Everyday Engineering

"It Tells You How to Make and How to Do Things"

VOL. 3 MAY, 1917 No. 2

A Call to the Amateur Mechanics and Experimental Engineers of America

IT is within the province of the *American Society of Experimental Engineers* to be of material service to the country. Now that the organization is an accomplished fact and chapters are being formed throughout the country, we are rapidly approaching the point where we shall have something tangible to offer as an example of the value and thoroughness of the training received by our members largely through practical experimentation.

For the very practical suggestion which prompts this appeal to you, we are indebted to Raymond Francis Yates, A. S. E. E., of Niagara Falls, N. Y. Incidentally, let it be known that Brother Yates has the honor to be the first duly accredited member to join the Society. So keen has his interest been and so valuable his suggestions that we feel it our duty to publicly acknowledge our indebtedness to Brother Yates in connection with the organization of the Society.

The plan suggested will be taken up in detail at the first official meeting of the A. S. E. E. to be held shortly at the Laboratory, 104 Fifth Avenue, New York City. At this meeting committees will be appointed to work out the various problems. However, in order that the proposed movement may be launched without a day of delay, we shall endeavor to outline the project here as clearly as possible.

It is suggested that the Society take up the construction of certain pieces of apparatus, preferably of a therapeutic nature, each chapter performing the work on a certain part of the whole, and the final assembly to be done in the Headquarters Laboratory. After the necessary tests, the apparatus is to be turned over to the Red Cross for whatever service it may be best fitted for.

The apparatus suggested is as follows: A complete portable *X*-Ray equipment for field use, built to a design that adapts it for this use; a complete high frequency and therapeutic apparatus for use in field hospitals and in convalescent camps; a complete, portable ozone or ultra violet ray water purifier; pasteurization apparatus for milk; sterilizers for field hospitals; and, in short, every form of apparatus that would be of practical use in this most important branch of the service.

We are communicating with the local Red Cross Headquarters where we shall request that a committee of a surgeon and an engineer be appointed to confer with us in order that the designs may be worked out in accordance with the strenuous demands of military use.

The complete design for each project will be worked out at Headquarters and the details of construction split up into definite sections. Comprehensive blueprints and descriptive data will cover each section. The various chapters of the A. S. E. E. throughout the country will be assigned units of the work of construction. These assignments will be made after an analysis of the local facilities has been made for each chapter. The various chapters will be expected to perform the specified work of construction and to forward the completed unit to Headquarters for final assembly, test, and delivery.

Members throughout the country are urged to expedite the formation of local chapters in order that this great work may be speedily accomplished. For those who are bound by family or home ties and who cannot enlist, it is suggested that this is the very finest manner in which they can serve their country. The results will be tangible and practical and no man connected with the work need be ashamed of the part he has played in his country's service.

Bear in mind that the little bit of mechanical work you do on one of these outfits may be instrumental in saving the lives of hundreds of wounded; and every wounded man placed back in the ranks or rescued from lifelong suffering is worth many fallen ones.

Our little organization is young but our power is gigantic; the circularization of the charter members a few days prior to this writing shows many who are equipped with machine tools or who are fitted by profession or trade to undertake work of this kind. Let us all get together in the interests of Science and Humanity and dedicate ourselves to this very practical work if we cannot serve our country in a more effective manner. Each and every man of us should do his bit, large or small though it be.

We are glad to publish in this issue the names of the Charter Members, Officers, and Organizers of the American Society of Experimental Engineers. Each of these men has pledged himself to do his utmost to advance the cause.

As you read this, will you not refer to the published list and ascertain whether the A. S. E. E. is represented in your City? If you find the name of a Charter Member there, will you not make it a point to meet him and give him your support and assistance in the enrolment of others? *If your City is not represented, will you not sign and mail to Headquarters the application for membership* that you will find on the page following the list? If you will do this, you may be instrumental in making country-wide an organization that many believe is destined to achieve great things for its members, the Nation, and for Experimental Science in general.

Fraternally yours,

President,

The American Society of Experimental Engineers.

Full particular of the Society may be obtained by sending a self-addressed and stamped envelope to the American Society of Experimental Engineers, Aeolian Building, New York City.

Officers and Charter Members of the American Society of Experimental Engineers

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How the War Affects Amateur Radio

Just as this issue goes to press, the order comes to dismantle all private radio stations in the United States.

For an explanation of what this means and a discussion of the present amateur status, see "A Chat With the Editor" and "Radio Engineering" departments in this number.

APPLICATION FOR MEMBERSHIP

The American Society of Experimental Engineers.
Aeolian Building, New York, N. Y.

Gentlemen:

I hereby make application for the degree of Associate Membership in the American Society of Experimental Engineers in which, upon acceptance of my application, I am to share all of its rights and privileges.

I enclose (check, money order, draft) for Two Dollars ($2.00), one-half of which sum is to enter or extend my subscription to EVERYDAY ENGINEERING MAGAZINE, for a period of one year, and the remaining half to pay my annual dues in the Society, for one year from date.

It is understood that, upon acceptance of my application, I am to be supplied with the regulation certificates of membership and the Official Publications of the Society during the tenure of my membership.

In making application for membership, I do hereby solemnly pledge myself to abide by the By-laws of the Society and to do my best in the advancement of practical scientific knowledge and the development of the characteristic of resourcefulness in my fellow men; furthermore, I do pledge myself never wilfully to be guilty of an act unbecoming an American citizen. Failing in these pledges, by word or deed, I shall be deemed unworthy of membership in the American Society of Experimental Engineers, and shall thereby forfeit said Membership with all of its right and privileges.

Signed ....

City or Town ....

Street Address ....

State ....

My age is .... Nationality ....
If naturalized, say so.

My Education ....
Grammar or High School, College, Correspondence, etc.

Am employed as ....
If still at school, say so.

Am particularly interested in ....
Branch of Science or Craftsmanship.

Why I want to join the A. S. E. E. ....

....

....

....

I suggest the name of .... Address ....

.... as a worthy member of the A. S. E. E.

HOW A PHYSICIAN BUILT HIS OWN X-RAY OUTFIT

A Complete Equipment for X-Ray and High Frequency Work Constructed from Standard Wireless Transmitting Apparatus

THE separate instruments used in the construction of this outfit were described in the March number. In this instalment, the assembly of these instruments into a suitable cabinet will be considered.

The details of the cabinet are given in Fig. 1. The box may

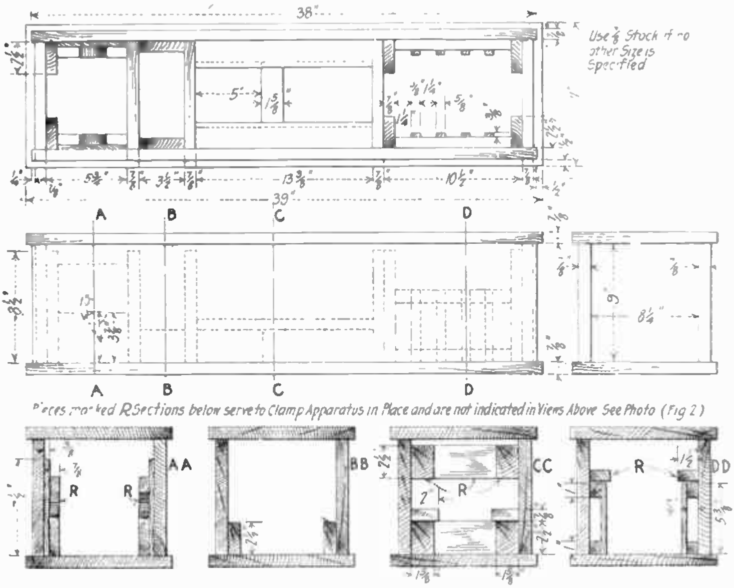


Fig. 1. Details of cabinet for apparatus.

be constructed of mahogany, oak or white wood stained and finished to suit the taste of the builder or to harmonize with the furniture in the office. All of the necessary details of the cabinet are given in the drawing and it is believed that further description will be unnecessary.

Referring to Fig. 2 which is a photograph of the complete apparatus as it appears in the cabinet, the reader will note that the various instruments are arranged in the following order from left to right: impedance coil, safety condenser, transformer, and oscil-

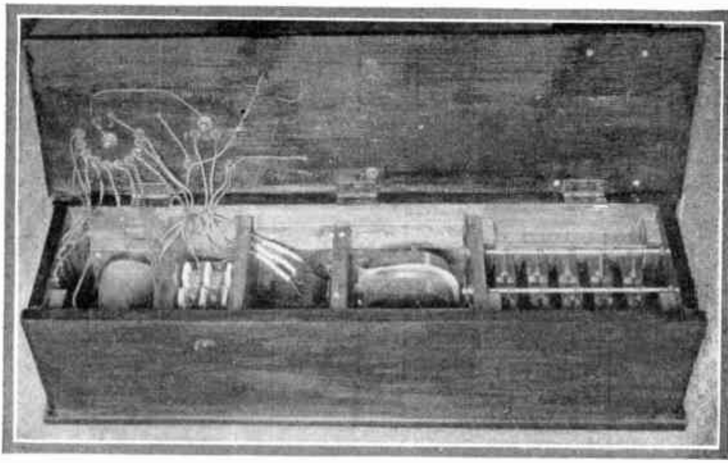


Fig. 2. Interior of cabinet showing arrangement of apparatus.

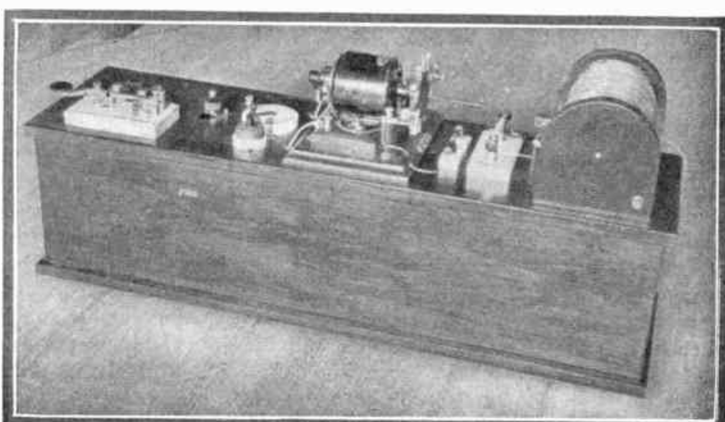


Fig. 3. Complete apparatus showing control switches on cover of cabinet.

lation condenser. Fig. 3 shows the cabinet with cover shut down and the following instruments mounted upon it: operating key, impedance and primary regulators, rotary gap, switch and controlling rheostat, single pole single throw knife switch, stationary gap, and inductance coil.

Referring to Fig. 4, we have an enlarged view of the left-hand end of the cabinet with impedance coil removed to show method of mounting. This coil consists of a core of iron wire made up into a bundle 2 in. in diameter and 7½ in. long. On this core is placed a single winding consisting of 700 turns of No. 14 D.C.C. wire disposed in even layers and with eight taps taken out of the wind-

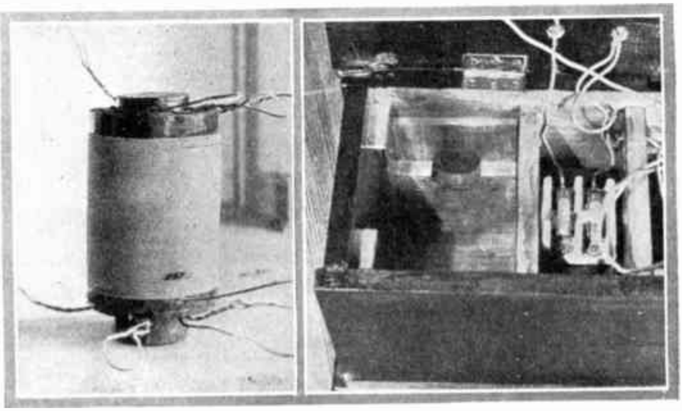


Fig. 4. The impedance coil and, on the right, the method of mounting it.

ing at the last eight layers. These taps, together with the starting and finishing ends of the coil make ten leads in all to be connected with the contacts of the impedance switch on the cover of the cabinet. The object of this impedance is to reduce the amount of current flowing through the primary of the transformer, when operation at full power is not desired. The impedance, furthermore, makes it possible to produce some very curious and valuable phenomena in connection with the high frequency discharge.

Referring once more to Fig. 2, we find the protective device, which consists of two standard condensers of the telephone type, having 2 mfd. capacity each, connected in series, with the outside leads placed across the primary supply wires and the neutral

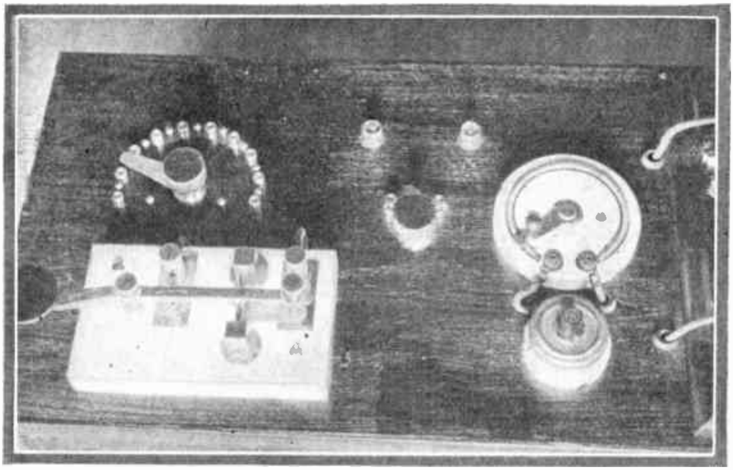


Fig. 5. Operating key, impedance regulator and rotary gap switch.

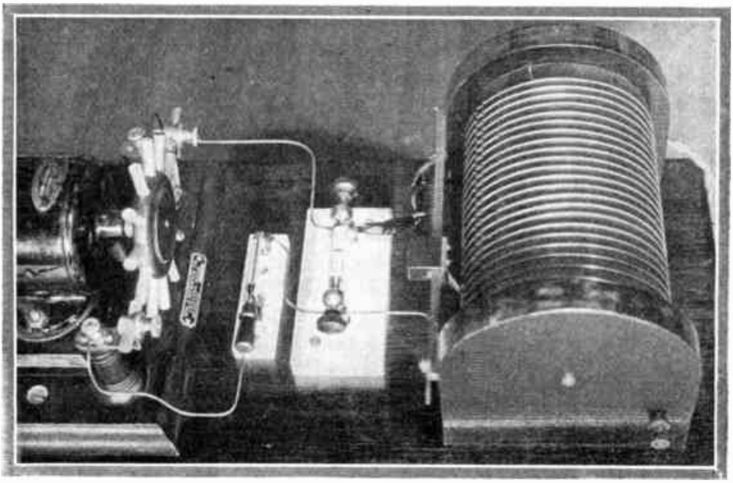


Fig. 6. Rotary and stationary gaps and inductance coil.

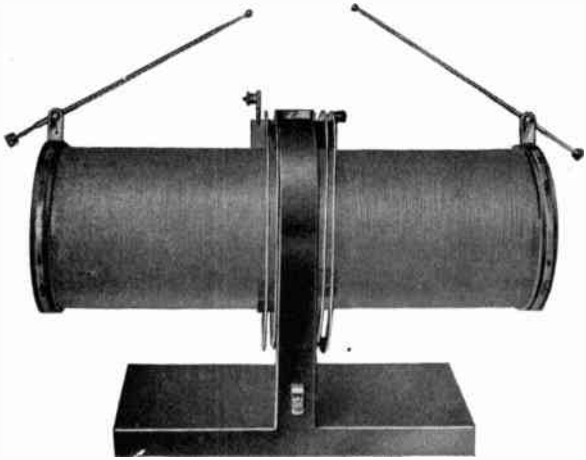


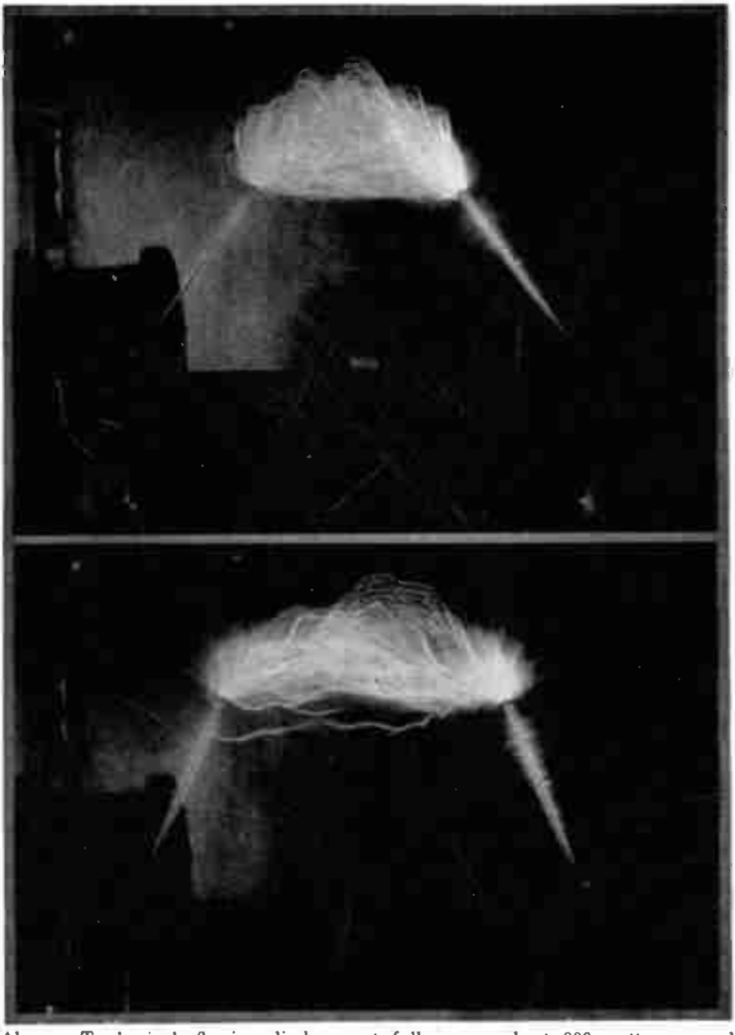
Fig. 7. Tesla coil for X-Ray work.

point grounded. This protective device can be purchased in the open market about as cheaply as it can be constructed by the amateur. Its use is absolutely essential to the safety of the apparatus and the house wiring.

Next we find the high tension transformer which is secured in the cabinet by means of wooden clamping pieces clearly indicated in the drawing. At the end of the first layer of the primary winding, a tap of flexible cable is soldered. This will be of great service in connection with the impedance in producing such effects as the spray or effluve so desired by many practitioners. The secondary leads from the transformer make connection with the ends of a pair of brass rods which pass through the partition and directly over the condenser. Across these rods is also secured a safety gap comprising two pieces of flat brass strip, so arranged that the space between their ends is not greater than ⅝ in.

The rods should be insulated from the cabinet and the partition where they pass through the walls by means of hard rubber or composition bushings such as are used in incandescent lamp sockets. These rods pass directly through the end of the cabinet where they terminate in binding posts from which the desired leads may be taken.

The mounting for the condenser is so arranged that a free cir-



Above: Twelve-inch flaming discharge at full power, about 900 watts, exposed one second, lens f/4.5.

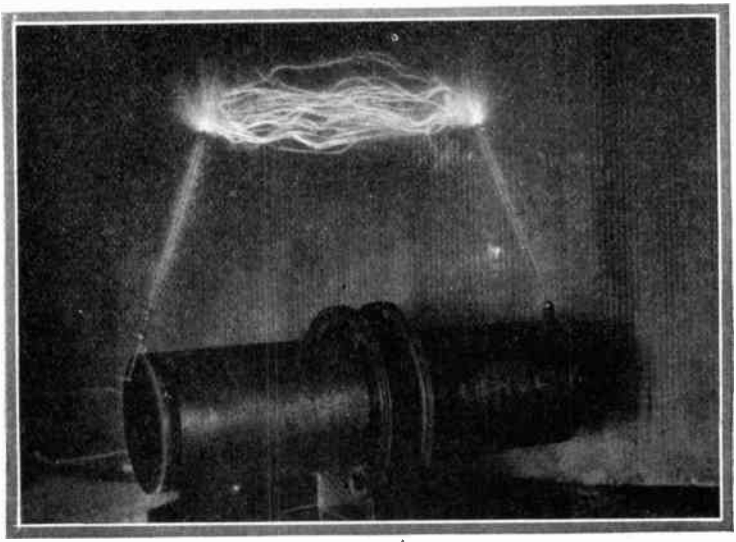
Below: Twenty-inch discharge at 900 watts, exposed one second with same speed of lens.

Exposures made on Premo speed filmpack in darkened room.

culation of air is produced between the sections and around them. This is essential if the outfit is to be placed in long continued operation.

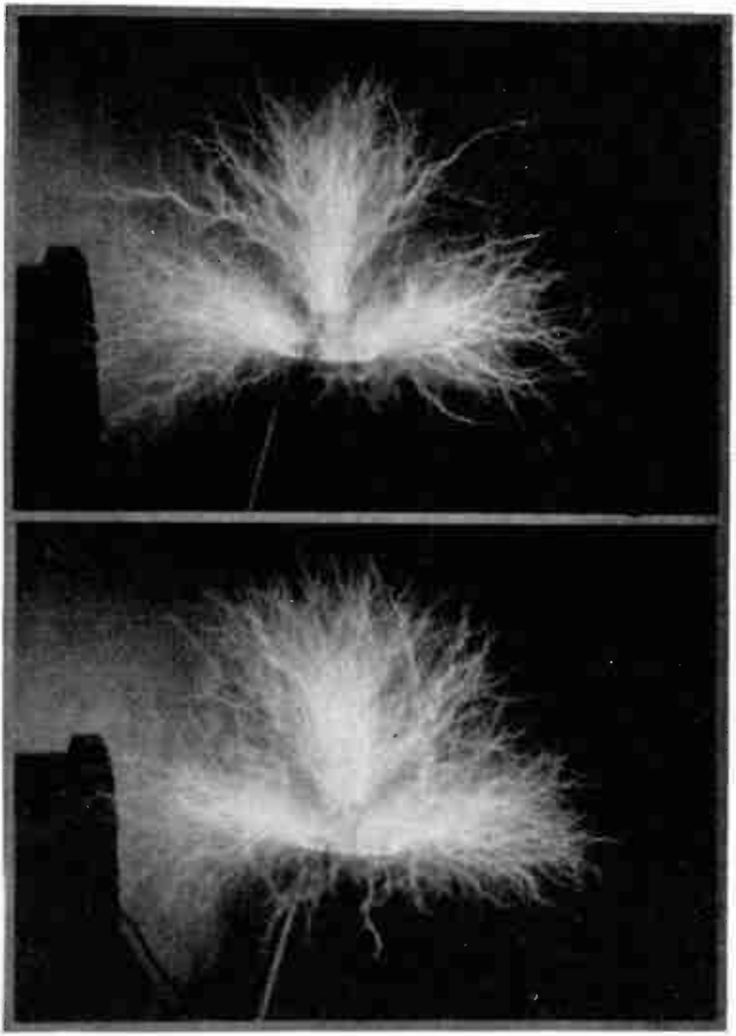
The diagram of connections for the entire outfit is given in a separate drawing.

Referring to the illustration Fig. 3, we note that all of the



Simulation of "static" discharge, twenty inches long, 200 watts, all impedance in series with primary. Exposed three seconds with f/4.5 lens.

controlling switches and other parts which require adjustment are located on the cover of the cabinet. The standard wireless key at the left is of course placed in series with the transformer primary circuit. Fig. 5 is an enlarged view of this end of the cabinet and it shows clearly the arrangements of the controlling switches. Fig. 6 is an enlargement of the right-hand end of the cabinet showing how the rotary and stationary gaps are placed in multiple merely by closing the small knife switch. For all currents at full power or thereabouts the rotary gap is used. For the more delicate currents such as that required for vacuum tube treatment, the stationary gap is employed. By using the full impedance and closing

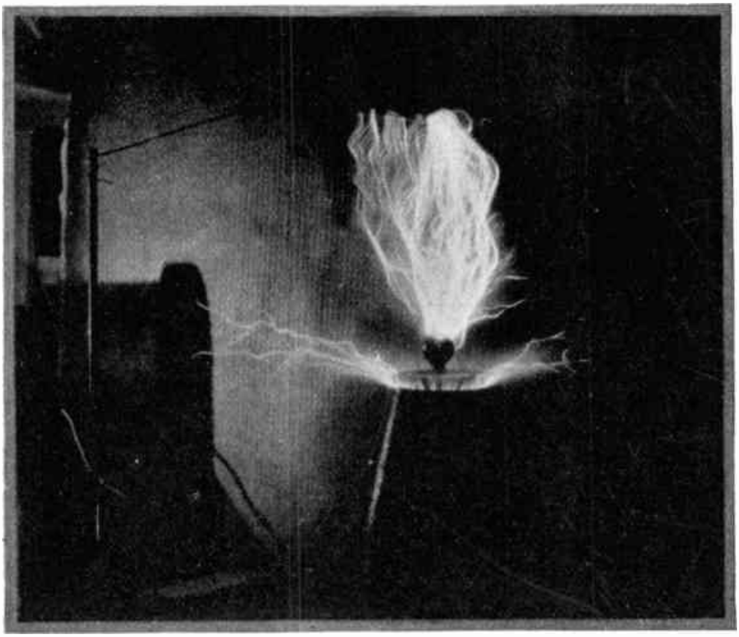


Above: Spray or "tree" discharge from Oudin resonator reaching out thirty inches, 600 watts, half of impedance in series, exposed three seconds at f/4.5.

Below: Discharge at 900 watts, exposed four seconds.

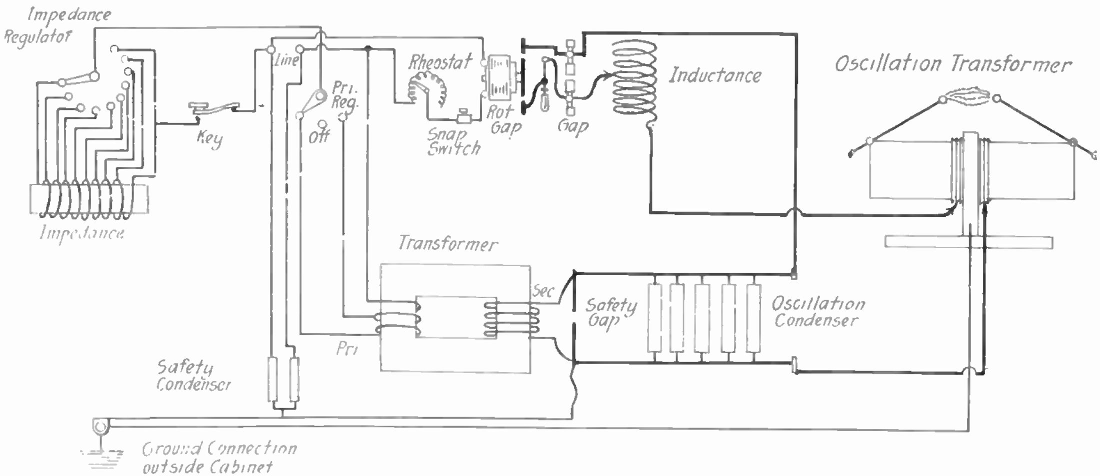
By cutting in impedance the discharge is made delicate and "thin." The face or hands may be held close to the coil in this event to get the sensation of a "static breeze."

in the stationary gap, a spark a fraction of an inch in length and so mild that it may be directly applied to the bare skin without any pain whatever may be produced. From this we may go to the other extreme by opening out the stationary gap, starting the rotary, and cutting out all impedance. This will give us the crashing flame shown in some of the illustrations of the discharge.



Discharge at 900 watts from resonator to a ground wire. The spark is thick and white. Combustible material is readily ignited by it. Exposed two seconds at f/4.5.

The inductance is placed in series with the primary of the oscillation transformer or Tesla coil. This inductance consists of 20 turns of No. 10 bare copper wire, wound upon a cardboard drum or cylinder, and with each turn separated from its neighbors by a generous space. This winding may be done by winding two turns of heavy cord in parallel with the wire, removing the cord after the winding is finished. A substantial sliding contact is mounted



Wiring diagram for the complete apparatus. The Tesla coil shown may be displaced by the resonator when it is desired to obtain current for vacuum tube treatment.

upon the wooden coil ends, as shown clearly in the illustration Fig. 6. This coil is of great service in obtaining resonance by tuning the oscillation circuit.

Oscillation Transformer

In the March number a cone-shaped oscillation transformer was described. We have included in this article a few illustrations of the discharge produced by this coil. For X-ray work, however, the Tesla type of oscillation transformer is somewhat better as it produces a bipolar discharge instead of one of the monopolar type.

A form of Tesla coil available in the open market at a reasonable price is illustrated in Fig. 7. The construction is simple and believing our readers might care to build one, we are giving herewith the specifications. The primary consists of six turns of edgewise-wound copper strip 10¾ in. inside diameter. This helix is divided into two parts of three turns each, connected together in the middle and mounted upon bakelite posts on either side of the central upright piece which is of wood. The secondary consists of two cardboard cylinders wound with a single layer of No. 24 double cotton covered wire, the winding covering the entire length of each cylinder with the exception of an inch at either end. This winding must be very thoroughly filled with shellac, layer after layer being put on, and each one being thoroughly dry before the next is applied. The secondary coils are joined at the center and this point connected with a binding post which leads to the ground wire. The outer ends of the winding lead to the discharge rods shown in the illustration.

Spark Pictures

We have included a number of interesting photographs of the discharge produced by this apparatus and in the caption under each halftone we have specified the characteristics of the discharge and the amount of current necessary to produce it.

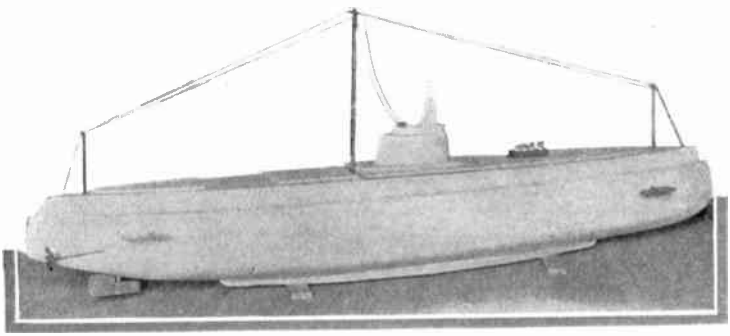
The operation of the apparatus and the technique of electrotherapeutics must be left for a later article as space will not permit of its treatment in this issue.

THE CONSTRUCTION OF MODEL SUBMARINE *EM2*

THE CONCLUDING INSTALMENT OF THE SERIES, COVERING THE ASSEMBLY, DECK, RADIO EQUIPMENT, ETC.

THE superstructure of the model is so designed as to permit of ready access to the machinery within through the openings which are covered, in the case of our model, with simple hatches of wood secured by means of brass nuts on screws passing up from beneath.

A complete drawing of the superstructure and decking is given in Fig. 1 which shows a plan and a side elevation in section. Note that the superstructure is built up of two thicknesses of ⅞ in.

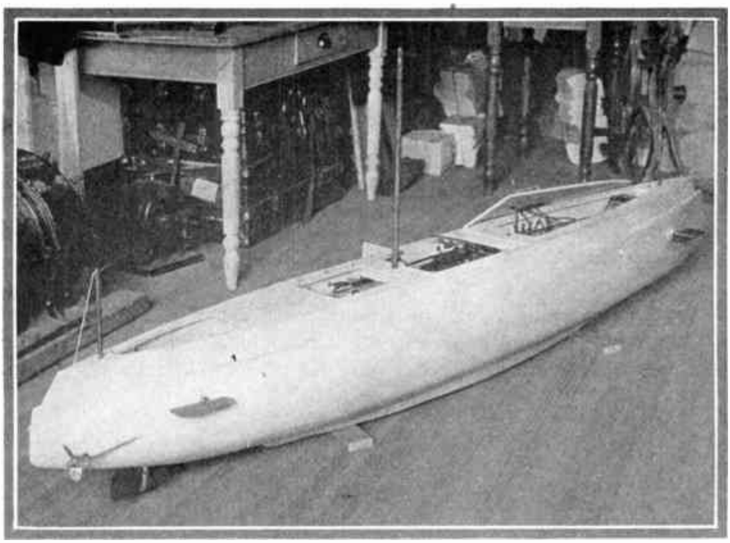


The submarine completed and ready for launching. The signal lights which indicate the position of the controller arm may be seen on the deck, forward.

material and one of ⅜ in. stock. The latter is secured after the former are worked down to finished shape. In this thin piece of lumber are placed the brass machine screws which hold the nuts for the hatches. All dimensions are given in the drawings.

In placing the superstructure on the hull, and, likewise, in nailing the two pieces of stock together, the white lead and whiting cement is to be used plentifully. This cement was described in the January, 1917, issue which contains the first instalment of the series. The cement is to be applied to the stock on both surfaces before nailing together.

To counteract possible warping, the superstructure should be



The model with hatches removed to permit of access to the machinery within the hull.

secured with both screws and nails. A flat-head screw placed every 8 ins. or so will draw the superstructure right down to the hull, squeezing out the cement which can be scraped off when nearly hard, leaving a perfect union between hull and superstructure. As the decking of thin wood is placed on the superstructure after the latter is securely fastened, the screws and nail heads are covered.

Wiring and Machinery

The wiring and the installation of the machinery were done after the superstructure had been finished. The object of this was to insure that the interior fittings might be removed after the deck was finished. We knew that if we could install the machinery we could as readily remove it.

The greater part of the wiring was done with No. 14 standard rubber covered and the balance with No. 18 fixture wire. The insulation on these conductors is so good that little care need be exercised to keep them apart. They may be "fished" beneath the

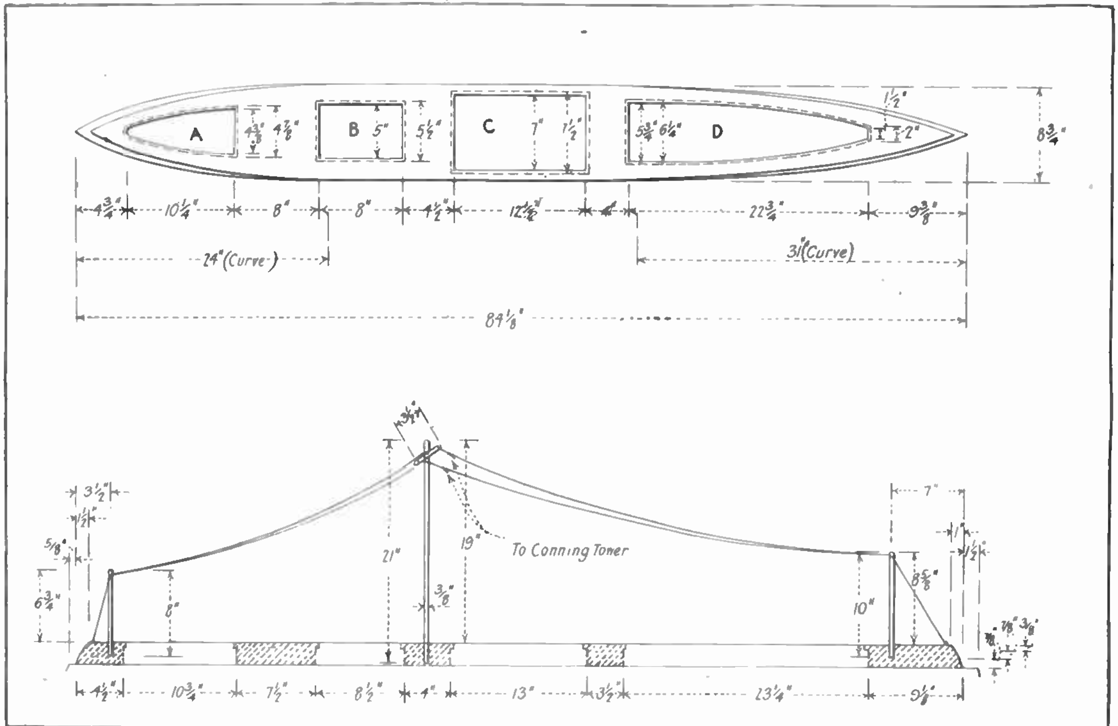
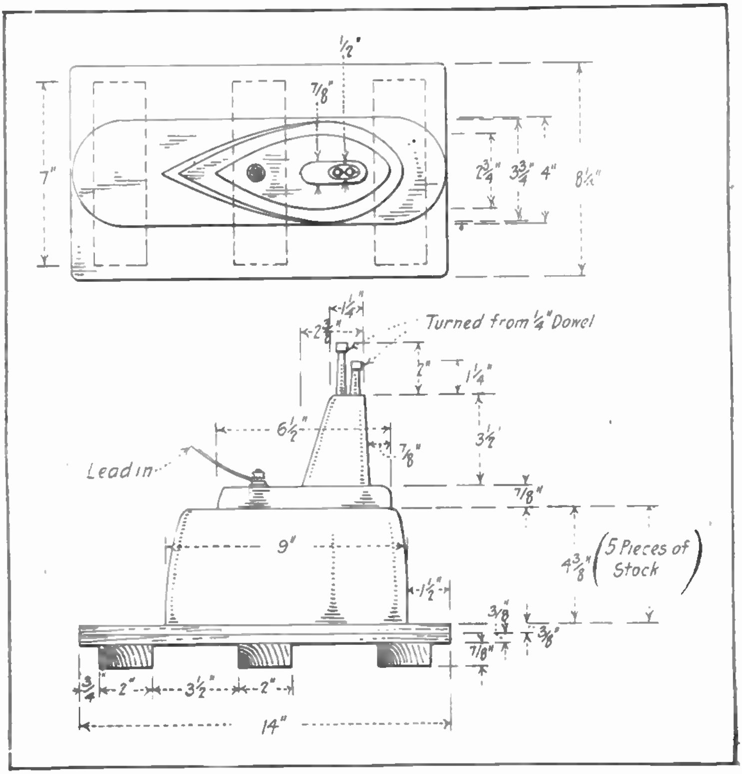


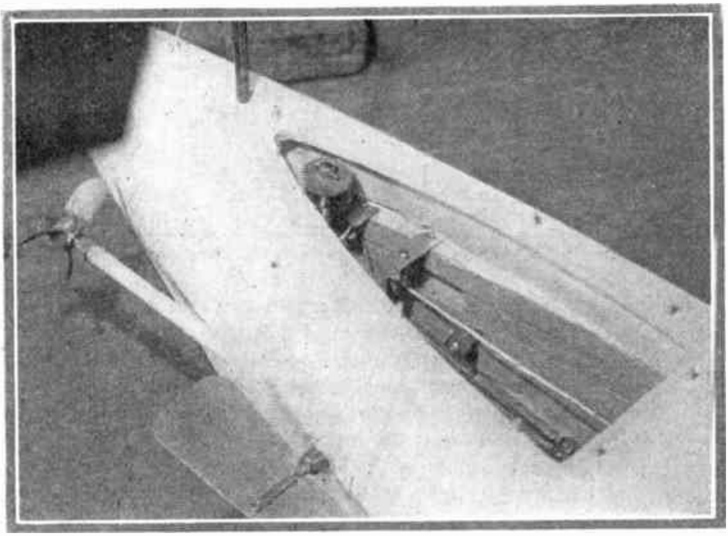
Fig. 1. Details and dimensions of the superstructure and radio aerial.



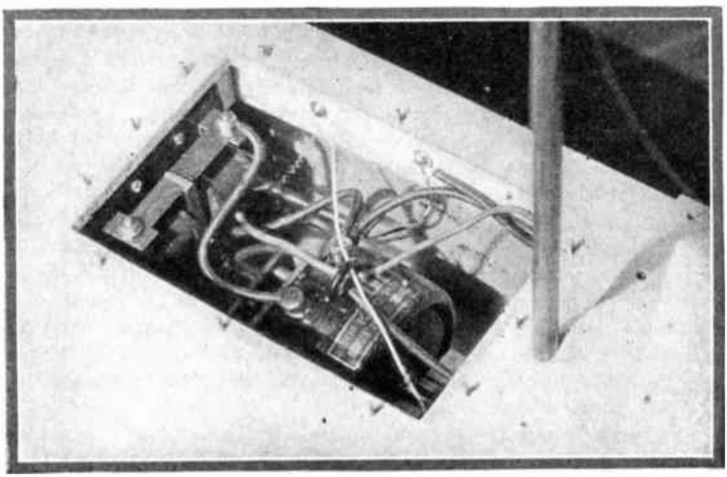
The conning tower and periscopes mounted upon the hatch covering the storage battery compartment.

deck and held under staples with impunity. On all circuits where the current is heavy, the larger wire was used.

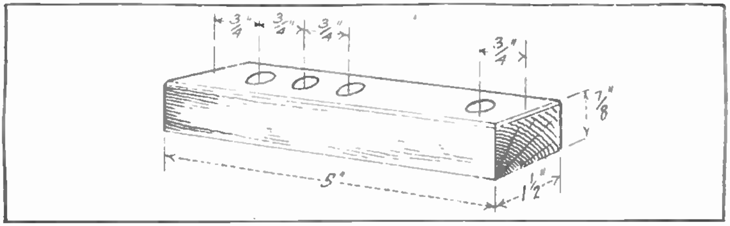
As a measure of safety, 10-ampere fuses should be inserted in the leads from the large storage battery and 5-ampere fuses in those from the small control battery. This protection is really very important as the current from either battery on short circuit might easily reach a hundred amperes or even more. Incidentally, such a discharge would ruin the battery. The heaviest current drawn is 15 amperes; however, this is only for an instant and the fuses specified will hold it easily for the second or two it is on.



A glimpse into the stern, showing rudder release solenoid.



The driving motor compartment, showing relay switch which turns on and off the current at an impulse from the control device.



The signal lights are mounted on this block, which is secured to the forward deck.

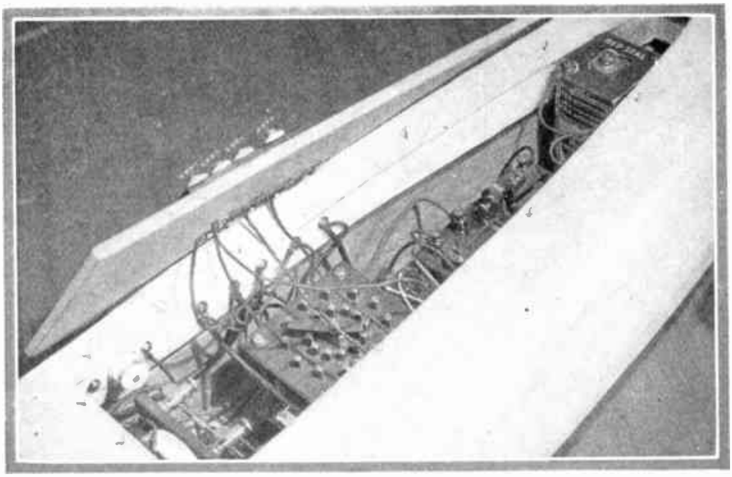
As an additional precaution, it is well to provide switches just inside the battery compartment in order that the two batteries may be totally disconnected from the mains when the model is not in use. In the photograph showing the battery compartment, the switch at the left is to disconnect the main battery while the one at the right starts and stops the control device motor. When these switches are open, no current can flow through the circuits even though the controller might be left in an "on" position.

Number of Controls

In view of the pressure upon the time of the Laboratory Staff for serious research work, the model *EM2* has been rushed to completion without the various control devices that were originally planned in its design. These include such features as deck guns, torpedo tubes, lifeboats, signal and searchlights, etc. These accessories will be developed and described as time permits but in this hour of more important need, it is felt that such models may well be left for the future.

EM2 has controls as follows: turn to right, neutral; turn to left, neutral; start motor, stop motor. The diving planes are manually operated; that is, they are tilted to the diving position by hand. Should any reader, in building this model, choose to add the radio control, he has but to construct a mechanism similar in principle to that employed in the control of the rudder. The design for these diving plane solenoids will be given in a later number as a separate article.

In order to use the central control device described in the last issue, the contacts have been grouped into pairs by bridging across adjacent studs so that each contact is repeated as the arm travels around. The leads from the contacts are of flexible lamp cord



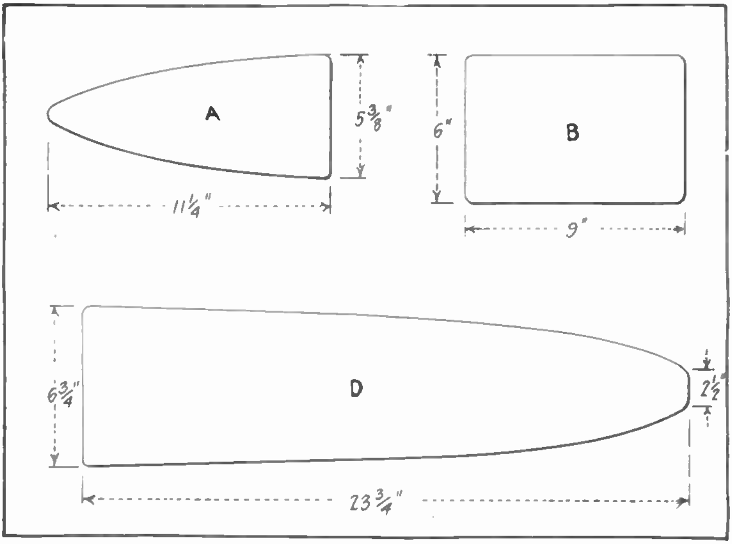
The "heart" of the submarine. The controller and relay exposed through removal of the forward hatch.

brought up to screws and washers along the side of the opening in the superstructure. The relay switch which serves to turn on and off the current to the driving motor is described in a separate article in this issue.

Conning Tower and Radio Equipment

The drawings give all details of the conning tower and deck fittings. The aerial is carried by a tall central mast and it inclines toward a shorter mast at either end of the craft. We have found that thoroughly dry dowel boiled in paraffin provides a good mast of high insulating qualities. So effectual is this treatment that no insulators were found necessary. It is admitted, however, that the true model maker will not be content with such an arrangement. For him we suggest the employment of tiny insulators turned from hard rubber or black fibre rod of about ¼ in. diameter.

The lead-in is taken from the centre of the aerial and brought down to the contact on the deck of the conning tower. From this point, a piece of rubber covered lamp cord leads to one side of the coherer. The other side of the coherer is connected with a heavy wire that leads down through the hull and makes electrical connection with the lead keel.



Dimensions of the hatches.

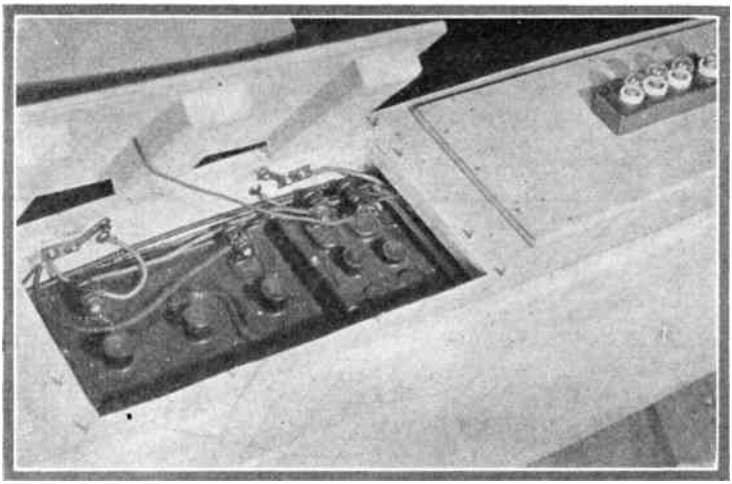
Submerging the Model

The ballast tanks in the lower part of the hull are of sufficient size to hold water to completely submerge the model. A piece of brass pipe leads from the machinery deck both fore and aft to the outside of the hull where each pipe terminates in a small pet cock. When these cocks are opened the air in the tanks is permitted to escape with the result that water enters. When the model is "trimmed" by the bow and stern, the pet cocks may be closed, thereby preventing the entrance of more water. To discharge the water ballast, air pressure is applied to the pet cocks by means of rubber tubing from a tank.

The Transmitting Apparatus

The coherer in the control device is sufficiently sensitive to respond to the impulses sent out by a spark coil of the standard "2-inch" wireless type. In our experiments we did not attempt to tune the transmitter but merely used the obsolete method of connecting the antenna and ground across the spark gap. Our antenna was a wire some ten feet long, attached to a bamboo pole.

The maximum distance for fairly reliable operation was found



Central hatch lifted, showing the storage batteries and the switches which disconnect the circuits when the model is out of commission. At the extreme right the signal lamps may be seen.

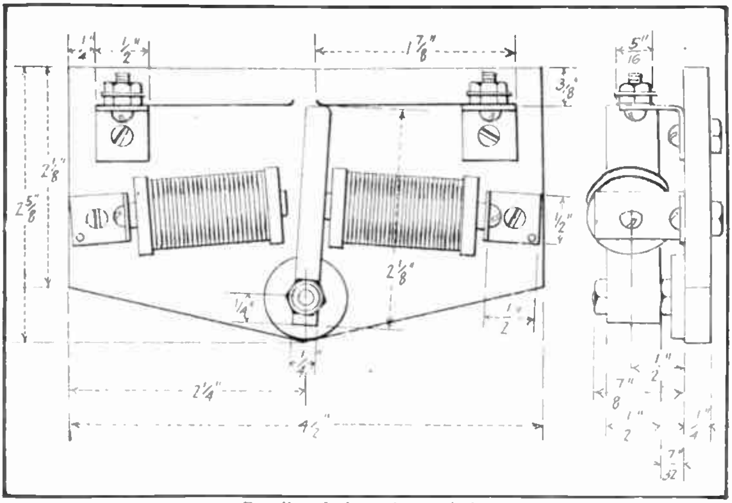
to be about 100 yards. A tuned transmitter, tuned to the exceedingly short natural wave length of the diminutive submarine aerial would increase the distance as would also a transmitter of greater power.

The adjustment of the coherer is a tedious task but when once attained, we found it reasonably permanent. We used a mixture of about equal parts of pure silver and nickel filings which must be quite free from grease. The best working distance for the coherer plugs was found to be between ½ and ⅝ in. with the space between practically filled with filings.

DESIGN FOR A REMOTE-CONTROLLED RELAY SWITCH

A Device Which Makes It Possible to Turn On and Off the Current to an Electric Motor from a Distance

ONE of our problems in the construction of Model Submarine *EM2* was to provide a means whereby the current operating the main driving motor could be turned on or off by the control device. The switch controlling this circuit of course had to be of such a construction that the contacts would remain in the desired position until the next impulse came. Furthermore, from the economic standpoint, it was essential that no current be used to maintain the switch contacts in either position, the impulse serving merely to bring the contacts to the on or off position as the case might be.



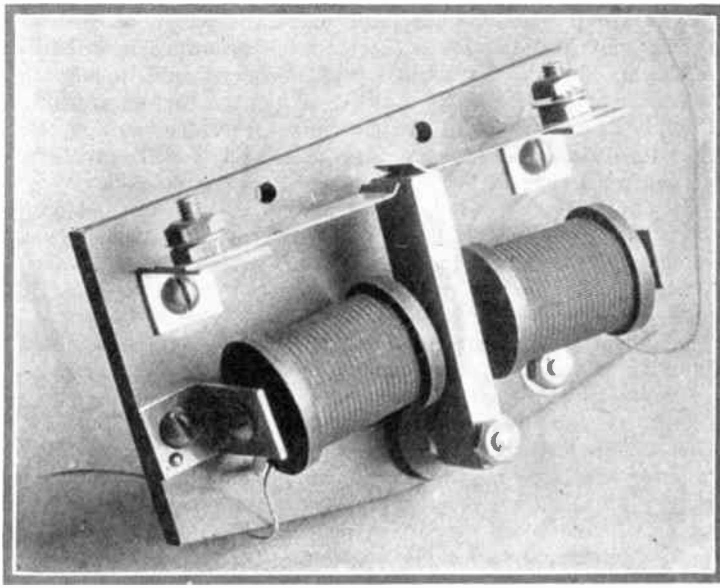
Details of the relay switch.

Some experimentation resulted in the relay switch shown in the photograph and the drawing. The construction is so simple and the device, withal, so effective, we have decided to incorporate the description in a separate article from that covering the submarine. In this manner it is believed the device will be brought to the attention of others than the builders of the submarine model. The switch is a device of innumerable applications by experimental engineers, hence our desire to illustrate its principles to a large majority of the readers.

Essentially, the switch consists of an arm of soft steel, pivotally arranged between the poles of two magnets, and above this armature two springs of phosphor bronze so disposed as to contact with the end of the armature as the latter is drawn to one side or the other by means of the magnet through which current is sent.

The construction is so obvious that we feel little actual description is necessary save a few suggestions that may serve to help the builder in little difficulties we encountered.

The magnets are of the standard instrument type of 2.5 ohms resistance each. These magnets are sold at such a low price in the open market that we have found it cheaper and more satis-



Photograph of the relay switch constructed for use in Submarine *EM2*.

factory to purchase them outright than to construct them. Each magnet is mounted upon the upright of a piece of brass angle as shown in the illustrations. The distance between armature and pole piece of the magnet should not be greater than 3/32 in. to insure reliable operation without the expenditure of an inordinate amount of energy in the act.

The armature is a piece of cold rolled steel (unless wrought iron is available) of ¼ in. by ½ in. section. It is drilled for the pivot at its lower end and this fit should be a good one. The armature should swing freely back and forth but a loose and slovenly fit cannot be tolerated as it will lead to trouble.

The spring strip contacts are mounted upon brass angle pieces and their adjustment is shown by the photograph infinitely better than a thousand words of explanation could describe it. This adjustment is possibly the only "ticklish" part of the job. Too much pressure will prevent the armature from being drawn to the reverse position. Too little pressure will not hold the armature in the desired position against the inevitable vibration of a model boat hull or locomotive body. Of course the design of the switch is such that gravity aids in keeping the armature in either one position or the other as, when it shifts from one side to the other, the center of gravity shifts with it. When the correct adjustment is obtained, the armature will click over from one position to the other the instant the current is applied and it will stay in that position until current is sent through the other magnet.

In our case, the switch serves merely to turn on and off the motor current. To this end, one of the contact springs is connected with the motor (see illustration in the submarine article, this issue), while the armature is connected with the line. The opposite spring is left "dead."

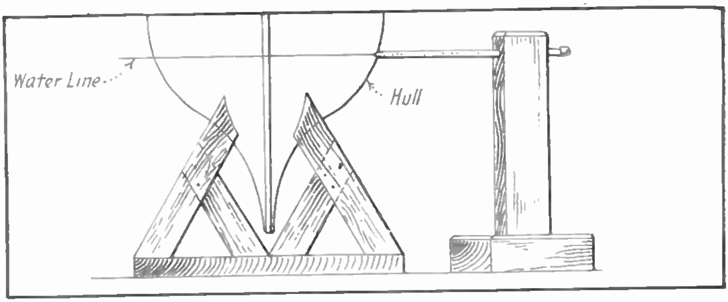
Modifications of this idea could be made to produce a pole-changing or motor-reversing switch by fitting the armature with two contacts which would pass from one pair of springs to the other to reverse the armature leads, for instance. Other applications, with a slight change in design incorporating a spring and a lighter armature might be made to produce a continuous pole-changer to convert direct current into alternating. Such applications will doubtless suggest themselves to the ingenious experimental engineer.

HOW TO PAINT A MODEL BOAT HULL

By Edward W. Hobbs, A. I. N. A.

ONE of the most important processes in the completion of a model boat is the painting. However beautiful the lines of the hull may be, no matter how good the workmanship put into the construction of the boat, it is all to a very great extent wasted if great care and attention are not given to the painting, and, oddly enough, it is this phase of ship construction that is most frequently neglected or given scant attention.

We will suppose that a model boat has been almost completed, and that the hull has been properly shaped. sandpapered. and finished. Before commencing the painting it must first be given a coating of priming—this may be either a good quality lead-color paint or a mixture of equal quantities of red and white lead, diluted with turpentine or gold size. This should be applied with a soft brush and well worked into the wood. Leave this until it is thoroughly dry. This may take from 24 to 48 hours, according to the time of the year. When it is dry very carefully sandpaper the same with fine old sandpaper until a very smooth surface is



How the water line may be marked.

obtained. If the wood is particularly porous it may be advisable to give a second coat of the priming or a plain lead-color paint. This, again, must be left until thoroughly dry, then sandpaper until perfectly smooth.

The wood should now be ready to receive the desired color. At this stage two methods of finishing the work could be followed. either the boat may be enameled with any well-known enamel, and directions for its use are always supplied by the maker. but three points should be borne in mind when using the enamel: to apply a thin, even coating of color; allow it to dry thoroughly hard before lightly sandpapering or rubbing down the surface, then apply a second coat. and when this is thoroughly hard, rub it down with pumice powder until a smooth polished surface is obtained. If a glossy finish is desired, a third coat of enamel should be brushed softly over the surface, taking great care to use a clean brush to apply the enamel, and above all, to work the brush in one direction and not backwards and forwards, as this method causes the varnish in the enamel to lose much of its brilliance, and the excellence of the result is spoiled. The alternative process is one that gives the very best results, and is obtained by the use of paint known as "coach color ground in oil." This can be obtained from most high-class oil and color merchants, but do not be confused with the ordinary painters' color ground in oil. "Coach color" is what you want. It is much finer and merely requires thinning down with turpentine to the required consistency and is applied with a fairly thin brush evenly and lightly to the surface of the boat.

This color usually dries in two or three hours, but is not hard enough for polishing for at least 12 or 24 hours, according to the state of the weather. In wet, cold weather paint takes two or three times as long to dry hard as in warm, fine weather. Five or six coats of this color should be applied to work up a good body, and between each coat the work should be very lightly sandpapered and in the latter stages should be rubbed down with pumice powder.

Of course, while this rubbing down and polishing process is going on the boat and brush must be kept well away from dust, and the work should be wiped down with a damp linen cloth. Afterwards dry thoroughly with a clean dry cloth before applying the next coat of color and, naturally, the model should be hung up to dry—if possible, deck upwards—in a room as free from dust as possible. It is usually practicable to hang any model boat in this way, and is worth the trouble, as more dust settles *on* anything than rises up to it.

When the boat has been finished so far with the color it must be varnished, and this requires both skill and practice, but the best method to acquire the knowledge is to try for oneself. A good start is made by preparing a small quantity of varnish. One that gives results for model work is "Valspar," and which possesses the virtue of not turning white in the water, as many of the ordinary commercial varnishes do, and of course this would spoil the effect of a nice model boat. Having obtained the varnish, a small quantity should be poured into a clean tin lid, and with a small brush (not too soft) the varnish should be applied with an easy and definite action. Care should be taken to apply the same evenly to the surface of the model. The idea is to put on exactly the right amount of varnish at the start, and not to be compelled to brush away the surplus of one part to make good the deficit in the other. Above all, the brush should be used only in one direction, usually from left to right, and the varnish must not be worked or brushed to and fro, as this causes the varnish to "cloud" and so lose its pristine appearance. Two or three light coats give better results than one or two heavy coats. In six to eight hours this varnish would appear dry to the touch, but must be left at least 24 hours, and probably longer, before it is rubbed down with pumice powder as, if the varnish is not quite dry and thoroughly hard, the heat generated by the polishing process will "lift" the varnish.

The pumice powder can be purchased ready ground for use and is very much like flour in appearance. To use it a pad of soft linen should be made, dipped in water and then dabbed in the pumice powder. This is then rubbed with a short circular motion on the hull. After three or four turns with the pad the circular rubbing movement should be carried forward over the whole surface of the model, dipping the pad in the water frequently. Skill alone can be acquired by practice, but the result obtainable is well worth the trouble expended on it. A very beautiful effect is obtained by varnishing the boat with two or three coats of varnish and polishing the same between each coat, and very lightly rubbing down the last coat with pumice powder, but after preparing the pad as already described, covering the same with a single layer of linen, this is made thoroughly wet and used as a rubber, which has the effect of producing a glossing but slightly dulled surface very much akin to glass. When it is desired to indicate the water-line of the model, or to paint it in two colors, some means of marking the divisions between the two colors is necessary. This is accomplished in many ways, but the simplest and best is with a scribing block to scratch mark the water-line. If a proper scribing block is not available, a substitute may be made with a block of wood, through which has been driven a long metal point, as shown in illustration, which indicates graphically the whole process. It will be found that several coats of color will not obliterate this scratch line, but care and a small brush will enable a clean, straight line to be obtained between the two colors by painting up to the line.

It will readily be seen that to paint any model boat, either sailing or power-driven, in a satisfactory manner, requires a considerable amount of care and time for the result to be both permanent and good.—*Junior Mechanics and Electricity.*

Home-made Plumb

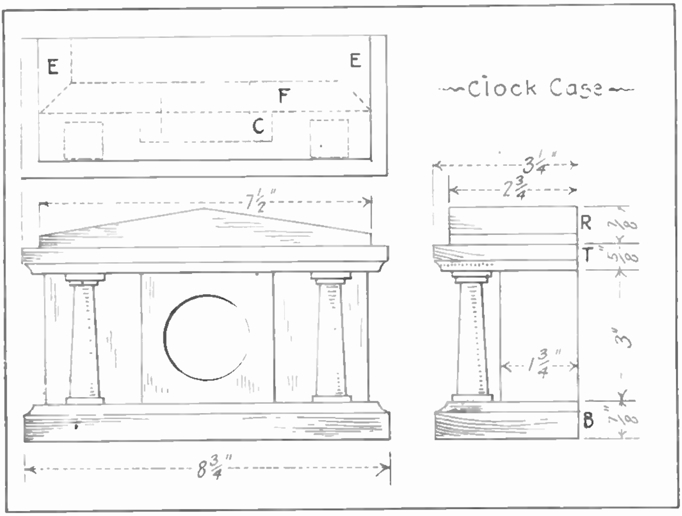
A very good plumb can be made from a portiere knob in the following manner: Unscrew the cover of the knob and insert your cord, making a substantial knot on the inside. Screw the cover back and use as an ordinary purchased plumb.

CONSTRUCTION OF A CLOCK CASE

By F. E. Tuck

THIS case is designed for the small circular clocks 2 in. in diameter, which are carried by the trade generally. For a larger size the dimensions must be changed in proportion. The following pieces of hard or cabinet wood are required:

One roof, *R*, ⅞ in. x 2¾ in. x 7½ in.
One top, *T*, ⅝ in. x 3¼ x 8⅜ in.
One base, *B*, ⅞ in. x 3¼ in. x 8⅜ in.



Plan views of the completed clock case.

Two ends, *E*, ¾ in. x 1¾ in. x 3 in.
Two pillars, ⅞ in. x ⅞ in. x 3 in.
One frame, *C*, ¾ in. x 3 in. x 3 in.
One front, *F*, ¾ in. x 3 in. x 7½ in.

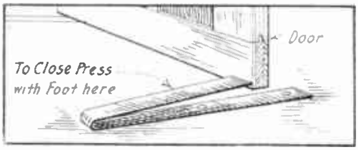
Several of these pieces must be modified as shown in the plans. Saw off the corners of the roof piece to give it the proper slope and, with the extension bit, bore a 2-in. hole through the frame *C* and the front *F*. The concave edges of the top and base pieces can be hollowed out with a small gouge and a rat tail file. The pillars will yield to coping saw and knife with the exercise of a little patience.

Every piece should be carefully worked out, with square corners and straight edges, planed, scraped and sandpapered to a smooth finish before the case is put together. Also be certain that all parts fit perfectly. A bad joint will spoil the appearance of the whole case. The pillars should be made a trifle too long so that they may be trimmed down to an exact fit after the rest of the case has been assembled.

In assembling the parts use headless brads as dowels, and bind together with glue. Brads, if used at all, should be put in where they will not show. First, fasten the clock frame *C* to the front piece *F*. Next secure the three pieces *E*, *F*, *E* with close-fitting joints and attach base, top and roof pieces. Apply the clamps and let stand for 24 hours. Then put the pillars and oil, wax or stain the case to suit. Insert the clock from the rear and fasten it in position with hardwood wedges, or with strips of thin metal held by small screws. The completed model makes a very attractive piece for the home or office.

A Screen-Door Stop

On many places a screen door is in the way at times, as in warehouses and stores. When anything is being moved in or out, the screen door with the spring on it is in the way. It might be locked or hooked back out of the way, but usually you do not take time to do this if you are in a hurry. A little device herewith described will hold the door back out of the way, and release it with a light pressure of the foot. It is made of a piece of heavy strap iron about 1½ in. wide and 2 ft. long. Two holes are drilled near one end. The other end is then bent around to form an elongated "U," the width of which is determined by the height of the bottom of the screen door above the floor. Then screw this device to the floor, at the place where it is desired to hold the door, so that the bottom of the door will slip by the closed end of the "U," and will be caught by the open end due to the slight spring in the iron strip. The door is released by stepping lightly on the spring until the door will come back and be permitted to close.



The spring stop.

Contributed by
FRANK SAHLMANN.

HOW TO SET AND USE THE PLANE

THE plane is one of the most useful tools in the cabinet-maker's kit, and the one with which the beginner will have his greatest difficulties. It would seem that the proper use of the plane comes only after extended practice, yet an analysis of the planing process with care and forethought in handling the plane, should eliminate most beginners' troubles.

Kinds of Planes

In our tool list we have specified only two planes, the 14-in. jack plane, Fig. 23, and the 7½-in. block plane, Fig. 24. For average work, these two will suffice, yet a 24-in. jointer and a combination plane may well be added to the kit at a later date—the jointer being an especially valuable tool for cabinet-making.

There are various types of planes on the market. Fig. 23 shows an all-metal plane, while in Fig. 25 is illustrated one with a body of wood. It has the advantage of lightness, but is more apt to become nicked up, marred, and to lose its shape. Fig. 26 pictures an iron plane with a corrugated bottom. Since there is less metal pressing against the surface being planed with this type, it offers less resistance, hence it is easier to push.

Parts of a Plane

In Fig. 27 the various parts of an iron plane are clearly illustrated. The numbers represent the following:

1A—Double Plane Iron
1—Single Plane Iron or Bit
2—Plane Iron Cap
3—Plane Iron Screw
4—Lever Cap, or Clamp
8—Brass Adjusting Nut
9—Lateral Adjustment Lever
11—Handle
12—Knob
13—Handle Bolt and Nut

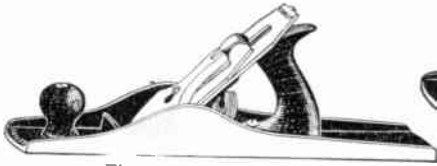


Fig. 23. Iron jack plane.

Fig. 24. Iron block plane.

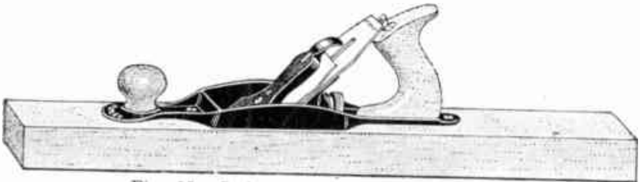


Fig. 25. Jack plane with wooden body.

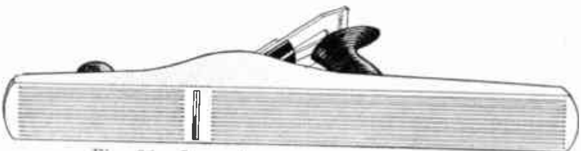


Fig. 26. Iron plane with corrugated bottom.

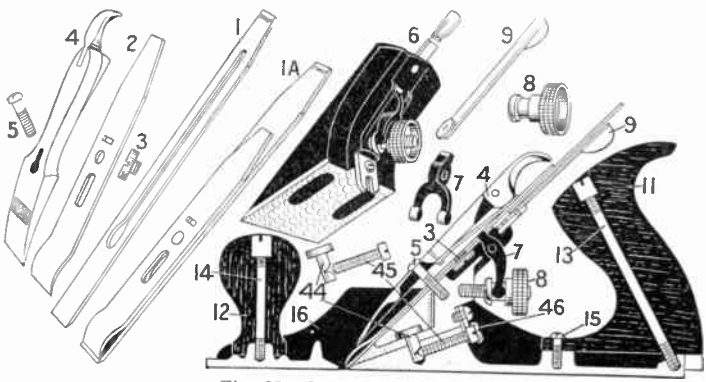


Fig. 27. Parts of iron plane.

5—Cap Screw, or Clamp Screw
6—Frog
7—Y-Adjustment
44—Frog Adjusting Pin
14—Knob Bolt and Nut
15—Handle Screw
16—Plane Bottom, or Body
45—Frog Adjusting Screw
46—Frog Adjusting Screw

A study of the illustration while comparing it with the amateur's jack plane will be of great help. Do not remove the frog, No. 6, or the cap screw No. 5, as these are usually adjusted correctly at the factory, but remove the lever clamp, No. 4, by lifting the lever, and the double iron No. 1A. With the thin edge of the lever cap used as a screw driver, loosen the plane iron screw, No. 3, which permits the plane iron to slide out from the cap. Do not take the screw entirely out, as it is easily lost—merely loosening it enough to slide the iron.

Our next step in actual work would be to sharpen the iron, but, since this explanation will take so much space, we will postpone it until the next installment.

Adjusting the Plane

With the cap, No. 2, held—screw head up—in the left hand, lay the iron with the *straight side down*, over the screw head. Do not push the iron out over the end, as it would dull the sharp edge, but swing it out to one side, then back with the sharp edge of the iron projecting over the edge of the cap, as at 1A. This projection should be a little less than 1/16 in. Tighten the screw with the lever cap just as it was loosened.

Now lay the assembled iron on the frog with the screw head down and the *little rectangular end of the Y-adjustment coming up through the rectangular hole in the cap.* Place the lever cap over the clamp screw, No. 5, and push the lever down. With the fingers of the left hand touching the opening in the plane bottom, Fig. 28, turn the brass adjusting nut, No. 8, with the thumb and first finger of the right hand, until the sharp edge of the iron is felt. It should project, for average work, about 1/64 in., although this projection, which represents the thickness of the shaving taken, will accurately be determined by trial. *It should always be just as small as the work will allow.*

By feeling of the opposite corners of the plane iron as it projects from the bottom of the plane, determine whether or not it is set straight across. If one corner stands out farther than the other, move the adjusting lever, No. 9, toward the projecting

Fig. 28. Adjusting the plane iron.

corner. This will straighten the edge, and *it should always be set perfectly straight across.*

By carefully going over these instructions while following them with the actual process, the adjustments should be easily mastered.

Squaring Up Stock

The first operation that an amateur must learn is the squaring up of stock. Of course it is possible to purchase stock at the mill squared up and sandpapered to dimension, thus making hand planing unnecessary, but *the efficient workman must be able to square up stock* as occasions will constantly arise where this knowledge will be necessary.

By squaring up stock we mean the planing of an over-size piece down to exact dimension so that the surfaces are square with each other when tested with the try-square.

The Process

Fig. 29 illustrates a board which has been planed from larger

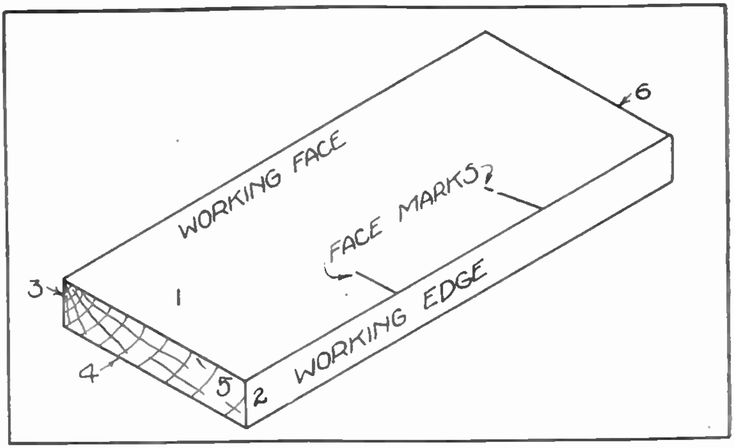


Fig. 29. Illustrating the steps to follow when squaring up stock.

stock. The numbers indicate the order in which the surfaces are planed. This order may be stated as follows:

1. Select the best broad face and plane it *flat*. This is the "working face" and should carry "face marks."

2. Plane the edge adjacent to the face marks *flat* and *square with the working face*. This is the "working edge."

3. Set the marking gauge to the exact width, gauge *from the working edge on the working face,* and plane the opposite edge until the gauge line is *split* and the edge is square with the working face.

4. Gauge the thickness all around the edges and plane the opposite face down to these gauge lines, being very sure—when gauging—to hold the head of the gauge against the working face. When the lines are split, test the face for flatness.

5. Plane one end smooth and square with the working edge and the working face, measure the correct length, and square knife lines over the face and edge. Plane down to split these lines and test with the try-square.

The use of the try-square, gauge, rule, and knife for both testing and laying out was fully explained in Chapter IV,* and should be carefully reviewed as the planing process progresses.

* See December, 1916, number.

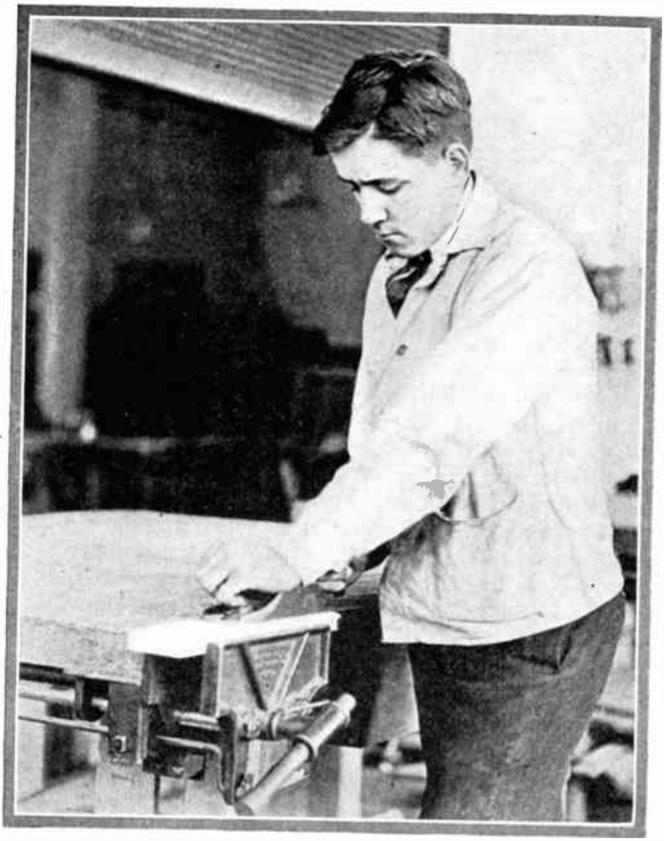


Fig. 30. Correct method of holding plane.

Notes on Planing

We will assume that the craftsman is planing up a small piece of stock, using his jack plane on the faces and his block plane for the ends. He must be very sure that his iron is sharp, set fine, and *straight* across the bottom of the plane. Placing the wood with one broad face up in his vise, he should assume the position of Fig. 30. The one thing that he must now watch is to keep the plane *flat* on the surface of the wood. To do this, he must *press*

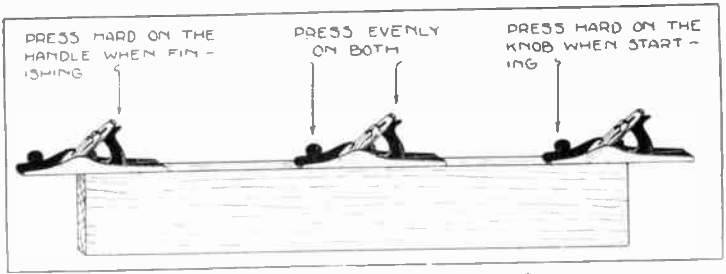


Fig. 31. Points of pressure when planing.

down hard on the knob when *starting* the stroke, press down evenly on both knob and handle when the plane is over the wood, and *press down hard on the handle* when *finishing* the stroke. Figure 31 illustrates the points of pressure.

The first stroke should be taken on the edge nearest the planer; then he should proceed across, covering every point of the surface. If it is very uneven this operation must be repeated a few times. When he has it planed smooth, it should be removed from the vise and tested for flatness. If ridges are noted the plane should be set still finer and the high spots "feathered" off. By that we mean the gradual lowering of the plane to the surface while it is being pushed forward, and the gradual raising of it after the ridge has been covered.

Follow the order as given above exactly, noting the following. There are no measurements taken when planing the "working face" and the "working edge." The head of the try-square and the head of the marking gauge *are always* held against the working face and the working edge when laying out or testing. The working edge is the narrow face to which the "face marks" run. When planing the working face and the working edge, no shavings should be taken off so thick that printing can not be read through them. When planing an edge, be sure that the body of the plane is kept parallel to the edge of the board. There is no reason for using a 14-in. plane swung so far to the side that but 6 in. of it are in use. Be sure to exactly *split* all gauge and knife lines so that one-half of them can still be seen on the wood. Be sure to plane with the grain, as a smoother surface will be obtained. When planing end grain, never push the plane entirely across the piece, but work from the edges in toward the center.

(*To be continued*)

RADIO ENGINEERING

Practical Experiments in the Radio Transmission of Energy

WHAT ARE YOU GOING TO DO WITH YOUR WIRELESS?

There are two classes of radio workers. One class has already taken down their aerials, put away their apparatus, and turned to baseball or other games, forgetting wireless as quickly as they took it up. The other class has lowered their aerials, but are wondering what they will do with all the instruments they have made and purchased.

For the first class there is little more in radio work than the pleasure of hearing signals or the sound of a spark. The second class, however, will continue in radio work as if nothing had happened. Some of the manufacturers who have developed the finest apparatus for the Government never use an antenna in the work. It is also possible to conduct experiments with all types of receiving sets without testing on signals from distant stations in the usual way.

Therefore, the experimenters who are interested in developing apparatus of the highest efficiency, who *design* their instruments and not throw them together, can do just as much as ever before.

The radio articles in EVERYDAY will take up the construction of apparatus by means of which development, experimental, and research work can be carried out, with the idea of improving apparatus so that, when the war is over, the experimenter will find his equipment far advanced from its former efficiency.

Particularly at this time we urge upon the readers of this magazine the value and necessity of radio work. The operators who have only listened to noises neither benefited themselves or the radio art, but now, when work of this kind is out of the question, it is time to carry on the really worth while experimenting. Wireless telegraphy will be used more extensively than ever for intercommunication, and it is for you to do your bit, if not manually on the firing line, mentally and experimentally in the safety of your homes.

There is another consideration. While the Government has required the removal of all aerials, this does not mean dismantling the apparatus. The war has already brought so many surprises that we can no longer foresee what emergencies may arise. For this reason, it is the duty of every man who owns a radio station to bring it to the highest efficiency, adding the best apparatus he can afford, to be ready to put his set in commission for special work. This is the least you men can do if you do not go into active service for our Government.

The radio articles to come will take up experimental work without the use of aerials, and preparatory measures necessary to keep all stations in readiness for all emergencies.

AUDION CIRCUITS AND APPARATUS

By M. B. Sleeper

With Drawings by the Author

A SHORT wave and a long wave tuner have been described already, as well as a condenser set, with the vernier adjustments. There are two other instruments used in both damped and undamped wave reception—a variometer and a primary condenser switch, to connect the condenser in shunt or series with the primary inductance.

A variometer consists of two windings, one fixed and the other movable. When two coils are placed in inductive relation, that is, near together, and are connected in an alternating current circuit, each coil possesses a certain value of inductance. There is also mutual inductance between the coils, due to the interlinking of the magnetic fields of the two coils. When the coils are joined so that their fields assist each other, the total inductance of the circuit is where

$$L = L_1 + L_2 + M$$

L = total inductance,
L_1 = inductance of one coil,
L_2 = inductance of other coil,
and M = mutual inductance.

If the fields oppose each other,

$$L = L_1 + L_2 - M.$$

The value of M depends upon the relative position of the inductances. In a variometer, the mutual inductance is greatest

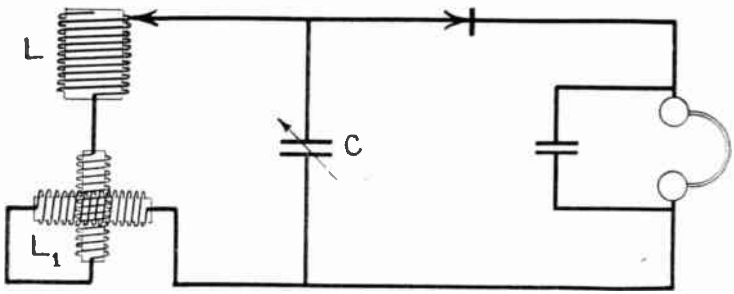


Fig. 23. Circuit used in determining the inductance of a variometer.

when one coil is directly inside the other. By moving one coil from the other, the inductance of the circuit can be varied without sliders or switches. Moreover, the inductance can be adjusted very accurately, a particular advantage in undamped wave reception.

The variation in the wavelength of a circuit, due to a change in the adjustment of a variometer, depends upon the inductance and capacity of the circuit. If, for example, a variometer is connected in series with the primary of a receiving tuner, to give a closer variation of the wavelength.

$$\lambda = 59.6 \sqrt{(L + L_1)\,C}$$

where λ = wavelength in meters,
L = inductance of circuit without variometer, in cms.,
L_1 = inductance of variometer, in cms.,
and C = capacity of circuit in mfds.

If L is 20,000 cms., L_1 10,000 cms., and C 0.001 mfd., the wavelength is 326 meters. But if the inductance of the variometer is doubled, 20,000 cms., and the other values kept constant, the wavelength will not be doubled, for by the formula above, it is only 376 meters.

With the usual equipment of the experimenters, it is impossible to measure the inductance of a variometer, or to calibrate it in centimeters. However, the work can be done with a wavemeter, either purchased or borrowed. A condenser of known capacity is also needed. For practical measurements, the standard variable condenser of 0.001 mfd., adjusted to maximum capacity, is satisfactory. The variometer, secondary of the tuner, and condenser should be connected as in Fig. 23. The wavemeter is connected with a buzzer,* and the wavelength of the receiving circuit deter-

* See *Everyday Mechanics*, July, 1916, or Pacent's book, "Construction of a Transatlantic Receiving Set."

mined. With the wavelength and capacity known, the total inductance is

$$L + L_1 = \frac{\lambda^2}{C\ 3552}$$

Then, with another adjustment of L, the secondary, the difference in the two values of $L + L_1$ is the inductance of the variometer. For example, if the wavelength at the first setting is 326 meters, and the capacity is 0.001 mfd., $L + L_1$ will be 30,000 cms. Then at the second setting, with an increase in L, the wavelength is 376 meters, $L + L_1$, will be 40,000 cms. Therefore, L_1, the in-

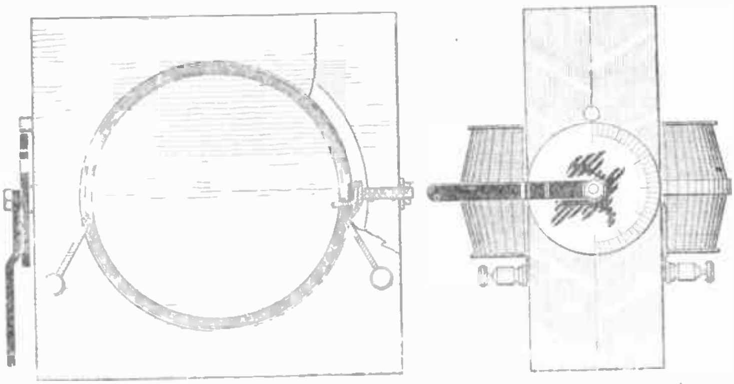


Fig. 24. A variometer gives the close adjustments required for undamped wave reception.

ductance of the variometer, will be 10,000 cms. A complete inductance curve can be plotted in this way for the scale on the variometer.

The greater number of turns of wire on the coils, the greater the inductance. There should be a few more turns on the ball than in the ring, to keep the inductance the same in both coils. No. 26 wire is about right for practical purposes.

Fig. 24 shows a side view of a variometer with the ball in a vertical position, and a front view with the ball horizontal. Other details of construction are given in Figs. 25 to 27.

The most difficult part to make is the ring, Fig. 25. This is composed of two pieces of wood, 5½ in. square and 1 in. thick. The pieces are fastened to a face-plate, and are cut out at the

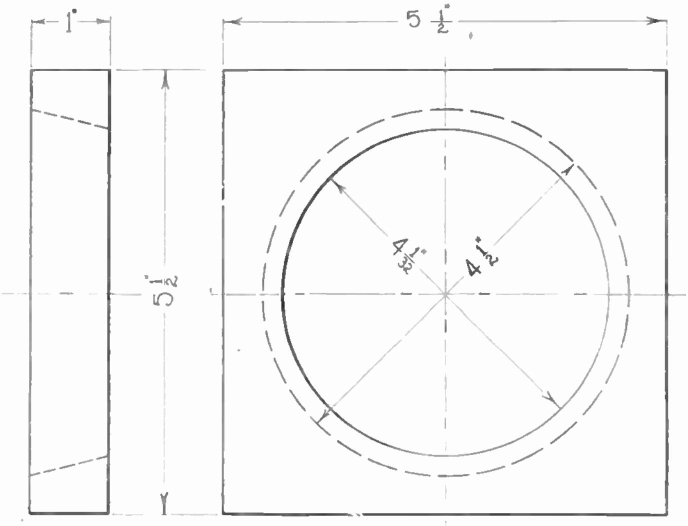


Fig. 25. The ring, in which the outer coil is fastened with shellac.

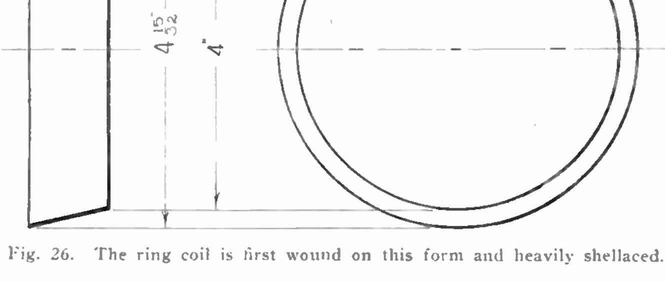


Fig. 26. The ring coil is first wound on this form and heavily shellaced.

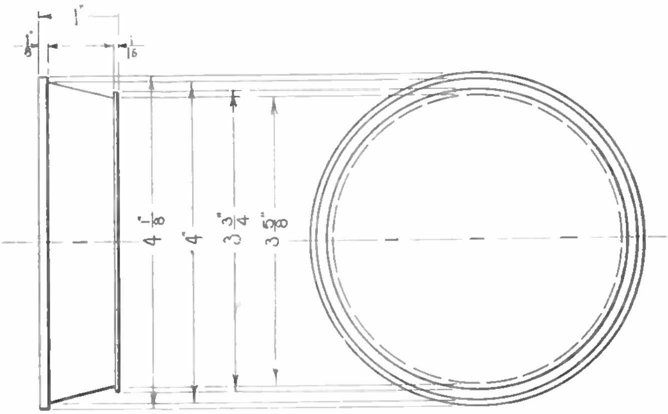


Fig. 27. This shows one-half of the ball which supports the rotating coil.

center on a lathe. If the experimenter has not the facilities for the work, it can be done cheaply in a wood turning shop. With both frames completed, the winding must be fastened inside. The easiest method is to wind the wire on a form, Fig. 26, and shellac it until the wires hold together. Then, by running a very thin strip of brass under the wire around the form, the coil can be loosened and slipped off. After that, it is fastened inside one of the rings by thick shellac. In doing this work it is best to wind the wire on the form and turn the ring to fit exactly over the coil. The winding must not extend all the way to the larger diameter of the ring, as space must be left for the rod on which the ball turns. Be sure that both coils are wound in the same direction.

Fig. 27 gives the dimensions for one-half of the ball. When this is wound, and the two halves fastened together with glue, the hole for the rod must be drilled. Without a lathe it is rather difficult to do it accurately. In a lathe, however, it is easy. The procedure is as follows: Put a 3/16-in. drill in the chuck, and a dead center in the tail stock. Now make a small hole with a center punch just between the two halves of the ball. Then put the drill in this punch mark, and run up the dead center against the other side of the ball. If the ball is rotated it is easy to see whether or not the dead center is diametrically opposite the point

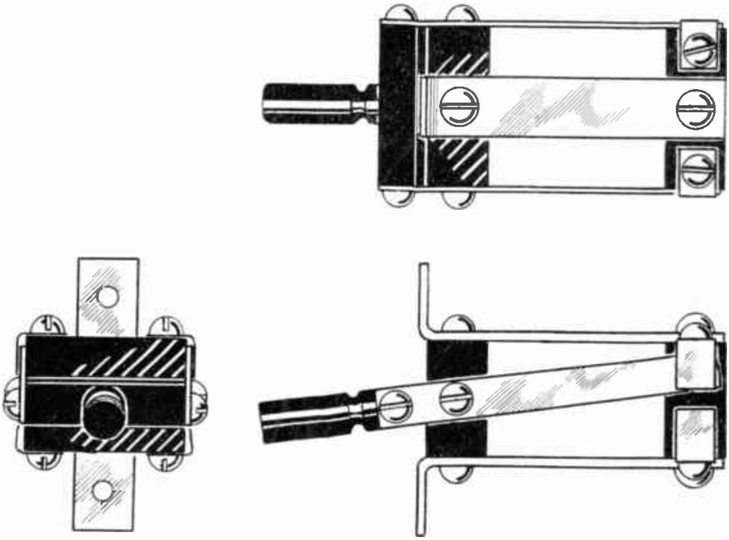


Fig. 28. This switch may be mounted at the inside of a panel or beneath the operating table.

of the drill. The position of the center can be changed until the ball turns true. Then it is in the right position for drilling. If the drill will not reach clean through turn the ball around and drill from the other side. The two holes will meet exactly. After the holes have been drilled in the ring the center rod is forced into the hole in the ball.

Fig. 24 shows how connections are made to the rotating coil. Pigtails of fine, stranded wire, insulated by a silk or cotton covering, are put through holes in the outer flanges of the ball and soldered to the ends of the winding. Then they are wound around the shaft and brought out to binding posts.

The details of the handle and indicator will be left to the individual builder. On this particular instrument a hard rubber disc, 2 in. in diameter and ⅛-in. thick, is fastened on the shaft between a threaded washer and the handle. The long handle allows a closer adjustment of the variometer than a small round handle. and keeps the hand out of the field of the coils. The adjusting arm can be bent into the shape shown in the drawing by softening it over an alcohol flame.

Telephone switches are often used to change a condenser from series to parallel with an inductance. However, these switches are quite expensive. Fig. 28 shows a double pole, double throw switch which can be made at a very low cost.

The switch consists of two hard rubber end pieces held together at the top and bottom by 1/16-in. brass strips. The arms of the switch are pivoted on machine screws at each side of the front end-piece. The arms, in turn, are joined by another hard rubber strip, which holds the handle.

Two clips are fitted to the hard rubber piece above and below the arm. When the handle is pushed down, the arms connect with the upper set of clips; when it is raised, the lower clips are connected. Connections are soldered directly to the clips and arms with the flexible cables.

By means of this switch, the primary condenser can be connected in parallel for long waves, or in series for the short waves.

Four of the simplest and most efficient hook-ups for undamped wave reception are given in Fig. 29. The first one is an ordinary Audion circuit, with the addition of two fixed inductances, coupled inductively. A variometer or two small coils of 100 turns of No. 24 wire will serve the purpose. If a variometer is used, one coil is connected with the secondary of the tuner; the other coil is joined to the B battery circuit. The connection between the variometer windings goes to the variable condenser and filament. The coupling between the two small inductances produces a beat effect in the grid and plate circuits, making the undamped wave signals audible. This circuit is easy to adjust since there is only a variometer in addition to the usual apparatus. A condenser is shown in the diagram, connected across the phones and battery. This may be of the Murdock type, with a capacity of 0.01 mfd., or a 0.001 mfd. condenser filled with oil. The circuit will usually work if this condenser is omitted, although it is better to use it.

Some experimenters do not know whether an Audion is oscillating or not. The simplest and most accurate test is to touch one of the binding posts on the secondary condenser. If the Audion is oscillating there will be a plucking sound, easily recognizable because there is practically no response when the Audion is not oscillating.

With the connections just described it is only necessary to vary the coupling between the two small coils and to adjust the condenser in the grid circuit. When signals are heard, the coupling

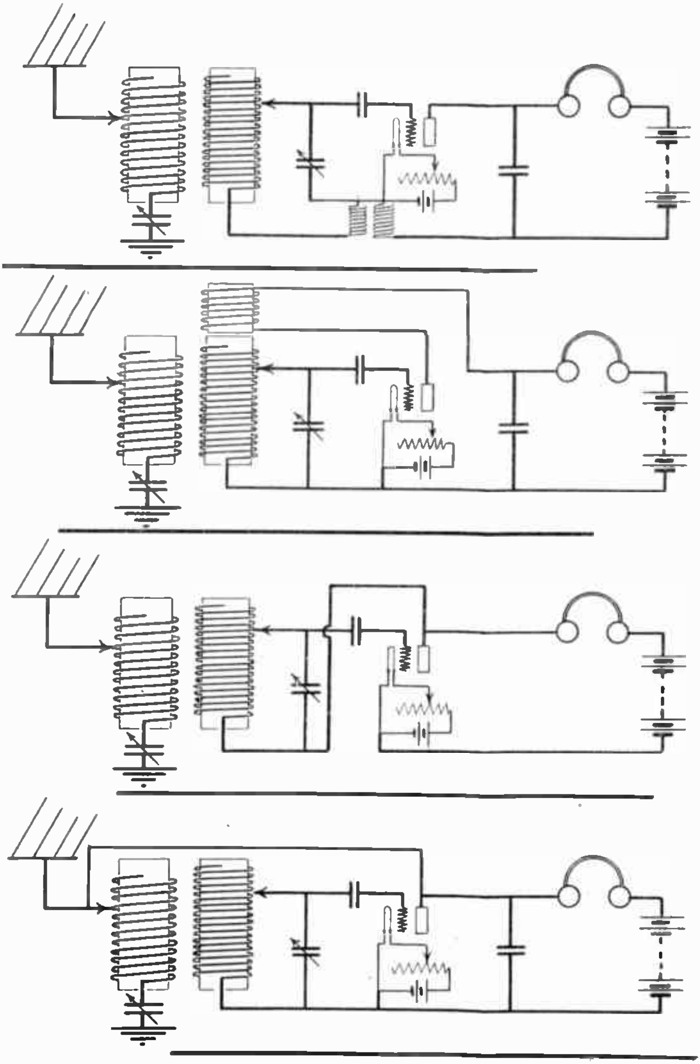


Fig. 29. Simple circuits work better and are easier to operate than those having an assortment of inductances and capacities.

of the tuner should be loosened and the circuits tuned to the incoming signals. A very close adjustment of the secondary condenser is necessary, and for this reason the verniers, already described, should be used. A little practical experience will teach the operator more than several pages of instructions, for every set has its own peculiar characteristics, sometimes tricky, but easy to master.

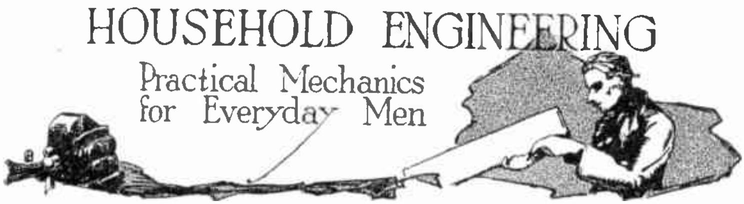
The second diagram in Fig. 29 gives the hook-up used extensively in the Navy. Here a non-adjustable coil of about 300 turns of No. 28 wire is wound on a tube three inches in diameter, connected in the grid circuit. This coil is loosely coupled to the secondary inductance, producing a reactive effect between the grid and wing circuits, as in the first case. The coil just described is the right size for signals up to 15,000 meters; for shorter wavelengths, such as the telephone or Oscillion signals, the number of turns may be reduced to 100 turns. All the other apparatus and the adjustments are similar to those in the first circuit.

The simplest circuit of all is the standard de Forest hook-up, the third from the top. Here one side of the tuner is connected to the plate, instead of the filament, as in the usual Audion circuit. No additional adjustments are required to make the bulb oscillate, other than the variation of the A and B battery controls.

In the fourth diagram the antenna is joined with the plate. Some operators have difficulties in making the bulb oscillate with the current, but with the knack discovered, it is easy enough.

Any of these circuits, in connection with the other apparatus already described, will bring in Nauen as far west as St. Louis, or farther, under favorable conditions. As a rule, a single wire antenna, 150 to 300 ft. long and 40 ft. high at each end, is large enough for transatlantic work. The addition of more wires, or an increase in the elevation of the antenna, is not as effective in strengthening the signals as increasing the length of the aerial. It must be remembered that with the best of circuits and aerials, the results depend principally upon the care taken in the construction of the apparatus and in its skillful manipulation. If the instruments described are properly built and operated, they will give a greater range than the best of complicated receptors.

The next article of this series will describe apparatus for heterodyne effects, with separate oscillators to produce beats in the incoming signals. Amplifying circuits will also be discussed.



Helps in Geometrical Drawing

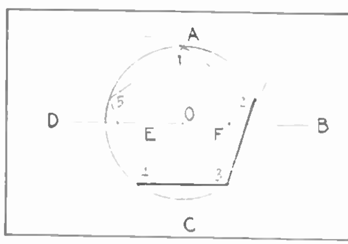
In drawing geometrical figures it is often desired to inscribe regular figures in circles. A way of inscribing regular hexagons, pentagons, octagons and squares is given herewith. This is not original, but I have never seen some of these appear in magazines, so it might be of interest to some of the readers to know how this is done.

To inscribe a square in a circle, simply draw two diameters at right angles to each other and connect the points where they touch the circumference by straight lines. The resulting figure is a square.

To inscribe an octagon in a circle, draw two diameters at right angles to each other in the circle and bisect the angles between each two lines, making four straight lines passing through the center of the circle. Connect the points where these lines cut the circumference by means of straight lines and an octagon will be the result.

To inscribe a hexagon in a circle, take the radius, or half the diameter, and apply it to the circumference. It will go six times even. If these points are connected you will have an inscribed hexagon.

To explain how to inscribe a pentagon in a circle, a figure is given in order to give a concrete example how this is done. A circle of any diameter is laid out. Call this circle *O*. Two diameters are drawn, at right angles to each other. These diameters are designated as *DB* and *AC*. Bisect one of the radii, as at *E*. Place the center beam of the compass on *E*, and with an arc equal to *EA*, describe a circle, cutting *DE* in the point *F*. Then get the ex-



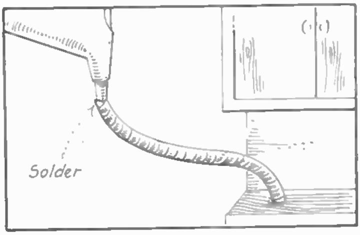
How a pentagon may be inscribed.

act distance from A to F, and divide this into the circumference. It will go just five times. The points where the circumference is touched are then connected by straight lines, and you will have a five-sided regular figure inscribed in the circle.

Contributed by FRANK SAHLMANN.

AN IMPROVED FUNNEL OIL CAN

In nearly every garage you will see measuring cups for oil and gasoline with a small funnel for pouring the liquid into



The most inaccessible places may be reached.

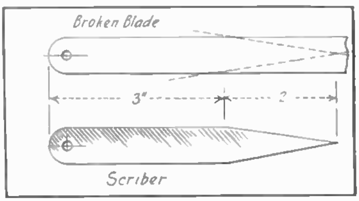
another vessel or opening. This funnel on the cup is quite handy if the opening into which the oil or other liquid is to be poured is in an accessible place. However, much oil is lost if the funnel does not fit into the opening of the other vessel. To prevent this loss and to make it much easier to replenish the oil, where the oil pipe opening is out of the way, a device is here shown that will do away with all of this. A piece of old flexible speedometer shaft housing is cut off and soldered to the end of the funnel on the regular measuring cup. When it is desired to pour the oil into a remote opening, the end of the flexible tube is inserted, and the oil all reaches the place for which it was intended, and none will run over the side of the hole.

Contributed by FRANK SAHLMANN.

AN EASILY MADE SCRIBER

The writer recently required a scriber and, having none handy, made one that gave such good results that he is passing the idea along.

A 5-in. piece was cut from a broken hack saw blade, and the teeth ground off on the emery wheel. Clamping it in a vise along the dotted lines shown in



The scriber is easily made.

the illustration, it was a simple matter to cut it roughly to the finished shape by means of a chisel. The rough edges were then ground off, and the point given a chisel edge.

The simple tool was so satisfactory that it remains in the tool kit.

Contributed by T. W. BENSON.

AN OIL CAN HOLDER FOR AN AUTOMOBILE

Many of the cheaper automobiles are not equipped with a holder for the oil can. Such a holder is easily made and is well worth the trouble. Secure a piece of tin a little larger than the base of the oil can, and cut it out in the form of a circle, just the size of the base of the oil can, but leave three little projections, 1 in. long and ½ in. in width, spaced equally on the circumference. Bend them up and

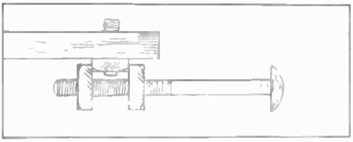
The oil can holder is made of tin.

then bend the top of each one out just a little. The oil can will be held in place by these arms. Now punch a hole in the center and bolt to the pan on the engine. It is best to put a thick piece of felt under the holder to prevent the tin rattling against the pan. On some cars it is very convenient if bolted to the pan just in front of the carburetor. The oil can will be easy to get when you want it, and still will not be rattling around when the car is in motion, as is the case if the can is just set down in front of the carburetor.

Contributed by FRANK SAHLMANN.

SUBSTITUTE FOR WRENCH

When in need of a wrench, a good substitute can be had by using a large bolt and two nuts as shown in the illustration. This



Here is a good substitute for the wrench.

device will often reach places where an ordinary wrench would not.

Contributed by C. H. THOMAS.

TO REMOVE PRINTER'S INK

A newly discovered method of removing printer's ink, for a slight cost, from ordinary "pad" paper is this: Take chloride of lime and vinegar in the proportions of 4/5 chloride of lime and 1/5 vinegar. As soon as prepared, the solution turns slightly yellow. Then apply to the spot, which will disappear.

Contributed by H. G. FRANK.

Remove grass stain from white goods by rubbing with molasses and washing in warm soap suds.

HOW THE WAR AFFECTS AMATEUR RADIO

JUST as this issue goes to press, we receive semi-official information to the effect that all amateur radio stations throughout the country are to be dismantled immediately. In grim substantiation of the soundness of our information, the Police Department of New York City has received orders, supposedly direct from Washington, to see that all private aerials are taken down at once and that all apparatus, both sending and receiving, is placed out of commission regardless of whether the owner has a Government license or not. These orders are said to have been issued on Saturday, April 7th, and at this writing, Monday afternoon, April 9th, every private station within the knowledge of this magazine has been dismantled. This includes the experimental stations of a number of prominent amateur manufacturers in New York and also the aerial on the Experiment Station of this magazine at Van Nest, N. Y.

Doubtless this sweeping demolishment of the amateur stations is justified from one point of view. This is no time to quibble or to start investigations. The action must be swift and certain. That much is freely granted.

However, does it not seem unfortunate that the Secret Service of the country should be deprived of a peculiarly effective and astonishingly well-organized source of information that cannot possibly be duplicated through the authorized Navy Stations owing to the pressure of their work and the rules and regulations which govern their operation? The thousands of amateurs throughout the country should constitute a watchdog of great potency. Many of their stations have a range of operation on the receiving side that is not duplicated by those of the Government. Does it not seem that by means of a system of intelligent selectivity, many of these thoroughly well equipped plants could be operated under

Government supervision? Apparently no effort is being made in that direction.

From the published reports and those given the writer verbally this morning, a number of very curious and remarkably effective forms of apparatus hitherto unknown have been uncovered in the process of demolishment by the police. One of the most interesting examples was a statement spread broadcast to the effect that a transmitter capable of sending signals 1,000 miles and more could easily be set up as a portable apparatus in the tonneau of a motor car. We should certainly like to see this apparatus.

What Shall the Amateur Do?

However, looking the matter straight in the face, boys, we must admit that this is no time for idle criticism or futile argument. The authorities are doing absolutely nothing but their duty—they are following orders.

We, also, have a duty to perform. That duty is first, last, and all the time to obey the orders of our Government. Let us forthwith let down our aerials, disconnect our apparatus, preserving it carefully and taking it down in such a manner that it may again be erected should the official call come.

After doing that simple and obviously necessary act of duty let us sit down and write briefly, concisely, to our Radio Inspector for each district, giving him accurate, important details of our stations both transmitting and receiving, and close this list of dependable data with the simple statement that this station is at the service of Uncle Sam should he find an opportunity to use it.

Let us refrain from mass meetings, hot headed discussions and arguments, ranting and tearing at the way the amateurs have been treated. Let us quietly and in a dignified manner and without an element of self-assertiveness tell our Inspector just what we have to offer our Government, each one of us, and then await the call. Rest assured it will come if the need arises.

In the Meantime

There has been no order issued and it is inconceivable that there will be one restricting intelligent experimental study of the art of Radio Telegraphy and Telephony. Just because we cannot transmit and receive is no sign that we should abandon radio even during the period of the war. Lest our amateur friends labor under an incorrect impression, let them be advised that one of the brightest radio engineers the writer knows—the designer of some of the finest apparatus in use to-day—cannot "pound the brass" any better than a rank amateur. In fact, up to a year ago he did not know one letter of the code from another.

At this time when we must refrain from operating for the pure fun of doing it, why should we not enter upon an era of concentrated study of the principles of design and construction. We can carry on our work uninterruptedly so long as we do not let our signals get out on the ether. We can perform experiments in the laboratory, build apparatus, test it with phantom aerials which do not transmit signals; we can read, practise with a buzzer set, listen in to a similar set; we can brush up on mathematics; in short, we can make good on the points we have neglected just because of the fascination of the signals coming through the ether.

Do Not Forget the Manufacturer

If the amateur radio industry is to survive the war, the manufacturers—the firms that build our instruments—will have to be assisted over this period of temporary inactivity. If the amateurs throughout the country shut down on the manufacturers, that is, refrain from buying any goods at all during this time, the aforesaid manufacturer will think the game is not worth the candle and will soon decide to forget the amateur.

The aim of these few remarks is not to urge amateurs to load up with a lot of transmitting and receiving apparatus to be consigned to the attic storeroom. What we do wish to impress upon our readers, however, is that they must not let themselves be cast into oblivion without a struggle. Practically every manufacturer of amateur radio apparatus carries a line of general experimental apparatus as well. Nearly all make or sell instruments that may be put to many and varied uses other than the transmission of signals. For instance, the X-ray and High Frequency Outfit described in this issue is built up of standard radio transmitter parts. Does not this one example suggest the possibility of valuable and interesting experimental work through the medium of the very apparatus in our stations and laboratories?

Our point is this: let the erstwhile operators read and study and experiment with radio if they will; let them also investigate the possibilities of their radio apparatus in other lines of endeavor as for instance the medical application or perhaps the cultivation of plants and vegetables; above all, let them lend what assistance they can to the manufacturers of apparatus and to the publishers of the books and magazines through which they get their information; finally, in doing all this, let them appreciate the duty they owe their country—a land which has given much and asked for little in return.

CAN YOU RUN A LATHE OR DRIVE A CAR?

FROM its inception, the policy of this magazine has been to teach men how to do things; this instruction has been largely through the medium of working models, the construction of which we have endeavored to explain.

The summary of a year's correspondence, however, has shown that there is rather a dearth of practical mechanical knowledge among a certain class of our readers; the old-timer simply "eats it up" and cries for more, but the new arrivals in the realm of practically-applied science and mechanics frequently are puzzled when it comes to the simple use of tools that the Editor had believed was taught in every manual training school in the country.

Now this little chat with you is not in the nature of a criticism or an exposition of the shortcomings of either our readers or their instructors in the schools. Rather let it be a frank recognition of a condition that exists possibly through a lack of close application or an appreciation of the importance of the matter. What we aim to do is to try to find a way in which this condition may be overcome with the facilities at our command.

A knowledge of practical mechanics and the use of tools will not hurt any one. A thorough grasp of the essentials of the subject may prove of incalculable value in view of the crying needs of our country for skilled mechanics, engineers, artisans, draftsmen, etc. The man who can run a car and keep it running; the chap who can make a forging for a repair; the machinist who can turn that forging into a finished part in an emergency with perhaps limited tool equipment; the radio man who can unpack a transmitter and receptor and *install them* ready to operate inside a few hours; that man is worth to his country infinitely more than the man who can do nothing but pull a trigger. We do not mean to decry the brave lads who suffer the hardships and perils of the trenches—far from it; what we aim to show is that a single technically-trained man may have it in his power to save the lives of a hundred of his untrained comrades in an emergency, or, he may, through a single application of his engineering knowledge and skill, render effective the efforts of a host of his non-technical brothers whose work might be indefinitely hampered through one of the countless accidents which are inevitable under such circumstances.

Our country is at war and we owe to it, each of us, his full measure of service and devotion. In the aggregate, the part this little magazine can play is perhaps small; but if, through our best efforts, we can instil into but five per cent. of our readers at least a glimmering of the essentials of practical engineering, or to stir them into action which will induce them to partake of that knowledge from some other and perhaps better source, we shall feel that our efforts have not been in vain. From the fact that we shall tell our story to more than fifty thousand followers with each issue of the magazine, we may deduce that our efforts will not be without result.

Accordingly, while the policy of the magazine in the main will not change in the slightest, we announce that commencing with the June issue, our principal aim will be to show, by means of authoritative and well-illustrated articles, how to do all manner of things which may be of service to the man with the instincts of a mechanic or an engineer in this hour of our country's need.

We shall try to show how to use the lathe, milling machine, planer; how to use wood-working and machine tools in general; how to run motor trucks and cars; how to take care of gasoline engines and electric motors and generators; how to install and test radio transmitters and receptors; how to perform emergency repairs of all kinds; in short, how to become a practical engineer in the emergency sense of the word. We cannot hope to train men in the nature of a school or college nor can we compete with the school of practical experience. What we can do, however, and what we aim to do, is to give the essentials of the subject in as simple and understandable and practical a manner as we know how.

In this task we have mapped out for ourselves we shall have need to call upon every dollar of our resources and every man among our contributors in the search for dependable material. In view of this, we shall ask those among our readers who feel that they have had experience which might prove of assistance to the "other fellow," to come forward with practical letters or articles and, if possible, photographs and drawings.

ELECTRICAL EQUIPMENT, by H. W. Brown, B.S., M.M.E. Cloth bound, 6 x 9, 229 pages, 109 illustrations. Price $2.00. Published by McGraw-Hill Book Co., New York, N. Y.

Mr. Brown, drawing on his experience as an engineer with the Westinghouse Company, has put into this book the very material which he needed, but had to discover by experience, when engaged in practical engineering work. All unnecessary or seldom-used data has been omitted, but, as far as possible, he has covered the essential details of the selection of electrical equipment for shops, factories, and industrial plants. The points for consideration in deciding upon direct or alternating equipment in relation to various uses of the current are clearly explained. A. C. and D. C. generators, transmission, motors, and lighting systems, with their controlling apparatus, are described and discussed. The latter part of the book is taken up by a list of motor equipments and the types of motors for each case, and a long table of the costs of different parts of electrical equipment.

This book will clear up many difficulties or questions encountered in the designing of electrical installations.

HAND BOOK FOR MECHANICS, by F. E. Smith. Cloth bound, 8vo. 328 pages, profusely illustrated. Price $1.50. Published by D. Van Nostrand Co., New York.

For the man who lacks an academic education or, for that matter, every man who has felt a want for a book giving rules for mensuration, explanation of solving formula, etc., Mr. Smith has compiled this volume. His object seems to have been the writing of a book which would not be out of place in any experimental workshop. It is not filled with technical terms, but written in a style suitable for the man to whom it is addressed.

Such chapter headings as "The Strength of Materials," "Simple Machines," "Specific Gravity" and "Mensuration" give a brief outline of the practical information it contains.

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