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ELECTRICAL ENGINEERING—Chapter XVI.

Alternating Current Motors. Part 2

A. E. WATSON

In the preceding chapter it was mentioned that a series wound direct current motor, with laminated field magnet, would run, though not well, on simple alternating current circuits. The reasons for the "not well" have of late been carefully scrutinized, and means found for eliminating them in a fairly satisfactory degree. Just what the troubles and their appropriate remedies are will be explained at some length in the latter part of this chapter.

The original series motors offered for use on alternating currents were for desk fans only, and a rather curious modification of connections of such little motors is well worth noting. If the connection between armature and field be removed, and the brushes short-circuited on themselves, but given considerable lead, the armature will run with the alternating current connected to the field alone. See figure 69. The explanation is that the alternating magnetic flux from the field induces secondary currents in the armature coils that are favorably situated, and then repels those coils; as soon, however, as the first coils have been pushed along, the action of the brushes and commutator continually presents other coils for similar repulsion. This is therefore known as the "repulsion" type of motor. It has characteristics of operation resembling those of the ordinary series type. Recently some attempts have been made to resuscitate this construction, and develop it for railway traction, but the results seem conclusively

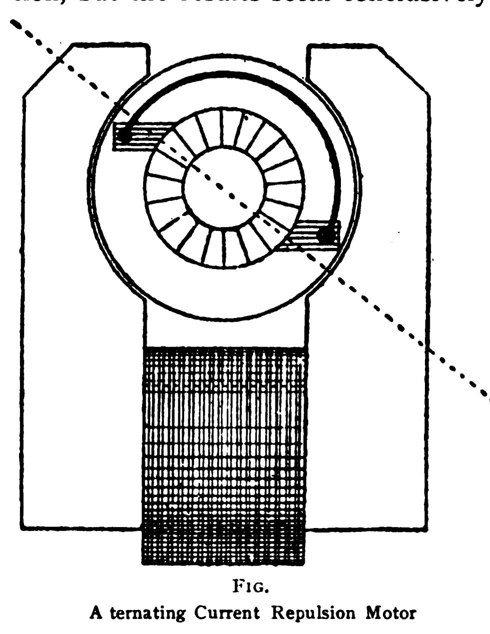


FIG.
A ternating Current Repulsion Motor

to indicate that it is much the inferior of the two.

Another form of the repulsion motor is one in which all the armature coils have one connection in common with a ring, while the other ends connect with the separate segments of a commutator. The ring is close to the ends of the segments, and a single brush is wide enough to extend across the ring and commutator. By this device current is allowed to flow in a single coil, and then this one is pushed along until another takes its place. A serious defect in this arrangement consists in the fact that only a small part of the armature winding is in use at a given instant. Rather a novel spectacle is presented by this commutator-collector single-brush device.

The reality of this repulsive action can well be brought out by energizing a large straight laminated-core electromagnet with alternating currents, and suspending a copper ring in front of one of the ends. In the lack of a better piece of apparatus, an ordinary spark coil may be tried, the flow of current being controlled by lamps used for resistance. The ring will always turn edgewise to the end of magnet, so as not to embrace any lines of force; for just as soon as some other position is taken, lines of force will thread through the ring, and induce in it currents always in the direction to be repelled. By using liberal sized coils, the repulsion can be made very energetic, and if the copper ring be of wire bent around and soldered, the joint will quickly be melted. It will be recognized that this is merely a transformer action, the electromagnet windings being the primary, and the ring the secondary. In the case of the repulsion motor, the lead given to the brushes preserves a certain obliquity of position of the active coils, so as to allow for the successive production of these secondary currents.

After the invention of the highly successful two-phase and three-phase induction motors, it was shown that somewhat similar constructions would operate on single-phase circuits, that such motors would be cheaper to build, longer lived, and of higher efficiency than those employing commutators. The solution of this problem lay in the principle now known as "splitting" the phase. Since one of the effects of self-induction in a circuit is to produce a lag of the current behind the electromotive force, it is obviously possible to provide two circuits in parallel with each other, one of which has a minimum and the other considerable inductance. Then when connected to a single phase supply, the current will flow in one of these paths at a later instant than in the other. If these are the two circuits of a two-phase motor, a slight imitation of the rotary field magnetism of such machines will be produced. It would be futile even to aim for full 90 degrees difference in phase relations, for then, in accordance with figure 56 of chapter XIII., the lagging current would exert no power. Just enough inductance is introduced to enable a start, however feeble, for when synchronous speed is approached the torque enormously increases. This device of separating a single alternating current into two components differing in phase is due both to Ferraris and Tesla, and was first used by them in 1889. A diagram of a two-phase motor, in which the pole windings are all similar, with exterior starting arrangements, and a single-phase supply is given in figure 70. An ohmic

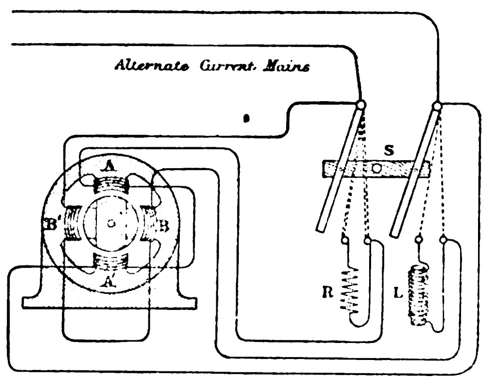


FIG. 70
Two-phase Motor on Single-phase Circuit, with Phase-Splitting Device

resistance, R', represented by zig-zag lines, is included at the start in one circuit, while an inductive resistance, L', represented by a coil on an iron core, is in the other. Coils A and A' will therefore be energized by current lagging behind the electromotive force by the amount due to their own inductance, while in coils B and B' there will be the further lag due to the interposition of the extra inductance L'. After attaining a good speed, the switch is moved still further, thereby cutting out both these resistances, and allowing both windings to operate in parallel. Though apparently with four poles such a field has essentially only two, the subdivision into four parts being merely to accommodate the two phases. Synchronous speed would be attained only when acting as a two pole machine. Recognition of this point is evinced by the winding shown on the rotor, consisting of two broad short circuited bands of wire; each band is wound diametrically, a familiar requirement for direct current armatures to fit a two pole field magnet. In the particular diagram given, A and B' finally combine to produce one pole, while A' and B make the other.

A modification of this split-phase arrangement is to let the poles A and A' embrace considerably more of the rotor, with the coils B and B' wound on their tips; for starting, these latter coils are short-circuited by closing a small switch, and then, when full speed has been attained, removed from circuit. The objection to leaving these coils permanently closed is that they are really secondary transformer windings and would demand unduly large primary currents in the other coils. A case, however, in which such short circuits are tolerated, is in the present self-starting fan motors. The principle is further and lucidly illustrated by reference to figure 71. Here various copper bands are represented as embracing the pole tip, and successively lagging currents will be induced in them by the action of the main current winding. A shifting of the magnetism over the face of the pole will result, and this will drag the short-circuited rotor in the direction shown by the arrow. Of course the currents induced in the rotor are the ones proportional to the torque, but with these starting coils left permanently in circuit, great heat and waste results. In figure 72 is shown the actual form of the short-circuited sheet copper bands largely employed on four pole fan motors. In addition to their electrical function in starting the rotation, they serve to hold the main field coils in place.

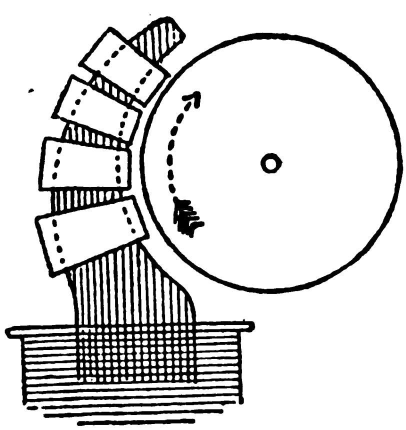


FIG. 71
Short-circuited Coils on Pole Tips for Giving a Shifting Field Magnetism

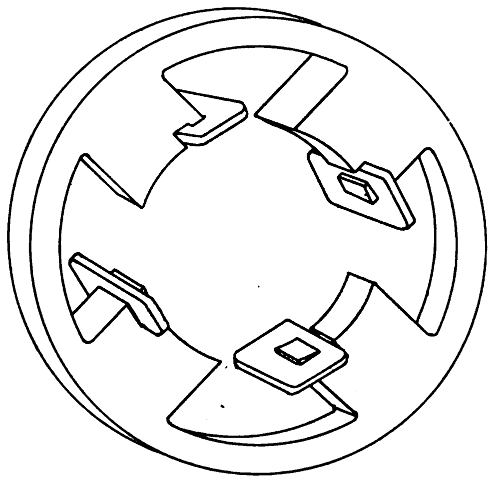


FIG. 72
Single-Phase Fan Motor Field Magnet with Shading Coils on Pole Tips

For all the shifting-field motors the simple squirrel cage rotors are now commonly used. The construction is cheap and highly effective. One point of great importance in the mechanical design is in having a very small clearance between stationary and revolving parts. The induction motor is really a transformer, with the primary winding on the stationary and the secondary on the revolving member. All the lines of force produced by the one should cut the other, and in the regular construction of transformers this criterion is closely attained by having both coils on the same iron. With the motors, some separation of these windings is imperative, but it is made of scant amount. In machines of 100 horse power the clearance may be only one-sixteenth of an inch; in those for about 5 horse power, one-thirty second, and in fan motors only one-sixty-fourth of an inch. By whatever amount lines of force produced by the primary do not cut the secondary, the self-induction of the motor is increased and the power factor reduced. This means the requirement of more amperes to produce a given power, and interference with the regulation of voltage on the circuit.

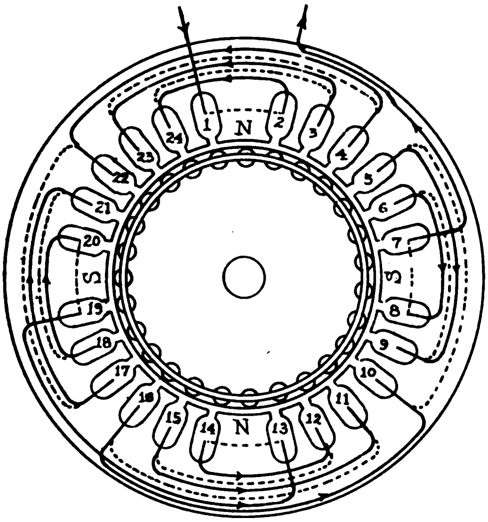


FIG 73
Diagram of Stator Winding for 4-pole Single-phase Motor, with Squirrel-Cage Rotor (not Self-starting)

Though the multiphase motors in themselves may leave little to be desired, their use is prevented by lack of the proper circuit.. Station managers object to the complexity and expense of providing three or four wires and two or three meters for small customers, hence there is an increasing demand for efficient single phase motors of moderate size, say from one to ten horse power. For such purposes some manufacturers often supply ordinary three phase machines, allowing two phases to be connected in series, as if a single circuit, and then putting a condenser or reactive-coil in connection with the other phase to enable a start to be made. This latter circuit would then be cut out. A good winding for the stator of single phase motors can be made by imitating that employed for generators. Concentric coils may be used, grouped in any desired number of poles, the iron in the centers of the groups being magnetized the strongest, and then the neighboring teeth having gradually less strength, in accordance with the requirements of a good wave form.

Figure 73 represents the circuits of a four pole single-phase stator and squirrel cage rotor. At a given instant, current may be imagined as coming in the direction of arrow at top,,and passing into No. 1 slot, then by the dotted line to slot No. 2, again to the front, then into 24, return by 3, then into 23, return by 4, then into 22, and by a reach in the other direction to 17, and so on for all the slots. The large teeth in the center of top and bottom groups will then be strong "Norths," their adjoining teeth weaker, while similarly, the poles on right and left will be "Souths." With every alternation of the current these polarities will be exchanged. Upon closing the main switch to such a motor, large currents will be induced in the short circuited rotor, demanding correspondingly large currents in the stator coils, often sufficient to blow the fuses, but there will be absolutely no tendency toward rotation. With no load connected, a vigorous start can be made, by hand, in either direction, and the rotor will continue in a rather hesitating and feeble manner, but with increasing speed there will be a gain in torque, until synchronism is approached, when the load may be applied. For a four pole 60-cycle motor of one horse power, 1600 revolutions might be attained,—the synchronous speed being 1800.

Self starting features, though with feeble torque, could be provided by making the slots deeper, or by introducing extra ones, in which additional coils, following the scheme of figure 70, could be placed, and the split phase principle utilized. One coil could embrace the tooth between slots Nos. 22 and 23, then spread into slots 21 and 24, finally into 20 and 1. Similarly for the other groups of slots. This auxiliary winding would be placed in the slots, occupying not more than one-half the space; if of relatively fine wire, with three or four times as many turns as the main winding, the start could be made by connecting the two circuits in parallel, as shown in figure 70, but if of coarse wire of few turns, it should be short circuited by closing a switch, giving the effect represented in figure 72.

It is an interesting fact to observe that fan motors cannot ordinarily be used for small powers. Such motors are designed so inefficiently that large dependence is placed upon the breeze to keep not only the person cool, but also the machine itself; when a pulley is substituted for the fan, even when motor is running free, the coils get ruinously hot.

Sometimes, as for starting heavy machinery, a single phase motor is desired that exerts strong initial torque, and has also the high efficiency and inherent speed regulation of an induction motor. These apparently irreconcilable factors have actually been attained, the best construction being that by the Wagner Electric Co., of St. Louis. In this the stator is wound in accordance with the diagram given in figure 73, but the rotor has a winding and commutator as if intended for direct currents. Considerable lead is given to the brushes, to enable start to be made as a repulsion motor. Some sparking, and as in case of a series motor, no particular limit of speed is involved. However, a centrifugal governor, inside the armature, is provided, that at synchronous speed slides a ring along the shaft and short circuits all the commutator segments, and at the same time removes the brushes from contact. From this instant the motor operates on the induction principle. Though of rugged running qualities, these motors require a large starting current, and at most have a low power factor,——about .7, but in these respects are no worse than other single phase constructions.

For railway engineering, multiphase motors are not all appropriate. Aside from the inconvenient and even dangerous requirement of two or three trolley wires, in addition to the use of the rails, for conductors, there is the further disadvantage that such motors imitate the characteristics of direct current shunt wound machines,—i. e. are best adapted for constant speeds. As explained in chapter IX, series wound motors are the simplest and best. It is true that in Europe a few mountain railroads, consisting of single tracks and no crossings, have been equipped with three phase apparatus, but the results sought were simple, or regarded as merely experimental. New zest attaches to electric traction in this country by reason, as earlier indicated in this chapter, of the attempts to utilize series wound motors on single phase circuits. While thus utilizing the powerful starting torque and variable speed qualifications of this sort of machines, there is the other invaluable gain from the need of but one trolley wire. Further, even for the heaviest traffic, demanding large currents, there is still no need to use a "third rail," or other heavy conductor, for since the transformers can be placed on the cars or locomotives, very high potentials can be carried on the trolley wire, long distances from power stations can be tolerated, and infrequent substations provided. As compared with the limitations and great expense of the common 500 volt direct current systems, the possibilities of this alternating current system are being vigorously enquired into, and some highly encouraging results have actually been attained. Some small roads have been in operation for nearly two years, and some existing steam roads have been trying heavy locomotives equipped with motors of large size.

Among the causes that have militated against favorable operation of series motors on alternating current circuits may be mentioned, primarily, the self-induction and sparking. Of these, the former can be minimized by low frequency of alternations, few turns of conductors on the field, and special coils to neutralize the inductance of the armature. To make a completely non-inductive field winding is a contradiction of terms, for the sole purpose of that winding is to induce magnetism. Since self-induction increases directly as the frequency, a low figure, 25 cycles per second, has been adopted, with the possibility of using still lower; increasing also as the square of the number of turns, there is obvious gain in producing the required number of ampere-turns by use of large currents and few turns rather than by the opposite proportions. With the adjunct of transformers on the cars, there is the ability of getting any desired voltage. About 200 volts maximum is the potential actually employed, but instead of securing the regulation of speed by insertion of ohmic resistances, various lower voltages are impressed upon the motors, taps for the purpose being led out from the transformer windings at appropriate intervals. The "compensating" winding on pole tips provides a number of ampere-turns just equal and opposite to that of the "cross magnetizing" factor of the armature. The other troublesome defect,—the sparking of brushes, has been limited by the employment of multiple wound armatures, very narrow sections of the windings, and numerous commutator segments. Thin carbon brushes are used, bridging across not more than two segments at a time, thus short circuiting only one coil, with a further diminution of this short circuit current by the interposition of high resistance commutator leads. Even when the armature is not rotating, but the current turned on for starting, the alternative flux of of the field would induce very large short circuit currents in the coils undergoing commutation. This is called the "transformer action" of the motor, and when rotation is taking place, this extra current flows through the brushes in addition to the main working current. With direct current motors the adoption of carbon brushes was sufficient to suppress the sparking, but further expedients were needed to cope with the new conditions.

Figure 74 gives a diagrammatic representation of the scheme of circuits and, to some extent, the actual arrangement of the coils of a 4-pole motor of this kind. For clearness, a ring armature is shown, whereas in practice a drum would be found. The multiple character of the winding is emphasized by the four brushes and cross connections. The compensating windings consist of four sets, each being divided into three concentric coils, and set into notches in the polar faces. One of the regular field coils is also represented, being slipped in place only after these special windings are located. Both field windings and the armature are connected in a simple series circuit, but the compensating coils are arranged to have their currents under the polar faces always flowing in the opposite direction from those in the neighboring armature conductors. In the main field coils the current may flow either way, as determined by the position of the reversing switch, to give the desired direction of rotation. The high resistance feature of the commutator leads cannot well be shown in the diagram, but they are made of German silver, and looped back into the armature slots before the copper coils of the regular winding are inserted. Of course only a very few of these strips at any instant are inserted in the main circuit, as suggested in the diagram by those shown with the arrow heads.

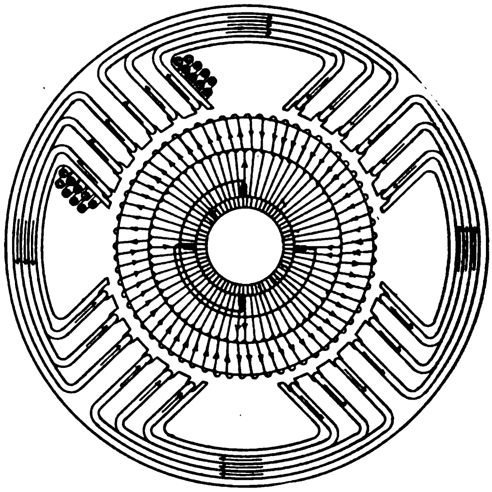


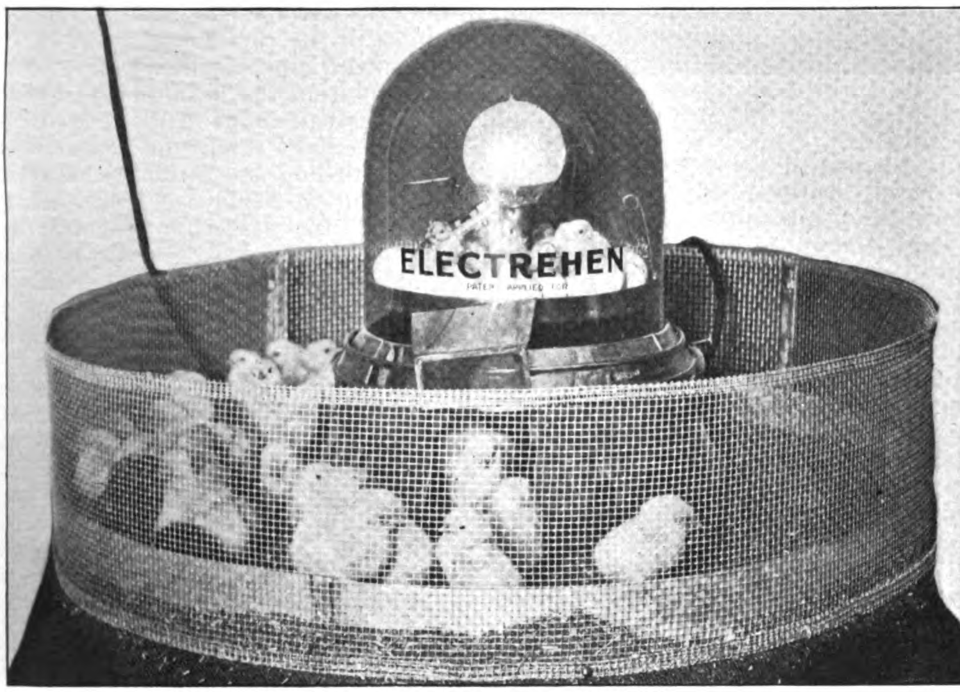
FIG. 74
Series-Wound Motor with Compensating Coils on Pole-tips. Railway Type

The results attained with locomotives equipped with this type of motors, now being tried in the New Haven railroad and in the St. Clair tunnel, are being viewed with great interest, for in them the immediate future of extensive traction projects seems involved.

Incubating Chicks by Electricity

FRANK C. PERKINS

During the recent annual convention of the American Poultry Association at Niagara Falls there was a most interesting display of electric incubators showing chicks being hatched by means of current supplied from the Niagara Power Plants. In these new and novel electric incubating devices the necessary heat for hatching the chickens was provided by incandescent lamps controlled by thermostats and electric diaphragms with german silver wires imbedded in asbestos base, these conductors also being operated in series with thermostat.



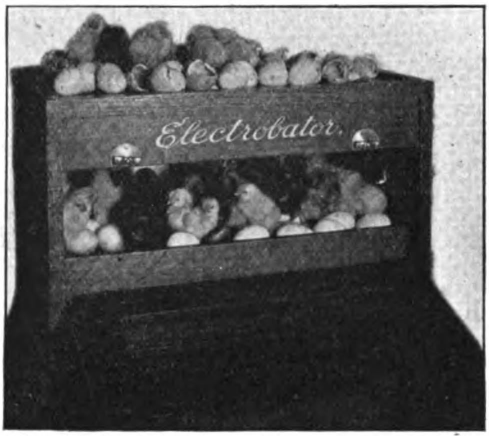
The Electric Hen, for Show Window or Home Use

Some new and novel electric heating devices for hatching chickens by utilizing electric current to provide the necessary heat are seen in the accompanying illustrations.

The "Electroplane" is so arranged as to be easily placed in any of the ordinary oil incubators now in use throughout the country, its purpose being to supply electric heat in place of the oil heat usually used, at the same time not in any way interfering with the use of the incubator should oil fuel be desired.

By means of this device all of the disagreeable features of oil incubators are avoided, there being no fumes, smoke or offensive odors, and the device is made safe and attractive for use in the home.

The "Electrobator" is a purely electrical incubating device and therefore differs from the attachment above described for use in oil machines. In the upper part of the "Electrobator" is located an electroplane similar to that above mentioned, equipped with a thermostat for controlling the temperature and maintaining the same constant at 103 degrees Fahrenheit. This thermostat is very sensitive and delicate in adjustment, there being a variation of only a fraction of a degree at any time in the Electrobator. An electric condenser is provided on the electroplane, placed in parallel with



The Electrobator

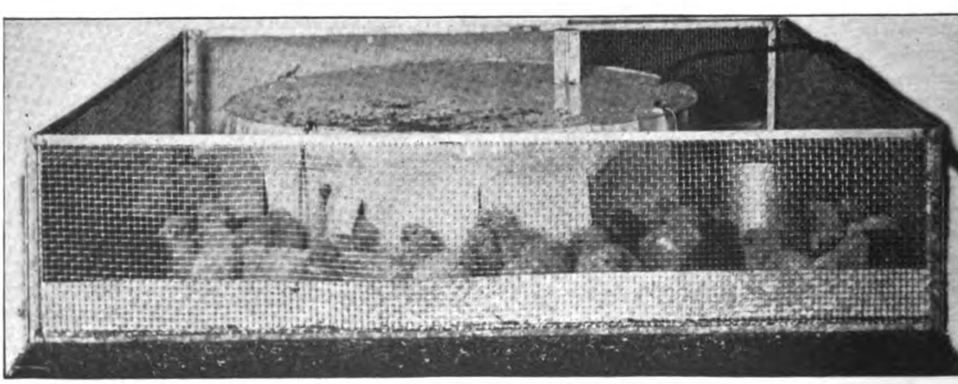
the terminals of the thermostat so as to avoid sparking at the contacts, which are of platimum.

The "Electrehen" was designed and constructed by the writer at the laboratory of the Cyphers Incubator Company for use in nature study in schools and kindergartens, the electric lamp providing all of the necessary heat for incubating the eggs and for brooding the chicks after they have been hatched. It is only necessary to connect the machine, which is a unique and artistic oval glass case mounted on a gun-metal or oxidized copper base, with a flexible cord and plug to any electric lighting circuit, either alternating or direct current of 110 volts pressure, in order to be ready for operation. By turning the switch of the incandescent lighting socket sufficient current is provided for maintaining the proper temperature in the egg-tray for hatching and brooding the chicks. The eggs lie in a nest surrounding the incandescent lamp which is of 16-candle power of the round bulb pattern. This attractive device can be placed in the furnished parlor or library of an electrically equipped home, in the window of a store or in the display rooms of any department house, working satisfactorily day and night without the slightest attention as the current maintains practically a constant temperature with but the slightest action on the part of the thermostat.

A drawer is provided, which is partly drawn from the base, and the electric chicks run about in the fenced enclosure, about three or four feet square, making an attractive feature for a window display to hold the attention of the passerby. Electric incubation even on a large scale is thoroughly practical and undoubtedly will be utilized to advantage in the country as well as the city where current is available.

This form of load is very attractive for the electric lighting companies, and the rates obtainable are as low as for power and heating purposes. The service being for 24 hours per day and for 21 days continuous run for each hatch, it is a most desirable and constant load from the central station point of view.

Don't consider the boss your enemy, for if you do he can never become the ideal boss.



An Electrical Mother, or Brooding Pen

A 25-Foot Auxiliary Yawl

VII. Rigging

CARL H. CLARK

The work of the preceding chapters having been carried out, the boat should now be ready for the rigging. The first step must naturally be the making of the spars. In some cases small trees may be worked into fairly good spars. As a rule, however, the comparatively large size at the butt and the probability of knots and crooks, necessitates an undue amount of shaving and trimming to reduce them to the required size. For this reason it is usually best to select dimension stock from a lumber yard. Clear spruce should be used, taking care to secure pieces without checks or large knots. The sticks should be straight, and of slightly larger diameter than the finished spars.

In lining out the spar, a center line is struck with a chalk line on two opposite sides of the stick. The diameter of the spar at several points is then measured off across the center line and the contour of the spar drawn in on both sides. The stick may then be trimmed down to these lines with a broad axe, and finished with a roughing plane. This leaves the stick with the proper taper one way, but parallel the other way. The contour of the spar is then laid off on the two other sides and the stick again trimmed to the lines, thus leaving it with the proper taper each way, but square. With a draw knife the corners are now trimmed off, leaving the stick octagonal. It may now be shaved to a round shape, using the drawknife with a sort of spiral motion around the spar. The final smoothing is done with a jointer or jack plane, set, first coarse and then fine, and finally with fine sand paper. As soon as the spar is completed it should be given a coat of white shellac, and then spar varnish. The smaller spars would best be made first, in order to get the practice before making the larger ones.

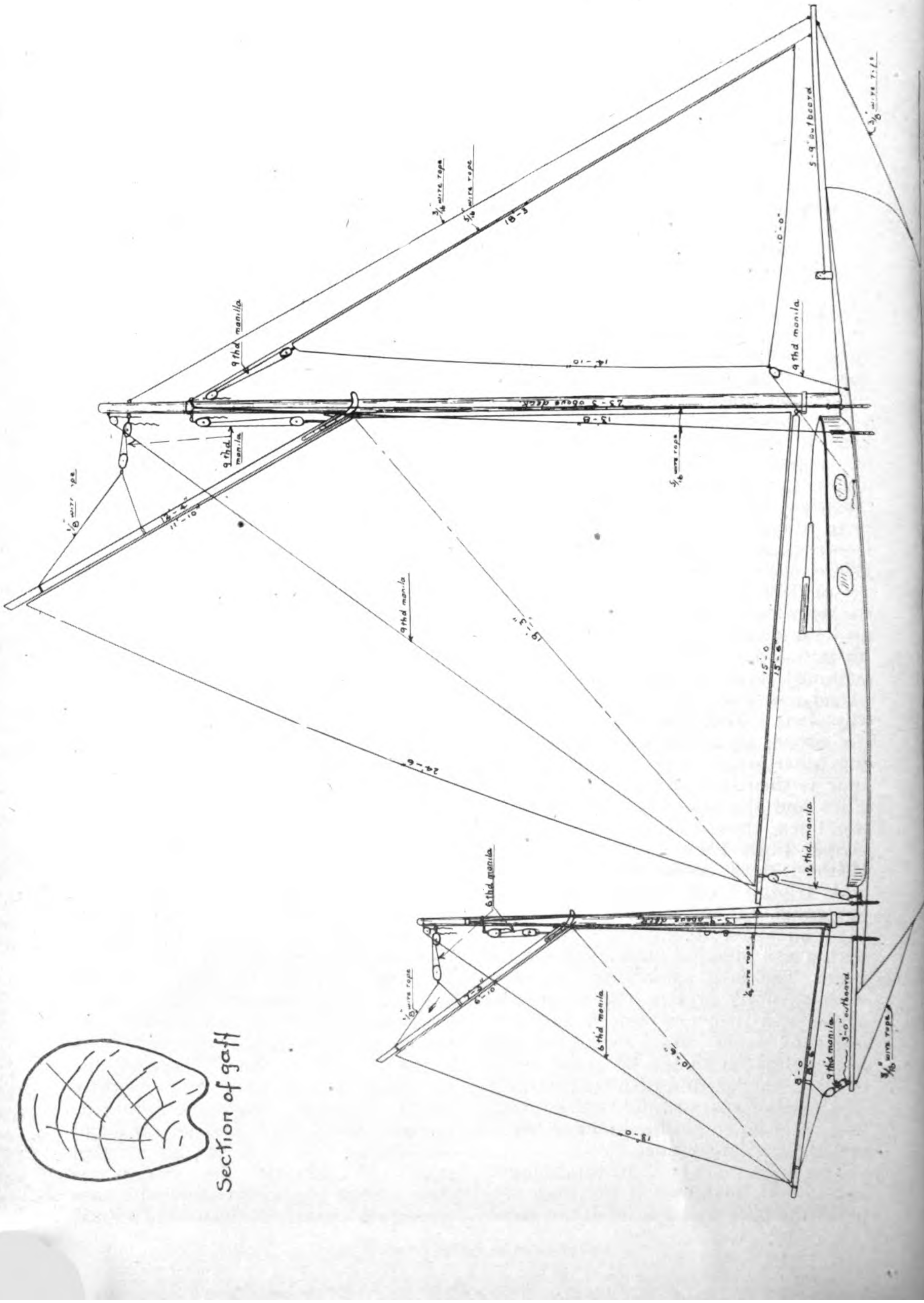
The main mast is 27 ft. total length, and is 5 in. diameter at the deck, 4½ in. at the gaff, and 3½ in. at the head. The mizzen mast is 15½ ft. over all, 4 in. diameter at the deck, 3½ in. at the gaff, and 3 in. at the head. Both masts are provided at the lower end with a tenon which fits the mortise in the mast step. Eyes should be provided as shown for the throat and peak halliards, and the topping lift.

The main boom is 3½ in. diameter at the middle point, tapering to 3 in. at the ends, and is 15½ ft. long. The mizzen boom is 3 in. diameter at the middle, tapering to 2½ in. at the ends. Both booms have a galvanized iron "gooseneck" or hinged fitting to attach the boom to the mast.

The gaffs are of elliptical or pear-shaped section, the main gaff being about 3 in. deep by 2 in. thick and the mizzen gaff about ½ in. smaller in size. The small cut shows the sectional shape of the gaffs, the groove along the lower side being about ½ in. diameter, to take the edge rope of the sails. The gaffs are provided with "jaws" to clasp the mast. These jaws are made of oak, and may be cut from a solid piece or may be purchased in the rough state from a dealer in yacht supplies. The jaws are fastened on with rivets through jaws and gaff. An eye is also provided to take the throat halliards.

The bowsprit and boomkin are made from 2 in. spruce plank. The bowsprit should have a mortise cut in it to fit over the top of the stem. The heel of the bowsprit fits into a mortise cut into the bitt-post. The boomkin is fastened with galvanized iron bolts. Eyes are provided in both boomkin and bowsprit, about as shown.

Chain plates of galvanized iron are fastened to the hull by through bolts in the positions shown. Those for the mainmast should both lead slightly aft of the mast, while those for the mizzen should lead, one forward and one aft, as this mast has no forward stay. If possible the chainplates should be so placed that the bolts pass through a frame. A heavy eye should


Section of gaft
9 thd manila
6 thd manila
12 thd manila
24'-6
15'-0

be worked into the stem and the stern board to take the bobstay and boomkin stay.

The stays are of wire rope of the sizes shown. The upper ends of the stays have spliced loops which fit around the mast and rest upon the eyes for the halliard blocks. The lower ends of the stays are spliced around iron thimbles. The forward stays leading to the bowsprit should be made to the exact length to be fastened to the eyes with shackles. The side stays should be made about 6 in. short, to allow the fitting of a turnbuckle, or a lanyard to take up the slack. The bobstay is made exact length and the bowsprit sprung down to allow it to be put in place.

Unless one is used to it, the splicing of the wire rope is rather difficult, and it is the best plan to have the splicing done by some one who makes it his business. Many business concerns selling wire rope make a practice also of splicing and other work at reasonable cost.

There are many varieties of blocks to be had, running from the ordinary galvanized iron blocks up to the mahogany pattern with roller sheaves. for the halliards, which are comparatively little worked, the cheaper galvanized iron pattern will oftentimes answer. For the sheets, however, a better block should be used as there is much more wear upon them. The style of block used will depend upon the amount of money at the disposal of the builder. Single blocks are used throughout. The size should be such that the specified sizes of rope will run through them readily, even when swelled by moisture.

For the halliard and sheet blocks, the upper block in each case should have a plain hook, and also a "becket" or eye in the opposite end to take the free upper end of the halliard. The lower block of each pair should have a pair of "sister hooks" and no becket.

For the jib sheet a pair of single "jib sheet blocks" should be used. For the topping lifts a plain galvanized iron block is sufficient.

A pair of double deck halliard blocks should be provided and set on braces at the foot of the main mast level with the top of the house. The main and jib halliards and topping lift lead through these deck blocks and make fast to cleats on the after bulkhead of the cabin. The mizzen halliards and topping lift make fast to cleats on the mast below the goose neck band.

A ½ in. galvanized iron traveller about 3 ft. long is to be fastened to the deck just aft of the standing room for the main sheet. Galvanized iron or wooden cleats for sheets and other ropes may be disposed as experience and convenience may require.

The sails would best be ordered from a sail maker, as it is hardly advisable to attempt to make sails of this size. The best plan will be to take the sketch to the sail maker and allow him to take his dimensions from it. The sails should be made from heavy drilling. The main sail should have two rows of reef-points about 4 feet apart. The mast hoops should be equal in number to the holes in the hoist of the sails. They should be larger than the mast by ¾ in. for the main mast and ½ in. for the mizzen.

In finally rigging the boat, if the builder is not experienced in this work, help should be obtained, as there are many small points which cannot be described in an article of this kind.

Everyone who has sailed a boat has certain details of rigging which he has found to be particularly convenient, and many valuable hints may be obtained in this manner.

Before launching, the boat should be given a final smoothing and a finishing coat of paint and varnish all over. The under water portion should have a good coat of anti-fouling copper paint, to prevent its becoming dirty by long exposure to the water.

When the boat is first launched she will probably leak somewhat, but after being in the water for a few hours the planking will swell and she will gradually stop leaking.

For ballast, cast iron is, on the whole, probably the best. It should, however, be painted before using, as otherwise the rust from it makes the inside of the boat very dirty. In some cases small stones, about the size of an egg may be used, but they are not as compact as iron. The amount of ballast needed can best be told by a trial under sail, more being added until the desired stiffness is obtained. As an average, from 600 to 900 pounds will probably be needed.

Other details such as anchor, lights, etc., may be purchased as occasion demands.

A new boat will be found to need a considerable amount of care during the first season, while the various parts are settling themselves into shape. All parts should be kept well painted and varnished. After the first season the usual spring overhauling and painting is sufficient.

If the boat has been carefully built from good stock there is no reason why, with proper care, she should not remain as good as new for many seasons.

(The six previous instalments of this article published in "Amateur Work," giving full directions for building this yawl, may be purchased at ten cents each, on application to our publishers. Eds.)

Unscrewing Nuts

When nuts are met with that refuse to start under the persuasion of a wrench of appropriate size and with a reasonable expenditure of force, great care should be used in dealing with them. The practiced hand can tell about how much force it is safe to use in a given case by the springy feeling which is experienced when the screw begins to twist rather than the nut to start. If too large a wrench is used, or if a piece of pipe is slipped over the wrench handle to increase its leverage, it is often an easy matter to twist off a bolt or stud without starting the nut. When this accident occurs, the remaining part of the stud has to be drilled out, the hole tapped and another stud made and put in place, and considerable expense is the result. In case a nut will not start without such an expenditure of muscle as endangers the screw itself, it becomes necessary to deal with it specially.

Sometimes it is only necessary to squirt the nut end of the bolt with kerosene and allow it to remain over night, when it will be found that the oil has freed this rust around the threads which has caused the trouble. Under some conditions a nut may be loosened by the use of the flame from a blow-torch, which is allowed to play upon the edges of the nut, expanding it faster than the screw itself expands. Tapping a nut with a hammer will often cause the rust which binds the threads together to loosen and permit the nut to be removed, but care should be exercised that the projecting ends of the thread are not battered out of shape, as then the nut will be likely to strip as it is taken off, or if removed successfully cannot be started on again without the use of tap and die. In cases of very refractory nuts the cold chisel and hammer may have to be resorted to, although the nut is oftentimes spoiled in the process. The point of the chisel is set near one of the corners of the nut and pointed in the general direction in which the nut is to turn. When the chisel has cut into the nut sufficiently to secure a footing, repeated light tapping will generally cause loosening. Several footholds of the chisel may have to be used before the result is accomplished. —The Cosmopolitan.

Brushes for Small Electro-Motors

The brushes for small electro-motors are generally made of hard copper or brass strip unnecessarily wide considering the amount of current they have to conduct, and are sprung to bear well on the commutator. More especially is this the case when the commutator is not quite true, which causes the brushes to jump and spark unless they are made to bear very hard on commutator. Thus they act as a brake and absorb from 25 per cent. upwards of the power.

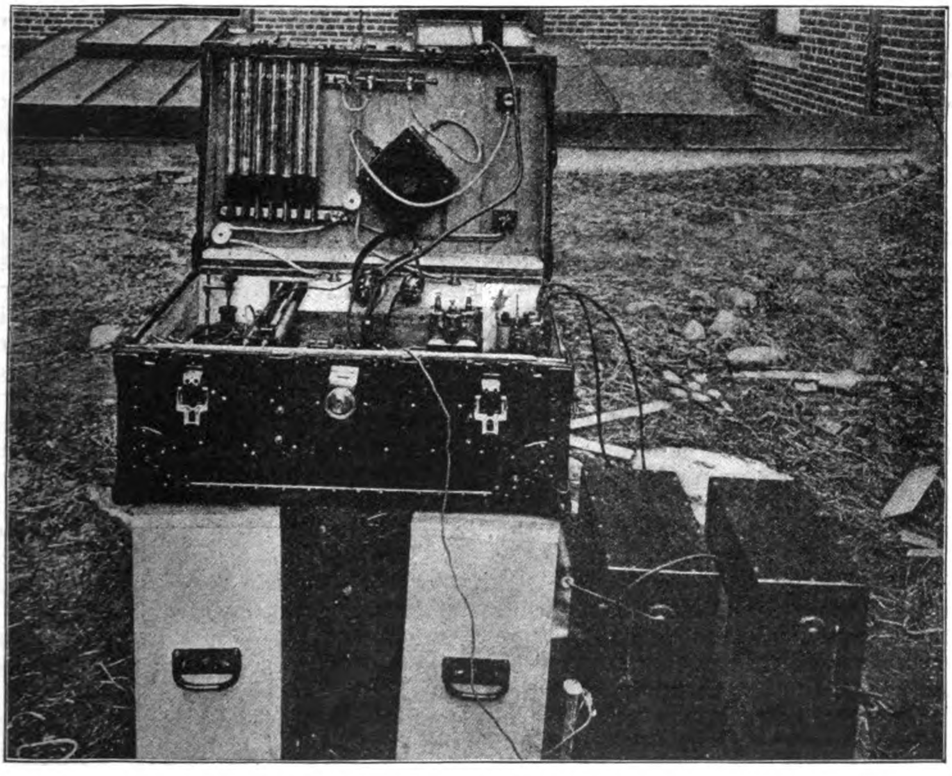
I will advise readers to make them of about half-a-dozen (more or even less, according to size of motor) of the No. 36 wires from a piece of flexible electric light lead. It will be impossible to put pressure on these sufficient to absorb any power, and at the same time they have sufficient spring to make good contact.—A. Green, in The Model Engineer.

A New Government Portable Wireless Telegraph Apparatus

R. H. WHITE

When you read the word "wireless" you think of a stationary electric plant, a building with receiving and transmitting apparatus, and one or more towering masts with an extensive guy rope system. Nevertheless, a wireless outfit which can be packed upon the backs of three mules, and regular army mules, at that, is an accomplished fact. For some time the Signal Office has been experimenting and constructing and has now evolved a type of instrument which for compactness, strength and reliability goes far beyond the expectations of those whose ideas of a wireless outfit is confined to some such outline as is given above.

The instrumental part of the outfit —that is, the key, detector, condensers, tuning coil, etc., etc., are permanently fastened into and carried in a trunk, little larger than an ordinary steamer trunk, and weighing, complete, about one hundred and fifty pounds. Two storage batteries, sufficient for ten hours of continuous sending, are provided, in wooden cases, which are used as supports for the trunk when the outfit is unpacked. A mast is used, made up of ten six-foot sections, jointed together and held in position by guys. Along these sections runs a copper strip which makes electrical connection with its neighbor when the joint and socket ends are fitted each to each.



Portable Wireless Telegraph Apparatus for Field Service

The load is apportioned as follows: One mule carries the trunk and the instruments therein, one mule carries the two batteries, and one the ten lengths of mast together with a bag containing extra ropes, wire, pegs, etc.

The entire outfit is thus packed on three mules; while in service a tent would undoubtedly be used to protect the outfit from rain and dust, it can not be considered that a tent forms an integral part of the apparatus any more than it does so form part of any other outfit of communication used by the Signal Corps.

These outfits are packed upon the mules in the same aparejo (aparayo) that is used throughout the army for fastening to the back of the mule supplies of all kinds.

The outfits are designed for the hardest kind of field work, and while yet and for a long time to come, nothing connected with wireless telegraphy can be truthfully recorded reliable, these outfits are as reliable as any—partly on account of their simplicity and partly on account of the great care and pains taken in their construction. They have a sending and receiving radius to sister stations of from fifteen to twenty-five miles. The wireless outfit provides the possibility of a detached body of men being in constant communication with the main body, across an enemy's line if need be, and with no possibility of interruption save an attack on the party itself.

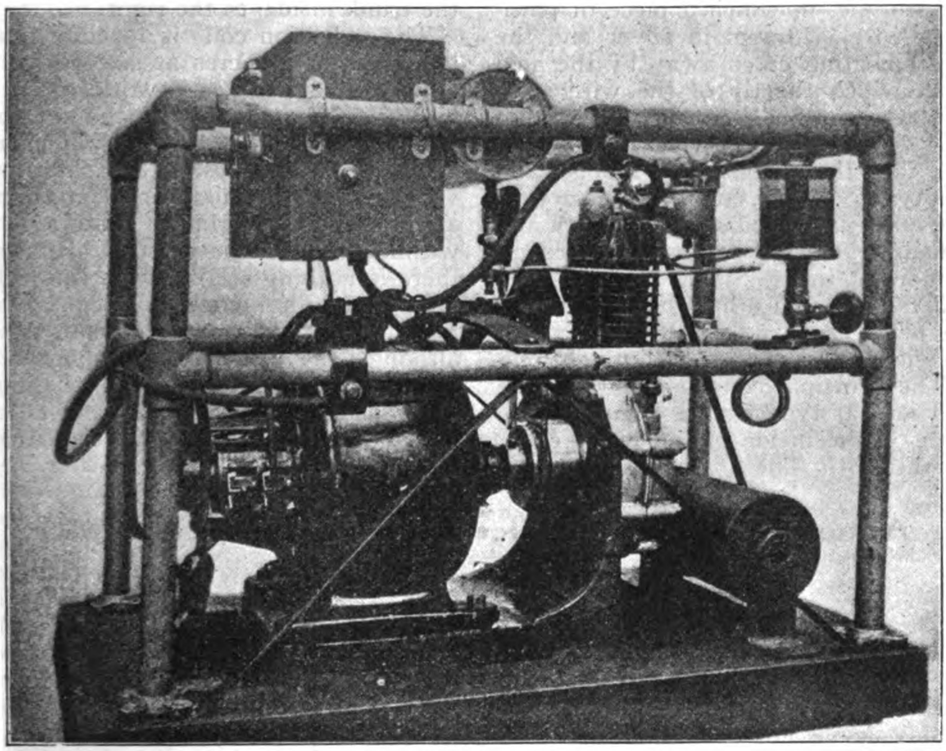
A charging station is a necessity and this is provided in the form of a gasoline engine and generator unit, weighing three hundred pounds and which is to be transported in the wagon train which is inseparable from the movement of a large body of men over an extended area. This unit is strongly and serviceably built within a heavy pipe frame, to prevent damage from blows and knocks, and can be used not only for charging batteries but for supplying the current used in sending messages from headquarters. Further than this, a generator worked by man power is provided, for smaller columns, and which serves very well, but is, of course, somewhat exhausting to the men who have to turn the cranks and which has not the capacity of the power plant.

Recently the wireless outfit was tested at Fort Myer, Va., with special reference to the erection of the antenna pole, the King kite, used when the pole would take too much time, and the wave length of the individual apparatus tested.

In order to accentuate the bad points of the apparatus, a body of untrained men were used, men who had had no previous practice in erecting an antenna mast. In spite of this drawback, the mast went up in little less than three-quarters of an hour, a time which can be reduced to fifteen minutes and very possibly much less, with practice. The operation is as follows: Along the topmast section of the mast the top guys are wound, on hooks, and these are first unwound and laid out at right angles on the ground. These topmost guys, by the way, are of wire for half their length, and leakage is guarded by double insulators where the connection is made with woven cord. These four wires spreading from the top form an umbrella antenna. The top pole is fitted to the pole next below it and these two raised in the air and a third slipped into place. The pole is held upright by four men at the ends of the four guys. Here another set of plain cord guys, also doubly interrupted with insulators, comes into play, which is taken in charge by four additional men. Three more sections are pushed up, one after the other, and then four more guys, making twelve in all, are attached, and pulled taut by four men. The last two sections are pushed home and the mast stands, somewhat insecure in appearance and bent and twisted, but it stands. It is but the work of a few moments to so order pulling and slackening on several guys that it stands straight—when two men, with pegs and an axe, fasten the guys securely to the ground. Meanwhile a tent has been erected close to the mast, the trunk lifted from the aparejo and placed on top of the two empty boxes in which were the storage batteries. A ground antenna is spread to four small poles and guys, an electrical connection made between apparatus and mast with insulated cord, and the apparatus is ready for work, either in sending or receiving.

While limited in radius on account of both power and elevation where sister stations are concerned, there is no difficulty in getting into communication with large stations, such as Cape Henry or Navy Yard or Sandy Hook, over a distance of one hundred miles and even more. This provides for the possibility of relaying a message to a sister station out of range of the original sender but in range of the more powerful if more distant station which could be in communication with both small stations.

It happens at times in such work taken out, and laid lengthwise with the other two stretchers, the kite rolls up in small space, and can be instantly erected without any tools, by merely reinserting the cross-stretcher and tying in. The kite cord is composed of forty-two strands of phosphor-bronze wire, woven about a hemp centre. It serves itself as the antenna when carried up by the kite. It works well if five hundred feet have been paid



Portable Gasoline Engine and Generator for Field Wireless Telegraph

that it is necessary to open communication in the least possible time. This can be done, if there is slight breeze, by the use of a kite. The kite used in the Signal Corps is called the King kite, from the sergeant who invented it—a combination Malay and box kite, without a tail, very steady in a slight breeze as well as a wind and extremely compact. The kites are either six by six feet or eight by eight feet, have two stretchers from top to bottom and one from side to side, which last is removable by unhooking sockets and untying two cords. When this is out—better if the wind carries up more. This wire cord is wound on a hand reel. The kite itself is flown from a bridle which is attached to the cord. The kite has a boxed-in space of a triangle pattern, a compression release opening, and is yet shaped like the familiar six-sided Malay kite.

A number of these wireless sets, each one slightly different from its predecessors, as improvements were suggested, have been issued and sent to various posts and commands. There will be a number yet made and distributed, all of the most recent, trunk-contained pattern, and they will be largely used in army manoeuvres, which will put the final test to their arrangement and construction.

The spark is about a quarter of an inch in length, varying of course, with the strength of the current, the distance to which the message is being sent, the spread of antenna, etc. It springs from between two brass electrodes plainly seen in the illustration. The detector generally used is the electrolytic, in which a piece of platinum wire is drawn in silver and the silver coating eaten away by the acid with which the tip of the wire is in contact in a small cup in the form of the detector here used. In spite of the fact that constant filling and emptying of this cup is necessary as the outfit is moved, the simplicity and reliability of this detector has recommended it to the Signal Corps over others, although others have been and are being used, and will be experimented with as fast as they are brought out.

The principal condenser is of the Leyden jar type, and is plainly to be seen on the inside of the trunk cover to the left. There are eight in this set, but here, again, the number of tubes, and size and capacity of the condenser varies with the general style and capacity of the apparatus.

The tuning coil for receiving messages is of copper wire on a rubber centre—the tuning coil for sending messages is of rubber-covered wire. The first is in the trunk to the left, partly seen, with the tuning traveler above it—the second coil is about the square rubber support on the lid of the trunk inside, to the right.

The induction coil is specified as taking eight amperes at sixteen volts when the interrupter is working.

While the apparatus can be seen by any one interested, in the laboratory of the Signal Corps, at Washington, very exact details, and anything approaching a working drawing is withheld, for obvious reasons, although there is nothing secret about this construction. The whole matter is yet in so much of an experimental state, although the present instruments are highly satisfactory, that no definite data has been or will be furnished as yet as to minute constructive particulars.—Electrical Review.

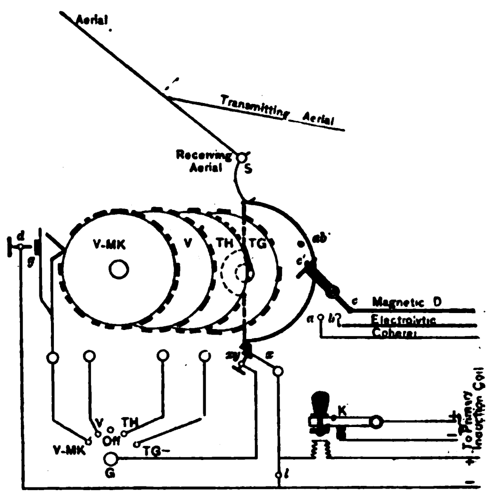
Automatic Calling Device for Wireless Telegraphy

W. R. CARROLL

The writer's attention has been called to the article by Mr. T. H. Reardon in the March issue of the "Electrical World" describing an automatic calling device for a telegraph line. At about the time this article appeared I had constructed and put into use a similar, though a more elaborate device for automatic calling with a wireless telegraph transmitter. The wireless station where this was put in use is the one on Yerba Buena Island, San Francisco Bay, under control of the United States Navy Department, which station did excellent service during the San Francisco disaster of a year ago.

In addition to the wireless telegraph equipment of this station there is a wire telegraph system of the Postal Telegraph Co., connecting with the Commercial Pacific Cable Co.'s line to Hawaii and the Orient, and also local and long distance telephones. As a visitor to the station one day remarked, the island has connection with the outer world through air, under water and over land.

The wireless telegraph station communicates regularly with the Navy's wireless stations at Mare Island on San Pablo Bay 20 miles away and with Farrallone Islands 35 miles at sea beyond the Golden Gate. The transmitting apparatus is similar to that in use at all modern wireless stations. The receiving devices include a coherer system with tape recording apparatus; an electrolytic receiver with high resistance double-head telephone receivers and a magnetic detector so arranged that it can be left attached to the transmitting aerial at all times even when sending. By this arrangement it becomes possible for the receiving station to "break" the sending station,



Automatic Calling Device for Wireless Telegraphy

just as is true on land lines, and to secure at once a repetition of lost signals instead of waiting until the sending has ceased as is done with all other receivers.

The auto-sender is shown in the accompanying diagram. There are four transmitting or type wheels and a half-wheel or aerial control wheel as it may be called. The calling wheels bear the call letters of the different stations, TG being Mare Island and TH Farallones. The wheels V and V-MK are for sending out a continuous train of V-signals for the adjustment of another station. All of these wheels and the half-wheel are on a common shaft which also carries the drive wheel of a set of gears which propels the traveling iron core of the magnetic detector, and the whole is belted to a small motor. The speed of the motor is controlled by a slide rheostat, and a telephone hook switch in the circuit serves to set the mechanism amoving when the telephone is taken up for receiving or whenever it is desired to start the automatic sending. Underneath the lever of the sending key K is an armature and an old pair of relay magnets having a resistance of 75 ohms, which actuated by a shunt circuit from the main battery serve to manipulate the key whenever the circuit is closed at one of the contact points d by the flat spring g when the latter is pushed into contact by the teeth on the rim of the type wheel. A condenser or a lamp l of suitable resistance is shunted across this make-and-break to obviate the spark and render the signals sharp and clear. This form of make-and-break is well adapted for telegraphic work. The switch G connects to the wheel desired or it opens the circuit entirely for hand sending with key K.

The half wheel is not fastened tightly to the shaft, but is held by means of a compression spring under a nut on the end of the shaft. If it is desired to send V-signals or call continuously, when the detector is used the aerial switch A is moved to the point c and the back arm catches on a stop pin c' on the half wheel, thereby stopping it and placing the aerial in permanent contact with the detector D. If the detector is not to be used the back arm is placed on a stop pin ab' just an instant after the spring brush s has slipped off the segment and the aerial is no longer in contact with the half wheel. The contact xy at the spring brush x at the opposite side of the half wheel serves to keep open or close the magnet circuit as the segment revolves. When the switch A is on either a or b and the half wheel is free to revolve it closes the magnet circuit just an instant after the aerial spring S flies open, and when the segment moves around and again engages the aerial in contact the magnet circuit is broken and the transmitting signals cease.

The signals on each half of the wheels TG and TH are composed of the letters three times repeated and signal TI, the last being the call letter of Yerba Buena station. When the control wheel is in motion the magnet circuit is broken one-half of the time. By this arrangement the calls are not continuous but intermittent and during the interval the coherer or electrolytic receiver is thrown in circuit and the station called may reply and business then proceed in the usual way. If it is desired to call continuously the back arm is placed in contact with pin b.

When the V or test signals are sent out signed MK, as occurs once in each revolution of the wheel occupying about one-half minute, the receiving station is aware that the sending station is using the magnetic detector and that it can "break" and interrupt the signals when enough test signals have been received to have secured the desired adjustment. Should the sending station operator be called away to some other duty he switches over to the plain V wheel and allows it to continue sending for some prearranged time as agreed upon for adjusting purposes.

In order to have type wheels for any call letter desired, a wheel is made with changeable teeth. With floating (ship) wireless stations coming in contact every day with new stations this arrangement would be quite useful. The type wheel and make-and-break as used in this device are what is known as the Omnigraph transmitter and are made by The Omnigraph Co. of New York.—Electrical World.

The Value of College Graduates in Technical Work

In an address delivered at the recent dedication of the new Engineering Building of the University of Pennsylvania, Mr. Frederick W. Taylor discusses the causes and possible remedies for one defect which, he states, practically all young college graduates seem to have in common. That is, their dissatisfaction and comparative uselessness for a period of from six months to two years immediately following graduation. An exception, however, is made of those men who through necessity or otherwise have, either before or during their college course, come into close contact and direct competition with men working for a living. That this condition has attracted serious attention was illustrated by an example cited wherein a certain company in filling several attractive positions, specified that technical graduates should be given a preference, but that none should be employed who had not been graduated for at least two years.

If such an idea becomes general, there is a hard time ahead for the young technical graduate, but we do not believe that the facts of the case warrant any such general application, and that an examination of the records of the men graduated from our technical schools in 1905 will show that any large proportion of them have been even comparatively useless to their employers. There are, no doubt, individual cases, and in certain particular localities possibly a fair proportion of the men where this condition will be found to be true, but it is a matter for individual consideration, and the whole class should not be condemned by the failure of one or two. This is a matter of men not of car wheels or air hose.

The address points out the fact that the sheltered existence, and comparatively lax discipline of the colleges and universities are such as to make the following contact with real life considerable of a shock and probably disappointment to the ordinary graduates and makes several suggestions for improvement in this respect. Possibly the most important of these is the suggestion that the university make it obligatory for the student to spend six months or more, preferably at the end of the freshman year, in some commercial, engineering or manufacturing establishment—there to work as an employe at whatever job is given him. The idea of this is to give the student close contact on an equal plane with practical workmen, so that he may be aided in developing an earnestness of purpose which will be of benefit not only after graduation, but in the remainder of his college course as well.

Some such scheme would, no doubt, be of much practical value to the student, provided it could be arranged as not to curtail or further crowd the present usual course of instruction.

One of the most novel and interesting publications that comes to our exchange table is The Novelty News, of Chicago, a business man's magazine handsomely illustrated, covering the field of novelty and specialty advertising, premium methods, souvenirs, emblems, post cards and advertising goods generally. It contains sixty large pages and is full of new ideas from cover to cover. It's $1.00 a year.

STANDARD SYMBOLS FOR WIRING PLANS

AS ADOPTED AND RECOMMENDED BY

THE NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION OF THE UNITED STATES and THE AMERICAN INSTITUTE OF ARCHITECTS.

Copies may be had on application to the Sec'y of The Nat. Elec. Cont. Assoc'n, Utica, N. Y., and the Sec'y of The American Instit. of Architects, Washington, D. C.

Ceiling Outlet; Electric only. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Ceiling Outlet; Combination. $\frac{4}{2}$ indicates 4-16 C. P. Standard Incandescent Lamps and 2 Gas Burners. If gas only

Bracket Outlet; Electric only. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Bracket Outlet; Combination. $\frac{4}{2}$ indicates 4-16 C. P. Standard Incandescent Lamps and 2 Gas Burners. If gas only

Wall or Baseboard Receptacle Outlet. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

Floor Outlet. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.

6 Outlet for Outdoor Standard or Pedestal; Electric only. Numeral indicates number of Stand. 16 C. P. Incan. Lamps.

$\frac{6}{6}$ Outlet for Outdoor Standard or Pedestal: Combination. $\frac{6}{6}$ indicates 6-16 C. P. Stand. Incan. Lamps; 6 Gas Burners.

Drop Cord Outlet.

One Light Outlet, for Lamp Receptacle.

Arc Lamp Outlet.

Special Outlet, for Lighting, Heating and Power Current, as described in Specifications.

Ceiling Fan Outlet.

S^1 S. P. Switch Outlet.

S^2 D. P. Switch Outlet.

S^3 3-Way Switch Outlet.

S^4 4-Way Switch Outlet.

S^D Automatic Door Switch Outlet.

S^E Electrolier Switch Outlet.

Show as many Symbols as there are Switches. Or in case of a very large group of Switches, indicate number of Switches by a Roman numeral, thus; S^1 XII; meaning 12 Single Pole Switches.

Describe Type of Switch in Specifications, that is, Flush or Surface, Push Button or Snap.

Meter Outlet.

Distribution Panel.

Junction or Pull Box.

Motor Outlet; Numeral in center indicates Horse Power.

Motor Control Outlet.

Transformer.

Main or Feeder run concealed under Floor.

Main or Feeder run concealed under Floor above.

Main or Feeder run exposed.

Branch Circuit run concealed under Floor.

Branch Circuit run concealed under Floor above.

Branch Circuit run exposed.

Pole Line.

Riser.

Telephone Outlet; Private Service.

Telephone Outlet; Public Service.

Bell Outlet.

Buzzer Outlet.

2 Push Button Outlet; Numeral indicates number of Pushes.

Annunciator; Numeral indicates number of Points.

Speaking Tube.

Watchman Clock Outlet.

Watchman Station Outlet.

Master Time Clock Outlet.

Secondary Time Clock Outlet.

Door Opener

Special Outlet; for Signal Systems, as described in Specifications.

Battery Outlet.

Circuit for Clock, Telephone, Bell or other Service, run under Floor, concealed.
Kind of Service wanted ascertained by Symbol to which line connects.

Circuit for Clock, Telephone, Bell or other Service, run under Floor above, concealed.
Kind of Service wanted ascertained by Symbol to which line connects.

NOTE—If other than Standard 16 C. P. Incandescent lamps are desired, Specifications should describe capacity of Lamp to be used.

SUGGESTIONS IN CONNECTION WITH STANDARD SYMBOLS FOR WIRING PLANS.

It is important that ample space be allowed for the installation of mains, feeders, branches and distribution panels.

It is desirable that a key to the symbols used accompany all plans.

If mains, feeders, branches and distribution panels are shown on the plans, it is desirable that they be designated by letters or numbers.

Heights of Centre of Wall Outlets (unless otherwise specified)

Living Rooms	5' 6"
Chambers	5' 0"
Offices	6' 0"
Corridors	6' 3"

Height of Switches (unless otherwise specified) 4' 0"

On Making Up Photographic Solutions

H. W. RICHARDSON

What is easier than to say "and dissolve in water to make ten ounces," or twenty or forty, as the case may be? Yet in making up most of the solutions that we use in photography it is not sufficient guide to anyone who is unfamiliar with the particular substances employed, and it is with that in view that I have thought a few words on the subject of making up solutions may be of value.

One of the first phrases that needs explanation is "Water to." In some formulas the quantity of water to be taken is stated thus, "Water, ten ounces." In others, the expression "Water to ten ounces" is employed. The two do not mean the same thing, although I do not think that in a single instance in photographic procedure it matters whether the water is the measured amount stated or whether the solution is made up to the total bulk given. For this latter is the meaning of "water to." We are apt to overlook the fact that when solids are dissolved in water, while they do not, as a rule, increase the bulk of the water to the extent of their own bulk, they do increase it considerably. The expression "water to" any amount means, then, that after dissolving the solids in a quantity of water a little less than the amount stated we add more water after they are dissolved to bring the total bulk of liquid to the amount given.

How many readers get puzzled over the formulas in which "parts" figure. How much is a "part"? I have been asked, and how can we make up such a formula as—Hypo, five parts; alum, three parts; water, forty parts. It is easily answered. Parts, unless otherwise stated, are parts by weight. As an ounce weight of water is a fluid ounce, or at least is near enough to a fluid ounce for the two to be used indiscriminately, it is only necessary in making up a formula such as this to weigh out the hypo and alum in ounces and to measure the water. If we do not want forty ounces we can use less by taking a half or a quarter of the total quantity, thus—Hypo, five ounces; alum, three ounces; water, forty ounces: or—Hypo, two and one-half ounces; alum, one and one-half ounces; water, twenty ounces: or—Hypo, one and one-fourth ounces; alum, three-quarters ounce; water, ten ounces. The ounces referred to should be apothecaries' ounces of 480 grains; these are the ounces indicated by the weights sold with scales for photographer's use, unless the weights are marked "oz. avoir." when they are avoirdupois ounces of 437½ grains. In some formulas the ounces are distinctly described as avoirdupois ounces. The difference between the two kinds of ounces, although too large to be altogether ignored, is not, as a rule, important in formulas that are given in ounces at all, except to this extent, that any one user of the formula should always use the same ounce in making it up, otherwise his solutions at one time may appear to work much more quickly than at another. The difference between the two, in any of the baths in ordinary photography, is not going to make a success into a failure, but needless laxity should be avoided.

One of the first solutions the photographer has to make up is a hypo bath. Now hypo is a very easy salt to dissolve, especially in hot water, and we can weigh out the quantity necessary, put it in a jug, and pour boiling water on it, stirring it up with a stick until it is dissolved. The jug should be kept for this purpose, as when once hypo solution has been made in it it is practically impossible ever to get every trace of hypo out again, simple as it seems to wash it out, and even a trace of hypo is very harmful at times. When a solution is made thus with boiling water and wanted quickly, the cold water necessary to bring it up to bulk should not be added at once. The hot solution should first be quickly cooled as much as possible, and then cold water added. This will bring it down to a workable temperature much faster than by diluting and then cooling. It is quickest cooled by pouring it out into a flat dish (not a vulcanite or pulp one, which would be spoilt by the heat), and filling the jug up with cold water. In a minute or two the jug is emptied and the hypo put back into it, while the dish is cooled with the cold water in the same way. Two or three changes will very quickly effect what is wanted.

When the hypo is not wanted very quickly it may be dissolved in cold water, but as it is not so soluble in cold as in hot, and as the act of dissolving cools the liquid very much, this may take a long time. A pound of hypo may be placed in a Winchester quart (80 ounce) bottle of water, and at the end of a week all may not be dissolved. Had a wide mouth bottle been used, and the hypo hung on the top of the liquid in a muslin bag, instead of lying at the bottom, the hypo would have dissolved in a few hours instead of several days.

In making up developing solutions, particularly in the case of a pyro solution, the action of ordinary water on pyro is very rapid, and the solution discolors almost the moment it is made. To prevent this, it is the practice first to dissolve the preservative, sodium sulphite or potassium metabisulphite, usually the latter, and then to add the pyro. Sulphite may be dissolved in hot water; the crystals, if the water is very hot, suddenly become an opaque instead of a clear white, but no harm is done. The pyro must not be added till the solution is cold. If sulphite is used it is usual to add a trace of acid, citric acid will do, which liberates a little sulphurous acid, as can be detected by the smell, and helps to preserve the pyro. Hot water must not be used to dissolve metabisulphite, as this drives off some of its sulphurous acid, and so weakens its power as a preservative. The best plan is to hang the metabisulphite just below the surface of some cold water which has been boiled briskly, and allowed to cool quietly without shaking. The metabisulphite will dissolve without any agitation in an hour or two, and then the pyro or other developer may be added.

The order in which the different ingredients are dissolved is often important; and when no information on the subject is volunteered, the order in which they are given in the formula should be followed, except that the water, which is generally put last, must first be taken. If metol, for example, is dissolved in water and then sulphite is added in any great quantity, the metol may all be driven out of solution again. A ferrous oxalate developer is made by mixing a saturated solution of ferrous sulphate with one of potassium oxalate. If the oxalate is added to the sulphate, a thick muddy fluid quite unsuitable for use is formed, whereas if the sulphate is added to the oxalate we get a clear red liquid, which is what we want. In making up toning baths, the gold solution should always be diluted freely with part of the water and then added to the sulphocyanide, or whatever other substance is used, and not vice versa.

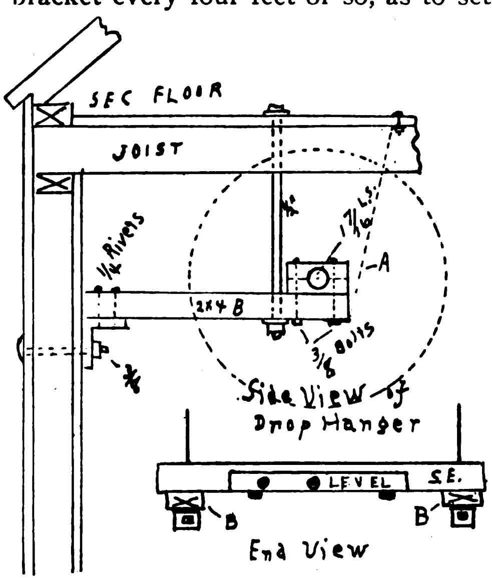
When a solution has to be boiled, as in the case of sodium sulphide for sulphur toning, it will not do to use a saucepan or other kitchen utensil, but a thin glass boiling flask must be got from the chemist. This may be supported on a piece of iron wire gauze over a spirit lamp or gas stove, and the liquid boiled in it without the slightest fear of the glass breaking, and without any risk of contamination, as would be likely to follow the use of an enamelled iron or similar vessel. Those who have done any chemistry understand the use of a glass flask for this purpose, but to those who have not it seems strange that it should be possible to boil liquid in a glass vessel without risk of breakage, but it is quite easy.

Gelatine and glue, which is only impure gelatine, are curious substances to dissolve. They need hot water, yet if placed direct in hot water they may take an interminable time to dissolve. They should always be allowed to soak in cold water until quite soft, and then when placed in hot water, or heated, they will liquefy completely almost directly. When chrome alum has to be mixed with gelatine, as when preparing paper for single transfer carbon, the chrome alum must not be added suddenly, or the gelatine will just separate out in an insoluble form. The quantity of water should be divided, the gelatine dissolved in one part and the chrome alum in the other, both should be made hot, and then the alum should be added to the other a little at a time, with stirring. No precipitation of the gelatine will then take place if the chrome alum is not present to excess.

From what has already been said it will be seen that almost every solution has its peculiarities, and that these should be understood if it is to be made up easily and correctly. There are many other points to which reference might be made, but these must be left for another paper.—Photography.

Home-made Drop Hanger

For those having or intending to have power in the shop, I will show my way of making drop hangers for line shaft. The 2x4 B is of pine studding, about two feet long, with nine-sixteenths inch hole for one-half inch rod, set back eight inches from the front end of the bracket to allow room for pillow blocks or boxes. At the inner end, on the under side of the bracket, is riveted on an L shaped, one-fourth by two and one-half inch iron, or an iron at least two inches wide using three one-fourth inch rivets. To fasten to the wall use a three-eighth inch bolt, placing a bracket every four feet or so, as to set



directly against the studding in the wall. If at any place you have a heavy pulley, put in a flat brace, A, which otherwise is not necessary.

The blocks for shaft-bearing are of one and one-fourth by five inches ash or any good hard wood, and eight inches long. It may be better to buy pillow blocks. I bought one to have at the end of the shaft for the collars to rub against. I made the others of ash. To bore the halves straight, mark square across the center of the blocks, saw about one-sixteenth inch deep, clamp a pair in the vise; the points of the bit will follow the cut made by the saw. The amount of drop may be made to suit, a couple of inches more than one-half the diameter of the largest pulley you intend to use. If 24 inch is the largest, then a 14 inch drop ought to bring clearance enough. Where a pulley can be put between joists it allows more room. See dotted circle. Our line shaft is one and seven-sixteenths inches and runs about two hundred revolutions. I would not run a line shaft faster because it is harder on the bearings, and as a countershaft is necessary for most, if not all the machines, the speed can be regulated by them. In lining up the shaft start at one end, fasten one bracket, then use the straight edge SE which should be long enough to reach the next bracket, and have projections for a level to rest on at the lower edge. Have quite long threads on the one-half inch rods to allow plenty of adjustment in case the floor is out of level. Square each bracket out from the wall after passing the one-half inch rod through, and when up to place, mark for the three-eighth inch bolt in the wall. By having the one-half inch rod on the back side of the blocks it makes it easier to get the shaft in place.

Good as the electric motor is, as compared with other prime movers of machinery, it should not be expected to do its best and most economical work unless it is itself in good condition. Electrical machinery should undergo inspection that its condition may be known and correction made if necessary.

Mechanical Drawing

WILLIAM C. TERRY

Isometric Drawing.—A drawing in isometric projection represents an object approximately as it appears to the

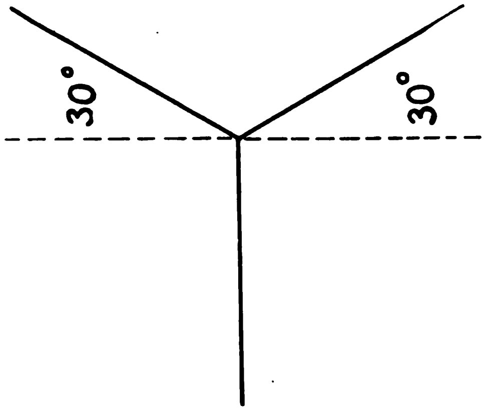


Fig. 1

eye. This projection is used as a substitute for true perspective to save time and labor. Isometric drawing is based on the following fundamental principles, as easily applied as they are remembered: (a) There are three lines called isometric axes (see Fig. 1). These are a 30 degree line in one direction, a 30 degree line in the other direction, and a vertical line. These three lines drawn from the same point, form a Y. (b) The isometric axes represent lines mutually perpendicular to each other, and correspond to the three dimensions, length, breadth and height. Measurements along a horizontal line are not made in isometric drawing. In Fig. 2 are shown six different views of the same object. The three figures on the right are similar to the three on the left. Taking the figures in pairs, the only difference between two which correspond is that in one case the longest 30 degree lines extend to the left, while in the other they extend to the right. Either method is correct. (d) Vertical lines in the object are parallel in the drawing. Lines parallel in the object are parallel in the drawing.

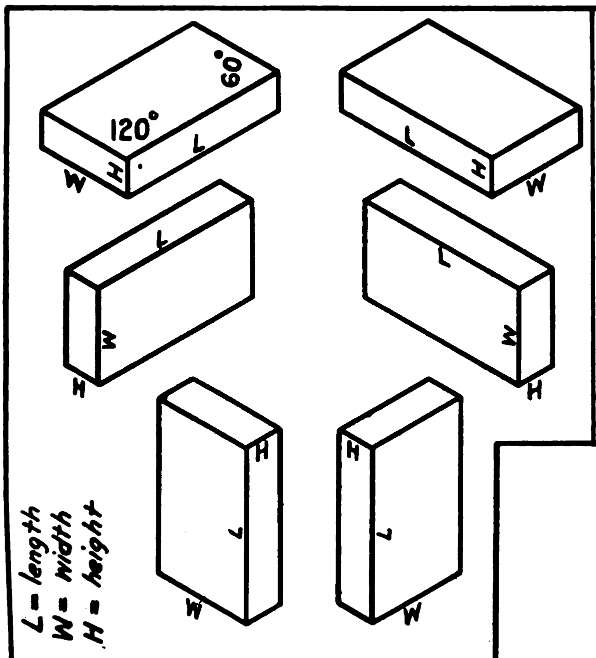


Fig. 2

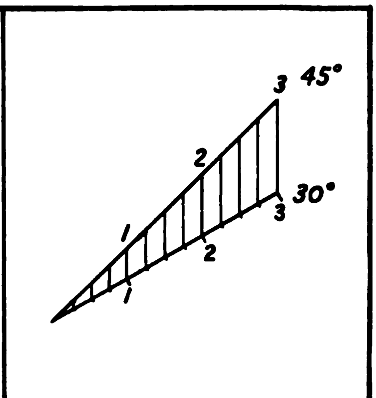


Fig. 3

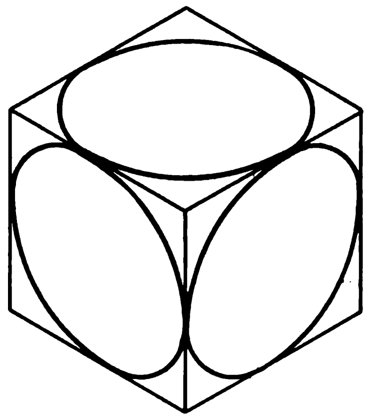


Fig. 4

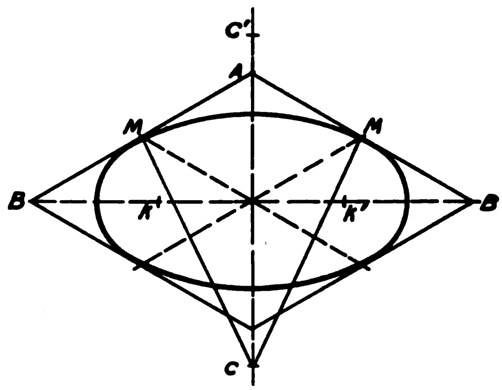


Fig. 5

Right angles in the object are usually either 60 degrees or 120 degrees in the drawing. See Fig. 2.

An isometric projection of an object, if drawn to full scale, makes the object seem larger than it really is; to offset this, an "isometric scale" is sometimes used. Such a scale can be constructed as follows: Lay off true inches on a 45 degree line and drop vertical lines; these intercept isometric inches on a 30 degree line. The inch may be subdivided in a similar way into as many parts as are necessary (Fig. 3).

If the isometric scale be transferred to the edge of a strip of cardboard it can be used like an ordinary scale. All circles take the elliptical form and are projected upon one of the three planes shown in Fig. 4.

The ellipse is drawn from the four centers (see Fig. 5) c, c', k, k'. To get center k, lay off bk equals bm.

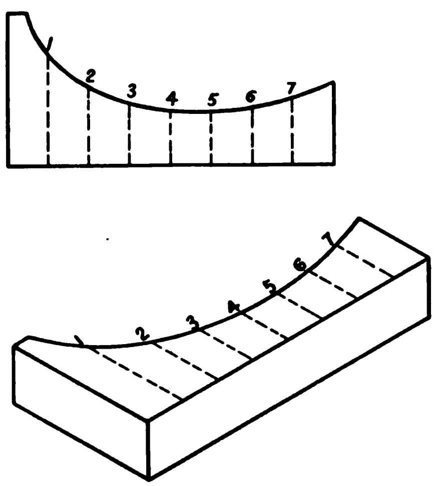


Fig. 6

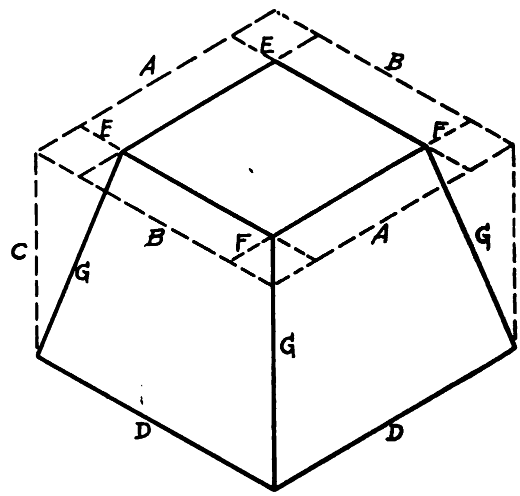


Fig. 7

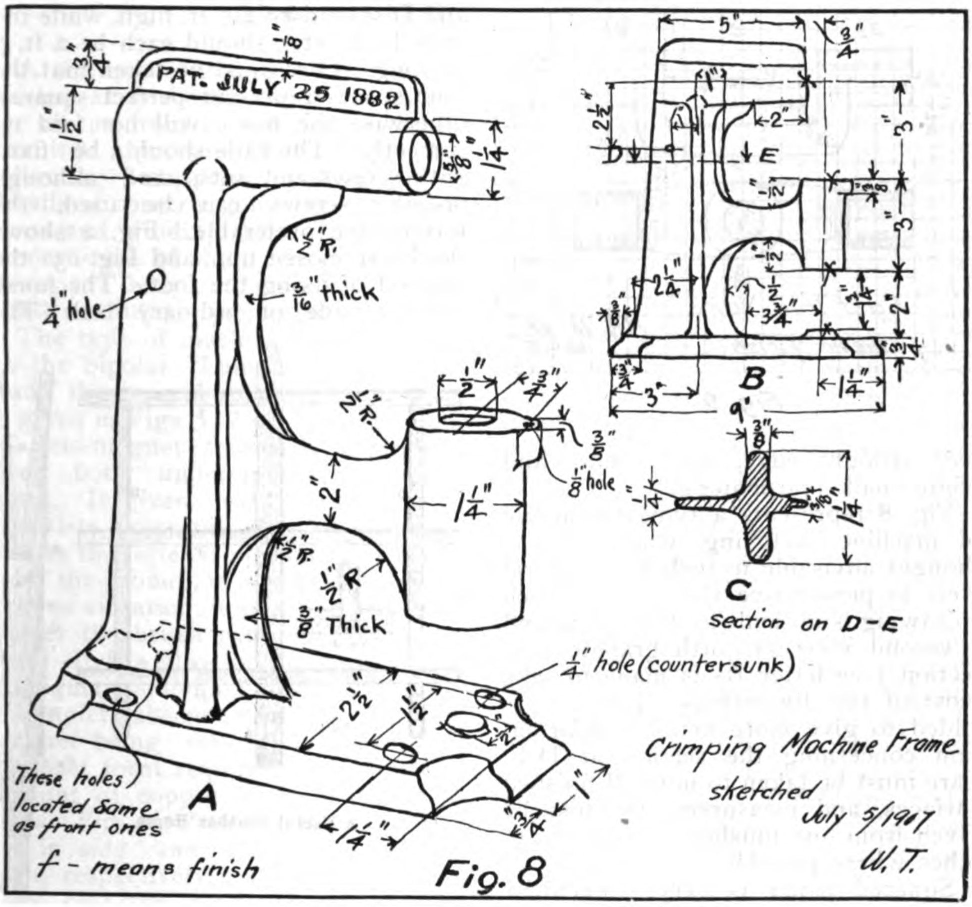


Fig. 8

To get center c, lay off cm equals ab equals a side of the circumscribed square. This method applies to the use of any scale and is a close approximation. The ellipse is not tangent to the sides at m, but the error is not perceptible.

The method of drawing irregular curves is illustrated in Fig. 6. The left hand figure is the true shape of the upper and lower faces of a block. The right hand figure is the isometric drawing of the same block, and the corresponding ordinates are marked with the same numbers, 1, 2, 3, 4, 5.

Let us construct a frustrum of a pyramid. Draw a cube, (remembering our lines are construction lines only), see lines aa, bb, c and dd. Fig. 7.

Measuring in from lines a, b, one-half the difference of base and top, we draw lines ee and ff. Sloping edges of our finished frustum will be lines drawn from the intersection of lines e and f with the corners of the base. Notice the sloping edge nearest the draftsman, which falls directly over one line of our cube, and needs only to be extended at the top. The dimensioning of isometric drawings will be taken up in a later number.

Sketching.—Draftsmen and mechanics are oftentimes called upon to take detailed measurements and make free-hand sketches of machinery and engineering structures, in order to make finished working drawings of improvements or additions. In some cases of engineering work a level or engineer's transit is called into play, but we will consider machine details

The tools generally found necessary are as follows: A large scratch pad, sketch book or a sheet of heavy manila paper tacked or glued to a thin board, a medium soft lead pencil, folding rule, flexible steel scale, calipers, plumb-

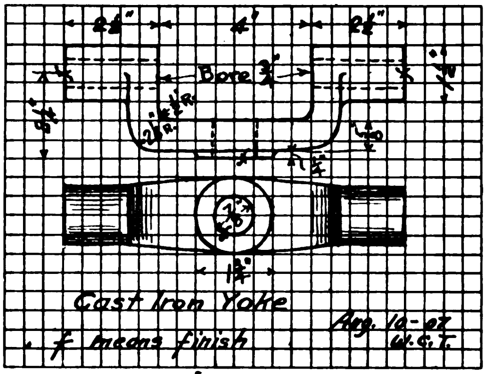


Fig. 9

bob, straight edge, steel square and white chalk (carpenter's).

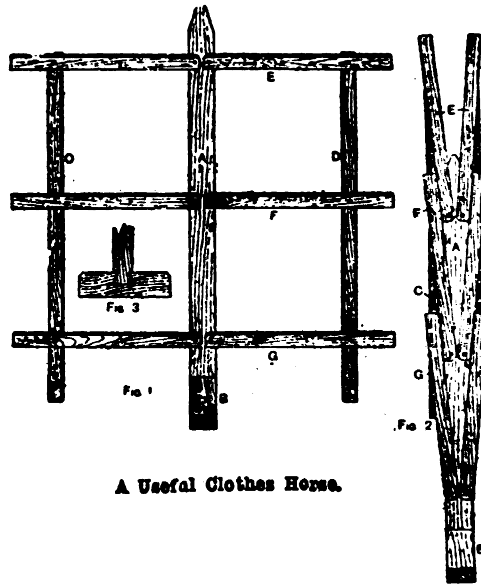
Fig. 8 represents a typical example of machine sketching, where it was thought advisable to include a general view in perspective (letter A). Such a drawing is difficult to dimension, and a second view in orthographic projection (see letter B) is made to take most of the dimensions. Letter C is added to give more detailed information concerning the section at D-E. Care must be taken to note all finished surfaces, and measurements must be given from one finished surface to another where possible.

Squared paper is very convenient for free-hand sketching of machinery and can be bought ruled in light blue with spaces of one-fourth inch, which is most convenient for shop work; see Fig. A.

A Useful Clothes Horse

The accompanying illustrations show a useful clothes horse, which can also be used as a towel rail for the scullery. The advantage it possesses over the ordinary folding clothes horse is that it is more rigid, and when not in use it occupies but little space.

Fig. 1 shows the clothes horse opened ready for use. The centre upright A and the foot B should be cut from stuff 4 in. by 4 in., while the remaining portions, C, D, E, F, and G, can be cut from stuff about 2 in. by ¾ in. The pieces C and D should be cut and fixed so that they will be flush with the centre piece A. The uprights C and D should be 4½ ft. high, while the rails E, F, etc., should each be 2 ft. 7 in. long. Care must be taken that the four spaces represent perfect squares, otherwise the horse will not fold up correctly. The rails should be fixed with screws and nuts, and although ordinary screws can be used, the former are preferable. Fig. 2 shows the horse closed up, and Fig. 3 the method of fixing the foot. The horse can be made of ordinary deal. The



A Useful Clothes Horse.

centre upright A can be pointed as shown, or cut flush at the top with C and D.—Work.

The total length of submarine cables in the world is about 450,000 kilometres, 279,622 miles, of which 60 per cent. are British, 10 per cent. American, a little more than 9 per cent. French and about 7 per cent. German.

It is no man's business whether he has genius or not; work he must, whatever he is, but quietly and steadily; and the natural and unforced results of such work will always be the things that God meant him to do and will be his best.—John Ruskin.

Don't poke fun at the micrometer man just because you are a "two-foot-rule" machinist and have always got along all right.

How to Make a 1 H.P. Motor

A correspondent has asked for particulars as to the construction of a motor to run from a continuous-current circuit at a pressure of 100 volts. The following description embodies full details of construction, with all dimensions and winding data, of a good modern-type of shunt-wound motor to develop 1 b.h.p. at a speed of about 1,800 revolutions per minute.

The type of machine is that known as the bipolar "Lahmeyer" or "Iron-clad," the general appearance of which is given in Figs. 1, 2, and 3. This type of field-magnet possesses advantages over both under-and-over-type carcases. It gives, for example, more complete protection to the armature, and as the latter is at a medium height from the ground, it is not liable to excessive vibration, nor is it so low as to render the brush gear difficult of access. It has also the advantage from a magnetic standpoint, in that there is a complete absence of joints, the field-magnet being one solid casting of compact form requiring the minimum amount of copper in its magnetising coils. Figs. 1, 2, and 3 show the motor in side and end elevations and plan, respectively. The carcase is of grey cast-iron well annealed of the dimensions shown, having lugs cast on each side to take bearing brackets of the radial type. These brackets are fitted to radial seats, which are machined out at the same time as the armature bore, to ensure perfect alignment of the bearings. Fig. 4 gives sections of the iron bearing brackets, which are of the self-oiling type, and fitted with hard gunmetal bushes (Fig. 5), which are slotted at the top to allow the oiling rings A to hang on the journals. These oiling rings revolve with the shaft, and as their under sides dip into a reservoir of oil, distribute the lubricant along the top of the journal in a constant supply so long as the machine is running. Any excess of oil exudes at the ends of the bushes, and drains back into the oil reservoir to be used again. The screw B, when removed, drains the oil away.

The armature C, with the commutator D in position, is shown on an enlarged scale in Fig. 6. The shaft is turned out of 1-in. round Siemens-Martin steel to the dimensions given, and the stampings, firmly pressed and hammered up, are secured by the clamp nut with locking screw E as shown. The stampings or laminations consist of thin charcoal-iron plates one-fortieth inch thick, four inches in diameter, with one-eighth inch centre hole, and are provided with sixteen slots, seven-sixteenths inch wide by three-eighths inch deep. It will not be necessary to insulate the stampings either from one another or from the shaft, but they should be so assembled on the shaft as to leave five bands, three-eighths inch wide, equally spaced and of three-sixteenths inch less diameter than the full size, so as to provide recesses into which the binding wires which hold the armature conductors in position will sink and not project, but remain flush with the rest of the armature core. It is easier to cut down a sufficient number of stampings to the smaller diameter before assembling, than to turn grooves in the core afterwards, as the teeth are liable to break out.

The construction of the commutator is shown in Fig. 7. The segments of hard-drawn copper are insulated with a good, clear, natural mica (indicated by the black lines in the figures), and clamped up hard in an iron clamp-ring, by which they are then chucked, the interior bored, and the ends recessed as indicated. The sleeve, which is one inch in external diameter and screwed fourteen threads per inch, clamp-ring, and nut having been then prepared, a tightly-fitting mica or micanite tube is made for the interior of the segments, and a quantity of mica or micanite cloth washers split very thin for the end insulation, to slip on tightly over the brass sleeve. All the mica insulation should be one-thirty-second inch thick. Without taking the iron clamp-ring off the commutator pass the insulated sleeve through the centre, and with sufficient mica washers at each end to give about one-sixteenth inch thickness of insulation.

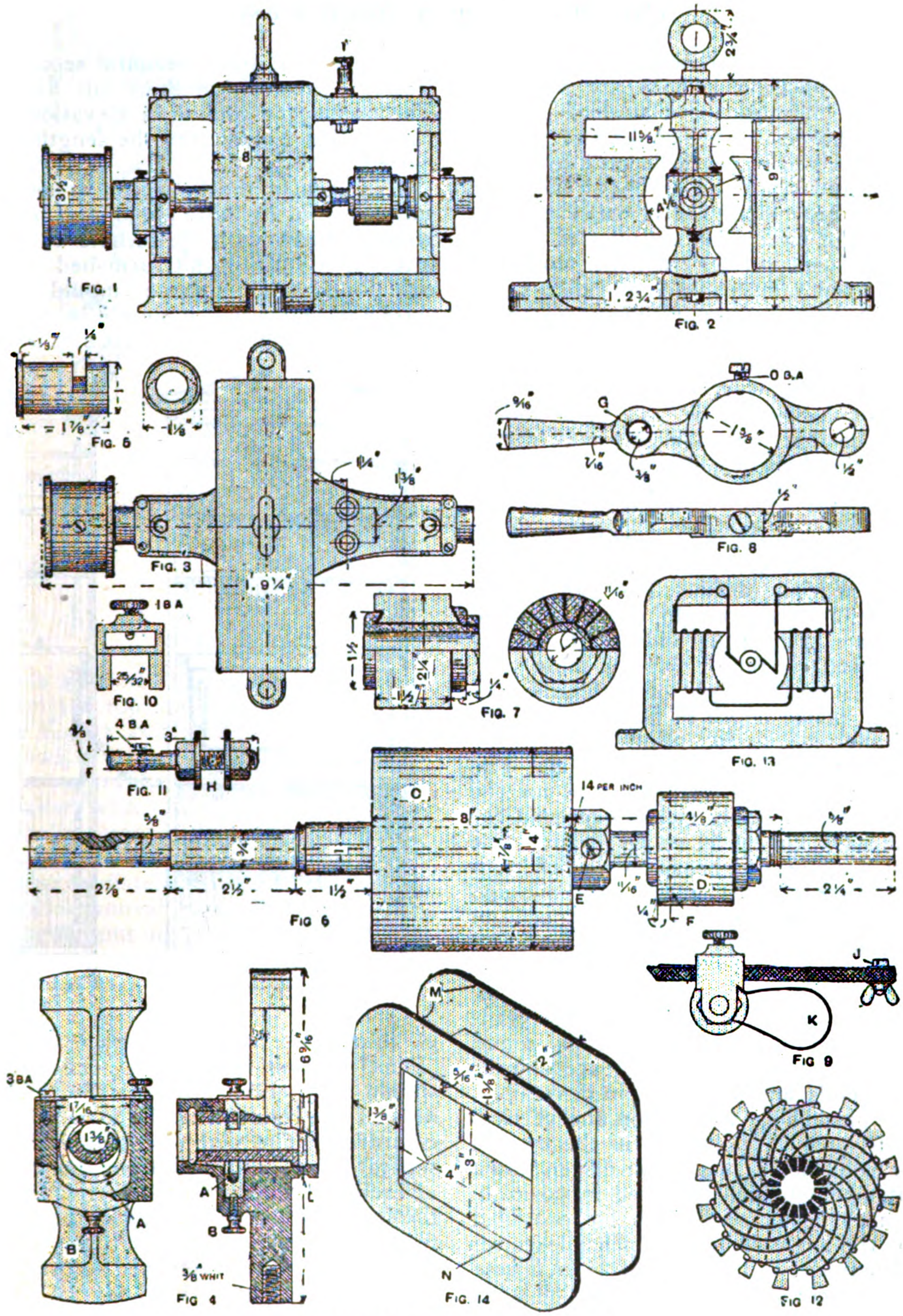
screw the brass nut and clamp-ring on the sleeve firmly. Make the whole commutator thoroughly hot, and then take up any slack in the nut. Then the outer iron clamp-ring can be removed when cool, the commutator mounted on a mandrel, and the exterior surface finished to size. A very keen fine round-nosed tool, a slow speed, and liberal lubrication with turps, is needed to get a good finish on copper segments. The dotted line F (Fig. 6) represents the pitch line of the screws for connecting the armature wires to the segments. The brush rocker (Fig. 8) and the brush pins and holders (Figs. 9 and 11) are fully dimensioned in the drawings, and require no particular comment. The thick circle G (Fig. 8) represents a fibre bush, whilst H (Fig. 11) are insulating washers, J (Fig. 9) a screw to take the leads, and K a steel spring three-quarters inch wide, six inches long, and twenty-five-thousandths inch thick. L (Fig 4) is a groove formed on the front bracket only, for the rocker set-screw to engage in. Figs. 10 and 11 are side-elevation of a brush holder and brush pin, respectively.

A diagram of the armature and field-magnet connections is given in Figs. 12 and 13, one turn of wire only per section in the former being shown, to avoid complicating the diagram. For a machine intended for a 100-volt circuit, the armature (Fig. 12) should be wound with 320 conductors of No. 16 S. W. G. in sixteen sections, four layers deep, and five turns per layer per slot, whilst each bobbin of the field-magnets (Fig. 13) should be wound with nine pounds of No. 22 S. W. G. Both armature and fields must be carefully insulated before commencing the winding; for this, a supply of fifteen-mil. micanite cloth and one-sixty-fourth inch hard red fibre sheet will be required. Each slot in armature requires first a channel or trough-shaped piece of micanite cloth made long enough to extend one-eighth inch beyond the iron core at each end, and flush with the top of the slots. Over this a channel piece of the thin fibre is to be placed, similarly shaped but divided laterally in the centre, to allow any shrinkage (to which fibre is rather liable) to take place at the centre rather than at the ends, where there is more danger of leakage occurring. Wherever the end winding crosses previous sections, the underlying wires must be protected by a layer of adhesive insulating tape or micanite.

The construction of the bobbins will be gathered on reference to Fig. 14. They are wound on skeleton frames built up of thick vulcanized fibre side pieces M one-eighth inch thick, held together at the top and the bottom by sheet-iron clips N turned up at the edges. The skeleton frame is mounted on a block of wood of the same section as the pole pieces, with side flanges to prevent spreading while being wound, and should be insulated with one layer each of micanite cloth and thin fibre, as with the armature. The starting end of the wire is brought through the side of the bobbin and secured temporarily, and the block with the bobbin frame should be mounted between the lathe centres for convenience in winding. The wire on both the armature and the fields, when completed, requires baking under a gentle heat to expel all moisture from the cotton covering, and thoroughly soaking with two or three coats of good shellac varnish and again dried under heat.—Work.

Microscopic study is adding much to our knowledge of the properties of steel. It has recently been shown, for example, that there is an important difference between steels rolled, or annealed, below a temperature of about 750 degrees Centigrade and those annealed at higher temperatures, which are thought to have been overheated. They do not endure "fatigue" so well as those annealed at the lower temperature. The permanent and injurious microscopic strains are more minutely subdivided and more uniformly distributed in the less heated steels, and this fact is regarded as explaining their superior ability to endure "fatigue."

A red incandescent light is much more convenient for developing photographic films in a dark room than any other kind of a ruby light can be.



Constructional Details of 1 h.p. Motor

How to Make a Book-Case

Figs. 1 and 2 show in front and sectional elevations a bookcase with secretaire, suitable for a student or anyone who desires his books and writing materials to be ready at hand for reference and study. An "open" bookcase is the only kind that is really convenient and handy for a student's use, as he requires to refer frequently to books for a few minutes only, and then to replace them. A separate bookcase with doors takes too much time to open and close, especially when it is apart from the writing desk or secretaire. One serious objection to an open bookcase is that the book gets very dusty. A spring blind fitted behind the cornice will effectually prevent the free entry of dust.

The bookcase is intended to be constructed of oak, fumed, and finished with a dull polish. The general dimensions are: height (floor to top of cornice) 7 ft. 3 in., width 3 ft., ends 1 ft. wide, height of writing table 2 ft. 6 in., internal height of secretaire 1 ft. 6 in., inside depth of bookcase (width of shelves) 10 in., plinth 4 in. by 7/8 in., and cornice 2 3/4 in. by 2 in. The ends are of 1-in. oak, grooved for the blind 1/2 in. by 3/8 in., and rebated for the back boards 5/8 in. by 3/8 in. The shelves are of basswood faced with oak (see Fig. 3) where exposed, and the sizes are as follows: Top and bottom of secretaire 1 1/4 in., base and top of bookcase 1 in., and the remainder, which are loose shelves, 3/4 in. thick. The fixed shelves are dovetail-housed into the ends, see Figs. 4 and 5, in which two methods are shown. The ends and top are pin-dovetailed, the pins being worked on the vertical ends, and the holes cut in the top, so as to allow the top to be driven down after the shelves are fixed in position. Tonk's bookcase fittings are provided for the loose shelves, which allows for adjustment at intervals of 3/4 in. These fittings consist of metal strips (Fig. 6) pierced with rectangular holes at 3/4-in. centres, into which metal studs (Fig. 7) are inserted. On these the shelf rests, and is held in position by small projections on the studs, these forcing into the shelf slightly. Fig. 8, which gives vertical and horizontal sections, clearly shows the method of fixing. The strips are shown in elevation at Fig. 2, which indicates the length required.

The back of the bookcase is boarded with 3-in. by 3/4-in. V-jointed basswood, which, with the whole of the interior, is stained and varnished. An oak plinth and cornice mould are shown in detail, and it should be noted that the front piece of the cornice is 1/2

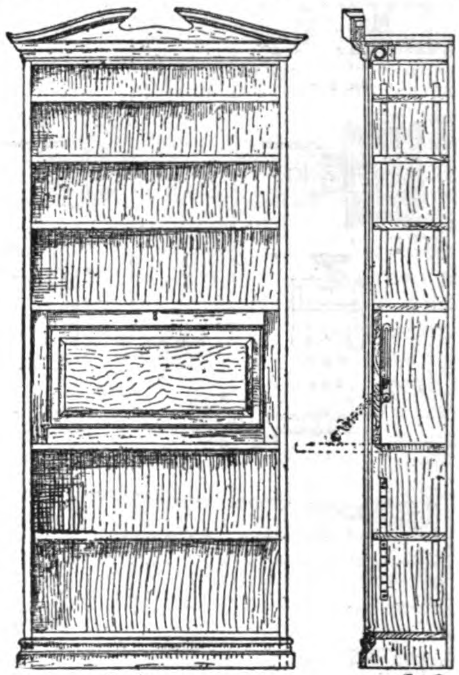
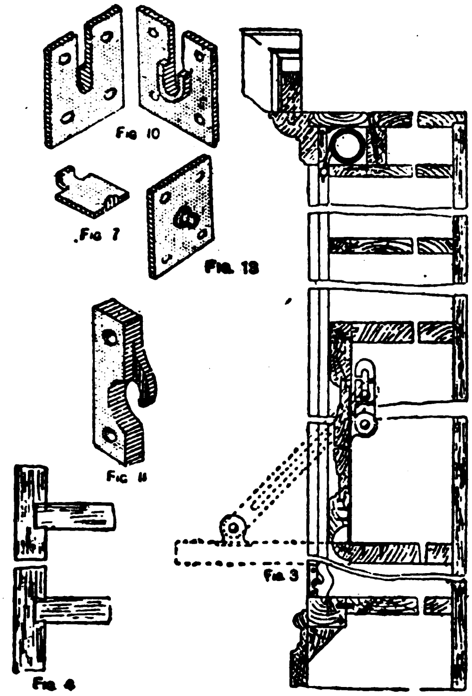


Fig. 1 Fig. 2

in. thicker, to fill up the space to the "blind" groove. At each end this should be checked down to the thickness of the return moulds, to which it is mitred. The pediment mould is a separate one, springing from the level at each end, and returned vertically in the solid across the opening in the centre of the pediment. The ogee portion of the mould is returned across the bookcase ends, and the body of the pediment is 7/8 in. thick, cut to the curve for the reception of the moulding. The whole of the pediment is jointed to the cornice by a four 3-in. by 3/8-in. dowels.

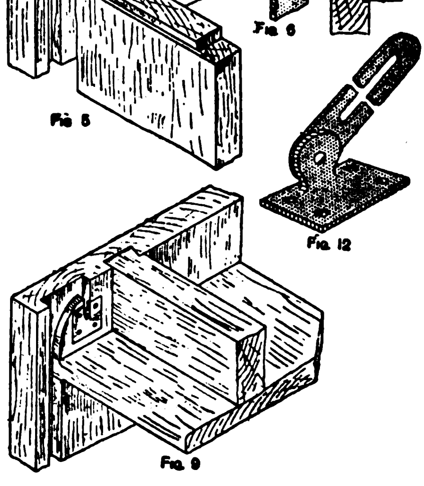
To receive the spring blind, a square



recess is formed behind the cornice between the top and false top (see section Fig. 3 and detail Fig. 9). The method of preparing the ends of this recess to receive the roller and blind, together with the fittings to receive the roller centres, are also shown. It will be seen also that a portion of the top, immediately covering the roller, is made removable, to allow of the roller being put in position. The blind is attached to the roller with strong tape and tacks, and inserted in position rolled up. The bottom edge of the blind is hemmed and edged with leather, to receive a 3/8-in. round iron or brass rod, projecting at the ends into the grooves made for it. The blind should be wide enough to pass 1/8 in. into the groove, and to allow for this the fittings (Fig. 10) in which the roller rests, and the surrounding surface at the ends of the roller box, are sunk to the required depth to clear the roller ends. Shop window-blind material will be found best for the purpose, being strong and durable, and the colour can be chosen to harmonize with the furniture. Stops are necessary at the sides (both top and bottom), one pair to keep the blind down, and the other to prevent the bar pulling up into the recess. Details of the bottom stops are shown in Figs. 3 and 11, for which a wood pattern could be made, and the pieces cast in brass, filed up and lacquered. The head stops (see Fig. 3) are strips of hardwood slotted and a screw passed through into the sides. After inserting the blind roller, these are slid down into the position shown, the screw turned tight, and the cover fixed on. The stops cannot slide up if the screw gets loose, as the cover binds tight against it if made as shown. When the roller is required to be removed for repairs, etc., the cover is taken off, the stop screws loosened, and the pieces slid upwards to clear the blind rod.

The edge of the false top is rounded over at each angle to avoid rubbing, and all the shelves and secretaire front are set back for the same reason.

The secretaire is shown in full detail at Figs. 2 and 3. The hinged angle is formed as a rule joint, hung with strong brass backflap hinges, and brass guides and suspenders are provided at the edges (Fig. 3, 12, and 13). All these could be made out of thick plate, but the sketches indicate some



parts of cast brass, 1/8 in. thick. The stop and guide (Fig. 13) is a brass plate with a packing or shoulder piece soldered to it, and a hole bored through the centre to take a strong round-headed brass screw, which secures and forms a guide for the slotted suspender (Fig. 12).

The flap is framed (see Fig. 2) with a raised panel, recessed sufficiently inside to take a green-baize covering, which, when glued in position, leaves a flush writing surface. The interior fittings of the secretaire are not shown, as these are best arranged to meet requirements.

The spring roller for the blind, and the hinges and lock for the secretaire, can be obtained from almost any ironmonger, and the fittings for suspending the writing table can often be bought from the same tradesmen.—Work.

How to Grind and Set Edge Tools

M. COLE

Stones used in grinding, etc., consist of small particles of silica (quartz) naturally cemented into a mass, known as sand stone. The grains vary much in size, so that the stone may be of fine or coarse grain, suitable for rough grinding or a fine oil stone. The grains of silica are harder than steel, so that they will scratch that metal if rubbed upon it, but they are easily displaced. A stone that will grind hardened steel can be scratched by soft iron, which does so by displacing the grains of silica. When a grindstone is revolved at so high a speed that the centrifugal force so produced overcomes the adhesion of the particles, the stone bursts or flies to pieces, a frequent cause of accident in grinding shops. There is a limit of speed beyond which it is unsafe to revolve a grindstone, or even an iron fly wheel—cast iron fly wheels often breaking and projecting the fragments to great distances, if driven at too high a speed. Any flywheel can thus be broken, but stones are even more liable to this accident on account of unseen cracks which may exist. A small stone must be revolved at a greater speed than a large one, in order to get the same surface speed. As the stone becomes gradually smaller through wear, it is usual to have spare pulleys so as to be able to replace the driving pulley with a smaller one, getting greater speed to make up for the wear of the stone in order to get the full amount of work out of it.

Sandstone is softened by being constantly wet, so that if a trough is used to contain water, and so fitted that the stone is partly immersed, as the stone usually comes to rest in the same position, one side will be softer than the remainder and wear much quicker, the stone soon becoming of irregular shape instead of circular. If the stone is kept in the open, uncovered, the sunshine will harden the part exposed to it, giving the opposite effect to that produced by the water bath. Grindstones are usually used wet for the following reasons: friction produces heat, and the friction of the metal on the stone if driven at a high speed would heat the edge of the tool enough to draw the temper. The water also helps to keep the stone clean by preventing the fragments of steel ground off clogging between the grains of the stone. A wet stone cuts quicker than a dry one, but the surface left is not so fine as in dry grinding, which is sometimes used for finishing such work as razors before hardening them, though the dust given off is very unhealthy. Oil is used on the finishing stone for the same purpose, of allowing the tool to slide more easily on its surface, while the grains of silica project through the film. The quality of the stone required depends entirely on the work to be done, just as various cuts of files are required. Artificial grindstones are made from the grit of grindstones cemented by suitable means into shape.

The old method of fixing a stone to the axle by wooden wedges is a dangerous one, as the wood driven in tightly when dry, expands when the moisture reaches it, and is a frequent cause of cracked stones. A much safer plan is to use lead, which is poured melted into the space between the axle and the stone. It must then be drifted up with a blunt chisel so as to fill the hole, as it will have contracted in cooling. The lead should be poured at as low a heat as it will flow at. Melted sulphur or Portland cement are good substitutes for lead. For very large stones, wedging is best, as it allows a little adjustment, and the wood can be kept dry. The axle may run in iron bearings. A good fit is not necessary, as it cannot be maintained, the grit invariably getting into the bearings.

If a trough is used for water supply, it should be hinged at one end so that when not in use it can be let down a few inches, and so prevent the stone being partly immersed when idle. A safer way is to fix a can of water so that it will drip on to the stone. For small stones, a bit of sponge or cloth, fixed so that it touches the stone, and can be kept wet, answers very well.

Speed of grindstone should be as great as can be got by turning crank or treadle, the fatigue of the operator will be found an excellent preventive of too high a speed. For stones run in a treadle lathe or in similar mounting, the speed should be low enough to allow the tool to rest against the surface continuously. If at too great a speed, it will be found impossible to work the treadle unless the grinding is intermittent. Emery wheels are usually marked with the speed with which they may be run with safety.

Keeping the surface level is a very important matter. When gouges are ground on the same stone as flat tools, it is difficult to keep the surface level. If the stone is broad enough, a groove may be kept near the edge, if narrow it is as well to keep one at the side near the edge. The face of a grindstone can be turned true when required, with an old file or bit of iron pipe, turning frequently to get a fresh cutting surface, which displaces fragments of stone.

Oilstones are of many sorts, but it should be remembered that the finer the stone, the less metal is removed at each stroke, and a good cutting edge can be got with a quick cutting stone. The finer and slower ones are sometimes used for producing a polish rather than a cutting edge. Usually wood-working tools do not require so fine a stone as metal cutting tools, such as gravers. Every oilstone should be mounted in a wood block, with a cover to keep the dust off it. It is a good plan to fix a bit of hard wood at each end of the stone, thus lengthening it say two inches at each end. The tool traveling from one block of wood to the other, will traverse the whole length of the stone, so preventing it wearing hollow.

An oilstone is generally used with oil, Neatsfoot or olive being the best. Thin this with paraffin oil—never use turpentine for the purpose as it causes the oil to dry quickly. Glycerine is a good substitute for oil, and is less liable to thicken on the stone. Some oilstones work well with water.

If an oilstone is neglected the oil dries on it, forming a hard skin, which prevents any good work being done on the stone. It can usually be cleaned off with kerosene or gasoline, or may be boiled in a strong lye (soda or potash dissolved in hot water). Some of the old oil will have sunk below the surface of the stone, this takes some time to loosen again. It is often quicker to put a fresh surface on the stone.

Hollow face is caused by using the middle of the stone more frequently than the ends. When several persons have the use of one stone, it is sometimes advisable to fasten a bit of wire round the middle of the stone as soon as it shows a little hollowness, so compelling them to use the ends.

In spite of all care, oilstones will wear to an uneven surface. To bring it level again, clean off all trace of oil, and rub on a flat stone with plenty of water. A sheet of rough glass paper placed on a level surface does very well. If the back of the paper is chalked well it will not slip about. If the stone is a very hard one it may be necessary to use emery, either in powder or cloth, starting with coarse and finishing with fine grade. The stone must lie level on the workbench and be firmly supported. If not, it rocks with each movement, and good work cannot be done with it. Gouges should be set on a stone kept for the purpose, or it will be impossible to get a good edge on the flat chisels, etc. Sometimes the stone is so mounted that either side can be used, in such case one side can be kept for round and pointed tools.

Emery wheels, when solid, should be run at the highest safe speed, but it will be found that an emery wheel, even of small size, takes a great deal of power to run, and only small ones should be driven by foot power. An emery wheel should never be mounted in a good lathe, as some of the dust is sure to find its way into the bearings. The special grinding and polishing lathe heads are very cheap, and the same one will carry a polishing mop. If, however, there is no alternative, the wheel can be mounted on a spindle carrying a pair of cheeks, such as can be had ready made for the purpose. A leather washer should be placed each side of the wheel to get a good grip.

The top of an emery wheel should run from the user. The reason for this is, that if any small object should get between the face of the wheel and the rest, when the wheel is running towards the user, it would by suddenly checking the wheel cause it to burst. Most accidents with emery wheels are due to this.

In grinding edge tools, the wheel should be kept well wetted, or there is great danger of burning the edge, or at least of drawing the temper. This applies mainly to solid wheels, when run at a high speed.

Emery faced wood wheels are very useful and easily made. The wheel is built of wood and faced with emery by glueing the surface and rolling in the emery powder, which, when dry, adheres strongly enough for the purpose if run at a moderate speed. Another way is to glue emery cloth on the wheel, being careful that the joint laps over so as not to catch the work. The flat side of the wheel may also be covered and is useful for polishing.

Coarse or fine emery wheels can be had, suitable for a variety of purposes; from coarse ones used instead of files for removing a quantity of metal, to the very fine ones that will finish a tool nearly as well as an oilstone. If overheated, wheels are apt to glaze, especially some makes. Where only one wheel is used for grinding gouges and chisels, a groove can be made in the face for gouges, and flat tools ground at the side of the wheel. For irregular shapes a pewter wheel can be used, fed with oil and emery powder.

Artificial hones are to be had made from grindstone dust cemented together to a block, also emery blocks fine and coarse. These should be avoided if it is possible to get the proper oilstones. Artificial grindstones when of good make are, however, superior to natural stones for fine grinding, though somewhat higher in price. The grit is very even and the texture more regular than the natural stones. They are less liable to wear out of shape or to soften in the water.

Circular grindstones are of comparatively recent date, and even today are unknown in many parts of the world, where workmen manage to put a good edge on tools without them. Rubbing on a flat stone will sharpen a tool quite as well as holding it against a revolving circular one, though the process is much slower.

Substitutes for oilstones are specially useful for insides of gouges, etc., and are slips of zinc bent to required shapes and used with oil and emery, they are largely used also for beading planes, etc. A piece of any very hard wood or of bull neck leather can also be used for the purpose.

HINTS ON GRINDING AND SETTING

Forge thick, grind thin, is a good motto, so with new tools see that they are left large enough for the skin of steel (which has been partly de-carbonized in forging) to be ground off. The extra labor will be well repaid by the superior quality of the finished tool. Do not expect the oilstone to do the work of the grindstone, and do not put off grinding too long. Setting should be done frequently, as a few strokes on the oilstone every few minutes is more economical than using a tool after the sharpness has gone just "to save time." Dull tools don't cut quickly and do not leave a clean surface. When the tool has been ground to the correct angle, it loses a portion of the ground surface every time it is set, until it gradually becomes either a curve or a series of ridges, instead of a flat surface.

Wire edge is formed on a cutting edge in setting or in grinding, by the edge becoming so thin that it is bent over the other side instead of being worn away. Though called wire edge, it is really in the form of very thin curled sheet metal. It must be removed either by drawing the edge across a bit of hard wood, or by placing the blade on the oilstone so that the back lies flat upon it, and giving a few strokes while in that position. The setting can then be continued, but so long as the wire edge remains the chisel will not cut. All flat tools, such as chisels or plane irons, should have a few strokes on the wrong side during the process of setting, without waiting for the wire edge to form, but being careful that the tool lies quite flat on the stone. A very acute angle gives the best cutting edge, but renders it so much weaker. The razor is an example of a very small angle, the axe of a very large one at the edge. The one is required for great keenness, the other for strength.

Plane irons should be slightly curved at the edge to prevent the corners digging into the wood. Jack planes are most curved, trying planes least so. In grinding a plane iron, let the stone run towards the tool. It will make a little mess that way, but gives the best edge, and less liability to wire edge. If the stone is flat, it is merely a question of holding the tool steady, but if irregular on the face, the tool cannot be level edged. The larger the grindstone, the nearer a flat surface the ground part will be, while a small stone gives a hollow surface, which however is easy and quick to set.

Gouges. In grinding these, let the stone turn away from tool, and give a half turn to and fro all the time the tool is on the stone. Do not grind a bit and then turn a little, or the result will be a lot of flats instead of a continuous surface. When setting a gouge, the tool is moved on the stone just as a chisel is, but at the same time a turning movement must also be given to it, to and fro, otherwise a series of flat surfaces will be formed. A groove in the stone will make this much easier. There is a little knack in this, but it is soon learned. The inside must also receive a little attention to prevent wire edge, just as with a chisel. Slips of stone or zinc with emery are used for this.

Tool ends require to be put on the grindstone, especially gouges, or they do not preserve their proper shape. Chisel ends also are liable to become out of square with their sides.

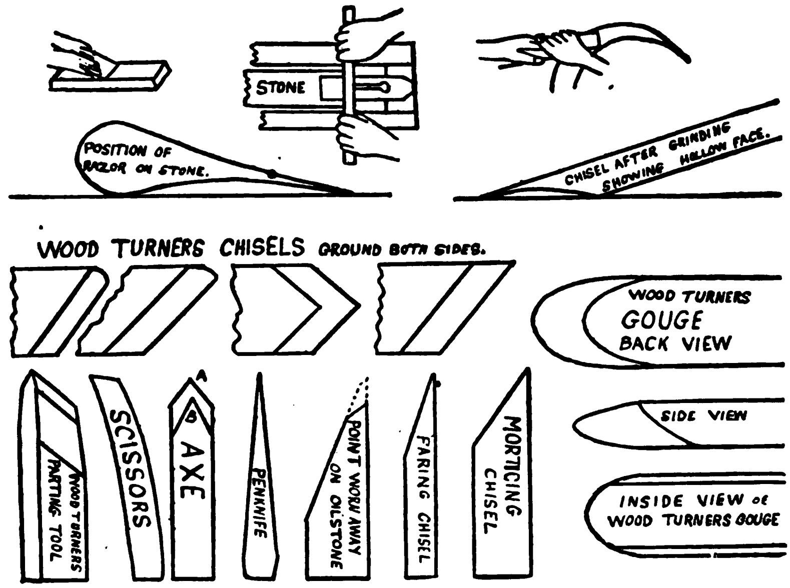
Wood-turning tools, except gouges, are ground on both sides, not as ordinary chisels, on one. Turning gouges are ground with a much longer bevel than joiners' gouges. The ends also differ, for while the joiner's gouge is flat at the end, the wood turner's gouge is rounded so as to prevent the corners catching in the work, all the cutting being done with the top of the curve.

Razors are ground hollow along the side so that in setting the edge very little need be removed by the oilstone. Not being subject to rough usage, the blade is of a very acute angle. In setting on the oilstone, the thick part at back must rest on the stone as well as the thin edge, and be moved about so as to produce a series of loops instead of a to and fro motion as with a chisel. Other ways are to give long sweeps from end to end of the stone, or a series of short strokes across the stone, but in all cases both heel and edge must rest on the stone. A razor requires a stone of very fine texture, so as to give as smooth an edge as possible, yet in spite of all that can be done the edge of the best razor is, when examined under a microscope, like a saw.

Where a good quality of oilstone is not available, one of low quality can be much improved by adding a little finest elutriated flour of emery (common emery powder will not do) used with ordinary oil. It has a marvellous cutting effect, and produces just the right edge for wood working tools.

EXPLANATION OF DIAGRAMS

In the above diagrams the three at



the top show: 1—The position of the hands when setting plane iron on the oilstone. 2—How the plane iron is held to the grindstone when there is no rest for it. This is the best way when the stone is uneven, it also allows the tools to travel from side to side of the stone. 3—The centre one shows how a plane iron is held down to the stone by a stick grasped in the hands, The other end rests on a ledge or the edge of a trough which should be about level with the centre of the stone. This method is suitable for a stone turned by power, if by hand it will be found rather tiring to the one who turns the grindstone.

A razor is shown in section, and shows how both the edge and the back rest on the stone, which thus acts as a guide to keep the edge at the correct angle, though as razors are not all the same thickness at the back, the angle will vary a little with the thickness of the back.

A hollow ground chisel is shown next to the razor. All chisels and other tools have this hollow face if ground on a circular stone, and the hollow varies with the size of the stone, being greatest with the smallest sized stones. This is not a disadvantage, as it leaves less metal to be taken off with the oilstone. The angle shown where the edge touches the stone is too small, but every time it is put to the stone the angle becomes greater, until it is so altered that it is necessary to re-grind it. In an ordinary size of grindstone this hollow is hardly perceptible, but it is there all the same.

Wood turners' flat tools are ground and set on both sides. It will be noticed that two of them are ground around at the top corner. This is to prevent the point digging into the wood in turning soft wood, though a skilled worker can manage with the sharp corner left on.

The wood turners' gouge, shown in three diagrams, is ground to a curved shape and the work is done entirely with the top of the tool, while with a joiner's gouge the whole curved end is used for cutting, and is therefore not rounded off but is really a curved chisel. Both of these are set in a hollow in the face of a special oilstone, and a touch given to the inside with a narrow stone or slip. It is bad practice to set gouges on the same stone used for flat chisels, etc.

Joiners' chisels are shown in three diagrams. The mortise chisel is very obtuse (large angle), as it is used for heavy rough work, and is also very thick in the body. The paring chisel is for the very finest work, the ordinary joiners' tools being ground to an angle between the two. The diagram also shows the effect of trying to make the oilstone do the work that should be done by the grindstone.

The penknife is shown in section as usually shaped; large blades of pocket knives have a larger angle. In either case, in setting them, carefully avoid a razor edge to them, as it is too weak for ordinary usage. They should be set to the angle B in the axe diagram.

Surgical instruments. Operating knives and lancets have a razor edge, except those for cartilage, which are more obtuse.

Axe and hatchet, when in the hands of an expert, may be set to the edge of a chisel, but for domestic use should not be sharper angled than B, while with careless grinding the edge often gets as obtuse as at A. Common hatchets are left rather soft, so can be edged with a saw-file.

Scissors are difficult to grind, and in most cases require to be done at the top edge only. If the edge is too far gone for this, then the side must be ground a little on a small stone, but as little as possible, as the true grinding is done at the top edge. If not very carefully done they will cut themselves, one blade cutting into the other. If not at once seen to they will require a lot of metal ground out to correct them again. This is often caused by the rivet being too tight or too loose, or the flats inside the joint not being corrected when grinding.

However carefully ground and set a razor may be, it has when seen with a high power magnifier a saw-like edge. To further improve this, it is finished on a strap of some kind. The old form was two pieces of leather glued to a board, one side treated with a polishing paste, the other left smooth. The more modern form is a flexible strap, one end hooked to the wall, the other end held in the hand. With this form it is important to keep a good strain on the strap to prevent the razor sinking down into the surface so producing a round edge. The razor should be drawn back first, the whole length of the strap, then turned over on its back, and again brought to the other end, repeating if required, and finishing with a couple of strokes on the smooth side of the strap. The palm of the hand sometimes takes the place of a strap, and is also used by joiners, etc., after setting tools.

Carving knives and steel. The old form of steel is really a long file, having scratches lengthwise instead of small teeth. The more modern form is 4, 6, or 8 sided, having a hollow along each side, the edges of these sides are the cutting edges. Two or three wipes of the knife on a steel will remove enough metal to leave a sharp cutting edge. A good substitute for such a steel is a three cornered saw file, with the teeth ground off on a grindstone. It is much quicker than the ordinary form of steel, and is easily ground again when required. A tool constructed on a similar principle is made for sharpening knives. Two squares of very hard steel are fixed so that they overlap at their lower edges the other parts forming a V. When a knife blade is drawn between the blades, a portion is scraped off each side near the edge leaving it very keen.

Wood scraper. This tool is used to remove (by scraping) the small inequalities left in wood by the plane. It consists of a piece of sheet steel, often a bit of a saw blade, and is ground to bring the edges all straight and square. To set this tool, it is held firmly against the bench, and the edges rubbed very forcibly with a bit of hard steel—usually a small chisel. This has the effect of turning over the edges, so producing what is so carefully avoided in all other wood working tools, viz: wire edge.

Small metal working tools such as gravers, are set on the oilstone in the same manner as woodworkers' tools, but being a harder steel they require a free cutting stone, and frequent setting.

Oilstone slips can be had in many sizes and shapes, and in all qualities. They are so cheap that it is a mistake to economize by doing without them.

Guides for tools. Many forms of these have been introduced, in most cases consisting of a holder for grasping the tool, and provided at its other end with a wheel or roller which touches the grindstone or oilstone while the edge of the tool also touches the stone further away. This method ensures the edge being ground to the correct angle, and having the edge square to the side, provided the stone is level on the face, but with an uneven stone they do not produce such good work as is done by the free hand. Tools for ivory and complex ornamental turning are sometimes required to be very exact in the angle to which they are ground. Some special holders are made for these, which allow the tool to be set with mathematical correctness by means of a scale and index, the tool being ground on a horizontal disc supplied with emery or other grinding powders.

Centre bits are sharpened with a file, which for this purpose should be "dead smooth." The sweep part gets just a touch on the inner edge, never touching the outer edge, except to remove the burr. The blade is filed on the upper edge only, and if necessary any burr or wire may be removed from the other side. The blade edge may then receive a touch from a slip of oilstone to finish off. When the sweep has been filed away below the level of the cutting edge the tool becomes useless.

What article pleases you best?

Drawings for Field Use

Somebody who has evidently had experience with the troubles of handling large blue prints in the field, prepared for a recent issue of the "Street Railway Journal" a vigorous editorial on the advantages of small drawings on construction work. This is a subject that has been discussed several times in "The Engineering Record," and is now beginning to attract the attention it deserves among engineers. There may be some good reason for producing large blanket drawings, impossible to hold flat in a high wind in order to take off a few dimensions necessary for the contractor's foremen, but that reason is difficult to ascertain. The manufacture of these blanket drawings is more troublesome than that of small prints. Of course a poor draftsman likes to spread his work over as much area as possible, because the inequalities and imperfections of it are not readily taken in at a glance, but a competent draftsman can turn out a drawing on a small scale, with all necessary information on it, which will be a decidedly attractive sheet. It is only necessary to compare drawings from establishments which use large scales with those from offices that have adopted the small scale to see how much better the latter generally appear. Inasmuch as a drawing is intended to convey information, it is manifest that the one which conveys the most information in a legible fashion at a single glance is the best. When it is necessary to search over a sheet of considerable size in order to secure data that can be obtained on a small drawing at a single glance, the latter arrangement manifestly offers advantages. If more draftsmen had to do field work from the drawings which they prepare, it is probable that there would be a considerable revision of office opinions regarding the right size or drawings and lettering.

In the production of drawings intended for field use, there are only two considerations to be attended to. The first of these is the production of the drawing in an economical fashion, so that it will be suitable for its use and not be too expensive to make; and the second is the usefulness of the drawing to the man who must employ it. These two considerations are not always satisfied by the same means. Economy and system in drawing office methods make it desirable to use sheets of standard size. In consequence it sometimes happens that certain kinds of drawings must be made to a larger scale than is really necessary or else they will look very lonesome indeed on the sheet on which they are drawn. As a general proposition it is probably true that the best results are obtained when drawings for field use are made on a scale which is sufficient to give satisfactory details except in the case of a few small parts. These parts are then drawn out at a larger scale on the same sheet. In this way all of the necessary information is brought together in compact form. Under the old practice of making the scale of the drawing conform with the smallest details of the whole work to be illustrated, the sizes of the sheets often became excessive; not only this, the drafting labor was enormously increased, for the wholly unnecessary work of making large scale drawings was obligatory under such a system.

A fairly skilful draftsman is able to prepare drawings which are capable of reduction photographically, without any sacrifice of legibility. In consequence of this fact some engineering offices are now preparing drawings with the express idea of having them reproduced for field use by the camera.

This plan enables both the drafting office and the field force to secure the most satisfactory results. The manipulation of a camera is not at all difficult, and the preparation of plates of 8x10 size or about that is neither expensive nor troublesome. If these plates are carefully made from tracings which are drawn specifically for the purpose of photo-reduction, the results seem surprisingly good to those who examine them for the first time. The prints made from such plates are just as clear as the original tracings and are much easier to use in the field. Every field engineer who has had occasion to employ blue prints knows their inconvenience, while the few engineers who have been fortunate enough to receive prints made by photographic reproduction will never be satisfied with anything else. Even as a matter of economy, probably, this system of preparing field drawings will be found the most satisfactory of any. With certain classes of drawings such photographic reduction may be out of the question, but there are a good many kinds of construction where they are entirely applicable, and engineering offices which have to distribute a large number of drawings to field men during the coming season will do well to look into the advantage of this system.—The Engineering Record.

How to Replace a Window Cord

The replacing of a broken sash line is a fairly simple matter, but its infrequency, coupled with a lack of constructional knowledge, doubtless has deterred many from attempting what is otherwise a comparatively easy affair, when set about by the right method, which will now be described.

In the illustrations, Fig. 1 shows a part inside elevation of a pair of double-hung sashes. The first thing to do is to insert a stiff screwdriver, or an old chisel, between the joint of the fillet and casing at A and B. Bend the fillet out well in the centre, and this will cause the mitred ends to leave their joints with the top and bottom fillets respectively. Another way is to lower the top sash, and make an inclined cut at C with the tenon saw. Then the lower part of the fillet only need be removed. The object in trying to do as little damage as possible is to save the trouble of painting or graining. With the removal of this fillet, the lower sash can be swung around, and the broken cord removed from the groove in the sash frame, as shown at D (Fig. 2).

Next remove the lead weight from the window frame. This is effected through openings, made for the purpose in the frame at E and F (Fig. 3). The openings are neatly covered with fillets, and are sometimes difficult to locate, as the subsequent layers of paint tend to conceal the joints. A few light blows will start a crack in the paint at the joints. Then insert the screwdriver at the top and bottom ends of the fillets at G and H (Fig. 3), and prise out evenly. If very tight, bore a hole with a brace and bit as shown by the dotted lines F, knock out the two parts. Then remove the lead weight, insert the new cord over the pulley J, pull it through the opening, and fasten it to the weight. Replace the latter in the frame, swinging the sash in place temporarily, and haul the weight up till it touches the pulley, keeping the cord quite close to the sash. Then let it drop back 2 in., and mark on the cord the position of D (

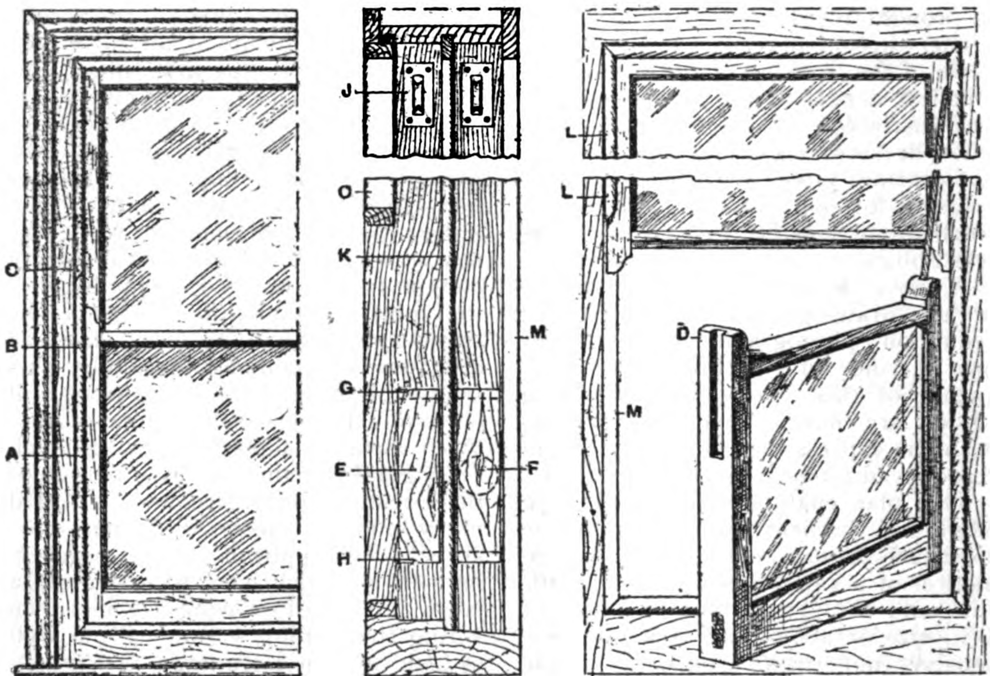


FIG. 1 FIG. 3 FIG. 2

Replacing a Broken Window Cord

the top of the sash (Fig. 2) with black-lead or chalk. Swing the sash out, and support it at a higher position. Then fix the line or cord in the groove D (Fig. 2) with copper tacks or short clout nails, cut off the surplus end of the cord, replace the sash and fillet, and stop the brad holes, etc., with putty coloured to suit, or touch up with paint.

If the top sash line has to be renewed, the fillet must be taken away as just described for the bottom sash; also the parting slip K (Fig. 3). This slip is housed into a shallow groove, and is not bradded or otherwise secured. It is, of course, fixed with paint, and will require prising out of its position. When this is done, both sashes can be removed from the frame. In Fig. 2, the lower part of the fillet L and also the parting slip are removed, the line indicated by the letter M representing the outside square-edged part of the framing, which cannot be removed.—Work.

A New Kind of Locomotive.—Very successful experiments have recently been made in Bohemia with a new type of locomotive, known as the overheated steam system. By this system, the steam, after passing from the boiler, and before entering the cylinder, passes through a series of pipes directly exposed to the combustion gases, and this heat transforms the particles of water contained in the original steam into steam also, thus adding considerably to the force which is finally admitted to the cylinder.

There appears to be a considerable reduction in the consumption of both fuel and water attained by the use of this system, and, in the opinion of local railway experts, great improvements in the service will be made. At a recent trial of this style of locomotive, a speed of 68.35 miles per hour was attained.

Don't count how many motions you have to go through; just see how quickly and easily you can make them and get you work out of the way.

A stitch in time often answers for an excuse for being late in the morning.

The Utility of Inventions

JOHN E. BRADY

The laws of the United States provide that patents may issue for any new and useful art, machine, manufacture, etc., under certain conditions, and hence it follows that, in order to be patentable, an invention must, among other attributes, disclose utility. It is not sufficient that an invention be new; it must be useful as well, or it cannot be accorded the protection of the patent laws. By useful invention is meant such a one as may be applied to some beneficial use in society in contradiction to an invention which is mischievous or injurious to the morals, the health or the good of society. A useless invention, even if patented, is not and never will be any profit to the public, and the patent granted thereon is void. New inventions in regard to some trifling article of dress, such as "hoops, or crinolines," or, in the language of Judge Story, "a new invention to poison people," are not patentable. The one is frivolous and the other mischievous. Page vs. Perry, 1 Fish. Pat. Cases 298. Utility, as predicted of inventions, means industrial value; the capability of being so applied in practical affairs as to prove advantageous in the ordinary pursuits of life, or to add to the enjoyment of mankind. But a mere curiosity, a scientific process exciting wonder, yet not producing physical results, or any frivolous or trifling article or operation not aiding in the progress nor increasing the possessions of the human race, whatever be its novelty, and whatever skill has been involved in its production, does not fall within the class of useful inventions nor become the subject matter of a patent. Robinson on Patents, Vol. I. p. 463. In Crouch vs. Speer, 1 B. & A. Pat. Cas. 145, it was said that the test whether an invention is useful in the sense of the patent law is not whether it is not mischievous or hurtful, or insignificant, but whether it is capable of use for a purpose from which some advantage can be derived. If it be useful in this sense the degree or extent of its usefulness is altogether immaterial. It is not necessary that it should be the best means of producing a desirable result, but a means, although inferior to others, of producing it.

Inventions which accomplish definite practical results may nevertheless possess such attributes as destroy the benefits that otherwise they would bestow upon the public. Inventions whose chief or only value resides in the facilities which they afford to men to perpetrate some wrongful injury either by fraud or violence upon each other, are thus regarded as destitute of real utility. For the same reason arts or instruments which, if completed and in actual use, might be of benefit to their employers, are sometimes held to be devoid of real utility on account of the great risks incurred in their construction. The courts, in their consideration of this subject, must necessarily contemplate the entire scope and effect of the invention, as well upon the maker and operator as upon the customer; and if the net result to the community at large is not a benefit, the inventor has no claim upon the public.

The acts of Congress which authorize the grant of patents for designs were plainly intended to give encouragement to the decorative arts. They contemplate not so much utility as appearance. The law manifestly recognizes that giving certain new and original appearance to a manufactured article may enlarge the demand for it, may enhance its salable value, and may be a meritorious service to the public. It, therefore, proposes to secure for a limited time to the producer of those appearances the advantages flowing from them. Gorham Company vs. White, 14 Wall (U. S.) 511. Utility is not negatived by the fact that the manufacture covered by the patent has no function except to decorate the object to which it is designed to be attached. In such cases utility resides in beauty. Whatever is beautiful is useful, because beauty gives pleasure, and pleasure is a kind of happiness, and happiness is the ultimate object of the use of all things. Walker on Patents, p. 73. The Westinghouse Electric & Manufacturing Company, being the owner of a design patent (No. 24,416) issued March 22, 1902, to Albert Schmid, brought an action against the Triumph Electric Company, seeking to enjoin under the patent. The patent involved covered a design for a configuration of a frame for electrical machines. It was held that the word "useful" in the section regulating the issue of design patents does not require that the shape or configuration of an article, in order to be patentable shall add some new utility to the article but is used merely for the purpose of excluding such things as might have a vicious or corrupting tendency, and that a new and original design for an article may be patentable where it merely improves its appearance. But it was further held that, assuming that a frame for an electric machine might be made the subject of a design patent, the frame design in question was not properly patentable for the reason that it was neither new nor original in view of the existing state of the art. The only originality which the counsel for the complainant could reasonably claim for the design patented was found in the curvature of the bases of the pillars for supporting the shaft and of the supports to the cylinder frame for the field; and these were considered differences which would suggest themselves to any workman, and which did not involve the exercise of inventive genius, which is as essential to the validity of a design patent as it is to the validity of a mechanical patent. Westinghouse Electric & Manufacturing Company vs. Triumph Electric Company, 97 Fed. Rep. 99.

It seems that utility is negatived if the function performed by the invention is injurious to the morals, the health or the good order of society. Thus, an invention to improve the art of forgery, or one to facilitate the spread of a contagious disease, or one to render water or air intoxicating would, of course, be unpatentable for want of utility. The more completely such an invention could perform its function the more objectionable it would be in this respect. Walker on Patents, p. 73. In the case of National Automatic Device Company vs. Lloyd, 40 Fed. Rep. 89, the complainant moved for an injunction restraining the infringement of a patent for a "Toy Automatic Race Course." The device covered by the patent consisted of a shaft projecting upward from the centre of the base of a circular shell or case, to which shaft a clock-work mechanism was so geared that it could be made to revolve by releasing the escapement of the clock-work. On the shaft were mounted two or more radial arms, to the ends of which were attached small toy figures of horses. The clock-work was released by dropping a coin through a slot in the machine, whereupon the shaft would revolve, carrying the radial arms with it, for a short time, when the clock-work would be shut off, allowing the arms to revolve of their own momentum. The proof showed that the only use to which the device had been put was to install it in saloons and other drinking places, where the frequenters thereof might lay bets as to which toy horse would be the last to stop or would stop nearest a certain designated point; in other words, the machine was used only for gambling purposes. For this reason the machine was held not to be a benefit to society or "useful" within contemplation of the patent act and the patent was declared void. It was urged that the machine was susceptible of being utilized as a toy or child's plaything, but the fact that no such use of it had been made was considered a sufficient answer to that contention.

Inventions the object of which is to afford amusement and diversion are classed among patentable subjects; but only the mechanical agencies employed can be patented. Under this rule it was held that the patent of the Paul Boynton Company, covering an inclined gravity railroad terminating in a body of water, which provided an amusement popularly known as "Shooting the Chutes," was invalid, one of the reasons being that, in view of the old art of launching ships, there was no patentable novelty in the combination of an inclined railway located near a body of water and a boat-shaped car or toboggan, adapted to move downward over the railway and to be propelled forwardly upon the water by the momentum derived from its descent. Paul Boynton Company vs. Morris Chute Company, 82 Red. Rep. 440.

In the Cushman case, 1 McArthur's Pat. Cas. 569, an electrical patent was refused on the ground of the absence of utility and an appeal was taken from the decision of the Commissioner in so refusing. The device for which a patent was sought consisted of an improved method for protecting objects from the effects of lightning by surrounding that part of the lightning rod which is embedded in the earth with a galvanic battery. Its construction and functions were described by the inventor in the following language: "To facilitate the discharge of the electricity from the conductor to the earth is the object of my present invention, and it consists in surrounding that part of the lightning rod embedded in the earth with plates of dissimilar metals, arranged in such manner as to constitute an open galvanic battery. Electromotive power will divide the electricity on the metallic plates and, as they are insulated, they will act as a condenser of the electricity that is opposite to that of the air. Should there be a high electrical tension of the air, by this means the electrical fluid conducted through the rod is more readily discharged by uniting with the opposite electricity as it accumulates on the surface of the plates. When the discharge flows from the earth to the air, then the rod conducts from the plates such electricity as is opposite to that of the air." The reason which the Commissioner gave for refusing a patent was that the intensity of the action arising from either the copper or the zinc plate, or both, in the earth, is thousands of times too small to be sensible as compared with that of a flash of lightning. "The latter has force enough to strike through hundreds or thousands of feet, or sometimes through miles of air. The former has not force enough to strike through the thousandth part of an inch. These are well known facts and the thing must be entirely without practical effect." The court was satisfied that the device in question could be put to no beneficial use and the Commissioner's refusal was affirmed.

The degree of utility is not material and a patent may rightfully issue, so far as that quality is concerned, provided the invention be of some use and benefit. Nor does the simplicity of a device indicate in any way the absence of utility, for this is a recommendation of the usefulness of the article rather than an objection thereto. The existence of utility in an invention is not to be determined by comparing it with other arts and devices, but is rather to be ascertained by an examination of the particular art or device in question. It is not essential to the patentability of a device that it should supersede or be superior to others previously used for the same purpose; nor does the fact that an invention has been displaced by some subsequent invention import a lack of utility. If, however, a patented article rapidly takes the place of all others of similar kind and is successful commercially, these are considerations tending to show that the public welfare has been advanced by its production and that it is characterized by utility within the meaning of the patent laws.—Electrical World.

Water-proof glue is manufactured of gum shellac three parts and India-rubber one part by weight, these constituents being dissolved in separate vessels in ether, free from alcohol, subject to a gentle heat. When thoroughly dissolved, the two solutions are mixed, and kept for some time in a vessel tightly sealed. This glue resists the action of water, both hot and cold, as well as most acids and alkalis. If the glue is thinned by the admixture of ether, and applied as a varnish to leather along the seams where this has been sewn together, it renders the joint or seam water-tight, and almost impossible to separate.

Work for the firm's interest and sooner or later the firm's interest will be your own.

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EDITORIALS

With this number the ELECTRICIAN AND MECHANIC enters on a new period of its career. We have increased the price to ten cents a copy. We have also doubled the size of the magazine. By the increase in the number of our pages we are enabled to greatly increase the scope of our articles without reducing the space devoted to electrical topics. In deference to the wishes of many of the readers of "Amateur Work" we shall devote a number of pages in each issue to furniture making and other branches of woodworking. We shall also have a regular department of photography, which will be informatory and practical. Model building will receive its full share of attention, and all forms of tool work in wood and iron will be written about by acknowledged authorities. A regular monthly feature will be illustrated articles devoted to interesting developments of electricity and mechanics currently and prominently in the public eye. No branch of science or mechanical work likely to appeal to our readers will be neglected. We aim to provide a varied list of contents in each number which will appeal to all tastes. We most earnestly bespeak the support of all who read this number; our subscribers we ask to show this and succeeding numbers to their friends; those to whom the magazine is new will, we trust, buy again and become regular readers.

Our staff of regular contributors will include Prof. A. E. Watson and Ira M. Cushing, experts in electrical design and practice; Wm. C. Houghton, for metal work and model making; Carl H. Clark, boats and gas engines; Wm. C. Terry, draughtsman and mechanical expert; A. Frederick Collins, inventor and designer of wireless telegraphs and telephones; Frank R. Fraprie, editor of "American Photography"; and numerous other writers of national reputation whom we cannot at present name. Each of these gentlemen is prepared to answer questions on his own special subject.

This number will be seen by many thousand readers who have never before had a copy of ELECTRICIAN AND MECHANIC. We trust that the majority of them may be moved to subscribe. If the merits of the magazine alone are not sufficient, we recommend to their attention the offer of a fountain pen as a premium made elsewhere. We guarantee absolutely that this pen is exactly what it purports to be, the equal of any pen sold in America for $1.25, and will cheerfully make good the claim of any reader who may try it and be dissatisfied. For those who wish to get a book as a premium, we will give a yearly subscription and any 25-cent book which we advertise for $1.10, or a subscription and any 50-cent book listed by us for $1.35. We will offer a liberal commission to any subscriber who may wish to canvass his friends for subscriptions. Full particulars will be given on request.

Some of our readers who are interested in photography have suggested that we offer prizes for good photographs and reproduce the best in our pages. As this plan is adopted by many of the photographic magazines, and seems to be pleasing to readers, we are willing to make the experiment, at first in a modest way. We therefore offer a prize of one dollar for the best picture sent in by a reader before November 1. Any reader, whether a subscriber or not, may send in prints, as many as he likes. Title, name and address must be written on the back of each print, which may be mounted or unmounted. The best print will be reproduced in the magazine. Unsuccessful prints will be returned if sufficient postage is enclosed when they are sent. Pictures will be criticised by the editor if requested, and any photographic questions will be answered in the magazine. If the idea proves popular, the prizes will be given from month to month, and perhaps increased in number and amount.

In order to stimulate interest among our readers interested in woodworking, we offer a prize of five dollars for the best article on the construction of a piece of furniture, illustrated by satisfactory drawings fit for reproduction, received by December 1st. The sole condition is that the article and drawings shall be good enough to use. Unsuccessful articles which may be published will be paid for at space rates. Each article must be marked "For Furniture Competition," and be accompanied by stamps sufficient for its return.

Any reader who has a complaint of not having received numbers of "Amateur Work" due him on subscriptions or orders is invited to communicate with this office, and we will endeavor to have the matter satisfactorily adjusted. Complaints of numbers of ELECTRICIAN AND MECHANIC lost in the mails will also receive prompt attention and adjustment.

Whoever knows electricity best esteems it most.

Book Reviews.

Carpentry and Joinery: A working manual of approved American practice in the selection of lumber, the framing of buildings, and allied branches of the art of carpentry construction, by Gilbert Townsend, S. B., Constructionist with Post and McCord, Architects, New York City. Illustrated. Chicago, American School of Correspondence, 1908. Price, $1.00.

This excellent manual of about 150 pages contains in limited compass as much real meat as many a volume of thrice the size. It is no exaggeration to say that there is not a superfluous sentence in the book. The author has written, not to fill space, but to tell what he has to say as clearly and concisely as possible. In this he has succeeded. The practical worker in carpentry will find this volume exactly suited for his needs, and the solution of many a knotty problem may be found in its pages. The first chapter treats of the characteristics and selection of lumber, a most useful subject for all workers in wood. Then follow three chapters on layout and framing of a building, roof construction, and special framing. There is no problem in the construction of an ordinary building, which cannot be fully and correctly solved by reference to these pages. In fact this book alone is sufficient guide for the framing of any structure which can be built of wood. It should be in the hands of every carpenter.

Basket Making, by T. Vernette Morse. Illustrated with 106 working designs. Chicago, the A. Flanagan Co. Price, 25 cents.

This handy little manual gives full directions, profusely illustrated, for the construction of all kinds and weaves of baskets from reed, rush, and raffia. This industry is profitable, easily learned, and can be practised readily at home. The book can be cordially commended as an excellent guide.

Mechanics for Young America, reprinted from "Popular Mechanics." Price, 25 cents.

This book, intended for boys from

ten to twenty, gives numerous illustrated directions for the manufacture at home, of simple materials and with few tools, of such things as boats, water motors, wind mills, searchlights, burglar alarms, ice boats, water bicycles, cabins, camps, clocks, fishing tackle, kites, street railroads, etc. A live book for live boys.

Disston Lumberman Handbook, containing a treatise on the construction of saws and how to keep them in order, together with other information of kindred nature. Henry Disston and Sons, Philadelphia.

If there is any point connected with the manufacture, care and use of saws not covered by this book, a very careful reading has failed to disclose it. Every sort and description of saw, from a diamond toothed stone saw 100 inches in diameter to the smallest hand saw is fully described, with instructions for its care and use. A chapter of great value is devoted to the filing of saws, and is one which should be read by every mechanic. Descriptions of other Disston tools, especially files, are given, and form most interesting reading. The book will be sent free to any reader who will mention this magazine, by addressing the firm in Philadelphia, in accordance with the address given above.

We have received from the North Bros. Mfg. Co., of Philadelphia, a catalogue of their "Yankee Tools," describing automatic screw drivers and drills of their well-known make. It will be sent free on request to any address, as noted in their advertisement on another page.

Calorimetry

The province of calorimetry is to measure the quantity of heat which a body parts with or absorbs, when its temperature sinks or rises through a certain number of degrees, or when it changes its condition.

Quantities of heat may be expressed by any of its directly measurable effects, but the most convenient is the alteration of temperature, and quantities of heat are usually defined by stating the extent to which they are capable of raising a known weight of a known substance, such as water.

The unit chosen for comparison is called the thermal unit.

Three methods have been employed for determining the specific heat of bodies:

(1) Method of melting or fusion of ice.

(2) Method of mixture.

(3) Cooling.

The method of determining specific heats by the fusion or melting of ice is based on the fact that to melt a pound of ice 80 thermal units are necessary, or more exactly 79.25.

Black's calorimeter consists of a block of ice in which a cavity is made, and which is provided with a cover of ice. The substance whose specific heat is to be determined is heated to a certain temperature, and is then placed in the cavity, which is covered. After some time the body becomes cooled to zero. It is then opened, and both the substance and the cavity wiped dry with a sponge which has been previously weighed. The increase of weight of this sponge obviously represents the ice which has been converted into water.

In determining the specific heat of a solid body by this method, it is weighed and raised to a known temperature, by keeping it, for instance, for some time in a closed place heated by steam; it is then immersed in a mass of cold water, the weight and temperature of which are known. From the temperature of the water after mixture the specific heat of the body is determined.

Equal weights of different bodies whose specific heats are different will occupy different times in cooling though the same number of degrees.

Put a bit of tallow into the hole bored for a lag bolt and it will go easier. The bolt squeezes the tallow ahead of it and greases the hole as it advances.

The Jack of all Trades has had his day. If a man is good at one thing nowadays he is a prize.

QUESTIONS AND ANSWERS

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

Owing to the large number of questions received, it is rarely that a reply can be given in the first issue after receipt. Questions for which a speedy reply is desired will be answered by mail if fifty cents is enclosed. This amount is not to be considered as payment for the 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. Neither do we guarantee that the answers will be satisfactory for any special use or purpose required.

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.

351. **Permanent Magnets.** J. C., Tampa, Fla., asks (1) How are permanent magnets energized? (2) The field magnet of a certain dynamo is not permanently magnetized. Does it need to be, in order to start a current? (3) Must the aerial wires of wireless telegraph stations be above the level of trees, windmills, etc.? A.—(1) By momentarily touching the ends to the poles of a powerful electro-magnet. (2) The fields of all practical dynamos are of the electro sort. Ordinary iron, once magnetized, will retain enough to enable starting at subsequent times, without further attention. (3) Entirely dependent upon the distance to which the messages are to be sent; the higher these wires the less the interference from other objects.

352. **Telephone Circuits.** A. D., Philadelphia, Pa., kindly offers a solution of the third question of No. 305 given in the August issue. He sends diagrams of the different circuits involved, and shows that when the secondary terminals are reversed, the current from the local battery has to pass through the secondary winding as well as through the primary. Of course the insertion of this high resistance reduces the battery current to a small fraction of the normal. The original question did not explicitly limit the case to a series phone, with local battery. The real combination of primary and secondary currents in the common battery system is by no means as easy to explain. We are always very grateful to our readers for helping us out in lines that are highly specialized, or in which we make obvious mistakes.

353. **Soldering Aluminum.** G. T., Kansas City, Mo., asks how to solder a copper wire to a sheet of aluminum? A.—No means either of soldering or plating this metal have yet been found.

354. **Wireless Telegraphy.** C. Q. asks how much a wireless telegraph apparatus which will send fifty miles will cost, and how large a spark coil is needed. A.—Complete apparatus for sending a message to this distance would cost some hundred dollars, and would require excellent working conditions to be reliable. The coil would advantageously be one large enough to give at least a ten or twelve-inch spark. Our publishers sell several books on the subject, which should be thoroughly studied before the construction of a large apparatus is attempted.

355. **Dynamo Winding.** J. B. S., Chicago, Ill., asks if it takes the same amount of power to run a 20-watt dynamo with a 12-section commutator and a 20-watt dynamo with a 2-section commutator? A.—The 12-section machine allows the use of a better armature winding, and would prove more economical of power than the one with only a single coil and two segments.

356. **Wireless Telegraphy.** F. W. P., Brooklyn, N. Y., asks what should be the resistance of a relay to close circuit through a telephone receiver to receive wireless messages from a station four miles distant, and if a 4-inch spark coil and an antenna 60 feet high are sufficient to transmit messages four miles? A.—A relay wound to 250 ohms resistance should be used. A coil giving 4-inch spark will transmit messages four miles, provided the receiving apparatus is in proper adjustment, and the aerial wires are of proper height.

357. **Phonographs.** R. F. A., Carmine, Texas, asks for a good book on phonographs and record making, and whether a phonograph driven by an electric motor will run smoothly and regularly without the use of a governor. A.—We know of no such book, and suggest you write to any of the large phonograph concerns for information. Yes, provided motor is a good one, and the source of current is a regular electric light supply.

358. **Miscellaneous.** V. W. C., East Bridgewater, Mass., asks (1) What is the voltage of an Edison primary battery, type SS? (2) When will the article on a model steam engine and boiler appear? (3) Has any system for the transmission of power wirelessly been invented, or is there any likelihood of such in the near future. A.—(1) 0.9 volt. (2) Such a series is being planned for, to begin in an early number. (3) No.

359. **Power for Toy Dynamo.** W. B. asks (1) What sort of an engine would be suitable for driving a 10-volt "Wonder" dynamo? (2) When an electrolytic interrupter is used with an induction coil, is the ordinary vibrator needed in addition? (3) Where can tin-foil for condensers and hollow brass balls for influence machines

be obtained? A.—(1) A toy dynamo is too small to fit a special steam or gasoline engine. You would find it very difficult to control the speed. A water-faucet motor would probably be the simplest and cheapest. (2) No. (3) The International Brass Co., 76 Beekman St., New York City.

360. **Correspondence Schools.** R. K. M., Morristown, N. J., asks (1) Is there a practical outfit for sale, consisting of miniature lamps, engine and dynamo? (2) Are the correspondence schools reliable concerns, and are their diplomas duly recognized? A.—(1) No, we do not know of such except as one might be made for the "fun of it." You might advertise in our exchange columns. The difficulty in the operation of such installations consists largely in the fact that quite as much supervision is necessary as in the case of larger plants, and that small engines do not readily maintain a uniform speed, with change of load. (2) Yes, these courses have been arranged by highly competent men, and have proved a far more satisfactory method of conducting home study than even the founders anticipated.

361. **Storage Battery Voltage.** J. S., San Francisco, Cal., asks if a storage battery, giving a certain voltage and current, is used to operate lamps of a lower voltage, should a rheostat be inserted, or are the batteries inherently self-regulating? A.—No, the batteries are sources of constant potential, and if it is not convenient to rearrange the cells in a different manner, you must insert a resistance of some sort. Of course you have the additional opportunity of putting several of the low voltage lamps in series, a much more economical method.

362. **Tesla Transformer.** A. C., Monrovia, Cal., asks (1) Is there an iron core in a Tesla transformer, and how much separation is there between primary and secondary? (2) Would plate glass and tinfoil act as well for a condenser as a Leyden jar? (3) How thick a piece of paraffin will a 4 1-2 inch spark puncture? A.—(1) There is no iron core,—hysteresis and eddy current in it would prevent a sufficiently quick break of the primary circuit. Half-an-inch, or more, dependent on the size of the coil, and the length of sparks desired. Sometimes the coils are wound open, with a separation of from one to three inches, and immersed in a barrel of paraffin oil, the terminals being brought out through wooden tubes, also filled with oil. (2) Yes, but rather more bulky, and with the thin glass necessary, there would be too much danger of breakage. (3) We do not know, perhaps one inch, but the real test would be variable, dependent upon the purity of the paraffin, and to what extent air and moisture had been removed from it.

363. **Electrophorus.** C. G. S., Oakland, Cal., asks (1) Will resin take the place of a resinous substance, in making an electrophorous? (2) Of what is gold leaf composed? (3) What form of coherer is the most sensitive for use in wireless telegraphy? A.—(1) Yes, but the addition of some beeswax makes the plate less brittle. (2) Of pure gold. (3) There is such a variety of constructions that we do not know which is used the most. The iron, silver and nickel filings or turnings, with a trace of mercury, in a vacuum, seem to be largely used. The electrolytic "barretter," with telephone receiver, is capable of higher speed. The detector described in the July, 1907, issue is still another effective form.

364. **Electromagnetic Chuck.** C. A. T., Fitchburg, Mass., asks for directions for making an electromagnet capable of holding work on a planer bed or face plate of a lathe. A.—Some years ago some exploiting along the lines of such electromagnetic chucks was undertaken by a concern in Worcester, Mass. In themselves, they seemed to have some desirable qualifications, but there is associated with them the intolerable nuisance that all cutting tools and measuring instruments with which they come in contact become magnetized. Chips therefore stick to the tool point, and the delicacy of touch with calipers, or such like, is considerably impaired. In Underwood's book, "The Electromagnet," you will find about all the data you need for designing a very large variety of electromagnets.

365. **Architect's Rule.** R. F., Natick, Mass., asks (1) How to read the scale on an architect's rule? (2) How to read and use a protractor? (3) How is a current stepped up by a transformer. A.—(1) The modern form of the rule is triangular, and the divisions extend over one foot in length. On one edge there are simply the 1-16" divisions, but on the other edges there are divisions indicated as 3-32, 3-16, 1-8, 1-4, 3-8, 3-4, 1 1-2 and 3. These fractions or numbers mean the inches that represent the actual feet. Of course a house cannot be drawn full size, and these divisions in the rule allow, for instance, the drawing to be 1 1-2 inches to the foot, and the space of 1 1-2 inches is therefore divided into 12 equal parts, each of which can be taken as representing a foot in the actual construction; this results in the drawings being one-eighth size. Such a scale is very convenient for representing various details, but would require inconveniently large sheets for the complete plans or elevations, so for such drawings the 3-4 inch to the foot scale would be preferred; you will find this part on the rule also divided into 12 parts. The architect's rule is largely used by mechanical draftsmen, while the form technically known as the engineer's, with divisions of sixths, tenths and twelfths, is common with civil engineers. (2) A protractor is usually a semi-circular piece of sheet metal or horn, divided into 180 degrees, and is used for measuring or laying out angles. The draftsman's form need not be very accurate, but the mechanic who builds the machine must have a more highly specialized form, else he will not be able to fol-

low the draftsman's design. (3) Current is not ordinarily stepped-up by a transformer; the designation is specified as raising the voltage, or pressure. For ordinary electric distribution the pressure is lowered for the safe and convenient use of customers, but identical constructions of transformers can be used for both lowering and raising the pressure. For instance, a transformer may be connected to a 2000 volt dynamo, and step the potential up to 10,000 volts, then a similar transformer step it down to 2000 again. Any desired voltage is obtained by using a corresponding number of turns of wire in the winding. The ordinary medical, or shocking coil, is one form of step-up transformer, operated not by mechanically generated alternating currents, but by rapidly interrupted direct currents from a chemical battery. Of course, every degree of rise in potential is accompanied with a corresponding reduction in amount of current. In addition, there are some unavoidable losses, so that a little more energy must be put into a transformer than can be gotten out.

366. **Transformer for Miniature Lamps.** C. A. S., Taunton, Mass., asks for the design of a transformer that will step the 3-4 volt of a Daniell cell up to 10 volts, for lighting lamps. A.—You are on quite the wrong track. The simple form of induction coil that alone works with interrupted battery currents loses about half the energy put into it. If you wish to light lamps, do it direct from the batteries, using a sufficient number to get the desired voltage. The resistance of the fine wire of the secondary,—to say nothing of its self-induction,—is so great that almost all the voltage is wasted in driving the meagre current through it instead of through the lamp. You know that even when the secondary is short-circuited, the current is too small to be of any use. When you take the handles, the conditions are somewhat changed, for in this case, the resistance of the body is very high as compared with the filament of lamp, and in consequence of the small current that flows, considerable difference of potential exists at the terminals; with the secondary open-circuited, no current at all flows, but the difference of potential between terminals is then a maximum.

367. **Direct or Alternating.** R. A., Cincinnati, O., asks (1) Is the current supplied for residence lighting direct or alternating? (2) Can any dynamo be used as a motor, or vice versa? (3) Can a direct current dynamo be used as an alternator? A.—(1) Both kinds are supplied in almost every large city, the direct being used for short distances from the stations, and presumably getting the advantages derived from storage battery regulation, while suburban districts and towns are more economically supplied with currents of the alternating sort. (2) Yes, this point has been especially emphasized in the series of articles on Electrical Engineering that we have been publishing for a year. (3) Yes, but with only two poles in the field magnet you would get a very low rate of alternations; the multipolar field is preferable for ordinary speeds.

368. **Dynamo Output.** C. E. H., Chicago, Ill., asks (1) What will be the output of a dynamo with armature 9" long, 6" in dia., wound with No. 20 wire, while field has a core 6" long, 4" in dia., wound to an overall diameter of 6-1 2", with No. 25 wire; commutator has 44 segments, and speed can be about 2000? (2) Is it necessary to have a rheostat in the field circuit of such a generator? A.—(1) Your data are quite insufficient for a calculation, but the appearance is that of a 500-volt machine, and good for about 4 amperes. You do not state the material of field, whether wrought or cast iron, whether with one spool or two, nor how many conductors there are on armature. We judge latter is of the smooth rather than of the toothed variety. (2) Yes, or you will have no means of adjusting the voltage to any definite value.

369. **Alternating Current Motor.** J. W. K., San Antonio, Tex., sends a full size sketch of sheet iron punchings for armature and field of an alternating current commutator motor. Six poles are shown for the field, but the armature, though 6" in dia., resembles the simple shuttle form, adapted for only two poles. He asks (1) What size of wire to use—commutator to have six segments? (2) What power will it develop? How many amperes will it require at 110 volts pressure? A.—Your design is rather old fashioned, and rather ineffective, and we can best answer the questions in a general way. You evidently have been copying the scheme of an original "Emerson" fan motor, with stationary commutator, and revolving brushes; only one pair out of the total six field coils is operative at any instant. Such a construction even in small sizes, involves considerable sparking and a low power factor; in a larger size, such as you contemplate, the sparking would be very severe, and the power factor no better. Since the invention of the simple induction motors, no one has had the temerity to build this unsalable form. If you wish a synchronous motor that will utilize the field magnet, as constructed, you will find explicit directions for one of just this size, in Watson's "How to build a One-K. W. Alternating Dynamo or Motor."

370. **Induction Coil.** P. C., Paris, Tex., has two pounds each of Nos. 16 and 36 insulated wire, and asks how to use it in making the most effective induction coil? A.—We can do no better than to refer you to the excellent article beginning on page 23 of the July 1907 issue. Use only about one-half the coarse wire, all the fine, letting the general dimensions be about three-fourths of those given.

371. **Battery Motor. Graphophone.** R. F. A., Carmine, Tex., asks (1) How many Edison "S" cells are required to run a

10-volt, tenth-h.p. motor? (2) Would the heating of the stylus of a graphophone, by electrical means, be an aid in the production of records? A.— (1) About 15 cells. (2) It would be worth trying, but we have a suspicion that it has been tried and abandoned. Of course with cylinders made of wax there would be some difficulty in establishing a circuit, and with metallic records, the heat might be sufficient to take the temper out of the fine point.

372. **Magneto Dynamo.** F. O. S., Morgantown, W. Va., wishes to change a small telephone magneto into a dynamo for 8 volts, speed to be about 2400, and fields to have either a shunt or series on the steel bars. He asks what will be appropriate sizes of wire to use? A.— We would suggest No. 22 for the armature, No. 25 for a shunt, or No. 18 for a series winding,—about one-half a pound on each limb.

373. **Dim Lamps.** J. C., Tampa, Fla., says (1) that in the printing office where he is employed there are five motors, of 20, 10, 5, 2 and ½ h. p. respectively, connected in series; that when the largest is started, the lights burn dim, but that when all the motors are running, the lamps go about out. What is the reason, and can a remedy be provided? (2) Why can a shock be obtained from an arc lamp pole when it is wet? (3) Why is the blowing of a fuse under a trolley car accompanied with a noise resembling an explosion? A.— (1) This is a common fault, and is the natural result of inadequate apparatus or bad engineering. Perhaps the steam engine has merely a throttling governor; with such there is a serious falling off in speed when the load increases. The generator may be provided with a shunt winding only on its field, whereas it should really have a field over-compounded 5 per cent. or even 10 per cent. Slipping of the belt, due to its insufficient size, or if direct coupled, reduction of boiler pressure, would exaggerate the falling off in voltage that is experienced. Perhaps, also, the motors are connected to the lighting mains instead of being wired directly back to the switchboard. Nothing larger than the ½ h. p. should be on the same circuits with the lamps. You make a gross error in stating that the motors are connected in **series** with each other,— they certainly are connected in **parallel.** (2) Some of the insulators on the line are cracked or otherwise leak, and the wet pole provides another leakage path. (3) The fuse boxes have the "magnetic blow-outs," and the sudden rupture of an arc by this means makes the same rush of air as in case of discharge of a gun. You have seen that when a trolley wheel comes off the wire, a flash a foot long will follow. An even greater one would take place in an enclosed place, and were it not for the presence of the electromagnet in the fuse box, a much larger and more dangerous device would be involved.

374. **Diminutive Automobile.** H. Y., Tampa, Fla., asks (1) What horse power would be required to run an automobile with body 4 ft. long and 2 ft. wide, weighing 17 lbs.? (2) What is the lowest voltage that a 1 h. p. motor can be wound for, and what size of wires would be needed? (3) In a four pole motor, is the field winding placed on the poles or between them? A.—(1) You must not forget that the engine, fuel, water, or motor and batteries also need hauling, and these parts often weigh more than the car body and passenger. You cannot expect to make a lighter vehicle than a motor bicycle, and the motive power on such is often rated at 1½ h. p. (2) As low a voltage as you please. A very low voltage motor could be had by utilizing an ordinary plating dynamo for the purpose. Of course the supply of current must be from similar machines, and the large conductors required would limit the practical transmission to a few feet distance. The lower the voltage, the greater must be the number of amperes, demanding correspondingly large and heavy commutators and brush holder rigging. Usually the point sought is to have voltage as high as possible, therefore minimizing the weight and cost of these parts and also saving in the size of line wire. (3) Around the poles.

375. **Worm and Screw.** H. C. C., West Winfield, N. Y., asks how to figure a worm and screw to reduce a speed of 1200 rev. per min. to 1 rev. in 2 min? A.—It would seem impracticable to attempt this in a single reduction. A single thread screw would require 2400 teeth in the gear,— clearly a large and difficult thing to make. It would be easy to use a double reduction, with single thread screws and the two gears having 40 and 60 teeth. Using identical gears of 48 teeth each would probably reach the desired result as closely as the motor adheres to the particular speed you mention.

376. **Storage Battery Troubles.** E. T. F., Renovo, Pa., has a 2-cell portable "Chloride" accumulator, that is intended for being charged at a 15-ampere rate for 10 hours at a time. He actually does the charging from a 110-volt circuit, using a 50 c. p. lamp for resistance. Afterwards, on putting the battery on "short circuit" with a volt-meter, it shows 4 volts, but as soon as any attempt is made to get any current, it fails; even with battery on an actual short circuit through a meter, the latter refuses to show any signs of current. What is the trouble? A.—We should judge that the solution had largely disappeared from the jars. A mere dampness of the mud in the bottoms suffices to show something on the voltmeter, but the resistance is too high to let any current flow. It is rather lucky for your property that this is the cause, for had the cells been in good condition, you would probably have burned out the ammeter on such a short circuit, and buckled the plates of the battery. High rates of discharge

are injurious, and of course a short circuit is the worst case. Your only safe method is to open the cells, remove the plates, clean out the jars, and reassemble with fresh solution. If the negative plates are white, they are badly sulphated, and this should be removed by giving them a preliminary charge in the wrong direction, using plain sheets of ordinary lead for temporary negatives, this partial transposition into positive plates is a simple and effective remedy for sulphating. Be sure that the specific gravity of solution is kept at normal value. You had better send to the manufacturers for a copy of their regular instructions. The charging you have practiced has not been at more than 1½-ampere rate through the lamp, hence you need to continue the action for a much longer time. It is a rather bad expression, and really not the truth, to say that the cell was short circuited through the voltmeter,—as a matter of fact this sort of instrument comprises a very long circuit of high resistance wire, and at most allows but the merest trace of a current to flow.

377. **Induction Coil.** A. H. S., Phila., Pa., asks (1) Is No. 33 double silk covered wire good for the secondary of an induction coil? (2) What is the matter with a coil that is supposed to give 1" sparks, but fails? Primary consists of No. 16 wire wound on a core that came from a telephone coil, while secondary is made from 1¾ lb. of the No. 33, condenser has 4 sq. yds. of tin-foil. (3) Can a Marconi wireless telegraph outfit communicate with a DeForrest system? A.—(1) Yes. (2) The insulation between primary and secondary, or the insulation in the secondary, has probably broken down. You can easily see that an electromotive force that will send a 1" spark through the high resistance of the air will make a vigorous effort to follow the almost metallic path between the various parts of the coil itself. You will find the article beginning on page 23 of the July issue well worth reading and following. (3) Marconi messages can be picked up by a DeForrest receiver, but the Marconi coherer cannot follow rapidly sent messages.

378. **Small Dynamo.** E. R. K., Milwaukee, Wis., is making a small dynamo with a four-slot cast iron armature, 2" long and 1-⅜" dia.; each slot is ½"x⅜", and is wound with No. 20 wire. Field is of Manchester type, 6" long, 2" wide, with two cores, each 2" long and 1" dia., wound with No. 22 wire. He asks (1) How the armature should be wound, and how many segments there should be in the commutator? What will be the output, when speed is 2500 rev.? (3) What are good proportions for a 75-watt dynamo? A.—(1) Let it be continuous, like any drum armature, winding the slots half full only before bringing out a loop; four segments. (2) 4 or 5 amperes, and 10 volts. (3) Use a 12-slot laminated armature, 2-½" long and 2" dia., with a field magnet about 10 per cent. larger than the one just described.

379. **Rejuvenating Dry Batteries.** A. R., Rock Island, Ill., asks how to re-energize old dry cells? A.—See article on page 40 of the August issue.

380. **German Silver Wire.** V. B. R., Petersburg, Ill., asks (1) What is the resistance of German silver wire as compared with the same size of copper wire? (2) Where can such wire be obtained? (3) At what speed should a telephone generator be run to obtain the largest output of current? A.—(1) The trade recognizes what is known as 18 per cent. and 30 per cent. wire, meaning wire that has approximately 18 and 30 times, respectively, the resistances of copper. (2) Any large dealer in copper wire or any manufacturing jeweler can supply it. (3) If you mean for ringing purposes, not over 1000 rev., or the alternations will be too fast for the bells, but if you have rewound one for use as an experimental dynamo, and have on some strong binding wire, a speed of 2500 may be permitted. You must recognize, however, that the bearings for the shaft are not well calculated to stand continuous use nor high speeds.

381. **Igniter Coil.** R. O., Port Jervis, N. Y., asks (1) if a single dry cell will be sufficient to operate a jump spark coil for igniting the charge in a home-made gasoline coil? (2) What is the difference between a jump spark coil and an induction coil? A.—(1) No, several cells will be necessary. About as much energy is required to ignite the charge in a small engine as in a large one. It is like starting any fire,—as large a match is needed for a small fire as for a large one. The total effort upon the piston is believed to be due not to a single explosion but to a rapid succession of them, therefore the successive jumping sparks are more effective than the single ignition that would be obtained from a flash spark. (2) They mean the same thing.

382. **Gasoline Engine.** R. E. P., Greenburg, Ind., asks (1) What is the cause of oil being pumped out of the main shaft bearings of a 1¾ h. p. motor-cycle engine? (2) What is the correct time of opening exhaust valve on such an engine when running at 2500 rev.? (3) How many 16 c. p. lamps should such an engine run? Cylinder is 2" dia. 2½" stroke. A.—(1) The engine is of the "2-cycle" sort, and depends upon the compression in the enclosed crank case to force its charge into the working cylinder. The bearings for the shaft are probably too loose, and the valve may be set forward too far. (2) With such an excessive speed we should anticipate just the troubles as you have just mentioned. Half that speed is high, and the 2500 rev. causes undue expense for fuel and introduces difficulty of effective lubrication. The set of the valve is to be determined by experiment. Proof of too much advance is evinced by difficulty in starting the engine. (3) If the engine is actually 1¾ h. p., you ought to be able to light about 20 lamps.

383. **Battery Bands.** S. K. H., Morristown, Ind., asks (1) Where can hard rubber bands be obtained for holding storage battery plates together? (2) What is meant by "draw-bar" pull of a car motor? (3) What would be a little clearer explanation of the "one-half square, the value .707, etc., referred to on page 3 of the July issue? A.—(1) Your terms are a little different from those that agree with our experience. **Soft** rubber bands were formerly used to hold the plates together,—with suitable insulators interposed, but when subjected to the action of the acid, such material is rather short lived. The common practice is now to slip elongated loops of hard rubber over the positives, to hold the plates **apart.** Hard rubber is unaffected by the acid. The Electric Storage Battery Co. of Philadelphia will probably have what you want. (2) If the car was anchored to a post, through the medium of a spring balance, the useful pull could be seen as of easy determination. Over ordinary level tracks, a horizontal or "drawbar" pull of 25 lbs. is sufficient to move a ton. Thus a car equipped with two G. E. 800 motors would then suffice to move a car and its load aggregating 64 tons. (3) If you have a card or board cut square, and measuring .707 ft. on a side, its area will be one-half a square foot, or, a square piece of land measuring .707 of a mile on a side will have an area of one-half a square-mile. Conversely, if you know the area of any square, you can find the value of one of its sides by extracting the square root. The square root of .5 is .707.

384. **Gas Engine, Literature.** C. V. Kalona, Iowa, asks (1) What are the names of some good books on gas and gasoline engines? (2) What is the coating that resembles galvanizing or tinning, used on such engines? A.—(1) We advertise a 25c and a 50c book; you should have them both. Our publishers can inform you of others. (2) Aluminum paint. It is also largely on mail boxes.

385. **Model Racing Boat.** F. W. F. has built a model flat-bottomed racing boat on a kite-shaped plan, 57 inches long and eight inches wide. He wishes to drive it by a "Standard Porter Motor, No. 1." He asks if this motor will give sufficient power to drive the boat at high speed and what the size of the propellor should be. A.—From the scant data which you send it is rather difficult to give a definite answer. We would, however, hardly think that the Porter motor which you mention would be satisfactory. You do not say what kind of batteries you intend to drive the motor with, but we would say that the weight of any batteries would be a decided disadvantage, when added to that of the motor. About the only way to determine the size of a propellor will be by trial, perhaps by making one from sheet metal and trimming it until the proper size is obtained. The question with racing boats is how to obtain the greatest amount of power with the least weight of both machinery and hull. The electric battery and motor are about the heaviest source of power that can be used. We would rather incline to the idea that some form of spring motor would be preferable for your use.

In a recent communication to the Electrician of London Prof. R. A. Fessenden states that he has developed a new method of sending wireless telegraphic messages during the daytime by means of a different type of electrical impulse from that which he had previously employed. This impulse has made it possible to cut down the absorbing power of daylight to a small fraction of its previous amount.

The system has been tried from Brant Rock, Mass., to the West Indies, the distance being approximately the same as that from Newfoundland to Ireland. The success is so noticeable that Prof. Fessenden believes that transatlantic wireless telegraphy during daylight is assured.

The new impulses are less efficient during nighttime than the old ones, but they give results which are equally good by night and by day. A comparison between the effectiveness of transmission obtained through their use and the use of the older type is about as follows, the distance being from Brant Rock to Washington, D. C.

When the old impulse produces an effect equivalent to 1,200 between the hours of 10 and 12 at night the same impulse would give a strength of signal between 12 and 12.30 at noon of only thirty. The new impulse under the same conditions will produce an effect at the receiving station of about eighty between 10 an 12 at night and of seventy-six between 12 and 12.30 at noon.

The fact that the newer signals are weaker in daytime than the old is thought to be of no consequence, it being much more important that there should be no marked difference between the transmission during the daytime and at night. Rough measurements over long distances seem to show that the new type of impulse does fall off somewhat when transmitting 1500 miles or more but that the rate of falling off does not compare with that of the old type of impulse, so that the signals received are much stronger.

There is another pressing wireless problem awaiting solution, says the Electrical Review, and that is the development of commercially practicable selectivity. Until a number of stations can work side by side without affecting one another the field for the new system is certainly limited.

One cable across the Atlantic will not begin to handle the messages which are now transmitted daily, and until the wireless system can handle something like the same number of messages the cable system has nothing to fear. Given a selective transmission, an equally good transmission by day and by night, transatlantic transmission will become practicable; but until both of these problems have been satisfactorily solved, the wireless system must be content with a very subordinate position.

SALE AND EXCHANGE

Advertisements under this heading, without display, two cents per word, cash with order, minimum 50 cents. Black-faced type, 4 cents a word, minimum $1.00. Exchange advertisements will be inserted for subscribers once in 12 months without charge, subsequent insertions one cent a word.

WANTED — Ten copies of Electrician and Mechanic for December, 1906. We will give a copy of Dry Batteries, price 25 cents, for a copy of this number in good condition. Write your name and address on the wrapper, and we will mail you the book, or your number back again, if we get more than we need. Sampson Publishing Co., 6 Beacon St., Boston, Mass.

New Cell — Don't throw away your old dry batteries. New Cell is a preparation which positively renews dry batteries at a cost of 2 cents each. Trial package and catalogue 10 cents. Adams Electrical Co., Kewanee, Ill.

How to Make an Annunciator — Full drawings and directions for 10 cents. Sampson Publishing Co., 6 Beacon St., Boston, Mass.

How to Make a Small Electric Motor without Castings, full drawings and directions, ten cents. Sampson Publishing Co., 6 Beacon St., Boston, Mass.

Wireless Receiver — We are selling the complete parts of the Excelco Detector for $1.00 by mail postpaid. Parts are as follows. Base, Binding Posts, Support Rod, Thumb Screw with platinum point soldered in, Glass cup, Zinc Strip. Will "catch messages" sent out from stations several hundred miles away. Just the thing for long distance experimenting. V. H. Laughter Co., Byhalia, Miss.

Two Ways of Renewing Dry Batteries — Printed book for 25c coin. Nu Cell 15c. Electric Supply Co., Kewanee, Ill.

Electrical Novelties and Supplies — At wholesale prices to anyone. Large catalogue free. Agents wanted. Illinois Electric Works, Dept. E. Kewanee, Ill.

For Sale — Engines 1 inch stroke, ¾ inch bore, either marine or horizontal types, complete, $5.00. Automatic high pressure flash boilers for operating these engines, complete with all accessories, $5.00. Engine and boiler mounted on base, piped up for use, $10.50. Castings and material for engines, $1.00; Blueprints, 25c. These are the most modern and powerful power plants for their size on the market. Order before the holiday rush. O. N. Hansen, 183 DuBoise Avenue, Elgin, Ill.

Can you sharpen a small twist drill true the first time you try? If not, the Ideal Twist Drill Grinder can do it for you at little cost. Send for information, it may pay. Ideal Machine Works, Brooklyn, N.Y.

For Sale or Exchange—7-volt A. C. Dynamo (hand) with case, lamps, switches, etc. Will exchange for electrical books or something electrical. R. K. Mosler, 19 Western Ave., Morristown, N.J.

For Sale or Exchange — One bicycle minus tires in good running order, a first class wheel. One Evert's Encyclopedia, $1.50, almost as good as new. One book on Dynamos and Electric Motors, 50 cents, and How to Make a One-eighth H. P. Dynamo or Electric Motor. Would like to trade for a 40 watt generator, and a four bar telephone generator, or what you have electrical. A. S. Kilenger, Thomas, Oklahoma.

For Sale — One dozen lenses 6 in. diameter, $2.00 each, would be cheap at $3.00, some are a little scratched at the edges; one Manhattan battery fan motor, 10 in. fan, $2.00. One medical induction coil in a mahogany case, $3.00, or will exchange for small gasoline or steam engine. Write Edward Flamme, St. Hilaire, Minnesota.

For Sale — Midget dynamo-motor $3.00, Franklin 1/12 h.p. battery motor $2.75, 75 watt dynamo-motor, new $7.50, material for 4 in. spark coil $14.65, single pole receivers 40c, new but shopworn 60c, transmitters 30c, generators $1.25, Bulletin No. 2 on telephones free. Murray E. Main, Delaware, Ohio.

For Exchange — 2 carbon cylinder batteries, 1 miniature lamp and base, 6 V, 3 C.P. A book explaining dynamos and motors and how to build them, also a lot of Henty books, etc., for what you have electrical, send stamp with letter. Address, Rogers D. Rusk, McConnelsville, Ohio.

Exchange — 150-ohm relay, 4-ohm sounder, 2 keys, telephone receivers, transmitters, 300-volt meter, 150-volt meter, 2 amperemeter, 10 amperemeter, 200 amperemeter, wireless coherer, snare drum, carbide bicycle lamp, pyrographic outfit, 3¼x3¼ camera and outfit, sword, books, chafing-dish (alcohol), 6-volt baby dynamo, magneto hand generator, flashlight, 20; 1 potential transformer, gas engine coil, 500-1000 ohm multiplier, 100-6000 ohm multiplier, 10-lb. steel vise, magneto ringing-out set, etc. Wanted: khaki shelter tent, haversack, rifle or other campers' apparatus, or spark coil. Address W. Bronson Taylor, Y.M.C.A., Schenectady, N.Y.

Data and information on wireless telegraph stations and apparatus exchanged. W. C. Getz, 645 N. Fulton Ave., Baltimore, Maryland.

For Sale—One complete wireless telegraph outfit, will work up to one mile. One Manhattan type dynamo, 6-segment commutator, armature 3¼x3¼ made of insulated discs, size 6x9x3x¼ in. thick. Has detachable water motor, brass bearings, nickel-plated oil cups. On 70-lb. pressure it will give 20 volts, 5 amp. On same pressure the water motor will give ⅛ h.p. Wireless telegraph outfit, $19.00, hydraulic dynamo, $6.50. Joe Cook, 1009 Ashley street, Tampa, Florida.

For Sale — ¼ h.p. motor castings 50c; 1/16 h.p. fields 25c, 1/10 h.p. dynamo castings $2.00. Photos. Roy A. Crihfield, 225 3d St., Lincoln, Ill.

For Sale—1¼ h.p. Bicycle Engine, new, $20.00. Castings for same $6.50. C. E. Shook Mfg. Co., Waterloo, Iowa.

For Sale — One ¼ h.p. Motor, 110-volt. New. Complete with rheostat and extra brushes. Cost $15.00, Price $8.50. Other bargains. Write. Laurence Hanke, Sutton, Nebraska.

For Sale or Exchange — One $6.00 Meyer pattern piccolo, almost new, for set of telegraph instruments or a dynamo. Earl Hardman, Nora Springs, Iowa.

Free — Our large illustrated catalog. All papers and magazines. McClures and American magazines, both a full year, for $1.65. B. R. Hopkins, Subscription Agency, Rockland, R.I.

Wireless Telegraph Diagrams — Series of ten blueprints of latest systems in transmitting and receiving circuits, per set 50c, W. C. Getz, 645 N. Fulton Ave., Baltimore, Md.