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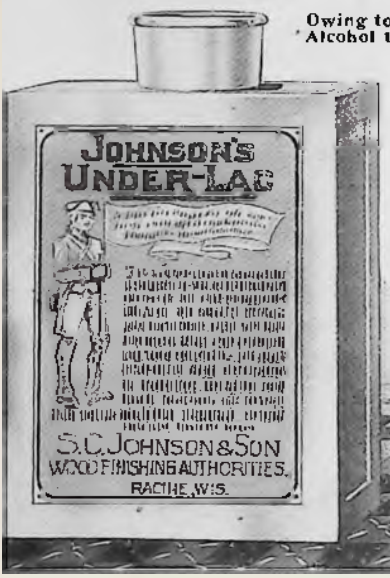

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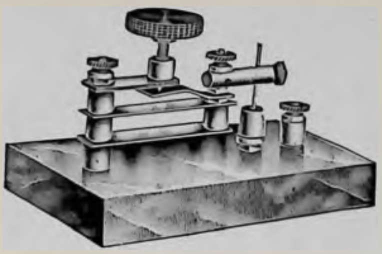

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Electrician and Mechanic

VOLUME XX NOVEMBER, 1909 NUMBER 5

FORGING FOR AMATEURS—Part XII

F. W. PUTNAM, B.S.

TEMPERING TOOLS OF THE SECOND CLASS

(Hardened all through)

Tools of this class are usually tempered as follows:

First heat the whole tool to a uniform hardening heat and then completely cool it. This will harden it throughout. The surface is then to be polished bright and the temper drawn by laying the tool on a piece of red hot iron until on the surface appears the desired color. This color, for such tools as milling cutters and taps and dies, would be generally dark yellow or light brown. While the tool is being reheated on the red hot iron, it must be turned almost constantly. If this is not done, the parts which are in contact with the hot iron will become overheated and consequently too soft, before the other parts have been heated enough.

Another method of reheating is to put the tool in a bath of melted lead or heated sand. Large tools are frequently heated on a sheet of iron, laid directly over the fire. When the steel is taken from the fire, it is a good plan to hold it in the shadow of the forge, because the hardening heat can be more accurately distinguished in this way. You will find that the color of the heat will appear rather different here than in the sunlight, and there is a much better chance of obtaining uniform heat by judging in shadow than in the open sunlight, which, of course, varies a great deal in intensity.

In hardening, a great deal depends on the annealing. The sole object of annealing is usually understood to mean the softening of steel. Thus we read, according to one authority, that the definition of the word *annealing* is to heat and gradually cool in order to soften or toughen.

Now if this were the only object, we could buy our stock annealed much better and more satisfactorily than we could do it ourselves, and I believe that, as a rule, it is a good idea to buy the steel in this condition.

I have found that a peculiarly shaped piece of work, or one with a hole in it, such as a milling machine cutter, or perhaps a punch press die, should be annealed after a hole somewhat smaller than the finished size has been put through it and it has been roughed somewhere near its size, all traces of scale having been removed. I believe it is best to anneal almost every tool which must maintain its shape when hardened.

After the outside surface of the steel has been turned off, if the steel is quite low in carbon and an extremely hard surface is required, I usually charge or add to the stock, extra carbon. This can be done by packing it in what is known as an *annealing box*, with some substance that will give off carbon, such as granulated charcoal and charred leather in equal quantities. After packing the steel is subjected to heat, the length of time for heating depending of course upon the size of the tool, and also upon the desired hardness of the cutting surface.

The annealing heat must be hot enough to allow all the strains in the steel, which are common because of rolling and hammering in the steel mill or forge shop, to be overcome. We should never hammer a piece of tool steel to a shape in the forge shop at a hardening heat. The steel must be hot enough to flow properly under the hammer, and it must have a uniform heat throughout, else we will tear the particles of steel upon it.

When we harden the piece, we must heat to a forging heat, just as when we anneal it. The heat must be very uniform, and the piece must be kept there long enough to overcome any tension or strain that might show itself when we later harden the piece.

After the tool has been packed in the box with the mixture just mentioned, so that no part of it shall come within a couple of inches of the box at any point, drill several ¼ in. holes through the cover for test wires. Put the cover in place and lute with fire clay. Run some $\frac{3}{16}$ in. wires down through the holes to the bottom of the box and allow them to stick up through the cover for a couple of inches, or at least long enough to get hold of readily with a pair of tongs. Then place in the oven. When we think we have kept the piece in the box long enough, so that it is hardened through, draw out one of the wires and if it is red hot its entire length, we time from there. If the wire is not red hot, wait a few minutes and then draw another wire and so on, until we draw a wire which shows red its entire length. I believe this is as simple a method as there is for timing heats, in what is known as packed hardening of steel and case hardening of machine steel and wrought iron, for stock that is under 1 in. in diameter, I run for ordinary annealing about one hour, and the larger sizes correspondingly longer.

If it happens that I do not wish to put any extra carbon into the steel, then I pack with clear granulated charcoal. The boxes must cool down as gradually as possible and one must be very careful and not pack in any substance that has a tendency to take away or extract any carbon from the steel, or with anything that will put any impurities into the steel that we do not want there. Any form of bone, either raw or burnt, should never be brought in contact with tool steel, either in the process of annealing or hardening, because it contains a high percentage of phosphorus.

The steel maker is constantly at work, aiming to get rid of all the harmful impurities that are in the tool steel, and we must be very careful not to put them back into the steel.

I have seen cast iron dust used as packing; but I do not believe in its use, for cast iron has a great affinity for carbon, and you can see that it will probably draw the carbon from the steel to such an extent that we will have trouble in hardening.

You will notice that I said that no part of the stock should come within two inches of the box at any point. If this precaution is not taken we will be liable to have the same effect as in the case of the using of cast iron dust, although to a less extent, but infinitely more troublesome since the carbon will be extracted from the sides nearest the box and not affected anywhere else. This will of course, make the hardening very uneven.

It frequently happens that we are not situated so that the above method can be used and very good results can be obtained by heating in a large charcoal fire to a uniform forging heat. Place in the bottom of an iron box about three inches of ashes. Next put in a piece of pine board and lay the work to be annealed on this, placing another piece of board on top and finally filling the box with ashes. The boards will, of course, smoulder and char and will keep the piece of steel hot for a long time, and the ashes will keep the air away from it.

This method is a very common one, and you will find many blacksmiths who use a box of cold ashes for the above. I do not like this method, however, if cold ashes are to be used, since they are liable to chill the surface, and if I am compelled by circumstances to use this method, I always use hot ashes.

Sometimes blacksmiths use in connection with this, lime; but I do not believe in using lime, unless it is heated before the steel is put into it. Lime is cold and has a great tendency to absorb moisture and this will naturally chill the steel in time, if it were allowed to cool in the air.

Excellent results can be obtained by heating steel for annealing in a muffler gas oven. It can be heated very uniformly. You can run it any length of time you wish and when the oven has become heated through, it will take quite a time for it to cool off. This method I will take up more in detail, later.

Still another method used in some

shops is to give the piece of steel what is known as a cold water anneal. I should never advise the use of this method if it is possible to use any other, but as it is sometimes necessary, I will give what I think is the most satisfactory way of doing it, and that is, to heat the steel to the proper tension and allow it to cool in the air until the red disappears, when the article is held in a dark place, or until a pine splinter ceases to catch fire when drawn across it. The piece is then plunged in soapy water and allowed to cool there. The hardening of a piece of steel is usually accomplished by heating it to a low red heat and then plunging it into some cool bath. Now a great deal depends on this bath, and it therefore becomes very necessary for us to understand the effects of its use on different kinds.

We know, of course, that the more quickly steel is cooled for a hardening heat, the harder and more brittle the steel is made. Files which are usually wanted very hard, are hardened by cooling in a bath of cold brine. The brine will cool the steel faster than a water bath would and consequently the steel is left harder than if it were hardened in water.

Springs which are usually wanted tough and not very hard are cooled in oil, because oil will cool much slower than water. Sometimes we have articles to harden, which are delicately shaped and very liable to crack when hardened. These are cooled in water which has a thin film of oil on the top of it. The oil will stick to the steel as it is plunged into the water and the steel is not cooled quite as quickly as if pure water alone were used. We, of course, must recognize this fact, that the faster steel is cooled, the more danger there is of cracking.

I have several times emphasized this statement, that the greatest care must be taken when hardening to have the steel *uniformly* heated. It must never be left in the fire a minute longer than is absolutely necessary to accomplish this, but on the other hand, it must be uniformly heated, or the results are liable to be very unsatisfactory.

If we take a milling cutter for an example, we find that the points of the projecting teeth may become very much hotter than the body of the cutter, while it is being heated. Now, if we dip this cutter into the cooling bath while the points are hotter than the body, they are almost certain to crack off.

The most common cooling bath is of course, clear cold water, although many blacksmiths use salt and water or brine, and for some purposes, a solution of one quart of sulphuric acid to 10 gallons of water is used.

If small articles are to be made extremely hard and tough, a good bath can be made by dissolving one pound of citric acid crystals in one gallon of water.

Another bath which is used with excellent results, is made by dissolving in three gallons of water, two ounces each of alum, sal ammoniac and saltpetre and one and one-half pounds of salt. This is to be used where steel is hardened to a low cherry red, not hotter.

It frequently happens that we have the same kind of work to do over and over again, and we must find out what gives the best results and then stick to it until we can find something better.

Now for ordinary work, a bath of clear water and one of oil and a jar with the citric acid solution will be found sufficient. My experience has shown me that water which has been used in hardening, if it is not greasy or dirty, is more satisfactory than fresh water. If it has been boiled before using, all the better, because it will not then generate steam so readily, for it is the steam which forms around the piece of red hot work in the bath and keeps the water away, that will make one part of our piece of steel soft, while a more exposed part is hard. The effect of the use of salt in the water is about the same.

When small pieces are to be hardened, or a tool which is extremely liable to crack, always warm the water slightly. This will give the article less shock when it is dipped and will not have the tendency to steam that extremely cold water has.

Springs usually are hardened so as to gain toughness and elasticity, and so a bath of tallow or sperm oil is the best for this work, using tallow for very small pieces and the sperm oil for larger ones. Raw linseed oil is used for very thin cutting tools, where great hardness is the desired quality.

Let us now consider a few pieces of work that might be hardened by the open fire method. Take for instance a reamer or cutter bore, or small tap: If we have a muffler oven, we simply put the piece in the muffler, if not, a tube should be used for the heating. When it shows a low cherry red, dip in a strong solution of potash and water, remove as quickly as possible and reheat in citric acid solution, salt and water or clear water, the former being preferable. The potash is used so that the piece of steel will remain bright enough for drawing the temper. Frequently, we may have a hollow mill, or similar tool, which has a hole part way through it to harden. If we wish the walls of the hole hard, we must dip in a bath with the hole up. Otherwise the steam will keep the water from entering the hole, and besides, this, the action of the steam will be liable to crack the piece.

If we are obliged to harden a milling machine cutter in a hard coal fire, be sure to use a piece of tube or box, so that the coal may not come in contact with the tool. Heat evenly. This means, of course, heat slowly.

If we use a charcoal fire, we must have a big one and keep the tool from the blast. If we have not been able to anneal after a hole has been drilled through it, first bring it to a cherry red heat and then set it to one side to cool off, at least to a black, after which reheat it to a hardening heat and dip in water to which a little salt has been added. Work the tool around in the bath, until it stops singing, after which it should be removed and plunged in an oil bath and left until cool.

If it is a punch press die, treat in the same way, except that we must plug up any holes with fire clay that it is not necessary to harden around, such as guide screw holes.

In the hardening of very large pieces, such as drop press dies, the tank should be arranged so as to have an inlet pipe pointing up from the bottom of the tank. After the piece of steel is properly heated, plunge it into the tank, open the valve of the inlet pipe and let the water play against the face of the piece or the steam will drive all the water from it and the piece will come out of the bath as soft or softer than it was before heating.

If hardening pieces of any size, we should immediately remove the tendency to crack from internal strains, which can be done by holding it over the fire until the piece is so hot that the hand cannot be held on it, or until a drop of moisture will cause a snapping noise. If we have large quantities of work from which we are to remove the strains, by all means have a tank of boiling water and put the pieces in this, as soon as they are removed from the bath.

Metal cutting saws can be hardened nicely between plates whose surfaces are kept oiled. The pieces should be heated in such a manner that the fire does not come in contact with them. When the saw is properly heated, place on the lower plate and as quickly as possible put on the upper plate, holding it there until cooled. On removing the upper plate, we shall find that the saws are perfectly flat.

We hear a good deal about lead hardening, and tempering, and so I will explain this method at this point. When hardening, the lead is heated red hot and the tools to be hardened are held in the lead until heated to the proper temperature. The top of the hot lead must be kept covered with charcoal, so as to prevent oxidation. If this was not done, the lead, when exposed to the air would soon become oxidized and wasted. The steel is cooled in the ordinary way. This is a good way to harden steel, as it may be very uniformly heated. For small work, lead is usually heated in an ordinary ladle. For larger pieces, other arrangements are used.

When the temper is drawn, the lead is not heated as hot as when hardening and the pieces to be tempered are laid on top of the melted lead; the steel being lighter than lead will float on top, so it may be easily watched during the heating. The pieces to be tempered are polished and heated until the proper colors appear, exactly the same as when heated in the ordinary way.

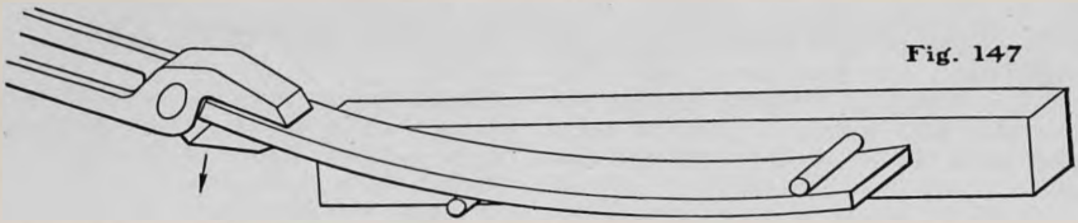


Fig. 147

THE DANGER OF WARPING IN COOLING

When heated steel is cooling, it will contract, and unless the contraction takes place uniformly on all sides, the piece is liable to be warped or sprung out of shape. A good example of this is a long thin, flat piece of steel, hardened by dipping into the cooling bath edgewise or flat-wise. It would probably spring out of shape in cooling. If dipped endwise, the piece would be cooled from all sides at once and would stand a much better chance of coming out of the cooling bath straight. It is usually better to dip cylindrical and long, thin pieces *endwise*, and round, thin discs and square, flat pieces *edgewise*. Perhaps as good an example of the treatment of long, thin work, is that of the hardening of files, and the method employed in this case may be used to advantage for many other pieces.

The files are heated in a pot of red hot lead. They are placed in this pot on end and when properly heated, are plunged end first, being held in a vertical position, into a vat of brine. Files nearly always warp somewhat when hardening and when the warping is slight, are straightened as follows: Against the top of the brine vat are fastened two wood strips about two inches apart and joined by two iron pins about six inches from each other. The hardener draws his file from the brine before it is entirely cold. The metal has just enough heat left in it to cause the water on the surface of the steel to disappear almost instantly. The file is then placed between the pins over one and under the other with the concave sides up as shown in Fig. 147, which shows one of the side straps removed. The blacksmith then bears down on the end of the file, springing it straight, and at the same time pours some of the cold brine on top of this concave part. This will usually straighten out the file and leave it perfectly true. Of course, if the files are too badly warped, we must reheat, straighten and then harden them again.

PACK HARDENING

I give below a method of pack hardening which has given very satisfactory results. Milling machine cutters and punches and dies hardened this way have had their efficiency increased greatly, and they do not go out of shape when hardened. The object attained is the increasing of the amount of carbon in steel to the extent that it will harden in oil. The percentage of carbon, being so high, the article is very hard and the grain compact. The oil leaves it tough and increases its uniformity many fold. The apparatus necessary to successfully try this method consists of an oven suitable for the business, where we can get and maintain for several hours the proper heat.

The fuel used may be coal, coke, charcoal, oil, in fact any form of fire, though I do not like to use coke and coal if the boxes that hold the work have to be placed in the fire. One of the best ovens, I believe, is a Brown and Sharpe Hard Coal Fire Oven. Oil and gas are very nice clean fuels and give a very even and easily maintained heat.

We will require a good quality of charred leather which must be pounded and sifted to about one-half the size of a pea, and mixed with equal parts of granulated charcoal. Put equal parts of this mixture in the bottom of the hardening box of the proper size to a depth of about two inches. Put in the work with wires attached, allowing them to project over the sides of the box, keeping the pieces to be hardened at least 1½ in. from the side of the box. Cover each layer of work with a layer of the mixture 1¼ in. deep. Put in another layer and so on until we are within 1½ in. of the top of the box. Then fill, put on the cover and lute with fire clay. Place the test wires down through the holes in the cover to the bottom of the box. When the box has in your judgment had time enough to heat through, draw one of the wires out of it and if it is red hot the entire length, time from then. If not, wait a few minutes draw another and so on until you draw one that is red. The time required to properly charge the steel depends directly on the size of the piece and the degree of hardness that must be reached. A small tool, ½ in. in diameter, should run an hour; a piece 1 in., two hours, etc.

They should then be removed from the fire, the work removed from the box one piece at a time by means of the wires attached to it, and plunged into a bath of linseed oil. Work around well in the bath until the red has disappeared, when it may be dropped to the bottom of the tank and another taken. The packing in the box will keep the work hot, while the other pieces are being dipped. Next remove as quickly as possible the strains.

When we are ready to draw the temper, we can brighten the steel and draw by coloring, if we have no other way, but if possible we should do it in a kettle or crucible of oil, gaging the heat carefully with a thermometer.

A very light yellow is 430 degrees, a straw color, 460 degrees, brown yellow 500, light purple, 530, dark purple, 550, gray blue, 570, pale blue 610, and blue tinged with green, 630 degrees.

The amount to which we draw the temper, of course, depends altogether on the steel we are using, the amount of heat given to it when it was hardened and the use to which it is to be put.

There are some makes of steel which when hardened the same as others will be found not to stand to be drawn nearly as much. A diamond point lathe or planer tool, properly forged from certain steels, does not need any drawing, while from other brands of steel it is necessary to draw to a pale yellow.

Taps, ¼ in. in diameter and under, made from one brand of steel, if used, would be plenty soft enough drawn to a straw color, but if made from other brands would need drawing to a light purple, a difference of about 100 degrees.

A milling machine cutter of the ordinary type is usually drawn from 430 to 460 degrees, or from a very light yellow to a straw, according to the use to which it is to be put and the strength of the steel.

A punch press die for ordinary work is usually drawn to 500 degrees, deep yellow, while the punch is drawn somewhat lower, or to about 530 degrees, a light purple.

Metal cutting saws hardened between plates with oil should be drawn to 530 degrees, if less than 1-16 in. thick. If thicker, draw them less.

As above explained, we must remember that the brand of steel and the amount of heat given will vary the above figures to a greater or less extent.

I have described briefly the use of red hot lead for hardening. To avoid having the lead stick to the work, various compounds are used. The work is dipped into these and allowed to dry before putting into the lead. I usually use a solution of cyanide of potash and water, made by dissolving one pound of granulated cyanide in one gallon of boiling water. Allow it to cool before using. It will at once heat in cyanide for hardening.

While we cannot recommend this method for cutting tools, there are times when we wish to get nice colors on the work. I know of no other method where such a variety of beautiful colors can be given a nicely polished piece of steel as may be obtained by heating in red hot cyanide of potassium, and dipping in water. The colder the water, the brighter the colors. We may produce a beautiful vine-like effect by having the inlet for the water above the tank and facing the end of the pipe, so as to supply the water. After heating the proper length of time, dip the tool in the water, first passing it through the spray. This will produce a vine-like appearance.

If we have a large crucible, we may oil each piece of work and suspend quite a number in the crucible at one time, putting in and taking out, making sure that no water gets to the melted cyanide, as it will fly and make a severe burn wherever it strikes the flesh.

If we find the pieces are too hot, we can draw the temper as much as we please by putting in oil and drawing by thermometers. The colors will not be changed. Please understand that I do not advocate this method for use in the case of cutting tools, but simply for pieces of steel where we wish to get beautiful colors.

The next article will take up the practical side of Tool Forging, with full directions for making the tools.

THE "DOUGHNUT" TRANSFORMER AND ITS CONSTRUCTION

EDW. H. GUILFORD

The latest idea in tuning devices for receiving wireless signals is the "doughnut" transformer so called because of the peculiar shape of the secondary winding. Its principle of action is practically the same as that of the ordinary loose-coupled receiving transformer. With this "doughnut" transformer, either of two sending stations having a difference in wave length of only two or three per cent. can be selected and all untuned waves may be shut out. It is much easier and quicker to operate than the ordinary loose-coupled receiving transformer.

German experimenters were the first to adopt this peculiar transformer, but Marconi soon saw its possibilities, and a form of it may be seen today in any Marconi station.

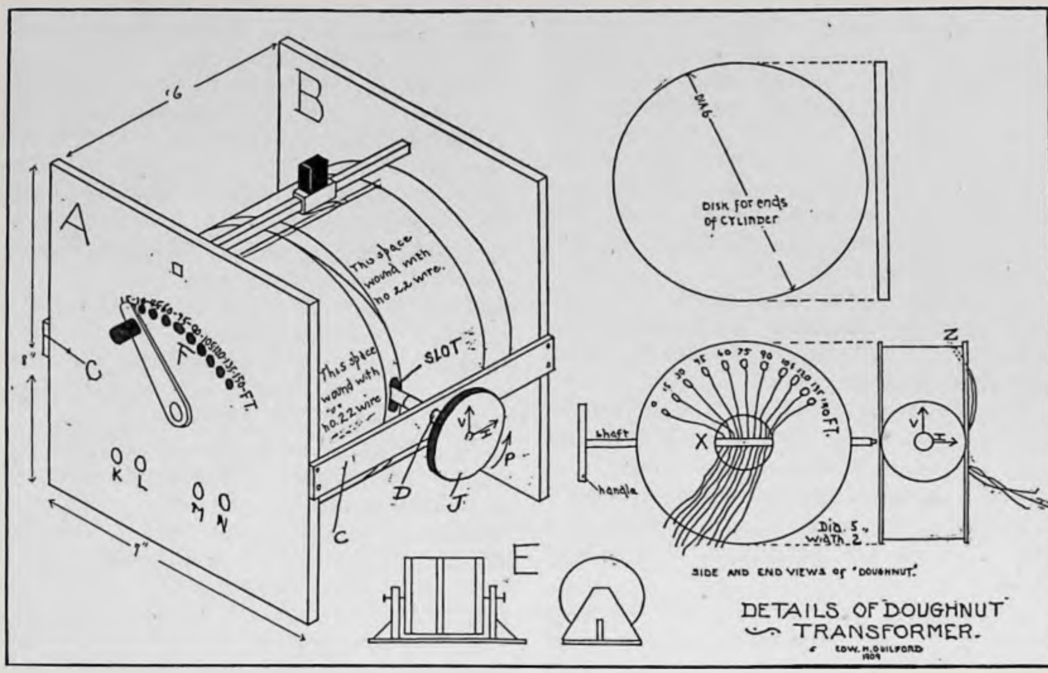
In connection with this piece of apparatus a variable condenser must be used in order to secure results.

The "doughnut" transformer consists of two parts, the single slide tuning coil, and a "doughnut" (see drawing) and I will give their construction in that order.

THE TUNING COIL

The tuning coil consists of a hollow cylinder of some insulating material upon which is wound a single layer of bare No. 22 copper wire. A sliding contact is so arranged that it may come in contact with any given turn of wire.

For the cylinder, wind a strip of cardboard 6 in. x 28 in. on two discs of wood 6 in. in diameter and ¼ in. thick (see drawing) so that the cylinder will have an axis of 6 in. and a diameter of 6 in. After gluing the overlapping ends of the cardboard together, wrap several turns of string around the cylinder to hold it in shape and set it aside to dry.



DETAILS OF DOUGHNUT TRANSFORMER.

Meanwhile the coil ends, A-B, may be fashioned. There are two of them, of wood, 7 in. x 8 in. x ¼ in. thick.

When the paste-board cylinder is dry, the wooden discs may be temporarily tacked in, one at each end, and the cylinder is then ready to be wound. The neatest way of doing this is to place the cylinder in a screw-cutting lathe and after setting the cog-wheels to turn 30 to 35 revolutions to the inch, feed the bare wire on to the cylinder through a small pipe in the tool holder. The cylinder should be thickly coated with shellac, so that the wire will bed firmly, and no turn of wire will come in contact with its neighbor. If the reader does not have a lathe at his command, the cylinder can be easily wound by hand, by making a support similar to the drawing E, and then winding a thread along with the wire so that each turn will be separated from its neighbor. The thread will at the same time serve to keep the wire wound evenly. A space ⅜ in. wide should be skipped in the middle of the cylinder, in order that the shaft upon which the "doughnut" turns may project through, and the winding should stop 1 in. short of each end.

The reader may wonder at the short length of the wound space on the coil, as compared with the average tuning coil, but account must be taken of the unusually large diameter of the cylinder. With a given amount of wire, the tuning coil which will receive the longest wave length, is the one with the largest diameter. This coil will easily receive a wave as long as 1,500 meters.

My object in designing a coil with such a large diameter is to have the "doughnut" as near as possible to both ends of the tuning coil.

After the cylinder has been wound, the wooden discs may be removed and then fastened to the square ends, A-B (one disc to each end), so that the centre of each disc is 3½ in. from the sides, and 3½ in. from the bottom of the square end.

The reason for fastening the discs on the square ends, instead of in the ends of the cylinder, is that the cylinder must be left open until the last, so that the "doughnut" may be placed inside.

The centre of each disc is placed nearer the bottom than the top of the square end, in order that there may be room at the top of the coil for the slider rod. This rod and sliding contact may be made after almost any ordinary pattern, the one in the drawing being one of the simplest to make, as the slider rod is of square cross-section.

Two pieces like C in the drawing should now be made of wood 6½ in. long, 1 in. wide and about ¼ in. thick. A hole, D, should be bored through the centre of each stick. They are to be used as bearings for the "doughnut" shaft, and also to hold the transformer together.

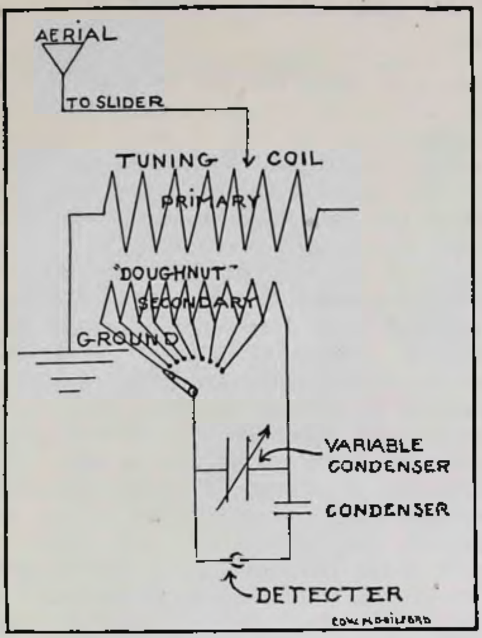
CONSTRUCTION OF THE "DOUGHNUT"

The "doughnut" is a cylinder of insulating material, wound with No. 28 single cotton-covered magnet wire. It is placed in the middle of the tuning coil, and by means of a handle is turned from a vertical to a horizontal position.

Turn out, or whittle, a cylinder of wood 5 in. in diameter and 2 in. wide. Pine, cedar, or some such light wood, should be used, in order that the weight be as low as possible. A slight ridge should be left on each outside edge, to keep the wire from springing off. A hole, about ¾ in. in diameter, should be bored through the "doughnut" along its axis (shown at x in the drawing) and a hole, ¼ in. in diameter, should be bored through a diameter. This hole is for the shaft, which is a rod of either brass or wood, ¼ in. in diameter and 8 in. long.

About 150 ft. of No. 28 single cotton-covered wire should now be purchased, and at every 15 ft. a place should be scraped bare, and a foot of No. 28 S.C.C. magnet wire be soldered to the bare spot. This will make ten leads soldered to the total length of wire.

Wind the wire on the cylindrical part of the "doughnut," starting at one side, and leaving about 1 ft. of the end with which to make connections. This end should be brought out through a small hole, such as is shown at Z in the drawing of the "doughnut." Wind the wire carefully and regularly, and as each lead is wound on, bring it out through a hole similar to the one bored for the beginning of the wire. As the wire is wound on, care must be taken that no bare spots (where the leads are soldered on) touch. If two or more such spots come together, insulate them from each other by means of a small piece of paper. As each lead is brought out, a small number, corresponding to the number of feet already wound on the "doughnut," may be placed above the hole through which it comes (see drawing of "doughnut"). When all the wire has been wound on the doughnut (and there will probably be from 2 to 3 layers), the leads should be brought down into the centre hole of the "doughnut," passed around the shaft and out the same side of the hole (see drawing at X). Shellac the whole



"doughnut," and we are ready for the

ASSEMBLY

A row of 10 switch contact points should be placed with a switch handle at one end of the tuning coil, and the contacts should be numbered 15, 30, 45, 60, 75, 90, 105, 120, 135, 150 ft. (see drawing at F). Four binding posts should be fastened at the points marked K-L M-N.

In order to place the "doughnut" in its proper position inside the tuning coil cylinder, the latter must be considerably flattened, so that the ends of the shaft may be slipped into the slots through the cylinder. The cylinder may be safely flattened if it has been thoroughly shellacked.

Now connect the leads of the "doughnut" to the contacts of the switch, taking care that the corresponding numbers are connected together. The lead of the "doughnut" marked O is connected to the binding post at K, and the switch handle is connected to the binding post at L.

The slider and one end of the tuning coil may be connected to the binding posts at M and N respectively.

Now slip the two side pieces, C-C, on the ends of the shaft, and then, after slipping the discs into the ends of the cylinder, the strips C-C may be screwed to the square ends in such a manner that the "doughnut" now inside the tuning coil, will be found to turn freely. A handle, J, may now be fitted to one end of the shaft, and the lines marked V and H may be plainly marked upon it. It will be noticed that the line marked V points in the direction of the plane passing through a diameter of the doughnut, while the line marked H points in the direction of the axis of the doughnut.

METHOD OF OPERATION

To select a station with an ordinary wave length, that is to say, from 450 to 800 meters, place the sliding contact at about the centre of the coil, and then move the switch, F, until the signals may be faintly heard. The slider may then be further adjusted, and to bring the signals up to their full intensity of sound, the handle, J, should be turned until the proper degree of coupling is secured. The handle should only be turned through an arc of 90°, that is, starting with the line marked V in a vertical position, slowly turn the handle in the direction of the arrow P (see drawing) until the line marked H is in a vertical position. The variable condenser should then be adjusted until the signals are at their loudest.

Silver Plating without a Battery

Dissolve eight silver quarters (money) or silver of equivalent amount in two ounces of nitric acid (strong), and to this add four ounces of common salt dissolved in as little water as possible. A heavy precipitate is silver chloride. Decant the liquid, add more salt solution to see if all the silver has been taken out. Wash the silver chloride precipitate with water and then dissolve it in a solution composed of two ounces potassium cyanide and three ounces sodium hyposulphite in 6 ounces of water. Filter the solution, if necessary, and make up to two quarts with pure rain water. Hang the articles to be plated in the solution suspended by a strip of lead or immerse the articles and boil them for ten to twenty minutes, according to the thickness of the plating desired. The articles to be plated must be free from grease, fat and dirt. By this method we get a durable and handsome silver plating on watch chains, rings, medals, watches, ornaments and german silver articles.

THE CABINET SCRAPER—HOW TO USE AND SHARPEN IT

"PHARAOH"

The cabinet scraper is a tool that is today a necessity in the hands of the hardwood worker, for no matter how carefully he may have set and sharpened his planes, it is absolutely necessary for high-class work, and especially so when that work is to be finished by the process known as French polishing, that the minute marks and ridges which are left by the plane be eliminated. The scraper, in one form or another, was used long before the inventions of sand and glass-paper, and today it is used before the final operation of glass-papering, and it is invaluable for cleaning up cross-grained hardwood and figured veneer.

Scrapers vary in size, shape and thickness, but the one in ordinary use is generally about 4½ in. long by 2¼ in. wide, and may vary in thickness from 1-16 to 3-32 of an inch. It is advisable not to buy too thin a scraper, as it is apt to spring to the inequalities of the surface, and in unskilful hands irregularities will thus be made in the surface of the woodwork, owing to the elasticity of the blade.

The cutting edge of a scraper depends upon the quality and temper of the steel from which it is made, and the dexterity with which it is sharpened and tuned.

Very few workmen thoroughly grasp the principle on which the scraper acts, and many find it the most difficult of tools to successfully bring to a cutting edge, in fact some experience quite a sporting element in the sharpening of this tool. The steel should be fairly hard, and should not file too easily, and it is of the utmost importance that the sides of the scraper should be free from any imperfection, and it should be polished up to a nice clean and smooth surface, as any indentation or roughness in the polishing of the sides will spoil the edge when turned, and thus an imperfect edge will be given.

The scraper, when correctly sharpened and tuned, is essentially a cutting tool, and should take off a shaving of uniform thickness.

To sharpen a scraper, first take a fine file and run it along the edge of the scraper, Fig. 1. The filing is best accomplished by putting the scraper in the vice and using the file lengthwise, and the ends of the scraper should be slightly eased off, as Fig. 2, to prevent the corners digging in. Then take the scraper and proceed to rub down the edge which has been filed on an oilstone, in a perfectly upright position (that is, at an angle of 90° to the oilstone), Fig. 3, until all trace of the file marks has been removed and the edge is clean and smooth. Then lay it flat upon its side on the oilstone and proceed in a similar manner to rub up the sides until clean, bright and polished, and care must be taken to have no turned or wire edge upon it; it should be dead square in section, Fig. 4 (which is, of course, enlarged), and should be keen edged on both sides through the entire length. The scraper is now ready to be tuned or burnished, which process slightly turns the edge over, this being accomplished by the use of a piece of steel of hard temper and round in shape. Scraper sharpeners can be bought at any tool merchant's, but a siutable piece of hard polished steel about 6 in. long and 5-16 in. diameter, one end of which is inserted into a large bradawl handle, answers admirably. To tune the scraper it is held in the left hand end-ways up, and near the edge of the bench, and it is burnished by passing the scraper sharpener about four times over the edge, of course repeating the operation on both sides, Fig. 5. The action is to slightly turn over the edge and produce a small burr with a perfectly even bend, the entire length of the scraper, see enlarged section, Fig. 6A. Do not use too much pressure when tuning, or the burr will be curled over too much, and care should be taken not to hold the sharpener at too acute an angle: about 80 to 85° between the scraper and the sharpener will give the best results. Defective sharpening is often caused by too great a pressure, and by giving too much slant when using the burnisher; the latter necessitates the scraper being held at too flat an angle when working, and it will be most uncomfortable to handle.

In re-sharpening, the majority simply re-burnish each side and the edges, but this is theoretically incorrect, for if

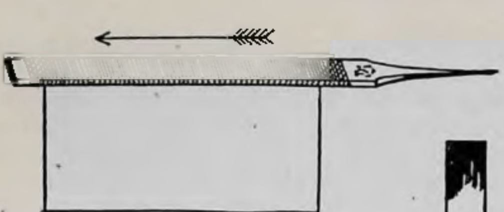


FIG. 1.—FILING THE SCRAPER.

FIG. 4. SECTION AFTER RUBBING DOWN.

FIG. 6.—EFFECTS OF BURNISHING.

FIG. 8.—EDGE OF MACHINE SCRAPER.

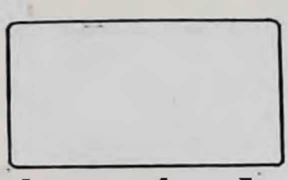


FIG. 2.—SCRAPER WITH CORNERS EASED OFF.

FIG. 7.—EDGE OF CHAIR MAKER'S SCRAPER.

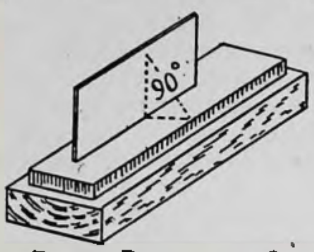


FIG. 3.—RUBBING DOWN ON THE OILSTONE.

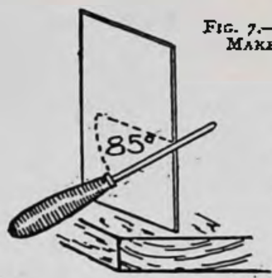


FIG. 5.—TURNING THE EDGES.

FIG. 9.—USING THE SCRAPER.

the scraper is properly sharpened in the first instance the burr will be pressed outwards, as B, Fig. 6, or closed upon the sides as C. A poor edge cannot be satisfactorily remedied by burnishing a second time, for the reasons stated above, and it is best to rub it down again on the oilstone and re-burnish to obtain a correct and satisfactory cutting edge.

Scrapers are made to various shapes for scraping coves, piano falls, etc., and may be obtained similar in shape to a French curve used for drawing.

Many chair-makers simply sharpen their scrapers on one side only, and slightly bevel the back away by grinding, as Fig. 7, and a somewhat similar method is used for the blades of the majority of power scraping machines, both of the English and American makes, and a section of one of these blades is given in Fig. 8. A slight bevel is produced upon the face side by grinding, the blade is then ground away at 40° at the back, and is burnished by a specially constructed machine. Many power scraping machines are now used in the large factories, and are often preferred to sand-papering machines, owing to their large output, clean work, and general economy. In Fig. 9 we give a sketch of the method of using the hand scraper.

—*The Woodworker.*

Does It Pay To Pick Up a Nail?

To settle a discussion, *Technical World* has figured out whether it does not pay to pick up a nail. It is claimed that one keg out of five is never used, but goes to waste. Assuming that it takes a carpenter ten seconds to pick up a nail, and that his time is worth 30 cents an hour, the recovery of the nail he has dropped would cost .083 cents. The money value of an individual six-penny nail is .0077, that is, it would not pay to pick up 10 nails if it took 10 seconds of time worth 30 cents an hour. Ordinary men who are not very quick can, however, pick up a nail on a moderately clean floor in five seconds. Assuming that this is a better average than the 10 seconds, and that we are paying the carpenter only 25 cents an hour, it will still cost to recover the nail .0347 cents, which is nearly five times the value of an individual nail. There is, therefore, a considerable factor of safety in the original calculation, and we are bound to believe that it will not pay to pick up nails.

BRASS FOUNDING

M. COLE.

Brass is cast in moulds of sand held in boxes called flasks. The lower half of the box is filled with sand, and the pattern pressed into it until only half projects, more or less according to the shape of the pattern. The surface is smoothed from the edge of the pattern or parting line to the edge of the flask, and the upper part put on. Parting sand is sprinkled over that part of the sand not occupied by the pattern, and the upper part filled with sand and rammed down hard. A board having been laid on the top, the upper half is lifted off and the patterns removed. A hole or gate for pouring the metal and some vents for the escape of gas or steam are made in the top of flask, and channels to lead the metal to the various parts of the mould are cut in the surface of the sand in the lower half of the flask. The moulds are then put in a stove or other hot place to dry and warm. When the parts of the mould are again placed together, the melted metal is poured through the gate, and, when sufficiently set, a smart tap on the gate piece breaks it off, leaving the castings more freedom to contract. In oddside moulding to save time a plaster cast is used, having hollows in it, such as would be made by the patterns when pressed into the sand to exactly the right depth. The patterns are placed in these hollows, and the moulding proceeded with. Plate moulding is a still further saving of time, as by this method the patterns, instead of being loose and having to be bedded down each time, are replaced by a plaster or other plate, having on each side projections taking the form of a half pattern and provided with channels and gate pieces. They are used in machine moulding where the work is done automatically. In fine work the face of the mould is covered with lamp black or charcoal powder, a torch burning pitch or other means being used to deposit a thin layer of soot on the surface, which is pressed smooth by inserting the patterns and closing the flask.

The sand is a special sort selected for its property of clinging well together when slightly damp, so as to retain the shape of the pattern after its removal; it is also porous, allowing much of the gas to escape. After being used, the heat of the metal having burned the sand in contact with it, the layer nearest the casting can only be used for filling, not again put in contact with the pattern, but only a thin layer of new sand need be used.

Parting sand is a fine dry sand required to dust over the surface of the sand between the pattern and the edge of the flask, to prevent the two lots of sand in the parts of the flask from adhering and so breaking the surface when the upper one is lifted off. Bricks broken up to a fine powder, or any fine dry sand or charcoal powder may be used.

Facing sand must be new and sprinkled over the face of the pattern through a sieve of say 20 wires to the inch, or fine powdered charcoal, or pea-flour may be used for the first layer, following with new sand, using a dredger or bag of open canvas to dust it on with, the sand forming a layer one inch thick.

Flasks are boxes of iron or wood in which the lid is as deep as the body, and the top and bottom loose boards, or really two frames of wood or metal of equal size, and provided with some means of bringing their edges exactly even all round. Usually this is done by projecting lugs, those on one frame having taper pins that enter into holes in the lugs of the other frame. An easier way is to screw strips of wood on all four sides of one frame, so that they project over the frame, or by bolts or dowels. In any case the frames must be provided with means to ensure accurate refitting to the same position they occupied to each other when the sand was being rammed down on the pattern. For small brass work, a good size is 12 in. by 12 in., 4 in. deep each frame. These can be made of dry wood 1¼ in. thick, and well cramped at the corners. It is worth while to give these a couple of coats of good paint to prevent the damp from the sand soaking into the wood and warpeng it. A few ribs of thin wood should be tacked on the sides lengthwise to hold the sand more firmly when lifting off, or a coat of clay water will serve the same purpose. The pattern is usually of wood, but when a lot of castings are required a metal one should be made. Patterns are expensive, and moulders do not have to pay for them, so that with a fragile pattern it is advisable to have only one casting made, and trim this up for use as a pattern. The requirements of a good pattern are (from a moulder's point of view), *a* that it has enough taper to allow its being lifted out of the sand without disturbing the impression; *b* that it is quite smooth; *c* so proportioned that metal flows well to all parts, and in cooling it shrinks evenly. There are some shapes that cannot be cast to come whole after cooling, on account of some portions remaining fluid after other parts are set. If the pattern to be cast from is rough, it should have a coat of shellac varnish.

MOULDING

Place a half flask on a board a little larger than itself, for lifting by after filling. Fill with old sand and press well down, level off the top, and put the pattern in its place on the sand, pressing down till it has entered the sand far enough, viz:— so that both parts of the pattern will leave the sand in their respective halves of the flask without breaking the edge of the mould. This is very important, and a good deal of skill is required to do it properly. For example, in moulding a ball: if more than half is under the sand, it will break the edge in pulling out, while if less than half is in the one side of the flask, more than half must be in the other side and do the same damage there. For this reason a ball is a difficult thing to mould, and the pattern is either made in halves or has a line on it as a guide. Steam engine cylinder patterns are usually in halves, and other patterns where exactness is important. All properly made patterns are tapered both sides, except those that have one face only and are flat at the back, these are moulded in one side of the flask, the back level with the parting line, and are very easy to work with, being laid on their backs on the level surface of the bottom flask.

Under cut patterns are made in two or more pieces fastened together with wires so that after sinking them in the flask, by removing the wires the pattern can be withdrawn in pieces.

PARTING LINE

The pattern having been bedded down as required in the first half of the flask, the sand must now be smoothed down with a smoother or small trowel from the edge of the flask to the parting line of the pattern, or such line as will enable both parts of the mould to leave the pattern. This is usually a straight line, but not invariably. In patterns of an irregular shape it must be trimmed to flowing curves from the parting line of the pattern to the edge of flask, gradually diminishing till it forms a straight line or flat surface. A little parting sand is now sprinkled through a sieve on the sand and the other half of flask put in position, the uncovered half of the pattern projecting into it. Some new sand is sprinkled through the sieve to form a layer say one inch thick on the pattern and plenty of old sand added and well rammed down with a piece of wood, adding more as required, but carefully avoiding those places where the pattern comes near the surface, ramming most where there is no pattern until level with the top of the flask. A board is now put on the top of the flask, and the whole affair turned upside down, so that the bottom of the flask is now at the top. This half is carefully lifted off with the sand it contains, if necessary loosening it round the edge of the flask; the sand will fall out of it and what remains on the pattern is brushed off with a soft brush (small hand brush). A little more parting sand having been sprinkled over the sand between the pattern and edge of flask, replace the half flask and proceed to fill as before, ram the sand and level off. A board is now put on top of the half flask and it is lifted off and reversed.

GATE FOR POURING

This must be arranged for before filling the second part of the flask. Place a piece of brass tube 1¼in. wide or a taper plug of wood, so that the bottom rests on the sand at the parting line, in an unoccupied corner of the flask, and when the sand has been rammed down, remove the plug leaving a hole through which the metal is to be poured. It leaves a sharp edge on the sand which must be rounded with the finger, or some of the sand will be carried down with the metal. The top of the flask is now lifted off, and laid on its side, as there is then less risk of the sand falling out by its own weight.

REMOVING THE PATTERNS

These must be lifted out very carefully. If there is plenty of taper, and they are quite smooth, this is easy enough, but usually they require a little rapping to loosen them. If so it is well to wet the sand a little just round the edge where it touches the pattern, using a rag dipped in water and allowing it to flow down one corner of the rag while drawing it along the joint. Rapping always causes the mould to enlarge and consequently the casting to be a little larger than the pattern. In metal patterns a hole is drilled and plugged with soft wood, so that a pointed tool can be inserted for lifting with. Heavy patterns are lifted by screw rings (as used for picture frames) screwed into them.

Runners and vents must now be made. Runners are channels cut in the sand, leading the metal from the gate to various parts of the mould, and it is important that they are large enough, especially when the castings are small. Where possible the metal should be led not only into the mould but out of it at the other side, so as to get a flow through the details of the mould and thoroughly heat it before the metal that is to form the casting reaches it. It is good practice to put a hole similar to the gate at the other corner of the flask to form an air gate, the metal driving the air before it and rising till it fills, this will insure equal pressure of metal in all parts of the mould. Vents to allow the escape of steam and gas (produced by the heat of the metal and the moisture of the sand) are made by piercing the sand in the upper flask at the highest parts of each detail of the mould with a wire. A fine knitting needle does well for this, as it is smooth and pierces better than a rough wire would do.

FETTLING THE MOULD

There is usually a little disturbance of the sand in removing the pattern, this must be dressed over with tools called smoothers of various shapes, as small trowels, balls, corners, etc. Very good ones can be made from bits of brass sheet and tube.

Dry the mould by any suitable means, either in an oven or near the fire. This is with the double object of expelling moisture that would produce steam, and to prevent chilling the metal. When done and quite warm, place the two parts of the flask together very carefully to get accurate register, as the accuracy of the casting depends on this, and place on the floor with a heavy weight on it to minimize the risk of accidental disturbance.

Smoking the mould is often done for good work where the natural surface of the casting is preserved, but for such as are to be turned or otherwise worked up to a smooth face, this may be omitted. The mould, before the flask is closed, is smoked by burning pitch, resin, or any other material that gives off a dense black smoke, to form a layer of soot on the surface. The patterns are replaced and the flask closed, so that the pressure of the pattern gives the smoked surface a smooth skin. If the pattern has been blackleaded and well polished, it will further improve the face. A rag dipped in kerosene oil makes a good smoke torch, or lamp-black may be dusted on the mould through a fine sieve.

Pour the metal from the crucible into the gate until the mould is full and the metal rises in the air gate to the top of the flask. If too little metal is used it will not have pressure enough to penetrate the details of the mould. For this reason some flasks are made to pour at the side, so getting a better pressure. When the metal in the gate is set, it must be broken by pressing with an iron rod to allow the casting greater freedom to contract.

HALF PATTERNS

For special work the pattern is sometimes made in two or more pieces fastened together with wires, so that they can be removed from the sand in parts after the wires are withdrawn.

This enables patterns to be moulded that are so shaped that they could not be otherwise drawn.

HOLLOW CASTINGS, CORES, AND CORE BOXES

When a hollow casting is required, it is necessary to place a core in the mould of such shape that the metal flows round it instead of filling the mould, so that the contents of the mould are partly a metal and partly a heat resisting substance that occupies the hollow in the metal, which is broken up and removed when the casting is cold. To hold the core in position in the mould, some special pieces are put on the pattern called prints. In moulding the pattern these prints leave hollows, usually two, one at each end of the pattern, and the core resting in these the metal flows round it instead of filling the entire mould. For plain holes, round or square, the cores can be made by hand from a mixture of sand and clay-water, with a little flour or pea meal to bind it together. This is mixed up to a stiff paste and rolled or otherwise worked to shape, when dry it can be smoothed with a file if required. For more accurate holes, use brass tubes to fill and press out the core. For cores of irregular shape, where accuracy is required, core boxes are used.

CORE BOX

This is usually a wood mould of two or more parts in which the composition forming the core is rammed. When opened the core is removed and dried: it requires very careful handling while moist. If very thin, it may be strengthened by using some wire or thin nails to form part of the core. Some holes should be made with fine wire to help the moisture escape while drying. The core is of course longer than the cavity it has to form, the extra length resting in the hollows of the mould formed by the prints. To save the expense of wood core boxes, they are sometimes made of plaster of Paris, which with care does well for the purpose, but is more likely to be broken (see plaster moulds). For a single casting it is seldom worth while to make a core box, as the core can always be carved or moulded.

SELECTING THE METAL

There are many qualities of brass varying from the finest bronze of 90 per cent. copper, 10 per cent. of tin, with sometimes a little zinc to increase hardness as in bronze coinage, down to the stuff used by builders for house fittings, locks, etc., mainly of zinc, often even lead added, and copper enough to color the mass a little, it being further darkened by lacquering: still it is brass. In a small foundry old stuff is largely used, and the previous use of the article is a good guide as to quality. Steam fittings and water taps are always high standard, also any pieces that have a good deal of turning or screwing about them. Small gas fittings are very low and locks usually worst of all. In small stuff, as filings and turnings of brass, a few bits of iron usually get mixed in; to remove these a magnet must be used. It need not be a very powerful one, but should never be put away without a bit of iron across the end. Caution.—In melting scrap be careful there is no moisture in any of the pieces, or the furnace may be blown up. A little water makes a lot of steam.

The metal should be broken up small enough to fall to the bottom of the pot. If too large some of it will jam across and be suspended long after the bottom lot is melted, and the bottom lot burned before the top lot melts. Scrap having large surface such as wire should be hammered solid before putting into the pot. Tin should be added after the copper is melted.

Crucibles in which the metal is melted are now made of a mixture of clay and plumbago, and with careful handling can be used 10 or 12 times. They are made in many sizes so that there is a saving in using the smallest size that will hold the required quantity of metal, and it is quicker heated than a larger one. The crucible is lifted with special tongs and held by them while pouring the metal. A new crucible should be placed mouth down in the furnace and made red hot, then be slowly cooled before it is used for metal.

MELTING THE METAL

Make a good fire in the furnace and

allow to burn clear and free from smoke, add a good layer of coke, and, when this is well started, put the crucible charged with metal on the fire covered with a piece of an old crucible or slab of fireclay to prevent coke getting into it, bank round with coke and close the furnace. The metal should be ready for pouring in half-an-hour. On removing stir well with a piece of wood and remove dross from the surface as far as possible. Lift with the tongs and pour into the mould. An assistant with a metal rod should be handy to remove any dross there may be and prevent it going into the mould with the metal.

MELTING NEW METAL

Place the copper in the crucible first with a little lump borax for flux, when melted add the tin and zinc, and remove as soon as the lot is melted. If left too long the zinc and tin will be burned out. If the crucible is uncovered in the fire, the sulphur fumes from the coal and coke will spoil the metal. For small jobs, the melting can be done in a blacksmith's forge fire or even in an ordinary kitchen fire place, if a sheet iron draw plate is used to cover the open part and get a good draft. Nasmith says in his autobiography that when a school boy he made brass castings in his bedroom, but that was in Edinburgh where chimneys are tall and have a good draft.

MAKING A SMALL FURNACE

The following is an easy and cheap way of making a small furnace for melting brass, etc. Make a cylinder by rolling up some wire netting, say 1 in. or 1¼ in. mesh, about 13 feet of 24 in. wide will do: this will form a cylinder 15 in. wide of 3 layers. Tie with wire at several places so as to get it compact and well shaped. Provide three U-shaped pieces of iron rod 1¼ in. by ¼ in., each, to be 32 in. long before bending, and bent so that the sides are 4 in. apart, to form the legs of the furnace. These must be tied with wire inside the wire cylinder, so that they project 6 in. beyond the edge. See that they are level, so that the furnace will be upright when completed. For the fire bars cut up a length of 1 in. square or round iron to make 6 lengths graduated so that when pushed through the netting they will project 1 in. outside the wire. They should be ¾ in. apart, and about 1 in. above the bottom of the netting and well wired on to it. The spaces each side between the bars and the wire must have some ¼ in. iron rod inserted running across like the fire bars, but slanting upwards, so as to hold the clay to be moulded each side of the bars. All the bottom except the bars being closed airtight. Fire clay (which is sold in a dry powder) is worked up with water to a stiff dough and rolled out to say 1¼ in. thick rolls of convenient length. These are now placed on the inside of the wire cylinder, commencing at the bottom and working upwards until it is all lined with the clay. Each layer must be well pressed down and worked, so that it penetrates the wire and forms a layer not less than ½ in. thick outside, and a total thickness of 2 in., also covering the bottom except the space occupied by the fire bars, this part should slope upwards. The clay can be smoothed with a bit of wood kept wet, adding more clay where required to get an even surface. The top of the stove must now be made. This can be of sheet iron with a turned over edge of say 1½ in. and should fit fairly well, but can be luted on with clay. It is provided with a piece of pipe say 3 in. long and 4 in. diameter for a length of stove pipe to fit on to form the flue, also an opening near the outer edge say 8 in. square for feeding the fire and inserting the crucible. A lid must be provided to cover this hole. It is a great improvement and saving of fuel if some rod iron is worked across near the top in the same way that the fire bars were inserted. Some clay is worked on to this, and it reflects the heat downwards that would otheriwse be wasted in making the iron top red hot. To burn the clay make a good clear fire in the furnace and feed with coke, putting on the top and using a 6 ft. length of stove piping to get draft. Cast iron rain water pipe answers well, though sheet iron stove pipe is lighter and less liable to be broken.

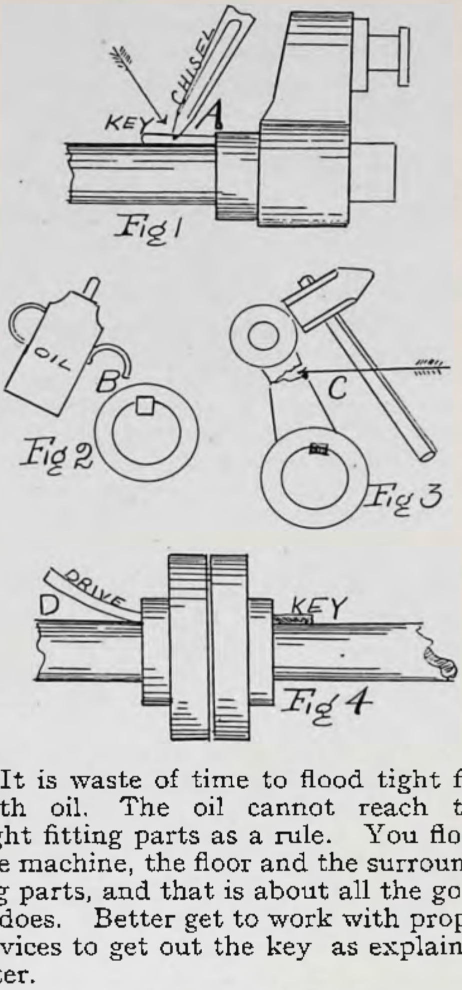
(To be continued.)

REMOVING KEYS FROM ELECTRICAL MACHINE PARTS

GEORGE RICE

Some men go to work in a very queer way to remove refractory keys from connecting parts in electrical machinery. The other day I saw a man working with a hammer and cold chisel on a key after the fashion exhibited in Fig. 1. The key was a square one, feathered to place in the usual way, and apparently all right. The workman had occasion to remove the crank, and in order to do so, had to get the key free so that the hub could be slipped off from the end of the shaft. Instead of procuring a spline and driving the key from the inner side, he went to work with the destructive cutting edge of the chisel as at A. In a very little while, he had the edge of the tool sunk well into the key and the key was still fast. Finally the head of the key was chopped off. Then he proceeded to pry and cut further inward on the key. Still the key remained. Finally the proper driving spline was procured and the key driven out by inserting the end on the opposite side and driving through. A foreman of the shop happened along in season to give the directions. Otherwise the workman would, no doubt, have cracked the hub of the crank in his attempt to get the key out. In another shop, I observed a party deluging the collar of a keyed shaft on an electrical device with oil from a can spout, as at B Fig. 2. The floor and parts of the machine were well covered with the grease.

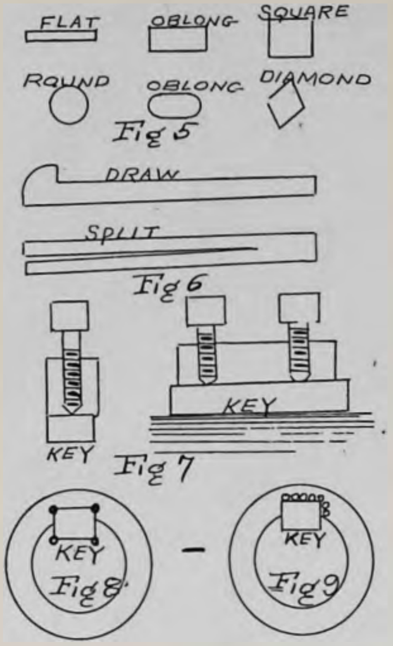
Occasionally the party would stop and bang at the key and the collar with some tools. Several times, it looked to me as if the man had lost his temper and was putting out his spite on the stubborn key and collar. But he persisted in what he was doing. It is not safe to interfere with some men when they are excited over some job that does not go right. Ultimately, the man broke the collar, as I supposed he would. He remarked that it did not matter, as they had extra collars. But his extra collars failed to fit. The foreman of the shop used some hard words. The machinery was delayed quite an interval until a new collar was turned.



It is waste of time to flood tight fits with oil. The oil cannot reach the tight fitting parts as a rule. You flood the machine, the floor and the surrounding parts, and that is about all the good it does. Better get to work with proper devices to get out the key as explained later.

At another time, I witnessed a so-called electrical machinist plying a hammer good and sound direct on a crank. I was astonished. I soon saw that he was trying to get the key free. He plied the hammer in his efforts to shake something loose, hoping that the key might move out. Instead, the arm broke off, as at C. Then there was trouble, as no extra arm was available. The electrical machine remained idle a week, until a new arm arrived from the manufacturers.

It is all right to use the driving spline, as at D, Fig. 4, on a key when you want to get off a coupling or kindred part. Unless the key is driven too hard, or is rusted to position, the liability is that you will get the key freed.



Much depends on the character of the design of the key. Some of the thin, flat keys rust and adhere so securely that it seems almost impossible to get them out. Often the round keys bind very fast.

In Fig. 5, we show some of the various kinds of keys your electrical machinery may be keyed up with. You will have to consider the various constructive details of all in removing keys. Of course the draw key, Fig. 6, is readily handled, providing that it does not bind too much, for the reason that you can get a grip on the head. Headless keys have to be driven, as all know, whereas the key with the head may be pried out by means of the head or driven from the foot, as desired. Then there is the bothersome split key, which men slip in so easily and get out with so much trouble. The split key is furnished with a wedge-shaped key to slide into the slot when the key sets in the key way. Then the wedge key is driven, expanding the split key in the seat. If you can get the wedge key out, you can remove the main key very easily. If not, you are up against a proposition, and may have to do some boring, cutting, swearing and hammering, ere you get the key out.

In Fig. 7, we show the set-screwed keys, depending, as a rule, upon the tips of the set-screws to retain the keys in place. Hence, to turn up the set-screws will usually free the keys so that the keys may be driven out.

Finally, we refer to the manner of getting out keys that insist in sticking, regardless of hammering, use of splines, pouring of oil, gouging and filing. The process is simple and consists merely in drilling a hole in each corner of the key seat, as in Fig. 8. Sometimes the key can be freed when one hole is bored. If not, bore another and keep on, until all four are drilled. Then again, instead of boring at the four corners, the process may involve the drilling of a line of holes at the top of the key as in Fig. 9. This usually liberates the hardest fitting of keys. Of course the holes leave your keyways a little larger. Then finish off the keyways with the square file, and remove the surplus portions. Then get a larger sized key. The larger key will absorb the surplus space made by boring, and you will get a fit as snug as the original.

THE MUIRHEAD-LODGE EXPERIMENTS IN SELECTIVE WIRELESS TELEGRAPHY

A paper by Dr. Alex. Muirhead and Prof. Oliver Lodge on some experiments and measurements in accurate wireless tuning with open-cirucit radiators, and the conditions, under which perfect selection is possible, was read to the Royal Society, and the general interest in this subject is the excuse for going into the paper at some length. The essence of it is that in signalling across land both radiator and receiver must be completely insulated from, and elevated above, the earth, if they are to be persistent oscillators such as are capable of accurate tuning. Earth connection damps out the vibration and spoils tuning; and to get the best effect, the lower capacity area must be not only insulated, but must be elevated above the earth until its capacity with respect to the upper aerial is a minimum. To prove this, the received energy was measured at a distance station by a Duddell hot-wire meter; and several series of measurements were taken with the lower capacity at different heights above the earth, and also when connected with the earth. The sensitiveness of a thoroughly tuned Lodge-Muirhead system is extreme; small power is sufficient, and the inductive connection of the collector to the receiving instrument may be separated by a surprising interval without stopping communication. Under these non-earthed conditions, every other station, even near and powerful ones, can be tuned out and their disturbance eliminated. Directly earth connection is made, tuning of the radiator and collector is nearly gone, for they no longer have any persistent free vibration period. Samples of a large number of measurements are recorded in the paper.

A most striking experiment to illustrate the facility and perfection of tuning on this system, when insulated capacity areas are employed without any earth connection, was made on May 14, 1907.

Each aerial of the Lodge-Muirhead system consists of a pair of capacity areas in the form of a couple of very open "Maltese crosses" or squares of wire suspended horizontally from four posts like the framework of a carpet, one above the other, and both well insulated from the earth. Connection with each is made in the middle by a special elaborately stranded cable to the instruments, but no earth connection is made at all. A wheel coherer—revolving steel disc dipping into oiled mercury—is employed as detector under the conditions of accurate tuning; or sometimes a point coherer, similarly treated with oil. An electrolytic coherer is even more sensitive, but its leakage damps vibrations out and prevents the accumulation of impulses necessary for accurate tuning, whereas the film of oil on the wheel coherer insulates until the oscillations in the receiving tuned condenser circuit have mounted up sufficiently to break it down and overflow through the detector. That is in brief summary, the way signalling works, and the following account has reference to signalling across Kent between Elmer's End and Downe:

At two stations, Downe and Elmer's End, respectively, the upper capacity area of each aerial was bisected diagonally, the two triangular halves being insulated from each other, and each connected to its own independent receiving or sending arrangement. The lower aerial was not bisected, but was doubled, an additional insulated area being placed a few feet below the ordinary one. By this means, each station was practically doubled, and the two halves at each station made to correspond to a different wave-length. Two senders at Elmer's End were then set to work simultaneously, one to transmit the word "Liverpool" continuously for a long time, the other the word "steamships" continuously in the same way. Two independent receivers at the Downe station—one of them a siphon recorder, and one a telephone, though both might easily have been automatic recorders—each of them inductively connected with one-half of the aerial there, now received simultaneously, one of them a succession of "Liverpools," the other a succession of "steamships," without the slightest confusion or interference or overlapping of any kind. In other words, diplex telegraphy (as distinct from duplex) was found quite easy on this system of tuning, which was specified by one of us in 1897.

Another experiment more recently tried is the following: Two stations were arranged at Downe, 1,200 ft. apart, either of which could speak with great ease to Elmer's End, and was strong enough to speak to a station 30 miles away. One of the Downe stations was then switched on to "receiving," and both Elmer's End and the other station at Downe were set speaking to it. The wave-length of one was 300 metres, of the other 660 metres, so as to compare civil and Admiralty conditions. By the mere motion of a handle, the frequency of the receiving station could be altered at will, so as to correspond either with the neighboring sending station 1,200 ft. off, or with the distant sending station seven miles off—which distance might, however, have been increased immensely without any difficulty. A few trees intervened between the neighboring stations. In these circumstances, when properly adjusted, each station could be heard separately; that is to say, messages could be received first from one tuned-in station and then from the other, without any disturbance from the station tuned-out, although both stations were sending all the time strongly and simultaneously. The ease and large margin, with which selection could be achieved, shows that the two neighboring stations could have been put still nearer, while still retaining the power of complete tuning-out.

Further experiments in the same direction were conducted as follows:

The two stations at Downe, 400 yds. apart, were re-arranged so that there were no trees between, only a few low hedges, thus making the test manifestly more severe. A given power was then employed for sending at one of these neighboring stations and the same power at the distant Elmer's End station, while the other neighboring station was arranged for receiving from either of these two at pleasure. Experiment was now directed to determine the conditions under which the neighboring station could be completely cut out while still the distant one could be clearly heard. In other words, to determine the amount or separation between the primary and secondary of the inductive connection which would eliminate all disturbance from the neighboring station adjusted to ordinary commercial wave-length, while it would permit perfect signals to be received on the siphon recorder from the distant tuned station of longer or more nearly naval wave-length.

Case 1—Elmer's End sending with a wave-length of 580 metres. Neighboring Downe sending with a wave-length of 300 metres. The receiving Downe station was attuned so as to cover a range of wave-length about 580 metres on the average, but extending more than 20 metres above and below. Under these conditions, it was possible completely to cut out the local station on a coupling of 3½ in., that is, with 3½ in. separating primary and secondary coil of the inductive connection; whereas from Elmer's End perfect signals could be obtained without disturbance on any coupling between 3½ in. and 7 in. Indeed, as the exact pitch was reached at the receiving adjustment, the signals received boomed out, as it were, very strongly.

Case 2—The Elmer's End wave-length was shortened to 510 metres, the local Downe station remaining at 300 metres, and again a series of readings was taken at the receiving Downe station adjusted to an average of 510 metres wave-length.

The coupling separation, which now just managed to cut out the local station, was 4 in. Anything above 4 in. gave perfect signals from Elmer's End, and no disturbance.

Case 3—On shortening the distant wave-length still more, so as to make it 450 metres, the neighboring station could not be completely cut out without at the same time introducing a trace of superposed disturbance into the messages received from the distant station.

Case 4—The difference of wave-length between the two stations was now, therefore, again slightly increased, the Elmer's End wave-length being adjusted to 480 metres, with the local station still remaining at 300.

In this case, perfect and strong signals could be received from Elmer's End again, but the separation of the inductive connection had to be as much as 6 in., in order completely to cut out the local signals from the neighboring station. It follows, therefore, that when two powerful stations are so excessively near each other as they were in this case—namely, in adjoining fields—a distant signal can be heard with perfect clearness, *i.e.*, without any trace of disturbance, only when its wave-length is more than half as great again as that of the neighboring station; but that undisturbed signalling is much more easy when it approaches double that magnitude, or, of course, when the neighboring stations are not quite so close together. In no case was any trace of harmonic detected; *e.g.*, when a station was sending 300 metres, and the neighboring receiving station was attuned to 600 metres, it did not necessarily feel any disturbance. The waves emitted and received by these radiators appear to be practically pure.

The North Pole and the aeroplane will make 1909 a memorable year. They are two great feats of human determination.

HOW TO MAKE AN EXPANDING BOOK CASE

In these days of cheap literature, books are constantly accumulating, so that the old style of book case, in which the accommodation is fixed and unalterable, becomes out of date. What is wanted is such a case as is always complete in itself, and which presents a finished appearance, and yet can always be added to; that is, until it fills the space which is available for the purpose. Such an ideal book case we show in front and end elevations respectively, in Figs. 1 and 2. It is formed in sections, the top of each separate section forming the bottom of the next, the base and cornice being parts by themselves.

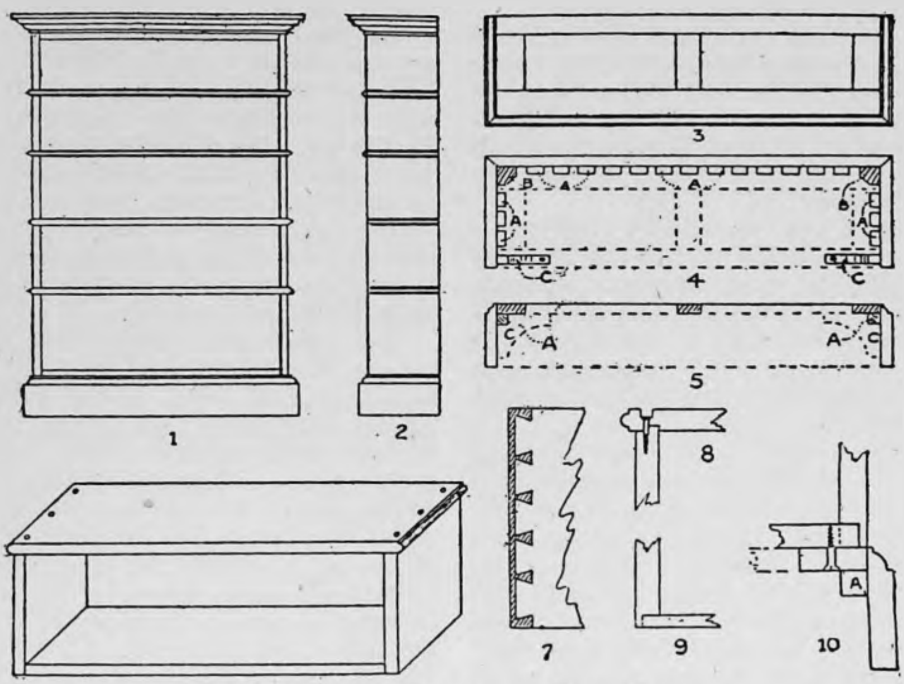
A bookcase, such as we are describing, should be made substantially, and we recommend that it be made entirely of one inch wood (to hold an eighth of an inch less when finished), especially if made in one of the softer kinds of woods; if hard wood is used it may be slightly less in substance, but it is better to err on the side of too much than too little.

To commence the construction, we start on the base, which consists of the front and two ends, mitred together at the corners, and moulded at the top edge. This is all that appears in the finished bookcase, but these pieces are fixed to a framing, tenoned together as in Fig. 3, this framing forming the foundation for the bookcase proper to rest on.

The first-mentioned parts of the base may be nailed to the framing, or if the case is to be in hard wood, and it is preferred not to have nails showing, it is easy to insert screws from the inside, through the front and end of the frame, into the other parts.

In addition to the nails or screws for fixing, a series of angle blocks must be glued round under the framing, and in each corner of the base, as at A and B, respectively, in Figs. 4 and 5, while the two brackets C stiffen the ends at the back. These latter will require fixing with screws, but all the angle blocks can be fixed with glue only, by applying it plentifully to the two sides, and rubbing the block to and fro sharply in the angle; this expels the surplus glue, and makes the block form perfect contact with framing and base.

The bottom compartment next claims attention, this differing from all succeeding ones in having both bottom and top



ELEVATION AND DETAILS OF BOOK CASE.

as shown in Fig. 6, which is a sketch of the complete compartment.

The bottom of this should be dovetailed into the sides, using what are technically called "lap" dovetails, which simply means that the end grain will show on the under side only, the ends of the compartment lapping over the bottom, so as to cover the end grain where in ordinary dovetailing it would show.

Fig. 7, which shows one end of the compartment on the underside, will illustrate our meaning. Should this, however, be too difficult for anyone to undertake, the bottom may be lapped into the sides, and fixed with screws, dispensing with the dovetails.

The top of the compartment is fixed on by a different method entirely, being trenched to take half the thickness of the ends, the trenches being stopped back from the front edge, so that no suspicion of them will be seen after the parts are fixed together.

The ends are shouldered, leaving a portion on the inside to fit in the trenches and cutting the same away at the front, to coincide with the stopped portion of the latter. The fixing of the top to the sides is done with three screws at each end, as shown in Fig. 6 and sectionally in Fig. 8.

It will be noticed in the latter drawing that the head of the screw is sunk into the wood to the extent of nearly half the thickness of the latter. This is done with a purpose, these holes forming the means of attaching future parts to the bookcase as the necessity arises. Thus it will readily be understood that they must in all cases be exactly the same distance from the ends and front, and equal distances in relation to each other.

Before the compartment is fixed together finally, the sides, top and bottom must be rebated to take the back as Fig. 9, the rebate in the top being stopped so that it does not run past the sides, or it will show outside.

The moulding on the end of the top may be of any pattern preferred, the astragal as shown being as good and as easy to write as any, while, if preferred, the front edge may overhang to the same extent, and have the same moulding worked on it, as shown in the two upper sections in Figs. 1 and 2. The bottom compartment finished should be fixed to the base by screwing top into it through the framing of the latter, as in Fig. 10.

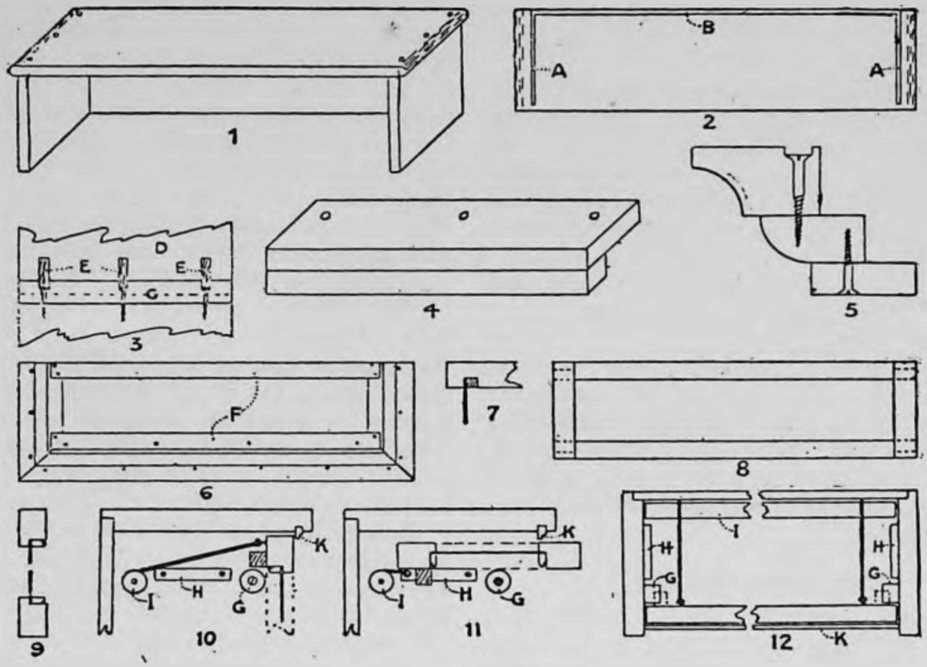
We have mentioned no height or depth for this lower compartment, this being a matter to decide according to requirements, but this being where the largest books will be stored, the size should be regulated to suit, that is, in regards the height especially; the depth should be ample; the deeper it is the firmer the bookcase will stand, an important item, when we know that it is likely to grow as high as the room will allow. Thus we should not make the sides less than eleven inches wide, which will give the base a width of twelve inches.

We have now to make the remaining compartments to carry the bookcase as high as needed at present. This if carried out to the elevation given, will be four more. However, as they will be all alike (unless variations are made in the height) it will serve all purposes if we describe the making of one only, and this one we now show in Fig. 1, from which it can be seen that it consists of the two ends, back and top only.

The top is attached to the ends by means of a trench and tongues, as before described, fixed firmly with three screws, the heads of which must be sunk well below the surface for the reasons already given. All this is straightforward so far, but in case anyone should not be quite clear as to the stopped trenches, etc., we give in Fig. 2 a plan of the under side of the top, showing the trenches A and the rebate to take the back, B, this latter being stopped at the trenches. We also show an alternative moulding on the ends of the top, in case the astragal given before should prove too difficult for some of our readers to work.

In Fig. 3 we give a sectional detail of the fitting of one compartment on the other. C is the top, fixed to the end by the screw, the dotted line showing the trench, while D is the end of the compartment above, in which are inserted the three dowels, E, fitting closely in the holes above the screw heads.

Now it is evident that if the bookcase is to fit together properly and easily, the dowels and screw holes must all be exact, and to attain this by measurements is difficult; but by making a template, as Fig. 4, it is very easy to get all alike.



COMPARTMENT AND DETAILS OF BOOKCASE.

To mark the holes in the tops, the template is used as shown, while for the dowel holes in the bottom of the ends, another strip, as shown by dotted lines is fixed in, this strip having a width equal to the overhanging portion of the top.

We can now consider the compartments as finished, and will get on with the cornice, which is best built up in sections as shown in Fig. 5. Each of the three members shown must be mitred at the angles, and screwed to the one below it as shown in the plan (Fig. 6), the bottom member being strengthened by screwing on the two stretchers, F, before the other members are fixed. The bottom member should be made of such a length and width as to overhang the upper compartment about half-an-inch, and we should mention that the top of this should not be moulded, but finished level with the ends, and this must always be the top, no matter how much the bookcase is extended.

The cornice is fixed by screwing through the top of the compartment into it, it being better to do this than to merely lay on, and be held in position by dowels, as is sometimes done.

Should it be the wish of the maker to have embossed leather strips under each shelf, the tops should be grooved before fixing together, the leather can then be inserted in the groove, and held tightly by a strip of wood, as in Fig. 7.

Should doors be required, they must be made of such a size as to fit closely sideways, but with a quarter inch to spare in height. An elevation and section of one door is shown in Figs. 8 and 9 respectively, and as no trouble is likely to ensue in the making, we can consider this as done, and proceed to show how they are fixed.

A small roller, pivoted on screws, is fixed at each side of the opening, some 1½ in. from the front, and the thickness of the door down from the top. A thin strip is also screwed on at each end, on a level with the top of the rollers. G and H (Fig. 10), show the rollers and strip respectively.

At the back of the case is fixed a spring roller (the kind used for roller blinds will do) and two strings are connected to the door and the roller in such a way that when the door is lifted to a horizontal position, the roller winds up the strings and pulls it back, as shown in Fig. 11.

A strip screwed to the top of the door on the inside (or two blocks will do) prevents the door dropping out when it is pulled forward for closing, these blocks being placed so that they will catch on the roller G but miss the strip H. See dotted lines in Fig. 12.

Two small dowels should be fitted in the bottom of each door, holes being made below for them to rest in and hold the bottom in place, and at the top it is best to have the small moulding, K, this looking better and also stopping the opening between door and top.

It will be noticed that if it is intended to fit doors as here described, each compartment must be at least 1½ in. higher than the books it has to contain, so that really each door means considerable waste of room. At the same time they make the case practically dust proof, thus it is a great improvement, while a case with doors looks much better than one without.

Who Owns the Air ?

It surely does not need the vision of a seer to prophesy that, in no far-distant future, air ships or dirigible balloons will become familiar means of travel. That perfection or even real practicability has been attained in methods of air navigation is by no means claimed. But the problem is "up" and judging by the ever increasing efforts of men of all nations to solve it, it will not "down" until its successful solution has been reached.

In the wake of air navigation follows a series of most interesting questions: By whom may "rights of way" to traverse the atmosphere be granted? Has a balloon operator the privilege of landing anywhere? May he scud along over a man's property at but a short distance above the ground, leaving in his wake possible injury to trees, buildings, etc., to say nothing of the ill smell from the motor?

At this date, calls for definite legislation on the subject are being heard. A writer in the *Hamburger Nachrichten* says:

"The navigator of the air ship has so far been allowed at his own sweet will to sail hither and thither in any direction. There is evidently need of some legal regulations in this matter, especially as to the height above the earth at which he may be free, perhaps, also, as to the direction in which he may shape his course. For the rights of the landed proprietor must be guaranteed, and his property protected from damage. According to the law now in force the property rights of the landholder are limited to the surface of the ground which he possesses. While he must have interests in the atmosphere up to a certain limited height, it is difficult to say how high those rights extend. It is easy to see that the property-holder is exposed to damage, even when the air ship sails above that limited height. The proprietor or occupier of property ought therefore to have some protection against damage or danger from dirigible flying-machines. It is an abominable nuisance, for instance, when an air ship or dirigible propelled by an ill-smelling motor circles over a man's garden or house at a slight altitude from the earth."

Along the same line, even more serious questions might arise. May an enemy, in time of war, photograph a fortress from the air? May explosives be dropped from some war balloon into the very heart of the hostile camp? Where may ships from the air land? Not far from the writer's home, a runaway balloon did considerable damage, to say nothing of causing general alarm among the inhabitants of the community, by descending into tree tops and spilling out several hundredweight of rocks that had been attached to it to help hold it in anchorage. To quote again:

"There should be the strictest regulations enforced with regard to the alighting or landing of an air ship. Hitherto, descending air ships, when they landed on the ground, have been received as if their occupants were shipwrecked mariners, although their descent may have been accompanied with serious damage to the place. Sometimes they crush in the roof of a house or tear up a whole farm, as did the lost French balloon Patrie. As a dirigible is supposed to be under control, this fact makes more reasonable the demand that definite landing-places should be appointed. It should no longer be permitted the navigator of the air to land in a pleasure-garden or park. He who lands in a place not designated by law should be held liable for the damage done. Perhaps the proper landing place for foreign balloons would be the custom-house of the various towns or villages."—*Gas Review.*

INTERIOR ELECTRIC LIGHT WIRING—Part II

GEORGE J. KIRCHGASSER, E.E.

FUSES

Fuses are devices intended to (by being destroyed themselves) prevent damage to wires of an electric circuit or apparatus connected thereto, due to the flowing of a greater current than that for which the circuit or apparatus was designed. Three types of fuses are in common use: the open link, the enclosed or cartridge, and the Edison plug types. The first type is shown in Fig. 11, the link portion being lead alloy, and the tips a harder metal, copper sometimes so that a good terminal connection can be made. The lead alloy would be injured and would not make a strong bearing surface. This kind of fuse is used mainly on switchboards in engine rooms, where the floor is of concrete, and no damage can result from the melting of the fuse wire. Here, too, there is someone who knows about the use of fuses. The enclosed cartridge type is shown in Fig. 12, and has what is called the knife blade contacts. For interior wiring where the voltage is usually 110 or 220, the knife blades are left off and the contact made by the ferrules fitting into spring clip terminals, as shown in Fig. 13, where the amperes do not exceed 60. Above that, and up to 600 amperes the knife blade form of contact must be used, as a more secure contact is assured. These fuses are used on all feeders where the current exceeds 30 amperes, and often on branch circuits of lighting systems. No cabinet is necessary, because no melted fuse wire escapes from the enclosing cartridge.

Cartridge fuses, as shown in Fig. 14, are used to fit into Edison plug casings, the cartridge being inside of a brass tube, which is itself enclosed by a porcelain exterior shell. The ferrule of one end of the fuse at the bottom makes one contact of the plug, while in the upper end a spring clip attached to the brass shell receives the upper ferrule contact. This type can be used for voltages up to 250 volts, and where the amperes do not exceed 60. The cartridge can be renewed and replaced by unscrewing porcelain portion.

Probably the commonest of all types of fuses are the Edison plug fuses, an illustration of which is seen in Fig. 15. These are used for branch circuits and for feeders where the amperage does not exceed 30, and voltage, 125. The cap has an isinglass window, through which the fuse wire can be seen. Cut-out or fuse blocks are shown on Plate 1. The casing receiving the plug is of copper or brass and the body of porcelain. The current is lead to the cut-out block terminals, through the fuses and to the branch circuit.

When service to a building comes from a central station (Public Service Electric Co.), we should find at the entrance, main fuses and a main switch, as shown on Plate I. The main fuses are to protect the entire inside equipment and should be of such size as to blow or fuse before enough current flows to injure the wires from the entrance to the branch fuses. Beyond this point, the circuits are protected by the smaller fuses placed in the branches. In the illustration shown, there are three branch circuits which should not carry more than 660 watts each, and if this were on a 110 volt system ($660/110 = 6$), 6 ampere Edison plug fuses would be found in the branch cut-out blocks. If the voltage is below 125, 6 ampere fuses are used. An increase over 660 watts per circuit is sometimes allowed, and 10 ampere fuses are put in the branch circuits. Figuring the three circuits to take 3 x 6 amperes or 18, we would use either No. 12 or No. 10 slow-burning or slow-burning weatherproof wire, as the distance from the entrance to the branches is short, but it is best to use the larger, as on adding another circuit or changing lamp sizes, the capacity would still be sufficient. Main fuses of 20 amperes and a 25-ampere main switch would be ample. The size of the fuses for branch circuit feeders and mains is very important, and they should never exceed the carrying capacity of the wires, as given in tables, page 10. A fuse corresponds, in a sense, to the safety valve of a boiler. If a boiler is known to be able to stand a certain number of pounds pressure, the safety valve is set at a considerably lower figure, so that the valve will blow and release the pressure if it reaches a predetermined value and save the boiler any strain, and prevent the possibility of an explosion. The fact that we sometimes hear of boiler explosions does not throw any reflections on the safety device, but rather on the man in charge of the boilers. He may have wilfully or ignorantly weighted it down so it could stand more pressure than the boiler. If electric circuits are over-fused, we have the same result; the fuses will stand more current than the wires which they are supposed to protect, and the wires will get hot and leave the fuses intact. Proper capacity fuses will open the circuit and the trouble can be located before any damage has been done. It is always best to place all fuses in cabinets and in a position within reach of the floor, because if they are way out of reach they will be hard to locate in case of repairs, and to save the necessity of clambering up on a ladder or boxes the temptation is strong to put large fuses in all the circuits to make sure that no fuses will be blown. Also, if the premises are in the least dusty, the fuses and cabinets will get in a dirty condition unnoticed. The main switch should also be placed within easy reach, be of sufficient capacity, and, in dusty places, must be placed in a cabinet, as the dust settles on the knife blades. It should be arranged to keep all knife switches and fuses, if possible, out of rooms, where there is much dust or explosive or combustible vapors or gases, for an arc forms on opening a knife switch while carrying current. Otherwise well made dust-tight cabinets, wood, lined with asbestos board, slate, or marble ¼ in. thick or lined with sheet metal or made entirely of metal for conduits systems, should be used.

In open style wiring in factories or mills, use is sometimes made of fused rosettes so that apparently there seems to be more than 660 watts on a branch. One type of rosette is shown in Fig. 19. They are made of porcelain, and are used to suspend pendant lamps (see Plate I), and to connect them to the circuit wires. There are special kinds for open wiring, for moulding, knob and tube wiring, and for conduit; most all that are used in ordinary wiring being fuseless. The National Electric Code allows linked fused rosettes to be used on circuits if the voltage is not over 125, and enclosed fused rosettes on circuits not over 250, if the fuse in the rosette does not exceed 3 amperes and when used on circuits protected by not larger than 25 amperes. With a fused rosette, a short circuit or ground in lamp cord or socket would blow the fuse in the rosette and not disturb the rest of the circuit. For instance, in a mill having, say, 40 pendant lamps on each floor on a 108 volt system, we could run a pair of No. 10 or No. 12 slow-burning wire, preferably the former because it is heavier, and suspend each lamp from a fused rosette and put 25-ampere fuses in the feeders. The flexible cord, if the lamps are just pendants, can be of the ordinary kind, but if they are long and to be used as portables or hung over nails, etc., the heavier reinforced cord only should be used. It has an extra rubber insulation and a strong outer braid. With this cord sockets having their outlets threaded for ⅜ in. pipe should be used, and a socket bushing having an inside diameter of 13/32 in. For ordinary flexible cord the socket threaded for ⅛ in. pipe with the insulating bushing, as shown in Fig. 18, having a hole of 9/32 in. diameter. After the cord is secured under the binding screws in the socket and also in the rosette, a knot which has been placed in the cord takes the strain from the binding screws.

The making of joints and splices is of such importance that a few remarks seem necessary. Wiring should be so arranged and laid out beforehand, that the splices and joints will be as few in number as possible. Fig. 16 illustrates a splice and Fig. 17, a tap joint, a knob being used to secure the wire so that no strain comes on the joint. On circuit 3, Plate I, a cleat is used to support and secure the wires. After removing the insulation, the wire should be scraped with a knife, and enough winds made to give a big contact surface between the wires. A gasoline blow torch is usually used in soldering the joint, care being taken to have the solder well sweated in. This secures the joints so that for all times the contact will be good. If we are making a splice in a No. 14 wire and make just a few loose winds and drop a little solder on top, the contact area will not be equal to the No. 14, and as the current carrying capacity depends on the area, the circuit will tend to heat up at the splice, and, in time, this joint may even loosen up enough to arc. For large feed wires and cables, patented splicing devices are often used. The exposed metal at the tap or splice must be covered after the work is finished; for rubber-covered wires, a rubber tape is first wound about, and then secured in place by ordinary friction or bicycle tire tape. For other insulations, the friction tape is often used alone.

MOULDING WORK

In Part I, October number, the different systems of wiring were named and open knob work and open cleat work were discussed. The next type mentioned was moulding work and this kind of exposed construction wiring will be explained here.

The difference between open, exposed, and concealed wiring is somewhat confusing. We speak of open knob, of exposed or concealed conduit work, and of concealed knob and tube work. In open work the wires are in plain sight, insulated and supported by knobs or cleats. In exposed construction (which really includes the open knob and cleat systems), the wires may be out of sight, but the moulding or conduit in which the wires are run are exposed. Moulding must always be run this way, while conduit may be run on the exterior of the walls or ceiling, or be concealed. In "Concealed Knob and Tube" wiring, the conductors are concealed between the ceilings and floors and walls. This type of construction will receive further attention.

There are two kinds of moulding in use today, wooden and metal. The wooden has been in use for some time, while the latter is of more recent introduction. Moulding wiring can be used where there is no concealed system installed, and where the appearance of

Fig. 18 

Socket Bushing

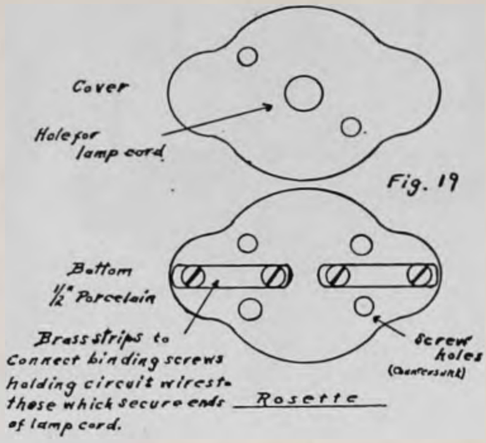


Fig. 19

Rosette

open knob or cleat work would prohibit their use. A good many buildings of years ago were built without having a complete wiring system installed, so that when electricity is wanted for use instead of ripping up floors and walls to put in a concealed system, some open or exposed system is resorted to. In some places, open work fills the bill, in others, moulding does the work; but in residences, the wiring must be concealed for appearance sake.

Wooden moulding is made in two parts, a backing and a capping. Fig. 16a gives an idea of its appearance, the capping, which is on top, holding the wires in place in the grooves. The dimensions shown in Fig. 17a are the minimum allowed by the National Electrical Code. Soft wood is used to a greater extent than hard wood, but the latter is stronger and does not absorb moisture as readily. To help check this absorption, the moulding should be thoroughly

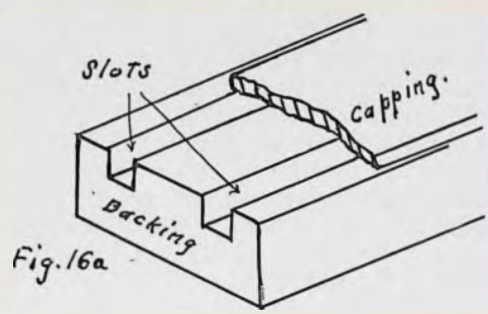
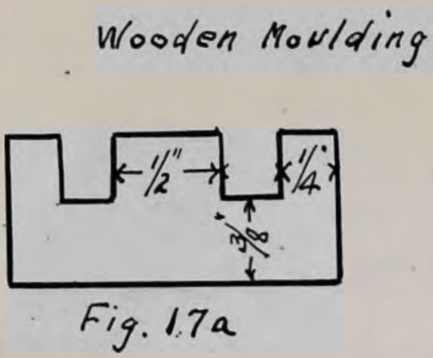


Fig. 16a

Wooden Moulding



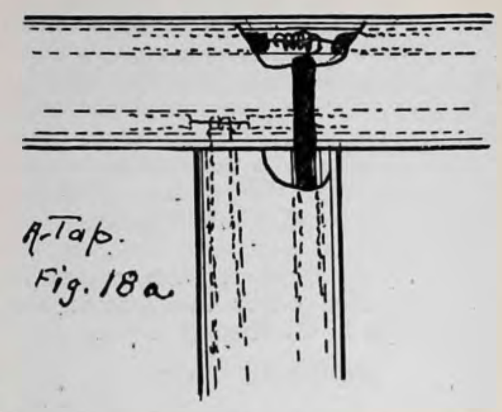
coated with a waterproof material or impregnated with a moisture repellant. Two coats of shellac are often used to paint the moulding. Wooden moulding can be made in different sizes and with more grooves than two, but the ordinary two-wire kind, as shown in the figure is most commonly used in electric lighting work. This is about 1 in. high with the capping on, and 1⅝ in. wide.

Single braid rubber-covered wire is used because a good insulation is necessary, the wires being in direct contact with the wood and only separated by the tongue of the moulding. As we said before, wood absorbs moisture and the capping becomes loose also, so moulding should not be run in cellars, outside of buildings, in windows near panes, or in any damp place. It is advised to put a ½ in. backing of wood where running on a brick wall that is liable to "sweat." Moisture being a conductor also, might cause leakage of current from one wire to the other, or between them and some other conductor (as a gas pipe, for instance), with which the moulding may be in contact.

Because of its construction, moulding should always be run exposed. The capping, when it dries, is easily injured and at its best is not very strong or lasting. It is not suited at all for use on side walls below about 6 ft. above the floor, or where there is much vibration. It is a weak construction.

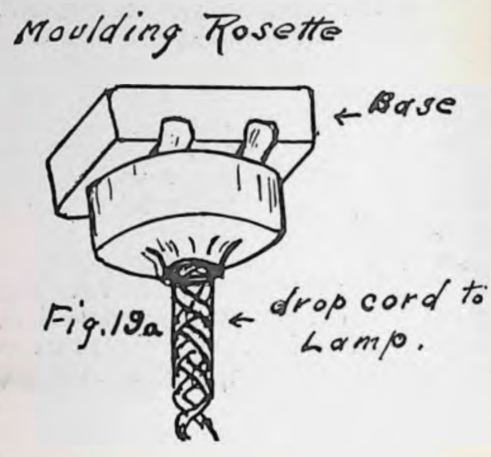
In putting up wooden moulding, the backing is first screwed to the wall or ceiling, as the case may be, then the wires are laid in the grooves and the capping nailed on to the tongue of the backing. This kind of wiring is often tinkered with, joints and splices left unsoldered and untaped, and being easy to install, fosters carelessness.

Fig. 18a shows how one wire is brought over the capping where a tap is made to prevent the crossing of the wires, which would result if they were kept below the capping. The capping must be cut away as shown, and the joints taped with both rubber and friction tape after the soldering has been done. Whenever we find a tap and



do not see part of the wire brought over the capping as in the figure, we can suspect a defective tap. There is, however, a device on the market known as a splice protector, the use of which is not as great as it should be. It is made of porcelain and while safer, also makes a neater job, as it is not necessary to bring one wire over the capping, and the capping need not be cut away.

Fig. 19a shows a porcelain rosette as used for drop lights. The base has grooves in the same position as the moulding, and there is room in the cap for the knot, which is made in the cord for the purpose of taking the strain from the binding screws holding the cord



wire. Other types of rosettes can be used, but this one is well adapted.

METAL MOULDING

As the name implies, this is made of a metal,—steel. Fig. 20 is almost the actual size of a piece of the type made by the National Metal Moulding Company of Pittsburg. By noting the construction of the backing and capping, it will be seen that no nailing is necessary to hold the capping in place. This is snapped over the backing, which is first screwed to the wall or ceiling. The precaution is taken to countersink the holes in the backing, so that the interior is smooth, the heads of the screws coming flush with the metal. This

Fig. 20

moulding is less than ½ in. high as against 1 in. of the wooden, and the width, 1 in. as against 1⅝ in.

To prevent corrosion and rusting, the interior and exterior of the metal must be treated. The Lutz metal

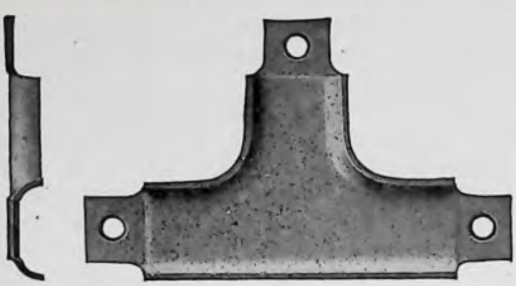


Fig. 21

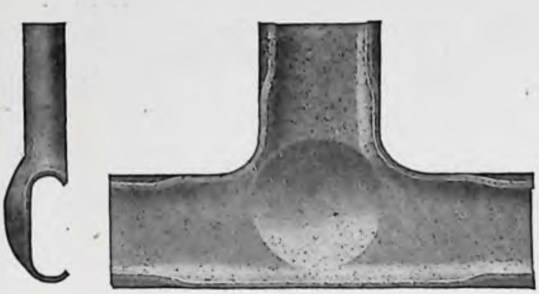


Fig. 22

moulding made by the American Circular Loom Company of Boston is electro-galvanized, and the National

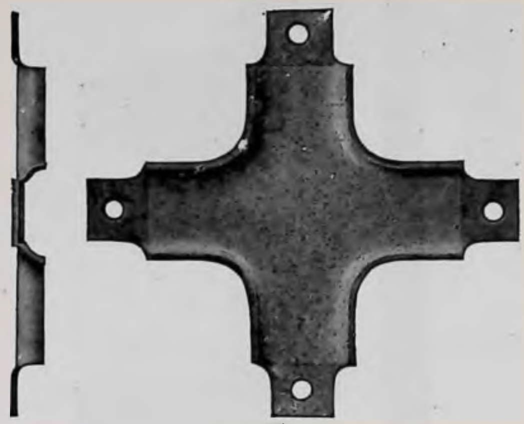


Fig. 23

is "Sherardized." In this latter treatment, the metal is heated in drums to a high temperature in contact with powdered zinc dust. The dust enters the pores of the heated metal and forms an outer surface of zinc-iron alloy,

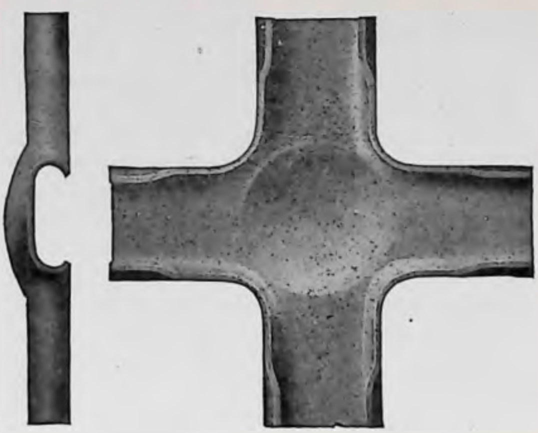


Fig. 24

which is said to be non-corrosive and rustproof. This surface also can be painted and finished to match surrounding woodwork, etc.

Metal moulding being small, furnishes a neat appearing method of exposed wiring construction, the wires being concealed and protected, and not showing at taps. When wiring old buildings for lights, a choice must be made from the following: open knob, cleat, exposed conduit, metal or wooden

Fig. 25

Fig. 26

moulding. Conduit is the best and strongest we know of now, but run exposed on ceilings or walls is not of very good appearance; metal moulding is just the thing for some places and has a good appearance; wooden moulding is of fair appearance, but is not well thought of; open work wiring is adapted for uses described in Part I.

Full lines of fittings have been designed for use with metal moulding to take care of all conditions met with in construction. There are crosses, tees, elbows, fixture brackets, junction boxes, combination switch and outlet boxes, rosettes, base couplings, etc., etc. Figs. 21 and 22 show the base and capping of a tee, Figs. 23 and 24, of a cross, and Figs. 25 and 26, of an elbow. The holes seen in the backing are for the purpose of coupling to the rest of the moulding. In Fig. 27, it is attempted to show some of the uses of these fittings.

Metal moulding being small cannot be used for carrying large feed wires and its use is restricted for use by the code to circuits of not greater than 660 watts capacity. In other words, it is adapted for branch circuits, as 660 watts is the capacity allowed by the code for branch circuits. Twelve ordinary carbon filament lamps of 16 c.p. size, equal 660 watts. Because of danger from mechanical injury, this moulding should not be used on walls near (within 5 or 6 ft.) floors or pass through floors without protection. By placing in a 1 in. iron pipe, sufficient protection will be provided. A better way would be to bring the metal moulding to say 5 ft. from the floor and use rigid conduit from there down. Below the ceiling, the moulding work could be taken up. Plate II in the October issue should be a method of using conduit in a similar case. As regards moisture and general use, the same rules are applied by the National Electrical Code as for wooden moulding. That is, it is not to be used where there is liable to be moisture, or where subject to mechanical injury, and never to be concealed. The maximum voltage of the system on which this construction is used is put at 300 by the code, but this is really no restriction, as on most all lighting systems the voltage is either 110 or 220 approximately.

Double braid rubber-covered twin wires, as seen in Fig. 20, are used almost exclusively for metal moulding work, for, as the two wires are together, they are easier to handle than if two separate wires were used. The two wires being in the one moulding prevent any induction troubles (which will be discussed more fully under "Conduit Wiring"), if alternating current were used on the system. Direct current does not cause inductive disturbances under any condition.

As metal is a conductor of electricity the moulding should be grounded, so that in case of any leakage of current from the wires, due to defective insulation, etc., or from some part of a fitting or joint, a path will be provided to carry the current directly to the earth and blow the branch fuses, incidentally.

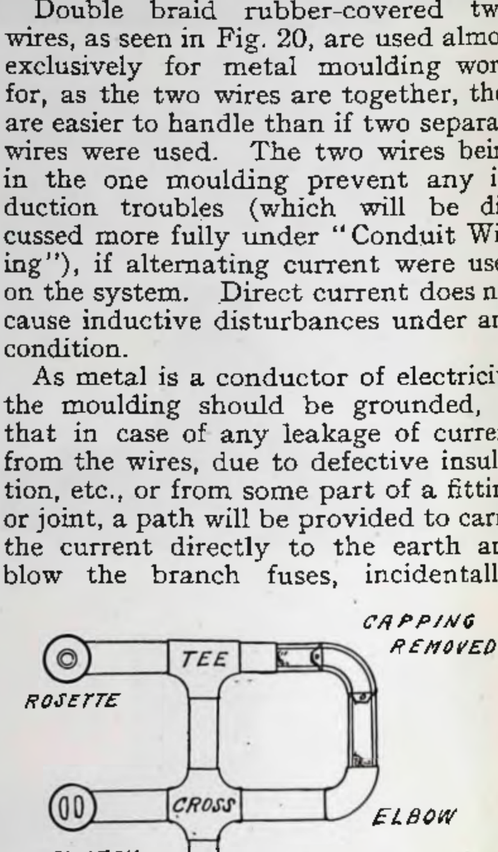


FIG. 27.

First of all, adjacent lengths and fittings of the mouldings (base couplings are used) must be joined firmly to form a good continuous metal circuit as if the whole was one piece. A wire then run to the water main (preferably on the street side of the meter), and fastened by a ground clamp will carry current that the metal moulding might carry at some time to the ground. The current flowing from the wires in the moulding to the moulding, and through the ground wire to the earth must pass through the fuses which protect each branch circuit and these fuses will be melted if much current flows and prevent any damage. The blowing or melting of the fuses will indicate where the trouble is, and by removing the capping the fault can be located by inspection. This subject of grounding will also be referred to in the article on conduit wiring.

Concealed knob and tube wiring will be described and illustrated in the next article. This construction is used to a great extent in house wiring and also in the smaller mercantile buildings.

The excavation of the New York State barge canal is being done on some sections by machines of unusual capacity. Conspicuous among these is a bridge conveyor, sometimes known as the grab machine. It consists essentially of a cantilever bridge, 428 ft. in length and 90 ft. in depth, supported on two traveling towers, and a grab bucket of truly cyclopean dimensions operated from the cantilever. The bucket weighs 17 tons empty, and its jaws, when extended, are 20 ft. apart, and measure 10 ft. in width. The capacity of this huge maw is a dozen cubic yards or from 12 to 15 tons at each bite. The jaws crunch together with an ultimate closing power of 137 tons.

The water produced by the melting of glacier ice in summer flows down through crevasses to the bottom of the glacier and, forming a channel by erosion, emerges often as a large stream. In the Arctic regions these phenomena take place on a very large scale. The Danish expedition to the northeast coast of Greenland, conducted by Mylius and Erichsen, discovered and explored vast caverns thus formed by glacial streams. Some of these caves are 60 or 70 ft. in height and more than a mile long. In winter the streams cease flowing, but the caverns or tunnels remain ready to receive the streams of the following summer.

Sometimes, when you are sorely tried by difficult problems in connection with your work, it is both helpful and refreshing to lay them aside until you have had a good night's rest.

Memorizing Ohm's Law

"E" stands for the pressure
Which we are taught to use,
Divided by "R," for resistance $\frac{E}{R}=C$
Will give us "C," the juice

"C" is "E divided by R," $C=\frac{E}{R}$
With this we don't get very far,
But "E" is "R times C," you see, $E=R\times C$

And "R" is "E divided by C." $R=\frac{E}{C}$

"W," watt is "Current times
Electromotive force," $W=C\times E$
And "seven forty-six" of them
The "Power of a horse." 746=H.P.

—*Telegraph Age.*

The Westinghouse Company has taken a step which ought to receive general commendation and imitation. At the present time, we have quite a number of gauges for wire, sheet iron, etc., known as the B. & R., Birmingham, British, Standard, etc. On account of the confusion arising there from, the Westinghouse Company, in some of their shops, have cut loose from them all and make such measurements in decimals of an inch. If all manufacturing concerns would follow their example, a world of trouble and expense would be avoided.

In the matter of the purchase of an automobile, the questions to be considered are the weight and the horse power. Other things being equal, a motor car should average less than one hundred pounds to the horse power, and it follows that the lighter the weight of the car, when materials are not sacrificed in its construction, the greater will be the economy in fuel and tires.

LOW PRICED CONDUIT WIRING

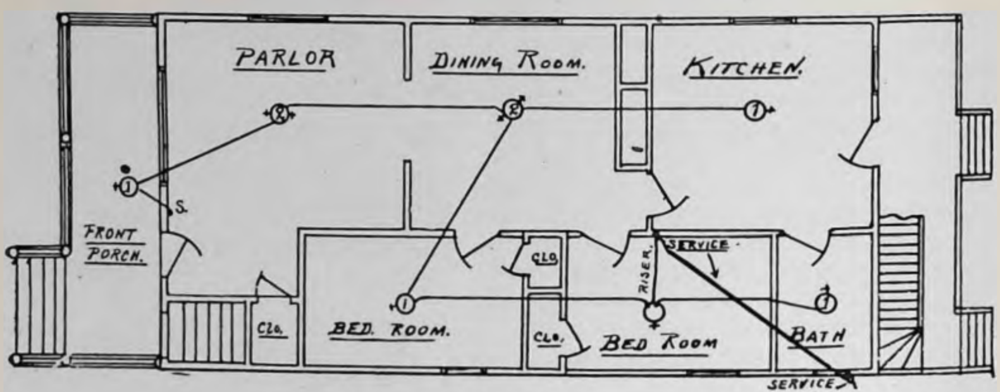
In the city of Chicago, no system of concealed wiring is permitted except conduit, and in the low-priced flat buildings and workmen's cottages, this rule has caused a demand for cheap wiring in duct that has been met by a class of contractors known to the trade as "flatters," who have reduced the wiring of these style of buildings to such a system that prices averaging less than $2.00 per outlet are not infrequent, and $2.20 to $2.60 are about the average.

The work covered by the contract at these prices consists of the complete conduit system with wires pulled in and connected up, all switches and cut-outs in place, ready for the service company to attach their wires outside at the rear wall and place their meters in the basement, and for the fixture company to hang the chandeliers and brackets.

In addition, the contract usually covers the bell wiring and frequently some system of speaking tubes; all of which is included in the average prices mentioned above.

An actual case is here given with list of material, prices, etc. (See accompanying plans).

A frame two-story, two-family building erected for a butcher employed in the stock yards, who intended to live with his family in one flat and rent the other until the building had been paid for, when, if circumstances allowed, it could be remodeled into a two-story residence at very little cost.



—FIRST FLOOR PLAN.—

The basement walls were of concrete supporting a frame house using 2 in. x 6 in. studs for the outside walls and second floor ceiling joists; 2 in. x 10 in. timber for the first floor ceiling joists, and 2 in. x 4 in. studs for the partition and roof rafters. A false floor of sheeting lumber 5 in. x 7/8 in., on top of which was laid 1¼ in. x 1¼ in. strips filled in between with a deadening of cinders. All gas, water and electric pipes of less than 1¼ in. outside diameter were laid on the rough floor before the strips and deadening were put in place.

The lighting consisted of one 2-light chandelier in each parlor, and each dining-room; one 1-light chandelier in each kitchen, bathroom and in each of the four bedrooms; one 1-light chandelier over entrance stairway of second floor; another on the front porch, and one wall socket in the basement. One switch for the stairway light, one for the porch light and one for the light in the basement, making a total of 19 lights, 17 outlets, 2 circuits and 2 meters.

In addition, the specifications called for front and back door bells and electric door opener from the second floor to the entrance door.

The material actually used was as follows:

16 4-in. outlet plates.

3 4-in. square boxes and covers.

1 3-in. round box.

240 ft. of ½-in. "Economy" conduit.

250 ft. of No. 14 duplex wire of Detroit Insulated Wire Co. make.

50 ft. of No. 14 single conductor double braid wire.

350 ft. of No. 18 annunciator wire.

1 Federal socket and cover for 3-in. round box.

3 Diamond H. single pole flush switches and plates.

1 iron cut-out box 10 in. x 14 in. x 3 in.

1 fused extension main switch 15 imp. 3 pole.

1 double end 3-wire to 2-wire cut-out.

1 door opener.

5 push buttons (one wood and four brass).

2 batteries.

30 locknuts for ½-in. conduit.

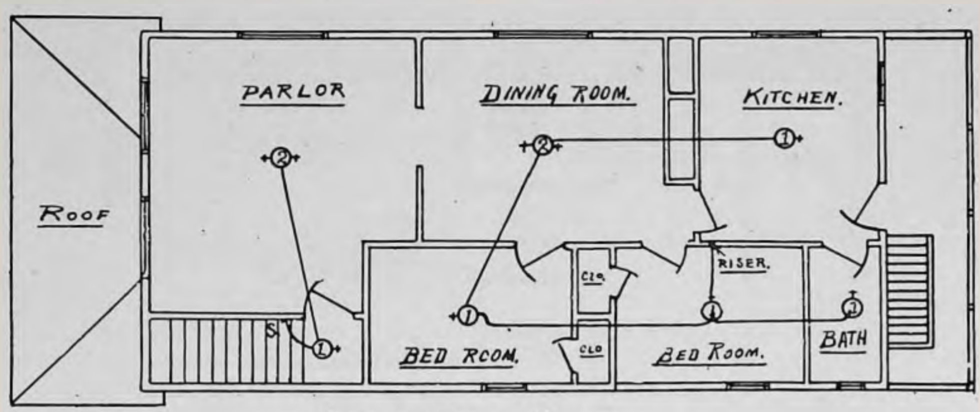
30 Star bushings for ½-in. conduit.

Tape, solder, gasoline and lard oil.

Five bids were opened for this job, one for $43.50, one for $39.00, two for $37.00 each and one for $32.00, which last bid was the one accepted. This bid was at the rate of $1.88¼ per outlet; and the contractor claimed he made a profit on the job, but failed to state the amount. Perhaps the ¼ cent per outlet was all profit.

HOW THE WORK WAS DONE

When the rough floor was laid and the partitions in place and before any floor strips were nailed down, the wagon arrived at 8 o'clock in the morning with the conduit, boxes, outlet plates, pipe tools, bench, step ladder and wireman. The bench was a 10 ft. x 14 in. plank with the vise attached, and it was fastened to the partition studding on the second story. A measurement was taken of the height of drop bend necessary for the ceiling outlets for this floor, and twelve lengths of duct laid on the bench with the couplings toward the vise. Each length in turn was placed in the vise, the coupling forced half way up on the threads and taken off, the end reamed and laid to one side. When all had been so treated, the bundle was reversed on the bench. Each length was now set in the vise with 10 inches projecting through. the die was turned on to the thread, the end reamed, a piece of straight 1-in. pipe 3 ft. long was slipped down about 4 in. on the end and pulled until the short end was at right angles to the remainder, making a bend which measured 8½ in. from the back of the duct to the end. When the twelve drop bends were finished, the ladder was set under the outlet in the parlor, the



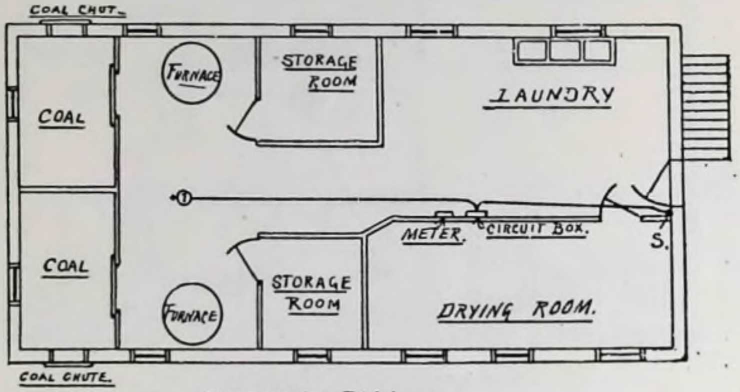
SECOND FLOOR PLAN.

cap taken off the gas pipe, the plate slipped on and the cap replaced; one length conduit was laid on the joist, its bent end fastened into the plate and the plate nailed to the joist with the long end of the duct pointed toward the hall outlet. The same was done with the dining-room outlet, except that two lengths were used, one pointing toward the kitchen and one toward the front bed-room outlets. The ladder was then placed in the kitchen, the plate fastened up and a length of duct set in, but not fastened. Instead, it was marked at the end of its mate from the dining-room, taken down, cut, threaded, a coupling put on, taken back, screwed to its mate, put in its hole in the plate and the bushing screwed on.

The bath-room outlet came next. In this case, the plate was allowed to remain loose, the duct being placed in the hole, the ladder moved to the rear bed-room, the plate put on here, and the duct from the bath-room marked at a point over the hole it would occupy in this plate; it was taken down and placed in the vise with the mark 4 in. outside of the jaws, cut off 10 in. from the jaws, threaded and bent as the other drop bends had been, put up, fastened into the plate in the bath-room, the plate nailed to the joist, a piece of ⅞-in. strip put on top of the joist under the duct, and a nail driven in at each side of the duct.

The riser duct was bent in the same manner, but without cutting, as the end could extend down as far as it would in the partition. Another drop bend was put into the plate in the rear bed-room pointing toward the outlet in

The rough floor was cut at the outlets for the conduits with a bit and a key-hole saw, using the ducts of the upper floor for a guide, and a new measure for drop bends secured; enough lengths of conduit were placed on the bench to make half the bends required, cleaned, reamed and bent as before. The longest of the pieces cut off from the ducts used for the upper floor were also bent at the threaded end to the correct length for drop bends, and the piping of the bottom floor started. Full lengths with the bent end pointed down were placed at various outlets, the short pieces with the drop bends were fitted to them; then the runs between the bath-room and rear bed-room, and those between the front room and hall were fitted as before, except that longer drop bends were necessary.



—BASEMENT PLAN.—

the front bed-room, fastened in with its bushing and the plate on this outlet fastened up as before.

The front bed-room outlet was finished at one set of the ladder, measuring, cutting and fitting one piece for the dining-room, one for the back bed-room, and placing a length for the front hall outlet. The ladder was then moved to the front hall outlet, a piece measured, cut and screwed in place for the bed-room, run in the same manner as the one from the bath-room to the rear bed-room, another cut and screwed to the duct from the parlor, and a switch leg bent in the same manner as the riser bends, a nipple cut to bring the end in the partition to the proper height for the switch box, the box fastened in place and one floor finished at 10:45 a.m.

The service duct was run from outside of the rear wall to the point where the risers descended to the basement and extended down with them; no plates were put on until the conduits were all in place and the bell wires on the second floor were run so that it would not be necessary to carry the ladder down and up again.

The method of wiring for the bells was to start one wire at the back door button on the first floor, run it up past the back door button on the second floor, and loop it out at this button, run it over the ceiling joist to a point over the door-opener button and bell on the top floor, looping it out at the button only. Another wire was run from the kitchen bell on the first floor up past and looped out at kitchen bell and front bell on second floor, down past and looped out at front bell on first floor and on down into the basement, together with the first wire and one from each of the front bells and one from the door opener button, where all were properly tagged.

While this was being done, and before the ladder was taken from the second floor, a wire was run from the second floor rear door to the second floor kitchen bell, and after the ladder was taken below, a corresponding conductor was run for the first floor back door-bell.

The bell wiring was finished by running wires down from the front door buttons and the door opener to the basement, and tagging them.

The outlet plates for the first floor lighting were next put on, the three risers extended the proper length into the basement duct run from door of basement to where the cut-out box was to go, and in to the light in the furnace room on the ceiling, leaving time for the wireman to gather up the tools, bench and left-over material and leave them in a convenient place for the wagon man to pick up before quitting time.

The second day's work consisted of placing the cut-out box, nailing up a board for the meters, pushing in all the wires, connecting up the switches, main switch, cut-out, the socket in the furnace-room, batteries, push-buttons and bells, and poling up the wires at the outlet plates so that the fixture hanger could make no mistake in his connections.—*Electrocraft.*

How to Stick Leather on Metal

In order to fix leather to metal, dilute one part (weight) coarsely crushed gall nuts with eight parts (weight) of distilled water about six hours, and filter through linen. Then pour one part (weight) of cold water over one part (weight) glue, let it stand for 24 hours and heat the whole, whereby a concentrated glue solution is obtained. Now coat the leather with the warm gall nut extract, bring the glue solution on the roughened and warmed metal, lay the leather on it, press it firmly, and allow to dry in the air. The leather will adhere so firmly to the metal that it cannot be separated without tearing it.

Dyed Food for Birds

Dr. Sauermann, an Austrian, has obtained curious results in coloration by feeding birds on food dyed with aniline. Pigeons became of a beautiful red. Other birds turned a fine blue with methyl violet. Canaries very soon bred with the rainbow. The experiments promise to have important results in this direction. The English sparrow by a little art in his nourishment might emulate the humming bird. Whether this would be to his advantage is another question. We are afraid that fashion might cast envious eyes upon him and cause him to regret his sober livery.

Cement for Wood, Metal or Glass

In answer to a correspondent, the *Painters Magazine* gives the following formula for a tough, quick-hardening cement that will not shrink after becoming hard and will unite wood or stone to glass or metal:

"The simplest formula we know of, is to mix monoxide of lead, known as litharge or massicot, preferably the latter, which comes in a yellow powder, with enough glycerine to make a paste of the desired consistency, and use it immediately after mixing. This cement may be colored by adding dry colors in small portions, but these must not be more than 10% of the quantity of the massicot or litharge used or it will prevent quick setting. Gentle heating will make it set in a few minutes, and then it will resist both pressure and heat."

Chicago has 56 miles of tunnels 40 ft. below street grade. They are used for the carrying of freight to and from railway terminals and the business houses within the tunnel district by means of electric locomotives. The tunnels are 6 ft. wide by 7½ ft. high, with laterals running from the main lines into the sub-basements of the buildings. The congested down-town district has been greatly relieved by this tunnel system, which permits not only the easy and economical hauling of merchandise, coal and other supplies to the large business houses, but as well the rapid removal of debris from wrecked buildings and from the site of building excavations.

QUESTIONS AND ANSWERS

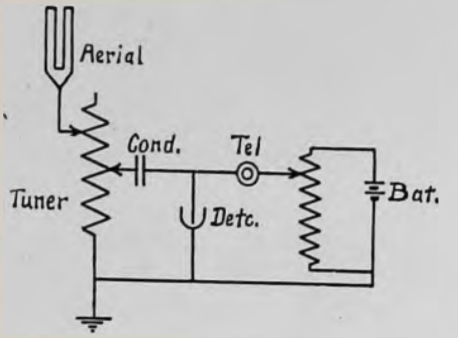
Questions on electrical and mechanical subjects of general interest will be answered, as far as possible, in this department free of charge. The writer must give his name and address, and the answer will be published under his initials and town; but if he so requests, anything which may identify him 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 letter, and only three questions may be sent in 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.

1160. **Spark Coil.** A. K., Philadelphia, Pa., asks: Will you kindly let me know through your paper, how to convert a make and break spark coil into a jump spark, or how to make a vibrator for gasoline engine. I have a small gasoline engine and only have a make and break spark coil, but want to run engine with jump spark ignition, also can a sufficient spark be produced with a small dynamo connected to spark plug and run from fly wheel of engine? "Also" is there any way of winding an ordinary spark plug to produce sufficient spark to run engine without batteries or can a combination spark plug and coil be made to work? Is there any book on giving directions how to build a simple small producer gas plant? Is there any book that treats on the theory and practical uses of the "Gyroscope?" Ans.—You cannot make a gas producer on a small scale.

1161. **Wireless Connections.** C. B. M., Cazenovia, N.Y., asks: What is the most efficient wiring for the following instruments:



electrolytic detector, 2,000 ohm receivers, potentiometers (made by Electro Importing Co.), variable condenser (same Company), and a single slide tuning coil? (2) What would be wiring for the same instruments used with silicon detector? Should I use four wires? Ans.—(1) See diagram given below. This is good for either silicon or electrolytic. The aerial as shown is the one recommended by W. C. Getz.

1162. **Underwriters' Rules.** F. F., Wilmington, Calif., asks: (1) Where can I procure a code of underwriters' rules regarding electric wiring of all descriptions? (2) What will same cost me? Ans.—(1) Boston Board of Fire Underwriters, 55 Kilby St., Boston, Mass. (2) No charge.

1163. **Wireless Connections.** C. A. L., New York, N.Y., asks: For some time I have been using a crystal detector and slide contact tuning coil, but results are so poor that I wish to try and use some other arrangements. Can you help me? I wish to use magnetic detector, oscillation transformer and variable condensers to tune to 2 or 5%, through great interference and static to a distance of about 800 miles or better. My aerial consists of 4 wires of 7-strand copper wire, 200 ft. long (horizontally), and about 75 ft. high, the 75 ft. leads being nearly vertical. Of course, I know how the magnetic detector and transformer is constructed, but want to know the proper windings to obtain the very best results, and what resistance phones to use, as I hear such conflicting statements regarding the magnetic detector. Or would you recommend the so-called "audion?" But if the magnetic detector will answer, I prefer to use that on account of its positive action. Ans.—Regarding the detector, would advise that pericon detector consisting of zincite or copper pyrites is much more sensitive than the magnetic detector and you will find that it will give excellent results in connection with an inductive tuner. A good form for an inductive tuner consists of a primary wound with No. 14 wire on a cylinder 4¼ in. in diameter. In this cylinder, a secondary winding is inserted wound with No. 28 wire on a movable cylinder about 3½ in. in diameter. The length of the respective windings may be altered in accordance with the height of the aerial: that is, if the aerial is a short aerial. The primary, as well as the secondary, may be made longer in order that the stations having a longer wave length may be more easily received, and on the other hand, if the aerial is a high one, the tuning coil need not have such great linear dimensions.

1164. **Magneto Generator.** D. Y., Meridian, Idaho, asks: (1) What the voltage of a 5-bar Stromberg telephone magneto would be if wound with No. 21 wire in place of the present No. 36? (2) How can direct instead of alternating current be obtained from such a machine? (3) How many cycles and phases would be obtained? Ans.—(1) 5 to 10 volts, but of course you have a wide leeway of speed for the armature, and this directly affects the voltage. (2) Use a 2-segment commutator. (3) At 1,800 revolutions, which is a good speed, though 3,000 can be used, the cycles will be 30,—being equal, in a 2-pole machine, to the number of revolutions per second. The current will be of only a single phase. Explicit directions for reconstructing such a magneto will be found in the March, 1907, issue of this magazine.

1165. **Armature Winding-form.** C. T., Kansas City, Mo., asks for directions for making such a device. Ans.—About the simplest construction, and one quite available for many armatures, is given in Fig. 11, in the article on "Armature Winding," in the Nov., 1908, magazine. Other shapes are given at greater length in Hobart's "Armature Construction," a book which we would be pleased to procure for you.

1166. **Problem in Resistances.** J. A. S., Allegheny, Pa., asks: (1) How is problem on page 23 of Sloane's Arithmetic done? As stated, a motor that can take 3 amperes at 30 volts pressure is connected in series with 20 ohms resistance to 110-volt supply; what shunt must be put around the motor to allow the proper conditions? (2) How can the electromotive force of the spark that takes place at the break of an inductive circuit, as that of an electromagnet, be computed? (3) What should be the size and construction of a small transformer for operating toy motors, etc., requiring 5 to 25 volts, on a 110-volt circuit? Ans.—(1) Whereas the answer follows the simple law that the voltage needed varies directly as the resistance of the circuit, and is readily found by the proportion given, an analysis of the problem may make the matter clearer. If the 3 amperes only, that the motor can safely take, flows through the circuit, there will be only 60 volts wasted in the 20 ohms resistance, leaving 50 to be imposed on the motor, whereas only 30 are to be permitted. 20 volts more are to be taken up, hence if 1 ampere more is allowed to flow through the resistance, but not through the motor, there will then be the full 80 volts used, leaving the 30 for the motor. If 30 volts are required for driving 3 amperes through the motor, the equivalent resistance of this circuit is 10 ohms. Currents divide inversely proportional to the resistances of the respective circuits, and if three parts of the current are to be passed in one, and one part in the other, making four parts in all, the shunt circuit must have 30 ohms resistance, and plainly, a circuit to pass 1 ampere, when 30 volts act, must have 30 ohms resistance. If you put 10 ohms and 30 ohms in parallel with each other, their combined resistance is 7.5 ohms. The total resistance of the circuit will then be 27.5 ohms, through which 110 volts can send just 4 amperes. (2) Since the time during which the spark exists cannot be determined, the computation of the e.m.f. you ask for cannot be made. (3) If you can procure two "kicking coils," such as are used in alternating current multiple arc lamps, and connect them in series on the 110-volt circuit, you can derive about all the intermediate voltages you desire by connecting to suitable taps that protrude from the various coils.

1167. **Composite Wound Dynamo.** A. B. C., Douglas, Mass., asks for a diagram or description of a "composite" field winding for a dynamo. (2) For a diagram for transforming a single phase alternating current into three phases, and also into two phases. Ans.—(1) If you will refer to Fig. 57 in the Aug., 1907, magazine, you will see the appearance of an alternating current dynamo with such a field winding. The scheme is for an alternator "compound" winding is to a direct current generator. The field spools consist of two independent and well insulated windings. One of these may be of smaller wire than the other, and is supplied with direct current from the small machine belted to the nearer end of alternator. Sufficient excitation is obtained from this source to give the full voltage from main machine when at no load. The armature winding of the alternator connects to the commutator that is represented between the exciter pulley and the bearing,—commutator having just as many segments as there are poles,—and the brushes belonging to this adjunct connect with the other coils on the field spools. The article referred to will explain the method of interior connections, and the results sought to be obtained. (2 and 3) A single phase current cannot be transformed into any other number of phases.

1168. **Motor Alteration.** J. E. L., Salt Lake City, Utah, asks, if directions have been given in the Electrician and Mechanic for converting a direct current motor into one suitable for use with alternating currents? Ans.—No, for except in case the field magnet is laminated and series winding is used, it is not possible, and even then it may not be practicable.

1169. **Platinum.** H. W. W., Redlands, Cal., asks if this metal is best for make-and-break contacts, and where can it be obtained. Ans.—Yes, from Baker and Co., Newark, N.J., and almost any electrical instrument making concern, or dealer in chemical supplies.

1170. **Motor Alteration.** E. L. R., Cortland, N.Y., asks how he can change an old alternating current motor of the "repulsion" type into a generator for direct currents, maximum possible output being desirable. Ans.—From your sketch, we judge that all the mechanical requirements can be readily met, but there will be difficulty in making the field magnet self-exciting. Laminated construction is essential for alternating current use, but for your direct current generator, there would be no opportunity for retaining any residual magnetism. You would always have to excite the field separately, say from a battery, or at least have double windings on the field, one occupying about one-quarter of the space and fed from the battery, the other, taking the rest of the space, and connected in shunt to the armature. You can avoid this necessity by clamping the laminations between two cast iron end plates, of the same shape as the sheet iron, and ¼ in. thick. They could taper down to a knife edge at the ends of poles. Field winding would be of the consequent-pole order, the narrow spaces between the polar spaces being wound with wire, after the manner of a Gramme ring armature, and the four coils connected in reverse directions, or the poles could be fitted with curved coils, slipped on in the ordinary multipolar manner. This latter would be the better. Put on all the No. 23 wire possible. For armature, you will need the series winding to match the needs of the 23 segment. Some directions for winding such will be found in the Nov., 1908, magazine. Use No. 20 wire. Brushes in two places on the commutator, one-quarter of the circumference apart, will suffice.

1171. **Toy Motor.** C. C. H., Washington, Kan., asks: (1) How to make such a one, with make-and-break contact, for running on small battery power? (2) Should the vibrator spring of a wireless sending set be stiff? Ans.—(1) Of course you must realize that such toys, being so small in size, and using only one pole of the electromagnet, are very weak, and may not be able to run on a very weak current. If you had an ordinary double coil and double armature on a sizable iron shaft, the improvement would be very marked. For the three prong armature shown, you need a commutator with three segments. You can make a good one from a piece of brass tube, marking six lines lengthwise, dividing the stock into six segments. Make saw cuts on these lines, but extending only for about half the length of the tube. Remove three pieces between the cuts, and mount the desired piece on a wooden hub. Attach one wire from spool or binding post to a brush that will run on the completely cylindrical portion, the other brush touching the interrupted portion. If the spaces are a little wider than the segments, and the brushes do not press too hard, the armature will surely turn. Some adjustment of position to the commutator will be necessary, and it may be that a balance wheel will be advantageous. (2) It should be slender and short, so as to make the vibrations easily produced, and at a high rate.

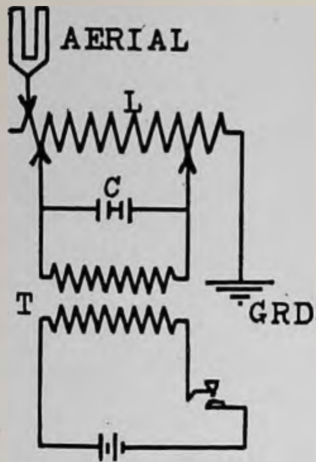
1172. **Polarized Bell.** F. N. B., South Newberry, Vt., asks upon what principle such a bell for telephone work is constructed. Ans.—The significance of the word "polarized" is that the device has poles, namely, magnetic poles, and those of a permanent sort. Therefore the bell contains a permanent magnet. In this respect, it differs from an ordinary battery bell, for that possesses an electromagnet. The polarized bell is fitted with two spools, and in that respect it resembles the other sort. There is, however, no make-and-break piece; the vibrating armature, to which the hammer is attached, lies in such a position that one end is magnetized by the presence of one end of the permanent magnet, and the other end lies between the soft iron cores that are attached to the other end of the magnet. Now when alternating currents are sent from the magneto generator into the coils, these soft iron poles are continually strengthened or weakened, or actually reversed in polarity, whereby the light armature is alternately attracted and repelled. The qualifications of this sort of bell are that it is adapted for very small currents, has no contacts where sparking and corrosion may take place, and that it does not require a direct current.

1173. **Fan Motors.** W. M., Parsons, Kan., writes that he has a General Electric fan motor, for 110-volt 60-cycle circuit, that was in a fire. He asks if he sent to the factory for new wire, and wound new coils, would the machine run? Can a 50-volt 10-pole fan motor be rewound so as to be used on a 110-volt 60-cycle circuit? Ans.—It is not necessary to send so far, and the company would not be likely to care for such a small order. You can procure the wire from any electrical supply house in your vicinity. Merely send a sample of the size desired. Probably the revolving member of the motor is uninjured. Wind all four coils alike, put them in place in symmetrical manner, connect two outer ends of two adjacent spools together, then inner ends in the next adjacent place; then the inner ends in the space opposite, then, finally, lead two outer ends to binding posts. The second change proposed cannot be done. You would have to wind the 10 poles so as to give but 4 poles, and you can see that the arrangement will not fit.

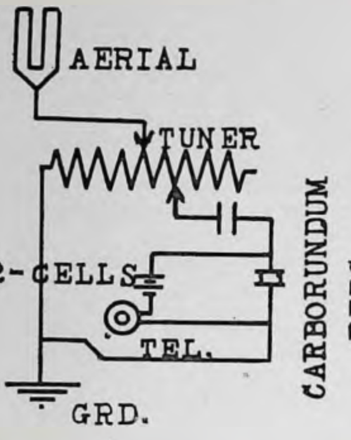
1174. **Windmill Power Station.** M. K., New London, Ill., is thinking of building a windmill power station, the scheme being to let two weights be lifted, alternately, and, when running down, to drive a dynamo. The weights will be allowed to go into deep holes in the ground, thereby saving the expense of building a tower. With the adjunct of storage batteries, will the idea be practical? Ans.—We think there is likely to be great use made of wind for power, in coming years. Your proposition to use a duplex sort of weights is new and good, but of course the involved gearing will waste some power. Will not the holes you propose soon become wells, into which the weights will not so readily sink? In winter, a filling with snow would interfere with the operation. Storage batteries will be necessary, but the accessory apparatus is considerable, and often bothersome.

1175. **Armature.** C. V. M., Springfield, Ohio, asks what size of wire should be used on a core 1¼ in. long and 1¾ in. in diameter, having 11 slots 5/10 in. in size? Power is to come from batteries. What size for field magnet? Ans.—No. 23 will do for armature, No. 20 for field. As you give no idea of construction or dimensions of latter member we can give no reliable directions.

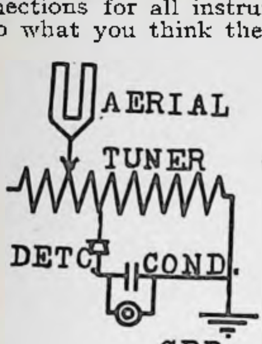
1176. **Wireless Telegraphy.** W.G.B.R. Co., Waupaca, Wis., asks: We have a wireless outfit which is giving us considerable trouble, no doubt due to lack of knowledge on my part, but I am unable to get it going right and wish to consult your question department. The following is a description of the outfit, etc.: Aerials 65 ft. high, 50 ft. long, 4 bare No. 14 copper wires, with lead of bare wire direct to instruments, only touching one insulator, running through hole in window-glass; stations 10 miles apart, street railway, phone, incandescent and arc light wires run



by our office, causing considerable induction. Instruments on hand, 2-in. coil, spark balls, 10 cells dry battery, 6 leyden cell condenser on sending side; receiving side consists of carborundum and liquid detectors, double slide tuning coil, and 3 cells dry battery, and 1,000 ohm receiver. I am able to send one, but



only at times, and my spark seems to split and die out, although my cells test out good and strong. I am also at a loss how to connect up my tuner as it has a double slide. Will you kindly give me by return mail at your earliest convenience a small plan showing proper connections for all instruments, and advise as to what you think the trouble is,



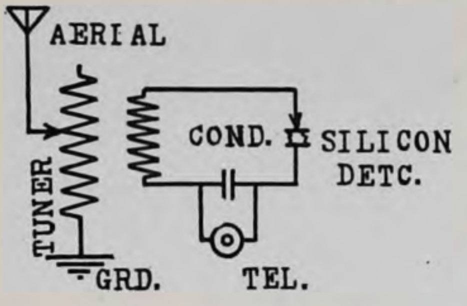
also any suggestions you can make that would aid me. Ans.—Use only two of the Leyden jars and connect as shown in Fig. 1, at "c." Then vary the connections on the inductance "L" until the other station advises you of the adjustment at which your transmission is strongest. Dry batteries are not a good source of power, but they should work satisfactory for a while. On the receiving side use the sketch shown in Fig. 2, which should give you good results. However if you use a silicon detector, the sketch given in Fig. 3 will be found superior by far to that in Fig. 2.

1177. **Wireless Telegraphy.** V. E. D., New York, N.Y., asks: (1) Would you please tell me if the enclosed wire is all right for an aerial and its number. (2) If two 5-ampere hour storage cells connected in series can be charged from a current of 4 volts in 5 ampere hours and how many amperes would it take? (3) If spark balls to be used on a ½ in. coil may be ½ in. in diameter. Ans.—(1) No, this is about No. 21, and is by far too small. No. 14 or its equivalent in stranded wire should be used. (2) If you have two 5-ampere 2-volt cells you can connect them in series and charge them in a 5.4 volt source of power. The required time at a 1 ampere rate would be about 6 hours. (3) Not necessarily, they can be any size.

1178. **Wireless Telegraphy.** G.J., Ypsilanti, Mich., asks: (1) I am planning to build a coil for wireless telegraphy as follows: core ⅝ x 6 in., primary 3 layers of No. 16 d.c.c. magnet wire, each layer of 4½ in. long, secondary 16 sections of No. 30 enameled wire, each section ¼ in. thick without side diameter of 4 in. Is it a good coil for wireless work? (2) Please state capacity in watts, size of spark and distance it would send if each station used tuned circuits and an electrolytic detector? (3) Will you please give me the directions for making an electrolytic interrupter? Would you use coil on 110 volt a.c. or on batteries? Ans.—(1) Yes, very well designed. (2) About .3 k.w. Distance about 15 miles using 30 ft. aerial. (3) Use 2 glass jars, one 8 in. diameter, then 4 in. In the small one bore a 1/10 in. hole, 1½ in. from bottom. Put a strip of lead in each, connecting leads to battery and coil respectively. Fill both jars with solution of part sulphuric acid to 8 parts water. (4) On a.c. with lamp black resistance.

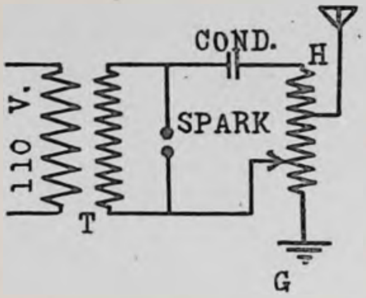
1179. **Wireless Telegraphy.** J. R. J., Birmingham, Ala., asks: How far will the ¼ k.w. transformer as described by Mr. W. C. Getz transmit from a 100 ft. antenna, there being no trees in the immediate vicinity to check the ether waves. I wish to use this in connection with wireless telephony and wish to know about how far it will operate in day time and after night. (2) About how many dry batteries of the Sun No. 6 Type will it take to operate this transformer and what size converter will it take to change the current from d.c. to a.c. (3) In explaining in the Electrician and Mechanic how to renew dry batteries, you do not state how many ounces or pounds of each ingredient is required to make one cell. I wish to have it the power of a certain number of batteries, say 10 or 12. Ans.—(1) From 50 to 200 miles. (2) Would state that this type is not suitable for wireless telephone work, nor is an induction coil. (3) Overlooked, will be answered directly.

1180. **Wireless Telegraphy.** F. B. H., E. O., N.J., asks: Can you supply me through your magazine with a diagram of connections

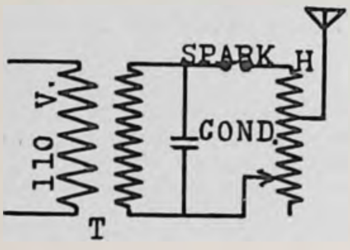


for a silicon detector in connection with the loose coupling tuning coil described in your September number? You will probably notice that there are no receivers included in the connections shown in that number. Ans.—You will find this circuit very good for the silicon detector.

1181. **Wireless Telegraphy.** M. H. S., Gloucester, Mass., asks: (1) Kindly tell me which diagram will give me the best results. The manufacturer gave me No. 1, but I get



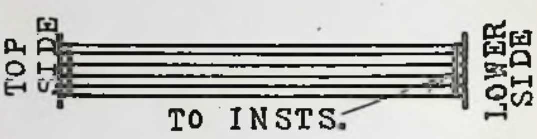
a larger spark with No. 2. I use a ¼ k.w. transformer, helix of 90 ft. No. 14 wire and 50 ft. aerial. (2) Is a helix made of 90 ft. of No. 14 copper wire on a wooden bram too large or too small for use in above set. If so, kindly give right dimensions. (3) Kindly give dimensions for a helix of copper ribbon. Is 4½ ft. of copper ribbon 1 in. wide and $\frac{1}{16}$ in. thick, too large or too small? Ans.—(1) Properly tuned, one is as good as the other, though No. 2 is preferable. (2) Rather large for the size of wire used. Use about 15 turns



No. 3 on a 12 in. diameter spaced 1 in. apart. (3) On above dimensions for copper ribbon.

1182. **Wireless Telegraphy.** J. L., Harvey, N. D., asks: I herewith enclose you print of my wireless station in my room. The sending helix is not shown, because it is too clumsy to set on the table. Will have a larger table soon or might have a counter which will give me easy reach to everything on it, and will hold more. This way it is too crowded to do much. My tuning coil is 20 in. long and 4 in. in diameter, wound with No. 16 single-covered wire. Is that too heavy? Single head receiver 500 ohms. Mercury tantalum detector as described in Electrician and Mechanic, 2 qt. Leyden jar. Make a potentiometer out of an 8 in. piece of No. 9H lead pencil, which seems to be good and hard. A seven plate solid condenser made out of seven 6 x 8 negatives (glass) and 6 sheets of tin foil. Can a variable condenser be made out of tin foil? Or what is the best material for the sliding plates, and what size should they be for receiving according to the insulating plates of a variable condenser? What resistance? Have a silicon detector too, but the tantalum works best. Have tried the electrolytic also, but the trouble I have every time I leave is drawing the acid out every time, then when you want to work again you'll have to putit back in the carbon cup. It's a kind of risk against breaking the fine wire. Regarding the tantalum detector, can the mercury be left in the cup? What is best to shunt across the spark gap, Leyden jars, or ordinary plate condensers? Series or shunt? Ans.—Dirt is apt to settle on surface of mercury if uncovered. Tin is best for adjustable condenser plates.

1183. **Wireless Telegraphy.** C. B. D., Boothbay Harbor, Me., asks: (1) Will you please state in your paper, Electrician and Mechanic, the receiving radius of a wireless telegraph station having a horizonatl aerial composed of two 6 pin arms 70 ft. apart, one in 40 ft., the other 35 ft. from the ground and 300 ft. above the sea level, which is directly in view. The aerial is strung with



6 strands of No. 14 aluminum wire. Instruments are tuning coil, adjustable condenser, electrolytic detector, potentiometer, and two 1,000 ohm receivers. (2) How should the aerial be connected to obtain the best results and if instruments are located in shop 100 ft. distant, using No. 8 copper wire rubber-covered for leading in wire will there be any loss in receiving range? (3) How can I improve my receiving range? Ans.—(1) About 500 miles using sensitive electrolytic detector. Using inductive tuner, it may be increased to 1,000 or 1,500 miles. (2) Connect aerials as shown herewith.

DESCRIPTION OF A NEW YORK FARM CONDUCTED ON SCIENTIFIC PRINCIPLES

Upon the west bank of the Hudson River, about a hundred miles from New York City, there is located in the quiet little village of West Camp, a model farm known as Larchmont Farm.

Not long ago, a company was organized under New York State Laws to raise fruit and poultry products for the New York City market, and the selection of a site for a farm was immediately begun. It seemed at first, as though the project must be abandoned, for although nearly three hundred farms were considered, there was not one that met all the requirements specified. In some, the water supply was insufficient, in others, shipping facilities were poor, some were too far from New York City, etc. The company considered the following as being the general requirements of a site suitable for the industry:

1—Proximity to New York City. 2—A large frontage on the Hudson River, near a dock. 3—Land elevated so that from some spot, entire farm could be seen. 4.—Convenient freight and express facilities. 5—Land must be well drained. 6—Land must slope to south or east. 7—Must contain several hundred young fruit trees. 8—Must be a fertile soil, free from stones. 9—Must contain a stream with abundant water supply. 10—Must contain some timber. 11—Telegraph and telephone communication. 12—Should have some sand, gravel and stone.

Finally, a farm was thrown on the market, which the owner had recently inherited. This farm was visited, inspected by the company and immediately purchased, as every requirement had been met. Considering the remarkable adaptability, the farm was purchased for a sum far below its intrinsic value. It is an interesting fact that the company, in less than two months after purchasing, were offered for one tenth of the farm as much as they paid for the entire tract.

Development work soon commenced, and as a result, the company owns a splendid 100-acre farm, unsurpassed in fertility, and located in the fruit belt of the beautiful Hudson Valley. On the west are the tall peaks of the Catskill range of mountains; on the east, the Berkshire Hills in Massachusetts; to the south, the Shawangunk Mountains; while by the farm, runs the Hudson River visible for twenty miles. The river frontage of the farm is about three thousand feet.

A narrow strip of land was purchased, running from the farm to the railroad station, over which a private road was built. This road shortened the distance to the station from two miles to a thousand feet. By railroad express, shipments reach New York City in about three and one half hours. A steamboat landing adjoins the property where shipments to New York City in the evening reach there the next morning. For shipping facilities, there are few farms as well located.

From the extreme north end of the farm the land slopes to the south and east. Here the office building and manager's house were erected, where a view of the entire farm is obtained. The land is well drained, fertile and free from stones. There are at present about five thousand young fruit trees just coming into bearing. They consist of many varieties of apple, pear, peach, plum, cherry, and quince, with an abundance of small fruits, such as currents, berries and grapes. These are maintained in the highest state of productiveness by modern scientific agricultural methods, the products shipped to the "fancy trade" in an attractive manner, and the highest prices obtained.

Through the farm runs a stream furnishing an average flow of 120,000 gallons daily. This is fed by a number of never-failing springs of pure cold water. Additional water is obtained from wells, one of which runs one hundred and thirty-six feet into the earth through solid rock. A portion of the farm is in timber, much of which is cedar. There is also sand, gravel and rock, which is used for building purposes and roads. There is not an acre of marsh or waste land on the farm. Outside of the woodland, the entire farm is arable. The location is dry and healthful, so essential to success with poultry.

Telephone and telegraph communication is available and no facility for the rapid and satisfactory handling of business has been overlooked. Ice may be obtained from the Hudson in any quantity. Many of the buildings are already up and in use. They have been designed to reduce labor expenses to a minimum and to afford convenience.

The location and contour of the land is such as to afford an excellent air drainage for all parts of the farm, which in a large measure insures against destruction from late spring frosts so damaging to fruit buds in some localities. The soil is deep, rich, and black and contains an abundance of humus, and is shown by the tree and vegetable growth on the land to contain plenty of available plant food of all kinds. The physical and chemical properties of the soil make the farm ideally adapted to the production of a fine quality of fruit. Fruit grown at Larchmont Farm attains remarkable size, owing to the care given the orchards, and cannot be surpassed for richness of flavor and coloring. A large yield is always assured. Scientific fruit culture and poultry raising are two of the most profitable business enterprises known, and in them this company are making a grand success. The demand for their product is unlimited.

The incorporators of the company owning this farm decided that modern "high finance" would not be desirable and to the best interests of stockholders and have therefore kept the capitalization low. Although the assets of the company are over $60,000 the capitalization is only $20,000, which is divided into two hundred shares full paid and non-assessable with a par value of $100. The company is offering the balance of its unsubscribed stock to investors at par, in order to complete development work. No preferred stock or bonds have been issued, thus giving the shareholders the first lien on the company's earnings. The officers of the company are assuring stock holders of the future brilliant success of the enterprise, by agreeing to take no compensation for their services until dividends of 24% are paid. With these dividends and the assets behind the company, the value of the stock will be greatly enhanced, and will mean a profit of many hundred per cent. for present stock-holders and those subscribing to the present offering.

The company is putting out a prospectus which deals with THE SCIENCE OF INVESTMENT, and describes the enterprise with an outline of the poultry business. This prospectus is mailed postpaid to any investor requesting it. The company is financially sound and present conditions indicate a future of prosperity at the farm, with every prospect of increasing revenues each year. With the issuing of the balance of its treasury stock, the plant will be fully equipped and turning out its maximum with the efficiency the additional capital will provide.

If you are looking for a safe and sound investment where the element of risk is eliminated and large dividends assured, we suggest that you write to this company, whose address is Larchmont Farm Inc., Box 116, West Camp, N.Y. They will be glad to supply any further information.

LARCHMONT FARM,

Box 116,

West Camp, N.Y.

Please send your prospectus and full information of your farm.

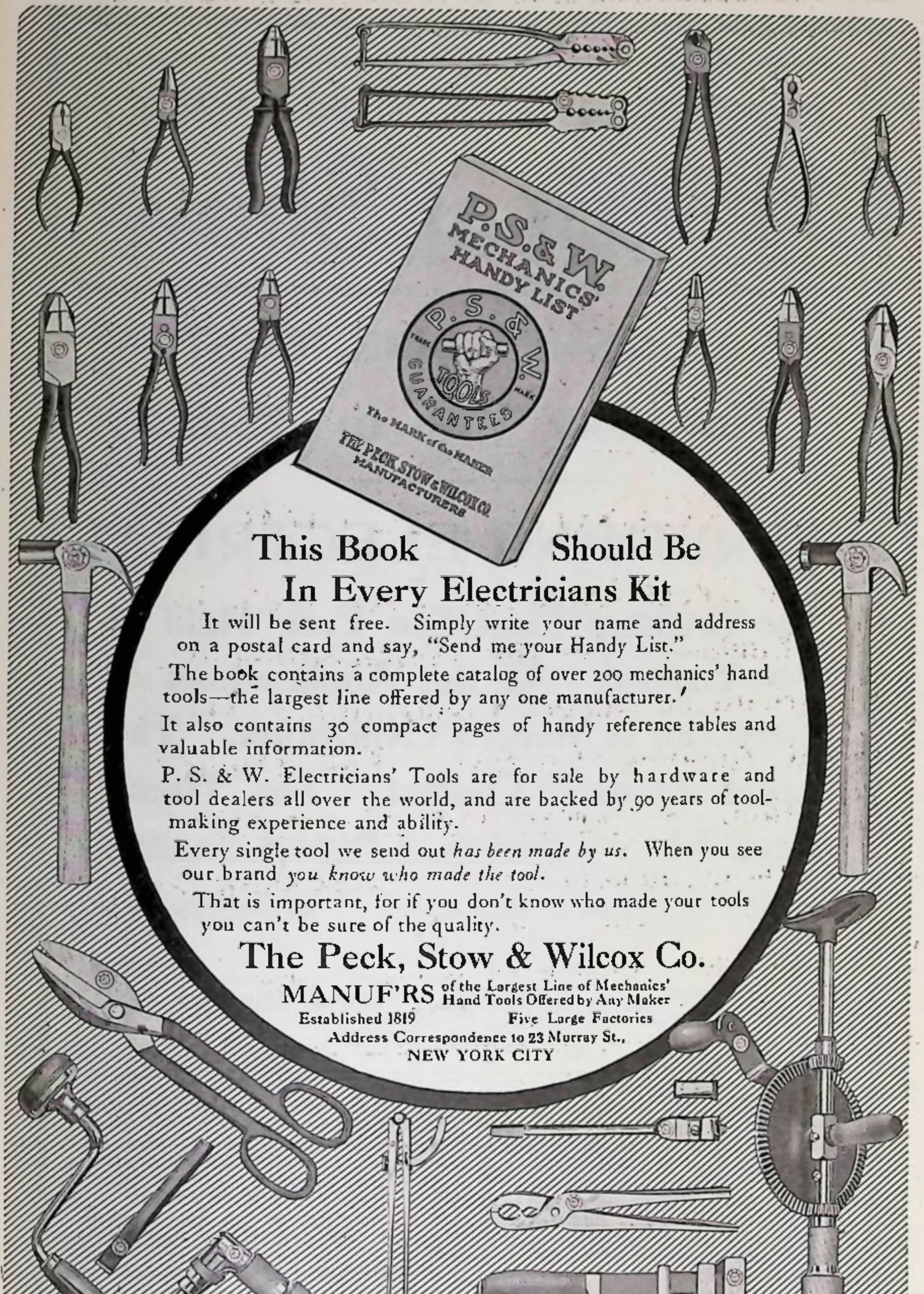
Name ....

Street ....

Town ....

State ....

E. M. 11.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