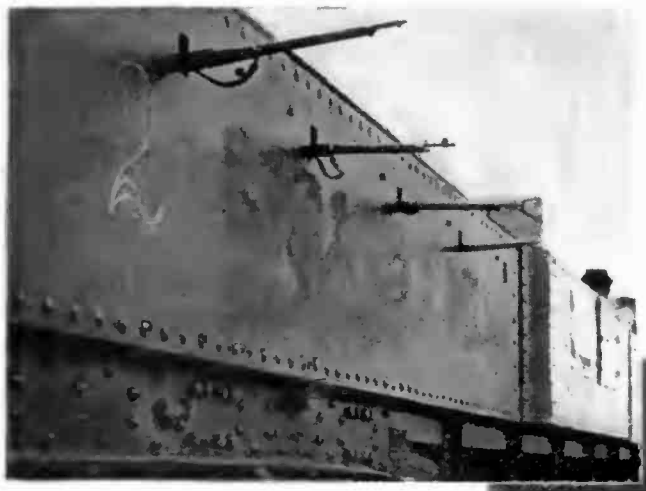
Photos. Copyrighted International News Service.

Belgian refugees from Antwerp arriving at Putte on the frontier of Holland. During the siege of Antwerp by the Germans many civilians travelled in every available form of vehicle to the boundary of Holland in order to escape the horrors of war.

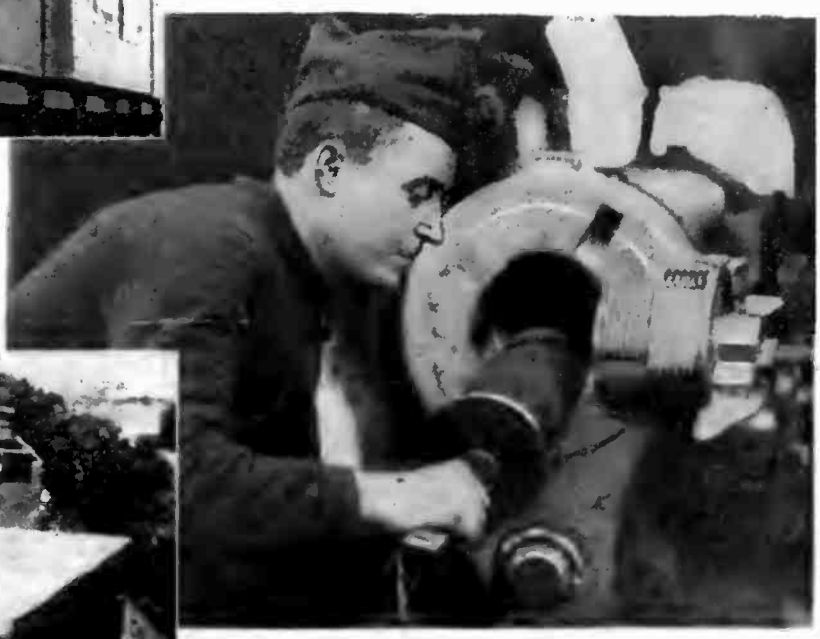
Japanese artillery in action on the plains of Shantung during the siege of Kiauchau. After a persistent siege of Kiauchau, a German colony in China, the Japanese troops succeeded in capturing it with a minimum loss of life.

At the right: Japanese wig waggers signalling orders across the plains of Shantung. Above: Soldiers paying their last salute of respect to a dead comrade.

Photos. Copyrighted International News Service.



Armored train at Ypres with rifles projecting through the loop holes in its sides. The Belgian army has employed a large number of these armored trains with telling results. The riflemen are secure from hostile rifle fire yet capable of meting out severe punishment to their opponents.

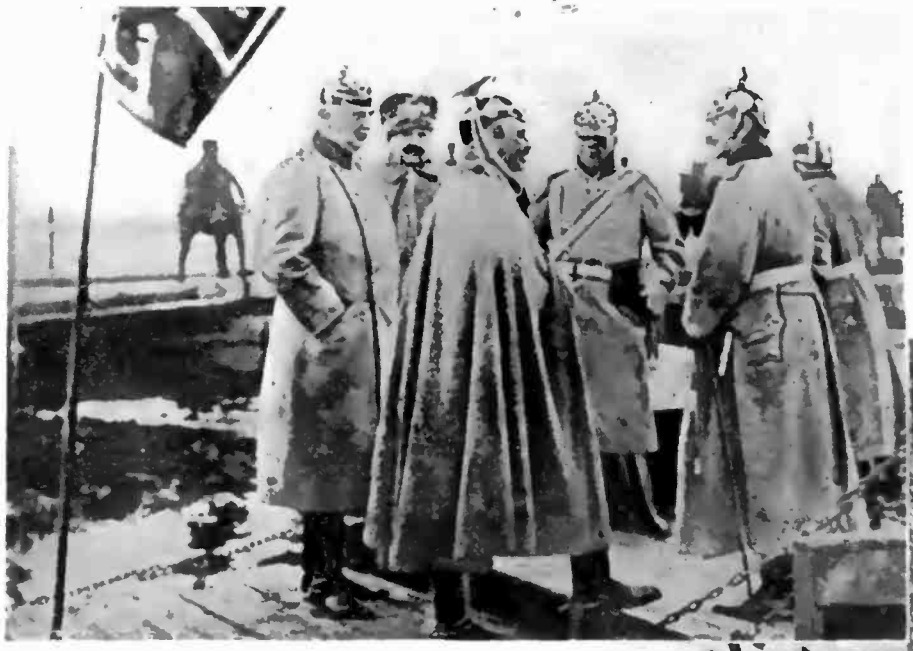


A Belgian gunner placing a shell into the breech of a gun on an armored train during an artillery duel with the Germans.

A group of Belgian sharpshooters firing from an armored train near Ypres. Not only do such trains carry facilities for a number of sharpshooters, but they also are provided with one or more guns of considerable size.

During the last days of the defense of Antwerp, the Belgian and British soldiers and marines made use of numerous armored trains such as the one shown in this view.

Photos, Copyrighted International News Service.



This is the first picture of the Kaiser at the front. The Kaiser may be seen at the extreme right consulting his generals while standing on a pontoon bridge over the Meuse River.

A German dirigible of the Zeppelin type in course of construction. From various reports credited to travelers arriving from Germany, it is understood that the Teutons are now building a large fleet of Zeppelin airships presumably for an attack on the English cities.

A general view of the occupation of Malines, Belgium, by the Germans. German soldiers as well as Belgian prisoners appear in this view.

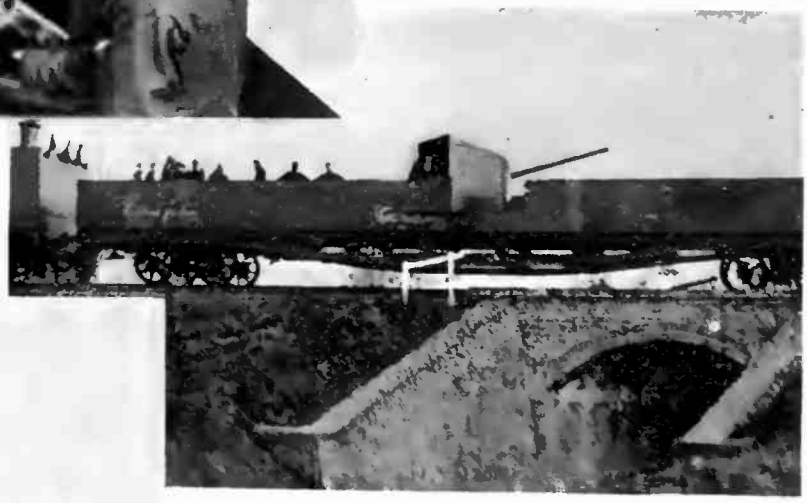
Parisians watching a German aeroplane dropping bombs on Paris. This was a frequent occurrence until the French aviators became more active.

Germans breaking up camp in Russian Poland. After having reached the very suburbs of Warsaw, Russian Poland, the German army of the East was obliged to retreat before the onslaughts of the Russians. The retreat was executed in marvellously systematic order without confusion and with minimum losses.

Belgian soldiers defending Antwerp. Here are seen the Belgian sharpshooters on the banks of the Nethe waiting to fire on the Germans advancing along the opposite bank. The smoke in the background is that from buildings set on fire by artillery.

Monitors, such as the one shown in the accompanying illustration, have played an important part in the battle of Flanders. The allied and German armies have been fighting near enough to the coast to permit of the light draft British monitors taking an active part in the artillery duels. In the oval the British marines on board a monitor are seen firing at a German aeroplane that is flying over them. The monitors are occasionally threatened by aeroplanes and submarines, but the crews are on the alert to prevent damage to their ships.

British naval gunner getting the range for a gun while Belgian members of the armored train crew stand by ready to load. In no previous war has the armored train been used to such a great extent as in the fighting in Belgium.



British gunners on a Belgian armored train near Ypres.

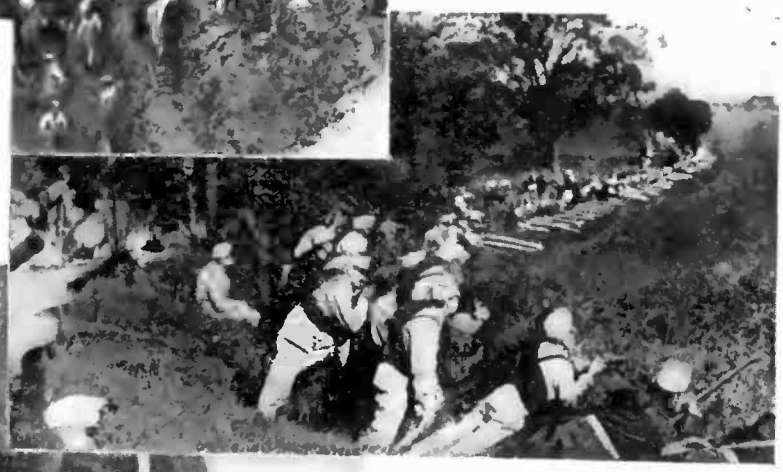
When threatened with the bombs of a German aeroplane flying overhead, the crew of a British armored train at Ypres brought their anti-aircraft gun into position and repelled the attack. Guns such as this can be fired at any angle and have an exceedingly long range.

British naval gunner preparing a meal on board a Belgian armored train near Ypres for his Belgian comrades. Room is at a premium on these armored trains, as may be seen.

Photos. Copyrighted International News Service.

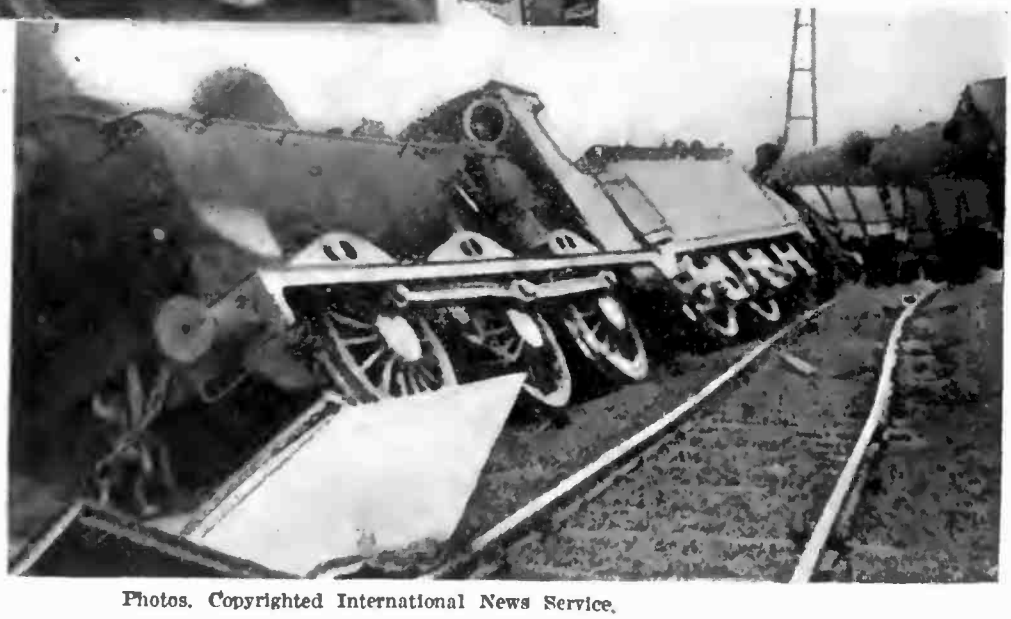
Below: The most striking feature of the European conflict has been the extensive use of trenches. In fact, earthworks have proved to be more effective against the attacks of an enemy than the most powerful permanent fortifications. Here is seen a regiment of Austrian infantry intrenched.

Above: This view conveys an idea of the remarkable efficiency of the German army engineers. In order to check the German advance the Belgians blew up a tunnel on the main line of a railroad. Here are seen the German engineers excavating the ruin.



Belgian refugees boarding a fishing smack at Ostend, Belgium, in order to be transported to England. There are thousands of Belgian refugees in England at the present time.

This locomotive and its train of cars loaded with sandbags was turned loose by the Belgians on the railroad tracks leading from Malines towards a German camp. The Germans apprehended the coming of the wild train and wrecked it by means of a barricade.



Photos, Copyrighted International News Service.

A section of a French quick - firing battery changing positions between Montmidier and Roye. Each soldier carries a portion of the mittraileuse or machine gun to the next position, where it can be assembled in about one minute.

A scene on the road leading to the firing line along the Aisne. This is quite a common sight along any road that leads to the battle-front. A constant stream of supply and ammunition wagons flows constantly back and forth bringing the necessary materials for the men on the firing line.

Below: A company of French marines bivouacing in Belgium. According to reports it is gathered that the French marines have given a very good account of themselves in several of the desperate combats in Flanders and Northern France. These men have proved resolute in holding positions allotted to them as well as valiant and almost irresistible in their bayonet attacks.

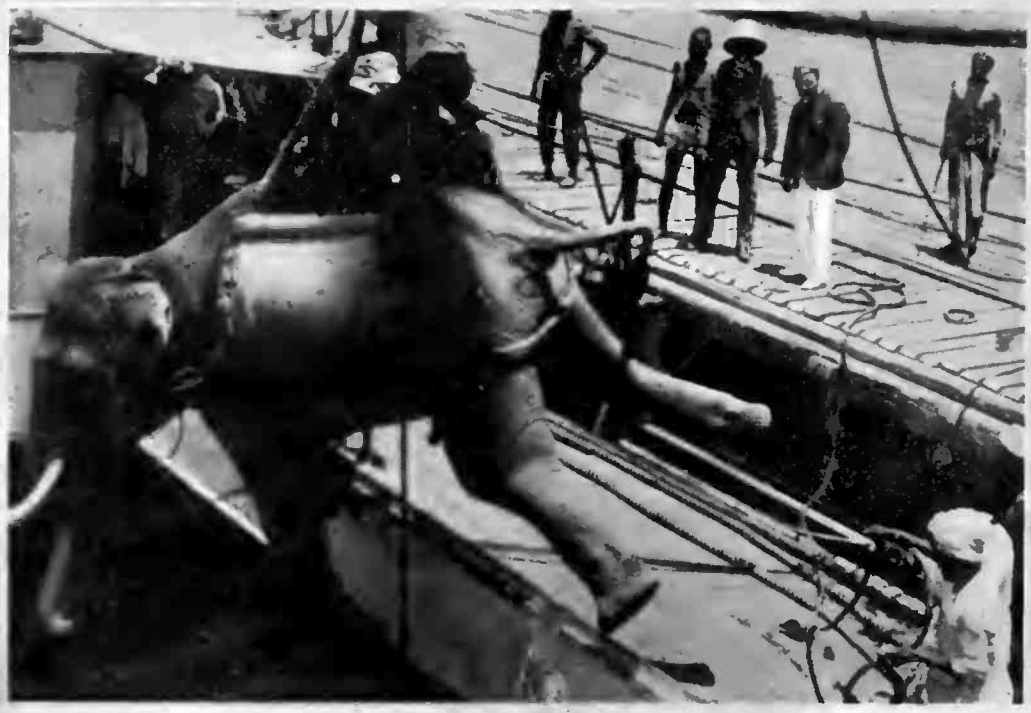
Above: For a hundred francs—about $20.00 in American money—this French soldier signalled the position of a French battery to the enemy near Rheims. He was discovered in the act and summarily shot.

Photos, Copyrighted International News Service.

At the Left: During the excavating of ancient ruins of native Indians in Peru, this oddly shaped chair was uncovered. It was probably employed by the Incas many centuries before the landing of Pizarro in Peru.

Above: Here is an American Indian watching a baseball game. The remarkable growth of hair of this Indian is much in evidence. Many Indians still refuse to have their hair cut and take pride in braiding it.

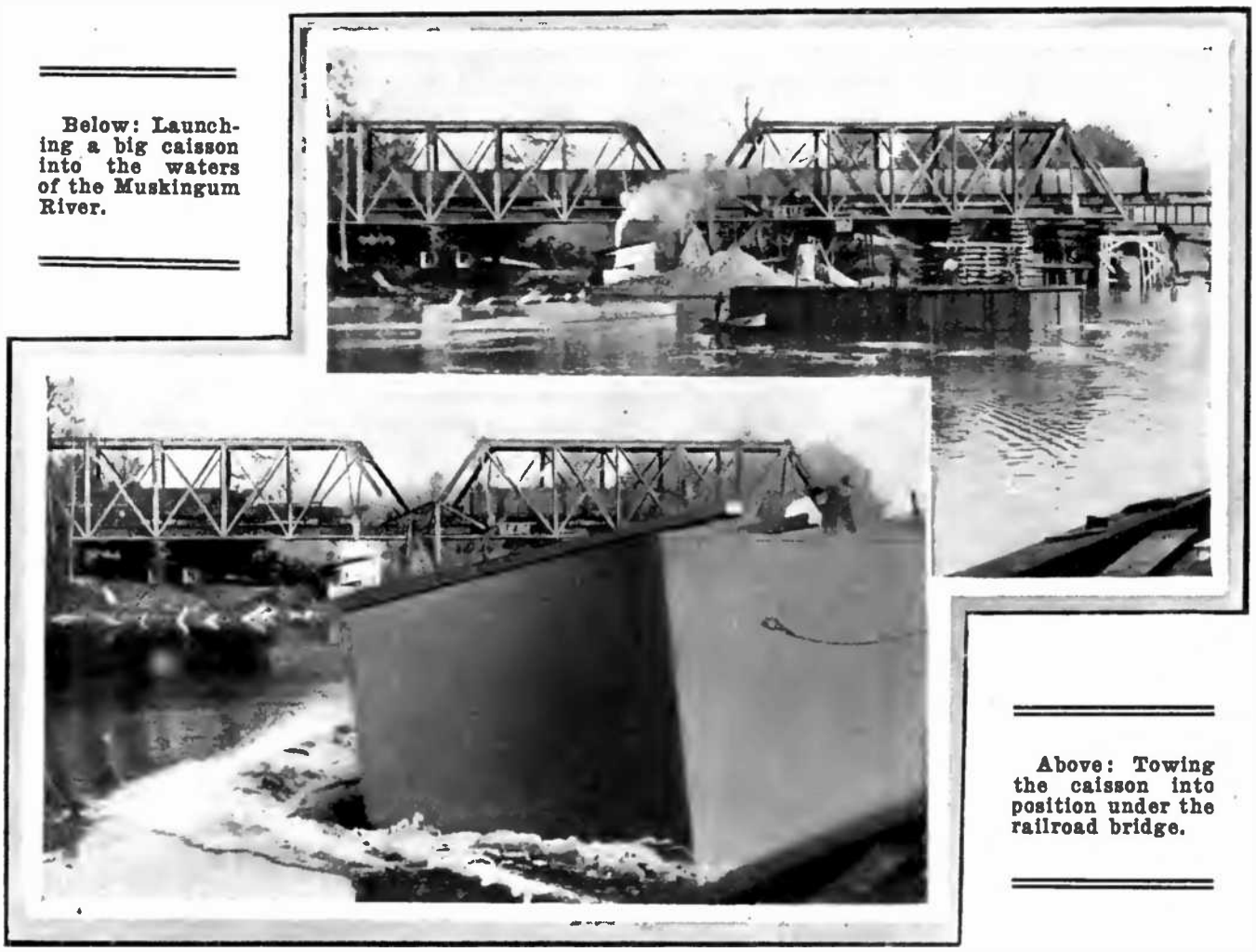
Below: One of the common sights in India is the loading of elephants on shipboard. A band of canvas, as shown in the illustration, is fastened around the huge beast and connected by ropes to the derrick.



LAUNCHING A BIG CAISSON

The accompanying views show an interesting phase of bridge building. This huge caisson, 19 feet wide and 55 feet long, was launched into the Muskingum River and towed into position under a bridge where it played its part in the construction of a pier.

The caisson slid down the ways into the river, entering the water with considerable splash. The usual custom of breaking a bottle of champagne at launchings was suspended on this occasion. A number of engineers watched the operation to see that nothing was allowed to go wrong.



Below: Launching a big caisson into the waters of the Muskingum River.

Above: Towing the caisson into position under the railroad bridge.

CENSOR APPOINTED ON RAILROAD TELEGRAPH LINES

To insure against the improper use of the telegraph wires by its employees, the Lehigh Valley Railroad has followed the policy of the belligerent nations abroad and appointed a censor.

However, the prompt handling of messages will not be interrupted by the activities of the censor as is the case with the military censors. A carbon copy of every telegram to be transmitted for an employee of the Lehigh Valley Railroad will be sent immediately to the censor, who will scan it carefully, determine whether it contains unnecessary words or could be properly handled by mail, note his comments on the message and return it to the sender. The management figures it will not be necessary to point out such useless words continuously, and that the employees will learn the lesson quickly and save the company a considerable sum of money in tolls. The censor will be located in the office of the Superintendent of Telegraph and will scrutinize every message from every office from the highest to the lowest.

Last year the fire loss on the Canadian timber reserves was the smallest ever known, only one-fiftieth of one per cent. of the area being burned over.

AUTOMATIC ARTILLERY IN MILITARY SCHOOL

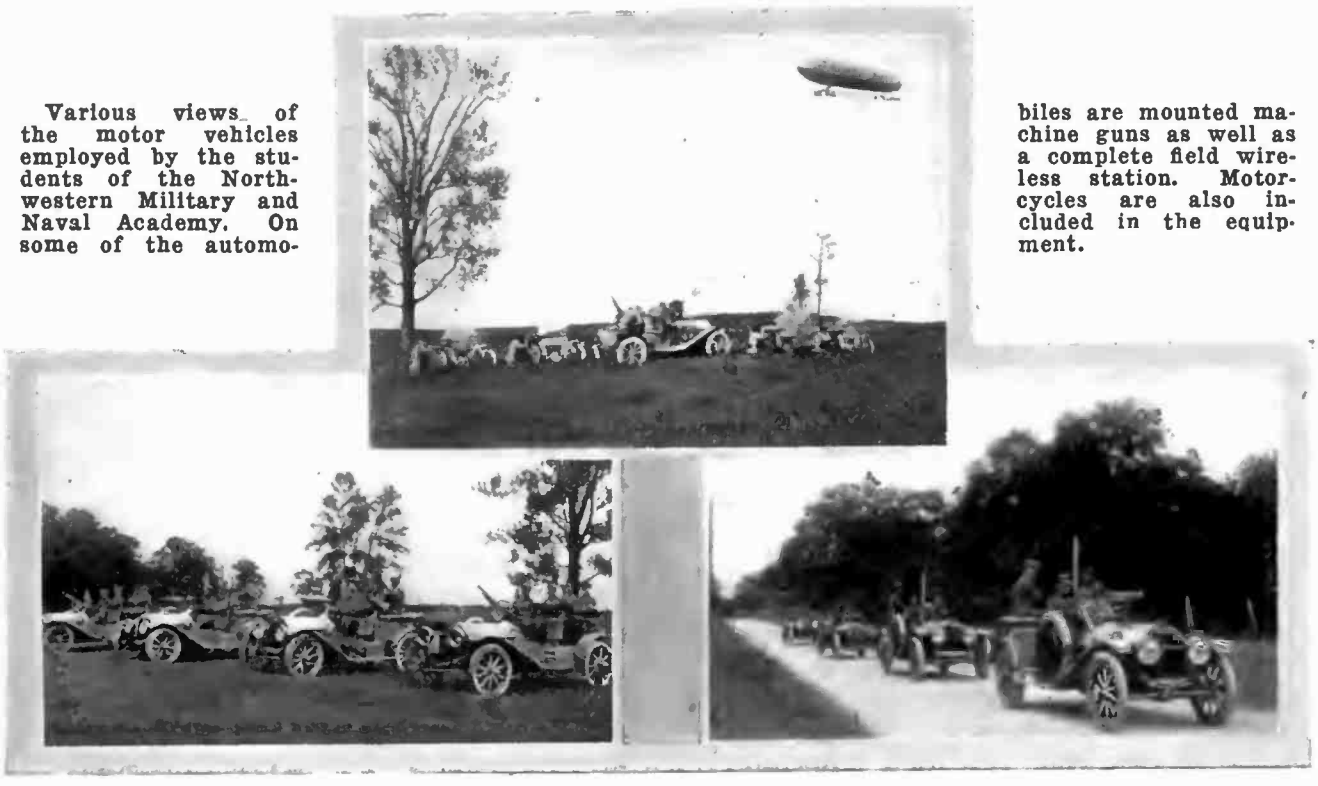
By C. L. Edholm

THE development of the automobile for military purposes is indicated by the fully equipped fleet in a Wisconsin academy, which operates a number of machine guns mounted on cars, together with a couple of field wireless outfits with telescope masts set in the specially built bodies.

The history of this motor corps for cadets goes back as far as 1897, when a Chas. Duryea, three-cylinder automobile was secured and equipped with a Colt automatic gun. The experiment proved so well worth while that two "steamers" were built in 1901 in the manual training shops of the academy; the pupils doing almost all the work. These were likewise equipped with artillery. In 1909 a Cadillac "30" was added to the fleet.

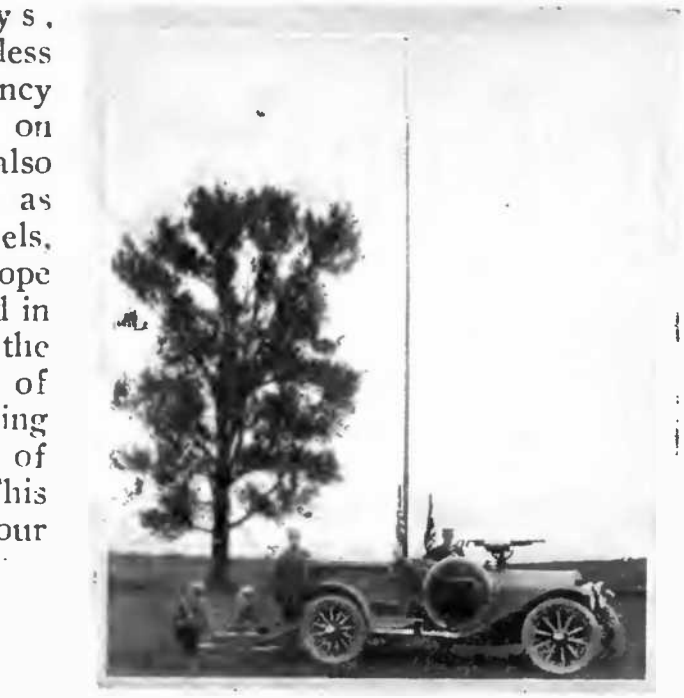
The Cadillac car was tested over thousands of miles of travel and the results were so satisfactory that two more of the same make were added to the fleet. In 1910, a great year for aviation in this country, the students of the Northwestern Military and Naval Academy were kept abreast of the times by instruction with autos equipped with dirigible destroyers, target practice among the ranges of the clouds being indulged in. These destroyers with a crew of students made the Glidden tour from Cincinnati to Dallas, Tex., returning to Chicago by way of Omaha. Both students and cars alike were deserving of great credit because of the record made on that severe grind. These two cars were numbered among the nine successful entrants to complete the tour, although 38 started.

Shortly thereafter, the remaining two Cadillacs which compose the fleet were secured and furnished with electric generators connecting directly with the engines, wireless instruments and 45-foot telescopic masts; the latter being built at the academy shops. These two cars are now used for field work in transmitting radio messages, and in addition, the automobiles carry a machine gun, an electric searchlight and a heliograph for visual signalling, together with the neces-



Various views of the motor vehicles employed by the students of the Northwestern Military and Naval Academy. On some of the automobiles are mounted machine guns as well as a complete field wireless station. Motorcycles are also included in the equipment.

sary wires, guys, etc., for the wireless masts. Emergency outfits for use on bad roads are also carried, as well as axes and shovels, and coils of rope which can be used in connection with the "windlass" hubs of the cars for pulling the machines out of mud holes. This fleet made the tour from Lake Geneva, Wis., to the United States Military and Naval Academies at West Point and Annapolis, the party, consisting of thirteen students and the commandant, making a 3,000-mile trip. Motorcycles for scouting form part of the corps, which is said to be unique.



A wireless equipment carried by automobiles. A machine gun is mounted on these vehicles for protection against the attacks of an enemy.

Because of the important fact that in this mechanical age a boy's education is incomplete without some knowledge of the late developments in electricity, aviation and the motor car, it is encouraging to see these subjects handled together with academic training. As a matter of course, the students need slight encouragement to master these branches to the best of their ability, for it is as natural for a healthy youngster to be interested in mechanics as for a duck to take to water; all they need is a chance.

The practical experience gained through actual contact with and use of the machines places the finishing touches on the education of the young students, preparing them as it does for the many problems which are bound to arise in their after life.

HYDROSULPHITE COLORS

It is said that the fastest colors on the market are what are known among dyers as hydrosulphite—colors that are dyed with hydrosulphite in a caustic bath. These colors are as nearly fast as any can be made and have been adopted by our Government to be used in army uniforms after being submitted to very severe tests.

The dyeing of these colors on cotton yarn is very simple, especially when the Scotch tub system of dyeing is employed. The proper way to dye these colors is to use the vacuum type of dye machine, as the dyestuff experts hold that all air should be eliminated from the cotton before the dye-stuff is applied, and this type of machine is best suited for that purpose, because in this system the cotton is stationary and the dye liquor is forced through the cotton by means of pumps.

Don't forget, the next cover of this magazine will appear as MODERN MECHANICS.

Making the Iron Cross

IN view of the fact that numerous reports from Europe state that Iron Crosses have been awarded to German soldiers and sailors for acts of bravery during the present conflict, the various processes in manufacturing this military decoration are of unusual interest at present.

The Iron Cross is a Prussian military order or decoration that was first instituted by the Prussian Emperor Frederick William III as a reward for distinguished services during war. For a time it was abandoned but again revived in 1871 during the war with France. Since then these decorations have been

Pouring the Molten Iron Into Molds for Casting the Center Portion of the Iron Cross.

awarded to German soldiers and sailors who merit them.

The Iron Cross consists of a Maltese cross made of iron and edged with silver. It is worn suspended from the neck by means of a silk cord or ribbon, or at the buttonhole. The superior decoration of the Grand Cross is a cross of double the size and is reserved for officers of high rank who have successfully carried out a campaign, won a decisive battle or conducted a brave defense of a fortress or position.

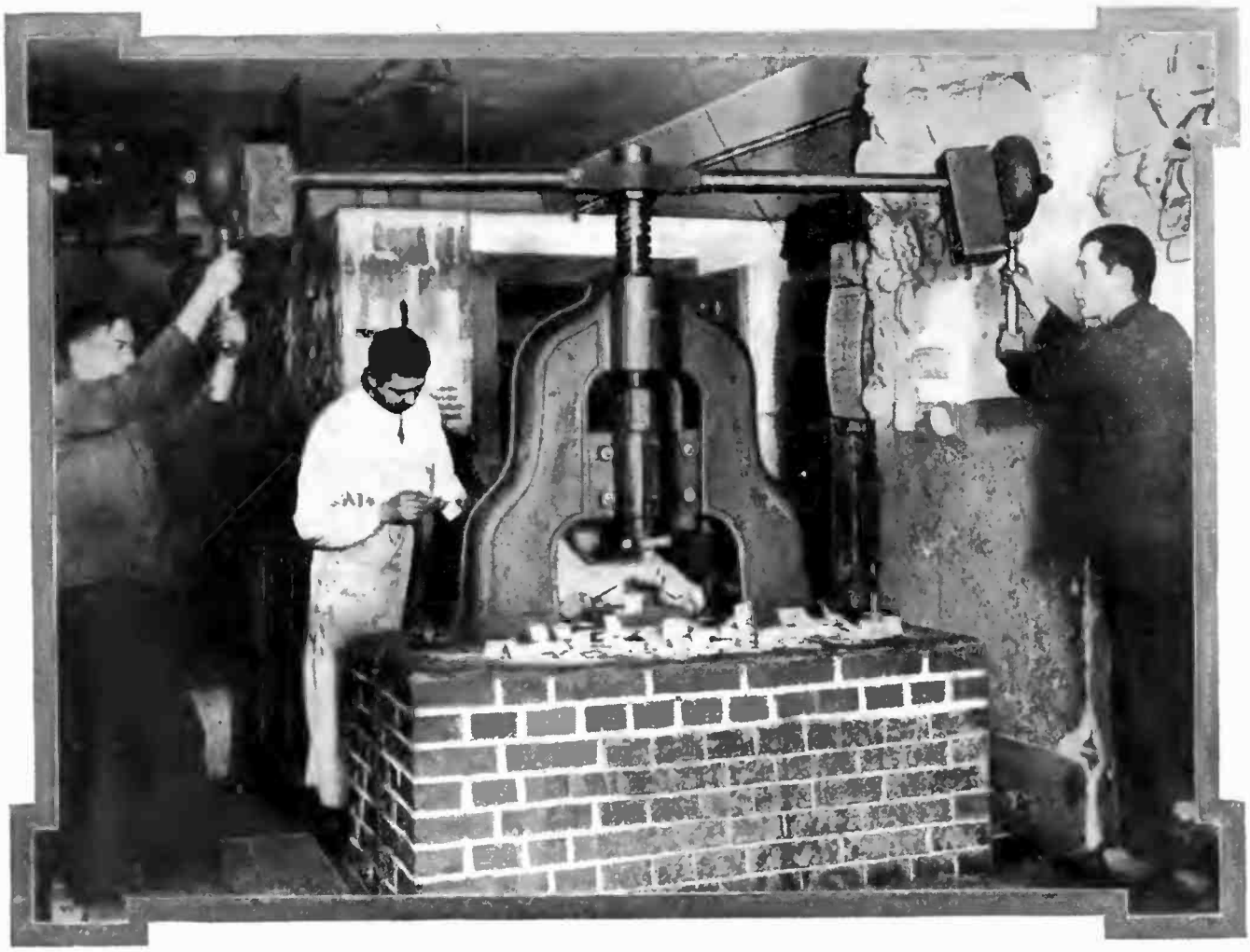
In the accompanying views the various steps in making the Iron Cross are shown. One of the very first operations consists of pouring the iron into molds to give it the right form for the cross. Meanwhile, the silver is punched out to give it the proper shape and recess for holding the iron center portion. The silver portion is then cut to the proper shape with a very fine scroll saw. Thus the iron and silver parts of the cross are ready for assembling. Following the finishing touches that are given to the cross, the decoration is highly polished on a buffing wheel, fastened to its ribbon, and then stored away for future presentation to German soldiers and sailors.

Woman worker polishing the finished Iron Cross on a buffing wheel. Below: An expert workman engraving an Iron Cross.

Photos. Paul Thompson

Using a scroll saw in order to cut out from a silver sheet the silver edge of the Iron Cross. Previously, the silver squares have been punched to shape.

The Iron Cross is a decoration of very pleasing design and is quite conspicuous among the many orders of the European nations. Since the present outbreak of hostilities between Germany and the allied nations the Iron Cross has been



Huge Manually-Operated Punch Employed for Stamping Silver Squares to the Proper Shape.

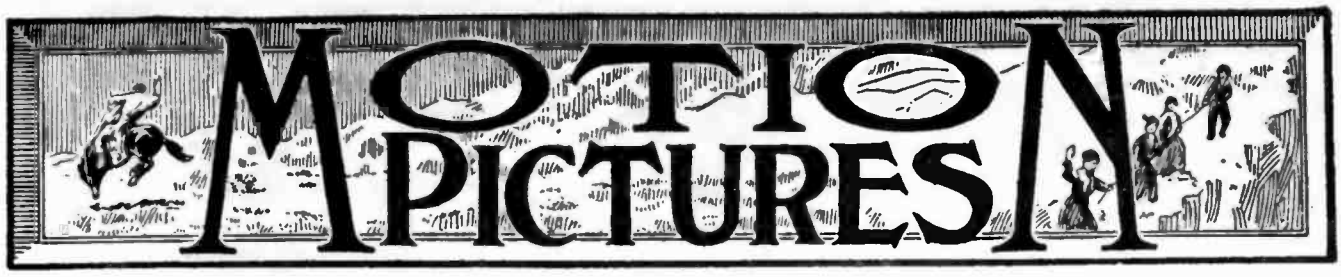
awarded to many soldiers and generals as well as to naval men. Conspicuous among the latter are the men comprising the crew of the German commerce raider *Emden* and the German submarine *U-9*.

ELECTRIC PIPE ORGANS

Even the "king of instruments," the modern pipe organ, has not been able to withstand the steady advance of electricity and to-day what are known as electric actions are being used in nearly all of the big instruments being constructed. With this system the organ and the console or keyboard can be separated; the organ being often placed in an entirely different part of the building from the keyboard. However, the real object of the electric action is to lighten the touch and, at the same time, to give immediate response when the key is depressed.

Several years ago it was discovered that the touch in large organs became so heavy that it was with the greatest difficulty that the organist could press the keys. Then compressed air came to the rescue and tiny currents of air were used to open the pipes. Although this action is still used, it is generally slow in responding and the sound may not come for some time after the key is depressed. With electricity, on the other hand, the response is instantaneous no matter how far the organ is from the keyboard. In some cases the electric action has been combined with the pneumatic.

The electric action is really a miniature telegraph. When the organist presses a key, a tiny current of electricity is sent through a wire to the pipe. This little current opens the pipe and lets the air in from the windchest. The electric action has made possible the placing of the well-known echo organ in another part of the hall from the main organ and yet connected with the same keyboard.



BIG SERIAL IS COMPLETED

Daring scenes in motion pictures are not enacted without risk to the players. More than that, injuries are often suffered by the players. The following is a doctor's report on the injuries to actors who produced the "Trey o' Hearts" serial:

"Cleo Madison, a badly lacerated kneecap and severe bruises about the back and shoulders; George Larkin, one ear nearly torn off and bruised and battered legs and body; Harry Vallejo, a sprained wrist; Leigh Smith, poison ivy over both arms and his face; Ray Hanford, a cut on the knee and bruises too numerous to mention; Rex Hodge, congestion of the lungs; Tom Walsh, sprained back; Wilfred Lucas, a pair of feet swollen and blistered until he cannot walk on them; Johnny Pierce, a broken nose."

Of the entire company not one escaped without injury or illness, and every morning and evening before the

The "Trey o' Hearts" Company on an Improvised Stage on Waterfront at San Diego, Calif. Director Wilfred Lucas and Cleo Madison are Seen in the Right Foreground.

door of the Red Cross tent a line would form of limping, coughing players, hobbling along with requests for bandages, liniment, lotions, cough remedies and a little of everything in the doctor's medicine chest.

REDUCING THE TIME REQUIRED TO DRY FILMS

Speed is a by-word in the motion picture business to-day. Speed is demanded everywhere, in the scenario, in the studio, in the camera men, in the cameras themselves, in the projection machine and in the developing room. Indeed, the only place that never seems speed-ridden about a film manufacturing plant is the drying room where the tens of thousands of recently developed films are left draped on drums for hours at a time to dry. In the past it has been considered impossible to hurry this operation. To turn fans on the moist films meant that their surface would become coated with dust; while to open windows or construct ventilating systems in the drying room presented the same drawback. But through the ingenuity of a veteran in the motion picture game, Mr. Farini, who is in charge of a large studio in Yonkers, speed has at last been dragged into the drying room.

Electric Heaters Used in Drying Room of Studio to Hasten Drying of Films.

Mr. Farini was recently given a "batch" of releases to get out in fast time. It happened that the weather was particularly humid just at that period and the films in the drying room were left hanging for ten hours before they were thoroughly dry. Ten hours for drying was out of the question on the releases Mr. Farini had in hand and he decided to try an experiment. He visited the local electric light company and secured the use of four large electric beer vat dryers. These he had connected and installed in the drying room, and much to his gratification the steady temperature they produced in the building dried his releases in exactly half an hour. That meant that his little discovery had cut down the time required to manufacture motion picture films by at least three or four hours. Moreover, on investigation it was found that the films that were dried so quickly remained very tough where the films that were left to hang for hours became watersoaked and easily torn.

A NEW PRODUCING COMPANY

With a motion picture plant that is modern in every respect, the Liberty Motion Picture Company started active operations a number of weeks ago. The plant is situated at Germantown, a prominent suburb of Philadelphia. Mr. N. E. Milligan, a former stage director in stock as well as productions, has been engaged as head producer. Milligan is at present absorbed in his fourth multiple reel photo-play. Howard G. Bobb is general manager of this new company. The factory of the company has the capacity for turning out four million feet of the finished product per week. In the studio there is adequate space for sixteen good sized sets.

The releases now in preparation will be put into circulation in the near future.

The cover of the next issue of this magazine will bear the new title "MODERN MECHANICS."

ABOUT forty-five minutes from Broadway, New York, on the road to Boston, is the thriving city of New Rochelle. Many are the industries for which New Rochelle may justly be proud, but probably none is regarded with greater pride than that of producing photoplays.

New Rochelle is the home of the Thanhouser studio. Thanhouser and New Rochelle are inseparable: the mentioning of one calls for the other. Just the word "Thanhouser" on a letter mailed in New Rochelle will speed that letter straight to the Thanhouser studio. If the production of a Thanhouser photoplay calls for a few fire engines, they are immediately placed at the disposal of the producer. Indeed, the Thanhouser directors may consider anything in the city at their disposal if the scenario demands it. Hence an ultra-liberal amount of realism in Thanhouser films.

I recently had the good fortune to visit the Thanhouser studio and be shown through the numerous departments of this industrious community—or should I say "family," for never have I witnessed a more homelike atmosphere and spirit of good fellowship in a manufacturing establishment. At any rate, I had an opportunity of seeing the home of the Thanhouser films from the camera to the shipping tin, or, putting it in metaphorical terms, from the cradle to the leaving of home for the outside world.

The Thanhouser is housed in two large concrete buildings. One of the first things that catch the eye and admiration of the visitor is a garden that fronts the street leading to the buildings. At the time the writer visited the studio this garden was laid out with a ledge of rocks in the background, down which leaped a waterfall. The water gathered in a rocky basin below and then flowed over numerous boulders into a cave. Two rustic bridges, trees and other bits of foliage completed the landscape. And the remarkable feature of this garden was that everything—even the large, rocky ledge in the background—had been constructed by the studio carpenters, entirely of wooden framework and canvas painted in photographic colors much in the same manner as an artist retouches a photograph for halftone engraving purposes. But this is not all. The brook entered the cave for a very definite and remarkable purpose.

Under a wooden platform on which scenes are staged when weather permits, I was led into a wonderful under ground cave. It consisted of many little passages, grottoes, out-of-the-way corners and large chambers, all bound in by rocky walls marred with the most grotesque stalactites and stalagmites. Through the cave passed the brook; the water being sufficiently deep to float a flat bottom row boat. And as in the instance of the outdoor scenery, the entire cave was constructed of wooden framework and painted canvas.

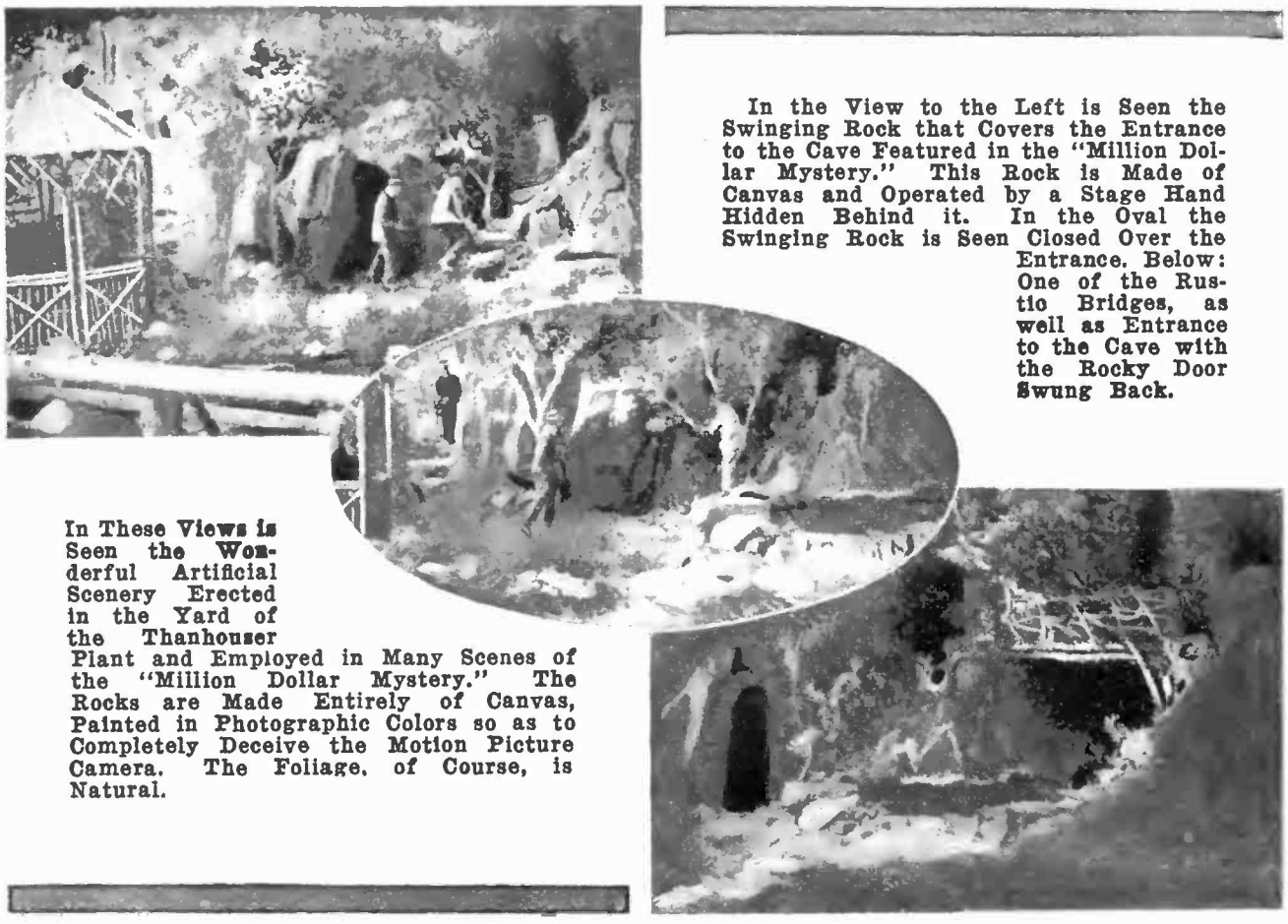
All of this scenery was employed in certain episodes of "The Million Dollar Mystery." It is indeed difficult for any-

one who has seen reels of this serial, in which the cave is employed, to be convinced that the cave is not a natural one.

The property room of any studio is one of the centers of interest. In a measure it aptly signifies the scope of the producer—his facilities—or call it stock in trade if you desire. If the property room of the Thanhouser be regarded as a criterion, the facilities of this studio are well nigh unbounded. Not even in a large metropolitan furniture store would one find such a complete and varied assortment of house-furnishings, much less the fittings for offices, bar rooms, churches, schools and what not. I would unhesitatingly challenge anyone to suggest some indoor scene that could not be rendered with the proper atmosphere in the Thanhouser studio. Perhaps I am too enthusiastic, for giving the matter further thought it is quite possible that ancient scenes or others entirely out of the ordinary could not be fitted up from stock. But then there are the studio carpenters to reckon with.

In one section of the studio there is a large space devoted to the carpenters. These men are clever and ingenious artisans, skilled in their calling and capable of turning out any piece of property that may be necessary in producing a photoplay. For instance, in "The Million Dollar Mystery" the men constructed a safe of wood and cardboard, painted with aluminum enamel, that surely defied detection in the film. Even the bolt mechanism could be operated by turning the usual lever handle, although the bolts consisted merely of wooden sticks finished in aluminum. Another clever piece of property was a rural fire department pump and hose cart that later added much mirth to a farce comedy film.

You must not assume by the foregoing that everything in producing photoplays is intended to deceive the camera. This is far from being the case, for where actual furniture can be employed it most certainly is. In one set for the "Zudora" series I have seen $2,000 worth of new furniture used for the first time.

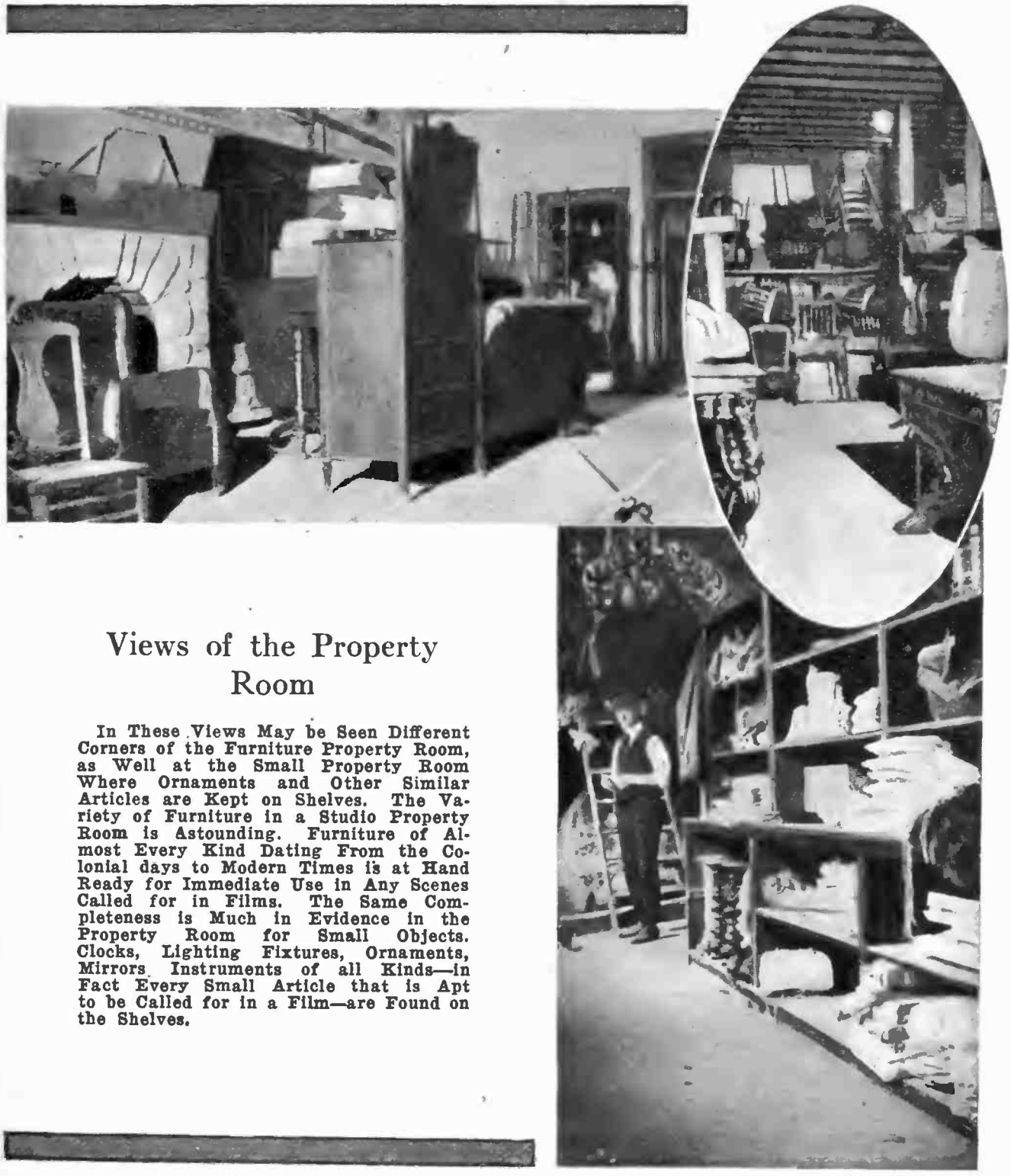


In the View to the Left is Seen the Swinging Rock that Covers the Entrance to the Cave Featured in the "Million Dollar Mystery." This Rock is Made of Canvas and Operated by a Stage Hand Hidden Behind it. In the Oval the Swinging Rock is Seen Closed Over the Entrance. Below: One of the Rustic Bridges, as well as Entrance to the Cave with the Rocky Door Swung Back.

In These Views is Seen the Wonderful Artificial Scenery Erected in the Yard of the Thanhouser Plant and Employed in Many Scenes of the "Million Dollar Mystery." The Rocks are Made Entirely of Canvas, Painted in Photographic Colors so as to Completely Deceive the Motion Picture Camera. The Foliage, of Course, is Natural.

Before concluding the preparation of sets it is but fair to say a word regarding scene painters. These workers are busily engaged in painting the background and side walls for sets. They work in a long, narrow room, along one side of which is placed the huge surface to be painted. This surface may be raised or lowered on a suitable framework through a long slot in the floor, so that a painter standing on the floor can reach any part of the surface without difficulty.

Aside from the property room containing the furniture there is still another room devoted to small pieces. It would be next to impossible to cover the entire contents of this room. Shelves of great length and extending from the floor to the ceiling are loaded down with small objects of all kinds. Here are a few selected at random:



Views of the Property Room

In These Views May be Seen Different Corners of the Furniture Property Room, as Well at the Small Property Room Where Ornaments and Other Similar Articles are Kept on Shelves. The Variety of Furniture in a Studio Property Room is Astounding. Furniture of Almost Every Kind Dating From the Colonial days to Modern Times is at Hand Ready for Immediate Use in Any Scenes Called for in Films. The Same Completeness is Much in Evidence in the Property Room for Small Objects. Clocks, Lighting Fixtures, Ornaments, Mirrors, Instruments of all Kinds—in Fact Every Small Article that is Apt to be Called for in a Film—are Found on the Shelves.

Telegraph and telephone instruments, doctor's instruments, ornaments of all kinds, firearms of every conceivable type, picture frames, mirrors, clocks, every object can be found. Ask for a bedroom setting and the men will bring in the furniture in keeping with the story, place the various pieces in posi-

One of the Companies Engaged in Producing Princess Brand Comedies at the Thanhouser Studio. The Three Groups Represent Soldiers, Civilians and a Police Force in a Side-Splitting Comedy entitled "The Dead Line."

chandeliers and lighting fixtures. Take, for instance, the single item of clocks. There are alarm clocks, grandfather's clocks, mantelpiece clocks, bureau clocks, wall clocks and so on down the line. The stock clerks know where tion, use the proper bedding, arrange a scarf on the bureau with the proper articles neatly laid out on top of it and attend to the numerous other details that insure realism.

The studio proper is an immense

glass covered room in the same building as the property rooms. At least ten sets can be employed at once on this floor; at the time the writer visited the studio at least one-half of the floor space was taken up with sets of the "Mystery" films—left standing until the series was completed—yet leaving ample room for six other active sets.

The lighting of the studio is aided by the glass roof; the studio being a daylight one. Under the glass there is an elaborate system of shades that can be adjusted so as to vary the intensity of the light over any particular part of the floor. When the daylight is not of sufficient intensity, arc lamps are employed. These comprise several carbon arcs enclosed in a metal hood and mounted on casters to facilitate moving them to any part of the floor.

To properly describe the work of the directors and actors is rather difficult, at least in so short a space. To a visitor watching the activities in the studio the general impression is that of several independent groups of individuals, each absorbed and at work on its own particular problem and seemingly disinterested in the work of the others. The sets comprise a back wall and two sides, furnished with such fittings as may be necessary. The actors are quite shut in from the outside world by the walls. In front stand the director and the camera man with his machine. When everything is in readiness for taking the scene, the director shouts "lights," bringing several electricians on the run with arc light stands that are soon connected to the source of current by long, flexible cables. Elsewhere may be seen stage carpenters busily engaged in erecting a set; in another part of the studio the carpenters are demolishing a set; while perhaps in a corner may be seen a director surrounded by his company to whom he is explaining the action of the scenario.

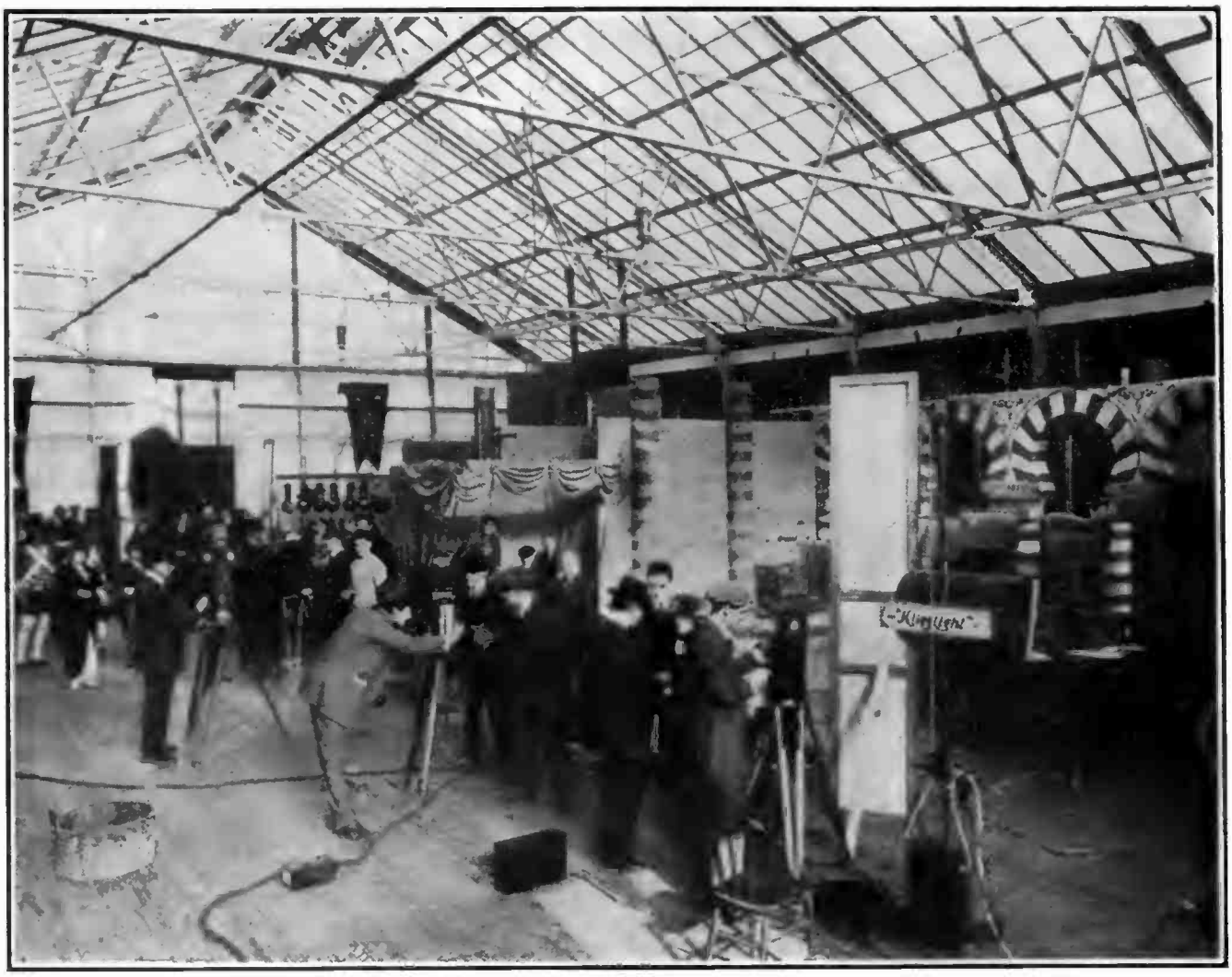
The handling of the film is a most interesting part of the Thanhouser plant. This is accomplished in another building from that occupied by the large studio, although there is a

One of the Rustic Bridges Constructed by Stage Carpenters in the Thanhouser Yard.

daylight studio of lesser magnitude housed under the same roof as the developing and printing departments.

The developing room is entered through a winding entrance, so constructed as to effectively shut off all light, yet permitting the free passage of air. For the first few moments it is impossible for a visitor to see anything and in consequence he feels helpless. After a time the oblong red lights are visible around the room and by their dim rays may be seen the long, narrow tanks in which the film is developed. The celluloid strips are wound on simple wooden frames and allowed to remain in the developing tanks for the required length of time. The dark room hands occasionally lift a frame from a tank and bring it in front of a red lamp to ascertain the extent of the development. In other tanks the films are fixed and washed.

The room where the films are printed, *i. e.*, where the positive films are printed from the negative, is perhaps more interesting than the dark room.



A General View of the Huge Daylight Studio in which Thanhouser and Princess Brand Films are Staged. In this Picture the Arrangement of the Different Sets is Clearly Seen.

It is also entered through a winding passageway that excludes all outside light. In this room there are a number of printing machines constantly clicking away. It may be added that the red lamps are brighter in this room than in the dark room; the positive film stock being less sensitive than the negative. The printing machines appear as so many fire-flies with their flickering red lights. As the negative and positive strips move along one picture at a time, a shutter opens for an instant and permits the rays of a powerful light to pass through. By observing the relative strength of the red light through the moving film strips, the operators can determine the intensity of the negative and time the printing accordingly.

After the films are developed they are dried in a special room that is kept warm and dry, the celluloid strips being wound on cagelike wooden frames. When the strips are thoroughly dry, they are ready for assembling.

The assembling room is equipped with long, low tables at which sit many girls engaged in piecing together the various strips of film that go to make a complete reel. It is most interesting to watch these girls working, for they are extremely apt at handling the film. Each has a reel and stand at her right on which to wind the film as fast as it is assembled. Little rolls of film are piled about, each accompanied by a strip of paper marked with the name of the film and the number of the scene. Each girl has a typewritten list of the scenes in the order in which they should be assembled. The workers take the different lengths in proper sequence and cement them together with liquid adhesive. Another part of this work consists of polishing the film

strips. The girls wind the strips on large, wooden, cagelike frames that have been covered over with soft cloth. The surface of the film is then gone over with a cloth as well as with the palm of the hand until it is lustrous and without spots of any kind.

When a film has been assembled and finished, it is sent to the projecting room. Here are found two motor-driven projecting machines attended by two men. The film is taken out of its tin and placed in one of the machines. The operator has before him the typewritten assembly sheet. It is his duty to compare the projected film with the assembly sheet, making sure that the scenes, leaders and inserts follow in proper order and are without flaw. After being thus inspected and found correct, the film is placed in a flat tin can and is sent to the shipping room, there to be shipped to the exchanges throughout the United States and the world. From the exchanges the film ultimately finds its way to the motion picture theatres and the audiences.

AN EXCITING AEROPLANE ACT

Sliding down a rope from a fast flying aeroplane and landing on the hurricane deck of a freight train moving forty-five miles an hour is a job that would make almost any soldier of fortune look to his laurels. It has all the thrills of war and none of the emoluments of heroism.

Charles Gorman of the Majestic-Mutual forces did the trick recently near the Mutual's Los Angeles studios, and did it not once, but twice. First, he rehearsed it so that W. C. Cabanne, director of "Out of the Air," the play for which the thriller was staged, should be satisfied it could be done, and then Gorman "went and done it."

Captain Hodgson, a well-known California aviator, handled the machine, and F. A. Turner and Signe Auen were on hand, ostensibly as principals in the production, but really, as they thought, to serve as first aid to the heroic dead. Gorman liked the stunt so well he has offered to do it again some day. He is not being crowded one little bit for his job.

TWO WELL-KNOWN FILM PERSONAGES

In the accompanying view is shown D. W. Griffith, the well-known motion picture director comparing notes with Harry Aitken, President of the Mutual Film Corporation. Mr. Griffith is credited with having brought the film drama to its present state of perfection and importance. He is the originator of many of the now common effects in photoplays, chiefly the gradual opening and the fade-away at the beginning and end of a film, the "flash back" where a story occasionally flashes from one scene to another to indicate simultaneous incidents and hold the audience in suspense, and the slow and emphatic acting—particularly facial expression—coupled with close-up photography.

Messrs. D. W. Griffith and Harry Aitkin—Two Well Known Personages in Filmdom.

ACTING IN SULPHUR MINE HARD ON SHOES

"Sheriff" Arthur Mackley and Howard Gaye each was forced to purchase a new pair of shoes as the result of putting on the Reliance-Mutual thriller, "The Miner's Peril." The company used an old sulphur mine in the Topanga canyon in the Santa Monica mountains for the mine shaft. The ground near the mine shaft was so hot from the sulphur fumes that it burned the players' shoes. The company was able to work only a half hour.

NEW FEATURE PRODUCTION WITH A CAST OF 15,000 PERSONS

There have been many feature photoplays of six, seven or even eight reels with casts totaling 3,000 to 5,000 people. But it has remained to the daring of the famous director D. W. Griffith of the Mutual Film Corporation to produce a feature entitled "The Clansman" in some scenes of which appear 15,000 persons. Beyond any doubt this is the first time that casts in excess of 10,000, or, for that matter, probably over 5,000, have been employed in a film production.

There are 12,000 actors in this production who take part as soldiers of the United States army, as members of the famous Ku Klux Klan, as natives of the city in which the dramatic action takes place, and as the objects of the wrath of all these people. Three thousand more actors are negroes, fleeing from the Ku Klux Klan organization.

One may gauge the magnitude of the action by the following incidents: Once the 3,000 negroes, who were driven from their homes by the Ku Klux Klan, really took fright at the savageness with which they were attacked and more than half of them refused to return to work. As a result the director had to hire about 2,000 negroes and photograph the scenes over again in which the black folks figured. One of the leading men, Henry Walthall, as well as Director Griffith, both had bad falls from their mounts. In one instance Griffith's horse fell upon him in a mad gallop across country, with the result that the film had to be delayed several weeks until he recovered.

MINING CAMP CONSTRUCTED FOR "MOVIES"

In the new Universal serial, "Master Key," the director, Bob Leonard, has gone to no little expense and trouble in order to have constructed a thriving mining camp in the midst of the Californian mountains. There are a half dozen or more shafts sunk into the side of a mountain at various points, with car tracks issuing from their mouths and running on to great dumping mounds. There are the powder and tool houses, piles of logs used for beaming the tunnels, scores of ore cars, well constructed shacks for the miners and their families, as well as everything else that is necessary for giving the scenery a true mining camp appearance. The entire atmosphere of the mining camp is most realistic and leaves absolutely nothing to the imagination of the audience.

GERMAN GOVERNMENT TAKING MOTION PICTURES OF WAR

It is reported by one of the American correspondents in Germany that the German government has commissioned the Express Film Company, a connection of Pathé Frères, to take official moving pictures during the course of the war. These pictures are designed to disprove the charges of German atrocities. Under certain conditions scenes of actual fighting are being taken. The conduct of the German soldiers after the capture of a city is being recorded by the motion picture camera.

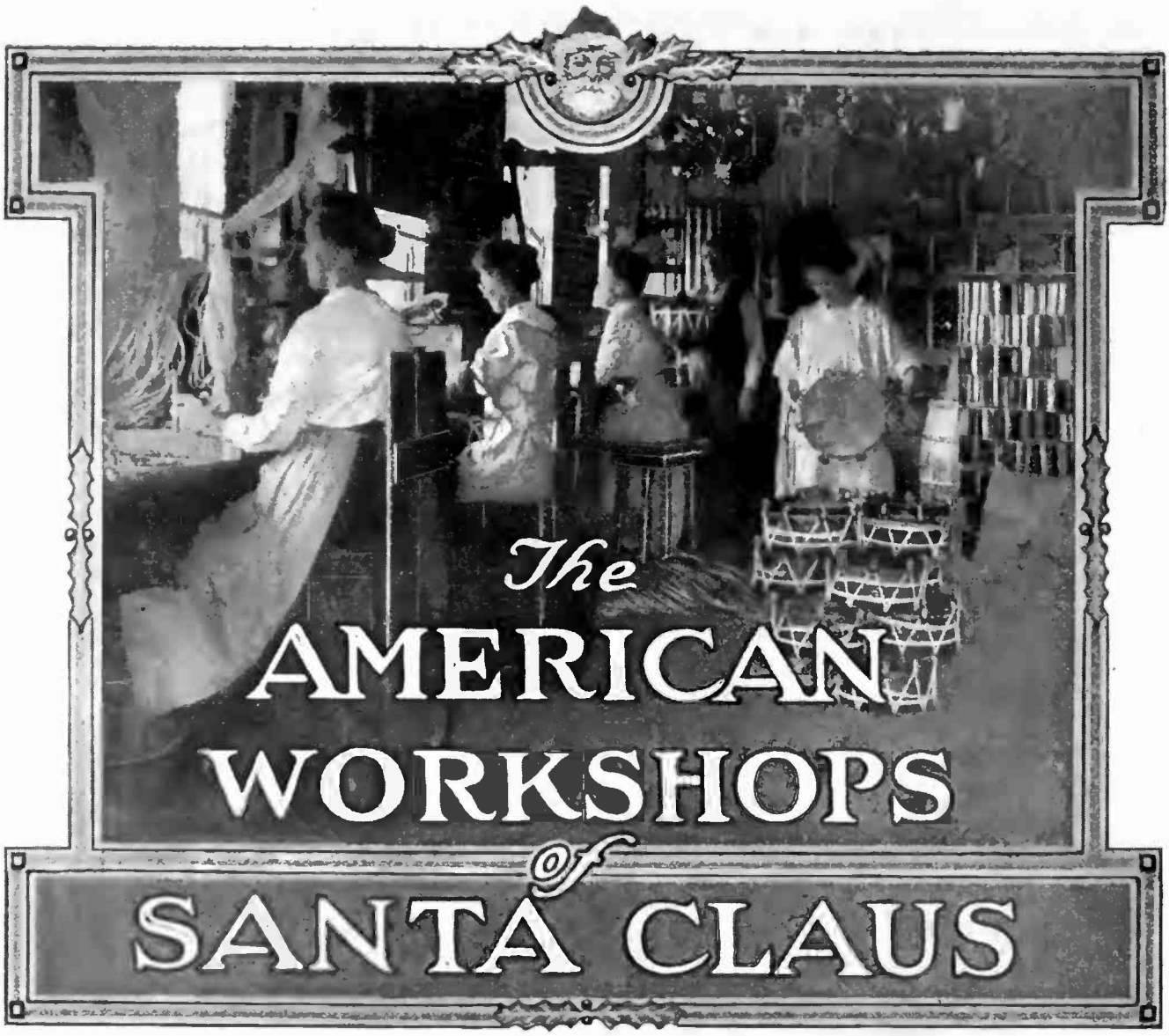
Being hoisted from a swiftly moving motorboat on to a hydro-aeroplane while traveling at full speed over the Pacific, is the experience of Signe Auen in the political story, "On the Wings of Love," just produced by W. Christie Cabanne of the Majestic-Mutual forces.

THE LATEST IN CONCRETE

In the accompanying views are seen a few of the latest applications of concrete in Pasadena, Calif. And in view of the fact that California leads in the artistic employment of concrete, these examples may be considered as the most advanced in the field.

In the center view is seen the Women's Rest House in Library Park, a striking example of a concrete building of attractive architecture. In the oval to the left is a park bench, the ends of which are of concrete and serve to hold two heavy boards that are held in place with pegs. Such a bench may be constructed at a cost of about $10. In the topmost view is seen a street sign located on the curb stone. These concrete signs may be made at a cost of but $4 and they are proving highly useful as well as adding to the decorative appearance of the concrete walks and curb stone. In the right hand oval is seen a similar idea applied to house numbers. In beautiful contrast to the white concrete are the many bronze lamp posts that are being employed in lighting the thoroughfares of Pasadena. In the lowermost view is seen one of these artistic lamp posts as well as the name of a home on a small concrete slab.

It is undisputedly admitted that in the matter of artistic employment of concrete for a wide diversity of purposes, the cities in southern California are far more advanced than other American cities. Concrete is used in many ways and for almost infinite purposes in California. Many of these applications are new and even unknown to Eastern home builders. Concrete is not expensive to employ and is exceedingly durable, while its appearance, when properly combined with wooden trimmings, is pleasing.



The AMERICAN WORKSHOPS of SANTA CLAUS

Photos. Paul Thompson

THE American Santa Claus is thinking hard these days as to how he can fill the stockings of his many American youngsters to the brim. His German workshops, heretofore producing the greatef part of the toys for young America, are now closed because of the European war. It presents quite a problem for this mythical gentleman to meet the unprecedented emergency, for no aid can be counted on from Germany. It is in the United States that the shortage must be met.

In Massachusetts, not far from the New Hampshire border, is the town of Winchendon, thriving in the shadow of Mount Monadnock. Winchendon is America's Toy Town. It occupies the same relative position in American industry as Nuremburg does in Germany. In fact, the New Englanders are prone to call it "The American Nuremburg." It is to the artisans of Winchendon that Santa Claus has appealed for the greater supply of Christmas toys, and the scenes of extreme activity in the town are ample proof that the appeal has been heard —and answered.

Winchendon is essentially a Toy Town. The very atmosphere reverberates with the spirit of Toyland. As the train pulls into the station the visitor to the town is surprised to find a huge rocking horse standing on the green near the depot. It is the idol of the town—its very spirit as it were—a huge toy that symbolizes the *raison d'etre* of the town.

Winchendon is also a manufacturing town. Yet it has none of the characteristics that are usually closely associated with a highly industrial community. There are no closely grouped and ugly

workingmen's homes; no tall, dirty, smoke-belching chimneys, nor grim factories with barren, cheerless walls, bounded by dark, narrow streets. Instead, the visitor is surprised to find gay, clean cottages that house the happy workingmen; the white walls of these homes standing in sharp yet pleasing contrast to the neat and extensive lawns that surround them. The three toy factories are just outside the village, forming the points of a triangle the sides of which encompass the town of Winchendon. The factories are clean and inviting, and surrounded by toy gardens.

The entire importation of toys from Germany in 1913 was valued, at wholesale rates, at $8,856,575. During the same period the American manufacturers produced playthings valued at $8,264,000. But the latter sum includes such products as sleds and other similar articles that cannot be strictly termed toys, so that eliminating articles of that nature and considering only the actual toys, the amount is estimated at about $4,000,000. When war broke out in Europe, only one-third of the total amount of toys to be supplied by Germany had been delivered to American distributors. The remaining two-thirds was to be shipped some time between July and the Christmas holidays. On the face of these facts it would appear that American manufacturers must supply additional toys to the value of $6,000,000 to meet the shortage caused by the commercial isolation of Germany. But in actuality this is not the case. For one thing, since war has broken out shipments of toys have been received from Germany. True they

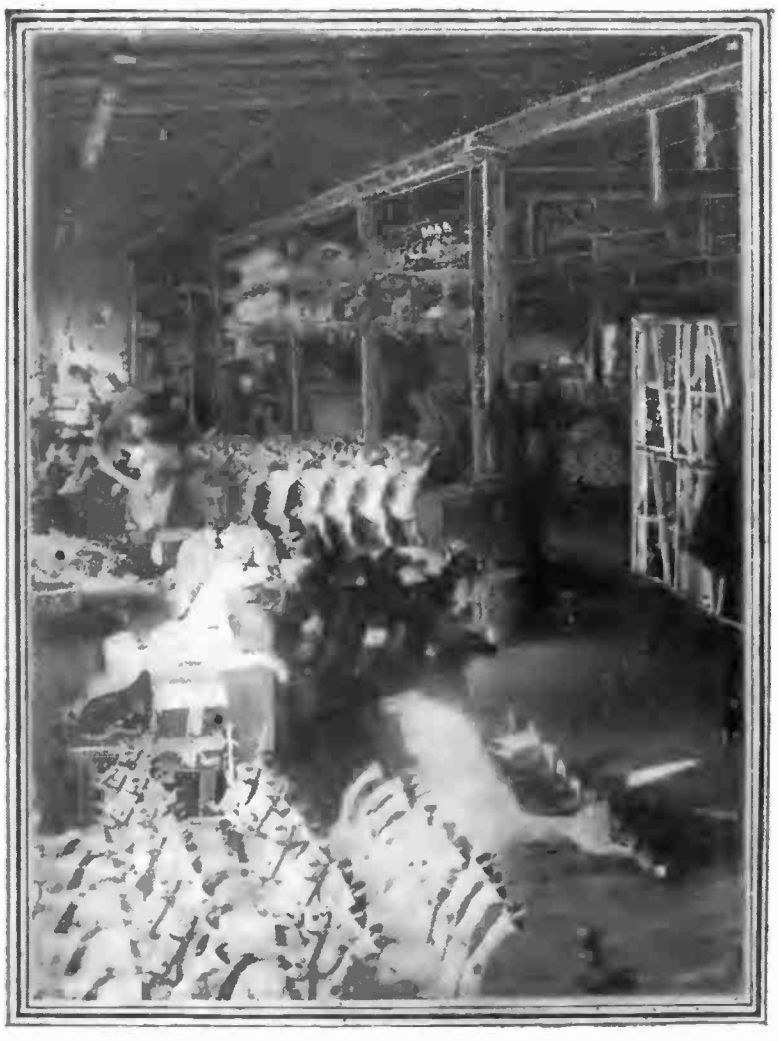
Above: Workman Using Airbrush to Spray Paint on Wooden Horse. These Toy Animals are Turned Out in Large Quantities at Winchendon.

At the Left: Women Packing Wooden Animals into Noah's Arks. Below: Workmen Modeling Wooden Horses with Saws and Scrapers.

were insignificant when considered by themselves, but figured collectively they helped swell the total of German toys now on hand in America. Then again, there is the large supply of toys left over from last Christmas. Each year the toy dealers have a considerable amount of unsold goods which are packed and stored for the following year. Indeed, this is one of the principles of this line of merchandising.

It is now obvious that the toy makers of Winchendon have not as great a task before them as the plain facts would indicate, yet the problem is none the less a difficult one to meet for this year. And it is not this year's demand only that must be met. It is stated by authorities that should the war suddenly end now, there is scarcely a chance that Germany would be in a position to furnish toys for at least three years to come. Furthermore, with the great costs of the war that will have to be met by the people of Germany whether victorious or otherwise, it is probable that German toys will have to be sold at a price that will cause their elimination from the American market in favor of domestic products. Thus it is plain that the Winchendon manufacturers have a task before them which promises to be a perennial one. To sum the statements that have been made by leaders in the toy industry: It is indeed doubtful if America will ever buy toys in great quantities from European manufacturers.

Winchendon is ready to meet any demands that Santa Claus may make on its toy shops. More men are being employed to turn out the toys and wings are being added to some of the factories. The Toy Town has heretofore produced about two-thirds of the toy drums and over one-half of the musical chimes, rocking horses, blackboards, and dolls' trunks made in America. It also turns out a large percentage of the dolls' furniture, mechanical toys and pianos that bring joy to the hearts of the American children. From the Winchendon factories there flows forth to American markets a constant supply of wooden toys such as dolls' houses, bowls, washing machines and toy boats, including such games as ten pins and ring toss. Each day one of the factories turns out 7,000 toy drums retailing at 10 cents each, as well as enough dolls' trunks to fill seven freight cars.



Women Workers Putting the Finishing Touches on Wooden Horses.

The war has not been all in favor of the toy makers of Winchendon. Many of the materials employed by the factories have, in the past, been secured from countries now at war. For instance: A certain grade of burlap used in covering doll trunks has always come from Dundee; the zinc has come from Antwerp; the dyestuffs and inks have come from Germany. But American ingenuity is rapidly finding substitutes and the manufacturing of toys goes on undaunted.

It must be admitted that German toys will be missed this Christmas. While domestic toy makers can duplicate almost all of the German toys—and even improve on them in many instances—there are certain toys that they are unable to supply. Perhaps the most striking of these are the mechanical toys turned out in immense quantities by German manufacturers and sold at extremely low prices. American toy makers frankly confess their inability to supply the demand for these toys this year. German manufacturers have long been making a specialty of simple mechanical toys. They have devised special machinery to turn out these products in such large quantities and at such low costs that the field is certainly their own beyond competition. But American toy makers, in the same breath as the confession of their inability to make these toys, will tell you that the demand for mechanical toys is negligible in volume. They claim these toys are only sold when shown—that seeing them creates the demand which did not previously exist.

The Gluing of Wooden Toys Calls for Dexterity and Extreme Neatness.

Santa Claus is relying mainly on Winchendon to have this Christmas mean as much to the American youngsters as ever. His representatives, the retail toy merchants, are looking to Winchendon for their goods. With the artisans of the quaint Toy Town of America working 24 hours a day and with added facilities of all kinds, the youngsters are not doomed to disappointment. And what is more, the greater portion of the toys will bear that legend that is coming rapidly into its own in every line of manufacturing—"Made in America"—truly a feature of this Christmas that must bring cheer to the patriotism of all Americans.

Don't forget that the next cover of this magazine will appear as MODERN MECHANICS.

RAISING STATUARY AT THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION

The method employed in raising the great pieces of statuary to their high positions on the buildings of the Panama-Pacific International Exposition by means of a traveling steam crane is indeed novel. The statue seen in the illustration weighs 3,000 pounds and is 14 feet in height. The normal length of the boom on the crane is 40 feet. The extension, as shown in the picture, is 66 feet long, making a total length of 106 feet. With this equipment an average of 50 statues in one day are raised to their permanent positions. The height of the parapet shown in the photograph is 65 feet. Unusual facilities are offered for crane work and for the handling of exhibits at the exposition by reason of the standard railroad tracks which run into each exhibition palace on the grounds.

Not only is the railroad system which extends throughout the exposition grounds employed in the handling of statuary, lumber and various

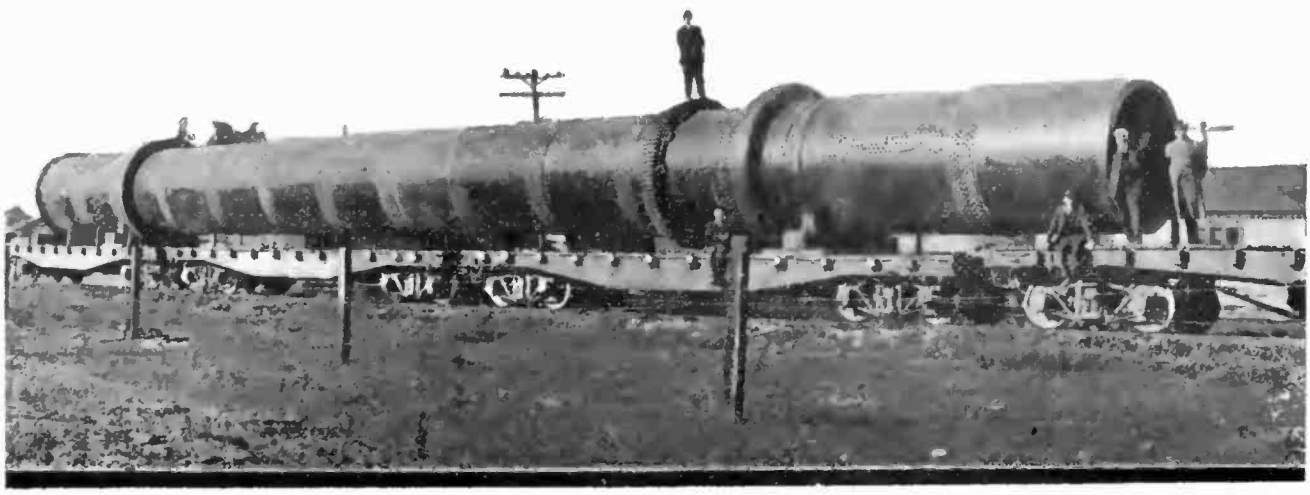
Steam Derrick Placing a Statue on a Building at the Panama-Pacific Exposition Site.

supplies, as well as rare trees, including palms from distant parts of the world, but by means of the exposition ferry slips where freight cars are landed direct from the trans-continental lines upon the grounds, the exhibits may be brought from all parts of the country without any extra handling. The cars in which the exhibits are originally shipped are switched directly onto the rails of the Exposition Terminal Railway and are run into the buildings to which the exhibits are consigned.

When all the exhibits are installed, the tracks will be covered over, buried beneath roadway and lawn, until the end of the exposition. Then they will again be exposed to be used in the removal of all that was brought into the exposition grounds.

FOUR FLAT CARS TO HAUL SINGLE PIECE OF FREIGHT

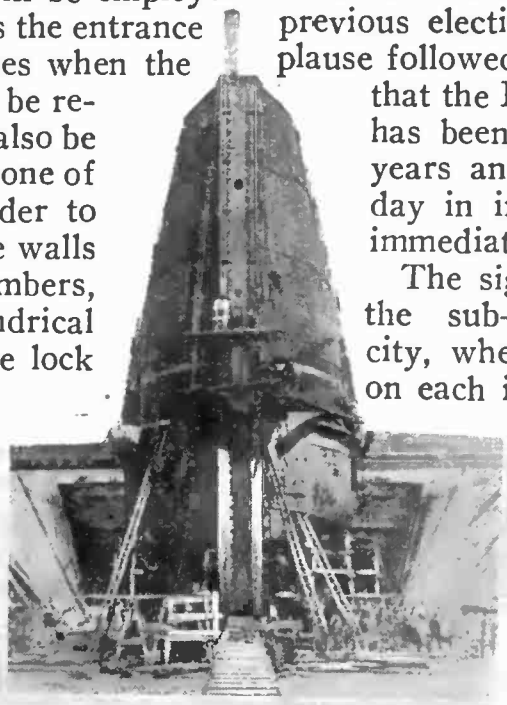
A steel tube 120 feet long and ten feet in diameter was hauled across the continent recently, requiring four flat cars to haul it. The weight was 149,000 pounds, and it is said to be the largest single piece of freight ever shipped by rail for such a distance. It travelled from Wilkes-Barre, Pa., to a cement plant in Riverside, Calif., where it is to be installed as a kiln in one of the leading cement producing sections of the country. The huge tube was set upon swivels resting on the ends of the cars in order that it might take the curves. When the consignment reached the Salt Lake station in Riverside, the pipe was covered with inscriptions scribbled by persons along the route, indicating the attention that the great pipe had aroused.



Four Cars Were Required to Haul this Steel Tube Measuring 120 Feet in Length and Weighing 149,000 Pounds.

A GIGANTIC CANAL GATE

Recently a large concern in San Francisco finished building for the Panama Canal the largest floating gate of its kind ever constructed. This gate will be used in connection with the maintenance of the Panama Canal. It will be employed as a barrier or dam across the entrance to anyone of the lock sites when the mitering lock gates are to be repaired or painted. It can also be used for unwatering any one of the lock chambers in order to make an inspection of the walls and floor of the lock chambers, as well as the cylindrical valves installed within the lock walls.



End View of the Gigantic Floating Gate While Still on the Ways.

Below: The Gate being Towed by an Ocean-Going Tug to its Destination.

At the Left: The Canal Gate at the Moment of Launching at San Francisco.

It required 1,500 tons of structural steel to build the caisson and 800 tons of permanent ballast placed in its bottom to give it stability in its light draft position The caisson has been taken to the Isthmus of Panama on a tugboat.

NOVEL WAY OF ANNOUNCING ELECTION RETURNS

The results of a bond election held in St. Louis, Friday, November 6, were flashed into 50,000 homes and practically all of the theatres within five minutes after the last vote was counted, by means of signals sent over the electric light wires to all parts of the city.

By a code of "winks," made known in advance, everyone who was in the vicinity of an electric light knew that a $2,750,000 bond issue had finally been authorized after being rejected at three previous elections. In many places applause followed the lights' announcement that the Municipal Free Bridge that has been standing idle for three years and costing the city $490 a day in interest, would be finished immediately.

The signals were operated from the sub-stations throughout the city, where the switch was pulled on each individual trunk line. The time consumed in announcing the news was less than five minutes.

SEARCHLIGHTS FOR EXPOSITION ARE TESTED

Recently a test was made of the 950 big searchlights and reflectors mounted on the roofs of the palaces of the Panama-Pacific International Exposition. The most extraordinary feature of the test was the fact that the globe surmounting the Tower of Jewels was seen 70 miles out at sea. The Tower of Jewels is hung with 125 cut-glass gems of many tints covering the struc-

ture from the summit, 348 feet above the ground, to a point 98 feet below. On this structure the beams of 50 fixed searchlights located at vantage points on all sides of the tower will be played.

ELECTRICAL ENERGY SOLD IN WORLD'S PRINCIPAL CITIES

The use of electrical energy for industrial and domestic purposes is not nearly so general in Europe as in this country. The following table from *Cosmos* gives the number of kilowatt hours of energy per inhabitant sold in the year in the different large cities of the world:—

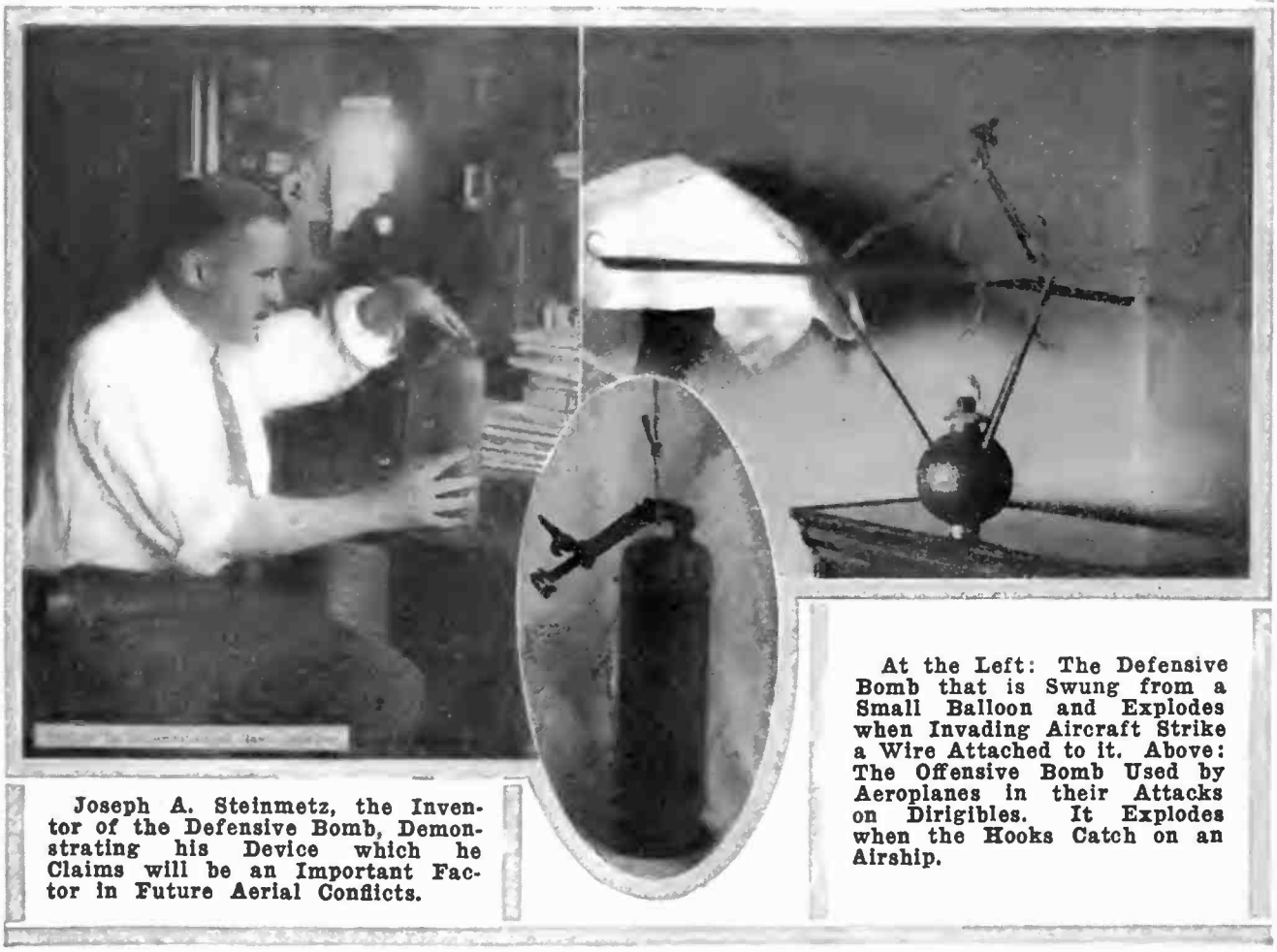
Chicago 425, Boston 400, New York 360, London 130, Buenos Ayres 123, Berlin 111, Hamburg 43, Paris 27.

AN ALBINO GOPHER SNAKE DISCOVERED IN CALIFORNIA

What is reported to be the second albino snake ever found, and the first ever caught alive and watched carefully for purposes of scientific study as to characteristics and habits, was given to Professor Storer, of the Department of Vertebrate Zoölogy, by a farmer who found it in the country near Berkeley, California. The snake is about the size of the ordinary gopher snake, but is marked by the entire absence of color. This peculiar reptile, which has a sort of fleshy hue with a bit of a pinkish tinge, is being closely watched by the members of the class who frequent the Museum of Vertebrate Zoölogy for any developments of unusual characteristics.

It is said that the German invaders of Belgium, whatever else they may have destroyed, have been careful not to injure park trees. The cavalrymen, so a report goes, are forbidden to tie their horses to trees for fear that the animals will gnaw the bark.

DEADLY AERIAL BOMB



Joseph A. Steinmetz, the Inventor of the Defensive Bomb, Demonstrating his Device which he Claims will be an Important Factor in Future Aerial Conflicts.

At the Left: The Defensive Bomb that is Swung from a Small Balloon and Explodes when Invading Aircraft Strike a Wire Attached to it. Above: The Offensive Bomb Used by Aeroplanes in their Attacks on Dirigibles. It Explodes when the Hooks Catch on an Airship.

The Water Mill Where the Water is First Utilized in Driving a Turbine Wheel. It is Connected by Cable to Wheel Downstream.

UNIQUE WATER MILL

A water mill in Western Ontario has the unique distinction of utilizing the water over again. After the water has passed under the mill's turbine wheel, it flows down the mill creek for a short distance until it comes to a tower. Passing under the tower, the water drives a wheel from which a wire cable is stretched across to a wheel on one of the mill walls. The cable thus drives the machinery with the water that has already been used further upstream.

After the Water has Passed Through the Turbine Wheel of the Mill, it Drives the Wheels of this Tower. A Cable Transmits the Power to the Mill.

"LIVE" RUBBER MEN MADE OF AUTOMOBILE TIRES

In a California street parade was recently entered a float bearing two monstrous men of "live" rubber automobile tires. These animated figures were forced to perform the most ludicrous "stunts" by means of compressed air, generated by an engine that was hidden in the body of the float. A system of valves, worked by two concealed operators, caused different parts of the anatomy of the rubber men to alternately extend and collapse with most striking results.

The float was an advertisement for a local tire supply firm.

A Float on which are Mounted Two Rubber Tire Men.

MEDICINE MADE TASTELESS BY NEW INVENTION

Who has not revolted against a dose of castor oil, rhubarb or other nauseous medicine? The placing of such drugs in soluble capsules was a great step toward making it possible to swallow without tasting them, but even so there are many people who cannot swallow a capsule.

An ingenious Frenchman has produced a cup that has been hailed as a boon to persons who have to take such substances as cod liver oil. He calls it the "pomponnette." When you drink your medicine from it, it gives you first some liquid that is pleasant to

the taste and to the smell. This is succeeded without interruption by the medicine, and this again by a delicious liquid, each flowing separately without the possibility of becoming mixed. Thus you have taken your medicine and have not perceived either its revolting taste or odor.

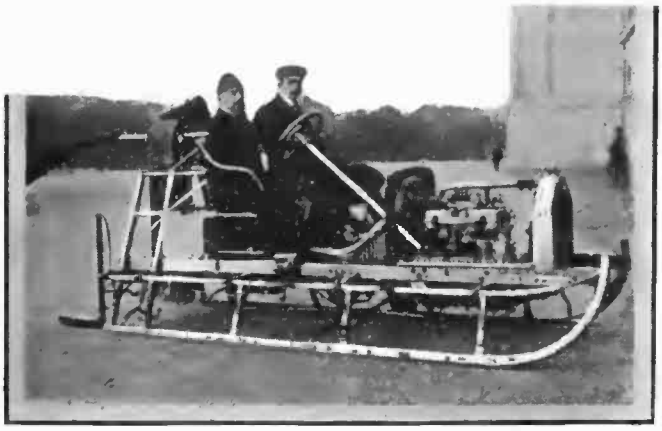
The pomponnette holds twice as much as the dose you are to take and it must be drained at one draught. However, there is no difficulty in this connection. It has three compartments, one above the other, the upper and lower containing the orange juice, wine or whatever pleasant liquid you may prefer. The middle one contains the medicine. The two partitions are movable and must be adjusted to rest upon the liquid so as to leave no air spaces. These partitions are pierced with oblique grooves that make it impossible for the liquid in one compartment to pass into another except by flowing horizontally. This prevents the liquids from mixing.

When you raise it to your lips, you drink first the contents of the upper compartment; when this is almost empty, the contents of the middle compartment begin to flow, and when this has gone, the lowest compartment gives out its contents in turn.

The pomponnette is being used commonly in France for administering doses of cod liver oil, which, to most persons, is one of the most nauseous substances taken as medicine.

A NOVEL MOTOR SLED

Motor-driven sleighs are no longer a novelty at the present time. But the type illustrated in the accompanying view presents many new features. It was built by an Austrian aeronaut who applied the method of propelling air-



Sled Driven by Aerial Propeller, Capable of Developing High Speed.

ships and flying machines to this vehicle.

In back of the body two large wings are mounted on a shaft that is connected with the engine. These wings serve to drive the sleigh. It is said that the vehicle starts up gradually and without shocks. The engine is placed in the front and develops 24 horsepower.

Another novel feature is presented in the method employed for guiding the sleigh. This is very much the same as the principle employed in steering a boat. Behind the runners are two large planes which touch the ground and are moved to the left and right by means of rods, levers and the inclined steering post. Two pairs of hooks, which may be pressed down into the snow through a foot pedal and a lever, serve as brakes.

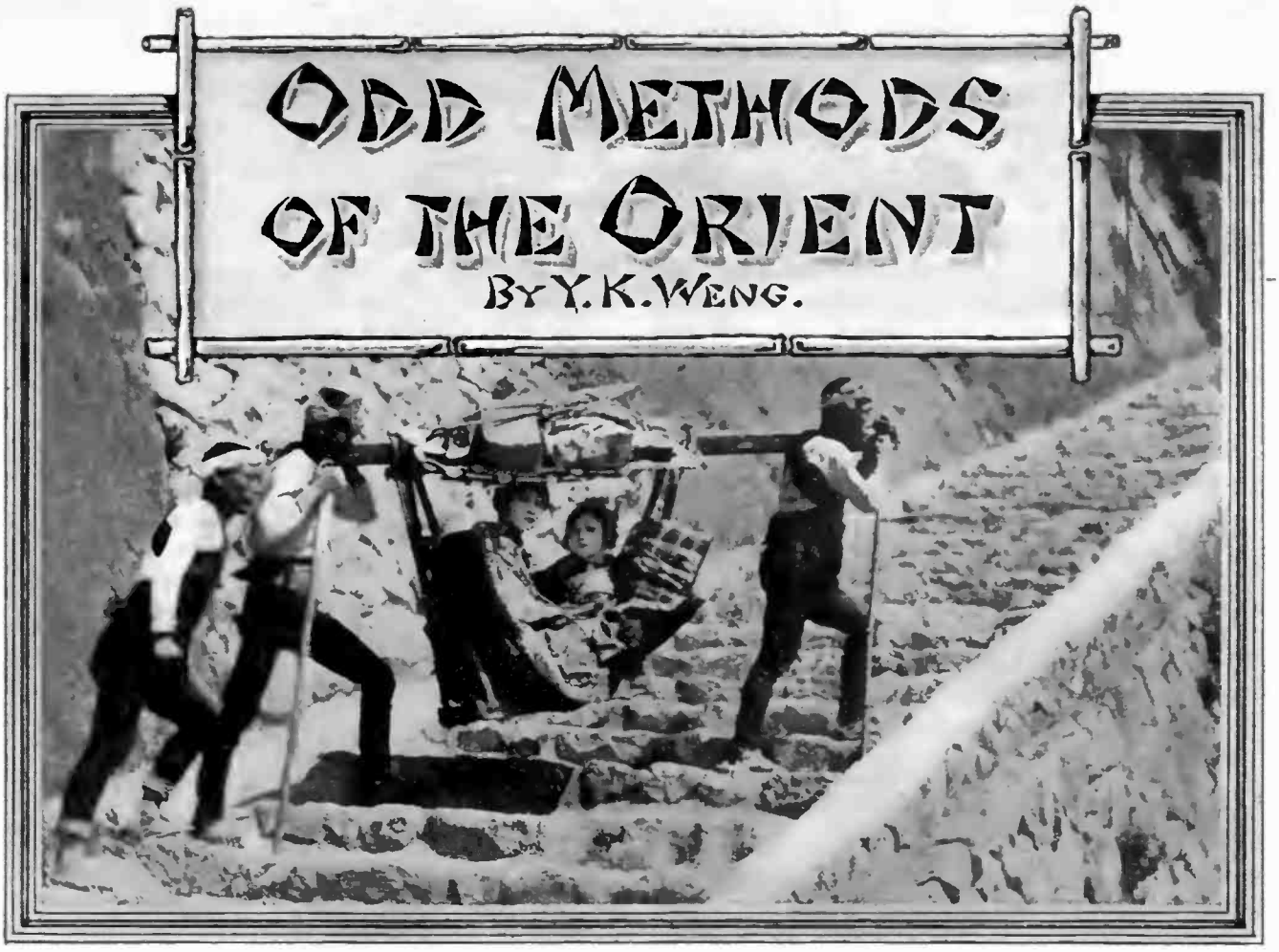
In several trials in the vicinity of Vienna a speed of 25 miles per hour has been obtained on soft snow. On a hard snow surface almost double the speed has been developed. Still greater speeds have been attained on ice.

A FAMILY FOOTBALL FIFTEEN

A queer football team has been formed in England. It is composed of fifteen brothers who form a complete rugby team and have issued a challenge to any similar team. Needless to say, they will have a hard time finding any opposing team, as very few families of the present day contain fifteen children, let alone fifteen brothers, and when such a family is found it is doubtful whether they could all be persuaded to play football.

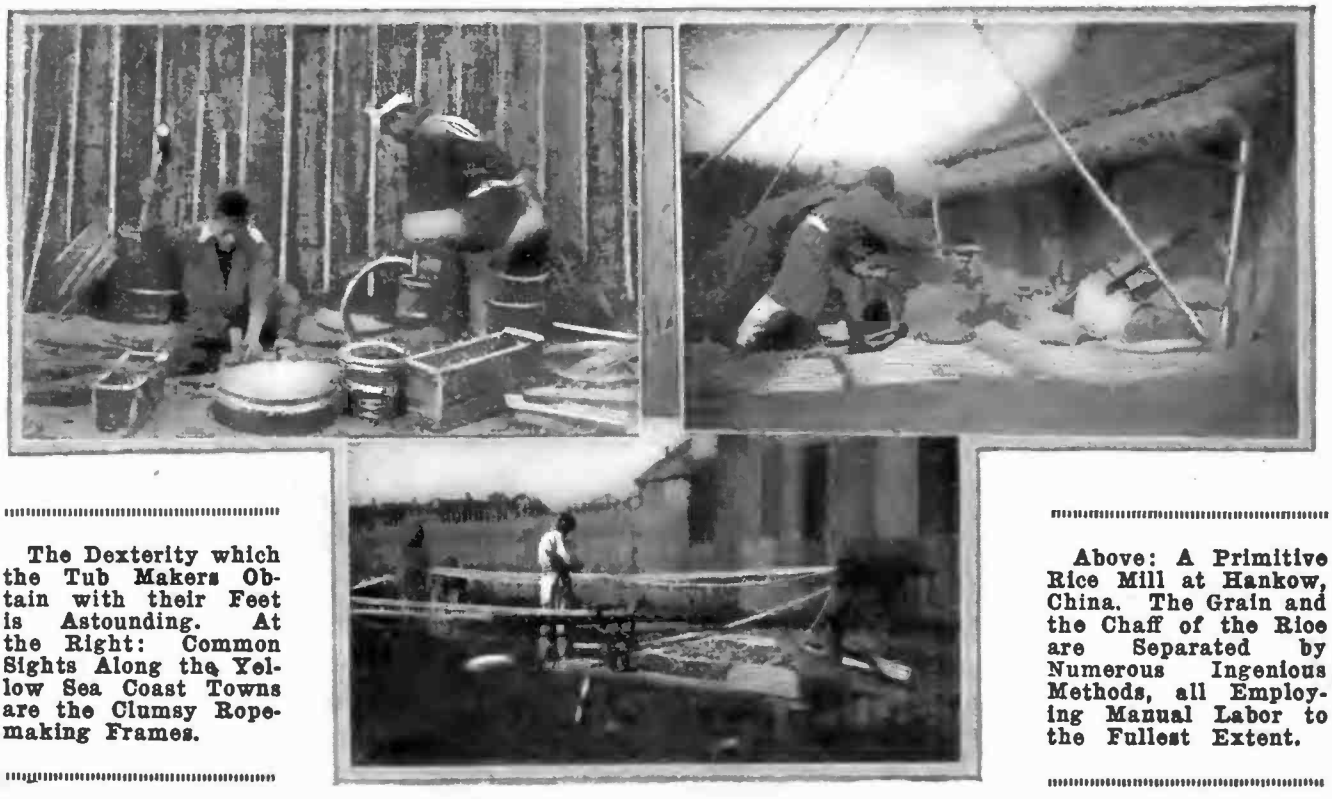
ODD METHODS OF THE ORIENT

BY Y. K. WENG.



GIVEN a problem of any type whatsoever to work out, the Oriental mind will arrive at a mental conclusion by a process of reasoning exactly opposite to that followed in a Western mind. The same rule applies to the methods used in accomplishing any particular task.

In China or Japan, a workman in removing a heap of stones or bricks or dirt will not carry one load the entire distance. Instead, he will carry one load

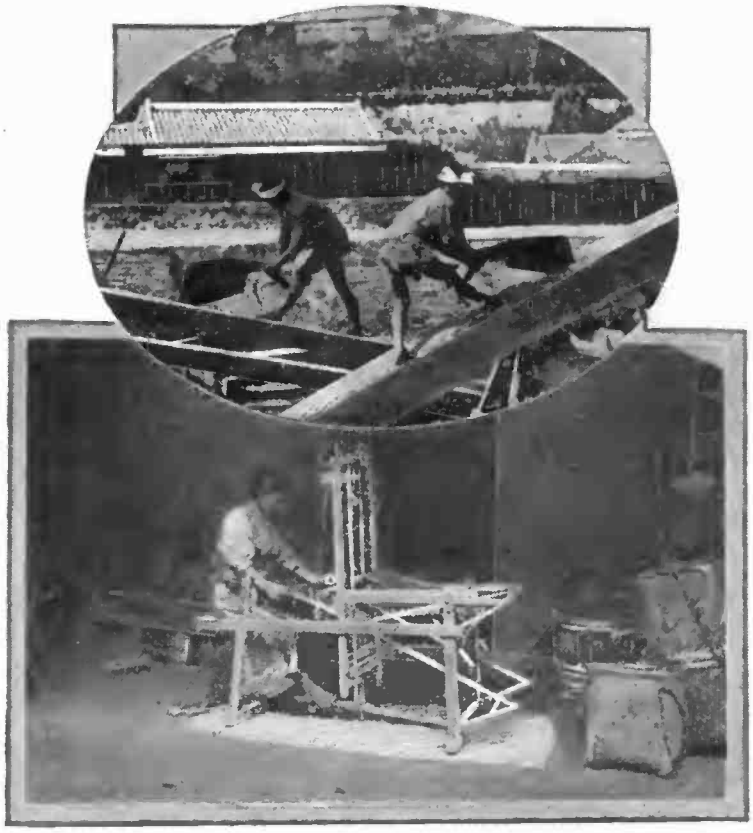


The Dexterity which the Tub Makers Obtain with their Feet is Astounding. At the Right: Common Sights Along the Yellow Sea Coast Towns are the Clumsy Rope-making Frames.

Above: A Primitive Rice Mill at Hankow, China. The Grain and the Chaff of the Rice are Separated by Numerous Ingenious Methods, all Employing Manual Labor to the Fullest Extent.

a short distance towards his destination and put it down. Then he will return to the pile, get a second load and place it alongside the first. He will continue in this way until the entire heap has been moved a step of the journey. Then he will repeat the manoeuver until, in time, the heap arrives at its destination by a series of short jumps.

Chinese or Japanese building construction methods also differ radically from those that are employed in this country. Instead of erecting an adjustable scaffold and raising it upward, floor by floor as the building progresses, he constructs an intricate bamboo network about the contemplated structure. In effect, the finished building is completely veiled until it is finished.



In the Oval: The Oriental Saws Cut on the Backward Stroke. Above: Hand Looms in Japan are Diminishing at the Rate of More Than One Thousand a Year.

An unusual form of tool employed in the Chinese and Japanese carpentry trade is the saw which is designed to cut on the backward instead of on the forward stroke, just contrary to the way saws are used in this country.

The lack of modern machinery of different sorts has compelled the Oriental manufacturer to devise numerous unique methods employing manual labor only. The making of wooden tubs is an interesting example of this. Whereas American tub and barrel machines turn out the finished product from crude lumber by a simple mechanical process, the Japanese method is painstaking and exceedingly tedious. The staves are cut and whittled to shape by hand, and the assembling is done by an ingenious manipulation of both hands and feet. The tub bottom is firmly grasped between the feet, and the staves are put in, nailed with wooden plugs and bound with the hands. The dexterity which the crouching workmen attain with their feet and particularly their toes is astonishing.

Ropes and halyards for the junks and sampans of the numerous rivers of China are made by a laborious process of hand weaving. A common sight in the coast towns along the Yellow Sea are the clumsy wooden frames for rope making. Several lines are stretched tightly between the uprights, and the ropemaker plies a tapering ebony or bone needle in and out among the cords until they are knit in a solid, even strand. Strange to say, these ropes can compare quite favorably both in strength and durability with Manila ropes. It is a fact worthy of mention in passing that the unpainted Chinese junks and sampans, although constructed without the use of a single metal nail, endure the buffets of the congested streams and the extremes of Chinese weather sometimes for more than a hundred years.

Rice mills are, of course, very primitive in Japan and China, although modern machinery for this purpose is being imported to some extent. Usually the grain is flayed by hand, and it is then ground by numerous ingenious methods. A common procedure is to erect a large bamboo tripod, suspend an inverted wooden cask from the angle and separate grain from chaff by pounding.

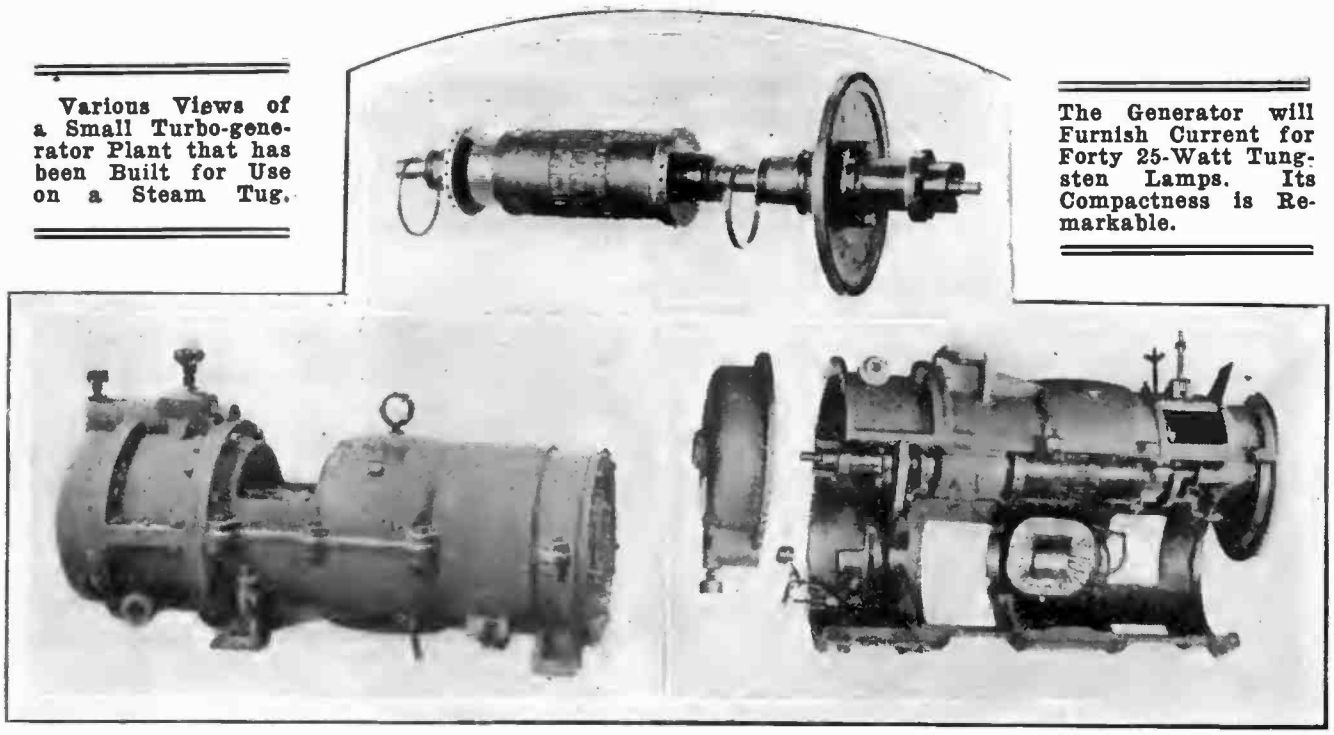
More than a thousand hand looms are being discontinued yearly in Japan with the importation of improved English electrically-operated mills. Thousands of the old hand looms, however, may still be seen in various parts of the Mikado's empire.

Executing a Pirate in Canton, China. Chinese Sampans Built Without the Use of a Single Nail. The Finished Building is Completely Veiled Until the Bamboo Lacework is Removed.

Chinese executions of public criminals differ radically from the hangings and electrocutions of America. There, a capital offender is decapitated. He is given a formal trial, and if his offence is of a serious enough nature, as murder or piracy, and he is convicted, his head is cut off with a sharp broadsword.

Experiences with forest fires in the national forests this year show that automobiles, where they can be used, furnish the quickest and cheapest transportation for crews of fire fighters. Motor rates are higher than those for teams for the actual time employed, but the total cost per distance traveled and in wages paid to men in getting to fires is much less. The time-saving is self-evident; trips which ordinarily require two days' time by team have been made by automobile in a few hours. The rapid arrival of the fire fighters often prevents dangerous fires from spreading.

Various Views of a Small Turbo-generator Plant that has been Built for Use on a Steam Tug.



The Generator will Furnish Current for Forty 25-Watt Tungsten Lamps. Its Compactness is Remarkable.

A TINY TURBO-GENERATOR PLANT

One of the latest wonders in the field of electric current generating apparatus is the tiny steam turbine equipment illustrated in the accompanying views. This equipment has been recently turned out by one of the leading electrical manufacturing firms for use on a small tug plying the waters of New York Harbor. It is said to be the smallest steam turbine equipment ever constructed for practical use. It measures 35⅛ inches in length, 18¾ inches in height and 13¾ inches in breadth. The electric generator of the outfit can supply current for forty 25-watt tungsten lamps, being rated at one kilowatt capacity. The only moving parts of the equipment comprise the rotor of the turbine and the armature of the generator. These are driven at a speed of 4,000 revolutions a minute; a centrifugal governor maintaining a constant speed.

This turbo-generator outfit fills a long-felt want in the way of electric light plants. Heretofore, a lighting plant for small vessels has necessitated devoting considerable space for installing the machinery. However, this equipment is so compact that it may be installed in a corner of any engine room without inconvenience. The weight of the equipment is but 405 pounds. Steam pressure at full load varies from 75 to 250 pounds per square inch.

REMARKABLE CHINESE PIGEON WHISTLES

Probably the most unique musical instruments employed in any country are the odd Chinese pigeon whistles. The accompanying view shows a pigeon with one of these whistles on its tail. The whistles are very light, weighing but a few grams, and are attached to the tails of young pigeons soon after their birth, by means of fine copper wire. When the pigeons fly, the wind blowing through the whistles sets them vibrating and thus produces a melodious open-air concert, for the instruments in a flock are all tuned differently. On a serene day in Peking, where these instruments are manufactured with great cleverness and ingenuity, it is even possible to enjoy this aerial music while sitting in one's room.

In spite of the seemingly large variety of pigeon whistles, there are but two distinct types: those consisting of oblong bamboo tubes placed side by side, and a type based on the principle of tubes attached to a gourd body or windchest.

They are lacquered in yellow, brown, red, and black, to protect the material from the destructive influences of the atmosphere. The tube whistles have either two or three, or else five tubes. In some specimens the five tubes are made of ox-horn instead of bamboo. The gourd whistles are furnished with a mouthpiece and small apertures to the number of two, three, six, ten, and even thirteen. Certain among them have, besides, a number of bamboo tubes, some on the principal mouthpiece, some arranged around it. These varieties are distinguished by different names. Thus, a whistle with one mouthpiece and ten tubes is called "the eleven-eyed one." Some have the shape of a pig's head.

As to the materials and implements used in the manufacture of pigeon whistles, there are small gourds that serve for the bodies, halves of large gourds—a particular species imported from Shantung to Peking for this spe-

A Pigeon with a Chinese Pigeon Whistle, Showing the Method of Attaching this Musical Instrument. Chinese Pigeon Whistles, from the Simplest to the Most Complicated, are all Hand-made.

cial industry—from which stoppers are made that fit into them, and four kinds of bamboo: cylindrical pieces of a large species that grows in the south, used in making the mouthpieces of the large tubes; thin sticks for making those of the small ones; hard bamboo for the large tubes themselves; and a soft kind for the smaller ones. The separate pieces are fastened together by means of fish glue applied with an iron nail One workman is said to be able to turn out about three specimens a day, indicating that the work requires some time and skill.

A MAMMOTH ELECTRIC ADVERTISING SIGN

The latest electric advertising sign erected by the Commonwealth-Edison Company of Chicago is located on top of a building at Michigan Boulevard and Randolph Street.

This sign is claimed to be the largest motograph in existence.. It measures 130 feet in length and 50 feet in height. The moving letters are 12 feet high and may be read nearly a mile and a half away. Every night a different legend appears on the sign extolling the virtues of electricity and of electrical appliances.

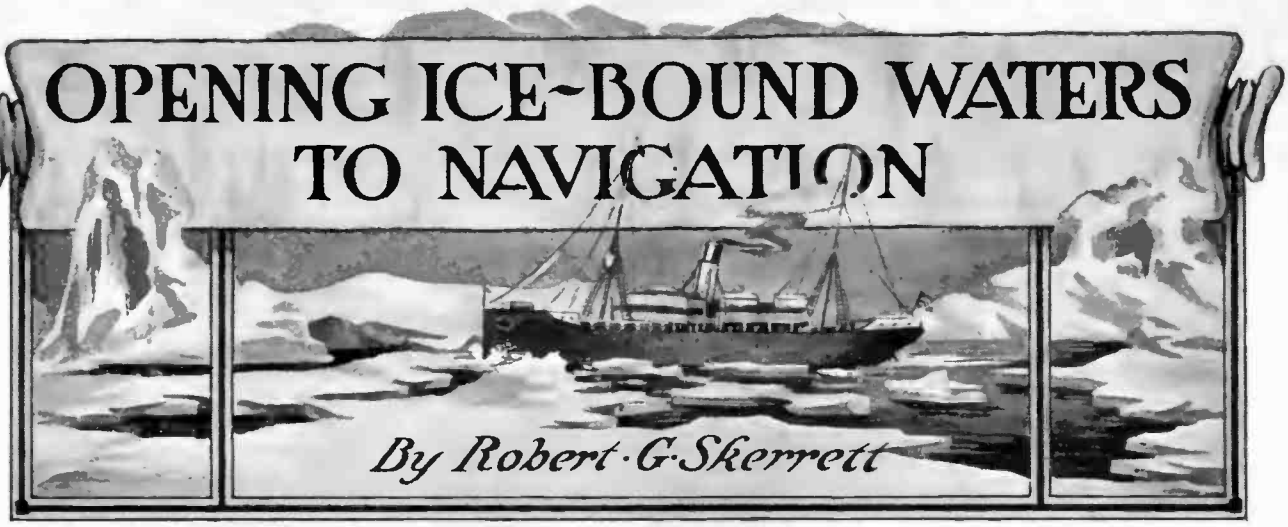
WORLD'S LARGEST CHEESE 25 FEET IN CIRCUMFERENCE

The world's largest cheese has just been finished at West Martinsburg, New York, and will soon be shipped to the World's Fair in San Francisco. It is four feet seven inches high and 25 feet around. One hundred and six thousand pounds of milk were required to make this gigantic cheese.

A Huge "Talking" Electric Sign that is being Employed in Chicago for Advertising the Advantages of Electric Light and Power.

The town forest of Baden-Baden, Germany, yields an annual profit of $5.25 per acre, or a total net profit of nearly $67,500. Germany is an exponent of advanced forestry.

OPENING ICE-BOUND WATERS TO NAVIGATION



By Robert G. Skerrett

WHATEVER be the outcome of the war in Europe, whether it give to the Czar an open port to the outer world by reason of added territorial possessions, Russia may confidently look forward to a commercial revolution in that her trade routes to the seas beyond need not hereafter be hampered by barriers of ice. At least, that is the promise of an American inventive genius—a man who has already startled us by his amazing mechanical achievements. We refer to Elmer A. Sperry, who has found so many helpful uses for the gyroscope.

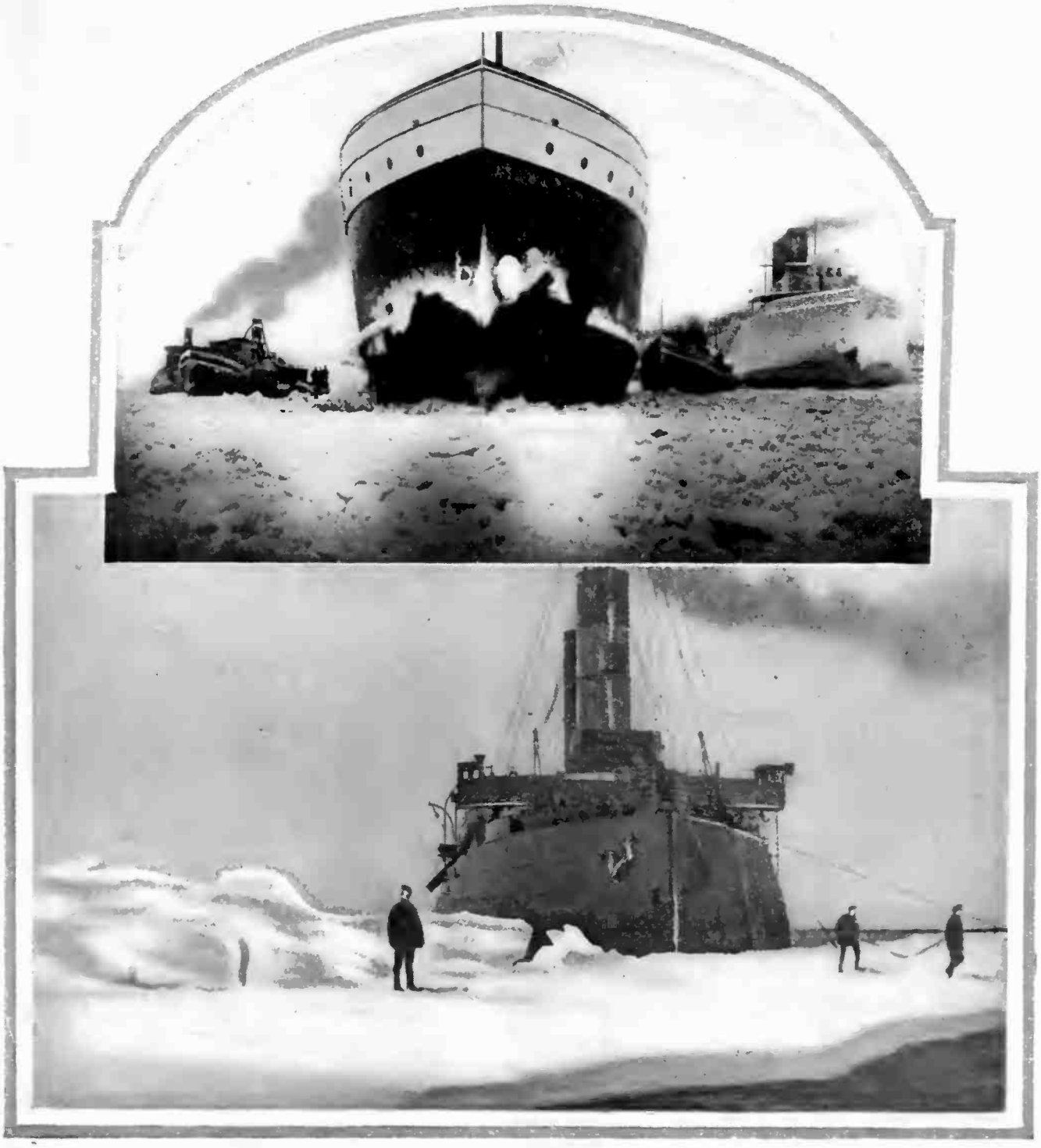
It is probably an old story to you that Russia has longed for many decades for a port on open waters in the winter time; a harbor that she could control and which would lead directly to the free seas. Politically or strategically, call it what you may, her outlets on the Black Sea are not unrestrained because there is the ultimate passage through the Dardanelles guarded by Turkey. In the north, her Baltic ports serve well enough in summer time, and so does Archangel on the White Sea, but then comes that long interval when Jack Frost grips these waterways and makes navigation well nigh prohibitive. Again, in time of war, there is the vexing problem of Denmark's neutrality, and the Danes hold the keys to the western gateways of the Baltic. True, Archangel is entirely under Russian dominance, but the open period normally for that far northern port is scarcely more than three months in the summer time, and then the Arctic ice gathers in the White Sea and builds a pretty effectual bulwark against the activities of shipping.

These are apparently insurmountable obstacles, and yet Mr. Sperry says they need not be, and he promises to overcome them by means of the gyroscope. This sounds decidedly fantastic, and yet there is a substantial basis of fact and accomplishment upon which to build this prophecy. However, before we give the details of Mr. Sperry's plans and his arrangement with the Russian Government, it is needful that we know something about ice conditions in the Baltic and the White Sea, and recall what has already been done in the way of efforts to battle with the barrier floes.

The "Ashtabula," One of the Big 5,000-Ton Car-Ferry Steamers Employed on the Great Lakes.

When Japanese mines sank

one of the Czar's battleships outside of Port Arthur, the Russian navy lost its foremost scientist, Admiral Makaroff. Happily, some years previously, he devoted his engineering skill to the design-



Two Instances of Steamers Caught in Ice Jams and Obliged to Remain Inactive for a Considerable Length of Time.

ing of an ice-breaker, and from his plans there was built that notable craft of 8,000 tons, the *Yermak*. The ship was structurally of somewhat unusual form and exceptionally strong. She was meant to force her sturdy bluff bow up and on the ice, and by sheer weight and the forceful drive of her 10,000-horse-power engines was expected to crush the opposing floes. Admiral Makaroff planned and builded well, and her performances confirmed the Admiral's expectation. The vessel was really built for service in the Kara Sea, which is practically ice-bound the year through, and preliminary to dispatching her there she was given a rigorous trying out on an experimental run to Spitzbergen against heavy polar ice.

At times, the *Yermak* was rushed di-

rectly against polar ice 14 feet thick, but the floe cracked sharply under the attack—showing the tremendous momentum of the assaulting craft. As a result of some weeks of bumping around in the neighborhood of Spitzbergen Admiral Makaroff brought out the fact that the prime essential for an ice-breaker in that region was hull strength and not necessarily engine power. On the other hand, when tried out in the Baltic, the conditions were quite reversed. Not that the body of the ship need not be very strong—for that is necessary of course—but effective work hinged more upon the available horsepower of the propelling engine. Admiral Makaroff also found the fresh-water ice in the Baltic to be stronger than the salt-water ice in the Arctic Sea; but where the Arctic floes split in long cracks the Baltic hummocks and drifts were shattered into a hampering clutter immediately about the *Yermak* and at the point of attack.

The Simple Toy Gyroscope—the Principle of which is Applied for Opening Ice-bound Waters to Navigation.

With the Arctic ice the cleverage readily opened up a clear way through which the ice-breaker could push, but the friable Baltic ice behaved in another way. Let us quote from a report made by this notable authority. "When the ship charges into it, it does not form long cracks, but breaks under her. When the ship passes half of her length in such a floe, she touches so many fragments that they stop her progress by their friction and pressure upon the craft's plating forward. When the ship stops, there is no other way than to back and charge again. This time, before the bow of the vessel touches solid ice it has to run through a hundred feet or so of broken ice. That diminishes very much the speed of the boat, which, on a second charge, may make very little headway. It happens sometimes that after the ship stops going ahead it wont go backwards, and it may take half an hour and the alternate working of the engines ahead and astern before she can be got free."

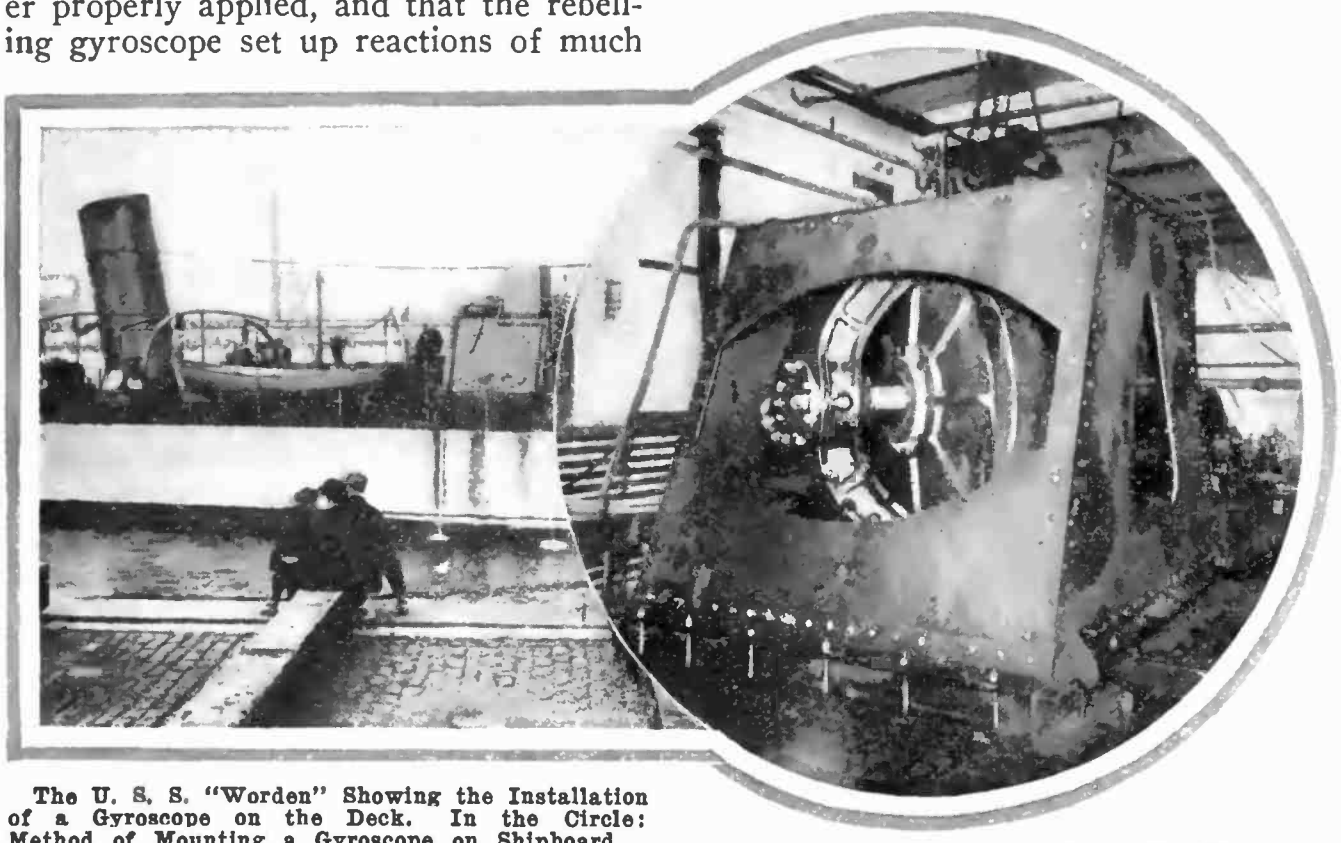
The ice-breaking problem has been with us for many years in America, and on the Great Lakes navigation is kept open for weeks in the late fall and started early in the spring by means of certain little tugboats that are able to break paths open for the big car ferries and other large steamers which cannot do this for themselves, strange as it may seem.

As we shall see, it is not always best to follow the advice of that popular song, "Sit down, sit down, sit down you're rocking the boat!" The small tugs in question are purposely designed to rock, and by this rocking motion they deal sidewise blows to the ice while their propellers are forcing them steadily forward through the broken pieces and at good speed against the solid edge of the floes or hummocks. These tow boats have abnormally big rudders worked by steam steering engines, and this sculling motion rolls the little craft from side to side. Big steamers would do the same thing if so equipped, but the cost of such an installation would be prohibitive. Now we come to Mr. Sperry's solution, for he makes it possible for any vessel to break her own way and all because of her capacity to

roll rhythmically under the impulse of suitable gyroscopes.

We are not going to elaborate upon the workings of a gyroscope, because most of us know enough about this form of the spinning flywheel to recall its obstinate tendency to revolve in a given plane or forcibly to resist external efforts to disturb it in its chosen path. Now Mr. Sperry went further than this, for he showed that the gyroscope could be swung at will first to one side and then to the other side of this chosen path by means of a moderate application of power properly applied, and that the rebelling gyroscope set up reactions of much greater moment or force than the power required in the disturbing apparatus. In other words, he found a way to stabilize a torpedo boat by merely swinging a gyroscope spinning in a vertical plane to one or the other side so as to neutralize the upsetting impulse of a wave. The bigger the wave the more the gyroscope was turned to oppose it. Instead of shifting a large weight from port to starboard on the boat's deck, the mere movement laterally of the pivoted gyroscope answered the purpose.

The aim in the case of the U. S. S. *Worden* was to stabilize the craft so that she would ride steadily upon a troubled sea. Just the same, it was discovered that the boat could be rocked vigorously when lying in still water by the arbitrary turning of the stabilizing gyros. Learning how the little tugs broke the ice on the Great Lakes, Mr. Sperry proposed to install a gyroscopic stabilizing plant on one of the big 5000-ton car-ferry steamers, so that the same equipment could be used to steady the vessel in rough weather or to rock her when seeking to break her own way through the ice floes. Hearing of his perfected plans for the steamer *Ashtabula,* the Russian Government was at once interested. Up to a point Admiral Makaroff's *Yermak* had proved practical, but, as has already been explained, even that powerful vessel had the greatest difficulty in plowing through the Baltic ice because of the manner in which she was held or gripped by the broken fragments.



The U. S. S. "Worden" Showing the Installation of a Gyroscope on the Deck. In the Circle: Method of Mounting a Gyroscope on Shipboard.

It was clear that an ice-breaker provided with self-rocking power would be able to do far better work, and a ship of 8,000 tons fitted with the Sperry gyroscopes would have it in her power to deal staggering lateral blows to the surrounding ice. While her rolling motion freed her from the grip of these fragments her engines would drive her with all their energy forward against the barrier—thus alternately breaking, crushing, and get-

ting clear of the gathering debris. Accordingly, Mr. Sperry has under way designs for this very service, and he says that it will be possible for him to furnish the required installation upon a moderate weight of not more than two per cent. of the total displacement of the craft carrying it. This is really remarkable, because other stabilizing methods call for a much heavier sacrifice and even then do not compare in efficiency. The beauty of the arrangement is that the same apparatus that rocks the ice-breaker can steady her when that is desirable.

A Huge Great Lakes Steamer Caught in the Ice Pack During Severe Winter Weather.

With her Baltic ports kept open in this manner during winter time, it will make it possible for Russia to maintain her oversea commerce uninterruptedly. But what she can thus do in the Baltic, Russia can repeat in the White Sea and along the northern coast leading out into the Atlantic. Archangel, which commonly is open to navigation from July to September only, can be made a free port the year through. The commercial significance of this must be apparent without further elaboration here.

There is a scientific interest besides in what Mr. Sperry's invention promises to make effective in the name of trade. When Admiral Makaroff carried the *Yermak* into the Arctic Sea on his experimental ice-breaking trial trip to Spitzbergen, he then conceived the startling plan of reaching the North Pole by means of a kindred craft especially strengthened to battle with the heavier obstacles to be met in such a venture. We know that the unfortunate *Karluk,* as other polar exploring steamers, was caught in the ice and carried irresistibly to her doom. An ice-breaker modeled somewhat after the broad design of the *Yermak* and provided with rocking gyroscopes might reasonably be indifferent to such circumstances, and whether the objective be the Pole or not, still a ship of that character might greatly facilitate Arctic investigations and serve other essentially practical ends in those waters.

For once, there is a goodly measure of sanity in being able to rock a boat at will, and out of the toy top has evolved an instrument, thanks to Mr. Sperry's skill, capable of battling effectively with Nature in both her angry and her grimmest moods. In effect, he stills the tumbling seas and he cleaves the frigid bulwarks that have so often balked the mariner or crushed his ship.

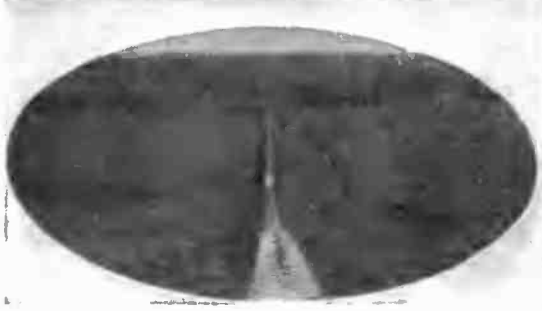
IRRIGATION CANALS FOR ALBERTA'S DRY BELT

One of the greatest irrigation projects designed to effectively redeem an enormous acreage of otherwise waste land is that of the Southern Alberta Land Company. Some 400,000 acres are owned by the company in the Canadian province, of which one-half is regarded as irrigable. The location is in the vicinity of Suffield on the main line of the C. P. R. The water diverted from the Bow River to supply the system of canals, reservoirs and laterals, enters the main intake at a point about thirty miles east of Calgary and forty miles west of the celebrated Bassano dam. The total distance of artificial waterways is 170 miles, excluding reservoirs. Some remarkably long flumes have been constructed, one being 5,000 feet and crossing the "Mile-Wide" Valley. Across one of the creeks encountered on the route is an inverted syphon consisting of a pair of wooden stave pipes, each 7 feet 6 inches in diameter and 1,047 feet long. From the intake

to the first storage reservoir is 45 miles. The main reservoir runs north and south and is the most important piece of construction in the whole scheme. It is formed in a dry coulee, 21 miles long and at the widest part about 12,000 feet across, narrowing down to about 2,000 feet between precipitous banks towards the southern end. The maximum capacity of the reservoir will be about 300,000 acre feet.

Views of Alberta's Gigantic Irrigation Work

Views of the Bassano Dam Forming Part of a Reservoir that will be about 3,000 Acre Feet when Completed.



Views of the Extensive Engineering Work as well as One of the Numerous Flumes.

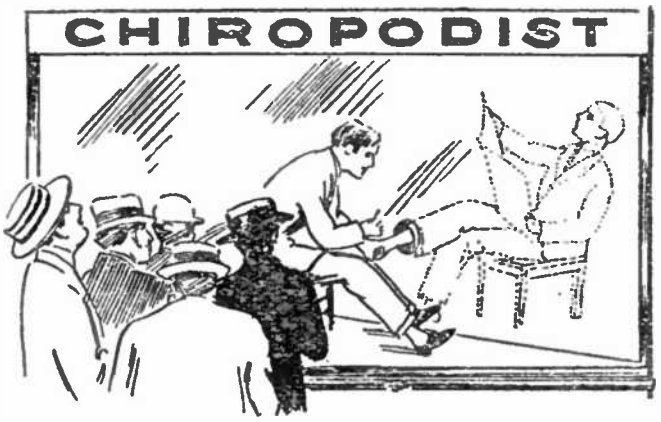
Outside of its use for fence posts, black locust finds its principal utilization in insulator pins and brackets for telegraph and telephone lines.

UNIVERSITY COURSE IN NEUTRALITY

The University of California now offers among its many extension courses a class in the neutrality of the United States and its citizens during the present European struggle. This is conducted under the direction of the division of University extension, and is under the immediate supervision of the department of international law. This is one of the many interesting developments in college curricula as a result of the war. This course has aroused great interest and probably other colleges may follow suit.

A PECULIAR WINDOW ATTRACTION

A chiropodist in a western city occupies the window of a prominent barber shop, making his appeal to men only. The window is partitioned off both front



A Western Chiropodist treats His Customers' Feet in Full View of Passers-by.

and back with heavy curtains. In the front curtain there is a hole for the customer to stick his foot through. By plying his trade in full view of the public he demonstrates his ability to do expert work in a sanitary manner. The publicity gained, together with reduced prices for the work, brings him plenty of patrons.

AN UNUSUAL BUT EFFECTIVE GARAGE SIGNAL

An interesting bit of "Safety First" work has been put in practice by the proprietor of a garage in Louisville, Kentucky, whose example might well be followed in other places.

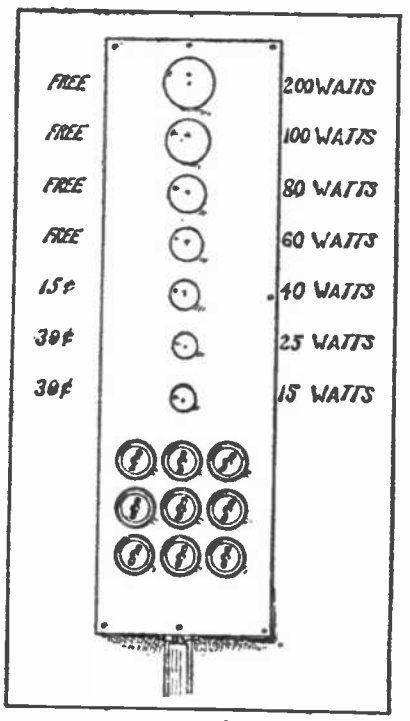
Motor vehicles leaving this garage are obliged to cross the sidewalk of a busy street along which pedestrians are passing at all hours of day and night, and as a warning a lamp has been installed in front of the exit in a large globe, on each side of which the word "Danger" is painted in large letters.

This lamp is lighted from sunset to sunrise and in itself forms an effective cautionary signal. It is, however, supplemented by a loud-ringing gong, which is automatically operated whenever a vehicle approaches the exit door; a steel plate being so placed that it automatically closes the contact with a copper spring and rings the bell whenever the wheels pass over it.

Reports state that it is interesting to note how pedestrians passing along the sidewalk intuitively "stop, look and listen" at the instant the bell begins to ring and wait until the automobile has crossed the sidewalk into the street. It has been suggested that local authorities would do well to enforce the installation of such a device at the entrance to every garage located on busy thoroughfares.

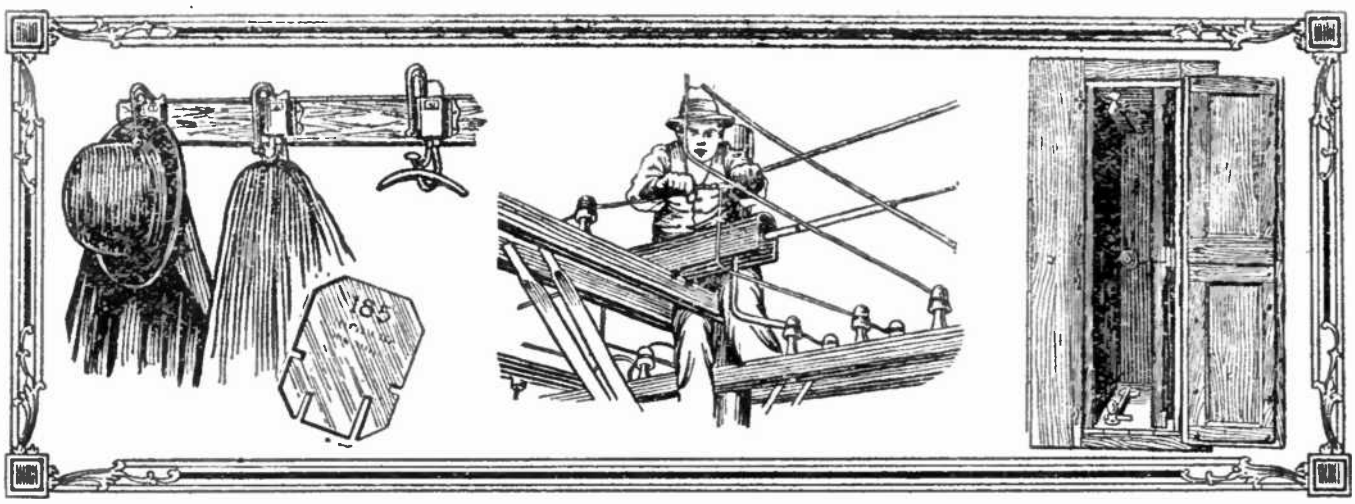
A PRACTICAL ELECTRIC LAMP DISPLAY

An electric company of Hartford, Conn., has placed a board in the retail office which shows vividly the scale of prices for lamp renewals. The lights on the sign vary in size from five hundred to fifteen watts, and opposite each one is the price for a new one. The clerks found that it was difficult to pursuade the public that the bigger lights were sold at a cheaper rate than the smaller ones. It frequently took five or ten minutes of valuable time to convince a patron that the scale was right. Now they see at a glance and believe their eyes.



A Novel Electric Light Price List.

The box is seven feet long and three feet deep, of painted pine boards, as shown. Snap switches at the bottom control each light. The device was built by the clerks and not only serves its purpose, but is also a good advertising medium.



Coat Checking Device. Protective Device for Linemen. Electric Incubator Control.

New and Improved Devices

Coat Checking Device

An ingenious coat and hat checking device has recently made its appearance in the novelty market. The device consists of a series of coat hangers above each of which is placed a locking member that prevents the coat and hat being removed from the hanger once the check, which constitutes a key, has been removed.

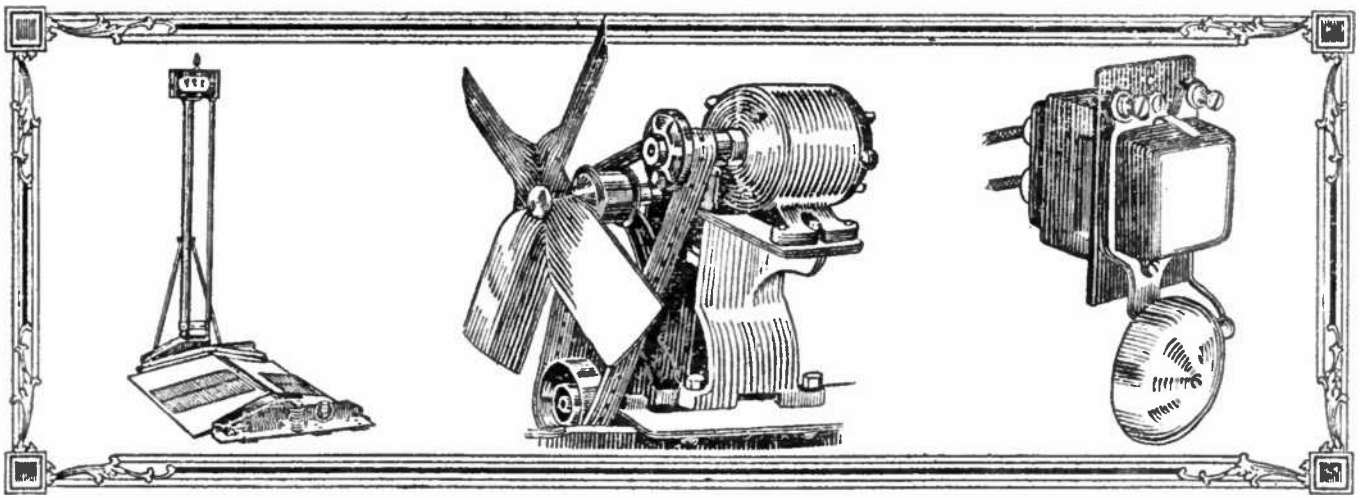
The system should find a ready field in the lobbies of hotels, in restaurants, theatres, and other places where the public gather and where the "Watch your hat and coat" signs offend the eye at every turn. The system will also dispense with the necessity for an employee in the usual check room in small places where this expense is not justified.

Protection for Linemen

A new device intended to afford protection for linemen against dangerous shocks through contact with high voltage wires has recently been introduced. The device is a rigid shield of heavy rubber composition, which rests on the cross-arm and encloses the conductor, leaving a three-inch air space on all sides. The shield is made of an inverted U section thus allowing it to be quickly placed over the wire which is slipped into end sockets holding it securely in place so that the guard cannot be loosened by wind or through contact with the lineman's body. The cross-arm on which the shield rests, bears all the weight and the shield does not come in contact with the wire at any point throughout its length. An additional protection is afforded through the use of slotted flexible tubes adapted to be slipped over the conductors. These tubes are furnished with the shields and the latter can be supplied in successive sizes, making it possible to "nest" them in order to economize on space in transportation.

Electric Incubator Control

Through an ingenious arrangement of its three electric circuits, a new electrically-heated incubator effects a wonderfully perfect control of its temperature. The first of the three circuits serves to raise the temperature approximately to the desired point. At this point a thermostat is operated and a second circuit in series with the first is put into operation, tending to maintain an even temperature. In this circuit are one or more lamps which may be lighted by pressing a button when it is desired to examine conditions in the incubator chamber. A third circuit, operatively connected with the second circuit by means of a thermostat, is put into operation in case of any increase in the voltage of the electric current that might tend to raise the tem-



Truck Counter. Automobile Lighting Generator. Compact Bell-ringing Transformer.

perature to a dangerous degree. The resistance of the latter circuit is such as to lower the temperature of the incubator chamber so that the latter is held to an even temperature without endangering the hatch through fluctuation.

In one of the accompanying illustrations may be seen the thermostats at the sides of the incubator chamber and the wires which are heated to raise the temperature are disposed over the top of the chamber.

Truck Counter

An ingenious machine designed to automatically count truck loads of merchandise is shown herewith. It is claimed that where any considerable amount of shipping is being done, the truck counter will frequently save its cost in a single day through the elimination of errors that inevitably creep in where the usual method is employed. The counter is so made that when the truck rolls on to the apron, the weight of the truck load presses the apron down, the truck wheels move the lever forward and the load is tallied. As the trip lever moves forward, it also goes down, and with it the narrow apron; therefore the platform becomes so nearly level that no resistance is offered to the trucker. As the truck passes off of the machine, the latter is instantly set for the next load. The machine cannot be tripped by the weight of the men pushing the truck or by returning with either an empty or a loaded truck.

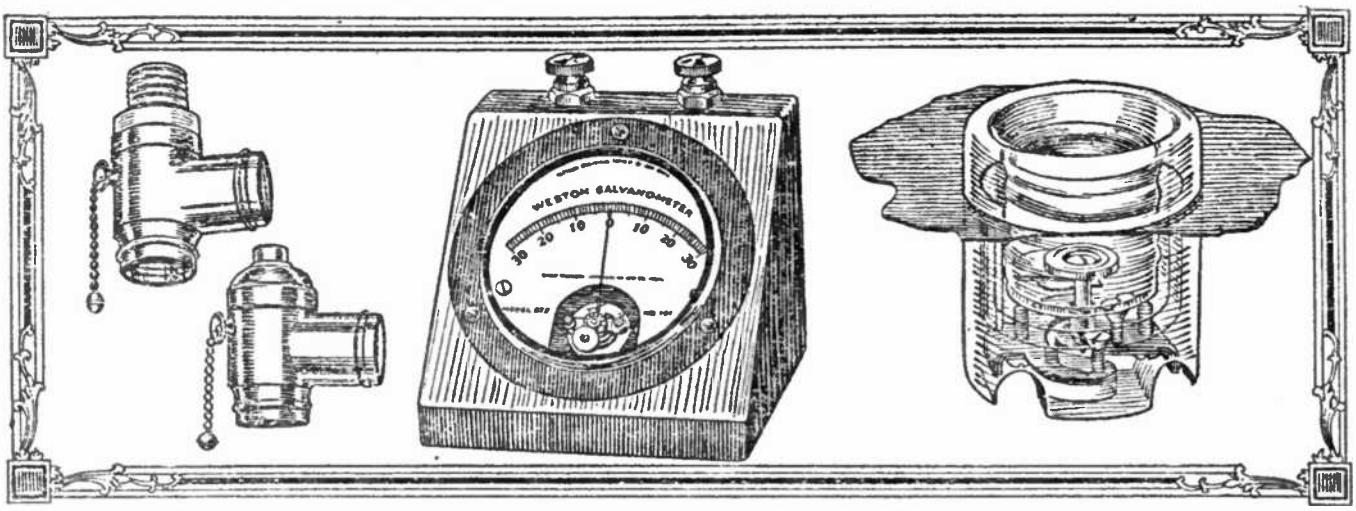
Lighting Generator for Light Car

An ingenious belt-driven lighting plant for light cars is shown in the accompanying illustration. The belt is perforated with a series of holes which engage with spurs on the pulley of the generator, thus insuring certainty of drive even though the pulley be of small diameter. The complete drive is the equivalent of a leather chain which adapts itself perfectly to the sprocket on the generator shaft as well as to the plain pulleys on the fan and crank shaft.

The generator can be placed on most cars as shown in the illustration, a triangular drive idea being employed. The requisite speed for the generator, from 1800 to 2000 revolutions per minute, can be obtained without the use of an inordinately large pulley on the engine shaft because of the small pulley diameter made possible on the generator shaft by means of the spur drive.

Compact Bell-Ringing Transformer

A combination of an exceedingly compact bell-ringing transformer with a flush plate adapting it to be fitted into any standard single-gang switch box is shown in one of the accompanying views. The transformer is adapted for use in residences where it is desired to place the transformer near the bell. The plate, to which the transformer is attached, is drilled to fit any standard iron box bell. It will also take a flush switch plate where it is desired to make the finish correspond to the finish of the hardware



Twin Pull Sockets. Compact Student's Galvanometer. Sign Receptacle.

in the installation. The transformer is given a drastic high voltage test for insulation faults and is designed for operation on 110-volt, 60-cycle circuits with a secondary potential of 10 volts.

Twin Pull Sockets

Pull sockets with outlets for two lamps have recently been introduced. An attachment plug, of course, may be substituted for one lamp or two attachment plugs may be used instead of two lamps. The socket is made in two types. In one type both outlets are simultaneously put "on" or "off" by successive pulls of the chain. In another type, the straight outlet alone is affected when the chain is pulled, the lamp in the angle being "on" all the time. The first type is useful where it is desired to turn on and off two energy-consuming devices at the same time or where one outlet holds a lamp which is used as a pilot lamp for an appliance connected to the other outlet. The second type is useful when it is desired to have a lamp or other energy-consuming device equipped with its own switch connected to the angle outlet. A shade holder can be attached to either outlet and can be held in its normal position relative to the lamp.

Student's Galvanometer

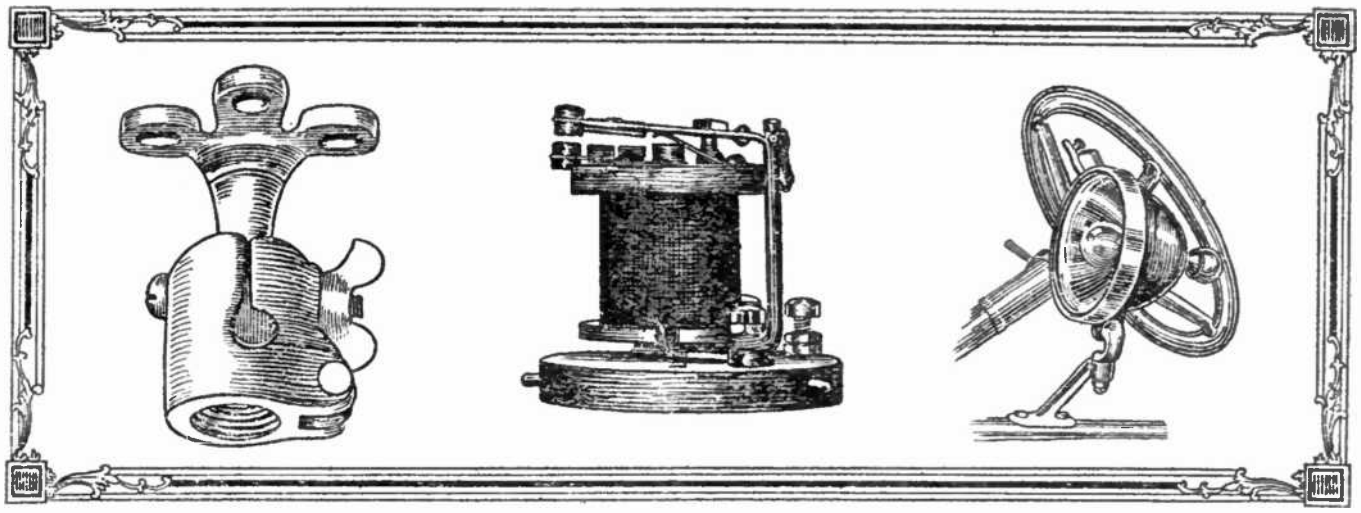
A portable galvanometer designed to meet the requirements of students in high school laboratories has recently made its appearance on the market. It is particularly adapted to the use of science instructors as a portable instrument of great durability, reasonable sensitivity and moderate cost. The galvanometer is mounted on a base at an angle of 45 degrees so that the face is inclined to a position in which the reading may be taken most conveniently. The base of the instrument is 3½ inches in width and the total height including binding posts is 3½ inches. The scale is 2.35 inches in length, is uniformly divided and is calibrated 30-0-30. A zero adjusting device is provided.

It is claimed that in action the galvanometer is extremely responsive and well damped; indeed, it is said that on dead short circuit it is periodic.

New Sign Receptacle

A sign receptacle of interesting design has recently been offered to the trade. The receptacle goes into 1⅜-inch hole and requires no lug or slot to prevent it from turning. It is prevented from turning by three fins on the front portion of the porcelain, which bite into the sheet metal of the sign as the two portions of the receptacle are brought together with the center screw. The latter does not come into direct contact with the center contact of the lamp and there is accordingly no tendency for the screw to loosen by friction of the lamp on the screw-head.

The entire front portion of the receptacle can be removed and replaced without disturbing the line connections



An Adjustable Hickey. Automatic Cut-Out. Automobile Spotlight.

Since the receptacle goes into a perfectly smooth hole, it can be set in any desired position and then be positively prevented from turning by tightening the center screw.

"Hangstrait" Hickey

The hickey shown in an accompanying view should be a boon to the electrician who installs fixtures on ceilings. How many times is a chandelier found to be out of true after the crow-foot has been attached to a crooked stud or a drop that is out of the perpendicular? And even assuming that good workmanship has provided a good, level base upon which to screw the crow-foot, a crooked thread on the end of the fixture pipe will produce the undesirable twist in the fixture.

The new hickey obviates all of these annoying difficulties. It consists of an adjustable, malleable iron ball-and-socket joint of great mechanical strength. The wires are brought straight through an opening larger in diameter than that of the pipe to which the hickey is attached, hence there is no straining of the wires. The hickey is low in price and neat in appearance and it would seem that the many advantages presented through its use should justify its employment in practically every case where a fixture is to be hung. The hickey is made in a variety of styles with outlet box studs, crow-foot or tripod, or to fit insulating joints.

Automatic Cut-Out Device

A compact and serviceable automatic cut-out has recently been placed upon the market and it should find ready favor among autoists and motor boat enthusiasts. The cut-out is designed to protect the storage battery by making the circuit when the generator is running at the proper speed and breaking it when the generator stops or its voltage falls below the normal value required to charge the battery. Thus it prevents the discharge of the battery back through the generator when the low-voltage point is reached.

Spotlight for Automobiles

Spotlights are becoming quite a fad among motorists. They are especially convenient for spotting out guide boards, house numbers, and the like, at night or for following the sharp angles of mountain roads that cannot be seen by the rays of the stationary headlight. A very convenient light of this kind has recently been perfected. It is swung on a perfect universal joint, enabling the driver to throw the light at any desired angle. The light is made with attachments by means of which it may be secured to almost any part of the automobile or motorcycle.

Gasoline Substitute Is Given Official Test

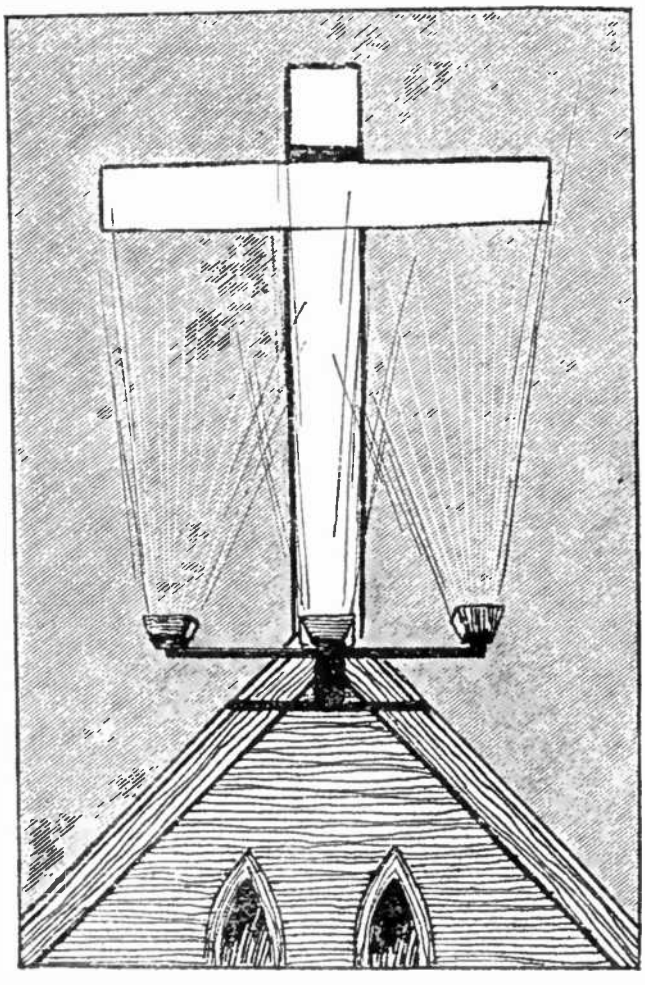
A few days ago an official test was given to zoline, the new substitute for gasoline. A stock Marmon car using this product for fuel was driven for one

thousand miles at a speed of fifty miles an hour on the Indianapolis speedway under the auspices of the Automobile Association of America. The results of the trial run are said to have been entirely satisfactory and apparently this test proves the practicability of the new fuel It is said that there was a surprisingly slight deposit of carbon on the cylinder heads and the pistons and that what little carbon was found was soft and quite easily removed.

It is claimed that the new substitute for gasoline can be made for 1½ cents per gallon.

A Novel Lighting Effect

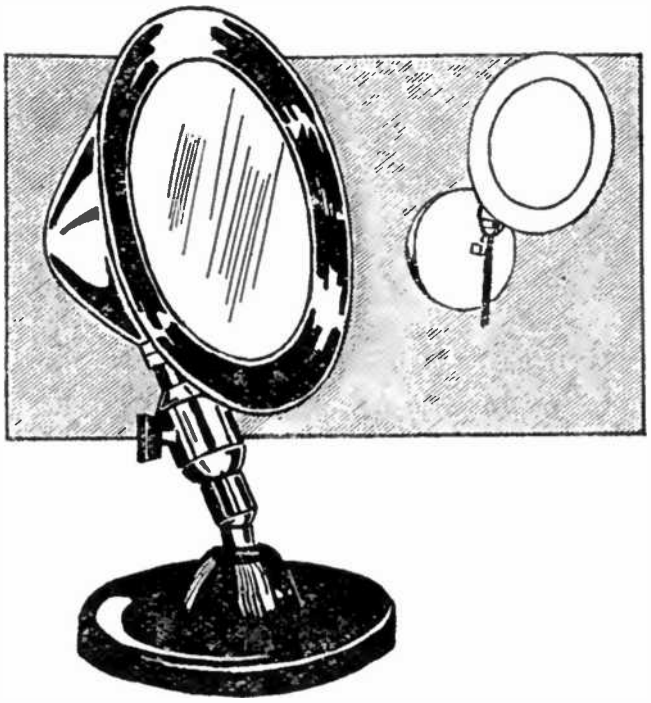
A novel idea has been employed in lighting a cross on a church in a Western city. The cross is painted white and incandescent lamps are arranged in reflectors on both sides of it in such a manner that when the lamps are lighted, their rays will fall upon the white cross, thus causing it to stand out boldly in the darkness. The reflectors are so adjusted that the point of light in each is completely hidden from the view of spectators in the street.



A Novel Method of Lighting a Cross on a Church Top. The Cross Stands Out Prominently against the Dark Sky.

A New Portable Lamp

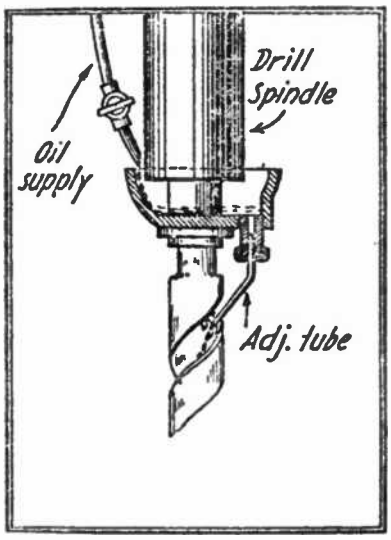
A new and unique development in portable lamps is shown in the accompanying illustration. It consists of a circular mirror, a metal reflector, a lamp socket, a silk cord and an attachment plug. The socket is mounted directly on the base by means of a hinge joint that permits of the adjustment of the lamp and reflector through a wide range of angles. The six-inch mirror is supported by three clips, flushed with the opening of the reflector. The mirror is surrounded by an open space through which the light is diffused. This lamp was originally designed for the man who shaves himself. With one adjustment it illuminates all parts of the face—under the chin and both cheeks. However, after the clips have been released and the mirror removed, advantage can be taken of its adjustable features by using it on a sewing machine, the piano, or the writing desk. The device also makes a very convenient reading lamp. A lug on the base provides for hanging it on the wall when so desired.



A Portable Lamp of Pleasing and Efficient Design, which May Be used on Table and Wall.

Oil Feed for Drill Press

On a press using taper shank drills, an oiler to lubricate the drill points can quickly be rigged up out of parts usually found around the shop. The main part is the oil cup. In this case the steam chamber from an old 1¼-inch steam whistle was employed. The threads were bored out and the hole tapered to slide down to within ⅛-inch of the large end of the largest sleeve used on the press. A block of brass shaped to the curve of the cup was sweated on and drilled and tapped for ¼-inch pipe thread. A short ¼-inch nipple with a valve packing nut on one end was screwed into the cup. A short piece of ¼-inch outside diameter copper tubing curved to lie in the flute of the drill is pushed in the nipple and the packing nut tightened to hold it in position. By using the packed joint the feed tube may be adjusted to feed oil into the flute of any drill from ½-inch up to the largest. When using drills with same number of taper as the spindle the cup is placed directly on the drill shank. As the oil follows the flute of the drill down to the point and lips, this method is much cleaner and more economical of oil than when the latter is squirted on with a can.



Contributed by

JACK ROACH.

Dark Room Lantern

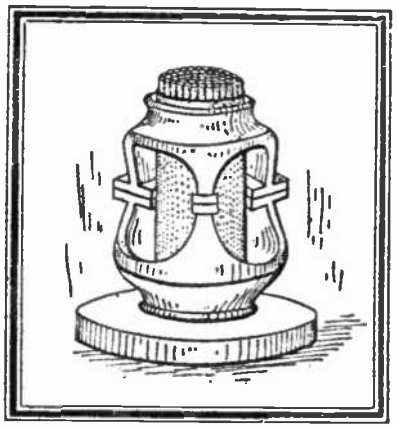
For one who has electric lighting current at hand there is perhaps no handier dark room lantern available than one made from a 25 cent candle lamp of the folding variety with a hole punched in one of the metal ends through which the base of the bulb is screwed. Such a lamp with the bulb removed, of course, can be packed in a very small space and in consequence is ideal for the traveler.

Contributed by

EDWARD F. HALLOCK.

A Novel Match Stand

The reader will probably see at a glance that the essential parts of this stand are the holders of two inverted mantles. A piece of fine sandpaper is wrapped around a wooden roller and then glued up to form a tube which fits the inside of the mantle holders. A base is made from a disc of wood and the various parts assembled with glue. The wooden roller is of course removed in order that matches may be placed inside the tube of sandpaper. When the glue is dry the holder may be filled with matches and it is obvious that they are to be scratched on the wall of the sandpaper tube through the openings between the legs of the gas mantle holders.

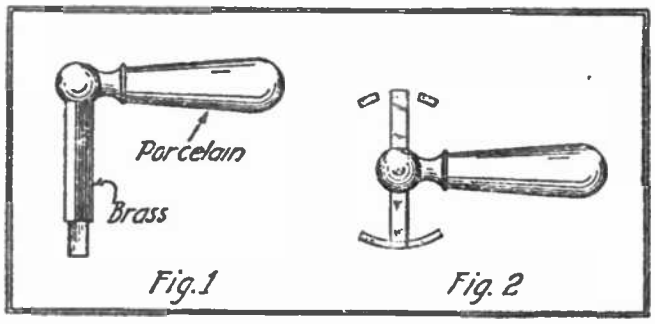


Contributed by

J. NELSON HILL.

China Insulating Handles

The china handles used on certain types of faucets are very useful articles to have around when constructing electrical apparatus. They present a neat



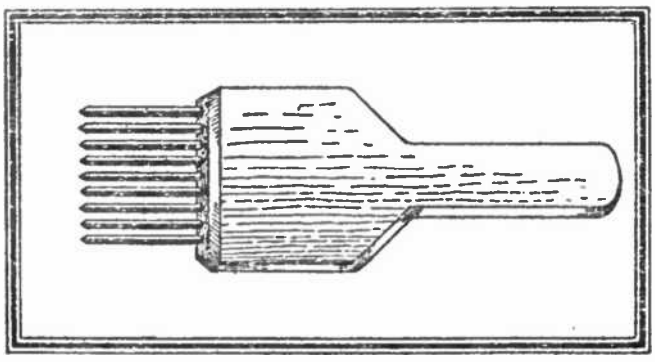
appearance and possess good insulating qualities. Such handles can be found on the scrap pile at almost any plumbing shop and can be purchased for little or nothing. Fig. 2 shows the working part of a 3-point switch made from such a handle by soldering a flat strip of brass at right angles to the stem. In the switch referred to the current carrying parts were all beneath the apparatus table in a wireless station, only the handle projecting above. Where the stem passed through the table, a hard rubber bushing was used.

Contributed by

H. W. Smith.

Nail Picker

Take a piece of pine board or any other soft wood six inches long and four inches wide and shave it to a shape not unlike a butter paddle, leaving the broad end about an inch thick. Trim the long



corners with a knife or file. Drive a row of ten penny finishing nails into the end of the broad part near enough together to let the shank of a six or eight penny nail enter, but not far enough apart to permit the heads to pass through. File the heads of the nails down to points.

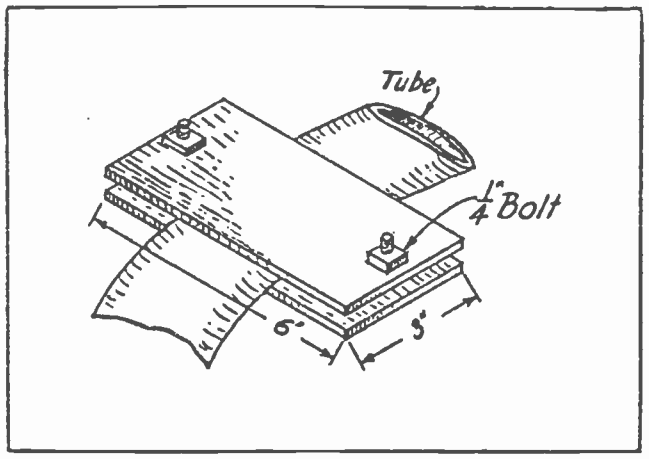
This makes a device that is very handy and serviceable to the box maker or anyone who has much bench nailing to do. A few jabs into a box of nails and it will gather a hand full of them, heads all one way and ready to be taken off, thus saving the time and trouble of turning them in the fingers as they are fed to the hammer.

Contributed by

Theodore Wilson.

Tire Patch Clamp

A handy inner tube patch clamp for the tubes of bicycle and motorcycle tires may be made by bolting together two



3 by 6 inch pieces of iron as shown in the accompanying sketch. The holes in the under piece should be a snug fit for the shoulder of the bolts, while those in the upper piece should be an easy clearance fit. It is preferable to employ wing nuts on the ends of the bolts in order that no wrench may be necessary for tightening.

Contributed by

Francis W. Nunenmacher.

Protecting the Edges of a Flag

To prevent a flag from becoming frayed at its edges it is only necessary to run a fine copper wire around it. This will prevent the flag from waving in sharp and snappy jerks that result in ripping the edges.

Contributed by

Edmond Von Kaenel.

CONSTRUCTION OF A PRACTICAL SURVEYOR'S TRANSIT

By R. L. Kenyon

A transit that will comply with nearly every necessity may be constructed by the handy man at a nominal expense. The material needed will be an oak disc 14 inches in diameter and 5/8 inch thick, a brass disc 10 inches in diameter by 1/8 inch thick, a piece of 1½ inch brass tubing 14 inches long, a 5 inch protractor, 6 feet of ¼ inch square brass rod, four brass ferrules and some glass tubing to fit in the latter.

tion is to calibrate the brass disc by dividing it into 360 degrees. It will be a saving in time and money to have a machinist do this on a milling machine, since it will take him but a short time and the charge will be very slight. The machinist should be instructed to make every 5th line come into the 3rd circle and every 10th line come in a little further as shown in Fig. 3. When this has been done every 10th division may be stamped with steel numeral dies as

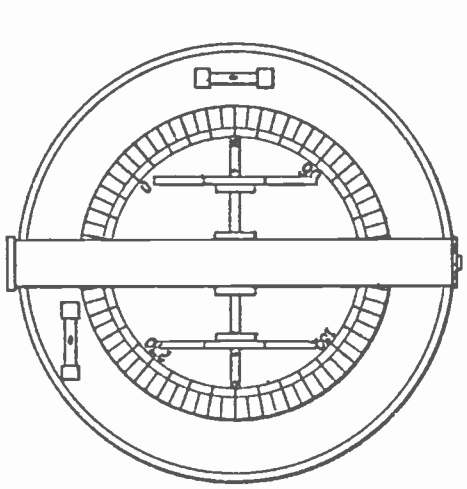


Fig. 1

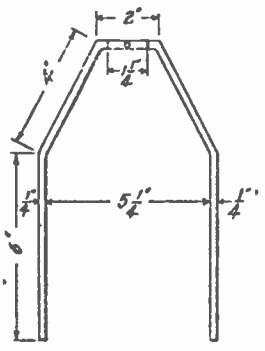


Fig. 8

Fig. 9

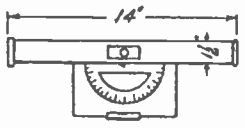


Fig. 7

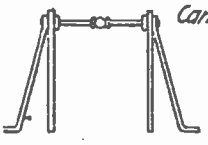


Fig. 6

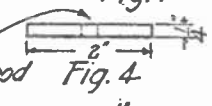


Fig. 4

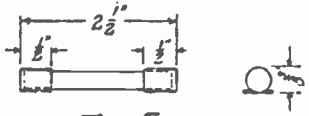


Fig. 5

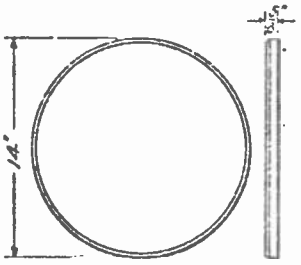


Fig. 2

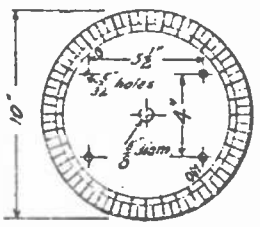


Fig. 3

The oak disc should be turned true on a lathe and centered. With reference to Fig. 3 in the drawing the holes may be drilled in the piece of sheet brass as indicated and the brass disc fastened to the wood with small screws, making sure that the centers of the two discs coincide. The next operation is to calibrate the brass disc by dividing it into 360 degrees. It will be a saving in time and money to have a machinist do this on a milling machine, since it will take him but a short time and the charge will be very slight. The machinist should be instructed to make every 5th line come into the 3rd circle and every 10th line come in a little further as shown in Fig. 3. When this has been done every 10th division may be stamped with steel numeral dies as 10, 20, 30, etc., on up to 370. The surface may then be smoothed off with a scratch brush or coarse piece of emery cloth, finishing off with fine cloth and finally lacquering.

The square brass rod is to be cut and bent into the shape shown in Fig. 8, and two short lengths of the rod are

cut and both are secured to the supports at the top as shown in the drawing. The blocks may be secured either with machine screws or by riveting. A hole should be drilled through each of the pieces and on through the support and tapped for an 8-32 machine screw thread. A hole should also be drilled in the bottom of each leg and tapped with the same thread. Two pieces of rod should be bent to the shape of the braces shown in Fig. 6 and secured in position.

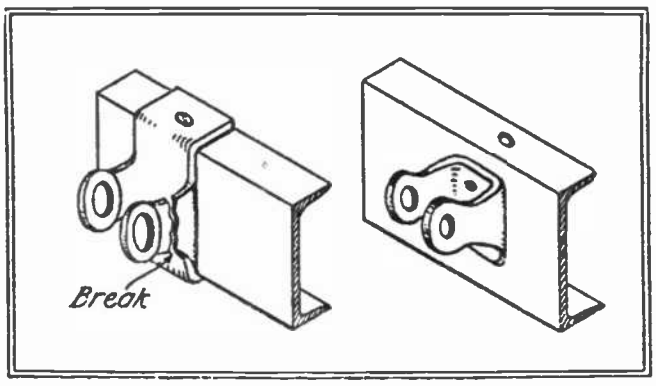
The brass tube should next be fitted in place. A short piece of the square brass rod is fitted to each side of the tube and a hole is drilled in each of these pieces, care being taken to see that the holes are diametrically opposite. Two short pieces of 5/32 inch round brass rod are threaded at one end with an 8-32 die in order that they may be fitted into the holes in the top of the supports shown in Fig. 8. They should be of such a length as to support the tube over the center of the disc when the parts are assembled. A cross composed of two pieces of No. 36 copper wire should be soldered in each end of the tube. The tube is completed by soldering the protractor to the underside as shown in Fig. 7. If the extra refinement of a level is desired it may be affixed as shown in the drawing.

A two-inch disc of brass is fastened over the center hole in the oak disc and precisely in the center a 5/8 inch hole is drilled and tapped. A couple of copper burrs are placed over the hole and the upper disc bolted down so as to be firm and yet free to revolve. The two levels are attached to the oak disc and an index to read on the horizontal protractor is placed in position. A socket fastened to the underside of the oak base to fit a camera tripod completes the job.

The zero readings should be checked so that when the tube level is horizontal the reading on the small protractor is zero. If desired the two may be fitted with telescopic lenses and in that case the cross hairs of fine wire should be placed at the foci of the lenses. The cross hairs may be adjusted by leveling the whole transit and finally the telescope. A pole should then be marked off to the exact height of the center of the tube and then the operator may sight on the pole at a distance of several hundred feet. The ground should be perfectly level in doing this and if it is not possible to get so long a range of level ground a shorter distance may be taken. After these corrections the instrument is ready for use. Its operation is essentially the same as any surveyor's transit of approved design.

Torque Rod Bracket Repair

The bracket carrying the front portion of the torque rod on the writer's



automobile broke one day at the point illustrated in the accompanying sketch. The car being an extremely old model, and knowing the delay occasioned by the ordering of a new part, it was decided to repair the break in the home workshop. The old bracket was first removed from the car and thrown in the junk pile. A piece of 3/8-inch flat steel stock was first annealed and then cut and hammered into the shape of a U of the proper dimensions. The necessary holes were then drilled and the new bracket was riveted to its proper place on the cross member. The entire job took but a few hours and the expense amounted to practically nothing.

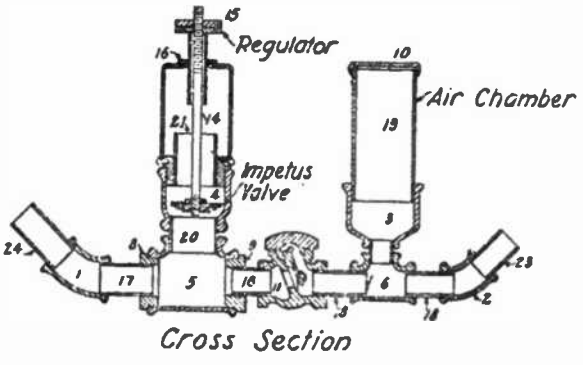
Contributed by

ADOLPH KLEIN.

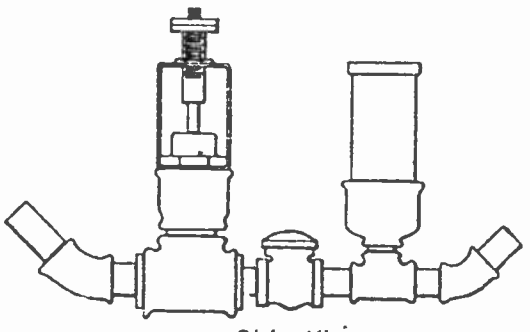
Hydraulic Ram from Pipe Fittings

The contributor takes exception to the explanation of the process of purification offered in an article in the November issue of POPULAR ELECTRICITY AND MODERN MECHANICS under the title "A Sanitary System on the Farm." The article in question states that the absence of oxygen makes the bacteria destroy themselves and while it is true that the process of purification is due to bacterial action, the bacteria are those that can exist without the presence of oxygen. There are two classes, *i. e.*, "anærobic" or those requiring no oxygen, and "faculative" or those that can live with or without the presence of oxygen. In a sewage tank these two classes of bacteria use the organic matter as food which has settled out of the sewage thereby partially destroying it. A portion of it that is not destroyed is liquefied. For further purification the discharge from the tank could be run over a small space of ground filled with ¼ to 1 inch of gravel and drained at the bottom.

In order that the gravity water supply from a spring to the house might produce an effective 20 pounds pressure per square inch, the spring would have to be 40 feet above the fixture where the water is drawn and as springs are seldom found on a high piece of land with the house built in a hollow, this means of supplying water would not be practicable in many places. The drawing illustrates a simple form of hydraulic ram that may be made from pipe fittings and which will pump water to a height of more than 50 feet when placed 5 or more feet below the level of a spring and supplied through a pipe from 35 to 40 feet long. The entire bill of materials entering into the construction of this ram can be obtained at a plumbing shop for something less than $5. It is felt that a detailed description of the ram is unnecessary inasmuch as the construction is shown very clearly in the appended drawing.



Cross Section



Side View

Ram Made of Pipe Fittings

1 - 1" 45° Ell #1	1 - 1½"×1½"×1½" Tee #5	1 - 1¼"-¾" Bushing #9	1 - Iron Washer #13	1 - 1" Short nipple #17
1 - ¾" 45° " #2	1 - ¾"×¾"×¾" Tee #6	1 - 2" Cap #10	1 - ¼"×6" Rod #14	1 - ¾" " #18
1 - 2"-¾" Reducer #3	1 - 2"-1¼" Bushing #7	1 - ¾" Check Valve #11	4 - ¼" Nuts #15	1 - 2"×5" nipple #19
1 - 2"-½" " #4	1 - ½"-1" Bushing #8	1 - Rubber Washer #12	1 ⅜" Lock nuts #16	1 - 1¼" Close nipple #20
		1 - 1¼"×2¼" nipple.		

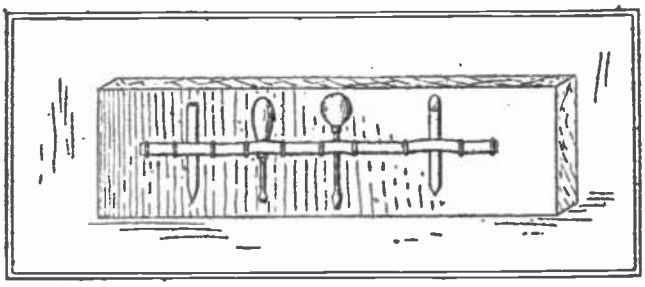
With 7'-0" head and 35'-0" drive it uses 1.1 cubic feet and delivers 1 gallon every 1½ minutes to a height of 42'-0". With an increase of head and drive pipe, it will pump higher and deliver a larger volume.

Contributed by

LESTER J. MILLER.

Handy Tool Rack

A tool rack is an absolute necessity to the handy man or model engineer. The rack shown in the illustration is made by stapling at intervals a length of rubber



of square section to a wooden back. It is most useful for odd tools other than sharp cutting tools.

Contributed by

J. N. Hill.

Storage Battery Containers

A cheap and highly satisfactory container for the elements of a storage battery or rectifier may be made of wood as follows: Make a box of the required size from white wood of suitable thickness, smearing the edges of the wood generously with an acid-proof cement. Also paint the inside of the box with the cement before assembling. (An excellent cement for this purpose was described by Earle E. Taylor in the July number of this magazine.) Reinforce the box wherever necessary with battens and permit a stream of the acid proof compound to flow down the inside of each corner and around the bottom of the box. Dip the top of the box in melted paraffin to keep salts from crawling.

Contributed by

George M. Hearne.

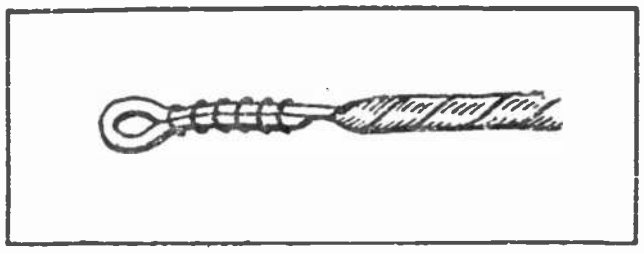
A Handy Lug

A handy lug or battery connector may be made from a cotter pin having a hole in the head sufficiently large to fit snugly over a battery binding post.

To make the connector, wind a piece of No. 20 copper wire around the legs of the cotter pin and secure by a drop of solder. Protect with tape and you have a lug that may be used to great advantage in many ways.

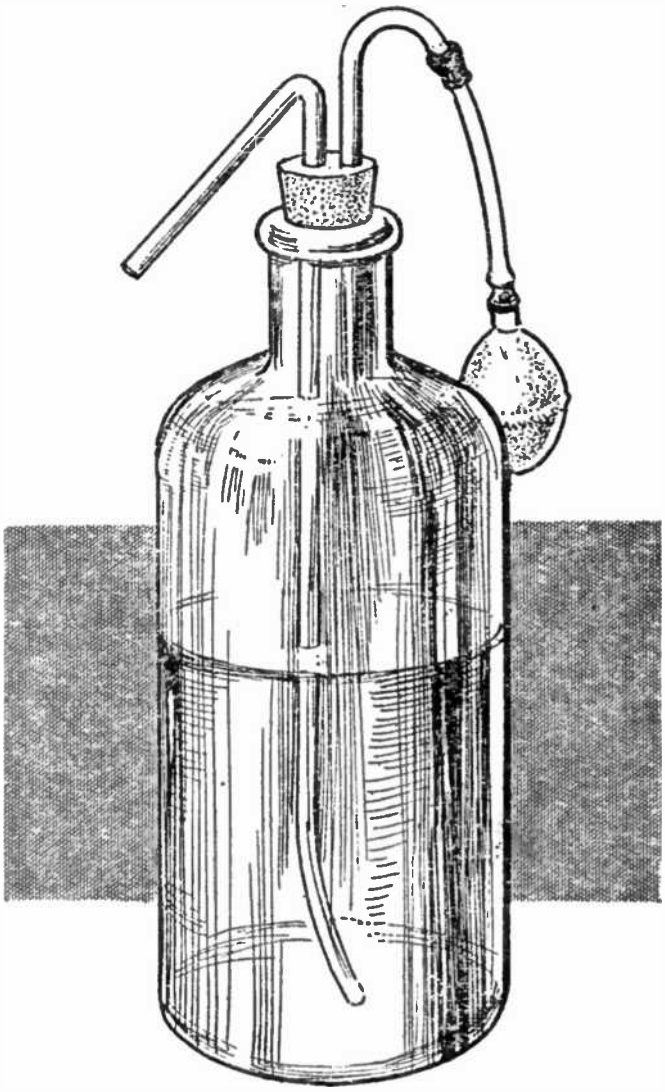
Contributed by

Lacy Conway.



Handy Siphon Bottle

A prescription department in a large city drug store has a handy utensil in the shape of a gallon siphon bottle for distilled water made with two pieces of glass tubing, a rubber tube,

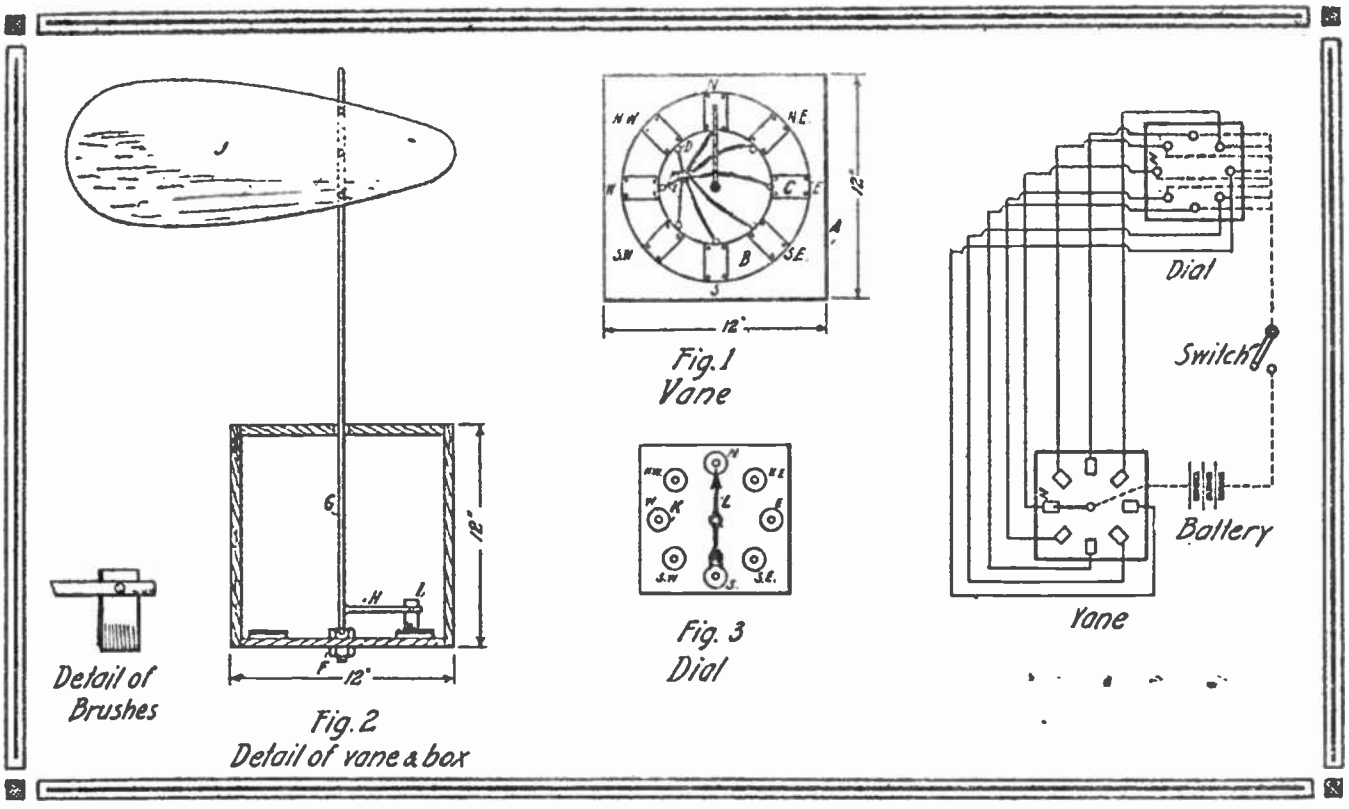


and an atomizer bulb. When the bulb is pressed air is forced into the bottle causing the water to flow into the prescription bottle held under outlet tube.

Contributed by

N. Mitchell.

¶ A good tinting fluid for incandescent electric lamp bulbs can be made by mixing aniline dye with a solution of water-glass. An inferior substitute for the water-glass is a solution of gelatine in water.



AN ELECTRIC WEATHER VANE

L. B. Robbins

Being a lazy individual and desiring to save myself the trouble of going to the window to ascertain the direction of the wind by the weather cock on the barn, I built a device that shows, by closing a switch in the house, which way the wind is blowing.

As will be seen by the following description, the device is quite simple and can be made by anyone at all handy with tools. It comprises essentially a vane and a dial.

The vane consists of the vane proper and the vane box. The bottom of the box, *A*, is made of a piece of one inch ash or oak 12 inches square. Find the center and describe two circles, 6 inches and 10 inches in diameter, respectively. Cut a ring from sheet rubber, such as is used by plumbers for packing valves, with the two diameters the same as the two circles on the board. Tack this ring to the board exactly over the circles so that it lies perfectly smooth and flat. This forms an insulated track, *B*, for the eight contact plates, *C*, which are cut from No. 18 sheet copper and fastened at each corner by ¾ inch brass screws. These plates are placed equidistant around the rubber track and represent the eight principal points of the compass. On the inside edge of the plates fasten a binding post, *D*. In the center of the base bore a ¼ inch hole and fasten a 1½ inch bolt, *F*, in the head of which has been drilled a hole ¼ inch in diameter and about the same depth. Somewhere between the center of the board and inner edge of plates bore a hole, *E*, through which the lead wires may pass.

Now, if you are enough of a blacksmith, take a piece of ¼ inch round bar iron, *G*, 2 feet 4 inches long. At 1½ inches from one end weld at right angles a piece, *H*, of the same stock 5 inches long. Saw a slot 2 inches long in the end of this arm and in one tine of the fork thus formed drill a hole and tap for a machine screw. This is to hold the contact brush, *I*, which is made of three or four strips of thin brass an inch wide and two inches long. Fringe these at one end for a space of

about ¾ inch. When laid together the plain ends are placed in the slot and held by the adjusting screw. Through the other end of the rod drill three ⅛-inch holes at right angles to the direction of the arm, the top hole two inches from the top of rod and the others two inches apart. Cut out the top of vane box and through the center bore a hole just large enough to take the rod without binding. Slip the top over the rod and box in three sides, making the box 12 inches square. Set the rod in the socket and adjust the brushes so that they bear lightly but firmly on the plates. The open face of the box should be closed by a hinged door through which adjustments can be made. The box when finished should be given two or three coats of linseed oil to protect it from the weather and prevent warping.

Now make a vane, *J*, and rivet to the rod through the three holes previously bored. The vane is best made of two sheets of light galvanized iron riveted together with an opening left to slip over the rod.

The dial is a series of eight magnets, *K*, arranged to correspond to the plates in the vane box. On a piece of wood 8 inches square describe a circle 6 inches in diameter and at eight equidistant points on the circumference drive a tenpenny nail, leaving the heads 1½ inches above the surface. Each nail when wound with a half a dozen layers of No. 20 insulated wire makes an excellent magnet. Cut an arrow, *L*, from some light non-conductor such as whale bone and at the point attach a small piece of iron. Find the balancing point and make a small depression on the under side. Mount the arrow on a pivot in the center of the dial so that it will swing at a height equal to that of the magnets and very close to them.

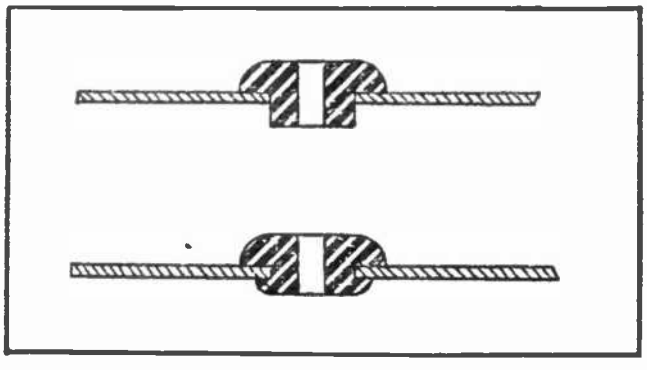
Place the dial in a convenient location in the house near the battery and switch, and secure the vane on the roof, with plate marked "North" pointing due north.

The wiring from the vane to the dial is shown in the accompanying diagram. The dotted line is the ground wire, leading from the bolt, *F*, to battery and switch, and ending with a branch wire leading to one terminal of each magnet. The solid lines represent the wires from each plate which lead to the second terminal of the corresponding magnet. Thus the wire from the plate marked "North" leads to the magnet marked North on the dial. Four cells of dry battery will be found sufficient for ordinary distances.

When the switch is closed it may be necessary to spin the pointer lightly so it can quickly seek out the right magnet through which the current is passing and thus indicate the direction of the wind.

To Fasten Socket Bushing in Fixture Canopy

Trim about one-eighth inch from the threaded end of a bushing and insert



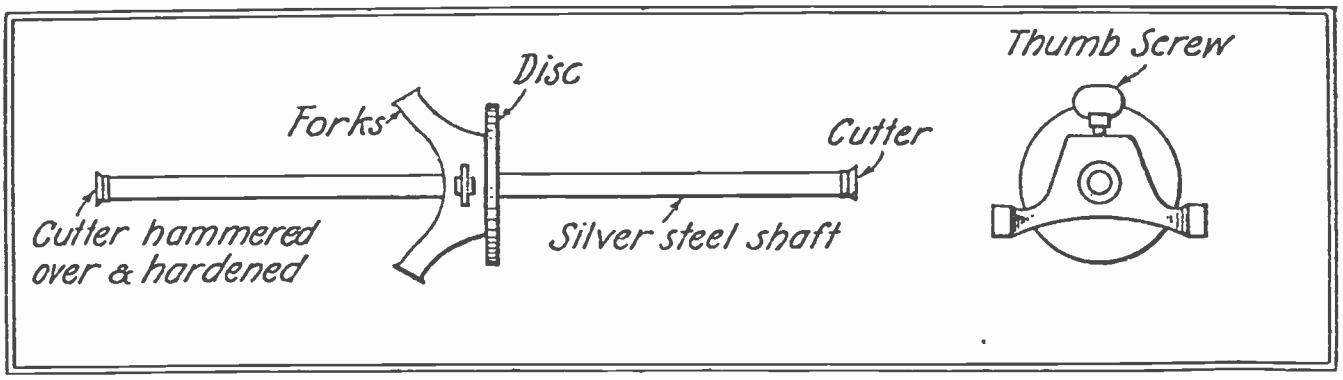
into hole in the canopy. Heat the threaded end with a match or candle, which will quickly soften the rubber. Before it hardens press out edges with the thumb, thus forming a shoulder and locking the bushing.

Contributed by

C. K. THEOBALD.

A Useful Marking Gauge

The illustrations show a simple marking gauge which the writer designed and made some time ago and which is now in constant demand among his fellow pattern makers. It will be seen that the gauge head has two working faces, the disc for straight gauging and the forks for gauging curved surfaces, two cut-



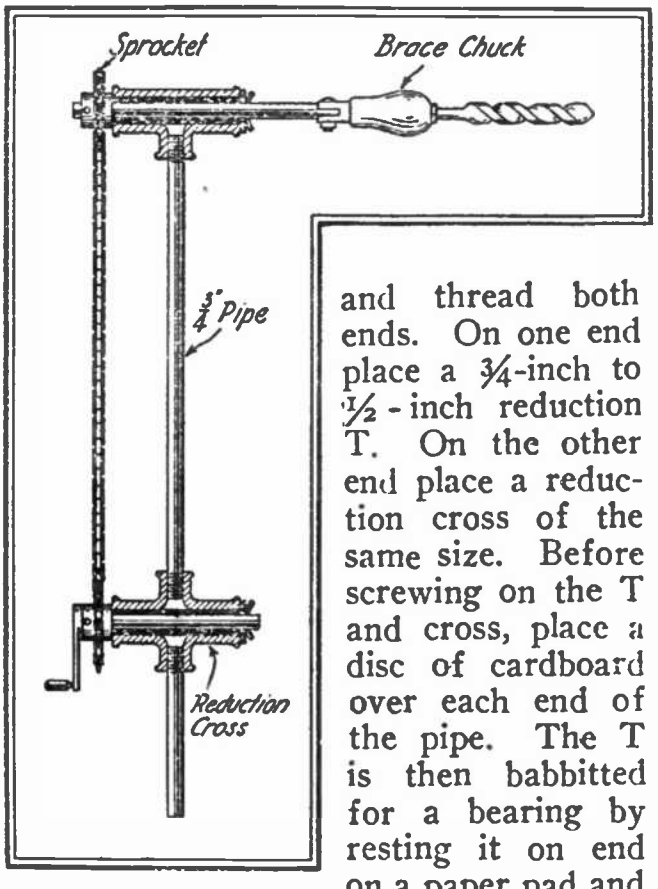
ters being also provided on the shaft. A pattern is required for the head—a useful lesson in small pattern making—and if the cutters are properly hardened the gauge may be used for marking metal as well as wood.

Contributed by

J. NELSON HILL.

A Boring Tool for Tight Places

A very satisfactory boring tool may be made out of pipe fittings as follows: Cut a five-foot length of ¾-inch pipe



and thread both ends. On one end place a ¾-inch to ½-inch reduction T. On the other end place a reduction cross of the same size. Before screwing on the T and cross, place a disc of cardboard over each end of the pipe. The T is then babbitted for a bearing by resting it on end on a paper pad and standing a ½-inch diameter steel shaft upright in it. The babbitt cannot escape as it is poured in around the shaft because of the disc closing the end of the pipe. A two-foot length of pipe is inserted in the other side of the cross and the cross is then babbitted to make a bearing similar to that in the T. Two sprockets are next procured and bored to fit the ½-inch shaft. One of these sprockets is fitted to the end of a 3½-inch length of shafting and this is put through the bearing in the cross, being held in position with a washer and cotter pin on the other end. A crank bolted to the sprocket completes the driving mechanism.

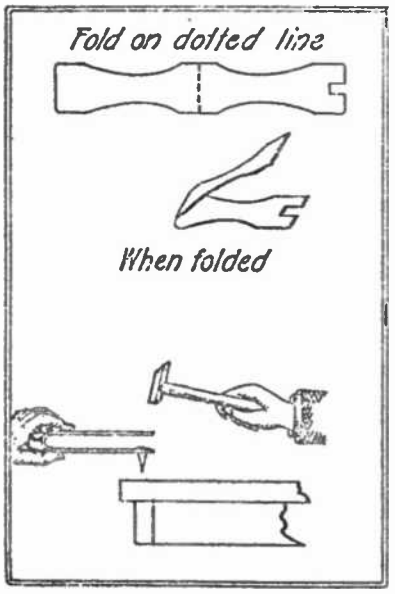
A shaft four inches long is fitted with the remaining sprocket on one end and on the other end is fastened a chuck removed from an old brace. It may be necessary to cut a shoulder on the shaft to make it fit into the chuck. A length of sprocket chain connects the sprockets and the machine is then ready for use.

Contributed by

PATTERSON D. MERRILL.

A Handy Tack Holder

When one has to drive a very small nail or short tack it is often difficult to hold until it has "taken root" from the first blow of the hammer. The simple device shown in the accompanying illustration will prove very useful in such a case and it may be quickly made from



a bit of tin or cardboard. The nail or tack is inserted in the slot and the overlapping piece of metal serves to hold it by its head. This gives a sort of handle by means of which the tack can be held just where it is wanted and in a perfectly upright position, ready to be started with the first blow of the hammer. The holder can then be withdrawn and the tack driven home.

Contributed by

THEODORE GATHMANN.

A Convenient Wire Rack

A convenient wire rack with removable spools for holding lamp cord, fixture wire and various sizes of other wires from which small quantities are often taken, may be easily constructed as illustrated and described herewith.

The frame and spools are made of wood, the cores of the spools being about 3 inches square with rounded corners. For the spindles on the spools ¼-inch crowfeet are used. These nipples are threaded on both ends so that a crank, made from ¼-inch pipe fittings as shown, may be readily fitted to any spool for the purpose of winding. Slots are cut in the sides of the frame as shown, thus making the spools interchangeable.

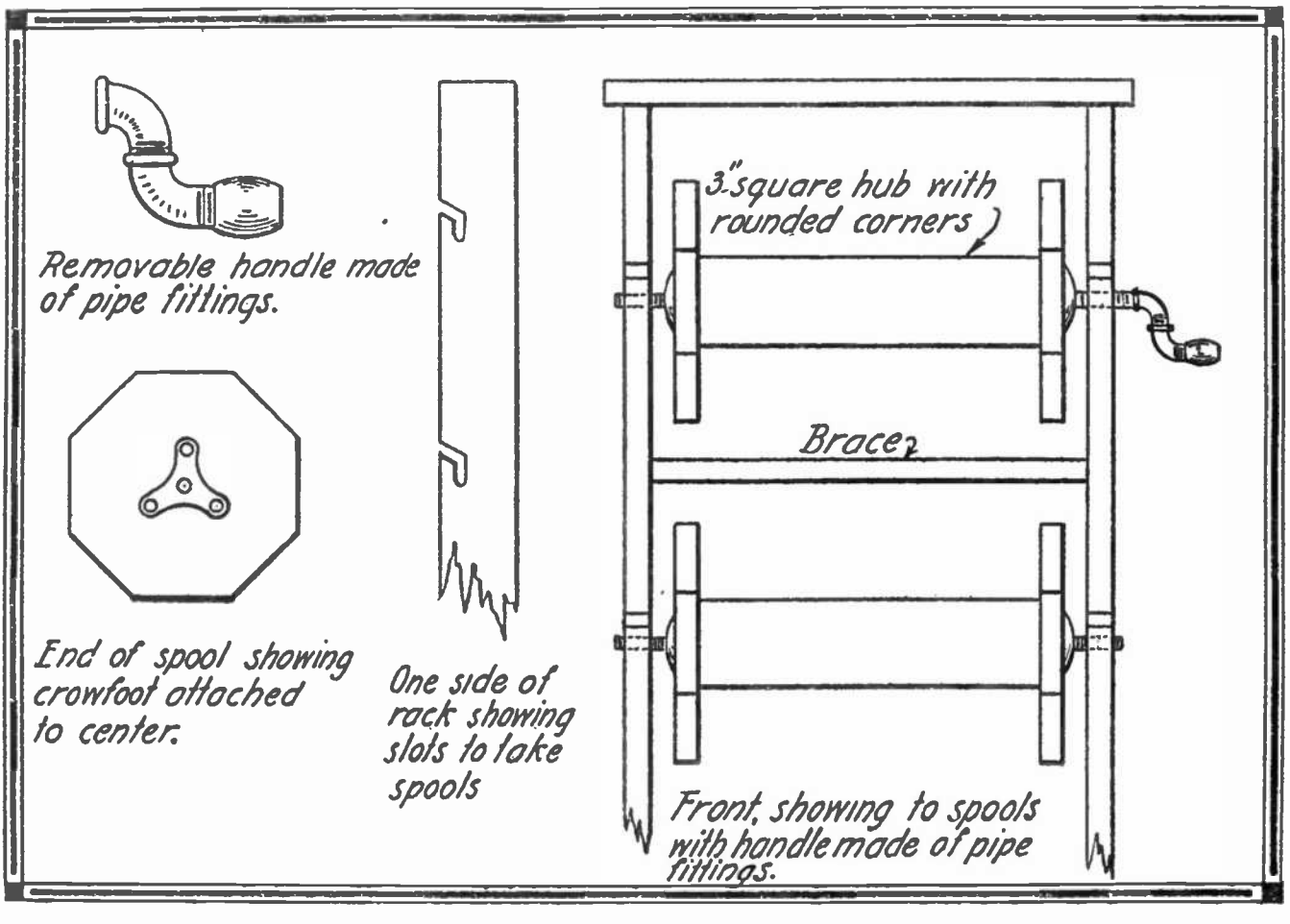
Cross braces are secured between the sides of the frame, and the rack is suitably fastened to the floor, about one foot from the wall.

Contributed by

C. K. THEOBALD.

Needle In Arm Located by Means of Magnetism

One of the employees at the power plant of which the writer has charge had the misfortune to break a needle off in his arm about an inch above the wrist. The local surgeon worked for some time and, as the wound was in a serious place, declared the patient should be sent to a city in order that an X-ray examination might be made. Through an ingenious application of magnetism, however, this was rendered unnecessary and it is believed that the method of procedure which resulted in the recovery of the needle, will be of interest to readers of this magazine.



ELECTROLYTIC RECTIFIER CONSTRUCTION

By Chas. E. Mullin

This rectifier utilizes both sides of the wave and may be connected directly to 110-120 volt A. C. without other resistance, thereby greatly increasing the efficiency. It will furnish 80 to 90 volts D. C. and will carry as high as 5 amperes on intermittent service. By doubling the surface area of the plates, the capacity may be considerably increased.

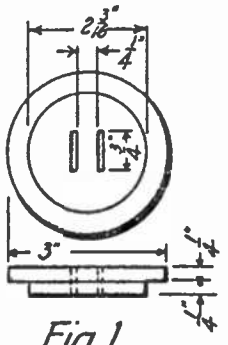


Fig. 1

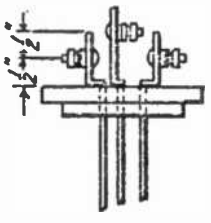


Fig. 3

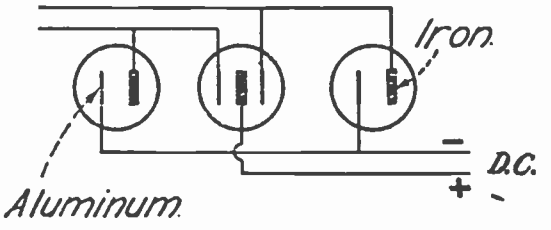


Fig. 6

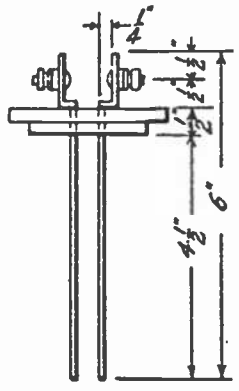


Fig. 2

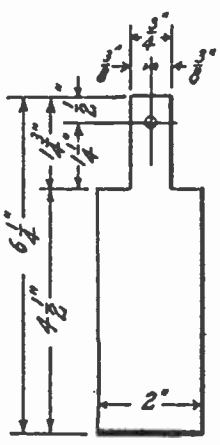


Fig. 4

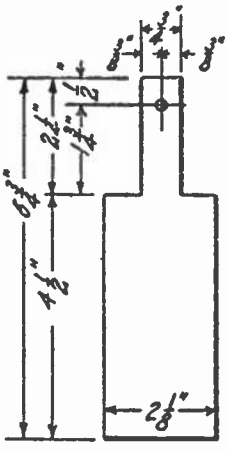


Fig. 5

The following material will be required:

2 sheets of iron 2 × 6¼ inches, ⅛-inch thick.*
1 sheet of iron 2⅛ × 6¾ inches, ⅛-inch thick.*
4 sheets of aluminum 2 × 6¼ inches, ⅛-inch thick.
7 Binding posts.
3 one-pint Mason fruit jars.
1 piece pine or other soft wood, about ¼ inch thick, 4 × 20 inches.

The four aluminum and two iron sheets should be cut into plates 2 inches wide by 4½-inches long, with a lug 1¾-inches long and ¾-inch wide on one end of each, as shown in Fig. 4. The single large iron sheet should be cut 2⅛-inches by 4½-inches, with a lug 2¼-inches long and ¾-inch wide as shown in Fig. 5. These lugs should be drilled about ½-inch from the end with a hole suitable for a binding post.

Three discs, about 2 3/16-inches in diameter, to fit neatly into a pint jar, and three 3-inches in diameter, should be cut from the wood. These discs may be boiled in paraffine to prevent warping. One of the smaller discs is fastened in the center of each of the larger discs, as shown in Fig. 1, so as to form covers for the jars. In two of these covers, two slots, each 3/16-inch from the center and parallel to each other, should be cut as illustrated in Fig. 1, each ¾-inch long. One slot should be wide enough to tightly admit an iron plate lug, while the other should be wide enough to admit the lug of an aluminum plate. The third cover should have three slots, one in the center to fit the lug on the largest iron plate, and a slot 5/16-inch on each side of it, to take a lug from an aluminum plate, as in Fig.

* NOTE: Lead or carbon plates of the same surface area may be substituted for the iron plates.

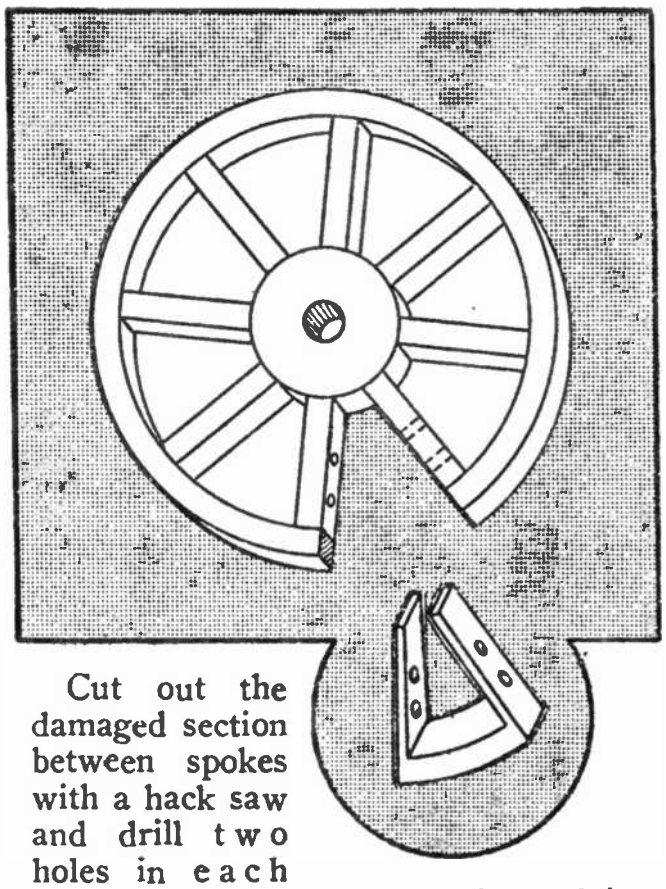
3. These lugs are forced through their proper slots in the covers, and bent L-shaped as shown in Figs. 2 and 3, so as to hold the plates in position, parallel to each other and ¼-inch apart. They are then fitted with suitable binding posts—the screws of which pass through the holes in the lugs—for connections.

The jars are filled to within ½-inch from the top, with a saturated solution of acid sodium carbonate, ($HNaCO_3$), in water. (The commercial $HNaCO_3$, commonly known as baking soda, which can be purchased from any grocer for about 10 cents per pound, is very satisfactory.) The covers are then placed on the jars; the plates extending down into the electrolyte. The plates are now connected as shown in Fig. 6, and the A. C. side connected to the line through a switch. The switch should be open when the rectifier is not in use. To start the rectifier, the D. C. circuit should be completed for a few minutes through a resistance. For convenience in handling, the jars may be mounted in a triangular or long box.

The tops of the jars should be dipped in melted paraffin to prevent the salts from creeping upwards.

Repairing Truck and Small Car Wheels

If the rim of a small car or truck wheel is chipped or broken it may be easily repaired by the following method:



Cut out the damaged section between spokes with a hack saw and drill two holes in each spoke for bolts. Have a piece of iron shaped at any blacksmith shop to snugly fit in the opening, drill holes to correspond with those in the spokes, adjust the section and tighten nuts.

Contributed by

B. W. Verne.

A Non-Acid Soldering Paste

An excellent non-acid soldering paste can be made by adding enough paraffine to a five-cent bottle of vaseline to make the mixture remain solid in warm weather. Add one-half ounce of zinc chloride dissolved in a little alcohol to the foregoing mixture and stir it thoroughly. The alcohol soon evaporates and leaves the chloride thoroughly mixed, when it is ready for use.

It will be found that only a small amount of this paste is required for a job and that the solder sticks immediately. Furthermore, the work—if it happens to be copper or brass—will not turn green. This paste is excellent for instrument work.

Contributed by

Warren C. Thomas.

Chemical Fire Extinguishers

It is important for builders of the fire extinguisher that was recently described in these columns to remember that sulphuric acid has the property of absorbing water from all convenient sources. It is therefore suggested that the acid bottle should be fitted with a loosely-fitting cork in order to prevent the acid from absorbing water and weakening itself, as well as running over into the soda solution. The cork should be made of lead.

Contributed by

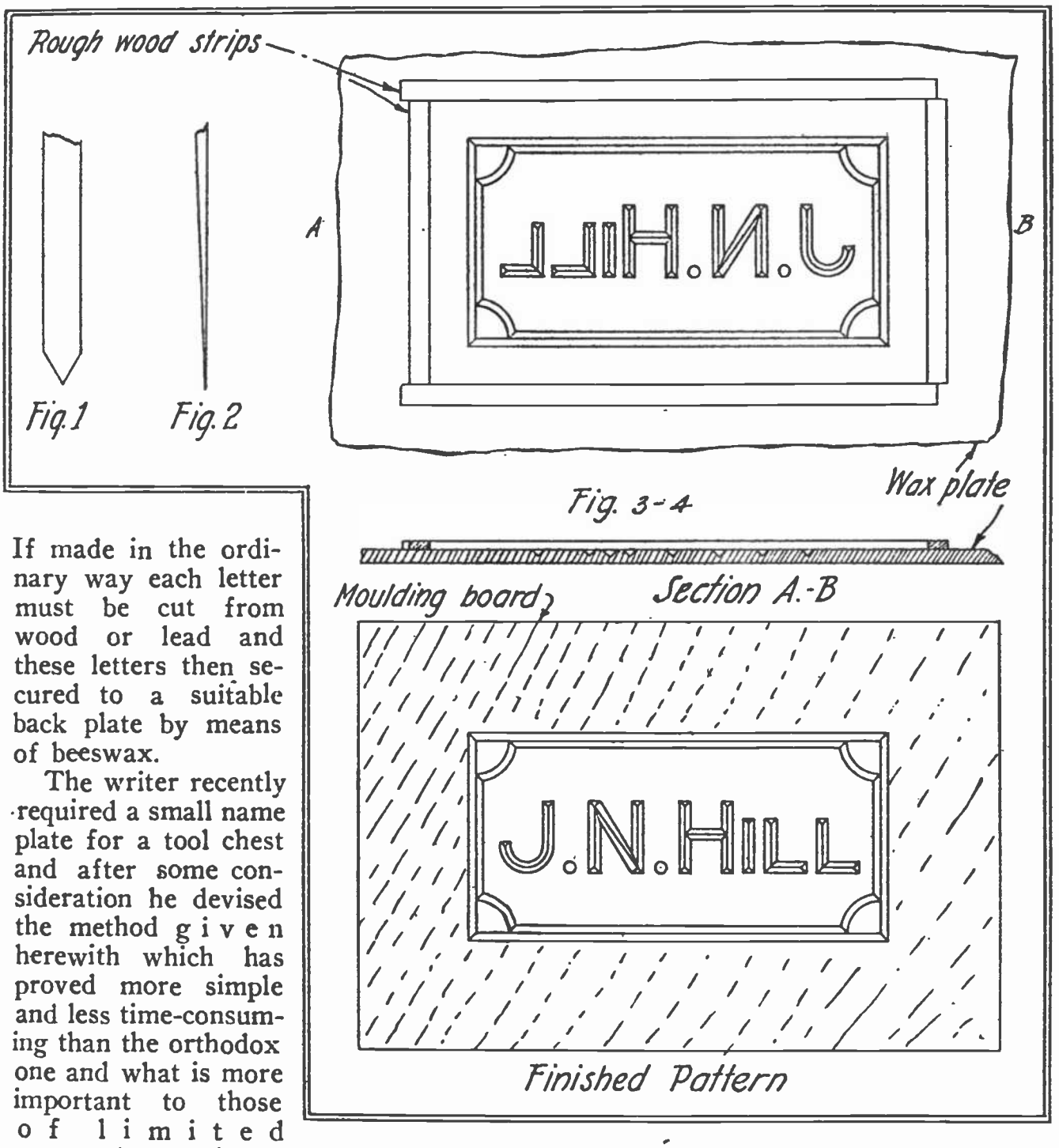
Warren C. Thomas.

MAKING PATTERNS FOR SMALL NAME PLATES

By J. Nelson Hill

Perhaps one of the most difficult jobs for an amateur patternmaker is a small name plate pattern with raised letters. If made in the ordinary way each letter must be cut from wood or lead and these letters then secured to a suitable back plate by means of beeswax.

The writer recently required a small name plate for a tool chest and after some consideration he devised the method given herewith which has proved more simple and less time-consuming than the orthodox one and what is more important to those of limited means it requires no special tools. A little thought will show the reader that if letters were cut backwards and deeply into a flat surface of wax and a plaster cast of this then made, the lettering will be raised and in the right direction. Care is of course needed and a few remarks as to details together with the illustrations appended will clearly explain the process. To make sure that the printing shall be uniform, the name plate is drawn full size on paper. This drawing is then traced through in order to reverse the lettering while held against a window pane. The ideal wax to use is that employed in casting talking machine records, but



this material is not always available and a good substitute will be found in beeswax. A thin plate of wax with a perfectly plane surface is prepared and the drawing of the name plate traced upon the surface. The lettering is cut into the wax with a special V-shaped tool made as shown in Figs. 1 and 2. The tool is held vertically when working and the user will find that it is quite a simple matter to carve out the reversed lettering cleanly and neatly.

Having finished the mold and decided upon the thickness of the required name plate, the worker should tack some strips of thin wood or cardboard around the recessed border but well away from it as illustrated in Figs. 3 and 4. The strips are oiled to prevent the plaster sticking, but oil must not be rubbed on the wax as it will tend to dissolve the latter. The pattern is cast from superfine plaster of paris which is mixed with water to the consistency of very thick paint. This mixture is then poured into the mould and the cast left to dry. This will take several hours and the worker must be very careful to leave the cast in position until the plaster is set quite hard, otherwise it will surely break when an attempt is made to remove it from the mould. If it does break, however, there is no cause for alarm as the pieces of the pattern may be stuck on a moulding board with thick shellac and then neatly varnished all over ready for the founder.

An Inexpensive Smoking Cabinet

This cabinet is made to hang in a corner of a room as the drawings indicate. The door is pivoted at the middle to swing quite around in either direction bringing the pipes, case and pouch holder to view so that they may be easily taken out when wanted. The pipe rack itself is a length of thick rubber stapled at intervals to separate the pipes. The pouch holder is a piece of wood screwed to the door on the angle. Brackets are put inside the cabinet both to strengthen it and to provide shelves for odds and ends.

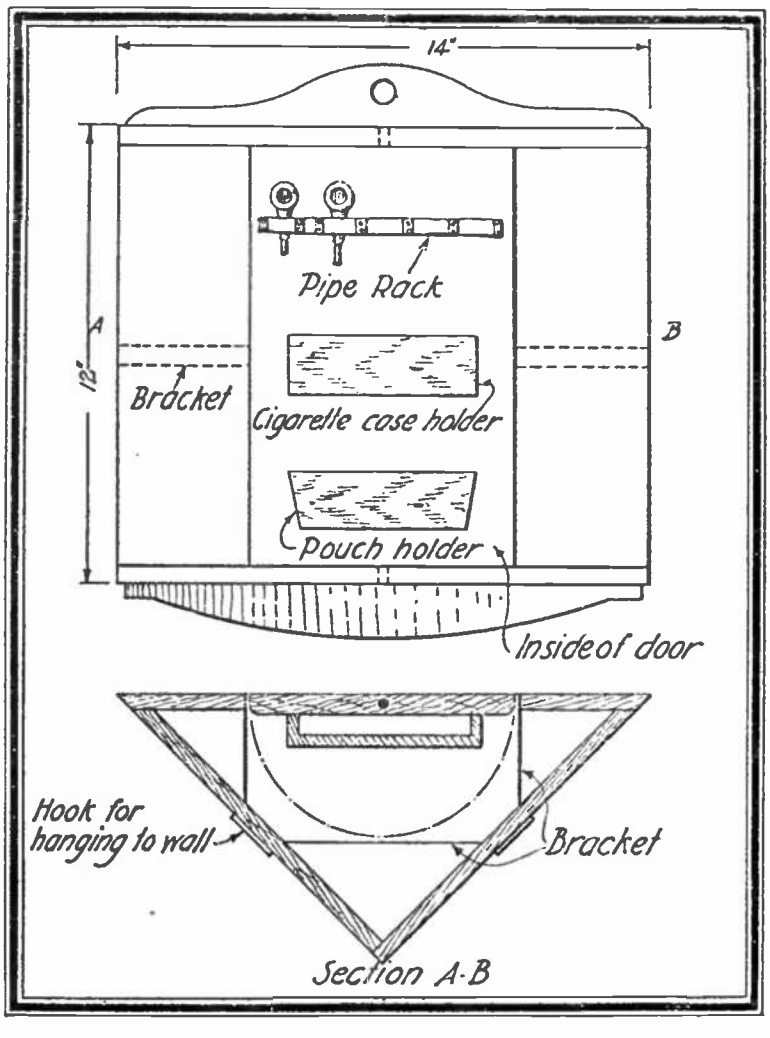
No special woodwork joints were employed in the construction, the complete cabinet being built up of white wood in a minimum of time. The severity of the plain panels and the door may be relieved by incorporating a fretwork design in some contrasting wood. The top shelf of the cabinet is used for the tobacco jar.

When the cabinet is suitably finished and rigged up in position, the maker will be able to sit within easy reach of his smoking tackle.

The cabinet may be stained to harmonize with the woodwork in the room.

Contributed by

J. N. Hill.



SOLDERING OUTFIT THAT IS ALWAYS READY

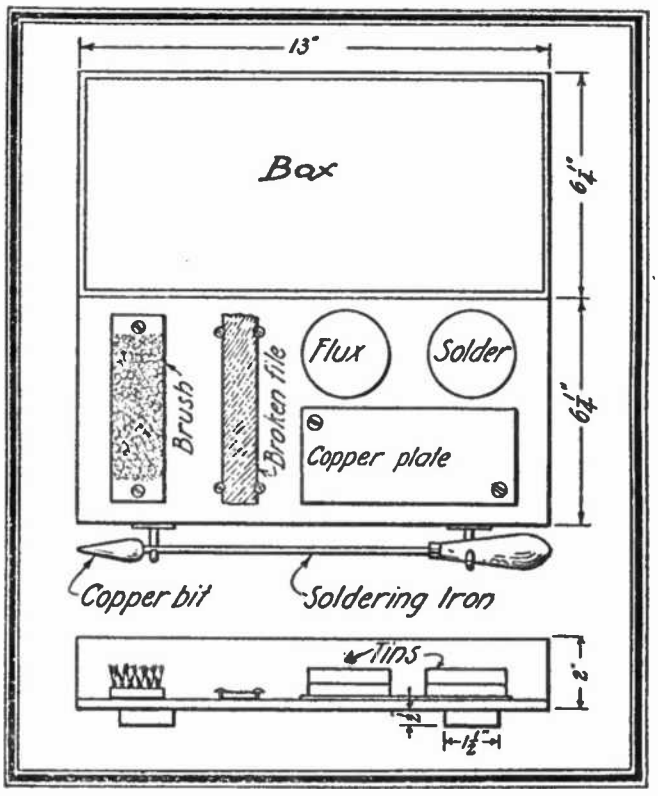
By Nelson Hill

Many readers may wonder why the above title has been chosen. The reason is not far to seek, for it is undoubtedly true that many of the failures which are met with when soldering are due to the fact that the necessary tools and materials are often scattered about, thereby confusing the worker when a cool head is essential. Considering that a knowledge of soldering is one of the chief assets of the model maker or handy man about the home, it is certainly worth the trouble of getting together an outfit that will insure a successful start.

The outfit shown in the sketches is easily assembled with the aid of a few tools and a little knowledge of wood working. It contains everything for soldering with the iron, which is the method usually employed. As the sketches are figured and lettered, a full description need not be given and a short explanation will suffice. The box shown at the top of the plan drawing is for oddments, *i. e.*, a piece of clean rag, files for cleaning up the work, etc. The outfit board on which the tools are fastened is the onetime lid of the box and these two parts are arranged as shown by screwing battens on the underside.

The brush for touching up the iron when heated and the file for the same purpose are both screwed to the board thus giving freedom for the hands to look after the job being done. The file is only to be used when the iron has been overheated and requires re-tinning. The box of flux and the box of solder are also screwed to the board. The piece of sheet copper is purposely fastened to the board in order that the worker may try the heat of the iron, for if the iron is sufficiently hot to run the solder on this it will be hot enough to solder brass or tin.

The two coat hooks to lay the iron on are screwed into the battens at the front. This completes the description of the outfit proper, but before ending a few tips on the use of the soldering utensils may not be out of place. When heating the iron do not get it to a red heat or re-tinning will be necessary. A point just below a dull red heat is the ideal state and it is best obtained in an ordinary fire or gas flame. Do not buy a very small iron, for it will not retain the heat. When soldering in awkward places the solder should be cut up in small pieces with shears, or scissors if no one is looking, and after fluxing the place to be soldered, putting several bits of solder in position ready for running with the heated iron.



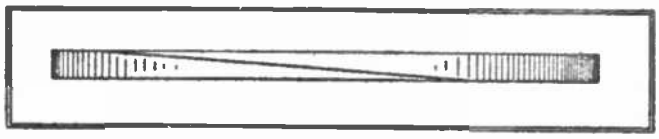
Cleanliness is the greatest point and the outfit described, in addition to having the merits before mentioned, will certainly aid in this. With such an outfit in his possession there is not the slightest excuse for the amateur if he fails to become proficient in the art of soldering.

Soldering Fluid

A good soldering fluid can be made by placing a few clippings of sheet zinc in muriatic acid; the zinc should be added in small quantities until the acid will not consume any more. When the boiling has ceased, the fluid is ready for use.

Leak-Proof Piston Ring

A common one-piece piston ring can be made very nearly leak proof by cut-



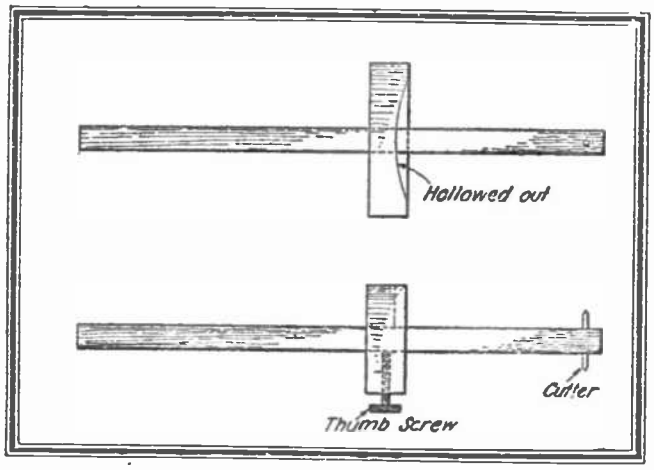
ting the joint as long and slim as possible as indicated in the sketch. The longer the cut, the narrower the crack after the cylinder wears a trifle.

Contributed by

W. F. SCHAPHORST.

Improved Marking Gauge

An ordinary woodworker's marking gauge can be improved to gauge lines around curved objects with the expendi-



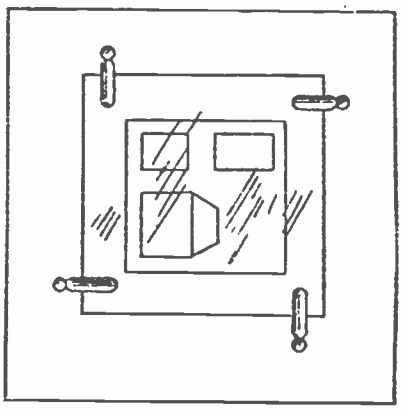
ture of a little time and trouble. The improvement consists simply in cutting a hollow out of the face of the head as shown in the drawing. The gauge may then be used for marking either straight or curved surfaces as desired by reversing the head on the rod.

Contributed by

J. NELSON HILL.

Printing Frame for Blueprints

A handy idea for use in an emergency when one has a large blue print to make from a negative or a tracing and when no regular printing frame is available is suggested in the illustration herewith. A plate of clean glass is backed up with a piece of the thin wood used on the backs of picture frames and the two held together by means of four clothespins. The negative or tracing and the blueprint paper are placed face to face and held in close contact between the glass and the wood. When it is desired to examine the print in order to determine when correct exposure has been given, one clothespin may be removed and a corner of the wood lifted up without fear of getting the paper and tracing out of register.



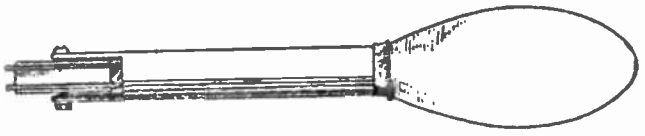
Contributed by

EDWARD F. HALLOCK.

PAINTER'S STRIPING WHEEL

This little device is used to paint a stripe on wagon bodies, autos, signs, machinery, etc. It is easily made and better and faster work can be done with it than with a brush. The device consists of a disc arranged to rotate in a slot cut in the end of a piece of brass tubing which has a rubber bulb attached to its other end. A quantity of paint is drawn through the tube into the bulb which is gently pressed to maintain a constant supply of color on the disc while the implement is in use.

The striping wheels or discs may be made with grooves of different widths to make stripes of all varieties. A



dotted line stripe may be obtained by cutting notches in the face of the wheel at regular intervals.

Contributed by

A. H. WAYCHOFF.

THE SPLIT LOG DRAG

By F. K. Haskell

The successful operation of a drag involves two principles: The first concerns the length and position of the hitch, while the second deals with the position of the driver on the drag. Each influences the other to a large extent and successful manipulation of the drag is dependent upon an understanding of both of them.

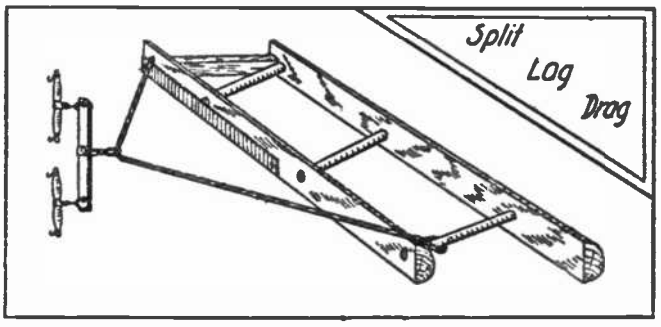
For ordinary purposes the snatch link, or clevis, should be fastened far enough toward the blade end of the chain to force the unloaded drag to follow the team at an angle of 45 degrees. This will cause the earth to move along the face of the drag smoothly and will give comparatively light draft to the team, provided the driver rides in the line of draft.

The distance from the drag at which the team is hitched affects the depth of the cutting. Shortening the chain tends to lift the front slab from the ground; a longer hitch causes the blade to cut more deeply. The length of the hitch may be regulated by lengthening and shortening the chain at the end which runs through the hole in the blade end of the drag. Usually two horses are enough to pull a drag over an ordinary earth road.

The object of the drag is to move earth toward the center of the roadway and to raise it gradually above the surrounding level. While this is being accomplished, all mudholes and ruts will be filled, into which traffic will press the fresh earth. The drag does the best work when the soil is moist, but not sticky.

In soils full of loose stones or even small boulders the drag does good service. The loose stones are drawn into a windrow down the center of the road, while the earth is deposited around the boulders in such a way that the surface is leveled.

The approximate cost of a split-log drag, labor and material is about $3; the



cost for dragging one mile, going over several times, team and driver, is just what you will make it from $1 up, depending on the number of times required to go over the rough road.

The advantages to be gained from the persistent use of a road drag may be summarized as follows:

The maintenance of a smooth, serviceable earth road free from ruts and mudholes. The obtaining of such a road surface with the expenditure of little money and labor in comparison with the money and labor required for other methods. The reduction of mud in wet weather and of dust in dry weather.

A WIRELESS DASHLIGHT

The small and familiar pocket searchlight has been utilized by a Massachusetts wireless enthusiast as a means of illuminating the dashboard instruments of his car. To the case of the searchlight he has fitted an attachment by which means it is held to the steering post, just below the steering wheel, thus making it very accessible to the driver. The lamp used has a locking device so that constant illumination may be had if the driver so desires.

This lamp is very useful and exceedingly inexpensive. It may be readily placed on any car that does not happen to be already fitted with an electric dashlight.

The Russian government has placed an embargo on all kinds of lumber, to prevent its exportation; walnut lumber, including Circassian walnut, much prized by American furniture makers, is specifically mentioned.

Where Shellac Originates

Dr. Leonard Keene Hirshberg,
A.B., M.A., M.D. (Johns Hopkins)

SEALING wax, furniture polish, varnish, lacquer, hot stiffening and "shellac" itself are all from shellac, one of civilization's first aids. Some fifteen thousand and more tons of shellac were imported into this country last year for use in the manufacture of talking-machine records, electric apparatus and many other things.

The shellac industry is one of the oldest known. It dates back beyond the oldest Sanskrit records and has been known for thousands of years. Yet this whole, great industry depends upon the life of an insect! Scientists in the employ of the British Indian Government have just published a monograph on this wonderful little creature and its behavior.

The scale-insect which makes shellac much as bees make honey, is a first cousin of those pests of every farmer, to wit, plant lice, the San Jose scale and other bugs, parasitic to vegetation. It is called the *Tacehordia lacca*, this shellac insect. It makes its abode upon all sorts of trees in India. The Banyan and Mango trees do not escape them. Each *Tacehardia lacca* is really a miniature siphon and great numbers of the insects dwell together in harmony. At the mouth of every one of them is a tiny lancet with which they pierce the tree. Through the opening thus made each insect leads a vegetarian life and sucks sustenance. Thus it draws sap from the tree which passes through its little body and after being modified is finally changed into the shellac which we know, which is excreted at the back. This "lac" accumulates and gradually builds itself up around the insect into a small, dome-shaped excrescence.

Owing to the legion of these insects, they have a tendency to melt and fuse together. Thus, a beautiful incrustation of shellac is formed upon the branches of the trees.

About the beginning of July, tiny red larvæ can be seen to swarm out of these incrustations in countless numbers. These spread hither and thither over the neighboring twigs. Each little larvæ is oblong in shape, with two minute eyes, two short feelers and six short legs.

Curious tufts of white, powdery hairs, which are actually the "lungs" of the insect, grow from its chest. For two or three weeks this "swarming" continues just as with bees. Each one sets about "setting up a claim," as it were, in order to start in business for itself to establish a "siphon" to make shellac on its own account. It must do this within twelve hours or its fate is sealed. During this time, it takes no nourishment. The greater number of them are, of course, doomed. Enough, however, are "lucky" and find an abiding place somewhere upon a twig.

At once the successful insect settles down to the business of eating and forming shellac. The female insects produce a larger incrustation than the males. At the end of two and a half months the male creeps out backwards from under the edge of its scales. It is now seen to have four eyes instead of two.

As soon as the males mate with females whom they soon find, they die, for their life work has been fulfilled. Two and a half months later the females stop work. They then lie quiet for another month and allow the thousand new-born young to leave their bodies. They, then, die also.

There are thus two generations every year. Were it not for their enemies, such as birds, cold, frost, caterpillars, siroccos, and the like, India would be overrun with these insects.

The shellac is collected to-day as it was, perhaps, ten thousand and more years ago. The natives simply break off the encrusted branches and sell them to jobbers as "stick-lac."

THE HOME CRAFTSMAN

Describing the Construction of a Simple Morris Chair, With an Explanation of the Mortise and Tenon Joint

By Ralph F. Windoes

Illustrations from drawings made by the author.

IN the greater number of furniture projects, the mortise and tenon joint is used almost exclusively. Its construction is rather difficult for the beginner, yet its holding power is great, giving it an advantage over other joints for this class of work. The simple design for a Morris chair that has been selected in order to explain this joint will, no doubt, appeal strongly to the home craftsman. In the retail furniture stores this chair sells for $21.00, while the home craftsman will be able to make his own for not over $15.00, depending, of course, upon the grade of leather that he purchases in the cushions.

The lumber needed should be purchased as follows, planed and sandpapered to exact dimension at the mill:

Legs, 4 pcs. 1¾"x1¾"x23⅝", plain oak.
Rails, 2 pcs. ⅞"x5"x21", quarter-sawed oak.
Rails, 2 pcs. ⅞"x5"x22½", quarter-sawed oak.
Arms, 2 pcs. ⅞"x4¼"x33½", quarter-sawed oak.
Back rod, 1 pc. 1 3/16"x1½"x21¾", plain oak.
Seat supports, 2 pcs. ⅞"x2"x19", plain oak.
Seat slats, 7 pcs. ½"x2"x22", plain oak.
Back verticals, 2 pcs. ⅞"x2½"x26", plain oak.
Back slats, 2 pcs. ⅞"x2½"x22", plain oak.
Back horizontals, 2 pcs. ⅞"x2¾"x16½", plain oak.

Begin the construction of the chair by cutting the tenons on the rails. Select the best piece ⅞" x 5" x 21" for the front rail. By *best* is meant the piece with the fewest imperfections as to grain and markings. Measure it very carefully and if it is over-dimension, cut it down to size. Consulting Fig. 1, it will be found that at *A* there is a piece represented in top, side and end view. Notice the "face marks"—checks on the "working face" and the "working edge." It is from these checked faces that the joints will be laid out, and in so doing remember this: *do not hold the head of the try-square or run the head of the marking gauge against a face that is not checked.* If one does, the chances for accuracy are greatly lessened. At *B* in the same illustration, one will find knife and gauge lines represented. Beginning on the left end of the board, measure in 1" and square around the piece, remembering the above rule. Actually *cut* in the wood to a depth of about 1/16" with the knife, as this will give the chisel a start when

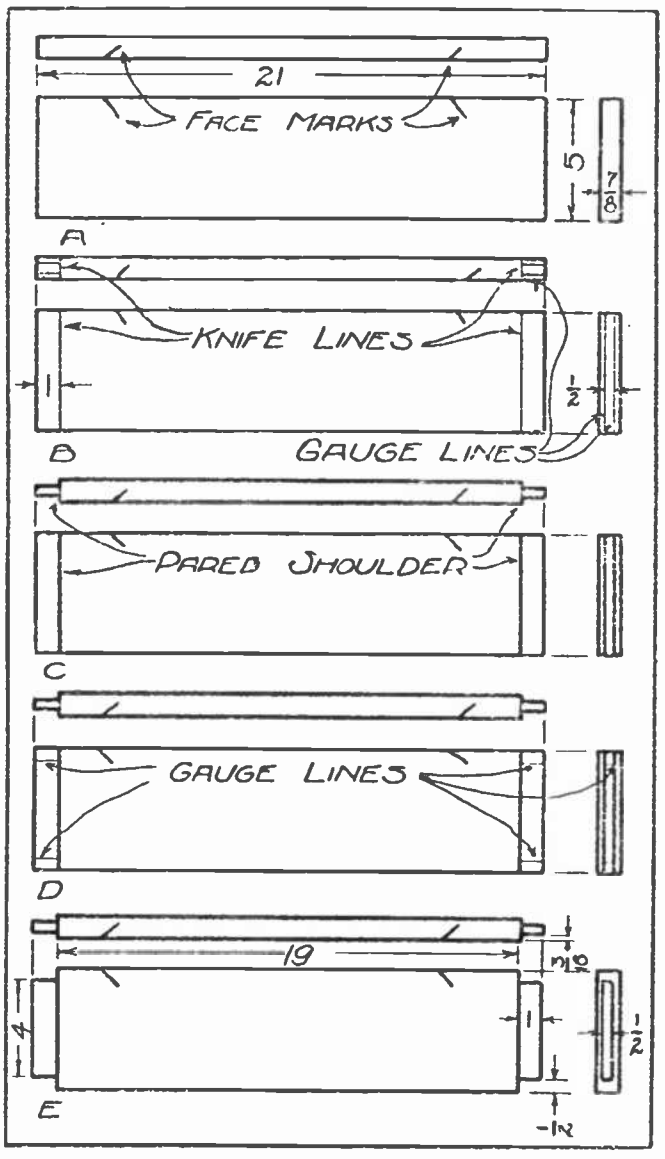


Fig. 1.—Methods of Cutting the Tenons on Chair Rails.

the shoulder is pared down. Next measure over from this knife line 19", and square another knife line around the piece. Be sure to measure over from the first line — not in from the other end, as exactly 19" is required between shoulders. Set the marking gauge — with the rule rather than by the scale on the gauge — for 3/16", and gauge over the ends and on the top and bottom edges to the knife lines—*running the head of the gauge against the checked working face.* Next move the gauge head over to 11/16" and gauge a parallel set of lines, as the drawing shows.

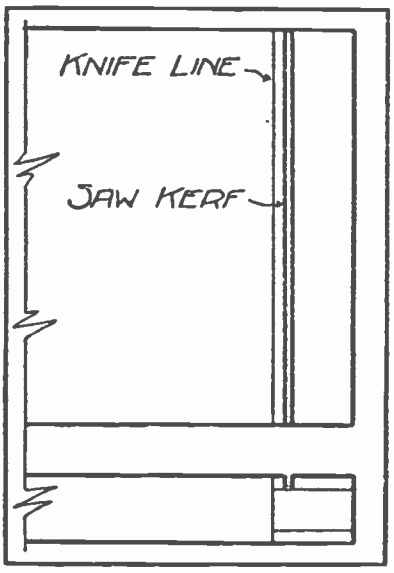


Fig. 2.—Method of Sawing Shoulder on Chair Rails.

In Fig. 2 is shown the method used in sawing this shoulder. Run the saw about 1/16" from the knife lines, cutting in the waste wood, down to the gauge lines. Watch the saw on both edges of the piece and saw straight across, using the back saw for this work. With a sharp chisel, cut out the waste wood down to the gauge lines, being careful to keep the cheeks of the tenon exactly parallel to the faces of the wood. You are now ready to chisel down the shoulders to the knife lines.

Consulting Fig. 3, an easy method is disclosed for doing this. Secure a small block of wood with two edges at right angles, and clamp it tightly on the piece at the knife line—one side of the right angle resting on the face of the board and the other running straight up from the knife line. Fasten this securely in the vise or to the bench top. With a 1" chisel, holding its back tightly against the block as the drawing illustrates, pare the shoulder down. This method will make a perfectly square, sharp shoulder —so essential to the proper fitting of a joint. But notice this, the back of the chisel must be perfectly straight. If it has any bevel at all, it will tend to run out at the bottom of the cut, preventing the joint from pulling up tight in its mortise. After chiseling on both ends in this manner, the piece should assume the appearance of *C*, in Fig. 1. At *D*, we find more gauge lines added; this time to the cheeks of the tenons and on their ends. These lines are gauged ½" from the edges of the wood, making the finished tenon 4" wide. Chisel on these lines, very carefully, and the result should appear as at *E*.

In this manner *all tenons* for the chair are cut, no matter what their size may be, or where they are located. It is the method by which the best work is accomplished, and the amateur craftsman should learn no other.

Returning to the large working drawing, notice that the back rail, on "The Main Frame of the Chair" will be exactly the same size as the one just described, and that the two side rails will have the same sized tenons, but the distance between their shoulders will be 20½" instead of 19".

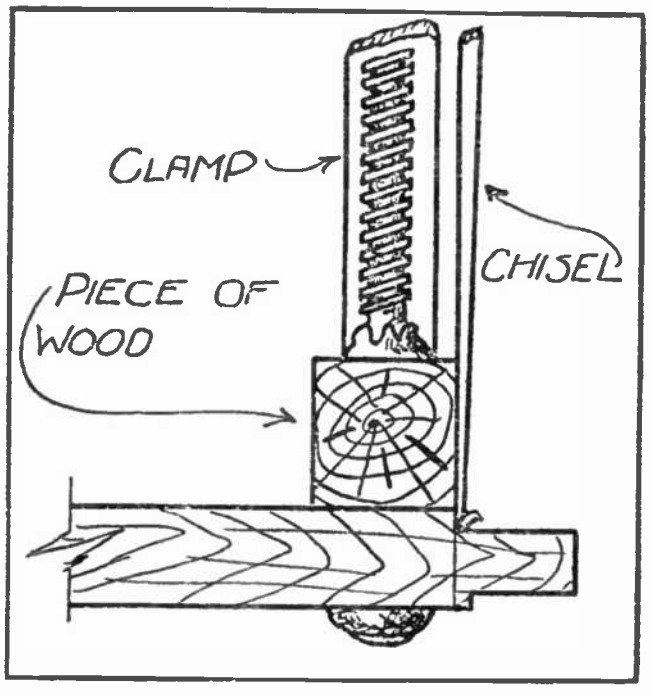
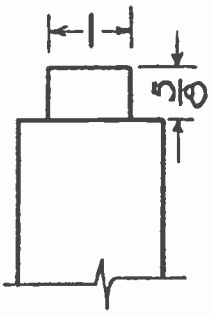


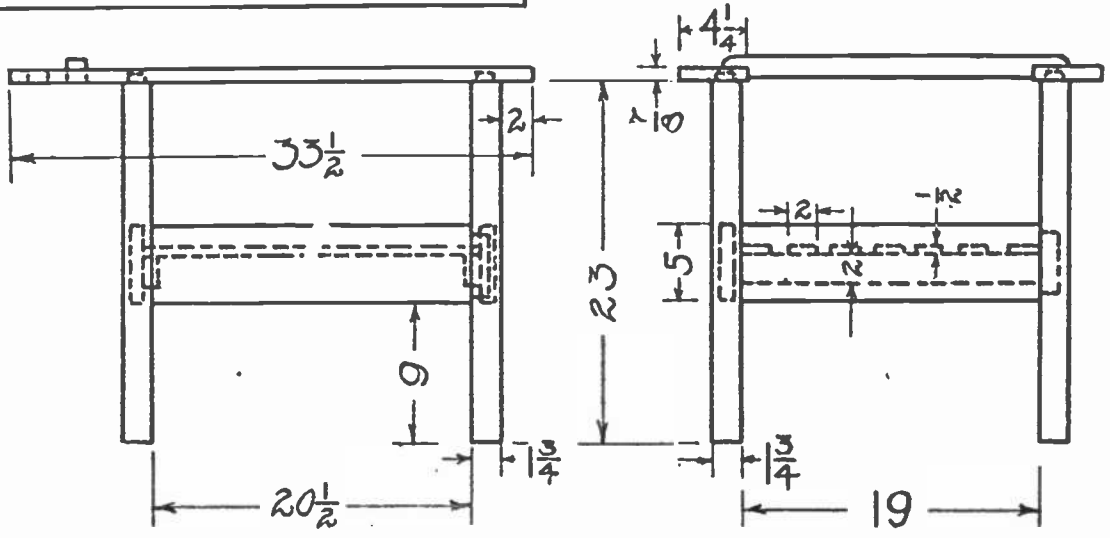
Fig 3.—Suggestion for Chiseling Sharp Corner on Shoulder.

When all of these tenons have been cut, lay out the short tenons on the up-

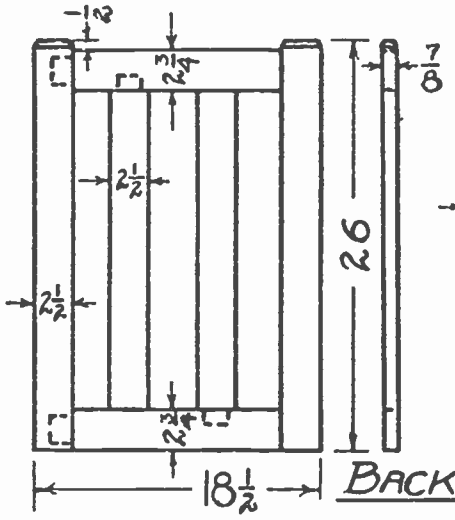
MORRIS CHAIR.



DETAIL OF UPPER END OF LEGS

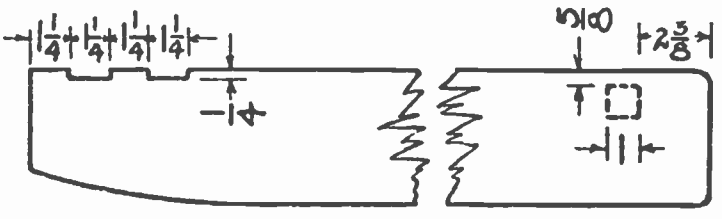


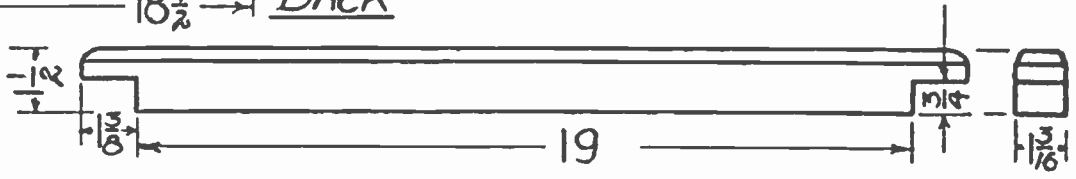
MAIN FRAME OF CHAIR



BACK

DETAIL OF ARMS





DETAIL OF BACK ROD

per ends of the legs. Notice the detail on the drawing. To do this, be very sure that you measure up 23" from the bottom ends of the legs, rather than 5/8" down from the top. Cut these tenons as you did the others.

Next turn to the "Back" in the working drawing. Notice that the horizontals are tenoned into the vertical sides, and the vertical slats into the horizontals. Be very sure that you understand the drawing, as small details have been omitted for the sake of clearness. For instance, the tenons, dotted lines, are only illustrated in the left vertical, but we know that the same construction holds true for the right, as both sides are alike. On the horizontal slats, only one tenon is illustrated on each slat, but, understanding as we do the construction of such a piece, this omission is not confusing. The same holds true in the main frame of the chair. Notice in the front elevation that the tenon on the front rail is illustrated on the right end only, the same space on the other end being used to show the end view of the side rail. On the side elevation, in the same drawing, the right tenon of the side rail has been drawn in, as well as the end of the front rail and the strip that holds the seat slats, the result being quite confusing. On the left end of same, the tenon has been omitted, resulting in a clearer understanding. Hence, in our furniture drawings, we will omit invisible edges where the construction will be made clearer by so doing, but, because one tenon only is shown, it does not mean that the other end of the same piece has none. If one tenon should be missing, we will make a note of it in the descriptive matter.

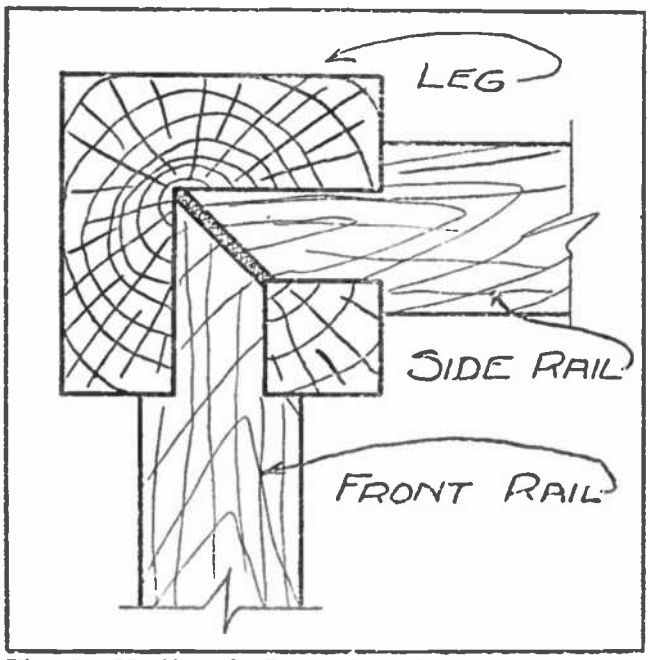


Fig. 4.—Mortises in Legs of Chair to Hold Tenons.

Next, turn to the mortises into which the tenons will fit. Consulting Fig. 4, which is a cross section through one of the legs at the point where the tenons enter the mortises, we find that the latter run straight through into each other, and the ends of the tenons are cut off at an angle so that the rails can be brought tight up against the legs.

In Fig. 5 is depicted the layout for the mortises. Notice that the working corner is the inside corner, and that a mortise is cut into each working face. The reason for doing this is apparent; since it is desired to have the rails at right angles to each other when they are assembled, we are more sure of it if we use these faces, as they *must* form a right angle to begin with. The two opposite faces seldom form one from their construction.

Lay the mortises out from the drawing, the bottom knife line being 9½" from the bottom of the legs, and the top one 4" up from that. The lines are gauged 5/8" and 1⅛" respectively from the working corner on both faces. Be sure that you do not run the gauge or the knife lines out from the corners where they cross over 3/16", as the shoulders of the rails will not cover them if you do.

With a 7/16" bit, bore a series of holes between the lines the depth of the mortises, and chisel the cheeks at right angles to the faces. Fit each tenon into its respective mortise as the work progresses, and mark both tenon and mortise with a corresponding number when they close up tight. After these leg mortises have all been cut, fit the frame of the chair together, and clamp it up, without using any glue, in order to see that it is square and firm. If you find it so, glue it together and clamp it tightly, being very sure that the corners are square

Next, notice the detail of the arms and work them to shape very accurately. The left arm, as you would face the chair from the front, is the one detailed, and the right is exactly like it but reversed. Do not cut the 1¼" slots for the back rod to fit into until the arms have been attached. Cut the mortises for the front leg tenons and fit the arms in their places before laying out the back mortises. These, being rather shallow, will need to be chiseled out entirely without boring any holes first, as you will then run no risk of the worm of the bit protruding in the face of the arm. When carefully fitted, glue and clamp the arms into place, pinning the tenons from the inside of the arms with ¼" dowels.

Next, cut the mortises for the chair back and glue these pieces up. The back can be fastened to the main frame with Morris chair hinges, which can be obtained in most hardware stores. They are attached to the top edge of the back rail and the bottom ends of the vertical members of the back, using flat head screws.

With the back rod made as detailed, place it into position against the back and mark the slots. Cut these with a sharp saw and chisel, so that the back will swing against the rod evenly and not touch it in one place only.

Screw the seat supports into place on the front and back rails, and nail the seat slats onto them. This completes the construction. Before finishing, see to it that every visible particle of glue has been scraped off and every rough or dirty spot removed. Then give the entire chair a good sandpapering with No. o sand-paper, and dust thoroughly. Stain, fill, shellac, and wax — processes that have been stated so often in this series that they need no repetition here.

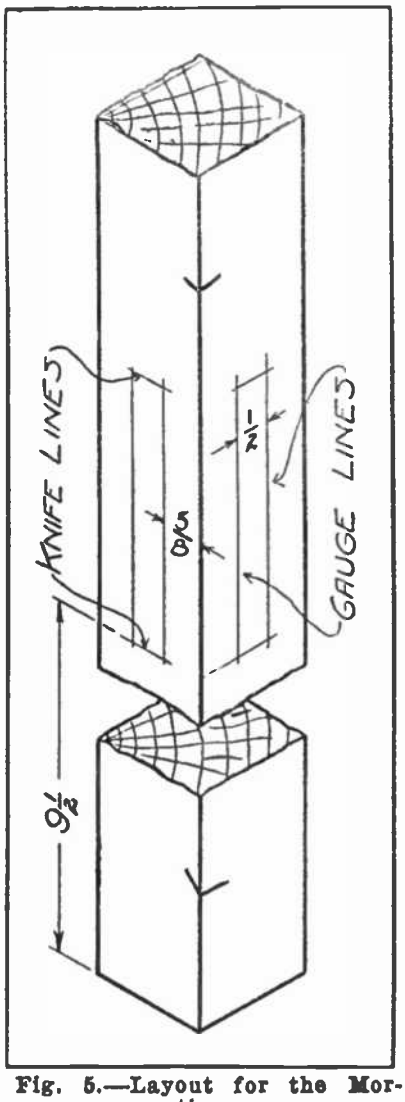


Fig. 5.—Layout for the Mortises.

Cushions, such as the ones illustrated, can be purchased in colors to match the finish of the wood.

It is said that a good flexible cement for rubber or leather can be made by mixing a small quantity of castor oil with thick shellac varnish. The oil prevents the cement from becoming brittle when dry.

IMITATING PRECIOUS STONES

Those engaged in the imitation of precious gems very often copy Nature with conspicuous success.

Zircons are composed of silica and zirconia. Their luster is deceptive, a means having been discovered of extracting the color, thus leaving them diamonds to all appearances, although their falseness promptly proclaims itself under test.

Precious stones are often dyed with such thoroughness that, it is claimed, the stone may be broken without discovery of the process, that is to say, by the uninitiated.

There is a town in Germany, Oberstein, the sole industry of which is the manufacture of imitation jewelry and the dyeing of chalcedony and other stones. The onyx, carnelian, bloodstone and agate may be enriched in color by immersion in the dye-pot. The stones are placed in vessels containing the coloring matter and are then subjected to great heat for periods varying from a few hours to a week or more. In the case of chalcedony, which shows bands

of different degrees of intensity, certain of the bands take the color and others do not. The stones then receive a further stewing in pots containing other dyes.

Fluorspar is capable of great improvement in tint when subjected to a heating process and crucidolite is given a hue of blood-red by a similar method.

The emerald and the cat's-eye are of all stones the most easily imitated. One family at Oberstein is said to possess the secret of converting crucidolite into cat's-eye. Cat's-eye may also be made of aragonite, some of the hornblendes, and even of fibrous gypsum.

CURIOUS PHOTOGRAPHY

Curious results are obtained when certain objects are photographed under different lights. For example, plates of a landscape obtained by infra-red light give the sky a jet black and trees and grass as white as snow. Ultra-violet light photographs or pictures obtained through a quartz lens heavily silvered on one side show white garden flowers as quite black.

If the moon's whiteness were due to the presence of zinc oxide, then the localities in which this substance was present when photographed by ultra-violet rays would not appear white, but black. This plan has been tried in the case of lunar photographs, and in the neighborhood of the crater Aristarchus it is clearly shown that there is a considerable area whereof the surface material differs from that in its proximity

In ordinary light this shows no variation from the rest of the surface, but repeated photographs taken with the quartz lens and silver lens prove that some unsuspected substance exists on that spot. The difficulty is to determine its nature. The only way at present, it seems, consists in photographing different rocks until one is found that presents the same characteristics as those of this district of the moon. There have been unavailingly tried lavas, volcanic débris. and minerals of many kinds.

THERMOMETERS TO MEASURE HEIGHT

The measurement of heat is by no means the sole function of the thermometer, since this instrument is also employed in the determination of the height of mountains.

The reason for this employment is to be sought in the pressure of the atmosphere on the surface of water. The greater that pressure the greater the temperature needed to boil the water. As we ascend there is less and less pressure, and water will boil at a lower temperature than 100 degrees Centigrade or 212 degrees Fahrenheit. For every one thousand feet of ascent water will boil at one degree Centigrade lower.

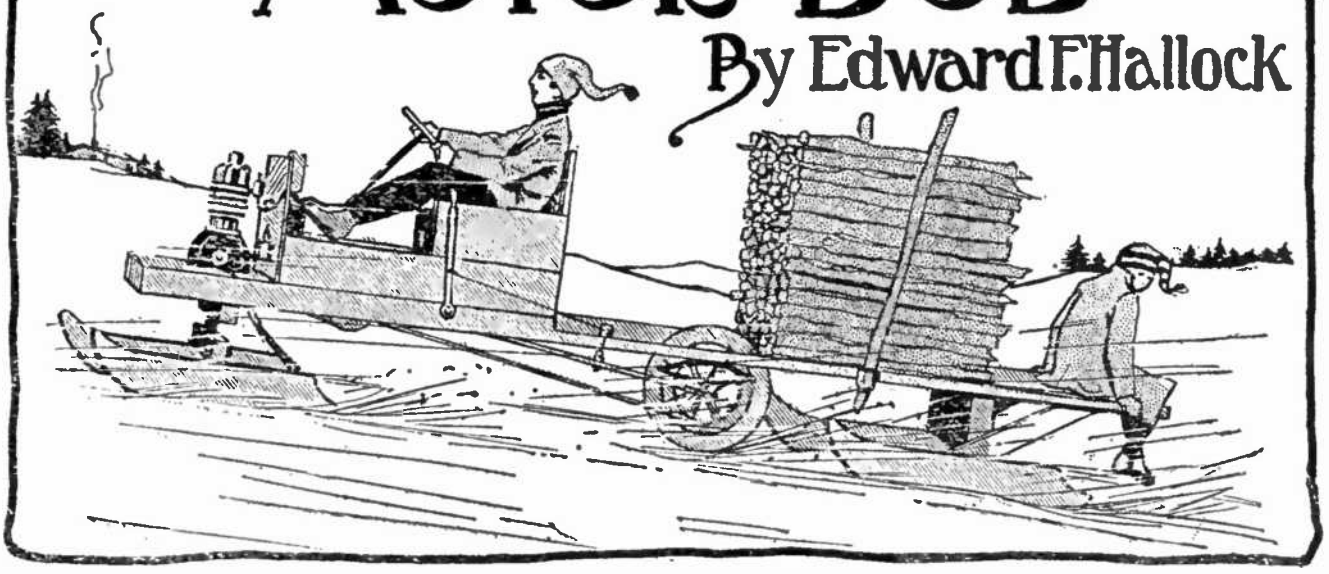
No ordinary thermometer, however, may be used in scientific work of this nature. Extremely delicate instruments must be employed. They must be quite lengthy, so that the scales may be divided into fractions of a degree. The apparatus for work of this sort is called a thermo-barometer or hypsometer. There is a small metallic vessel for boiling water, and on the inside of this vessel are placed these delicate thermometers. The claim is made that their accuracy is such that the height of a mountain may be determined within ten feet. It would seem, however, that this claim is not entirely justified, since the pressure of air does not decrease uniformly as the ascent is made. Despite this fact, the thermometer is a valuable aid to the surveyor.

MEETING OF COMMITTEE TO FORMULATE NATIONAL ELECTRICAL CODE

It is announced that the biennial meeting of the Electrical Committee of the National Fire Protection Association will be held during March, 1915, in New York City. The exact place of meeting will be announced later. As has been customary in the past, the provisions of the National Electrical Code as they now exist will be considered, together with the reports of all sub-committees, followed by such revisions and additions as may be found necessary.

SLEIGHING UP-HILL IN A MOTOR BOB

By Edward F. Hallock



If you have a motorcycle or a motorcycle engine at hand you will find enjoyable use for it during the Winter months by constructing a motor bobsled. But even if you have no engine and must purchase one, you will be amply repaid by the fun and usefulness derived from the motor sled. The construction of the motor bob may be altered, while such accessories as brakes, lamps, comfortable bodies, etc., may be added, at the desires of the builder. In an early issue of MODERN MECHANICS there will be described a cyclecar employing the same motor and transmission, so that the investment may be worked to the utmost during every season of the year.—THE EDITOR.

NOT all of us, unfortunately, reside in those portions of the country where the flowers blossom the year round and where snow never falls. For such of us as do make our homes under these ideal conditions, the open season for motorcycles or cyclecars, as the case may be, extends from one end of the year to the other, barring a few wet days which only serve to make the dry ones more enjoyable.

For the great majority of those who make use of the light motor vehicles either of the two or four-wheeled type, the first touch of frost, heralding the coming of cold weather, hastens our efforts to find a suitable place and put our machines in "dead" storage for the winter. But as we take our bobsled from the barn or the cellar or other convenient place in order to make room for the motor vehicle that is to lay inactive during the winter months, one cannot help but feel that the enjoyment to be gotten from coasting down the long inclines and icy slopes on the steel-shod bob would be ever so much keener were it accompanied with the knowledge that the vehicle was also capable of transporting its load back up the hill again. And the thought of the power plant of the motor vehicle lying *passé,* so to speak, during the months to come leads a few of the more progressive and ingenious to attempt to devise a plan whereby the motor can be made to propel the sled with the same vim that it exerts when on the wheeled vehicle. And here's one solution of the problem, and withal a simple one that can be worked out by

anyone with few tools and little trouble.

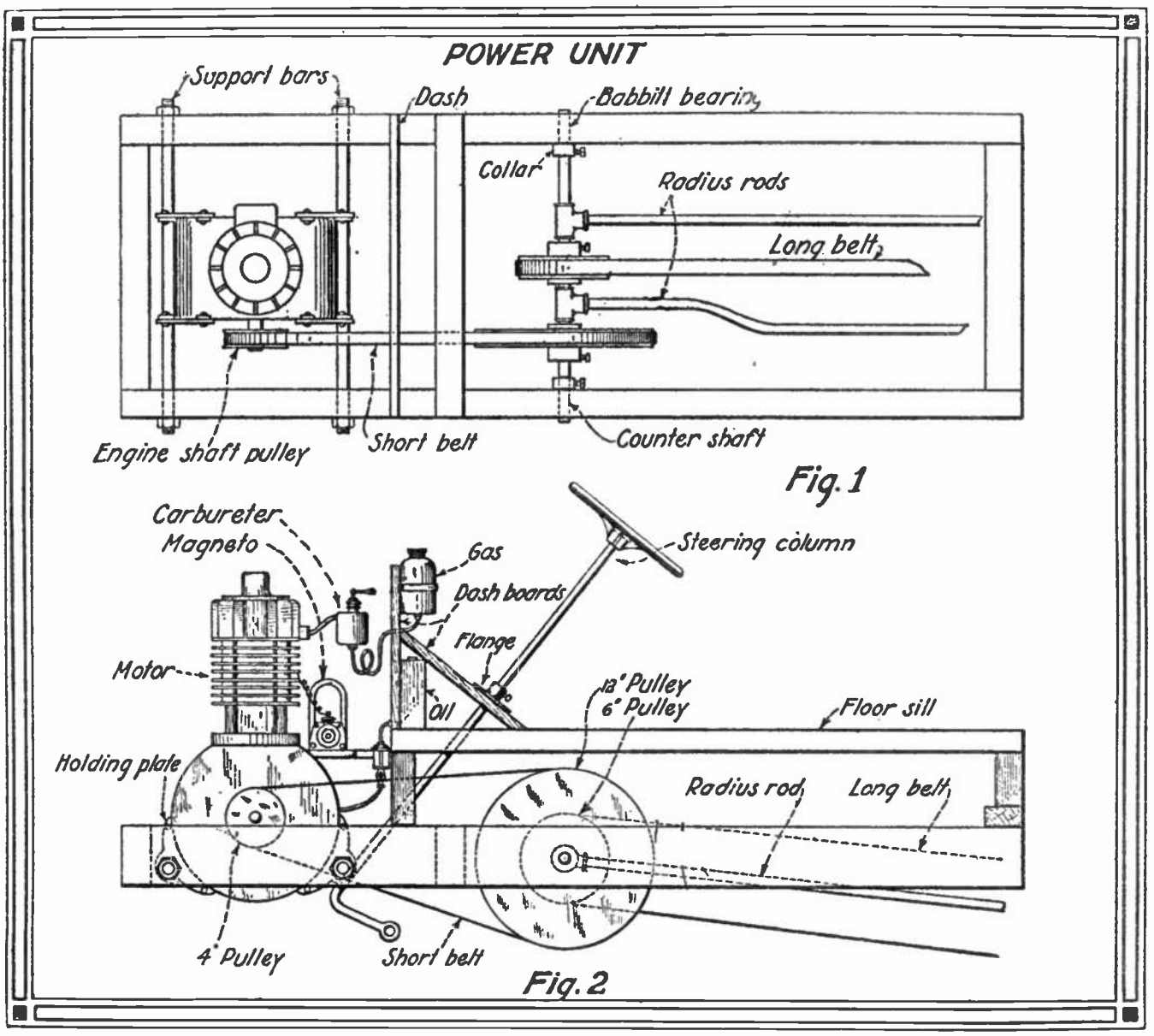
With the details of the construction of the sled itself, we will not greatly concern ourselves. Suffice it to state that, save for a framework of 2 by 4-inch timbers which offers a firm support not only for the flooring holding the passengers, but also for the power plant and transmission system, it is orthodox in every way. By way of adapting the power plant so that it can be removed from the sled and used in connection with a cyclecar during the summer months, it has been designed so that it is, with its countershaft, a unit that may be separated from the remainder of the vehicle simply by undoing a couple of lag screws which serve for the attachment of the motor-supporting frame to the framework of the bobsled.

The arrangement of the motor and the countershaft which serves as a gear ratio reducing element, is best made clear by reference to Fig. 1, which is a plan of the power unit with the accessory devices such as the tanks, steering column and floor boards removed to expose the more vital elements to view. The supporting frame is made of a couple of stringers of 2 by 4 spruce or pine five feet in length, spaced 20 inches overall apart by means of cross pieces of the same material. The four-inch faces of the string pieces are made the vertical sides so that the greatest strength is obtained. One of the cross members is placed across the front, directly between the two pieces, while another is distanced two feet on centers behind the front member. Six-inch cut nails are used to secure the joints. The rear cross member is not interposed between the two side members of the frame, but is laid across the top, as is clearly indicated in the diagrams, and nailed down in place so as to provide greater clearance for the main driving belt.

The motor, it will be seen, is held firmly in place in the space between the front two cross members, being attached by means of anchor plates to a pair of supporting bars. These bars are formed of suitable lengths of ¾ inch pipe made a tight fit in holes drilled through the two string pieces. They are locked firmly in place at either end and insured against movement by pins which are driven through suitable holes drilled through the pipes. These bars, it will be noted, also serve to make the motor framework more rigid. The distance between the bars, will, of course, depend upon the overall dimensions of the crankcase of the motor that is used. Before the dimensions can be determined with any degree of accuracy, it will be necessary to have the anchor plates, which serve to attach the motor to the bars, made by a blacksmith. These plates are made of ¼ inch boiler plate, suitably shaped so that holes can be punched to take at least two of the bolts that pass through the crankcase as well as a suitable hole for the passage of the supporting bar. When the anchor plates are ready, bolt them in place on the base chamber and measure the distance between centers of the bar holes on the respective plates on either side of the motor. This distance is the space that should be allowed for between the holes drilled for the supporting bars in either of the string pieces, and obviously, the holes in the respective frame members should be equally spaced from the front of the frame else the motor will not line up correctly in the frame.

Before finally setting the motor in the frame, the overall width of the motor between the outside faces of the face plates should be obtained and this measurement subtracted from the distance between the inside faces of the string pieces or side members of the frame, which obviously will be about 16 inches. The remainder after the subtraction should be divided by two and four lengths equal to this dimension of one inch or 1¼-inch pipe cut to slip over the bars between the anchor plates and the side frames so as to space the motor correctly in the center of the framework and ensure its staying there. These retaining collars should be put on when the motor is being placed in the frame the last time, and obviously if they are a little tight fit between the members that fact will prove rather beneficial than otherwise for it will result in a more firmly mounted motor.

The countershaft is placed directly behind the center cross member of the frame, sufficient clearance being allowed, of course, between the cross member and the larger pulley to defeat all chance of the pulley rubbing against the cross piece. As for the pulley dimensions they, of course, will depend upon size of the motor, or more truthfully upon the power which it is capable of delivering. In the sketches a single-cylinder motorcycle motor is indicated and the pulley diam-



cters are based upon the assumption that the motor is capable of developing between four and five horsepower, which is the average performance of motors of this type. The belt pulley on the engine crankshaft is four inches in diameter and it drives to a pulley 12 inches in diameter; the ratio is obviously 3 to 1. However, the smaller pulley on the countershaft is but 6 inches in diameter while the belt rim on the motorcycle rear wheel which is used as a propelling wheel and to which it is belted scales at 20 inches. Therefore, the ratio of this secondary drive system is 3⅓ to 1 and the ratio of the complete drive system 3 times 3⅓ or 10 to 1. It will be found that with a motor of this size, the ratio indicated will give about the best all around results, permitting the heavily laden vehicle to be started without undue tendency for the motor to stall, and adapting it to climb some surprisingly steep hills or push its way through deep snow without overworking the little power plant. At the same time, when the character of the surface which is being negotiated permits, a speed of from

15 to 20 miles an hour can readily be attained and maintained.

With a twin-cylinder motor developing from seven to ten horsepower, it is readily apparent that the gear reduction need not be so great, for the greater power and more uniform torque of the double-cylinder power plant makes starting and hill climbing easier. In this case higher gearing will permit of greater speed being attained on the level without risk of speeding the motor past its critical point and thereby harming the mechanism. In this case the use of a ten-inch large pulley and an eight-inch small pulley on the countershaft is to be recommended as producing the best ratio for all around service.

The countershaft itself is a piece of cold rolled steel shafting ¾ inch in diameter. It is just a trifle over 20 inches in length so that when it is journaled in the side members of the frame, it protrudes just a bit over the sides. It is mounted on babbitt bearings which are cast into the side members. The method of forming the babbitt bearings is shown by one of the smaller illustrations. After the size of the larger pulley has been determined as outlined above, a distance which will give the pulley ample clearance with regard to the center cross member of the frame is determined behind this cross member as the location of the countershaft and holes 1½ inches in diameter are drilled at this point through the side members. Care should be taken in drilling these holes, not only to distance them correctly from the cross member and between the top and bottom of the frame members, but also to drill them perfectly true with regard to faces of the beams. It will be seen that the diameter is a full inch greater than the diameter of the shaft providing for a bearing ½ inch thick all around the shaft. Directly over the center of these holes and leading into them, vertical holes ½ inch in diameter are drilled, providing the channels through which the molten babbitt is poured in the making of the bearings and afterwards, when the bearing has been formed, the metal core which not only forestalls the bearing rotating in its socket or working out of place, but the medium through which the oil hole for the lubricant is drilled.

When the holes have been finished to the satisfaction of the operator, preparation is made for pouring the metal into them. Four cardboard dams are made, properly provided with holes through which the shaft slips snugly, and these are positioned on each side of the respective string pieces and tacked firmly in place with carpet tacks. Care should be exercised in positioning the cardboard retaining pieces, of course, to see that the holes for the reception of the shaft are exactly concentric with the holes in the string pieces so that the shaft is exactly true with relation to the framework. A layer of tissue paper then is pasted over the ends of the shaft where it passes through the string pieces in order to provide the necessary clearance for free running after the babbitt has been poured. The shaft is placed in position once again, and to eliminate all chance of the metal escaping through slight fissures around the shaft, the portions of the shaft adjacent the cardboard dams should be wound with asbestos cord. The babbitt, of good quality, should be heated to a point where it will just char a piece of wrapping paper which is dipped in it and held for a minute or two. If it is colder than this it will not run freely, while greater temperature results in brittleness in the cast. The dross should be caused to rise before the metal is poured by stirring in a bit of paraffine, after which the top is skimmed with an iron spoon. The metal should be poured through the vertical hole in the string pieces until the hole is entirely filled. When the metal has cooled down, the shaft can easily be driven out and removal of the cardboard and all traces of the tissue paper will reveal perfect journals. A drill then is passed down through the cores of metal clogging the pouring holes and serves to make perfect oil holes for the lubrication of the bearings.

A wick of twisted cord inserted in the oil hole will tend to hold the fluid and keep it from spilling and it will also serve to prevent dirt and grit from entering.

A couple of ordinary hexagonal nuts of proper bore for the reception of the shaft, and provided with steel set screws for attachment to it, serve to retain the shaft in proper position and are placed at either end just inside the string pieces and bearing against the babbitt journals. The pulleys are quite as simply made as the rest of the device. They are of 2¼-inch face made to take a 2-inch flat leather belt such as is ordinarily used for the transmission of power on belt drive motorcycles. They are built up of three pieces of ¾-inch plank sawn to correct diameter and screwed together cross grained to eliminate all chance of splitting or warping. The sawing, of course, is best accomplished with a jig saw, but an ordinary keyhole saw will serve the purpose, if carefully handled, in the absence of the more expensive tool. When assembled, the face of the wheel should be well sandpapered to eliminate all roughness and the face should be slightly rounded or crowned with a file or rasp in order to keep the belts centered. The wheels are provided with ½-inch pipe flanges with the holes reamed to ¾ inch to fit snugly over the shaft, and which, like the collars, have been provided with steel set screws to grip the shaft and hold the wheels in place. Of course, the wheels are drilled for the passage of the shaft.

Before proceeding to tell how to assemble the shaft

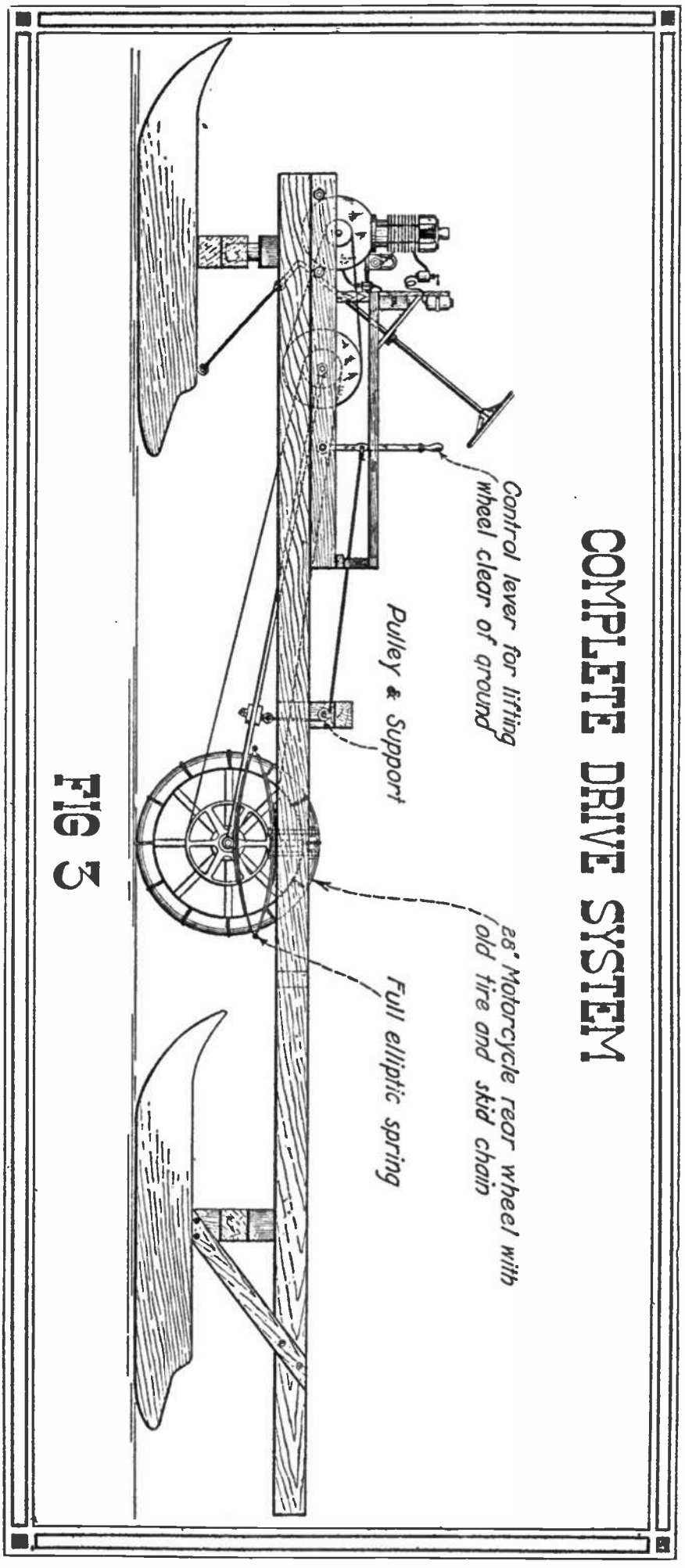


FIG 3 COMPLETE DRIVE SYSTEM

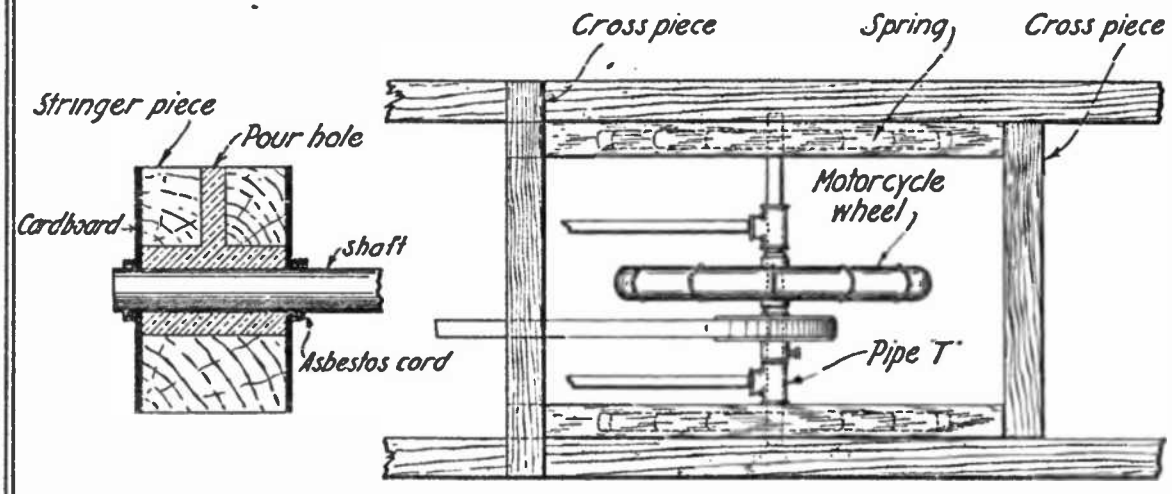


Fig. 4

Fig. 5

when bearings and pulleys have been completed, it is well to call attention to the method of control of the vehicle. By reference to the sketches it will be discovered that power from the countershaft is transmitted by means of a belt to a 28-inch motorcycle or cyclecar wheel mounted at a point near the middle of the bob. This wheel, ordinarily, is held in contact with the snow-covered surface of the ground by means of a couple of full elliptic leaf springs which have been procured from some discarded push cart or from some wagon builder. It is shod with an old tire, either inflated, if it be good enough for that, or else filled with sand or some other substance so that it retains its shape. It is caused to grip the slippery surface by means of a skid chain which is tightly adjusted to the tire. A pair of radius rods, made of ½-inch water or gas pipe, are interposed between the axle carrying the wheel and the countershaft and serve to preserve the distance between the wheels and keep the belt always at the proper tension. Under these conditions, it will be readily apparent that the drive wheel is free to move over rough ground and bob up and down without in the least interfering with the certainty of the drive.

Provision is made for lifting the drive wheel clear of the road surface by means of a lever pivoted to the sub-frame member close to the steering column and handy to the hand of the operator, which acts through a pulley and woven iron cable to lift the wheel from the ground through the intermediary of the radius rods, as is clearly shown. By this means the use of a clutch and some special means of starting the engine are eliminated and the mechanism considerably simplified. The clutch effect is not done away with, however, for by gradually bringing the drive wheel in contact with the icy surface, the vehicle is gently but firmly started on its way, provided, of course, that the motor is running. A latch, obviously, is provided on the control lever, which may be either foot or hand operated, to keep the wheel in inoperative position when need be. As for starting the motor, that is simplicity itself. The wheel, lifted clear of the ground for the purpose, is given a flip over in the right direction turning the engine over with it until it fires. Even a belt idler is done away with by this means.

The method of mounting the drive wheel is made clear by the accompanying sketch. A sort of sub-frame is made inside the larger frame, with two cross members and two longitudinal struts to

which the upper ends of the springs are firmly bolted. The forward cross piece is placed across the tops of the two string pieces to provide for belt clearance, but the rear one is between them and all joints are made fast by nailing with cut nails. The short axle of the wheel is discarded, and in its place is used one of sufficient length to provide bearing not only for the lock nuts but also for the Ts which are used on the ends of the radius rods and for the springs. The axle can be made up at any machine shop at very slight cost and should be made of the best steel and threaded from both ends for the greater part of its length to provide for the adjustment of the ball bearings. If the Ts on the ½-inch pipe should prove loose over the axle, which undoubtedly they will, the fault can be corrected by the use of babbitt metal to fill up the space and eliminate slack. T pieces are also used on the countershaft end of the radius rods and in this case the holes are filed or reamed out until the shaft turns freely through the holes. The device is assembled as shown in the sketches.

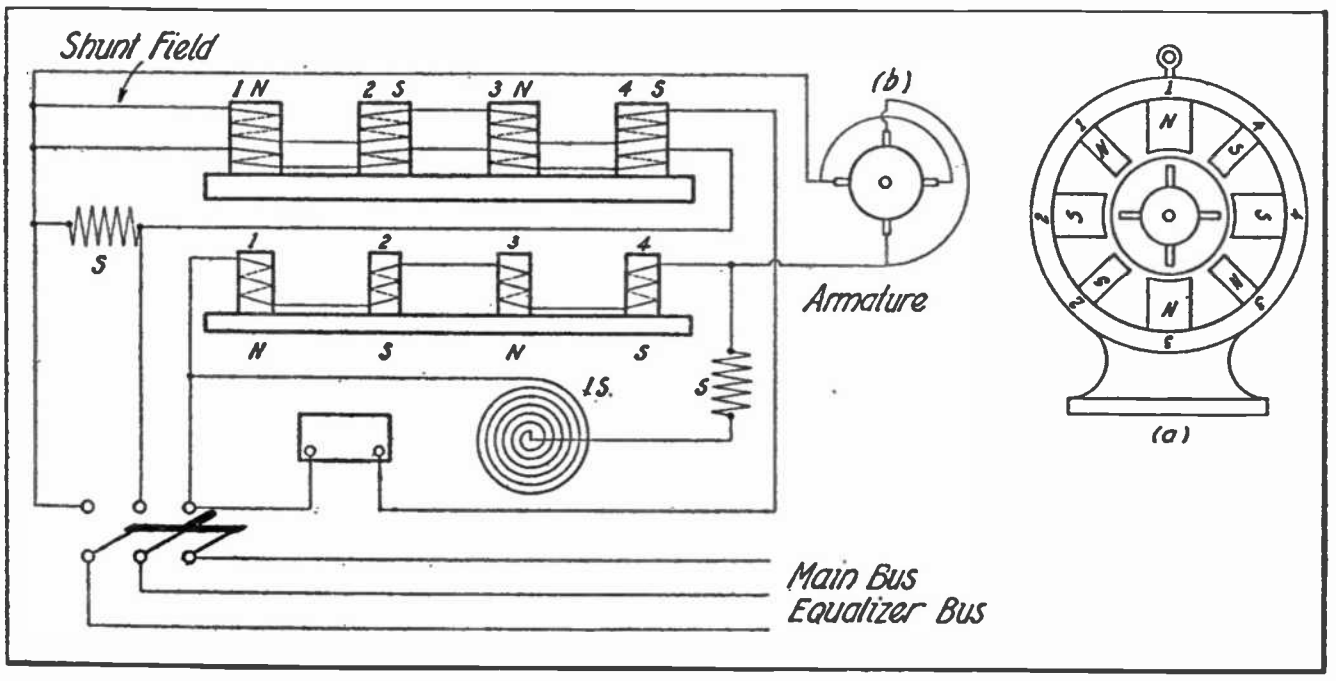
As for the rest of it, that is best left to the individual tastes or requirements of the builder. Of course, some sort of a steering column will be desired, and an arrangement of the sort is worked out in the plans. A flooring for covering the transmission elements also is shown, as well as a dash for the support of the gasoline and oil tanks, but as was said, these details are best left to the individual tastes of the builder and are not vital to the correct operation of the finished bobsled. A headlight and automobile horn will prove valuable.

INTERPOLE DIRECT-CURRENT MACHINES

By J. H. Wickman

IF a number of turns of insulated wire, connected in series, are rotated within the fields of magnets, an induced current is set up in the wire. If no means of commutation is provided, it will be an alternating current; but if a commutator—like those used on direct current machines—is provided to keep the direction of flow the same, it will be collected as direct current. Thus we have the main principle of generating either alternating or direct current.

When direct current is commutated,



Wiring Scheme for an Interpole Dynamo.

or, as we may say, reversed in the coil, since this is really what it does, a local magnetic flux due to the current also reverses and in so doing sets up an electromotive force in the coil which opposes this reversal and is referred to as a reactive voltage.

When the armature is revolving and carrying a heavy load, the lines of force have a tendency to bunch at the tips of the poles in the direction of rotation, thus causing an uneven distribution of magnetic flux over the pole face, which also means an uneven distribution over the armature face as well, forming one cause of poor commutation of currents and sparking at the brushes.

Until a few years ago this sparking could only be counteracted by shifting the brushes ahead in the direction of rotation of the armature to a neutral point which theoretically would require a movement of the brushes for each change of load on the machine. In recent designs of nearly all direct current machinery the auxiliary poles intermediate between the main poles, shown in part *a* of the diagram, have been introduced in order to obtain satisfactory commutation with a fixed brush position for all loads, this being the most satisfactory solution from the commercial standpoint.

These auxiliary poles are wound to carry a proportional part of the main current, being shunted by the series shunt *S* and the inductive shunt *IS*, shown in part *b* of the accompanying sketch. The inductive shunt acts as a reactance in case of a heavy overload and forces more current through the interpole windings, thus compensating for all loads automatically. These shunts are not used with some of the smaller machines, and in such cases all of the main current passes through the windings of the interpoles.

The windings are proportioned to provide a magneto-motive-force at any load sufficient to neutralize the armature magneto-motive-force and to provide a field of sufficient intensity to neutralize the reactive voltage set up in the armature coils while short-circuited under the brushes, or, in other words, the function of the interpole is to provide a magnetic flux of force opposite to and greater than the flux which produces the reactive voltage in the armature coils.

SPARKING OF INTERPOLE MACHINES

Sometimes conditions arise to counteract the effect of an interpole; this defect usually manifesting itself by a local sparking at one or more of the brush studs, while the commutation at the others will remain good. This effect can be caused by a short-circuit within the interpole winding, which may be detected by a resistance test of each of the interpoles until the affected one is located.

Frequently at the first installation a heavy local sparking will be produced by the reversal of one interpole, although in this case the effect on the operation at this one particular brush stud will be a worse sparking than if the coil were short-circuited, because by reversing an interpole it will increase the reactive voltage instead of decreasing it. The reversal of the entire interpole circuit will usually—but not always—manifest itself by heavy sparking at all the brushes on light loads. A polarity test—which is nothing more than to take a small hand compass and go around the pole pieces while they are magnetized quite strongly and see that they are in the right relation with reference to the rotation—may be applied in order to correct any reversed condition.

The diagram in part *a* shows the correct position of the poles with reference to the direction of rotation which is shown by the arrow. The remedy, after finding the wrongly connected pole or poles, is to reverse the connections in order to maintain the series of interpoles alternately N and S in the periphery.

When making the connections of the interpole circuit, care must be taken that the polarity of this field is correct with reference to that of the main shunt field, that is, the connections must be such as to place a N

pole of the commutating field ahead of the N pole of the main field, that is, beyond it in the direction of rotation.

With reference to the diagram, No. 1 N commutating pole lies ahead of No. 1 main pole with reference to the direction in which the arrow is pointing.

CARE, OPERATION, ETC.

The general care, control, operation and maintenance of this type of machine is about the same as any other direct current machinery, with the exception that when it is necessary to reverse the direction of rotation by means of the field connections, the extra field would have to be reversed as well as the others. These machines will carry a momentary overload of 400 or 500 per cent. without undue sparking at the brushholders, which is a large factor in their favor.

THE PREPARATION OF EMERY

Emery stone does not go upon the market in the same form in which it comes from the ground. It is mined in various places in the form of a loose or compact granulation. It is found in Greenland, Europe and Asia Minor. It has also been found in the United States at points bordering the Atlantic coast from Massachusetts to Georgia.

The deposit, after being mined, is crushed into small pieces. These in turn are pulverized by stamping. The powder is then put through one of two processes of grading according to fineness.

The first method is the simple one of merely sifting through sieves of graduated sizes of mesh, beginning with the coarsest and working down to the finest. The second method is somewhat more complex. A number of copper vessels, graded in size, are prepared, set in a row, and filled with water. The emery dust, churned up in water, is then piped into them, beginning with the smallest and proceeding by stages to the largest. The agitation of the emery-bearing water is greatest in the smallest vessel and consequently the largest grains of emery will first sink to the bottom of that vessel. The grains which are a degree smaller will be deposited in the next largest vessel, and the process may be carried as far as is desired.

After being thus precipitated the emery dust is either marketed in its pulverized form for polishing purposes or made into one of the emery products, stone, paper, or cloth. The stone is made by combining the dust with clay and baking it, the paper and cloth by spreading it upon the surface desired, which is first coated with glue.

HOW DYNAMITE EXPLODES

A great many persons entertain the notion that, in exploding, dynamite seeks "the line of greatest resistance." They know that if a quantity of black powder be placed upon a rock and lighted by a fuse, it will simply flash, scorching the stone; and that if a bit of dynamite be exploded on the same rock, the rock will be shattered. Hence the conclusion, quite erroneous, has been reached that dynamite follows the line of greatest resistance. Nothing could be farther from the truth than this. The black powder ignites and explodes much less rapidly than does dynamite, with the result that the force of the powder is soon dissipated in the atmosphere surrounding it. In the case of dynamite, however, the explosion is so sudden, "the attack upon the air" so instantaneous, that, for a fraction of a second, the air actually resists. The force of the dynamite is so tremendous that it is turned into the rock, which, for the instant, becomes the line of least resistance.

An illustration of all this may be seen in lightning discharges. A fork of lightning streaks across the sky. It packs the air so densely that it can no longer make rapid progress in that direction; so it turns aside to follow the line of least resistance. It "cannot wait for the air" to yield. The same is true in the case of dynamite.

SMALL ALTERNATING CURRENT MOTORS

How to Make a Compensated Series Motor of One-half Horse-power for Single-phase Circuits.*

By A. E. Watson, E. E.
Professor of Electrical Engineering in Brown University, Providence, R. I.

Illustrations from drawings made by the author.

THE motors thus far described have been inherently of the constant speed type. While in some cases some variation from the normal speed is possible, it is usually at the expense of efficiency. As long as the induction principle is involved, the only satisfactory speed is that which aims towards synchronism with the generator.

It is certain, however, that many applications of electric motors demand a variable speed, and that over a wide range of such operation the efficiency shall be reasonably high. It is curious that in the solution of this construction recourse should be taken to certain principles found in the very first motors that would operate on alternating currents, namely, the series type. As long ago as 1888 motors of this sort were made, but only in small sizes. It was observed that while such motors, if made with laminated field magnets, would run, it was accompanied with such destructive sparking at the brushes as to be intolerable. The substitution of carbon for copper brushes improved matters a little, but even then the construction was regarded as practicable only for such small sizes as were applied to driving fans and sewing machines. The discovery of the induction principle in 1891 led at once to the discontinuance of the manufacture of such series motors.

For more than ten years after this not a series alternating current motor was made, but with the demands of heavy or long distance railroading, inventors began to ask if, after all, there was not a chance for this type of motor. At first the proposals were discounted as visionary, for if the construction was impractical for a fan motor what chance could exist for one of a hundred or more horse-power? While some problems in electric traction can be regarded as by no means yet solved, the production of effective motors operating on single-phase currents, and adopted on numerous railroads in various parts of the world, is one of the most notable accomplishments of present-day engineers.

The two serious shortcomings of the series alternating current motor were its sparking and small output. Actual heating of the iron from the rapid reversal of the magnetic flux was readily overcome by laminating the field structure as well as the armature, but while the sparking might perhaps be reduced to less destructive character, the fact that a large and expensive structure would yield only one-half the power of other sorts promised to be a permanent handicap. This small output is due to what is technically denoted as a poor "power-factor"; that is, the current is far out of step with the voltage. It is interesting to note that the final means adopted to improve the power-factor were also vital for sparkless commutation. In order to make clear the description of the special winding for the motor to be described in this article, a review of certain principles associated with electric circuits may well be brought in.

When a current flows through a simple coil of wire that embraces iron, a magnetic condition is established. In many cases this is the very result desired, as for example, in a field magnet. The more magnetism produced, the better. In certain cases, however,

* This is the last instalment of a series that has appeared in every issue of MODERN ELECTRICS AND MECHANICS from February to July, 1914, and in every issue of POPULAR ELECTRICITY AND MODERN MECHANICS to date. Back numbers may be secured at 15 cents each while the supply lasts.

where the coil and the iron are present, the magnetism may not be desired. In such cases as resistance coils in electrical measuring instruments, while iron may not really be present, still a small yet undesired magnetic flux may be established. The condition can be avoided by winding the coils "non-inductively," by which is meant that one path of the current is intimately associated with another part conveying the same current in the opposite direction. Evidently the magnetizing effect of one will just neutralize that of the other. It is really no more difficult to wind the coils with this qualification, for it is only necessary to loop the wire in the middle, and to wind towards both ends, or for longer lengths, to solder together the wire from two different spools, then to wind coincidently from the two rather than from a single one. Finally, both ends will be on the outside, thereby allowing convenient connection to binding posts. Now, current flowing in by one wire will be ex-

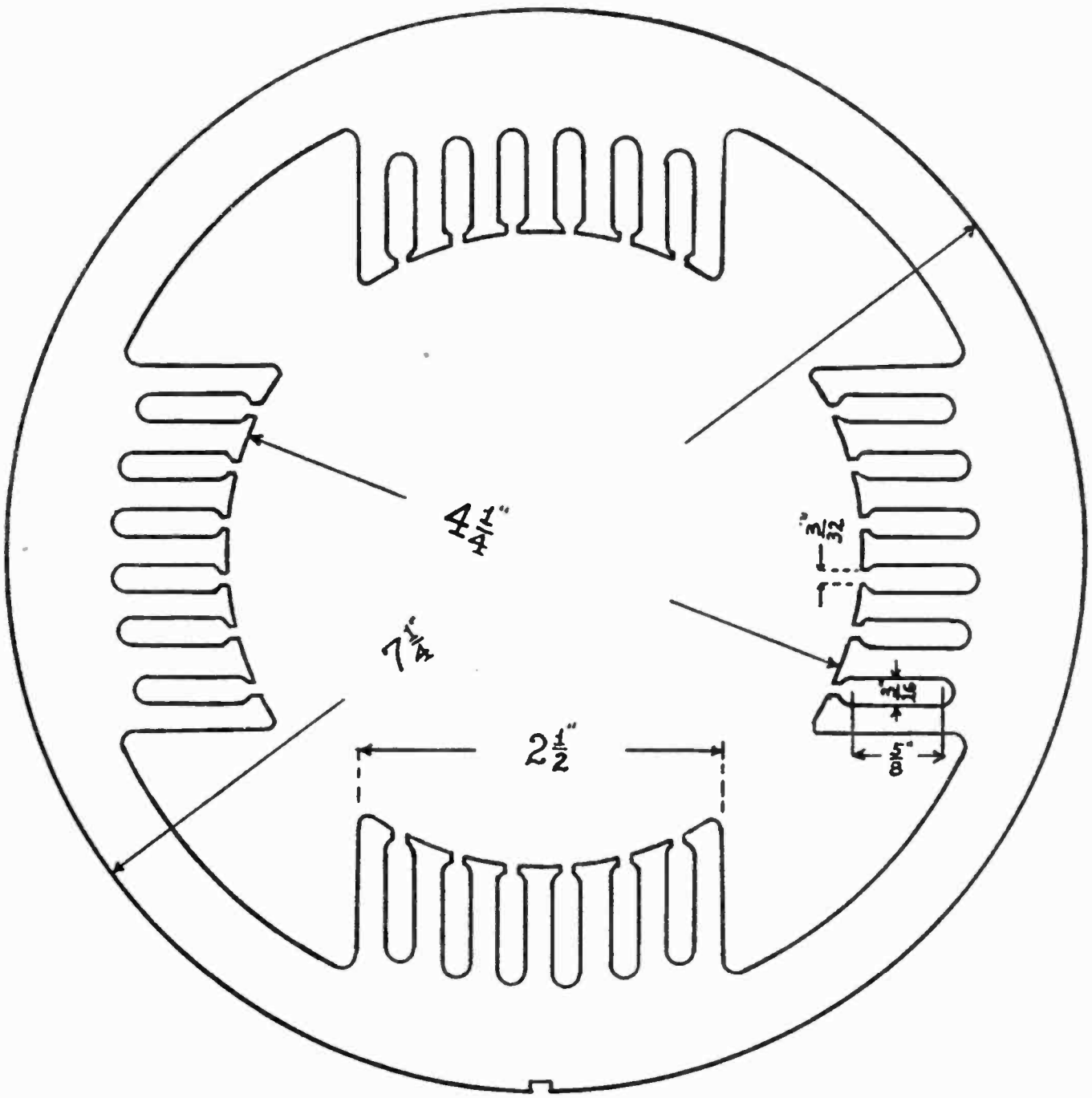


Fig. 45.—Field Punching for Compensated Series Motor.

actly parallelled by an opposite current in the other wire. The attitude of such a winding towards alternating currents proves its difference from the ordinary, or inductively, wound coil, for while such currents find great obstacles to their passage in the latter, they will flow through the other quite in keeping with Ohm's law.

The application to the case of the armature of a motor can now be foreseen. Any such definite winding is inherently inductive. This can be proved by taking any direct currrent armature quite apart from its field magnet, and sending through it, by means of contacts at the positions normally occupied by the brushes, any suitable strength of direct current. The iron core will exhibit poles at as many places as there are such points of contact. With a ring wound armature, contact can be made to illustrate any desired number of brushes, but a drum armature, of course, is wound to fit some particular number of poles, and hence cannot be used in any other than one way. Direct current will flow in such a winding quite in obedience to Ohm's law. Now, if alternating current be sent through the winding, quite a different result will be experienced, for even though many times the former voltage be used, the actual current may be decidedly less. The reason is found in the fact that the winding really constitutes a choke coil, and that the impedance to the passage of alternating currents may readily be many more times as large as the resistance.

To have prevented the direct current from establishing a magnetic field, there might have been employed a sort of stationary cage of windings to surround the entire armature, so arranged that every wire of the regular winding would be paralleled by one of the cage but conveying the same current in the opposite direction. Then, if in one place the current were trying to establish a magnetic field, it would at once be offset by the same currrent flowing in the opposite direction in the neighboring wire. The crucial test to apply to such a winding is to submit it to alternating currents, when, if effective, no greater voltage will be required than for the direct current case.

At first thought it may appear impossible to apply such counteracting windings to the armature already embraced by the field magnet, but space for such is found in the face of the pole pieces themselves. By cutting narrow slots with still narrower openings space is found for the wires, and these must of course provide for as many or even more ampere-turns than the armature itself exerts. Another suspicion may occur to the reader—that such windings may nullify the rotational powers of the armature winding. The force to rotate the armature wires is really due to the main flux set up by the regular field winding, and the only additional effect on the compensating winding, since it is cut by the same field flux, would be to exert upon it a rotational effect in the opposite direction, but being securely located in the slots, it is unnoticed.

Really the scheme of the compensating winding is not new, for it has frequently been applied to direct current machines, purely to prevent the necessity of shifting the brushes under change of load, a result now more cheaply attained by use of "interpoles." These latter, however, correct the armature magnetism in but narrow belts, and not over its entire surface as is required for the more complete suppression of sparking. Turbine driven direct current generators have even been made with both interpoles and compensating windings.

With the armature self-induction thus eliminated, whereby the operation will be dependent, as desired, purely upon the counter electromotive force due to rotation, the next factor to consider is the field winding. To make it non-inductive would clearly be a contradiction of terms, for by a field winding is meant one that is inductive, and the other expression would mean no field at all. At best, the self-induction of this member can merely be made of small amount. As the only hopeful recourse, since self-induction increases as

the square of the number of turns in a coil, there will be advantage in winding the field of the motor with relatively few turns, therefore for low voltage. Although the supply will not ordinarily be at a presssure lower than

worth the extra cost and labor involved.

Possibly some wonder may be felt as to why a shunt winding has not been proposed. From the considerations just expressed it will be clear that such a winding, with its numerous

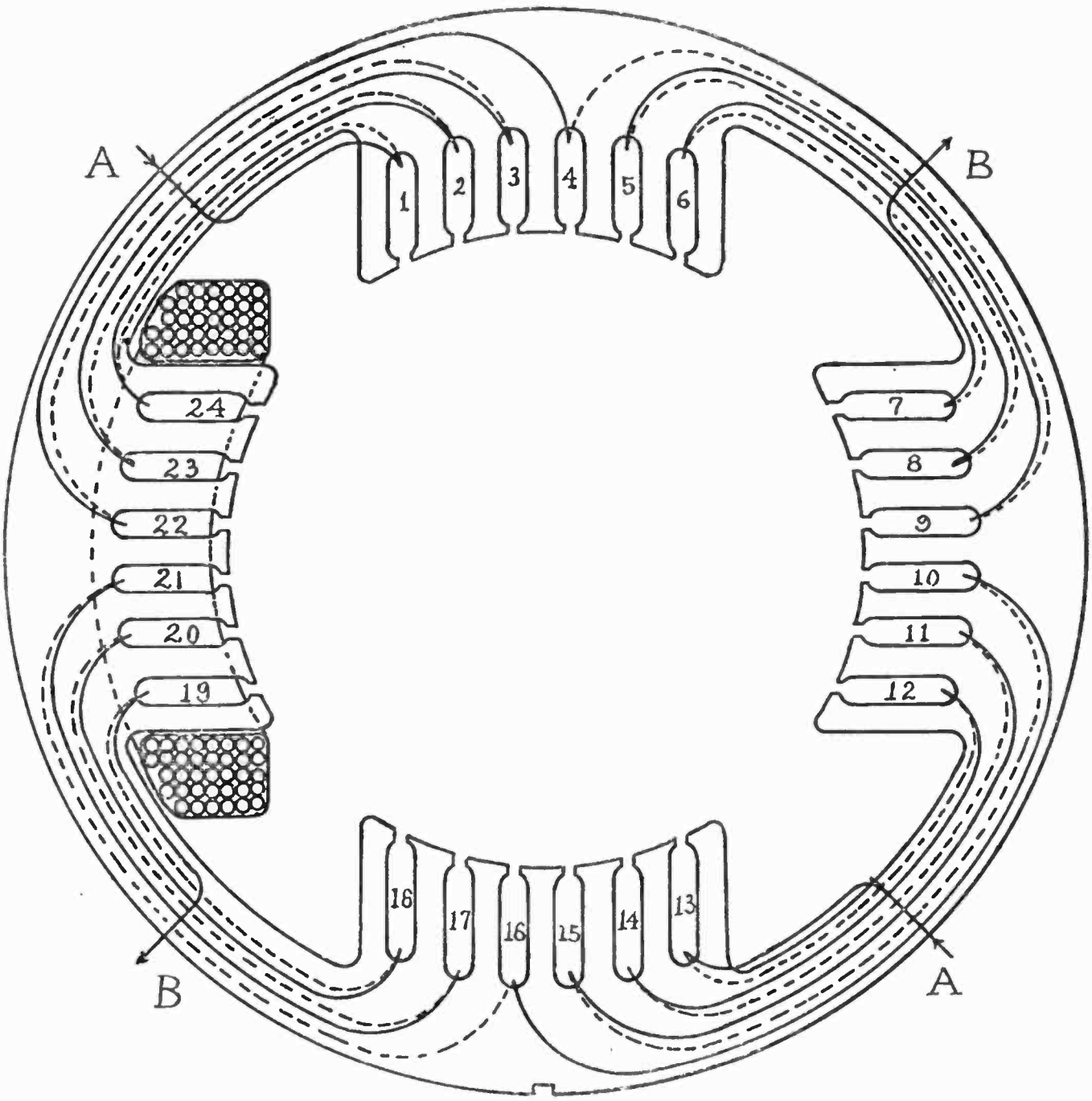


Fig. 46.—Diagram of Compensated Winding for Series Motor, showing also One of the Regular Field Spools in Position.

100 volts, it is here recommended that a pressure of about 30 volts at the motor be provided. This will require the use of either a two-coil transformer or an auto-transformer, but such devices waste almost no power, and the gain of the low voltage will be well

turns, would have an exceedingly high self-induction, therefore permit practically no alternating current at all to get through it. Further, what little current might get through it would flow at the wrong time to be useful. The lag would be nearly 90 deg., there-

fore quite inoperative on the armature, for first there would be current in the armature, but no field magnetism with which to act; then there would be a little field magnetism, but no current in the armature. This out-of-step fatality is perforce absent from the series motor, for if current flows through one member of the machine it does so coincidently with the other.

With the acceptance that a series field winding is the only sort permissible with such a motor, and next that a low voltage is desirable, the sort of armature winding to be provided must be decided upon. Whereas for the repulsion motor, in which an odd number of slots was advantageous, a series, or 2-circuit armature winding was described, for this case a multiple winding, requiring four brushes, will be best. About 20 amperes may be employed for full load, therefore a liberal size of commutator and the contact of four brushes will be none too much.

The most prolific cause of sparking in an alternating current "commutator" motor, especially at the instant of starting, is due to the transformer action experienced by the coil undergoing commutation. At that instant the brush bridges across two segments, and the maximum value of the alternating flux will be threading through the coil attached to them. A very large current will then flow, quite likely larger than the main operating current, which rapidly heats the coil; then as rotation takes place, this large local current will be broken at the tip of the brush, resulting in a flash of quite destructive nature. Continued action of this sort will rapidly destroy the copper. If such a load is applied to the motor that it cannot readily start, the prolonged current in this short-circuited coil will be liable to burn it out. There is a feeble current of this sort constantly produced in a direct current dynamo, but the electromotive force being merely due to the inexact setting of the brushes, as regards the neutral region, sufficient resistance to reduce the current to a negligible degree is offered by the carbon brushes. With an alternating field flux, however, the case is serious, and even hard carbon brushes are quite ineffective. Since for readily conveying the large current good conducting carbon or graphite must be used, a remedy must be sought in some other direction. This is found in the expedient of employing high resistance leads between the armature winding and the commutator. Then, in order to complete its circuit, this undesired current will be compelled to travel through two such links in series. Since only those leads are concerned which connect to the commutator segments making contact with the brushes at a given instant, the internal resistance of the armature as a whole is not thereby seriously increased, therefore the efficiency of the motor is not noticeably impaired. A further step towards elimination of sparking will be made if the number of coils and commutator segments be made as large as possible, the electromotive force generated in any one coil thereby being a minimum.

With these various considerations relative to the principle of operation of a series motor described somewhat at length, but presumably in a convincing manner, certainly well verified in practice, the modifications over former published designs can readily be stated and comprehended. For the provision of a definite line of commutation, a field magnet somewhat resembling that for a direct currrent machine will be advisable. In order to prevent the flow of eddy currents, the structure must be of thin sheet iron and well separated by use of tissue paper or varnish. Armature self-induction should be neutralized by a compensating winding. Field magnet should be series wound, there being gain in the adoption of a low voltage, with consequent requirement of but few turns. Although mention has been made of the voltage, no reference has yet been made to the speed. Since a series motor is being described, inherently adapted for variable speeds, no principle of synchronism enters, so by applying suitable voltages, almost any

speed within wide limits may be utilized. By making the secondary of the special transformer with numerous taps, as many different voltages as desired may be readily available.

In Fig. 45 is shown one of the sheets for the field structure. The builder will find it awkward to make, and for constructing a single machine, for which the making of punch and die would be a disproportionate expense, ing shown in Fig. 33 of the August number of the magazine may well be used, the dimensions for the shaft and core being obtained from Fig. 32. In place of the collector rings described in that article a liberal size of commutator, such as was shown in Fig. 42 of the December issue, though with 24 rather than 23 segments, will be required. Still better would be 48 segments, with two coils per armature

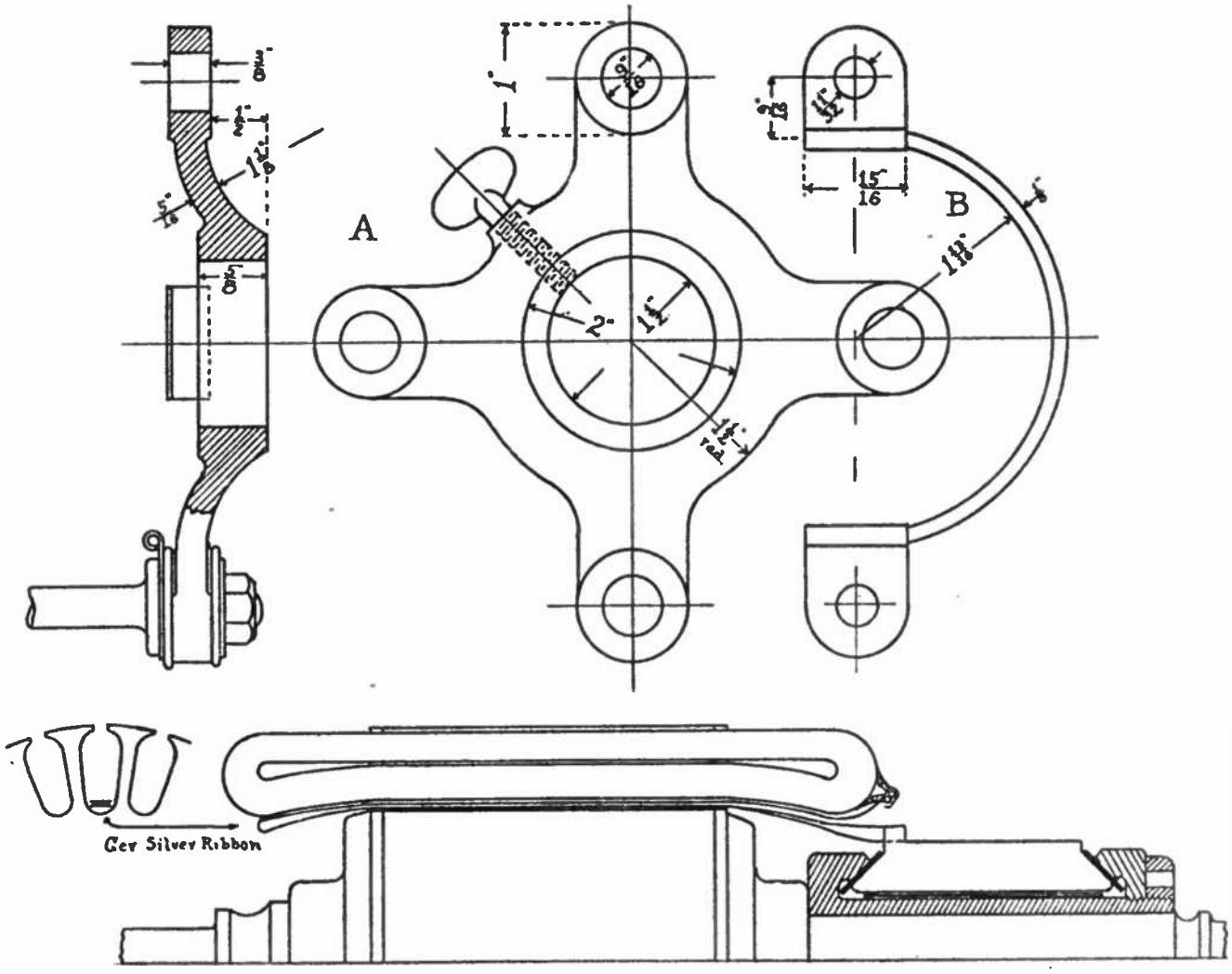


Fig. 47.—Details of Brush-holder Yoke, Cross Connector and Commutator Resistance Leads.

recourse may be necessary to drilling, sawing, and filing methods. Since the magnetic density is to be at a lower value than for the induction motor, a small cross-section of the outer ring, or yoke, portion will be entirely sufficient. Some modification will consequently be necessary in the width of the flange and ring used for clamping the sheet iron within the cast iron frame.

For the armature the 24-slot punch- slot. The brush holders and spindles of these same articles may be copied. A four-ended brush holder, with cross connections for the spindles, as shown in Fig. 47, will complete the list of special parts.

After assembling the field structure with its end-sheets of fiber as in preceding cases, the polar slots being filed out smoothly and insulated, the compensating winding is first to be placed, and this will consist of four No. 14

wires in parallel, fumbled in place through the narrow openings, quite in the manner employed for stator coils. If preferred, the builder may wind each of these four groups with a single wire, then finally connect the four separate coils in parallel with each other. The actual disposal of the wires will present some difficulty. Space for the regular field windings must be reserved, so these extra coils must be bent back and around out of the way. Reference to Fig. 46 will indicate the method to be followed. One of the coils may be imagined as beginning at "A," and passing through slot 1, then directly back to the inner diameter of the clamping ring, thence to slot 24, back to slot 1, and so on, until as many turns as possible, say four or five of the bundle of wires, have been placed, then into slots 2 and 23, finally in slots 3 and 22, each successively larger spread of the coils requiring disposal at a greater distance from the center. Without cutting the coil, continuance may be made, if the builder chooses, into slots 4 and 9, then 5 and 8, 6 and 7, the end being at "B." Since this order will require the largest radius to be first used, the builder will decide for himself whether this can readily be accomplished. A similar start is to be made in slot 13, ending at B′ from slot 19. By connecting A′ to B the two groups will be put in series, then the other ends attached to terminals on the connection board.

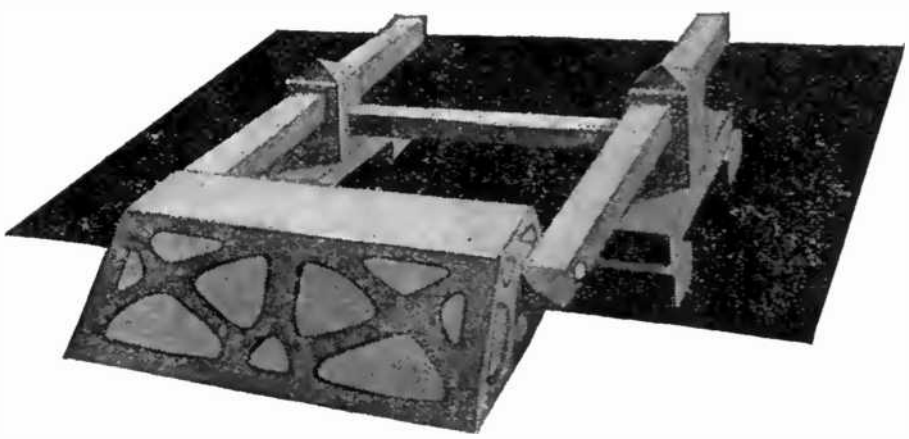
After these coils have been placed, the space remaining for the regular series coils may be seen, it being a good provision to make a sheet metal or cardboard templet that will readily pass over the pole pieces and their protruding windings, then to make the winding-form sufficiently large to fit them all. If a single wire is to be used it should be No. 8 in size, and then all four coils are to be connected in series. If preferred, No. 14 may be substituted, and the coils connected in parallel with each other. In either case the wire is so stiff as to preclude the possibility of bending the coils after they are wound, so the shape to fit the curvature of the polar bore must be introduced into the winding-form itself. Cotton tapes laid in the form before the winding begins can be used to hold the coil together while substituting the final covering. The two ends of the field winding may be led to two special terminals on the connection board.

For the high resistance leads of the armature, thin ribbon of German silver, say 3/16″ or 1/4″ wide, and .02″ thick, in strips about one foot long, with well tinned ends, are to be provided and insulated with varnished cambric. Each should then be doubled in the middle and laid in the bottom of the insulated slot, the open end being left for the connections as shown in Fig. 47. After placing the coils, which may well be of No. 16 wire, wound quite in the manner of any direct current armature, their ends are to be joined in the usual method for a multiple winding. While these protruding ends may be joined by use of fine wire and solder, they are also to be further secured by bending around them and soldering one end of each of the ribbons. The other ends of the ribbons are to be given a twist and soldered into sawcuts in the commutator segments.

To provide for the cross connections of the opposite brush-holder spindles, sheet copper ends joined together by soldering a ⅛″ diameter brass wire makes a simple and light structure. Two such are needed, one being located on the inside surface of the yoke, as seen in the figure, the other, joining the other two spindles, being just outside the yoke. By this means ample clearance is obtained. Flexible cables are to join each set of spindles with terminals on the connection board. Since there will be in all six terminals —two from the main field winding, two from the compensating winding, and two from the armature, and ready means should be adopted for connecting them as desired, a good plan will be to have a fiber block on each side of the machine, each fitted with three binding posts, one for each circuit. These posts should be of generous size.

A Lamp for the Piano*

A PIANO lamp of pleasing and practical design is depicted in the wash drawing. The realization of both of these qualities is seldom found in a lamp of this type, for it is not infrequently the case that practical utility is sacrificed for the sake of artistic effect or *vice versa*. The design offered herewith will produce a lamp that may be adjusted to clearly illuminate the sheet of music while completely shielding the faces of the musicians from the direct rays of light; at the same time, the lamp will prove an inconspicuous ornament on the top of the piano.



View of Completed Piano Lamp.

The lamp is made of a wood to match or harmonize with that of the piano case; the stock should be ordered planed and sanded to the required width and thickness and the builder will then have only to cut to the proper length, square up the ends and assemble. The dimensions of the various parts comprising the lamp are given in Fig. 2, and the complete bill of materials is as follows:

(*A*) 2 pieces 10″ long, ⅞″ square.
(*B*) 2 pieces 1¾″ long, ½″ diameter dowel rod.
(*C*) 2 pieces 3″ long, 1¾″ square.
(*D*) 4 pieces 2″ long, 2″ wide, ⅞″ thick.
(*E*) 2 pieces 6″ long, 1¾″ wide, ⅞″ thick.
(*F*) 1 piece 11½″ long, ⅞″ square.
(*G*) 2 pieces 10″ long, 5″ wide, ⅛″ thick.
(*H*) 1 piece 10″ long, 2″ wide, ¼″ thick.
(*I*) 2 pieces 4⅝″ long, 4½″ wide, ¼″ thick.

In addition to the wooden stock enumerated above, the builder will require two pieces of art glass, 9½ inches long by 4½ inches wide and two pieces cut to the shape and size of the end pieces *I*, Fig. 2. An electric lamp key-socket, bushing and flexible cord with plug attached will also be required. The lamp socket is mounted as shown in the drawing at *J*. This mounting requires a strip of ⅛ inch sheet metal bent into an L and drilled with a hole to pass the socket bushing in the long portion and to take the round-head screws in the foot.

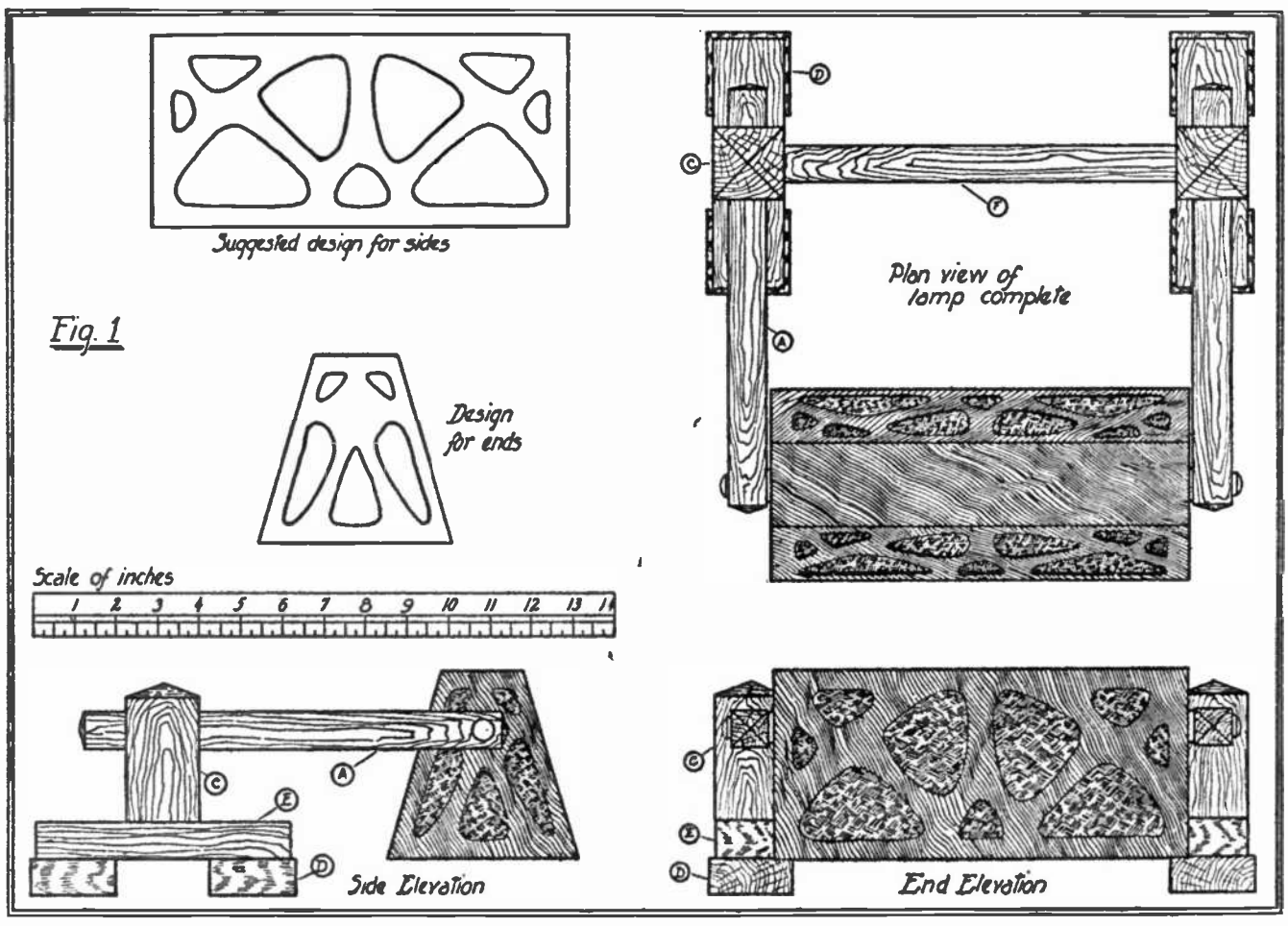
Having provided himself with the necessary stock of materials, the builder may proceed to prepare them for assembly. With reference to the pieces *A*, the hole for the dowel may be bored through each and the ends pointed as shown in the drawing. The pieces of dowel, *B*, require no description save that one end

* This article is one of a series that appears regularly in this magazine, describing the construction of lamps of many different designs.

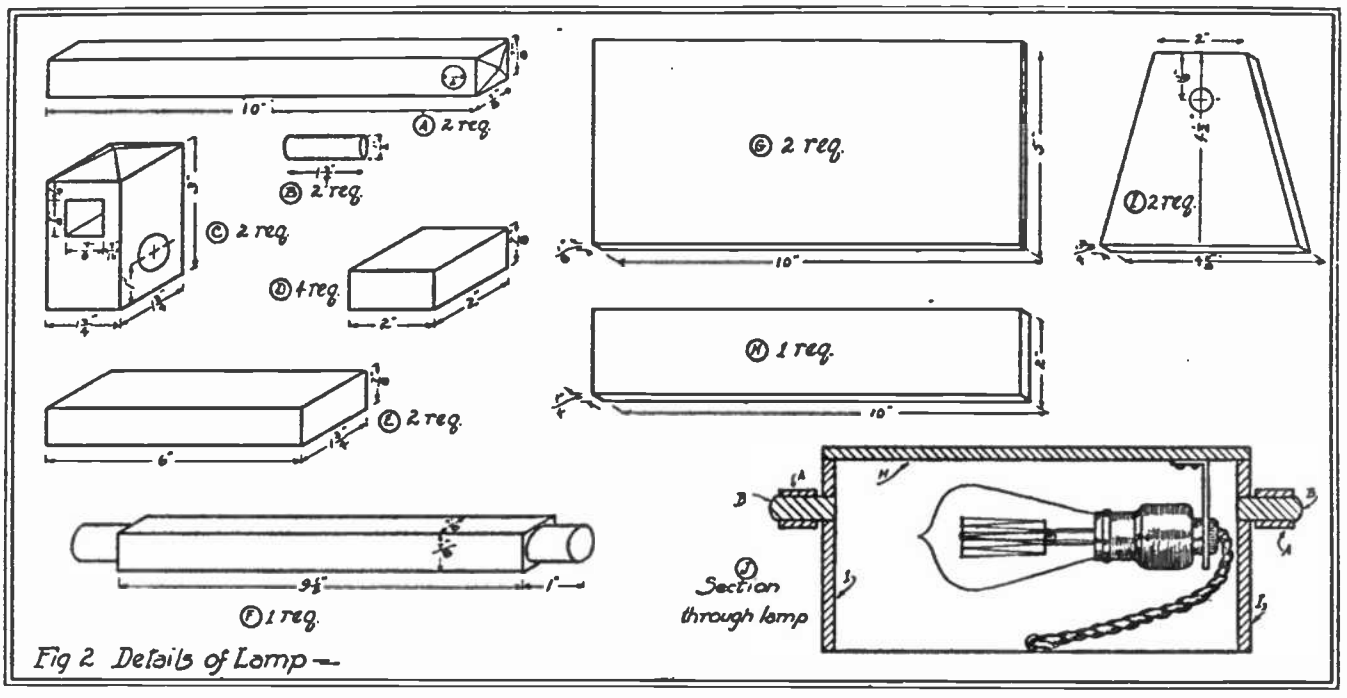
of each is rounded off. The posts *C* are pointed at the top and the hole in each is bored one inch deep with a ¾ inch bit to take the round portion of the spreader *F*. The square opening is chiseled entirely through each post to take the piece *A*. The pieces *D* and *E* require no comment other than that a hole is bored in each of the D pieces in order that they may be loaded with melted lead so that the lamp will not tip over when assembled. The hole in each piece should be as large as it can be made without splitting the wood.

The piece *F* is doweled at each end as shown in the drawing and the diameter of the rounded portion should be a full ¾ inch, in order that it may be a tight fit into the hole in the piece *C*. The side pieces *G* are of thin stock suitable for scroll saw work and in Fig. 1 is suggested a design for the side of the lamp as well as one for the end pieces *I*. The latter are of heavier material than the sides, as the reader will note. The top piece *H*, is likewise of ¼ inch stock.

After the design has been cut out of the sides and ends, the builder may proceed with the assembly. The top piece of the lamp shade is to be secured to the ends with glue and very slender brads and its edges given the proper bevel in order that the sides will fit nicely when they are adjusted in position. The latter are likewise secured with glue and brads. The art glass may next be placed in position within the shade and in this operation the builder will require a few strips of thin wood. The lamp socket may then be affixed and attention given to the base of the lamp. Reference to the various drawings in Fig. 1 will make this assembly quite clear. The feet *D* are secured to the pieces *E* with glue and nails after they have been filled with lead as mentioned previously. The posts *C* are either nailed or screwed, preferably the latter, to the bases and the spreader rod *F* is secured with glue as the complete base is set up on a flat board to insure perfect alignment of the various parts. When the base has been assembled and the glue dried, the shade may be suspended between the arms *A*



Drawings of Completed Lamp showing Method of Assembling.



Details of Parts of Piano Lamp.

by passing the short dowels *B* through the holes in the arms and into those in the ends of the shade.

The woodwork may be finished in any manner desired and it is only necessary to suggest that the staining and varnishing should be done before the art glass has been put in place.

HOW GOLD LEAF IS MADE

The metal worked by the "gold beaters" comes to them in wide bars or nuggets. It must be weighed, melted and made into inch-wide ribbons before the beating begins. The ribbon is then cut into inch squares and beaten with a hammer wielded by a stalwart workman. When each leaf has been beaten thin it is transferred to a mold, where it is beaten again for a period of four hours. The beating is accomplished by means of a wooden hammer weighing from seven to eighteen pounds on a sheepskin cushion resting on a granite block.

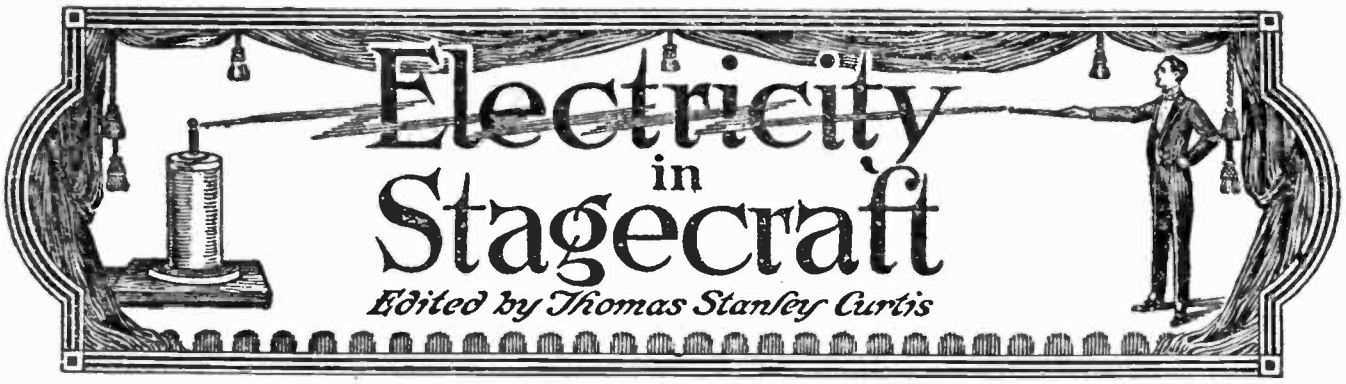
The gold beaten is usually twenty-two or twenty-three karats fine. A little alloy of copper or silver is added to make it spread. It would be impossible for the beaters to handle absolutely pure gold.

Gold leaf is packed more by the aid of the breath than that of the hands. The operation of transferring a sheet of almost transparent gold leaf from one place to another is of such delicacy that it is possible to accomplish it only by a slight puff of the breath. The packers are, for the most part, girls to whom, after the beating of the gold, the leaf is handed.

The girls lift the unshaped leaf from the mold with a pair of wooden pincers, flatten it out on a sheepskin cushion by gently blowing on it, cut it into a perfect square, place it between the leaves of the book, and flatten it out with the breath. A book consists of twenty-five leaves, and a skilled operator can pack seventy books in a day.

THE BEEDLE FAN

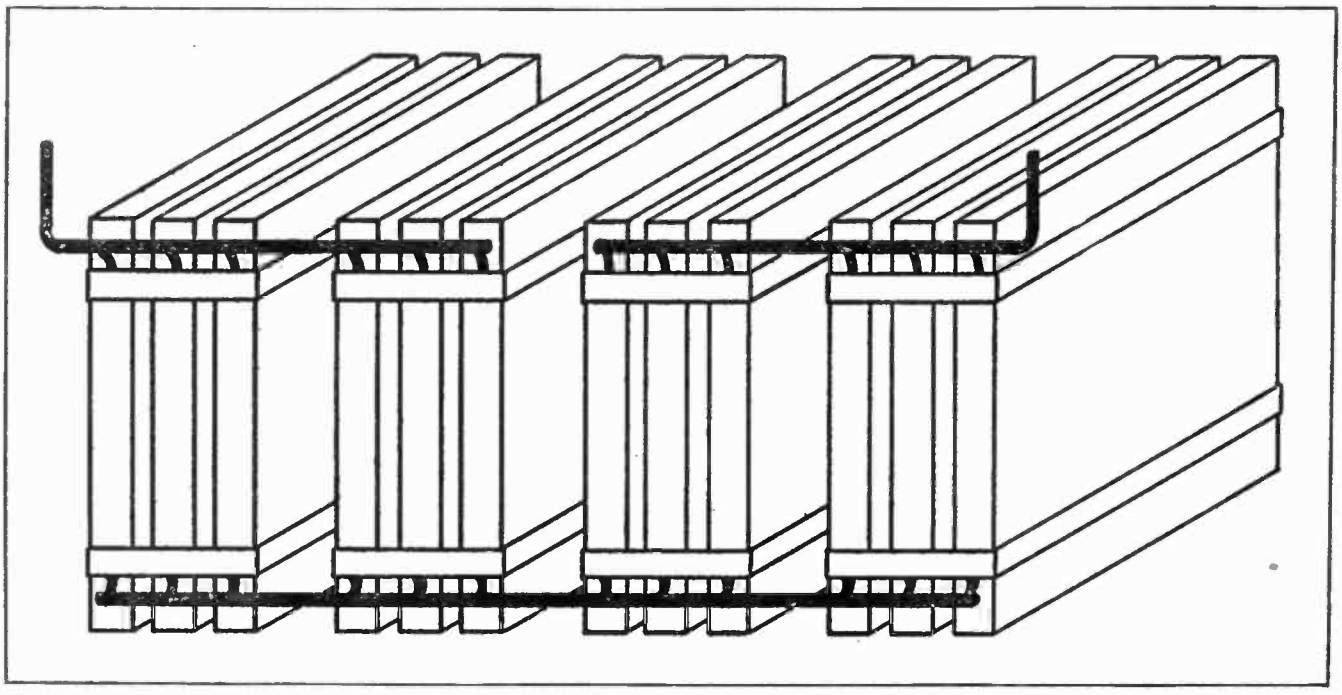
This is an English invention, in which the revolving blades are made with curved surfaces, of a peculiar form, which impel the air in a direction parallel to the axis of the fan. It is said that virtually the whole power is utilized in making the air "travel," and very little in simply churning it up. It is believed that the invention may find practical application in the propellers of ships and aeroplanes.



Apparatus for a Spectacular Vaudeville Act*

THE present article, which deals with the high tension condenser to be used in connection with the apparatus previously described, is the concluding instalment of the series on the making of the high frequency transformer outfit. The next instalment will be devoted to detailed instructions for setting up and operating the apparatus covered in this and preceding articles. Subsequent numbers of the magazine will present the constructional features of various other instruments and devices to be used in the presentation of an up-to-date electrical act for the stage.

Before proceeding with the description of the condenser, it may be well to state that this particular feature of the outfit presents many difficulties in its design in view of the fact that the condenser is to be subjected to much rough handling and moving about. The data offered herewith is for a condenser having glass plates for its dielectric, but the author would suggest that this material, while highly satisfactory for use in a condenser to be used in but one place, is obviously subject to breakage and is at a further disadvantage from point of weight. Its use is suggested in the present paper merely because the stock is readily obtained and this at a low figure.



Complete Condenser, Showing Method of Connecting.

* This article is one of a series that has appeared in the September, October, November and December issues of POPULAR ELECTRICITY AND MODERN MECHANICS.

Sheet mica, while several times as costly, is far superior in every way and its use is strongly recommended to those who feel that the extra expense is justified by the advantages gained.

For the condenser proper, 120 sheets of 8 by 10 inch photographic glass will be required. This glass, in the form of discarded negatives, may be obtained from almost any photographer for a small sum. In addition to the plates above-mentioned, the builder will require some 24 plates additional to serve as cover glasses for each condenser unit. A few extra plates to replace possible broken or defective ones will not be amiss.

The first operation will be to clean the emulsion from the glasses and this is readily done by soaking the plates in hot water. It is not essential that the plates be made perfectly clean of the emulsion if the plates have all been developed and the silver dissolved, but it is desirable to get the surface and particularly the edges for a space of an inch or more as clean as possible. The plates, when cleaned and dried, are to be placed in a warm oven prior to having the metallic coating of tinfoil placed on each side.

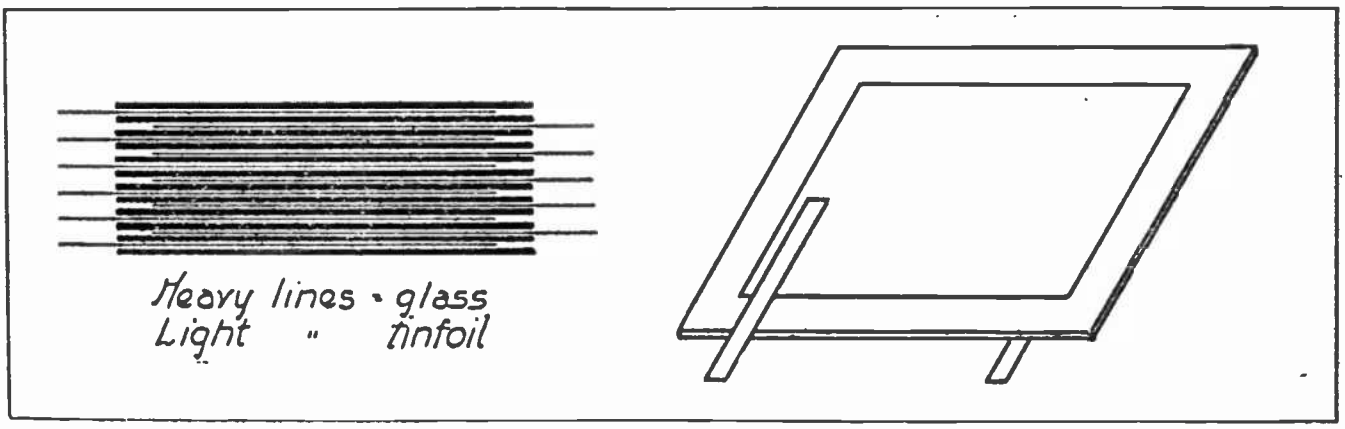
This coating is of the heavy foil used by florists and may be obtained in strips 48 inches long and 6 inches wide at almost any florist's shop. It comes in packages of one pound and averages some five strips to the package. The foil should be straightened out and cut off into rectangles 6 by 8 inches in size in order that when secured to the glass it will leave a margin of an inch all around.

The condenser is made up into units of ten plates each and each plate is to be coated on both sides with the tinfoil. In all there will be 12 units connected up as shown in Fig. 13, that is, two sets of six units each connected series-multiple.

To coat the plates the builder should provide a lump of beeswax and a "pounce" made by enclosing a wad of cotton within a soft cloth. A warm plate is taken from the oven and laid upon a cloth-covered table top. The lump of beeswax is rubbed lightly across its surface to provide a thin and even coating. A sheet of tinfoil is immediately placed in the centre of the glass and rubbed into close contact with the pounce, starting at the centre and, with a circular motion, working out toward the edges. This will result in a perfect union of glass and foil at all points. The plate is immediately reversed and the other side coated in like manner before the plate gets too cold to melt the wax. The remainder of the plates are to be treated in a similar manner when they are ready for the connecting lugs, after having had their edges dipped in melted wax far enough to cover the edges of the foil for a space of an inch or so to prevent brush leakage.

The lugs are of thin copper ribbon, tinned at one end and affixed electrically to the tinfoil at alternate ends on both sheets of foil with a deft application of the soldering copper. A little practice on a scrap plate will soon enable the worker to master the operation of soldering the copper to the foil without

(*Continued on page* 120)



Showing Method of Assembling Plates of Condenser with Lugs Projecting. Also View of Single Plate of Glass with Tinfoil in Position.

Practical Electro Therapy

Edited by Thomas Stanley Curtis

Application of Various Currents*

WE have learned in previous articles what the various kinds of electric currents are, how they are produced and, in a measure, how they are applied. In the present instalment, the application of the high frequency or oscillatory electric current will be under consideration. An explanation of the characteristics of this form of current was given in the October number of this magazine as were also suitable analogies illustrating the principles of electromagnetic induction. The matter will, therefore, not be reiterated here and it is assumed, in offering this article, that the reader is familiar in general with the action of alternating electric currents.

In the accompanying illustration, Fig. 15, a diagram of an oscillatory circuit is given. At the left, the reader will note the primary of a high tension transformer. This instrument takes the alternating current from the line wires at the voltage commonly employed for lighting purposes and steps it up to a value of perhaps several thousand volts on the secondary or right hand side of the first figure in the drawing. From this point on, the reader will see the true oscillatory circuit which comprises a spark gap, represented by the two small circles, the condenser, represented by the heavy black lines, and the primary of a high frequency transformer at the extreme right in the drawing.

The condenser is a device for storing electric energy at high pressure or voltage and in this diagram it is shown in such a position that it will take the high voltage from the secondary of the transformer and store it up until the pressure becomes so great that the current leaps across the spark gap in a succession of crashing discharges. While this discharge occurs, the current is surging back and forth through the circuit of the condenser, gap and primary of the high frequency transformer at a speed or frequency of perhaps hundreds of thousands of times per second. This high frequency current will be maintained in the circuit as long as current is supplied to the primary of the low frequency or step-up transformer for the latter instantly restores the charge in the condenser as fast as it discharges through the oscillatory circuit. The current in this circuit is flowing at approximately the voltage of the transformer secondary and for certain purposes in electro-therapy, it is desirable to employ a much higher potential. This desirable feature is readily obtained by applying the transformer principle once more and adding a secondary coil of many turns of fine wire to the primary coil of the high frequency transformer. In this case, however, no iron core is used, for its employment would retard rather than assist the transformer action where high frequency currents are involved. The top of the secondary winding is connected with a ball discharger from which sparks may be drawn or to which the connecting cords leading to electrodes may be attached.

The high frequency current is finding a most important place in the field of electro-therapy at the present day and its use in many of the familiar ailments has

* Continued from the December issue of POPULAR ELECTRICITY AND MODERN MECHANICS.

proven very beneficial. The current possesses the most peculiar properties and while a thorough discussion of its characteristics from a medical standpoint cannot be given in the present article owing to lack of space, still it is believed that a mere sketch of some of its interesting points will not be out of place.

Many years ago it was learned that if an alternating electric current be increased in its frequency to a point far beyond that used for commercial purposes, the current could be applied to the human body at voltages that would ordinarily cause serious shock or perhaps death. By increasing the frequency of the current beyond 100,000 cycles per second, the current was rendered practically painless when applied to the body and its presence was not accompanied by the characteristic muscular contractive effects of the low frequency alternating and the direct currents. This discovery practically revolutionized medical electricity as it permitted the investigators to make bolder strides into the future and to bring to light many facts of inestimable value to modern electrotherapy.

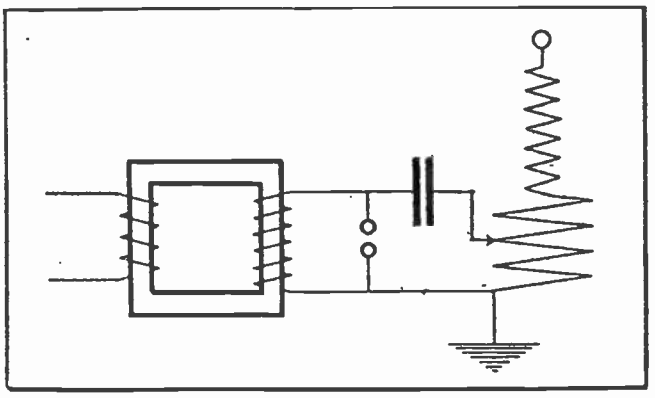


Fig. 15.—Diagram of an Oscillatory Circuit.

A FREAK OF LIGHTNING

A vivid flash of lightning closely followed by a sharp clap of thunder and a report from the switchboard like a pistol shot, startled the telegraph operator and other clerks who had just reached the office and were getting books and reports in readiness for the day's work.

The cashier turned to the safe, as he had done every morning for months, and began to twirl the knob, setting it on the numbers which had opened it hundreds of times. He was astonished when it did not open the first time and after repeated failures, called the agent. Numerous draymen were waiting at the window for freight bills, and the bills were in the safe, which could not be opened on the combination that had so long been used without a hitch.

The cashier made duplicate bills from office records and cleared the office of draymen while the agent continued his efforts with the lock without result. Finally he decided on a system. Knowing the lock contained three tumblers, he used the old numbers on all but one, skipping to the next figure and repeating this with each tumbler, but still it would not open. He was about ready to wire the superintendent for authority to have the door drilled open, when he decided to try it once more, and using the first and last figures of the combination and a new figure for the middle tumbler, the bolt clicked in the notches and the door was opened.

On examination it was found that lightning had struck the safe doing no damage except to knock loose a spring that held a shoulder in position on the middle tumbler, leaving it free on the stem of the knob. It was only by mere accident that the middle tumbler was stopped in the right place on the last trial.

The propellers of aeroplanes such as are used in the present European war may be made of selected ash, which is both strong and light and will not split under vibration or shock, or of built-up layers of spruce with mahogany centers. The framework of the machines, too, is generally made of wood, spruce being much used on account of its straight grain and freedom from hidden defects.

Electroculture Shows Good Results

THE latest reports from experimenters who are carrying on research in the electrical stimulation of plant life in various parts of the world offer conclusive evidence of success. In practically every experiment the period of maturity has been notably lessened, while the quality of every crop treated has been greatly improved.

More to the point, however, is the fact that the yield has been increased without exception. In one case reported, the increase was just about 40 per cent. in a plot of electrically-forced strawberries, as against an adjoining plot untreated. In the same test, beets were increased in yield 30 per cent., cucumbers 19 per cent. and tomatoes 20 per cent.

However, the increase in profits to the commercial producer does not lie so much in the matter of greater yield as in the advanced maturity which places the product on the market earlier and so commands a higher price. A peck of tomatoes in advance of the regular season when the market is not overstocked, is worth more in net profit than a barrel later on when every tomato field is sending fruit to the market by the ton.

In a recent Chicago truck garden experiment, posts eight feet high were set twelve feet apart about the plot to be electrified. From these posts wires were stretched taut both ways, making overhead squares twelve by twelve feet. The network of wires was electrified in the manner described in recent issues of this magazine.

A report made for the first year of the experiment shows that although the season was unusually dry, all of the vegetables and farm crops planted in the electrified area developed an unprecedented growth even when compared to favorable weather conditions by the ordinary method.

As an example: musk melon seeds planted the eight of June ripened in a little over eight weeks and with such remarkable evenness that all the melons were marketed in six days. The yield was 365 perfect melons from a plot twenty feet square or over 40,000 per acre. But even of more importance than the heavy yield of salable fruit, was the fact that they were on the market before other local melons, and as they matured in a few days they were all sold before ordinary stock came on the market.

In all of the experiments reported it was found that fruit, vegetables and flowers grew faster, to a greater size and of a better quality, when thus fertilized with electricity. Those who have applied the electrical treatment in crop production find their crops mature about a month in advance of the ordinary season.

APPARATUS FOR A SPECTACULAR VAUDEVILLE ACT

(*Continued from page 117*)

melting the latter. The drawings in Fig. 14 illustrate the location of the connecting lugs and also the way in which ten plates are piled one on top of the other to form a complete unit. This assem-

bling having been done with the entire lot of plates, the projecting lugs may be clamped with the pliers and soldered to short lengths of copper ribbon ready for connection with the bus-bars of the condenser. The plates of each unit should be bound with tape to afford mechanical strength and ease of handling. A plain piece of glass is placed on either side of each unit under the binding tape.

The twelve units are to be assembled in a strong wooden case and each unit should be separated from its neighbor by strips of wood covered with felt. Connections are made as shown in Fig. 13, to bus-bars consisting of several strips of copper ribbon fastened together. The connections with the outside of the case are by means of heavy flexible cables made by binding a number of strands of fine insulated copper wire under one cover as described in a previous article.

A SLOT MACHINE FOR NEWSPAPERS

After all the devices to which we have been accustomed in the various slot machines, not only for making sure that the wares will not be delivered until a coin has been inserted, but to reject all coins that are not the proper denomination as well as all slugs, we are indeed surprised at the simple innovation of a Greek lad in San Pedro, California. He goes so far in showing his trust in the public that he has established racks of wire on the telegraph and electric light poles at the main corners of the town, so arranged as to hold a number of newspapers in such a position that the upper half of the front page may be read by all who pass, thus arousing their interest in the contents of the rest of the columns hidden from view. The purchaser merely drops one cent in the slot in a small red leather box attached to the pole just above the rack.

At first the trustful Greek did not even have a lock on the small boxes, but the raids of the small boys of other denominations soon reduced the funds in the "slot machines" faster than he could get around to collect them. It is a fact—and one that has caused much comment—that few people try to cheat the boy who has inaugurated this convenient and silent system of selling papers, either by taking the papers without even making a pretense of putting in a coin, or by pretending to slip a penny into the slot. If all of our papers were sold on this system of trusting the public we would not be bothered with a great amount of shouting on the streets.

ELECTRIC EQUIPMENT OF THE PANAMA CANAL

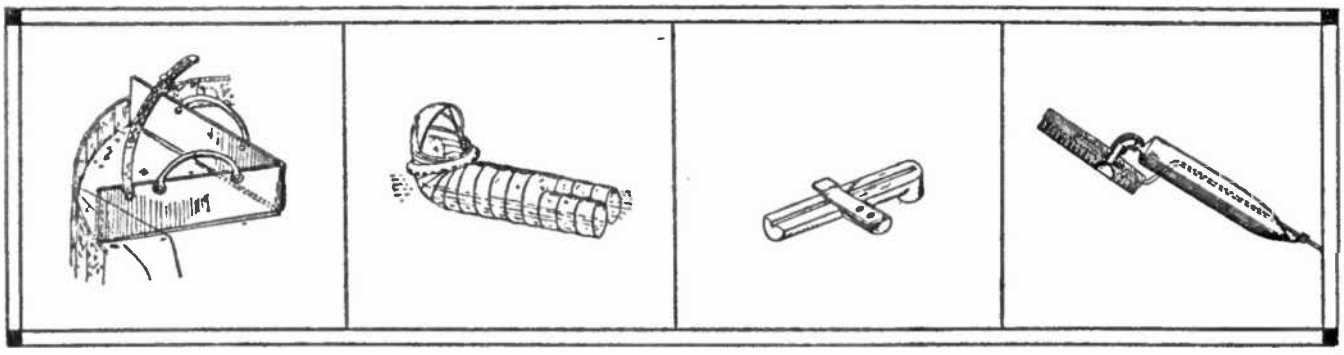
Nearly two thousand special drawings were required in the fabrication, and there were also involved the following unusual quantities of materials in the electric equipment of the Panama Canal:

Special slate bases	1,300	
Small castings	160,000	
Screw machine parts	1,200,000	
Copper rod and bar	58,000	ft.
Asbestos lumber	9,000	sq. ft.
New patterns	650	
New jigs, templates, tools, etc.	625	
Porcelain parts	18,000	
Special bus supports	6,800	
Gal. pipe (framework)	21,000	ft.
Special gears	2,390	
Special instruments	640	
Miscellaneous sherardized pieces	300,000	
Cases for boxing	4,150	

The combined weight of the centralized control boards for Gatun, Pedro Miguel, and Miraflores is about 39 tons. In their construction there is employed:

More than 2¼ miles of interlocking rod;
About six million feet of control leads—made up in 5 and 8 conductor cables;
732 indicator motors;
464 control switches.

All of the lock machinery motors, control panels, centralized control boards, power station generating apparatus, switchboards, transmission line substation equipments, coaling stations, and practically the entire electrical equipment for the wharf terminal cranes and for the extensive permanent repair machine shops were manufactured by the General Electric Company.



Recent Novel Patents

Apparatus for Cutting Butter

One of the most unique patents that have been granted within the last few months is an apparatus for cutting butter. It consists of two hinged members sharpened on one edge and fitted with handles. The two members can be so spaced as to form any desired angle and held in that position by a connecting member.

Life-Saving Apparatus

Of the many inventions for life saving at sea, that of a New York inventor is among the most interesting ones. As shown in the illustration it is an odd shaped suit that is worn by persons to enable them to float in the water. A life ring is placed around the neck portion to prevent the suit from capsizing. The head of the wearer is held above water and is protected by a hood.

A Needle Threader

In one of the accompanying illustrations is shown a simple needle threader that has been patented by an Oklahoma inventor. It consists of a member that has a groove on one side in which to place the needle which is then firmly held by a springy metal strip; the thread being passed through a hole in the back of the member and passing through the eye of the needle held in the groove. Of course, the walls of the hole gradually converge as they approach the eye of the needle.

Cream Massage Device

In order to facilitate the application of massage cream, a Chicago inventor has patented the device shown in one of the sketches. It consists of a massage member to which is connected a collapsible massage cream container by means of a tube. As the massage member is employed on a patient's face, a slight pressure on the collapsible tube supplies the cream in any quantity desired.

Pineapple-Eye Snip

A New England inventor has been granted patent rights on an implement for removing the eyes of pineapples. As shown in the illustration, this device is very much the same as a pair of ordinary pliers, with the one exception that the jawlike portion is sharpened so that the two members can be pushed into a pineapple and then brought together in order to remove the eye.

A Drinking Cup

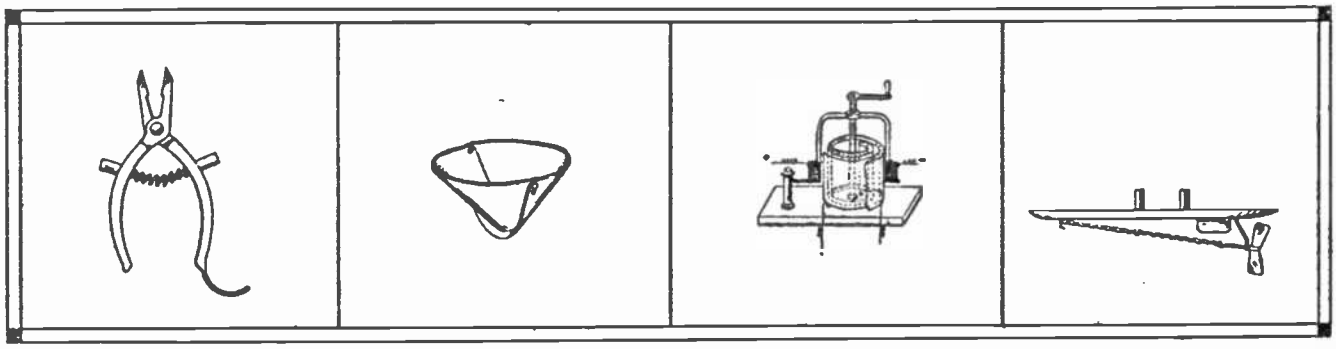
A very clever form of drinking cup has recently been patented by a West Virginian inventor. As shown in the illustration, this cup consists simply of two sections held together by metal eyelets in such a manner that normally the cup is absolutely flat. When it is desired for use, one section is turned around so as to form a cone-like container.

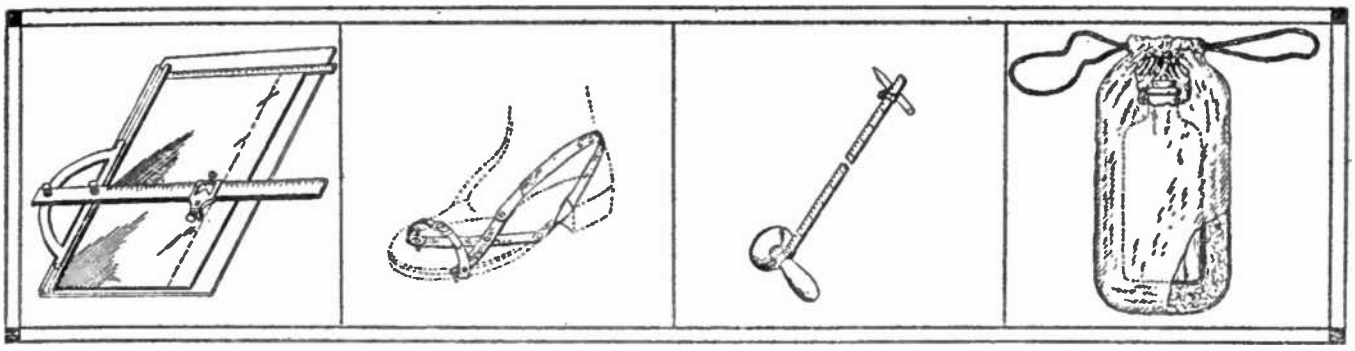
A Clever Electrical Instrument

To an Austrian inventor an American patent has been granted for an electrical measuring device shown in one of the illustrations. This device is termed an Electric Capacitative-Inductive Coupling. While the exact use to which this instrument can be put is not made clear in the patent papers, the commendable feature of the device is the mechanical construction. It will be noted that as the handle is turned, the coil is lowered and the condenser strips in the center are spread further apart from each other.

A Toy Motor-Boat

A New York inventor has succeeded in obtaining a patent on a rather novel toy in the form of a motor-boat driven by a rubber band motor. As shown in the illustration, the top consists of a light hull with such ornamentation as smokestacks in order to give it a realistic appearance, as well as a rubber band motor under the hull driving a large propeller.





Glass Cutting Tool

To facilitate the cutting of glass in any desired shape an inventor has patented the device shown in one of the accompanying sketches. It consists of a base on one side of which is a metal groove that holds a sliding portion to which is attached a straightedge. As will be noted, the straightedge can be adjusted to any angle by loosening the set screw. The sliding member is made in the shape of a protractor and graduated accordingly. On the straightedge slides a member holding a piece of marking chalk. In use, the straightedge is set at right angles and its sliding member is moved to the desired width. By sliding the straightedge at right angles a chalkline is drawn on the glass.

A Shoe Attachment

Among the many recent patents granted for articles of Winter use is a simple attachment that may be fastened to any shoe by means of a simple strap. The attachment consists of two metal pieces crossing each other with spikes on the undersides in order to permit of sure footing on ice. A back strap is provided for holding the attachment in the rear while a strap with a buckle is fastened around the toe portion of the shoe for holding the front.

Device for Drawing Circles

A simple device for drawing circles is the subject of a patent that has been secured by a Michigan inventor. This device is exceedingly simple, consisting of a center member for holding a swinging arm, the arm portion, a clamp sliding on the arm and holding the writing member, and lastly, the writing member. The arm is graduated and it is only necessary to move the clamp to the desired degree to secure a circle of any radius within limits.

Mailing Bag for Bottles

A New York inventor has recently secured a patent on a novel mailing bag for bottles, which is shown in the illustration. It consists simply of a bag made of waterproof material and which may be closed by drawstrings at the top. A smaller inner bag is also employed and between this and the outer bag is a space filled with suitable material for protecting the glass bottle from breakage. The material will also absorb the contents of the bottle should it be accidentally broken. One feature of the bag to which the inventor calls particular attention is that the bottle stopper is held firmly in position by the upper portion of the bag closing over it.

Device for Pulling On Shoes

A Canadian inventor has just secured patent rights on a device for pulling on shoes. The device consists of stationary and pivoted members so fastened that the latter may be given an upward movement by pulling on a lever. In pulling the movable member upwards, a lower wedge-shaped portion also gives it a sideway movement so as to form a grip with the stationary member.

Paper Box for Mailing Purposes

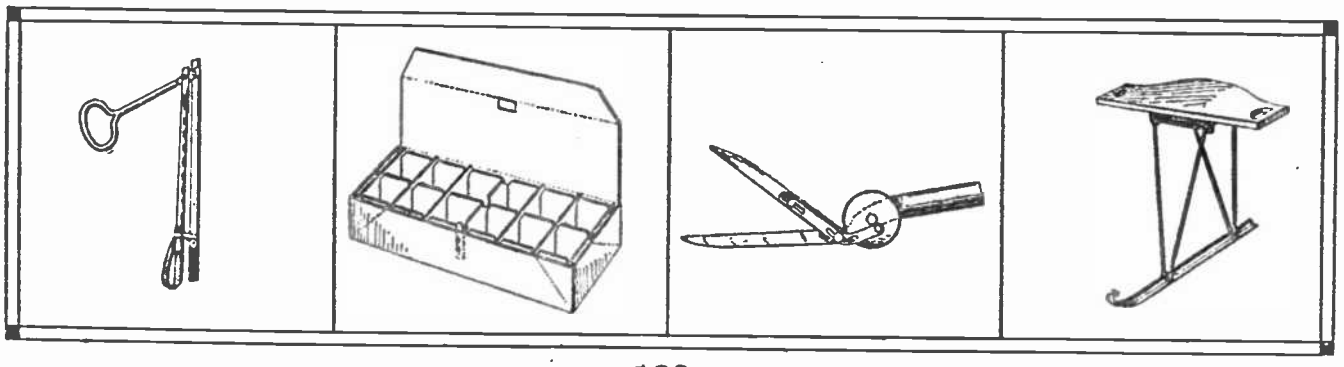
In order to meet the demand for a safe method of shipping eggs by parcel post a patent has been taken out for a paper box by a New York inventor. As will be seen in the sketch, this box is designed much along the same lines as the usual egg boxes fitted with partitions. However, it has a double wall in order to take up shocks. Furthermore, a metal strip fastened to the front of the box, passes through a slot in the lid of the box when the latter is closed and can be bent back to secure it in place during shipment.

Novel Shears

A Michigan inventor has recently patented a design of shears possessing many unique features and advantages over existing types. As will be seen in the illustration, the shears consist of two blades of the usual variety, a wheel member to which one of the blades is connected, and a handle. As the shears are pushed along on a surface, the upper blade is given a cutting movement through the rotation of the wheel to which it is connected. Adjustments are provided for regulating the length of the cut. Obviously, such shears make it a simple matter to cut through fabrics of all kinds.

A Coaster Sled

A sled of entirely new design is the subject of a patent granted to a Pennsylvania inventor. The sled consists simply of a board in which two holes for gripping with the hands are provided, a single runner and the necessary framework. Inasmuch as the sleigh has but one runner, its operation requires considerable skill, while on the other hand, it will probably develop greater speed and provide more enjoyment than the usual type. The rider sits on the board firmly holding each side and balancing himself while coasting down the hill. One novel feature is that the framework can be folded up and the sled carried without difficulty.



BOOK REVIEWS

Reference Book on Modern Motor Cars

Under the title of "The Modern Motor Car" there has been published a most excellent work of reference on the modern automobile and everything pertaining to automobile engineering.

Even a casual glance through the many pages of this work* does not fail to reveal that the subject is covered in a thorough and understandable manner. Another feature that is immediately noticed is that the various phases in automobile engineering are considered in proper sequence—a point in favor of the book if it is to be employed as self-instructor on the subject. Briefly, the work covers its field in five parts, as follows: The gasoline engine, carburetors and carburetion, oiling systems and lubricants, cooling, and ignition.

"The Modern Motor Car" is profusely illustrated with comprehensible diagrams clearly showing the construction and operation of every important part of an automobile. The text is clear, to the point, complete, yet devoid of any unnecessary description.

This book will be found a very valuable reference for anyone having to do with a motor car, whether he be a repairman, owner, driver, student or salesman.

* *The Modern Motor Car*, by H. P. Manly. Published by Laird & Lee, Inc., Chicago, Ill. Contains over 512 pages and 217 illustrations. Bound in full leather, flexible covers. Price, $2.50.

Handbook for Electrical Engineers and Students

Although there are many excellent reference books for engineers that are compiled in a condensed, handy form, it is doubtful if there can ever be a superfluity of such works—especially good ones.

Another splendid reference work for engineers and students has recently been published under the title of "American Handbook for Electrical Engineers."* There is scarcely a single subject on electrical engineering or any topic akin to the electrical field that has not been covered in this work. Of course, everything has been condensed, yet the very essence of each subject is given. The work contains many excellent tables and formulas that will be found a great aid to anyone engaged in electrical engineering.

It would be impossible in a review of this kind to enumerate the subjects covered. Suffice it to state that there are over 2,000 pages in this work and in each description of a subject not an unnecessary word is employed. This will give one an idea as to the immense scope of the book. One important feature of the book is that all subjects are arranged alphabetically, beginning at the front and arranged in regular order to the last page. This greatly simplifies the matter of referring rapidly to any desired subject.

We do not hesitate in recommending this work to engineers and students in electricity. It comprises a splendid reference library in itself and will be found a constant aid.

* *American Handbook for Electrical Engineers*, compiled by a staff of specialists headed by Harold Pender, Editor-in-Chief. Published by John Wiley & Sons, New York. Contains over 2,023 pages. Profusely illustrated. Bound in leather, flexible covers. Gilt edge pages. Price, $5.00.

A Reference Work for the Experimenter.

Mr. Edelman has added another contribution to his already numerous works devoted to the experimenters and wireless amateurs of America. His latest work is entitled "Experiments"* and deals with the hobby and profession of experimenting.

The work is divided into two main parts. The first part is devoted to numerous experiments that may be performed by anyone. Most of the information has been secured from the leading scientific magazines; the experiments being culled from these various sources with commendable judgment. Not all of the experiments have been the suggestions of other writers, for there are many by the author of the work, prominent among which are those comprising the series on simple experiments in chemistry which appeared in *Modern Electrics* several years ago. The second part—in reality an entirely separate work—is devoted to teaching an experimenter how to conduct his work systematically so as to obtain the greatest benefits from his labors. Inasmuch as this portion of the book is said by the author to be a compilation of many methods and suggestions of the leading experimenters of today, it is quite unique and invaluable to anyone engaged in research work.

"Experiments" covers a field that is yet comparatively barren of reference works. It is a forerunner of many other books that will sooner or later be published to aid those who devote their time to developing new devices or processes, or discovering new principles, of importance to mankind.

* *Experiments*, by Philip E. Edelman. Published by Philip E. Edelman, Minneapolis, Minn. Contains 256 pages and is profusely illustrated. Cloth bound. Price, $1.50.

Interesting information on telephone receivers for wireless purposes as well as a code chart and time signal facts is contained in the catalogue of C. Brandes, Inc., 1 Liberty Street, New York. A copy will be mailed on request to anyone sending a two-cent stamp.

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.

PREVENTING BELL TROUBLE.

(1) W. H., Brooklyn, N. Y., asks:

Q. 1.—Can the sparking at contacts of electromechanical gongs be reduced? The coils have 40 ohms resistance and the batteries give 15 volts. Eight bells are operated in parallel.

A. 1.—The use of high resistance shunts, as you suggest, will be advantageous, but to predetermine just what number of ohms to use would be only a matter of experiment. There would be the disadvantage, however, from the use of such resistances in that there would always be a leak of current through them. Your best plan will be to use condensers, and a large variety of sizes are now available at very low prices. Address the Western Electric or the Automatic Electric Company, of Chicago.

CHARGING STORAGE BATTERIES.

(2) L. L. F., Cornish, Me., asks:

Q. 1.—Can a 6-volt, 60-ampere-hour storage battery be charged by means of a 14-volt, 3-ampere direct current magneto generator?

A. 1.—Yes, and 3 amperes is a good rate for such a size of battery. Be sure you have a voltmeter of the permanent-magnet type when testing for polarity, else you are likely to reverse the charge, with consequent great injury to the plates. Of course, you also require an ammeter, and the current can readily be adjusted by use of an iron or German silver wire inserted in series with the cell.

Q. 2.—Is the current obtained from a mercury arc rectifier or any form of electrolytic rectifier pulsating or quite uniform?

A. 2.—It is pulsating, therefore it is not altogether adapted for operating such electromagnetic devices as have solid iron cores, nor for exciting the field of an alternator.

WEATHER BULLETINS.

(3) A. A., Pittsburgh, Penna., asks:

Q. 1.—What do the additional letters used by Arlington when sending the weather bulletins stand for? They formerly only sent eight, but now they send seventeen. Also please explain the meaning of the fourth number in each report.

A. 1.—While this matter has been covered before it seems worth while to repeat it because there seems to be considerable misunderstanding as to the meaning of these reports. At eight o'clock every evening the weather is observed and reported by telegraph to Arlington, where the combined bulletin is sent out broadcast at ten o'clock each night. This bulletin is divided into two parts, one for the Atlantic Coast and one for the Great Lakes. The report for the Great Lakes is only sent during the open season or from April to December. The letters used in these bulletins designate the following places where the weather conditions are observed: S—Sidney, N. S.; T—Nantucket; A—Atlantic City; H—Hatteras; C—Charleston; B—Bermuda; K—Key West; P—Pensacola; these make up the Atlantic Coast and Gulf Division. The Great Lakes Division is: DU—Duluth; M—Marquette; U—S. S. Marie; G—Green Bay; CH—Chicago; L—Alpena; D—Detroit; V—Cleveland; F—Buffalo. These latter stations do not come in the report directly after the Atlantic Coast stations, but after the wind forecast for the Atlantic Division. The numbers following these letters consist of the following information: The first three numbers are the barometer, the first figure of the barometer report is omitted as it is unnecessary. The next or fourth number is the direction of the wind, the compass being divided into eight parts for this purpose. North is 1, Northeast 2, East 3, etc. The fifth or last number is the velocity of the wind in the Beaufort scale.

ELECTROMAGNETS AND ACCUMULATORS.

(4) W. B., Cleveland, O., asks:

Q. 1.—What should be the dimensions and winding for electromagnetic coils suitable for use in energizing permanent magnets, such as are employed on ignition generators, the available circuit being 110 volts, direct current?

A. 1.—For such momentary uses it is com-

mon to allow a current far in excess of what the wire could permanently withstand. For instance, if you use the current for only five minutes at a time you could safely permit two to three times as much current as would be safe for a continuously working dynamo. Of course, you wish the coils to be adapted for any size of magnets that may come to hand, and for this reason you can well have the two spools quite independent, a piece of lamp cord providing for putting them in series. If the largest size of stock you find to be ½" x 1½", you can make the rectangular holes in ⅛" fiber flanges ⅝" x 1¾"; and if the closest distance between poles is 3", you can then make outside dimensions of flanges 2⅞" x 4", except that a good place for attaching binding posts will be furnished by letting one side of one flange of each spool be about an inch wider. The connecting member can be of thin sheet metal, either iron or copper, with a winding space between flanges of 4". You can use No. 18 d.c.c. wire, 80 turns per layer, 18 layers, giving a resistance of the two spools in series of 13 ohms; or you can use No. 20 wire, 100 turns per layer, 22 layers, with a resistance of 30 ohms. About 5 lbs. per spool will be required.

Q. 2.—What are the chemical reactions in a lead storage cell?

A. 2.—On the charge the positive plate becomes oxidized (rusted), while the negative becomes less oxidized and sulphuric acid is formed. During the discharge the positive plate becomes less oxidized, an increase in the amount of lead sulphate taking place, while at the negative plate also the metallic lead becomes more or less sulphated. You will find clear and complete descriptions of this action in Watson's book on storage batteries.

RADIO TRANSFORMER.

(5) J. L. G., Rosser, Manitoba, writes:

Q. 1.—In Chapter 1, Section 9, of "Principles of Electric Wave Telegraphy and Telephony," Fleming states that an induction coil can be used as an alternating current transformer if the break and condenser be removed and the primary terminals be connected to a source of alternating current. I thought that the core of the coil must be of the closed core type before it would work on alternating current.

A. 1.—The statement in Fleming is perfectly correct. There is no need for the core to be closed before the coil will work as an alternating current transformer. The earlier government specifications for their naval radio transformers up to several kilowatts often called for open core transformers. The closed core has a much less reluctance to offer the flux so that closed core transformers can be much more economically constructed for power work, but for wireless work this high reluctance is often an advantage to limit the secondary current when the spark jumps, so that we find many open core transformers used in wireless work, but very seldom in power work.

Q. 2.—I am taking up a course in electrical engineering. What particular branch of that profession would you advise me to follow?

A. 2.—The answer to this question can only be determined by you. You know best what you prefer to do. Do what you think you will be most contented in, then you will have the best success there. There is electric traction, central station work, telephone, and other branches of the profession for you to choose from. The central station industry offers fully as good an opening as the other branches. To get into this work you would probably be required to serve time in some power station as operator or load dispatcher, but the ultimate field is very good.

Q. 3.—What kind of a break will I need with a 12-inch spark coil?

A. 3.—The most practical would probably be an independent hammer interrupter operated by an auxiliary circuit.

AUDION.

(6) J. S. S., Plymouth, Wis., asks:

Q. 1.—Can a step down transformer be used to supply the current for the heating element of an audion detector? The transformer is to be used on 110 volt, 60 cycle alternating current.

A. 1.—No, a transformer cannot be used to supplant a storage or primary battery to supply an audion detector. The audion is dependent in its action on the fact that the current through the heating element is emitting ions in a given direction which enables it to act as a rectifier. If alternating current were used the polarity of the grid would constantly be changing and the audion would no longer act as a rectifier. Having to use a storage battery or some other equally constant supply of direct current greatly limits the application of the audion for amateur use. This is unfortunate, since the audion is a very sensitive device.

PSEUDO AERIAL.

(7) J. D. E., Parisville, Miss., asks:

Q. 1.—I am located about 70 miles from the high power station at New Orleans and would like to put up a receiving set so as to hear them. It is inconvenient to put up an aerial and we have 110 volt A. C. in the house but with no day current. Could I use these electric light wires as an aerial when the current is off?

A. 1.—We doubt if you would have any great success with this type of aerial, although it might possibly work if the line is ungrounded. The mass of iron due to the transformer at the end of the line would probably damp out any received signals so that you could not use these wires for an aerial. Why not try putting up an indoor aerial?

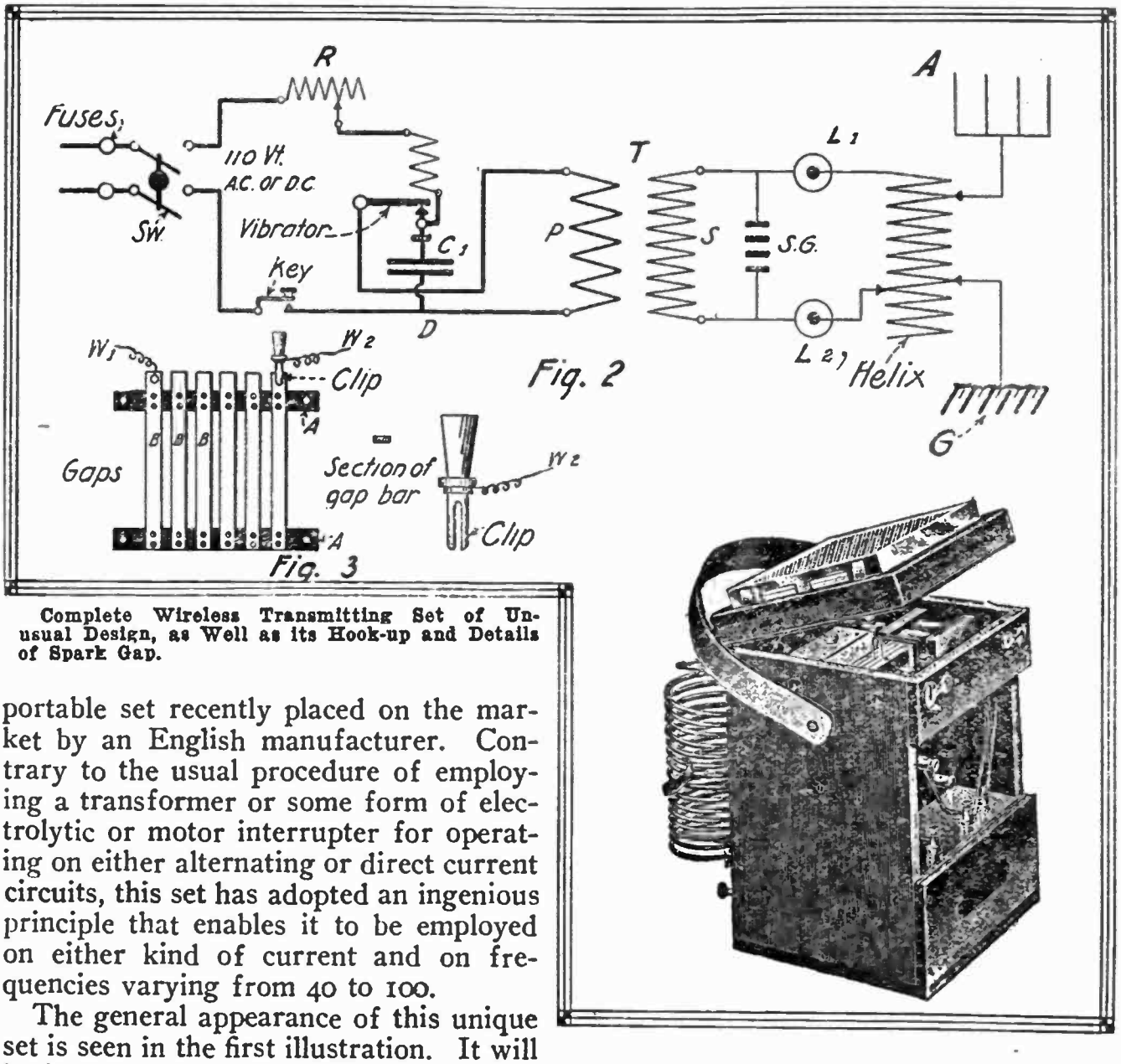
Radio Section

Devoted to the encouragement of the amateur and experimenter in the field of radio communication

TRANSMITTING SET OF RADICAL DESIGN

A NEW and rather radical departure in the design of wireless transmitting equipment is presented in a portable set recently placed on the market by an English manufacturer. Contrary to the usual procedure of employing a transformer or some form of electrolytic or motor interrupter for operating on either alternating or direct current circuits, this set has adopted an ingenious principle that enables it to be employed on either kind of current and on frequencies varying from 40 to 100.

The general appearance of this unique set is seen in the first illustration. It will be immediately noted that the apparatus is exceedingly compact and rugged, permitting of its use to good advantage for army work as well as on aircraft. The set comprises everything necessary for transmitting with the exception of the 110-volt generator. These sets have been made in capacities ranging from 1/8 to 1 K. W.



Complete Wireless Transmitting Set of Unusual Design, as Well as its Hook-up and Details of Spark Gap.

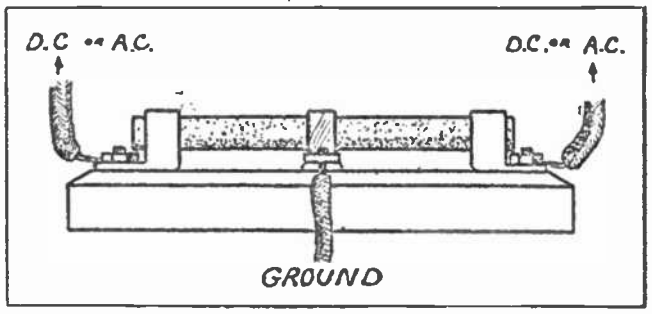
The set includes a step-up transformer of very small proportions, a special magnetic vibrator, leyden jars, tuning helix, vibrator condenser and key. The general arrangement of these parts may be gained from the accompanying wiring diagram. It will be noted that 110 or 220 volt current passes through fuses and a switch to the rheostat and choking inductance *R;* thence through the vibrator magnet winding *M,* on through the vibrator break and around the primary coil *P* of the step-up transformer *T,* back through the key to the source of current. Current flowing through this circuit causes the vibrator to make and break the flow of current in the primary circuit many times a second. Frequencies emitting a tone equivalent to that of a 500-cycle set may be obtained with stiff tension on the vibrator armature. Oscillations are created in the tuned circuit comprising the inductance *P,* condenser C_1 and spark gap *E.* It will be noted that the vibrator gap acts as a spark gap of the oscillatory circuit just outlined. This circuit must be tuned correctly, of course, in respect to the secondary circuit, if best results are to be obtained with the set.

The secondary transformer circuit is connected to two leyden jars L_1 and L_2 and also to a spark gap *SG* and a helix for tuning in the aerial and ground. The spark gap is exceedingly ingenious and of somewhat unusual design, as may be seen from the sketch of the gap. Although this gap is sometimes termed a "quenched" gap by some builders of radio apparatus, in view of the fact that the gap is open it cannot be considered to be of the quenched type, since many gaps of that kind depend for their efficiency upon the feature that the spark discharges occur in a partial vacuum. However, irrespective of the type to which this gap may lay claim, it is a very efficient gap for the purpose. It comprises a number of zinc bars *B* about 1/8 x 3/8" in section and from 6 to 8" long. These are mounted on two hard rubber or fibre bars *AA.* A clip fastened to a flexible cord lead permits of any number of gaps being connected in series. The individual gaps are quite short, being about 1/64". Series gaps of this design are very efficient in producing a sharp condenser discharge, since they cool much faster than would a single, larger gap.

The outfit is so compact and possesses so many features that many amateurs could well adopt the principles presented. Of course, no definite dimensions can be given and much experimenting must be resorted to in order to find the best proportions for the various parts. The condenser C_1 is perhaps the most difficult part to construct inasmuch as it must be made of tinfoil and mica, the latter being about eight to ten mils thick. The vibrator should be fitted with very heavy silver contacts about 1/4" diameter or more.—H. WINFIELD SECOR.

PROTECTIVE DEVICES

One of the best and most widely used devices for protecting generators and motors operating a wireless circuit is shown in the accompanying drawing. A high resistance carbon rod is mounted in such a way as to allow the two ends to be shunted across the D. C. or A. C. low tension lines, while the middle of the carbon rod can be connected directly to earth. By this means the induced currents due to electrostatic induction are led directly to earth without injuring the low potential circuits. The carbon rods offering a very high resistance to low tension currents only allow the high tension induced currents to pass and they



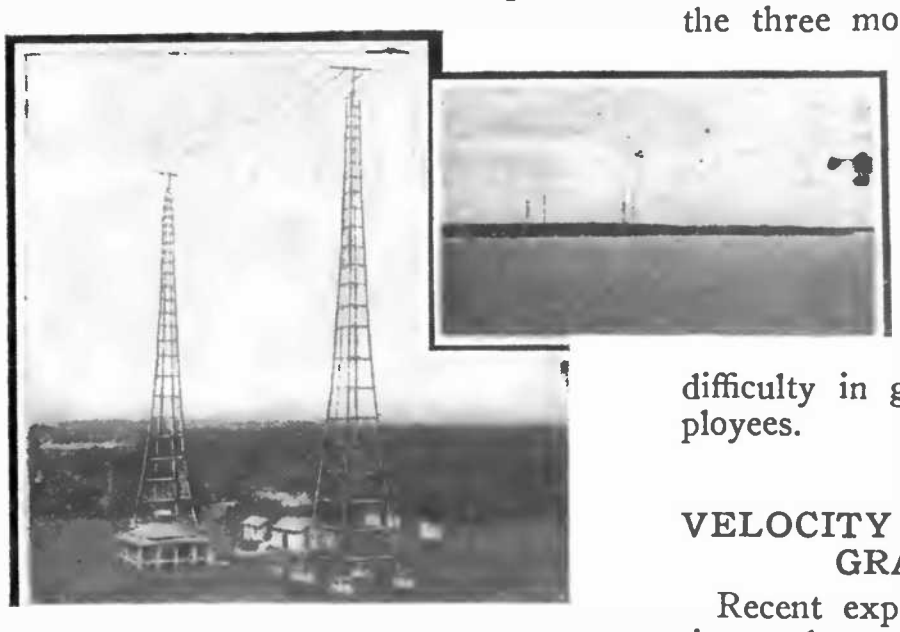
Graphite Rod and Connections for Protecting Power Lines.

thus find their way directly to earth, while the low tension currents are not affected.

This device is necessary in all cases where a motor is directly connected to a rotary spark gap. On transmitters using from 2 K. W. upwards, these protective devices are indispensable and should be shunted across the primary of the transformer, the A. C. and D. C. terminals, and across the motor and generator fields.—GEO. S. SMYTHE.

WIRELESS STATION ON CARIBBEAN SEA ISLAND

SOME 250 miles north of Colon in the Caribbean Sea lies a strip of land two miles long by one wide known as Swan Island, upon which has recently been completed a wireless station requiring two 250 horsepower engines when in operation. The station is owned by the United Steamship Company and has in constant attendance two operators.



Close and Distant Views of the Wireless Station at Swan Island, in the Caribbean Sea.

These, with from fifteen to twenty white men and as many Jamaica negroes, constitute the sole population of the island, which produces from 15,000 to 25,000 cocoanuts monthly.

The soil is excellent, producing all kinds of tropical fruits and vegetables. Duck, teal pigeons and turtle abound. They have a water distilling apparatus capable of providing for 100 men and large tanks for collecting rain water. It is difficult to keep men on this isolated island. Steamships anchor out ½ or ¾ of a mile from the shore about once a month and lighter needed supplies and mail to the men.

Laborers leaving New Orleans or other ports must sign a contract to remain at least three months. Their transportation is furnished and all expenses on the island paid. If they leave before the three months expire they forfeit their wages, getting nothing for any work they may have done. Sometimes they stay longer; a few have remained two or three years. No women are allowed on the island. That may, in a measure, account for the difficulty in getting and keeping employees.

VELOCITY OF WIRELESS TELEGRAPH SIGNALS

Recent experiments of French scientists to determine the velocity of wireless telegraph signals indicate that this velocity is slightly lower than that of light. The method adopted is to send out a signal from the Eiffel Tower to another station whose distance has been very accurately calculated. At the moment the signal reaches the second station a return signal is automatically sent back. The time of emission and reception is recorded by means of a photographic micro-galvanometer in which the record is made on a moving band of sensitive paper. Thus the time elapsing between two successive records will measure very

accurately the time taken by the signal to travel the double distance. As the result of these experiments the following figures have been arrived at:

Paris to Toulon, .00237 sec.; Paris to Washington, .02122 sec., with a possible error of .00001 sec.

This indicates that the average velocity of the wireless signal is about 296,000 kilometers (185,000 miles) per second; that of light being about 186,000 miles per second.

RADIO LAW OFFENDER IS PUNISHED

An amateur radio operator residing in the Bronx section of New York City has recently pleaded guilty before Judge Foster in the United States District Court in New York City to the charge of operating a wireless station without the necessary government license, using a wave length in excess of 200 metres which interfered with commercial stations, as well as using unofficial radio call letters. He was fined by the Court and cautioned not to repeat the offense.

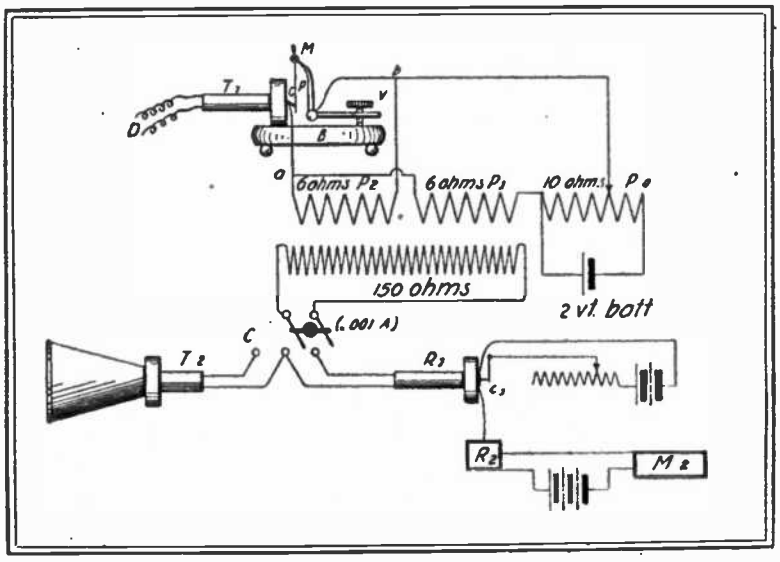
This is the second case of its kind reported to the District Attorney by W. D. Terrill, Radio Inspector in charge, for a violation of the radio laws. The former case was that of another New York amateur who was fined by the Court the sum of $50 for operating a radio telephone without a license.

These two instances should act as a caution to all amateur wireless operators. Anyone violating the radio laws is more than certain to be discovered and brought to Court sooner or later.

THE BRANAS MICRORADIOGRAPH

At a recent meeting of the French Academy of Sciences, M. Branas described an instrument which he calls a microradiograph and with which he has been experimenting successfully. This device constitutes a new method for the reception and registration of radio telegrams by means of a Morse recorder of the conventional design.

The instrument consists of two parts: the amplifier and the relays. The amplifier includes a variable resistance contact, an open magnetic circuit transformer and a potentiometer. The variable resistance *c* is placed between two pieces of platinum; one of these is attached to the diaphragm of the telephone T_1, and the other is a part of the pendulum *P*. The period of the pendulum and the pressure of contact are regulated respectively by the counterweight *M*, which is movable, and the screw *V*. The whole is mounted on a block *B*, supported by springs in order to deaden any vibration, and which may be enclosed in a glass case to protect it from sound waves.



Wiring Diagram of New Wireless Recording Apparatus.

The primary winding of the transformer is divided into two equal parts P_1 and P_2. The part P_1 is mounted in derivation

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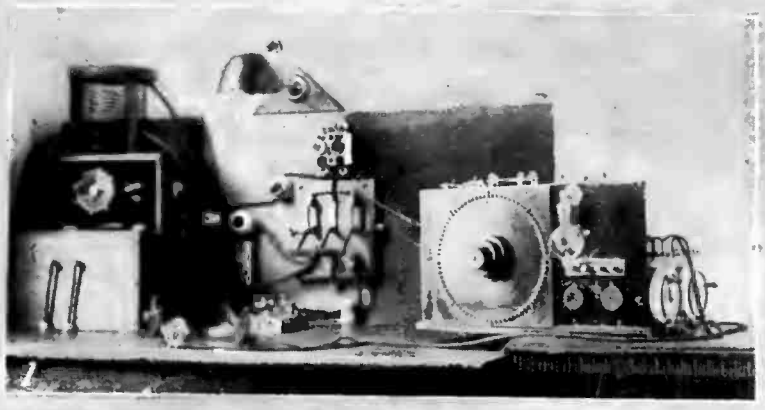
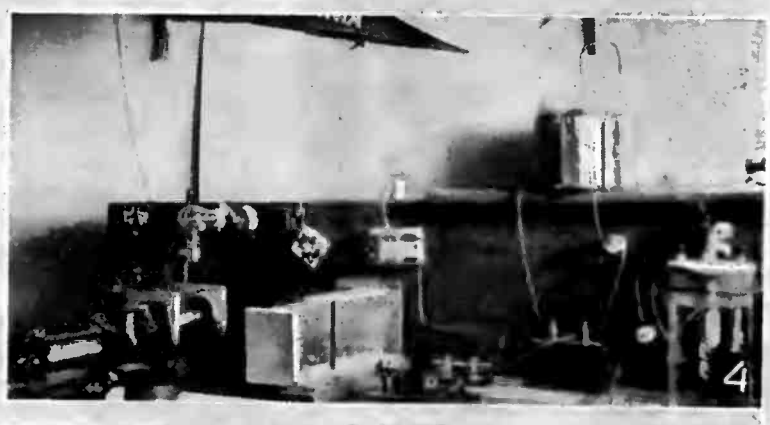
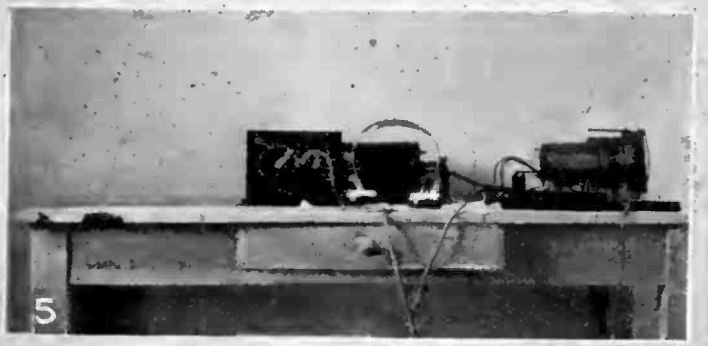
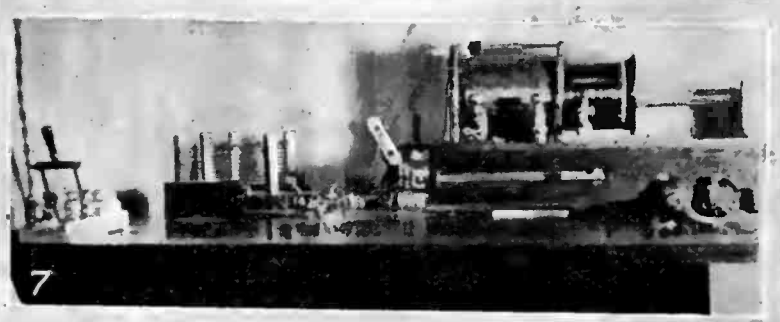
AMATEUR WIRELESS STATIONS









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

(1) Wireless transmitting and receiving outfit of Louis W. Elias of Columbus, O. Most of the apparatus has been made by the owner of the station. (2) Wireless station of Royal Weith, Chicago, Ill. (3) Wireless station of Charles Reynolds of Binghamton, N. Y. Three receiving sets are employed in this station, any one of which may be used for reading time signals from Arlington, Va. (4) Wireless station of H. Woods, Glendale, Cal. (5) Wireless station of W. Buckner, Paris, France. (6) Wireless station of Frank Pierce, Lincoln, Nebr. A 1 KW. transmitting set is employed. (7) Receiving and sending apparatus of T. C. Thompson, Montreal, Canada.

upon the contact c, in such a way that the current leaves the potentiometer P_0, continues across the half of the primary P_1 to the point a, where it divides to pass partly by the winding P_2 and partly by the contact c; thus reaching the point b and from there to the potentiometer. The direction of the current therefore changes from one-half of the primary to the other. The commutator C permits the sending of the current from the secondary winding either to the loud speaking telephone T_2 or to the relay R_1. The latter consists of a contact c' similar to the contact c, and is mounted in derivation with an ordinary relay R_2 which is necessarily in short circuit while the contact c' is not broken. At the moment that this contact is interrupted, the relay R_2 works and causes the operation of the Morse apparatus M_2.

WIRELESS TIME SAVERS

By P. H. Markmann

HOW many operators have tried to "raise" a station and, on account of the sharp wave of their transmitter as well as the great selectivity of the instruments at the receiving end, have been unable to make themselves heard?

The above troublesome factors, namely, sharp waves and close tuning, are absolutely necessary; the first is due to the law and the latter to the large number of sets in operation.

The author was troubled in this manner until he came across a method that permits of obtaining a broad wave without changing the transmitting adjustments or employing excessive wiring. It is simplicity itself and consists of a small rheostat regulator in the aerial circuit. The damping in the circuit depends on the resistance as one of the factors, with the result that an increase in the resistance augments the damping of the aerial thus creating a broad wave. In this manner, if an operator desires to call a station, he inserts a little resistance in the aerial and proceeds to call the station desired. The operator at the receiving end does not have to have his instruments closely tuned to the transmitting wave length in order to hear it. Of course, as soon as the station has heard the call and is tuned to receive the message, the resistance is cut out. If the rheostat regulator or other suitable form of variable resistance is inserted in the circuit above the aerial switch, the same procedure can be employed for receiving. By adding resistance it will be found that messages may be received over a wide range of wave lengths.

The aerial switch is usually a bore and it will be found advisable to adopt a good break-in system. There has been any number of these systems described in the columns of past issues of this magazine and its affiliated publications. As a word of suggestion, however, a system should be selected that has no spark gap in the ground lead since it will be found preferable.

Another source of considerable bother is the rotary spark gap, for it continues to run long after the current has been shut off, seriously interfering with the receiving operations. If it is connected to the aerial switch it requires considerable time to attain its speed, while on the other hand, if a separate switch is used to control it, that much extra work is involved.

There are two ways for doing away with the foregoing disadvantages. In the first place, it is possible to employ a gap similar to that of the old Marconi discharger. It consists of two contacts on the motor shaft revolving between a set of stationary plugs arranged in a circle. One-half of these are connected

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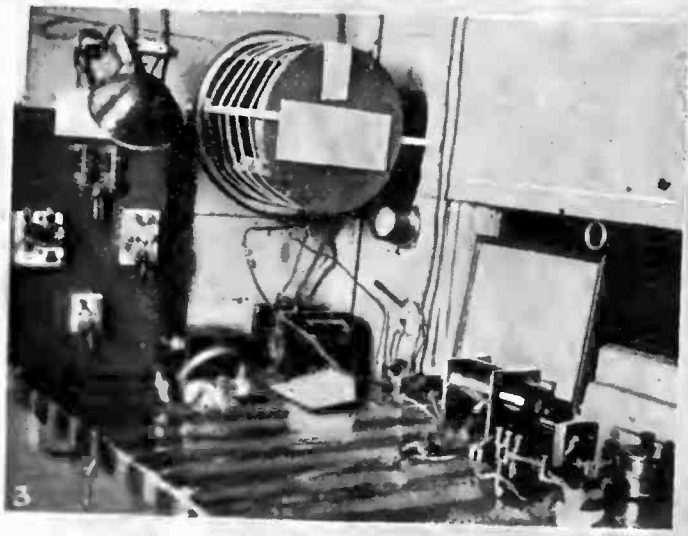
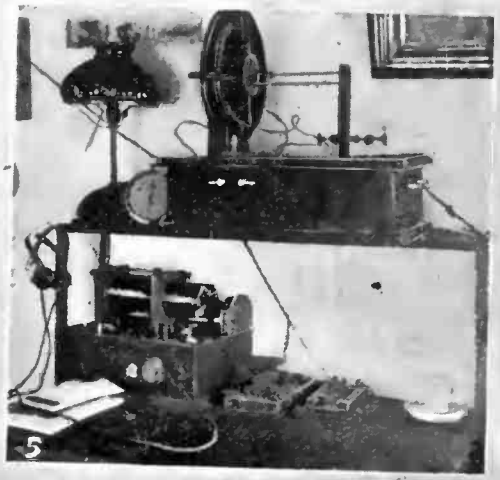
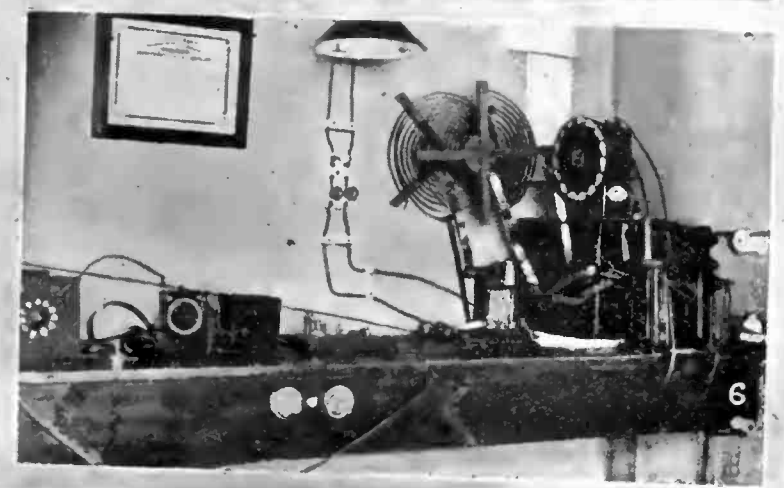
AMATEUR WIRELESS STATIONS







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

(1) Wireless station of Roy Waller, Cambridge, O. (2) Wireless station of Alfred Meuler of Oconomowoc, Wis. Practically all of the apparatus in this station has been home-made. (3) Receiving and sending apparatus of Carl Kottler, Milwaukee, Wis. The sending set consists of a one-inch coil operated from a step-down transformer. (4) Wireless station of W. E. Merrill of New York City, N. Y. The owner of this station has been aiming at efficiency and compactness in building his apparatus. (5) Wireless station of Ercil Armold, Chapman, Kans. (6) Wireless station of Edward L. Norton, Rockland, Me.

to one side of the current while the other half are connected to the other side. This gap starts quickly and, since it carries but little weight, it likewise stops quite suddenly. Another method is to employ a quenched gap. Of course, the usual chorus to this assertion is "It can't be done. I have 60 cycle current." But it *can* be done. It will give a mushy sounding spark, to be sure, but the efficiency is very high. And efficiency should not be confounded with the tone of the spark. It merely remains for the receiving station to have a tikker and great results can be obtained with a quenched gap.

A tikker is something which every station should have among its collection of detectors. It can be readily made, merely consisting of a toy motor, a grooved brass disc and a piece of springy brass wire. The disc is placed on the motor shaft and the wire is arranged to press lightly against the groove. The motor is driven at full speed. The wire and the disc are connected in series with the telephone receivers; the latter being shunted across a variable condenser employing air for the dielectric. However, the condenser need not be gradually variable, and one with five different capacities, which will be found ample, can be made as follows:

Twelve sheets of aluminum four by six inches are obtained. These should be perfectly flat and laid one above the other in a box of suitable size to hold them. The sheets are separated by strips of thin mica laid around the edges. Six of the sheets are connected to one post and the balance are connected to three contacts as follows: One sheet to the left-hand point, three to the center point and two sheets to the righ-hand point. The switch lever should be wide enough to bridge two contacts. A little thought will readily demonstrate how five variations of the capacity may be obtained by using the contacts singly or in pairs.

SILVER PLATING WIRELESS INSTRUMENT PARTS

Silver plating is particularly suitable for the metal parts of wireless instruments, as brass or copper left in its natural state will tarnish, spoiling the appearance and reducing the efficiency of the instrument. Even if these parts be nickel plated, nickel is a comparatively poor conductor and whatever is gained in appearance is lost in efficiency because the high frequency currents used in wireless travel apparently only on the surface—the plating—of the metal. The difference is so small as to be negligible, but when the infinitesimally small amount of current coming into a receiving instrument from a distant station is considered, it can be readily seen that any tarnished or dirty contacts, or any metal of low conductivity in the circuit, is liable to affect the working of the instrument and should be carefully guarded against. Silver, being a slightly better conductor than copper, should be used wherever possible in the instrument circuits.

A NEW TIME SIGNAL SERVICE

The Illinois Watch Company, of Springfield, Ill., announces the installation of a new transmitter of much higher power than hitherto used and invites all amateurs who pick up their time signals at 11.55 to 12.00 and 7.55 to 8.00 Central Time, to notify it of the fact by postcard. The signals should be audible from Denver to the Atlantic.

It is reported that Peter Cooper-Hewitt, of mercury-arc fame, is working upon radio apparatus of new and interesting design, in which the use of the mercury-arc bulb is indicated. While the time is not yet ripe for a public announcement, still it is hoped that further details may be available for publication in the February number.

How Wireless Stations are Tuned

By Geo. S. Smythe

To many readers the tuning of a transmitting set is still a mystery. In the contribution that follows the methods of tuning employed by Government inspectors and commercial companies are explained at length.

TO tune a transmitting circuit containing an oscillation transformer, three readings are required: the wave length of the open circuit, the wave length of the closed circuit, and the wave length of the complete set coupled in the ordinary manner.

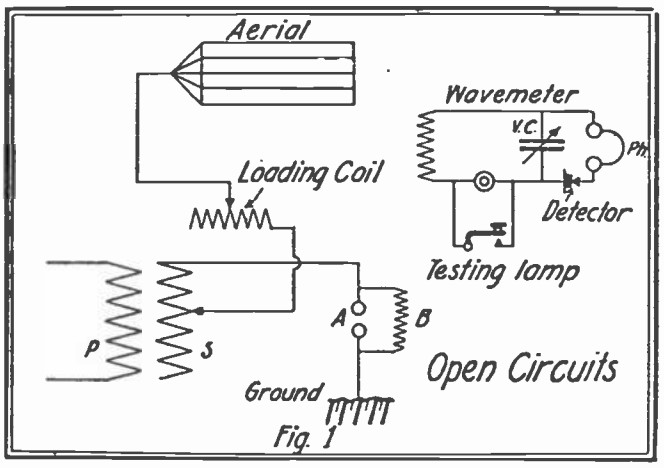


Fig. 1

The wave length of the open circuit is obtained by entirely disconnecting the oscillatory circuit from the primary of the oscillation transformer as in Fig. 1. A small spark gap *A* is placed in series with the antennæ and is energized by a small induction coil *B*. When the induction coil is placed in operation high frequency oscillations are set up in the open circuit, the period of which can be determined by varying the capacity *c* of the wavemeter until the loudest sound is produced in the head 'phones. The wavemeter being now in resonance with the open circuit, the natural wave length can be found by referring the reading of the capacity on the wavemeter to the graph or table on the lid of the meter.* To tune to a definite wave length the inductance in the secondary of the oscillation transformer should be varied until the wavemeter registers the wave length required. It is generally found that the number of turns in the secondary is not sufficient to step up the wave length. In this case a loading coil is necessary.

The closed circuit should then be tuned with the earth and aerial connections removed from the helix. The primary of the oscillation transformer and spark gap should be energized in the regular manner. Instead of using the detector on the wavemeter as in the last experiment, the small lamp should be

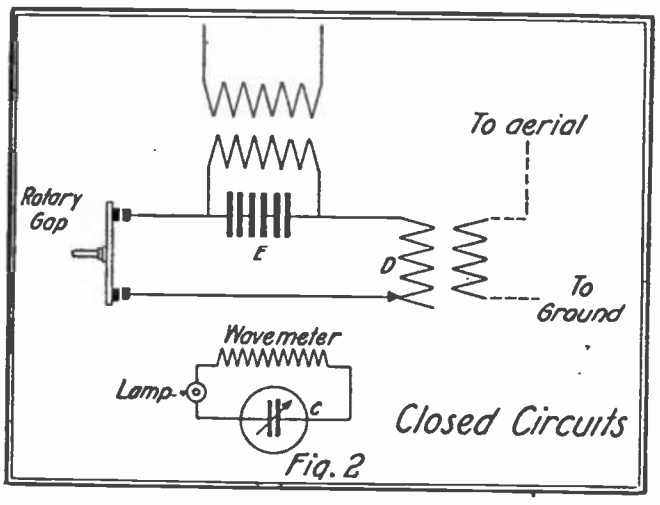


Fig. 2

* The author is referring to the Marconi wavemeter. However, other wavemeters may be used in a similar manner.

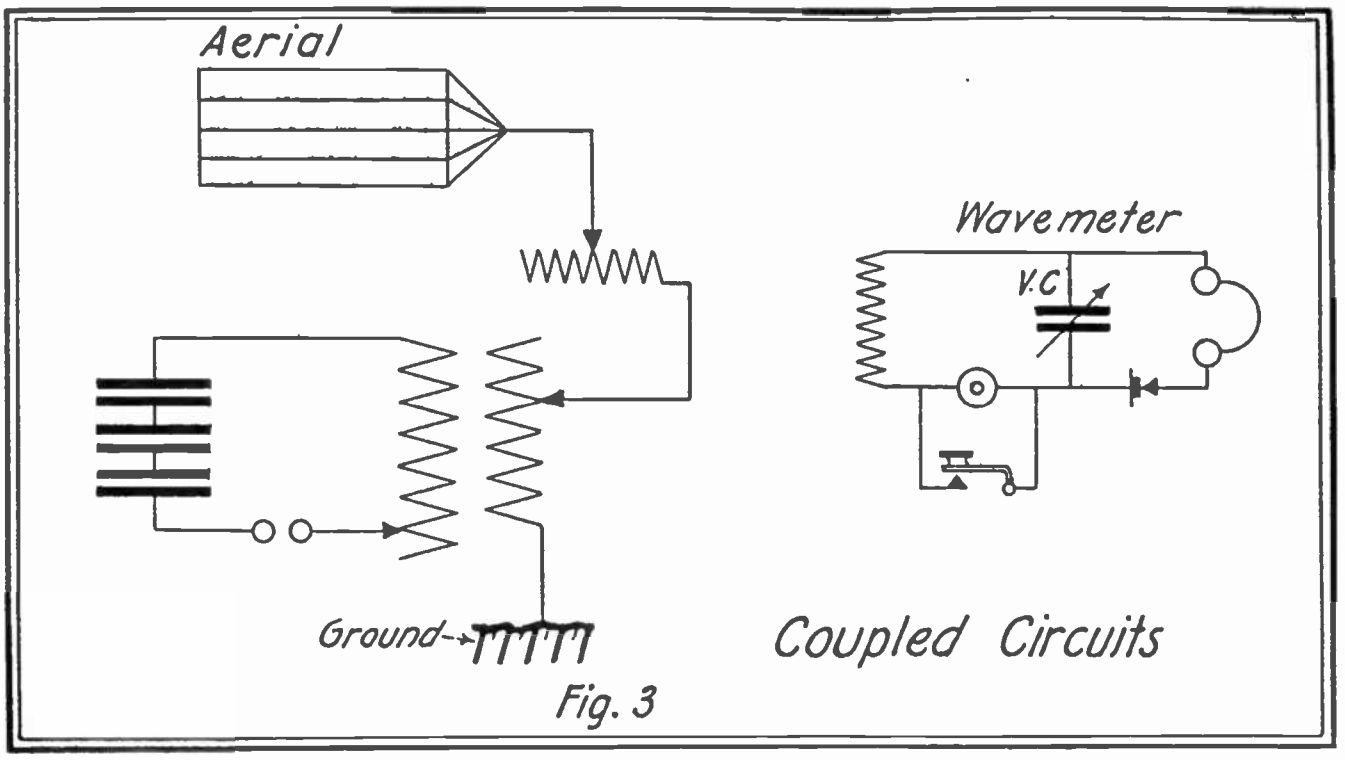


Fig. 3

used. The point of resonance between the wavemeter and the closed circuit will be indicated by the maximum glow of the lamp, but care should be taken not to bring the meter too near the closed circuit when the key is pressed, inasmuch as the induced oscillations may be so strong as to burn out the light or puncture the insulation of the inductance coil. The circuit can then be tuned to the required wave length by adjusting the inductance *D* or capacity *E* of the closed circuit. The arrangement can be seen in Fig. 2.

After the two circuits have been independently adjusted to the required wave length, the set should be coupled in the regular manner as in Fig. 3. When the circuit is energized the wavemeter will show two points of intensity, thus giving two separate wave lengths. This is due to the magnetic fields of the open and closed circuits acting upon one another and causing the antennæ to have two periods of vibration. This can be effectually minimized by reducing the coupling of the oscillation transformer until the wavemeter shows as far as possible a single radiation.

The degree of coupling can be figured as follows: Suppose the reading on the wavemeter indicates that two waves are being radiated, one being 630 meters, the other being 570 meters, the degree of coupling would be,

$$\frac{630^2 - 570^2}{630^2 - 570} = 9.9 \text{ per cent.}$$

NOVEL INSULATORS FOR SMALL AERIALS

Large wooden spools on which thread is wound may be easily converted into insulators for small aerials where a low power is employed for transmitting, or in cases where an aerial is employed for receiving only.

The spools are first baked by leaving them in an oven for a few hours in order to eliminate all moisture. They are then soaked in melted paraffine, followed by another baking, and finally shellacked.

Spools treated in this manner make attractive and very efficient insulators. They may be employed in the same way as common porcelain knobs. To provide better insulation two or more should be employed in series.—JOHN B. RAKOSKI.

The next cover of this magazine will appear as MODERN MECHANICS.

AN IMPROVED BUZZER TRANSMITTER

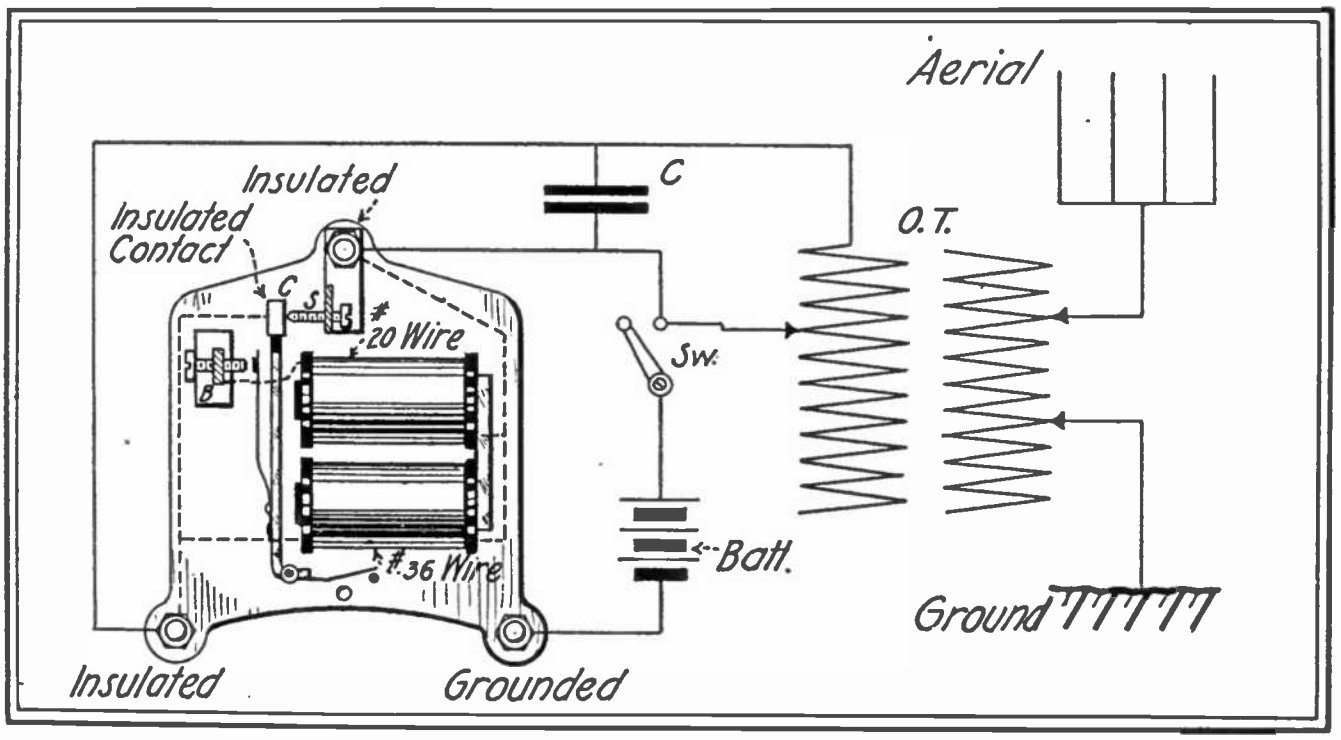
WHEN it became necessary for the writer to employ an oscillation transformer in connection with a buzzer transmitter because of the wireless law, it was found that the distance covered was greatly reduced. Not wishing to employ a larger set for local work, it was decided to change the windings on the magnets of the buzzer and put on another contact or "gap." With these alterations the writer can now cover a greater distance with an oscillation transformer than was possible with the old method.

In order to make an efficient buzzer transmitter that will operate in connection with an oscillation transformer, remove the two magnets from the buzzer and take off the windings. The iron cores are then covered with Empire tape. One of them is wound with No. 20 wire, while the other is wound with No. 36. The former is placed nearer the free end of the armature as the speed of vibration can be better regulated. The inside ends of the wire on the two magnets are then connected together and to a binding post set in the upper screw-hole yet insulated from the frame. The screw is also used to hold a small lug *L* which is threaded for the screw *S*.

The other end of the No. 20 wire is attached to the adjusting screw bracket *B* as in the regular buzzer connections. The other end of the No. 36 wire is fastened to the insulated binding post of the buzzer and to the insulated contact on the armature. The contact piece *C* is so placed that it forms a small gap with screw *S*, the latter regulating the length of the gap.

This arrangement makes the buzzer a small closed core transformer, but since such an instrument will not work directly on battery current, the vibrator must be employed. A small condenser is placed around the primary contact to reduce the sparking as well as increase the efficiency of the buzzer. If the buzzer is employed in connection with a step-down transformer instead of batteries, the primary contact may be done away with and the ends of the No. 20 wire connected with a key in series, direct to the low side of the transformer.

The gap is synchronous and the set should emit only one wave length.—FRANK H. BROOME.



Hook-up for Buzzer Transmitting Set of Original Design. Such a Transmitter Will Emit Waves in Keeping with the Wireless Law Restrictions.

AN INEXPENSIVE ROOF INSULATOR

An inexpensive roof insulator may be made from ordinary material as follows:

Take three thick porcelain plates, one of which should preferably be a soup plate, and drill or otherwise make a ¼-inch hole through the center of each. A convenient method of accomplishing this is to use a flat ended iron rod ¼-inch thick, fitted into an ordinary hand drill, using plenty of emery and oil while drilling. The plates are assembled in the manner shown in the sketch, being bolted on a threaded brass rod 12 inches long. To make the insulator water-tight, a rubber washer should be used between the roof and the second plate. The remaining plate is then tightly bolted to the brass rod on the inside of the roof. As this bolt holds the entire structure in place, it should be turned tight, although care must be employed not to place too much strain on the plates. Both ends of the lead-in rod are then fitted with thumb screws and the connections made as usual.

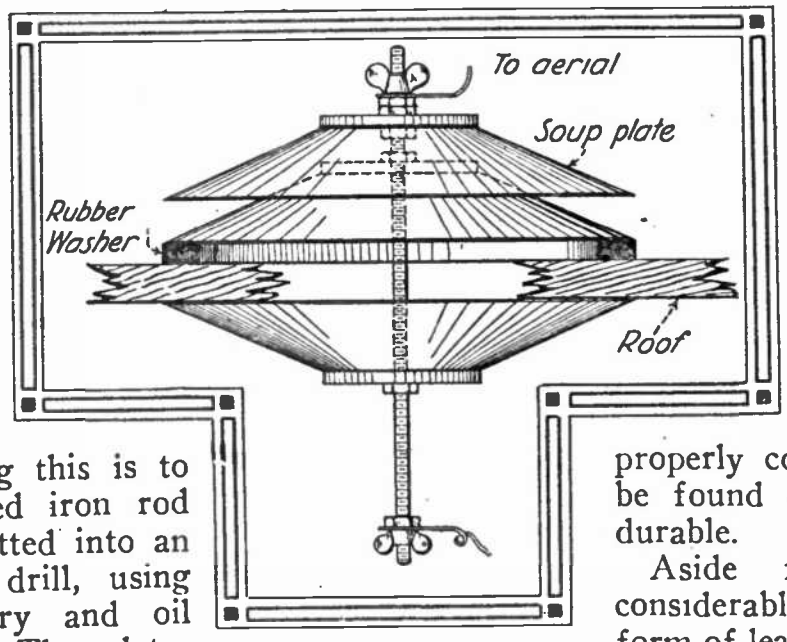


Diagram of Inexpensive Roof Insulator.

Although the arrangement at first appears to be a fragile one; if properly constructed it will be found quite strong and durable.

Aside from possessing considerable strength, this form of lead-in insulator has excellent electrical qualities. Owing to its unique design it is almost impossible for the transmitting power to leak off to the ground, even when the insulator is wet from rain, and it is obviously impossible for rain to leak in through the hole in the roof.—CHAS. BERNTSWILLER.

REGARDING THE SENSITIVITY OF THE AUDION

In the December issue of *Popular Electricity and Modern Mechanics* an article appeared on page 700 entitled "At Last—A Permanent Detector." In this article a statement regarding the new detector reads as follows: "As for the sensitivity and tone of signals of the detector, it is claimed to be more sensitive than the audion which is considered the most sensitive detector in use today."

The De Forest Radio Telephone and Telegraph Company of New York, has taken exception to this statement, writing as follows:

"Two of the inventors of this detector were present at a test which was conducted in the laboratory of this company, at which tests it was conclusively shown that their detector was less sensitive than the S grade or Standard Audion bulb and was not equal in sensitive quality even to the best mineral detectors. It compared favorably with the silicon detector which is far less sensitive than the audion. Tests of the U. S. Bureau of Standards show that the S grade Audion is at least 50 per cent. more sensitive than the best mineral detectors and for results of these tests we refer you to the Bulletin of the Bureau of Standards (Vol. 6, No. 4, page 540)."

The writer of the article appearing in the December issue had no facilities for testing the sensitivity of the new detector. Nor did he cite any of the advantageous features and comparative sensitivity of the new detector on his own authority. The statements were not claims of the writer or this publication, but were made purely from a reportorial standpoint. Furthermore, this magazine declines to enter into controversies which are properly between manufacturers.

CONSTRUCTION OF AN OIL INSULATED CONDENSER

Knowing that many amateurs have never attempted the construction of an oil condenser merely for fear that it is too difficult to build, I have endeavored in the following article to de-

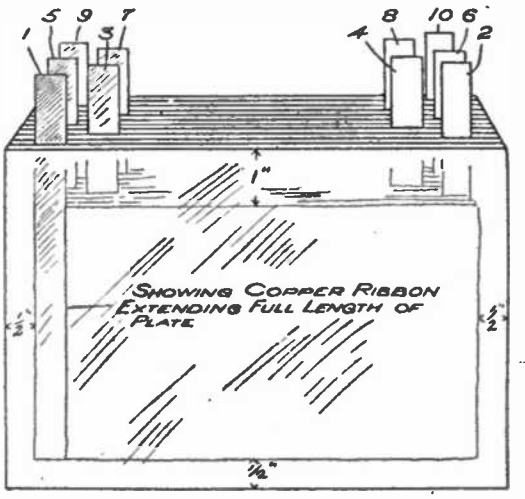


Fig. 1.—View of Glass Condenser Plates Assembled.

scribe the essential points in the construction of an oil insulated condenser, which no amateur should hesitate to construct.

To save expense, old photographic plates may be used for the dielectric. They can be obtained for little or no cost from a photographer or photo-engraver. If plates are used, every trace of emulsion must be cleaned from them by several baths in hot lye water. When clean, the plates should be bright and shiny with no spots on them. They may be of any size, from 6½ by 8½ inches up. If lugs are of proper dimensions to reduce connection resistance to a minimum, the smaller the plates are the better. Plates 6½ by 8½ inches are large enough for transformers up to about five kilowatts, but a great number of plates are necessary and if the voltage is too high the plates must be connected in series—parallel, to prevent puncturing.

The tinfoil should be fairly heavy. One piece is fastened to one side of each glass plate by means of the oil in which the condenser is afterwards to be immersed. This is done by putting a little oil on the tinfoil and after it is laid on the plate, squeezing all the oil possible out from between the tinfoil and the glass. A ½ inch margin should be left on three sides of the tinfoil and on the fourth side, one of the long edges of the plate where the lugs are to be taken out, the margin should be 1 inch. In oil this margin will suffice for condensers subjected to a pressure up to 30,000 volts.

The lugs should be made of copper ribbon at least ½ inch wide. These are laid on the tinfoil in the proper position before the next plate is placed. The pressure of the plates when bound together before immersion in oil will make good contact between the copper lugs and the tinfoil sheet. In this condenser each alternate sheet, beginning with the first, is connected to one terminal and each alternate sheet, beginning with the second, is connected to the other terminal. In order to prevent sparking to the lugs, the lugs coming from alternate plates are staggered, as shown in Fig. 1.

The containing tank for the oil and condenser plates is made of heavy gauge galvanized iron. It is strongest when made in one piece, as in Fig. 2, the lap seams being well soldered to-

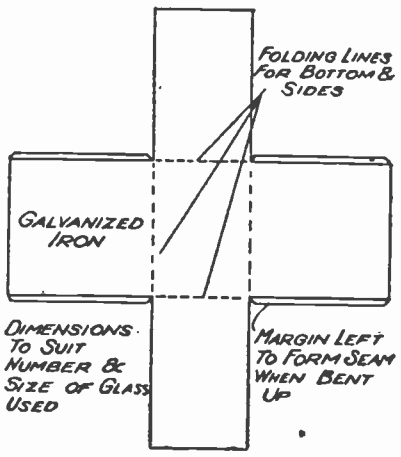


Fig. 2.—Pattern for Condenser Tank.

gether. The dimensions of the tank should suit the size of plates used, but the tank must be large enough to permit good insulation between the edges of the plates and the bottom and sides of the containing tank. It must also

be deep enough to permit covering the plates with oil.

The lugs, as before stated, come out on one of the long sides of the plates so that the distance between the two sets of lugs is the greatest possible. Tape about ten of the plates together and put them in the oil tank with the lugs all coming out on top.

The connection of the alternate plates to the two common terminals is accomplished by means of two heavy busses of copper or brass rod. They are fastened to the containing tank by hard rubber in positions parallel to each other and running almost directly over their respective lugs. One way of connecting the lugs to the busses is by soldering stranded wire to each lug and running each wire or two to a hole drilled in the buss rod, a set screw being used to hold the stranded wire in place. This method allows any number of plates to be cut in or out. The details of this construction are shown in Fig. 3.

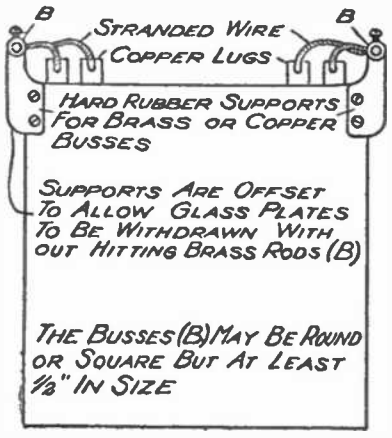


Fig. 3.—Method of Making Connections with Lugs.

To finish the apparatus, it may be placed in a mahogany or oak case. Even if not put in a case, some form of a top must be made to keep out all dust and dirt. It is well to remember in finishing the apparatus, that none of the conducting metal should come in contact with anything but the hard rubber supports that are necessary to hold it in place, otherwise an undue amount of current will leak away.

A good grade of transparent oil-switch or transformer oil should be used in the condenser.

Of course, the dimensions may be varied should the builder desire a smaller or larger condenser, the various parts being kept in about the same proportions. The condenser will be found very satisfactory.—PAUL R. FENNER.

A SUBSTITUTE FOR A TELEGRAPH SOUNDER

When a flame is brought between the two terminals of an energized circuit, the flame will be deflected towards the negative pole. This interesting phenomenon of a flame can be very successfully utilized in place of a sounder for telegraph work.

Play a candle flame, or some other source of flame, between two conductors placed in circuit with a telegraph key and a battery current of not less than ten volts. When the circuit is closed by the key, the flame will immediately assume a flattened shape, but resumes its normal shape immediately after the key is released. This property of a flame, it will readily be seen, can be used for receiving telegraph signals in place of a buzzer or sounder, as the deflection of the flame can be easily read in place of the ordinary sounder signals.

This interesting phenomenon can also be utilized in determining the positive or negative poles of a line, as a deposit of carbon will accumulate on the negative pole.—CHAS. BERNTSWILLER.

AUTOMOBILE TOP EMPLOYED AS WIRELESS AERIAL

The correspondent of an English automobile trade journal writes regarding an interesting application of wireless telegraphy on a motor car, in which the top was used as the aerial.

According to the report, it is gathered that an English cavalry patrol recently came across and captured a German touring car in which were two German officers. The engine had broken down and the men were unable to make their escape. One of the patrol chanced to notice a wire leading to a metal member of the automobile top. A careful search revealed a complete receiving outfit.

ARLINGTON TIME SIGNALS FLASHED 4250 MILES

The effectiveness of the time signal service rendered through the Arlington radio station is evinced in a recent report made by Capt. J. A. Hoogewerff, Superintendent of the Naval Observatory at Washington. The time signals flashed at noon every day and at ten o'clock at night have been reported from a point 600 miles south of Rio de Janeiro, at which point the total distance from the Arlington station is 4,250 miles, according to the statement made by Capt. Hoogewerff in his annual report just made public.

NEW DETECTOR PROVES EFFICIENT

MOST wireless amateurs have been looking forward to the invention of an ideal detector of the crystal type combining extreme sensitivity, neatness—yet small, and above all, easily adjusted and when in that condition, capable of retaining its adjustment for some time. Everyone who has experimented with wireless apparatus is familiar with the patience and skill that are required to adjust the ordinary crystal detectors for securing good results. Furthermore, the aggravation caused in losing the adjustment by an accidental knock or jar, necessitating the readjusting of the detector, is too well known to require further mention.

All that has been sought in the way of a detector is claimed to be realized in the invention of Eugene T. Turney of New York City, of a new detector, namely, the "Crystaloi," derived from two words "crystal" and "alloy," which constitute the elements of the detector. This detector seems to be ideal in all respects, sensitive, small, neat of appearance, easily adjusted, and above all the ability to retain the adjustment. It is claimed by the inventor that it will withstand any ordinary shock or jar, will not burn out or go dead, requires no renewal of parts or the use of batteries, thus eliminating all operating expense.

All that is needed to adjust the detector is a buzzer, found in most every amateur station. By simply rotating the small wheel-like cylinder that houses the elements until the loudest response is heard in the telephones, it is adjusted to its maximum sensitivity and is ready to receive anything within range of the receiving apparatus. The detector appears to be extremely sensitive to frequencies ranging from 240 to 500 cycles, bringing these signals in much louder and clearer than the ordinary detectors. Upon inserting the detector in circuit a sharpness of tuning will at once be noted. It allows one to use more inductance, thereby making the circuits more rigid, conducing to sharp and selective tuning. Another remarkable claim is that static is reduced to a certain extent, allowing one to read signals which otherwise would be unreadable. A brief description of the antennæ and apparatus used to draw the above conclusions would not be amiss.

Antennæ of the umbrella type, four wires 45 feet long; two wires being 10 feet high, the other two being 20 feet high, spaced about 5 feet apart, all connected at highest end—about 30 feet from ground. Receiving apparatus comprises: inductively coupled tuner, Crystaloi detector, fixed condenser, variable condenser and 3200 ohm 'phones. Connected up as modified Telefunken Set. With this set the writer has copied all stations from V.B.A. Port Arthur, Canada, to Miami, Fla., and ships out at sea from three to four days; the Marconi station Miami coming in very clear and distinct, a 5-kw. non-synchronous rotary gap being employed by that station. Messages from the Panama R. R. Co. steamships K.M.A., K.M.X., K.M.S., K.M.H., when three to four days out, come in with remarkable clearness, these ships being equipped with Telefunken 500 cycle sets of the quenched spark type.—H. ESKAY ENDERWOODS.

On Polyphase Subjects

THE present number marks the beginning of a new volume for this magazine. It has perforce gone through a period of evolution in the past six months; the work of the Editors has of necessity been tentative,—a process of feeling out, as it were. And the reason for this will be readily apparent to the thoughtful reader.

Editing has ever been a more or less thankless task; no one or two human beings could possibly contrive to satisfy or even please a family of considerably more than one hundred thousand other human beings; the more especially when this family is divided into three distinct classes, each with its own individual likes and dislikes. Yet this was the physically impossible task set before the Editors of this magazine when it was given birth through the consolidation of *Electrician and Mechanic* of Boston, *Modern Electrics* of New York and *Popular Electricity and the World's Advance* of Chicago. Each of the three magazines had its own particular following and each was a power in its own field. To combine three such publications into one and to make the consolidation thoroughly satisfying to the diversified tastes of the three distinct classes of readers was a well-nigh superhuman task.

From the start the work of editing has been carried out as a scientist might carry out a series of investigations. Experiments have been performed and the results carefully noted; the failures weeded out and the successful ones repeated. As a result of this experimental work, a very definite conclusion has been reached—a definite policy evolved.

MODERN MECHANICS starts its new year with a new and far-reaching name—a name the Editors purpose to make typical of the contents. And a few words will serve to make the reader conversant with the policy that is confidently expected to achieve this result. The aim will be to provide for the wants of perhaps two classes of readers and in such a way as to make this provision a perpetual one. The two types of readers are, first, the layman who knows nothing whatever about electricity, mechanics or science, and, second, the practical handyman, mechanic or electrician who knows his business, but who is at the same time wise enough to know that the other fellow may have something of value to tell him. For the first man there is the bright, newsy, pictorial section with its hundreds of short, interesting articles on the latest achievements in the fields of electricity and mechanics. Herein, he learns what science is doing to lighten human labor and how it can be made to do his own tasks. For the second man, the practical man, there is the entire second half of the magazine, written by practical men, and devoted to the needs of the handy-man-about-house, the mechanic and the practical worker in the electrical field.

The layman will be prone to criticise the practical man's section and the mechanic will say that he is not interested in the popular section; but let each think for a moment and realize that at some time or other he either has been or will be, as the case may be, in the other fellow's shoes. As the layman's knowledge increases, he will wander into the rear portion of the magazine. He has perchance read a description of some device or machine that would prove a boon in the home, office or factory; perhaps the first thing that strikes his eye as he glances through the practical section is a clear and simple set of instructions telling him how to make, with the simple tools to be found in the average home workshop, the very device he has read about in the popular section. Thus, the layman gradually becomes the practical handyman and his interest in the first portion of the magazine gives way to the new one, born of practical knowledge, in the rear section. But,—we must not forget that for every convert to the practical section there is another brand new layman to take his place, and so on, *ad infinitum*.

A Narrow Escape

"Now, Zeke," the parson said, "you know you must live a Christian life. Have you stolen any chickens during the last six months?"

"No sah, no sah," said Zeke fervently. "Ah ain't done stole no chickens."

"Nor turkeys, nor pigs?"

"No sah, no turkeys nor pigs?"

"I am glad to hear it," said the leader, "and I hope you will continue in this way."

Zeke on his way home said to his wife in a cautious undertone: "Golly, I'd suah been er lost niggah ef he'd said 'ducks.' "—*Successful Farming.*

Surprising

A lady, returning home unexpectedly, found her domestic using the drawing-room for the purpose of giving a select party to her friends. "Ann, I am surprised!" she ejaculated.

"So am I, ma'am," replied the unabashed girl. "I thought you wouldn't be back for a fortnight."—*Chicago Ledger.*

A Homely Tale

A new electrical student seeing a large resistance hanging on the wall of a laboratory remarked to his professor: "Does it not look like a harp?" Whereupon the professor replied, "The only tune it will play is "Ohm-sweet-ohm." ("Home, Sweet Home.")—*W. H. Prendergast.*

Auto Ailments

"Brother Jim has the automobile face. Joe has the motor-bike back and sister Sue has the auto-speed craze."

"Any other automobile ailments in your family?"

"Well, papa says he has the automobile pocketbook, and it's badly punctured."—*Minneapolis Journal.*

Well Taught

An English bishop, offering an orange to a little child, remarked sweetly:

"Now, my little man, I shall give you this orange if you tell me where God is."

"My lord," answered the child, son of a clergyman, "I'll give you two oranges if you'll tell me where he is not."—*Boston Journal.*

A Horse Laugh

Motorist (blocked by load of hay)—"I say, there, pull out and let me by."

Farmer—"Oh, I dunno ez I'm in any hurry."

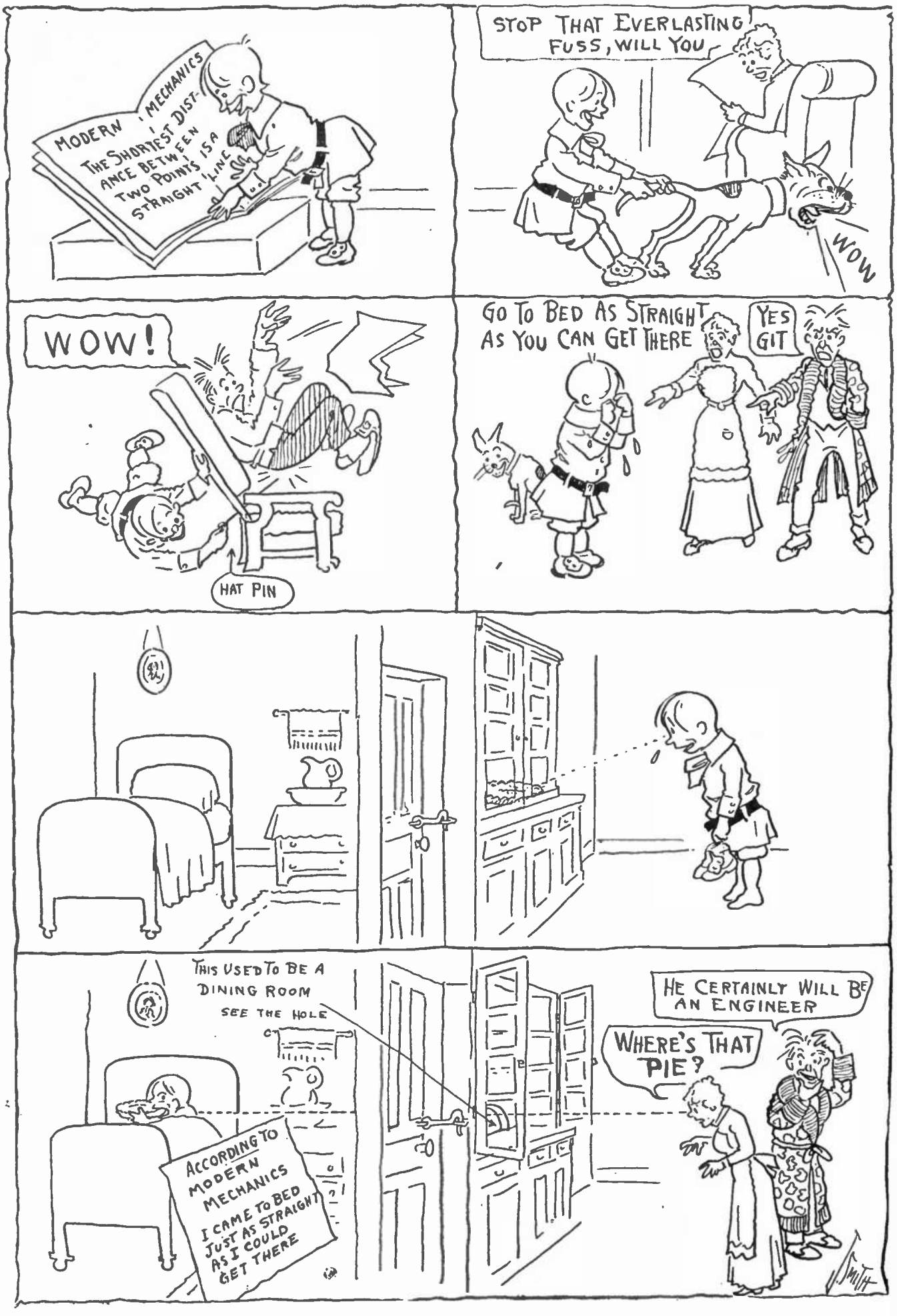
Motorist (angrily)—"You seemed in a hurry to let that other fellow's carriage get past."

Farmer—"That's 'cause his horse wuz eatin' my hay. There hain't no danger o' yew eatin' it, I reckon."—*Springfield Republican.*

Knew of One Advocate

Gabbleton—"Edison declares that four hours' sleep per night is enough for any man."

Kidder—"By Jove! That is exactly what my baby thinks!"—*Judge.*


MODERN MECHANICS
THE SHORTEST DISTANCE BETWEEN TWO POINTS IS A STRAIGHT LINE
STOP THAT EVERLASTING FUSS, WILL YOU
WOW
WOW!
HAT PIN
GO TO BED AS STRAIGHT AS YOU CAN GET THERE
YES GIT
THIS USED TO BE A DINING ROOM SEE THE HOLE
ACCORDING TO MODERN MECHANICS I CAME TO BED JUST AS STRAIGHT AS I COULD GET THERE
HE CERTAINLY WILL BE AN ENGINEER
WHERE'S THAT PIE?
SMITH