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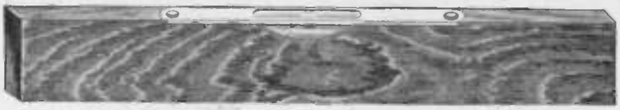

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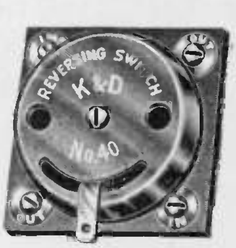

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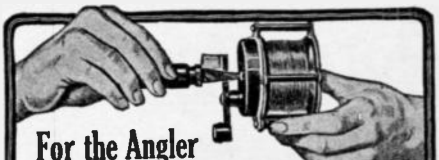

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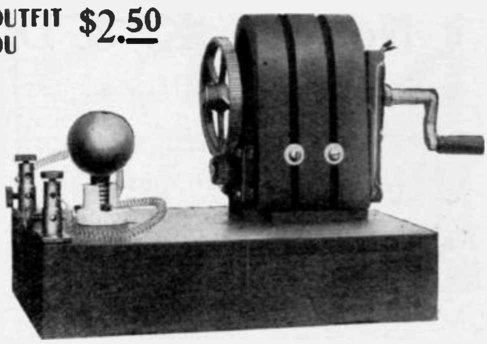

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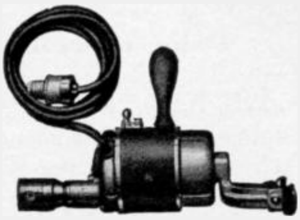

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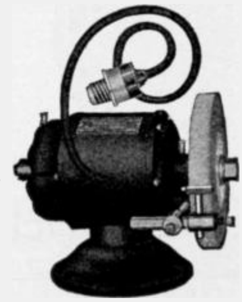

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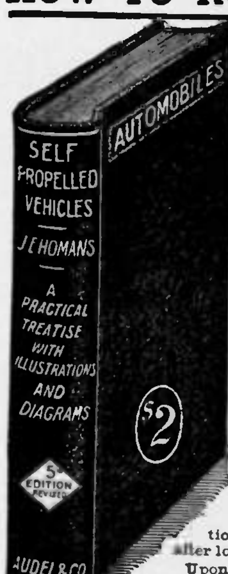

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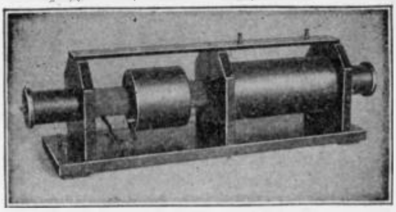

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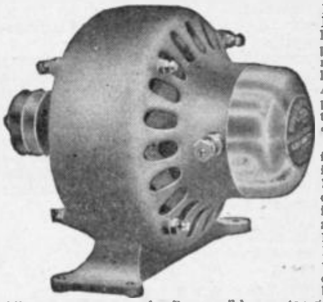

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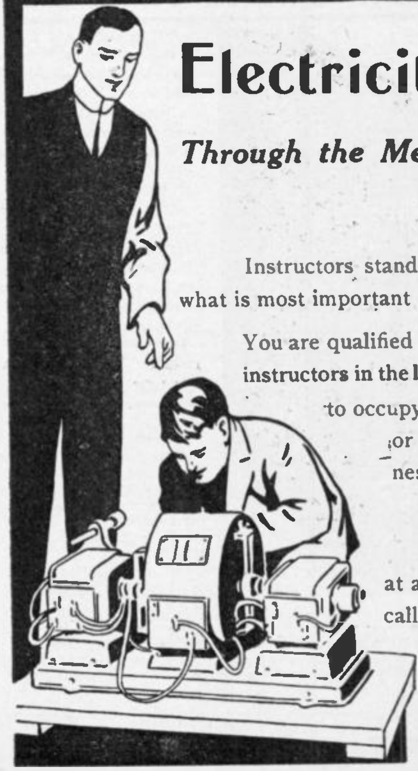

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VOL. XXI. SEPTEMBER, 1910 No. 3

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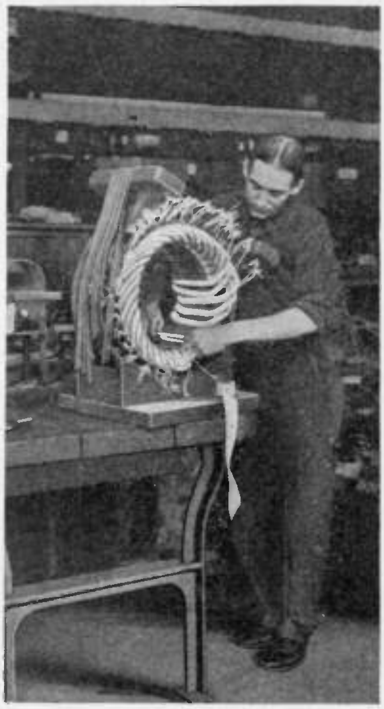

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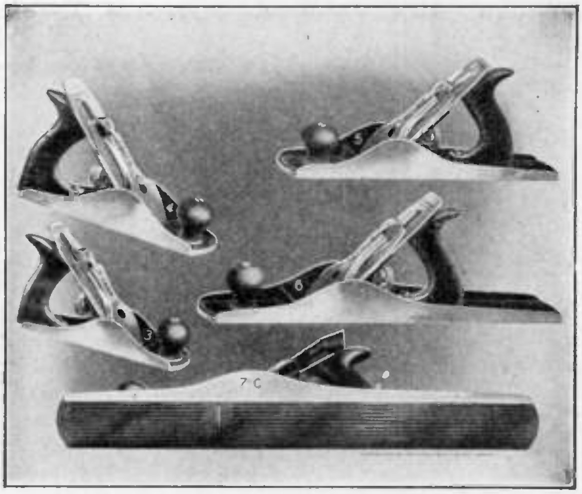

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VOLUME XXI SEPTEMBER, 1910 NUMBER 3

THE MANUFACTURE OF THE COMMERCIAL ELECTRIC LAMP BULB

W. E. ALBERTSON

Of the many thousands of small electric lights seen every night by the people in our towns and cities for illuminating and decorating purposes, little is known of the care and skill necessary, together with the great number of operations required, to make a single lamp. Even many teachers in our big schools tell their scholars about the old mercury method of exhausting the air, which has given away some years ago to the more modern and more speedy method of the oil submerged vacuum pumps of the present time.

The bulb proper is blown by an expert glass blower who takes from the furnace the exact amount of molten glass on the end of his pipe, holding it downward so as to allow it to become elongated by its own weight, and at the same time gently blowing to enlarge and make it hollow. When it has become the right temperature and shape, he lowers it into the iron mold, the shape of which is to determine the shape of the finished bulb. While blowing it out to fill the mold he swiftly revolves it so as to completely do away with the crease of the mold so often seen on bottles and fruit jars. This bulb thus formed is now broken from the blow pipe and wrapped in tissue paper, for the purpose of keeping it clean while being packed and shipped to the lamp factory.

These bulbs have to be washed upon their arrival at the lamp factory. This is done by girls, who unwrap and rinse them well in warm water containing chemicals to remove the smoky color left in the bulbs.

These bulbs after having gone through the wash are allowed to dry in trays, and sent to the tubulator, who punches or blows by means of her fire, a small hole in the bottom of the bulb where the tip is always seen. Directly over this, she welds a piece of 3/16 or 1/4 in. glass tubing, at the same time melting it down and leaving the hole into the bulb a little larger than the size of a pin. This tube serves a double purpose; one as a handle, by means of which the hot bulb may be held, and another as a vent through which the air and gases may be exhausted later on. Many factories have machines that facilitate this operation, as it takes the average person some time to learn to do passable work.

As yet the bulbs have long necks left on by the glass blower, which have to be blown off as it is called. To do this the bulb is picked up by the glass tube just put on and laid upon a couple of revolving discs. This makes the bulb revolve with a 2 jet fire playing on opposite sides of the neck at about 1/2 in. from the small end of the bulb. Under the intense heat from these gas fires, forced to the two points by six air jets, which also furnish oxygen enough to make it burn all the carbon from the gas, leaving a blue flame, the glass soon gets red hot in a narrow path or ring all around the glass neck. In another instant the operator sees the glass begin to bend, so she takes hold of the protruding end with a pair of pliers and gently pulls it off like a piece of very soft taffy. At the same time the bulb revolving, twists it in such a manner as to completely close the neck, forming a small knot of extremely hot glass in the centre. With a short, quick blow through the tube the hottest portion is blown out into a round bubble about the size of the original bulb, and without letting out any of the air she continues to blow carefully until the thicker and cooler portion is enlarged to almost the original size of the neck. This large bubble instantly cools and is brushed off with the hand or pliers, making it ready to receive the carbon filament on its mounting.

By those who have observed, it is noticed that the carbon or filament was mounted on a couple of fine platinum wires protruding from a glass stem. This stem is generally made from a piece of 3/8 in. glass tubing cut the proper length and placed in a suitable iron chuck, which revolves it in a gas fire, heating the end so the operator can ream it out into a funnel shape. These are called the flanges, from which the stems are made.

Pieces of No. 22 copper wire are cut about 5 in. long and to one end of each of these is fused a piece of No. 7 platinum wire (for 16 c.p. lamps). This is done by melting the end of the copper wire into a tiny globule in a gas flame and sticking the end of the platinum wire into it. The molten copper coming in contact with the platinum, forms an alloy so as to make a perfect electrical connection. It might be interesting to state here that although the fire is not hot enough to melt platinum alone, it melts readily enough when allowed to alloy with copper.

The flange described above is placed on a perpendicular holder, large end down. The copper wires are placed in small holes inside of the flange, which serve as a guide to hold the wires to the opposite side of the glass while it is turned into the gas fire and made to revolve. The blaze strikes the glass in such a way as to heat and melt the top edge of the tube only. When this becomes soft and sticks to the platinum wires, the operator stops the machine and presses a small lever which closes two small iron fingers, pressing the molten glass into the proper shape, entirely enclosing the small knots formed by the fusing of the copper and platinum, and at the same time cooling the glass sufficiently to enable it to hold its proper shape. Platinum is the only metal that has ever been successfully used for this purpose, and the reason is, that it is the only electrical conductor that expands and contracts in the same ratio as glass under different temperatures. While the glass is still in a soft molten condition a short piece of nickel or iron wire is pressed into it, to be used later on for an anchor to hold the filament.

The stems are now annealed by being placed in holes bored in wooden blocks, thus allowing them to cool very slowly.

In another department girls are busy treating the carbon filaments. These carbons are made by squirting cellulose out through a glass nozzle into wood alcohol, where it immediately hardens into a tough string which coils up on the bottom of the bottle. This is cut in proper lengths and wound on carbon forms of the desired shape and packed in graphite. The entire mass is then heated white hot and held so until every particle has become thoroughly carbonized.

The carbons thus formed are black and brittle, and the shape given them during the process of carbonizing cannot be changed. A bunch of about fifty of these is selected and cut the proper length on a measuring gauge, allowing for the short piece necessary to be broken off by the clamps and for the lapping over when pasted on the platinum ends. They are then separated from the bunch one by one, and placed in small brass clamps so arranged on a fibre block as to form an electrical connection with the apparatus. A bell jar is lowered on this set of carbons and a pump extracts all the air, while the girl fills another set of clamps. A mercury gauge tells the operator as soon as the air is all out and she immediately opens a valve allowing a hydro-carbon gas to be drawn from a closed iron tank containing a high-grade gasoline. This allows the mercury to fall, as the gasoline immediately turns into a gaseous state on account of its being released from the atmospheric pressure. This is retarded, however, by a valve between the gas tank and the bell jar, the strength of the gas in the latter being at all times under the control of the operator, and measured by the drop in the mercury column, usually between 2 and 4 in., depending on the kind of lamps to be made.

This gas now flowing in a steady stream through the bell jar has washed out every trace of air in it, making it safe to turn on the current into one of the carbons at about 330 volts. This makes it white hot, throwing out a very intense white light, at the same time being surrounded by the gas. It immediately takes upon itself a layer of carbon, which in turn increases its size, and lowers its resistance. A voltage regulator placed on the feed wires will not allow this increase of load, due to the decrease of resistance, to lower the voltage, but keeps it normal. The result of this is, that the carbon increases in size in exact proportion to the amount of carbon deposited upon its surface. If there happen to be any portions in the carbon smaller, due to uneven shrinkage during its manufacture, that portion will, on account of its greater resistance, become hottest at the start, therefore taking on the carbon from the gas faster than the rest, and by so doing, making the filament of one uniform diameter and resistance throughout its entire length. If it was not of the same diameter throughout, the smaller portions of the carbon in the finished lamp would burn brighter, greatly shortening the life of the lamp. We now have the carbon continually growing in size and brilliancy, and consequently the current required to maintain this increase is increasing proportionately. At the proper time this action must be stopped, and for this purpose an automatic cut-out is used, consisting of a solenoid which is constantly pulling down a lever similar to the pointer in an ammeter, and retarded by an adjustable counter weight. When this increasing current has become strong enough, the lever is pulled down to the point where it makes a contact in a secondary circuit which actuates the cut-out, stopping the current that is building up the carbon.

This operation is then repeated with the rest of the carbons under the bell jar, after which they are taken out and broken off, ready to be pasted on the platinum ends in the glass stem. The carbon is no longer black, but instead, is nearly white, this outer layer being much harder than the original carbon. It is the custom of some manufacturers, after the right amount of carbon has been taken from the gas, to immediately raise the voltage sufficiently to weld the carbon coating and the carbon core, thus making them one solid mass. This does away with all danger of the coating cracking or scaling off, which would make the lamp useless.

The carbons treated, and the stem mounts made, the next step is to paste the carbons upon these mounts. First, the two carbon ends are stuck on the two platinum ends with a very little graphite paste, and allowed to become dry, the joints afterwards being covered entirely, and baked bone dry in a gas oven. It is very necessary in pasting these not to get the paste between the carbon and the platinum, as it would cause the separation as soon as the current was turned on.

These carbons, now mounted, pasted, dried and straightened, and placed 100 on a tray, are delivered to the glass department where they are to be sealed in the glass bulbs. There are several different kinds of machines used to hold the carbon in place while sealing, but they all accomplish about the same results. The stem is first placed on a hollow iron rod into the hole of which the copper wires are inserted. This serves a double purpose: first, to hold the glass stem in the fire and second, to protect the copper wires from the intense heat of the gas fire required to melt the glass. The bulb is then lowered over the carbon into a cup which holds it in place, and the whole swung into the fire which plays on the two sides. This intense heat falling directly upon the frail fringe left from the blowing off of the long neck, immediately melts it, allowing it to curl up, tending to close the opening of the bulb; but as the flange was made so as to nearly fill this opening, it is immediately surrounded by this molten glass and is thereby heated itself. Only a few seconds are required now to weld the two together, making a perfectly air-tight seal. All the time the bulb and flange are being revolved, so as to make the seal perfect all around. The bulb is now removed from the fire and the holder, at the same time cooling sufficiently to hold its shape and allowing the operator time enough to insert her pliers to straighten the stem and thereby centre the carbon inside the bulb.

These lamps having been tested and

placed in trays are passed into the pump room where they are painted. This is a very simple process, as it consists of the forcing, by compressed air, of the paint up into the exhaust stem about 2 in., or not quite to the portion where it is drawn down small. The paint is merely phosphoric meck mixed with wood alcohol to the consistency of milk.

After the paint has become dry the lamp is ready to pump. The stem is placed in an exhauster similar to the one used before, and the joint of the glass and rubber is sealed with castor oil to insure an air-tight seal. This exhauster is connected to a double cylinder vacuum pump immediately in front of the operator. It exhausts into another larger vacuum pump which relieves the atmospheric pressure from it. This double cylinder vacuum pump runs continually with both cylinders submerged in a special vacuum oil and each joint is sealed with oil as well as the valves always being covered. The connections between the pump and lamp being pumped are all of glass, brass and rubber tubing, the rubber being about 1 in. in diameter with a hole about 3/16 in. in diameter. This rubber often becomes porous, the holes being so small that they cannot be seen until the rubber is stretched. It then causes all kinds of trouble.

The lamp having been placed in the exhauster and the valve opened, it requires about 5 seconds to draw all the air out of the lamp. The electric current is then turned on at about 50 volts and gradually increased by cutting out resistance until it runs up to about 150 or 175 volts. At the same time a small bluish purple flame surrounds each of the paste joints. Now the operator with her blow torch gently heats the painted stem which gives off a gas, only a part of which enters the bulb. The rest is pumped out by the vacuum pump. After this continues a certain length of time the flame stops and at that moment the operator must stop heating and turn off the current, as to continue longer would make the lamp gassy. The blow torch is then applied to the thicker portion of the tube which has not been painted, and where the tip is to be, until it becomes melted. The atmospheric pressure then forces the walls together and by their being melted, a perfect seal is formed, after which the tube is pulled off and the tip thus formed, melted round on the end. If all the operations thus far have been perfect the lamp is perfect; but the slightest crack or leak renders it perfectly useless.

There are two or more theories as to the chemical changes that take place in a lamp while being pumped. One is, that gas is formed by the burning of the paste, or rather, the ingredients in the paste, which is charged with static electricity, either negative or positive, and that this gas formed has an attraction for any heated body; therefore it surrounds the filament and clings close to it. The other gas formed by the heating of the phosphoric meck is charged with static electricity also, but of an opposite nature, therefore it being repelled by charged gas already in the bulb, seeks refuge at as great a distance from it as possible, clinging to the inner surface of the bulb. Now the bulb is first filled with the one gas that has a tendency to cling to the heated carbon, and the other gas is forced into it, sneaking, as it were, around the inside of the bulb and gradually becoming stronger and stronger until it reaches that point where the one is just as strong as the other, forming a perfect balance and stopping the little flame which either produces or shows an excess of the original gas. As a proof for this, let the pumping be carried on a little too long and the lamp is then gassy, or let it not be carried on far enough it is also gassy, showing an excess of either one kind of gas. In both cases the test is the same on the coil. Another test is to take a perfect lamp and heat the outside of the bulb. It will then show gassy, but may then be brought back to its normal condition by burning the lamp at a higher voltage. This all shows that the heat seems to attract the one gas which stays where it is last placed.

Another theory is that the two gases formed combine to form a solid, which is deposited in the form of a fine powder over the inside of the bulb.

Lamps taken from the pump room are tested by placing the wire end on one terminal of an induction coil throwing a 3/8 in. spark. If the color or glow which fills the lamp is violet, the lamp is gassy, and if the color is blue, the lamp contains air, due to a small leak in the seal, stem, or tip, and has to be thrown out. In case the lamps test out gassy they are hung on a rack and lighted at about 125 volts. If they are not too bad they will in a very short time test all right, showing no color at all when applied to the coil.

These good lamps, now without bases, are of numerous voltages varying about five both ways. This is due to differences in the condition in the treating apparatus, differences in the length of cut, and in the amount of lap on the platinum wires.

To determine the proper voltage of each lamp they are placed on a photometer and read. This is done by placing a standard lamp, of which is known the candle power, at one point in a dark room and placing the lamp to be read at another point. Directly between the two is placed a waxed paper or telescope eye-piece. The lamp to be read is then revolved to give the average light and at the same time lighted. The resistance is then adjusted so that the two lights are equal, being shown by the shadows on the waxed paper, and a reading taken which tells the voltage required to make the lamp burn up to the required candle power. Another reading is taken to show the amount of current required which represents the wattage of the lamp. These figures are marked on each bulb with a wax pencil so they may be sorted.

Lamps having been sorted for the voltage and wattage wanted are then ready to be based. The bases are generally bought from some brass factory ready to fit on the lamp. These are fastened on by means of a cement made of Portland cement, marble dust and shellac, making a thick paste which can be smeared on the inside of the bases. The lamp bulb is placed, with its neck up, into a brass cup which holds it firmly as the wires are threaded through the base terminals and the cement-filled base is put on it. One lamp is prepared after another in this manner, and the cups holding them placed on a wheel, so as to revolve under a semi-circular gas oven covering the bases like a hood. This heat drives out and burns all the alcohol in the cement, making it hard and waterproof.

The bases properly cooled, the wires are cut off close and soldered to the terminals. This, with the final test on the induction coil and by lighting the lamps, completes the general making of the incandescent lamp.

Except the few thrown out as bad, they are then washed, dried, labeled, and packed for shipment.

AN EASILY MADE UMBRELLA STAND

The umbrella stand which we illustrate in Fig. 1 is very compact and would be suitable for a house in which the hall space is limited.

Figs. 2 and 3 show front and end elevations of the stand respectively, and the principal dimensions to which the stand may be made are also given in these illustrations. Figs. 4, 5 and 6 show details of the construction. Any of the usual cabinet hard woods may be used; oak, however, is preferable.

In making the stand a start is first made upon the legs. They are 2 ft. 6 1/4 in. long by 1 1/2 in. square in section, tapering at the top end to 1 in. square in section, as shown. Then prepare the upper framework, which consists of

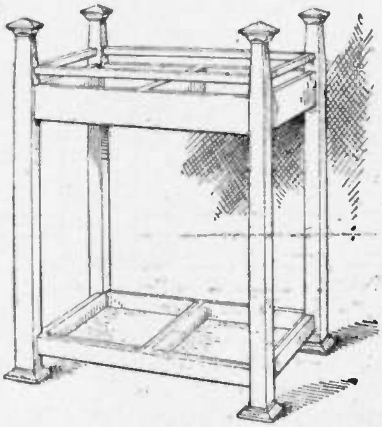


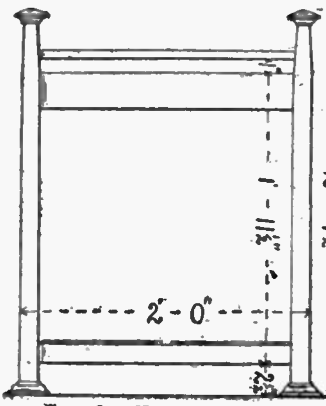
Fig. 1. Umbrella Stand.

a centre, two end and two side rails, which are 3 in. deep by ¾ in. thick. The side and end rails are stump-tenoned as deep as possible into the legs, the end of the tenons being mitred together as shown at Fig. 4. The centre rail is framed into the side rails exactly in the centre, with a dovetail groove joint, as illustrated at Fig. 4. The groove in the side rails should be stopped ½ in. from the top edge of the rails.

Small rails measuring ¾ in. square in section are framed into the legs. The rails are stump-tenoned into the legs.

The lower framework is very similar to the upper framework. The rails are 1½ in. deep by 1 in. thick. The side and end rails are framed into the legs, as shown at Fig. 5; the inner edges of the rails overhang the inner edges of the legs ¼ in., as shown. The rails are framed into the legs with bare face mortise and tenon joints; the ends of the tenons are mitred together; and the portions of the rails which overhang on the inside of the legs are mitred together as shown at Fig. 5. The centre rail is framed into the side rails.

When these details have been carried out, the whole of the framework should be taken apart and cleaned up, preparatory to being finally fixed together. In fixing the framework together, first fix the side rails into each pair of legs, glue



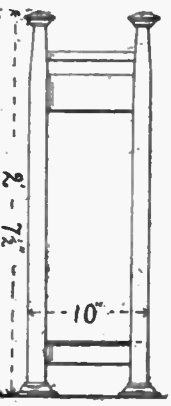


Fig. 2. Front View. Fig. 3. End.

being used to secure the joints. Then fix the end rails in position and finally fix the centre rails.

The pediments at the top end of the legs are made up as shown at Fig. 6.

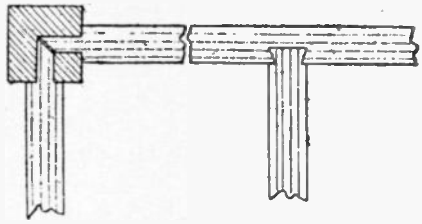


Fig. 4. Upper Framework.

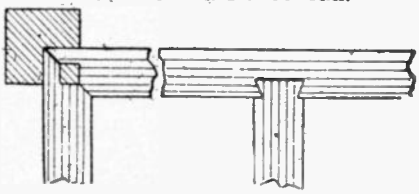


Fig. 5. Lower Framework.

Fig. 6. Details of Cap and Toe.

The caps are 2½ in. square by ¾ in. thick; the tops of the caps are chamfered as shown, and they are mortised and tenoned to the top end of the legs. Pieces of moulding are mitred around the legs underneath the caps; the moulding being ½ in. wide by ¾ in. deep.

The bearers at the bottom of the legs are 3 in. square by 1 in. thick; the edges are moulded, and they are mortised and tenoned to the bottom end of the legs, as shown in Fig. 6.

Two metal drip pans are fitted to the bottom of the stand; the pans fit in between the openings in the lower framework, the overhanging edges of the pans keeping them in position. The pans may be procured from a local ironmonger or tinsmith.—*Home Handicrafts.*

Another remarkable alloy has appeared in Germany, called Ruebel bronze, after its inventor, Walter Ruebel. Its main ingredient is magnesium, to which zinc, copper and aluminum are added. A fine-grained homogeneous alloy of considerable strength and no specific gravity is thus obtained. This new alloy is important in constructing airships. The Zeppelin airship, with its mechanical parts of the new metal, would weigh 3½ to 4 tons less than at present constructed.

MACHINE SHOP PRACTICE.—Part III

The Shaper

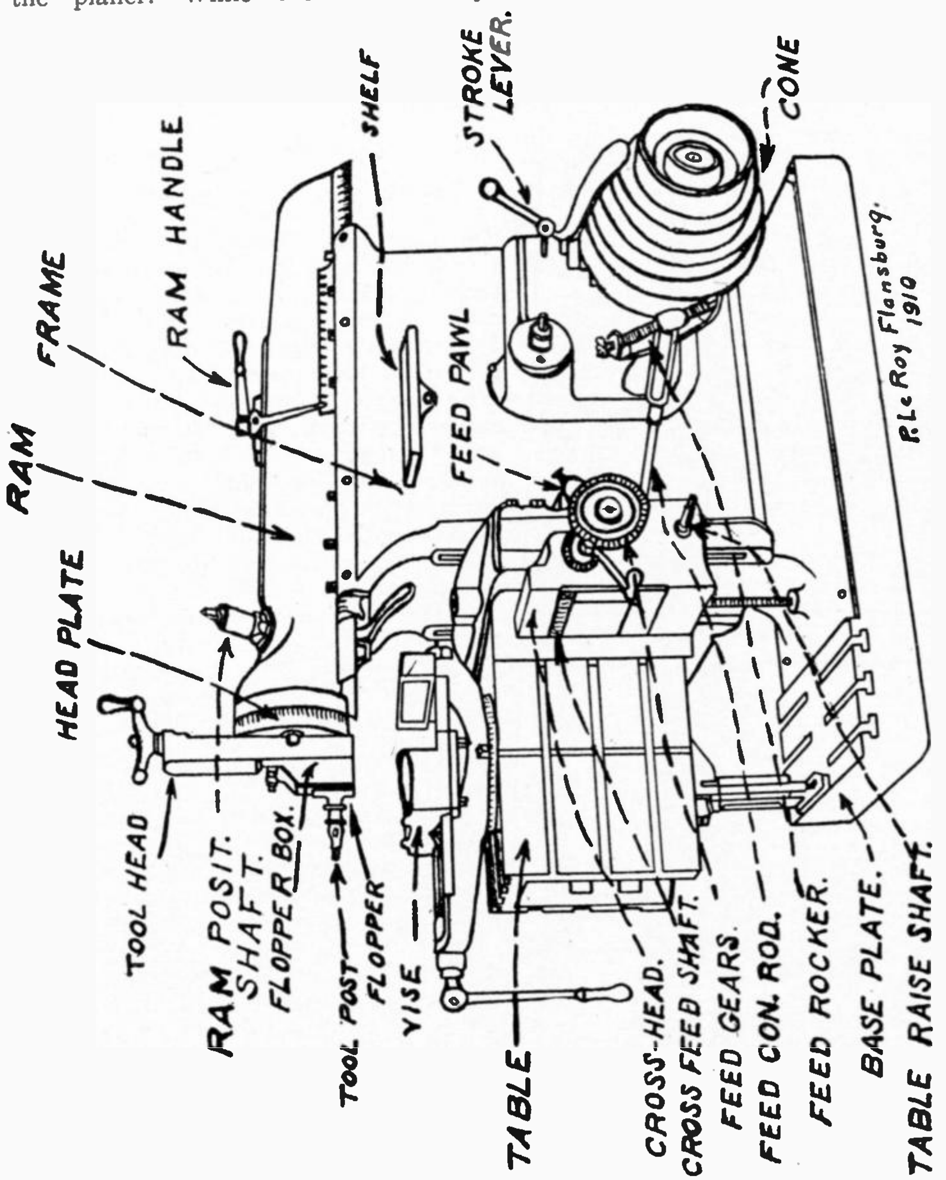
P. LE ROY FLANSBURG

The shaper is, in many ways, similar to the planer, which was described in one of the previous articles. The whole duty of the shaper is to produce flat surfaces and it can do practically the same kind of work as is done by the planer, often the work being done with equal ease on either machine. The shaper is a straight line cutter, and when short pieces of work are to be planed, it is used in preference to the planer. While there are many forms of these machines in common use, there are only two general types: namely, the friction shaper and the crank shaper.

On the friction shapers there are usually two cutting speeds while the reversing speed is as 3 is to 1.

On the crank machine the cutting speed is varied by an adjustment in the length of the stroke, thus giving quite a range of speeds.

The shaper covers a field formerly



SHAPER.

filled by hand work, such as hand clipping, etc.

When the machine is in operation the work is held stationary while a reciprocating cutting motion is given to the tool. The feed motion is given to either the tool or the work; when given to the tool the machine is called a travel-head shaper. On small shapers it is customary to give the feed to the work table, the tool head having no side travel.

A single-geared machine is where the motion is transferred directly from the driving shaft to the connecting rod and ram. These shapers are usually smaller than the double-geared shapers and are used for lighter work. Because of the fact that in them, the cutting tool travels while the work remains stationary, quite high speeds are obtainable. However, there is only one uniform travel given to the ram and cutting tool during the forward and backward stroke.

The double-geared machines are fitted with link or other quick return motion to ram, the larger ones having two heads or saddles each independent of the other. On these heads, two tools are operated simultaneously upon the same piece of work. The down-feed is by a hand wheel or is made automatic by the use of a ratchet and pawl worked from a disc on the driving shaft. By an adjustment of the pawl, a feed in either direction is obtained.

The varieties of work for which the shaper is adapted range from the planing of key seats in shafting to the planing of the valves and steam parts of an engine. Since the machine is always strongly made, very heavy cuts may be taken without much damage being done to either the tool or the machine.

The shaper head swivels to any angle, and is carefully graduated. When it is in the desired position it may be securely locked.

A simple, efficient down-feed is easily obtainable, and the down-feed is carefully provided with a collar, graduated to thousandths of an inch.

The vise used on the new machines is of an improved, double-screw form, mounted upon a graduated, swiveling base thus allowing either straight or tapering pieces to be clamped into it, both securely and rapidly.

Often the different speeds are obtained through the use of a speed-change gear box. When this is used one obtains a large and constant area of belt while the disagreeableness of belt shifting is done away with.

If one wishes to plane angles it is possible to do so by simply tilting the table.

There are four general ways of holding the work. The first is by clamping the work direct to the platen; and this is the most common way. Some little ingenuity is required to do this successfully and not waste a great deal of valuable time. The second way is to clamp the piece of work in a shaper-chuck. If the piece of work is higher than the chuck jaws, bed the piece of work in the chuck frame, otherwise bed it in parallel strips and hold these in the chuck jaws. The third way is to clamp the piece of work to special fixtures, which are made especially for that piece of work. The fourth way is to hold the piece of work between planer centres. This is largely used for some types of work.

The tools used on the shaper are very similar to planer tools, although they are not generally as heavy. The roughing tool is given a slightly rounded lip. The parting tools have their edges as narrow as is consistent with their own safety, while the smoothing tool somewhat resembles the roughing tool, except that it is given a straight edge instead of being pointed.

In the October issue of this magazine the "Milling Machine" will be explained.

Mr. Clifford B. Harmon made a new American amateur record for sustained flight on July 3d. Mr. Harmon remained aloft 2 hours and 3 minutes in his Farman biplane above the aërodrome at Mineola, L.I. He intends shortly to attempt a cross-country flight above Long Island Sound. He will start from Mineola and fly to his residence near Greenwich, Conn.

Knud Rasmussen is preparing an expedition at Cape York which will be sent northward to study the American Eskimos. Rasmussen expects to be away for two years.

ELECTRICAL SHOP NOTES

H. WINFIELD SECOR

In electrical shop work there are many "kinks," which will save much time and labor if they are used. The writer, having had some experience along this line, will try to describe a few useful ideas which have been applied in several shops, both for repair work and manufacturing purposes.

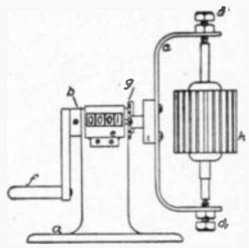


Fig I-

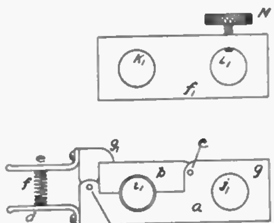


Fig II-c

A very simple and efficient machine for winding small drum armatures, such as fan motor armatures, may be made as shown in sketch below.

A cast iron or other base *a* of the form shown is obtained, and a hole drilled through the top of the standard to accommodate a piece of 3/8 in. steel shafting *b;* this has the handle *f* on one end, and has the other end threaded to fit an iron block *i*, which is screwed fast to the saddle *c*, of 1 in. x 1/4 in. wrought iron, bent to the shape shown. Two 5/16 in. centre screws d_1 and *d* and locknuts, are tapped into the arms of the saddle *c*.

The drum armature is swung on its centres, between these centre screws, which are pointed on the ends for this purpose. It is very tiresome to keep count of the number of turns, when winding these small armatures by hand, so an ordinary bicycle cyclometer *e* is fastened on to the base in such a position that a dog *g* fast on the shaft and rotating with it, engages the toothed wheel on the cyclometer, advancing it one tooth every revolution. Hence, one revolution of the shaft, equivalent to one turn of wire on the armature coil, will register 1 on the cyclometer. If this instrument is of the non-resetting type, simply deduct the reading taken when starting to wind from that when finished, and the difference will be the number of turns on the coil.

Armatures to be wound in this machine should be insulated as follows: Take a long piece (about a yard) of

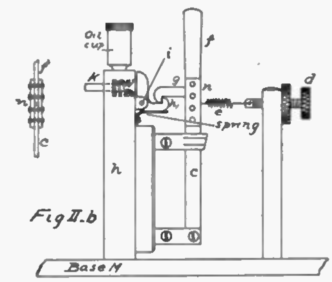


Fig II.b

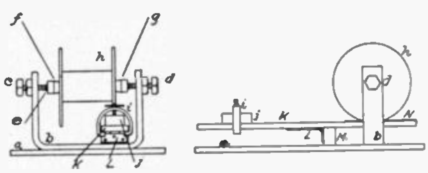


Fig III-a

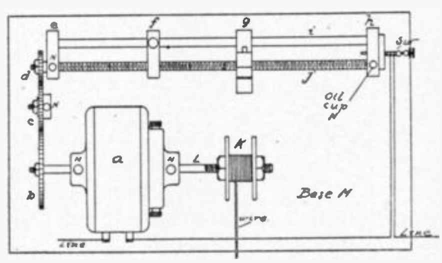


Fig II-a.

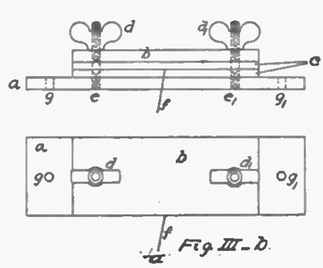


Fig III-b.

thin muslin, as wide as the length of the armature core, and shellac it well. Make several iron pins 6 in. long, and slightly smaller than the core slots. To insulate the core, shellac it, then stick the shellacked cloth, which should be partly dried and quite sticky, down into one of the slots. Now, one of the iron pins just made is forced in the end of the slot and through the fold of cloth, thus pushing it against the sides of the slot and making it conform to its shape. Pulling the cloth tight from this slot, stick a fold of it down into the next slot, passing another iron pin through it, etc., etc. Proceed to insulate the whole armature in this manner. After the first two or three slots are insulated the pins used for them may be removed, using them for the other slots; thus three or four pins are all that is required to insulate the whole core. When the armature is mounted in the winding machine, the wire can be easily and quickly guided into the slots, as there will be no projecting pieces of insulation to catch it.

A machine which will stop winding coils when the requisite number of turns have been wound on them, and capable of a wide range of adjustment, is easily made, as in Fig. II *a*, *b*, and *c*.

Fig. II *a* illustrates the plan of the machine. The small motor *a* (1/16 to 1/8 h.p.) has an extended shaft *L*, which carries on one end the coil form *K*, and on the other the gear *f*, which drives the intermediate gear *c*, which in turn meshes with gear *d*, fast to the shaft *j*. This shaft has a fairly fine thread, cut along its entire length, the shaft being about 3/8 in. in diameter and 20 in. long. A good pitch for the thread is 26 to 28 threads per inch. The shaft *j* revolves in two bearings *e* and *h*; *i* is a plain round guide rod, also carried by these bearings; an adjustable gauge block f_1 (see Fig. II *c*) slides along the guide rod and shaft *j*. It has two slip holes K_1 and L_1, drilled through it to allow of it being instantly slid into any position, and fastened in place by the set screw *m*.

The traveling cut-out or switch trip-block *d* is shown by *g*. It is made in two parts, *a* and *b*, hinged at *c*, so as to open when the dog g_1 is released by pressing together the thumb pieces *e* and *d*, which allows of opening the block and sliding it back to its starting point quickly. The hole *j* is a slip hole, enabling the block to slide along the rod *i*. The hole i_1 is tapped out the same thread as the thread on the shaft *j*. Thus when the shaft revolves the block is propelled along.

Fig. II *b* shows details of the automatic cut-out switch, which is tripped by the trip-pin *K*, passing through the bearing pedestal *h*. This pin when pushed outward by the advancing traveling-block *g* throws over the dog h_1, pivoted at *m*, on the piece *i*. This causes h_1 to disengage with *g*, with the result that the switch-blade *c* is pulled open by the spiral spring *e*, adjusted by the thumb-screw *d*.

The pieces *f* and *g* may be fashioned out of one piece of brass and riveted between two fibre pieces as at *n*, to the switch blade *c*, thus insulating it. A handle is formed by *f*, to reset the switch by.

A small oil cup (such as a fan-oil cup) should be fitted into the top of each pedestal over the journals of the revolving shaft *j* to lubricate it.

The machine described can be used for a wide range of work, including all kinds of coils up to 2 or 3 lb. coils.

The number of teeth in the three gears and the pitch of the shaft thread will depend upon the speed of the motor and the class of work to be performed. It will be evident from the foregoing description that once the machine is built, a certain number of inches along the gauge rod *i* will represent so many turns of wire on the bobbin *K*. Hence, with the gauge block set at the point corresponding to the desired number of turns, the traveling trip-block, propelled by the threaded shaft *j*, will advance from *f* toward *h*, until it hits the switch trip-pin *K*, which will throw out the switch and stop the machine. Either a foot-operated or automatic brake should be placed on the machine, so it will stop as soon as the power is cut off. The motor should revolve right-handed when viewed from the bobbin end. It is possible to wind field coils 2½ in. in diameter with 1,600 turns of wire, in 1½ to 2 minutes on this winder, utilizing a 1/8 h.p. motor to drive it. The wire should be wound on under pretty good tension, which can be accomplished with the appliance about to be described.

A device for holding wire spools while unreeling them and applying tension to the wire without injury to it in anyway is shown in Fig. III *a*. A U-shaped piece *b* is bent out of wrought iron bar and has the two trunnion screws *c* and *d* threaded through the legs of it, which are adjusted to swing between them the threaded spindle *e*, carrying two coned nuts *f* and *g*, between which is clamped the wire spool *h*. The tension is applied on the rim of the spool end by the lever *K*, hinged at *L*, which has a piece of brass on its upper surface at *n*, where it bears on the spool. A small weight of 1 or 2 lbs. *J*, and a clamp *Q*, allow of applying any desired tension by moving the weight along the lever and clamping it in the desired position. Dimensions are not given for the various parts, as its size will depend upon the diameter of the spools used in it.

In winding heating coils, rheostats, etc., and for binding armatures with heavy wire, the tension clamp, seen in Fig. III *b*, is widely used. It is a handy tool, being very small and compact, allowing it to be carried around in a tool-kit without undue weight.

Referring to the figure, *a* is a base piece of brass or steel, having two securing holes *g* and g_1 drilled at the ends and the two threaded studs *e* and e_1 threaded and pinned into it also. These studs carry at their upper ends two thumbnuts for clamping the upper metal piece *b* and the base together, between which is placed a couple of fibre linings *c*, about ⅛ in. thick. The wire *f* is passed between the fibre pieces, keeping it from injury. In use the block may be fastened to the floor by two wood screws, or anchored by attaching wires to the holes *g* and g_1, allowing it to be in the air and in line with the wire coming off the reel, which is generally preferable.

(*To be continued*)

THE "WASH" OF AN AEROPLANE

Those of our readers who have sat in a racing shell, or stood at the wheel of a racing yacht, will remember how troublesome is the "wake" of a competitor, whether it takes the form of the wash of his sculls, or of the disturbance of the air as it sweeps from the leach of the mainsail of a weatherly yacht that is beating out to windward some distance ahead. In the case of two racing yachts that are thrashing it out on the same tack in a struggle to windward, there is a certain relative position of the two, in which the disturbance of the air, caused by its passage over the sails of the leading yacht, will prove exceedingly troublesome to the second boat, especially if she be but a few lengths astern and sailing close to the wake of the other. When this occurs there is nothing for it but to put about on the other tack, and so get clear of the interference.

With the rapid development of mechanical flight, the remarkable extent of which was shown so clearly in the recent brilliant performances at Rheims, it has become evident that the "wash," or interference, which is inconvenient to a sailing yacht, may become positively disastrous to that yacht of the air, the aeroplane. It was not until the Rheims contests that an opportunity was presented to determine the effect of one aeroplane upon another, when, in meeting or overtaking, they passed in rather close proximity. It is quite possible that the question of interference had never occurred to the aviators at Rheims, but it is certainly a surprising fact that the existence of such interference, and its evidently serious character as shown when several machines were in the air at once, should not have excited more attention, both at the time and in subsequent expert discussions of the Rheims contests.

When such a large body as an aeroplane, spreading several hundred square feet of surface, and weighing from a quarter to half a ton, is driven at 50 miles an hour by propellers that are revolving at from 1,000 to 1,200 revolutions per minute, it is certain to leave in its wake a complicated series of aerial cross currents, whirlpools, and vortices.

Now, judging from the description of eye-witnesses of the Rheims races, the behavior of the aeroplanes, when they swept into rather close proximity to one another, indicates that these artificially created wind storms were present, and that they seriously affected the equilibrium of any aeroplane that came within their influence. The "wash" from propellers, driven, as in the case of Blériot's monoplane, by an 80 h.p. engine, and the air waves set up by the passage of his planes must be very serious indeed; certainly the air will not regain its equilibrium until long after the machine has swept by.

Two notable instances of this interference occurred when several aeroplanes were in the air together. During one race when Farman was rapidly overhauling opponents who were flying at the same level, he encountered the "wash" of the machines and his own aeroplane was thrown into rather violent oscillation. Before he could pass, it was necessary to make a wide detour to the right or left, or swing up to a higher level into undisturbed air. On another occasion when Latham, flying high, overtook a competitor who was travelling at a lower level, it was noticed that his own aeroplane made a sudden dive, as though drawn downward by the suction of the machine below him.

We attach no little importance to a question which must become increasingly serious as the number of flying machines is multiplied, and the favorite lines of travel become populous with these mechanical birds of the air. "Leeway," as the sailors call it, will become even more necessary to the air yacht than it is now to the sailing yacht. Woe to the aviator who, flying low with scant clearance between himself and the ground, is overtaken by some aeronautical scorcher, who sweeps up from behind, and with the characteristic snort of triumph whirls onward, giving him his aerial dust. Happy for him if he recover his rudely disturbed equilibrium at the expense of a broken wing and not of a broken neck. Perhaps after all, we have been a little too "previous" in felicitating ourselves upon the unlimited room that will be afforded for flight through the air; evidently the clearance demanded by our 60-mile-an-hour aeroplane must be measured by something far wider than the stretch from tip to tip of the planes, or the length from head to tail.—*Scientific American.*

A Method of Laying Angles

There are many ways of laying off an angle such as by means of the different instruments, but the average person does not need such great precision as when a transit or compass is used or does he have them if he should need to use them.

There is a very simple way of laying off angles to a large scale in which a 100 ft. tape line and a few surveyor's pins are used. Pieces of heavy iron wire about a foot long will do as pins.

To understand why this method is true, it will first be necessary to see some of the properties of the circle. There are two ways of expressing the amount of rotation between two lines or the angle. One is in degrees, minutes and seconds, the other has for its unit the radian. A radian is an angle situated at the centre of a circle and has an arc on the circumference equal in length to the radius of the circle, or equal to about 57°.2958′. The circumference of a circle equals 2π times the radius; now if the radius of the circle equals π, then there would be 2π radians in the circle, but as the relation of angle: arc is always the same by geometry, for any size radius there are 2π radians in 360° or π radians in 180°. 180° divided by π gives 57°.2958′, or about 57°.3.

To utilize this in laying out an angle, take a pin and place it at the vertex of the angle which is to be laid out. Often there is a stake with a nail in it already placed so that this first pin can be dispensed with. Now take a length of tape equal to 57.3 ft. and mark out a circle, or part of one, with this length as a radius, placing pins at intervals of 18 to 25 in. apart. Now it will be seen that with a circle having a radius of 57.3 ft. radius, 57.3 ft. along the circumference will equal one radian or 57°.3 and 1 ft. equals 1°.

To prove: $2\cdot\pi\cdot 57.3=360.0159$; $\pi=3.1415$. That is, 1 ft. for each degree of the circle and 360 ft. for the whole circumference.

FORGING FOR AMATEURS.—Part XXII

Duplicate Work in Forging

F. W. PUTNAM, B.S.

Whenever several pieces are to be made in the machine shop, as nearly alike as possible, a great deal of time and labor is saved by the use of dies or jigs. These dies are blocks of metal which are used for the purpose of holding and properly locating a piece of work while it is being machined, and are provided with the necessary appliances for guiding, supporting, setting and gauging the tools in such a manner that all the work produced in the same gauge or fixture will be alike in all respects, even though the use is made of comparatively unskilled labor. By being alike, I, of course, mean simply that the pieces will be near enough alike for the purposes for which the work being machined is intended.

The main object of using jigs and fixtures is naturally the reduction of the cost of machine details on machines being built or made in great number. This reduction of cost is obtained in consequence of the vastly increased rapidity by which the machines may be built and because of the employment of cheap labor, which is possible when using tools for interchangeable manufacturing.

In forging work we find that dies or jigs may also be used to great advantage whenever several pieces are to be made as nearly alike as possible. The term *jig* may be applied to practically any contrivance used in bending, shaping or forming work. It usually is simply a combination of some sort of flat blade and one or more clamps and levers for bending. For simple bending work these dies or jigs may be very cheaply and easily made of ordinary cast iron and for most purposes are even left rough and unfinished.

For the first examples of duplicate work, I wish to take up simple bending, an example of which is shown in Fig. 231. As is shown, the dies which I used for making this bend are simply two blocks of cast iron, one a rectangular block, the size that the inside of the bend is to be, and the other a block which has on one side a groove which is the same shape as the outside of the piece to be bent. The blocks are usually made a little wider than the stock to be bent.

The stock is first cut to the proper length, brought to a yellow heat, placed on the hollow block with the small block placed on top of it as indicated by the dotted lines at *B* (Fig. 231). The bend is made by driving down the small block with a few blows of the hammer. Work of this kind is very usually done under a steam hammer and the dies shown in the figure may be used in this way, even under as large as a 3 lb. hammer. Dies of this kind are sometimes fitted to the jaws of an ordinary vise, the bending being done by tightening up the screw.

Of course, these dies must have a little clearance; that is, the opening in the hollow die must be slightly larger at the top than at the bottom, while the small or top die is made slightly smaller at the bottom. To make the dies easier to handle, a hole is usually drilled and tapped in each block and round bars drilled and screwed into the holes to form handles.

Fig. 232 shows the handles in place and also a simple duplicate die for making the hook shown at *A*. This hook is bent from stock ½ in. x 1¼ in. to fit around the flange of an I beam. The hooks were about 8 in. long when finished. For bending these, two cast iron blocks or dies were used, as shown at *B*. These dies are nothing but rough casting, patterns being made by simply laying out the work on a piece of 2 in. white pine, and then sawing into shape on a band saw. The block may be laid off as shown in Fig. 233 at *A*, the sawing being done on the dotted lines. This will leave the blocks of such a shape that the space between them when they are brought together with the upper and lower edges parallel is just equal to the thickness of the stock to be bent.

Patterns like this require plenty of draft, which is very easily done by simply planing the sides after the blocks are sawed out, so that they will taper slightly, as shown at *B*, Fig. 233, the dotted lines showing the square sides before being planed off and drafted, as indicated by the solid lines.

When the castings are made, a 13/32 second hole is drilled in the right hand end of each block and tapped with a ½ in. tap. A piece of ½ in. round iron about 36 in. long is next threaded with a die for about 2 in. on each end and bent up to form the handle. A check nut is screwed on each end, and the blocks screwed on and locked by bringing the nut up against them so that the finished dies will look as shown in Fig. 232.

The handle will form a spring so that the dies are held far enough apart to allow the iron to be placed between them.

Now dies of this kind may be very readily made to cover a wide variety of work and they are extremely inexpensive. The dies shown in Fig. 232 will require only about ¾ of an hour for pattern work, with perhaps as much more time for fitting the handles, so the entire cost will be inside of $1.50. The same handle may easily be used for any number of dies of about the same size and if any one of the dies becomes broken, it can be replaced at a very small cost. Cast iron dies like these just described have been used to bend several hundred pieces and then show no signs of giving out, although they might snap at the very first piece, should they be made of hard iron. For this reason, it is advisable to cast an extra set to have on hand, in case one should prove defective. These dies may be used on any ordinary steam hammer which has flat forging faces and not only that, but they may be placed directly under the hammer or removed without interfering in any way with any other work, since they do not have to be fastened down in one position.

Fig. 234 shows a loop with ends bent in. Forgings of this type are frequently wanted in large numbers. To make them, the stock is cut to the proper length and the ends bent at right angles. To make all of the pieces alike, one end of each piece is first put in a vise and bent as shown at *B* (Fig. 234). The other ends of the pieces are then all bent the same way, by hooking the bent end over a bar which is cut to the proper length, and bending down the straight end over the other end of the bar, as shown at *C*. The final bend is made over a cast iron form, similar to *D*. This casting should be about 2½ in. thick and the dovetail-shaped base made to fit the slot in the anvil base of a steam hammer. When this form is used, the anvil die is removed and this form put in its place. The strips to be bent are laid on top of this form and a heavy piece of flat stock, 1½ x 2½ in. bent into a U shape, so as to fit the outside of the forging and placed on top. A light blow of the hammer will force the U-shaped piece down and so bend the stock into the proper shape. Fig. 235 shows the use of the form in the steam hammer. The dotted lines indicate the position of the pieces before bringing down the hammer. The most satisfactory results will probably be obtained by bringing the hammer down lightly on the work, then by turning on a full head of steam. Force the ram down rather slowly, so as to bend the stock gradually and easily. This will be found to be much more satisfactory than the use of a quick, sharp blow. The U-shaped piece does not need to be exactly the same shape as the forging. It will be satisfactory if the lower ends of the U are the proper distance apart. When the strip is bent over the form, it naturally follows the outline, and it is only necessary to force it against the form at the lower base of the sides. In work of this character, the final bend is sometimes made by using a second die, which is fastened to the ram of the hammer in place of the U-shaped loop.

For most work of this kind, two dies are necessary, but of course they are not expensive to make. The upper die is made very easily to fit in the dovetail on the ram, and held in place with a key.

RIGHT ANGLE BENDING

Fig. 236 shows some very simple and convenient tools for bending right angles in stock which does not run over ½ in. in thickness. The lower one is made so as to fit easily over the anvil of the steam hammer. The projecting lips on each side will prevent the die from sliding forward or back. This one has a handle screwed in, as in the case of the die shown in Fig. 232. Both of these bending tools may be made of cast iron, the patterns being sawed from a 2 in. pine plank. If possible, have these dies cast from tough gray iron, rather than hardy white pine, because they are very much less liable to break if cast from the gray iron. Where these dies are intended to do a large amount of work, the iron is frequently of the grade known as chilled iron, the faces being hardened or bent for a depth of at least 1 in.

COIL SPRINGS

The dies which I have just described are used only for simple bends, the bending force coming from one direction only. Where a complete circle or a series of circles is formed, a rather different arrangement must be used.

Fig. 237 is a good example of this

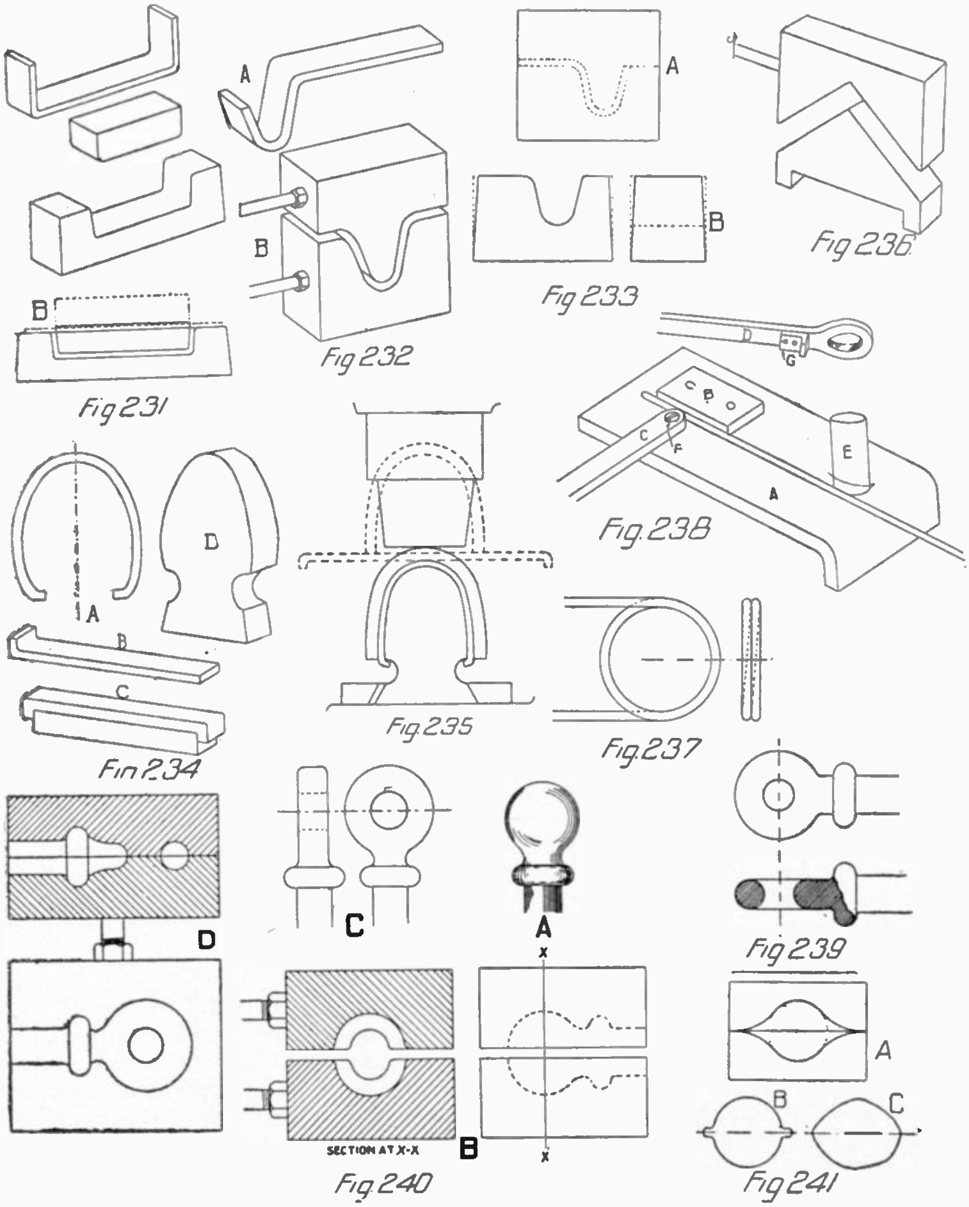


Fig 231 Fig 232 Fig 233 Fig 234 Fig 235 Fig 236 Fig 237 Fig 238 Fig 239 Fig 240 Fig 241

kind. This bending may be done cold, but for hot bending the operation is precisely the same. In Fig. 238, this is bent from a base plate *A* ½ degree, and has one end bent down at right angles, so that it may be clamped in an ordinary vise. The cylinder, or *E*, is simply a 1 in. stud screwed into the bend. *B* is a piece of ½ in. by 1¼ in. stock, 2 in. long, fastened down with two rivets, and used as a stop for clamping the stock again while bending.

C is a lever made of a piece of 1 in. by 1¼ in. stock and 10 in. long, one end being ground round as shown. This lever turns on the screw *F*, which is threaded into the base plate. *D* is the bending lever and has a hole punched and forged in the end large enough to turn freely on the stud. Opposite to the underside of this lever is riveted a short piece of iron, which has one end bent down at right angles. This piece is so placed that the distance between the stud *E* and the inside face of the bent end, with the lever in position for bending, is about 1/64 in. greater than the thickness of the stock to be bent.

To bend the stock, place in the position shown in the sketch and pull the lever *C* over to lock it in place, with the bending lever *D* dropped over it in the position shown. To bend the stock, pull the lever around in the direction of the arrow, giving it as many turns as are wanted for the spring, or whatever is to be bent. The piece may be slipped from the stud by loosening the clamping lever and then lifting off the bending lever. For jigs of any kind, it is best to use a stop which should be placed so that the end of the stock will come against it, so as to ensure placing and bending all the pieces as nearly as possible alike.

DROP FORGINGS

I shall in a later article take up the work of drop forging in some detail, so at this time will make mention of only one or two simple examples of this kind of work. As my readers probably know, drop forgings are forgings which are made between dies in a forge or drop press. Every die has a recess in its face so shaped that when the dies are in contact the cavity left will have the form of the desired forging.

One of the dies is fixed and the other movable; that is, one is fastened to the bed of the dropped press directly in line with and under the second die, which is fastened and keyed to the under side of the drop, a very heavy weight, running between vertical guides. The forging is done by simply raising the drop and allowing it to fall between the guides of its own weight.

There are usually two or more sets in the die faces, the first set being used for roughing out the stock roughly to shape, and the other set for finishing the forging. These dies are known respectively as the Break Down Dies and the Finishing Dies.

In complicated work several intermediate dies are sometimes required. The example given below is one which might readily be called a drop forging, since the work is done between forged dies.

DROP FORGING EYEBOLTS

Fig. 239 shows an eyebolt and Fig. 240 shows the dies which are used together with the different steps required in the making of the eyebolt. Round stock is required for this and is first shaped as shown at *A* (Fig. 240), this forming being done in the die shown at *B*. Both dies shown in this figure are made exactly the same as ordinary hammer swages; that is, simply two blocks of tool steel fastened together by means of a spring handle.

The inside faces of the blocks are formed to shape the piece as shown. The stock is to be revolved through at least 90° between each two blows of the steam hammer and the hammering continued until the die faces just touch. The next thing is to flatten the bolt to about the thickness of the finished eye between the bare hammer dies, after which the hole is punched with an ordinary punch under the hammer. A finishing die, *D*, is used for the final work. This die, which is shown in section in Fig. 240, is so shaped that when the two parts are together the hole left will be exactly the same shape as the finished forging. Notice, however, that in the first die, the holes do not conform exactly to the required shape of the forging; that is, the holes are rounded off quite a little at the edges instead of being exactly semi-circular.

Fig. 241*A* will make this clearer perhaps. The dotted lines show the shape of the forging, while the solid lines show the shape of the die. The reason for this is that if the hole is an exact half circle in section, the stock which is larger than the small parts of the hole after being struck with the hammer is left like *B*. The metal is forced out between the flat faces of the die, thus forming fins. After the bar is turned through 90° and another blow struck with the hammer, these fins are duplicated and in hand work make a bad place in the forging.

If the hole is a modified semi-circle, the stock will be formed as shown at *C*, and then may be turned and worked out, forming "cold shuts."

CAST IRON DIES

As I have said, much duplicate work is done with cast iron dies and also much drop forging work, and if the work is not too heavy, these dies are satisfactory, and the cost is very small as compared with the steel dies used for the same purpose. Drop forging may be done with the steam hammer by simply keeping the dies in the dovetails which are made for the top and bottom hammer dies.

Welding work is often done in this way, because the metal to be worked is in such a soft condition that there is very little chance of smashing the die.

FORMING DIES HOT

Dies similar to the ones shown in Fig. 240 are usually expensive to make, especially if the work is done in a machine shop. Rough dies for this kind of work may be made in the forge shop by shaping them hot. The blocks for the dies are forged and a plank, or master plank, as it is called, which is the same shape and size as the forgings the dies are expected to form, is made from tool steel and carefully hardened. The die planks are next heated, the master plank placed between them and the dies hammered together, the master plank being turned frequently during the hammering. This method will, of course, leave a cavity exactly the shape of the master plank. Where two or more sets of dies are required, there must, of course, be separate master planks for every set of dies. Dies made in this way will have the corners of the cavities well rounded off, because the metal is naturally pulled away during the forming. Dies of this type may be used to advantage with almost any kind of steam hammer.

For spring hammers, power hammers and Helve hammers, the die faces are usually formed as just described, but the die blocks should be fastened to the hammer and anvil of the power hammer itself, replacing the ordinary dies.

Repairing a Mirror

We doubt whether an amateur can patch the amalgam back of a mirror so as to make a satisfactory job, says the *Druggist's Circular;* but we know of nothing to prevent one from experimenting along this line if he wants to, and here is some advice which may be of assistance to the experimenter.

First: clean the bare portion of the glass by rubbing it gently with fine cotton, taking care to remove any trace of dust and grit. If this cleaning be not done very carefully, defects will appear around the place repaired.

With the point of a pen-knife cut upon the back of another looking-glass around a portion of the silvering of the required form, but a little larger. Upon it place a small drop of mercury; a drop the size of a pin's head will be sufficient for a surface equal to the size of the nail. The mercury spreads immediately, penetrates the amalgam to where it was cut off with the knife, and the required piece may now be lifted and removed to the place to be repaired. This is the most difficult part of the operation. Then press lightly the renewed portion with cotton; it hardens almost immediately, and the glass presents the same appreance.

Second: pour upon a sheet of tinfoil about 3 drams of quicksilver to the square foot of foil. Rub smartly with a piece of buckskin until the foil becomes brilliant. Lay the glass upon a flat table, face downward; place the foil upon the damaged portion of the glass; lay a sheet of paper over the foil, and place upon it a block of wood or piece of marble with a perfectly flat surface; put upon it sufficient weights to press it down tight; let it remain in this position a few hours. The foil will then be adherent to the glass.

"ARTS AND CRAFTS" JEWELRY AND HOW TO MAKE IT

RALPH F. WINDOES

The "Arts and Crafts" line of jewelry put upon the market recently, met with a great demand by lovers of the unique. So great was the demand, and still continues to be, that dealers put enormously large prices upon it compared with the cost at which it is made. For the craftsman who desires to make his own jewelry we will herein describe and illustrate methods of procedure by which he should find little difficulty in constructing it; and as the cost is slight and the work extremely interesting, he will find himself well repaid for the time and money expended.

First, obtain the following articles:

1 pair steel snips, 2 in. cut.
1 ball-pein hammer, 10 oz.
1 flat file, 6 in.
1 piece 16 gauge soft copper, 6 x 6 in.
1 piece 16 gauge soft brass, 6 x 6 in.
1 camel's-hair brush, medium size.
1 camel's-hair brush, large size.
½ pt. asphaltum varnish.
½ pt. turpentine.
3 oz. banana oil.
4 oz. nitric acid.
1 box polishing powder.
1 block hard wood, 3 x 3 x 6 in.
1 block iron or steel with at least one smooth surface, 1 x 4 x 4 in.

The above articles will cost in the neighborhood of $2.75 and will not exceed $3.00. The block of iron can be picked up around any machine shop at little or no cost.

With the above outfit all parts of the jewelry can be made excepting the fittings. These consist of scarf pin stems, cuff button backs, belt catches, fob mountings, etc. They may be purchased from any jeweler or direct from the Frost Arts and Crafts Workshop, Dayton, Ohio. The beginner had better have his soldering done for him by a jeweler, as the cost for each article is small and the cost for a good, hard soldering outfit is considerable.

As all the designs are made in about the same manner, a description of the processes involved in making a hat pin will answer for all.

First decide as to the material for the head, copper or brass. In this case we will give the choice to brass. Next

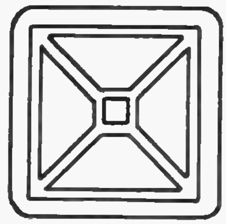


FIG. I.

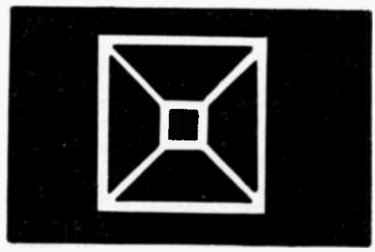


FIG. II.

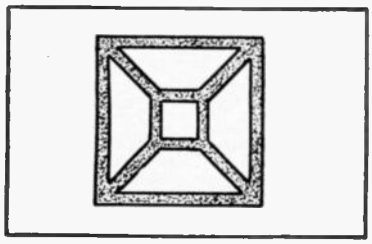


FIG. III.

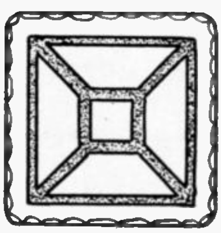
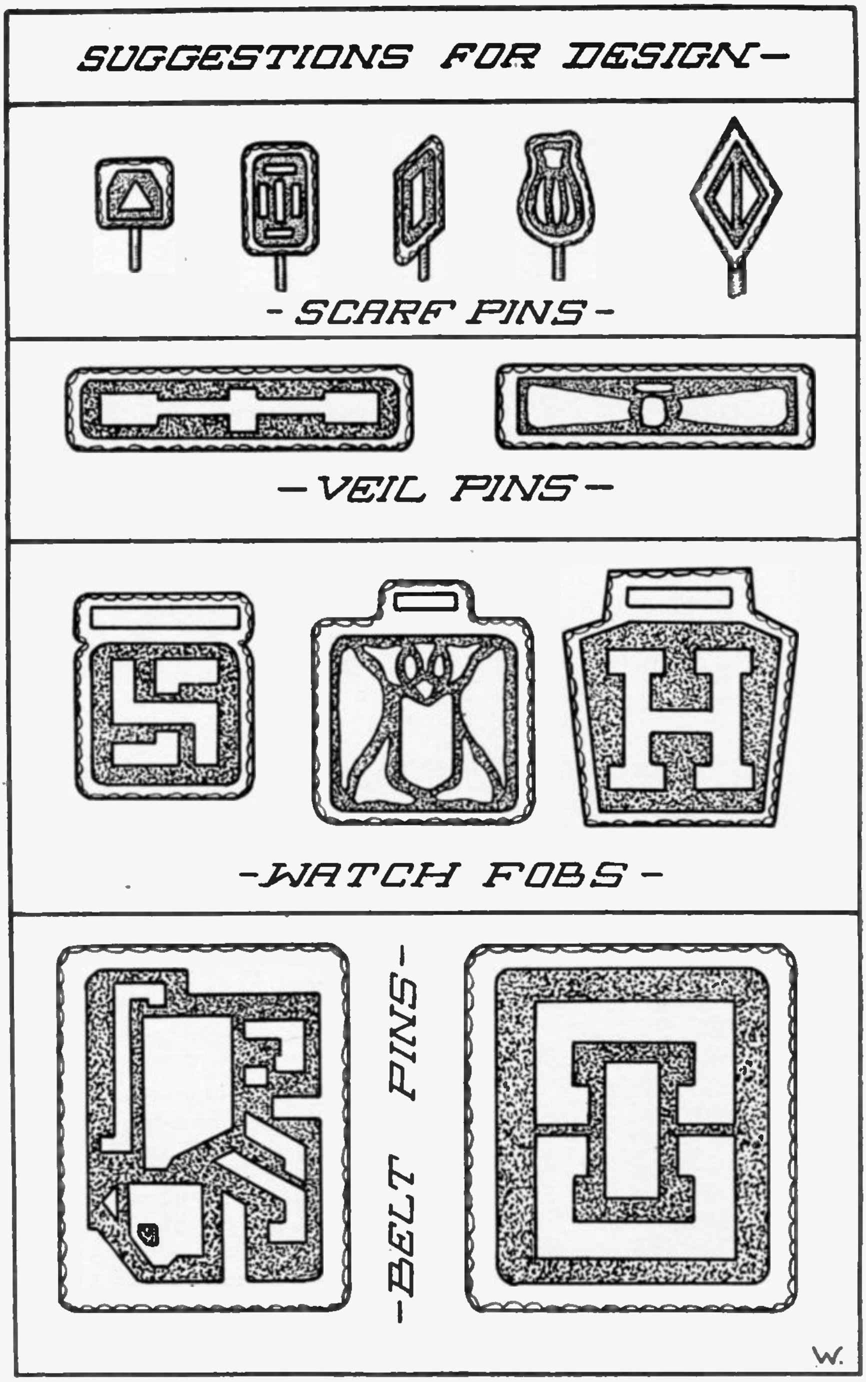


FIG. IV.

W.

draw an appropriate design as in Fig. 1, and transfer it to the brass by means of carbon paper. The piece of brass transferred to must be a little larger than the design. Now paint over the parts



of the design that are not to be etched with the asphaltum varnish, and it will assume the appearance of Fig. 2. The back of the piece must also be covered. Allow it about an hour's time to dry in and then immerse it in a solution of one part nitric acid to five of water. This solution must be kept in an earthenware dish as the acid will attack any metal in contact with it. Allow it to stand in the acid until it is etched deep enough, but do not let it etch too deep as this would weaken it considerably. Take it out and wash it in clean water, and then let it stand in a dish of turpentine until the varnish softens, after which it can be easily removed. After removing the varnish it will appear as in Fig. 3. Now take the snips and cut out the pin head from the metal and file the edges smooth. Place it upon the iron block and strike the edge with the ball-pein of the hammer so that it appears as in Fig. 4. Next place it, face down, on the end of the hardwood block and strike the centre of the back with the round end of the hammer. This raises the design.

It is now ready for the jeweler. Take it to him and have a pin soldered to it, which will cost about ten cents, providing it is hard soldered. Next polish it good with the powder and cover it with banana oil so that it will hold its polish. If the popular green background is desired, it can be gone over with the following verdigris solution:

Copper nitrate, 48 gr.
Ammonium chloride, 48 gr.
Calcium chloride, 48 gr.
Water, 3 oz.

These directions hold true for all the pieces excepting the watch fob. In this case a place has to be removed for inserting the leather strip and this can be removed in the following manner: After the design on the fob has been sufficiently etched, take it out, wash it, dry it, and cover it all over with the varnish, excepting the groove which is to be removed. When the varnish is dry put it back in the acid and leave it there until the groove is etched away. Then clean it as the pin was cleaned, and attach the mountings.

With a little originality and care, any one can make his own jewelry, and although it may not be as nice as that made by professional craftsmen, he has the satisfaction of knowing he made it himself.

TO RENDER CLOCK DIALS LUMINOUS

Clock dials are rendered luminous in the dark by means of luminous paint. Of course, in doing such work, it is necessary to block out the figures—that is, paint the entire dial with the exception of the figures. You can no doubt purchase such paints, and we would advise you to do so if possible, but for the benefit of those who cannot procure them, we give the following somewhat condensed exposé of the materials employed and manner of combining them in preparation of luminous paints. The property of absorbing and afterwards emitting light is possessed by many substances, like the mono-sulphide of calcium, barium, strontium, uranium, magnesium, aluminum and several others, which, after being exposed to a strong light for some time, have the property of giving off or emitting the light absorbed. Phosphorus is also sometimes added as an ingredient which both intensifies and prolongs the luminosity. The ashes of seaweed are used to supply the phosphorus; also calcined marine shells. The preparation of the materials for luminous paints generally involves processes of a complicated chemical nature, which in many instances are not easily explained, but still essential to satisfactory results. Balman's process of preparing luminous paints, as set forth in the specification of his patent, is as follows: "The phosphorescent substance employed is a compound obtained by simply heating together a mixture of lime and sulphur, or substances containing lime and sulphur, such as alabaster, gypsum, etc., with carbon or other agents, to remove a portion of the oxygen present; or, by heating lime in a vapor containing sulphur. This phosphorescent powder can be employed as a paint by adding a mixture of gum mastic and turpentine, or drying oils such as are employed for the preparation of ordinary paints."

The next advance in the preparation of luminous paints was a French compound, which incorporated phosphorus as above mentioned. The method of preparation was as follows: 100 lbs. of carbonate of lime and phosphate of lime, produced by the calcination of seashells, and especially those of the genus *Fridæna*, and the cuttle-fish bone, intimately mixed with 100 lbs. of lime rendered chemically pure by calcination, 25 lbs. of calcined sea salt, 25 to 50% of the whole mass of sulphur (incorporated by sublimation), and 3 to 7% of coloring matter in the form of powder, composed of mono-sulphide of calcium, barium, etc., which possess the properties of shining in the dark.

We have now stated the basis of the composition of all luminous paints. In the practical use of these paints there was a disagreeable feature to overcome—the paint seen by day or artificial light was not the same tint as was emitted when the paint became luminous and shone by itself. We have all seen luminous watch dials which, when seen by ordinary daylight, had a sort of creamy look, and in the dark shone with an uncanny lilac tint. We give below a list of colors and the mode of preparation, which show the same color either by daylight or when emitting absorbed light. These colors are usually mixed with a certain varnish known as "lake varnish," prepared as follows: Zanzibar copal is melted over a charcoal fire, and 15 parts of this substance is dissolved in 60 parts spirits of turpentine. After thorough incorporation of these substances the mixture is filtered and 25 parts of pure boiled linseed oil added; the resulting varnish is employed for mixing the luminous paints, which are ground in a paint mill, employing granite rollers, as iron or steel rollers would affect the paint.

Pure White Luminous Paint.—Mix 40 parts of the above lake varnish with 6 parts of prepared baric sulphate, 6 parts of prepared calcic carbonate, 12 parts of prepared zinc sulphide (white) and 36 parts of calcic sulphide in a luminous condition. Work these ingredients into a coarse emulsion and grind between the granite rollers as described.

Red Luminous Paint.—50 parts of lake varnish, 8 parts of prepared baric sulphate, 2 parts of prepared madder lake, 6 parts of prepared realgar (diarsenious disulphide) and 34 parts of calcic sulphide in a luminous condition, and the mixture worked the same as for white.

Yellow Luminous Paint.—48 parts varnish, 10 parts prepared barium sulphate, 8 parts barium chromate and 34 parts luminous calcium sulphide.

Blue Luminous Paint.—42 parts varnish, 10.2 parts prepared barium sulphate, 6.4 parts ultramarine blue, 5.4 parts cobalt blue, 46 parts luminous calcium sulphide. Luminous paints for artists' use can be prepared by substituting East India poppy oil for the lake varnish. Luminous paints can also be mixed with wax or collodion. In a recent issue of the *Druggist's Circular*, we find the following reply to a correspondent desiring information on this subject:

Luminous paints for watch dials or other objects which it is desirable to see in the dark, consist mainly of certain sulphides. These paints have apparently failed to meet the expectation aroused on their introduction, as they do not seem to have come into use owing, probably, to want of permanence, but we append information regarding them which may be of some interest. One variety is made by calcining carefully cleaned oyster shells in a closed crucible, adding to 20 parts of lime so obtained, 6 parts of sulphur and again heating in the same manner. For the production of a yellowish-green phosphorescence, the following combination has been published:

	Grams
Shell lime	100
Sulphur	30
Starch	10
Plumbic acetate	0.035

To obtain a violet phosphorescence the following formula has been published: Mix 20 grams of shell lime with 6 grams of sulphur and 2 grams of starch, all in powder. Add to the mixed powder a solution prepared by dissolving 0.5 gram of bismuth nitrate in 100 c.c. of absolute alcohol with the addition of a few drops of hydrochloric acid. After the alcohol has evaporated, heat the mass to a redness in a covered crucible for twenty minutes. After the crucible has cooled remove a thin layer from the top of the mass, pulverize and heat again for half an hour. The granules which form must not be powdered too finely, as the phosphorescence would be thereby diminished.

DESIGN AND CONSTRUCTION OF MODEL AEROPLANES—Part II

Air Currents

EXPERT

To be successful in flying model machines it is necessary to know something about air currents, and we have a fine object-lesson in the observation of a bird's flight. Taking a soaring bird, a gull for instance, how easily it appears to fly; it glides through the air with wings outstretched to the full, and only flaps them for upward or greater forward motion.

It must be remembered that a bird, when in the air, like any other body heavier than the air, is continually falling, and yet a soaring bird can remain almost motionless and glide considerable distances without a perceptible movement of its wings.

This natural phenomenon is of very common occurrence, but is little understood, and is generally taken for granted. In a dead calm a bird cannot soar, but the air is very rarely quite still; there are always moving currents, and these are usually inclined upwards. It is by taking advantage of these upward currents that a bird is enabled to soar, and a knowledge of how these atmospheric movements are caused will be advantageous.

When air is warm it becomes lighter (we see this in the paper balloons inflated by heated air), and consequently rises, its place being taken by cold air from above. Air also, as wind, travels in various directions, from horizontal to vertical, the different directions being caused by obstructions, cliffs, hills, trees, etc.

For instance, a horizontal wind moving along the ground in the direction of the arrows in the diagram, Fig. 1, would follow the contour of the land.

An obstruction, such as a cliff, would cause the wind to take a vertical direction, or supposing there is a hill, as indicated at Fig. 2, the direction of the wind would follow the inclination of the ground, and would also, to a somewhat limited extent, follow the downward inclination of the hill.

The aeroplanist, if such an expression is allowed, should take advantage of an upward current, particularly when he wishes to try the gliding capabilities of his model.

Several chapters could be written on the causes and effects of the various disturbing elements in the atmosphere, but the model maker need only concern himself with the air as it immediately affects him.

In calculating the speed of a body moving through the air, we cannot take the miles covered per hour in relation to the land. The velocity of the wind has to be taken into account if a comparison with land speed is required. One may row a boat at a speed of 5 miles an hour with the stream, and pass the river banks at a much greater speed, and in the same way if rowing at the same rate against the stream very much slower progress is attained.

In the air we may have a very light breeze, at 2 to 4 miles per hour, a light wind up to 12 miles an hour, and a high wind or gale up to 40 miles per hour and more. Supposing we have a body traveling at a land speed of 5 miles an hour against a wind of 5 miles an hour, we should find that the body would be motionless in relation to the land; were the wind to increase to 10 miles the speed of the body would be 5 miles per hour backwards, but supposing the wind dropped to 1 mile per hour the speed of the body would be 9 miles per hour.

If the same body traveled at the same speed with the wind also the same speed, say, 5 miles an hour, the body would travel 10 miles in relation to the land; with an increased wind velocity the speed would be considerably increased.

It is necessary to understand this, for when we read that a certain aeroplane traveled at 50 miles an hour, it may be that in relation to the land it may only have been traveling half the distance.

CENTRE OF PRESSURE AND GRAVITY

We mean by the centre of gravity, that particular point where the weight is centred in the pull towards the earth.

The centre of pressure is an imaginary

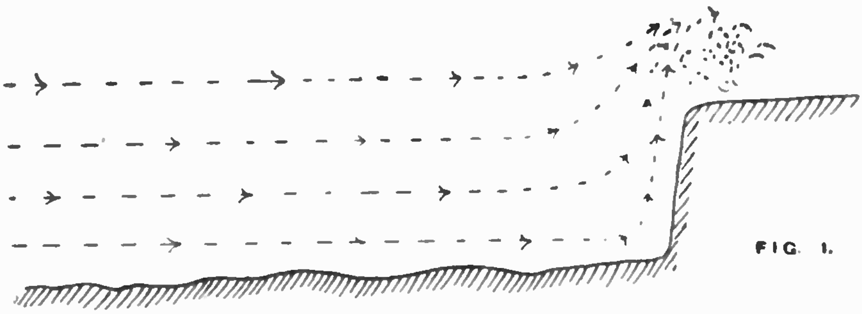


FIG. 1.

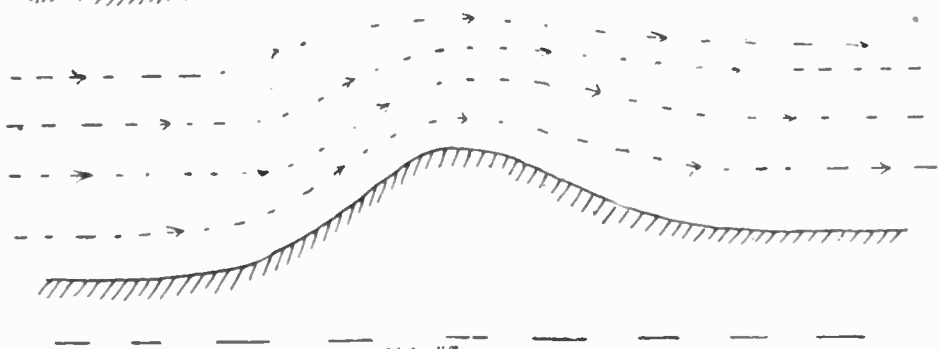


FIG. 2.

1 Effect of horizontal wind obstructed by a high cliff.
2. The effect of an horizontal wind following the contour of the land.
3. Diagram showing centres of pressure and gravity acting on an aerofoil.
4 Diagram showing the streamline form, lower portion with obstruction causing disturbance.
5. Effect of square body meeting the air.
6. Effect of conical body meeting the wind.

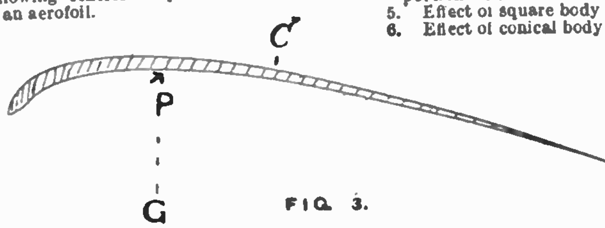


FIG. 3.

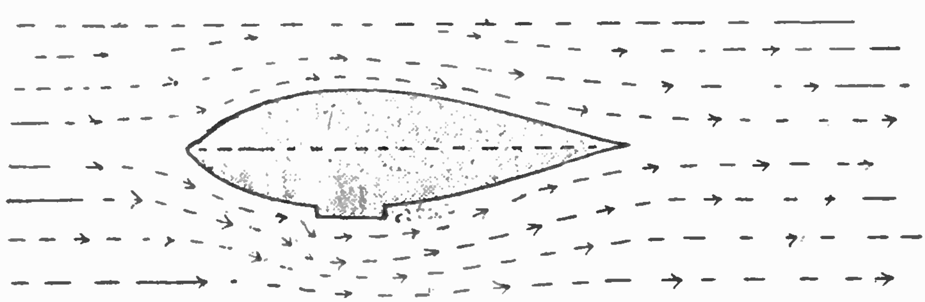


FIG. 4.

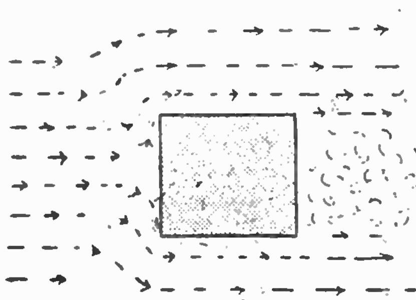


FIG. 5.

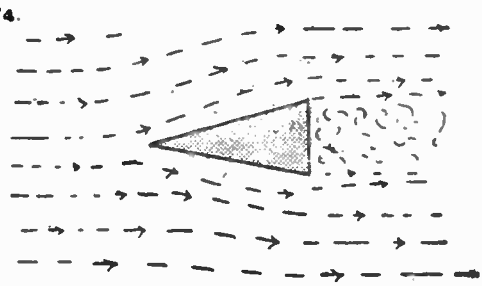


FIG 6.

line along the plane, dividing it into two equal pressure areas, and it varies according to the angle at which the plane meets the air. For an illustration of the above points, Fig. 3, we will take an aerofoil at an angle of 1 in 10, with the centre of pressure at *P*. The actual centre of the aerofoil is at *C*, and the centre of gravity directly underneath, as shown by *G*. We will suppose that the centre of gravity is carried along in front of *G;* this will have the effect of pulling the front of the plane down, and altering the angle of the plane; so, to ensure the plane being in perfect equilibrium at the most suitable angle for flight, it is necessary to have the centres of pressure and gravity coincident.

It is very necessary, in designing aeroplanes, that the machine should be so balanced that these centres will coincide; and, in many cases, to ensure longitudinal stability, it will be necessary to have an adjustable weight or a movable aerofoil, so that adjustment is a simple matter.

This is particularly necessary when elevators are used. A slight alteration of elevator will alter the angle of flight, and this may bring the centre of gravity either in front or behind the centre of pressure.

HEAD RESISTANCE

The shape of a flying machine is an important matter, and apart from the planes, consideration must be given to most suitable forms for the framing, and the shape which offers the least resistance to the air will be found the best.

Birds and fishes have what is known as streamline form; this is shown at Fig. 4, where the dotted lines represent the flow of air surrounding the steamline form.

At Fig. 5 is shown the effect of a flow of water or air around a square block; the flow is disturbed right in front, and at the rear there is a vortex of small eddies, known as dead water or air.

We have a similar occurrence in a cone-shaped block, as shown at Fig. 6, but cut away the shoulder, and notice the lines at Fig. 4.

The ideal form is that shown at the top of Fig. 4, and all parts of the machine should, as far as possible, be as near to this shape as possible.

There is so much to be learned in the flight of gliding models, that no model maker should neglect to make and fly those illustrated in the accompanying diagram.

An aeroplane model will reproduce with perfect fidelity the flight of a full size machine, and in the same way a gliding model will also show the capabilities of various forms of planes, and it is most interesting, as well as instructive, to watch the glides of paper aeroplanes.

The materials required comprise cartridge drawing paper, cardboard, wire, gum, and in a few minutes we may put into actual practice any particular form of aerofoil we desire.

We will take, first of all, the single plane glider shown at Fig. 1. Cut it out in paper to the dimensions given at Fig. 2, hold it up in the air and let it fall.

It will be seen that the plane will turn over and over again until it reaches the ground. Now cut a thin strip of cardboard and fasten it on, as shown by the dotted line, and try again. This time the plane will glide to the floor. Further experiments may be made by reducing the width of the plane, the distances covered in each glide being noted.

We will now try a slightly curved aerofoil. Cut out the same plane to the dimensions given at Fig. 3, and slightly curve the back edge from the centre, as shown at Fig. 4, and notice the difference in the glide. Again bend up the ends to the dotted lines and try again. This glider should also be held upside down and allowed to fall: it will be noticed that it will turn completely over and fall on the ground in the correct position.

A third type of monoplane glider is shown at Fig. 5. Cut out a piece of cardboard 10 in. long and ⅝ in. wide; at one end stick on a paper plane, made in the same way as Fig. 1, with the cardboard edge on the inside. This plane should be 10 in. long and 3 in. wide. At the other end of the narrow strip gum on a plain piece of paper, 5 in. long and 1¾ in. wide (Fig. 6). Hold it up and allow it to fall. Next bend up the front

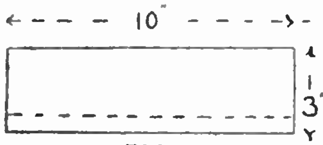


FIG. 1.

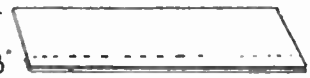


FIG. 2.

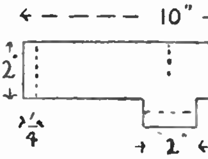


FIG. 3.

FIG. 4.

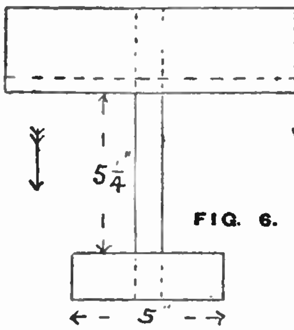


FIG. 6.

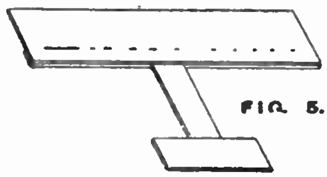


FIG. 5.

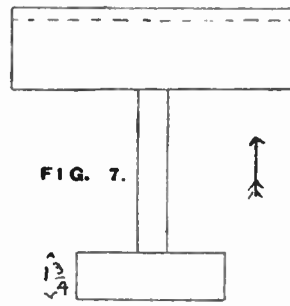


FIG. 7.

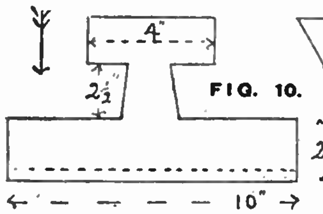


FIG. 10.

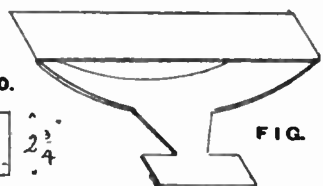


FIG. 8.

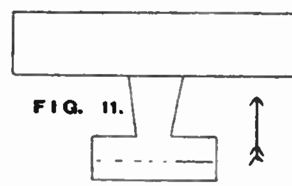


FIG. 11.

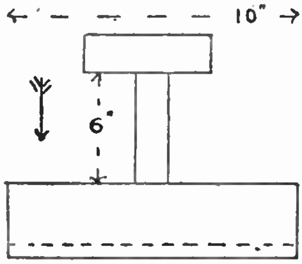


FIG. 14.

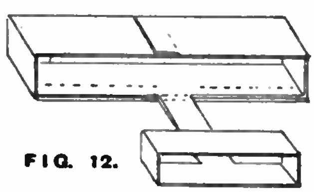


FIG. 12.

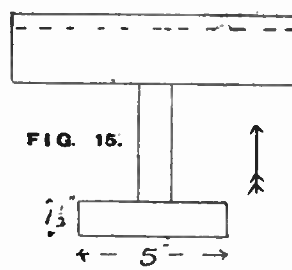


FIG. 15.

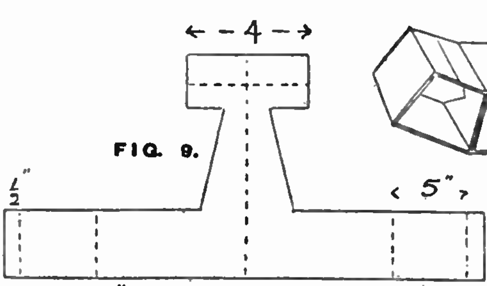


FIG. 9.

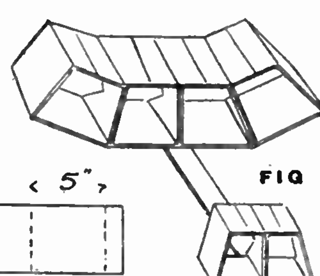


FIG 16.

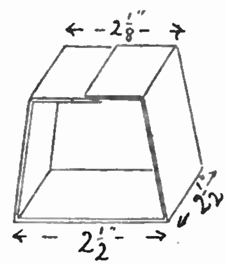


FIG. 17.

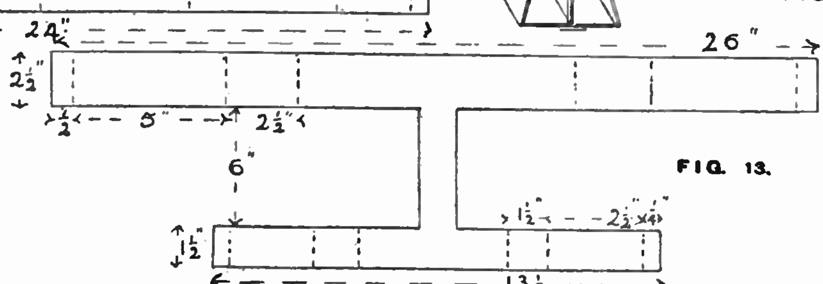


FIG. 13.

at about one third of the length to an ⅛ in. and note the increased length of the glide. This glider fully illustrates the value of a front elevating plane in a monoplane.

Experiments should now be made with bi-plane gliders, three different types being shown. Fig. 8 is a very simple glider and should be cut out as shown at Fig. 9. The cardboard weight should be placed in front under the elevating plane and the under portion of main plane carefully bent, so that the top is quite straight. Much interesting knowledge of the action of elevating planes may be gained with this glider. A piece of fine wire should be placed along the lower planes and bent over the edge, and the elevator bent to various angles.

At Fig. 12 is given the miniature of a well-known type of aeroplane, cut out as shown at Fig. 13, and we may make two different treatments of it, one with the elevating planes in front and a thin strip of cardboard under the front lower edge of the main planes.

The other treatment with the small planes behind requires a heavier strip of cardboard under the front lower edge of main planes. There is no need to have any weight on the rear planes.

The necessity for having a negative angle to the rear planes will be noticed, and experiments may be made to show the effect of one or two more vertical planes placed between the main planes.

At Fig. 16 is shown another form of glider, which is worth while experimenting with. It is made of cartridge paper and stuck on a length of cardboard. Make four paper boxes, as shown at Fig. 17, marking them accurately and gumming on the top edge to the dotted lines, thus taking up ¼ in. Next gum these together and cut out the back to a V shape with a pair of scissors. The two front planes are smaller, but made in the same way. This model gives five glides and answers very well if the front edges of the two middle boxes are weighted with cardboard and the small planes used as a tail.

The number of experiments possible is practically unlimited, and as so much profitable instruction may be gained by noting gliders in motion, the model maker should take some trouble to make the above and any other model he comes across.

It is a simple matter to reduce to a small scale the shape and area of large planes, and it will often save much disappointment if the ambitious model maker were to reduce his design to paper glider dimensions, and so test the gliding properties of his planes before making them up full size.

It may be that the gliders shown above do not answer as well as might be expected; but thickness of paper or cardboard or inaccuracy of balance will be sure to cause some alteration, and it will probably take a little adjustment in each case before a successful glide results.

Models based on the above gliders will be described in future articles and having previously made the paper aerofoil, the model maker will find it much easier to appreciate the areas, etc., of each plane.

ILLUSTRATIONS

Fig.
1. A simple glider—No. 1.
2. Method of making simple glider.
3. Method of making glider with slightly curved plane.
4. Glider with upturned edges and curved plane—No. 2.
5. Glider with elevating plane—No. 3.
6. Method of cutting out.
7. Same glider with tail instead of front plane.
8. Simple bi-plane glider.
9. Method of cutting out—No. 4.
10. Same glider with tail.
11. Plane of glider—No. 4.
12. Bi-plane glider—No. 5.
13. Method of cutting out glider—No. 5.
14. Plane of glider—No. 5 with tail.
15. Plane of glider—No. 5 with elevating plane.
16. Glider—No. 6.
17. Method of making cartridge box for glider—No. 6.

Special interest attached to the recent launching of the torpedo-boat destroyer "John Mayrant" at the Cramp's shipyard. She was christened by the great-great-grand-daughter of John Mayrant, who was a midshipman on the "Bonhomme Richard" during the historic fight between that vessel and the "Serapis." The "John Mayrant" is 293 ft. 10½ in. long, 27 ft. beam, and will draw on her trials 8 ft. 4 in. She is to make 30 knots an hour. Her armament consists of five 14 lb., semi-automatic guns and three deck torpedo tubes.

MACHINE SHOP
THEORY AND PRACTICE

Edited by OSCAR E. PERRIGO, M.E.

THE APPRENTICE IN THE SHOP

Last month we took occasion to comment upon the unusual opportunities which the conditions of the present time offer to the young men entering shops and manufacturing establishments as apprentices. In this article we propose to discuss some of the conditions, privileges and responsibilities of the apprentice in the regular routine of the shop work.

The time-honored rule, which in former years the apprentice was seldom allowed by his elders to forget, was "Keep your eyes and ears open and your mouth shut," is rather too much of the spirit of the old adage, "Spare the rod and spoil the child," to be favored or even tolerated in the modern shop.

It is true that apprentices were permitted to ask questions of the older men. Sometimes their questions were answered, but often they were entirely ignored. It must also be said that when questions were answered the information was not always given in good faith, and, instead of giving him the information desired, the apprentice was made the target for many stale and so-called practical jokes by the men. Hence, the "left hand monkey wrench," the "round try square," the "three-cornered rat-tail file," and numerous others of the "smart Alec," but more or less imbecile type.

Along somewhat similar lines and from somewhat similar ideas, it was sometimes expressed that "cubs are a nuisance generally"; ("cub" was the old shop name for an apprentice). He was more likely to be "cussed" than commended, to be snubbed than instructed. In his work he was given most disagreeable and monotonous tasks, particularly during his first year, and a studied effort seemed to be made to get as much productive work out of him as possible, and to afford him as little real information as convenient.

Beyond sweeping floors and cleaning up machines, "snagging castings," rough painting and similar work, he was shown (not taught) some simple operation and then kept at it for days and often weeks, until its very monotony was enough to everlastingly disgust him with the machine business. A time-honored shop incident reflects this condition in a very true light.

Tom and Bill were apprentices in different shops and meeting on the street one day proceeded to compare notes on their shop experiences, when the following conversation took place.

"Say, Bill, have you got on a machine yet?"

"Oh, yes, got on one last month."

"What are you doing?"

"Tapping nuts."

"How many did you tap?"

"A barrel full."

"What did you do next?"

"Tapped another barrel full."

And he would probably have been tapping nuts indefinitely if he had not made such strenuous objections to the job as to induce the foreman to give him another.

But these ideas and methods, or rather the lack of them, are changing for the better, and bright apprentices are taking up the work with a more definite purpose than before of learning the trade in a thorough and systematic manner. On the other hand, the conditions of apprenticeship and the lack of thoroughly competent mechanics in nearly all lines of manufacturing are of such a nature as to make it imperative that the shop men shall see these matters in a different light from their former conception of the subject and modify their plans accordingly. Now, instead of making the apprentice a veritable shop drudge he is not only given many opportunities for learning to be a good mechanic, but he is given much practical information and instruction and offered ample opportunities for the practical experience at both hand and machine work without which no man can become proficient.

However, there is another side to the matter which must not be overlooked. The shop is not a school, but a manufacturing concern, and must produce its regular output, and it must do this at a profit or quit the business. The school is an institution where the corporation, the town or the city, must *spend* money. The shop is a business proposition and must *earn* money. The college is largely dependent upon gifts. The machine shop must depend on business ability and "hustle."

Therefore, the officials are very liable to be more concerned in the economical production of the output than in the education or training of the apprentices. The foremen are employed with these ideas in view and are usually so burdened with the duties of running their departments efficiently and economically that the work fills every moment of their time. They must take the orders from the office, procure the materials from the store room, the forge shop or the foundry, assign properly qualified mechanics to do the work, supervise the routine work, and be responsible for all its details, crowding the work to its completion, frequently within an unreasonably short period set by the office. His job is a continuous round of work and worry. He has little time and less patience to instruct boys, and frequently he is not competent to do it if he had both time and inclination.

Just here is where the shop instructor of apprentices should come in. He is not only a practical mechanic of ability, but selected because of his aptness as an instructor; and it is his duty, not only to go through the various departments giving instruction and information to apprentices, but to see that they get what they are entitled to, "a square deal." He is the coming man in the apprenticeship question, relieving the foremen from many duties for which they generally have little time or aptness, and successfully accomplishing the object of the proprietors,—that of turning out good workmen.

However, not all proprietors think they can afford the services of such a man, seeming to regard him in the light of an expensive luxury, desirable but not really necessary. In such shops the apprentices are to a considerable extent left to their own devices and must, in many cases, depend on their own efforts to "pick up the trade," as opportunities occur for them to do so.

But to the ambitious apprentice, eager to gain information and experience, there are constantly recurring opportunities for doing so, which, if taken advantage of in the right spirit, will surely be noticed by older persons and often result in instructive hints given by older workmen, a majority of whom take a more or less active interest in the young man energetically endeavoring to learn the trade.

It often happens that the young, active and impressible mind of the observant apprentice is able to note conditions and suggest devices, improvements and methods that will not only be of value to the manager of the plant but bring its author into the favorable notice of his elders. It may be in the form of a tool, that will enable it to cut faster or easier or smoother, or to retain its correct form for a longer period of time, so that there will not be so much lost time in grinding it. He may be working with a drill jig or a milling fixture and notice that if he fastened his work into it with a cam-lever instead of a set screw or a thumb screw he could do it quicker. Or, that the chips might be brushed out of it much more readily if there was a slot cut in the base of the jig which he could brush them into.

When the author was an apprentice he was put to work on certain pieces that required numerous operations of putting into a lathe, turning and taking out. He conceived the idea of using multiple stops on the lathe, by which several turning operations could be performed without taking the work out of the lathe. The result was that the entire job was turned over to him and the contents of his pay envelope very materially increased in consequence. This last result, while important, was not nearly so much so as was the practical experience which he gained in his personal responsibility for the job.

Another method by which the apprentice may gain the esteem and assistance of his elder shopmates is that of his manner of behavior toward them. He must show a proper respect for them as older, whether or not they are better men. He must be very careful not to thrust his unsolicited opinions upon them, but rather put his ideas in the form of questions. He must not say to the middle-aged machinist, "Look here, Jones, I think you would do that job better if you would do so and so." He will get much more attention, and possibly some useful information if he says, "Mr. Jones, I was just thinking whether it would be any better to do that job so and so." This will set the older man to thinking and the apprentice is likely to get some benefit from his experience along this or similar lines.

Steady and cheerful devotion to the work in hand, whether it is pleasant or disagreeable, is another characteristic of the apprentice that will usually make friends for him in almost any shop.

One of the most disagreeable classes of men in the shop is the man with a chronic grievance. He imagines that every other man has a better job than he and that he never gets proper credit for his good work or the rate of pay to which he is entitled. Naturally, he is not popular with the other men or much in the favor of the foreman. His position is disagreeable and he daily makes it more so. His example as well as his presence should be shunned by every self-respecting apprentice.

The apprentice is liable to hear many more or less derisive remarks about "the fellow that watches the clock." He is generally accounted a "time server," who is more interested in listening for the quitting-time whistle than he is in getting his job out on time and in a workmanlike manner. Loafing on a job is generally called "soldiering" in the shop and the man that watches the clock is an adept at this, often succeeding in deceiving the busy foreman. But he soon establishes an unenviable reputation and when "work gets slack" he is usually the first man to be "laid off." His example is a very bad one for an apprentice to follow.

True, there are commendable ways of "watching the clock." Let him watch it to ascertain how many minutes he can cut off the time of performing an operation; how much better time he can make than the last apprentice who had the job, and yet do it a little *better* than the last fellow. There are two very important factors to success along this line; first, to do the job a little *better* than the last fellow; and, second, to do it a little *quicker*. And these conditions will not long exist before the foreman is aware of it, although the apprentice may not realize the fact.

The apprentice should endeavor to learn each part of the work *thoroughly*. And this idea should extend to the most minor details of the work. He should master every operation included in the work as he comes to it and practice it so faithfully that the education of his hands may keep pace with the education of his head. He should not forget that thoroughly learning the use of each tool or machine makes it easier for him to learn the use of the next.

His previous experience has been in the school, in which each day he has been confronted with a multitude of different studies relating to many subjects, and he has been required to spend a little time on this and a little time on that. He has been the victim of "study periods," each succeeding one of which has an inevitable tendence to efface the former subject from his mind. So long as he remembered enough of this variety of subjects to pass an examination he was safe. But with the examination in the one set of subjects in his mind they were relegated to a more or less state of oblivion in the new subjects by which he was later deluged.

In the shop the conditions are entirely different. Each different tool and process must be thoroughly learned and mastered so that there will be no hesitation of hand or brain whenever the time comes to make use of the knowledge acquired. It must be so learned as to never be forgotten. Some of the best machinists in the country were several months learning to properly handle a file. But, as the old workman said, "Why, I can handle a file as naturally as a duck can swim."

It is, however, a lamentable fact that many of the "half-baked machinists" of the present day who have "picked up the trade," instead of really and thoroughly learning it, are a sorry sight to a good workman when they undertake to do a first-class piece of work at filing. In fact, they cannot do it at all. Such a man can never be rated, either as a good workman, or an "all 'round machinist."

This condition holds good in all branches of the trade. No part of the work can be slighted without resulting to the detriment of the machinist. For this reason the English insisted upon seven years as the period of apprenticeship. Our American practice is to reduce this to four years, and it will require all of this time for even a bright young man to so thoroughly learn the trade that he can be depended upon at any and all times, and under all circumstances, to be equal to the emergencies which may confront him, and be able to give a good account of himself on any job that may be assigned to him.

And even with this preparation he is far from being a "full fledged" workman. However well he may have improved his opportunities, and however thoroughly and conscientiously he may have worked and studied at his trade, he lacks that most essential element, *experience*. This he can only acquire with years and opportunities

Consequently, having learned the trade, it should be his constant endeavor to profit as much as possible by his shop experience. He should seek to get this experience in different shops and on different classes of work, particularly during the next few years after completing his apprenticeship and before he "settles down" to a steady line of work. Such experience will be very valuable in learning the different methods of various shops and manufacturing establishments and also in enabling him to select the kind of work and the location that will be likely to prove to him the most pleasant as well as remunerative in the coming years of his riper experience in becoming a credit to himself and an honor to the craft, as that much sought for and respected workman, "the all 'round machinist."

The Budapest aviation meet seems not to have been a brilliant success, either financially or aeronautically. During the first days at least, the spectators were not as numerous as had been hoped. The number of accidents was remarkable. Frey, caught in the wake of Illner's monoplane, was driven against a stand and smashed his machine, almost creating a panic. Three persons were seriously, and seven slightly injured. Frey himself escaped with a whole skin. Illner, Latham, Efimoff, Chavez and Bjelovuzi also met with accidents, and were more or less injured. In every case their machines, however, were total wrecks. The Frenchmen made the poorest showing, largely because they were waiting for favorable weather conditions. They had nothing to lose by waiting, for they were each guaranteed 50,000 francs and traveling expenses.

On the opening day of the Rheims meet Wachter fell to his death in his Antoinette monoplane owing to the wings breaking off while he was at a height of 500 ft. Details of this accident are not yet available, but according to cable dispatches both wings broke completely off the body and fluttered down to earth behind it. The boat-shaped body, with the heavy 50 h.p. motor in its bow, naturally dropped to earth at a terrific pace, the unlucky aviator being instantly killed. While a comparatively new aviator, Wachter had nevertheless made many excellent flights. On May 15th he remained aloft 2 hours and 2 minutes. Wachter is the second pilot of an Antoinette monoplane to lose his life recently, the other being young Hauvette Michelin, who was killed May 13th at Lyons, by the falling of one of the pylons used to mark the course when the monoplane hit it while running along on the ground.

One can very often cut down his expenses by cutting out his extravagances.

EDITORIAL

We have received some interesting explanations of possible causes of the fading-out of wireless signals, a topic which was mentioned in an editorial of last month. Two of these papers will be published in the October issue. Further notes or experiences on this subject will be cordially received by the Wireless Editor.

We would be pleased to consider manuscripts on the production of undamped waves. If you have built a transmitting set which has proved to send out a closely tuned wave, write it up and send it in with suitable drawings or photographs.

A description of the construction of some form of transmitting arc would prove especially acceptable.

We learn that the government tests with the Fessenden wireless telegraph instruments did not come up to early expectations. The ships upon which some of the sets were installed seem to have been unable to receive signals sent out by Brant Rock at distances greater than 900 miles. Notwithstanding this fact, the sets will be accepted by the government.

Plans for the big 600 ft. tower station to be erected near Washington have been abandoned, and, instead, four smaller stations will be erected.

The third installment of the article on a nine-inch reflector will be published in the next issue.

Some of the articles to be published next month which should prove of interest to our readers are: "An Easily Made Screw Plate for Small Dies," "How To Construct An Electric Toaster;" "A Small Working Model of a Dutch Windmill;" the concluding sections of Electrical Shop Notes, and "Construction of Aerial Towers for Wireless Telegraph Stations;" "The Construction of a Small Wall Cabinet;" and "The Value of an Exchange of Ideas," in the department of Machine Shop Practice.

One of the best wireless stations owned by a private individual in the vicinity of Boston is that of E. A., in Stoneham, Mass. The editor of our Wireless Telegraph department is enthusiastic in his praise of the neat and business-like appearance of that station. The equipment includes a 100 ft. mast with a form of T aerial, and a two-story operating shed, wherein there is, amongst other things the operator's bunk. The power of the station is rated at ½ k.w. Two systems of receiving are in use, using double slide tuning coil and an oscillation transformer, a quick throw switch being used to change from one to the other,—but we will say no more until we receive those photographs and that complete description which have been promised us!

"The Manufacture of the Commercial Electric Lamp Bulb," by W. E. Albertson, published in this issue, describes simply and thoroughly the making of electric lamps, and it should prove interesting to a number of our subscribers. Manuscripts of this nature are solicited by us, and we shall be pleased to consider anything of a similar nature which our readers may send in.

If preliminary plans are fulfilled, the Harvard Aviation Meet, to be held this fall at the Harvard Stadium, will be the greatest aerial event yet held in the United States. The leading aviators of both Europe and America have signified their intention of competing for the valuable prizes, and the fortunate persons who witness the various flights will probably see many records broken. At least $50,000 in purses will be offered and a very large entry of both American and foreign airmen is already assured.

WIRELESS TELEGRAPHY

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

ELECTROMAGNETIC WAVE PHENOMENA

SAMUEL F. KERR

There is one branch of wireless telegraphy which the amateur experimenter has not investigated very thoroughly, and that is, the study, to any great degree, of electromagnetic waves. He has applied himself diligently, and to good advantage, to the construction of practical apparatus, until now it would not be a difficult task to design a small wireless station complete in all its details, from the testing buzzer to the aerials. Even now the wireless telegraph is becoming too commonplace for some experimenters and they are looking for new worlds to conquer, as it were. Some have taken up the investigation of the wireless telephone, and are making better progress with it than when they originally took up wireless telegraphy, owing to their superior knowledge gained through experience, and, to a great extent, to the electrical publications from which they absorb a great many practical ideas and much valuable information.

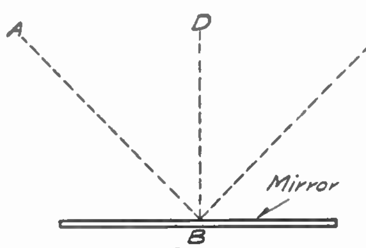


Fig. 1.

But the phenomena of electric waves have not been investigated very thoroughly, probably, because the experimenters have never given the idea a thought, but more probably because they have been too busy with the practical end of the science. However, a little investigation of the subject will not only be very interesting, but will add to the experimenter's practical knowledge.

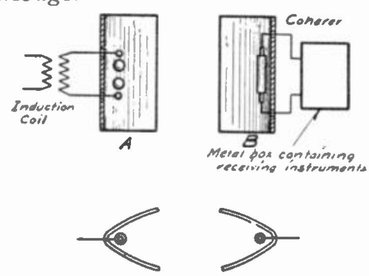


Fig. 2

In 1888, having devised a transmitter or radiator of electric waves and a sympathetic receiver which he termed a resonator, Hertz succeeded in producing electromagnetic waves in a way which permitted him to examine their propagation through space. It was known before that these waves existed, that they could be created by a discharge of high tension electricity, such as that obtained from the secondary of an induction coil or from a static machine, but the invention of wireless telegraphy waited for a method of detecting these disturbances of the ether. Clerk Maxwell, one of the leading scientists of his day, had investigated the subject very deeply and had described the conditions under which these disturbances took place, but had wrestled in vain with the problem of finding a detector. With his resonator Hertz not only solved the problem, thus proving that Maxwell's electromagnetic theory of light waves was correct, but laid the foundation of a practical wireless system. He also proved that the electromagnetic waves created by a discharge of high tension electricity are much the same as ordinary light waves, having the same velocity and capable of being reflected, refracted, polarized, etc., but having a much longer wave length.

I will now describe the phenomena of

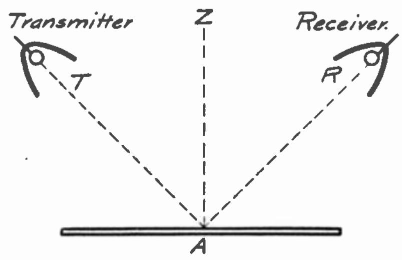


FIG. 3.

reflection, refraction and polarization of waves, first using light waves as an analogy, as it is easier to comprehend the meaning of light waves than the more intangible electromagnetic waves.

REFLECTION

By reflection (of light) we mean the light thrown off from a body on which it falls, and it is reflected in the largest quantities from the most highly polished surfaces. Thus, although most substances reflect it in a degree, polished metals, looking-glasses or mirrors, etc. reflect it in so perfect a manner as to convey to our eyes, when situated in the proper position to receive them, perfect images of whatever objects shine on them, either by their own or by borrowed light. The laws of reflected light are that when light falls perpendicularly on an opaque body, it is reflected back in the same line, towards the point from which it came, as, for instance, a person standing before a mirror. If it falls obliquely, it will be reflected obliquely in an opposite direction at an equal angle. This can be explained by referring to Fig. 1. If the eye is at point *A*, by looking at point *B* on the mirror we are able to observe objects at *C* that are not directly in front of the mirror. If a line *B D* is drawn perpendicular to the mirror, it will be found that the angles *A B D* and *C B D* are equal.

Now that we have considered the reflection of light waves we can apply the principle to electromagnetic waves. The properties of electric waves can be very clearly shown by means of the apparatus shown in Fig. 2. The oscillator, which is of the Righi type of two large balls between two smaller ones, is placed along the focal line of a parabolic reflector *A*, made of some metal, say zinc. This mirror being opaque to the waves reflects them in the same way as does the reflector behind a searchlight, so that, instead of spreading out in all directions, the waves are confined to a parallel beam. The knobs of the oscillator or spark gap are connected to the secondary terminals of an induction coil or to a static machine. The receiver which consists of a coherer is also placed along the focal line of a parabolic reflector *B*, the terminals being connected with a circuit which includes a battery of one or two cells and a galvanometer. If a galvanometer cannot be had, a relay may be substituted with some indicating device in its local circuit so as to indicate when the coherer becomes

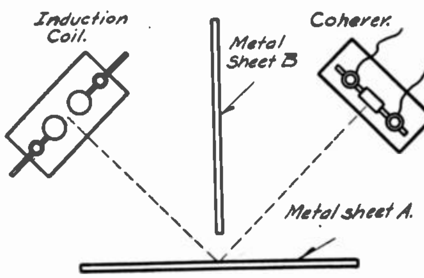


FIG. 4.

conducting. These instruments, with the exception of the coherer, are enclosed in a metallic box for the purpose of screening off stray waves. The waves sent out by the oscillator, instead of spreading out in all directions, as they do ordinarily, are confined to a parallel beam by the aid of the parabolic reflector, and thus the receiver is benefited by receiving the total energy of the waves radiated by the oscillator. These reflectors have never been used for practical purposes, however, but Marconi used them experimentally and succeeded in reflecting the waves a distance of two miles.

The oblique reflection of electromagnetic waves from metallic surfaces can be shown by arranging the transmitter and receiver as shown in Fig. 3, and it will be found that the coherer only becomes conducting when the plate, which is made of zinc or some other metal, is placed so that the angles *TAZ* and *RAZ* are equal. By referring to Fig. 1, which illustrates the reflection of light, it becomes apparent that the laws that govern the reflection of light waves can also be applied to the reflection of electric waves.

The amateur experimenter can perform the above experiment without the aid of the parabolic reflectors, by arranging his apparatus as shown in Fig. 4. The transmitter consists of a small induction coil, a battery capable of operating the coil and a key. The receiver consists of a metal filings coherer in series with a dry cell and galvanometer or relay to indicate the arrival of the waves. The oscillator or spark gap may be two small brass balls. Start the experiment by not using any

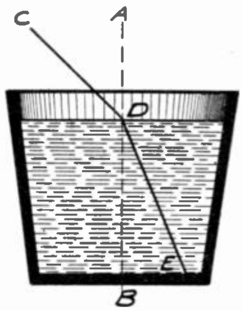


FIG. 5.

metal plates and adjust the coherer so that there is positive action when the induction coil is operated. Now insert the metal sheet *B*. This shuts off the direct waves and prevents the coherer from operating. Now take the metal sheet *A* and hold at different angles. When it is held in such a position that the coherer becomes conducting and the galvanometer responds, it will be found that the angle on either side of the metal sheet *B* is equal to the other.

REFRACTION

Light waves will traverse a given substance, such as air, water or glass, in a straight line, provided, of course, no reflection occurs and there is no change of density in the composition of the medium; but when light passes *obliquely* from one medium to another, or from one part of the same medium to another part of different density, it is bent from a straight line or is said to be refracted. In other words, when light passes from one medium into another, in a direction *perpendicula*

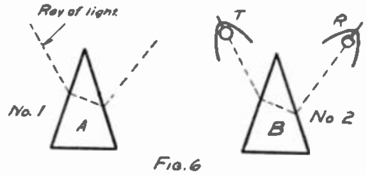


FIG. 6

to the surface, it continues on in a straight line without altering its course; but when it passes *obliquely* from a rarer into a denser medium, it is refracted toward a *perpendicular* to the surface. The angle of refraction is increased or diminished in proportion as the rays fall more or less obliquely upon the refracting surface, and to the relative densities of the two media. Referring to Fig. 5, suppose *CD* to represent a ray of light striking the surface of the water. Now, when the ray *CD* enters the water it will no longer pass through it in a straight course, but will be bent or refracted toward the perpendicular line *AB* as shown in the diagram. The effects of the refraction of light may be further illustrated by immersing a straight stick or pencil in a glass of water. It will be noticed that at the point of immersion the stick appears to be bent or broken. This is due to the fact that the rays of light proceeding from the part of the stick immersed in the water are caused to deviate from a straight line as they pass from the water into the air.

Some substances have a greater refractive power than others.

Now that we understand the refraction of light to some extent, it is not hard to apply the analogy to the case of electromagnetic waves.

Fig. 6 shows two diagrams: diagram No. 1 represents the refraction of a ray of light through a glass prism *A*. As can be seen the course of the ray is altered when passing through the glass prism. In diagram No. 2, Fig. 6, *A* represents the prism, *T* the oscillator and *R* the receiver, both equipped with parabolic reflectors to direct the waves in parallel beams. The receiver consists of the usual coherer in circuit with a galvanometer or relay. Now the refraction of the electromagnetic waves occurs in precisely the same manner as does the refraction of light. Owing to the fact, however, that the lengths of the electric waves are much greater

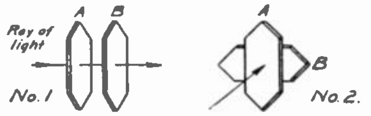


FIG. 7.

than those of light waves, the prism *A* would have to be so large that, if made of glass, the cost would be prohibitive. However, any good insulator will suffice for the prism, pitch and paraffine being very good.

POLARIZATION

When a ray of light is transmitted through certain transparent crystals, it undergoes a remarkable change in its characteristics. It is no longer reflected or refracted, but the effect produced is termed polarization and the ray of light thus affected is said to be polarized. Certain minerals, especially the one called tourmaline, have the property of polarizing a ray of light transmitted through them.

If a ray of light is passed through a thin plate of tourmaline, as *A* in Fig. 7, diagram No. 1, in the direction indicated and is received upon a second plate *B* placed symmetrically with the first, it will pass through both tourmaline plates without any difficulty; but if the plate *B* is given a quarter turn as in diagram No. 2, the light is totally cut off. Now, it is generally supposed that in a common ray of light, the vibrations of the ether which produce it take place in every possible direction, transverse to the path of the ray, but in polarized light they take place in only one direction, or are all in one plane.

For instance, the molecular structure of tourmaline is such that the vibrations in one plane are allowed to pass, while those in other planes are absorbed. The transmitted ray, having all its vibrations in one direction, can readily pass through a second plate of tourmaline, provided the structural arrangement is symmetrical with the first; but by turning the second plate partially around, the symmetrical arrangement is altered and the vibrations are intercepted. In the same manner a board may be slipped through a grating if its plane coincides with the length of the bars; but if a second grating is put in front of the first, with its bars at right angles to the bars of the first so as to form a screen, the board can no longer pass through.

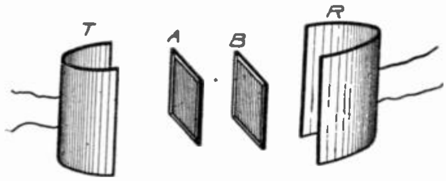


FIG. 8.

Now, with electromagnetic waves we have the same phenomena. Referring to Fig. 8, *T* represents our transmitter and *R* the receiver, both being equipped with parabolic reflectors. *A* and *B* are two wooden frames upon which copper wires are strung about ¼ in. apart. As long as the wires in the two frames are parallel, as shown in the diagram, the coherer will be affected and respond when waves are being created by the transmitter; but immediately upon turning the frame *B* one quarter around, in such a manner that if the two frames were placed together they would form a screen, the waves are blocked, so to speak, and the coherer ceases to respond entirely.

This imitates exactly the experiment of passing light waves through the tourmalines. When the two tourmaline plates are arranged so that their molecular structure is symmetrical, light is allowed to pass. Taking the case of electromagnetic waves, when the two frames are arranged so that their wires are parallel (which corresponds to the molecular structure of the tourmaline plates), as shown in Fig. 8, the waves are allowed to pass. But as soon as the second plate of tourmaline or the second frame of wires (these are termed analyzers) is given one quarter turn the respective light and electromagnetic waves are shut off entirely.

CONSTRUCTION OF AERIAL TOWERS FOR WIRELESS TELEGRAPH STATIONS

W. C. GETZ

In this article I shall describe the construction of the aerial tower and ground for a high power wireless station. In the June issue I gave the design for a concrete wireless station, and it is my intention to consider the present article as the second one of a series dealing with up-to-date wireless installations.

While it is realized that but very few experimenters can afford a concrete building, and the type of antenna treated in this article, yet the information given can be successfully applied to a less pretentious outfit.

Referring to Fig. 1, there is given four different types of masts or towers that are representative of the best construction in modern practice. The first, *A*,

Types of Aerial Towers.

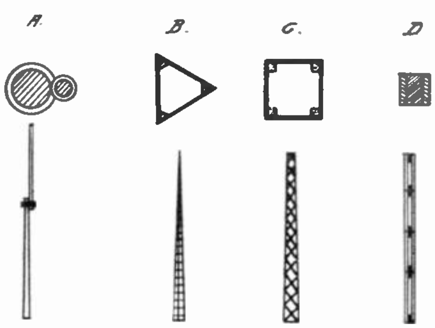


Fig. 1.

is probably the most simple and serviceable type when it is possible to obtain the sections in the right lengths. For a mast 100 ft. in height, the lower section would have to be at least 60 ft. and the upper section 43 ft. to allow sufficient material for the joint.

In *B* is shown the triangular tower type of tower, which is usually made similar to many windmill towers of angle iron, with horizontal side braces every several feet. Finished, this makes a pyramidal structure that is very strong and serviceable.

In *C* is given the square tower structure with lattice cross-bracing. This makes a very substantial structure when built properly. In Fig. 2 is shown a tower of this type installed at Fort

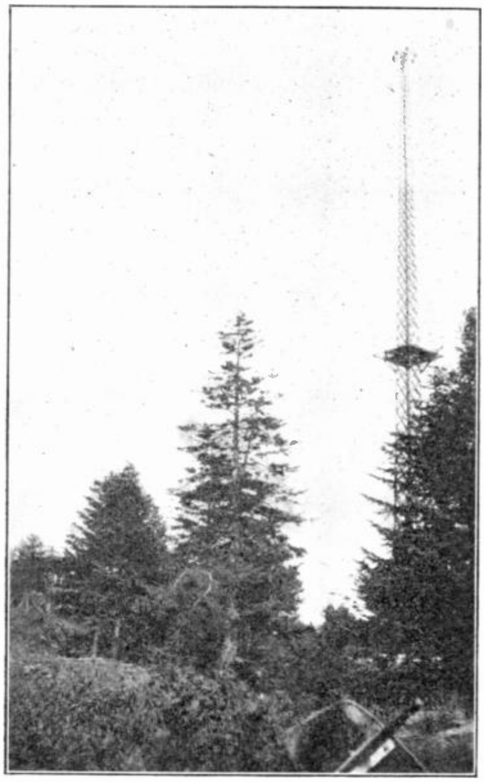


Fig. 2

Levett, Me., which forms part of the wireless equipment that the author installed while working for the Signal Corps. This is 100 ft. high, and is built of angle-iron. It is mounted on a concrete base, and is guyed from four corners at a point 60 ft. above ground.

There is yet another type of tower or mast,—that shown at *D* of Fig. 1. This is the reinforced sectional type of mast, and is made of short lengths of lumber bolted together with blocks between them at the joints and at other suitable intervals acting as reinforcing braces. In the photograph at Fig. 3 is shown a mast built on this principle. This picture is of the famous Manhattan Beach Station, "DF," of the United Wireless Co., outside of New York City, a station that can be heard anywhere along the Atlantic coast.

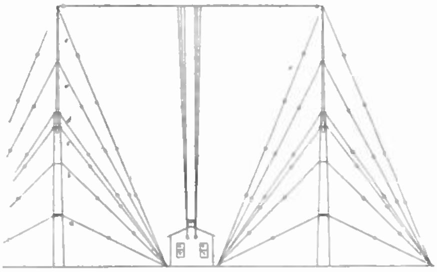
With these several styles of construction given, the experimenter can choose for himself the type he desires. For this article, however, we shall discuss a combination of the tower *C* style, with a top-mast of the *A* style on it

Referring again to the photograph of the Fort Levett tower in Fig. 2, it is seen that this is only adopted for the "fan" or for the "umbrella" type of aerial. Now, the author has always preferred the flat-top, "T," "L" or "7" aerial which require two towers, and while in this case it will make the cost twice that of a single tower, the difference in the ability to make so many different experiments with the two towers, impossible with only one, is held to justify the expense.

In this connection it should be noted that the naval authorities at Washington have abandoned the idea of erecting the 600 ft. tower that so much has been written about, and have decided to erect four smaller towers instead.

The position of our towers will be similar to that of the Manhattan Beach Station, of which an excellent view is given in Fig. 5. It will be seen that the distance from the station to the aerial of our scheme, as shown in Fig. 4, is in the same relative proportion as the above.

View of Station and Antenna from Side
Fig. 4.



In Fig. 4 the towers are erected on a line 20 ft. east of the east wall of the station, and are placed 100 ft. apart. The towers are each 61.5 ft. high, and upon them are placed the respective masts, each of the latter being 46 ft. high. When lashed in place they allow the horizontal aerial to be 100 ft. above ground.

Referring to Fig. 6, we are given a design for the foundations of the towers. As each tower weighs over 1,500 lbs., when complete, it is necessary that the foundation be exceedingly substantial.

For that reason we have selected a concrete base built on a solid foundation of rock or well-packed earth. This base is to be 18 in. deep, pyramidal in shape,—5 ft. square at the top and 6 ft. square at the bottom.

It will be noticed that in one corner a channel is left in the base, and on each side of the channel is an abutment with holes for a 2 in. steel pin to be inserted. The use of this will be described later on.

Nothing will be given here about the building of the forms or molding of the concrete as this was thoroughly discussed in the issue of June, 1910, regarding the "Concrete Wireless Station." The mixture used will be:

Cement, 1 part; sand, 3 parts; broken stone, 5 parts. For both bases, this will require 2 barrels of cement, 1 cu. yd. of sand and 1¾ cu. yds. of broken stone.

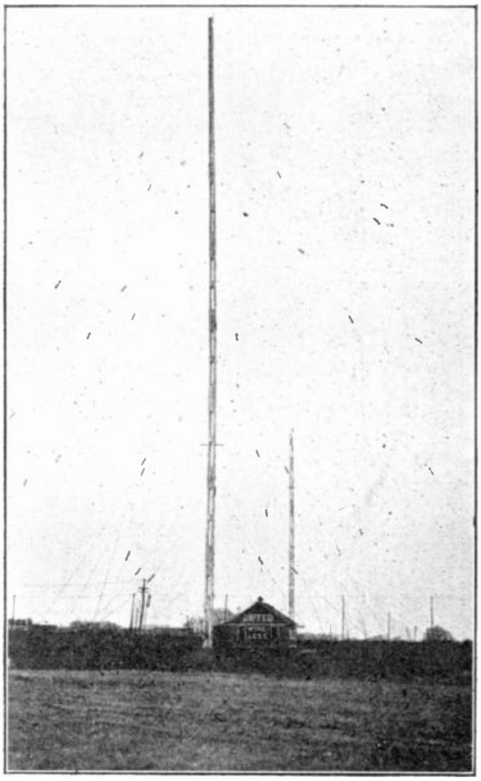


Fig. 3

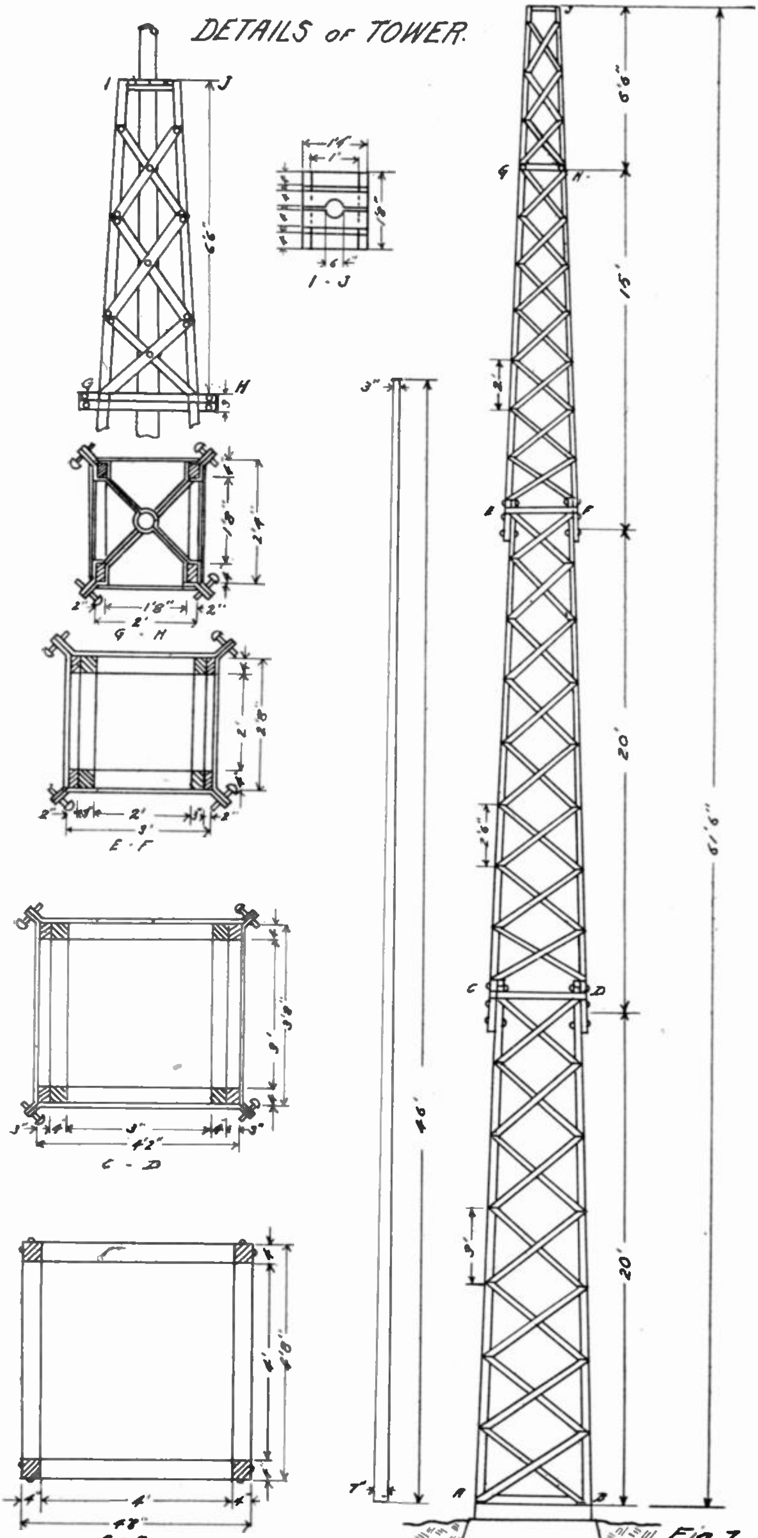
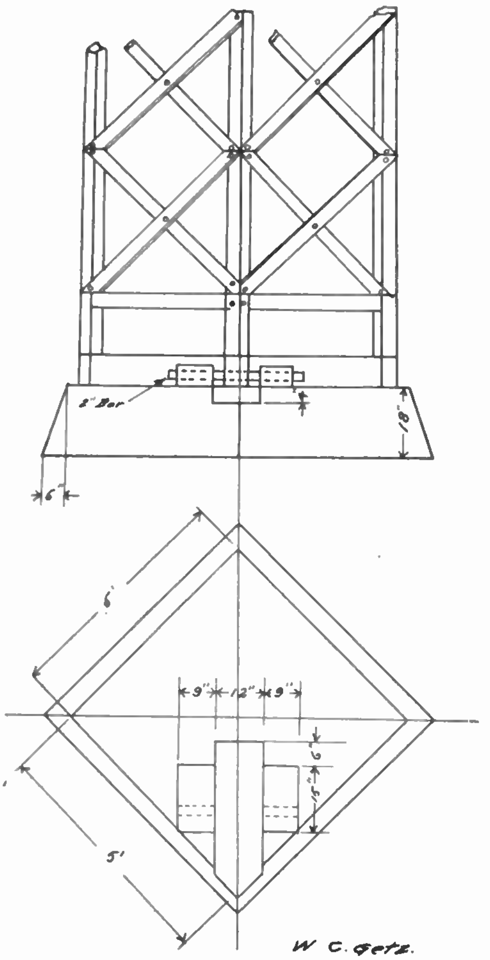

DETAILS OF TOWER
I
J
G
H
6'6"
I - J
G - H
E - F
C - D
A - B
E
F
C
D
A
B
15'
20'
20'
51'6"
46'
W.C.O.

Fig. 7

Concrete Base for Tower. Fig 6



The bases should be allowed to set at least two weeks before any strain is placed on them. The abutments should be reinforced with bars of iron bent to conform with the general outline. The Atlas brand of Portland cement is specified.

We will now consider the construction of the towers. In Fig. 7 is given a drawing showing the assembled tower, the mast, and cross-sections of the tower at certain points.

The tower proper is built of three sections. In the first or base section, the four uprights are 22 ft. lengths of 4 in. x 4 in. timber. At the base these are bolted to four 4 in.x 4 in.x 4 ft. blocks, making a square base. This makes the first section 4 ft. square inside at the bottom, and it tapers up to 3 ft. square inside at the first joint. The cross-braces are of 1 in. x 4 in. wood, the length decreasing as they go up. They are placed on 3 ft. centres on this section. As shown in this drawing and in Fig. 6, each is shown bolted at each end to the uprights, and in the middle to the opposite brace. In order to economize it has been decided to let one bolt do at the uprights, and overlap the two braces, tied at each point. This will effect quite a saving in bolts, and should be adopted as it is as strong as with two bolts.

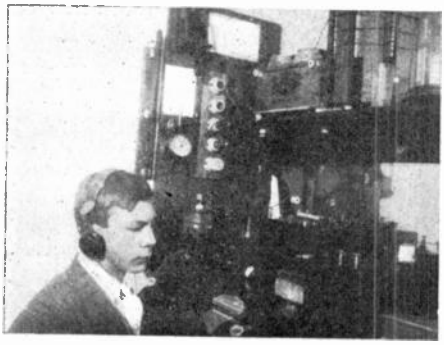
The second or centre section is composed of four uprights each 3 in. x 4 in. and 22 ft. long. At the bottom it is fitted with 3 in. x 4 in. blocks each 3 ft. long. It is also equipped with 12 in. iron braces, shown in the section *C–D*. Besides serving the purpose of bracing the joint, these irons are also used to hold the guy wires, a thimble being slipped over the guy, and fitting on the end of each bolt as shown.

This section tapers to 2 ft. square on the inside at the top where it joins the third or top section. The cross-bracing is of 1 in. x 3 in. wood set on 2½ ft. centres. This has the same provision for brace-irons at the top *E–F* as at *C–D*.

The third section consists of 2 in. x 4 in. uprights fastened as shown tapering to 1 ft. square inside at top. The cross-braces are 1 in. x 2½ in. stuff, placed on 2 ft. centres; 6½ ft. from the top is placed a cross-brace of 2 in. x 4 in. blocks and a special shaped iron brace set, as shown in the section at *G–H* and in the enlarged elevation above *G–H*. This to hold the butt of the mast. This as well as all other brace-irons is made of ½ in. x 2½ in. iron. At the top, *I–J* of this section, four 2 in. x 4 in. blocks are fitted, the centre blocks having a hole to fit the mast. A brace-iron (not shown) similar to that used at each joint is placed here for guying purposes.

The towers should be made of yellow pine or chestnut, and only well-seasoned wood should be purchased.

(To be continued)



A Unique Amateur Wireless Equipment

The wireless telegraph apparatus shown in the accompanying illustration is that of a Cleveland amateur operator, C. R. Derstenlager, who states that with this outfit he can readily hear all commercial stations on Lake Erie and pick up messages from the boats, but is capable of sending messages for a distance of only three miles.

The sending outfit consists of a 1 in. spark coil seen in the corner of the photograph with spark gap mounted on top. This coil is worked on 110 volts alternating current with an electrolytic interruption made from an old wet battery. In front of the interrupter may be noted the key and on the shelf the helix and Leyden jars.

The wireless receiving equipment includes a tuning coil, double slide with gauge attached and aerial switch above the coil together with two detectors, carborundum and silicon, as well as a variable condenser, potentiometer and a pair of head phones of 1,500 ohms.

The aerial consists of four wires suspended between a pole on top of the house and one on top of the bark, giving a total height of 40 ft. at one end of the antenna and 25 ft. on the other end. In this amateur outfit is also included a tuning coil and a span, containing 5 detectors, one each of carborundum, silicon, molybdenite and two of the electrolytic types. A receiving outfit is mounted on a box and the end of the phones connected to a switchboard jack. In the illustration may also be seen a small portable wireless apparatus between the receiving and sending apparatus, also a Marconi receiving outfit.

FRANK C. PERKINS.

The Arlington Heights Wireless Club was formed on July 9, 1910, by Messrs. Doane and Peterson. The object of the Club is to experiment with wireless telegraphy and telephony.

All persons desiring to become members are requested to send name, age, address call and a brief description of their station, to Mr. A. Harold Peterson, 154 Westminster Ave., Arlington Heights, Mass.

Capt. Hovland of the Norwegian navy has invented a printing wireless telegraph receiver, which operates in a manner similar to the Hughes and Boudot printing telegraphs and is not influenced by stray waves.—*La Nature.*

Returns From Fight Sent by Wireless

Amateur and professional operators along the Pacific coast near San Francisco received returns by wireless by rounds from the Jeffries-Johnson fight, which was fought at Reno, Nevada, on July 4th, at the same time that the bulletins were being posted in front of the large newspaper offices.

The returns were flashed from TG, a large wireless station in San Francisco, at the offices of the Western Wireless Equipment Company.

The returns were also received by several ships out at sea, among them being the Oceanic Steamship Company's liner "Sierra" on her way to San Francisco from Honolulu, whose operator gave out the fight bulletins to the passengers as soon as they were received.

At 3:39 p.m. TG was sending out returns from the twelfth round when he suddenly started on the fifteenth, saying that Jeff was getting wobbly and that Johnson had knocked him out.

The news was posted on the bulletins at 3:41. Later Hillcrest, the U. W. Co.'s big 15 k.w. station at San Francisco, sent out the news of Johnson's victory, as did also the government station at the Farallone Islands.

ELLERY W. STONE.

The Telefunken Company and the Lepel Wireless Telegraph Syndicate have been experimenting with new systems of wireless telegraphy, in which the Hertzian waves produce characteristic musical notes, which can be very easily distinguished from the harsh and rattling noises produced by the receivers of other systems.

Prof. Rossi has devised a new wireless telegraph receiver, which he calls a convector. The apparatus consists essentially of a very fine iron wire, suspended vertically and carrying a small mirror at its middle point. This wire is traversed by an alternating current of low frequency, and oscillates between two bar magnets. The oscillations are projected by the mirror upon a scale in the form of a luminous band, and the length of the luminous band begins to fluctuate in an aerial electric waves, but as soon as these waves reach the wire, the amplitude of its oscillations and the length of the luminous band begin to fluctuate in a manner which corresponds to the character of the messages sent out from the transmitting station. The signals can be recorded by photography.

It is announced that the English coast stations of the Marconi International Marine Communication Company have been purchased by the British Post Office, which has also acquired the right to use, for the next 14 years, all existing and future patents of Marconi, which relate to the operation of these stations. The sum paid to the company is about $67,000. The stations at Poldhu and Clifden will continue to be operated by the Marconi Company, for communication between England and the continents of Europe and America.

Chief Operator Snyder and wireless instruments at the Beaufort, N. C. government station

Sampson Pub. Co.

Gentlemen: I am sending under separate cover four photos taken at the U.S. Wireless Station at this place. Being a sort of central point on the coast between north and south, the operators have many busy hours both day and night. It is said the operator with receiver was on duty at time of distress of *Kentucky*, last winter off Hatteras, and that he was the first to wire the news to Washington.

Respectfully,
A. D. DART.

Beaufort, N.C.

NEW WIRELESS ASSOCIATION

The Springfield Wireless Association was organized at their rooms, on Saturday, May 14, 1910, starting with a membership of 12 members.

The following officers were duly elected: A. C. Gravel, president; T. F. Cushing, secretary; Roy Armstrong, treasurer and Donald W. Martensen, technical adviser.

The purpose of the association is to regulate the amateurs so as to cause no annoyance between amateurs and commercial companies, or between the amateurs themselves. Also to assist the amateurs in this vicinity in the proper erection of stations, location of trouble and proper selection of apparatus for their respective stations.

Any amateurs wishing to join should write to the secretary.

Editor Wireless Dept.
Electrician and Mechanic.

Dear Sir: Please answer the enclosed questions as soon as possible in the *Electrician and Mechanic.*

I have just changed the location of my station and when I get it in running order again, I will send in a couple of photos. I find that not only myself but all the amateurs around here are particularly pleased to learn shortcuts in making apparatus, such as those knife switch contacts as shown in current number, and think that more contributions of a like nature would be very enjoyable. Although only 10 miles from Boston, I have yet to hear any amateur interference with N.A.D., although I am told *he* has held his key down for long periods when unoffending amateurs were talking, but I have no doubt that there are two sides to the subject.

I heartily agree with the "Washington Amateur," and hope that some such law as he has suggested will come into effect instead of this "Wireless Trust," Robert's bill.

Hoping I haven't taken too much of your time, I remain,

Yours respectfully,
Stoneham, Mass. STUART R. WARD.

P.S.—This month's Wireless Department is "the best yet."

Regulating Time by Radio-Telegraphy

The possibility of employing signals sent by wireless telegraphy to correct the time of chronometers and clocks has long presented itself to many minds, and not long ago a practical test was made between two great transatlantic steamships in mid-ocean, which thus exchanged their chronometer times. One was found a few seconds in error. Messrs. Claude and Ferrié have just reported to the Paris Academy of Sciences the results of their experiments with wireless time-signals between Paris and Montsouris, showing that the method is capable of furnishing comparisons within a limit of error of less than one one-hundredth of a second. The experiments are to be continued between Paris and Brest by means of the great installation of the Eiffel Tower.

A Call to Amateur Wireless Operators

To the Editor of the *Scientific American:*

The amateurs and experimenters in wireless telegraphy in New York City and Philadelphia have started a movement to organize all the amateurs in America with a view of expressing to Congress the opinion of the organized amateurs as regards restrictive legislation. The amateurs desire that a full opportunity may be given them to express their views to Congress before any of the pending bills be enacted into law.

I have been retained as counsel for this movement. If your valuable paper will publish this letter, I trust that every wireless enthusiast throughout the United States will send his name to me at my office, Hibbs Building, Washington, D.C.

GEO. HIRAM MANN.

QUESTIONS AND ANSWERS

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

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

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

IF YOU DO NOT FIND YOUR QUESTIONS ANSWERED IN THIS ISSUE, KINDLY REPEAT, AS A LARGE NUMBER WERE LOST IN THE MAIL

1446. ½ **K.W. Transformer.** W. E., San Francisco, Calif., asks: (1) Kindly give me data on a ½ k.w. transformer and condenser to run on 110 volts a.c.? Ans.—See article on 500 watt coil in the August, 1908, *Electrician and Mechanic*, and Construction of a Condenser, in the April, 1910 issue.

1447. **Dynamo: Proper Size of.** J. I. E., Charlotte, N.C., asks: (1) What voltage and amperage should a dynamo have to run two motors; one a 4 volt, 1¼ ampere; the other a 10 volt, 1 ampere? (I intend to use a rheostat to bring down the voltage.) (2) What difference will it make to use a 100 volt meter on a 110 volt current, instead of a 10 volt one? Ans.—(1) Assuming that you wish to use direct current your problem is not a hard one. Your motors would, of course, be wired in parallel to the dynamo and since the highest voltage needed is 10, the dynamo should deliver its output at a pressure of 10 volts by the addition of a resistance in series the 4 volt motor hence

$$\frac{1}{4} = \frac{10}{R \times 16} \text{ or } R = 24 \text{ ohms.}$$

So by introducing a resistance of 24 ohms in series with the 4 volt motor, it may be safely used on a 10 volt line. The output in amperes of the dynamo should equal the sum of the amperes used by the motor of 1¼ amperes. Allowing a little more than the above figures for friction, the line voltage may be brought down to the proper amount to determine the proper resistance. Use Ohm's law

$$C = \frac{E}{R}$$

The resistance of the motor should first be known

$$\frac{1}{4} = \frac{4}{R}, \text{ whence } R = 16$$

Now to have a current of ¼ ampere flow through a line where the e.m.f. is 10 volts the total resistance must be the required resistance plus the resistance of the motor, or 16 ohms. (2) Do not use a 100 volt meter on a 110 volt line.

1448. **Receiving Distance.** S. R. W., Stoneham, Mass., asks: (1) What ampere switch and what size ground wire would be needed to give protection from lightning, if all wires are on outside of house and connected as shown to a ground of 25 sq. ft. Hen wire and a No. 16 or 18 lead in wire? Would prefer a cable of two or more wires to ground if below No. 12 is needed. (2) With water pipe ground and aerial 36 ft. long, 27 ft. high, of 3 phosphor bronze wires, and above set, what of following stations can I receive? Bridgeport, Conn., 2 k.w.; Fire Island, N.Y., 5 k.w.; Nantucket Shoals lightship, 5 k.w.; New York City, 2 k.w.; Portsmouth, N.H., 3 k.w.; New York City, 15 k.w. Ans.—(1) See the May, 1910, issue. (2) Your aerial is too low and too short. It is doubtful if you could receive any of the stations you name.

1449. **To Renew Dry Cells.** B. C. W., Santa Ana, Col., asks: (1) Is there any way to renew dry batteries, and if so, how? (2) How much would it cost to make the wireless instruments, as shown on page 423 of the May issue of the *Electrician and Mechanic*, that will send and receive 150 to 200 miles? (3) How much will it cost to make about a ½ h.p. steam engine? Ans.—(1) Dry cells may be temporarily renewed by boring holes in the pitch at the top of the cell and moistening the interior with a solution of vinegar, or sal ammoniac or salt water. (2) A set of wireless instruments to receive 150 to 200 miles, if made at home, can be made at a cost of $12. This price is only approximate, and includes aerial wire, ground wire, aerial switch, tuning coil, condenser, detector, 500 ohm phone, etc. (3) A ½ h.p. steam engine can be made at a cost of $15 to $20, the exact amount depending upon the amount of work which you do.

1450. **Electricity Through One's Body.** N. S., Medford, Wis., asks: (1) How much current and volts pressure can a man allow to pass through his body from one hand through the other, or from hand in the earth, without suffering any bad results? (2) If a man can answer all the questions asked about stationary engineering can he get a license, or must he be able to give reference and whole experience in order to get a license, and can he obtain blanks for examination with all the questions, and where? Ans.—(1) It depends upon whether the current is direct or alternating, and if the latter, the frequency of alternations must be taken into account. For some people, 10 amperes at 500 volts pressure would be sufficient to kill them, while for others that amount of current would be harmless. Generally speaking, 500 volts and 1 ampere is the least that would ever kill any one. If the current is alternating the above discussion would apply, until alternations become so rapid that they will not affect a person. The discharge from a Tesla coil cannot be felt, although the voltage is high in the thousands. The amperage in this case is, of course, very small. (2) The answer to this question depends upon the locality in which one lives. We advise you to consult the nearest license bureau of steam engineers. Write to Milwaukee, Wis.

1451. **Tuning Coil.—Iron Wire for Rheostat.** H. P. H., Abilene, Kansas, asks: (1) What length iron wire No. 16 will I need for a rheostat, reducing 110 volts a.c. to 80 volts 5 amperes? (2) What wave length tuning coil is necessary for 100 mile receiving set? (3) Can I use No. 18 copper wire; if so, how many feet for above coil? Ans.—(1) You are slightly "mixed" in your understanding of wireless instruments. We presume you want the size of tuning coil which will receive messages coming from a distance of 100 miles. Now a tuning coil which will receive from a station sending 5 miles away, will receive also a message coming from a distance of 1,000 miles. Hence any of the tuning coils described in our recent issues will serve your purpose. See the *Electrician and Mechanic* for February, 1910. (3) See February, 1910, issue of this magazine.

1452. **High Frequency Coil.** R. A. H., Chicago, Ill., asks: I have a spark coil giving 1½ spark, and want to build a high frequency coil of the large proportions. Will you please advise what size and amount of primary and secondary wire to use, also the size and relative positions of the two coils? I will thank you in advance for this. Answer in next month's issue. Ans.—See "The Construction of a Tesla Coil," in the May, 1908, *Electrician and Mechanic*.

1453. **H.C. Receivers.** K. H., New Dorp, S.I., asks: (1) I have two sets of H.C. receivers; one set wound to 4,000 ohms, the other to 2,000 ohms. Why don't I get the better results with the 4,000 ohms set than the 2,000? (I don't.) (2) Kindly explain why it is that when I put the receivers on that it generally takes two or three minutes for the receivers on the right-hand side to respond to the signals as well as the left. I have reversed the receivers and find that one of them never works right until I have been using them for a short while. (3) I have an aerial 4 wire, 50 ft. long, 250 ft. above the sea level, 3 miles inland; 4,000 ohm receivers, silicon detector, tuning transformer, fixed and variable condensers; instruments 30 ft. below aerial; ground, in well. What ought to be my range? Ans.—(1) Upon receipt of your inquiries, we wrote to the Holtzer-Cabot people for an explanation of the phenomena which you experienced. At the same time, we mentioned the fact that our wireless editor had the same experience with his H.C. receivers. We have today received the following reply: "We think, no doubt, that the trouble is caused by the receiver diaphragm being affected by the warmth from the ear. These diaphragms are adjusted very close, and it is possible that when cold, the air gap between the pole pieces and the diaphragm is greater than is the case after the receivers have become warm. There should, however, be no difference between the receivers on a head set. We will do some experimenting to determine if possible what feature of the construction causes the difficulty of which you complain." In regard to the first question, we would say that there is very little difference in strength of the signals received, whether 2,000 or 4,000 ohms receivers are used. In reply to the third question, we would say that we refer you to question No. 1311, in the May issue of the *Electrician and Mechanic*, where you may find an answer.

1454. **Receiving Distance—Proper Measurement of Aerials.** F. C. W., St. Louis, Mo., asks: (1) At what distance should I be able to hear a 5 k.w. commercial station with an aerial 50 ft. from the ground and 30 ft. long? Instruments are located 15 ft. below top of aerial. Instruments: variable condenser, fixed condenser, tuning transformer, perikon detector, electrolytic detector, silicon detector and potentiometer. (2) What sort of an aerial should be used with a ½ k.w. open core transformer, helix, condenser and electrolytic interrupter to transmit 100 miles? (3) When you speak of an aerial as being 50 high do you measure it from the ground level or from the level of the instruments? Ans.—(1) From 75 to 150 miles. (2) You would have considerable difficulty in transmitting a distance of 100 miles over land with a ½ k.w. transformer. Use an umbrella type aerial as described in the May, 1910, *Electrician and Mechanic*. Your sending distance would probably be about 50 miles at the most. (3) The height of an aerial is measured from the ground.

1455. **Relay—Lightning Arrestor.** C. N., Upham, N.D., asks: (1) What is a relay and how is it constructed? (2) Do I have to have a lightning arrestor in any place in my wireless telegraph outfit? (3) How does one cloud get its negative charge and another its positive? Ans.—(1) A relay is an instrument used to signals made of a very weak current of electricity. They are used principally in telegraph circuits and by their action close a local circuit which is strong enough to operate a telegraph sounder. (2) Yes. See article by Mr. Guilford in the May, 1910, *Electrician and Mechanic*. (3) See article in September issue on atmospheric electricity.

1456. **Wireless Mast.** A. J. S., Maynard, Mass., asks: (1) Am planning to erect a metal mast to be constructed from galvanized iron pipe, as follows: first section 35 ft., 2 in. pipe; second section 25 ft., 1½ in. pipe; third section 20 ft., 1 in. pipe; top section 20 ft., ¾ in. pipe. (2) Would it be safe to erect this mast on a square of ground measuring 30 ft. each side, or would the angle be too small to give sufficient anchorage? (3) Can the top guy-wires be used for an antenna if properly insulated, and the remaining guys be broken up into short lengths by means of strain insulators? Ans.—(1) I could not advise you to use iron pipe for your mast which you are contemplating. It has been found impractical to build masts of iron pipe of such a height, the danger being in erecting them, as they have a great tendency to buckle. I do not know of an iron pipe mast ever having been built higher than 60 ft. There is a firm in this city, the Clapp-Eastham Company, 727 Boylston Street, who make a metal mast, using special method of construction, which has been found to be quite easily erected to a height of 100 ft. The mast comes in 10 ft. sections, and being made of sheet metal is very light. It is built so that the guy-wires are used as the antenna, as the mast would not support the strain of any other form of aerial. We would suggest that you write them, as they will be pleased to give you information about it. (2) In regard to your second question, we would say that a plot of ground 30 ft. on each side is entirely too small to erect a 100 ft. mast. The guy-wires for a 100 ft. mast are usually anchored at least 50 ft. from the base of the mast. (3) In regard to your third question, we would say that the top guy-wires may be used for an antenna; in fact, any of the guy-wires and this style antenna, called the umbrella type, has been found to be in most cases the best all-round type of aerial for both sending and receiving.

1457. **Size of Cores.** E. S., Providence, R.I., asks: (1) How do you tell how many ohms there are in a coil? (2) Does the size of core make any difference to the coil? (3) What do you mean when you say 10 in. coil? A coil that gives a 10 in. spark? Ans.—(1) Certain measuring instruments are necessary. (2) Yes, the output of an induction coil influenced considerably by the size of core. (3) A 10 in. coil is one which will give a spark 10 in. in length.

1458. **Brass and Copper—Electrolyte—Detector.** G. D. L., Pittsburg, Penn., asks: (1) Can brass or copper be hardened after they are annealed? If so, how? (2) Of what does the electrolyte in the electrolytic detector consist of, and what is the best metal for the metallic electrode? (3) Can a silicon or a perikon detector be used efficiently without a condenser. Can you give me the wiring diagram of a receiving set using both detectors and not having a condenser? Ans.—(1) Brass and copper are hardened by working them, and annealed by heating. For instance, hammering a piece of sheet brass or copper will harden it to a greater or less degree while brass or copper wire may be hardened by drawing it.

1459. **Wire for Tuning Coil—Glass for Condenser.** H. B., Middletown, Ohio, asks: (1) How many pounds or feet of wire is used on the tuning coil and potentiometer, and what are the drums made of? (2) How many kilowatt would the transmitting outfit be and how far can I receive? Is window glass all right for the condenser? Ans.—(1) About 250 ft. for tuning coil, about 100 ft. for potentiometer. The drums are made of cardboard. (2) About 1 k.w. Window glass will do for condenser, although it is not the best.

1460. **Dynamo.** H. H. G., Worcester, Mass., asks: (1) Could you give me data on construction of dynamo for an induction coil of about 10 in., using vibrator as described first in your June issue? Dimensions: core 18 in. long, 1½ in. diameter; primary three layers No. 10 d.c.c. wire; secondary, 12 lbs. No. 30 s.c.c. insulated with paraffin, shellac cardboard, and empire or linen cloth. It is to be wound in sections 3⁄16 in. thick. (2) I am thinking of running dynamo with an arrangement of gears and a weight that will fall 5 or 6 ft. every 10 hours. Would this be practical? Ans.—(1) It would prove very impractical and costly to build a dynamo for such a purpose. (2) No, it would be impossible.

1461. **Reflecting Telescope.** J. B. B., Washington, D.C., asks: (1) What is, and how to obtain the "rough tool" on which you work the glass. Is it to be made to order, or can it be bought from a supply house? how accurately must its surface curvature conform to theoretical figure? That is, can the ordinary blacksmith, say, cast it or cut it from design or pattern? (2) If I use carborundum instead of emery, shall I get the same grades as you need in emery? Would not it be best to rough out with the harder stuff, and do the fine grinding in the emery at least for the novice attempt? (3) I do not want—cannot handle, ready—the bulky telescope resulting from a 9 in. in the 63 in. focus, or even 6 in., 60 in. I plan to make a mirror, $D=6$ in., $F=48$. Can you give a rough idea of what such a reflector would do, officially and otherwise; would it be fairly conveniently "portable"? What would be its over-all dimensions and tube diameter? And roughly, what magnification would it stand, if well figured, with good definition? In mirrors, $D=$ approx. 6 in., could you suggest a better set of dimensions near what I have given above? (4) How small—diameter— can a mirror be successfully ground, and how small a reflector telescope can be made? Could a 3 in. one give bright enough images, with say, focal length 30 to 36 in., to stand 20 to 40 diameter magnification? Ans.—The rough tool is usually turned from cast iron, and is cut with a spherical curve. Fuller information on this subject can be found in Orford's "Lens Work for Amateurs;" price, $1.50. Carborundum may be used instead of emery, and cuts quicker, but must be used with more caution. Probably emery would be safer for a first attempt. In regard to the working qualities of telescopes, you would have to apply to some astronomer, as this is information which we regret being unable to give you. Why do you not write or call at the Naval Observatory in your city, where we are sure they will give you information, and where you can probably look over considerable literature on the subject? A telescope with 48 in. focus would naturally be about 4 ft. over all, and the tube diameter does not need to be much greater than that of the mirror. Reflecting telescopes are not usually considered very portable instruments, being best set on a permanent foundation with clock work. There is no lower limit to the size of the reflecting mirror. Naturally, the smaller it is the more accurately it must be figured, and much magnification is not very practical. You would do better, if you want magnification, to get it by using a larger lens, thereby collecting more light.

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BOOK REVIEWS

Mission Furniture: How to Make It. Part II, Popular Mechanics Handbooks, Series No. 3. Popular Mechanics Co., Chicago.

This neat little handbook describes the construction of mission furniture, and is written in easily understood language, so that any amateur carpenter can make the pieces described therein. The book is profusely illustrated with half-tone cuts, and also with numerous working drawings. Altogether, no one who contemplates building a piece of mission furniture should start without first providing himself with a copy of this handbook.

Flying Machines: Construction and Operation. By Jackman–Russell–Chanute. 221 pages. Charles C. Thompson Co., Chicago. Price $1.00.

This book completely describes the construction of a glider to cost $20, and also the construction of a bi-plane. Data on all the modern successful heavier-than-air machines is given, together with working plans and illustrations made from photographs. The theory of flying is presented to the reader in an easily understood form. The book should be valuable, not only to the amateur aviator, but to all those who would know more of the art of flying.

The Wireless Telephone. By H. Gernsback. Modern Electrics Publication, New York City. Price, 25 cents; cloth, 50 cents.

This little handbook professes to be a "Treatise on the low power wireless telephone, describing all the present systems and inventions of the new art."

It consists mainly of a series of short descriptions of various attempts at telephony without wires.

TRADE NOTES

The Holtzer-Cabot Electric Co., of Brookline, Mass., have issued some new pamphlets descriptive of their type "C" and "K" motors, which should prove interesting to our readers. Their type "C" motor is one used for elevator purposes. The type "K" motors are of the direct current type and are interesting in that the larger sizes may be used as generators.

The Holtzer-Cabot Co. also make pumping sets, which have proved highly efficient for the work which is required of them.

The University of Pittsburg, Pittsburg, Pa., has adopted a plan of co-operative instruction which is unique and blends most satisfactorily with the engineering and industrial environment of that institution. Believing that students who spend their vacations while at school in engineering offices and industrial shops have been better prepared for entrance upon their life's work, the trustees have adopted a plan of co-operation to cope with this phase of the situation. Pupils enrolling there get, besides the usual amount of time devoted to instruction, four periods of three months each, in the engineering industries of the Pittsburg district. By this plan the student gets the usual theoretical course and in addition twelve months of practical work, all in the space of four years.

Mr. William C. Getz, of the United States Signal Service, has completed the installation of additional telephone apparatus at Fort Snelling, Minn., and has also finished his work on the wireless station at Fort Riley, Kansas. He is now at Fort Leavenworth, Kansas, installing a target range buzzer system.

The Ge Mazda Lamp

It is a question only of time when the carbon filament incandescent lamp will be a thing of the past, and while it is still in general use, it is being rapidly replaced by the more modern and highly efficient metal filament lamps, of which the Tungsten filament lamp is the most recent development.

Bulletin No. 4739, just issued by the General Electric Company, describes the **Ge Mazda** incandescent lamp which has an improved Tungsten filament and gives the high efficiency of 1 to 1¼ watts per candle. In other words, the **Mazda** lamp divides the cost of current by three, or gives three times as much life for the same expenditure of energy.

The bulletin describes this lamp in great detail, and illustrates the various sizes of this type of lamp for use on multiple circuits. It contains tables showing cost of operation and life, effect of voltage variation on candle-power and watts, relative costs of lighting with various lamps for equal illumination, etc. It also devotes considerable space to the reflectors necessary to give the best results.

Battery Charging Rheostats

A most interesting booklet of 48 pages, entitled "Battery Charging Rheostats," has just been published by The Cutler-Hammer Mfg. Co., of Milwaukee. The booklet describes this company's entire line of battery charging rheostats, comprising two types for charging ignition batteries and six types for general charging work, for electric pleasure vehicles and for trucks. Full-page illustrations of the various types are shown besides several special types such as a motor-generator set panel and a panel for use with a gas engine driven dynamo and storage battery. One section of the booklet is devoted to descriptions and illustrations of protective panels and devices. The applications and advantages of the low current cut-out, maximum voltage cut-out, solenoid switch and overload circuit breaker arrangements are pointed out. These devices prevent overcharging and protect the batteries against damage due to abnormal current conditions. The method of tabulating the electrical data and the list prices is worthy of comment, all information being condensed into a single table. This publication (copies of which can be obtained on request) should prove of value to all interested in battery charging.

We have been advised by one of our advertisers, Modern Systems Correspondence School, that inquiries have been received, and they have been unable to send free information in regard to their courses, owing to the fact that the inquirers failed to give complete name and address. We would, therefore, suggest that persons interested make application again.

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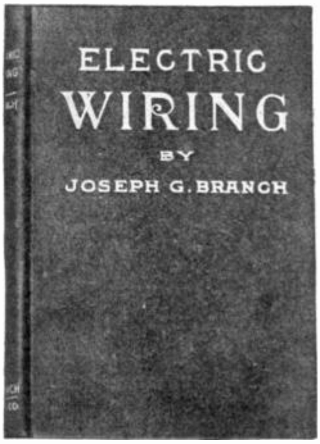

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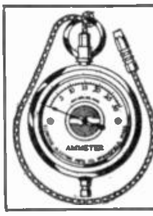

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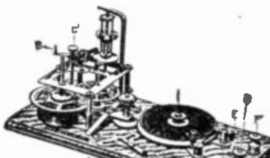

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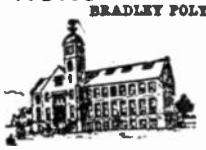

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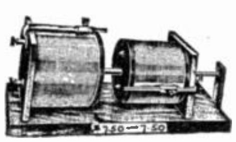

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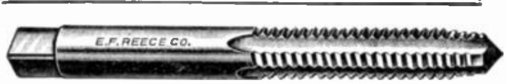

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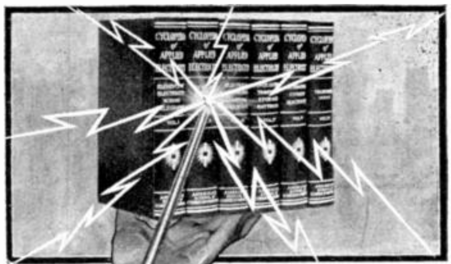

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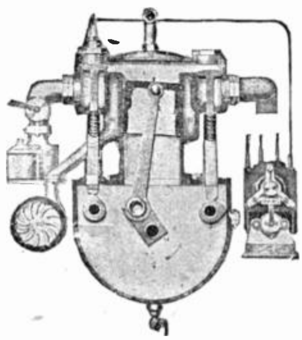

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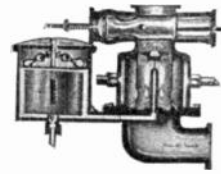

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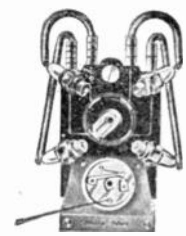

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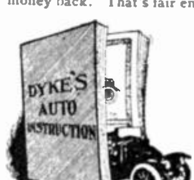

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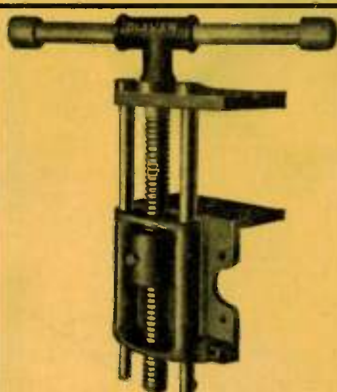

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