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Wright's Aeroplane

Armature Windings

Wireless Telegraphy

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ARMATURE WINDINGS — Chapter I

RING ARMATURES FOR DIRECT CURRENTS

A. E. WATSON, EE. PH.D.

RING armatures were the sort used in the first practical dynamos. Invented in principle by Pacinnotti in 1860, they were so modified and utilized by Gramme, in 1870 and after, that the name of the latter is more often associated with this particular construction. The winding of such an armature follows simple rules, and though represented by remarkably clear diagrams, is unfortunately hampered by awkwardness and expense in the actual

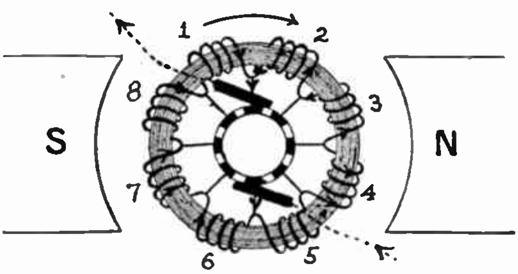


Fig. 1. Simple Ring Armature with Bipolar Field-magnet

manufacture. While drum armatures are more readily wound and offer some valuable qualifications in operation not possessed by those of the ring type, they are by no means so satisfactorily illustrated, and though ring armatures are now largely supplanted by those of the other sort, enough of them are still used to warrant an explanation at some length, the more so since some of the methods of representation can be logically extended to apply to the drums.

Of course a field-magnet with only two poles is the simplest and is properly the first to be considered. In Fig. 1 is given an elementary diagram representing the scheme of the winding and connections. A circular cross-section of the iron core is suggested by the shape of the coils, but such a shape would never actually be used, for there should be considerable length in the axial direction, the core really being a hollow cylinder. Gramme's first dynamos employed iron wire rings for this detail, but modern machines invariably involve the use of sheet iron.

In the diagram, eight coils are represented, but they are really connected with others in a continuous direction, so that except for the convenience of the winding and the necessity of leaving out ends for attaching to the commutator segments, the winding might be shown with entire uniformity. Eight segments of the latter are necessary, but since a circuit can be traced from any point in the winding around to the starting-point without involving the external circuit to which the brushes attach, the winding is distinctively designated as of the "closed" circuit type. A winding of the Siemen's shuttle sort, and of the Brush arc dynamo, as will be more clearly explained farther on, is of the "open" circuit order.

By application of Fleming's right-hand rule for generators, the direction in which the electromotive force acts, for any particular assignment of polarity of field and direction of rotation of the conductors, may be found. With north on the right, and clockwise rotation, the forefinger will be found pointing into the paper for those conductors under the north pole and towards the observer for those under the south pole. In the diagram the arrows are necessarily represented on the idle edge of the armature, but the reader will understand that the portion of the conductors directly under the faces of the poles is meant. Since the armature is symmetrically wound, with both poles of the same strength, and all coils moving at the same speed, there is the same electromotive force induced under one pole as under the other. One set of coils cannot send current through the opposite set, any more than two steam boilers under the same pressure can send steam into each other. The two boilers can unite, however, to supply a single engine, and similarly, these two sources of current can and do unite to supply the external circuit. That these two internal circuits exist is of fundamental importance in dynamo design, for evidently, any given wire need be proportioned to carry but one half the current demanded from the machine as a whole. With multipolar field-magnets there will ordinarily be the same principle of two or even more paths for the current, the extraordinary case being, as with only two poles, the open circuit winding; in that case, all the current has to pass through one wire.

Referring again to the diagram, it will be seen that coils 1, 2, 5, and 6 lie outside the immediate influence of the poles, and have little if any electromotive force induced in them. They contribute momentarily an idle resistance, but except in the Brush dynamos, no attempt has been made to eliminate them from the circuit. No means are known of accomplishing it, and indeed, in well-designed dynamos, the waste of energy in forcing the main current through these idle coils is inconsiderable. Coils 3, 4, 7, and 8 are momentarily the ones active, but, with a rapidity impossible for the mind to follow, they successively become idle, then active again. By definition and by experience, force represents the rate of doing work, and the greater the rate at which the conductors are driven through the field of magnetic force, the greater will be the induced electromotive force.

Ring armatures are valuable for high voltage work, for the fact that the coils between which the greatest electromotive force exists lie at considerable distances apart, and have the benefit of the accumulated insulation. With drum windings, however, there is always the full pressure between coils crossing or overlapping each other. Ring armatures, too,— due to the greater surface of the wire exposed to the air for ventilation and cooling, — have a much greater overload capacity than those of the other type. For the same effective number of active conductors, a ring armature requires twice as many turns of wire as the other, and with the principle that the self-induction varies as the square of the number of turns, the ring inherently possesses four times the self-induction found in an otherwise equivalent drum armature. Therefore, for the combined engineering demand for a machine of high electromotive force and inductance, for series arc lighting, the ring winding is prominently the standard construction.

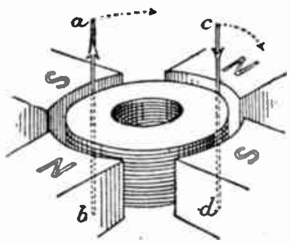


Fig. 2. Scheme of Conductors in Four-pole Field-magnet

In considering an armature winding for four or more poles, certain facts observable in the simpler case are still rigidly true. In its rotation, an armature coil passed from a given pole to one of the opposite polarity; in the multipolar field, the arrangement must consequently be of alternating polarity. If a certain direction of the electromotive force is produced under a certain pole, then the same direction will be found under all the like poles. A perspective diagram of a four-pole field-magnet with two conductors is given in Fig. 2, which is consistent with these ideas, and prepares the way for more conventional diagrams. In Fig. 3 this diagram is imagined as cut open and rolled out flat, — developed, as the draftsman would say, — showing the conductors moving towards the right, in front of the poles. Direction of the induced electromotive force here follows the right-hand rule without apology, and the reader should repeatedly seek to fortify himself in the application and appreciation of this rule by applying it without measure.

Figure 4 is a diagram corresponding to Fig. 1, but adapted to a four-pole field-magnet of the familiar type. With clockwise direction, as before, currents are consistently flowing away from the observer under the north poles, and towards him under the others. (In the representation here given, and commonly followed, a dot signifies the point of an arrow, while a cross means the other end). As in the simpler case, there was found a place to take away current from a segment between the south and north pole, so here current is represented as flowing from conductors 3 and

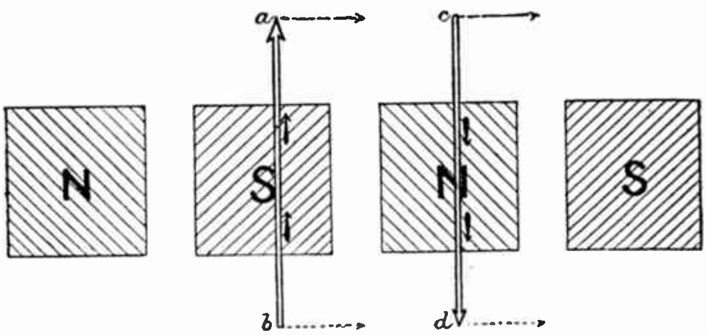


Fig. 3. Development of Arrangement shown in Fig. 2

4 to the segment *d* and thence to the upper positive brush; at the lower part of the diagram, however, the same conditions exist, for here, too, conductors are moving from a south to a north pole. Consequently, current from conductors 9 and 10 flows to segment *j* and to the lower positive brush. By similar examination a negative brush, — that is, where the current is imagined as beginning, is found on segments *a* and *g*. The external circuit could be connected between any two of these brushes, but because thereby unequal loads would most likely be imposed upon the different portions of the windings, it is common to make permanent connections between all the positive brushes and one terminal, and between all the negative and the other terminal. With symmetrical field-magnets, especially with the encouragement of equalizing connections (see Chapter V of the Engineering series), closely equal currents will then flow in all parts of the windings. As a substitute for brushes in all but two of the places of a multipolar dynamo with armature of this type, it is possible to "cross-connect" the commutator. This means that every segment is connected to its opposite. The scheme is practicable only in case the current output of the machine is low enough to be within the capacity of one set of brushes.

Examination will show that the armature winding for four poles is exactly identical with that for only two poles. The case will be as true for any number of poles. That is, a simple drum armature can be wound in the

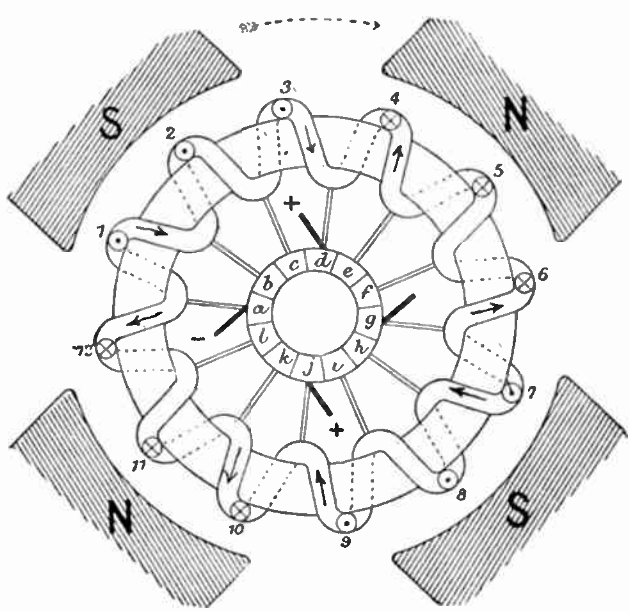


Fig. 4. Simple Ring Armature in Four-pole Field-magnet

ordinary manner, and then without any further preparation, it will operate in a field-magnet of any prescribed number of poles. Care must be taken, however, not to apply this principle in a manner to deceive one as to the proper electromotive force generated. With only two poles there are in series, from one brush to the next, one half the total number of conductors, and this is the maximum possible with this type of winding. Therefore there will be the greatest electromotive force produced. In amperes, the rating of the machine will be determined by the capacity of two wires. With four poles, the number of conductors in series from one brush to the next is only one half as many as before, and with the same effective number of lines of force per square inch from the field poles there will necessarily be only half as many volts generated. Since there are twice as many brushes as before, bringing current from two other wires, the number of amperes available will be doubled. The output of the machine, in watts, is seen to be unchanged; while the voltage is halved, the current is doubled. With eight poles, the figures would be, respectively, one fourth and four times as much as in the two-pole case. For high electromotive forces, therefore, use only two poles, as is illustrated by most arc dynamos, while for large current low voltage machines, say in small sizes. for plating, or in large sizes for power and lighting, use many poles.

An important point in armature design is an appreciation of the resistance of the winding in terms of that of the total quantity of wire employed. It is a simple matter to find this total amount, for the length of one turn and the number of turns are supposed to be known. From reference to standard tables, the resistance of that number of feet is at once seen. As wound upon the armature, however, the arrangement is not a single circuit, like a telegraph wire, but at least two circuits in parallel with each other, and more if there are numerous poles. In Fig. 1, the length from one brush to the other is seen to be only half that of the total length of wire, and ignoring the other circuit, the resistance from brush to brush is reduced at once to one half, and then when this other similar circuit is entered, the result is as if the cross-section of the wire was doubled, consequently the resistance is halved again. The actual resistance of a closed circuit armature winding, adapted for a two-pole field, is one quarter that of the simple wire involved. Similarly, for a four-pole field, since the length of wire from one brush to the next is only one quarter that of the total, and there are four paths in parallel, the resistance between the double sets of brushes will be one sixteenth that of the simple wire. A general rule can therefore be stated to represent the conditions for this sort of armature winding, henceforth called the "multiple," applicable, too, to its equivalent drum armature, — the resistance is that fraction of the total single circuit wire which has unity for the numerator and the square of the number of poles for the denominator. Application of this rule to large low voltage generators reduces the resistance to a surprisingly small fraction of an ohm.

Another method of representing the conditions of Fig. 4, and intended to be of help in explaining drum windings, is given in Fig. 5. This is a development, similar to Fig. 3, the wires and commutator segments being designated the same in both cases; the full lines represent wires on the outside of the core, while the dotted ones show the in-

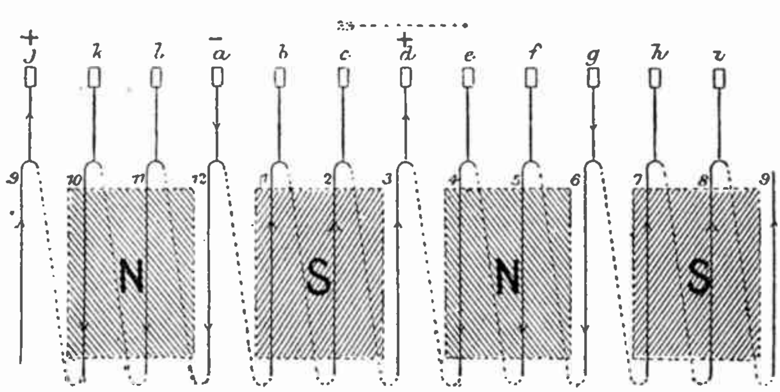


Fig. 5. Development of Arrangement shown in Fig. 4

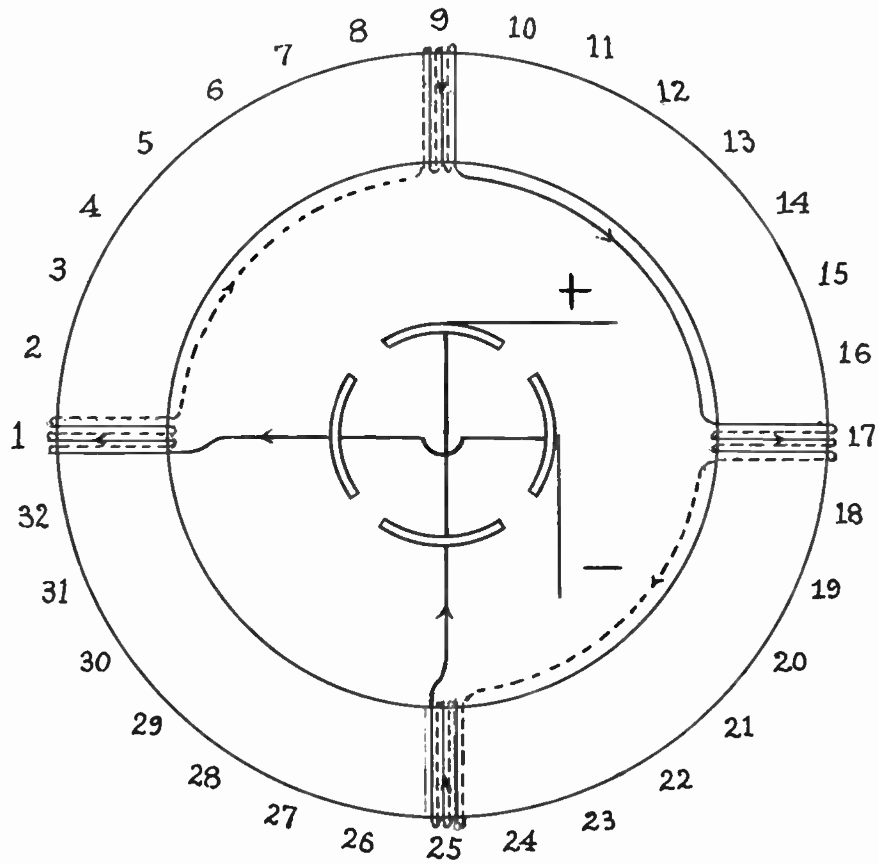


Fig. 6. Scheme of Winding a Ring Armature with Coils in Series for Use with Four-pole Field-magnet

active ones within. Arrow heads and the polarity of brushes are also consistently included.

Multipolar field-magnets can be imagined as equivalent to an assemblage of elementary machines, each with its two poles. When the multiple winding is specified, the conception is to be gained of a number of dynamos operating in multiple or parallel; the voltage of the set is determined by that of any one, while the current capacity is determined by their sum. Since it is also possible to connect these elementary dynamos in series, it ought to be similarly true for the multipolar armature winding. The case is no exception, and "series" wound armatures have very extended use. For ring cores, however, the practical accomplishment is so hampered by the numerous cross-connections, that it is not now often tried. With drums, there is no such limitation, and full explanation will be attempted in the next chapter.

One practical example of the series ring winding is furnished, though of the open-circuit type, as to be well worthy of mention. This is in the modern four-pole Brush arc dynamos, wound for upwards of 10,000 volts, though for currents of only 5 to 7 amperes.

The machine is really a development of the original double two-pole arrangement. In this, as will be gathered by reference to Chapter III of the Engineering series, the coils under opposite poles are connected in series with each other, rather than in the ordinary parallel manner. Each pair of coils terminates in a two-segment commutator, and the several groups are also connected in series, thereby resulting in giving a high total electromotive force. For a four-pole field, the same scheme is followed, and is fairly well shown in Fig. 6. While the commutator for each set apparently has four segments, the effect is really identical with two segments, for opposite ones are connected together.

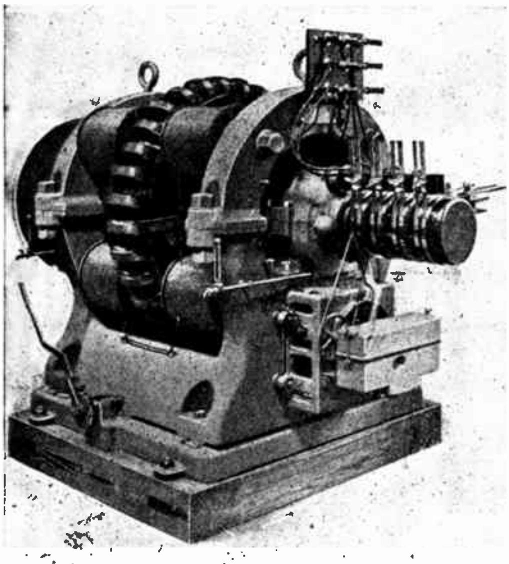


Fig. 7. Large Brush Arc Dynamo employing Winding shown in Fig. 6

Imagining the current to start at the negative brush, it will pass through coil 1, lying, say, under a double north pole, then pass by the wire shown by a dotted line to coil 9, under south poles, then through coil 17, under the second set of north poles, then through coil 25 under the second set of south poles, and then to the other segment of the commutator. The directions taken around the successive coils are correctly represented, for the electromotive force induced in coil 1 will be in the same direction as in 17, but in the opposite direction to that in coils 9 and 25. Regarding outer ends as going to the segments, inner ends will join 1 and 9, 17 and 25, but outer ends join 9 and 17. If current from an exterior source be sent through the winding, poles will be produced in the iron of the armature core, similar to an ordinary multipolar field-magnet. The next set of coils consists of 5, 13, 21, and 29; its commutator is associated with the one just mentioned, so that the middle of one set of segments is just beside the gaps in the other; the brushes belonging to these two commutators are clamped in the same holder. A second pair of commutators belongs to coils 2, 10, 18, and 26, for one set, and to coils 6, 14, 22, and 30, for the other; the third consists of 3, 11, 19, 27, and 7, 15, 23, 31; the fourth of 4, 12, 20, 28, and 8, 16, 24, and 32. The result is that twenty-eight out of the total thirty-two coils are successively in use, so joined as to give the highest possible electromotive force. A view of a complete machine is given in Fig. 7. In its entirety it represents a remarkable assemblage of principles, embodied into a highly specialized structure limited to the one branch of series arc lighting. Taken in connection with Chapter III of the Engineering series, a reader ought to be able to secure an accurate idea of the peculiarities of this class of dynamo machinery.

In the actual construction of ring armatures, especially those for high voltages, considerable caution must be used in insulating the interior portions of the core. The outer corners, too, where the supporting spider terminates, require careful covering, a good rule in every case being not to let the edge of the insulation be too close, but to bend the cloth into or over all such places. On the outer surface of a smooth core, where the insulating is easiest, it can be thinnest, thereby minimizing the air gap. Toothed ring armatures obviously are exempt from this consideration.

The reader may be interested to apply some of the theoretical principles to the examination of an actual armature, and for this purpose a small one is shown in Fig. 8, being suitable for a ½ kilowatt generator or ½ h. p. motor.

The dimensions employed are 4¾ inches in outside diameter, 3 inches in inside, and 3⅛ inches in axial length of laminations. With an air gap of ⅛ inch over the smooth core, the bipolar field-magnet can readily supply 400,000 lines of force, and with speed between 1800 and 2400 revolutions per minute, the various conditions of the winding and the use of the machine will be complied with. For convenience of holding the finer wires in place during the winding, fiber pegs are shown inserted into saw cuts in the brass heads, similar to the method employed with smooth drum cores. For coarse wires they are not particularly needed. The interior of the core is shown divided into eight equal spaces to match those on the exterior; the walls shown separately at *a* and *b* can be made of leather board or thin fiber, the unoccupied ones during the process of winding being temporarily filled with strips of wood.

In winding, it is well to measure the probable length required for one coil, to cut off a length of wire to exceed that with a reasonable margin, and then to begin the coil with the center of the wire. Two persons are essential for convenience and reliability, and

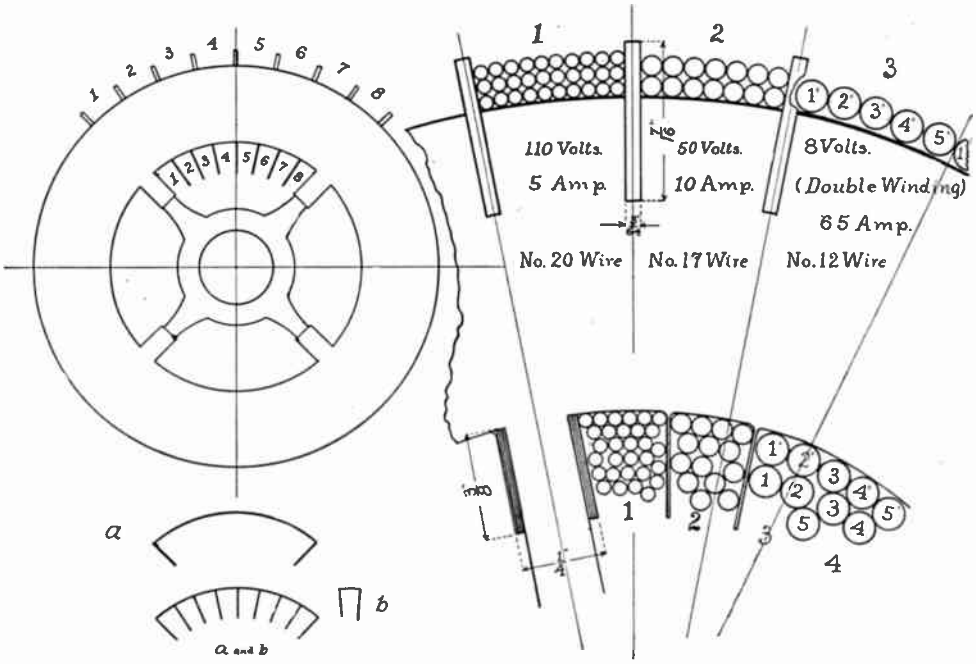


Fig. 8. Diagrams of Ring Windings for Small Dynamo

when finished both ends of the coil will be from the outer layer. Temporarily twist these ends together, and proceed with another coil. Finally, when connecting to the commutator, all the wires coming from inside the core are soldered first, then with a suitable advance to give the progression through the successive coils, the outer ends are attached.

For 110 volts thirty turns per coil are needed, and the largest wire that can be gotten into the space is No. 20; ten turns per layer, and three layers form the arrangement. For 50 volts fourteen turns suffice, and seven turns per layer, with two layers of No. 17 wire practically fill the same space. For a plating dynamo for only eight volts, special provision must be made. It is seen that the smallest number of turns will be secured when there is only a single layer of wire; this can be of No. 12 size, and will allow five turns per coil, and if the proportion holds, the result should be about 16 volts. To halve this value the expedient of winding two parallel and independent circuits must be employed. The entire space will thus be filled, but with only half as many turns in series; twice as many amperes will be available as a single winding could supply, but at half the voltage. The wires could be carried along together, using, alternately, two and three turns per segment, with the result of soldering four ends to each. A better method is that shown, in which the two windings are quite insulated from each other. With the thirty-two spaces and thirty-two commutator segments, imagine every other space and segment skipped, the remainder being occupied with a complete winding; then let the intervening spaces and segments be occupied by an exactly similar winding. The brushes would need to be thick enough to bridge across three segments, but sparking at the commutator would be lessened, or indeed eliminated, for now to hold a spark two insulations must be jumped instead of only one, as in the ordinary case.

Finally, let the rule be applied for finding the ohmic resistance of the different windings. The average length of one turn of wire may be taken as 11 inches. Thirty turns then require 330 inches or 28 feet; the total thirty-two coils require 900 feet. No. 20 wire has a resistance of 10.5 ohms per 1000 feet, but the resistance of the wire as wound upon the armature is not the 9.45 ohms resulting from this simple proportion; it is only one quarter as much, or 2.4 ohms. If 5 amperes is a safe allowable output for the armature, 12 volts will consequently be wasted in overcoming this resistance, or about eleven per cent of the total electromotive force. For the 50-volt case the total length of wire will be 416 feet, with a resistance of 2.2 ohms, but as grouped upon the armature only .54 ohm; at 10 amperes' output there will be .54 of a volt lost, or eleven per cent as before. For the low voltage case, the length of wire for each winding will be 74 feet, with a resistance for the simple wire of .12 ohm, or as wound, of .031 ohm; taken in parallel with another similar winding, the resistance will be halved, or only .0155 ohm. At 65 amperes' output the loss will be 1 volt, or not far from the same eleven per cent.

One fact should not escape observation, that in winding the same size of armature for various voltages, the wire for the higher voltage will occupy the more room. One reason is that the insulation is of about the same thickness on small wires as on large, and the accumulation of several layers becomes appreciable. Then again, the higher voltages require greater insulation from the iron core. The relative spaces occupied by the wire are brought out in the figure.

WIRELESS TELEGRAPH STATIONS IN BALTIMORE

THE wireless telegraph "mania" has reached a high state of development in the Monumental City, the majority of amateurs using the latest methods of tuned systems.

The ages of these amateurs vary greatly, the youngest being under fifteen years, while the oldest — well, that cuts no figure, but he is at least forty-five years young.

The development of this art was primarily in the hands of certain employees of the C. & P. Telephone Company, who advanced from the filings coherer stage to the tuned circuit and detector degrees in leaps and bounds. They, in turn, have started others, until at least thirty different wireless enthusiasts have excellent receiving and transmitting stations.

Among the best equipments are those of Mr. F. T. Iddings, the "Father of Wireless" in Baltimore; that of Mr. Harry Kirwan, of West Arlington; Mr. Robert N. Adams' station in Walbrook; and the station of W. C. Getz on Fulton Avenue, Baltimore. These were the original four in Baltimore wireless development.

The recent experimenters in this field, who have made notable records for the short time that they have been "on the job," are Mr. Slade, who has an excellent station at the Marlborough Apartments; Mr. Henry, whose station competes fairly with those of the government; The Voltamp Manufacturing Company, who have introduced an innovation in mast construction, in shape of a mast built of pipe sections; and the station of Mr. Bosley Thomas on Carrollton Avenue.

The former as well as the latter experimenters owe a good deal of their success to the cooperation of Mr. Kelly, of the firm of Wm. A. Read & Co., who with Mr. Waddell formerly operated the De Forest station on the American Building of this city.

Judging from the past success of experiments, Baltimore will soon hold the enviable position of being the center of wireless development in the United States. This is but right, since it was in Baltimore that Professor Morse first successfully demonstrated wireless telegraphy, and had the first telegraph line between Baltimore and Washington.

THE ELECTRIC FURNACE has found a new field of application in the manufacture of glass. The electric furnace is peculiarly fitted for the production of heat in the glass industry, since it introduces no impurities in the shape of combustion products. Molten glass being an electrolyte lends itself readily to electric furnace methods. The first electric furnace for glass making was designed in Germany in 1882. It consisted essentially of a carbon crucible, open at the base and lined with a net of platinum wire. Into this the raw material was fed, being fused by the heat dropping through into refining vessels beneath. A recent type combines the arc and resistance principle of electric heating. In this the furnace consists of three parts: the upper an arc for melting the raw materials; the intermediate, the resistance furnace, in which a species of refinement takes place which the molten mass completely undergoes before it overflows into the lower receptacle.

PATENTS—Part II

A LECTURE DELIVERED BEFORE THE SCHENECTADY SECTION, A. I. E. E.

ALBERT G. DAVIS

THERE is another power in the Court, which is the so-called Preliminary Injunction, or Temporary Restraining Order. This injunction is the one so much talked of in labor difficulties nowadays. The theory is this: If a man had some right which was being assailed by an irresponsible person, or if some irreparable damage was threatened, the Court might issue a preliminary injunction to keep things in their original condition until the right could be definitely ascertained. Take, for instance, the case where a man owned an estate merely for life (a circumstance which was common in England), and some one else was alive who was entitled to that estate at his death; and the tenant for life on this estate committed waste — cut down the ancestral shade trees, or dug mines in places where it was against the rule to dig mines — doing something to impair the value of the property, the Court would issue an injunction to prevent him from doing it. Or assume the case where a man is wrongfully in possession and the owner is suing for the property, and the person in control proceeds to commit waste. He knows that he will be thrown out eventually, and thinks he will get what he can out of it and turn it into money. If this happens, the Courts issue writs of temporary injunction, preventing this from being done, and maintaining the *status quo* until the case is settled. Our temporary injunction in patent suits is based on this. We say we have a good, strong, valid patent, and that we have invested money in this business; and here comes an irresponsible person who is competing with us, lowering our prices, selling an inferior article and spoiling our reputation, and so on. On that basis, we sue him. I have already said it may take a year or two to get a suit settled; so we petition the court for a temporary injunction, preventing him from further depredations and maintaining the *status quo*. These are sometimes granted, but ordinarily only when the patent has been sustained in another suit.

To obtain a patent an application is prepared, containing a petition, specification, drawings and claims, and an oath. The petition is respectfully addressed to the Commissioner of Patents. The inventor makes the statement that he is sole and true inventor, etc. These papers, together with $15, are deposited in the Patent Office and given a number — called the Serial Number, which is the application number, not the patent number — and are referred to an Examining Division. There are some forty odd examining divisions, some having to do with the electrical arts, some with the various mechanical arts, etc. Each of these divisions has a Chief and five or six assistants called Assistant Examiners. These are mostly young men, college graduates. They read the application through very carefully, see if it conforms with the law, if the drawing shows the invention properly, etc. And then they look at the claims, study each claim by itself separately, and see if every combination claimed in that case is new. Ordinarily they do not find them all to be new. They then write a letter to the applicant or his attorney, criticizing the drawing, perhaps, and stating that the applicant forgot to sign his name; that the ink is pale; that such and such a word is spelled wrongly in the specification; that the description is not full and complete so that they can understand it, etc.; that claim one is rejected on such and such a patent, such and such a publication, and so on. The attorney reads this letter, gets out his references, and tries to see wherein the invention is not described fully or is anticipated. He often finds that he made his claim too broad. He writes a letter back to the Patent Office in which he may modify or erase some claims, and may respectfully set forth his reasons for insisting that some of these claims are not met. And so goes the correspondence between the attorney and the Patent Office, which correspondence sometimes extends over a period of several years. The law only requires an attorney to answer a letter from the Patent Office within one year after it is written, but he must answer the letter fully and advance the case each time. Finally, the Examiner will have reduced the claims to a point which he considers proper, and the case goes out of the Examining Division, and the inventor receives notice of allowance. He is given six months in which to pay the final fee of $20, and the patent is then issued.

It does not always go as smoothly as that. Sometimes the attorney and Examiner disagree, and in that case there is a system of appeals which can be carried to certain courts in the District of Columbia; but the ordinary applications go through, as I have said. You will see the importance of having a good lawyer to draw the application, a man who knows something about the art and invention. I do not know of any other branch of the law which requires the ability that is needed to draw a really good patent application. It is an exceedingly difficult document to draw, and requires a man who is a great deal of a lawyer, a great deal of an inventor, and a prophet — for he must look ahead. Usually the inventor does not know what he has invented; he has not put it in its proper place in the art. The inventor ordinarily sees only one side of it, and it is the unusual thing for a case to be properly drawn. You might go to the very best patent lawyer in this country with an invention, and, I say, it would be the unusual thing to find out years afterward, when the patent was subjected to the test of courts, that it had been really well drawn — you will generally see where it could have been drawn better.

It occasionally happens that two, three, or four men invent the same thing at about the same time, and my chief in the Patent Office years ago, would jocosely advance the theory that there were "invention microbes" going around biting people to make them invent things, and if the same microbe bit two different people they invented the same thing! Some such theory almost seems necessary to account for the enormous number of cases where the same thing is invented by different people at about the same time. When two or more applications are pending in the Patent Office simultaneously, claiming or trying to claim the same invention, the office institutes Interference Proceedings to find out which is the first inventor. A certain official in the Patent Office, called the Examiner of Interferences, decides which of these is entitled to the invention, and from his decision an appeal may be had to other tribunals, and the proceeding is long and expensive.

In such a proceeding, the first question is as to who first reduced the invention to practice; that is, who first put the thing in practical form. It is not merely, or mainly, who filed the application first (although the filing of the application is regarded as equivalent to putting the invention in practical form), but the question is, who first reduced the thing to practice. Broadly speaking, he is the inventor, unless the other party to the interference can show that he was the first to see it in his mind in practical form, — to have a definite conception of the invention — and that he was using due diligence at the time the other party was making the invention. This means that if you make an invention, put it on paper, get witnesses, and do nothing else; and if somebody else subsequently makes the invention and files his application before you file your application, or builds the machine and runs it before you file your application, he is the first inventor. He is the inventor unless you show that at the time he came into the field, you were using reasonable diligence in perfecting that invention. In other words, you cannot sleep on your invention. In our practical experience it has happened that a man would come in with a sketch which he had had several years, asking us to get a patent and telling us that some other company was putting it out, although he was the inventor. He had made the sketch and filed it away. It would, obviously, be an injustice if we could, with that old piece of paper, take the invention away from the man who gave it to the world.

I have heard a man say that the average inventor is too secretive. His idea was that if a man makes an invention he should tell everybody about it — put it in the newspapers. That advice is not always good, but the Courts have ruled that no man can prove his invention simply by his own testimony. Even after a patent is issued, a man can take away that patent from a patentee, or rather get a new patent for himself, by showing that he is a prior inventor and that he was using reasonable diligence; unless he is barred by Sec. 4886, Revised Statutes, as by two years' public use, etc. Usually, then, a patent can be taken away on a proper showing that the patent was not issued to the really first inventor; therefore, it is necessary that a man should have his proofs in proper form. In the documents intended as proof of invention, the thing should be fully described. We want a man to write a good, specific letter, and have it witnessed by two or three witnesses — we want our proofs. We can then follow the thing up and put it through. The secretive inventor who is afraid to tell of his invention is always taking the chance of some one else, some independent inventor more communicative than he, taking his invention away from him.

Many employers require that inventions

made by employees along the employer's line of work shall belong to the employer. This rule is enforced by contract in many cases. With the General Electric Company it is a rule, whether a contract exists or not. This policy has been criticized by inexperienced men and by men unaccustomed to inventions; but as a rule, it has not been criticized by men who have made important inventions; such men have recognized that it is necessary, and eminently fair and proper.

In my experience it is rare for an invention to spring complete from one mind. It is ordinarily worked up through a long and painful process involving considerable expenditure of time and money. Of course one man, or one set of men, will take the last step, will devise the actual thing which goes into use, will make the suggestion which finally makes the device operative and successful. This man or group of men will necessarily have to make the patent application, but much of the real credit may well belong to others.

I do not suppose any question would be raised if we made a practice of keeping our various processes of manufacture secret, as an employer is ordinarily supposed to have the right to do; and I presume that an inventor, who under these circumstances devised a secret process and saw it put into use under his instructions in our works, would consider himself bound to keep the secret when he left us. Now, in a concern as large as the General Electric Company, it has been found practically impossible to keep secrets, and it is, in general, the policy of the Company to try to obtain through the patent law that protection which it cannot obtain by secrets. The only way in which this can be done is, of course, to have the inventor execute a patent application and assign it to the Company.

It should also be remembered that patents are not granted for every form of original work; in fact they protect only a limited range of inventive skill and effort. The man who lays out a great power transmission, carefully choosing the number of phases and voltages, arrangements of apparatus and circuits with reference to peculiar conditions; the man who designs a great generating station to meet the circumstances existing in some particular city or railway; the man who devises a scheme of financing, or who conceives a new idea in connection with the sale of our apparatus; all these men use their minds and use them in a highly creditable way, and sometimes the amount of ability and even genius required for such work is almost infinitely greater than that required to make the ordinary mechanical invention. None of these efforts are capable of protection by the patent system, so that the employee gets from them no benefit except the recognition of his skill and diligence, which the Company ought to give him, and which the Company tries to give every employee who does good work in its behalf. Why should the man whose mind happens to run in the direction of that limited class of original work capable of protection by the patent laws be treated in any different way?

And so it is the policy of the Company to enforce the rule which we have mentioned above, and to endeavor as far as it can, to recognize good work in any form, inventive or non-inventive; the good work of the mechanic, foreman, superintendent, or manager; the good work of the draftsman who lays out designs in such a way that the machine will properly fulfil the function for which it was intended, who puts enough material here and not too much material there; the good work of the commercial man; the good work of the clerk; the good work of every man who, in his sphere of action, does something for the benefit of the Company. That particular class of effort which leads to patents on inventions is somewhat more tangible, somewhat more easily recognized than any other class, and for that reason my experience shows me that it has been in general recognized, if anything, in more than its proportion to its deserts.

In closing this branch of the talk I can only say to those few who criticize or object to our system, that I would like to have them sit down and work out a policy on which they would run an organization of the size and complexity of the General Electric Company, which should be based on any other principle; to consider whether they would dare to assemble together thousands of good men from all over the world and to lead them into the very inside secrets of the business of the Company; to put them in a position where they are capable of making little improvements or big improvements; to put them in touch with the vital problems of the art years before the average inventor ever hears of such problems, without enforcing some such practice.

Now I suppose in considering any question, any system, any institution, it is worth while to stop and see if it is a good thing. No system is perfect, and no system is free from disadvantages, one of which in the Patent system may be the amount of money that it has cost. There have been taken out in this country about 800,000 patents. If we assume that these cost $100 apiece, we get $80,000,000 for the cost of taking out these patents. If we assume $1000 apiece to cover time of the inventor, experiments, etc., the sum becomes enormous. Another objection to the patent system is that it can be used as a vehicle of oppression. I suppose there is no power which cannot be used for evil. It has been said, and said doubtless with some measure of truth, that some great corporations sometimes oppress small corporations by filing patent suits against them without good cause, and this has been done — there is no question about that. I do not think, however, that it is a common practice. Where this is done once, a corporation is oppressed, pestered, and harassed a hundred times by the dishonest claims of fake inventors. However, the patent system has built up the interests of this country. No man, no corporation, nothing except the government could afford to run our research laboratory unless the patent system existed to protect the result of the work. The history of the steam turbine is a history of pouring hundreds of thousands of dollars into its development, and now the patent system of the United States is the thing on which we depend to help us to get our money back. The world at large is richer for the gift of this new prime mover, and the people who had the courage to put their money into it will find that the patent system will make it easier to get their money back. I think the same principle can be applied to all industries in which great sums of money have been spent, relying on the patent system for returns. Inventors, men of courage, perhaps men of poverty, sacrifice, work, and struggle along year after year, and at last bring out an invention; and the patent system has given them their encouragement and brought them their reward. And such a system as that is one which should be criticized in the spirit of benevolence, rather than in the spirit of destruction. — *General Electric Review.*

WOODPECKERS DESTROY TELEPHONE AND TELEGRAPH POLES

Birds are destroying the telephone and telegraph poles in the south and southwest, particularly in Texas, Arizona, and California. In some places fifty per cent of all the poles along the right-of-way have been riddled by these innocent offenders, which belong to the woodpecker family.

One of the Western Union officials, who has recently returned from an inspection through the west, reported having seen twenty-five telephone poles with two or three hundred holes drilled clear through them. Some of the holes were three or four inches in diameter.

An officer of the Illinois Central Railroad counted the white cedar telephone poles along the right-of-way near Covington, Tenn., which had been affected by woodpeckers, and found that out of two hundred and sixty-eight poles, one hundred and ten, or forty-one per cent, had been bored.

In some cases destruction of the pole takes only a few months, and the weakened condition makes it dangerous for a lineman to climb the stick.

The real object of the birds in drilling the holes is uncertain. One telephone man said that the humming of the wires was mistaken by the birds for insects excavating beneath the surface of the wood, and that they drilled the poles in quest of these imaginary insects. It is very probable, however, that the holes are excavated for an entirely different purpose. The woodpecker is a provident bird. At the proper season it stores up a supply of acorns and other foods for future consumption. In the summer, these holes are often found stored with acorns.

Many methods for preventing this damage have been suggested, but probably the most successful is preservation with creosote. A line of creosoted poles, opposite the one near Covington, was examined, and not a single hole was found. When it is considered that creosote will not only prevent the damage caused by the woodpecker, but also protect the pole indefinitely against both insects and decay, its great value as a preservative is apparent.

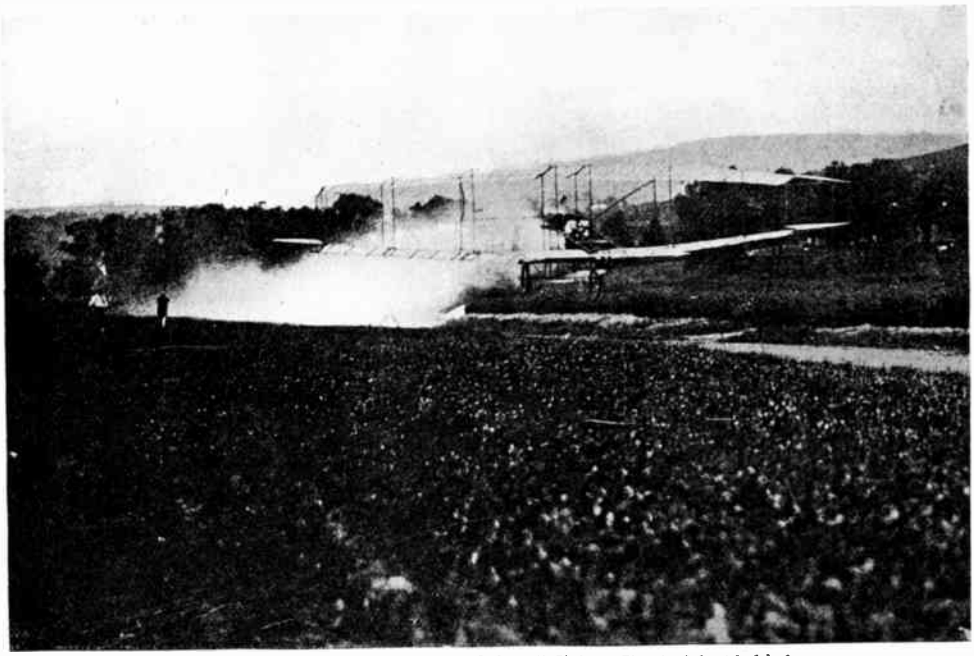
The Forest Service has spent considerable time in developing a cheap yet efficient method for the treatment of telephone and telegraph poles. The results of the work are embodied in several Forest Service circulars, copies of which may be obtained without cost from the Forester, Washington, D. C.

THE "JUNE BUG" AND ITS FLIGHTS

HARRY WILKIN PERRY

EFFORTS at flight with heavier-than-air machines which began at Hammondsport, N. Y., on March 18 last, with a flight machine called the "Red Wing," culminated on July 4 in the first successful flight of a kilometer in a straight line, publicly witnessed and officially timed, by the "June Bug." It is particularly pleasing to patriotic Americans that this flight, which was made especially for and succeeded in winning the International trophy presented for competition by the *Scientific American* to the Aero Club of America, should have been made on the National Independence Day. It shows that America is well abreast of France and other European countries in the development of the elusive yet alluring science of human flight, which has for centuries baffled the most studious and courageous investigators. It is now generally admitted even abroad that the United States leads the world in the development of the aeroplane through the efforts of the Wright brothers.

With a view to dispelling the growing impression that America was losing ground in this field of endeavor and of encouraging other inventors and experimenters, the Aerial Experiment Association was formed by Dr. Alexander Graham Bell, Lieutenant T. E. Selfridge, Glenn H. Curtiss, Captain F. W. Baldwin, and several other original students of aviation, to build airships and fly them publicly where all who cared to might look on and inspect the machines. These men believe that the most rapid progress in the development of successful flight machines can be made by a free interchange of knowledge and experience among students of the problem. Up to July 4 they had built and flown three aeroplanes. The first was the "Red Wing," which made a flight of three hundred and eighteen feet over the ice of Lake Keuka, at Hammondsport, on March 18, but was afterward wrecked by losing its balance and falling upon the ice. The "White Wing" was then built along the same lines as its predecessor and fitted with bicycle wheels. In its first trial on May 19 it flew two hundred and seventy-nine feet at an elevation of about ten feet from the ground, and again on May 22 it made a flight of more than one thousand feet, rising to a vertical distance of twenty-five feet and traveling at an average rate of thirty-six and one half



The "June Bug," Aerodrome, No. 3, in full flight. Cloud of dust behind

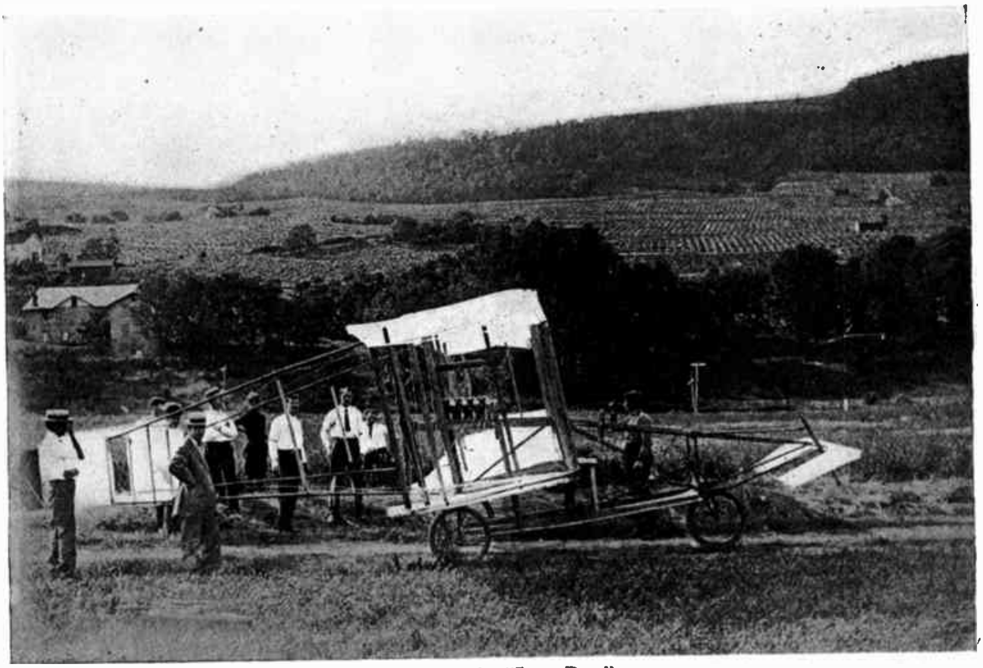
miles an hour. This machine was badly damaged by dashing to the ground when, in a later attempt, it was operated by a different member of the Association.

The "June Bug" was then quickly built and several trial flights were made with it on June 21, when in its maiden flight it traveled four hundred and fifty-six feet at a speed of twenty-eight miles an hour, and in its third ascent covered a distance of one thousand two hundred and sixty-six feet in twenty-five seconds, or at a rate of thirty-four and one half miles an hour. Four days later it was again taken out and on a second attempt driven three thousand four hundred and twenty feet in just sixty seconds before several hundred spectators, the flight being voluntarily brought to an end to avoid trees and a fence that surrounded the grounds and threatened damage because the height attained was only twenty-three feet. This performance was considered remarkable by the experts present, as it was only the seventh flight of the machine and the eighth made by the aviator, Glenn H. Curtiss. In order to cover such a distance within the grounds used by the experimenters it was necessary to fly in the arc of a circle, which required the perfect operation of the controls and engine. The success is attributed also in large measure to the revarnishing of the cloth of the planes to prevent passage of air through the fabric. Three failures of the machine to rise into the air on the day following its maiden flight were due, it was said, to the varnish being affected by excessive heat, leaving the cloth porous so that the air passed through.

Following the flight on June 25, which exceeded the kilometer by one hundred and thirty-eight feet, the officers of the Aero Club of America in New York were notified of the intention to make an official attempt for the $2000 trophy offered as a prize to the builder of the first heavier-than-air machine to fly one kilometer in a straight line before proper witnesses and timers.

On the evening of July 4, following a day of thunder showers, the first trial was made at six o'clock when the "June Bug" or Aerodrome No. 3 rose quickly into the air to a height of ten or twelve feet and, moving at a rate of thirty-five miles an hour, was steered to avoid a vineyard and sweep over a field of oats. It then settled down easily in a high grass without damage, but about one thousand feet short of the kilometer. It was pushed back to the starting-point and some adjustments made to the tail, which had been given too much of a downward inclination. Just as the sun went down at seven o'clock the aerodrome was started on its second and prize-winning flight. It left the ground sooner than was expected, two hundred and thirty-six feet before it reached the line marked for the start, and followed the same course as before, gliding with perfect equilibrium at a height of about twenty feet. Dropping slightly, it passed directly over the kilometer post, but, instead of alighting at once, flew on for about fifteen hundred feet farther in a sweeping curve, and descended easily in a meadow in which the hay had just been cut. The time of the flight was forty-two and one half seconds, and the distance covered fully a mile. Charles E. Manley, formerly assistant to the late Professor S. P. Langley, and Stanley Y. Beach, representative of the Aero Club of America, supervised and timed the trial, which was witnessed also by the following members of the Aero Club: A. M. Herring (one of the successful bidders for the construction of a heavier-than-air flying machine for the U. S. Army), Captain F. W. Baldwin (who is a veteran aeronaut), Alan R. Hawley, Augustus Post, E. L. Jones, and others.

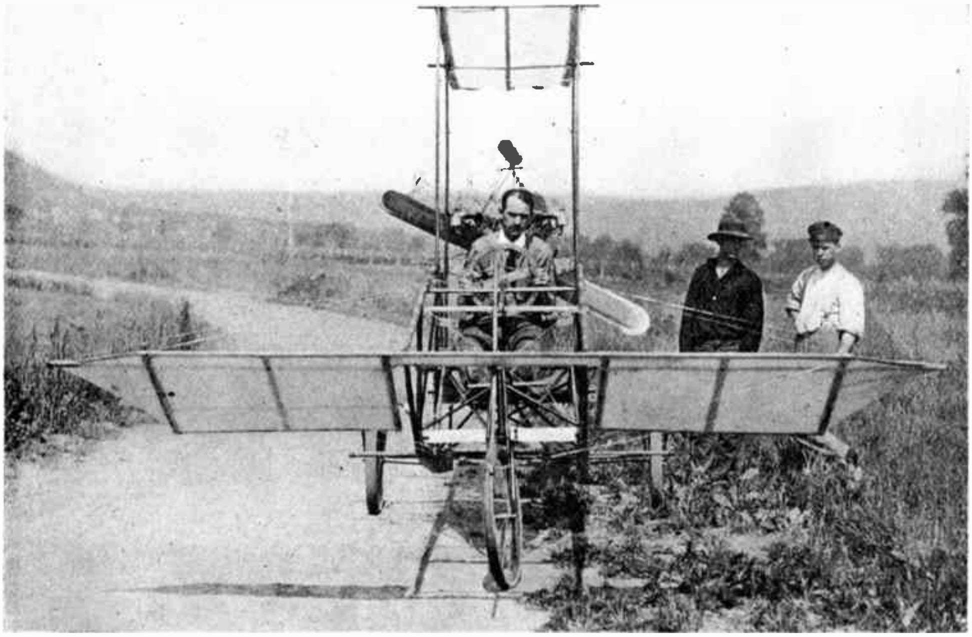
The "June Bug," which thus became the winner of the International Trophy, is, like nearly all of the heavier-than-air machines that have made really successful flights, of the double plane type. It differs in several important respects from other aeroplanes, such as the Wright brothers', Farman's and Delagrange's, as in having the "wings" made easily removable from the central framework carrying the operating mechanism and the aviator, and having the wings curved toward each other and tapered toward the ends. The central framework is of steel tubing and wood and is supported on the ground by three small bicycle wheels, of which the front one is used for steering. The weight of the flying machine, with its wings and tail, is nearly balanced over the rear wheels, but the operator sits well forward on a wooden seat in the middle of the tricycle frame. Over the under side of this frame is stretched fabric to assist the aeroplanes in supporting the weight. A similar strip of fabric is stretched at the top of the steel framework overhead. Almost in the center, directly over the rear axle and at the back of the aviator is the engine that furnishes the power for propul-



Side View of the "June Bug"

sion. It is a 40 h. p., air-cooled Curtiss gasoline engine, having eight cylinders set at an angle of 45° to one another, but with a common crank-shaft, as in the Curtiss 40 h. p. motorcycle that covered a mile in twenty-six and two fifths seconds on the sea beach at Ormond, Fla., in January, 1907. To the rear end of the crank-shaft is attached a two-bladed, six-foot propeller having wooden blades protected with metal along the edges. A frame of bamboo poles extending well forward supports the horizontal rudder used for ascending and descending. This rudder consists of a light frame covered with light cloth. It is pivoted at the apex of the bamboo frame on either side, and the cloth is cut away at the center so that the frame will not interfere with its movements. In the center, at right angles to the plane of the rudder, is a stick, to the ends of which the corners of the rudder are guyed with steel wire to strengthen it. The position of the rudder is regulated by this stick, which is pivoted near its upper end to a rod that extends backward to meet the end of the steering wheel post. A simple push or pull on the wheel alters the angle of the rudder. The steering wheel is grooved around its periphery and steel cables pass around it, through pulleys on either side and thence to the end of a tiller that guides the front bicycle wheel when running on the ground.

This complete running gear and frame — chassis, it is called in automobile parlance — has been driven at a speed of forty-five miles an hour on the ground. When flight in the air is to be attempted, the wings are attached on either side and a tail at the rear. The wings are not flat, but are curved upwardly along the front portion and downwardly along the rear portion. The material of the wings is nainsook stretched over a light wood frame and varnished. They are spaced apart by vertical rods and trussed stiffly in all directions by wires. At the extreme end of each wing is a triangular tip pivoted horizontally along its front edge, so that the rear corner can be moved up and down. It is by means of these movable tips that the equilibrium of the machine is maintained when turning and when air currents vary the pressure at different points of the wings. Wires attached to the movable corners of the tips pass through pulleys and to the operator's body, so that the instinctive leaning away from the side that begins dropping will depress the tips on that side, and by presenting more resistance to the air, tend to raise it, while simultaneously the tips on the opposite side are raised and the pressure reduced, allowing that side to drop correspondingly.



Showing Horizontal Rudder in Front and Propeller Blade in the Rear. G. H. Curtiss, Aviator

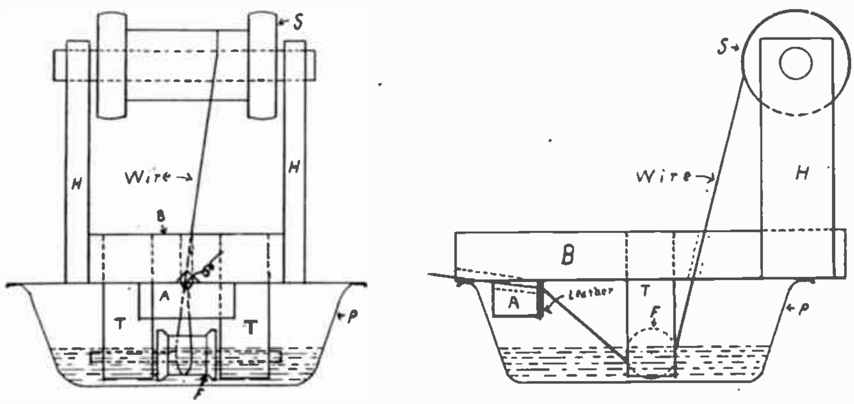
The "June Bug" is notable for the small size of its "tail" and the nearness of tail to the main portion. The tail is of box kite form, about half as deep and one quarter as wide as the aerodrome, and having the same general shape, the upper and lower planes curving slightly toward each other at the ends. This tail is supported at the ends of four bamboo poles extending rearwardly from vertical bars in the aerodrome proper, and serves the purpose of preserving fore and aft balance of the machine. At the rear of the tail, in the center, is a small vertical rudder, by which the course of the machine is directed to right or left, cables running from either side forward to the aviator.

From the foregoing it will be seen that the aviator, in addition to starting and stopping the engine, must steer the machine when running on the ground, must manipulate the horizontal front rudder to cause it to rise and descend, must move his body to adjust the wing tips to every movement of the aerodrome out of a straight and level course, and move the vertical rear rudder to swing to right or left to avoid obstacles or make a circuit at will. As a flight of a mile lasts less than two minutes from the starting of the engine to the alighting of the aeroplane, it may be guessed that the operator must be clear-headed and quick to act. Movements of the air are most uncertain, and when moving at nearly forty miles an hour at a height of from twelve to twenty feet from the ground, a delay of a second or two in correcting any tendency to drop at one end or to shoot downward or upward, may result in the wrecking of the machine and injury of the aviator. In one flight, when the tail was adjusted at an improper angle, the machine continued to rise too fast, despite efforts to keep it on a level course by means of the front rudder, so Mr. Curtiss left his seat and crawled out on the frame to bring his weight farther forward, thus causing it to descend until he could alight with it. The danger in thus displacing so great a weight when in motion is evident to any one.

Complete, the "June Bug" weighs about 430 pounds, and has supporting surfaces aggregating more than 400 square feet. From tip to tip of wings it measures 42 feet 6 inches. About 250 pounds' thrust is developed by the propeller when the engine is turning 1200 revolutions per minute and developing about 25 h. p. The motor is supported on a pair of horizontal wood bars bolted to the uprights of main frame and has a carbureter at the head of each cylinder — eight in all — supplied with fuel from a cylindrical, pointed gasoline tank supported in a strap-iron cradle directly above the engine. The engine has free exhausts, and the fly-wheel is very light, with wire spokes and a thin rim.

When in the air the "June Bug" has a stately motion that is deceptive as to speed. When moving at thirty-five miles an hour it seems to be going only twenty, since there are no near-by objects by which to estimate the rate. The exhausts are rapid, but not very loud. In rising from the roadway it leaves a cloud of dust, and a trail of blue smoke from the exhaust hangs in the air behind it.

The "June Bug" was designed by Lieutenant Selfridge, who was assigned by the United States Army to assist in the experiments of the Association. The funds for the work have all been advanced by Dr. and Mrs. Alexander Graham Bell. Dr. Bell is best known as inventor of the Bell telephone, but has given considerable study during recent years to the tetrahedral kite with a view to the adaptation of the principle to human flight.



HOW TO PARAFFIN WIRE

RAY HIGGINS

The following are notes on how to make an apparatus with which one can conveniently and easily paraffin wire, and as needed. It is simple, and can be easily made in a few minutes.

First procure the pan you intend to use for the purpose; one fourth gallon pan will be large enough.

The details of the construction are given in the diagram, in which P is the pan; B is the base of 1-inch pine; S is the spool of wire supported near one end of the base by nailing on the standards H and H; F is a spool, with narrow flanges, supported near the bottom of the pan by the standards T and T. These may be made of two short pieces of a roller fitted into holes bored in the base; A is a block of 1-inch pine with a piece of leather tacked on one side. Four nails should be driven in the base just outside of the edge of the pan to keep it from sliding off the pan.

Now, first having bored a hole in the base between the two spools, pass the wire through this hole, under the spool into the paraffin, then through a small hole in the leather and a notch in the block A, and a notch between the base and the pan. Now tie a string around the wire between the leather and the paraffin, making the knots so that they will not pull through the hole in the leather. This makes the wire smooth, and by making the string tighter or looser you can regulate the thickness of the paraffin.

Place the paraffin on the stove; when the paraffin is melted, pull out the wire as needed. To keep the pan from sliding, place a flatiron or some other weight on it.

INDUCTION COILS FOR WIRELESS TELEGRAPHY

R. P. HOWGRAVE-GRAHAM

THE amateur who is interested in wireless telegraphy will do well to make a careful study of Mr. Delves-Broughton's most interesting and valuable article published in the August issue. It gave me great pleasure to see the design of induction coils or transformers for wireless telegraphy treated in such a masterly and bold manner. Mr. Delves-Broughton has gone straight to the root of the matter, and no one who has experimented with wireless telegraphy at all can fail to appreciate the importance of obtaining a thorough grasp of the requirements of this particular branch of work. Such a grasp is shown in this article, and it should prove a death blow to the obstinate determination of many amateurs to spend much unnecessary time, money, and worry over buying or making coils giving long sparks when they are only for use in wireless telegraphy.

At the same time, the amateur should remember that such coils as Mr. Delves-Broughton describes are the worst possible type for radiators of small capacity, and are only an improvement for large capacity aerials in distance working. A hot fat spark is a great *disadvantage* where the capacity is small.

There are one or two other points which I should like to put before amateurs in this connection, and I hope that Mr. Delves-Broughton will pardon the intrusion into his grounds.

The amateur will always be apt to meet with contradictions and puzzles until he gets quite a clear conception of the difference between quantity and current. One can no more speak of the quantity of the current flowing than one can, in connection with a river, speak of the number of gallons of the rate of flow.

If one wanted to specify the rate of flow of a river it would be useless to say it was 1000 gallons: 1000 gallons where? A thousand gallons per yard, or per mile of length? A moment's thought will show that rate of flow must include the dimension of time. We would speak of a stream as having a rate of flow of 1000 gallons per minute or per second, which, in precise language, would mean that in every minute or second 1000 gallons flowed past the point in question. In fact, rate of flow = quantity divided by time.

In electrical work the current is nothing but the *rate of flow* or the number of units of electrical quantity (coulombs) which pass any point in the circuit during a second. Quantity may be entirely dissociated from any idea of current. A quantity of electricity, or, strictly speaking, an equivalent storage of energy by di-electric strain, can stand motionless in between the coatings of a Leyden jar, and is then static; but on joining the coatings by a wire, a flow takes place and the quantity stored passes round the circuit, manifesting itself as a current until the circuit is in equilibrium. Now what I want to emphasize is that the value of this current will depend on the nature of the discharge circuit, while the quantity which passes is fixed beforehand by the capacity of the jar and the potential difference to which its coatings are raised.

If the jar discharges through a long, wet thread, the current will be small and the quantity stored will take some time to get out; but if the circuit is of copper, there will be a strong current lasting for a very short time. If the right conditions are provided, this current will overshoot the mark and reverse the charge of the jars, producing oscillation; but this is another story. The great point is that the quantity is, in the simple case, fixed, and the average value of the current is the quantity divided by the time occupied by its motion. Let us now see precisely what is required of the secondary of a coil for "wireless." To begin with, the aerial must be charged to a potential sufficient to produce a spark at least a centimetre in length. As it is well to have a considerable margin to get certainty and regularity of discharge, we may design the coil to give 2-inch spark, as Mr. Delves-Broughton suggests. Furthermore, at each break of contact the *quantity* which the secondary coil can force into the aerial must be sufficient to raise it to the required potential, and the loss of voltage due to the flow of this quantity through the secondary must not be sufficient to lower the potential beyond a certain point. Mr. Delves-Broughton is, therefore, wise in designing for a 2-inch spark; and if everything is arranged to give the fattest spark possible, it simply means that the secondary is capable of supplying sufficient quantity to raise the capacity of the particular aerial used to the necessary potential, with sufficient margin to counteract irregularity and leakage.

The confusion between quantity and current is well illustrated in the Linesman's Detectors of commerce. These often have three terminals — the center one common; and the outers marked with the absurd symbols Q and I, meaning "quantity" and "intensity." The terminals marked Q go to a thick winding, and are, therefore, most suitable for indicating comparatively large currents at low voltages. The "intensity" coil is of high resistance, and is, therefore, suitable for small currents at comparatively high voltages.

After the above explanations it is hardly necessary to point out the absurdity of the symbol Q. The only ordinary instruments which measure quantity are the ballistic galvanometer and the quantometer, used for the measurement of magnetic flux.

Again, Mr. Delves-Broughton says that it is a question of the total number of watts produced by the secondary. The watt is a measure of the *rate of doing work*, while our concern in charging an aerial is the total amount of *energy* supplied to the aerial. *Energy* is rate of doing work multiplied by *time* during which work is done. Thus, if we wanted the most finally correct and scientific way of describing the operation of a given secondary coil with a given aerial, we should give the total amount of energy supplied to the aerial and the voltage to which that energy raised it. This energy could be expressed in watt-hours or in watt-seconds or kilowatt-seconds, or ergs.

Calculations of such values are very difficult, and clear thought as to their meaning is highly necessary.

The following instance may make my meaning clearer.

A 10-inch spark coil with continuous current and contact-breaker charges a set of jars, which I use for oscillatory experiments, to a certain voltage, which represents a certain energy storage. When I substitute an alternate current supply, I obtain a flaming arc from the secondary instead of a long spark; this arc, though it can be drawn out to 2 or 3 inches when once formed, will only jump $\frac{3}{4}$ inch of air space, and the voltage is therefore not very high.

Yet when connected to the jars, it is capable of charging them to a higher potential than before (once in every half wave), and therefore the coil supplies more energy per spark than it did before.

The watts, which can only be considered as having a definite value at any one given moment, or an average value over a given time, are probably much higher for a small fraction of a second at the break of the continuous circuit than they are at any moment when the supply is alternating.

Nevertheless the *energy* is more with the latter, simply because the active time is longer. All the time during which the alternating wave is rising to its maximum value energy is being stored in the jars and the total energy is the product of the average value of the watts and the time during which the energy is supplied.

With the make and break the momentary value of the power in watts is very large, but the time is so short that the energy is actually less than it is with the more gradual alternating current.

If we wanted to produce the maximum mechanical energy-storage in a strong spring we could do it more effectually by a gradual application of hand pressure than by a sharp blow with a light hammer; the rate of doing work would be greater at the moment when the hammer struck the spring, than at any moment during the application of the steady pressure of the hand.

The static energy stored in an aerial is equal to the quantity of electricity stored multiplied by the voltage to which the aerial is raised.

The dynamic energy conveyed by a current in a given time is equal to the quantity which passes during that time multiplied by the volts.

Now the quantity which passes is equal to average current multiplied by time, and the average watts equal average volts multiplied by average current. Therefore, the energy also equals average watts multiplied by the time during which the power is supplied.

The latter statements are only other ways of expressing what has gone before.

One other point arising from Mr. Delves-Broughton's article is in connection with his remarks about closed magnetic circuits. I do not think that there would really be any serious difficulty about insulating a closed circuit induction coil of such low voltage as Mr. Delves-Broughton's; at any rate, there is a far more important reason for using the plain straight cores which are usually employed.

It is well known that a closed magnetic circuit has considerable power of retaining magnetism when the magnetizing force has been entirely removed. The residual magnetism left in the core of a closed circuit spark coil is so great that the total flux change (to which the induction in the secondary is proportional) is less at the moment of breaking contact than it is when the magnetic circuit is open and can retain only a small residual flux. These remarks are solely intended to save the amateur any trouble which might arise from misconceptions as to the principles involved. and they in no way detract from the great value and originality of Mr. Delves-Broughton's article. —*The Model Engineer.*

HOW TO MAKE A CHOKE COIL

W. E. TURNER

THERE are many inquiries appearing in the Question and Answer section of electrical papers regarding rheostats and choke coils for alternating current, hand-feed arcs for picture machines, so perhaps a description of a choke coil I made a short time ago will prove interesting to a great many who own or operate picture machines.

A choke coil made as described below will generate practically no heat in the operating room, the heat all appearing in the lamps, where it is most useful.

But let no one so far forget himself as to try to use it on a direct current circuit, for its resistance is so low that it would cause a rush of current that would blow the service fuses.

Get some stove-pipe iron from a tinner and have him cut it in strips 3 inches wide and 24 inches long, making enough strips to weigh 10 pounds. Take about one third of the strips and cut them in half, making them 3 x 12 inches.

Dip the strips in thin varnish, and when dry bunch them together with half the short strips on each side of the long ones, as shown in the illustration.

Bind the iron tightly together and tape 4 inches at the middle with cotton or friction tape; then take 4 pounds No. 12 cotton-covered magnet wire and wind the taped part of the core, using two wires in parallel, or, in other words, double the wire before winding on the core. When one layer is complete as far as the tape goes, cover it with a strip of heavy paper and wind another layer on top of the first one; go on in this manner until all the wire is on, but leave a couple of loops in the last layer to adjust the current with.

Tape the coil carefully, and then bend the ends of the strips back over the coil, taking the strips alternately from first one end, then the other, and let the ends overlap on top of the coil, dividing the strip equally on each side of the coil.

When this is done, the whole thing should be bolted together tightly between two pieces of iron to prevent its humming.

This coil should be placed in an iron box and covered with oil or grease and the leads should be brought out through properly bushed holes and connected in the circuit the same as a rheostat.

The lamp will consume about 50 amperes with this coil in circuit, and give a good steady light, provided everything else is in good order.

EXPLANATION OF THE UNIT OF ELECTRICAL RESISTANCE. — The unit of resistance in electrical calculations is the ohm, which is equal to the resistance of a column of mercury 1 square millimeter in area, 106 centimeters in height, the standard measurement being taken at a temperature of 32° F. As in most other cases, every country has a standard of its own. The international ohm is an effort to establish a common standard. The two most often referred to besides the international are the British and the Siemens. Taking the international ohm as unity or 1, the British would be 1.0136 and the Siemens 1.0630. Then to reduce British ohms to international ohms, multiply them by .9866. It will be seen that to reduce international ohms to British they would have to be multiplied by 1.0136.

Do not worry; eat three square meals a day; say your prayers; be courteous to your creditors; keep your digestion good; exercise; go slow and go easy. Maybe there are other things that your special case requires to make you happy, but, my friend, these I reckon will give you a good lift. — ABRAHAM LINCOLN.

A SIMPLE CLOCK SYSTEM

ETHAN VIALL

The plan of using a master clock and a number of secondaries is becoming almost universal in large factories where clocks showing different time in various departments would be confusing.

The accompanying cuts illustrate the mechanism and operation of a set of master and secondary clocks, known as the Hight system, which is the simplest I know of. Figures I and II are top and side views, respectively, of the mechanism of the master clock.

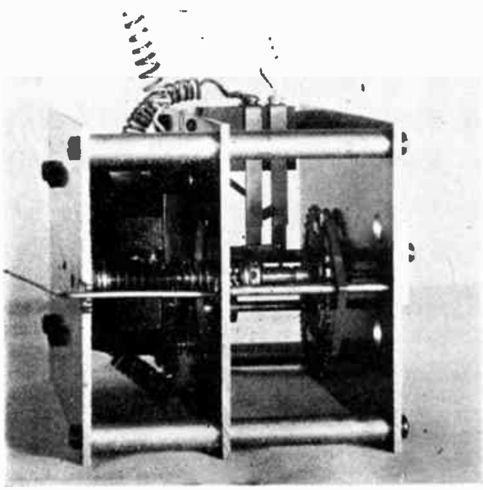


Fig. I

Referring to Fig. II, the escapement which gives the necessary impulse to the pendulum is actuated by the light coil spring A shown in the upper part of works.

This is given two turns to start with, and the escapement wheel, making one full turn, unwinds this spring one turn each minute. In revolving, the loop B is lifted by means of the pin C, and as soon as this loop passes over the center it drops down and completes the electric circuit running over wires E and F. This causes the motor to revolve and wind spring A one turn, and the motor also, by means of lever D, pushes loop B off the points of contact, breaking the circuit and stopping the motor. Thus it will be seen spring A always has at least one turn tension on it.

The pushing off of the loop B by the lever D gives a quick, wiping contact, and also takes away any strain on the spring A, so

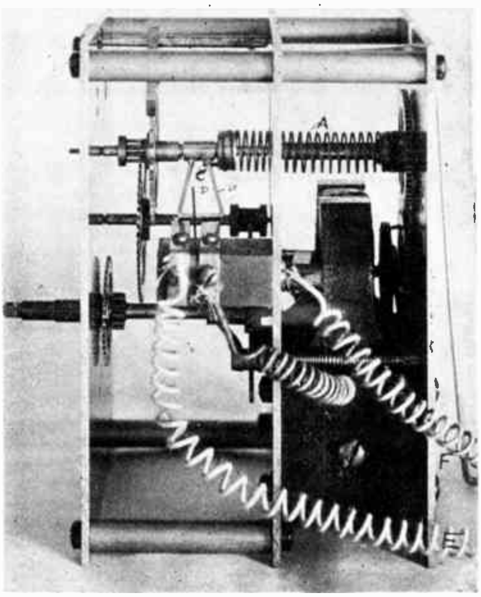


Fig. II

that all this spring does is to lift the loose loop B and to run escapement and hand train, the latter requiring very little power by reason of the leverage obtained by the application of the spring to the escapement wheel.

Figure III shows all there is to the mechanism of the secondary clock, which registers in hours and minutes only.

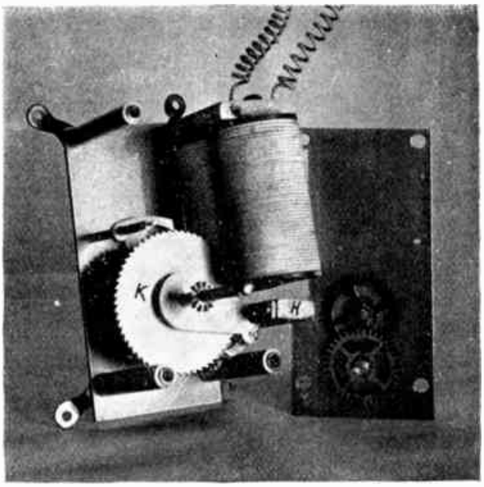


Fig. III

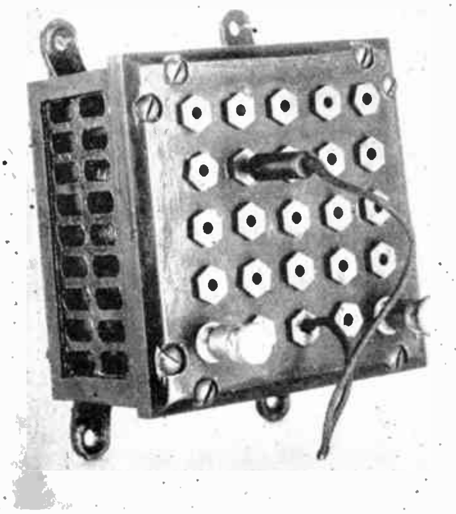


Fig. IV

As the loop B on the master clock drops down, the current which actuates the motor also passes through the coils of the secondary, excites the magnet, and draws up the weighted arm H, which is held up until the motor of the master clock breaks the circuit by pushing off the loop B. The weight of the arm H causes it to drop down, indexing the ratchet wheel K one notch. This wheel has sixty notches and is connected to a regular train shown on plate at the right, and as it moves one notch the minute hand is moved one space.

One great point in favor of this clock is the perfect insulation of the electrical connections. About two cells of ordinary dry battery are required for each clock; that is, a master and two secondary clocks would require six cells.

Where a number of clocks are on a circuit where one or more are liable to be cut out or put in, as on a renting system, a resistance system like Fig. IV is used. In this each clock added would need the pin moved ahead one hole — the cut shows seven on the circuit.

Figure V shows the form of motor used in the clock. This is also used for a toy motor, and it cannot be stopped in any certain position with the current on. I mean by this that most motors can be caused to remain stationary with full current on by holding or placing the armature in certain positions, but this motor will start as soon as one lets go, no matter what the position of the armature. The accuracy of the master clock and hence of the entire secondary system, depends greatly on the accurate adjustment of the pendulum on the master clock.

Any number of secondaries may be operated at once, and it is a great convenience to have all the clocks in the different factory departments exactly alike.

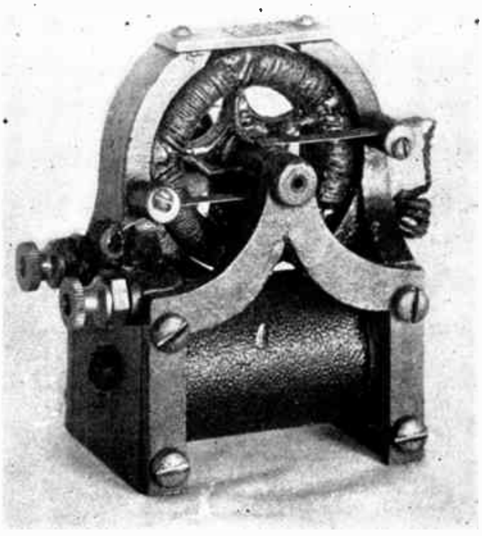


Fig. V

WATER power will work for part of the people all of the time; the wind mill, the horse and the steam engine will work for all of the people a part of the time; but the only thing that will work for all of the people all of the time is a gas engine.

The only time anybody gets fooled is when they won't give the gas engine a chance to show what it can do, and the only part of the people that gets fooled all of the time are the fellows who insist on doing things by hand "because grandfather did it that way."

RADIOACTIVITY

PROF. OTTO N. WITT

THE world has recently been surprised by and deeply interested in some discoveries in the domain of the fundamental principles of the constitution of matter. The reliability of the source from which these discoveries come as well as their startling nature have excited universal interest, and several scientists, notwithstanding the incompleteness of the reports thus far published, have taken up the subject and discussed it; among others Prof. Otto N. Witt of the Technical High School, Charlottenburg, Berlin. The following is a synopsis of an article by him:—

Lord Rayleigh, working in conjunction with Sir William Ramsay, discovered by a series of ingenious investigations a new constituent of the air, namely, argon. Lord Rayleigh then turned his attention to other physical problems, while Ramsay continued to work in the domain of chemical science.

The suggestion, coming from various sources, that argon was probably the same as one of the two elements helium or coronium, discovered by Lockyer years before by means of the spectroscope in the sun's atmosphere, was not verified.

Rayleigh, however, by careful study of the substances resulting from the liquefaction of air, found still other gases with new qualities. These were the elements neon, crypton, and xenon. In regard to the solar element coronium, we are still in doubt, but helium has been found in a number of minerals, most abundantly in the rare Norwegian cleveite. It has also been found in the gases of many mineral springs, and to-day, although still a very expensive substance, helium is really an article of commerce with which many investigators are experimenting.

All these substances, that is, argon, neon, crypton, xenon, and helium, have in common the property of being chemically inactive. All efforts to cause them to enter into chemical combinations have failed; they appear to have no chemical affinity for other substances, and it is assumed that their molecules do not, as other elementary gases, consist of two atoms combined, but are merely free atoms.

The explanations of these phenomena resulting from an investigation of the subject were surprising, not only by their own nature, but also with reference to the direction from which they came. As is well known, Becquerel in Paris had called attention to the fact that certain minerals, particularly pitchblende (uranium oxide), for example, send out peculiar rays, similar in many respects to the so-called cathode rays or Roentgen rays. This suggestion led his pupils, M. Curie and his wife, to follow up the subject, which led to the discovery of the radioactive elements radium, actinium, polonium, radiothorium, and radiotellurium. The rays of all these substances, exactly as in the case of the cathode rays and the Roentgen rays, were soon recognized as rays of a material nature. We had to admit that they were different from light and electricity, the rays of which, according to the Maxwell theory, we interpret as vibrations of the ether in space.

The new rays which science had brought to light consisted of particles of matter hurled with incredible force and velocity. But these particles proved so infinitely small that the mass which was assigned to them was an extremely small fraction of what we had been accustomed up to that time to regard as the mass of an atom, or the smallest possible part of matter.

This led to the promulgation of the electron theory, that is, to the assumption that the atoms themselves were compounded of ever so many smaller primitive atoms, and that the latter are the real basis of all matter. The electron theory was subsequently expanded by Oliver Lodge and numberless other investigators; and we see in it to-day the beginning of an entirely new foundation for the investigation of nature. It may be remarked in passing that the renowned English physicist, Lord Kelvin, has recently opposed this theory.

It was at the fifth International Congress for Applied Chemistry in Berlin, in 1903, that Sir William Crookes, the real founder of modern ray investigation, dared to announce for the first time on record that the radioactive elements are nothing but elements in a state of breaking down, in a condition of dissolution into original or primitive matter.

The elements of the greatest atomic weights are the ones that become radioactive and throw off the inconceivably small material particles of the electrons, which we may compare with the primitive nebulous matter. This material thus thrown off has been called by Rutherford emanation in radioactivity. What was required to make the analogy to cosmogenetic phenomena complete was the direct observation of the aggregation of the particles of the emanation (corresponding to the primitive nebula) to new elements of smaller atomic weights. This lacking element of the series it is to which the investigations of Sir William Ramsay relate.

As early as 1903 Ramsay and Soddy had found that the emanation from radium gradually changes to helium. This observation, which attracted immense attention at the time, and which in conjunction with Ramsay's previous investigations in this domain gained for him the Nobel prize, gave us at once an answer to the question above propounded as to the origin of helium.

Helium in all probability does not originally exist at all in cleveite and its other sources from which it can be produced; but the radioactive elements therein contained give out constant emanations, and these change gradually into helium.

By the agglomeration of the electrons of which the emanation is composed, to helium atoms, immense quantities of energy become free. This explains the source of the energy given off so constantly from radium preparations, which seemed so incomprehensible in the early days of radium investigation.

The observations of Ramsay on the formation of helium have been verified by innumerable investigators in recent years. But in the meantime Ramsay has discovered that the emanation does not always aggregate to helium. In the presence of water the formation of helium is quite an insignificant part of the change, and the resulting gas is mostly neon. And if instead of water a saturated solution of copper salts is present, argon is formed. The origin of all the inactive elements must therefore be considered as satisfactorily explained.

But this is not all. The energy set free by the concentration or agglomeration of the particles of the emanation shows itself, when other substances are present, in other ways besides the production of heat. It has long been known that the glass of vessels in which radium preparations are preserved undergoes a radical alteration, becoming colored brown or blue, which is ascribed to an ionization (separation into ions or electrons) of the constituents of the glass. But when Ramsay offered solutions of copper salts for the emanations to act on, and thus prepared argon, the action of the energy liberated was exerted on the copper present. This was split up into its primitive constituents, and as the resulting electrons grouped themselves anew a new constituent appeared in the solution, which Ramsay was able to find and identify by spectroscopic means. This newly formed product was lithium, besides which were found sodium and calcium.

But since the two last named elements are exceptionally widely distributed, and are, moreover, constituents of the glass vessels in which the experiments had to be conducted, Ramsay does not dare to assert that these metals were newly formed out of the emanation. But as far as the lithium is concerned, on the other hand, this appears to have been the case, because this metal is so extremely rare that an accidental occurrence of it in this experiment could hardly have been possible.

By the very latest experiments of Ramsay it has apparently been shown that not only can the inactive elements be built up out of the material constituents of the emanations, but that under the influence of the energy contained in the emanations even the old and well-known elements, highly susceptible of chemical reactions, like copper, can be converted into others just as well known. The transmutation of the elements, and particularly the transmutation of the metals, has thus become a fact.

We all know the spell that lies in the thought of the transmutation of the metals. For nearly a thousand years mankind has been striving toward the solution of this problem. To convert the base metals into gold was the aim, for hundreds of years, of the fruitless labors of the alchemists. Modern times have, under the influence of the sway of the atomic theory, declared the accomplishment of this purpose to be unattainable and the idea absurd. There was a time when he who wanted to occupy himself with the problems of alchemy would have been declared insane.

In proportion, however, as our faith in the atomic theory as the final solution of the constitution of matter began to wane, we became more lenient toward the alchemists and their work, and there have been many publications in the past decade in which the aims of alchemy are pronounced by no means unattainable.

In justice to the atomic theory, however, it should be stated that its greatest and most advanced advocates have for many years past themselves suggested in an indirect way the possibility of the transmutation of the elements.

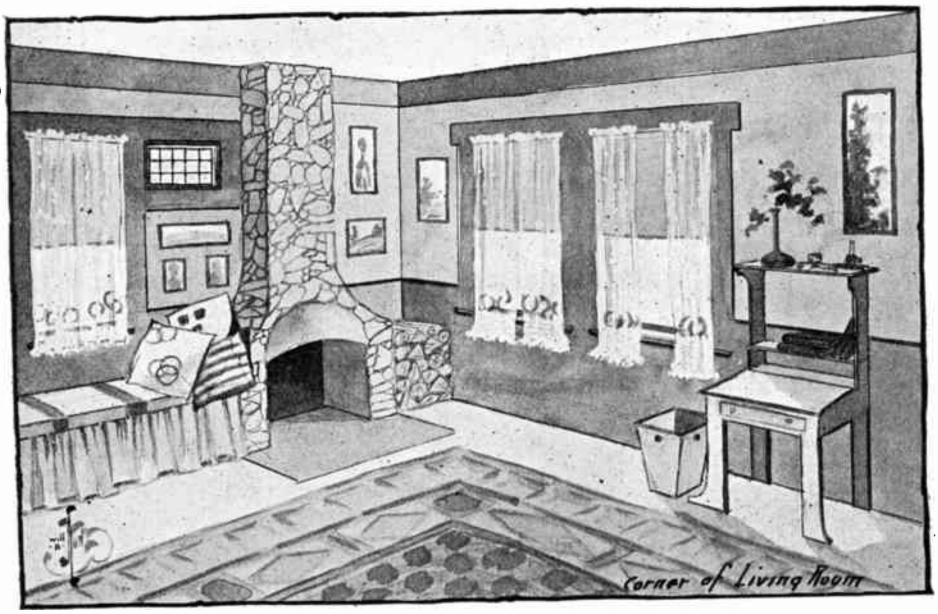
BUILDING CRAFT

A DEPARTMENT FOR WOOD WORKERS

Devoted to the interest of Home Furnishers

FURNISHING THE LIVING ROOM — Part IV

MABEL V. H. HUNT



THE LIVING ROOM

HAVING built the camp, the next thing is to furnish it, and perhaps it would be well to begin with the living room.

Finish the walls to a height of 3½ feet, with matched boards, either stained or simply varnished. Above this, tack burlap in its natural color. This may be simply joined, or it may be fastened by brass-headed tacks, thus paneling the burlap the width of the goods. If one prefers, the seams may be hidden by cleats of wood matching the wainscotting.

Next, the windows. Provide them with shades, of course, and those of dark green linen of good quality are cheapest, for although the first expense is considerable, a poor quality is far from durable, and nothing gives a room so dilapidated an appearance as cracked and faded shades.

For draperies, scrim, stenciled in conventional designs, is very dainty and practical. Scrim may be bought for fifteen cents per yard, and there are especially prepared dyes for the stenciling, which may be obtained at any art department. It may not be generally known that oil colors wash very satisfactorily in suds made of naphtha soap and luke-warm water, so that these may be used in place of dyes.

The fireplace, built of field stone set in cement is very attractive, and its beauty is further enhanced by brass andirons and fire screen, but as these are very expensive, there may be used, instead, plain black iron andirons, which are always in good taste.

A large black iron or brass hanging lamp with a fancy shade will go nicely with the fireplace accessories.

The window-seat admits of much originality of treatment. It may be left uncushioned, merely varnished or stained to match the woodwork; or it may be fitted with a cushion having a valance, or not, as one chooses.

Hunter's green denim or corduroy makes excellent coverings; so also do the various linens, cretonnes, crashes, and sateens sold at all upholstery departments. The plain, dark colors, however, soil less easily, and form a better contrast with the cushions, a good supply of which is desirable.

At certain seasons of the year uncovered sofa pillows may be had at greatly reduced prices, and at all times one may pick up remnants of tapestry and other upholsteries for very small sums. These make most attractive covers, and are often very rich looking.

One young couple of our acquaintance laughingly suggested that each week-end guest bring to camp a sofa pillow, which jesting remark many of their friends put into practice, glad to be able to add a touch of their own personality to the summer home where they were so hospitably entertained, as well as show their appreciation to their host and hostess.

Portières and couch covers may be made from fabrics similar to that of the window-seat cushion.

This being a summer home, not much furniture is required; a couch, table, bookcase, desk, and chairs being all the living room needs.

The floor, being oiled, is best without a carpet; a large art square, or several rugs, gives it a touch of home-likeness. A good-style cotton art square, suitable for summer use, may be purchased for $3, but one may pay whatever he chooses.

The most satisfactory couch is of the sliding iron variety, which may be separated into two single beds or drawn out into one of full size. These couches come provided with mattresses, and are both comfortable and durable. A good location for this couch is against the bedroom wall opposite the fireplace and seat.

The Mission Table described in the May issue of the ELECTRICIAN AND MECHANIC is suitable for a center table, and the bookcase designed for the June number will look well against the wall of the pantry.

A simple desk may be placed between the door and the windows, and it should be provided with blotters both large and small, an ink well of good black ink, pens and penholders, pencils, scribbling blocks, calendar pad, stamp box, sealing wax and taper, matches and stationery, bearing the name of the cottage, in simple design.

A waste paper basket may be made to harmonize with the room's color scheme, cut into shape from cardboard, the sections covered with cretonne or denim and tied with ribbon. If one desires, wall paper may be used for covering.

For wall decoration, unless one has plenty of pictures, he may passe-partout some of the many beautiful magazine covers, or to be more individual, he may tint some of his own snapshots,—almost every one owns a camera these days.

Failing the knack of doing either of these things, very pretty little pictures already passe-partouted are easily obtained at prices ranging from ten cents, upwards.

These make very effective decorations, the burlap being an excellent background.

Two plain, firm, mission rockers with leather seats, two standard willow chairs of good dimensions, and perhaps a child's rocker and a cricket or two, are all the seats necessary. If one has no children, the little rocker may seem superfluous, but put it in — you are likely to have small guests, and visiting in a grown-up's house is not always an unalloyed pleasure to a child.

A POINTER FOR THOSE WHO USE ELECTRIC CURRENT METERS. — It is claimed that a meter placed in a position where it is exposed to considerable jarring, will register an amount of current in excess of that passing through. The moral is to place the meter where it will not be shaken.

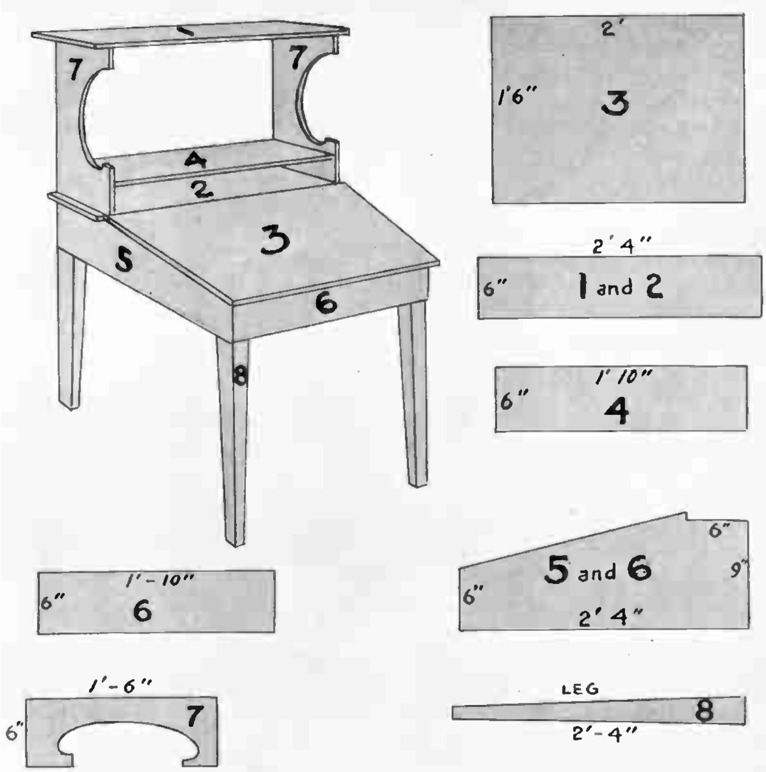
FROSTED BULBS POOR LIGHTERS. — So long as the carbon filaments are used there will be a fine deposit of carbon inside the bulb; and this, together with whatever dust may collect on the outside, increases the tendency of the rays of light to be reflected inside the bulb and be absorbed by the frosted glass. With the new metallic filaments it is claimed that all internal deposit is avoided. The tungsten filament, for instance, is subjected to so high a temperature in the process of manufacture that all its impurities are said to be driven off.

MISSION FURNITURE

DRAWINGS · AND · TEXT · BY
Will · B · Hunt 2nd

DESK

THAT APPEARS IN LIVINGROOM.



THE INDIVIDUALITY OF THE DESK

MABEL V. H. HUNT

In the article concerning the furnishing of the living room of the camp, you will notice that a desk is mentioned as one of the necessities for comfort.

For all people who profess any educational bent, a desk is a foregone conclusion when enumerating their needs in the line of household equipment. Whether it be simple or elaborate, inexpensive or costly, hand-made or machine-turned, its usefulness is apparent. In its fittings and care its owner's mental development is pictured to the observant eye of the world. This, of course, taken in conjunction with his books.

We are advocating strongly, in this Building Craft series, the making of a *personal* home, whether it be a summer camp or a permanent residence. We believe, we know, that one's individuality may be stamped upon his furniture and its arrangement as well as upon his clothing.

We have spoken in a previous edition of the bookcase and its position in determining one's standing, but we do not forget that the bookcase is, in a measure, collective. Here are grouped the favorites of the whole family, and perhaps, in addition, those of frequent guests. The gift, and the book picked up at random to while away time during a tedious journey, often stand side by side with one's own belongings, and in all probability, in their close neighborhood are rarely used text-books. This does not apply to the well-ordered library of the collector so much as to that of the average householder of to-day.

When, then, is the chance to show individuality? The answer is, "In the desk," and, were it practicable, we should advise one for each member of the family, with an extra one for transients.

A glance, and he who runs may read: —

There is the business man's desk; he who lives by rule and deviates not therefrom save in case of extraordinary event. The prosperous man he is, because of his precepts, and the smooth polish of the mahogany reflects the pigeonholes filled with orderly files of letters and memoranda, carefully sorted, banded, and labeled. He is the man who uses the card system, though he knows exactly where to look for any wanted note without reference, but who has in his mind his employees and puts himself under as strict rules as are they.

There is the oak desk of the man who is overworked. It is loaded with high masses of letters and orders, — a cleanly disarray sending forth the thought, "I'd like to clear this up if there were time." He does find opportunity occasionally, during a brief quiet period, but soon again the stress of life makes his efforts appear *nil.*

There is the desk of the man who has an artistic temperament. It is nearly hidden from view by stacks of magazines and clippings, not very different, save in subject, from those of his counterpart, the literary man. Sketches lie here and there, photos and tubes of paint, dishes of water colors and brushes, letters of criticism and appreciation, invitations and bills, until he, too, takes a day to "clear up" from sheer necessity, not choice, for he cherishes each atom of what seems to the uninitiated an inharmonious whole.

The women? Oh, yes! they also have desks.

You see that one with the dried grasses in vases and the workbasket for ornament? That belongs to the very busy mother who has always had so much of the Martha's part in life that her desk must needs be simply the receptacle for all the odds and ends which require a place of safe keeping.

Not its original use? No. But do not blame this woman; her lot in life is in a different sphere, but she is not less noble than the society favorite whose colonial desk with its rich note paper and its costly appointments give us a glimpse of the opposite side of life.

Then there is the desk of the average woman of the middle class, well stocked with such necessary things as appeal to good taste and the moderately filled purse, the blotter showing evidence of many letters of friendship and courtesy, and, by that same token, requiring frequent renewals.

This is the desk which most frequently has a secret drawer where lie the ashes of roses of girlhood, — mementos to be seen only by the owner's eyes, and by hers but seldom; in the hush of a summer's twilight, perhaps, or in the fanciful firelight while winter howls without; memories, sad or glad, which have no place in everyday life.

Here is the schoolgirl's desk with its snap-shots and souvenirs, its themes and basket-ball scores; its girlish effusions to kindred spirits, the usual offerings to the poetic muse, — and the inevitable dish of fudge.

Here is a different type, that of the sojourner in a strange land. This is extemporized from boards and built into a corner, from whence the traveler sends delightful letters of description, touched here and there with pathos and with humor, filled with her personality and with loving thoughts for those in the dear home land, whose familiar scenes are depicted in the many views which help to hide the primitive structure of the desk.

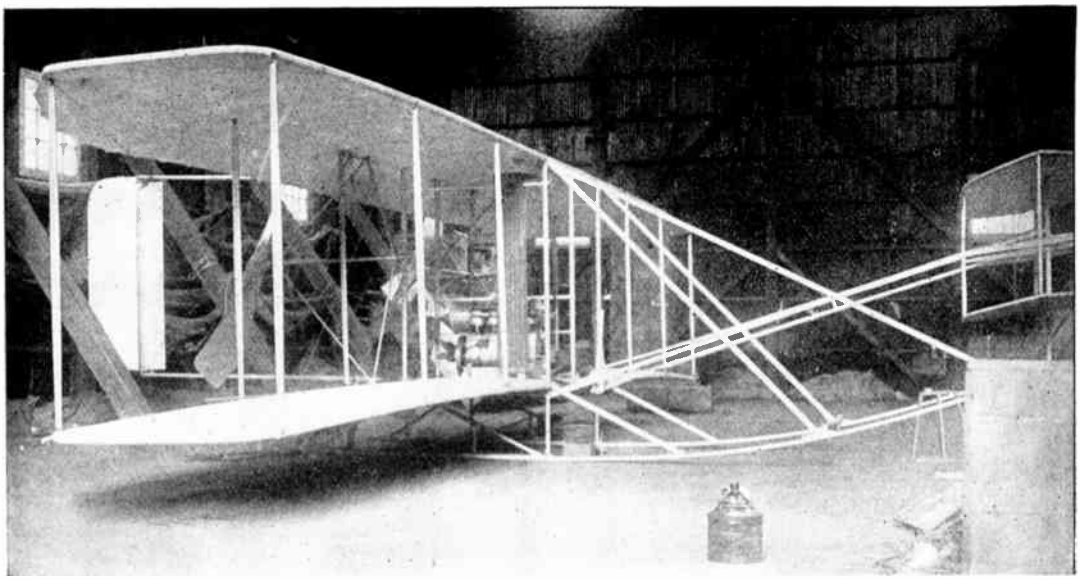
We pass on to this flat-top with its neat line of books and its pile of brown papers. What is this? "Mary Brown, 95 per cent, "Peter Tompkins, 58 per cent." Why, this belongs to a teacher, to be sure, and instinctively we know the large, thin book is a geography, the smaller red one an arithmetic. A drop of moisture on the blotter? Never mind! She is tired to-night, poor girl, and Peter Tompkins's 58 per cent is not encouraging. Besides, the most interesting book of late fiction lies there with uncut leaves. She knows who sent it, and blesses the donor in her heart, but with Puritan will power ignores the tempting pages until the last paper bears its correction mark and special work is prepared for the unsuspecting Peter's to-morrow.

To whom does this desk belong? It groans 'neath the weight of manuscript and envelopes marked "Printer's Proof and Copy." Oh! She is a writer of magazine articles. No, indeed, she doesn't write at that desk,—there is seldom room,—she generally clears a space on the end of the table and utilizes that. This is the girl who appreciates the man with the artistic temperament.

You think this desk too small for service? But glance at its contents and you will find proof to the contrary. Do you see the scholar's companion, an old valentine or two, the long division examples? And that book is "Child Life," Book IV. Now you know the owner is the ten-year-old daughter of the household.

This desk was made from the design shown in the accompanying sketch, built on a smaller scale, stained green, unpolished. It was a Christmas gift to the little maid, who thoroughly enjoys it.

And this brings us to this month's delineation, which represents a design along simple lines, for the carrying out of which any light wood is suitable. Details concerning construction are purposely omitted that the builder may use his judgment in joining the parts and calculating the amount of lumber to be used.



WRIGHT'S AIRSHIP IN SHED AT FORT MYER, VA. *Courtesy of "Collier's"*

The Wright Aeroplane is here shown in the balloon shed in the Government reservation at Fort Myer, near Washington. This is the machine operated by Mr. Orville Wright in test flights before U. S. army officers. It is a duplicate of the one used by Mr. Wilbur Wright at Le Mans, France, except for a slightly different arrangement of steering levers and other minor differences.

MACHINE-SHOP PHOTOGRAPHY

PROF. F. W. PUTNAM

The photographic department of a modern machine or tool manufacturing plant is considered to be as important an adjunct to its successful operation as the tool or draughting room. Five years ago I was approached by several salesmen who desired to sell me various machines and tools which I needed to equip a manual training department. The salesman to whom I finally gave my order was able to interest me, first, because of his thorough knowledge of what his machines could do; second, because of his thorough knowledge of the details of the machines; and third, because of the splendidly illustrated catalogue and book of photographs which had been supplied by his firm.

Most manufacturers do not care to increase the scope of a photographic department beyond a simple record of their standard machines for the purpose, primarily, of furnishing photographs to intending purchasers. To minimize expense, an amateur (who may be one of the firm), a draughtsman, or possibly even one of the workmen in the shop, usually attends to the photographic work which may be required.

These photographs usually show the machine as it would appear to an observer standing in front of it. This general view of the assembled machine is in many cases sufficient. In some cases, however, the purchaser desires further information regarding other features which are not clearly shown in this general picture, so that other views must be made.

In photographing an engine lathe, for instance, I would suggest views of the cone head, showing its construction; the carriage and apron, with views showing its working parts; the taper attachments and tool blocks; as well as any other features which will prove to the purchaser that the machine in question is superior to that designed by some competitor.

Anticipate, as I have said before, what your customer will especially want to know about your machine, and then be ready to show him a good, clear photograph to answer his question.

These detail photographs should be placed in the hands of the firm's salesmen to be used by them only for the purpose of selling machines. I believe that nothing can influence or impress a prospective purchaser more than a carefully selected set of good photographs, showing a machine in all its working parts.

Photography can be used to advantage in the foundry, where a photograph taken in the process of molding some very complicated piece might prove of great value for future reference.

In the pattern room photographs are often made for records of patterns, especially complicated ones. Frequently patterns are sent some little distance to be cast, in which case photographic records would show just how the separate pieces went together, especially if each piece in the photograph had a number marked on it corresponding to the number on the pattern piece itself. These patterns are usually photographed on a small, inexpensive plate, and a print from each pattern made a part of the pattern record. Frequently a card index is used for a pattern record, the photograph being printed or pasted on the back of the record card, showing at a glance, even to a novice, the shapes and character of the pattern itself, thus aiding greatly in picking out this particular pattern in the storage loft when the occasion required it.

In the machine shop, photography is useful in showing the work in its various stages of development, making a picture record of a complicated machine from the time the first machinery was done to the final or completed machine all ready for shipment.

This would be desirable, particularly, in cases where some special methods and appliances had been used in connection with the work, concerning which a record would be valuable in case a similar problem should come up in future work.

The cuts illustrating this article were very kindly loaned the writer by the Oliver Machinery Company, one of the most progressive firms manufacturing wood-working machinery in this country.

Figure 1 is a perspective view of a variety saw table, and shows the boring attachment with which this machine is equipped and also the countershaft.

Figure 2 is a front view of a motor head speed lathe. This cut shows the bed fitted with hand feeding carriage and swivel rest.

Figure 3 shows a perspective of a drop table variety molder. Note how the adjustable belt tighteners are shown and also the

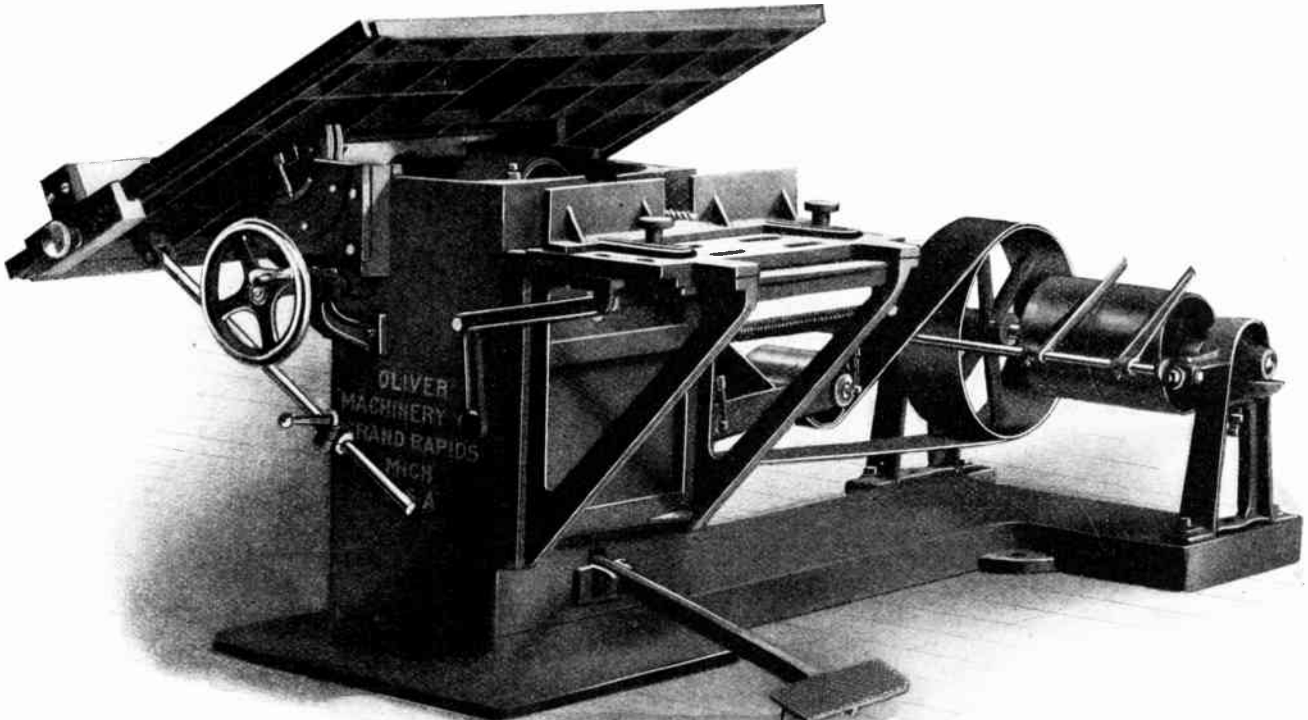


Fig. 1. A Variety Saw Table, showing Boring Attachment

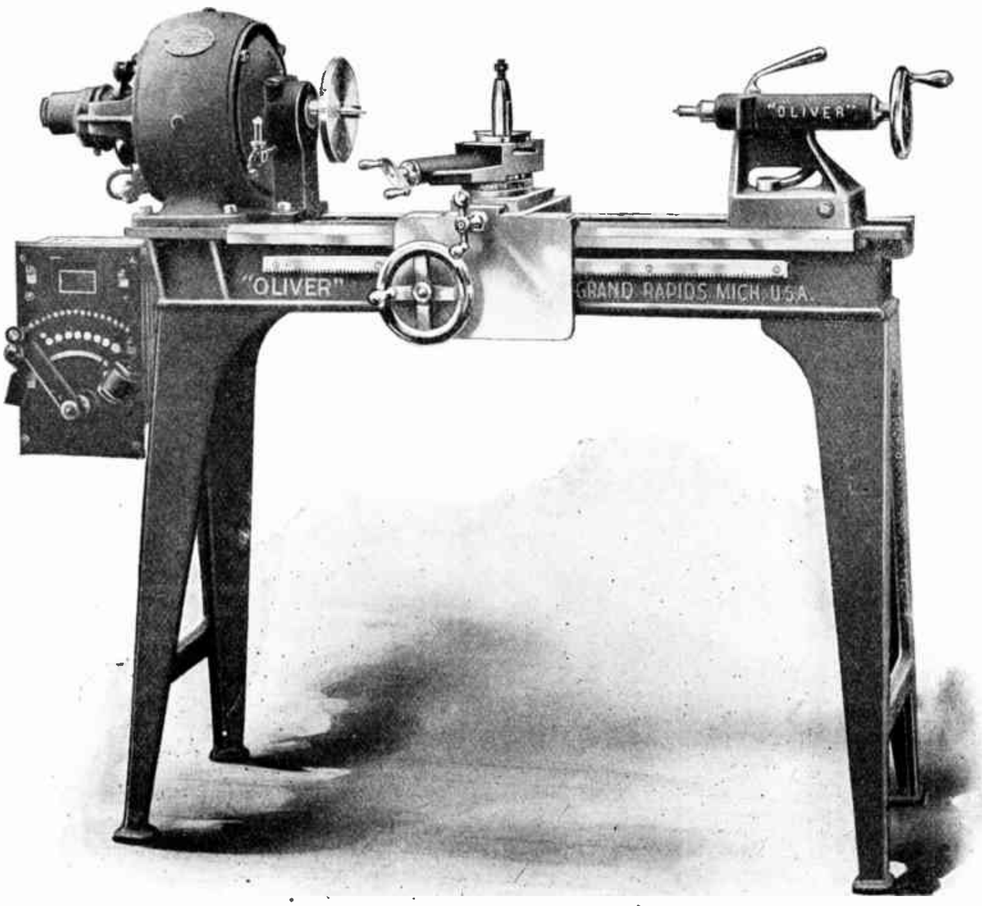


Fig. 2. Motor-head Speed Lathe

foot treadle for turning on or shutting off the power.

Every photographer has his own ideas and way of doing his work. He has a preference for a certain make of camera, lens, plate developer, etc. I give below the results of one excellent man who has done a great deal of machine photographing the past few years. He says: —

"In the first place, a good dark room is indispensable. It should be of ample size, well ventilated and well lighted. The light must be readily adjustable for the quickest or the slowest plates and also for printing gaslight papers. There should be a sink with running water, passing through a filter, and places or shelves at each side for your hypo tank and stock solutions. A rack over the sink is desirable for holding the developing tray and washing box. In an adjoining room should be placed shelves for storage of plates, a rack for negatives, and drawers arranged to keep supplies, paper, etc., with a broad top to be used as a table.

"If possible, arrange the dark room so as to do all your work in it, except the printing. Don't allow a lot of empty bottles or boxes to accumulate. Keep everything perfectly clean about the place. Have a place for everything and keep everything there. Select one brand of plate that you have found to act well in your particular work and stick to it. The same advice can well be applied to the developer.

"On machinery there is so much light and shade that great care must be taken to light it properly. If possible, place the machine where the light comes in from the north, but not where the strongest light comes in from the top. The upper part of a machine is

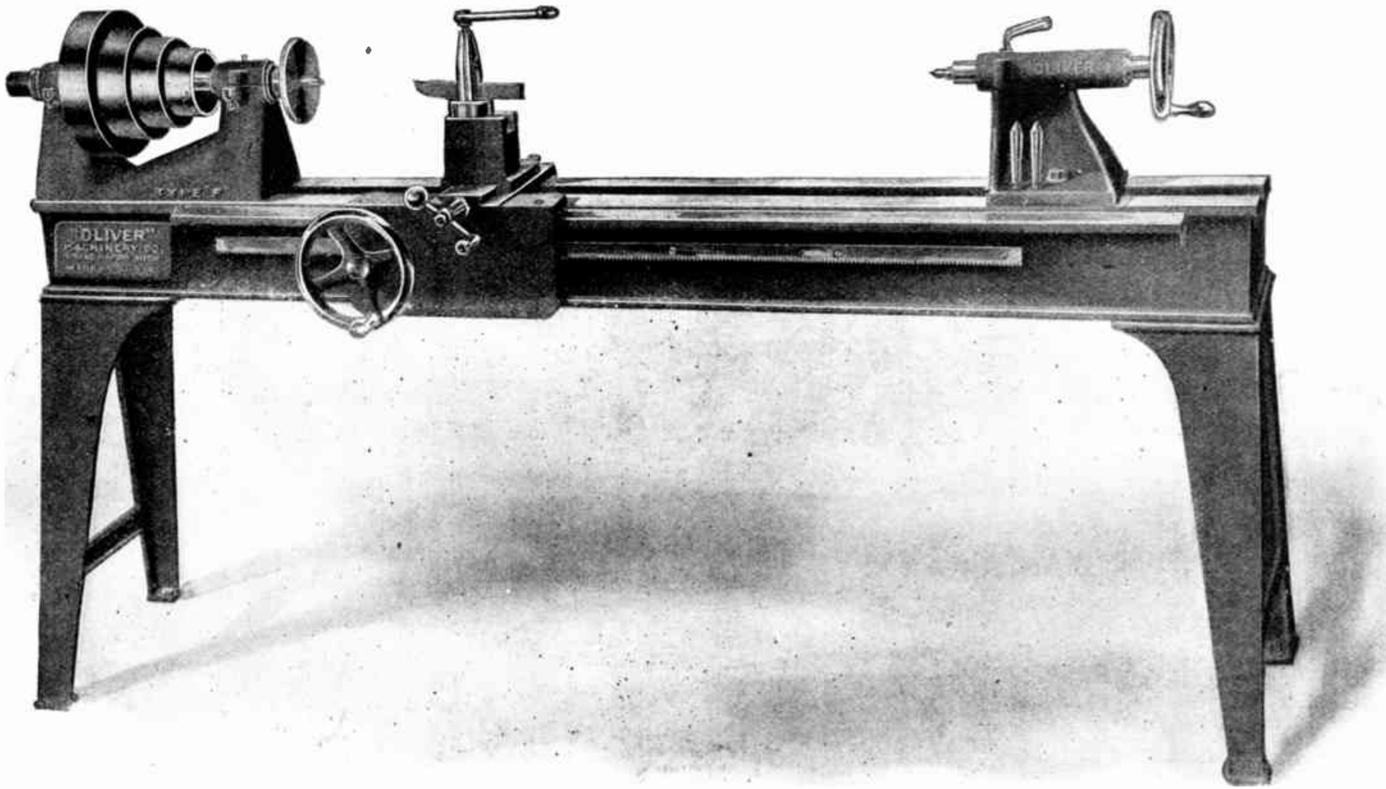


Fig. 3. Metal Bed Wood Lathe with Hand Feed Carriage

usually made up of bright work, and will be over-exposed before the lower portion, which is usually dark painted work, has had normal exposure. Therefore, it may be necessary to screen or cut off top light and reflect light into the darker parts of the machine, so as to give uniform lighting.

"I find it desirable, where there is much bright, polished work, to dull it by taking a ball of putty and tapping it over the bright work. This deadens the polish. This is necessary only where there is strong reflection. It is not desirable to have the picture too flat. Contrast makes an effective picture. Painting the castings a light color makes a very attractive picture, but the idea of a machine photograph is to give a picture which looks like the finished machine, and this is not the case where light paint is used. I find that by cutting off the top light and reflecting light into the dark portions of the machine I get a picture which is very satisfactory.

"Reflectors can be made of frames covered with white cloth, or paper preferably, which can be used at such angles as to throw a large amount of light on to the machine where it is most needed. The foreground should be prepared by laying clean white boards on a level with the machine, extending well in front, at each end, and at the rear as far as possible, so as not to show the joining with the screen. The screen should be carried back of the machine far enough to be out of focus, and if at all soiled, it should be kept in motion. A gentle swaying sidewise will be sufficient to make a clean background. Great care should be taken to keep this screen clean and to keep it far enough away from the machine so that no shadows are cast upon it, as this will greatly facilitate blocking out or painting out the background on the finished negative. This blocking out is necessary if a pure white background be desired.

"Usually the machine has the maker's name cast on it, as well as pattern and piece numbers. These can be prominently brought out by rubbing them over with chalk. Ordinarily, a well-exposed and developed negative requires no retouching. If, however, it should be necessary, my advice is to take it to some professional retoucher, and, at a slight expense, have it done properly. This is a trade in itself, and it is cheaper to have it done than to learn the trade.

"A long-focus lens I find to be the best, as it gives better definition and less distortion than a short focus, wide angle, especially if the machine to be photographed is long and narrow. The lens should be absolutely rectilinear, otherwise the straight lines in the machine will be curved and the whole machine distorted. Oftentimes, however, a cheap lens will give good enough definition and prove quite as satisfactory as a very expensive one. The box should be good and strong, and the tripod on which it is mounted should be heavy and rigid, so as not to vibrate or jar and blur the picture. Stop the lens down and expose for the shadows; develop slowly, and if necessary, accelerate development where it is weak. Continue development until all detail is out and there is sufficient density and contrast to give a good print. Do not get the plate too dense, as it makes a hard 'printer' and one that has too great contrast to be satisfactory.

"Regarding length of exposure, development, etc., one must be governed wholly by his own particular surroundings and conditions, the kind of plate used, the size of the stop, the time of the year, the hour of the day, and the value of the light on the work."

An Italian correspondent of the London *Times* predicts that the use of concrete in boat building will largely take the place of iron and steel. He says:—

"Large boats of reenforced concrete have been built already in this country, and five of these, of one hundred and twenty tons and more, were on commission for the Italian navy. The first of these boats, a one hundred and twenty ton barge, was built in 1906, on the plans of Mr. Gabellini, an Italian, who has given his whole attention to reenforced concrete, and who for many years has been conducting experiments with this class of material. This boat, which was built with double bottom and of the cellular type, was submitted to severe tests in the Spezia Arsenal, where a much larger boat built of iron and with an iron ram was directed against it without producing any considerable damage to it. After some time, and in consequence of the satisfactory results given by this first boat, four more of these barges were ordered on account of the Italian navy. It is my opinion that owing to the unfavorable conditions of Italy as an iron-producing country the problem of reenforced concrete for ships will meet with a good deal of attention here, and that experiments and trials on a much larger and more important scale will shortly be conducted."

ELECTRICAL CONVENIENCES IN HOTELS

Frederick A. Muschenheim, brother of William C. Muschenheim, proprietor of the Hotel Astor, is a graduate of the electrical engineering department of Stevens Institute, and an ardent enthusiast in all lines of electrical work. The result is that, from an electrical point of view, the Astor has more electrical devices in operation than any other hotel in the world. The hotel contains 112 large electric motors, besides innumerable minor ones, said Fred Muschenheim. "They lift its elevators, ventilate its rooms, freeze and cut its ice, wash its linen, burn its refuse, carry its dishes, seal its letters, cook some of its food, sew its linen, polish its silver, and do many other things for the convenience of the hotel patrons.

Besides an electric fire alarm system connecting the Astor with fire headquarters, an electric fire station in every corridor on each floor, each guest chamber is also connected with the engine room by means of an automatic fire alarm device by which the engineer can tell at once as soon as a fire breaks out in the room. This device consists of an ammonia-filled metal diaphragm. The diaphragm is put close to the ceiling, where heat naturally rises. Whenever the temperature of a room reaches 130° the ammonia begins to boil. This sets off an electric contact which operates a drop in the engine room and warns the engineer that the room has become dangerously hot. Another automatic appliance closes all doors leading to stairways, and thus shuts off draughts and smoke, at the same time permitting them to be opened by the slightest pressure of the hand.

A new application of the telautograph system has also been adopted in the hotel. By it written messages are transmitted by electricity from one part of the Astor to the other. To send names and messages correctly to its patrons is one of the hotel's most important duties. Every point in the hotel's central telephone switchboard is equipped with a telautograph transmitter. When the switchboard girl sends a telautograph message to a patron's room she writes it on a sensitive film in the telautograph transmitter in front of her. She cannot see her own writing on the pad, but a receiver reflects it back and lets her verify it at the same time that it appears on the receiving pad in the room of the guest. There is also telautographic connection at this central switchboard with the kitchen floor stations, porters, valets, information clerk, front clerk, cashier, service bars and engine room. The orders of the guests can thus be transmitted all over the house without the tremendous waste of time involved by having one person summon another to a telephone and repeat a message several times over until the other person understands. There are also no mistakes. Every order is written down. If the switchboard operator receives an order for something from the bar or restaurant, she will write it on her telautograph transmitter. It will flash to the service bar and also to the floor station nearest the guest's room. The order will be sent from the service bar in an electric dumb waiter and served by the floor boy. If a visitor comes to the hotel office and wants to be announced to one of the guests, the clerk writes the visitor's name and the number of the room occupied by the guest on a telautograph set standing in front of him and the message is repeated in the guest's room. The room clerk also uses the telautograph for sending departures and changes in rooms to the front clerk, to the housekeeper, and to the laundry. The system formerly used was for the room clerk to make this record in a book. Besides the telautograph system, the hotel has many electric clocks, an electric watchman's service, and also a system of electrical time stamps operated from a master clock. Each guest's letter box is equipped with a shutter and switch. Whenever a letter, telegram, message, or card is put in the box, in the guest's room an illuminated sign appears, reading: "Mail in the office for you."

Useful Place

Freddie. — "Say, wouldn't you like to have three eyes?"

George. — "Yes."

Freddie. — "Where'd you have the other eye?"

George. — "I'd have it in the back of my head."

Freddie. — "You would? I wouldn't."

George. — "Where would *you* have your other eye?"

Freddie. — "Why, I'd have it in the end of my thumb, so I could poke it through a knot-hole in the fence and see the ball game for nothin'." — *Delineator.*

A HANDY DRAWING BOARD

C. C. BOSWORTH

More young men and mechanics are studying drawing to-day than ever before. This is due, first, to the demand for skilled mechanics, and secondly, to the opportunities offered by the correspondence schools and evening classes for the mastery of the subject.

The Pursuit of Ideas

The board which I wish here to describe appeals as a handy drawing board more especially to those studying in evening classes. In fact it was the conditions accompanying study in an evening class which brought it into existence. As a general thing the student in an evening class attends his class about two or not more than three nights a week, and has about two hours of instruction, and in this limited time but very little can be accomplished. It is necessary and is generally required of the student that he study at home, which means that he must carry his drawing along with him. This necessitates either that he have two boards, one at the school and another at home, and that the drawing be rolled up and carried back and forth and relocated each time it is used, or that he carry the board back and forth with the drawing attached, and to avoid soiling it he covers it with a piece of paper or other material. At home it often receives abuse while he is away and it risks countless other mishaps which would not occur had he a place or way of fairly protecting it or of locking it up.

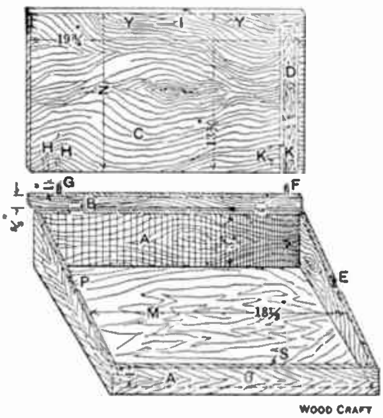


Fig. 1

I will now describe the cabinet board with the hope that it will fill the needs of those who are up against some or all of these conditions. Figure 1 shows the arrangement in detail. It consists of a cabinet or case A to hold the square, angles, rules, extra sheets of paper, and all the necessaries of a drawing outfit. This will be found a great convenience as a place in which to keep one's tools secure, yet handy.

The Common Outfit

It will be noticed that the body or base of the cabinet is higher in the back than in the front. This is done to give the drawing board, which forms the lid, a slight slant forward, and is very desirable where flat tables are provided. Frequently a common table supports the drawing board at home and the student then uses books, blocks or some other prop under the back end of his board to give it the needed slant forward. These extemporized arrangements are generally very unsteady and unsatisfactory. In the arrangement here shown the board is fastened to the cabinet in such a manner as to fill the bill for slant.

Details of Construction

At the top of Fig. 1 will be noticed a strip B hinged to the back and at the top face of cabinet above B and separated from it is a board C. These two pieces B and C form the top of the cabinet. C is the drawing board proper and is arranged that it may be put in place with either side out, one side of C having two battens to hold it straight, and the other side is plain to receive the drawing paper.

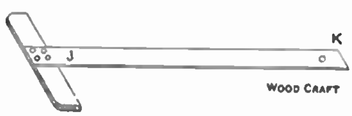


Fig. 2

The strip B being hinged to the back, is not removable. It has two pins F and G in the joint between B and C. These pins are not at the same distance from the ends and the joint edge on board C has four holes. The reason for this will be clear to mechanics of experience, but for fear that some one may not understand, I will detail the job. First, the two holes are bored unequal distances from the ends, say, the first hole 1 inch from the end and the other hole 2 inches from the other end of hinged piece B. Of course, this is done before hinging, and the hinges must be located so as not to come in the way of the pins F and G. Then this strip B is laid joint to joint on board C and the two holes H and K bored down into C about 1½ inches deep, using the pin holes G and F to guide the bit, and of course the strip B must be the same

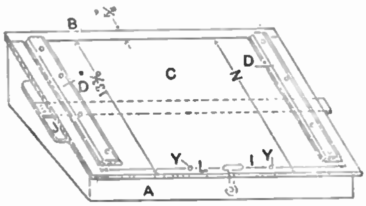


Fig. 3

parallel thickness as board C and evenly adjusted and firmly fastened to it so as not to move while boring. After boring these two holes H and K the strip B is reversed end for end and joint to joint and the two holes H′ and K′ bored as before, using the same precautions, and you will then have a true and freely working reversal arrangement for the board C.

Improving the Scheme

Some may say, "Why would not holes the same distance from the ends and only boring two holes in C do just as well?" Well, all I have to say is: try it and see for yourself, but don't try it on the pieces you have gotten out for your cabinet, but get two other pieces or narrow strips. Perhaps you can do it all right. I have, but it was when I wasn't trying. It can be done, but it takes great care and pains hardly worthy of the job in hand, and especially when an easier and perfectly accurate method presents itself to the workman.

Knowing readers may take exception to this long, drawn out and detailed description of a very simple operation. I take it for granted that they are not the ones who would need or wish to build such a cabinet, those who are beginning their life work. But for all that, who has not seen even those more advanced — in years at least — who would perform the operations here detailed without observing these precautions?

Expansion and Contraction

Now, the two battens D are screwed on to the back of board C. The holes or slots in D are made a little oblong to allow for expansion and contraction of board C. A round-head screw having a small washer under the head is best. The distance apart of the battens D, as shown at L, Fig. 3, is made just a bit less than the distance M inside of the sides of cabinet, say not more than 1-16 inch less. This assists in holding the lid in position, as does also the length of the battens on C, which should be just long enough to clear the inside front edge of cabinet when the lid is down in position, Fig. 4, for drawing. Then if the pins should become very loose in their holes, the board would not slip off of its base or become unsteady.

At S on the front piece will be seen a pin about ⅜ inch long and out of center of the width. This pin fits into the holes Y seen on board C and the object is to help retain the board C from slipping off the pins G and F when the lid is closed with the drawing inside. The instruction given for boring the pin holes G, F, H, and K also applies to the holes S and Y.

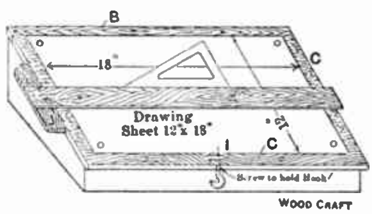


Fig. 4

At E, Fig. 1, is a pin in an opening and at the opposite side is another recess P. These recesses are a little deeper and wider than your T-square, shown at Fig. 2, and in which is a hole K which fits over pin E, all arranged so that when the lid is reversed with the drawing protected inside the cabinet, as at Fig. 3, the square is in carrying position and cannot slip out.

Protecting the Drawing

At I is shown a slot. This slot is made long, so that the hook which is pivoted at one end of the slot may slip through and be in position to catch on, regardless of which side of the board is up, and be out of the way of drawing. A padlock and staple can be substituted for the hook and eye, also a handle can be added by which to carry the cabinet, and it can be covered with a light oilcloth sack or other waterproof fabric to protect it from weather when in transit.

The Material

As to material, size and construction, it should be as light as practicable. For the sides and ends, ⅜-inch thickness is rigid enough and it should not exceed ½ inch. For the bottom ¼ or ⅜-inch thickness is sufficient, and the top should not be less than ½ inch and of the very best dry, soft lumber obtainable. White pine would be the best. Don't despair and fall down because you cannot obtain the white pine. The boards which I have here described were made of good yellow poplar, and have proven to be all that could be desired for the purpose for which they were designed, namely, for a 1905-06 class in the Y. M. C. A. course of mechanical drawing of which the writer is the instructor.

Size and Design

The size will be governed by the requirements of the course of instruction as to the drawing sheets; the inside width M should be a little longer than length of your sheets and the width N of board C wide enough that the drawing clears the inside edge of the front piece of the cabinet by at least ¼ inch when the drawing is face down inside. In construction it may be put together to suit the fancy, time, and pocketbook of the owner. It may be dovetailed, butt end jointed or halved. In the one here shown the ends or joints are halved in, and that makes a good cheap job. I have given the chief dimensions of the cabinet which we are using and which accommodates a sheet 12 x 18 inches.

I would add that on some of the boards we gouge a groove either in the top face of piece B or near the bottom edge of board C, deep and wide enough to receive a pencil, and a little longer than same. Being below the surface, the pencil when laid down is not in the way of angles or square. This prevents the pencil rolling off the board and it is always right in place. I have made quite a number of boards of different descriptions, construction, etc., and on many of the boards recessed the place for pencils and on some also a V-shaped recess to receive the three-sided draftsman's rule so as to have the side being used face up and flush with top of table, which is very handy, but in this cabinet board there is hardly space for that. — *Wood Craft.*

TO STAIN PINE A WALNUT COLOR

H. C. STANDAGE

1. Put 2 ounces of privet berries in ½ pint of liquid ammonia, and apply it to the wood; whether it be varnished or polished it will produce the color of real walnut, so much so as to be difficult to detect from that article.

2. Take 1 gallon of very thin shellac, add 1 pound of dry umber, 1 pound of dry burnt sienna, and 4 ounces of lampblack. Well mix these ingredients by sifting together, then add them to the shellac size. Apply one coat with a brush; when dry rub down with fine glass paper, and apply one coat of shellac or cheap varnish. It will then be a good imitation of walnut. This is adapted for backboard of mirrors and for the back and inside of casework.

These woods and also birch can be made to appear as if veneered with walnut. Dissolve 3 ounces of manganate of potash and 3 ounces of manganese sulphate in 5 ounces of water, and give the wood several applications with a brush. The potash manganate is decomposed when it comes in contact with the woody fiber, and thus a beautiful and durable walnut is obtained. If small wooden articles are to be stained in this manner, a very dilute bath is prepared, the articles dipped in it, and kept there one to nine minutes, according as the color is desired darker or lighter. — *Wood Craft.*

Smoke consumers and economizers are most efficient when the boiler is least efficient, because they depend for efficiency on the temperature of the waste fuel gases, the higher the temperature, the greater the original loss to the heat units in the boiler fire proper. The smoke consumer serves its purpose in permitting the use of soft coal or bituminous coal in cities where its use is limited by law. The economizer serves as a feed-water heater in place of using the exhaust steam, and is efficient usually in large plants in which the exhaust is far removed from the boiler.

ABSOLUTE ZERO

The temperature must be reckoned from absolute zero, which is 460° below zero of the Fahrenheit thermometer and 273° below zero of the Centigrade thermometer. Therefore, in making any calculations on existing thermometer temperature, it is necessary to add to each temperature 460° when dealing with Fahrenheit thermometer and 273° with Centigrade.

GLEANINGS FROM PHOTOGRAPHIC EXPERIENCE

ARTHUR B. WEEKS

BEGINNERS have many troubles with plates, paper, and developers, even when these are at their best. They have followed instructions and noted the ever present "exception" to the rules; and have occasionally turned out a fairly good picture. But have you not had the combination broken after having spent much time and money in attaining what seemed to you perfection? I had a certain plate and a developer with which, by manipulation of my own, I could count confidently on getting almost any result desired, with little fear of failure. One day, however, when I went to the usual place for developer, I was informed that there was no more of that kind in stock, and they could not tell when more would be received. As it chanced, they never bought more, and as I had destroyed my bottles, I had no means of identifying it elsewhere. This meant more costly experimenting; I tried all sorts of plates and developers in combination, but never found another to give me like results.

Since then, however, I have discovered the source of many failures. Living at some distance from the city proper, I bought my supplies from a small dealer; and it was only when his supply of plates and my particular developer ran out that I discovered him to be responsible for my lack of success. The pyro developers were too old, turning dark as saffron when the plate had shown only a fair degree of development. Possibly I should have known better; but should not supply dealers know when such material is defective? I have sent for printing out papers, to find on opening the package that they were several months past the guaranteed time. The dealer would not under any condition replace them. Yet when buying, I have been assured time and again that the materials were in good condition and satisfactory in every way.

I now buy my plates and developers from a large concern which sells to professional photographic studios, and my negatives are real gems. It is like getting back home again, and my interest has greatly revived; pleasure and recreation are mine again. I would pass on my combination, but it is hardly fair to do so through these columns. However, the plate is a well-known one, and the pyro developer is made by the same company.

If you have not tried Angelo Sepia Paper, experiment and you will be delighted with the beautiful results. It is printed similarly to Solio, but not so deeply. The salts and liquid required are supplied by the dealer. The manipulation is easy, and the tones are beauties. I have printed eleven of my first package of a dozen sheets, and each has been entirely successful. I have compared the finished pictures with carbon prints and find the effect finer by far. It is a bit more expensive, but is worth trying, even if you do not care to buy it regularly. I have before me a photograph of a bowl of flowers, taken indoors, against an olive-green window-shade as background. The flowers are white, with light green stems and leaves, and the result is most beautiful.

A friend recently had some photographs taken which cost her $13 per dozen; with this Sepia paper I was able to reproduce the same tones and effect. It is a big success; I even photographed her picture with very nice results. I do this work only as a pastime; but even as a recreation, it pays. Finally, insist on your dealer's keeping fresh materials, and use as much care also in buying your papers as your developers.

THE only mistake a man can make that will count against him is to try to make some other man carry the blame for his own errors. "Everybody makes mistakes," it is true, but that is no excuse and does not let any man escape his plain duty of confessing and correcting his own blunders. Full, free confession and shouldering righteous responsibility is the only way. A mistake made under these conditions will instantly become a stepping stone to the right thing — and success.

WE are to have an eight billion dollar crop this year, so the expert figurers say. That's a lot of money to take out of the ground, but it is good money, fairly earned, and paid out for the best products, the good things which seedtime and harvest bring. Uncle Sam needs to have a big granary to hold all the products of his farm this year. He is a prosperous old gentleman and nature helps him with bountiful hands. But sometimes he is not as wise in the spending of his wealth as he is in gathering it together. — *Exchange.*

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EDITORIALS

Aerial navigation seems to be the topic of the day. The newspapers daily bring accounts of new ascensions. In New England the race for the *Herald* cup continues, but as yet no one has landed the prize, although one man overshot Boston in the night and landed on the ocean shore to the south. As we go to press we learn of the shocking accident to the Wright aeroplane at Fort Myer, where the army tests are being conducted. Orville Wright, with Lieut. Selfridge of the army were making an ascent. They met with an accident to the propeller, which precipitated them to the ground, killing Lieut. Selfridge instantly. Orville Wright lies in the hospital, and may recover. The experiments will be continued at a later date. We are confident that the day will come when the airship will cease to be a novelty and will attract but a passing comment.

* * *

We take pleasure in announcing that another series of articles, by Professor A. E. Watson on Armature Windings, will begin with this issue. As many of our readers are working along these lines and wish accurate information, we feel confident that the course will be as well received as the one just closed on Electrical Engineering.

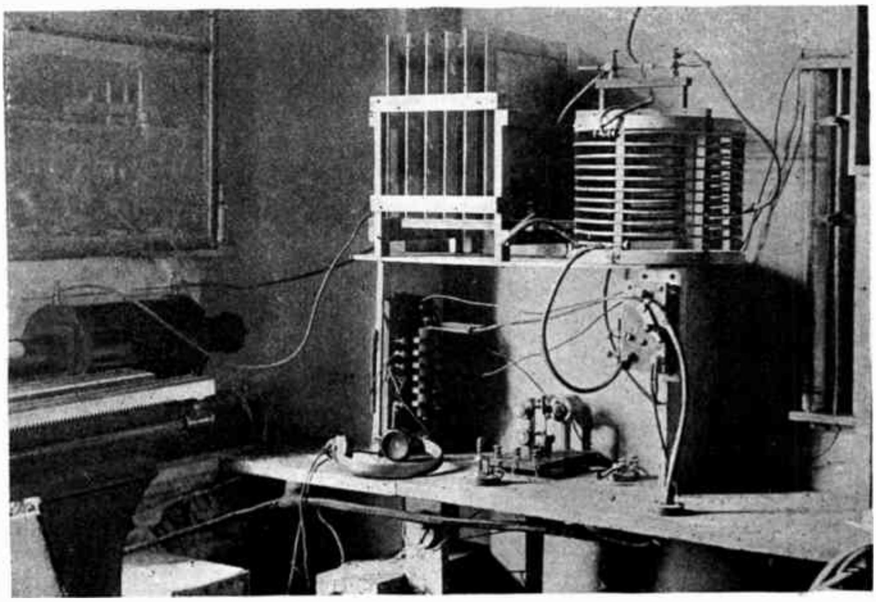
* * *

Our Wireless Club members are increasing in numbers and much interest and activity is shown all over the country in this department. Many enthusiasts are forming local clubs, chosing officers, and having regular meetings. Bringing these workers in close touch gives an opportunity for exchange of thoughts and ideas which can but be beneficial to progress of wireless. We hope later to publish some of the experiences of these clubs, and the successes of our many members.

There are in commercial use at least two methods of balancing a three-wire, direct current system supplied from generators of the over-all voltage of the system; one is to provide a motor-balancer, consisting of two machines exactly alike connected in series and rigidly coupled together, the extreme terminals of the pair being connected to the outside conductors of the system, and the junction between the machines being connected to the neutral conductor; the other is to provide two auto-transformers for each generator, the terminals of each being tapped into the armature winding at points between which the maximum difference of potential occurs periodically, the points of connection for one transformer lying halfway between the points to which the other transformer is connected. This latter arrangement changes an ordinary generator into what is popularly termed a "three-wire" machine. The neutral conductor of the system is connected to the middle point of each auto-transformer. There is a third method which is practical under some conditions of operation, — that is, to connect a battery of storage cells between the outside wires of the system, and connect the neutral conductor to the middle point of the battery. — *American Electrician.*

WIRELESS CLUB

This department is devoted to the Club members and those interested in Wireless Telegraphy. We will publish experiences, discoveries, and suggestions, which may be helpful to all interested.



Wireless Outfit constructed by W. S. B.

I wish to state that, as one of your subscribers to Electrician and Mechanic, I have been thoroughly pleased with the articles in your magazine of the past few months, especially those on "Wireless."

I also wish to state that I should like very much an article describing the construction of a closed core transformer for "wireless" transmission to work on alternating currents 110 volts, 60 cycles; and I would suggest that it be designed so that the cost of materials would not be much over $10. An article describing construction of chemical rectifiers for 110 volts alternating current, which would suitably rectify the current for experimental purposes, would be one many readers would be glad to see.

M. A., Campello, Mass.

Have a good sending station, having talked with De Forest station, about four miles away. Height of aerial to pole from spark-gap, about 25 feet, and the pole is 35 feet high, with umbrella aerial radiating from top of pole (eight ribs of 7-22 copper wire), each rib about 30 feet long, or total length of, say, 90 feet. Induction coil will give a 7½ inch spark. I use six glass plates, 10 x 12, with tin foil 7 x 9 inches on each side, connected in multiple, for my sending condenser, as shown by illustration. Battery, nine storage cells, worked at about 7 or 8 amperes. Have experimented quite a lot with independent interrupters, and I have now got one that will interrupt properly at a fast rate, and under current as above, without the points welding.

I have received Bridgeport, Conn., quite clearly. I may have received vessels farther off, but Bridgeport and Wilson's Point, Conn., seem about as far as I have received from inland stations. Fire Island I get very plainly.

W. S. B., Brooklyn, N. Y.

As a reader of the Electrician and Mechanic, I would say, in response to the editor's request for suggestions, that I should think an article on the hot-wire ammeter would be of interest. I have tried in vain to find out how this instrument is made and how it works. Even if the construction is too hard or expensive for the amateur, I think an explanation would be gladly received.

C. W. W., Melrose Highlands, Mass.

I am heartily in sympathy with any one that has the "wireless microbe," because I know how it has left me. I cannot get magazines or other articles that treat on this subject fast enough. They are not issued often enough. Wireless telegraphy is my hobby. I would suggest that you give a large portion of the magazine to that subject, especially the construction of practical wireless apparatus. I will ask that you publish an article on the construction and operation of high frequency transformers, as this seems to be one of the new and popular pieces of apparatus.

R. H. M., St. Paul, Minn.

I would like to have the names and addresses of members in this city. If the other members would like, we could meet at my office and talk over the matter of forming a local branch. I am the department manager of a large firm, and could furnish a down-town place to meet, with no expense.

W. W. B., Providence, R. I.

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.

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.

776. **Choke Coil.** K. E. V., West Park, Ohio, asks: (1) What is such a device? (2) On what principle are motors operated from a central station by wireless methods? (3) What is the action of a 2-cycle gasoline engine? Ans. — (1) It is a device for setting up a counter electromotive force, and is useful in circuits for reducing some standard alternating voltage to that needed for some particular device. See Chapter XIII of the Engineering series. (2) We do not know of such usage. (3) In this type of engine the crank case is made tight enough to hold a small pressure, and when the piston moves outward, — usually downwards, — the air is somewhat compressed. Then when the piston is ready to return, a port opens, and allows a part of this air to put a fresh charge into the upper portion of cylinder. At every two movements of the piston an explosion is allowed, whence the expression 2 cycle. In the other type of engine, the drawing in of the charge, the compression, the explosion and then the expulsion of the products of combustion require four movements of the piston, — two complete revolutions of the crank. The former are cheaper, the latter more economical and reliable in operation.

777. **Earth Circuit.** P. J. E., Belle River, Can., asks: (1) Why four dry cells will not ring a bell at a distance of 20 feet when the ground is used for one side of a circuit? (2) When current flows from a battery, does the voltage fall from the value it had on open circuit? (3) Does it harm a telephone receiver to send through it the current from secondary of an induction coil? (4) In measuring the length of an antenna in a wireless telegraph set, does the horizontal distance to the vertical part enter? Ans. — (1) Your "grounds" were probably too dry and insecure; copper plates in a permanently wet soil must be used or the iron pipes in wells. For such short distances, or even for several hundred feet, use two separate wires, without recourse to the ground at all. (2) Yes, for some voltage must be used to force the current against the internal resistance of cell. (3) Any current from this source that does not produce an intolerable sound in the telephone will be safe. (4) Measure from the spark-gap.

778. **Perpetual Motion.** M. H., Seattle, Wash., asks: (1) If a 500-volt generator can be electrically and mechanically connected to a 250-volt motor and set up a perpetual motion? (2) Can an arc light be made from a 1-inch jump spark coil when energized from storage batteries? (3) How are "three-way" switches connected so as to control a light from two different points, say from the head and foot of a flight of stairs? Ans. — (1) No. Dynamo machines get hot from the effects of the currents flowing in their windings, and this loss by heating represents the shortage from producing perpetual motion. Machines of 10 h. p. do not return over eighty-five per cent of the power put into them. (2) No, for the secondary of the induction coil has such a high resistance and inductance as to prevent enough current from flowing. You need 5 to 7 amperes for even an enclosed arc, 10 to 13 for an open one. The induction coil may supply .01 ampere. Use enough batteries, and get the light without wasting any power in the coil. (3) The following diagram will make the arrangement clear:—

779. **Magneto Dynamo.** J. F. S., Philadelphia, Pa., asks (1) If a telephone magneto be rewound and fitted with a two-part commutator, can it be used to operate an induction coil for jump spark ignition? (2) What is the size of wire sent? (3) Can it be used for the secondary of the induction coil, and what size should be on primary? Ans. — (1) Not very well, for the shuttle winding has too much inductance. Further, the solid iron core would get too hot from continual use, and the bearings are too meager. (2) No. 34. (3) Yes, if you have half a pound or more. No. 16 on primary.

780. **Factory Telephone System.** E. H. E., Winston, N. C., has such a system with thirteen stations, and complains that the transmission lacks the clearness of tones that are heard in an ordinary Bell telephone. What is the reason? Ans. — The cause is inherent in all the "intercommunicating" systems, and is due to the inductance between the various wires that are grouped into the cable. In your case fourteen wires pass through all the stations and their total lengths are considerable. The troubles can be minimized by judicious arrangements of the

apparatus, but not eliminated. Write to the Dean Electric Co., Elyria, Ohio, for advice.

781. **Friction Drive.** M. R., Shideler, Ind., asks (1) Is the friction drive successful as applied to the transmission gear of an automobile? (2). Will leather and aluminum answer for the friction surfaces? (3) Where can a 10 h. p. two cylinder, four-cycle, vertical, air-cooled gasoline engine be obtained? Ans. — (1) We think not. All sorts of such schemes were extensively exploited for street cars before the similar problems of automobiles renewed the agitation. Nothing short of a positive drive seems to be effective or economical. What will serve for driving a sensitive drill is quite insufficient for transmitting several or many horse power. (2) Yes, but wood will work as well and be cheaper than aluminum. (3) Insert a note in our advertising columns, or correspond with the large manufacturers.

782. **Transformer.** A. M., Cincinnati, Ohio, refers to an answer we gave to an inquirer of a year ago, in which we stated that there was no way of transforming a 3 to 4 volt current from Daniell's cells to 10 volts. He thinks an induction coil with relatively coarse secondary wire will actually accomplish the result. Is he correct? Ans. — In replying to a question we try to imagine just what was in the inquirer's mind. When the word transformer is used we understand the device that is operated by alternating currents. Since any battery supplies direct current, the transformer would be inoperative. You have in mind an induction coil, but no accurate measure is possible of the secondary electromotive force. A motor-generator set could be imagined as serving the end, but with the inquirer's stipulation of Daniell cells, we knew the power to be altogether too meager to allow for such an extensive collection of apparatus.

783. **Sandpaper.** P. M. E., Salisbury, N. C., asks how it is made. Ans. — The designation is a little untrue, for many years ago the use of sand for this purpose was discarded, and pulverized glass used in its stead. The name "flint" paper as printed on the sheets, is correct, for flint glass is the material. The sheets of paper pass beneath rotating glue brushes, and then receive the coating that is sifted upon them.

784. **Potentiometer.** H. A., Osage, Ia., asks (1) How one differs from an ordinary rheostat? (2) How are Edison primary batteries charged? (3) What is the theory of the electrical condenser? Ans. — (1) A potentiometer may be composed of two rheostats, used in such a manner that resistances are cut out of one at the same time as cut into the other. The effect is more clearly seen in the simple slide wire instrument, when the contact lessens the resistance on one side and puts it in on the other. With a given potential difference between the two extreme ends, any desired intermediate potential may be secured between either fixed end and the slide. Such instruments are of great value in connection with "standard" cells when calibrating voltmeters and ammeters. (2) Zinc for one element, oxide of copper for the other, in a solution of caustic potash. (3) There is a great deal of theory on this simple structure, but the idea seems to be that the sheets possess something akin to elasticity towards the electric push. They yield a little, but then try to spring back and to return the charge.

785. **Storage Battery Construction.** W. S., Toledo, Ohio., asks (1) for directions for the making. (2) Why will not the secondary current from an induction coil operate the primary of another coil? Ans. — (1) The April, 1908, magazine gives important directions, but Watson's new book on Storage Batteries is more complete. (2) The presence of the iron core is the reason, — it cannot change its magnetism fast enough, and you lack the conditions of "resonance," as explained in connection with Tesla coils, in Chapter XXV, of the Engineering series.

786. **Voltage Regulators.** A. E. N., Brett, Ia., asks (1) Where those of the Chapman sort are made, and what is the price? (2) Can acetylene gas be used for a small engine in place of gasolene? (3) What would be the dimensions of an 80-watt induction furnace? Ans. — (1) Address the Belknap Motor Co., Portland, Me., but we do not think those are now made. Although ingenious in principle, they involved some drawback. The price of such as we have seen, — though they were out of use, — could not have been less than $200. The Tirrel regulator, made by the General Electric Co., seems to fill the demands best, but the price is also high. (2) We do not know of such use. Perhaps some of our readers could enlighten the inquirer. (3) It would not be practicable to make a furnace so tiny; perhaps 5 kilowatts would be small enough.

787. **Series to Shunt Winding.** E. W., Merchantville, N. J., asks (1) What sizes of wire to use to change a No. 7 Carlisle & Finch dynamo, both field and armature now being wound with No. 20 wire, for 10 volts and 2 amperes, series, to 5 volts and 4 amperes, shunt? (2) How are Fuller batteries made? (3) Is 6 volts and 10 amperes the same as 10 volts and 6 amperes? Ans. — (1) The armature is undoubtedly of the closed circuit style, and for such a small machine it ought to carry 4 amperes without undue heating; simply rewind the field with the same weight, or more if you can get it on, of No. 23 wire. (2) A slab or cylinder of carbon is used in the outer vessel, in a bichromate of potash solution, of the ordinary composition. Within the porous cup is merely dilute sulphuric acid, or, indeed, only a strong salt solution, with a zinc shaped like a conical inkstand; a spoonful of mercury is kept in the bottom. (3) It is the same as far as power is concerned.

788. **Transformer.** G. G. M., Swissvale, Pa., asks (1) What should be the dimensions for a transformer for changing 110 volts to 10 or 20, with a current of 4 or 5 amperes? (2) What should be the dimensions of the wire for making a heater for a cup of water, for raising the temperature to 160° F.? Ans. — (1) We expect to publish an article in the near future on the construction of just such a device, but perhaps the most available thing you can do is to get the choking coils from two disused alternating current arc lamps, connect them in series on the circuit, and then lead your low voltage connections to any desired intermediate positions. (2) A great deal of time and money has been spent upon electric

heaters, and full knowledge of all the conditions of use as well as disuse is necessary. We advise you to write to some manufacturer, say the American Electric Heater Co., Detroit, Mich.

789. **Wireless Telegraphy.** L. P. Ponce, P. R., asks (1) Can successful communication be obtained between two places, 11 kilometers apart, with rather high hills between, using a system similar to the arc system and a silicon detector with tuned circuits, 110 volts a current, with which an arc about ½ inch long is obtained? (2) Is any article to appear giving directions for making induction coil to connect in shunt with arc in same system? (3) Will K. & D. rheostat and switch, No. 23, manufactured by Kendrick and Davis, be suitable for use as tuning coils on potentiometers? Ans. — (1) For amateur use the arc system is not to be recommended. A small core transformer used in connection with the antenna you mention would give better service. (2) Every number has strong articles on wireless. We can also give you the names of some good books on the subject. (3) No.

790. **Incorrect Answer.** H. L., Oakland, Cal., calls our attention to a glaring error in our answer to J. W. F., in the July number, in which the resistance of No. 23 German silver wire is given as 37 ohms per 1000 feet. We really cannot account for the error, for our tables show 381 ohms for the eighteen per cent grade, and 572 ohms for the thirty per cent. We are glad the reader detected the mistake and had the courtesy to report it. There are various grades of this alloy, and combined with various gauges for measuring the size, considerable variation from the above figures may be met. For instance, one list gives the value as 460 ohms.

791. **Mercury Arc Rectifier.** O. C. D., Town Hall, Pa., asks (1) What is its principle of operation? (2) What are the sizes of Nos. 10, 15, 16, and 18 double cotton-covered wires, over insulation, and Nos. 28, 30, 32, 33, 34, and 36, single silk-covered? (3) Where can brass balls be obtained? Ans. — (1) See Chapter XVIII of the Engineering series in the December, 1907, magazine. (2) .112, .067, .059, and .048 inch, respectively; .0156, .0126, .0105, .0095, .0088, and .007 inch, respectively. (3) From Queen & Co., Philadelphia, Pa.

792. **Condenser.** W. B., Washington, Pa., asks (1) Can gilt be used on glass plates and serve as a condenser? (2) What is the resistance per foot of the sample of copper wire sent? (3) How can the magnetism be restored to the field of a "Wonder" dynamo, — output 10 volts and 1½ amperes? (4) Can the winding be changed so as to allow an output of 2 amperes? Ans. — (1) Yes, provided you can get electrical connection to the films. We think tin-foil is the cheapest and easiest material. (2) No. 23 wire, with a resistance of 21 ohms per 1000 feet. (3) We do not understand your question. The machine has electromagnetic field, and if you find any failure, it is due to fault in the winding, or in weakness of the current. Drive the machine faster. (4) Use one size larger wire on the armature, and increase the speed.

793. **Condenser.** N. E. G., Cresco, Mich., is making one from twenty 4 x 5 inch photograph plates, with nineteen sheets of tin-foil, each 3½ x 4½ inches. He asks if the scheme is proper, and if the films should first be removed? Ans. — The dimensions are good, but from the small area of the foil and the thickness of the glass, you will have a very small capacity. Better remove the films, and shellac the glass,— the gelatine would absorb moisture.

794. **Induction Coil.** C. Z., East St. Louis, Ill., has tried to make a coil for 4-inch sparks, but gets only 1 inch length, while a spark ¼ inches long will jump between primary and secondary. What is the trouble? Ans. — In the first place, the coil is too small to give the desired output. Next, you have not sufficiently well insulated. When the structure is nearly all metal you must not expect the spark to prefer the air path to one within, where the jumping space is less. The structure should have several times as much insulation. Read the highly practical article on the construction of a 4-inch coil in the April, 1908, magazine.

795. **Steam Engine and Boiler.** W. G. Z., Camden, N. J., asks (1) Where such a combination can be purchased of sufficient size to run a K. & D. dynamo at full capacity? (2) Is it possible to get a spring motor with clockwork to run a "Midget" dynamo for thirty minutes at a time? Ans. — (1) Write to L. H. Wightman & Co., 130 State Street, Boston, Mass. (2) No, it is not practical. A water faucet drive would be easy.

796. **Induction Coil.** L. B., Somersworth, N. H., (1) has about 1000 feet of No. 34 silk-covered wire, and wishes to use it for the secondary of an induction coil, for which the primary is 8 inches long with ½ inch diameter core. What length of spark will it give? (2) A Ruhmkorff coil is a step-up device, while an ordinary lighting transformer is for stepping-down the pressure. Why these two dissimilar ideas? Ans. — (1) The quantity of wire is too small to give appreciable sparks, — say not over ⅛ inch, but it will give violent shocks. (2) The ideas are not contradictory, and the matter will be straightened out in your mind if you will read Chapter XVII of the Engineering series, in the November, 1907, magazine. Also in Chapter XXVII you will see lighting transformers connected in both the step-up and step-down manner.

797. **Frictional Electrical Machine.** E. N. T., Brighton, Mass., asks: How the pads are made and amalgamated? Ans. — Use chamois skin stuffed with curled hair. Amalgams are an advantage, but their explanation is not clear. Melt together one part of tin and one of zinc; then with special precautions not to inhale the fumes, stir in two parts of mercury. Before allowing to cool, pour into a wooden box containing some powdered chalk, and shake well. When cold powder it in an iron mortar, and preserve it in a stoppered glass jar. For using rub lard over the cushions and sprinkle on some of the powdered amalgam. Please observe that such machines are now quite obsolete, the "influence" machines, though sometimes precarious in their start, are much more powerful, and take only a small effort to drive.

798. **Telegraph Line.** R. A. B., Randolph, Mass., (1) has a metallic line with terminal instruments only, 424 feet apart. Four-ohm sounders are used. He wishes to know how many 6 x 8 gravity cells to install at each end, and through what resistance should they be connected during idle hours? (2) Will 3-ampere cut-outs at each end suffice? (3) What is the difference between telephone sets of the "series" and the "bridging" sorts? Ans. — (1) For your purposes we should recommend the European, or open circuit, method of operating. This will allow use of Leclanche or dry batteries. In either case, three cells at each end should suffice. A 50-volt incandescent lamp makes a convenient resistance. (2) Unless your wires pass near trolley or electric light wires, we should say that the cut-outs were superfluous. (3) The difference consists mainly in the size and winding of the magneto generators and the call bells. For series work the generators can give a maximum of about 75 volts, and the ringers have about 80 ohms; the other can give a higher voltage, often as high as 300, and the ringers have 1200 to 1600 ohms. In addition to ohmic resistances, inductances play an important part.

799. **Motor.** G. B. M., Nashville, Tenn., asks: (1) What resistance to put in circuit when using a 52-volt fan motor on a 104-volt circuit, frequency being the same? The motor runs at the proper speed, but gets hot. (2) A pocket ammeter behaves queerly. When the saw-edge is placed against the carbon of a dry cell a current of 2 amperes is indicated, but when contact is made against the brass clamp on the carbon, 12 amperes appears. What is the reason? In regular use the circuit is made under this brass clamp, so why does not 12 amperes always get in that circuit? Ans. — (1) Put in series with the motor a choking coil taken from some disused alternating current arc lamp, or copy the construction. (2) Against the carbon itself you make a very poor contact, but the brass clamp has a large area of contact, consequently less resistance. The current merely follows Ohm's law. (3) The ammeter represents a short circuit, but when you insert some desired device, you at once increase the resistance and diminish the current. On open circuit the resistance is infinite, hence, there is no current at all.

800. **Rheostat.** A. L., Waltham, Mass., asks: (1) Does a rheostat waste current? It seems to him that it saves current by lessening the amount that would otherwise flow. (2) A 3-bar telephone magneto is to be rewound so as to drive a 6-inch fan from six or seven dry cells. Which would be the better size of wire for the armature, No. 22 or 23? (3) A demagnetizing coil for watches is to have an axial length of 5 inches and a diameter of 3 inches, and to operate on a 110-volt alternating current circuit. What size and amount of wire should be used? Ans. — (1) It is a better expression to say that a rheostat wastes volts and energy. If your battery gives 7 volts, but the desired circuit gets only 3, you are wasting 4 volts in the rheostat. If a current of, say, 2 amperes, is flowing, you will be getting 6 watts usefully in the desired device, but wasting 8 watts in the rheostat. The scheme is like running a steam engine through too small a pipe; you waste a good deal of the pressure in overcoming the friction of the pipe. If the steam pressure was too high, you should properly reduce the firing. In your case it would be better to have the switch arranged to cut in or out more or less of the cells. (2) It makes only a slight difference in the speed of the motor; either size will be satisfactory. (3) About 10 pounds of No. 18 wire will suffice, but for safety have the coil connected in series with six to ten regular incandescent lamps. Then by turning on or off the lamps, one by one, you can get a wide range of current. Here again, you will be wasting volts in the lamps, but it is the simplest means of control, and for intermittent use quite as economical as any other.

801. **Rewinding.** H. L. S., Coldwater, Mich., has rewound two 60-watt, 133-cycle, 52-volt alternating motors of the Emerson induction type for 110 volts and 60 cycles; the change necessitated winding for four poles in place of the former eight. He asks (1) What power should they now give, and will they conjointly be able to drive a four pole $\frac{1}{8}$ h. p. direct current generator? (2) Where can instructions be obtained for making such a generator? Ans. — (1) The power will be reduced from the former rating by about twenty-five per cent, but probably they will drive a generator of the size you propose. (2) We do not think it practicable to have four poles in so small a machine, but Carlisle & Finch, of Cincinnati, have designs for some small sizes.

802. **Magneto Igniter Troubles.** M. G., University Place, Neb., has a magneto that fails to keep the engine in operation. It gives only 6 volts when the engine is running from the battery. He asks (1) What is the reason? (2) What voltage is proper? (3) Can the voltage of a dynamo be increased by winding the armature with more turns of finer wire than at present? Ans. — (1) We think that the magnets have weakened. Magnets are "permanent" in a limited sense only. (2) We think that 12 volts and upwards are a common allowance. You can improve matters for the dynamo by allowing a longer time for the contact. For economical use of the batteries the contact is kept on for the shortest time possible. A battery has no self-induction, and the current can establish itself in the circuit much quicker than it can when it has to flow from the armature winding of the magneto. Economy of current from the machine need not be considered. You can also keep the magnets up to normal strength by putting a series winding upon them, and possibly in that case dispense with the spark coil. (3) Yes, but in your case you might not improve matters, for you would increase the self-induction and resistance.

803. **Wireless Telegraphy.** W. A. B., Santa Rosa, Cal., asks if we can inform him regarding electrolytic interrupters, their construction, etc. Ans. — Mr. W. C. Getz, 645 North Fulton Avenue, Baltimore, Md., will furnish you with drawings.

BOOK REVIEWS

THE BURNING OF CHELSEA. By Walter Merriam Pratt, Sampson Publishing Company, Boston, Mass. Price, $1.50. For sale at all book stores. This book is one of our publications. We print below what other book reviewers say of it: —

We fear that the chief bid for fame made by Chelsea, in Massachusetts, will remain the recent disaster which Walter Merriam Pratt commemorates in the "Burning of Chelsea." This is a spirited description of the great fire, which will interest the inhabitants of Greater Boston, and will be of value to future historians. The author is able to fill one hundred and fifty pages with his story, using very little padding. — *New York Sun.*

An absorbing and remarkably interesting story of the great fire. Typographically, the book is beautiful, and is a record of one of the greatest conflagrations in history. It is peculiarly valuable as a book of reference. — *Boston Globe.*

Mr. Pratt's book is a vivid description of personal knowledge, and it makes a very good permanent memorial of the event. — *Providence, R. I., Journal.*

The story of the great fire is told in good, comprehensible language. — *Manchester, N. H., Union.*

It is a most interesting narrative, and a valuable history of what was one of the most disastrous conflagrations in the country's history. — *Salem News.*

The story, which is well told, contains a great deal that will interest firemen. — *The Firemen's Herald.*

It is a well-told story. — *National Sportsman.*

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WIRELESS TELEGRAPHY AND TELEPHONY. — POPULARLY EXPLAINED. By Walter W. Massie and Charles R. Underhill. New York, D. Van Nostrand Co. Price, $1.

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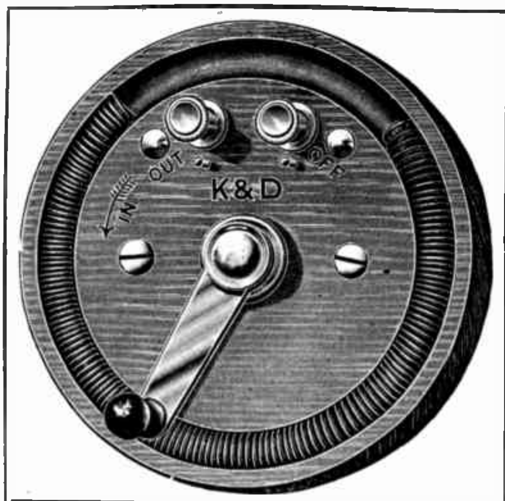

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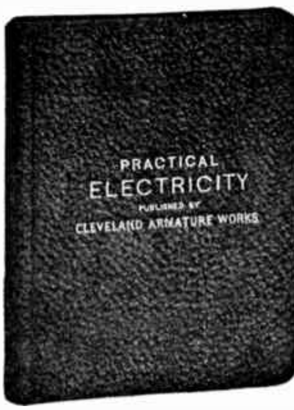

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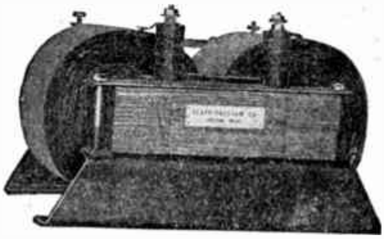

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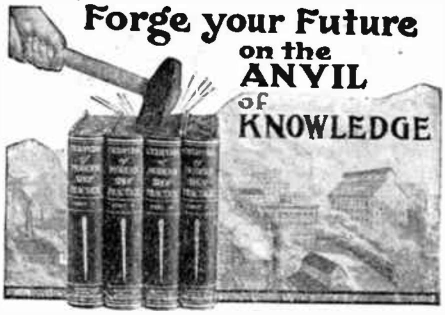

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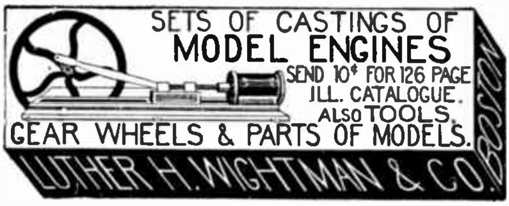

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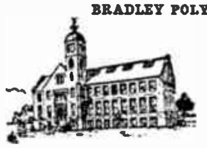

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