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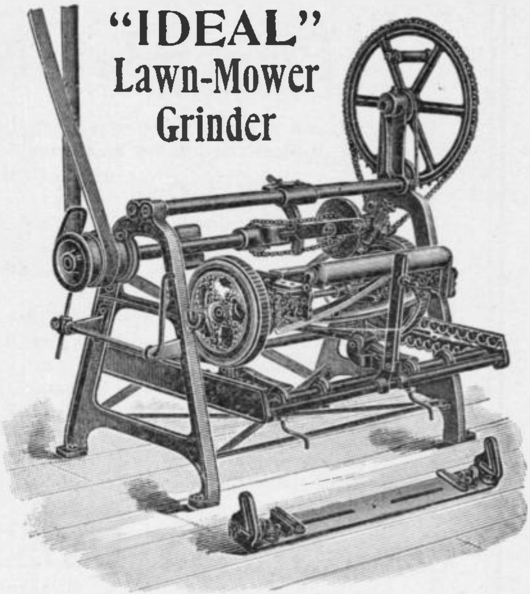

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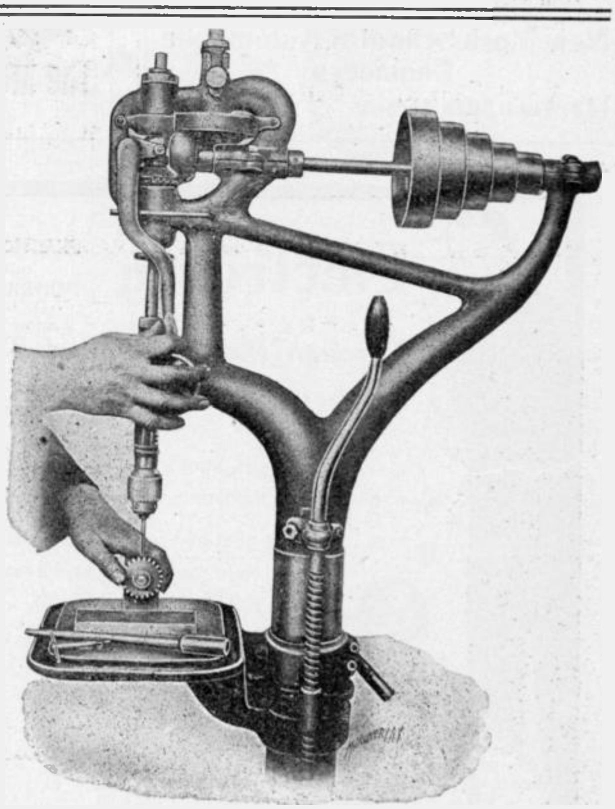

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Electrician and Mechanic

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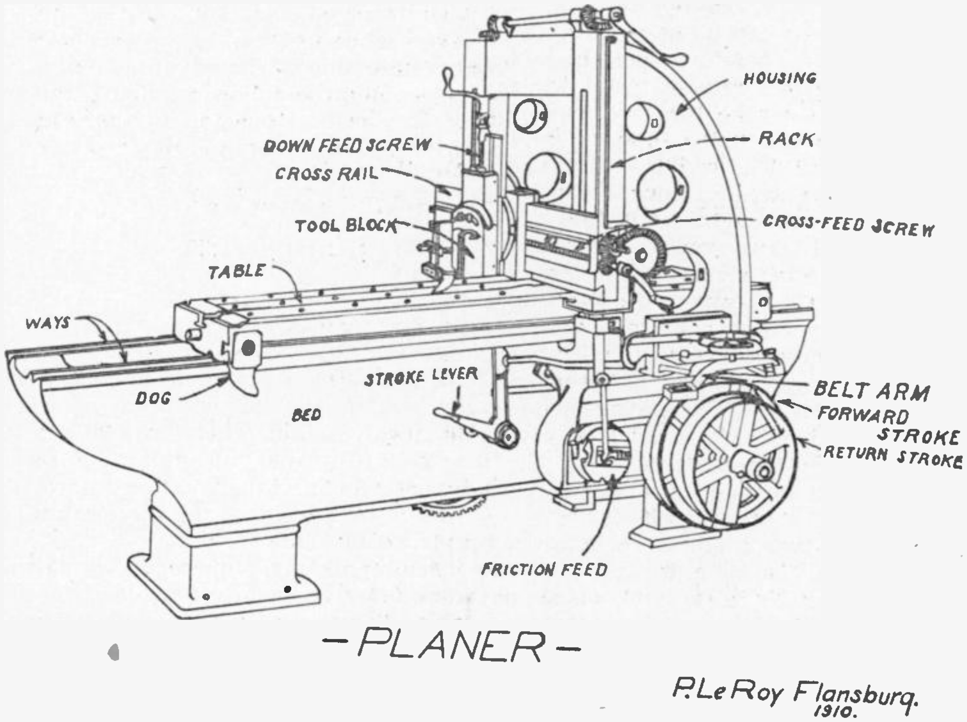
MACHINE SHOP PRACTICE—Part I

The Planer

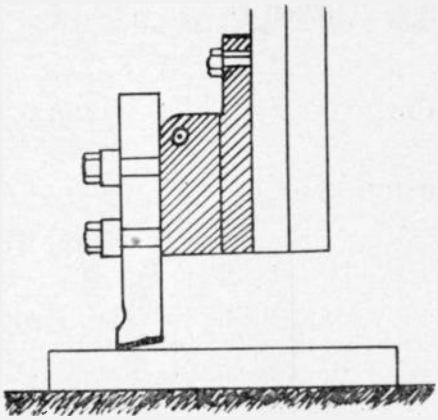
P. LE ROY FLANSBURG

Among the important machines in the modern machine shop is the planer, its chief function being to produce a flat surface. In order to accomplish this, the piece of work is fastened rigidly to a table having a reciprocating motion and the work is carried back and forth under the cutting tool, the tool being fed across the work at right angles to the line of motion of the table.

The drawing shows a standard type of the modern planer. The machine consists of a table upon which the work is securely fastened and which slides back and forth on the ways, the ways being V-shaped guides on the top of the bed of the machine. Rigidly bolted to the sides of the bed are the uprights called "housings," while on the front faces of the housings is fastened the movable cross-rail. On the cross-rail is carried one or more saddles, these saddles having the planer heads attached to them. In order to raise or lower the tool, a screw is used to which a handle is fastened. (This screw is known as the down-feed screw.) The mechanism feeding the cutting tool, and regulating the travel of the table, in planers are of various forms. In general two belts are employed, one for the forward and the other for the backward travel of the table. When the machine is in operation, the belts are shifted upon alternate tight and loose pulleys, in



-PLANER-



Tool in Position

such a manner that each belt becomes a driver, for short periods. The feeds are regulated by other independent devices, the attachments on the bed of the planer being used simply for shifting the belt. These attachments are called tappets or dogs, and they engage the reversing or stroke lever, which in turn is connected to the belt shifting pulleys. On the front face of the planer head is fastened the tool block, a most important part of the machine, and to this block the tool is fastened by tool clamps. The outer face of the tool block is a swinging face, as can be seen from the small drawing. Therefore when the tool is cutting, the face remains rigid while on the return stroke the face swings out, allowing the tool to pass freely over the work. The saddle can move across the cross-rail by means of screws, known as cross-feed screws, while the cross-rail itself can be raised or lowered by means of other screws. The screws which operate the raising or the lowering of the cross-rail are contained within the housing, these screws being operated simultaneously by means of bevelled gears. In order to make the table slide backward and forward, a rack is usually placed on the under side of the table, a pinion gearing into this, being driven through a train of wheels.

There are two methods commonly used to impart motion to the planer table. One is by a system of spur gearing, in which the power is transmitted to the table by means of gears. Planers thus driven are called spur-geared planers. The second method is by means of a spiral gear that engages with a rack on the underside of the table. The worm is driven by gears and shafts, which, in turn are driven by the belts. Such planers are known as spiral-geared planers.

It will be noticed in the drawing that the driving pulley or forward-stroke pulley and the return-stroke pulley have different diameters. The pulleys on the countershaft, to which these are belted, also have different diameters. By such a combination, the planer is made to run backwards on the return stroke, at a rate of speed 2, 3 or 4 times as great as the forward or cutting speed. The speed ratio is usually 4 to 1. This type of a planer is said to have a "quick-return motion." This method saves much time, for on the old-style machines as much time was required for the return-stroke as for the forward-stroke.

It will probably be noticed that there is only one cutting speed to be obtained from the ordinary planer, while nearly all of the other machines used in a machine shop can give several. This condition has recently caused a type of machine to be introduced, called the "Variable-Speed Planer." This machine is so arranged, that by using a "nest" of quick-change gears about six speeds are obtainable. The advantage of this is seen by the following figures given by Mr. W. S. Hagaman in the *American Machinist*, March 7, 1907:

Cutting Speeds Feet	Return Speeds Feet	Cutting Feet Per Hour	Gain
30	80	1,308	——
40	80	1,600	22%
50	80	1,845	41%
60	80	2,056	57%

The size of a planer is indicated by the size of the largest piece of work that it can handle. Therefore a 30 in. x 30 in. x 12 ft. planer, means that a piece of work 30 in. square will go through the housings and that the table can take a piece 12 ft. long.

Before planing a piece of work, the work must be securely fastened to the table. This operation is called "setting-up" the work. The manner of holding the work to the table depends greatly on the kind and size of the work.

Very often, if the piece is small, it may be held in a regular planer chuck or vise by the use of bolts and clamps, by pins and jacks or by specially designed holding devices.

If the work is sufficiently large to allow it to be set flat on the bottom of the chuck, the surface will usually be near enough true, to plane the sides of the work parallel. In order to make sure that the work is fairly bedded (that is in contact with the top surface of the chuck plate at all points), the upper face of the work is struck with a lead hammer, after the jaws of the chuck have been tightened properly.

If the work is too large to be held in the planer-chuck, or this method is found impractical, the work may be fastened to the table by bolts and clamps. T-shaped slots are always cut in the top of the table to hold the bolt heads and holes are provided for the pins, which are to keep the work from slipping. Planer bolts usually have large, flat, square heads. These heads are slipped into the T-slots from the end of the table. Planer pins are simply tapered pins which are used to prevent slipping of the work.

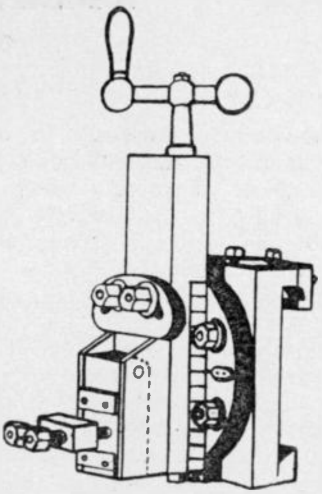
When a heavy cut is to be taken there is danger that if two planed surfaces are placed together, that the work will slip. This danger may be greatly lessened by placing a sheet of paper between the surfaces before clamping.

When a cut is to be taken, the tool is rigidly clamped to the tool-block, so that no more of the tool projects below the tool block than is needed to reach the work. The cross-rail is lowered as much as is feasible and then clamped securely to the housings. The tool is then adjusted by the down-feed handle until it takes the desired cut. At first the tool is fed over by hand but as soon as the cut is fairly started the automatic feed is thrown in.

The tools used on the planer are similar to those used on the lathe. Good angles for clearance, back-slope and side-slope on all ordinary work are as follows:

Clearance (front)	5 degrees
Back-slope (rake)	10 degrees
Side-slope	15 degrees

The keenness of the tools depends greatly on the angles of top front rake



Tool Block and Planer Head

and top side rake, while the strength of the tool depends on the angle of clearance and the angle of top rake. Tools used for wrought iron and steel are generally given more keenness than those used for cast iron. The term "feed" as applied to a machine tool, means the thickness of the cut or shaving taken by the tool.

The first cuts or "roughing cuts" are usually deep cuts, and for that reason the feed is fine as compared to that used for finishing cuts. However, it is best to take as much as the tool will stand without heating.

Finishing cuts are light cuts, and the feed depends on the metal the work is made from. With wrought iron and steel the feed must be fairly narrow, while with cast iron a much wider feed can be used.

Planers are usually designed for a cutting speed of about 20 ft. per minute and to have a return speed of 80 ft. per minute, but the cutting speed of planer tools is governed by the same laws as those which govern the speed of lathe tools. The speed should not be great enough to overheat the tool or to dull it too quickly, and of course the speed must vary with the hardness of the metal cut, the kind of metal and the kind of cut. When setting up a planer care must be taken to have a secure foundation.

Next month the drill press will be described.

FORGING FOR AMATEURS—Part XIX

Squaring Up Work

F. W. PUTNAM, B.S.

It frequently happens in hammer work, as in the case of hand forging, that a piece of metal, which should finish square in cross-section, becomes lopsided, as we say. When we meet with such difficulty, the easiest way to correct it is to hold the forging as shown in Fig. 201.

This shows the block placed on the die with the long diagonal of the diamond shape perpendicular to the face of an anvil. Only a few blows are necessary to flatten the work into the shape shown at *B*. The work is then rolled a little over in the direction of the arrow and the hammering continued, after which the forging takes the shape as shown in *C*. Finally after continued rolling and hammering, we obtain the square section at *D*.

MAKING SMALL TONGS

The ordinary flat-jawed tongs can be made very easily under the steam hammer, only two or three heats being necessary to finish the tong end. The stock is first heated to a high heat and bent as shown in Figs. 202 and 203.

In Fig. 203, *A* and *B* are two pieces of flat iron which are of the same thickness. The stock from which the tongs are to be made is placed as shown in the figure, and the hammer brought down lightly so as to make sure that everything is in the exact position, after which one sharp, hard blow will bend the stock into shape as is shown in Fig. 204.

After this part has been done the eye is to be started and the shoulder worked up. We place the bent pieces flat on the anvil with a piece of flat steel laid on top in such a position that one side of the steel will cut into the work and form a shoulder for the jaw of the tongs.

After this the steel is forced into the work until the metal is forged thin enough so that we may form the eye. This will leave the work in the shape clearly shown in Fig. 206. The part *A* is finally drawn out to form the handle, after which the jaw and eye are finally shaped, and then the eye is punched. Of course the final forming of the jaw, as well as the punching of the eye, should be done with an ordinary hand hammer. The handle is drawn out under the steam hammer.

For careful finishing we may use the taper tool shown in Fig. 197, or else a sledge and swages. From what directions I have given the reader will see that steam hammer work does not differ to any great extent from forging done upon a block anvil—the method of operation in either case being about the same. The steam hammer, however, enables us to do the work very much more quickly and effectively.

CONTINUATION OF RULES FOR HARDENING AND ANNEALING STEEL

My readers will remember that in the February and March articles I gave several rules to guide the amateur, especially in the hardening and annealing of steel, and as I have had several letters sent me recently asking for some more information on this subject, I will at this time continue with the set of rules which I had in mind.

RULE 14. *Directions for Hardening a Blanking Punch.*—Punches which are to be used for blanking sheet metal should be heated only where they are to be hardened. Fig. 207 shows a blanking punch which should be heated for hardening only from *A* to *B*. Here is a case where I recommend the lead bath over any other mode of heating.

As I explained in the hardening of a blanking die we must not allow the punch to cool thoroughly in the water, but rather withdraw it quickly and then immerse it in oil. The punch should be removed from the oil while there is still enough heat in the piece to boil a drop of water placed upon it. Do not be alarmed if the temper appears to run too low, since it requires between 425 and 440° Fahr. to start the temper on steel, so that a very pale straw color may be seen.

Now, when a piece is withdrawn from the oil in this manner, we may be sure that it does not contain over 250° of heat. I find it a good plan to draw punches by placing them in hot sand on an evenly heated plate of iron and allow to draw very slowly, since the slower a piece is drawn the tougher it becomes. Blanking punches, especially where the cutting edges are thin, can be drawn quite low, perhaps to a blue color, and sharp ends that have to cut a greater thickness than their diameter should be drawn down even lower.

We find that a punch will seldom break during the downward stroke, but that the trouble is largely caused during the pulling up of the punch. Heavy punches that are used for straight work can of course be left much harder, but even then it is advisable for the punch to be left softer than the die, so that,

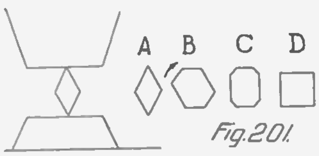


Fig. 201.

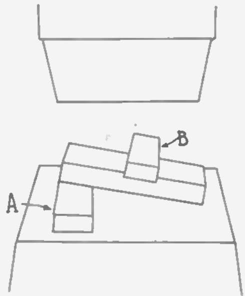


Fig. 203.

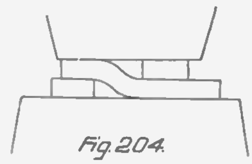


Fig. 204.

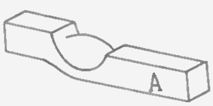


Fig. 206.

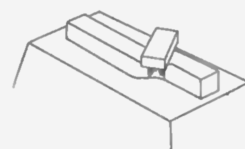


Fig. 205.

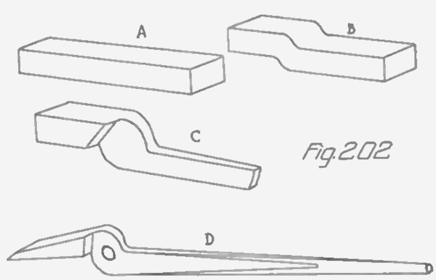
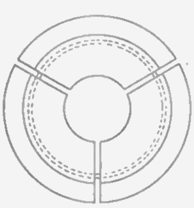


Fig. 202



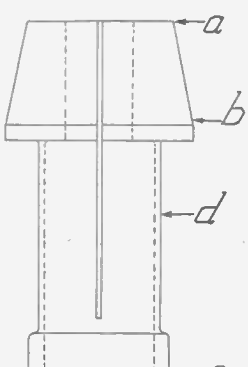


Fig. 210.

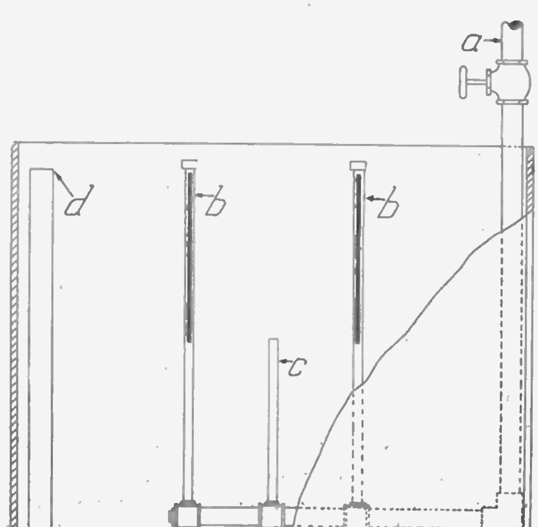


Fig. 208.


Fig. 209 A

in case an accident should occur, and the die change its position slightly, the die, as a result, being harder, will shear the punch. It is a much easier task, as well as a less expensive one, to make a new punch than a new die. Punches which are used only for cutting soft sheet brass are not usually hardened, since the punches are really kept sharp by shearing.

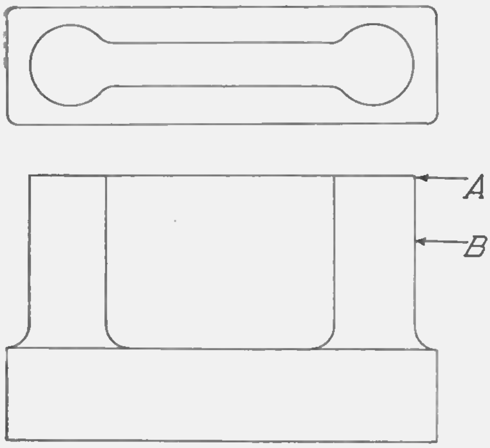


Fig. 207.

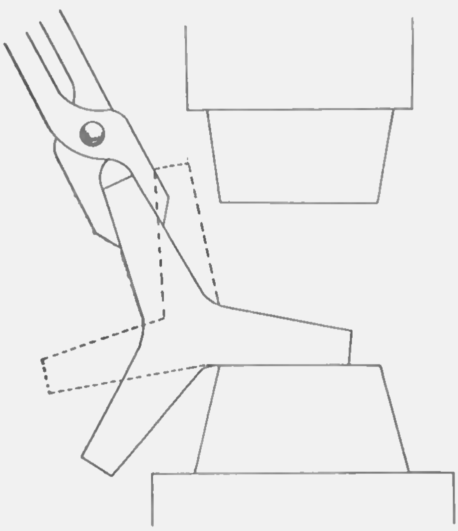


Fig. 209.

Rule 15. Dies used for drawing work, with or without a hole running clear through, should not be hardened in still water, but should be plunged in a tank of water which can be forced through or against the impression. This is shown in Fig. 208. One should be careful that the force is even with the surface of the water in the tank because it is to pass through 6 to 8 in. of still water before it comes in contact with the pressure. The results will be no more satisfactory than still water would give.

The die should not be left in the water until cool, but withdrawn as soon as the vibration is about to leave the piece and plunged into oil. Then remove it from the oil while it is still hot enough to boil water dropped on the piece and cover it well with oily sawdust.

It is essential to pack hot pieces in oily sawdust as it allows them to cool slowly and keeps out the air. Oily sawdust is most desirable as it packs better, and if the piece should be packed a little too hot, it draws the moisture from the sawdust and is prevented from drawing too low.

When pieces are packed in this manner they are not only tough, but also less apt to crack or burst, and the internal strains, which the hardening process causes, are slowly but surely relaxed. In the same manner we can harden drop dies for cold striking; drop dies for hot forging; forming dies and taps; bending dies, or any piece requiring a striking, forming, bending, or rubbing duty. To do this it is not necessary to draw the temper.

I presume many of my readers may raise this question, "Why should we not draw the temper on work of this kind?" There is a good reason for the answer, which is this: that on striking dies, etc., the temper is drawn because they are very brittle and the unprotected parts are apt to snap off. It is necessary to have a tool of this character as hard as possible, for when the temper is drawn the hardness is sacrificed.

Rule 16. *How to Harden Springs.*—A good way to heat small flat, round or spiral springs is in lead or in a muffle. One way of doing this is the placing of small springs in a tank and covering them with small pieces of charcoal and placing same in a furnace. The charcoal is used to prevent the air from cooling the springs while they are on their way to the bath. Better results are obtained by using thin oil as a cooling medium than heavy thick oil.

It is rather difficult to harden new spiral springs and at the same time keep them straight. Fig. 209 shows the way to wire a spiral spring. By placing a poker through the looped end of the wire, while the spring is still hot, no unequal strain is caused, as is the case when the spring is grabbed by a pair of tongs at both ends.

If the temper of springs is drawn in sand heated by gas or coal, while it is sufficient in many cases, it does not insure complete uniformity of temper, and if springs are drawn in oil hardened uniformly they will be tempered to the same degree throughout.

Place a number of springs in a pot of oil which is being heated over a slow fire. In a little while we find that the oil will catch fire on the surface. Allow this to continue until small blue sparks or flames appear on the surface of the oil, after which remove from the fire, dipping springs into a sieve placed over another tank of oil. Immediately the springs will blaze up. As soon as this happens, throw several handfuls of dry sawdust into the sieve and shake well for a short time. This will give a good even temper to all of the springs and they will also be perfectly clean.

RULE 17. *How to Harden Spring Collets.*—The general method of hardening spring collets all over and dipping in oil to harden may be improved upon. The two important requirements of a collet are to have the necessary spring that will open and release the work, and that the end should be hard so that the stock by passing through will not wear it quickly.

First, heat the collet in lead from *A* to *B* as shown in Fig. 210, then harden in water, after which draw the temper. After this heat the other end from *C* to *D* and harden in oil. This does not change the shape of the collet. When drawing a spring temper from *C* to *D* crowd a taper pin into the opening at *A* in order to open the prongs evenly and set the piece after the required temper has been obtained by cooling in oil.

The part between *C* and *D* is the only place subject to any great strain caused by opening and closing. Therefore it is not necessary to harden the part between *D* and *B*. Considerable time is necessary to thus harden collets, but the time spent is well worth the trouble.

The lead bath is used extensively for heating stay bolts, taps, machine taps, taper taps, hand taps, screw taps, nut taps, boiler taps, etc. The next article will continue with steam hammer work.

AN EASILY CONSTRUCTED MERCURY VAPOR LAMP

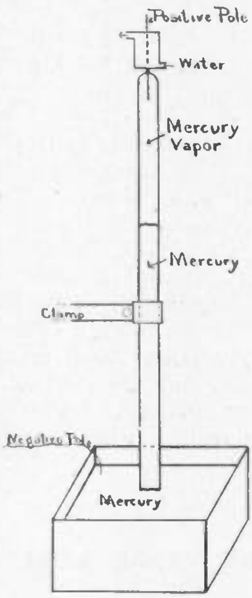
E. M. SYMMES

A mercury vapor lamp may be easily constructed by an amateur with the aid of very simple apparatus, by making use of the principle of the Toricellian, or barometric vacuum, *i.e.*, the vacuum produced above a liquid when a long tube, closed at one end, is completely filled with a liquid and then inverted with its open end under the surface of more of the same liquid. Under these conditions the liquid, if the tube be long enough, will fall to a certain height above the lower liquid level, this height being dependent upon the pressure of the atmosphere, upon the nature of the liquid, and to a small extent upon the temperature. The space above the liquid is left empty except for the small amount of liquid which evaporates into it, existing as vapor.

Mercury vapor lamps consist essentially of a positive electrode of iron, and a negative electrode of mercury, projecting into a vacuum saturated with mercury, *i.e.*, with mercury vapor. Minor details as to the means of starting may be omitted here for the sake of brevity. This vapor, under certain conditions, is capable of carrying a current of electricity, and at the same time being heavily heated to a dazzling, bluish white light.

This vacuum, in commercial lamps, is produced by a lengthy process of exhaustion, either by a combination of mechanical and mercury pumps, or by the latter acting alone. This is a very slow and tedious operation, and requires considerable machinery and experience.

The lighting, in commercial lamps, is done either by an electro-magnet which tilts the whole lamp so that the stream of mercury flows between the two electrodes for an instant only, making a spark on breaking, or by providing a "boosting coil," so-called, or a small coil that at the instant the current is turned on will raise the voltage considerably. In either case a spark is formed which lowers the resistance



of the lamp very considerably, thus allowing the main current to pass after that.

The object of this article is to show how all of these cumbersome details may be avoided in the construction of an experimental and useful lamp, by making use of the vacuum existing above the column of mercury in a barometer tube.

Procure a glass tube about 40 in. long, of about 1/4 in. bore, with medium thick walls, and open at both ends. By heating very carefully and gradually, first in smoky flame, and afterwards in the blue flame of a gas or gasoline torch, soften the walls so that they will fall together against a piece of No. 12 iron wire, thus sealing it into the tube. Perform this operation so that about 2 in. of the wire will be projecting into the tube, and as much projecting outward. Cool the tube even more gradually than it was heated, taking at least fifteen minutes for the complete cooling, and finally leaving it with a thick coating of soot.

Fill the tube thus prepared with some pure mercury which has recently been boiled to remove all of the enclosed and dissolved air. This boiling should take place in a glass or porcelain vessel, preferably the latter on account of its greater strength. If nothing else is available, an iron dish can be used, but under no circumstances one "galvanized" or coated with a covering of zinc or tin, as these coatings would immediately dissolve in the mercury. Very little, if any, of the iron would be dissolved, but it is very difficult to get the inside of an iron vessel absolutely clean. If glass or porcelain is used, the boiling must be done very cautiously on account of the ease with which mercury spirts when boiling, sometimes with almost explosive violence, cracking out the bottom of the vessel. In any case it is advisable to have a large dish below to catch any of the mercury in case of accident.

The glass tube must be *wholly* and *completely* filled with the mercury; not even a bubble of air may be left behind sticking to the walls, otherwise the operation will be a decided failure. When absolutely sure that all air has been removed, close the open end of the tube with the thumb, and, inverting it, place this end under the surface of more of the same mercury in an open dish. Then, still under the surface of the mercury, remove the thumb.

This done, the column of mercury will not remain completely filling the tube, but will fall to a height of about 29 in. In falling from the top of the tube, since there was no air present, it might be supposed that there would be a space quite empty left above the mercury. This is very nearly, but not exactly true, because the mercury, like water, only to a much smaller extent, will evaporate, thus filling the space above it with mercury vapor.

Clamp the tube in a vertical position, and attach one terminal to the mercury in the dish by merely inserting a wire in it, and the other to the iron wire projecting from the top. The power used may be the 110 volt direct current taken from the street mains, or from almost any other convenient source.

When the power is first thrown on no current will flow because of the very high resistance of the space between the electrodes. If a spark from an inch or even a ½ in. coil be sent across the terminals it will break down this high resistance, and pass. In doing so it will cause the formation of much more mercury vapor than before on account of its high heat. The path of this spark will then be of much less resistance than the space was before on account of the greatly increased amount of mercury vapor present. Because of this lowered resistance the main current is now able to pass, and in doing so will heat the vapor in its path to a bluish white, dazzling light.

In following this path the current has to overcome a certain amount of resistance, and in doing so naturally develops a certain amount of heat. This heat is made manifest by an evaporation of some of the mercury which later condenses on the sides of the tube and runs back, and also by a vigorous heating of both of the electrodes. The heating effect on the cathode or mercury is not productive of any inconvenience on account of the dissipating effect of the large amount of mercury present; but with the anode, or iron electrode, the conditions are somewhat different. This heat must be removed and the temperature kept down if the tube is to be operated for any considerable length of time, either by means of a small water jacket around the exterior part of the iron wire, or by fitting large radiating vanes on it to disperse the heat. This is because iron and glass expand by different amounts on heating, thus tending to spring apart, and cracking the tube at this point. This can be partially avoided by the use of nickel steel in place of the iron wire, because nickel steel has about the same expansion as glass. If the pocket-book will stand the strain, the trouble may be completely avoided, and the water jacket discarded by using platinum in place of the iron, since its coefficient of expansion is almost exactly the same as that for glass. If kept sufficiently cool in the way prescribed there will usually be no trouble. If, however, the trouble still persists it will be necessary to reduce the heating effect by cutting down the amount of current flowing by the introduction of suitable resistances in series in the circuit.

If it is desired to use this lamp on an alternating current it will be necessary to insert a large inductance into the circuit, otherwise the lamp would go out at the next reversal of the current, *i.e.*, when the voltage fell to zero. By the use of this large inductance the effect of the so-called "extra current" is utilized, preventing the arc from being extinguished. This inductance may be made by winding four or five layers of No. 14 insulated copper wire on a laminated iron core of about 3 in. in diameter by 8 in. long.

An interesting feature of this lamp when used on alternating current is its ability to rectify such currents, *i.e.*, to change them into direct currents. It does this by virtue of what is called "anode resistance," or a resistance at the iron electrode which is greater to a current going in one direction than to one in the other. Since the resistances are different, the amount of current in the two directions will be different, or there will be a greater flow of current in one direction than in the other. Summing all of these effects up will result in an effect similar to that of a direct current. This may be demonstrated and utilized by charging a storage battery inserted in series with the lamp.

This lamp, constructed as above, will give a brilliant light whose candle power is dependent upon the amount of current forced through it.

One of the latest electrical novelties for household use is the electrical razor. The form of the razor is similar to the well-known safety type; but the razor is given a vibratory movement by means of a rotary eccentric in the handle of the device. This motion is sufficient to cut the beard as the razor is drawn across the face.

HOW TO CONSTRUCT A MISSION CLOCK

F. C. CLAUSEN

A mission clock is something nearly every one wishes to possess, but owing to the high price is out of reach of a good many.

The purport of this article is to show how such a one may be made by most any one handy with tools, and at comparatively small cost, in fact all of the material should not cost more than $3.50.

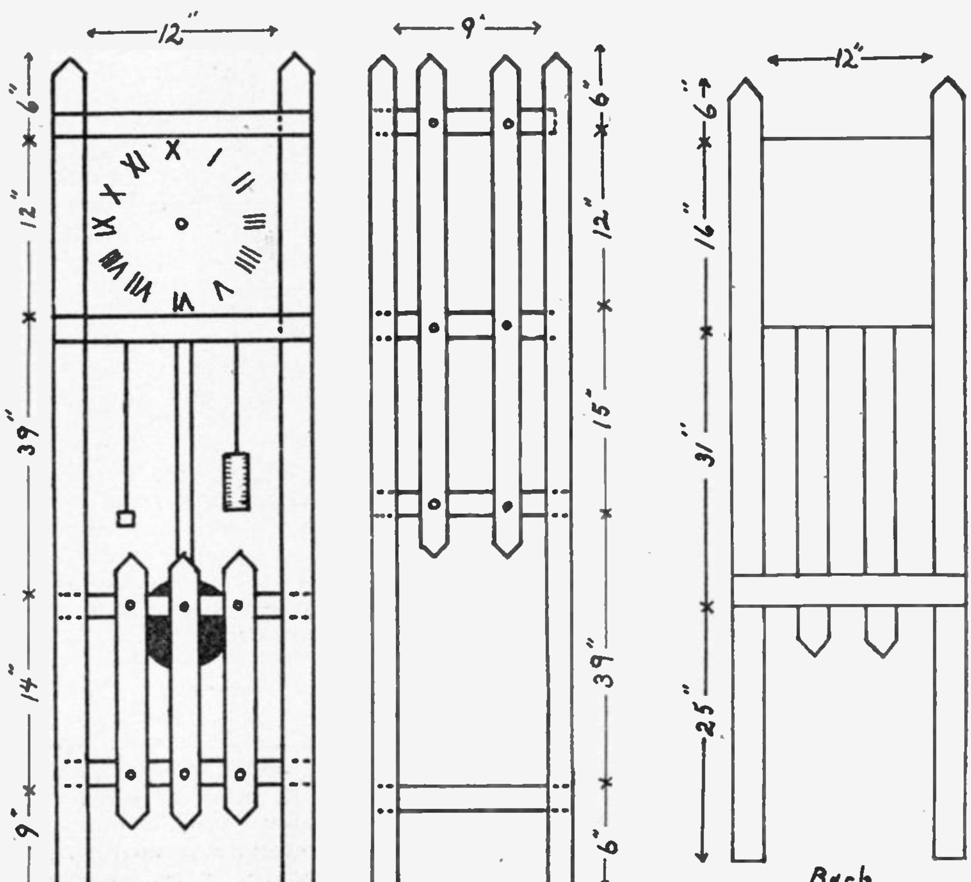
Of tools you do not need many.

We will construct the frame first, as this will be needed to mount the movement in, in order to test it. Go to a lumber yard and secure the lumber described below. This may be oak or Norway pine: oak of course is the best of the two. Have this planed and sand-papered at the mill.

4 pieces	6 ft. 6	x	1¾	x	1½	in.
5 pieces	15½	x	2	x	⅞	in.
8 pieces	10	x	2	x	⅞	in.
6 pieces	3 ft.	x	2	x	½	in.
3 pieces	20	x	2	x	½	in.
1 piece	6 ft. 6	x	12	x	½	in.

The four corner posts are pointed on top and places notched for cross-pieces as drawing shows (Figs. 1, 2, 3). The slats are pointed at both ends and fastened with round head nickel screws, excepting the two on back of frame: these are pointed on lower end only, the top being nailed to the back of frame.

The bottom on which the movement



Front Fig. 1   Side Fig. 2   Back Fig 3 rests is held in place by small strips of wood nailed to inside of cross-pieces in such a way that when in place it is even with top of cross-pieces.

Top and sides are fastened in the same way and held in place by small brads driven into cross-pieces. Back of frame is nailed or screwed between corner-posts. Top, bottom, sides and face should be removable. The face

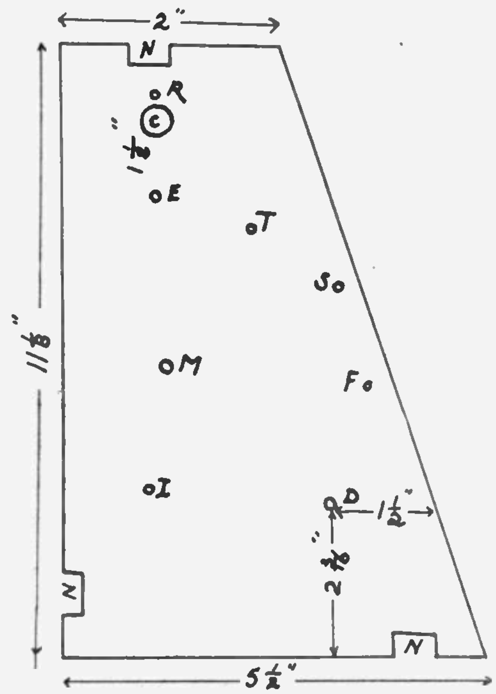


FIG. 4

Sidepieces for movement faces this way in clock frame.

or front piece should have a ¾ in. hole bored exactly in the centre of it.

Mahogany is best suited for making the movement, as it is lasting and easy to work. For this secure a piece 24 x 12 x 5/16 in. and you will have sufficient for nearly all parts of the movement. Two side-pieces are made from this (Fig. 4) both exactly alike; places are notched in these for distance pieces at *N* (Fig. 4). These hold the side pieces together. Distance pieces are next made (Fig. 8). Two of these are alike, but the third has one end longer and a slot sawed in this end; these pieces are fastened to side pieces with a screw in each end.

Before we start to make the gears for the movement it will be necessary to give a few instructions how to lay them out on the wood. This principle is applied in making all the gears and should be studied carefully. Secure a piece of drawing paper or heavy writing paper, draw a circle on this, say 6 in. in diameter (the larger the circle the less chance for error), and with a pair of dividers mark off six places equally distant on the circle (Fig. 5). Draw lines from centre to each one of these

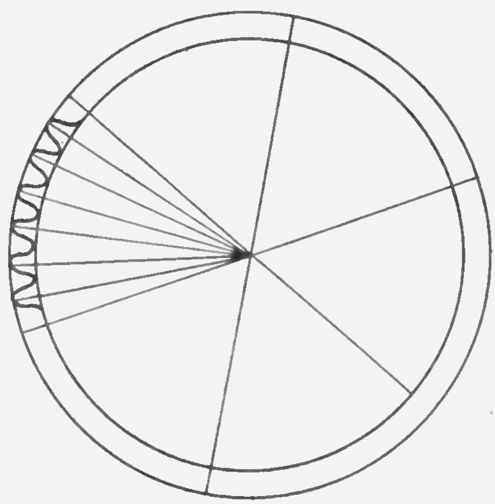


FIG. 5

Method of laying off teeth.

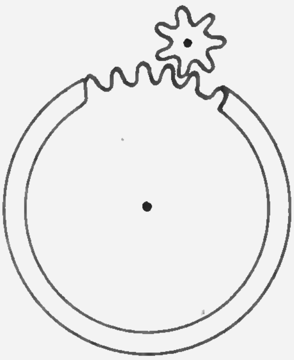


FIG 6

Showing how gears should be meshed and also type of small gear

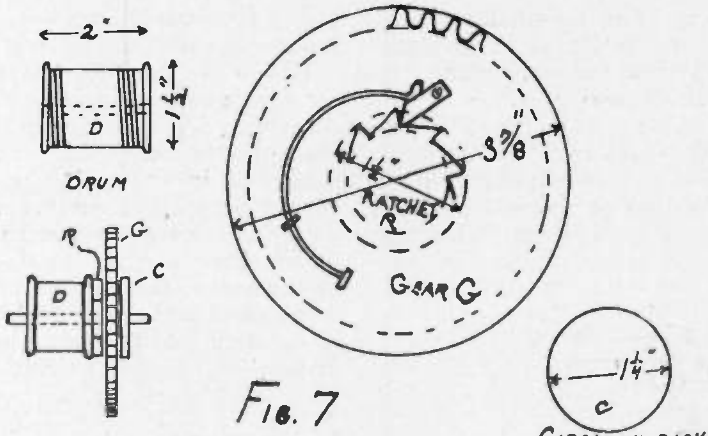


FIG. 7
DRUM, GEAR AND RATCHET WHEEL

points, then mark six equal spaces between these points and draw lines through centre to each one of these. You now have a circle divided into 42 equal spaces, and as this is the amount of teeth the first gear we make will have each one of the lines represent a tooth. (This same drawing will be used for laying out gears having 14 and 7

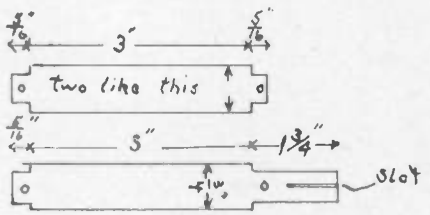


FIG 8
DISTANCE PIECES

teeth, respectively.) Draw a circle inside of this circle, the diameter to be the same as the diameter of the gear to be made (Fig. 7); and another circle 3/16 in. inside of this one, or 3/8 in. smaller in diameter. The space between the inside and outside circles represents the depth of the teeth. With a pin perforate the smallest circle at all the places intersected by lines running through the centre.

On the wood draw a circle the size of the gear to be made; saw the circular disc out and true it up as near round as possible with a file; now take the paper with intersected circle on, insert a pin through centre of this and into centre of circular disc of wood. Another pin is inserted through any one of the places perforated on the paper and driven into the wood. This holds the paper in place, while, with a pointed pencil, marks are made on the wood through pin holes in paper. Remove the paper, and with a ruler and pencil draw a line from these points to outside of circular disc. These lines represent the centre of the teeth; saw out a small portion of the wood between these lines and file teeth to desired shape (Fig. 5).

A small flat and half round file will be found very useful for this work. A

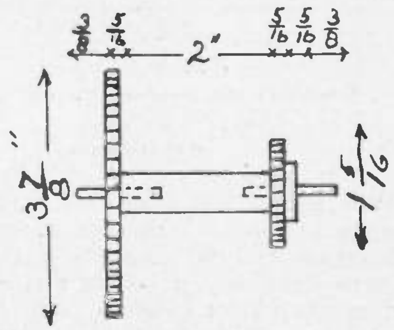


FIG 9
FIRST GEARS.

hack saw, the kind used by machinists, is the best you can get for sawing the gears out; break this in two pieces of equal length and fit a small handle to one of these. The other half of saw will be used for other purposes as will be explained later.

This gear being now finished we will call it the drum gear (Fig. 7). Next, procure a wire shaft 3¾ in. long and 5/32 in. in diameter. A hole is bored through centre of gear large enough so gear will revolve freely on shaft. The ratchet wheel is then made and a hole bored through centre of this, just large enough so it will fit tight on same shaft; then make a circular disc *C* (Fig. 7) to fit tight on shaft also.

The drum on which clock string is wound is then made and a hole bored through the centre to fit tight on shaft.

We will now make the gears meshing into the drum gear. There will be two of these, each one having 14 teeth: make these in same manner as explained above.

After gears have been made and teeth filed to desired shape, drill holes for 1/16 in. wire shaft, which should be small enough so 1/16 in. wire will drive tightly through them. Lay drum gear and one of these smaller gears on a flat surface or table with teeth meshing (Fig. 6) and measure distance from centre to centre; jot this down, and remember to do this with all the gears before drilling holes in side pieces of clock case.

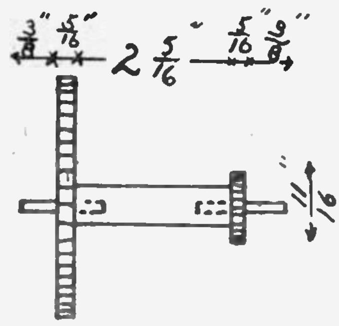


Fig 10
Second Gear

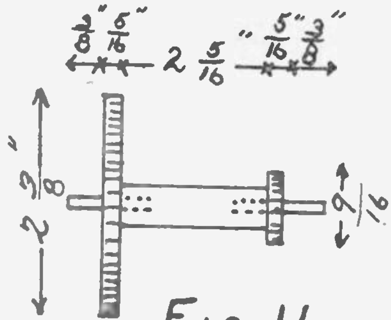


Fig. 11
Third gears

We are now ready to assemble parts for drum gear. Drive shaft through drum, leaving ⅜ in. protrude from one end. On the other end drive ratchet wheel close against drum, put gear next to ratchet wheel, and then circular disc next to that, but not so tight against gear but what gear will revolve freely on shaft. Fasten pawl (which engages ratchet wheel) to gear; this is held down by spring made of hair-pin wire (Fig. 7).

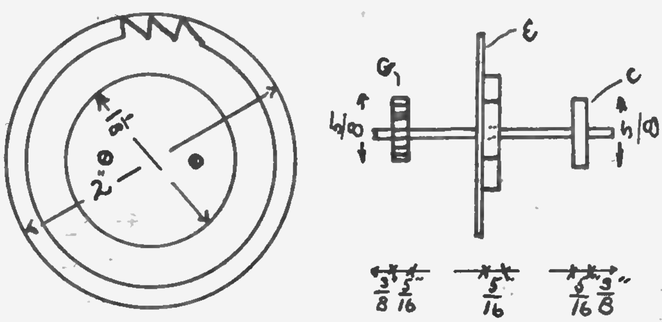


Fig 12
Escapement wheel E. Gear G
Circular disk C.

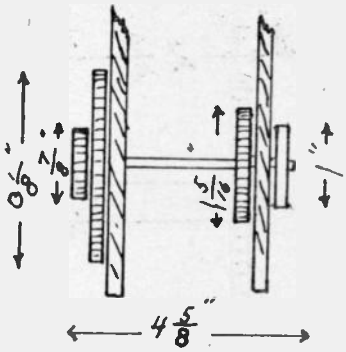


Fig 13
Intermediate gears
showing position in clock case

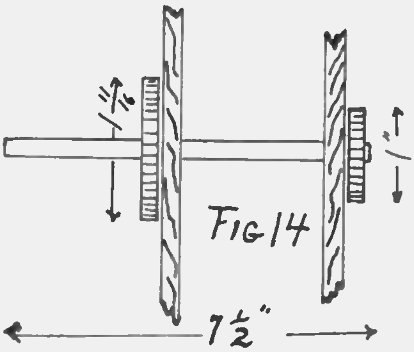


Fig 14
Minute hand gear
Showing position in clock case

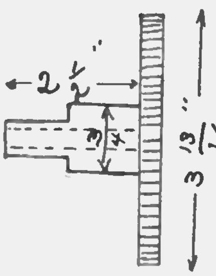


Fig 15
Hour hand gear

Lay side pieces together, drill holes through both of these for drum gear and first gear at places marked *D* and *F*. First gears are next in order. These consist of a large and small gear having 48 and 14 teeth respectively. The small gear having already been made, a small piece of square wood is sawed out (Fig. 9) and used between gears; this is better than using a wire shaft clear through, as the gears would be apt to slip on the wire; but by using wood between the gears they may be fastened to the wood with glue or small brads and in this way held firmly together. Two holes ½ in. deep are drilled in each end of the square piece of wood; two pieces of wire 1½ in. long by 1/16 in. in diameter are cut and driven through gears into square piece of wood, leaving ⅜ in. protruding from each end.

Second gears (Fig. 10) consist of two gears having 35 and 8 teeth respectively. Holes for these gears are drilled in side pieces at *S* (Fig. 4).

Third gears (Fig. 11) consist of two gears having 32 and 7 teeth respectively. Holes for these are drilled in side pieces at *T* (Fig. 4).

Escapement wheel and gear (Fig. 12) should be made next. Escapement wheel is made of brass 1/32 in. thick, and the teeth in this wheel are different from the others as illustration shows (Fig. 12). This is held in place on shaft by small circular disc; gear has 8 teeth (Fig. 12) and escapement wheel has 30 teeth. Drill holes in side pieces at *E* (Fig. 4).

ESCAPEMENT AND CRUTCH

Escapement is made of brass 1/32 x 5/16 x 4 in. and is bent in shape like cut (Fig. 16). Three holes are drilled

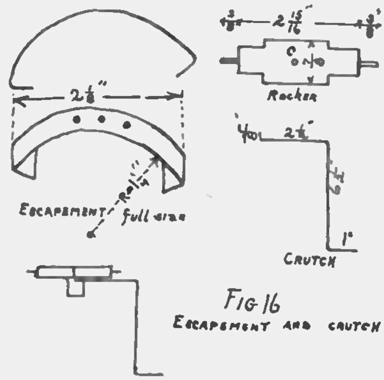


Fig 16
Escapement and crutch

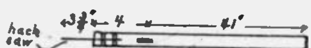


Fig 17
Pendulum Rod

Fig 18
Figures

through this, and it is then fastened on rocker made of wood (Fig. 16, *R*). Two small screws will be sufficient to hold it in place.

Crutch is made of stiff wire and bent in shape shown in illustration. One end of this is passed through escapement and rocker at *C* (Fig. 16), and double-pointed tacks hold it tightly in place. Holes for shaft for this are drilled at *R* (Fig. 4) in side pieces; another and larger hole bored immediately below in back side piece only, is for crutch to pass through *C* (Fig. 4). When this is put in place in clock case, escapement should engage a tooth in escapement wheel every time it swings back and forth; if it does not do this, straighten or bend until it will.

Intermediate gear (Fig. 13) consists of three gears having 40, 14 and 8 teeth respectively. These are mounted on a wire shaft 1/16 in. in diameter, the gear having 14 teeth meshes into drum gear. The other two gears are mounted on outside of front side piece, large gear next to clock case, and holes for shaft for these are drilled in side pieces at *I* (Fig. 4).

(Fig. 14) Gear revolving minute hand has 20 teeth and is mounted on wire shaft 5/32 in. by 7½ in. long. This meshes into gear having 40 teeth immediately below, and a circular disc holds this shaft in place in clock case.

Gear revolving hour hand (Fig. 15) has 48 teeth and meshes into the one having 8 teeth immediately below it. A circular stem is made of wood 2½ in. long having a hole drilled through the whole length of it, and is then secured in place on gear with glue or small brads, the whole revolving freely on shaft operating minute hand.

PENDULUM ROD AND BALL

Secure a stick 45 in. long, 1 in. wide and ½ in. thick (Fig. 17), saw slot in one end, fasten piece of hack saw blade in this with two clips made of stiff wire. A slot is sawed 1 in. long to admit crutch. Pendulum rod is then put in place in movement by passing end of hack saw blade through distance piece having long end, and is held in place by small peg inserted through hole in end of hack saw blade.

Fig. 19

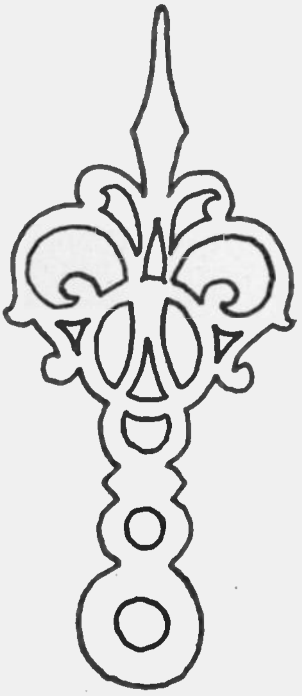


Fig. 20

Secure a piece of brass 6 in. square by ⅛ in. This you can get at any hardware store. Make a circular disc 6 in. in diameter, solder two clips made of sheet iron to one side of this and bend in shape to admit pendulum rod, then polish with fine emery cloth and oil. Pendulum ball is held in place on pendulum rod by small wedge.

The weights are made from scrap lead. About 7¼ lbs. will do: melt this and pour 7 lbs. into baking powder can. Before this cools insert a piece of wire bent like the letter U. When cool, the can may be cut away. A smaller weight weighing about ¼ lb. is made in a similar manner.

Put movement in place in clock frame, letting shaft carrying minute hand protrude 1 in. through face, then mark hole in bottom where pendulum rod is to go through. Another place is marked for string carrying big weight

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A CHEAP NINE-INCH REFLECTING TELESCOPE

II. Medium and Fine Grinding

M. A. AINSLEY

MEDIUM GRINDING

We will suppose now that the mirror is roughened out, and that the depth of the concavity in the centre is judged sufficient. It is hard to say how long this should take. My own mirror took well over ten hours to rough out, but with carborundum and a smaller mirror the work would be far quicker. However, my first mirror was of rather short focus—only 7 diameters—and I certainly should not recommend less than 8½ or 9 diameters for focal length.

The first thing is to get rid of every trace of the rough emery. The tool, mirror, handle, bench, etc., must be thoroughly rinsed and filled up with fresh water. The utmost attention to this is absolutely necessary every time the grade of emery is changed; otherwise the final surface is sure to show scratches which, if not appreciably affecting the performance of the mirror, are unsightly and unworkmanlike.

Having everything clean and free from grit, we "carry on" with No. 46 or No. 80, or something of the sort. It is not necessary to use so much at a "wet," and at this point we may shorten the stroke and introduce side motion. In fact, I have obtained the best results as regards freedom from sticking and regularity of curve by keeping the stroke quite irregular, sometimes circular, then straight for a bit, then elliptical, then spinning the mirror on its centre for a second or two, and then perhaps returning to a short, quick, straight stroke with a little (1 in. or so) side motion. This is a matter on which there may be several opinions; but I can only say that in working my second 9 in. mirror I never had the semblance of a "stick" from beginning to end of the fine grinding, and the spherical surface produced left nothing to be desired, both as tested optically and by the spherometer. The grinding is continued with No. 40 until the surface made by the coarse "roughing-out" emery is replaced by a uniform surface due to the "46," all coarse pittings having disappeared. This will not take long; but it is absolutely necessary to get rid of every trace of the rough surface. I have found it a good plan to have a series of plate-glass discs ground with the different emeries used, one ground with "1½," one with "46," one with "180," and one with "washed flour." The surface of the mirror can be compared with these as the work proceeds, and with the help of a pocket lens it is easy to see if the surface is a true "46," or "180" surface, and so on, or if any trace of the previous surface remains.

When the "46" surface is perfect all over, we may wet the mirror and test its focal length, either, preferably, by direct measurement in the sunshine, or by observing the reflection of a candle flame. If the mirror is made thoroughly wet and kept so, as Mr. Ellison recommends, and the image of the sun received on a visiting card, the position of the card where the image is smallest will give an approximate focus, and the focal length can be measured by means of a tape or a piece of string. If not short enough we must continue the rough grinding a bit further: if too short, the position of tool and mirror should be reversed for a bit; but if care is taken, this should not be necessary, and it may be repeated that the focal length does not matter so long as it is less than seven or eight times the diameter of the mirror. I will leave the mirror at this stage for the present. My next will deal with the fine grinding.

FINE GRINDING

We have now got rid of the surface produced by the coarse emery, and the figure of the speculum is beginning to approximate to a sphere. The object of the fine grinding is to perfect the spherical figure as far as possible, and to render the surface so fine that it can be readily polished. The fine grinding is commenced with No. 120, 150 or 180—it does not much matter which—and continued in the same manner as before until all trace of the "46" surface is gone. It will be found a great convenience to apply the emery to the tool by means of a flat, soft brush. The brush is dipped in water, then into the emery, and the small quantity it takes up is painted evenly over the tool. There is little fear of sticking at this stage; but if it occurs it is a sign that the emery is not spread over the tool sufficiently even. The stroke is kept irregular, as already indicated. It should not take long to get rid of the "46" surface, and, as I said in my last, it is important to do so completely. Any impatience at this stage of the work will render the final surface difficult to polish. After the "180," washed flour emery is used in the same way and with a similar stroke.

The use of the brush to apply the emery is even more to be recommended with the washed flour. If care is taken to have the emery quite evenly distributed, so that actual contact of the glass surfaces does not take place, sticking can be completely avoided. A little saliva, or a small quantity of soap in the water, will help to this end.

The washed flour produces a very fine surface, but not nearly sufficiently fine to polish; so it is necessary for the worker to prepare his finer emeries himself. My way was as follows:

Take 2 lbs. or so of washed flour emery and stir it up in a jug with half a gallon of water, then leave it to stand for one minute. The coarse emery will sink to the bottom, leaving the finer sorts in suspension; after the minute has elapsed, the water, holding in suspension the emery required, is poured or siphoned off into a basin, where it is allowed to settle for several hours. The water is then poured off and the emery may be dried and collected. The process is repeated, except that 5 minutes are allowed to elapse before pouring; then 15 or 20 minutes, then 40 minutes. It is possible to go even further, but I found that little was gained. We thus obtain a series of washed emeries of increasing fineness, the quantity obtained, of course, decreasing as the length of time during which the emery is allowed to remain in suspension increases. Very little of the finer grades is, however, required, and 4 lbs. of washed flour should prove ample for a 9 in. Of course the "one minute" and "five minute" not required can be returned to the washing jug. Care must, of course, be taken that none of the sediment in the washing jug comes over with the liquid. A siphon of india-rubber tubing is distinctly useful.

In practice it is not necessary to dry these emeries, the superfluous water having been drained off; they can be applied to the tool with a soft, flat, camel's-hair brush, and will contain just about the right amount of water required.

It will be seen that I used 1, 5, 20 and 40 minute emeries. There is no virtue in these figures, all that is required being to secure a steady diminution in the size of the grains.

After each grade is finished with, it is a good plan to add water to the emery left on the tool, and grind for a few minutes with the small quantity of emery left. This tends to fineness of surface.

Here a word of warning may not be out of place. The motion of mirror over tool with the fine emeries is exquisitely smooth and frictionless, and the mirror should never be left to itself on the tool without a hand to hold it, otherwise it is very liable to slip off with disastrous consequences.

Some workers recommend that the tool should be divided into squares, by grooves either ground or filed out. This is said to prevent sticking, and in large work is, I believe, essential. But I did not find it necessary for my 9 in., and in any case it would be a tedious job to cut the grooves. The fine grinding is not the least fascinating part of the work, the surface produced being so exquisitely fine it has been compared to the side of a tumbler in which milk has just been, and should be semitransparent, so that a candle flame can be seen at a distance of 10 ft. or more. In my case, after the fine grinding was complete, large type could be read through the speculum placed on its back, although the glass is 1½ in. thick.

The importance of obtaining a really fine surface before polishing cannot be overestimated. It is impossible to get a really good polish unless the surface is properly prepared, and each grade should be used until it fails to produce any further effect. Moreover, if care is taken over the fine grinding, the surface produced will be almost perfectly spherical.

On the completion of the fine grinding, the wooden disc and handles should be removed. This is easily done by standing the mirror on its edge, holding it firmly, and striking the edge of the wooden disc with a mallet. Any pitch left on the back of the mirror can be scraped off and finally washed off with turpentine.—*English Mechanic.*

THE FRENCH GASOLINE ENGINE AND PROPELLER OF SANTOS DUMONT'S SMALLEST AEROPLANE

FRANK C. PERKINS

The accompanying illustration shows one of the lightest European aeronaut gasoline motors and "L'Helice Integrale" as utilized on the smallest and lightest aeroplanes of Santos Dumont in making his remarkable speed records.

The propeller shown was designed and constructed by L. Chauviere of Paris and is said to have an efficiency of 90 to 97%. It operates without vibration at a peripheral speed of from 100 to 200 meters per second, so nicely it is balanced. The propeller is made of laminated walnut and highly polished, the cutting edge being straight and radial. The aim is without doubt to cut the air with a perpendicular stroke, the section of the blade being a sharp *D*, with the oval side forward.

The motor is a two-cylinder French engine, having an output of 24 h.p., of the Detuil-Chalmers type. One of these air-cooled, two-cylinder engines of 20 h.p. capacity was fitted to the first light monoplane of Santos Dumont and weighed only 48½ lbs., or less than 3 lbs. per h.p.

Recently twin-opposed cylinders, motors of the water-cooled type, have been designed and constructed of the Detuil-Chalmers type weighing 4 lbs. to the h.p. and capable of developing about 60 h.p. There are two pairs of opposed cylinders arranged side by side, with crank set 180° apart on a two-throw crank shaft, the connecting rods of each pair of cylinders being attached to one crank. A light bicycle form of fly-wheel is used on this aerial motor instead of a heavy fly-wheel and the cylindrical valves are located in the cylinder heads, both being mechanically operated. The total weight of this motor is about 240 lbs. and is provided with two spark plugs. The valves and exhaust elbows are at the ends of the two parallel cylinders. The motor is fastened to the framework of the aeroplane by means of two bolts, which pass through lung in the crank case. The opinions of aviators are about evenly divided between the air-cooled and the water-cooled engine as most desirable as air ship motors. Those preferring the former maintain that the air must ultimately be used for cooling even in the case a radiator is added, which at the same time thereby increases the total weight of the engine equipment.

PRACTICAL ELECTRICAL TESTING. PART III

W. C. GETZ

Correction

In the April issue, the formula on page 358, paragraphs 1 and 2, should read $G = R \times \frac{b}{a}$ and and $B = R \times \frac{b}{a}$, instead of $G = R \times a$, and $B = R \times a$, in the respective cases.

ESTIMATES FOR KNOB AND TUBE WIRING

G. J. KIRCHGASSER

Before estimating the amount of wire, tubes, knobs, etc., necessary for wiring a house or part of a house using the knob and tube system, the size of the house, rooms, etc., must be known, also the location of the outlets on ceilings, walls, baseboards or floor, what the outlets are to be used for (if for fixtures, how many lamps, etc.), the location of the service wire entrance, the location of branch cut-outs from which the branch circuits are to be run, and the location of switches (if any) for operating the different fixtures or lamps. Lamps are sometimes operated from the cut-out location and by knife blade switches in cabinets, but in offices, dwellings and stores snap or push button switches are located in convenient places so that lamps can be operated separately or in groups.

The following example will give an idea as to the proper procedure in arriving at an estimate. In the accompanying diagram,

W = side bracket 4½ ft. from ceiling. 1 lamp (16 c.p. carbon).
O = ceiling outlets for fixtures, the number = number of 16 c.p. lamps.
X = outlets in store (ceiling).
S = switch, 6 ft. from ceiling.
F = location of branch fuses, 5 ft. from ceiling.

This is a rough ground floor plan of an ordinary joist-constructed building. The joists are set usually on 12 to 15 in. centres; ceilings, 10 ft. high; partitions, 4 in.

If the service can be conveniently brought into building to basement or first floor near location F it should be done. If the service enters somewhere else feeders should preferably be run to a central fuse location if possible. For the rear rooms of this building there are 2 + 3 + 4 = 9 lamps on ceiling fixtures and 3 on side brackets, or a total of 12. As these are to be 16 c.p. ordinary carbon lamps, one circuit will suffice and can be laid out as in diagram. For the main runs not including loop for switches, we will need 2 x 5 ft. (fuses to ceiling) = 10 ft. plus 2 x 5 ft. (distance from wall to main run) = 10 ft. plus 2 x 32 ft. (distance to rear wall) = 64 ft. plus 2 x 4½ ft. (distance down to side bracket) = 9 ft. plus 2 x 20 ft. (distance across) = 40 ft. plus 2 x 25 ft. (distance to rear wall) = 50 ft. plus 2 x 4½ ft. (to side bracket on rear wall) = 9 ft. plus 2 x 8 ft. (distance from main run to wall bracket on east wall) = 16 ft. plus 2 x 4½ ft. (distance down to bracket) = 9 ft. This equals 217 ft.; allowing for waste and 2 switches we would estimate 250 ft. of R.C. wire.

As the joists run across the building the *number of tubes* would equal

$$\frac{\text{2 x the runs at right angles to joists in ft.}}{\text{distance of separation of the joists.}}$$

In this case

$$\frac{2 \times 32 \text{ ft.}}{1 \text{ ft.}} = 64 \text{ for line near west wall.}$$

(If joists were set on 15 in. or 1¼ ft. centres the denominator would be 1¼ instead of 1 ft.)

$$\frac{2 \times 25}{1} = 50 \text{ for line nearer east wall.}$$

The sum is 114, and an estimated total for this section of 125 tubes would be about right.

At each ceiling outlet 2 *knobs* would be required, or total of 6.

For wall brackets we want 2 at top, 2 at outlet, and 2 about 4 ft. up; total for the three brackets equals 18.

Four more are necessary where wires are tapped off for bracket on east wall, as the main run is about 8 ft. from east wall.

Where crossing from fixture outlet 3 to run on east side between the joists knobs will be necessary near where the joints or splices are made and every 4 to 5 ft. apart beyond. As the distance is about 18 ft., two knobs at the joints and two at 5 ft., 9 ft. or 10 ft., 14 ft. and where the right angle turn is made will be required. This equals 10 knobs.

In this case allow 10 for each of the two switches. The total number required will be 6 + 18 + 4 + 10 + 20, or 58. A little allowance should be made for loss and breakage so that 70 to 75 knobs would probably be needed.

The amount of flexible tubing can easily be calculated by knowing the number of outlets, allowing from 12 in. to 15 in. for each wire at each outlet, making between 2 ft. and 2½ ft. per outlet.

By bringing the circuit wires as near as possible to the location of the outlet, and putting the last supporting knob a short distance from it, less tubing need be used than if care is not taken. Sometimes a length of 6 to 8 in. is all that is necessary on each wire.

Now, to lay out the store, suppose we have four 100-watt Tungsten lamps on each side of the store, or a total of 8, and three 60-watt Tungstens in each window, or a total of 6. The diagram shows the simplest way to lay out the circuits, each having 580 watts. Switches for store lights at F.

Switches for window lights at Os.

Tubes necessary $= \dfrac{2 \times 32 \text{ ft.}}{1 \text{ ft.}} = 64$) : 2 main lines

$= \dfrac{2 \times 32 \text{ ft.}}{1 \text{ ft.}} = \underline{64}$) 128 say 130 tubes

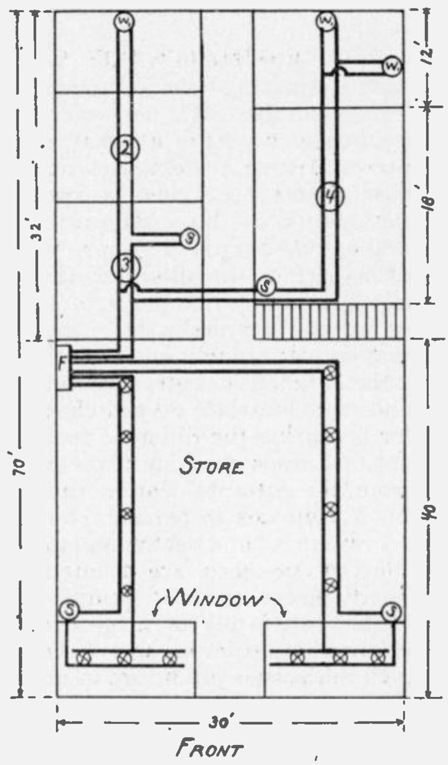
Wire:

2 x 32 ft. + 2 x 32 ft. = 128 ft., main runs
2 x 8 ft. + 2 x 8 ft. = 32 ft., windows
2 x 8 ft. + 2 x 22 ft. = 60 ft. distance from fuse cabinet to main runs
2 x 5 ft. + 2 x 5 ft. = 20 ft. distance from fuse cabinet to ceiling

Wire needed for connecting the window lights with their respective switches at Os can be figured as follows from the diagram: From each switch to the ceiling, 2 x 6, or 12 ft. (switches 6 ft. from ceiling, two wires); one wire from circuit wire to wall above switch, which is (from diagram) 8 ft. and one wire from window wiring to wall above switch, which is about 4 ft. The two single lengths last mentioned complete the loop to the single pole switch which is to be used to operate the window lights. The total feet of wire for each window would be 24 and double this for the two. The total for the store equals 128 + 32 + 60 + 20 + 48 + or 288, say 300 ft. of wire.

Knobs:

For 22 ft. run across to east circuit $\frac{22}{5}$ = 5 pairs or	10
For 8 ft. run across to west circuit $\frac{8}{5}$ = 2 pairs or	4
For 2 circuits run from fuses, 4 each	
Each switch for window lights = 7 (2 switches)	14



Windows (at each of 6 outlets 2) =	12
Two for each store outlet = 2 x 8	16
Total	64

For this floor complete, therefore, we could arrive at a close approximate of the cost of the material necessary. Between 550 ft. and 600 ft. of single braid rubber-covered wire, 250 to 275 tubes, and 125 knobs would be necessary. The amount of flexible tubing can be approximated by multiplying the number of fixture, light or switch outlets by 2½ (1¼ ft. for each wire). In our example there were 14 ceiling outlets in the store and 3 in the rear rooms; 3 wall outlets for side brackets and a total of 4 switch outlets. Allowing 2½ ft. for these 24 outlets a figure of about 60 ft. could be assumed.

If there is a second story to be wired, the same general method is pursued. Sometimes the fuses for the branch circuits are placed on this floor and the branch circuits brought to this location, which should be central, if possible. Two feeder wires (on a two-wire system) are run from the lower floor to the fuse cabinet. The size of the wires depends upon the number of branch circuits to be fed, but it is always safe to be liberal so in case more lights are added, or an extra circuit is run later, heavier feeder wires will not have to be used to replace the first. In case there are only one or two circuits on the upper floor, it is just as well to run them direct from the first floor, so that there will be no need for feeders and all the fuse blocks and fuses will be on the first floor.

Where there is no suitable location for the service entrance, switches, meter, cut-out blocks and fuses on the first floor, the basement if not too wet, is often used for this apparatus. Each installation has some points different from others.

Sometimes in wiring existing buildings (not those in course of construction) obstructions arise which make necessary different application in parts of the work and cannot be planned beforehand; but the best result will always be obtained if at least a rough sketch of the building or room to be wired is made, and outlets and circuits, with measurements, located. From the length then of the principal runs, number of circuits, and location of distribution centre a quick approximate of the amount of wire, number of tubes, knobs, etc. can be readily made. It is always best to run the wires either at right angles to the joists or parallel to them, as in case of repairs or additions the wires can more easily be found and traced.

A NEW METHOD OF PLATING

A lecture was delivered the other day at the British Royal Society of Arts by Mr. Augustus Rosenberg on a novel electrochemical method for the deposition of metals (whether single or combined as alloys) upon metal surfaces—a discovery of considerable interest to the electrical, the motor car, and other hardware industries.

The materials used by the inventor are known by the general name of "Galvanit," and are in the form of a dry granular powder, consisting of various intimately mixed principal and secondary ingredients. In use the galvanit powder is sprinkled upon a moistened cloth, applied in the manner of an ordinary metal polish upon the object to be treated, and in a few seconds a thin film of any metal desired is applied to the surface. This film, or test, is indistinguishable from electroplate, and, in fact, it is actually deposited by electrical action. No preliminary cleaning is required, nor is the application of heat necessary.

In the electrical industry the process simplifies and shortens the work of soldering cable joints, for a coating of pure metallic tin can be applied in a few seconds without any preliminary scraping or cleaning of the wire. The powder, indeed, can be effectively applied by the electrician with the corner of his handkerchief merely moistened with saliva, and when the wires are thus tinned they are ready for soldering without further preparation. The process also expedites the facing of zinc or copper process blocks with nickel, thus making them serviceable for printing with those reddish inks which contain mercury.

In the case of the nickel and other surfaces of motor cars, galvanit not only can be used as an ordinary cleaning agent for the removing of dirt, grease or oxidation, but a periodical application also replates the surface and prolongs its life indefinitely.

In the case of silver articles the surface can be cleaned and replated. The silver oxide or sulphide is removed, and the silver redeposited in pure metallic form. Mr. Rosenberg's powder not only cleans the object, but adds new silver thereto. The three essential ingredients of the galvanit powder are:

1. The metal to be deposited, which can be either in a pure or combined form.

2. A salt which is capable of producing an aqueous electrolyte when brought into contact with moisture.

3. A metal which is electro-positive with regard to the metal to be deposited.

In the case of the first ingredient, if it is desired, for instance, to deposit zinc, commercial "zinc dust" (which is largely contaminated with oxide) may be used. The pure zinc only is deposited, and the impurities remain with the residue. With regard to the second ingredient, when the salt used is ammonium chloride, ammonia is set free by decomposition, and acts upon any grease which may be present upon the surface under treatment. With the use of ammonium sulphate, a radical sulphion (SO_4) performs the same office in the case of other impurities such as oxides. In the case of hygroscopic salts, an inert material such as chalk or talcum ("soapstone") is added to prevent the absorption of moisture, and this is also an aid in cleaning and polishing the surface treated.

For the electro-positive metal, zinc or magnesium is usually employed, preferably in its elementary or pure state. To prevent any premature electro-chemical action, the zinc or magnesium is coated with some such substance as paraffin, rosin, or naphthalene. this temporary protective coating being removed by friction on application. A typical formula involving the use of an elementary metal is: commercial zinc dust, 15 parts by weight; ammonium sulphate, 5 parts; magnesium, 1 part; chalk, 10 parts; soapstone ("talcum"), 25 parts. This mixture, which takes on the appearance of a whitish powder, is used for depositing zinc.

As an instance of a mixture in which the salt employed as electrolyte is a salt of the metal to be deposited (and in which case the necessity of employing the elementary form of the metal may be dispensed with) is:

Nickel ammonium sulphate, 20 parts by weight; magnesium powder, 1 part. This mixture deposits nickel.

The theory of the reactions involved in this method of electroplating is that the particles of magnesium act as anodes, the object treated being the cathode. The moistened salt and the friction produce innumerable local circuits which throw down the pure metal. If the plating metal is originally present as a salt, then the electro-positive metal simply displaces it, and it becomes a deposit upon the object forming the cathode. If, on the other hand, the metal is originally present in the elementary form, then it first becomes transferred into a salt of the metal, and is thereafter displaced and deposited on the object as before.

The friction generated during the application of the moistened powder to the metal surface is essential to its successful operation. The friction cleans the surface to be plated, and it also prevents the formation of a hydrogen film upon the object, and thus arrests any tendency towards the polarization of the cathode. Finally the friction has a polishing effect due to the presence of talcum, or other similar substance. Thus cleaning, electroplating, and polishing proceed simultaneously in one operation. Mr. Rosenberg can control the rate of deposition by varying the proportion of the chalk and other ingredients; and he can also control the color of the deposit by varying the degree of alkalinity or acidity of the electrolyte. Normally the chalk ensures a certain amount of alkalinity, but this can be intensified by adding dehydrated sodium carbonate, or the acidity can be secured by including boracic acid or cream of tartar. Generally speaking, the acidity of the electrolyte produces a white lustre.

The preparation does not soil the hands, and is quite non-poisonous, containing neither cyanide, mercury, nor any free acidity. Exposure to the atmosphere for several weeks does not appear to produce any deterioration of the mixture.

As a commercial article galvanit will be shortly obtainable for depositing silver, tin, nickel, and cadonium, and these preparations will plate any metal surface with the single exception of aluminum; and aluminum can be plated when the ingredients of the mixture are in suitable proportions.

Wireless Telegraphy on East African Coast.

Consul Arthur Garrels, of Zanzibar, advises that two circuits of Marconi wireless telegraph have been installed on the Benadir coast in Italian Somaliland. One connects the posts at Mogodishe, Itala, Merka, and Lugh; the other Barawa, Giumbo, and Bardera. The Merka-Mogodishe line is in active use for both official and commercial business.

Belt Stretcher

HOWARD CLEMENTS

There is a great deal of trouble experienced in putting on a broad, heavy belt after it has been laced. This little device shown in the illustration will do away with a great deal of this trouble, and can be made by anybody in a short time.

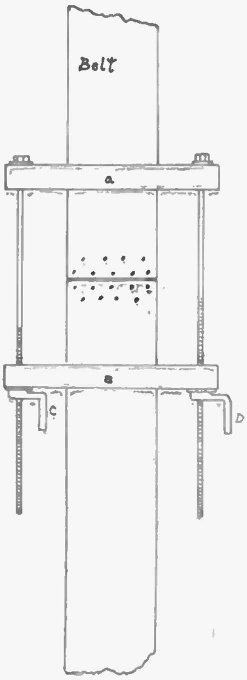


Fig 1

The material necessary for a 13 in. belt or under is as follows: a 10 ft. pine 2 x 4, 2 large square-headed bolts ½ in. x 48 in., 2 taps with bent handles, as *C* and *D* in Fig. 1, to fit the long bolts, and 4 smaller square-headed bolts 7/16 x 4 in. with washers.

Cut the 2 x 4 into 4 pieces, each 30 in. long; then dress the broad side until each piece is about 1½ in. thick. Bore two 7/16 in. holes in each piece 7 in. from the ends respectively, as *B* and

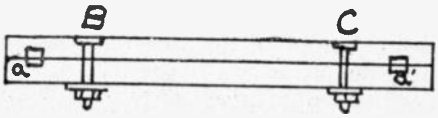


Fig. 2

C shown in Fig. 2. Then cut a groove 2 in. from the ends of each piece so that when two of the pieces are bolted together, with the small bolts, the grooves will form holes for the long bolts, as *A* and *A′* in Fig. 2. Now thread the long bolts up to about 18 in. of the head, also thread the handled tap to fit.

Insert the long bolts in the holes formed by the grooves in the two pieces *A* and *B*, as shown in Fig. 1, and screw on the handled taps. Care must be taken to have large washers next to the heads and the taps of the long bolts, and also next to the taps on the short bolts. The heads of the small bolts will have to be countersunk, as shown in Fig. 2, to prevent turning.

To use stretcher, loosen the taps on the short bolts and insert one end of the belt in each clamp, then tighten the taps, and then screw up the handled taps on the long bolts, which have been previously loosened until the ends of the belt meet. In this manner a heavy belt can be laced directly on to the pulleys.

How to Construct a Mission Clock

Continued from page 449

and in such a manner that string will hang straight down from drum. Another hole is bored on other side of movement for string carrying small weight. In winding clock all that is necessary is to lift large weight; the small weight takes care of the slackened string.

The movement is regulated by sliding the pendulum ball up or down on the pendulum rod.

Hands and figures (Fig. 18, 19, 20) are made from cigar box wood, using a scroll saw: these are sand papered smooth and gilded. Figures are put in place on face of clock with small brads.

A small can of the dull black japalac will be sufficient to cover clock frame.

By following these instructions exactly you will have a piece of work which is unique, in that it is hand made, is a good time keeper, looks very nice when finished and will last a lifetime.

WIRELESS TELEGRAPHY

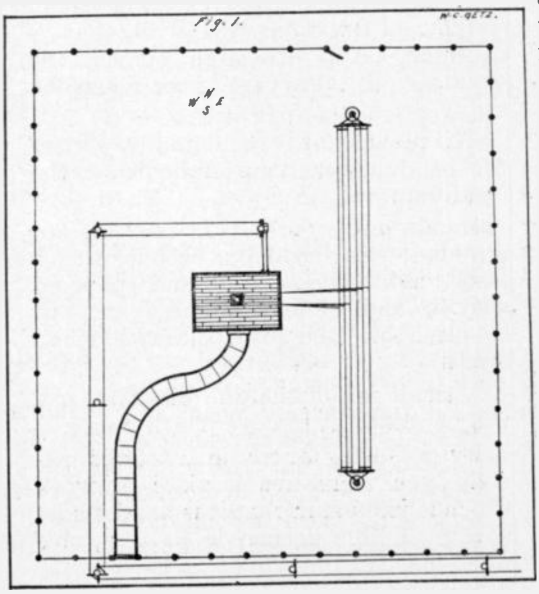
In this department will be published original, practical articles pertaining to Wireless Telegraphy and Wireless Telephony

THE DESIGN OF A CONCRETE WIRELESS STATION

W. C. GETZ

This article forms the first of a series dealing with the construction of modern high-range wireless stations and apparatus. While it is not my intention to duplicate either my previous articles, that appeared in this magazine during 1908 and 1909, or the series of articles written by Mr. Guilford, I shall, however, in a general way use the method of having a complete section in each article.

It has always been my ambition to design a wireless station that might be called an example of the best engineering and construction throughout. To this end, in the building I am going to describe, concrete has been chosen as the material of construction, inasmuch as a building made of concrete is not only stronger than one of wood or brick, but is also easier to build, neater in design, fireproof, and more suitable for our purposes.



Referring to Fig. 1, I have given a rough plan of the station, aerial, masts, and the lot on which the station is built. It will be noticed that the front of the station faces the road. This will be called the south side of the building. Of course the builder may change these details to suit the owner; but as a southern exposure is generally considered the best, for the present building this has been adopted.

The masts and aerial are on the east side of the building. The power lead is shown coming down the road in front. It then turns north, just west of the gate. It continues north for two poles, and then east to the transformer pole, whence the loop drops to the building.

A concrete path goes from the front door to the gate. The gate posts and door step are made of concrete. A wire fence surrounds the lot, and in the north-east corner a wooden gate is placed in the fence, allowing access to the field from this direction.

The building is placed about 20 ft. west of the centre line of the masts. The masts are each 100 ft. high, and 100 ft. apart. The details of the masts and aerial will be given in another article.

In Fig. 2 is given the plan of the station. It will be noticed that all walls are 9 in. thick. For a one-story building 6 in. could be used as the thickness; but as this building is made from the standpoint of solidity rather than cheapness, the walls are made of ample thickness to stand all strains and stresses. The foundation walls are 15 in. thick at the top, and spread outward to 23 in. at the bottom.

On the east wall of the building is placed a table for the wireless instru-

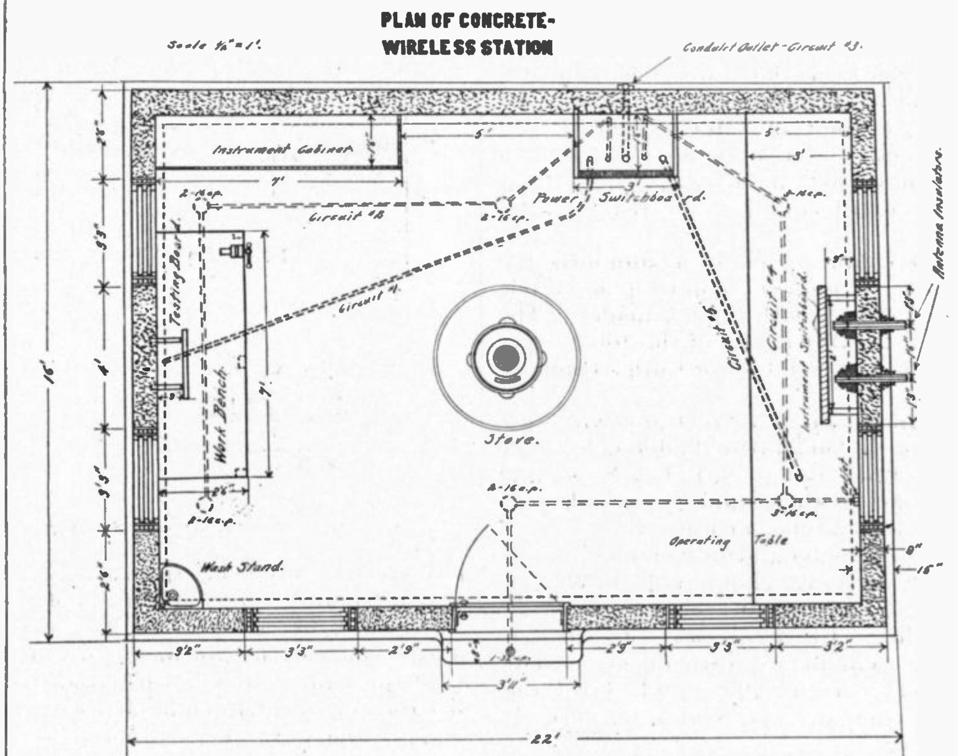


Fig. 2

ments. This table is 3 ft. wide, and it extends across the room, thus making it 14 ft. long.

Fig. 3 shows how this table is supported. On the north and south walls, 30 in. from the floor, there are two triangular projections of concrete, which extend from the east wall the width of the table. These projections are 3 in. wide at the top and 4 in. high. This supports the table on two sides. In the centre a cleat of 2 x 4 wood is carried across the table perpendicular to the east wall. Two pieces of the same stuff (2 x 4) each 28 in. long are then placed under this cleat, at front and back, thus giving a firm support to the table in the centre.

The table is made of wood 2 in. thick. It should be some kind of hard wood such as oak or chestnut, though pine may be used. It should be planed and sand-papered on all sides, and finished with two coats of shellac varnish.

Above the table, and in the centre of the east wall between the two windows, is the wireless instrument switchboard. The description of this will appear in another issue. The only provision now necessary is to place 4⅜ x 2 in. stove bolts in the wall, each in a corner of a square, having sides measuring 2 ft. 1 in. (see Fig. 4).

Back of the switchboard, between the two windows, two 2 in. holes, 9 ft. 6 in. from the ground and 16 in. apart, are placed for the aerial insulators. The distances from the windows to the respective holes is 13 in. as shown in Fig. 2.

On both the east and west walls the windows are placed 2 ft. 6 in. each from the outside of the north and south walls, and 4 ft. apart. All of the windows are of standard size,—2 ft. 4⅛ in. x 5 ft. 10 in. being adopted.

No windows are placed in the north wall. On the north wall 5 ft. from the east wall is the power switchboard. This is supported 3 ft. from the floor by angle irons, and 1 ft. 6 in. from the wall. Angle irons also extend from the north wall to the top of the board. These are shown in Fig. 4.

In Fig. 5 is given the front, rear and side views of the power switchboard. On this switchboard are mounted alternating current ammeter, voltmeter, and wattmeter. There are also four branch switches and a main switch and circuit breaker, all equipped for rear connection.

The main switch is a standard 100 ampere Trumbull double pole single throw switch with duplex blades. The circuit-breaker is also of the 100 ampere type, of either I.T.E. or Cutler Hammer make.

Branch switches No. 1 and No. 5 are each of the 50 ampere double pole single throw fused type. Switches No. 2 and No. 4 are of the 25 ampere double-pole single-throw type, with fuses.

The voltmeter and ammeter are preferably of the Westinghouse, G.E., or Weston make, of 120 volt, 60 cycle, or 130 cycle, according to frequency of current, A. C. switchboard instrument. The wattmeter is usually supplied by the power company who furnish the current.

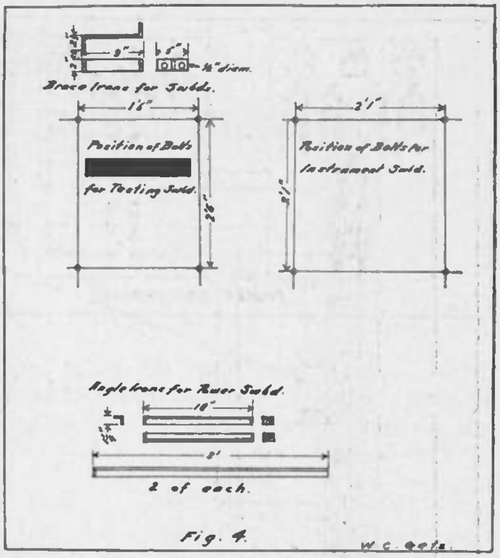


Fig. 4.

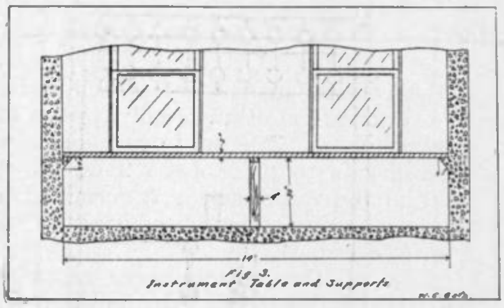


Fig. 3. Instrument Table and Supports

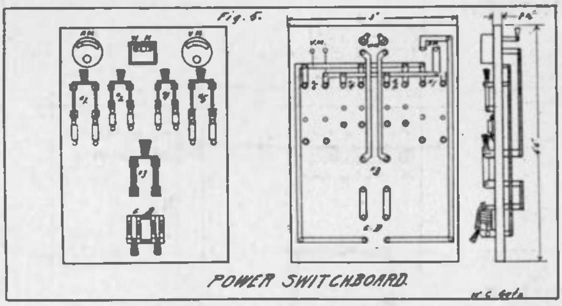
The board itself is to be made of 1½ in. slate, free from all mineral veins and cracks. It is to be 3 ft. wide and 4 ft. 6 in. high, with a ¼ in. bevel on the edges. All sides should be given an oil finish. This is done after sandpapering the board, by rubbing it with a rag dipped in machine oil. This leaves a dark, shiny finish, and also improves the insulating qualities of the board.

All connections are made on the rear of the board as shown in the side view. The main feed connections are of 1 x ¼ in. copper bars, and are 3 in. away from the board. The distributing bus-bars are also of 1 x ¼ in. copper, and are 1¼ in. from the rear of the board. Points of opposite polarity must be kept at least ¾ in. apart. Where connections are made to switch lugs the connecting strips from the distributing bus-bars are of 1 x 3/16 in. copper, and are, where running under main or distributing busses of opposite polarity, ⅛ in. from the surface of the board, thus allowing the specified ¾ in. clearance.

The distribution of power is as follows: From the transformer pole north of the station, two No. 2 stranded weatherproof lead wires connect at condulet to two No. 2 rubber-covered single-braided wires which go through the conduit to the wattmeter. This is circuit No. 3, and 1¼ in. conduit with a type C condulet is used—the conduit going horizontally through the wall to within 5 in. of the board.

From No. 1 switch, two No. 12 S.B.-R.C. wires go through a length of ¾ in. conduit that runs diagonally across to the testing switchboard on the west wall. This conduit is put in place before the floor is laid, and is 4 in. beneath the surface. This is shown in Fig. 2 as circuit No. 1.

From No. 2 switch two No. 14 wires run through a length of ½ in. conduit straight up to the ceiling, thence over the cross-stringers to an outlet box near the north wall in the centre of the station; then to outlet in northwest



POWER SWITCHBOARD.

corner; and from there to outlet in southwest corner. Each of these outlets are Bossert steel boxes, or other approved type, and each are to be provided with a two-lamp cluster to hang 18 in. below the ceiling. Each box to contain an insulated joint, and to conform in all respects to the National Electric Code.

Circuit No. 4 consists of two No. 14 S.B.R.C. wires run in ½ in. conduit from switch No. 4 to an outlet in the ceiling of the northeast corner over the operating table; thence to an outlet in the southeast corner; then to an outlet in the centre of the room, opposite the door, and terminating in a water-proof fixture outside the door. A branch also descends to an outlet on the east wall in the southeast corner of the operating table.

The two outlets over the operating table will each have a 3-lamp fixture. The outlet on the operating table will have an attachment socket for a Hubbell plug. The outlet opposite the door will provide for a 2-lamp fixture; and the fixture outside the door will be a weatherproof "goose-neck" for a 32 c.p. lamp. All other lamps inside will be standard 16 c.p.

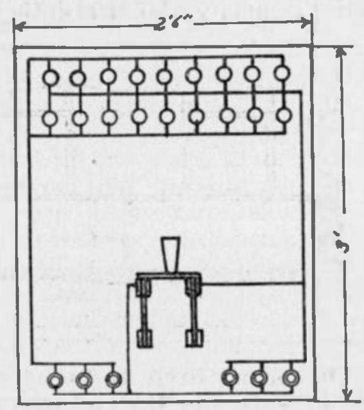
Circuit No. 5 consists of two No. 4 S.B.R.C. wires in 1 in. conduit running from switch No. 4, under the floor, and thence up to the operating table opposite the south window in the east wall. In running all conduit, extreme care should be taken to make all joints water-tight, and to see that no cement gets in the pipe while installing them. It has been the writer's experience to have charge of rewiring a large hotel where over 200 circuits went bad—due to the action of cement and water that got in the conduit while building.

All joints in conduit running under the floor should be wrapped with burlap, and dipped in asphaltum. The ends of the conduit should also be plugged while pouring concrete so that no particles can fall in during this operation.

The following data places the information about the wiring in a more concise form:

Circuit No.	Switch No.	Size Wire	Insulation	Size Conduit	Approx. Length	Approx. Amp.	Maximum Amp.
1	1	12	S. B. R. C.	¾"	20 ft.	9	17
2	2	14	"	½"	30 ft.	3	12
3	3	2	"	1¼"	3 ft.	70	90
4	4	14	"	½"	38 ft.	12	12
5	5	4	"	1"	15 ft.	46	65

In the northwest corner of the building is an instrument cabinet 7 ft. long, and 1½ ft. deep, containing shelves for instruments, spare parts, supplies, etc. This may be built to suit the owner, so no details will be given herein, other than the space occupied.



Testing Switchboard.

On the west wall centrally located between the windows is the testing switch-board. The wiring of this is shown in Fig. 6. The main switch is of the Trumbell type, 25 ampere double-pole single-throw. On the right hand side are three outlets for Hubbell plugs, direct across the 120 volt circuit. On the left of the switch are three other outlets wired in series with the lamp bank at the top. This lamp bank

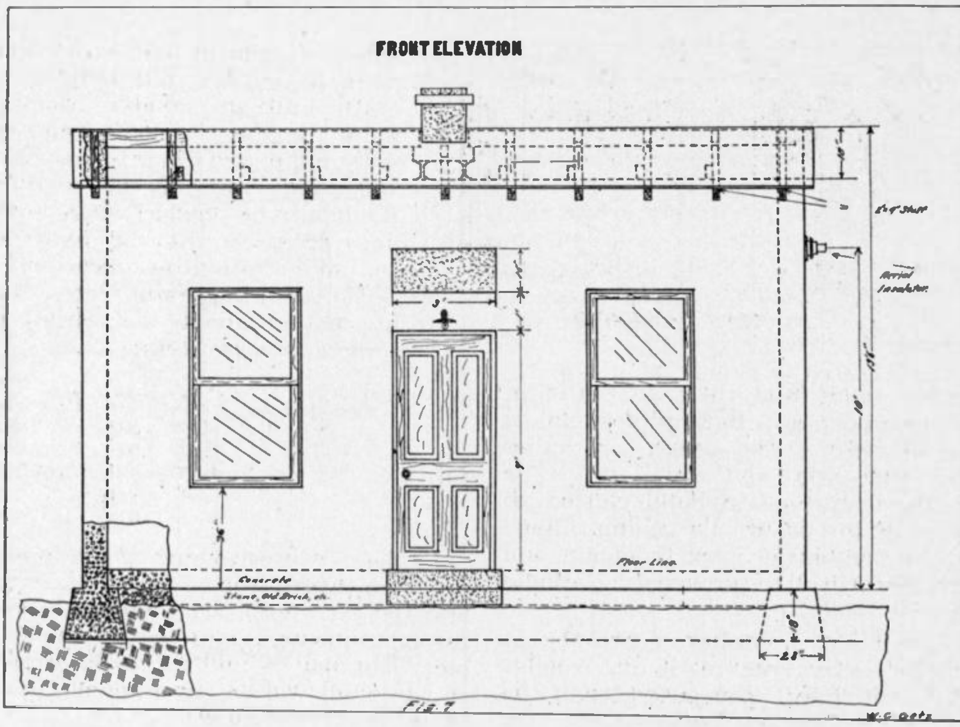


Fig. 7

consists of 18 sockets wired in multiple, for 16 c.p. lamps. All wiring to be done with No. 10 B. & S. gauge wire.

The board itself is of wood, 3 ft. x 2 ft. 6 in., and 1¼ in. thick. It should be of Georgia pine, free from knots and cracks, and very well seasoned. It should be dressed and sand-papered on all sides and given two coats of shellac varnish, and the edges given a ¼ in. bevel.

The board is fastened to the wall with iron braces, as shown in Fig. 4, thus being held 9 in. from the wall. The supporting bolts are also placed as shown in Fig. 4.

The work-bench is shown under the testing switchboard on the west wall. This should be substantially made with a heavy top, and should be equipped with a machinist's vise, and a back-stop for use when planing. It should also have several tool drawers, containing the following tools:

1 backsaw, 10 in.
1 crosscut saw, 20 in.
1 rip saw, 22 in.
1 hack saw frame and blades, 12 in.
1 4 ft. folding rule.
1 Stilson wrench.
1 monkey wrench.
1 ball pein hammer, 1 lb.
1 claw hammer, 1 lb.
1 jewelers' screw driver.
1 champion screw driver, 4 in.
1 champion screw driver, 12 in.
1 socket chisel, ½ in.
1 socket chisel, 1 in.
1 cold chisel, ½ in.
6 assorted files.
1 pair of 6 in. dividers.
1 ratchet brace, 10 in. throw.
1 combination square, scale, centre head and bevel.
1 jack plane.
1 fore plane.
1 block plane.
1 2 oz. soldering copper.
1 1 lb. soldering copper.
1 electric soldering copper.
1 pair metal shears.
1 pair 8 in. side cutting pliers.
1 pair 5 in. side cutting pliers.
1 pair 5 in. long nose pliers.
1 pair 5 in. diagonal cutting pliers.
1 wood countersink.
1 set metal twist drills, sizes 1 to 60.
1 set auger bits.
1 breast drill.
1 18 x ⅝ in. auger bit.
1 ⅜ x 24 in. Syracuse bit.

All of the above tools are not actually

necessary, but they will be found of use at various times, especially when quick repairs are necessary.

The bench should be at least 4 ft. from top to floor, and a good size is that as shown, 7 ft. x 2 ft. 6 in.

In the southwest corner of the room is shown a washstand with running water. This will prove indispensable at times, and should be included in the building whenever a water main or a source of water is convenient.

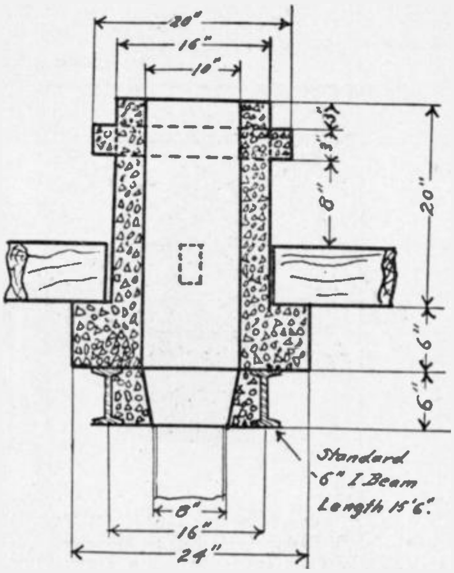
If in a cold or temperate climate, the stove shown in the centre of the room will be necessary in winter. An 8 in. stove pipe leads from the stove to the chimney above.

The interior arrangements having been described we will now consider the actual construction of the concrete station. As before stated the standard size of the window sashes is 2 ft. 4⅛ in. x 5 ft. 10 in. Allowance has been made on each size for the necessary framing, etc., so that the aperture in the concrete is 3 ft. 3 in. x 6 ft. The door is 3 ft. x 7 ft., and the aperture in the concrete, 3 ft. 3 in. x 7 ft. 3 in. The door sill is flush with the floor, while the windows are 30 in. above the floor or 3 ft. above the top of the foundation wall.

In Fig. 7 we have the front elevation of our station. It is seen that the concrete foundation is 18 in. deep, 6 in. of which is above ground. This foundation tapers outward on each side, so that while the top is 15 in. wide the bottom is 23 in. A pit 2 ft. 6 in. wide and 1 ft. deep is dug to correspond with the foundation dimensions, allowing room on each side to place the forms. Care should be taken to select a good site, with firm ground. The forms are placed in the foundation, and the concrete poured in. Above the earth inside the foundation walls is placed a 6 in. layer of old stone, brick, etc., and then a 6 in. floor of concrete.

The concrete mixture used for the foundation, floor and walls is the 1:3:5 mixture. That is one part cement, three parts sand, and five parts gravel. The cement should be of a good quality. The writer has found the Atlas brand of Portland cement to be excellent in all respects. It is therefore recommended in this article.

The sand should be clean and free



Method of Supporting Chimney.

from dust. It should be screened, to remove all dust. The gravel used should be broken quartz or shale, having an average face of 1½ in. width. Pebbles can also be used, if they are absolutely clean and free from dust and clay.

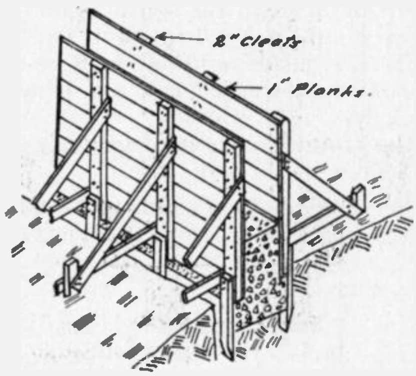
Not too much concrete should be made at a time. Just enough sufficient for use during the following half hour should be mixed. Mix the sand and cement dry at first, and then mix with gravel, with water, turning the batch over thoroughly with shovels a number of times until the mixture is of the same consistency all the way through. Where the mixture is made by hand it is better to throw the water on with a bucket rather than use a steady stream from a hose, as the latter is apt to carry away the fine particles of sand and cement, unless a fine sprayer is used.

In Fig. 9 is shown the method of making the forms in which we pour the concrete. These forms are made of 1 in. x 12 in. board with cleats of 2 x 4 in. stuff on the sides, every 3 ft. The boards should be of pine, and should be dressed on all sides, if a neat job is desired.

It is best to have enough forms to pour all four walls at once, as this saves time and makes a better job; but if it is desired to cheapen the cost of the

Fig. 9

Form for Concrete Walls.



job, one wall can be made at a time and the same wood used for the other walls. If this is done, iron bars, 1 x ½ in., bent at right angles, having each end 1 ft. long, should be placed where two walls meet to provide suitable bonding at the corners. At least three of these should be placed in each corner, spaced 3 ft. apart, vertically.

Before pouring cement in the forms it is a good plan to paint the inside of the forms with vaseline, crude petroleum, or soft soap, to keep them from sticking to the concrete when the latter hardens. It is best to erect the forms in sections of 6 ft. at a time, as in this way the concrete can be tamped down more evenly. The cleats can be made to extend the full length, and the additional boards added as required.

The forms should be left on the walls from 2 to 8 days after the concrete is poured, and no weight should be put on the walls until a month after the forms are taken off. In cold climates, both concrete and water should be kept at a temperature of 80° Fahr., and kept warm until hardened, as otherwise it might freeze and break down later on.

Water should be poured over the concrete constantly while hardening, as it cannot get too much water at this stage. The more water it absorbs the firmer it will set later on.

In making the forms for the front and side elevations, allowance should be made for the apertures for the door and the windows previously mentioned. It will be noticed that above the door there is an ornamental depression, 3 ft. wide and 15 in. high. This is about

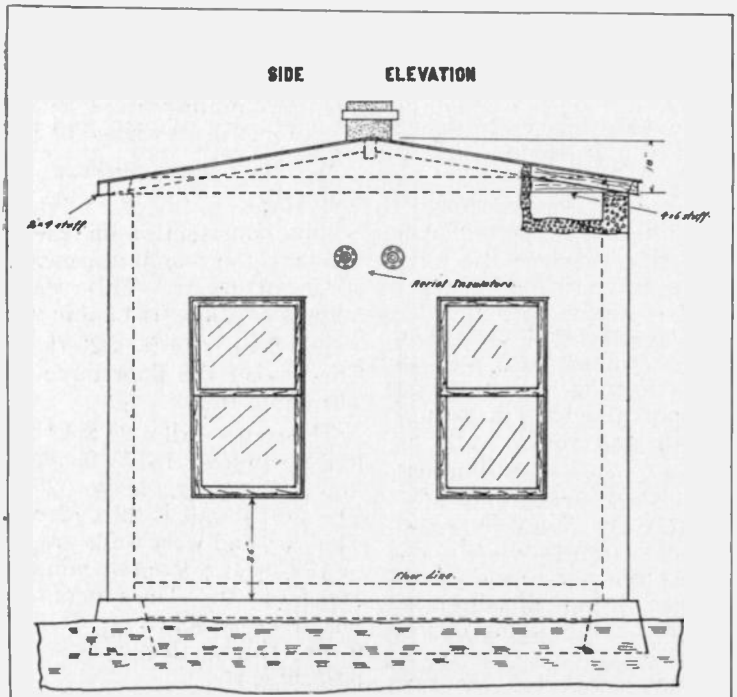


Fig. 10

1½ in. deep, and is made by fastening a board with slightly beveled edges, in the form for the front wall so that it will strike the proper place above the door. Care should be taken to see that this design is properly placed above the door, and is parallel to the lines of the building.

The front and back walls are carried up to 12 ft. in height. At intervals of 2 ft. between centres square apertures on the top are left for the roof scantling which will be later placed in position. These apertures are made to fit a piece of 2 x 4 in. scantling slanted as shown on the side elevation.

In Fig. 10 is given the side elevation. This is the way the east and west walls are made. The windows are of standard size as shown in the front elevation. 10 ft. above the ground situated midway between the windows are the 2 in. holes for the aerial insulators, in the east wall.

The north wall has no windows or doors in it. With the exception of the hole for the piece of conduit on circuit No. 3, there are no apertures of any kind in it, other than those at the top for the roof stringers.

These walls are 9 in. thick. The east and west walls are 12 ft. high on the sides and 13 ft. 6 in. high in the centre, thus making the roof have a slant of 1½ ft. in 8 ft. The outside width is 15½ ft., and inside width 14 ft.

It will be seen that the roof is supported by pieces of 2 x 4 in. scantling, which butt at the top on a 6 x 4 in. beam. At the bottom, the 2 x 4 in. is bolted to cross-stringers of 4 x 6 in. which extend across the building. The concrete walls go up flush with the top of the 2 x 4 in. scantling, a 2 in. ledge being left to support the 4 x 6 in. stringers on the north and south walls at the top. The 2 x 4 in. scantling get additional support by being bolted to the 4 x 6 in. stringers. They dove-tail or are fastened with iron saddles to the centre beam. At the north and south walls they project 4 in., allowing the roof to drip clear of the building in wet weather.

The chimney is supported by two standard 6 in. I beams, of Cambria, Carnegie, or Pencoyd steel, placed 16 in. apart on centres as shown in Fig. 8. These I beams are 15 ft. 6 in. long and extend across the building from the north to the south wall. The centre beam of 4 x 6 in. is in two sections, the inside end of each section supported on the ledge of the concrete chimney. This chimney is moulded on the ground, and raised to place after hardening.

The outside of the chimney is square, but the inside is round, tapering to 8 in. in diameter where it meets the stove-pipe.

The roofing consists of 1 x 12 in. boards nailed on the scantling, and covered by some approved form of roofing material, such as "Rex Flintkote," "Amatite," etc. This should fit snug all over, particularly around the chimney.

One more word about the concrete walls. After removing the forms, the walls should be rubbed down with a carborundum brick, to remove all signs left by the joints in the forms. At this stage the window and door frames should be put in, and thoroughly made fast to the walls. The floor should be finished with a 1 in. layer of mortar of 1 part cement, 2 parts sand.

The concrete steps are then moulded, and the building fitted with the proper furnishings as described at first.

We will now consider the cost of material.

The cross-section of the foundation is 2.4 sq. ft., and the mean perimeter is about 68 ft. This will give us a volume of about 164 cubic ft.

The floor is 14 ft. x 20 ft. x 6 in. deep. This makes the floor have a volume of 140 cubic ft.

The south wall is 22 x 12 or 264 sq. ft.; less 2 windows 18.75 ft. each; and one door, 21 sq. ft., leaves 205.50 sq. ft. The north wall is 22 x 12 or 264 sq. ft. The east and west walls are each 12 x 16 or 192 sq. ft.; less two windows, leaving 166.50 sq. ft. The sum of these respective areas is 802.5 sq. ft. Each being 9 in. thick, this makes the volume 601 cubic ft.

The chimney takes about 4.5 cu. ft.

The total then becomes:

Foundation	164 cu. ft.
Floor	140 cu. ft.
Walls	601 cu. ft.
Chimney	4.5 cu. ft.
	909.5 cu. ft.
or approximately	33.5 cu. yds.

Allowing for extras and waste, 40 cu. yds.

Of this 40 cu. yds., with the 1:3:5 mixture, we will have the following material:

Gravel	40 cu. yds.
Sand	24 cu. yds.
Cement	8 cu. yds.

The costs of this material will vary with location. At present, the writer has taken the prices prevailing at the place he is in, namely Cheyenne, Wyo.:

Gravel, $1.50 per cu. yd. per job	$60.00
Sand, $1.90 per cu. yd. per job	45.60
Cement, $13, per cu. yd. per job	104.00
	$209.60

The cement will really come lower than this. Prices were quoted by the Atlas Portland Cement Co. at $2.15 per barrel, F.O.B. Fort Russel, Wyo., with 30 cents allowed on each empty barrel returned. It takes about 6½ barrels to make a cubic yard of cement.

The cost of lumber will be as follows, basing the price on $20 per 1,000 board ft.:

For roof:

11 2 x 4 in. x 8 ft. scantling—38 bd. ft.

8 4 x 6 in. x 14 ft. 6 in. stringers—91 bd. ft.

2 4 x 6 in. x 10 ft. centre beams.

1 in. planks, to cover 182 sq. ft., 182 bd. ft.

For the forms:

Approximately 900 bd. ft.

Total lumber required 1,230 bd. ft. Cost about $25.

Roofing material, tacks, etc.:

Approximately at 5 cents per sq. ft., will cost $9.10.

Window and door frames, sashes, etc.:

Approximately about $20.

Stove:

Approximately about $10.

Wash-stand:

Approximately about $8.

Conduits, outlet boxes, etc.:

Approximately about $15.

It is thus seen that, exclusive of the cost of the power and testing switchboards, the operating tables and work bench, etc., the cost of the materials will be about $300. This may seem high, but on the other hand the cost for labor to build will be only one half that of a brick or frame building of equal size, as with the concrete building unskilled labor can be employed averaging about $1.50 per day. With brick and frame buildings, it is necessary to employ skilled artisans whose wages average over $3.00 per day.

The cost of materials can be brought down to about $200 if it is desired, to cheapen the construction as following:

Foundation, 12 in. thick at top, 15 in. at bottom.

Walls, 6 in. thick; one cast at a time.

Roof, boards of forms used for roofing, after removal of forms.

Concrete: mixture made 1:3:7 instead of 1:3:5.

While this will not materially weaken the building, it will not be as substantial as if made as planned. Of course it will only be a few wireless experimenters who can really undertake the construction of this station, but the information given herein is valuable to all electricians, as concrete construction will come sooner or later into their work, and they will require a working knowledge of same.

The next article will deal with the construction of the aerial, masts and instrument switchboard.

American Typewriters in London

After investigating the trade in typewriters in London, Special Agent Henry Studniczka says that the American are the favorite machines of business houses He adds:

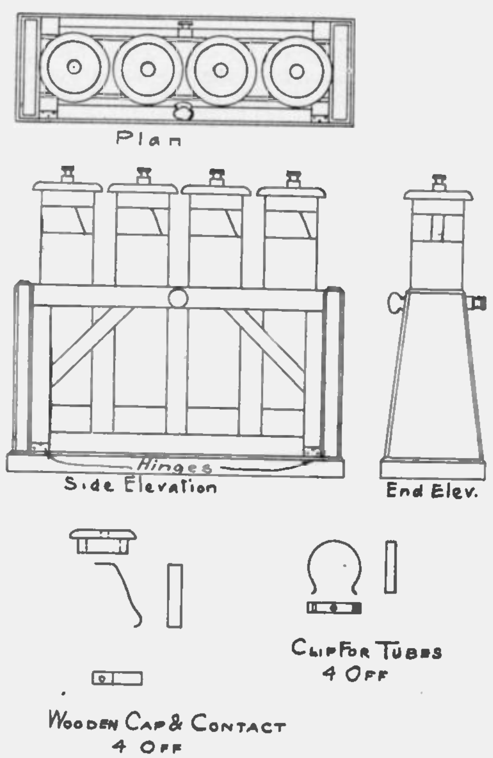
The Underwood, Remington, Hammond, Yost, Oliver, Monarch, Smith-Premier, and other American makes have salesrooms in London, and are getting seven-eighths of the London business. Only two English machines were found, and the companies selling them did very little local trade, but claim to have some business outside of London. These two machines are clumsy in appearance, are not as easily operated as the American machines, and American manufacturers need not fear them in their present condition. It is stated that the parts of these machines are made in Canada and put together after arrival here.

THE CONSTRUCTION OF A TUBULAR CONDENSER

The necessary articles for this condenser are: 4 Welsbach chimneys, 10 in. x 2 in.; ½ pt. of orange shellac; ½ lb. of heavy tin-foil (this can be bought at almost every florist's), and the material to make the case, which varies to suit the space on the apparatus table.

To work the creases out of the tin-foil, it is best to get a flat planed board about 8 or 9 in. wide and a couple of feet long. This is placed on the work table and part of the tin-foil is unrolled and placed upon it. Then a roller of some sort, a cardboard tube will do, is rolled up and down the tin-foil until the creases have disappeared. When this is done, 4 pieces 6½ in. long are cut off to form the outside casings of the chimneys. Then 4 more pieces 6 in. long are cut off to form the inside. Next spread a little shellac on one side of one of the 6½ in. pieces, and roll one of the chimneys on it, keeping the tin-foil in the centre of the same. Smooth out the wrinkles and repeat with the three other chimneys.

When this is finished take one of the chimneys and paint the inside quite heavily with shellac. Next get a wooden roller about ½ in. in diameter and roll one of the 6 in. pieces on it. Then put the stick and tin-foil into the chimney and unroll the tin on to the inside of the chimney. Smooth out the wrinkles as before and repeat with the other tubes.



Pour the shellac into a cup and dip one end of each tube into it as far up as the tin-foil. This will leave a smoother surface than if it were painted with a brush. When these ends are dry dip the others and the condensers themselves will be finished.

If you have a lathe, or can get the use of one, the next job is to turn up some caps to fit into the tops of the tubes, to make connections with the inside of the tubes. The writer used box-wood, which is easy to turn and which takes a fine polish. These tops should be well shellacked and drilled for the screw of a binding post. A suggestion for such a cap and contact may be gathered from the drawings.

The case is the next job to be tackled. It should be made of perfectly dry wood, pine preferred because of the ease with which it is worked, but may be made of hard wood just as well. This should also be well shellacked to prevent leakage of currents. If it is set on a glass plate it will help also. This case has the advantage of being easy to make, the tubes are held tightly in position and can be removed very easily without scraping off any tin-foil.

There are no dimensions shown in the drawing because it would make it more confusing. It is drawn to scale however, and they can be very easily figured out.

It might be well to add that the knob is to open the front so that the jars may be taken out at any time.

Connections are made to the outside of the jars by a strip of tin-foil shellacked to the back strip which crosses them. The best way to connect them is in series multiple. A flexible cord should be fastened under the binding posts on the ends and connection to the condenser made through the hole.

FRANK B. HANFORD.

HIGH EFFICIENCY INTERRUPTERS

The common automatic interrupter used on many induction coils usually causes a great deal of trouble and is not very efficient. It has been found by experiment that the armature of the interrupter is attracted by the soft iron core of the induction coil before the core is entirely magnetized. When the armature is attracted it breaks the current and hence the potential in the secondary circuit is not raised to its maximum value. Also the platinum contacts become burnt in a very short time, causing a very high resistance to the flow of the current if they are not filed very frequently. So we see all of these faults and many others are against the automatic interrupter. For this reason I have designed two in which none of these faults are present. The one which we will discuss first is an independent mercury interrupter suitable for coils giving from 2 to 12 in. sparks. It is made of material easily obtained, and is operated by an independent current from three or four dry cells.

The complete interrupter is shown in Fig. 1. To build it we will begin with the base *c*, which is made from heavy hard wood. Upon this base is fastened a piece of angle iron, which is partly shown at *B*. This supports *A*, which is an electric door bell with the gong and its supporting arm removed. The armature of the bell should have pivot joints and should vibrate very freely. One of the binding posts of the bell is represented at *d*, the other not being visible. A hole is drilled in the clapper of the bell for arm *E*. This is made of a piece of No. 10 copper wire, which passes into the glass jars *D* & *D'* through the wood or fiber covers *c* and *c*, and dips into the mercury *M*. The end which terminates in jar *D'* makes constant contact with the mercury, while the other end in jar *D* breaks the current. The mercury in this jar is covered with linseed oil to prevent an electric arc being formed on the break of the current.

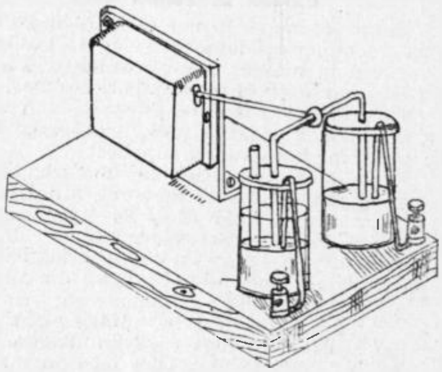


Fig. 1

A layer of oil ½ in. deep will suffice. A glass rod *e* is fitted in the cover so that it can be moved up and down to adjust the height of the mercury. The No. 10 copper wires *b* and *b* lead from the mercury and are connected to the binding posts outside the jars.

To use this interrupter connect the two main binding posts in series with the primary circuit of the induction coil, and to the terminals of the bell connect three or four dry cells or their equivalent. A rheostat should be inserted in this circuit to regulate the speed, and the glass rod is used to regulate the length of contact and height of mercury. No condenser is needed in the primary circuit of the induction coil.

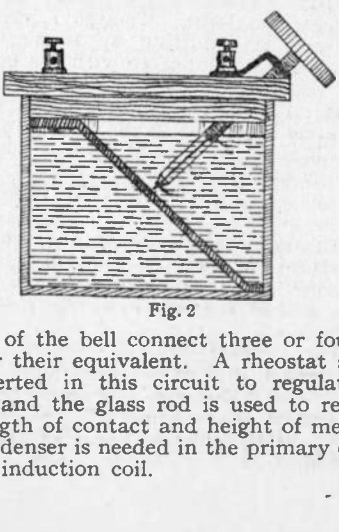


Fig. 2

Fig. 2 illustrates an adjustable Wehnelt interrupter, which is even easier to make than the mercury interrupter and is at the same time more efficient. We will first construct the cover *A* of hard wood. It should be thoroughly impregnated with paraffin to increase the quality of its insulation. A hole is provided for *F* which is inclined at an angle of 45° in order to make *H* and *C* meet at right angles. *C* is a sheet of lead of about No. 12 B. & S., having an area of about 25 sq. in. It rests at an angle of 45° and the upper end is supported by binding post *J*. *D* is a tube of glass with an inside diameter of ⅛ in and with very thick walls which is treated as follows:

At a distance of about 1 in. from one end heat the tube with a spirit lamp and carefully draw the tube out by pulling, until the small portion of the tube which is being heated is of a very small diameter. When the tube is cool break it in half at the point at which the diameter is smallest, one half of which may now be discarded. Now the tube will taper towards a point at one end but should have a hole in the point large enough to insert a No. 20 B. & S. platinum wire about ½ in. long. It is secured by playing on the end of the glass with a fine blow torch flame. The platinum wire should project outside the tube ¼ in. The black line inside the tube is a copper wire connecting the platinum *H*, and brass rod *F*, *E* shows connection being made between the platinum and copper wires by means of a little mercury poured in the tube, where the brass rod and the glass tube is cemented together. The upper end of *F* is threaded and screwed into the brass arm *I* which is tapped, and secured to the cover by binding post *J'*. *G* is a large hard rubber knob for adjusting the distance between the platinum point *H* and the lead plate *C*. The containing jar *B* is an ordinary glass battery jar about 6 in. deep and 5 in. in diameter.

The length of the platinum wire varies with the current used, its proper length being determined by cutting it shorter and shorter until a spark occurs at the secondary terminals of the induction coil, and the correct size must be determined by experiment. To operate this interrupter fill the containing jar almost full with a solution of sulphuric acid and water, the proportion being about 1 to 8 respectively. No condenser is needed with this interrupter.

JESSE O. FISHER.

A commerical wireless telegraph company, located in the Schofield Building, Cleveland, Ohio, has introduced a new feature in connection with "high-power" stations, eliminating the "crash" in sending.

A small house has been built on top of the building, directly over the operating room. In this little house, the transformer, Leyden jars, helix and spark gap are located, and the only part of the sending side of the whole apparatus in the operating room is the key.

The spark is very well muffled, and cannot be heard more than fifteen or twenty feet away from the little house.

A Wireless Telegraphy Experimenting Panel

Most experimenters in wireless telegraphy desire to have as neat a set of apparatus as possible and at the same time to be able to quickly change connections and circuits for experimental purposes. These two conditions can hardly be fulfilled at the same time, as in order to have a neat appearing set of apparatus one must hide his wires to a great degree underneath the operating table and bring them through holes when it is desired to connect them to a piece of apparatus. This practically makes it impossible to make rapid changes in connections.

The following panel which has been used with success by the author, however, accomplishes both of these results and in no way decreases the sensitiveness of a set if proper insulation precautions are taken.

The experimenter should first secure a piece of hard rubber (or even a piece of well shellacked hard wood will do) say 1 ft. square and 1/8 in, to 1/4 in. in thickness. Now bore say thirty-six 5/32 in. holes arranged in six rows with six in each row through this piece of rubber. These holes should be equally spaced and so arranged as to cover practically the whole panel. Now in each of these holes place a binding-post such as are commonly used on the carbons of dry cells. The panel should now be supported vertically in a rigid manner in back of the operating table. The terminals of each piece of apparatus, including the switches, should then be connected by means of heavy rubber covered wire to the backs of the binding posts of the panel, the wires passing through holes in the table and in back of the panel. The binding posts should then be screwed tight and the wires fastened. Each binding post should be numbered and a record kept as to what it is connected to. The panel is now complete and ready for connections to be made. By means of a diagram determine what binding posts ought to be connected. Connect these together by means of short rubber insulated wires on the front part of the panel, taking care to tighten the thumb nuts very well. If then it is desired to change any circuits, these changes can be made rapidly on front of the panel, having previously determined what binding posts are to be connected.

It will be found that thirty-six binding posts will be ample for the receiving sets of most experimenters. Although it is not advisable to use these panels for sending circuits, a separate panel may be made in which the binding posts are more separated and the wires kept further apart.

CHESTER A. GAUSS.

"E. & M. Wireless Club,"
Sampson Publishing Co.

It gives me pleasure to state that Local No. 6, of East Brady, Pa., of E. & M. Wireless Club, was formed on April 25th, with a membership of eleven. At first regular meeting at the home of H.D. McLaughlin, officers were elected as follows: L. E. Wahl, president; J. H. Wiseman, vice-president and treasurer; H. D. McLaughlin, secretary. A committee of three was appointed to draw up a form of constitution. After agreeing to meet on Saturday next at home of president, the meeting adjourned.

H. D. M., *Sec.*

The United States Civil Service Commission announces an examination on June 1, 1910, to secure eligibles from which to make certification to fill three vacancies in the position of wireless telegraph operator at $1,200 per annum each in the Philippine Bureau of Posts. An examination will also be held at the same time to secure eligibles for the position of wireless engineer in the Philippine Bureau of Posts. Two vacancies are to be filled. Applicants for either position should apply at once to the United States Civil Service Commission, Washington, D.C., for application form No. 2 and special form.

Unique Condenser Rack

Many amateurs do not care to make flat-plate sending condensers, owing to the work involved in making a rack which will allow of easy variation of the number of plates.

This objection is done away with, if what is known as a negative rack, is procured from a dealer in photographic supplies.

These racks are made for the purpose of holding glass plates till they dry, are wooden, and grooved to hold 12 or 24. The smaller size will do for most experimenters. Either cut or buy glass plates not larger than 8 x 10 in., as larger ones would prove too clumsy. Coat one side of each glass plate with tin-foil, leaving a margin of 1 in. Make eight such plates; also eight lugs 1 x 2 in. from a strip of tin-foil. Paste four such lugs on the left side of the tin-foil, on four of the plates, and paste the other four lugs on the right side of the tin-foil, on the remaining four plates.

MILTON GOODMAN.

Boise, Idaho, March 28, 1910.

Wireless Telegraph Dept.

Gentlemen: Referring to the article "Hampered by Amateurs," in the April, 1910, issue, I think that the plan adopted by the Chicago Wireless Club is a good one. It ought to suit the amateurs. Though I have no high-powered transmitting apparatus, and if I did, could not interfere with the government and commercial stations as they are too far away, it will not be long until there will be some here, and should any laws be passed it will affect us here as well as anywhere, so here is my opinion as given above.

Signed, "BOISE" AMATEUR.

An organization under the name of the Hartford Wireless Association has been organized, the purpose of which is to further the arts of Wireless Telegraphy and Telephony.

The Association invites all amateurs interested in Wireless Telegraphy or Telephony, and living near Hartford, to write the secretary, H. E. Chapman, 320 Wethersfield Ave., Hartford, Conn., for membership blanks.

QUESTIONS AND ANSWERS

Questions on electrical and mechanical subjects of general interest will be answered, as far as possible, in this department free of charge. The writer must give his name and address, and the answer will be published under his initials and town; but if he so requests, anything which may identify him will be withheld. Questions must be written only on one side of the sheet, on a sheet of paper separate from all other contents of the letter, and only three questions may be sent at one time. No attention will be given to questions which do not follow these rules.

Owing to the large number of questions received, it is rarely that a reply can be given in the first issue after receipt. Questions for which a speedy reply is desired will be answered by mail if fifty cents is enclosed. This amount is not to be considered as payment for reply, but is simply to cover clerical expenses, postage, and cost of letter writing. As the time required to get a question satisfactorily answered varies, we cannot guarantee to answer within a definite time.

If a question entails an inordinate amount of research or calculation, a special charge of one dollar or more will be made, depending on the amount of labor required. Readers will in every case be notified if such a charge must be made, and the work will not be done unless desired and paid for.

1329. **Oscillation Transformer.** Experimenter, Beaumont, Texas, asks: (1) What is an oscillation transformer and what is its purpose? (2) About what is the output in volts of a Kingston automobile coil with six batteries and a condenser in series with the secondary? Ans.—(1) An oscillation transformer is used to obtain sharp tuning both in transmitting and receiving circuits. With its use in transmitting a wave of practically one length may be sent out, while in receiving the oscillation transformer acts as an interference preventer. See article in February, 1910, issue of this magazine, "Design and Construction of a Wireless Telegraph Station." (2) You may roughly tell the voltage output of a coil by the length of spark it gives between points, an inch spark under such conditions representing about 20,000 volts, and other lengths approximating proportionately.

1330. **Transformer.** S. P., Norristown, Pa., asks: (1) If I wind the transformer described in the March issue, with No. 30 B. & S. gauge S.C.C. wire instead of No. 32, what spark length would I get? How many sections would I need? Ans.—(1) No. 30 B. & S.S.C.C. wire could be used instead of No. 32 B. & S.S.C.C. wire and good results obtained. The same number of sections would be used and the difference in power would be very little.

1331. **Condensers.** F. S. W., Hyannis, Mass., asks: (1) Can I use the condenser described in the January, 1910, issue for receiving with the portable wireless outfit? If not, please describe one I can use? (2) How far can I receive with the above outfit with an antenna 25 ft. high at each end, and 92 ft. between polar antenna? Wire is No. 20 single cotton covered. Does the covering on an antenna stop it from receiving? My ground is a piece of water pipe, 4 ft. long with a ground clamp for connection. (3) If I use the condenser described in the January issue, how will I connect the tin-foil and the glass? Do I connect all the tin-foil together or not? Do I connect the glass and tin-foil, or do I connect the wire to the glass and to the tin-foil? What do I connect to the 2 point switch, the glass or tin-foil? Ans. — (1) Yes, you can use the type of condenser described. You may also find description of other suitable types in the Questions and Answers columns of the issues you have. (2) See Mr. Getz's article in the February, 1910, issue, relative to wiring distances of wireless stations. The insulation will have no effect on the electric waves, but the wire you are using is too small. Get some No. 14 or 7 strand No. 21 copper cable. (3) Every alternate sheet of tin-foil is connected together at the end, each having a sheet of glass in between. This makes two sets of tin-foil, each set insulated by glass from the other.

1332. **Induction Coil.** E. L. M., Chelsea, Mass., asks: (1) Will you inform me how large a spark this coil will give: core 16 in. long, 1½ in. in diameter, primary two layers No. 14 D.C.C., secondary wound with 8 lbs. No. 30 D.C.C. boiled in paraffin? (2) Can this coil be used on a 110 a.c.? (3) How far will the above coil transmit, well tuned and condensed with aerial 40 ft. high, 50 ft. long? Ans.—(1) About 1¾ in. or 2 in. spark, but an excellent one for wireless work. (2) Yes, if a lamp bank or suitable choke coils are used in series with primary. (3) See article by Mr. Getz in February, 1910, issue, on "Working Distances of Wireless Stations."

1333. **Induction Coil.** H. P., Providence, R.I., asks: (1) I have about 3 pounds of No. 28 enamelled copper wire and would like to use it in a spark coil. Dimensions of same? Spark length? How many volts and amperes would it take? (2) Will my proposed way of making a spark coil work all right? Ans.—(1) Size of core, 8 in. long, 1 in. diameter primary, No. 12 or 14 double cotton covered; insulating tube 3/32 in. thick between primary and secondary; length of secondary 5½ in., outside diameter 3 in., wind in 40 sections. Use condenser bridged across interrupter made of 60 sheets of tin-foil 7 x 5 with paper insulation. Use current of about 4 amperes at an E.M.F. of 12 volts. The resulting spark will be about 1 in. long. (2) Yes, a coil designed in that manner would work. The above dimensions are, however, for the usual style of coil.

1334. L. M., Brooklyn, N.Y. Your questions would require more space than we can afford. Remit one dollar and we will mail you full and complete answers.

1335. **Wireless Distances.** J. C., Valley Falls, R.I., asks: (1) My receiving set consists of aerial 40 ft., 4 strands, No. 14 copper wire, 30 ft. long and 1 ft. apart, double slide tuning coil, silicon detector, pair 3,000 ohms receivers, condenser as described in the February, 1910, issue. Kindly tell me my receiving distance. (2) Do you think there can be an improvement made? Ans.—See article by Mr. Getz in February issue of this magazine.

1336. **Aerial.** E. P., Yonkers, N.Y., asks: (1) If I raised the aerial about 15 ft. above the roof at one end, would I increase the efficiency of my set? (2) What would be the best way of securing a very light 15 ft. pole to a chimney 4 ft. high? (3) Will you give me a good hook-up? Ans.—(1) Undoubtedly the difficulty with your set is the fact that the aerial is too close to the roof. We would suggest that you raise the antenna at least 15 ft. or more from the roof. Both ends should be elevated. (2) Why fasten the pole to the chimney? It is liable to be blown down, carrying the chimney with it. A better way is to set the bottom of the pole in a base made of two crossed pieces of wood, and then guy the pole to several points of the roof. (3) See Mr. Guilford's article in the May issue.

1337. **Tuning Coil.** E. S., San Diego, Cal., writes: In last month's issue I saw a piece about the construction of a transformer tuning coil, but the secondary slide will only slide the full range of the secondary while the coil is pulled out; but when the secondary is pushed into the primary, the secondary slider will not work at all. The instructions say to push the secondary into the primary and adjustment slider, then pull out; but when you pull it out, your slider remains still and your adjustment is again moved. I have wanted to make a transformer, but have been stuck on this. Will you help me out on this point? When you pull out the secondary to cut out interfering stations, you are bound to increase your detector circuit as your secondary slider works separately. Ans.—(1) The secondary slider is *readjusted* after the secondary has been moved.

1338. **Potentiometer. Cellulose Acetate.** E. S., Providence, R.I., asks: (1) How could I make a potentiometer? (2) Does the government publish a book about wireless stations or the addresses of the students, and how much does it cost or where do I get the book? (3) Could you please tell me where I could buy some cellulose acetate and how much for covering of wire? Ans.—(1) See article by Mr. Guilford in February, 1910, issue of this magazine. (2) The government book is out of print. (3) Cellulose acetate is a very difficult substance to make, and it cannot be bought commercially. It is manufactured by the makers of enamelled wire, and also by manufacturers of photographic films, and it is possible that you might be able to purchase it from the Eastman Kodak Co., Rochester, N.Y., if you want it in large quantities. We doubt this, however, and think that you will have to buy your enamelled wire ready made.

1339. **Receiving Distances.** J. R. B., Asbury Park, N.J., asks: (1) Where can bornite be purchased as described in the "1,000 Mile Detector," in the January issue. (2) Where can "Wood's Metal" be purchased, or does it have to be compounded by the experimenter? (3) How far can I receive with the following outfit: Tuning transformer, variable and fixed condenser, silicon and electrolytic detectors, a pair of 3,500 ohm phones with gold diaphragm, potentiometer, and battery; the aerial is composed of four 50 ft. strands No. 14 aluminum wire 2 ft. apart, and 40 ft. high. The instruments are 5 ft. above ground? Ans.—(1) Try Foote Mineral Co., 107 N. 19th St., Philadelphia, Pa. (2) It must be made by the experimenter. (3) See article by W. C. Getz in February issue of this magazine. About 500 miles.

1340. **Shocking Coil.** H. P., Rochester, N.Y., is intending to make one, and asks several questions, some of them referring to the article describing a coil of about the desired size, in the last February magazine. Ans.—It would be difficult to give explicit dimensions and other data for an induction coil, and to state that some other proportions would not work just as well. For such small currents as you would be likely to use for a coil of "shocking" size, we think the four layers of No. 20 (B.W.G.) wire, or No. 19 (B. & S.) would have sufficient strength and not pull the batteries down so fast as would be the case with only two layers of coarser wire. For such small coils, too, there would be no great necessity for subdivision of the secondary winding. The best way to prevent successive layers from coming into contact at the ends, next to the flanges, is to stop the wire when, say, ¼ in. from them, putting a strip of paper around to fill the place, both in respect to width and thickness. By this device, the distance from one wire to that in the next layer is so increased as to make puncture rather than creepage the only cause of break-down. Your proposal to use a "rheotome" in place of simple break-piece gives allowable means of varying the speed of the contact. As for what constitutes the most suitable battery, we think dry cells will be found satisfactory.

1341. **Interrupter.** C. D. S., Los Angeles, Cal., asks if the principle of the aluminum electrolytic rectifier can be used for an interrupter for a spark coil on a 60-cycle circuit? Ans.—The rectifier does not give the sudden break requisite for such purposes. It is true that the current is not entirely steady but it is approximately so. The Wehnelt interrupter does exactly what its name implies,—it breaks the circuit, and that too, with a speed and abruptness that often brings disaster to the coil.

1342. **Aerial.** R. A. B., Randolph, Mass., asks: (1) I am using an aerial of six strands of No. 13 aluminum wire 36 ft. long and each 1 ft. apart. It is 65 ft. high at one end and 35 or 40 ft. at the other end. I have a single slide tuning coil, variable condenser, fixed condenser, silicon detector, and a pair of 75 ohm receivers. What is my receiving radius now as it is? I use the water pipe for a ground. (2) I propose to make my aerial twice as long and the same in every other way as at present, change my tuning coil to a double slide, use potentiometer and battery with silicon detector and a pair of 1,000 ohm receivers. What would my receiving distance be then? (3) My aerial is connected as per diagram. Is it the best way? What improvements can I make over my proposed changes? Ans.—(1) and (2) See article by Mr. Getz in February issue of this magazine. (3) If possible connect wire to instruments in middle of antenna instead of at one end. This will, if the instruments are nearly underneath the middle of the aerial, prevent directional effects in both receiving and sending. See article regarding this by Mr. Guilford in April issue of this magazine.

1343. **Small Dynamo.** W. R., Mosgrove, Pa., sends a sketch of a bipolar field magnet, representing the design of the machine mentioned in answer No. 1278, in the April magazine. Base and upright poles are to be cast in one piece. Armature space is 3 in. in length and diameter. He asks if the design is good and what winding will be appropriate? Ans.—This is a good design for experimental purposes, is cheap and all the parts are accessible. It does not, however, comply with the modern idea of being enclosed. You can improve the proportions a little by putting extensions on the pole tips, after the spools are slipped on, and thereby get a larger useful polar area, and diminish the tendency towards sparking. Use armature punchings with round holes, such as are supplied by the W. & S. Mfg. Co., of Worcester, Mass. See F. E. Averill's advertisement in our magazine. If you use 16 slots and No. 20 wire,—all you can get in them,—and 10 lbs. of No. 24 wire on field,—5 lbs. per spool,—you will get a good working machine, adapted for about 110 volts.

1344. **Commutator Leads.** W. C. H., Kingston, N.Y., asks what rule is followed in attaching the ends of an armature winding to the commutator segments, so that the brushes will come in some particular position? Ans.—With bipolar field magnets it is convenient to have the brushes come either on a horizontal line or touching points about 45° from that position. If the poles are at top and bottom, the leads from the armature coils will then come just parallel with the shaft, or go to segments one-eighth of a turn forward or backward. With multipolar field magnets and form wound coils, it is common to lead the wires to the nearest segments and to let the brushes come where they will, but this usually means directly under the middle of the poles. In any case the right position for the brushes is on segments that connect with coils lying nearly midway between the poles.

1345. **Miniature Steam Turbine.** E. H., Galena, Ill., asks: (1) Does a turbine engine take more steam than one of the reciprocating sort? (2) What are the principal dimensions of a turbine of ¼ h.p. output? (3) What would be proper windings for a miniature dynamo having two wrought iron cores 1¼ in. long, ⅝ in. in diameter, with an armature space 2½ in. in length and 1¼ in. in diameter? Ans.—(1) The smallest size of commercial steam turbines seems to be those designed for operating locomotive headlights. In this case the aim is not so much of economy of steam,—for they are very wasteful,—but of economy of weight and space. Designs of such engines are not published, and with the great care with which the shapes of the buckets are laid out, and the clearances given, together with the skill required for providing suitable bearings, lubrication, and means for taking up the end-thrust, we think you had better study the subject pretty thoroughly before attempting to make one. The high economies reported for steam turbines are attained only with the very large ones, say those of several thousand h.p. (3) You do not state what voltage you wish, but if you use No. 23 wire on armature and No. 26 on shunt field, you will get something that will give a clue to some desirable potential.

1346. **Small Motive Power.** E. T., New York City, (1) has a 75 watt Carlisle & Finch dynamo that at 2,000 revolutions gives 40 to 50 volts. What power does it take to drive it? (2) What sort of driving power will best suffice to drive such a machine? Water, steam, and gasoline all seem to have their disadvantages. Ans.—(1) If you load the machine to the extent of 2 amperes you are getting the full rated load, and 75 watts means 1-10 of an electrical h.p. Allowing for all the losses, you should have about ¼ h.p. for driving it. (2) Motive power, in quantity small, and cheap to run has been the dream of the ages, and is not yet fully realized. For those like yourself, living in a city, there is no doubt that an electric motor comes the nearest to the ideal. Of course you would not use your dynamo for practical lighting, for a much better and cheaper source would be the supply at hand, but for experimenting with the little machine, you could not find any power clearer, safer, steadier, and more under control than a proper electric motor.

1347. **Dry Batteries.** C. V., Iowa City, Ia., asks: If the old carbons from dry cells can be used again, and how to make the mixture for renewals? Ans.—Yes, the carbons are still usable, but it improves their action to heat them red hot, thereby ridding them of occulted hydrogen. A good article on renewing dry cells was given on page 346, in the March, 1909, magazine.

1348. **Induction Motor.** J. S. P., Niles, Mich., asks for the general dimensions and winding data for a ½ h.p., 3 phase, 200 volt, 60 cycle, 4 pole motor. Ans.—This is about the size of the machine for which we expect soon to publish a series of articles. Explicit drawings and other directions will be given. If you wish a machine of liberal rating instead of the sort that now prevails in the "competition" makes, we would advise a rotor about 4½ in. in diameter and 2¾ in. in axial length. Have about 25 round holes, say 5-16 in. in diameter near the rim, opened by means of saw-cuts. Copper rods ¼ in. in diameter will serve for the "squirrel-cage" winding. Stator sheet iron should be thin and of high grade. Outside diameter should be 7 in. and inside 4 9-16 in. Have 24 slots about 7-16 in. x 9-16 in. Winding can be of No. 20 wire, wound with as many turns per coil as will go in, each coil occupying one half the slot, just as in the case of direct current drum armatures. Let the winding be arranged in two coils per pole per phase and finally brought together in a Y connection.

1349. **Rewinding.** P. C. L., Philadelphia, Pa., has a Crocker-Wheeler 1-6 h.p., 12 volt, 10 ampere, two pole, series wound motor. Armature has about No. 16 wire, and this is to be retained, but field has No. 10 wire. Can this part be rewound with finer wire and thereby allow use of machine as a shunt generator? Ans.—We recognize the machine as one of the sort manufactured over 20 years ago for operation on primary battery currents for driving sewing machines and the like. Some of the motors had armatures ingeniously wound with copper ribbon on edge. We have tried to do the very thing you desire. Our trial consisted in using No. 20 wire for shunt field, but although the two coils were put in parallel with each other the machine would not generate unless the speed was made dangerously high. The idea is that the entire output of the armature is insufficient to energize the field magnet. We hope you will try your luck, however, and let us know the results. We would advice you to try No. 18 wire.

1350. **Ignition Coil.** T. H. M., St. Louis, Mo., asks: (1) What voltage is used for the jump-spark coils? (2) How is such a coil constructed? (3) How is a high tension magneto constructed, such as are used without a coil for ignition purposes? Ans.—(1) The voltage is somewhat indefinite,—upwards of 10,000, perhaps higher. (2) The coil is simply well made, with an appropriate size of condenser. With No. 20 wire in primary and No. 38 in secondary, you ought to get good results; but success depends largely in using good insulation, and keeping out all moisture. (3) The high tension magneto really has an induction coil, but is included within the machine, so the appearance is that one is not used. Such a coil gives just one spark for each ignition.

1351. **Static Electric Machine.** A. S., Guadalajara, Mex., (1) has made an attempt to build such a machine having plates 5 in. in diameter, but it does not work. What is the reason? (2) What should be the general dimensions of a 1½ in. jump-spark coil? (3) How can glass be stained red? Ans.—(1) It would seem that you had tried to make too small a machine. The surface leakage over short distances may be the cause. We have not seen effective plates of less than 10 in. in diameter. (2) Let iron core be a bundle about 9 in. long, 1 in. in diameter, wound with two layers of No. 16 D.C.C. magnet wire; secondary with 2 lbs. of No. 34 silk-covered wire, both being measured in B. & S. gauge. Condenser should have about 100 sheets of tin-foil, each 6½ x 8 in., or the equivalent. About six large bichromate batteries will be necessary to give sufficient current. (3) The regular method of the glass manufacturers is to use cuperous oxide in the molten mass; but if you wish to prepare a single pane, say for use in a dark room, a make-shift method will be to "fix" an unexposed photographic plate (by soaking it in the ordinary hyposulphite of soda solution), whereby when dry it will merely exhibit a clear gelatine film. This film can then be given any desired color by dipping it in an aniline dye. To protect such a plate from action of the weather it could be attached to the interior of an ordinary sash, in front of the usual clear pane.

1352. **Small Dynamo.** E. T. K., Cambridge, Mass., sends a sketch of a machine having a 6-pole field magnet and a 12-slot armature, latter being 3 in. in diameter and 2½ in. long. Field cores are cast iron, 1½ x 1 in. in section and 1½ in. long. He asks: (1) whether a 6 or a 12 segment commutator should be used, and what the winding should be in order to give an output of 25 volts. (2) What cnanges should be made to allow machine to supply alternating current instead of direct? Ans.—(1) With so small a diameter of armature and so few slots the proportions and conditions are not good for a multipolar field magnet. For direct current you will need brushes at only 60° apart, and this means that the whole difference of potential will be across only two insulations. For direct current use, you ought to have but two poles. You will find an admirable description of an armature of closely these dimensions in Watson's "How to Build a ¼ h.p. Dynamo." A 25-volt winding is described in the pamphlet; but the speed that is appropriate for such a small diameter is not less than 2,500 revolutions per minute. Is there any essential reason why you wish to adhere to 1,400? (2) For alternating currents the conditions are much better and your proposed dimensions will give good results. Numbering the slots from 1 to 12, inclusive, let the first coil wind slots 1 and 3 half full; then without cutting the wire, wind an equal number of turns in the opposite direction in slots 3 and 5. Then a coil in slots 5 and 7, then in 7 and 9, and 9 and 11, finally in 11 and 1. There will be no wires at all in the even numbered slots, and they will be largely covered by the coils that go directly across them. Two ends will be left to the winding and these will go to collector rings. A simple way to make this last device is to mount two rings on a sleeve of wood. A piece of thin brass pipe will answer for stock, and in turning the wood leave the portion that is to be between the rings of a larger diameter than the rest. This will keep the two safely apart. A wire can be let into a groove in the wood and soldered to one of the rings, and then a second wire be led through a hole drilled in the wood its entire length, and then bent over and soldered under the other ring. If you use No. 20 wire, with about 50 turns per coil, or 100 wires per slot, and drive armature at 1,200 revolutions, you will get about 25 volts at 60 cycles. Field winding should be adapted for the particular voltage of the exciting current at your disposal. You can use S.C.C. wire, 30 turns per layer and 14 layers per spool, and have a total resistance of about 15 ohms. This winding will stand a current of upwards of 1 ampere, therefore about 20 volts can be applied. Have only about 1/16 in. clearance between armature and field.

1353. **Plating Dynamo.** O. A. R., ——, sends a simple but lucid sketch of a plating dynamo and wishes to know what changes to make in order to admit its use for lighting 110-volt lamps? Ans.—While the data you sent indicate 4 to 6 volts as actually employed in the deposition of copper, the total voltage figures to upwards of 7. Armature slots are unnecessarily shallow; if possible, double their depth. If the teeth are as thin as ⅛ in. at the bottom this will suffice. You can then wind with No. 20 D.C.C. wire, 6 turns per layer, and 5 layers for each half winding, or making 10 layers in all per slot. Field can be wound with No. 22 wire, and if you put thin paper occasionally between layers, the single covered will answer, and you can get in a little more wire than with the double covered. Output of machine will be about .5 amperes.

1354. **Primary Batteries.** I. J. B., Lawrence, Mass., asks for reference to some book on the construction of liquid cells, such as are adapted for supplying 6 volts and a steady current of 6 to 10 amperes. Ans.—Possibly the Fuller bichromate cells will fill your needs; but you will need to use a sufficient number of groups in parallel with each other to bring down the current in any one to not more than 2 amperes. You can count on a useful e.m.f. of 1.5 per cell, therefore groups of four in series, and three to five such groups ought to be satisfactory. Consult almost any good book in your public library, such as "The Voltaic Cell," by Park Benjamin, or "American Telephone Practice," by K. B. Miller.

1355. **Electric Heater.** J. P. R., Lewisburg, Pa., asks for directions for making a small electric heater that will be of about the same value as a hot water bottle. Ans.—One made by an amateur is apt to break down its insulation and then to constitute a very considerable fire risk. We should think a fairly safe and simple device would be to put an ordinary incandescent lamp in a wire cage, such as are regularly in the market, then cover the whole with asbestos paper or cloth, finally with strong cotton cloth.

1356. **Alternating Current Generator.** J.B., Sulphur Springs, Ark., has a private lighting plant, involving the use of a gasolene engine and an 8-ampere 125-volt direct current generator. He asks if it will be practicable for him to utilize this set in any way to produce alternating currents for wireless transmission, and if so will he need a transformer in addition? Ans.— Your generator probably has but two poles, and even if other things were favorable this number would not give a sufficiently high frequency to make the wireless set work to good advantage. Further, the use of the machine with collector rings for leading to the alternating current circuit would interfere with the regular operation of the lighting plant. You could put in a "rotary converter," or a "motor-generator" set, and get alternating currents in that manner; but since the project would involve a special machine, and perhaps two, you might as well provide a proper alternating current generator and drive it in the same manner as the present machine. Current from the latter could be used to excite the field magnet of alternator. There is an admirable description of such a machine, of 1 k.w. output, described in Watson's "How to Build a 1,000 Watt Alternating Current Generator," a pamphlet which we will be pleased to supply. Price, 50 cents.

1357. **Electrolysis of Water.** F. S., St. Paul, Minn., asks: (1) If water be decomposed by the electric current and the resulting gases be ignited in the cylinder of an engine, will not the piston first be expelled by the explosion; then when the condensation of the steam has taken place, will the piston be sucked back in again? (2) How much water will 1 kw.-minute decompose? (3) How much space will the resulting gases occupy? Ans.—(1) Yes, for the recombination of the gases really makes water, but the heat of the explosion leaves the water in the form of steam. When this condenses, a suction will be produced; but the condition within the cylinder will not be that of a complete vacuum, for low tension water vapor will be present. (2) At least 1.47 volts are needed for the decomposition of water. Then you must have voltage to overcome the ohmic resistance of solution and connections. We cannot tell just what this should be. If you succeeded in getting the actual pressure as low as 2 volts,—but you are likely to find 8 or 10 volts necessary,—the current to represent 1 kw. will be 500 amperes. This current will change 2.8 grams of water into hydrogen and oxygen gases per minute. At atmospheric pressure the volume of the mixed gases will be about ¼ of a cubic ft.

1358. **Ignition Dynamo.** F. R. F., Philadelphia, Pa., has a Watson ¼ h.p. motor which is now used as a generator to give make-and-break sparks for ignition purposes in a gas engine. He wishes to change the apparatus to give jump sparks, adding, of course, an induction coil. Will the dynamo be too strong? If it requires rewinding, what size of wire should be used? How many volts secondary are needed to give ½ in. sparks? Ans.—You do not state what voltage the present winding gives, so we cannot advise you as to the necessity of rewinding; but if 110 volts is the present rating, you will find it advantageous to use coarser wire. If it is for 25 volts, you can rewind the field only with coarser wire, and drive the armature at a considerably slower speed. Such secondary voltages have not been accurately determined, but the figures probably lie between 10,000 and 20,000 volts.

1359. **Pocket Accumulator.** L. B., Oklahoma City, Okla., is making one, following the directions given in the December, 1909, issue. He asks how he can tell when the battery is charged, what rate of charge and discharge is appropriate, and if it can be charged from an alternating source, using a step-down transformer, to about 20 volts, and then using an electrolytic rectifier? Ans.—The operation of storage batteries without adequate measuring instruments brought disaster and undeserved disrepute to the early users of storage batteries. You can, of course, use the cells without such desirable adjuncts, but they will not exhibit their qualifications to good advantage. You certainly need an ammeter of the permanent magnet type,—that is, one that will recognize the direction of the current. This with a hydrometer, for measuring the specific gravity of the solution, will allow you to dispense with the voltmeter. See our engineering articles on Storage Batteries, in the April and May, 1908, issues.

1360. **Underload Switch.** C. H., Des Moines, Ia., asks: (1) How to make such a switch for use in connection with storage batteries when dynamo is run by an ungoverned gas engine? (2) How is a simple thermostat made? (3) How is the starting winding of a single phase induction motor arranged? Ans.—(1) Recourse is often taken to use of mercury contacts. This is objectionable on some grounds, but from the frictionless character of the contact, the device is quite attractive. Bore two holes, say ¾ in. in diameter, about 1 in. apart, to a depth of about 1 in. in a block of wood. Make a U-shaped loop of copper wire, of No. 6 or No. 8 gauge, of such size as to reach from one of these holes into the other. Clamp the loop to one end of a freely swinging lever, say a foot long. A thin strip of wood will be better than metal, for it may be lighter and will move more quickly. Arrange to have a U-shaped soft iron core, say of ¼ in. round iron, about 2 in. long in the straight portions, attached to the lower edge of the wooden strip, and a long and slender spiral spring strong enough to pull up the lever until the copper loop is clear of the holes. Wind a double solenoid of about ½ lb. of wire of sufficient size to convey the main dynamo current, and place it so that when the lever is clear down, the ends of iron cores will be about half way in. Let one of the main wires from the dynamo lie in a slot or hole in the wood, and bend it down into one of the ¾ in. holes. One of the ends of the solenoid makes a similar connection with the other large hole; other end of solenoid goes to battery. Fill receptacles nearly to the top with mercury, and you will have a very effective circuit breaker. (2) Solder a strip of iron and copper together. In size they can be almost anything, but common dimensions would be about 8 in. long, ⅜ in. wide and 1/32 in. thick. Attach one end of the combined strips under a rigid clamp, and let the other end be allowed to swing, as directed by its natural bending, between two electrical contacts. One electrical connection is the upper support, hence two distinct signals can be given, dependent upon which of the two lower ones is engaged. (3) You will find a helpful explanation in the October, 1907, magazine.

1361. **Dynamo Rating.** F. J. C., Somerville, Mass., sends a sketch of a little dynamo, with a statement of its principal dimensions, and asks what its output should be, and if it will operate a 1 in. spark coil? Armature core is solid, is 2½ in. long and 1½ in. in diameter, wound in eight slots with No. 20 wire, 10 in a slot. Field is of cast iron, of slender section, wound with No. 18 wire. Ans.—Perhaps you might be able to get 5 volts and 5 amperes out of the machine, but you will be disappointed in its use with an induction coil. The machine has too much inductance in its own windings to allow the primary current to be made and broken fast enough. For general experimental work shunt wound field magnets are more convenient, and this you can provide by substituting No. 23 or No. 24 for the present No. 18, and making the proper connections.

1362. **Wireless Telegraphy.** C. D. S., Los Angeles, Cal., asks: Why cannot the principle of an Aluminum Electrolytic Rectifier be used as an Interrupter for a spark coil on 60 cycle current?

1363. H. B., Martinez, Cal. Your question would take up too much space. Remit a dollar and we will mail you complete directions with working drawings.

1364. **Transmitting Distance.** W. N. K., Vancouver, B.C. (1) You have an excellent set. You can receive a 2 k.w. station about 500 miles across the water. (2) Your transmitting distance is about 50 miles under ordinary conditions.

1365. **Umbrella Type Antenna.** H. L. S., Brookline, Mass. (1) See article by Mr. Getz in February issue of this magazine. (2) Use one mast, eight wires radiating in all directions from the top, connecting them to each other at both top and bottom; bring leading wire from the bottom. (3) Government call books are out of print.

1366. **Incomplete Question.** M. H. S., Gloucester, Mass. Please specify whether these instruments are to be used on alternating or direct current.

1367. **Alternating Current for Wireless Telephony.** P. T., Concord, Mass. (1) Yes, if secondary voltage is sufficiently high, say at least 12,000 volts. (2) No, a perfectly steady current must be used in wireless telephony. See article which will appear soon. (3) The system using the beam of light does not use choke coils, the system using Poulsen arc does.

1368. **Length of Aerial Wires.** P. H. L., Spring Brook, Ore. (1) Make aerial 150 ft. long and bring wires to instruments from the middle. (2) It is not quite as sensitive as either the electrolytic or the pericon, but it is more dependable in its action.

1369. **Transformer for 220-Volt Current.** W. T., Antioch, Cal. (1) You do not specify the power of the transmitting station. (2) By inserting proper resistance or impedance in the primary circuit any transformer described in this magazine may be safely used. Make it 150 ft. long, as high as possible at both ends, take wire to instruments from the middle and leave wires disconnected at either end. (4) No range is possible with this combination.

1370. **Aerial.** W. D., Brookline, Mass. (1) Your question is incomplete since you do not state the power of the station which you wish to receive. See answer to No. 3 of W. T., Antioch, in this issue. (2) A vertical aerial as high as possible. See article by Mr. Getz in the February issue of this magazine.

TRADE NOTES

Speaking of complaints—a man called at the Disston Saw Works some time ago, carrying a Disston Handsaw. He seemed very much aggrieved and complained bitterly about their sending out such a saw as the one he had.

"Why," he said, "it will not cut wood; in fact it will not cut anything."

This struck the Disston folks as being rather curious, for in their Seventy Years of sawmaking, some millions of saws have been made and sold by them. Upon examining the saw, however, the cause of the difficulty was readily apparent. The Disston representative casually asked the visitor if he thought the saw would cut iron. "No, of course it won't," said the visitor emphatically.

Asked if he could wait a few minutes, he said he could. Disston's man took the saw out in the shop, had it SPECIALLY FILED TO CUT IRON—(notice the specially filed part)—brought the same saw back, took the visitor in the machine shop, got a piece of iron bar about 2 in. in diameter, placed it in a vise, tightened it up, put the saw to work and in short order neatly sawed the bar in two without any trouble whatever, and the teeth were still in fair condition.

The visitor was utterly amazed. "Well," said he, "I wouldn't have believed it."

After an explanation of the trouble—simply a matter of the condition of the teeth in the saw—he asked: "Can you put it in proper condition for sawing wood"?

"Yes."

"Well, do it and I will never complain about a Disston saw again."

The majority of users do not know or give little thought to the fact that to obtain the best results in any particular class of work the saw must be specially toothed and filed for the sawing to be done.

Years of experimenting have determined just what shape or space, angle and bevel, should be given to the teeth, as well as the amount of set best suited for this or that class of sawing; that the tooth best adapted for sawing soft woods is not at all suitable for cutting hard woods. Of course, the work could be done after a fashion, but the result would not be as good as that obtained by the use of a saw properly toothed for its particular purpose. You can take a Rip Saw and crosscut with it, but note the difficulty.

In line with this it may be noted that even a blade saw made for cutting soft metals is not at all adapted for sawing the harder metals, nor will a saw made for sawing wood stand the work of cutting a combination of wood and metal without injury to the points of the teeth, thereby spoiling it for further use in making a clean, sweet cut in wood. A saw that is "fitted-up" for sawing wood has the teeth filed with a bevel back and front, given a proper set, enabling it to do fast cutting. A handsaw for sawing metal has no set on the teeth but is ground for clearance and filed straight across the front of the tooth, while to a limited extent it would cut wood but not in a manner that a mechanic desires. In other words, it is not adapted for wood cutting and its temper also is different from that of a wood-cutting saw.

It is for these very reasons that various patterns of saws are made and specially toothed for the different kinds of work. Experience in this line is the best teacher. Take a saw fitted up for sawing wood, try it on a piece of metal. No matter what kind of a saw it may be, or whose make, it positively will not do as good work afterwards in sawing wood without being refitted.

The Economy Drawing Table Co., Toledo, Ohio, issues an attractive catalog of drawing tables, sectional filing cases, work benches, etc., which they will be glad to send on application to any of our readers who may be interested in this line of goods.

C. G. Willoughby, of 814 Broadway, New York, known to all photographers as "Willoughby and a Square Deal," has just issued his catalog, No. 120, entitled "Willoughby Special." If you want a bargain in anything photographic write to him and get this list. It describes cameras, lenses, and lots of other photographic material which every camera owner will find interesting and useful. Send in your name for the list and you may be assured you will get a good trade.

Branch Publishing Co. of Chicago have in press a new book, entitled "Electric Wiring," by Joseph G. Branch. We shall take pleasure in reviewing this book as soon as it appears; in the meantime, would advise all readers interested in this subject to write to the Branch Publishing Co. for prospectus.

Those contemplating studies which are covered by the courses in the Boston Telegraph Institute of this city and also Framingham, Mass., will do well to write at once for a prospectus, which sets forth in a very clear manner the advantages such a school affords. From a personal inspection of the institution, we were very favorably impressed with the establishment, and feel confident that Mr F. H. Knowlton, its President and General Manager, is a very able gentleman, up to date, and thoroughly acquainted with the progress of present-day needs and requirements.

Peck, Stow & Wilcox Co., New York City, are advertising a fine grade of pliers in this number. They are also announcing they will send free a booklet containing 160 pages, entitled "Mechanics' Handy List." We advise our readers to send to them for one, giving name and address, and mentioning this magazine.

Mack & Co. of Rochester, New York, make good tools and get out an attractive catalogue, which they are glad to furnish free if you will give the name of this publication when writing to them.

BOOK REVIEWS

Pattern-Making. By G. H. Willard. To which are added chapters on *Core-Making and Molding.* With 312 illustrations. Chicago, Popular Mechanics Company, publishers, 1910. Price, $1.00.

The number of books on pattern-making is large, yet this one needs no apology. It is a most valuable addition to the number of books on the subject. The author not only knows his subject, but, what is more important, knows how to impart his knowledge to others. He starts in with a description of the tools required, listing and describing the necessary equipment. A chapter on woods and methods of sawing and gluing is very useful, and is followed by a description of the various forms of joints commonly used. Then follow chapters on lathes and tools and the various technical details of turning. Two chapters are devoted to the circular saw and its uses, and two to the various machine tools. Then follow twelve chapters on various simple and complex patterns which are likely to come into the average pattern-maker's experience, and while the various forms described and illustrated may not be required by every one, the principles elucidated are sufficient to cover almost every form of pattern in use today. The book is illustrated with excellent drawings which are extremely simple and clear.

Selected Shop Problems. By George A. Seaton, Director of Manual Training, Shaw High School, Cleveland, O. The Manual Arts Press, Peoria, Ill., 1910. Price, 20 cents.

This little booklet is one of the Manual Training Reprints, a series of pamphlets reprinted from the "Manual Training Magazine." It gives a number of woodworking problems, modern in style and design and of increasing difficulty, beginning with a padded stool and ending with a bookcase and desk. Herein is involved work emough to require considerable time, thought and skill on the part of the pupil, and the collection will undoubtedly prove of great value to manual training teachers. It is furnished at special prices in quantities for school use.

How to Run and Install Gasoline Engines. By C. Von Culin. Published by the author. New York, N.Y. Price, 25 cents.

This booklet is designed as a pocket companion for every user of gasoline engines and is especially valuable to the proprietor of a motor boat. It covers all the ordinary problems of setting up and operation. It will give directions for meeting any ordinary trouble with the engine.

Mission Furniture. How to Make It. Popular Mechanics Co., Chicago. Price, 25 cents.

This book consists of a series of drawings, mill bills and descriptions for making a number of well designed and useful pieces of furniture of mission pattern. It includes some twenty or thirty different designs for furniture for hall, parlor and living-room, excellently planned and well illustrated.

WIRELESS TELEGRAPHY

In response to many requests, we publish below a complete list of books in print on wireless telegraphy, with the prices at which we can furnish them, postpaid.

BOTTONE, S. R.
Wireless Telegraphy and Hertzian Waves. 1900 .... $1.00

BUBIER, E. T.
A B C of Wireless Telegraphy. 1904 .... 1.00

COLLINS, A. F.
Wireless Telegraphy. 1905 .... 3.00
How to make an Experimental Wireless Outfit. 1906 .... .25
Manual of Wireless Telegraphy. 1906 .... 1.50

DE TUNZELMAN, G. W.
Wireless Telegraphy. 1901 .... .75

EICHHORN, G.
Wireless Telegraphy. 1906 .... 2.75

ERSKINE-MURRAY, J.
Handbook of Wireless Telegraphy. 1907 .... 3.50

FAHIE, J. J.
History of Wireless Telegraphy. 1899 .... 2.00

FLEMING, J. A.
Principles of Electric Wave Telegraphy. 1906 6.60
Elementary Manual of Radio-telegraphy and Radio-telephony for Students and Operators. 1908 .... 2.00

HOWGRAVE-GRAHAM, R. P.
Wireless Telegraphy for Amateurs. 1907 .... 1.00

KENNELLY, A. E.
Wireless Telegraphy and Telephony, enlarged and reprinted. 1909 .... 1.14

KERR, R.
Wireless Telegraphy. 1902 .... .75

LODGE, O. J.
Signalling across Space without Wires. 1901 2.00

MASSIE, W. W., and UNDERHILL, C. R.
Wireless Telegraphy and Telephony Popularly Explained. 1908 .... 1.08

MAVER, W.
Wireless Telegraphy. 1904 .... 2.00

MAZZOTTO, D.
Wireless Telegraphy and Telephony. 1906 .... 2.00

MONCKTON, C. C. F.
Radio-telegraphy. 1908 .... 2.00

POINCARE, H., and VREELAND, F. K.
Maxwell's Theory and Wireless Telegraphy. 1904 .... 2.00

SAINT JOHN, T. M.
Wireless Telegraphy for Amateurs and Students. 1906 .... 1.00

SEWALL, C. H.
Wireless Telegraphy. 1907 .... 2.00

STORY, A. T.
Story of Wireless Telegraphy. 1904 .... 1.10

TESLA, N.
Experiments with Alternate Currents of High Potential and High Frequency. 1904 1.00

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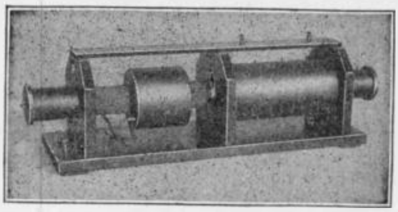

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