AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES.

VOLUME I

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES.

CONTAINING
ILLUSTRATED ARTICLES DESCRIPTIVE OF ELECTRICAL AND
MECHANICAL APPARATUS, FURNITURE AND OTHER
USEFUL ARTICLES, GAMES, PHOTOGRAPHY,
ASTRONOMY, BOOK-BINDING,
MECHANICAL DRAWING,
ETC.

VOLUME I.

PUBLISHED BY
DRAPER PUBLISHING COMPANY,
BOSTON, MASS.
1902.

PURITAN PRESS,
BOSTON.

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VOLUME I.

South-West News ...

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. I. No. I. NOVEMBER, 1901. Ten Cents a Copy

STUDIES IN ELECTRICITY.

DONALD M. BLISS.

I.

SOME of the most difficult problems encountered by the student of electrical science and industry present themselves at the very beginning of his studies, and their nature is indicated in the first questions he usually asks. What is electricity, what are the laws governing its action, and what are the terms so frequently used — volts, pressure, E.M.F., amperes, ohms, etc.? Of the making of textbooks there is no end, and the student or amateur will find standard works in most well-equipped bookstores, at a moderate price, in which he will find these questions answered very fully. Unfortunately, however, the explanation of the various terms and rules are so frequently complicated by mathematics and pure theory, that unless the student has access to a properly equipped laboratory and the services of a skilled instructor, a great deal of tedious labor is necessary to enable him to reason intelligently and appreciate his first problems. These conditions are not usually within the reach of the amateur, and the so-called popular works on electricity are worthless as a real aid to his studies, being largely compiled from manufacturers' catalogues, with a smattering of information taken at random from obsolete works from which the copyright has long since expired.

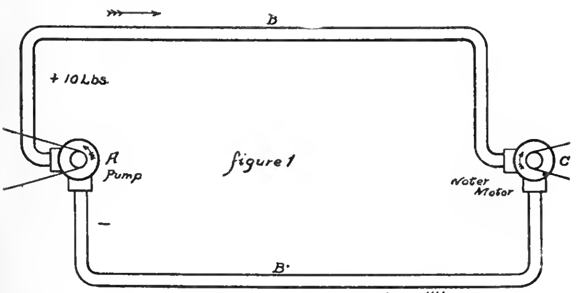
We will endeavor in this series of articles to "make haste slowly," and to illustrate each principle or rule by simple but comprehensive experiments with apparatus made by the student himself, thus maintaining an even balance between theory and practice, and enabling the student to secure a clear understanding of electrical science as it exists to-day.

To the question, "What is electricity?" no answer can be given. We know it only in the same way in which we recognize light and heat; namely, by the effects produced by its action. At this early stage it would be useless to examine in detail the theories most commonly accepted regarding the nature of electricity itself. We can only state that it is one form of the everlasting energy of nature, and displays itself to us as one member of the great trinity of natural forces — heat, light and electricity.

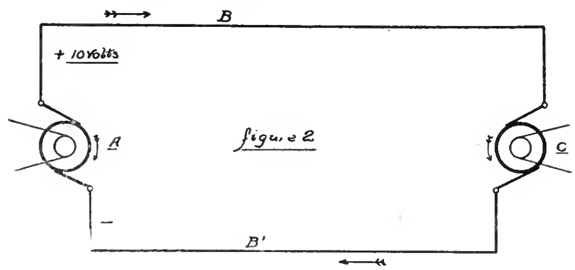
For many centuries electricity was only known in the impressive form, still exhibited in nature's laboratory by the thunderstorm, and in the feeble attraction of excited amber or resin for particles of paper or other light substances. The fact that this phenomenon of attraction was produced by the same force that forms lightning, was not suspected or proved until comparatively recent times.

The first and one of the most important facts to be noted by the student is that there is only one kind of electricity, and the difference between the lightning's flash and the feeble current generated by a single cell of battery is only one of degree; both effects being produced by the same force, the results differing only with the varying conditions in each case, and in direct accordance with well-known laws. The early experimenters conceived electricity to be a sort of fluid, and drew close distinctions between the various forms of electrical display with which they were familiar. Atmospheric electricity, frictional electricity, galvanic, and the electricity produced by earth currents, etc., were treated as though they were entirely separate forces. It is true that the action of electricity in many respects bears a striking similarity to the flow of fluids, and many of the terms and expressions used by the early scientists have been continued to the present time. As the purpose of these articles is to give the home student a practical knowledge of electricity as it is used in every-day life, as illustrated by the telephone, telegraph, electric light and power, electroplating, etc., the state of electrical action under high pressures, and known as static electricity, will not be taken up until a good start has been made in the more important and useful branches of the science.

Electrical action, whatever its form, is controlled by the amount of pressure, the quantity of current flowing, and the time in which such action takes place in any given circuit. The term circuit is applied to any electrical system allowing of a flow or circuit of electricity through its various parts. To take a familiar example: An electric-doorbell circuit is composed of a generator or battery, wires connecting the battery with the circuit-closer, or push-button, and the bell. The office of the push-button is to break or open the circuit at this point, so as to prevent the current flowing through the system and operating the bell until this contact is closed by pressing the button, when the current will at once flow through the circuit and operate



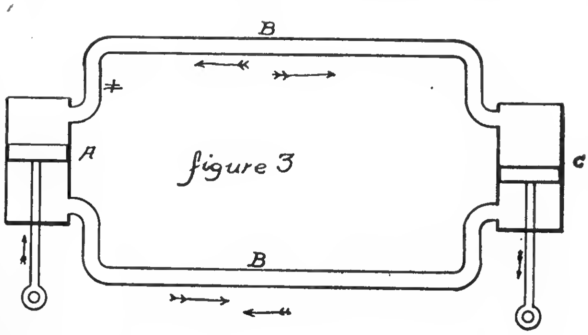
the bell or signal. As stated above, the action of a current of electricity in such a circuit resembles in many respects the behavior of a fluid under pressure. It will assist the student to a better understanding of the laws governing electrical phenomena by examining the accompanying illustrations: In Fig. 1, A represents a force pump of any type, here shown as a rotary pump, and driven by any source of power. C is a water motor of the same type, and B and B′ the pipes connecting the two machines. It is evident that if the pump A be driven so as to force water into the pipe B under sufficient pressure, the water motor C will revolve and may be used to furnish power, as indicated by the belt. It is also evident that all the water forced through the motor must return to the pump, so that a continual circulation of water takes place in the system so long as the pump is operated and the conditions remain unchanged. The water in the above case can only flow in one direction, as indicated by the arrows. If the pipes and apparatus are only strong enough



to run under the moderate pressure of say 10 lbs. to the square inch, and the pump could be driven at a higher rate of speed, so as to keep a pressure of say 1,000 lbs., it is apparent that the pipes and joints, or the weakest point of the system, would soon begin to leak, and finally burst, and the water escape.

It is also true that the rapid flow of water in the system will generate a certain amount of heat, owing to the friction between the water and the pipe, and they would become warm to an extent depending on the rate of flow and friction in the pipes. Now compare this diagram with Fig. 2, and the similarity will be apparent. A represents any source of electricity, such as a battery or dynamo, B and B′ conducting wires, connecting the dynamo with the electric motor C. If the dynamo be operated and the connection is complete, as shown, the current of electricity will flow in the direction indicated by the arrows, and the electric motor C will revolve and do mechanical power in precisely the same manner as the water motor in Fig. 1. The wires B and B′, and other parts of the system, will also become heated, the amount of heat depending upon the rate at which the current flows through the circuit and the resistance offered to the current by the wires. If the electrical pressure could be raised sufficiently high, the electricity would escape from the wires at the weakest point of the system, and a general display of fireworks with destructive effects would be noticed, thus corresponding to the bursting of water-pipes under heavy pressure in Fig. 1. The water pressure in the latter case was stated to be 10 lbs. to the square inch. In the circuit shown in Fig. 2 the electrical pressure is given as 10 volts, as electricity has no weight and is not a material substance. It is evident that we cannot use the term *pounds* in connection with the pressure produced by the dynamo.

The *volt* is the unit of electrical pressure, and derives its name from one of the early investigators, Volta. The manner in which this unit of pressure is determined will be explained in future papers. At the present time it may be stated that a cell of gravity battery using copper, zinc and a solution of sulphate of copper, delivers a pressure of very nearly one volt per cell, regardless of its



size. This battery is a familiar sight in telegraph offices, and it is used almost exclusively for this service. The pressure given by the familiar bell battery used for operating doorbells, annunciators, and consisting of a carbon and zinc cylinder in a solution of sal ammoniac, delivers a pressure of very nearly 1½ volts, while other batteries, to be described, will produce a pressure of 2 to 2½ volts per cell. A number of cells may be connected up in such a way as to add the pressures, and thus any desired voltage may be obtained. The current produced by batteries of this sort is continuous; that is to say, the current continually flows through the wires in one direction, as shown by the arrows in Fig. 2. The greatest electrical pressure known is exhibited in a flash of lightning. In this case it may be so high as to force its way through a mile or more of air, and the electrical pressure, many millions of volts.

To express the quantity or amount of electricity flowing in a circuit, the term *ampere*, also derived from a well-known scientist, Ampere, is used. In Fig. 1 we stated that a water pressure of 10 lbs. was produced by the pump A. This statement, however, does not give us any idea as to the amount of water flowing in the pipes at any given time; and if we wish to know this point, we should expect to be told that the rate of flow, or the amount of water passing through the pipes or through the water motor C, would be so many gallons per minute. The latter expression, of course, indicating the rate of flow. This is precisely what the term ampere indicates in an electrical circuit, and the derivation and the method of obtaining the standard is reserved for a future writing.

Once more referring to Fig. 1, we stated that the pipes and apparatus would become heated by the water passing through them under the pressure produced by the pump C, and we should state that this heating was due to the friction or resistance to the flow offered by the pipes. In an electric circuit, as illustrated in Fig. 2, the term resistance is used instead of friction. The unit of resistance, named for another investigator, Ohm, is called the *ohm* (pronounced like home without the *h*); and without at present going more deeply into the subject, it may be stated that an ohm is the amount of resistance offered by a wire or any other substance that will allow a current of one ampere, at a pressure of one volt, to pass through it.

Many of our readers have no doubt heard of the alternating current, in connection with light and power systems. We have already stated that a direct current is one that is flowing continually in one direction, around and through the circuit. An alternating current, as its name indicates, is a current of electricity that flows through a circuit, first in one direction and then in the other. This is well illustrated in Fig. 3, which shows two pumps of the ordinary or piston type, connected together and filled with water on both sides of the piston and in both pipes. It is evident that if the piston in figure A is pushed in and out, the piston in B will follow the motion of C exactly, or will be alternately pushed in and out by the action of the pump A, and the strokes of the piston in pump or motor C may be used to deliver power.

If the pump A was operated so as to deliver a pressure or thrust of 10 lbs., first in one direction and then in the other, we should have the same amount of power delivered to the pump or motor C, as in the case of Fig. 2. This illustration represents very clearly the action taking place in an electrical circuit supplied by a generator of electricity, delivering an alternating current. In practice, a dynamo of special construction is used, which delivers a current first in one direction, then in the other, at a very high rate; the number of alternations in many cases being as high as 16,000 per minute, or 266 per second. If electric lights were operated by a slowly varying current of a few hundred alternations per minute, the lights would flicker so perceptibly as to be useless.

The alternating current has peculiar properties not possessed by the direct current, and which renders it unfit for many applications in electrical industry. It is, however, largely used for lighting, and for the transmission of power in large amounts. Direct currents are almost universally used for the operation of motors, street railway systems, electroplating, telegraph, telephone, and many other applications. The student should bear in mind that a current of electricity, whether it be derived from a battery or a dynamo, is the same, and will produce equal results in any given case. For instance, if a system of electric bells has been operated by say 10 cells of battery producing a pressure of 15 volts, the system will work equally well if a dynamo is substituted for the battery, provided the dynamo is wound and operated so as to produce the same pressure, 15 volts, and has a current capacity equal to or greater than the battery itself displays. The principle on which all dynamos operate, known as magnetic induction, opens up an entirely new field of investigation, and must be deferred for future study.

We will in the next chapter take up the practical construction of an experimental battery and apparatus for demonstrating clearly the principles and laws of electrical action just described.

(To be continued.)

The practical sense of the German nation is evidenced by a ministerial decree forbidding motor-car racing in public thoroughfares throughout Germany. It is noticeable that strong opposition to automobile "scorching" is also appearing in the United States.

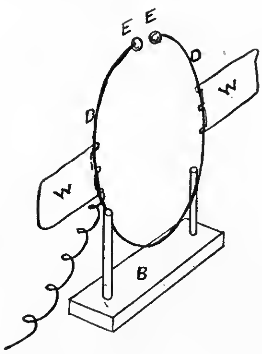
HERTZIAN WAVES.

If a stone be thrown into a pool of still water, the motion of the stone causes a disturbance on the surface of the water. Circular waves radiate from the point at which the water was struck, diminishing in height until no longer visible. The movement of these waves is slow; the eye can easily follow them and count the number of waves per minute. Other waves in a more elastic medium than water are found to be much more rapid in movement. The striking of a bell causes it to vibrate, which vibration imparts wave motion to the surrounding air. Our ears are so constructed that this wave motion, if the rate be not less than 16 nor more than 44,000 per second, is transmitted through the tympanum and nerves of the ear, and we become sensible of it as Sound. Certain bodies are responsive to a particular rate of vibration. If a violin be played close to a wine-glass in exactly the same tone as the vibration rate of the wine-glass, the wave motion from the violin will set up a vibration in the glass, sometimes so violent as to cause the glass to break in pieces. Many interesting instances of this harmony of vibrating rate are recorded in the various textbooks on Physics.

Sound waves, while much more rapid than the water waves, are still comparatively slow when we consider the rapid vibrating motion of heat waves. The rapidity of these waves is beyond the ability of the mind to comprehend except by comparison. That degree of heat termed "bright red" requires the atoms of the body giving out this heat to vibrate at the rate of 400 billion times per second. It has been discovered that, under certain conditions, electrical waves radiate through space and have the power to influence suitable objects prepared for that purpose. The particular form of electrical wave under consideration is that known as Hertzian waves, so termed from the comprehensive discoveries of Dr. Heinrich Hertz, of Carlsruhe and Bonn. By means of a series of masterly experiments based upon certain phenomena previously discovered by other scientists, Dr. Hertz, between the years 1886 and 1891, added greatly to the knowledge of these electric waves and their effects on adjacent bodies, enabling them to be put to practical use in wireless telegraphy.

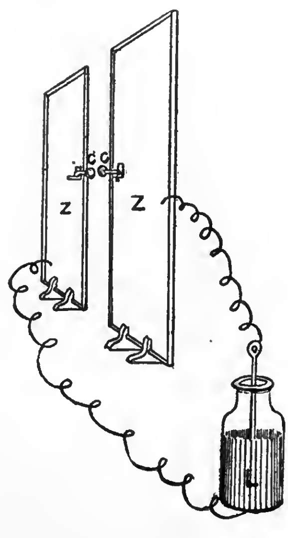
These Hertz waves do not have the extremely rapid vibratory rate of heat waves, though, as compared with sound waves, they are still very rapid, their vibrations being, as near as has yet been discovered, approximately 230 millions per second. These waves are set up by any sudden electric discharge, such as a lightning flash, or in a less degree by a spark from a sparking or induction coil or Leyden jar. They are made evident to our senses by suitable apparatus that, being adjusted to the same rate of vibration, receives the wave impulses and acts in unison with them. We may soon be able to learn of the approach of electric storms by means of instruments that will receive the electrical waves set up by the distant lightning flash.

The apparatus for demonstrating electric-wave action is simple and may easily be constructed at small cost. Procure two sheets of heavy zinc 16″ square, and mount them in a light wooden frame.



Small picture-frame moulding makes a neat-looking frame. At the center of one edge of each plate (Z) solder an L-shaped strip of zinc, the projecting piece being about ½″ long, and having a ⅛″ hole through it. To one end of two pieces of brass wire 4″ long and ⅛″ in diameter, fit brass balls (C) 1″ in diameter. The other ends of the wire are then put through the holes in the zinc angle-piece, and when the plates are placed in line, the two balls will face each other. The plates should also be fitted with ebonite or glass feet, raising them 2½″ or 3″ from the level. At the outside of one plate and in the lower outside corner of the other, bore small holes, and connect, by soldering, two pieces of insulated copper wire, size 16 or 18, which are to connect with the Leyden jar. This Oscillator, as Dr. Hertz named it, if placed on a stand with the plates in line and the balls from ¼″ to 1″ apart, according to conditions, will, when connected to the outer and inner coatings of the charged Leyden jar (L), set up powerful electrical or Hertz waves in the surrounding medium at the instant the discharge takes place between the balls of the "oscillator" plates.

These waves are taken up and made evident by a simple form of receiver known as Hertz's Resonator. This consists of ¼″ brass rod 5 feet long bent into the shape of a nearly complete circle 18″ in diameter. The unconnected ends are fitted with two 1″ brass balls; the distance between them is adjusted by bending the rod. Wings of thin sheet copper 6″ wide and 10″ long are fastened to each side of the rod by twisting around the rod extension strips that were left on the wings when they were cut out. In place of the brass balls the ends of the rod may be turned into two small circles, and soldered to make a perfect



joint. The brass balls are the best, and should be polished with emery-cloth before trying experiments. The circular brass rod (D) is held suspended by two round pieces of wood 8″ long and 1″ thick, the lower ends of which rest in holes bored in the base (B). Two round-headed brass screws on each upright hold the brass rod in place, one screw on each side of the rod. It will add materially to the success of the experiment if one wing is connected by a piece of covered copper wire to a "ground." The nearest gas or water pipe will answer. The base is a heavy block of wood with wooden uprights, upon which to fasten the circular rod.

The Leyden jar may be made from an ordinary quart glass milk or preserve jar, provided it is made of the right kind of glass: that is, a good insulator. To test this point, carefully clean and dry the bottle. When quite dry (it must also be cold), rub it briskly on the outside with a warm silk handkerchief. Reject any jar that does not quickly become charged so as to give a distinct spark. A sound wooden bung is then fitted to the mouth. The bung should be a new one, entirely free from acid or grease. A hole is bored through the center to admit a piece of brass rod about $\frac{1}{8}''$ in diameter and one-third longer than the bottle. The rod should fit very tight, and after putting it through the bung the top of the latter is given a liberal coating of red sealing-wax. The outside or top end of the rod is fitted with a brass ball 1″ in diameter, and to the inside or lower end is soldered a piece of brass chain 3″ long to aid in making a good contact between the inside coating of the jar and the rod. In place of the brass ball the rod may be turned to form a circle, but the joint must be carefully soldered and filed perfectly smooth.

The jar is then given the coating of tin foil, the inside being done first. The tin foil used should be heavy enough to withstand the work without tearing. A piece is first cut into a circle a trifle smaller than the outside diameter of the jar. Carefully cover one side with hot glue, and place it upon a dauber. This is made by wrapping a tuft of cotton wool to one end of a small stick and covering with cloth. Holding the jar with the mouth down in one hand, press the tin foil, by means of the dauber, firmly up against the bottom of the jar; then turn the jar upright and finish pressing the tin foil smoothly into place. The side coating should cover three-quarters of the distance from the bottom to the bung and lap over the bottom layer slightly. Owing to the difficulty of handling one large piece, it may be cut into halves. One side of the tin foil is covered with glue, placed lengthwise on the dauber and holding the jar horizontally, inserted in the jar. A quick turn of the dauber will allow the foil to drop lightly against the inside of the jar, when it may be set in place and smoothed firmly against the glass. The other half is then placed in a similar manner.

The outside is then coated in the same way and to the same height as the inside. It will not be necessary to divide the outside coating. The coatings should get thoroughly dry before using the jar. The proper apparatus for charging the jar is a Wimshurst machine; a description of the construction of one will appear in a future issue. In the absence of such a machine the jar may be charged from a rapidly moving leather belt, such as can be found in almost any factory. Hold the jar with one hand around the outside coating and the top of the brass rod about 1″ away from the belt. A few minutes in this position will allow the jar to be fully charged. Do not try to discharge the jar by making a circuit with the hand, as a strongly charged jar will give a shock that would be far from comfortable.

The discharge of the Leyden jar is made by bringing the ends of one of the connecting wires to the outside coating and the end of the other wire to the terminal knob of the inside coating. A sharp discharge will then take place between the balls (C and C′), provided all the parts are in proper condition. Some adjusting may be necessary to determine this. The waves set up by these discharges, on impinging on the wings (W) of the Resonator (this being placed eight or ten feet from the oscillator), set up sympathetic surgings in the ring (D) and these overflow at the spark gap between the two balls (E). The walls of a room offer no obstruction to the passage of these waves, but another current of electricity in the path to be traversed will interfere with it. Much interesting instruction may be derived from experiments with this apparatus.

The great objection to electric motors — that they will not run far enough without recharging — is said to be overcome. It is recorded that recently in England a circuit of 94 miles was run without recharging. It was done with a battery of 42 four-plate cells, with a capacity of 180 ampere-hours. The carriage was a four-wheeled dogcart, with two motors of two and one-half horse-power each. In going down grade the motors were reversed, thus making dynamos for charging the accumulators. In this way the current was not only saved, but a new current actually generated, rendering the battery stronger at the bottom of the grade than it was at the top.

ELECTRIC BELL FITTING.

I.

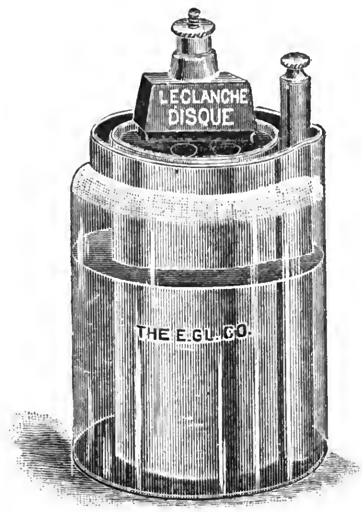
A RESIDENCE.

The use of electric bells is now so universal as to require no description of their adaptability to many household requirements. Simple in construction, easily fitted to new or old buildings, needing but little attention in operation, and serving so many useful purposes: any one of ordinary mechanical ability can, with but little expense, learn to make them or fit up a dwelling, office, factory or other place where they may be desired.

The essential parts are a battery for generating the current, the bell, a push button or buttons for closing the circuit and wire. The battery, of one or more cells, may be one of several different forms, depending upon the location and service for which it is intended. It is quite important that the battery used should be reliable and properly set up, as failure at this point affects the whole system, while a broken wire or bell may disable only a single point. The size of the battery is regulated by the amount of work required. Too small a battery would become quickly exhausted, the bells would ring faintly, or not at all, and disappointment follow, where, with a proper battery, very satisfactory service would be secured. Batteries that are overtaxed exhaust much sooner in proportion than do those of adequate size. One horse will fail to haul a load that two horses would have no difficulty in hauling for a long distance.

The Battery.

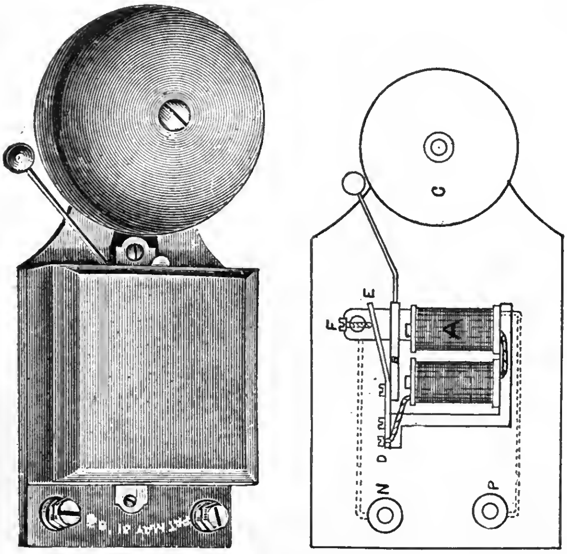
The Leclanche Battery is the form most generally used for electric bell work, although the Fuller or Edison-Lalande is used where the work is excessively heavy. For most places the Leclanche will be found adequate. The Leclanche cell consists of a glass jar, a zinc rod, the positive element; and a carbon plate packed in porous cup with a mixture of carbon and peroxide of manganese, which form the negative element. The porous cup, after being packed, is covered with a preparation of pitch. When these parts are assembled, the exciting fluid, a solution of sal ammoniac, is added. The solution should fill about two-thirds of the jar, and should be strong enough so that when the water has taken up all the sal ammoniac it will, there will be a little left in the bottom of the jar. So long as the wire circuit is open or broken no chemical action takes place; but when the button is



pressed, and the circuit closed, an electric current flows from the positive pole to the negative, and a chemical reaction takes place. The solution of sal ammoniac (chloride of ammonia) is decomposed, the chloride unites with the zinc to form chloride of zinc, while the ammonia extracts oxygen from the manganese, forming a soluble compound on the surface of the carbon. While the cell is working, the zinc rod is being dissolved, the manganese gives up oxygen, and the carbon remains unaltered. In time the zinc rod would have to be replaced with a new one, and a fresh solution of sal ammoniac replace the old one, which contains an excess of chloride of zinc. The peroxide of manganese absorbs oxygen from the air when the cell is not at work, to replace that extracted by the ammonia.

The top of the glass jar is covered, both inside and out, with a narrow coating of paraffin wax, to prevent the salts from creeping out of the jar and soiling the shelf upon which it rests. Where the paraffin has not been properly applied or rubbed off, the salts will at times gather on the outside of the jar. This can be corrected by cleaning off the salts, and recoating the jar with paraffin, obtained by melting a piece of wax candle in a cup placed in hot water. This description of a Leclanche cell is given to enable the reader to have a general idea of its parts and working. At another time a more complete description will be given, in connection with their manufacture out of such articles as may at times be discarded in the home.

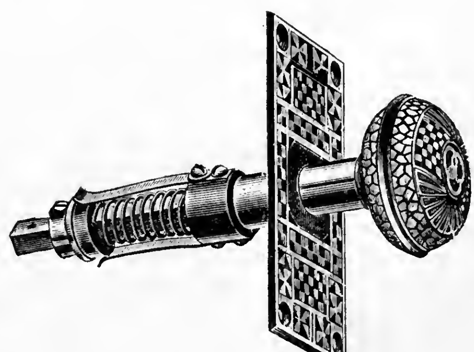
Several excellent forms of "dry batteries" are now much used for this work, and obviate all trouble with liquids, being purchased all ready for work when connected with the wires.



The Bells.

The form of bells generally used is that known as the vibrating or trembling bell (see Fig.). While the circuit is closed the bell will continuously sound, due to the rapid vibrations of the striker or hammer. The parts are: an electro-magnet, A, a vibrating armature, B, upon one end of which is the hammer, a bell of wood or metal, C, and connecting wires, screws and terminals. Upon closing the circuit the current enters the terminal, P, flows around the coils of the electro-magnet to D, continuing through the armature B and contact spring E to the screw F and the wire connection to the terminal N. In its flow around the electro-magnet the current has magnetized the cores, which now exert an attraction for the armature, causing it to approach the poles. This causes the hammer to strike the bell. This movement of the armature has brought the contact spring away from the contact screw, breaking the circuit. The breaking of the circuit prevents the current from exciting the electro-magnet, and the cores cease to attract the armature, which, owing to the tension of the spring, moves back to its former position, again closing the circuit; the current again enters the electro-magnet and the movement of the armature is repeated. These movements continue so long as the button is pressed, and are quite rapid.

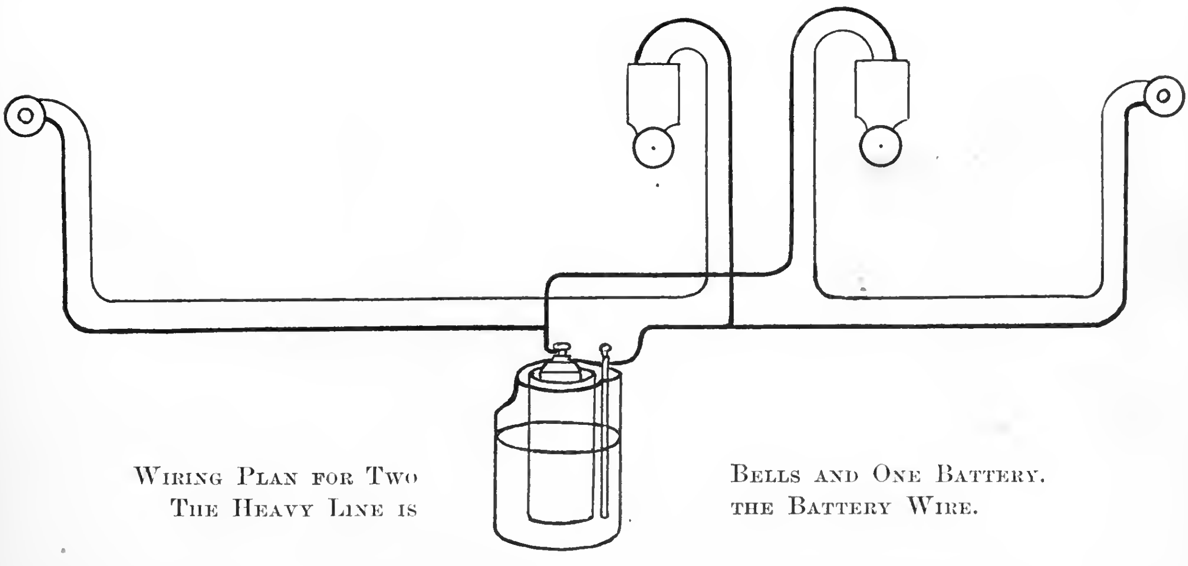
Should a bell not work as here described, the cause of the trouble will probably be found either in the cores of the magnet or the adjustment of the contact screw or armature spring. The armature spring should be flexible, and yet keep in contact with the contact screw. If, after closing the circuit, the armature seems to cling to the poles of the magnet, the probability is, that the cores are not made of suitable iron, which should be very soft; as only soft iron will quickly demagnetize, which is very necessary in electro-magnets. The proper adjustment of the contact screw can readily be secured by a little experimenting. If the armature is left too far away from the magnets, the ring will be a feeble one. A piece of watch-spring may be used to press lightly either side of the armature spring while the bell is ringing, and if the ringing improves, the necessary adjustment of screw or spring is at once evident.



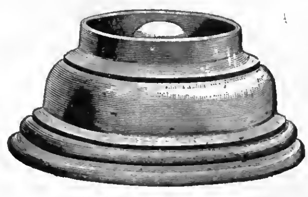
Setting Up.

To illustrate the method of setting up an electric bell outfit, it is assumed that the service to be secured consists of two bells, one for the front entrance of a dwelling and the other for the rear entrance, and that the bells are to be placed in the kitchen or rear hall, to ring where a servant may hear them.

The location of the battery is first determined, one cell being large enough for this work. It should be in a place where it will not freeze or yet get too warm. The cellar usually is the most suitable, as the temperature does not vary greatly in the different seasons, and wires may be run to it handily from any part of the house. An empty wooden box, of suitable size to hold the battery, should be nailed to a post or to the timbers of the floor above. The carbon is then placed in the jar, which is then filled about two-thirds full of water. The sal ammoniac is then added and the zinc placed in position. Several hours are required before the cell is strong enough to properly ring the bell. The wire is now strung; and, to avoid confusion, two colors of covering are used, one color for the battery wire and one for the bell and push-buttons wires. To wire the front door, the place for the push-button is determined. If a pull-knob of a doorbell is to be found, this may be utilized, or it may be taken out and an electric pull-knob substituted. A push-button may also be used, and the wires run through the hole. If no hole is there, one will have to be bored with a small bit or bell-hanger's gimlet. A similar hole through the floor will enable enough of the two wires to be pushed up from the cellar to reach the push-button or knob, with a little wire to spare for connections. If a push-button is used, unscrew the cover, push one wire through one of the small holes beside the screw, remove about one inch of the insulating covering, twist the wire one turn around screw, then tighten screw. Push the other wire through the other hole, and attach in the same way. Pull the wires back until the push-button lays flat against the casing of the door. If the wires prevent this, with a knife or chisel cut grooves in the casing for the wires, and the button can then be screwed to the casing. The wire should be tacked at intervals to keep it in place, care being used not to set the tacks so hard as to break the wire. The route of the wire should be as inconspicuous as possible. Specially prepared hollow molding can be obtained to cover wires where this is desirable. Returning to the cellar, the wire is strung along the timbers of the floor above in any way that may seem desirable, the battery wire being strung to the battery and the other wire to the point in the floor underneath the bells. Sufficient wire is measured to reach the bell before cutting.



Wiring Plan for Two Bells and One Battery. The Heavy Line is the Battery Wire.



The wiring for the rear door is done in a similar manner. The first battery wire may be tapped at any place, and a branch spliced on, if a saving of wire can be effected thereby. The return wire to the battery is strung to the bell, and this may likewise be spliced for a branch, the only requisite being a complete circuit of wire from the button to bell and battery; the button being the place where the circuit is open until closed by pressure. When splices are made, care must be used to fully insulate the point with tape prepared for that purpose. If such tape is not procurable, cotton twine may be used, and same covered with paraffin by melting a candle held over the joint and rubbed with hot table knife.

The bells are now secured to the wall, bell end down, the covers being removed to do this. The wires are then connected to the terminals, and all is complete. If the battery has been set up long enough in advance, and the work properly done, a pressure on the push-button should ring the bell. If the bell does not ring, inspect the work to see if all connections are made, and if all the parts are in working order. Where two or more bells are used, different tones should be used to enable them to be distinguished. A wooden shell can be used to replace a bell where a loud sound is not necessary.

BORING HOLES IN METAL OR WOOD.

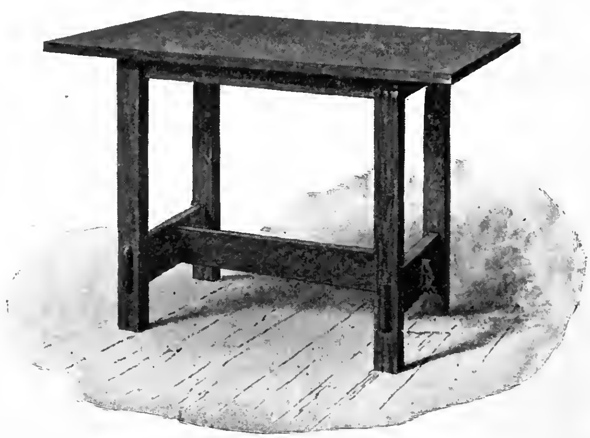
Should any of the readers of this Magazine have occasion to bore holes in metal and are not equipped with a powder-drill, they will find the drill illustrated by the figure, suitable for such work. It is used in an ordinary bitstock, and up to $\frac{1}{4}''$ or $\frac{3}{8}''$ will drill soft steel, iron, brass or other metals. It will not be injured, when boring through wood, by contact with nails, screws, etc., and will bore through any kind of wood without splitting it. For these reasons, it is a very handy tool for the amateur, and, being of low price, should be added to the tool equipment as occasion requires.

In Paris a new electric fire pump, which contains 100 gallons of water and is ready to start for a fire at any moment, is proving quite a success.

OLD DUTCH FURNITURE.

A Small Table.

The revival of the Old Dutch in household furniture affords the amateur many opportunities to display his skill, which needs not to be highly developed to produce many useful as well as ornamental furnishings for the home. Careful work and sharp tools are the main requisites, for upon the latter the former greatly depends. This is the first of a series of descriptive articles giving the necessary directions for making such articles as tables, desks, bookcases, china-cabinets, settles, beds, etc., all of which can be constructed by any one of ordinary skill and with a moderate equipment of tools. Much of the material may be obtained of the lumber dealer sawed to actual dimensions at but little extra expense, if pencil drawings of shapes and sizes be furnished with



the order, greatly reducing the heavy work that otherwise would have to be done. Such parts of the work as may be advisable to have done at the lumber dealer's will be indicated. Before beginning the construction of any of these pieces the necessary tools should be put in first-class condition. The time spent in doing this will be fully regained in the work to follow.

The first subject for trial is an occasional table of solid oak, its completed form being shown in the accompanying sketch. The top is 40″ long, 28″ wide and $1\frac{3}{8}''$ thick. As the work of gluing up the top requires clamps to hold the boards firmly together while the glue is drying, as well as accurately planed edges to avoid cracks, this work had best be done at the lumber-mill if it is possible to have it. The glue should be allowed to become thoroughly dry before the top is fastened to the frame.

The parts for the frame include four pieces for the legs 2⅜″ square and 28½″ long; two pieces 43½″ long and 2½″ wide and 1″ thick for the top of the frame to which the table top is attached; two pieces 21″ long, 5″ wide and 1″ thick, and one piece 32⅝″ long, 4″ wide and 1″ thick for the bottom of the frame. Also two small pieces for keys 3″ long, 1″ wide and ¾″ thick, and several pieces of ¼″ oak dowel.

Beginning with the legs, make the mortises for the cross-pieces. It is well to mark out with a pencil where the mortises are to come, the better to secure a good fit, and avoid the error of getting the mortises in the wrong sides. The mortises in the top end are 1″ wide, 1¼″ deep and ½″ from outside edge of leg, and extend 2″ from the end, the cross-pieces being cut down to fit, forming a shoulder which serves to make the frame rigid. With a bit bore holes to remove the wood, finishing with a sharp chisel, care being taken not to cut away too much wood and so cause a loose-fitting joint.

The mortises for the cross-pieces at the bottom of legs are 4″ long and 1″ wide, and are cut clear through the leg. The bottom of mortise is 4½″ from the bottom end of the leg.

The cross-pieces for the top of the frame are then prepared. The two side pieces are 27¾″ long and 2½″ wide. For the tenons on each end to fit the mortises in the top of the legs, cut a piece ½″ wide and 1¼″ long from the lower side of each end. The two end pieces are 17¾″ long, and pieces are cut from the lower side of each end, the same size as from the side pieces. Three holes in the side pieces and two holes in the end pieces are bored into the under sides to receive the screws that fasten the top in place. They should be ½″ in diameter to the depth of 1½″, and a trifle less than the diameter of the screw for the balance. The screws should be 1¾″ long and about ¼″ diameter.

The end pieces at the bottom are 21″ long, tenons being cut at both top and bottom of each end, 2⅞″ long and ½″ deep. The edge of the ends are beveled slightly with a plane to make a neat finish. In the center of each piece is cut the mortise to receive the bottom cross-piece, which should be 3″ high and 1″ wide. When these end pieces are complete, they are, together with the top end pieces, set tightly into the mortises in the legs, care being taken to see that the pieces are squared with each other. Then ¼″ holes are bored clear through the legs for dowel-pins to fasten the frame together. The dowel-pins are driven in, each end being sawed off flush with the leg and carefully smoothed over.

The bottom cross-piece is 32⅝″ long, tenons being cut, at top and bottom of each end, 2½″ long and ½″ deep. In the center of each end cut holes for the keys 1″ high and ¾″ wide, the outer edges being ¾″ from each end. The ends of the piece are also beveled, about a ¼″ bevel being made. The keys are straight pieces, 3″ long, 1″ wide and ¾″ thick in the center, each end being beveled off to ⅜″ thick. The cross-piece can now be placed in the mortises, the keys driven in place and secured by glue, when everything is found correctly fitted. The top side pieces are also secured by dowel-pins, and the frame is complete. See that all joints are correct before the final fastening.

To attach the top of the table to the frame, place it top down, on suitable supports, preferably two low carpenter's horses. Place the frame in position. At the ends the legs will be 5″ from the end of top, and at all sides 4″ from the edge. Bore holes in the top ¾″ deep, to match those made in the frame, setting screws in one or two holes, before making the balance, to ensure correct work. The table should now be carefully smoothed over with fine sandpaper, any holes being filled with putty. A convenient way of using the sandpaper is to wrap a strip around a small flat block of wood, changing the paper as soon as it becomes smooth.

A dark green or brown stain is the most desirable finish for the table, but before this is applied it is given a coating of filler. This prevents the grain from raising, and keeps the surface smooth. The filler, and a suitable stain and polish, can be procured of any paint dealer. The many excellent prepared stains and polishes now to be obtained at low cost, obviate the necessity of making them. At best the processes are complicated, and the materials not easily found, even in the large cities. The polish should have but little glaze, the graining of the stained oak giving the necessary character and tone to the work. A table, constructed as here described, will be found both useful and ornamental.

AMATEUR WORK.

85 WATER ST., BOSTON.

F. A. DRAPER . . . . Publisher.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

NOVEMBER, 1901

Contents

INTRODUCTORY.

In these days of many excellent magazines, the advent of another seeker for public favor may seem to require explanation for its existence and the field it proposes to occupy. The name, Amateur Work, supplies this information in part; the subjects included in this issue being typical of those to follow. Its aim will be to assist the amateur worker to obtain knowledge and skill in the many avenues that lie open to those who desire to learn, but who may have had difficulty in obtaining the elemental knowledge that must be acquired before advanced work is attempted. Most of the textbooks and trade papers presuppose a practical knowledge of the subject, and the elemental portion is omitted. This lack of practical instruction is a serious one, which this magazine will endeavor to overcome. A prominent feature will be constructive work for those who already possess a fair degree of handicraft, and who desire to improve leisure moments in a useful manner. Electricity, in its manifold development, will be given comprehensive, theoretical and constructive treatment. Household furnishings will receive adequate attention, as will also wood-carving, wood-turning, modeling, drawing, photography, astronomy; in short, everything that the amateur worker can accomplish within the home or workroom will find its place in these pages.

The special wants of readers will be met in the correspondence columns; answers to all proper inquiries being given by letter, in addition to publication.

The editors of the several departments are practical workers, and their presentation of the various topics will be in accord with the present-day practice. The instruction, whether practical or technical, will be accurate, and can be accepted by the novice with the knowledge that the methods he is following would receive the approval of the professional worker.

The thrifty mechanic, the young apprentice in the shop, the student in the technical trade or manual-training school, will all find Amateur Work a source of inspiration and self-help that cannot fail to be productive of advancement and profit. In time, the volumes will provide a store of industrial information, which will be invaluable to their possessor, approximating, as they will, the scope of a mechanical and scientific encyclopedia.

Dr. Armitage, an English physician, has used electric baths in the treatment of chronic lead poisoning, and in 40 severe cases 37 were benefited, some being completely cured. The rapid improvement is attributed to the change of the lead salts in the body into new and insoluble compounds. The apparatus used consisted of a large porcelain bath-tub, carefully insulated and provided with a large carbon negative electrode at the foot and a small movable carbon positive electrode, and a battery of 120 large Leclanché cells, connected in threes.

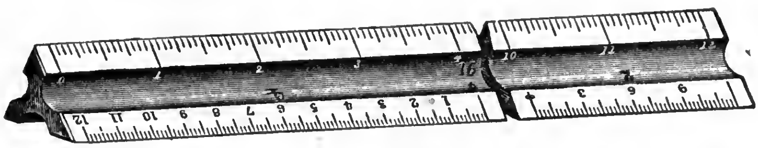
MECHANICAL DRAWING.

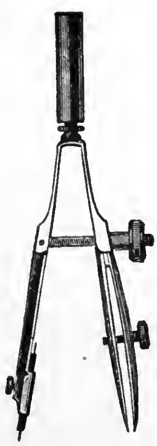
EARNEST T. CHILD.

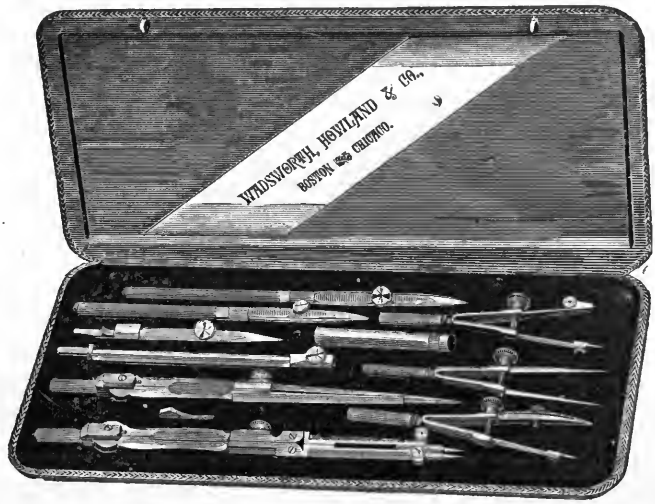
I.

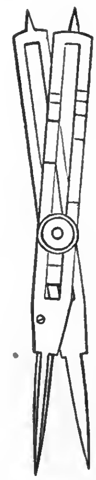
INSTRUMENTS.—THEIR USE AND CARE.

The student who is ambitious to become a draftsman must, like any other artisan, become perfectly familiar with his tools before he may attempt to perform his work. Of course, experience will in time teach one the proper use and care of his instruments, but the man who is forewarned is forearmed, and "a stitch in time may save nine," as the old proverb goes. It has been thought wise, therefore, to preface our talks on mechanical drawing by a few words on the use and care of drafting instruments, together with a brief description of those necessary and others which, while not absolutely indispensable, may aid in the production of more uniform and perfect work.









SET OF INSTRUMENTS.

The first requisite of any draftsman is a set of drawing instruments. This may be secured at a price varying from four or five up to twenty-five dollars for a set. One which will fill every requirement, and will last a long while with proper care, may be obtained for about ten dollars. It is foolish for a beginner to pay more, and on the other hand a cheaper set will not be apt to retain its accuracy, so this may be set down as a fair average figure. The instruments which should be found in such a set comprise the following:

One pair 6″ dividers with fixed needle-point, pen, pencil, and lengthening bar; one pair 5″ plain dividers with hairspring adjustment; one pair spring-bow spacers, one spring-bow pencil, one spring-bow pen, one 5″ pen and one $4\frac{1}{2}$″ pen.

To work readily, none of the above instruments may be dispensed with, though it would be possible to get along with a single pair of dividers with pen and pencil point. The advantage of the spring-bow instruments lies in their small size, and the fact that they will stay where adjusted and enable one to duplicate circles in any part of a drawing.

The hairspring adjustment on the plain dividers is very handy and saves much time and patience. This attachment is also applied to the larger divider, but it is not popular among professional draftsmen, although it has been found very useful by the writer. In selecting a set of instruments, the most important point is that the pens are of the best quality. The other instruments may be of a second grade, but the pens must be strictly first class. Those manufactured by Theo. Alteneder are considered the best, and they are certainly worth the difference in cost. The necessity of having first-class pens must appeal to all, as a large part of the finishing work has to be done with them.

Great care must be taken when using instruments to keep them in good condition. The box should be closed at night after work is over, the instruments having been previously wiped with a small piece of chamois skin kept for the purpose, and no dampness should be allowed near them. Pay particular attention to the care of the pens. Almost all drawing inks will corrode them more or less, and they should be carefully wiped, not only at the end of the day's work, but also at intervals during the work. The best penwiper is made of an old piece of sheet or shirt that is past other usefulness.

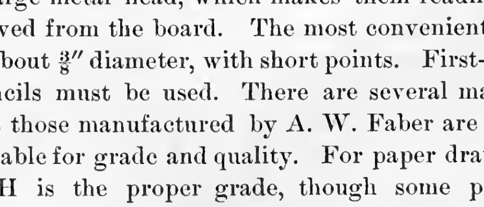
Drawing Board.

Drawing boards are of many kinds and sorts, varying in size from one large enough for a sheet of letter-paper to the long table used in railroad offices for profiles and other very long or large plans. The most convenient size is 23″ x 31″, built of 1″ pine, with cleats at the ends to prevent warping, and may be made at home, or may be purchased for about one dollar. The edges of the board should be straight, and it must be square, so that any side may be worked from. The best boards are made by gluing together narrow strips of pine and then planing the whole smooth. Pine is the most satisfactory wood, as it takes the thumb-tacks most readily.

The Square and Triangles.

The tee square consists of a long, thin strip of wood with its edges straight and with a cross-piece attached to one end at right angles. This cross-piece slides along the edge of the drawing board, and permits of drawing parallel lines. Triangles are used for drawing vertical lines from those drawn to the edge of the tee square. These are made in two forms; first 45 degrees having one right angle and two angles of 45 deg.; second, 30 x 60 deg. having one right angle, one 30 deg. angle and one 60 deg. angle. The 45 deg. triangle is used for cross hatching, and the 8″ size is the most convenient. It is necessary to have but one 30 x 60 triangle of about 6″ size, but it is very convenient to have another about 10″, making three triangles in all. The cost of a plain pearwood tee

square and three rubber triangles will be about two dollars. The rubber triangles however have been almost entirely superseded by transparent "amber" triangles, and the plan tee squares have been given place to others fitted with air edge of transparent substance; and while the expense is slightly greater, they are worth the larger outlay. One irregular curve will be found very useful on special work, especially in connection with machine drawing. Thumb-tacks are used for securing the paper to the drawing board. These are short tacks with



a large metal head, which makes them readily removed from the board. The most convenient size is about $\frac{3}{8}$″ diameter, with short points. First-class pencils must be used. There are several makes; but those manufactured by A. W. Faber are very reliable for grade and quality. For paper drawing H H is the proper grade, though some prefer harder; while for marking on tracing cloth a softer pencil, H grade, must be used. Nearly all pencil drawing is done on paper, and then traced in ink on the tracing cloth. Almost any rubber may be used, but for general work Tower's Multiplex is best, and Faber's circular is most convenient for fine work when there are many lines, only one of which is to be erased. Sand rubbers are made for erasing ink, and these should be always used in place of a knife, as the latter spoils the surface of the paper or tracing cloth, and makes it difficult to make a clear ink line after erasing. India ink in stick form was for a long time considered superior to all other inks. It had to be ground in a saucer, and it was necessary to grind it fresh nearly every day. While this is still used in some drawing-rooms, in a majority of instances it has been superseded by liquid ink of some make or other. The best liquid ink is manufactured by Higgins, and is almost universally used. In school work it is customary to have the pupil work on Whatman's drawing paper. This is the best paper made, and is comparatively expensive, listing 90 cents per quire for 15″ x 20″ size. A manilla detail paper may be obtained, which will answer every purpose, and not cost nearly so much. This is the paper most commonly used in drawing-rooms for laying out details of machines, etc. No draftsman's outfit is complete without a scale. The most convenient style of scale consists of a triangular piece of boxwood about 12½″ long. Being triangular it presents six straight edges, which are subdivided for scale drawing so that one inch may equal four, eight, or any number of feet. The common scales are ⅛″ to 1′, ¼″ to 1′, ⅜″ to 1′, ½″ to 1′, ¾″ to 1′, 1″ to 1′, 1½″ to 1′, 3″ to 1′ and one side is divided into inches and sixteenths of an inch.

The above-described outfit will be quite sufficient for any draftsman's needs, but there are other instruments which will often be found helpful. The first of these is the beam compass, which must be used where large radius circles are to be drawn. Proportional dividers are very useful in transferring a drawing from one scale to another, and a pentagraph may be used for the same purpose.

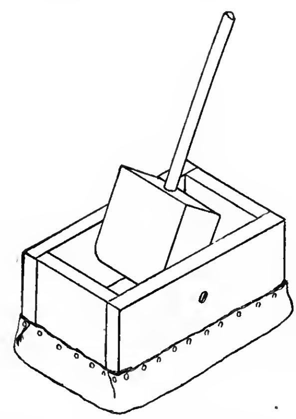
In laying off angles other than a right angle, a protractor must be used. This is a semicircle, subdivided into degrees. There are several devices in use for drawing section lines, but space does not permit of a full description of them.

(To be continued.)

The premiums offered are not cheap toys, but well-made and usable articles.

WAXED-FLOOR POLISHER.

Waxed floors require regular and thorough attention, if the surface is to retain the appearance so much desired by all good housekeepers. This involves much laborious work, which may be avoided by using the polisher here described. The base is a strong wooden box 10″ long, 6″ wide and 5″ deep. Several layers of old cloth, cut from a discarded garment, are tacked to the bottom for padding. A strip of heavy Wilton or other pile carpeting, 14″ long and 10″ wide, is then tacked over the padding. The carpeting around the sides prevents the polisher from scratching the baseboards or other furniture of the room. A suitable piece of carpeting can generally be found in the waste-box of any carpet-store.



The handle is made from an old broom or mop handle and a block of wood, the width of the latter being a trifle less than the inside width of the box, and 5″ long and 3″ thick. A hole 2″ deep is bored in one end large enough to hold tightly the handle, which should be glued or nailed, to hold it firmly in place. In the center of the sides of the box, 2″ from the top edge, bore two holes for two ½″ lag-screws that should fit these holes loosely, and be screwed into the block 2″ from the lower end. This allows the handle to be adjusted to push either way. The empty space in each end of the box is used for the weights. Flatirons or bricks are suitable. The polisher is pushed along the floor, and requires but little labor to give the floor a nice polish. Powdered wax is the most suitable to use with this polisher, and a little should be sprinkled on the floor before using the polisher.

TELEGRAPH INSTRUMENTS.

Frederick A. Draper.

A set of telegraph instruments adequate for good work on a short line may be easily and cheaply made, and much interesting and profitable information obtained therefrom.

As a preliminary to experiments in wireless telegraphy, the work here required would be most valuable, a thorough understanding of all the different parts of ordinary instruments being absolutely necessary to satisfactory results with the wireless. The parts here described, consisting of key, sounder and battery, are patterned closely after the instruments in regular use, having the different adjustments, from the use of which may be learned all that an expensive outfit would supply. A fret-saw would be very useful in the work, but may be dispensed with.

The Key.

The key and sounder are made upon a base, A, of any suitable wood, 8″ long, 5″ wide and $\frac{1}{2}$″ thick. The key will be first described. The two supports, B, are $\frac{3}{8}$″ thick, 1$\frac{3}{4}$″ long, $\frac{5}{8}$″ wide, cut in to form shoulders at the lower end. These are fitted to holes cut in the base A, 1$\frac{1}{8}$″ apart, the outer one being 1$\frac{1}{2}$″ from the right end. The lever C, at the part between the supports, is 1$\frac{1}{4}$″ wide and 5″ long; preferably of the shape shown in Fig. 1, but may be a straight piece. A round-headed brass screw, F, is put through, 2$\frac{3}{8}$″ from the front end, the wire M being carried around the screw under the head. The brass screw-eye G is

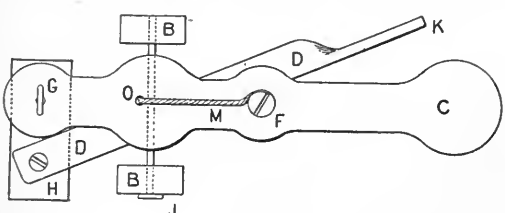


Fig. 1

$\frac{3}{8}$″ from the other end of the lever, and serves to adjust the degree of movement desired for the lever. A wire nail, J, holds the lever in place. It should fit tightly into the lever, but have play enough in the holes in the supports to move without friction. A small hole, O, is bored through the lever, for the wire M to be run through loosely to the under side of the lever to the terminal screw H. The terminal screw E is put through a section of a common thread-spool or other round

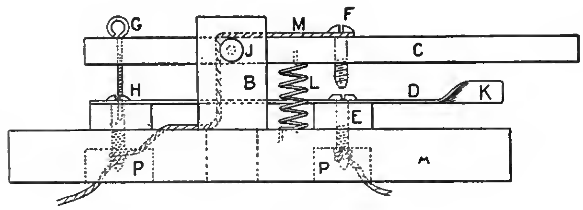


Fig. 2

section of wood, which has been glued to the base. The space is left for the arm D to slip under the head of the screw and make a good contact. The top of the head is filed off a little, to make a flat contact with the point of the screw F, which has also been filed flat. A 1″ hole, P, is bored in the under side of the base, to allow the screw E to project far enough to attach the wire connection. Two or three turns of bare wire around the point of the screw will answer, but soldering would be better. The compression spring L keeps the lever up, except when pressure is applied in transmitting messages. A rubber band attached to the other end may be used, if this spring is not easily procured. The spring is kept in place by the ends, which are straightened out to fit into holes in the lever C and base A. These holes can be made with a small awl.

The circuit-closer D consists of a strip of brass, held in place by the brass screw H, which passes through one end of a piece of wood, 1$\frac{3}{8}$″ long, $\frac{5}{8}$″ wide and $\frac{1}{4}$″ thick, into the base A and the hole P, allowing the end of the screw to be used to attach connecting wire. The other end of the wooden block serves as a rest for the point of the screw-eye G, a flat-headed brass screw being put through to hold the wood in place and prevent excessive wear from the screw-eye. The other end of D is bent a quarter turn, to form a resting-place for the finger when opening or closing the circuit. The wire M is 16 or 18 double-covered copper wire. The ends being stripped of the covering, one end is carried around the contact screw F, and the other end through a small hole in the base, to the point of the terminal screw H, the screw F being turned tight to hold the wire in place. The connections of the screw H and wire should be soldered, if possible. Four brass-head upholstering nails, one under each corner of the base, make good legs, and prevent the connecting wires from being injured. Regulate the screw-eye G, so that the lever C has sufficient play to separate the point of screw F, about $\frac{1}{16}''$ from screw E.

THE SOUNDER.

The only part of the sounder requiring special care in construction is the electro-magnet D. This should be made very carefully, as upon its proper working depends the success of the whole apparatus. The function of the electro-magnet, when excited by an electric current, is to attract the armature F, this movement of the armature making the "click," which the experienced operator recognizes, and so reads the message that is being transmitted. The well-known "horseshoe," or permanent magnet, attracts pieces of iron, and holds them in close contact until removed. An electro-magnet differs, inasmuch as it only has

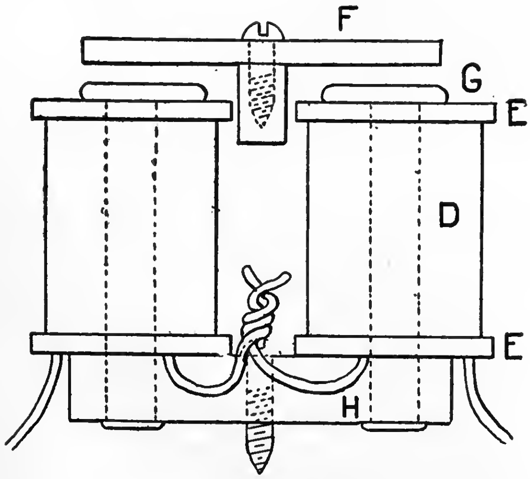


Fig. 3

attractive power while excited by the electric current. If an electro-magnet does not at once lose power when the current ceases, it is evident that the iron core is not of soft enough iron.

An electro-magnet, as here described, consists of the iron cores, G, the connecting iron base, H, the wiring, D, and nonconducting face-plates, E. The cores must be of very soft iron, $1\frac{3}{4}''$ long and $\frac{1}{4}''$ diameter. Iron rivets will answer, though Norway bar iron would be better. If any doubt exists as to the iron being soft enough for the purpose, by placing it in a coal fire in the stove

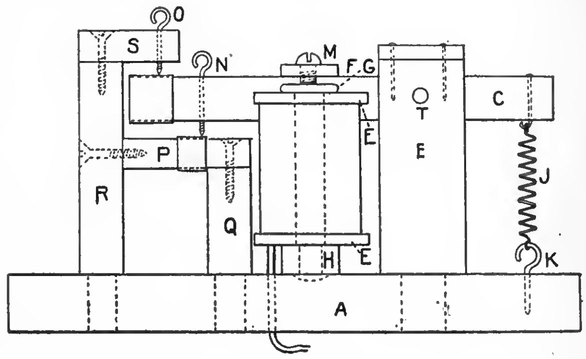


Fig 4

and heating it to a red heat, and then letting it get cold as the fire dies out, the required softness will be obtained. Hard iron will not be suitable, as it retains magnetism imparted to it by the electric current, while soft iron does not. The core must quickly demagnetize, otherwise the armature would not immediately separate from the core after being attracted to it, making it impossible to correctly transmit the signals. Having obtained suitable cores, they should have the lower ends filed down to fit holes drilled in the base H, which consists of a flat piece of soft iron, $2''$ long, $\frac{1}{2}''$ wide and $\frac{1}{4}''$ thick. The holes should be $1\frac{3}{8}''$ between centers, and $\frac{3}{16}''$ in diameter. An additional hole is bored in the center of H to receive the screw S. The cores can be filed down to fit, with the ends projecting slightly through the holes, and after being wound with wire, permanently held in place by carefully hammering a flange or head. After fitting the cores, they are removed and fitted with the insulating material. This consists of a round ebonite washer at each end, $1''$ in diameter, with the center hole, through which the core passes, made a snug fit. Two small holes are drilled in the washer at the lower end of the core, one hole close to the core hole, and the other $\frac{1}{8}''$ from the outside edge. These holes are for the ends of the coil wire to pass through. These washers are $1\frac{1}{8}''$ apart. Between them, and around the core, are wrapped three or four layers of waxed paper, care being taken to have the edges of the paper meet the washers, or, if available, a piece of ebonite tubing may be used. They should then be wound, beginning at the lower end, with No. 22 or 24 double silk-covered wire, laid on in even layers until the diameter of the coil reaches $\frac{3}{4}''$, the end of the last layer being at the same end of the core as the first end. Wind regularly and evenly. Any slight ridges may be corrected in the last layer by winding a strip of note paper once around the next-to-the-last layer, and winding the last layer over the paper. Three inches of wire should be left at each end for connections, as hereafter described. One coil is wound in the opposite direction from the other, the wiring of the two coils when upright taking the direction of the letter ∽. Another way of determining the direction of the wiring is by putting the two lower ends of the core together, to form a straight line. The wiring on both cores should be in the same direction as though they were a single piece. The winding completed, give the outside layer a coating of shellac, which will prevent moisture from interfering with the working. The appearance can be improved by covering with a strip of leatheret, the kind used by bookbinders for book covers. The coils are then fastened to the base H, the two outside ends of the wires being cut a suitable length, stripped of the covering, twisted together and soldered. (See Fig. 3.) To prevent any possibility of leakage of the current from the wire to the iron base, wrap the joint with twine, and cover with wax, or with bell-hanger's insulating tape. The electro-magnet is now complete, and may be put aside until the rest of the sounder is ready.

Two uprights B are now made, $2\frac{3}{8}''$ long, $\frac{5}{8}''$ wide and $\frac{1}{4}''$ thick, with the lower ends cut to form shoulders, as shown in Fig. 4. A cross-piece R, $\frac{1}{4}''$ thick and $\frac{5}{8}''$ wide, is nailed to the tops of supports. The lever C is $3\frac{5}{8}''$ long, $\frac{3}{8}''$ wide, and $\frac{3}{8}''$ thick.

The armature F consists of a flat piece of soft iron $2''$ long, $\frac{1}{2}''$ wide and $\frac{1}{8}''$ thick, with a hole drilled through the center for the screw M, which fastens to the lever C. The screw-eye N is $\frac{5}{8}''$ from the end of C, a hole first being made with an awl, to prevent the splitting of C. Another hole is also made with an awl $1''$ from the other end of C to receive the wire nail or piece of steel wire which serves as a bearing. The holes in C should be tight; the corresponding holes in the supports B should be large enough to allow free play of the lever C and prevent binding, and yet be without side motion.

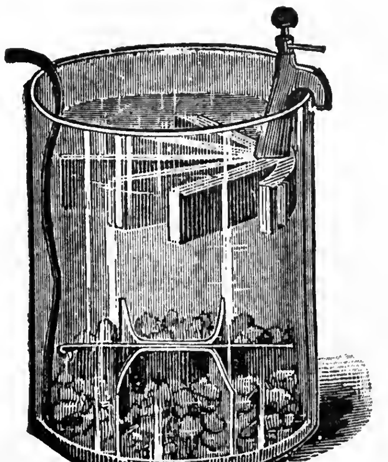
At the front end of the lever C make a hole to receive the small wire nail or large pin L, which should move freely, so as to turn with the spring T when adjusting the tension. The end of L is turned into a hook to hold the loop of the spring. The screw-eye K holds the outer loop of the spring, which should be without tension when K is almost unscrewed. The spring should be quite sensitive, as the lever C requires to be kept nicely balanced, and respond easily to the "pull" of the electro-magnet on the armature. A rubber band may be used in place of the spring, but is not so good for the purpose. On the other end of the lever C tack a strip $\frac{3}{8}''$ wide of thin tin: a piece of an old tintype will do nicely. This is to increase the sound of the "click." A similar strip is tacked around P for the same purpose.

The frame for regulating the movement of the lever C consists of the upright posts Q and R and the cross-pieces P and S, made from $\frac{3}{8}''$ square strips screwed, together, as shown in Fig. 4. The lower end of the uprights Q and R have shoulders, and are glued to prevent loosening. Care should be taken to make the holes for the screws with a sharp awl, so as not to split the wood. The wooden parts being all in position, excepting the lever C, the electro-magnet is attached to the base by a screw, the inside ends of the coil wire being left free to attach, one to the line wire and one to the wire from key. In the regular telegraph instrument these wires are carried through holes in the base to terminal posts and key; but these are omitted in this description, but may be added if desired.

The lever C is now fastened in place by the wire nail T and the spring J attached. When the lever is in correct position the armature should, by pressing it lightly with the finger, not quite touch the ends of the cores, which are known as the poles of the magnet. The movement of the armature should be less than $\frac{1}{8}''$, and is adjusted by the screw-eyes N and O.

The Battery.

The battery is of the form known as the "Gravity" type, and consists of a jar of glass or stone-ware; the positive element, zinc; the negative element, copper, and an exciting solution of sulphate of copper commonly called "blue vitriol." A battery can be purchased at low cost, and but little instruction is to be gained by making one; but the method is given for those who desire to try it. From sheet zinc cut three strips 2″ wide and 6″ long. Bind them together in the center with two complete turns of another strip ½″ wide and long enough to leave a free end 3″ long. Separate the ends so they will form a six-pointed star. From some sheet copper cut three strips 2″ wide and 6″ long. Rivet together in the center with copper rivet. Punch another hole through the strips just above the rivet and fasten a piece of copper wire, which, except where it is fastened to the strips, is covered with rubber insulating material. The ends



of the strips are then bent apart to form a star similar to the zinc. The copper is then placed in the bottom of the jar, which should be of about 8 quarts capacity. A pound of sulphate of copper in crystals is then placed around the copper strips, and water added to fill the jar to within about an inch of the top. A strip of wood is then placed across the top of the jar, the zinc lowered into the water till the top of the strips are covered about a half inch; the binding strip is then carried around the piece of wood, to hold it in position. Several hours are required for the battery to generate its full current of electricity. The line wires are attached, one to the zinc strip and the other to the copper wire, the insulation on the latter being removed and the line wire twisted enough to give plenty of contact. A battery of one cell makes only a weak current; so all connections must have plenty of surface to enable as much of the current to flow as possible. As brass corrodes, all connections should be brightened with a file or emery-cloth; and soldered if permanent. The brass terminal screws will need polishing at times, to enable the current to flow easily. It is to obviate this difficulty that platinum points are used on regular instruments.

Very few people have heard of automobile banks. Such, however, is the case, and the new institution is the property of the town of Mézières, in the Ardennes, France. In order to reach a savings bank the peasantry there have been compelled to leave their work and come to town, which meant to many a journey of several miles. Now, instead of having to go to the bank to deposit their savings, the residents on the outskirts of Mézières will have the bank brought to them. The new vehicle is unique in construction. It is propelled by electricity, and has four seats, one in front for the driver and three in the rear for the staff of the institution. These three seats surround a revolving table, located in the center of the carriage, on which the business of the bank may be transacted. Writing-desks capable of being folded up when not in use are arranged over each of the seats in such a way that when open they extend out from the sides of the carriage in a manner suitable for the use of persons standing outside who desire to open an account with the bank. On the table are to be found shelves for books, adequate stationery for the use of the clerks, and a small metallic strong-box. On certain prearranged days the car makes a tour of the country districts, stopping here and there as long as it may be necessary to dispose of the business in hand.

It is stated that one marked effect of the machinists' strike was noticed in a factory at Bridgeport, Conn. As a result of the disaffection among the workmen this company found it necessary to close one of its most important departments for a fortnight. During that time special machinery, designed by ingenious men, was quickly supplied, through the use of which one man was enabled to do the work of three, then four, and finally nine machinists.

ASTRONOMY FOR NOVEMBER.

SALUTATORY.

Of late years the number of those who take a more or less active interest in the science of astronomy seems to be rapidly increasing. The published descriptions of recently established observatories and the notices and reports of the results accomplished, with the increasing accessibility and reasonable prices of telescopes, have done much to foster this interest, and the increased facilities for scientific education, with the consequent increased frequency of the development of the scientific habit of mind, perhaps still more.

Many of those, however, who have procured telescopes after they have exhausted (save the mark!) the well-known objects, are at a loss to know how further to employ their instruments, and what to look for with them; many would like to engage in some course of observations which may have a real value, but do not know how to set about it, nor where to get the information necessary to enable them to do so.

Information and material exist in great abundance, but much of it is difficult of access; mostly scattered through the pages of various polyglot scientific periodicals, whose names the amateur may never even have heard, and couched in languages with which he may be unfamiliar. In many cases, also, he has not the time at his disposal to search for it.

To help such cases is one of the principal reasons for the existence of the astronomical department of this magazine.

For this purpose, as supplementary to the regular articles, it is our intention to open a regular column of answers to correspondents, in which we will endeavor to give replies to any questions which lie outside the scope of the textbooks and encyclopedias, or, where it can be done, give directions where and how to find the desired information or material, and thus encourage the habit of independent research, on which depends all real scientific growth.

We cannot undertake to answer all queries individually and personally, but will give them a place, when not outside the limit set above, in the column of Answers to Correspondents.

We shall be glad to welcome to our columns any original papers that may be offered, reserving, however, the right of rejecting any that from whatever reason we may consider to be unsuitable.

It is our purpose to open these columns to discussions on astronomical questions, so long as such discussions are carried on in a scientific spirit, and with due regard to courtesy; and we shall ourselves assume the sole right of judgment in this connection also as to where the line lies, and of excluding any communication in which we find it to be overstepped.

In some departments of astronomy much of the world's stock of information has been furnished, and many discoveries made, by amateurs; Tycho, Herschel, Rosse, Smyth, Dawes, Burnham, Barnard,— to name but a few of the long list,— all made their reputations as amateurs, and many have remained so to the end. It does not happen to every one to do such things as these have done, but any one who does faithful and conscientious work in the true scientific spirit will find himself welcomed to the fellowship of such men, and sure of their sympathy, appreciation and encouragement in any good work he may undertake; and this sort of sympathetic freemasonry is one of the great compensations of the scientific life, which is in no sense a life of ease or luxury.

Of course not all amateurs have the intention or the opportunity to go so far as this, but many soon tire of a desultory course of "star-gazing" (an expression always used with a certain undertone of contempt among the real workers), and wish to engage in some line, however limited, of original work. The reader would be surprised to learn to how great an extent our observatory staffs have been recruited from this element; and this not from the men of national reputation, but from those only known among the workers themselves.

The true scientific spirit is well voiced by Kenyon Cox in some fine lines which, though written for the artist, find a response in the heart of every man possessed of the true purpose:

> "Who works for glory misses oft the goal;
> Who works for money coins his very soul.
>
> "Work for the work's sake, then, and it may be
> That these things shall be added unto thee."

Constellations for November.

On the first of the month, at eight o'clock in the evening, the zodiacal constellations above the horizon, in their order from east to southwest, will be as follows: Taurus, Aries, Pisces, Aquarius, Capricornus, and Sagittarius. As we face eastward, the brilliant and extensive group formed by the Pleiades, the Hyades and Aries at once attracts the eye; above Aries, and just east of the zenith, lies the great "square" of Pegasus.

The northeast is brightened by Cassiopea, Perseus and Auriga, the latter led by its *lucida*, Capella, second only of all the stars then above the horizon to Vega, which in turn yields the palm of brightness only to the great Sirius himself.

The Polestar holds the "empty places" of the north almost alone, accompanied only by the Guards, and watched from the northern horizon by the Greater Bear. From the zenith downward to the northwestern horizon stream in brilliant array the Swan, the Lyre, Hercules, the Crown, gemmed with the bright stars Deneb, Vega, Ras Algethi, and Gemma.

South of this brilliant line, and due west from the zenith, lies Aquila, with its bright leader, Altair, and the small but old and well-known asterisms, Delphinus and Sagitta.

Below the zodiac is a dim-appearing region of small stars, relieved only by the great group of Cetus in the east, the lonely bright star Fomalhaut in the south, and the Galaxy region of Scutum in the southwest.

Four hours later, at midnight, the scene has changed; Hercules, the Crown, Aquila, Scutum, Capricornus and Sagittarius have set; Vega and Fomalhaut are trembling on the horizon in the northwest and southwest; but from due east to southwest stretches the northern stream of the Galaxy, studded and flanked by its retinue of blazing constellations, all the great ones of the northern heavens, from the Greater Dog in the east to the Swan in the northwest.

Canis Major, Canis Minor, Orion, Gemini, Taurus, Auriga, Aries, Perseus, Cassiopea, Andromeda, Pegasus, Cygnus, Lyra, all the greatest constellations of the north, are all in evidence at once.

And what an array of first-magnitude stars! Sirius, Procyon, Rigel, Betelgeuse, Aldebaran, Capella, Alpherat, Deneb, Vega; at the eastern end of the sparkling line the brightest, and at the western the second in brightness in the whole heavens.

All these constellations are rich in objects for moderate telescopes: in Canis Major, Sirius, by far the brightest star in the whole heavens, is also a star with a history; its possible change from a red star, as described by the ancients, to its present intense whiteness, its observed irregularities of proper motion, from which Bessel inferred the presence of the satellite actually discovered in 1862 by Clark, in the very place called for by theory, the strong suspicion amounting almost to certainty, that this companion shines by reflected light,—all combine to make it a most interesting star. The companion, however, is beyond the reach of modest equipments.

Four degrees south from Sirius is the fine cluster 41 Messier, visible to the naked eye, and a fine object in the telescope.

Orion, "the finest constellation in the heavens," is full of brilliant fields and interesting objects, of which we will only specify the brilliant star Rigel, and the great Nebula, which is conspicuous to the eye south of the three stars of the belt, and a glorious show in the telescope.

Taurus has the magnificent cluster of the Pleiades, unsurpassed in the heavens, and, near the star Zeta, at the tip of the northern horn, the wonderful "Crab" nebula, an oval cloud like a small comet in ordinary glasses.

In Auriga the brilliant star Capella, the third brightest to be seen in these latitudes, and the fine clusters 37 and 38 Messier are worthy of attention.

In Perseus is the famous variable star Algol, probably the first star which was noticed to vary in brightness; the splendid "Sword-handle" cluster in this constellation is a naked-eye object, and is a most glorious sight in even a small telescope; the cluster 34 Messier is also a fine low-power object.

In Andromeda, the well-known great nebula, 31 Messier, is visible to the naked eye, and has more than once been mistaken for a comet; the double (really triple) star Gamma Andromedæ is a beautiful colored object. There are many fine clusters and brilliant low-power fields in Cassiopea.

In Cepheusis, Herschel's celebrated "Garnet star," so called by him on account of its deep red color; it is the only one of these strongly colored stars visible to the naked eye. The remarkable variable star, U Cephei, is in this constellation.

Cygnus, the great Northern Cross, is full of beautiful views; in fact, all along its middle line of stars you can hardly point a telescope and not find a brilliant field; of its many double stars we will only refer to Beta and Omicron 2 Cygni, both fine in color; there are many telescopic red and variable stars in this constellation.

All the above objects are readily found with the help of a good star-atlas, and all are within the scope of a good 3″ glass.

Planets for November.

The November skies will be poor in planets. In the twilight during the early part of the month, Jupiter and Saturn being low in altitude, comparatively little detail will be visible on either, as their positions are not favorable for observation. Mars is far over in the west, and sets early. Venus, during the first part of the month, sets at about seven o'clock; she is not a satisfying object for small telescopes, as she shows little except glare, and insists on calling your attention to every weak point of your instrument. Faultless indeed is the glass that can stand her criticism.

Mercury may be visible in the morning, about the 21st. Uranus shows nothing to a small glass, and Neptune can only be found with the help of graduated circles, and, when found, only identified with the aid of a chart showing all the stars down to the ninth magnitude, as it appears in the small glass as a star of the eighth magnitude, and only the great telescopes of the world stand any chance of raising a disc on it, or of showing its satellite.

The Moon.

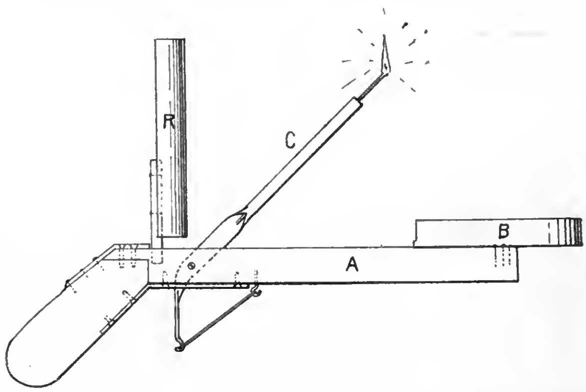
The November moon is new on the 11th, passes its first quarter on the 19th, and fulls on the 25th.

The moon is perhaps the most satisfactory of studies for a small telescope, as its nearness to the earth renders it the easiest of telescopic objects; the irregularities of its surface are visible with a very low magnifying power, even a field-glass showing the prominent features, while the continual change of aspect under the varying angles of illumination gives an endless variety, and all the objects of special interest at least can be seen with a 3″ glass. From the brilliancy of its illumination, the moon admits of the use of higher powers in its examination than does any of the other planets; in fact, the principal difficulty here is in the state of the air, the "seeing," as it is called. Even on the clearest appearing nights, this will often prove to be so bad as to render hopeless the use of any except the lowest powers. But during the temperate months of the spring and autumn there are often evenings when there seems to be scarcely any limit to the power that might be used.

Vega.

FLASH-LIGHT TORCH.

With the approach of winter, the amateur photographer begins to plan what he may do when inclement weather prevents work afield. Much pleasure can be derived from indoor work with a flash-light. The making of an excellent torch is a simple and inexpensive matter, as may be seen from the illustration. The materials required are: the cover of a tin spice-box, a small bean-blower, empty tin can, a piece of maple or birch 6″ long, ⅝″ wide and ½″ thick, and a few screws. The



spice-box cover serves as the flashing-pan B, and should be about 2½″ in diameter. A slot is filed or cut in one side, to allow the flasher to reach the powder. It is attached to the wooden rod by small wire nails. From the bean-blower, a small tin one, cut a piece 5½″ long. Then file a slot one-half way through 3″ from one end. The longer portion is left round, and to hold a wax taper or match. The shorter portion is hammered flat and a hole punched through it 3¾″ from the end, for a screw. This screw acts as the bearing, and is screwed up until the lever just works. Twist the flat end a quarter turn 1¼″ from the other end, and slightly curve it, like the trigger to a gun. The extreme end is curved to hold one end of a rubber band, the outer end of which is attached to a small hook on the rod.

The handle is a short piece of wood beveled to the rod, and fastened by screws and tin strips tacked over the joint. From the tin can is cut the reflector R, 8″ wide and 6″ high, to shield the eyes of the operator. One end of a wooden beef-skewer is split about three inches with a saw. The tin is placed in this slot, and two small wire nails driven through to fasten it. The sides are curved slightly towards the flash-pan. A hole is bored in the rod A to receive the bottom of the skewer, thus holding the reflector upright while in use, and allowing it to be packed flat for convenience in carrying.

To use, a charge of flash-light powder is placed flat in the pan and the wax taper lighted. When ready for the flash, press the trigger with the finger until the lighted taper reaches the powder. Hold the reflector between the flash-pan and the eyes.

ELECTRICAL ENGINEERING AND YOUNG MEN.

Professor F. B. Crocker is the author of an article in a recent issue of the *Saturday Evening Post*, entitled: "The Young Man and the New Force." He discusses in a most interesting and suggestive manner the opportunities and the requirements in the field of electrical engineering. He points out that the profession is one in which young men are peculiarly numerous and predominant, and says that having personally followed the careers of several hundred men, in electricity he is "convinced that they have gone ahead more rapidly than would have been possible in any other line of human effort. One of the reasons for this is that the industry is so new and has expanded enormously, forcing men ahead. The other reason is the fact that electricity is a peculiar subject. In its pursuit general intelligence or knowledge is not sufficient for pronounced success. A man possessing special taste for it soon differentiates himself from the others working alongside who may not be endowed with the same advantages. Such a man will forge ahead of his fellows at a rate that is absolutely impossible in any other calling in the world. The successful electrical engineer has more than mere ability. He is gifted with special talent, like the successful artist or the musician. Electricity is, to my mind, the only mechanical pursuit that has 'soul.' The successful electrician is born. Many of the qualities that are his are intangible, just as the fine musician's qualities are. But there must also be tangible qualities, certain fixed mental traits. He must have great mental alertness; the ability to think quickly, to grasp a given situation at once. He must be of an analytical turn of mind — that is, able to reason from cause to effect, or vice versa. In electricity one thing follows from another with absolute certainty."

While admitting the fact that electricity is more or less of a marvel in spite of its exactitude, Professor Crocker criticises the popular idea that electricity remains unknowable. He contends rather that the proper attitude of the electrical worker is that of willingness to accept innovation, and not of prejudice against it. "It is the first duty of an electrical worker to fall in with rapid advances and radical departures. Therefore, a necessary qualification for the successful electrician is an interest in things that are new *because they are new*. Any one with a strong conservative tendency would be at a disadvantage in the electrical field. This is probably the reason why Americans have got along faster than any other nation in the development and use of electricity. An American prefers a thing that is new, whereas a foreigner considers newness in itself an objection. The man who is interested in ancient literature, or in archæology, cares little for electricity. This is a fact I have observed among my own friends. Those who have gone into electricity with the idea of saving themselves labor have made a great mistake, because electricity requires fully as much application and intensity of purpose as any other line of work."

"But though these men and many others have done exceedingly creditable work and now fill responsible positions, it is a fact that the pay is not as large in the technical branches as it is in the administrative departments. This is true, however, in all other human pursuits. The technical men in a railway, for example, receive much smaller salaries than the executive officers. The same is true in chemical industries, and in many other lines. There is no more responsible position, or one requiring more knowledge or skill, than that of captain of a transatlantic liner, and yet his pay is comparatively small. The presidents of the steamship companies, with nothing like such direct responsibility, receive salaries ten or twenty times greater than those of the captains of the vessels. By the technical man, $5,000 a year would be considered a very good and $10,000 an exceptionally large salary. There is one thing to be considered, however. In the logical development of the new business scheme that is controlling all our great corporations, technical knowledge is beginning to be more and more to the advantage of the men who seek the great positions in these corporations. As the years go by, the demand will certainly become steadily greater for a class of men who combine executive ability with a thorough technical understanding of the work they are called on to supervise. Already we have a number of striking examples of technical men who have won great business positions."

Professor Crocker sees few limitations to the growth of electrical industry, and believes that most lines of manufacture and transportation are becoming dependent upon it.—*Electrical World.*

THE METAL NIOBIUM.

This metal has lately been prepared in the pure state by M. Henri Moissan with the aid of the electric furnace. The properties of this metal have been practically unknown heretofore, the metal not having been prepared in the pure state except by Roscoe, who obtained it as a gray powder. M. Moissan now produces a considerable quantity of the metal in the electric furnace, starting from an American niobite which contains niobic and tantalic acids. An alloy of niobium and tantalum is first obtained by reducing the powdered mineral with carbon in the electric furnace. This alloy is crystalline, of a light gray color, and contains about two per cent of combined carbon. By a series of reactions the niobium is separated from the alloy in the form of niobic acid, which, after calcination, is a pure white powder. To prepare the niobium, the acid is mixed with powdered carbon and pressed into small cylinders; a number of these are placed in a carbon trough contained in a carbon tube, and the whole placed in the middle of the electric furnace. A few minutes' heating suffices, with a current of 600 amperes and 50 volts. The decomposition is violent, and as soon as the niobic acid becomes fused a lively effervescence takes place. After cooling, a well-formed ingot of metallic niobium is obtained, which contains from two to three per cent of combined carbon. The metal has been examined as to its physical and chemical properties. It is quite hard and scratches glass and quartz easily. It is not fused in the oxy-hydrogen flame, and therefore its fusing point is above 1,800 degrees centigrade, but in the electric furnace it liquefies easily. As to its chemical properties, it is found to vary considerably from most of the other metals. It does not decompose water vapor at a red heat, and is almost unattacked by acids. Hydrochloric and nitric acid and aqua regia have no action upon it; hydrofluoric and sulphuric acids attack it but slightly, but it dissolves rapidly in a mixture of hydrofluoric and nitric acids. The gases attack it more readily. Heated in fluorine, it becomes incandescent and gives abundant fumes of a volatile fluoride. Chlorine attacks it at 205 degrees centigrade, with disengagement of heat, producing a volatile chloride, $NbCl_5$ of a golden-yellow color. Bromine vapor forms a light yellow sublimate, but iodine seems to be without action. The niobium, reduced to powder, and heated in a current of oxygen, takes fire at 400 degrees with brilliant incandescence, forming niobic acid. When the powdered metal is heated in a current of nitrogen to 1,200 degrees, each particle becomes covered with a fine yellow coating of nitride of niobium. The action of carbon is somewhat curious. When the metal is maintained in fusion in the presence of graphite, it slowly absorbs carbon, which enters into combination. Niobium does not readily form alloys with the other metals. Sodium, potassium and magnesium may be distilled over it without combining, and it does not form an alloy with zinc. When heated with soft iron in fusion a small quantity enters into combination with the iron. The alloy shows an irregular structure containing fragments of niobium, a combination of the two metals, or, perhaps, a double carbide, and pure iron in excess. Oxide of chromium is reduced by the metal in the electric furnace, and gives a brittle alloy of chromium and niobium. Fused potash attacks the metal with the formation of an alkaline niobate. Chlorate of potash reacts upon it at a high temperature with brilliant incandescence, and nitrate of potash attacks it with violent disengagement of nitrous fumes. The reactions obtained with niobium seem to place it apart from the other metals and ally it to boron and silicon.—*Electrical Review.*

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

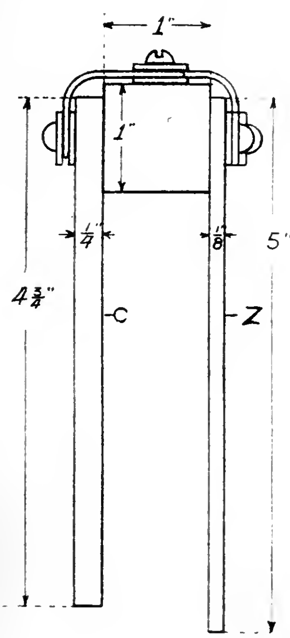
Vol. I. No. 2. BOSTON, DECEMBER, 1901. Ten Cents a Copy

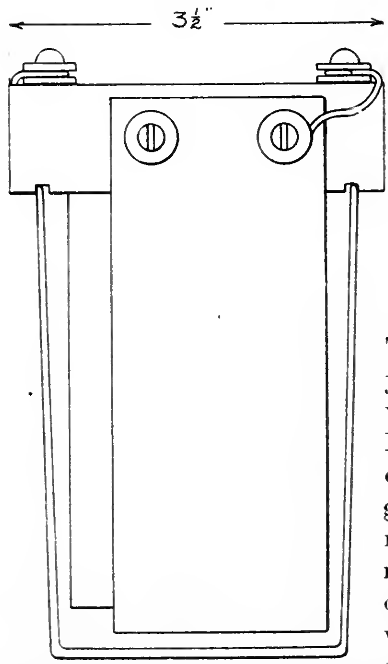
STUDIES IN ELECTRICITY.

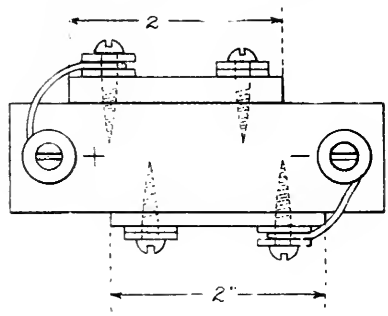
Donald M. Bliss.

II. Batteries.

The batteries most in practical use may be divided into two classes — single fluid and double fluid cells. The single fluid type consists of two plates of dissimilar metals, or one metal and carbon separated from each other, mounted on a suitable support, and arranged to dip into a jar containing an alkaline or acid solution. A galvanic battery is the name applied to a number of such single cells joined together so as to add their pressures or capacity together. The electrodes or poles of the battery cell are the terminals or binding posts connecting the ends of the plates. In connecting up a battery, it should be remembered that the polarity of any given electrode or binding post is always of the opposite sign to the plate with which it is connected. For instance, in the case of a zinc and carbon cell, the binding post or wire connected to the zinc will be spoken of as the negative pole of the cell, while the zinc itself is the positive element. In these articles, when the term "positive" or "negative" is used in connection with batteries, the polarity of the binding post or wire connecting to the same is always intended. In considering the substances most available for the formation of galvanic cells, the following table includes the most prominent members: 1, zinc; 2, cadmium; 3, tin; 4, lead; 5, iron; 6, nickel; 7, bismuth; 8, antimony; 9, copper; 10, silver; 11, gold; 12, platinum; 13, graphite or carbon. Any two of these metals will form a galvanic cell or couple, and produce a difference of electric potential when immersed in a suitable solution, the first one in the list being the positive element to the next one following, which of course is negative. If, for example, zinc and copper are used, the zinc will be acted on and will form the positive element. The greatest difference of pressure or potential will be developed between Nos. 1 and 13. For experimental purposes, a battery is required which will yield a great amount of current, together with the greatest amount of pressure per cell, and also be able to deliver its output continuously until the solution is exhausted. For the amateur, the type of cell which most nearly fulfills these conditions is known as the bichromate single fluid cell. Fig. 4 shows its construction very clearly, and it consists of a zinc and copper plate screwed to the opposite sides of a wooden cross-bar. Any suitable form of jar may be used, but fruit jars or large glass tumblers of about one pint capacity will be found the cheapest and most convenient. They may be purchased for a few cents each at any corner grocery. The wood cross-bar, it will be noticed, is notched so as to rest firmly on the edges of the bar. The zinc plate should be drilled with two holes, and screwed directly to the cross-bar by small round-headed brass screws, with a copper or brass washer or burr under each screw to give the wire to binding screw a good connection with the plate. The carbon plate must also be fastened to the cross-bar by two similar screws, but care should be taken that the screws of the two plates do not meet and make contact within the cross-bar. This may readily be avoided by not setting the plates exactly opposite each other, but mounting one plate about half an inch to one side of the other, so that the screws will be staggered and cannot touch. Care should be taken in drilling the carbon plates, as the substance is brittle, and if the drill is forced it is liable to crack the plate. On the top of the cross-bar, at each end, should be driven two more similar screws with two washers under the heads, as shown, and a short piece of copper wire should be connected around the head of one screw on the zinc and under the head of the connecting screw on the top bar. A similar wire should be run from the carbon plate to the remaining binding screw, as shown. This arrangement is preferable to connecting the wires directly to the plate. After the plates have been mounted in this manner, the cross-bar and the tops of the plates should be dipped in hot melted paraffin for about one inch of their length from the upper end, as shown, and they should be left in the paraffin long enough for it to thoroughly soak into the pores of the wood and carbon. This forms a protection against the corrosion of the acid, which will take place around the screws or in the plates if they are not thus protected. The plates when mounted in position on the bar should reach to within a quarter of an inch from the bottom. The solution used in this form of battery should be made as follows: Take 1 lb. of commercial sulphuric acid. Pour it slowly into one gallon of water, stirring constantly with a glass strip or rod. Some heating will be noticed when the acid is first put into the water. Do not reverse the process and pour the water into the acid, for excessive heat and probable burning will result. Sulphuric acid is a powerful irritant, and care should be taken not to get it in contact with the skin or clothing. After the acid has been added to the water, add twelve ounces of powdered bichromate of potash, and when the solution has cooled, it is ready for use.







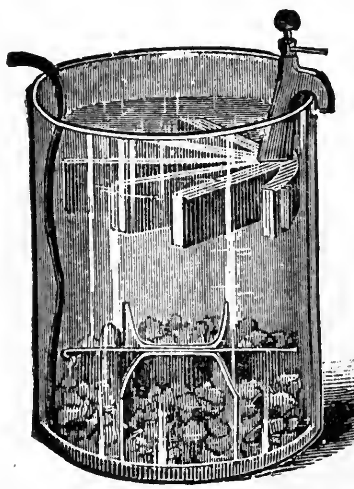
The solution may be left in the battery jars, but the plates should be removed when the battery is not actually in use. Before the zinc plates are fastened to the cross-bar, they should be thoroughly amalgamated with mercury. This may be readily done by pouring a small amount of mercury in a saucer or an earthenware dish, and rubbing it on to the zinc plate with a cotton swab, moistened with a solution of sulphuric acid and water. It may take a few minutes for the mercury to start the action, but when once under way it will spread rapidly over the surface of the zinc and form a uniform layer. Both sides of the zinc and the edges should be thus treated, and this process should be renewed when the zincs become badly coated or dirty from continued use. Before starting on the construction of the battery and experimental apparatus described, the student should provide himself with the following list of supplies: 2 lbs. of sulphuric acid, commercial strength, costing from 5 to 8 cts. per lb., 1 lb. bichromate of potash, at 15 to 18 cts. per lb., 1 gross round-head brass screws $\frac{3}{4}''$ long of No. 8 or 10, a few dozen copper burrs or washers, for fitting the screws, 4 lbs. No. 20 single cotton covered magnet wire, 6 zinc plates $5'' \times 2''$, $\frac{1}{16}$ to $\frac{1}{8}''$ thick, costing about

12 cts. per lb., 6 carbon plates same size, costing 8 to 10 cts. apiece, a few lbs. of paraffin wax, and 6 one-pint glass jars. For temporary use, ordinary sheet zinc such as is used by plumbers may be taken instead of regular battery zinc, but the latter is by far the more preferable, on account of its greater thickness and purity. Twenty-five or 50 ft. of No. 14 annunciator or bell wire should also be obtained for convenience in making the various connections between battery and pieces of apparatus.

It will be noted from the sketch that the zinc plate is a little longer than the carbon. As it is advisable to remove the plate from the battery when not in use, the extra length of the zinc plate will protect the carbon to some extent from breaking by frequent handling. A very convenient arrangement for a battery of this sort is to mount the cells on a wooden base, which has at either end an upright post, about 10 or 12 inches high. A rod or a shaft may be fitted in the top of the post and provided with a crank or hand-wheel so as to form a sort of windlass. The crossbars of each cell may all be suspended from a strip of wood which is connected to the shaft by a small chain or cords, and a catch or ratchet wheel should be fitted on the shaft, so that when the battery is not required for use the plates may all be raised above the jars by winding up the supporting chain or cord, and when wanted they may be instantly lowered into the solution. Another arrangement sometimes used is to have a circular wooden base with a post in the center, this post carrying a sliding support to which the plates may be connected.

While the single cell battery just described is perhaps the most convenient for the amateur, owing to ease of construction, compactness and strength, it is not used to any extent in commercial applications. Such cells may be divided into two types, the open and closed circuit cells. The first is adapted only for intermittent work, such as the operation of electric bells, annunciators, and all other devices requiring a momentary current. The form of open circuit cell used almost universally for this work is the Leclanche (Fig. 5) or some of its modifications. The elements are zinc and carbon, the zinc being in the shape of a rod or cylinder. The carbon in the original form consists of a plate mounted in a porous cell of unglazed earthenware surrounded by a mixture of black oxide of manganese and broken carbon, the top of the cell being sealed up with insulating compound. It is a single fluid cell, using a saturated solution of sal ammoniac. In the more recent forms, the porous cell is dispensed with and the negative consists usually of a carbon cylinder only. Dry batteries, now so largely used, are of this type, but instead of the solution of sal ammoniac, a paste is used and the entire cell is sealed up. Such a cell can be used in any position, and as there is no evaporation it is a very convenient form for light work, but cannot be renewed conveniently when exhausted.

The closed circuit cell is made in several forms, the most familiar being the gravity or sulphate of copper cell used largely for telegraph work (Fig. 6) and described in the last number of this magazine. Another cell largely used for operating telephone transmitters is known as the Fuller. The elements in this cell are known as zinc and carbon. The solution is a bichromate of potash in water to which sulphuric acid has been added. The zinc is cone shaped and placed in the bottom of a porous cell containing mercury and filled with water. The bichromate solution is outside of the porous cell surrounding the carbon. The mercury within the porous cell keeps the zinc constantly amalgamated. The pressure or electromotive force of this cell is only two volts, and it requires but little attention to keep it in good working order. Another well-known single fluid cell is the Grove, using zinc and platinum with a solution of nitric acid and water. The Bunsen cell differs from this only in the substitution of carbon for platinum. Both of these cells have a pressure of about 1.03 volts. There is practically no limit to the combination of metals and exciting solutions which may be used to form a galvanic battery. The above list, however, covers the forms most largely in use at the present time. An alkali solution may be used instead of acid in a battery, and a cell of this type, quite well known, is the Edison-Laland battery, which consists of a plate of oxide of copper for one electrode and zinc for the other. A caustic potash solution is used, which is covered by a layer of heavy oil to prevent evaporation. The electromotive force of this cell is quite low,—about .8 volt,—but as there is no action when on open circuit and the internal resistance of the cell is low, this form of cell is well adapted for operating small motors and is frequently used for supplying a current for phonographs and slot machines. Before leaving the subject of batteries, the student's attention is directed to the phenomena of polarization, a defect peculiar to nearly all forms of galvanic batteries. This defect may be well shown and easily investigated by taking a single cell of the bichromate battery described and filling the jar with a weak solution of sulphuric acid and water. Now if the two plates are connected by means of a wire, a current is at once developed. In a few moments, bubbles of gas will be noticed on the surface of the two plates, and the current and the strength of the battery will diminish rapidly as the accumulation of gas increases. The cause of this failure of the current depends not only on the weakening of the solution as the battery is in use, but also on the fact that the layer of hydrogen gas on the copper or carbon plate gradually increases the internal resistance of the cell and so prevents the maximum flow of current. In addition to this effect, the hydrogen gas on the negative plate and the oxygen gas on the zinc develop a counter electromotive force or pressure in opposition to the current flowing in the circuit. This failure of the battery is called polarization. If the gas be partially removed from the plates by



Gravity Battery.

shaking the cell or brushing the plates, the strength of the current will rise. In practical use, however, the same result is arrived at by chemical means. In the gravity battery, the hydrogen gas decomposes the copper sulphate, depositing metallic copper on the copper or negative plate, and frees the sulphuric acid, which was part of the copper sulphate, thus continually renewing the surface of the copper and preventing the accumulation of gas. In the Grove and Bunsen batteries, the hydrogen is reduced to water by the nitric

Leclanche Battery.

acid, thus keeping the negative element free. In the Leclanche type, the hydrogen is reduced to water by the oxide of manganese. In the bichromate cell, the chromic acid formed from the bichromate salt performs the same office. A rough means of showing the effect of polarization may be had by connecting an electric bell or the telegraph sounder described in the November number of Amateur Work, including a coil of fine wire or other resistance sufficient to make the bell-sounder work feebly on the single cell with acid solution described. When the plates are first put in the jar, the bell or sounder will work quite strongly, but as polarization increases, the effect will become gradually weaker until finally the instruments will refuse to work.

A railroad company in Pennsylvania prevented the striking miners in its coal mines from interfering with non-union workmen, who were employed in pumping water out of the mines, by building a barbed-wire fence seven feet high about the pump-house and dynamo plant, and then charging it heavily with electricity.

THE COOPER-HEWITT LAMP.

A New System of Electric Lighting.

Within the past few months there has been presented to the public a system of electric lighting which, in point of interest and results, bids fair to equal any improvement in lighting methods put forth in the past few years. This invention, known as the Cooper-Hewitt vapor lamp, was exhibited to the public first at a meeting of the American Electrical Engineers last spring. In construction this lamp differs very strikingly from the familiar incandescent lamp, and its principle of operation is also different from the arc light. The lamp has not yet been developed to a commercial stage, but the experimental period is so far successfully passed as to warrant the assertion that it will be on the market within a comparatively short time. In appearance the lamp consists of a glass tube, nearly an inch in diameter, and about three feet long. The ends of the tube are in some models expanded into bulbs, and in each end of the tube or in each bulb is inserted a single leading-in wire, terminating at upper end in a metal cup-shaped electrode, preferably iron, while on the lower end of the lamp is contained a small quantity of mercury, which is in metallic contact with the leading-in wire at this point. The air is exhausted from this lamp by a process similar to that used in the manufacture of incandescent lamps of the ordinary type. As the air is exhausted, the tube becomes filled with mercury vapor, which at a certain stage or vacuum becomes conducting to a current of relatively low pressure or voltage. In the samples so far exhibited, when connected to a 110 or 220 circuit, this current is first started through the lamp from one end to the other by a special device, when it continues to flow uninterruptedly, and gives rise to an intense light throughout the entire length of the tube, so long as the current is applied to the lamp. The results are practically the same, whether direct or alternating currents are used, although which current is the most satisfactory in commercial practice is not yet announced. The intense light generated by the passage of the current through the rarified mercury vapor is not caused by an arc between the terminals of the lamp, but is a true form of conduction. There is no intense heating of the terminals or the lamp, and there is a dark space around and in front of each electrode. This space and its appearance differ with different vapors used. When the lamp was first shown last spring, it gave a harsh white light. This defect has been overcome by introducing traces of nitrogen with the mercury vapor, which has the effect of imparting a reddish tinge to the light that is very pleasant to the eye. The stability of the light under a constant pressure or voltage seems to be dependent upon maintaining a uniform vapor density or resistance to the current. This again is determined by the amount of heat developed and the rate at which the heat is radiated from the lamp. By suitable proportions of the metal vapor the density of heat radiation is maintained at a constant point, after the lamp has been once started, so that there is no variation in the illumination. During the early experiments with this type of lamp, in order to start the lamp glowing, it was found necessary to heat the lamp to a certain temperature before the current would begin to flow through it. This defect has been eliminated by a discovery that a small quantity of sulphur compound introduced in the lamp would enable the current to start very freely. In addition to this modification, a special starting device is used, by which the current is turned on the lamp, an initial current of high potential is forced through the lamp, when the low tension current will follow it, and the lamp will glow at its full intensity. As there is no solid conductor, such as the carbon filament used in the incandescent lamp, and no carbon electrodes, as in the case of the arc lamp, it would seem as though the Cooper-Hewitt lamp should show a remarkably long life. The efficiency is stated to be much higher than that of any lamp of the incandescent type, and the cost of manufacture is small compared with the results obtained. What the effects of a prolonged test on this lamp are, has not been given out, and it is impossible to state whether it will deteriorate through blackening or discoloring of the glass or decomposition of the light-giving vapors. The method of manufacturing this lamp, described briefly, is as follows: A tube of the proper shape is first cleansed with acids, alkali and water. It is then thoroughly rinsed with dilute hydrofluoric acid, and then washed with distilled water, and is sometimes given further cleansing in a bath of hot hydrogen gas. If mercury is to be used for the conducting vapor, a small quantity of it is placed in the tube; and if sulphide of mercury is required for forming the starting material, a small amount of this substance is also added. Pure sulphur has been used instead of sulphide of mercury, but it has been found more difficult to reach the desired results than with the mercury salt. The lamp is then connected to an exhaust pump, such as is used in the manufacture of ordinary incandescent lamps, aud while the exhaustion is taking place, artificial heat is applied to the tube in any convenient manner. After the air and other free gases have been exhausted, an electric current of high potential is applied to the terminals of the lamp. The operation of the exhaust pump is continued, and as it approaches completion, a voltage equal to that under which the lamp is to be operated, is applied to the terminals. When the proper stage has been reached, the lamp becomes intensely illuminous owing to the passage of this current, and after some further adjustment the lamp is sealed off the pump, and is ready for use after the connectors and supporting devices have been added. It is impossible to state at this early stage what position the Cooper-Hewitt lamp will occupy in the field of electric lighting. It seems to have advantages over the Nernst lamp in simplicity of construction and the ability to manufacture it for comparatively small candle-power. It does not seem, however, as though it is as practicable of such minute subdivision as the ordinary incandescent lamp, and it is probable that it will be used chiefly for general illumination, thus occupying an intermediate position between the arc and incandescent systems.

At the present time it seems as though a distinct advance has been made in electric lighting, and future developments will be watched with great interest, not only by the general public, but by the manufacturers of electric-lighting apparatus and the central station managers.

Experiment has shown that an electric arc can be employed under water for fusing metal. The intense heat turns the water surrounding the arc into steam, thus forming an insulating cushion of vapor. It has been suggested that with proper apparatus the electric arc could be employed by divers for quickly cutting through large chain cables or iron plates under water.

OLD DUTCH FURNITURE.

John F. Adams.

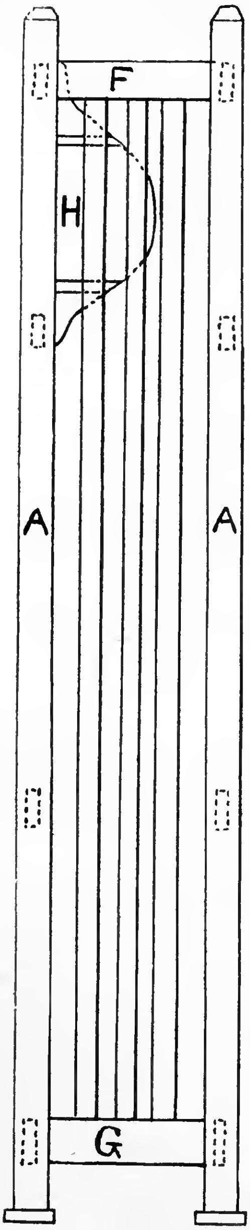
II.

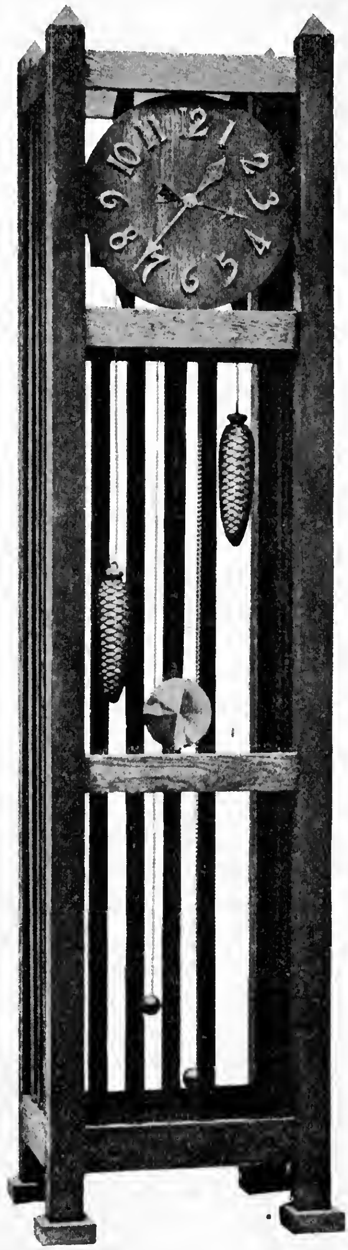
Hall-clock.

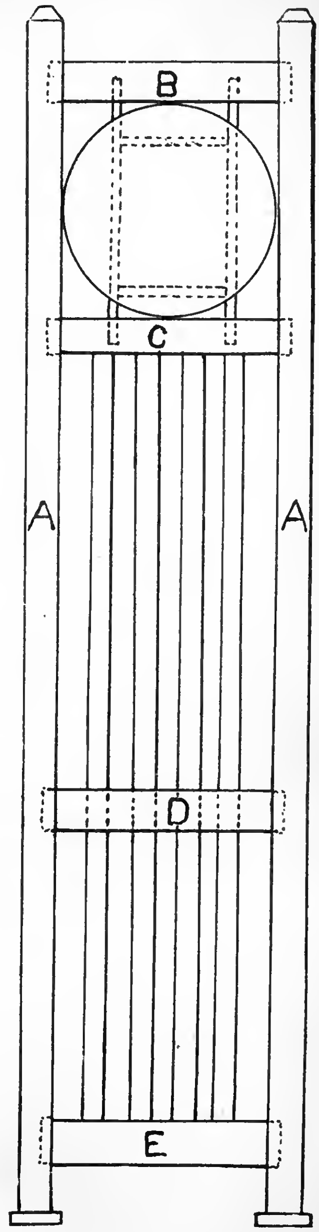
The hall-clock here described is of very striking appearance, and valuable where a strong decorative effect is desired. It is easily made, and will undoubtedly be the subject upon which many readers of this magazine will devote their leisure time during the long winter evenings. This description is limited to the construction of the framework and dial, the works to be purchased. At another time the description will be given of the construction of the works of a wooden clock, suitable for this frame.

The wood for this clock should be selected oak. The four corner-pieces, A, are 6′ 6″ long and 2⅛″ square. The top ends should have a ⅞″ bevel, as shown in the drawings. The crosspieces B and C are 2¼″ wide and 1¾″ thick. The crosspiece D is 2½″ wide, and E is 2¾″ wide, and both are ⅞″ thick. The uprights, A, are 14″ apart, which requires the crosspieces to be 16″ long, thus allowing 1″ on each end for the tenons that fit the mortises in the uprights, A. The crosspiece B is 3⅞″ below the tops of A; C is 14″ below B; D is 28¾″ below C, and E is 19″ below D. These pieces, as well as the crosspieces on the sides, are carefully jointed to A by mortise and tenon joints, the mortises for each crosspiece being centered in A. The front is entirely open, except where the dial is. The back is the same as the front, excepting that the crosspiece D is omitted; and between C and E are fitted four pieces, 1¼″ wide and ⅞″ thick, the space between A and the nearest piece being 2½″, and 1⅜″ between each piece. Allowing ⅝″ for tenons on each end of these pieces, they should be 51½″ long. The open space on the back between B and C allows the clock movement to be easily inspected at any time.

The sides have two crosspieces, F and G, only, both being 2¼″ wide and 1¾″ thick; and allowing 1″ on each end for tenon, are 12″ long, this making the uprights, A, 10″ apart. Three pieces, 1¼″ square and 67½″ long, allowing ½″ for tenon on each end, are fitted to mortises in these crosspieces. The outside ones are 1⅞″ from the uprights, A, and 1¼″ apart. Two pieces of board, H, 18½″ long, 6″ wide and ⅞″ thick, are cut to the shape







shown in the drawing and screwed to the cross-pieces B and C on the front. The dial is fastened to the front edges. They should be placed so as to properly receive the works, which are supported by cross-shelves, the dimensions of which are determined after the works are purchased. Holes will have to be cut in the bottom shelf, to allow the pendulum to swing and the chains for the weights to run through. No difficulty will be experienced in arranging this, if measurements are accurately made. A piece of thin board should be fitted to cover the back of the works, to keep out the dust. The blocks on the bottom of the uprights, A, are $3\frac{1}{2}''$ square and $\frac{7}{8}''$ thick, and fastened to the uprights by wooden pins, glued in. Wooden skewers, used by butchers to dress meat, will answer nicely, four holes being bored in each block, and the upright to receive the pins. Holes for casters may also be bored, and casters fitted when desired, but the clock stands firmer without.

The dial consists of a carefully selected circular piece of oak, 14″ in diameter and ¼″ thick. The figures may be of metal or wood; preferably the latter, using a fret-saw to make them. If of metal, get the fancy-shaped figure used in numbering street doors. Black iron figures can also be used, in which case the dial should be of white oak, and not stained. If wooden figures are used, they should be of very light wood, and glued to the dial after the latter has been stained. The outline of the figures should be marked on the dial before staining, and no stain applied to such places, as it would prevent the glue from holding strongly. To get the figures evenly placed, scribe a circle on the dial with dividers, cutting the bottom edge of 12 and the top edge of 6.

The frame and dial are finished in dark brown or green stain, as preferred, and wax-polished. A bright polish should be avoided, as it is not in harmony with this design. Care should be used in attaching the works that they are level, so as to get an even swing of the pendulum. The pendulum-rod should be stained to match the frame. If the rod is polished metal, a coat of light brown paint should be given it. The stain can then be applied, and the grain effect of wood secured. Careful attention to these directions will enable any one of ordinary skill to construct this very useful, as well as unique, piece of furniture.

HOW TO DEVELOP FILMS.

James F. Lucas.

We will assume that the developing-room is suitably equipped for the work and that the light is safe to work under.

On a bench or table, some distance from the red light, spread a clean paper, and on this place the rolls of film, seeing that each is wound tight as it comes from the camera, to prevent the quite frequent occurrence of fog-marks along the edge of the film.

Just previous to development obtain the following equipment: a pair of scissors, a knife, three large bowls or trays for washing, developing and fixing respectively, preferably 8″ x 10″ in size. Also a supply of fresh developer, a small bottle of potassium bromide solution, 1-10, for emergencies, acid-alum-hypo-fixing solution, glycerin and a clean towel.

With the knife, if necessary, cut away the paster which keeps the roll together. Hold the roll loosely in the left hand, and with the right grasp the free end of black paper and pull the paper out until the film is reached. Then, holding the end of the film and dropping the paper, continue to pull until the entire roll is exposed. Detach the inside end of the film from the black backing with the scissors, leaving the film entirely free. If the film has a scalloped edge, cut off about ⅛″ along its entire length, as the sharp corners will surely cut or scratch the surface before you are through with it.

Without any unnecessary handling, place the film in a tray of clean, cold water, face down, folding it over and over carefully, so as to have no sharp creases. Remove and reimmerse two or three times, to get rid of air bubbles and to partially flatten the film, making it easier to handle in the developer. Never attempt to cut your films apart until they have partially developed, as you are almost certain to cut into some picture. Allow your film to soak a minute, and meanwhile pour into the developing-dish enough fresh, strong developer so that it is at least ½″ deep, and place the same within a couple of feet of the light. Holding the strip by the ends with both hands, lower it, face down, into the tray. Move it to and fro, until every part of the surface has been thoroughly wet with developer. In the course of thirty seconds the images will probably make a faint appearance, when if some show a tendency to lag, while others darken up rapidly, remove the strips to the wash water again, and cut the pictures apart. Replace the slow ones in the developer and continue the process until the images are all out, which will probably take five or six minutes. By this time, even if no more detail can be obtained, the images will grey over, and further action will only block up the shadows and render the films useless. Place these in the wash water, and transfer the remaining films to the now somewhat slower acting developer. If they have the average snapshot exposure and conditions, they will probably develop up in three or four minutes. The back of the film should lose its creamy, yellow appearance and take on a dingy, grey color. Looked at by transmitted light, the image should show good strength and have a somewhat overdone appearance. Transfer to the wash water with the rest.

If, perchance, a few of the pictures show signs of darkening too quickly, which is seldom the case, they may sometimes be improved by washing the developer rapidly off and plunging into a plain solution of the potassium bromide, 1-10, before mentioned, for a few minutes soaking, finally finishing off with the developer well restrained with bromide; *i.e.*, add sufficient bromide solution, varying from a few drops to an ounce, to sufficiently retard the developer. Experience will be necessary to enable this to be correctly judged.

If the strip at the outset comes up uniformly, development may be allowed to continue without cutting, or after cutting the strip in halves for convenience, folding the film over and over without creasing, and continually but carefully changing its position in the developer.

After development is completed, rinse all films well in cold water and transfer to the fixing bath, where they should be kept moving for the first half minute, and thereafter at brief intervals. Peculiar yellow stains are liable to occur if this precaution is not taken, which no subsequent amount of fixing will remove. The films should remain in the fixing bath twenty minutes, and then be removed to cold water to rinse off the hypo-solution adhering, after which they should be washed in running water for an hour. After washing, swab off the surface with cotton, and place in a clean tray of glycerin and water, 1-32, for five minutes. Keep films moving in this as in other baths, for uniformity of results. Swab off once more with cotton, and without washing, drain and nail by the corners to a clean, soft-wood board, inclining the board against the wall on a shelf away from the dust.

If the strip has been developed in one piece, it may be laid over a broom-handle, end to end, film side out, with clip attached to the ends, to prevent curling.

In an hour or two, according to the temperature and humidity of the atmosphere, the films will be dry, and should be wiped off with a soft cloth, cut apart, if this has not been done, and placed between cards cut a little larger than the size of the picture. Mark for reference.

In spite of all care, scratches and pinholes will sometimes occur. They may be partially hidden by laying on the least bit of opaque, with a fine pointed brush, using the color as dry as possible. The prints will likewise require to be spotted, to correspond. To avoid these defects, use solutions cold, select a developer which does not contain a large proportion of alkali, use the acid-alum fixing bath, and handle the films with gentleness all through the process, not crossing them in the solutions, but working them side by side.

Long, fernlike lines extending lengthwise of the film are due to electrical phenomena in the process of manufacture, and cannot be helped. At certain intervals all films have a ridge crossing the film on the back, which may come right over an important picture. The ridge may be ground down with a knife, or some cotton and a little pumice. It is a defect in manufacture, and must be accepted as such. If during development a mealy sort of fog comes out all over the films, they were probably old and stale, or left in a damp place. It is always wise to get the freshest rolls possible, expose and develop expeditiously, and meanwhile keep them away from all abnormal atmospheric conditions. For a developer, the Metol-Hydroquinone is recommended, many formulæ for which are to be found in plate circulars and the photographic magazines. For the beginner, Hydroquinone alone is good, being slow of action and easy to manage.

DECORATIVE EMBOSSING.

An Artistic Yet Simple Method of Decoration.

We are all familiar with the fancy frosting with which confectioners decorate wedding and similar cakes. The utensils used for this work may, with slight modifications, be used to produce very ornamental calendars, photograph-frames, souvenirs, menus, programmes, window signs and other display cards, etc. For relief-map making it is excellent, and adds great interest to the study of geography. A photograph mounted upon heavy cardboard with a calendar pad beneath, and decorated by this process, would make a handsome present for a friend. But little artistic ability is required, the common embroidery patterns being readily adapted for the necessary designs. The process is easily learned if the directions here given are carefully followed.

The necessary articles are a syringe bulb of heavy rubber about two and one-half inches long, a glass tube one-quarter inch outside diameter and pointed at one end, a package of white water-paint, preferably of the kind known as "Alabastine," several papers of gold, silver and other colored bronzes and flitters, and a saucer or bowl for mixing. With the exception of the bronzes, these materials will cost about fifty cents. The syringe must have a strong suction. For the glass tube, a medicine "dropper" will answer, provided the flange is not so large as to prevent its being easily inserted in the rubber bulb. A better way would be to obtain a short piece of glass tubing, heat it near one end in an alcohol lamp and draw it out to a point. A little practice will soon enable this to be nicely done, and, once learned, the supply and shape of points may be varied as desired. An alcohol lamp may be made from a short, wide-mouthed bottle, through the cork of which a hole is bored with a gimlet or knife, through which is inserted a quill tube cut from a large hen-feather. The cotton wick is put through the tube, and should project a little so the quill will not be burned. The bulb and tubing can usually be purchased at the druggists', and a jeweller will form the glass points if the reader does not care to do it. The water-paint, bronzes and flitters can be secured of a paint dealer, as may also several pans of water-colors. The variety of colors of bronzes and water-colors purchased depends on how elaborately one cares to engage in this work. A good selection would be, one paper each of gold, silver, green, red and blue bronze, gold and silver flitter. Flitter varies from bronze in being flaky, while the bronzes are very fine powder. The appropriate uses of flitter will occur to the reader as progress is made in the work.

The materials are prepared and used as follows: the water-paint and water are first mixed in the proportion of about two parts water to five parts paint, the paint being gradually added to the water until quite pasty.

The proportion varies a little, the paint of different manufacturers not being alike. A little experience will enable the right proportions to be easily found. The rubber syringe is now squeezed flat, the open end inserted in the paste and then allowed to expand, thus becoming filled with the paste. Several insertions may be necessary to completely fill the syringe. When full, the glass tube is then inserted. If the bulb, held in the right hand, is now evenly and gently pressed, the paste will be expelled from the point in a fine round line, which may be guided by the left hand as desired. An even pressure is necessary, otherwise the line will be very uneven, with lumps in one place and nothing in another. Releasing the pressure stops the flow of paste, and this should be done in moving from one part of the work to another. A little practice with lines, curves and letters will soon enable even lines to be made at will. The lines are now white and for some effects are allowed to remain so. If a gold or other color is desired, the bronze is dropped over the work with a smooth table-knife, the work turned at different angles to allow the bronze to reach every part of the paste, then turned over and given a light rap with the knife to detach any surplus bronze and allow it to fall upon a piece of smooth paper used for that purpose. Bronze is not very cheap in price, so care should be taken in saving the surplus. If several colors are desired on the same work, the paste for one color is put on, the bronze of that color applied and the surplus removed. The paste for the next color is then put on, and colored, and this is repeated for each color applied. When white is wanted, in combination with colors, the paste for the white parts is the last to be put on. The work in one color should be perfectly dry before another color is applied, otherwise some of the second color will attach to the work of the first. Letters, half of which are one color and half of another, may be secured by removing the surplus of the first color from one side or end and the other color from the opposite side of the work, thus preventing them from getting mixed. Additional colors and tints may be secured by coloring the water used for mixing the paste with water-color. This is much less expensive than when bronze is used, yet is very useful for display cards. A design thus colored upon cardboard of a lighter tint of the same color may be made very attractive.

The utensils, when through using, should be thoroughly cleaned and keft in a jar filled with water. This prevents the paste from hardening and clogging up the tube and syringe.

The wide range of work possible with this process will become evident to the reader as experience is gained. Panels, screens, dadoes, are but a few of the lines of work, limited only by the artistic ability and desires of those who persevere.

CONCERNING SUPERHEATED STEAM.

Recently public attention has been once more turned in the direction of the use of superheated steam in our engines. The agitation of this question is by no means new. Along about the middle of the past century superheated steam was used to a small extent in several European countries, but was shortly given up. This was because of mechanical difficulties in the way of successful superheating, and not because the advantages in economical running were unnoticed.

Europeans, too, have been more forward in their attempts to utilize superheated steam than have Americans. On this side of the ocean the main object has been to employ saturated steam, and to obtain such a range of expansion as would yield the best results. To this end compounding was resorted to, and few attempts were made to increase the efficiency in any other way.

The steam which is generated in our boilers is, under favorable conditions, saturated steam. But with it it always carries a certain amount of excess moisture. This moisture exists even before the steam leaves the boiler. When it enters the steam main, no matter how excellent the covering, a certain amount of heat will be radiated, and this loss of heat can only result in the condensation of some of the steam. Consequently the amount of moisture is increased. Upon entering the engine cylinder, the walls of which are comparatively cool, there is a further loss by radiation, resulting in still further increase of moisture.

The use of superheated steam will not obviate this loss of heat, but it will reduce it to a great extent. Saturated steam is always of the temperature and pressure of the water from which it is generated, and its heat cannot be added to, while in contact with that water, without increase of pressure and temperature. But if it be led away from the boiler and passed through a series of coils, over surfaces which are heated to a higher temperature than the steam itself possesses, it will receive an addition of heat, without a change of pressure. This is the characteristic of superheated steam. It can be of any pressure and can be raised to any temperature within the limits of the superheating apparatus. In this it differs widely from saturated steam, which follows a certain fixed law in the relation of its temperature and pressure.

Let us follow the course of superheated steam sent from superheater to engine. If the degree of superheat is great, there will be no condensation whatever in its passage through the pipes. There will be a loss of heat by radiation, it is true, but unless this loss of heat reduces the temperature to or lower than the temperature corresponding to saturated steam of the same pressure, there will be no condensation. The same is true when the steam enters the cylinder. So that if the amount of heat added by superheating be equal to or greater than that lost in radiation, and so on, the interior walls of steam pipes, steam chest and cylinder will all be perfectly dry as far as moisture is concerned.

This is an additional advantage. Superheated steam, as the amount of superheat grows higher, approaches more nearly a perfect gas in nature and properties. Owing to this absolute dryness, it is less efficient in conducting heat than is the moisture-laden steam and the wet pipes and cylinder. So that the radiation loss when using superheated steam is much less than with saturated or wet steam.

The superheater consists of a coil or series of coils of pipe placed in the path of the flue gases, through which the steam is forced to pass as it travels from the boiler to the engine. Or the superheater may have an independently fired furnace. The main object, or rather the essential condition, being that the steam to be superheated shall pass through pipes surrounded by gases several hundred degrees hotter than the steam itself.

The reason for requiring such a heat for superheating must be evident. The steam is constantly in motion toward the engine, and so remains in the tubes but a short time. Yet in that time it must reach a certain temperature. This requires a high degree of temperature outside the tubes.-- *The Practical Engineer.*

It is said that experiments with the Delany telegraph system will be carried on by the Pennsylvania Railroad. With this system it is possible to transmit 8,000 words a minute, while a commercial rate of 2,000 words a minute is said to be possible with a single copper wire. With this system perforated tape is used, the characters being recorded electrolytically on tape which has been chemically prepared.

AMATEUR WORK

85 WATER ST., BOSTON

F. A. DRAPER . . . . Publisher

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

DECEMBER, 1901

Contents

TO OUR READERS.

THE interest shown in the first number of AMATEUR WORK by numerous patrons is very gratifying to those interested in its publication. We are sure this interest will be sustained by this and future issues. The field is a broad one, and will be carefully developed by experienced writers. Many interesting subjects are being investigated, and will eventually find an appropriate place in our pages. The constant endeavor will be, to so present the various topics as to stimulate the interest of our readers to attempting work that will afford them instruction and pleasure. Many young men idle away time which could be profitably spent in following work here presented. No one can tell when the knowledge acquired at leisure may prove of marked value in the business life.

Electricity is now so much a part of many kinds of business, that the "Studies in Electricity," if carefully followed, should be of great practical value. The successive chapters of this series will afford an opportunity for study, the equivalent of which can be obtained only from a technical school or from books costing many times the subscription rate of this magazine. The construction work and experiments to be presented are progressive, and in harmony with the development of the subject.

The chapters on "Mechanical Drawing" will give the student practical instruction in actual drafting-room practice. The separate parts, and finally an assembly of an upright steam-engine, are the subjects to be presented, together with much general information. The value of a knowledge of mechanical drawing, to any one engaged in manufacturing, cannot be overestimated. To apprentices in machine and electrical shops this opportunity for self-education should be welcome. Students in schools where this is not taught should likewise find these papers of grest value.

The many complimentary letters received from readers in widely separate parts of the country are an evidence that this magazine is providing for a want on the part of young men which hitherto has been unsupplied. We shall greatly appreciate any assistance that these readers can render towards giving it wider publicity and patronage.

THE news that the New York elevated railway lines will, within a few months, be equipped with electric power, will be welcome to the many thousands who travel on them daily.

MECHANICAL DRAWING.

Earnest T. Child.

II.

CONVENTIONAL PROBLEMS.

In our last talk we described the instruments which are necessary for the mechanical draftsman. Having secured the complete set or, if needs be, a partial set, the student should accustom himself to handle them properly. To learn to use dividers correctly will require some little practice, and the execution of a few conventional problems will be found the most satisfactory way in which to familiarize one's self with them. The following geometric problems have been selected from a large number, being the most important, as they cover the principles which apply to all.

Problem 1.

To draw parallel lines. Draw the line AB. At A, with radius R, draw an arc xx, and at B, with the same radius, draw arc yy. Draw line CD which shall be tangent to both arcs, just touching them. Line CD will be parallel to AB.

Problem 2.

To erect a perpendicular, bisecting a given line. On the line AB with center A and any radius, more than one-half AB, strike arcs xx and yy. With center B, and same radius, cut arcs xx and yy at 1 and 2. Draw CD through points 1 and 2. This line will be perpendicular to AB, and midway between points A and B.

Problem 3.

To erect a perpendicular at the end of a line. On line AB with A as a center and any radius construct arc xy. With center y and same radius cut xy at 1. With 1 as a center and same radius draw arc zz. Draw line from Y through intersection 1, and cut zz at 2. Draw lines AC through point 2. This line will be perpendicular to line AB.

Problem 4.

To construct a square. Proceed as in problem 3 to erect a perpendicular at A. With radius equal to AB cut vertical line at C. With center C and same radius strike arc xx. With center B, and same radius cut arc xx at D. Draw lines BD and CD. Fig. ACDB is a square.

Problem 5.

To construct an equilateral triangle. Draw line AB of the proper length for one side of the triangle. With radius AB and center A strike arc xx. With same radius and center B cut xx at C. Draw AC and BC, making triangle ABC, which is equilateral and also equiangular. By taking radii of the proper length, any triangle may be constructed in a similar manner. For instance, if AB =6 inches, AC=4 inches and BC=5 inches, radius for arc xx will be 4 inches, and radius for arc to cut it at C will be 5 inches.

Problem 6.

To construct a circle on any three points, given the points ABC. Draw lines AB and BC. Erect perpendiculars at centers of these lines as per problem 2. Construct these perpendiculars until they meet at point O. With O as a center and radius OA, draw a circle, and it will be found to pass through points B and C.

Problem 7.

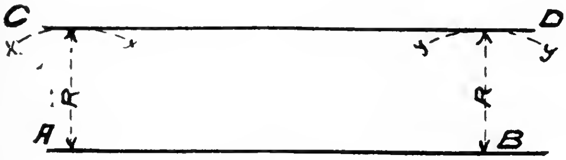
To construct a trefoil. Draw an equilateral triangle as per problem 5, and bisect each side as per problem 2. Then with the apex of the angles as centers and radius equal to one-half the sides draw arcs xy, yz and zx. In a similar manner a quarterfoil may be drawn about a square.

Problem 8.

To divide a straight line into a number of equal parts. Draw AB, and set off AC as an acute angle. Lay off on AC a number of equal lengths equal to the number into which the line is to be divided, say six. Draw B 6, and then draw lines 5-5, 4-4, 3-3, 2-2 and 1-1 all parallel to B 6, as in problem 1. These lines will divide AB as required.

Problem 9.

To inscribe a polygon of any number of sides



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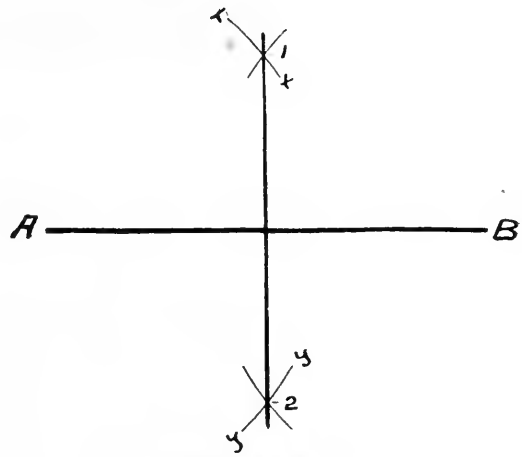

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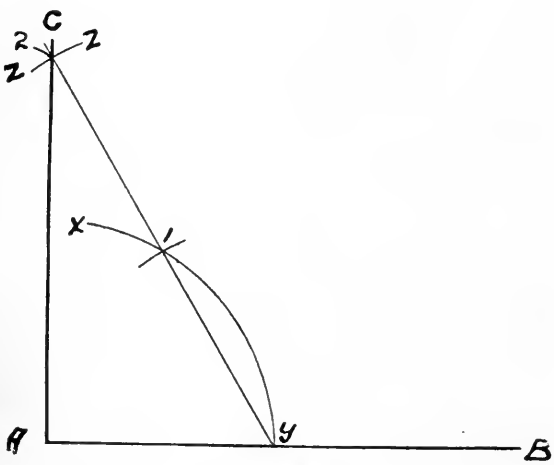

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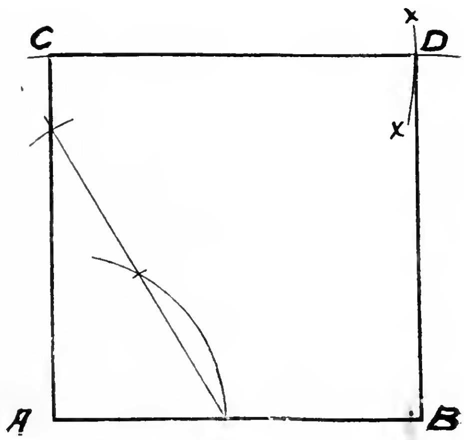

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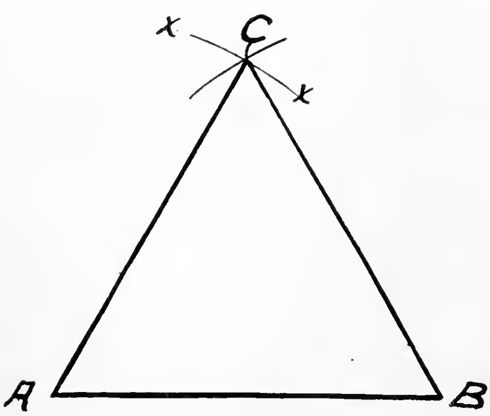

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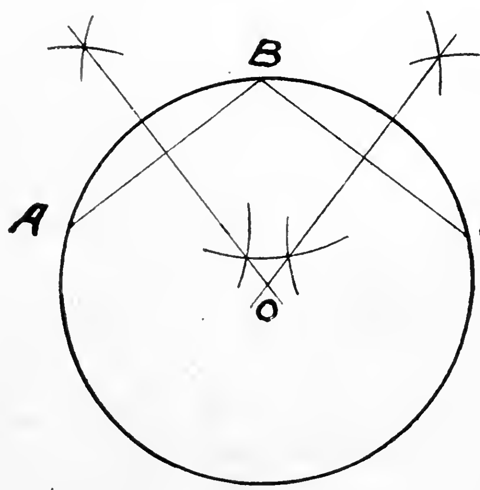

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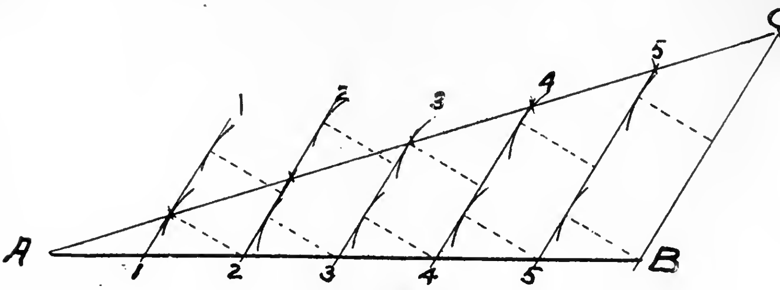

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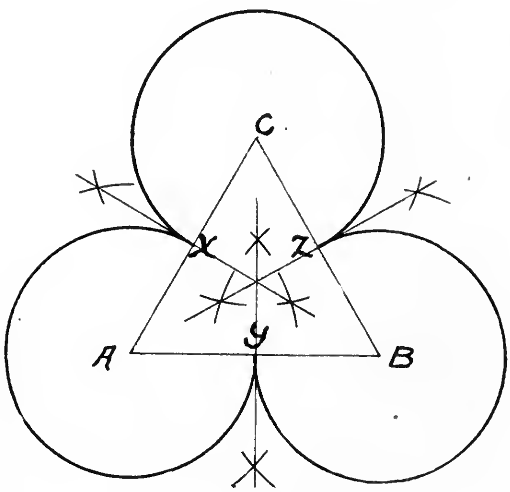

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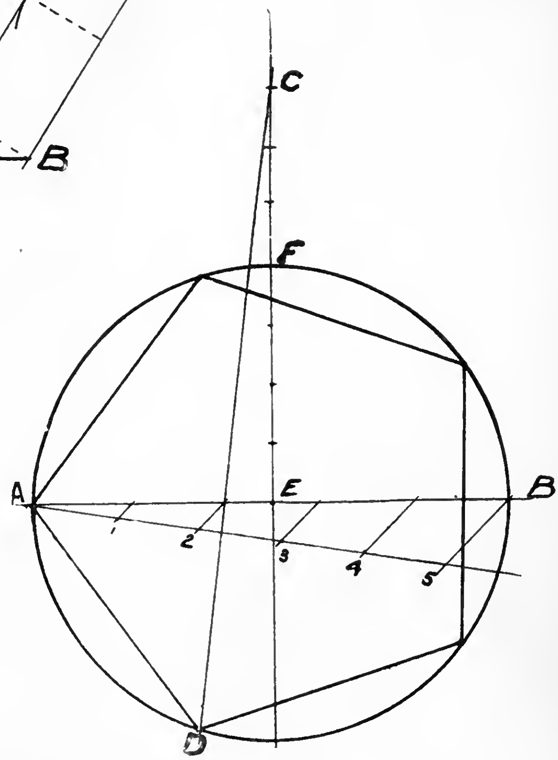


Problem No. 9.

within a circle. On center E draw a circle, and draw diameter AB. Through center E erect the perpendicular EC, cutting the circle at F. Divide radius EF into four equal parts, and lay off FC equal to three of them. Divide diameter AB into as many equal parts as the polygon has sides, and draw line CD through the second point from A, cutting the circle at D. Then AD is equal to one side of the polygon, and by stepping with the dividers around the circumference with the length AD, the polygon may be completed.

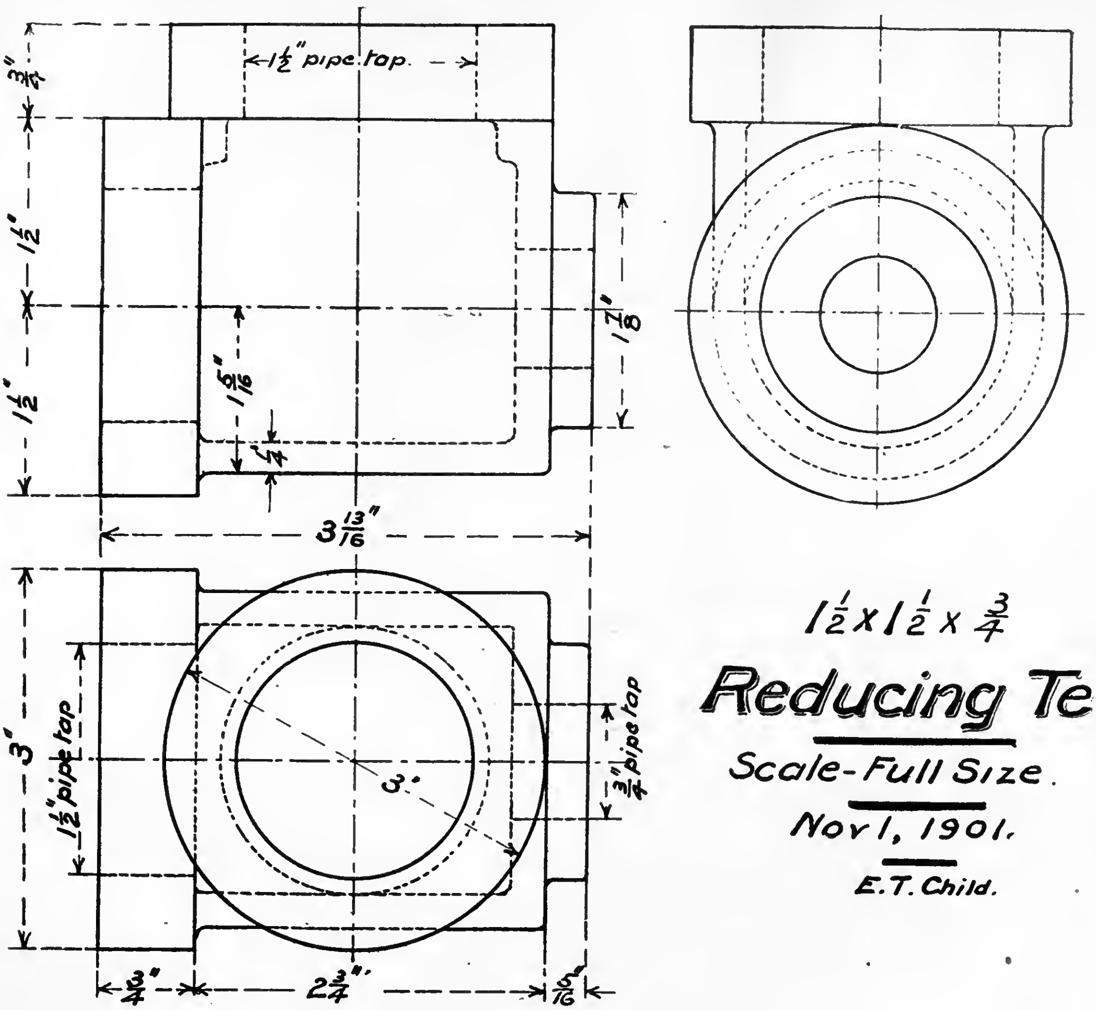
The student should work out the above problems carefully, drawing with pencil first, and then tracing his work in ink on tracing-cloth, preferably using the dull side of the cloth. It is a common mistake in schools to have the pupil ink in his work on paper; and while a very neat drawing is almost always the result, the pupil does not get the practice which he should have in the use of tracing-cloth. The use of paper for finished drawings has been practically abandoned in most drawing-rooms, and the cloth tracing stands as the record drawing. Thus the student is handicapped, as his work as a beginner in a drafting-room is invariably tracing on tracing-cloth from a pencil paper drawing, and unless he has had previous experience in using it he will surely find great difficulty in so doing. The writer's experience with beginners has been that they know absolutely nothing of the use of tracing-cloth, and blots, erasures, and even holes through the cloth are the not infrequent trials of the beginner, and his employer. It should be impressed on the student's mind that a thorough knowledge of the use of tracing-cloth is very essential to his success as a draftsman.

To make the ink flow well, the cloth should be well rubbed with powdered chalk or talcum, which should be carefully wiped off with a cloth. This will remove any oily particles which would tend to prevent the ink from flowing upon the surface evenly. To make the cloth lie flat, the selvage edge should be torn off. The cloth should be well tacked to the board, the thumb-tacks being not over ten to twelve inches apart. In erasing, care must be taken not to spoil the surface of the tracing, and a knife should not be used except for very fine work, and when used it must be extremely sharp. The safest way is to use a sand rubber, even though it erase more than necessary. It will not destroy the surface, and after a little powdered talcum has been well rubbed on the erased part, it may be inked again as well as at first. If tracing-cloth is not available, the paper drawings may be inked in, thus giving an idea of the use of drawing ink.

In completing the various problems, the construction lines may be drawn in full red lines, or in fine full or dotted black lines, the finished lines being drawn strongly in black. In later and more advanced work, construction lines are omitted. Before any ink work is done, at least one sheet should be made for practice in using the ruling pen, using various widths of line, dotted, dot and dash, and dash lines, to accustom one's self to the behavior of the drawing ink and ruling pen. It will be well to attempt drawing lines tangent to circles, which may also be drawn for practice. As previously stated, Whatman's paper is most commonly used for school work, and this undoubtedly makes the neatest looking drawing; but if tracing-cloth is available, manila detail paper will be preferable, as it is more commonly used in drawing-rooms, and the student can be working on the line of future practice. The cost of tracing-cloth is higher than Whatman's paper, and therefore it will be well to adopt a standard size of sheet as small as convenient. AMATEUR WORK is $7\frac{3}{4}''$ x $10\frac{5}{8}''$, and this is about the size of a standard letter sheet. If we adopt a standard $7\frac{1}{2}$ x $10\frac{1}{2}$ single and 15 x $10\frac{1}{2}$ double, it will work out very nicely. Manila paper may be obtained 22 x 30 (which will make four standard sheets) at about 60 cents per quire. This is about three standard sheets for two cents. Tracing-cloth may be obtained 30″ wide at about 28 cents per yard, and a sheet 22 x 30 will cost about 18 cents, which is $4\frac{1}{2}$ cents per standard sheet. The practice sheet may be used to help in learning the use of triangles and tee square, in drawing horizontal and vertical lines without having to use the problems which have been given above.

Having become fairly accustomed to the use of instruments, the next step will be to make a drawing showing three views of some simple object. Before this is done, a brief explanation of the rudiments of projection will be necessary. A mechanical drawing is never a picture, nor a perspective view. It is assumed that the eye is directly over each point of the object at the same time, and the dotted line is used to show parts which are hidden from external view. In other words, a mechanical drawing shows an object as if it were transparent or as if the X-rays were thrown on it. It must not be loaded with unnecessary detail, but it must contain enough to convey to the workman the necessary information to complete the work which it depicts. A simple object may be shown by two views, but it is customary to always show three views, and where the object is very irregular, additional sectional views may be taken.

A convenient arrangement places the plan in the lower left-hand corner of the sheet, with a front elevation directly above it, and an end view on the right. This leaves space for the title in the lower right-hand corner, where it is most conveniently seen as the sheet lies in the drawer. There is no established standard as to arrangement of views, but this has been found very convenient. The sheet should be numbered in the lower right-hand and upper left-hand corners, so that in case it gets into the drawer inverted, its number may be easily seen. The views must be placed in projection; that is, the center line of the front elevation will be directly above that of the plan, and that of the side view will be exactly in line with that of the front view and to the right. Let us take for our first regular drawing a steam-pipe-reducing tee. First locate the main center lines and begin to block out the views, carrying all three views along as closely as possible, as errors are more readily detected than when the views are finished separately. When the outlines of all three views are complete, then fill in the dotted lines and details, and finally line the pencil drawing in, preparatory to tracing. The drawing is now ready for the figures. Too much stress cannot be placed on the importance of this part of the work. A drawing may be perfect so far as lines and scale are concerned, yet may be entirely



SHEET PLAN (Reduced One-Third).

ruined by the use of crude or irregular figures. Great care must be used to make the figures well and of uniform size, and this part of the work should never be hurried. It will be well to check every figure by scale after the drawing is completed. Center lines are shown by dot and dash black lines, or full red lines, and usage differs regarding dimension and witness lines, but a dash black or a full red is the most common. Full red lines are preferable, as they show less strongly on a blue print, and a full line may be made more readily than one which is dotted. Dimension lines should be broken to allow space for the figure. Arrow or witness points should be made long, and at an angle of about 45 to 60 degrees, never wider, and the point of the witness mark should just touch the lines to which the dimension is given. The over-all dimension should be given where there is a series of subdimensions, to insure an additional check on the work. There are other important points regarding the figuring of drawings, which will be brought out from time to time as illustrations may arise. As stated above, the title should be placed in the lower right-hand corner of the sheet, and should designate the name of the whole, the special detail which may be represented, the scale, the date of completion, and the name of the designer, engineer or draftsman. Plain type should be used. The writer's experience goes to show that an Italic, Gothic letter entirely devoid of flourish is most readily handled by the largest number of draftsmen.

ASTRONOMY FOR DECEMBER.

On the 1st of December the sun sets at 4 h. 13 m. P.M., Standard Time (Eastern). A trail of planets follows after him in a regular crescendo of brilliancy. Mars, setting at about six o'clock, will, from its lowness in the haze, be difficult to see, except with a telescope. Saturn, about forty minutes further east, is followed by Jupiter, only a minute behind, and less than half a degree south, so that both will be in the same telescopic field with a power of thirty, and will continue so for at least a week.

Venus will have passed the two and will be fifty minutes further east, being near her greatest eastern elongation, which occurs on the 4th of the month. So that for a short time after sunset the twilight sky will be graced by the three principal planets in a row, each brighter than the one next west of it; a beautiful sight. Unfortunately they will be too low in the south for good definition in the telescope, though the contrast in the brightness and color of Jupiter and Saturn will be very evident, as long as they remain in the same field.

On the morning of the 1st, Mercury will be a little more than an hour east of the sun, and five degrees north of it, so that though it will probably be invisible to the naked eye, any one having a clear horizon and circles to his telescope may be able to pick it up between six o'clock and sunrise.

The sky at eight o'clock in the evening on the 1st of December will be very nearly the same as described for midnight of the 1st of November, with the exception that all the constellations will be about an hour further east, so that the two Dogs will not have risen. No planets will be visible, all having set, and the moon, being near her third quarter, will not rise for nearly three hours.

The moon will be absent from the evening sky until the 11th or 12th of the month, as she will be twenty days old on the 1st. She passes her last quarter on the 2d, and is new on the 10th; is at the first quarter on the 18th, and fulls on Christmas Day.

The early evenings of the month, therefore, will afford excellent opportunities for the study of the winter constellations. Orion, Gemini, Taurus and Aries are all up in the east, the former two stretching along horizontally from southeast to northeast, Taurus above them, and Aries above Taurus.

In the east, and to the north of Taurus, are Auriga and Perseus. The constellations above enumerated contain a great many stars of the first three magnitudes, in beautiful and striking configurations, and make the eastern sky very brilliant.

There will be eight stars of the first magnitude above the horizon; namely, Betelgeuse (Orion), Rigel (Orion), Aldebaran (Taurus), Capella (Auriga), Deneb (Cygnus), Vega (Lyra), Altair (Aquila), Fomalhaut (Pisces Austrinus): an hour or so later these will be reënforced by the arrival of Sirius and Procyon in the east.

Here the reader may very naturally ask, "What is a magnitude?" a question which it is not quite a simple matter to answer to his comprehension.

To an astronomer or physicist it would be comprehensively answered by the statement that a magnitude is that ratio between the light of two stars which is expressed by the number whose logarithm is 0.4. For the lay reader the most satisfactory way of explaining the question is to go a little into the history of the subject.

The early uranographers divided the stars visible to them into six classes or magnitudes, rather roughly defined, from the first, which included about a dozen of the very brightest, to the sixth, which were the faintest that a good eye could certainly distinguish on a clear night. Each magnitude was approximately half as bright as the next above it. While the stars were only roughly mapped and studied with the naked eye, it was sufficient.

But with the advent of the telescope the extension of the scale downward at once began to be a matter of difficulty. Men began to estimate half-magnitudes: the absence in the small field of the telescope of a number of standards of comparison, such as were available in naked-eye classification, made the estimation a matter of memory and judgment, and also greatly increased the difficulty of maintaining a constant value for the ratio expressed by the word magnitude. Struve, the

Russian observer, and after him others, began to estimate tenths of magnitudes. Each observer used a scale of his own, without much reference, apparently, to those of others.

From this resulted a great confusion of magnitudes in the catalogues which were brought out during the early half of the last century. The first to begin to reduce this chaos to something like order was Argelander of Bonn, in his great survey of the northern heavens, which included practically all the stars down to the ninth magnitude, and a great many yet fainter, and extended from the north pole to one degree south of the equator. Each star was observed three times, and as the catalogue when complete included 110,985 stars, it will be seen what an enormous labor it was. Each star when observed for position had an estimate of its magnitude recorded at the same time, and each magnitude in the catalogue represented the mean of three estimates, made by men experienced in this particular work. A great point was made of keeping to a constant ratio in the magnitudes, this ratio to be as nearly as possible that of the old naked-eye scale. The magnitudes in this catalogue (called the Bonn Durchmusterung) were at once accepted by American astronomers, and have been the standard to which all later attempts to reform the scale of magnitudes have been referred. Webb ("Celestial Objects," page 207, 4th ed.) gives a very interesting table, comparing the telescopic scales of several eminent observers with this "DM" scale, as it is called, which it would repay the reader to look up.

While Argelander was at work on this catalogue, the early experiments in stellar photometry were being made by Zöllner and others. In the seventies and thereafter, with the introduction of serious photometric work on the stars, in Pritchard's labors with the "wedge" photometer at Oxford, and Pickering's with the "meridian" photometer at Cambridge, an attempt was made by the astronomers and physicists interested in the question to unite upon a definite standard ratio, on which all photometric work should be based. The ratio finally adopted, as representing the scale heretofore used among the naked-eye stars, was the one first stated; viz., that number whose logarithm is 0.4, which is 2.52; so that a star is very nearly twice and a half brighter than those of the next magnitude below it.

As this ratio is a geometric one, it follows that a first-magnitude star is twice and a half brighter than a second, six times brighter than a third, sixteen times brighter than a fourth, forty times brighter than a fifth, and so on, until at the ninth it is four thousand times brighter.

Deneb in the Swan, and Altair in the Eagle, are good types of first-magnitude stars. Such stars as Sirius, Capella and Vega are much brighter than this, and their magnitudes are expressed in the photometric scale by decimals less than one; or if the difference is more than a full magnitude, by negative values; *e.g.*, Capella, 0.24; Vega, 0.10; Sirius, —1.72.

In the six ordinary naked-eye magnitudes, Heis enumerates 1,380 stars as being visible in these latitudes; the numbers in the several grades are: first to second, 13; second to third, 48; third to fourth, 152; fourth to fifth, 313; fifth to sixth, 854.

VEGA.

THE TELESCOPE.

Refractor and Reflector.

During the last half-century we have been so saturated with wonderful discoveries and inventions that we can form but a faint idea of the sensation produced in the minds of the people of the seventeenth century by the discovery of the telescope. Great discoveries, such as have crowded upon us so rapidly since the invention of the electric telegraph, were then few, and separated by centuries instead of by months as now.

How great must have been the wonder excited by this seeming reversal of the laws of nature, the apparent annihilation of distance by this marvelous instrument, most of our readers can probably have but a faint idea.

The writer has some realization of it, his surprise, wonder and delight at his first clear sight through a spyglass, at the age of nine, being still fresh in his memory.

Galileo has commonly had the credit of the discovery. But the idea was suggested previously by Kepler, and it is very probable that the Italian's invention was at least stimulated by seeing mention of the general principle, possibly in a letter from Kepler, with whom he corresponded.

As it happens, however, his invention was paralleled, if not anticipated, by two spectacle-makers in Middelburg, Holland, Zachariah Jansen and Hans Lipperheim, who independently made the same invention, except for the use of a convex instead of a concave eyeglass. But Jansen and Lipperheim are not such picturesque historical figures as Galileo, and so their fame has not lived as has the latter's.

The two forms are optically different, Galileo's, with the concave eyeglass *e*, as shown in the diagram, Fig. 1, intercepting the rays from the objective *o*, before they come to the focus, and making them parallel by bending them *out*, so that the only real image is formed within the eye.

Jansen's and Lipperheim's, on the other hand, using the convex eyeglass, placed beyond the focus of the objective at a distance equal to its own focal length, magnifies the image formed at that focus, rendering the rays parallel by bending them *inward*. (Fig. 2.)

Fig. 1.

Both these forms, in their essentials, survive in modern practice, Galileo's in the opera and field glasses, and Lipperheim's in the modern refractor, whose furthest point of growth is now the Yerkes equatorial.

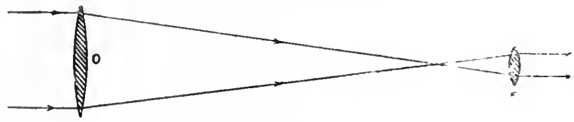


Fig. 2.

The Galilean telescope had the defect, inherent in its construction, of possessing a very small field of view, which more than offset its sharper definition, so that it was soon dropped in astronomical practice, and the Dutch arrangement became practically the only one in use.

It was soon found that the prismatic effect of the lenses limited the possible aperture of the objective

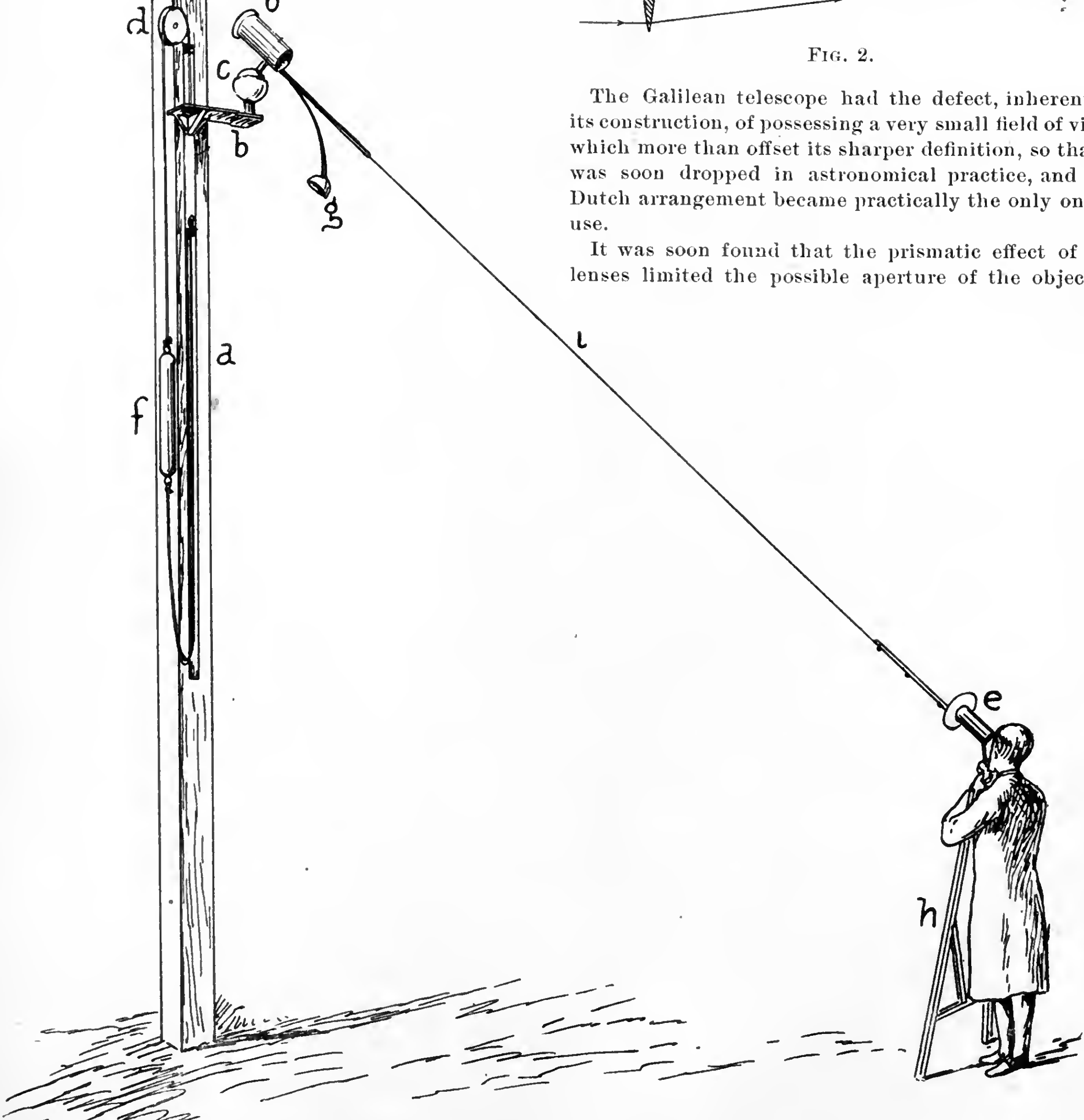


Fig. 3.

and power of the eyeglass, so that to obtain, for instance, a power of fifty, it was necessary to have a telescope six feet long, whose objective was limited to 1.32″ in diameter; astronomers mentioned the length of the telescope employed in any given observation, as indicative of the power used, and this practice continued even as late as the middle of the nineteenth century, although its force as indicating power was entirely obsolete.

So the telescopes lengthened out in search of power, until the devices for handling the tube and keeping it from bending under its own weight became so heavy and unwieldy that observing with them was almost impossible.

Huyghens, who, besides being an astronomer, was, for those days, an excellent mechanical engineer, invented an arrangement for using the telescope without a tube. The objective, set in a short tube, mounted on a ball-and-socket joint, was arranged so as to be raised and lowered on a tall pole; the axis of the short tube was controlled by a long cord, so that another short tube, carrying the eyeglass and held in the hand, could be brought into line with it. The illustration, Fig. 3, shows the appearance of one of these telescopes. *aa* is the post, *b* the bracket carrying the objective, which is mounted on the ball-and-socket joint *c*, and balanced by the weight *g*. The bracket and its load are counterpoised by the weight *f*, which is carried on an endless cord passing over the pulley *d*. The observer leaned on the rest *h*, and controlled the objective and kept it in line with the eye-tube *e*, by the cord *i*. The image of the object was received on the cardboard disc shown at the front end of the eye-tube, and the latter directed into place by an assistant.

With an instrument of this kind Huyghens discovered the fourth satellite of Saturn, and determined the form of his ring, which was before unknown; and Cassini discovered three other satellites of the same planet, and made his other discoveries, with such telescopes.

With such an equipment, observing must have been a terrible labor, and all these discoveries were made at such cost of toil and exposure as would daunt most modern observers.

These telescopes were made of dimensions up to 150 feet in length, and Auzout, of Paris, is said to have made an object-glass of 600 feet in focal length, but there is no record of its ever having been mounted for any useful observations.

The difficulties of observing with such glasses set the wits of many scientific men to work to find a remedy. Sir Isaac Newton and others attempted to solve the problem of making an object-glass free from color, but all failed, the difference in the refractive qualities of different kinds of glass being then unknown. Newton then turned his attention to the use of mirrors, and in 1672, with his own hands, made two small reflecting telescopes; these were about six inches in focal length, and one of them bore a power of 38, about equal to that of a four-foot refractor of that time. The performance of these instruments left something to be desired, as Newton, though, as he says, he approved the parabolic figure, knew no way of producing it, and had to content himself with spherical curves, which do not produce a perfect image. One or both of these telescopes is still in existence in the collection of the Royal Astronomical Society, if I am not mistaken.

The form of telescope devised by Newton, and ever since known by his name, is that now commonly used for reflectors, and is shown in the diagram below.

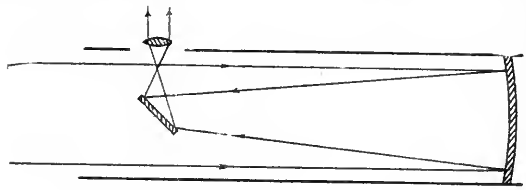


Fig. 4.

Where *a* is the large mirror, or speculum, as it is generally called, *b* the diagonal mirror, now usually referred to as the flat, and *c* the eye-piece, the course of the rays is shown by the arrows; the same remark applies to the other diagrams of reflectors.

The mirrors were made of speculum metal, an alloy of copper and tin, very white, hard, and brittle, and of high reflective qualities, taking a very perfect polish.

Gregory and Cassegrain invented forms in which one looked apparently directly through the tube, as in the refractor; this, however, was only apparent, and was accomplished by placing a small speculum, concave in Gregory's form (Fig. 5), and convex in Cassegrain's

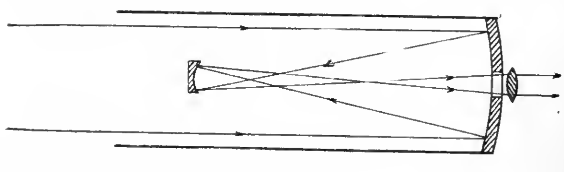


Fig. 5.

(Fig. 6), near the focus *o* of the great speculum, so that the rays were reflected directly back through a hole in

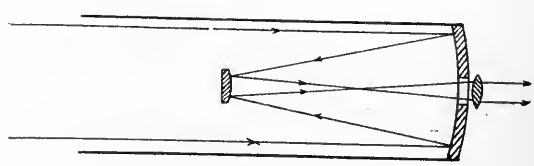


Fig. 6.

the center of the latter, to the eye-piece. These were powerful for their size, and handy to use, but were expensive, and were finally crowded out by the improved refractors of the next century.

The reflector has certain advantages over the refractor; there being but one large surface to be worked, instead of four, a perfect performance can be obtained at much less expense. All the rays can be brought accurately to the same point, as is not the case in the refractor, as will be shown farther on. The image at the focus of the speculum is absolutely free from extraneous color, being formed by reflection.

In point of convenience the reflector has one very great advantage, that the eye-piece is situated, not in the prolongation of the main tube, but at right angles with it, so that the observer, instead of having to hold his head in constrained and uncomfortable positions when viewing objects at high altitudes, can always, by rotating the tube in the cradle with which it is generally provided, keep the eye-piece in such a position that he can look into it as he would into a microscope, at the angle that best suits his convenience. Any one who has had to make careful estimates of magnitude, or to try to make out delicate planetary detail with a refractor, at an altitude within a few degrees of the zenith, or even to observe at those intermediate elevations where the eye-piece is just too low to get at comfortably when standing, and just too high to be reached without stretching up from any available seat, will understand how great and substantial an advantage this is.

When you add to this that about double the power can be had at the same cost, it will be seen that there are real advantages to be urged by the advocates of the reflector.

For fifty years the reflector remained the best telescope to be had. But the difficulty of obtaining suitable metal for the specula for many years hindered its progress; besides that, the processes for producing the best figure seem for a long time to have been kept secret in a few hands, so that they were very expensive instruments, and their size and power were limited.

Besides, the metal used reflected only about seventy-five per cent of the light, so that with two reflecting surfaces, and the light stopped by the small speculum, only half the light which entered the tube was finally available for purposes of vision, while the refractor utilized about ninety per cent of the light.

The refractor, however, was limited by the spherical aberration of the lenses of which it was made, that is, the impossibility of bringing all the rays to a single point by means of lenses made on spherical curves, and many attempts were made to obviate this by modifying these curves; but it was found that the chromatic aberration, caused by the action of the glass in separating the light into its component colors, was a much greater defect, as every bright object was bordered by a fringe of these colors, increasing rapidly with the increase of aperture and convexity of the lenses.

In 1729 Mr. Chester More Hall, of More Hall near Harlow, in Essex, England, succeeded in accomplishing the desired result, and is said to have made several telescopes. But he did not make his discovery public, and the matter went no farther.

In 1747 Euler tried a lens compounded of glass and water, "but," says Chambers, "it was a signal failure."

In 1758 Dollond invented the combination of flint and crown glass now in use, for which he received the Copley Medal from the Royal Society.

The rationale of Dollond's invention is as follows: If two similar glass prisms are placed in the path of a beam of light, with their refracting angles in opposite directions, the rays of light, which are separated into their primary colors by the first prism, in virtue of its dispersive power, and bent aside by its refractive power, will be refracted to the same extent in the opposite direction by the second prism, so that the beam will issue from it with its direction unchanged, and still white, the action of the first prism having been exactly reversed by the second.

Now a lens is similar in its action to a prism, the only difference being that its surfaces are curved instead of straight; so that if we have a convex and concave lens of similar glass and equal curvatures, the beam of light will, in passing through both, be bent out of its path and dispersed, as the separation of the colors is called, to precisely the same extent by both lenses, but in opposite directions, so that it emerges unchanged.

The optical glass of which all lenses are made is of two different kinds, called crown and flint glass. The latter has a refractive power slightly greater than that of the crown; its dispersive power is about three times as much greater as its refractive. Says Dr. Dick: "The edges of the lenses, one of crown and the other of flint glass, may be considered as two prisms which refract contrary ways, and if the excess of refraction in the one be such as precisely to destroy the divergency of color in the other, a colorless image will be formed. Thus if two lenses are made of the same focal length, the one of flint and the other of crown, the length or diameter of the colored image in the first will be to that produced by the crown as three to two nearly. Now if we make the focal lengths of the lenses in this proportion, that is, three to two, the colored spectrum produced by each will be equal." (I am not responsible for the good doctor's English, but his idea is clear enough.) "But if the flint lens be concave, and the crown convex, when placed in contact they will mutually correct each other, and a pencil of white refracted by the compound lens will remain colorless."

It also happens that when the flint and crown lenses are adjusted to best accomplish this result, the spherical aberration is also perfectly corrected, and the convexity of the crown lens is greater than the concavity of the flint to such an amount that the combination is virtually convex, and the rays form an image at its focal point.

This correction, however, is only approximate, though a close approximation, as the extreme rays of the spectrum cannot be brought to absolutely the same focal point by any combination of flint and crown lenses, though an infinity of approximations, all equally close, is possible; the problem is therefore what is mathematically called an indeterminate one.

In practice the curves are so computed as to bring the rays of greatest light intensity and the extreme rays together, so as only to lose those of least illuminating power.

There is always, therefore, in the achromatic, a fringe of violet light about the image of a bright object in focus. This is called technically the "outstanding light," a term the reader will often meet with in the literature of the telescope, and it is never wholly absent; this causes no difficulty in practice, as the eye very soon becomes accustomed to it, and disregards it, so that we actually do not see it unless we look for it.

The exact curves are different with different makers, each of whom has his favorite "formulas," as an indefinite number of different modifications will all be equally satisfactory in practice.

The early achromatics were very expensive, but in spite of this they made their way, and in a hundred years had practically crowded the reflector out of the field. But, about 1864, Foucault, of Paris, made some specula of glass, coated by an electrolytic process with a film of pure silver, which reflects as much light as an achromatic objective transmits. These specula were very satisfactory.

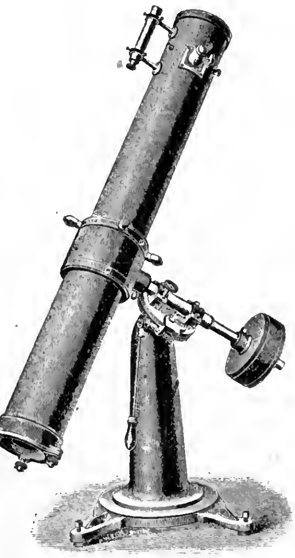


FIG. 7.

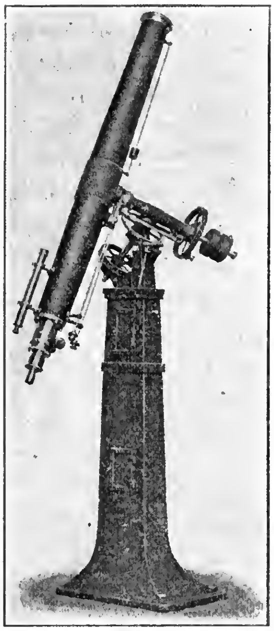


FIG. 9.

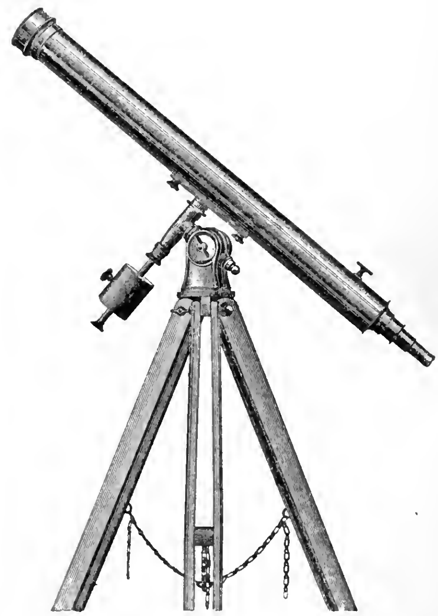


FIG. 8.

Since that time the reflector has steadily developed, and is now again a formidable competitor for favor with the refractor. Fig. 7 represents a modern 6½-inch reflector of American make, on a plain stand fitted for general planetary and star-gazing work; price, $250.

Fig. 8 is a three-inch refractor by Clark, on a corresponding stand; price, $150.

The reflector, however, has nearly four times the power of the refractor.

Fig. 9 represents a complete modern six-inch equatorial refractor, with circles, clock, etc. In such an instrument the mounting is often made by one firm, and the optical parts by another. The price of a refractor like this is about $1,500. The corresponding reflector would cost about $650.

Until 1830, a six-inch refractor was a large telescope. and an eight-inch a very large one. The Harvard Observatory fifteen-inch was a monster when made. Later advances in the manufacture of optical glass have extended the possible aperture to the forty inches of the Yerkes telescope, and this is very likely not the limit in this direction; though from the increasing engineering and other difficulties, this seems to be possibly the limit of useful increase.

The large reflectors of Herschel and Rosse were scarcely more than costly experiments. The Rosse specula were confessedly defective in definition. A French astronomer, who was shown Saturn with the great six-foot, said: "They showed me something, and said it was Saturn, and I believed them." Dr. Common, in England, however, has made silvered glass specula of three and five feet aperture, for photographic purposes, whose performance is understood to be excellent.

It will be seen that the beginner's choice between the two types is a difficult one, and it becomes more so the more he knows about the matter, as the advantages are pretty evenly divided. One is very likely to become accustomed to his first choice, and prefer it to the other, and to advise other seekers for information according to his prejudices. Either type is good, and the question practically resolves itself in the end into one of personal taste, and length of purse. VEGA.

PICTURE DECORATION.

This is a process for transferring *printed* pictures to boxes, furniture or other wooden surfaces. Some quite artistic and pleasing effects have been secured by this process. To illustrate how it is done, I will describe the decoration of a box used to store shoes and rubbers. The box was made of clear-grained whitewood of a light color. The corner joints were beveled, to make them show as little as possible. The surface of the wood was nicely sandpapered. The box was then varnished with spar-varnish. The pictures, before applying to the box, were moistened with water by dipping until all the paper was quite moist. Before the varnish was dry the pictures were placed upon the several places selected for them, face to the varnish, and carefully smoothed with a cloth so that all parts of the picture was in contact with the varnish. The pictures and varnish were then allowed to thoroughly dry. When dry, water was again applied to the back of the picture and the paper carefully removed, many applications of water with a sponge being necessary before all the paper was removed. Small pieces that were rather firmly attached to the varnish were taken off with very fine sandpaper. The ink of the printed picture was then found to stand out in clear contrast with the background of light wood, but in reverse view of the original. Coarse-lined pictures were used, such as Gibson drawings from *Harper's Weekly*. A large picture was the front centerpiece, small ones were in each corner; the lid had a similar number, each end had two or three. Border lines were secured from the borders of advertisements cut from magazines.

The process is not difficult, and, with a smaller subject, would be a quick one. The principal points requiring care are: to select proper pictures and get a good grade of varnish; to see that the pictures are well attached to the varnish.

W. B. G.

SENSIBLE BRIC-A-BRAC.

Everyone who has read Wm. D. Howells' "Hazard of New Fortunes" will recall the flat-hunting experience of the couple from Boston when they came to New York to launch a new journalistic venture, and their horror of one furnished flat in particular. This flat was so filled with bric-a-brac, spinning-wheels and vases that Mr. March, the man in the case, promptly dubbed it the "gimcrackery," and he continued to call it by this name until (and here is a moral) he rented it. Of course to be consistent he packed a lot of the "gimcracks" in barrels and stored them away somewhere out of sight, but the fact remains that the "gimcrackery" must have seemed the most homelike flat he visited.

That is the primal object of bric-a-brac. It makes *the* home *our* home. These small, or even large, decorative accessories are in a way the outgrowth of the lares and penates of the old Romans. In fact, some of the very clay images that the old Romans used as their household gods, now grace the cabinets and mantels of our own homes. But art objects have another use. They are the final touch, the bit of addition that makes or unmakes all the rest.

We are, happily, past the days of decorative rolling-pins and metamorphosed banjos, and all that sort of ugliness, but there is quite as much room for improvement as there ever was. This is evinced by the great lot of trash that is sold every year by the "fake auction" Japanese stores alone. Bric-a-brac should be purchased not because it is cheap and not because it is expensive, but because it completes a decorative whole, or gives a decided pleasure in itself. It need not be useful in the usual sense,—for to give pleasure to the eye is certainly a high usefulness,—but it should not be useless, unmeaning or obtrusive.

— *The Upholstery Dealer.*

While everybody has been predicting the ubiquity of the electric automobile as soon as the proper storage battery is devised, the fact that another interesting automobile application of electricity will be equally as much stimulated by such a battery, has generally been lost sight of. Just so surely as the electric automobile will be the favorite both for business and pleasure uses, so the electric boat will take the place of the gasolene, naphtha and steam yacht on our waters when the storage battery enters into its kingdom.

A railroad train in India ran into a herd of wild elephants, and brought to a very sudden stop. One elephant was killed and seven others ran away.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. I. No. 3. BOSTON, JANUARY, 1902. Ten Cents a Copy

STUDIES IN ELECTRICITY.

Donald M. Bliss.

III. Methods of Connection.

Four methods of connecting electrical devices cover most of the field in engineering practice. Figs. 5 and 6 show two methods of connection which will be used most frequently by the experimenter. The Fig. 5, known as a series connection, shows the zinc or negative pole of one cell connected to the positive or carbon pole of its neighbor. The cells are all connected up in this manner as shown, leaving an unconnected positive pole at one end of the series and a negative pole at the other. This method of connection has the effect of adding the pressure of the cells together, so that the total pressure of the series is that of one cell multiplied by the number of cells so connected. For instance, if the pressure of the single cell is $2\frac{1}{4}$ volts, the pressure of the six cells connected in a series will be $13\frac{1}{2}$ volts. While the pressure or voltage is thus increased, it should be borne in mind that the total available current in amperes is only that of a single cell.

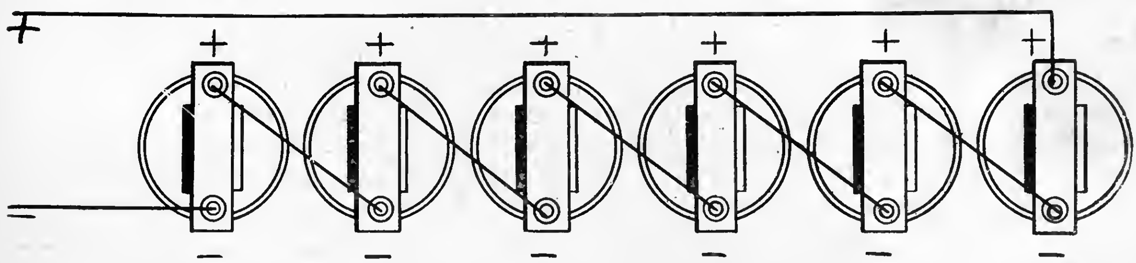


Fig. 5.

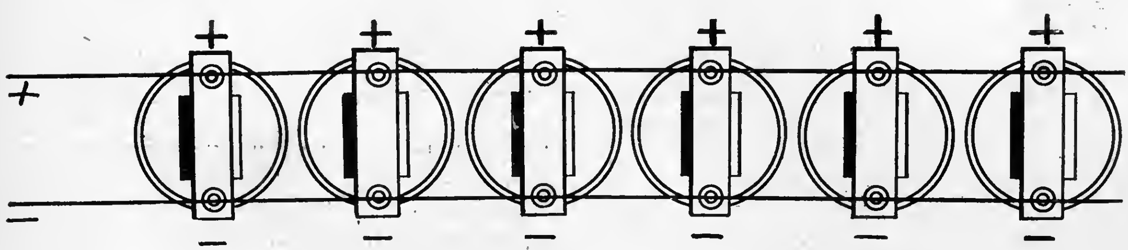


Fig. 6.

The amount of current that can be obtained in such a battery depends on the size of the negative and positive elements, and on the electrical resistance of the solution used in the battery. If it is desired to obtain from these cells the greatest amount of current, regardless of voltage, they must be connected in the manner shown in Fig. 6, known as the multiple, or parallel, grouping. In this instance it will be noted that all the positive poles are connected together by an independent wire, and all the negative poles by another wire. The difference of pressure or voltage from one of the connected wires to the other is evidently only that of a single cell, say $2\frac{1}{4}$ volts. As all the positive plates are connected together to one wire, and all the negative plates to the other, the battery then becomes the same in effect as a single large cell, having positive and negative elements,

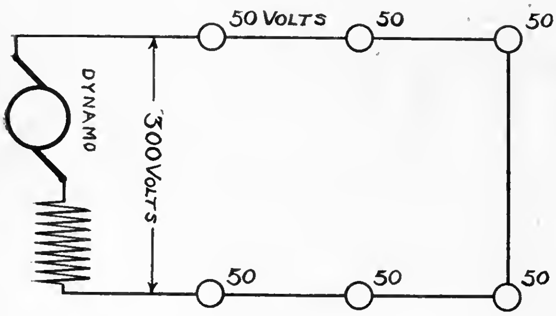


Fig. 7.

or plates, six times the size of a single cell. The available current is therefore six times as great, and the voltage of pressure one-sixth that of the series connection shown in Fig. 5.

While we are on the subject of connections, it will be well to illustrate the matter still further by reference to the most frequently used methods of connections in electric-lighting circuits. Fig. 7 shows the usual form of connection in series arc systems generally used for street lighting. The

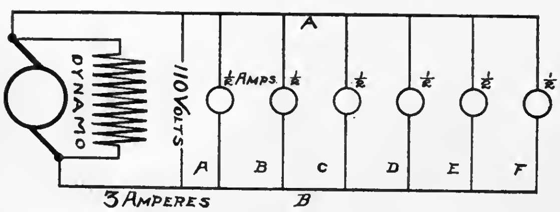


Fig. 8.

circles represent arc lamps in which the connections join one lamp in a series with another, so that the whole group of six lamps are in series connection with each other. If one lamp requires a voltage or pressure of about 50 volts, the six will require a total pressure of 300 volts, to operate them properly. As many as fifty lamps are sometimes connected in a series in this manner, and it will be seen that a total pressure of 2,000 to 3,000 volts may be necessary to operate a large number of arc lamps; and as the current becomes dangerous at about 500 volts, it can readily be seen why fatal accidents are occasionally met with on street-lighting circuits.

Fig. 8 shows the parallel, or multiple, connection generally used for incandescent lighting. In this case we have six lamps connected together across the main wires, or leads. As the standard incandescent lamp requires about 110 volts to operate properly, this pressure is maintained across the leads A and B. Each 16-candle-power lamp requires a current of approximately one-half an am-

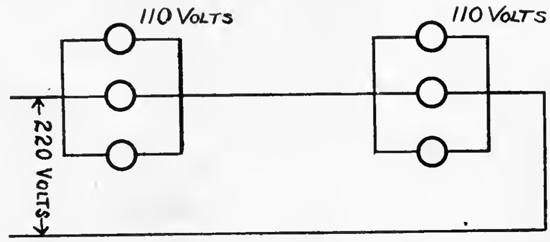


Fig. 9.

pere at a pressure of 110 volts. The six lamps will therefore require one-half multiplied by six, or three amperes, to operate the group. As there are frequently many hundred lamps so connected, it will be seen that while the total pressure of such a system may not exceed 110 volts, the current may reach several hundred amperes in each main circuit. As a matter of fact, the total current output of some of the largest stations operating in this system reaches many thousand amperes.

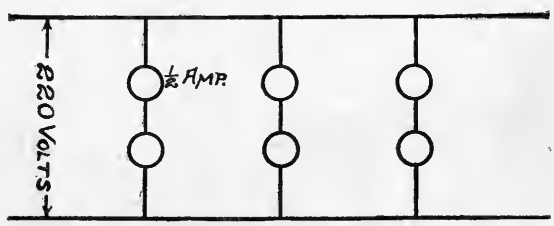
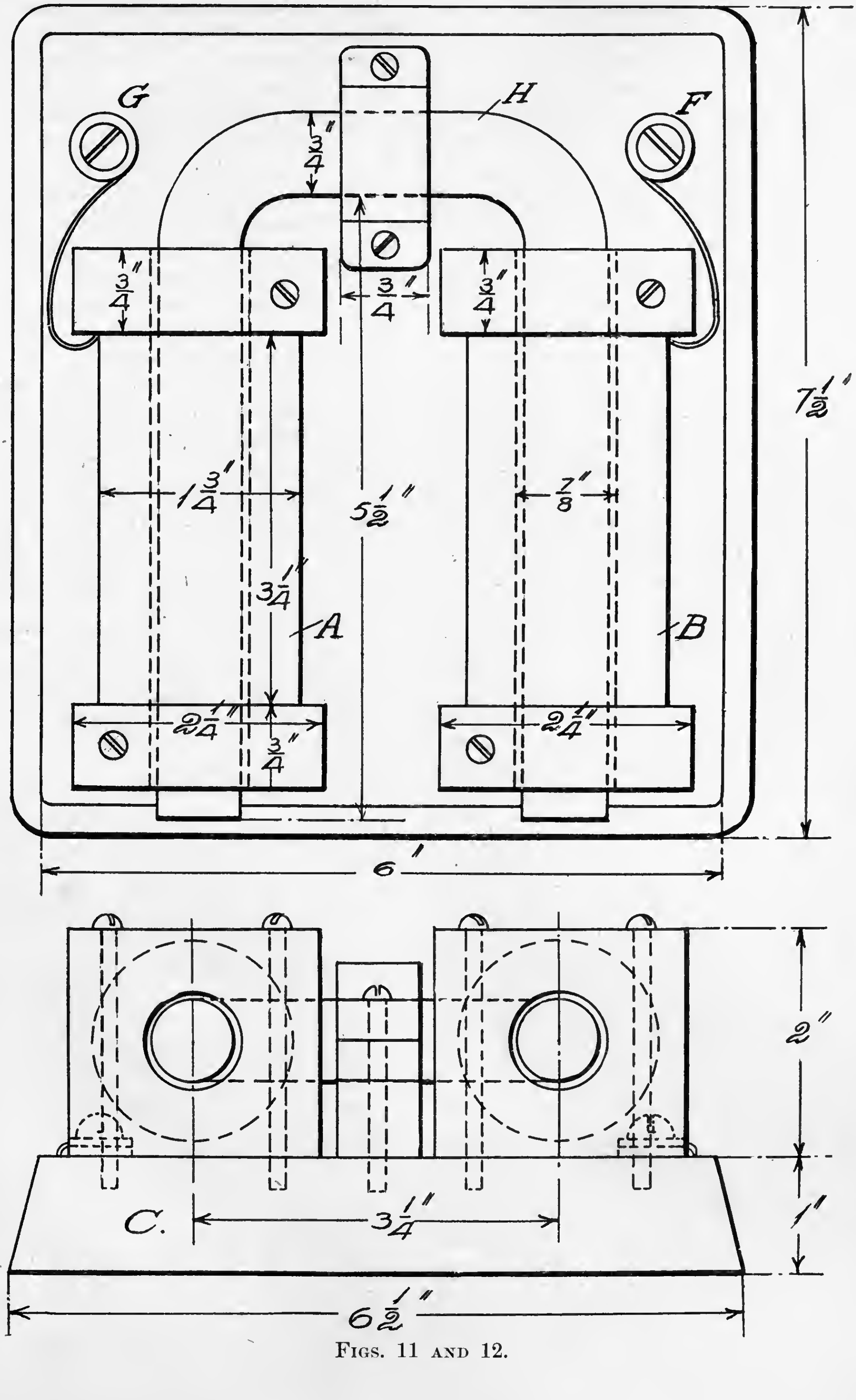


Fig. 10.

The two methods of connection, series and multiple, cover most of the connections used in electrical engineering.

There are two other arrangements of circuits sometimes used, which are illustrated in Figs. 9 and 10, Fig. 9 showing what is termed a series multiple, or series parallel, method connection. In this arrangement it will be seen that the whole circuit consists of a series of groups of lamps, batteries or instruments, the members of each group



Figs. 11 and 12.

being in multiple, while Fig. 10 shows the multiple series system, in which the devices as a whole are connected in multiple, but divided into groups in which the devices of each group are in series with each other. It is of course understood that these methods of connection may be used with any electrical device, whether it be a battery, lamp or other appliance. In most of the experiments to be described, the plain series connection will be found the most desirable.

Figs. 11 and 12 show an electro-magnet of a suitable size to give the best results from the battery described in the previous article. This magnet will be very convenient for making permanent magnets and a variety of experimental work, including a study of magnetism and the magnetic field. The magnet consists of two spools, A and B, of the dimensions shown, securely fastened to a wooden base, C, by means of screws passing through the heads of the coils into the base. It will be noted that the spool-heads are square and thick. This substantial construction is necessary, because the device when completed is quite heavy and is subject to considerable handling. The spool-heads should be sawn from hard wood, and the center holes drilled seven-eighths of an inch in diameter. Two tubes of several turns of heavy manilla paper or cartridge paper, formed around a three-quarter-inch rod, should next be made. These tubes should be glued securely into the heads of the spool, as shown. Care should be taken to see that the heads are all square with each other and the same distance apart. This alignment may be best secured by fastening the spool to a strip of wood while the glue is drying The holes for the fastening screws, and all other holes, should be drilled before the spool is wound. When this has been done, the spools may be mounted on a wooden arbor in the lathe, and wound.

Begin winding by inserting one end of the wire through the inner hole in the head E, and wind the wire on smoothly, layer after layer, until half of the wire has been wound on the spool. If the winding is not sufficiently smooth when the last two layers are being wound, a strip of stiff paper may be fitted around the spool and the last layer wound over the paper, making a smooth finish. The ends should be left long enough to connect to the binding screws, F and G, as shown. Connect the inside end of each coil together, and you may then make the core H. This is made from a three-quarter-inch bar of soft iron bent into the U-shape shown. This core, to give the best results, should be annealed by heating it red hot and allowing it to cool slowly. Do not fasten the coils to the base until the iron core has been made, for if the distance between the arms of the core does not come out according to the sketch, the position of the coils on the base will be altered accordingly. The winding may consist of two pounds of No. 18 B. & S. (Brown & Sharpe) gauge single cotton covered magnet wire. After the magnet has been completed, the coils may be given one or two coats of shellac varnish, and when dry the magnet is ready for use. The iron core should slide freely through the coils, as it will be found necessary to remove it in various experiments. To hold the core firmly in position, when required, two wood strips, hollowed out to fit the core, as shown at H, may be used. These strips, if screwed securely to the base, will hold the core firmly in position.

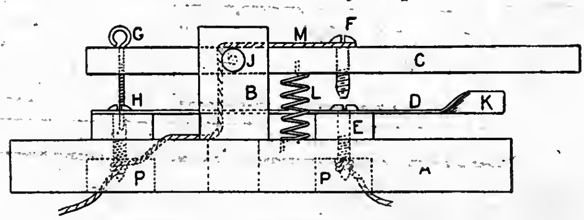


Fig. 13.

Fig. 13 shows a key, or circuit closer, which will be found most convenient for making and breaking the connection of the battery. It should be made as described on page 16, in the November number of this magazine.

Another device for rapidly interrupting the circuit is shown in Fig. 14. This will be found convenient for giving shocks in connection with the electro-magnet, for experiments with induction coils, and a variety of other uses. It is very easily constructed, and the amateur should not neglect to provide himself with such an interrupter. It consists simply of a wooden wheel turned in one piece, with its shaft. This wheel is mounted between two uprights on the base B. Before the wheel is taken out of the lathe, a circle should be marked on each side of it, and around this circle a number of wire nails should be driven through the wheel, so as to extend equally on each side. Two flat brass springs provided with connection

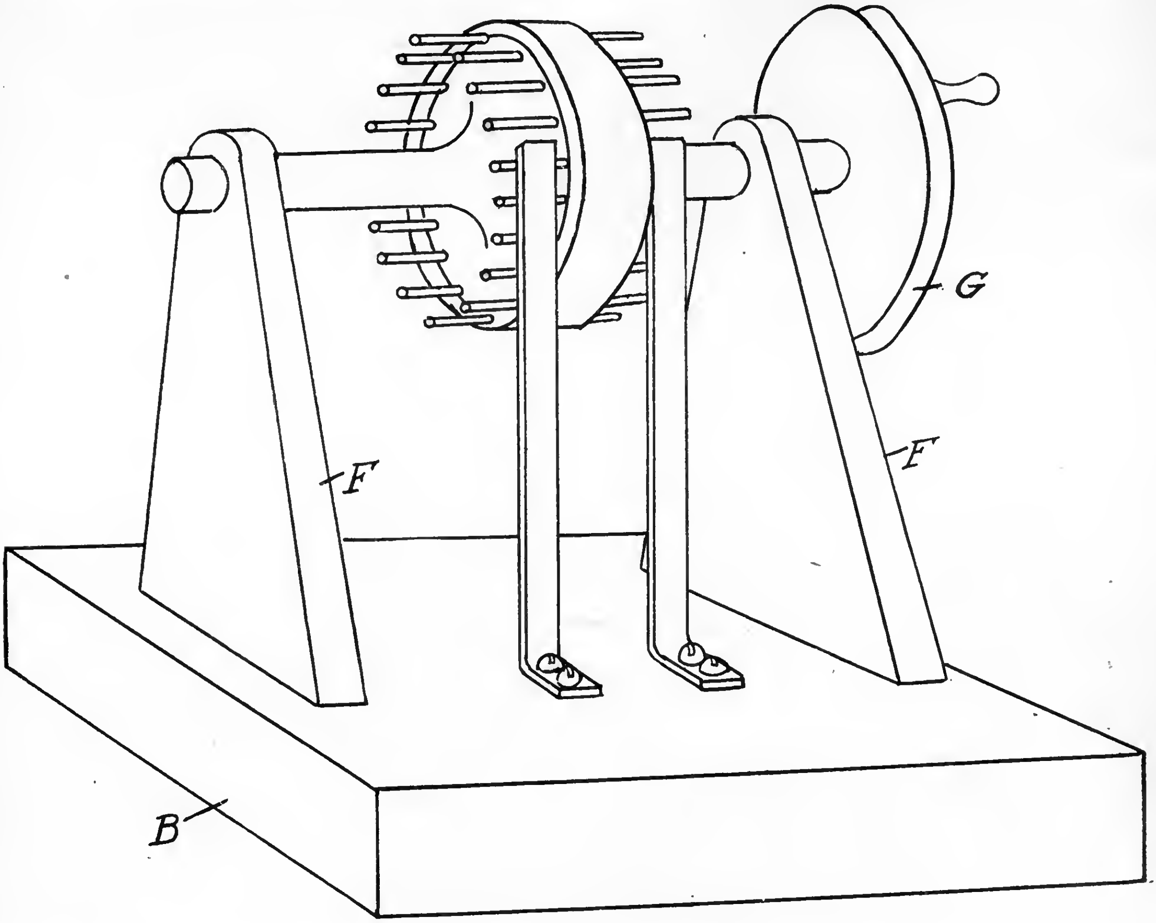


Fig. 14.

screws may be fastened to the base of opposite sides of the wheel, so that they will both bear gently at once on the pin which happens to be at the lower diameter of the wheel, as shown. The wooden shaft on one side of the wheel may be extended through the wooden upright or bearing, F, and provided with a small crank or handwheel, so that it may be easily turned. It will now be seen that as the wheel is revolved, the connection between the springs will alternately be made and broken as the device is operated. It will be found convenient to provide the handwheel G with a groove on its edge, so that, if necessary, it may be driven by a belt by any convenient source of power, such as a small motor run from a battery.

The proper connection for the battery, magnet and key, or circuit closer, is as follows: The wire is run from one pole of the battery to one of the binding posts on the base of the magnet. Another connection is made from the second binding post on the magnet to one of the connections on the key. The remaining connection on the key is connected with the other pole of the battery. In order to preserve the condition of the battery as long as possible, it is important at the conclusion of all experiments that the circuit be left open and the battery plates be removed from the jars. If this is not attended to, the battery will rapidly lose its strength, and solution will require frequent renewal, and the zincs cleaned and amalgamated; *i. e.*, treated with the mercury as described in the preceding article.

The Trans-African telegraph line has experienced interruption caused by elephants breaking down the poles.

HOW I BUILT A STEAM AUTOMOBILE.

J. M. McPhail.

The writer of this article has been requested to tell the readers of Amateur Work how he built a steam-propelled carriage at an expenditure of about three hundred dollars and a year's labor at odd times.

Having seen several of the different makes, and deciding to copy as nearly as possible one of the standard designs and leave the freak carriages to those caring to experiment, I started to take measurements of the different parts from the machines I saw in the streets and at the different exhibitions when they were to be seen. I managed to get all the correct measurements and lines of the standard vehicles.

The hubs were made first and were turned out of bar machine steel and made to be fitted with ball bearings. The cups for the balls were made out of the best tool steel that could be obtained, and were hardened, tempered and ground inside and out and then pressed into the hub. The hubs were drilled with holes for the spokes, and, after being nickel-plated, were ready for the spokes.

The rims were bought from a dealer for a small amount and drilled for the spokes to correspond with the hubs. These are 30″ in diameter and fitted with a 2½″ tire, which latter being built up, made a nice set of wheels, and being fitted with heavy spokes made them very strong.

The axles were procured from a manufacturer of drop forgings. They were turned in a lathe and fitted with the cones for the ball bearings.

The next and hardest part of the work was making the wooden patterns for the different castings of steel, for connecting the frame of steel tubing.

There are so many manufacturers who now make drop forgings, that there is no need of making patterns. Simply buy the forgings and machine them. This is cheaper than making patterns and having them cast.

The frame was designed to have, and fitted with, two long reaches, which strengthen the running gear of the vehicle.

The tubing for the frame of the running gear was 1½″ in diameter and heavy No. 10 gauge. Having cut and bent it to the proper shape, it was brazed into place and filed and finished up. The wheels and elliptical springs were then put on. The running gear was then ready for the body. I purchased the body of a carriage dealer and finished it myself.

A body for a steam vehicle can be bought for from fifteen to twenty-five dollars for a one-seated carriage and thirty to fifty for a double or surrey. This price is in the white, and the finish is extra.

Most of the readers of this article will think that the boiler where the steam is generated is very difficult to make, but in reality it is very simple. The boiler was made from a fourteen-inch piece of copper water-tank and is fifteen inches high, with two steel flanges or rings slipped over the ends, and then taken to a coppersmith and the ends of the copper shell flanged over to fit the steel rings. The two pieces of copper for heads were fourteen inches in diameter, by one-quarter of an inch in thickness. These were first drilled with three hundred half-inch holes and were then riveted on to the shell. The copper tubes, No. 20 gauge, were set in and expanded on the ends so as to make them tight under pressure. The boiler was next wound with three layers of piano wire one-sixteenth of an inch in diameter, which gives great tensile strength. This boiler, on a cold-water test, stood six hundred pounds pressure, and the writer has had three hundred pounds steam pressure and it has held tight.

On the subject of engines, it is useless for an amateur, unless very well equipped, to try and build one, as it takes so many special tools and patterns that, unless one has the time and money, it is a great deal cheaper to buy one. A good one can be procured for about eighty-five dollars, all ready to take steam. The engine should be large enough to furnish about four horse-power at a steam pressure of one hundred and fifty pounds.

The next process was to get a water-tank built to furnish water for the boiler, which was set in the back of the carriage. The one I used holds thirty-five gallons of water. There are also required two tanks to set under the footboard, to hold about nine gallons of gasolene. Also a copper tank to hold air to force gasolene to the burner, and a common bicycle pump to pump up the air pressure.

The next work was the assembling the different parts and fitting the piping to the steam and water gauges and burner for use under boiler. The latter is a stock article and can be procured from dealers. After everything was assembled and made to operate satisfactorily, the carriage was taken to pieces and the different parts painted and varnished, and the frame enameled the same as a bicycle frame.

The seat was upholstered in black leather, the bright works were nickel-plated, and the carriage again put together on the street as the work of construction was done in the cellar of the writer's house. Water was put into the tank and boiler, gasolene in the fuel tank and everything gotten ready for a start. The burner was lighted, and in a very few minutes there were eighty pounds of steam. The writer then stepped into the carriage, took the throttle in his right hand and the steering lever in the other and gently gave her steam. The carriage immediately started up a small hill and proceeded to the stable under steam. The thrill of delight as the carriage moved off was one of the most pleasant that can be imagined, as it meant that the work had been successful. The carriage was taken out on the road for several nights following and tuned up, and the little adjustments made that were needed, so that, in the short space of a week, it was running smoothly and with very little noise.

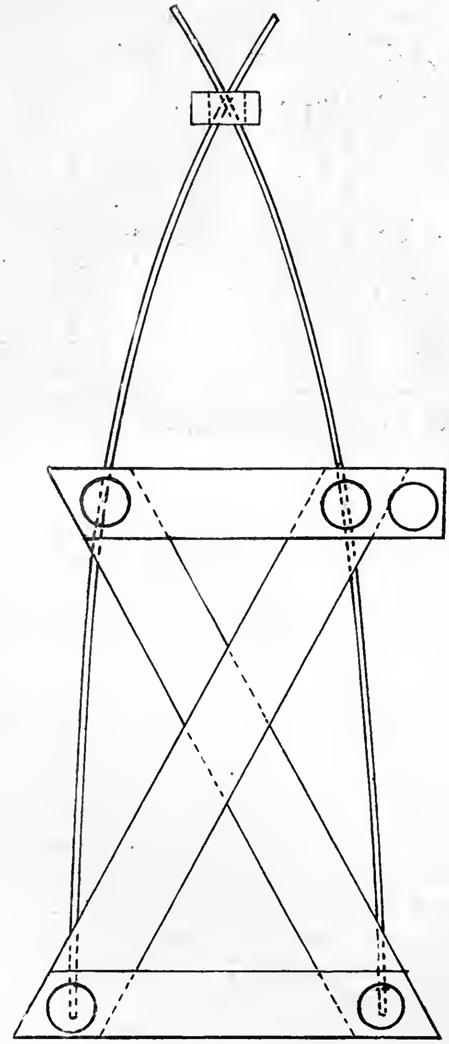
As the writer has said before, such a carriage can be built for three hundred dollars, not counting labor, and will weigh eight hundred pounds and carry three persons. It is one of the most satisfactory investments of time and money I ever made, and I am well satisfied with the results of my labors.

A PLATE-RACK.

James F. Rugg.

The plate-rack here described is an exceptionally useful kitchen utensil, and much prized by those who have used it. The labor of dish-wiping is avoided through the use of such a rack, and housekeepers will welcome anything that will dispense with this drudgery. The plates, having been washed, are put into quite hot rinsing water and thoroughly rinsed. They are then put into the rack and allowed to remain there until dry. This takes but a few minutes, the heat remaining in the dish when taken from the rinsing water affecting this. The top part should be filled first, to allow the dishes to drain before putting dishes under them. Dishes, and especially glassware, so dried, will have a fine polish, satisfactory to the most scrupulous housekeeper.

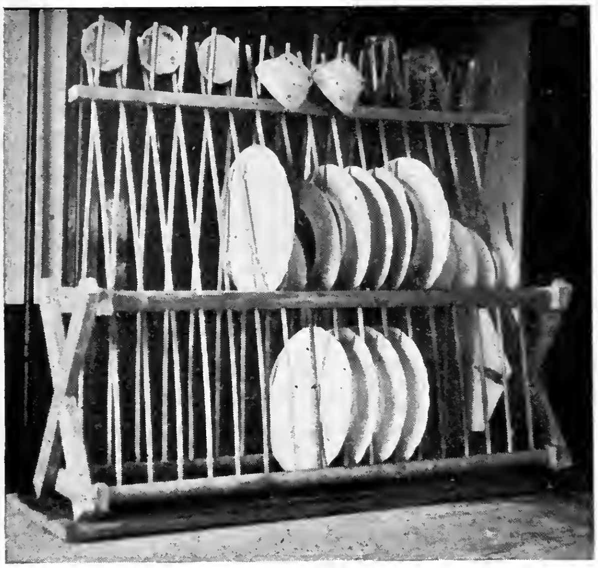
The materials required for a rack that will hold 36 dishes and an equal number of cups or tumblers are: 4 pieces clear birch or maple 24″ long, 1½″ wide and ⅞″ thick, and one piece 36″ long; 5 round pieces, 36″ long and 1″ diameter, 36



pieces doweling 30″ long and ¼″ diameter. The rack above illustrated was made in a hurry, and the X pieces were not halved to the crosspieces, nor the ends beveled. It is desirable to do this, as it makes a neater-looking rack.

If one is not familiar with wood-working, it will be advisable, before cutting out the pieces, to make a full-sized drawing of the end section as here given on one-quarter scale. The joints can then be laid out accurately and the work proceed more rapidly.

The X pieces are 14⅝″ long, allowing ⅞″ on each end for bevels. The bottom crosspiece is



9¼″ long and the top crosspiece 8⅜″ long. A 1″ hole is bored in each end of the bottom piece, the centers being 6½″ apart and 1⅛″ from each end. In the top piece three holes are bored, two of them 5″ between centers, the one on the beveled end being 1⅛″ from the end, and the other 2⅛″. The center of the third hole is 1″ from the square end. The bit should be sharp and care used in boring to prevent splitting the wood. The halves are now cut in the X pieces and crosspieces, those on the latter being on the inside. They are ½″ deep and should be accurate, so as to bring the surfaces of all the pieces flush when done. When these are completed, bore the holes in the X pieces to match the holes in the crosspieces. The round pieces that run lengthwise will then fit all right.

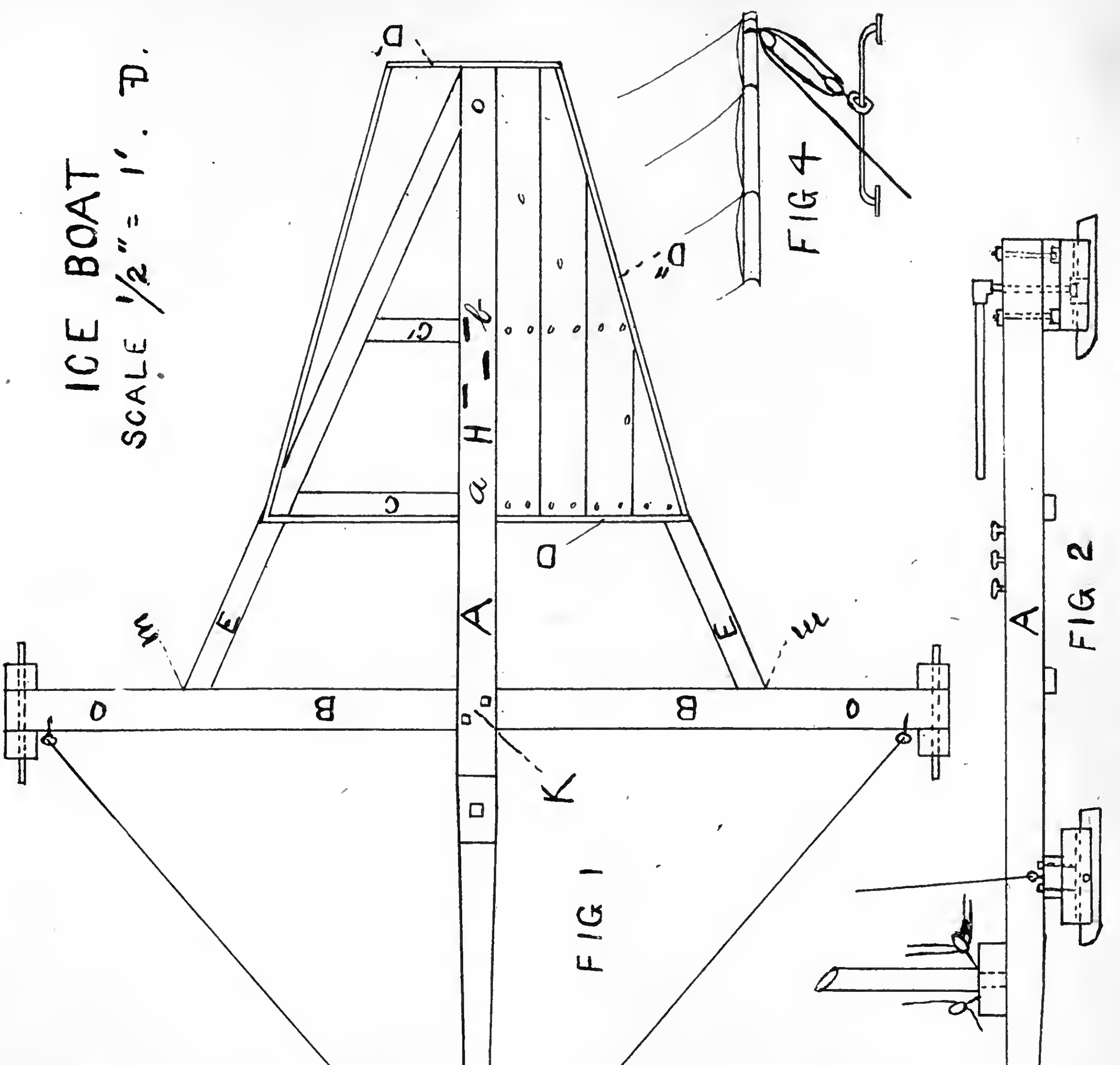
The round pieces are now bored with ¼″ holes to receive the dowel pieces. The holes in the two bottom ones are not bored through, about a ¼″ of wood being left. A pencil mark should be made along these pieces to insure getting the holes in line. Also care should be used to bore the holes in the same direction. A piece of dowel put in the first hole bored will serve as a guide for the rest. The holes are 1⅞″ between centers, and 1″ extra should be allowed on each end for fitting to the holes in the end pieces. No holes are bored in the upper outside round piece, this being used only when the rack is supported on a wall and rests on screw-hooks in the wall. In the upper flat piece, through which the dowels cross, bore ¾″ holes, 1⅞″ between centers, the center of the end holes being 1⅞″ from the end.

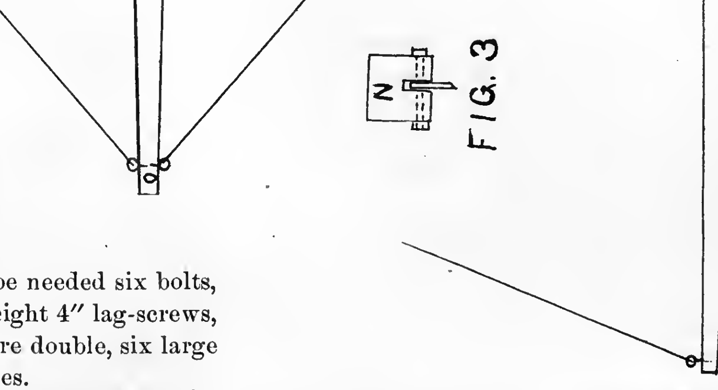
The rack is now ready to be put together. The round and end pieces are put together and glued. Two dowels are put in the end holes at each end, the tops brought together, and the top piece slipped over them and pressed down to the proper place. The dowels for the other holes are then easily placed. Beneath the rack should be a drain board. This is 9″ wide and 36″ long, with a ¼″ square strip along the sides and one end, the other being over the sink or a dish, into which flows the water from the plates. This drain board is sometimes covered with zinc, but a hard enamel paint will answer nicely. The rack is shellacked. The capacity of the rack may be increased or diminished by varying the number of partitions.

HOW TO BUILD AN ICE-BOAT.

A. S. Whittemore.

When a boy builds anything he generally wishes to know how to construct it at the least expense. In building an ice-boat he would like it strong, durable, and at the same time to cost little. The following plan for building an ice-boat is from actual experience, and if used will enable any one of but little skill to build a very serviceable boat. In building the boat from this diagram, the lumber required is: a spruce plank, A, 4″ x 5″ and 13′ long, for the backbone, a spruce plank, B, 2″ x 5″ and 10′ 4″ long for the crossbar, three pieces spruce, 2″ x 3″ and 7′ 6″ long for the braces, E and C and C′; C being 4′ long and C′ being 2′ 6″ long. Also four boards, D, 4″ wide and 1″ thick for the edging of deck, D being 4′ 9″ long, D′ 2′ long and D″ each 5′ 2″ long. The boards for the flooring should be of match pine ¾″ thick, and 35 running feet of 6″ width will be needed. Three





4″ x 4″ oak blocks 1′ long are required for runner-blocks. These should have grooves cut ¼″ wide and 2″ deep lengthwise through the center for the steel runners. This can be done at the mill when the lumber is purchased. There will be needed six bolts, 8″ x 1″, four large eye-bolts, eight 4″ lag-screws, seven pulleys, three of which are double, six large screw-eyes, wire nails and spikes.

The plank A for the backbone should be tapered from a point 5′ from the bow end down to a thickness of 2″ x 2″ at end, this tapered end serving as the bowsprit. This should also be done at the lumber mill.

The work of framing begins with attaching the crosspiece B to the backbone. Find the middle of crosspiece B, then, placing it on its wide side under the backbone A, bolt it on at K, the center of which is 6′ from the bow end. With lag-screws screw the planks E, which have been properly beveled, to the crossbar B at M, M, 3′ from the backbone, and again to the backbone and to each other where they meet beneath A at stern end. These two planks greatly strengthen the body of the boat and should be carefully fitted.

Next fit the crosspieces C and C′ and firmly attach to pieces E and A with wire spikes, taking care not to spring the pieces E while doing it. C is 1′ 11″ from B, and C′ is 1′ 8″ from C. The flooring is then sawed out and nailed to pieces C and E, leaving $\frac{3}{4}$″ lap beyond C through which to nail the side pieces to deck. The side pieces D are then nailed together and then attached to deck by being nailed through the flooring. The frame should be turned over or supported on horses to do this. Eight inches forward from the crossbar B attach a spruce block with lag-screws to the backbone. This should be 8″ long, 4″ wide and 3″ thick, and have in the center a hole 2″ square in which to step the mast.

For the runners procure three pieces of carriage spring steel, each 18″ long, 2$\frac{1}{2}$″ wide and $\frac{3}{16}$″ thick. In the middle have a $\frac{3}{8}$″ hole punched or drilled, the center of which is $\frac{3}{4}$″ from the upper edge. Grind two of them down as shown in Fig. 3 with the cutting edge outside. The third one should be ground on each side to give a V-shaped edge, this being for the steering runner. The front ends should be rounded like a sled runner. If a spring steel cannot be obtained, old skates ground as directed will answer the purpose. A $\frac{3}{8}$″ hole is bored in each runner-block, the centers being 1″ from lower edge, to receive the bolts holding the runners. The runners are then bolted into the blocks. At each end of the crossbar B, bolt the front runner-blocks, seeing that they are parallel with the backbone.

For the tiller take an iron bolt 1″ in diameter and 12″ long, having a square head, which should be tightly fitted into a hole cut in the block of the steering runner and put in before placing the runner in position. Bore a 1″ hole down through the backbone, the center being 5″ from the end. Insert the bolt of the steering runner. For the handle of the tiller, a piece of 1″ iron water-pipe 2′ long is required. On the end of the pipe have a thread cut and an L connection fitted, which latter will also fit the end of the runner bolt. A $\frac{1}{4}$″ hole should be drilled through the bolt and L, and a small bolt inserted to prevent the tiller from turning on the bolt. Three cleats are fastened to the backbone at H for the halyards, and one eye-bolt at the end of the bowsprit A, and one each on the crossbar at O and O′.

For the mast, secure a spruce pole 12′ long and 3″ in diameter at the base. For the boom, a spruce pole 11′ long and 2$\frac{1}{2}$″ in diameter at the mast end. For the gaff, a spruce pole 8′ long and 2″ in diameter. Fit strong V-shaped oak jaws at the throats of boom and gaff. The sail is of unbleached cotton, 11′ on the boom, 10′ on the mast and 8′ on the gaff. It should be hemmed at top and bottom, and also along the mast edge if the seams are run parallel with the slant of the outside edge of sail. It is desirable to have a stout line, clothesline will do, inside the hem to prevent the sail from tearing. Have the gaff peak up an angle of 60 degrees. The sail is fastened to the boom and gaff with loops of rope run through eyelets in the sail, and to the mast by rings of wood or heavy wire tied to eyelets in the sail. Make a jib 4′ 3″ on the base and 9′ high. This will run on the jib stay by stringing on the jib 1″ iron rings about 1′ apart. Make the mast stays of hemp clothesline running from the eye-bolts O O O to the top of the mast, fastening them in screw-eyes there placed, though an eye-band would be better if it can easily be obtained. Lash two pulleys 6″ from the top of the mast, one on the stem side for the throat halyards and one on bow side for jib, and another at the top for the peak halyard. The halyards are tied to the jib and gaff, and are the ropes used to hoist the sails, the peak halyard being the one running to the peak of the gaff, and the throat halyard the one running to foot of gaff. The jib requires but one. Cotton clothesline will do for the halyards.

To the backbone at the base of the mast drive in two staples, to which tie one single pulley for jib halyards and one double pulley for main-sheet halyards. To the piece D′ at stern, a horse for main-sheet traveler may be attached. (Fig. 4.) This is useful when beating to windward. The pulley or traveler ring should be tied on to facilitate unshipping the rigging.

FIRST WORK WITH A CAMERA.

Frederick A. Draper.

The first camera one possesses is generally the subject of considerable perplexity on the part of the owner. Focusing, exposure, plates, development, printing and numerous other questions rise to confuse, and their solution too often means the loss of valuable views that cannot be replaced. A little previous study into the conditions governing the use of a camera is desirable before beginning actual work for the first time.

A few words as to the basic principles. The rays of light that should enter the camera should be *reflected* from the object we desire to photograph. This requires that the direct rays of the sun should come from the back or side of the camera. By using great care, shielding the lens and other devices, a view may be taken when the lens faces nearly towards the sun; but this should only be done when it is impossible to get the view with the sun in a more favorable position. Never point the camera, as the writer has seen many a beginner do, directly towards the sun, as the only result will be disappointment. Use care in the selection of the view. Unless possessed of a long purse, promiscuous snapping the shutter will entail considerable expense and procure few views worth preserving. Friends are always willing to receive gratis several prints, especially if a good negative be secured. Some cases of this kind you really want, but many others were better dispensed with. Make it a point to do your best with each exposure, and you will soon find your work is good, and done with increasing ease. Study the artistic make-up of the subject, whether it be landscape, group or interior. A slight change of position or grouping may often greatly improve the result.

If plates are used, select one of the standard brands and stick to it until you know its workings thoroughly. Constantly changing the brand and kind of plate used, leads only to confusion. Make a record, in a book kept for that purpose only, of the time of exposure, kind of day, bright, dull, cloudy, etc., and by comparison learn the cause of the first errors. You will soon be able to prevent their recurrence. Keep the filled plate-holders covered from the direct rays of the sun. A foggy plate is often caused by laying the plate-holder in the bright sun while adjusting the camera. When removing the slide in the plate-holder, cover that portion of camera with a focusing or some other black cloth so the sun will not shine upon it. See that the lens is clean. A piece of chamois skin is the best thing to clean the lens with. Never use silk.

The amount of light admitted to the camera is varied by the diaphragm. On a bright day, a smaller stop, as it is called, may be used, than on a dull, cloudy day. The smaller the stop, the longer the exposure required and the sharper definition secured.

If possible, have your own dark room and do your own developing. This requires a ruby lamp, and one with both ruby and orange glass should be used. See that the room is absolutely light-proof. Dust your plate-holder and plates with a soft brush when loading. Make your first trials at developing with views that can again be taken if you fail with them. The developing formulæ given by the maker of the plates you are using will be satisfactory. Use fresh chemicals, also fresh plates. Buy your supplies of a reputable dealer, even if the cost is a little more than at some bargain-counter sale. Old plates and old chemicals are expensive in the results, even if you have them given to you.

Label your different bottles, pans, etc., and use each one only as directed. A mixture of chemicals in the same tray, even if only traces be present, is extremely likely to ruin a negative. The developer will flow more evenly if the plate has been previously wet with clean water. The developer, when first applied to the plate, should sweep over it in a wave as quickly as possible, and be kept rocking until development is well advanced. The usual faults of the novice are over-exposure and under-development. Keep these points in mind during your early work. In your first work, study carefully what you have to do, until you have it clearly in mind.

The many excellent printing papers now available, accompanied with complete directions for working, make unnecessary any instruction regarding the common kinds of prints. As progress is made, the inclinations of the worker will lead to experiments with more complicated processes, and when that time arrives, these remarks will be no longer useful.

AMATEUR WORK

85 WATER ST., BOSTON

F. A. DRAPER . . . . Publisher

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

JANUARY, 1902

Contents

ELEMENTS OF SUCCESS.

It has been said that the American youth has twenty things begun but only one done. This statement is undoubtedly much exaggerated, but it is a fact that too many attempts are made that are never completed. The lack of proper consideration of what is to be done and the means to do it, is probably the chief cause of this condition. It were better not to begin any work than to begin it and not complete it because it is no longer interesting. Should any one find a growing tendency on his part to do careless or incomplete work, every effort should be made to overcome it. The harmful effects of such a practice are many and permanent. A weak and vacillating character ruins many a man, no matter how great his abilities may be. The steady, thorough worker is the one who, in these days of large industrial enterprises, occupies the position of responsibility. This is because he can be depended upon to do what is required of him in the way and when it is wanted. This ability on his part was developed in younger days and became sufficiently characteristic of his work, so that it was recognized and thus procured his advancement. Our young readers who hope to succeed in their chosen vocation will do so only by acquiring the habit of being thoughtful, thorough and persistent in what they attempt now.

The successful transmission of signals across the Atlantic Ocean by wireless telegraphy, which was accomplished by the Italian inventor, Guglielmo Marconi, on Wednesday, Dec. 11, is entitled to rank among the notable achievements of the present century. The success of wireless telegraphy over moderate distances has justified the hope that much greater spaces would eventually be spanned by it, but the sudden leap from transmission over a hundred miles or so to the 1,800 miles distance from Newfoundland to Cornwall, was a surprise to even the most sanguine.

A practical illustration of the use of the telephone as part of a diver's equipment is being given at the exposition which is being held at the Chicago Coliseum this week. A telephone is attached to the helmet of a diver, who is under water for a number of hours. Visitors to the show can converse with the man, and the device is proving quite an attraction. The telephone was used by divers in examining the wreck of the "Idler," a private yacht from Cleveland, which went down on the lakes during the last season, thus enabling the men who were searching for bodies to keep those above promptly informed as to results.

MECHANICAL DRAWING.

Earnest T. Child.

III.

WORKING DRAWINGS.

Incidental to the practice work which the student must not neglect, it will be well to study as to the detail and general make-up of drawings. The first question that will naturally occur is: the class of line to use. The first tendency will be to use very light lines; but this should be avoided, especially in case the drawing is to be

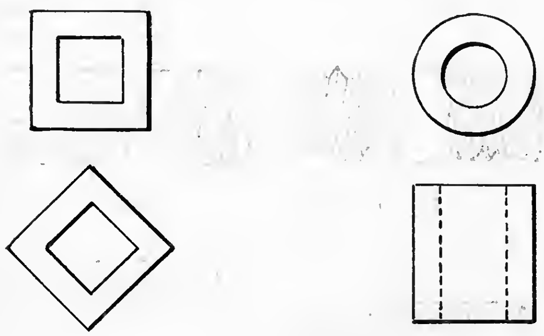


Fig. 1.

blue-printed, as fine lines are very apt to print out. The full lines should be about one-fiftieth of an inch wide, and the dotted lines about two-thirds as wide as the full. Those shown on page 41 in the December number are of the proper weight. It will be seen that shade lines are not used in this case. For regular shop work it is not generally found expedient to use shade lines, as they add to the cost of the drawing, and do not ordinarily add enough to the clearness of the drawing to pay for the outlay. For this reason, the drawings which will be given hereafter will omit shade lines. It will not do to entirely condemn the use of shade lines, as there are instances where a drawing will be incomplete without them. Our work will not be complete without a few words on this subject.

In using shade lines on a drawing, it is generally assumed that the light is coming from the upper left-hand corner of the sheet. This will cause shadows to be cast on the lower and right-hand lines. In case one surface is nearer the observer than another, the lower and right-hand lines of the nearest surface will be shaded. When two surfaces representing different pieces are flush, the dividing line should not be shaded. In some instances it will be found very difficult to determine just which lines should be shaded, but the general rule given above will almost always apply. Shade the lower right-hand quadrant of outside circles and the upper left-hand quadrant of inside circles, and always keep the shading outside of the surface which they bound. Shade lines or circles should be tapered off gradually to the regular weight of line. When shade lines are used, the light lines should be much finer than one-fiftieth of an inch. (See Fig. 1.) The various classes of conventional lines are shown by Fig. 2. No. 1 shows a fine full line suitable for drawing when using shade lines of the width shown by No. 2. The latter is the proper width of line where shading is omitted and the work has to be blue-printed. No. 3 shows a dotted line, No. 4 a dash line, No. 5 a dot-and-dash line, and No. 6 a double dot-and-dash line. It will be noted that Nos. 3 to 6 are finer than No. 2. This adds clearness and strength to the drawing.

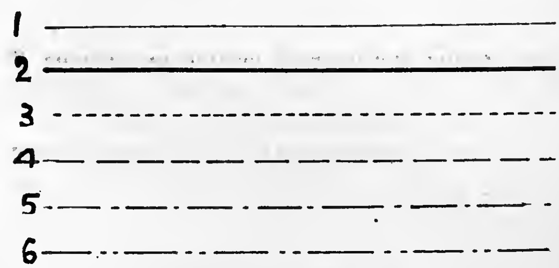


Fig. 2.

In expressing on the drawing the character of a surface other than a plane, it is often necessary to use what is called line shading. This is particularly effective in showing curved surfaces. To show a cylindrical surface (Fig. 3), draw parallel lines quite close together at the outside edge, but rapidly growing farther apart, until they stop about one-third way across the cylinder. The effect is strengthened by using heavier lines on the lower portion of the cylinder. In a similar way a sphere or a cone may be shown. A plane at an angle may be shown by parallel lines spread equidistant, one from the other, but this is seldom used to any great extent, as it is very apt to confuse the drawing.

A knurled surface is one which is cut by diagonal cross-grooves, to enable a firm hold to be secured, and is used particularly on hand check-nuts and cylindrical nuts. This is shown by diagonal cross-lines, and if the surface is a cylinder, he spacing is changed to give the effect of a round object (Fig. 4).

Working drawings are of several classes.

First.— Outline drawings, giving the general outline dimensions and space occupied, but not showing any detail or dotted work to speak of.

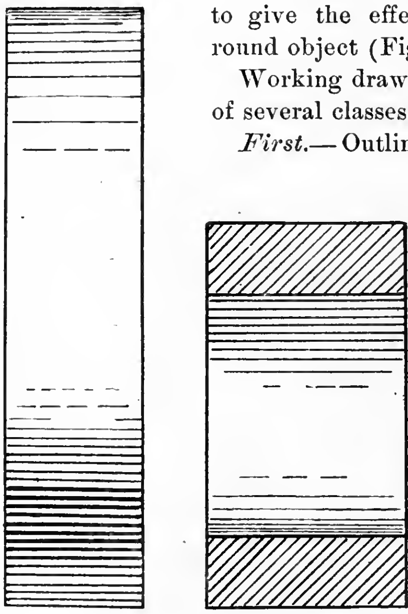


Fig. 3.

Second.—Assembly or erection drawings, showing the entire machine, with all its parts in their proper positions. This class of drawings will contain a great deal of detail and dotted work, as often the greater part of the working mechanism will be concealed behind some part of the frame or some other part.

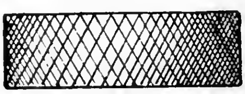


Fig. 4.

Third.—Detail drawings, showing to a large scale the individual parts of the machine, with all the information necessary for their completion. It is allowable to show several details on a single sheet, and in the case of steel forgings it is customary to show several on one sheet.

Fourth.— Some machines are so complicated that it is necessary to make a separate sheet showing all the special bolts used in their construction, together with a bolt list, and in some drawing-rooms it is customary to make motion diagrams for each machine; but these are rather outside of our present field, and are only mentioned here incidentally.

In making drawings it is often impossible to draw them full, or finish, size, and accordingly we must adopt some scale, so that a large object may be shown in a comparatively small space. That is, one inch on the drawing will be made equal to so many feet of the actual object.

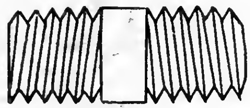


Fig. 5.

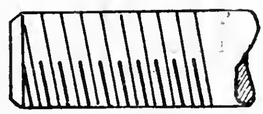


Fig. 6.

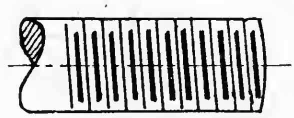


Fig. 7.

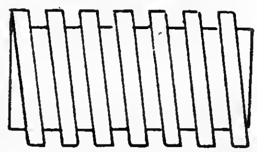


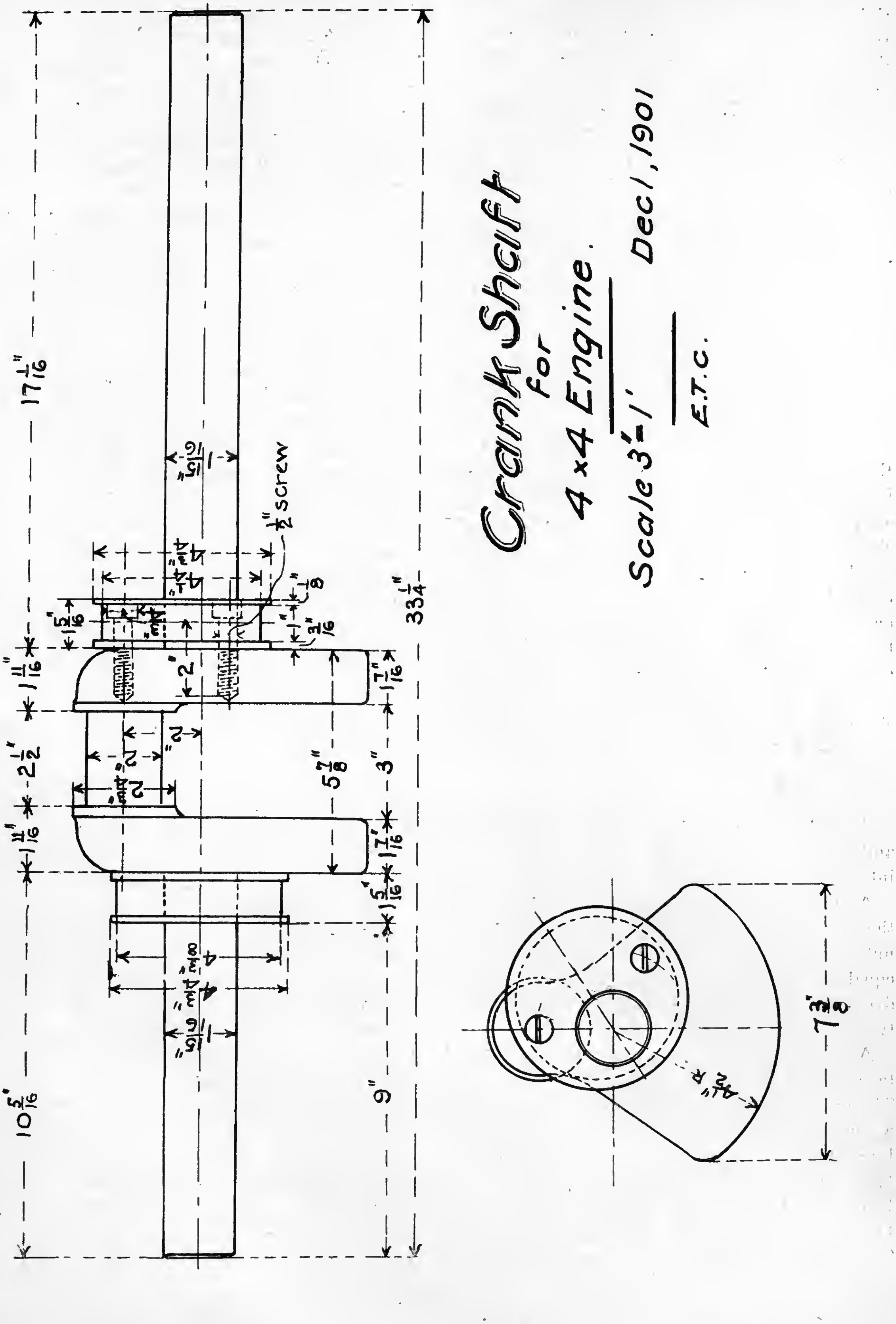
Fig. 8.

Referring to the November issue, page 15, we find given the common scales.

It is customary to make outline drawings in the proportion of $\frac{1}{4}''$ to $1'$, to $\frac{1}{2}''$ to $1'$; erection drawings on $1''$ to $1'$, to $1\frac{1}{2}''$ to $1'$; and detail drawings on $3''$ to $1'$, to full size; but these scales are often varied, a great deal depending on the size of the sheet, the number of screws, and the size of the object to be shown. The delineation of nuts, bolts and screw threads varies greatly, some draftsmen always showing the threads in detail, and others merely showing them by conventional lines.

The student should first be made acquainted with the various styles of thread used, and also with the different classes of bolts, screws, etc.

The most common thread is the V type. A


Crank Shaft
for
4 x 4 Engine.
Scale 3" = 1'
Dec 1, 1901
E.T.C.

right-hand thread is one which, when turned clockwise, will screw in, and a left-hand thread screws in when turned to the left. A double thread is one having two distinct threads following each other around the screw, and the pitch, or distance which the screw moves forward with one revolution, is double that of a single thread of the same size.

Fig. 5 shows a V thread drawn out in detail, one end showing a right-hand thread, the other a left-hand thread.

Fig. 6 shows the conventional method used for showing a V thread. If the screw is concealed, the lines will be shown dotted.

Fig. 7 shows a conventiona double thread. The ends of the screws are either rounded, as in Fig. 6, or chamfered, as in Fig. 7.

Fig. 8 shows a conventional square thread. A thread of this kind is extremely difficult to draw in detail, as it requires a full knowledge of descriptive geometry, and it will not be necessary to show it here, as it is rarely used in practice. If any long piece is to be threaded throughout its entire length, the threading may be shown at the ends only, and the fact that it is to be threaded throughout, covered by a note or by the use of a dimension line with "Thread" marked in place of a figure. Sometimes the outline of a screw is shown, as in Fig. 5, with the cross-lines omitted, but Fig. 6 is the most common method used. The great majority of bolts are fitted with V threads.

A tap-bolt is screwed direct into a tapped hole, and generally does not extend through the material into which it is screwed.

A through or nut bolt passes entirely through the material which it holds, being secured by a nut. It is customary to allow a thickness of nut equal to the diameter of bolt, and the extreme diameter of a hexagonal nut is approximately twice the diameter of the bolt.

A set-screw has a square head, the short diameter of which is equal to the diameter of the screw. The end of the screw is made nearly flat, to insure a good hold, as it is used for securing pulleys, collars, etc., to moving shafting. There are other types of bolts and screws used, which need not be described here. The method used in showing tapped holes is practically the same as for screws. The end view of a tapped hole may be shown by two concentric circles: by a full circle with a dotted one outside of it, or by a single circle with the word "Tap" written in, giving the size of the hole. It will be well for the student to make a practice sheet covering the work described above, and shown by the accompanying figures, in order to become familiar with the various classes of work described.

As stated in the December editorial, it is the intuition to use the details of a small upright engine, and finally the assembly of same as practice sheets, to be used in connection with our talks on mechanical drawing. One or more of the details will be presented with each number, giving the student sufficient work to occupy his spare time between the successive issues. These working drawings will be introduced in connection with the descriptive text, and will be illustrative of the work required in actual practice.

The detail given herewith shows the crank shaft with governor pulley on the left of the crank, and the eccentric on the right of the crank. The former is shrunk on to the shaft, and the latter is secured by means of two $\frac{1}{2}''$ round-head countersunk screws. It will be seen that the crank pin is slightly larger in diameter than the shaft.

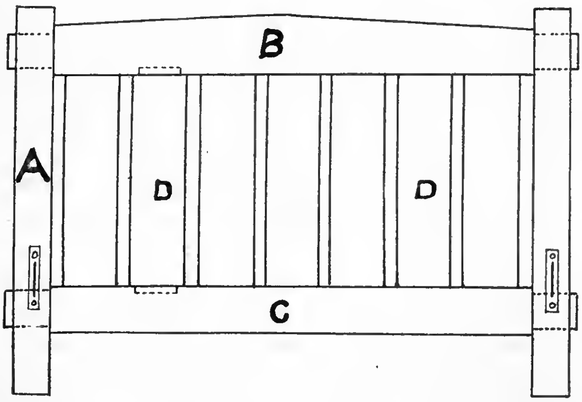
Our thanks to *Modern Machinery* for the review of Amateur Work published in the December issue of that magazine. It must have reached many readers, as the requests we received for sample copies in which this review was mentioned were quite numerous. We must, however, take exceptions to the limitations placed upon the word "amateur," which Worcester defines as "a lover of any art or science, though not a professor of it." It is for those who engage in work for the love of it, or the pleasure derived from it, that Amateur Work is published, and while most of the topics will be treated in an elemental way, the scope of the magazine is not restricted to this class. The professional worker already has numerous magazines at his command, *Modern Machinery* being an example. It is filled with excellent reading for mechanics, well illustrated, and should be helpful to any progressive workman. Published monthly by Modern Machinery Publishing Company, 810 Security Building, Chicago. $1.00 a year.

OLD DUTCH FURNITURE.

JOHN F. ADAMS.

III. A BOY'S BED.

THE bed here described is suitable for a boy's room; and a boy who is somewhat familiar with the use of wood-working tools would have no difficulty in making one. The necessary lumber,

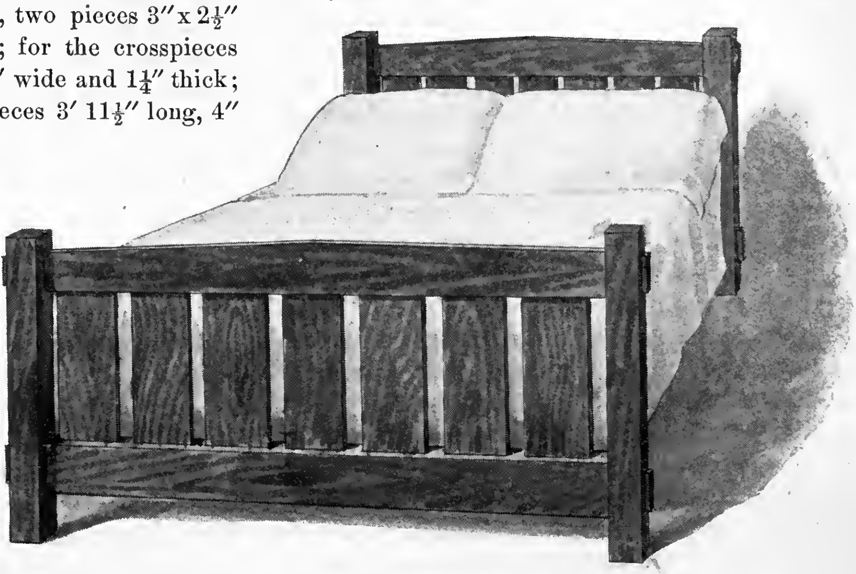


selected oak, is, for the posts A, two pieces 3″ x 2½″ and 36″ long for headboard, two pieces 3″ x 2½″ and 32″ long for footboard; for the crosspieces B, two pieces 3′ 11½″ long, 5″ wide and 1¼″ thick; for the crosspieces C, two pieces 3′ 11½″ long, 4″ wide and 1¼″ thick; for the upright pieces D on headboard, seven pieces 22½″ long, 4½″ wide, and ½″ thick; for the footboard they are 18½″ long. Also two boards 6′ 2″ long, 6″ wide and ¾″ thick for sideboards, and two strips the same length and ¾″ square, to go on inside of sideboards to hold the slats. Eight slats of pine or spruce 3′ 6″ long, 2½″ wide and ⅞″ thick are needed. A full-width bed can be made by lengthening pieces B and C and increasing the width of pieces D.

The posts are first mortised to receive the tenons of the crosspieces, as shown in Fig. 2, which is on the scale ¾″ to 1′. These mortises are ¾″ wide and 3″ long, and cut clear through the centers of the posts. The top of mortises for crosspiece B is 2″ from end of post. The bottom of mortises for crosspieces C is 5½″ from bottom of posts. The posts A are 3′ 4″ apart, the tenons on crosspieces being 3¾″ long, 3″ wide and ¾″ thick.

The pieces B rise to the center, being 4″ at the ends and 5″ in the center. This tapering can best be done at the mill. The mortises are then cut in the crosspieces to receive the tenons on pieces D. These mortises are 3½″ long, ½″ wide and ⅝″ deep, the pieces D fitting them by sawing out of each corner a piece ½″ square. The ends of the two mortises nearest the posts A are 1½″ from A. It is well to mark out the mortises with a pencil before commencing to cut them, to ensure getting them correctly placed. When all the mortises and tenons are cut, fit the pieces D into the crosspieces and then put on the posts, each joint being glued. The wood should not be cold or damp when being glued.

The side pieces are plain boards with the 1″ square strips screwed to the lower inside edge to hold the bed-slats. The method of fastening the side pieces to the head and footboards are left



optional, being dependent upon what can be purchased at the local hardware store. The various devices for this purpose are quite similar and easily applied.

The bed being completed, it is sandpapered smooth, and then given a coat of very dark stain, and then dull polished. Do not varnish or shellac, as a bright surface is not desirable for this style of furniture.

DIVERSITY OF THE MODERN USES OF PAPER.

It used to be said that there was nothing that could not be made out of leather. The same thing is now said of paper. From water mains, rifle-barrels and window panes, to clothing, tablecloths and napkins, the range of articles into which paper is squeezed, spun and chemically wrought, is bewildering. Further than that, the range of uses to which paper is applied is increasing rapidly. The United States are now the greatest producers of paper in the world. The export trade in paper has, however, not developed as rapidly as domestic production, for the reason that the demands of the home market have increased even faster than the capacity of manufacturers to supply them.

One of the most valuable of new forms of paper placed upon the market is a grease-proof paper, which is superior to any so far produced for the use it is put to. One of the uses of this grease-proof paper abroad is for the wrapping of butter for shipment. While there is plenty of merely grease-proof paper now made here, that is used extensively for the wrapping of hams, bacon and similar food products, it has not the merit of being odor-proof as well as grease-proof, and butter is so sensitive to odors that this paper would not serve in packing for shipment. The grease-proof paper, on the other hand, is absolutely odor-proof as well, and nearly all of the vast quantities of butter shipped from Denmark to England are wrapped in it. The butter reaches Great Britain in pound packages, closely enveloped in the grease and odor proof paper — packages that in a sense are hermetically sealed.

Probably the very latest commercial fact in the application of paper is in the way of fireproofing. Paper fireproofing, among other advantages, has this one, that the chemicals used penetrate the entire texture of the material, and are absorbed by it before it is rolled into any thickness that may be required, thus making them much more effective than when wood itself is treated with them. The paper wood thus produced is as hard as wood itself, is susceptible of brilliant polish and any variety of decorative treatment, is vastly lighter, perfectly adjustable and absolutely fireproof. The erection of skyscrapers necessitated a very serious study of fireproof materials and the fireproofing treatment of wood, and the result is that paper is coming very largely into use in all cases where woodwork has to be used. It is particularly adaptable for ceilings and is coming into great popularity for that purpose. The material has been adopted for the finishing of the interiors of warships, and the Pennsylvania Railroad Company is using it very extensively on the head lining or ceilings of passenger cars. The material commonly used for this purpose, being heavily treated with oils, is highly inflammable, and the adoption of the paper fireproofing material is only another precaution for the safety of passengers. In addition to the Pennsylvania road, the New York Central also, it is understood, is considering the adoption of the same material for the interiors of its passenger cars.

As for articles of daily use that are now made of paper, their number is surprisingly large. Eliminating such things as car-wheels, in which paper long ago demonstrated its superiority over steel; the water-buckets, the covering for hayricks, and other similar articles long of familiar use, there are hats, caps and clothing. In Detroit there is a concern which is doing a large and very lucrative business in the manufacture of paper clothing. Paper, of course, as demonstrated in the water-buckets, can be made almost as impervious to water as India rubber itself, and combined with layers of thin cloth a material is made which can be and is put into undershirts, waistcoats and jackets, which present a good appearance and are very durable.

In dress linings, skirt linings, coat linings and in facings, paper cloth is coming more and more into use, and is giving very good satisfaction. Good-looking and very durable hats are made of paper, and paper soles and heels for boots and shoes of the cheaper grades have long been in use. When it was said above that rifle-barrels were made of paper, only the literal fact was stated, although the paper rifle is not practical, for various reasons, among others the cost. It stood the strain of firing perfectly, but was made and considered only as a curiosity, illustrative of paper possibilities. Water mains made of paper, however, not only are a practical possibility, but are in actual use. Where the conditions are such as to warrant the very considerable extra expense of paper water mains,— as, for instance, where, from the nature of the bed in which they must lie, cast-iron mains would speedily oxidize,—paper water mains, costly as they are, become a matter of economy and are very generally used. Window panes of paper, likewise, are used in cases where there are such constant vibrations or such sudden jars as would break glass. By a chemical process paper may be made so translucent that a printed page can be read through it with perfect ease. Put in a window frame, it gives a soft light sufficient to illuminate a room for nearly all purposes not requiring a particularly strong, clear light, although objects seen through a paper window pane are seen as through a glass, darkly.

Waterproofs of paper are made in considerable numbers. The material consists of a lining of cloth in the middle with a coating of waterproof paper on both sides. Nearly all articles formerly in leather are now made of paper,— such as suit-cases, traveling-bags, etc.,— and so successful is the imitation, that a man who had himself been in the paper business for nine years bought an article of this kind in London recently under the full conviction that it was leather he was purchasing.

For all purposes of laboratory filtering, paper is superseding every other appliance, and there is in this State a large plant which is doing a very profitable business in manufacturing nothing but filter paper.

Along the line of recent inventions is a process for spinning paper into a fine thread which can not only be used for sewing, but out of which a very beautiful fabric can be woven. Specimens of tablecloths and napkins made by this process were exhibited in this city recently which compared very well in appearance with fine articles of linen. The process at present developed is pronounced by paper experts to be altogether too expensive for practical purposes, although it is easily within the possibilities that the day is not so very far distant when we will be using paper table linen. Still another freak exhibition of what can be done with paper was the production of a paper axe with an edge so hard and fine that it could be used for cutting. One of the recent and very successful applications of paper is in its use as an insulating cover for electric wires.— *American Exporter.*

The $200 automobile is still some time away. The materials alone cost more than this amount.

ASTRONOMY FOR JANUARY.

When the year opens, the bright company of planets that lit up the southwestern sky through November and a part of December will have dispersed. Venus alone will remain conspicuous, Jupiter and Saturn being too low in the west and too near the sun. Saturn comes up with the sun on the 9th, and Jupiter on the 15th of the month.

Venus draws slowly eastward until the 22d, when she becomes stationary; she attains her greatest brilliancy on the 9th. After the 22d, she turns westward and approaches the sun with apparently increasing rapidity. Mercury passes the sun on the farther side at the beginning of the month, and moves eastward, but in low south latitude; it does not reach its greatest eastern elongation until the 1st of February, and then will be so far south that it will be difficult, if not impossible, to pick up.

The moon reaches her last quarter on the first day of the month, is in conjunction with Uranus on the 6th, and new on the 9th; she passes Mercury and Mars on the 9th, and Venus on the 12th. She comes to the first quarter on the 17th, fulls on the 23d, and leaves the month as she entered it, at her last quarter.

On the 19th, at about eleven o'clock in the evening, there will be an occultation of the star Epsilon Tauri by the moon; at Washington the star will be hidden for about an hour and ten minutes, here for a rather less time. Such a phenomenon is very interesting to watch; the gradual approach of the moon to the star, and its sudden disappearance behind the invisible dark limb of the moon may be easily watched with a field-glass or small telescope, as the star is between the third and fourth magnitudes.

By Jan. 1 the summer constellations will have mostly disappeared; at eight o'clock in the evening Lyra will be on the northwestern horizon, and Cygnus following just above it.

But the eastern sky will be bright with the winter stars; the Great Dipper will have swung around into the northeast, and with Auriga and Perseus above it, Gemini, Taurus, Cetus, Orion and the two Dogs to the southward, and Cassiopea overhead, will make the eastern half of the sky luminous. The greater and lesser Dogs add each its first magnitude star, so that there will be eight of these in sight, though Vega is on the verge of setting.

I am often asked how to identify these constellations. Each of them has its own configuration of stars, as characteristic as the features of a man's face, and once these are familiarized they are never forgotten. Among the most characteristic of these are the Great Dipper of Ursa Major, the W group of Cassiopea, the belt and sword of Orion, the Hyades and the Pleiades in Taurus.

The easiest way to locate these roughly is perhaps by the use of a planisphere, such as can be bought from a dollar, and perhaps less, to three dollars, and which can be set at any given minute of the year. For more details, an atlas is useful, such as Klein's, Schurig's, or Upton's, which may be purchased for moderate prices at any shop where maps are sold.

With any of these, or a good celestial globe, by carefully studying the configurations and alignments of the brighter stars, the reader can in a short time become as much at home among the constellations as are most astronomers. It is a simple matter of the memory of the eye, and once learned is never forgotten.

VEGA.

THE NEW STAR IN PERSEUS.

DURING the last eight months the astronomer, whether professional or amateur, has very often found himself confronted by such questions as these: What is it? Where is it? Is it really new? Has it never been seen before? How do they know it is new? How long will it last? Can I see it? How can I find it? How can I tell it? All very natural questions and some of them easy to answer, while others are at present beyond the range of human knowledge.

It seems very strange to the casual observer, who sees the sky studded with apparently countless stars, that the presence of an additional one should attract such instant notice. He perhaps does not realize that although the stars appear to him countless, and scattered over the sky without any semblance of order, there are really only about two thousand visible at once to the ordinary eye, that not more than three hundred of these are at all conspicuous, and that the astronomer, from long acquaintance, is as familiar with their aspects as with the streets of his native town, so that the appearance of any object of considerable brightness lends an unfamiliar look to that part of the heavens, and at once attracts his notice.

Any one with a little practice may gain a sufficient familiarity with the principal groupings to readily identify a new comet or an inconspicuous planet by its appearance where he knows no star is ordinarily seen.

For instance, almost every one is so well acquainted with the group of bright stars called the Dipper that the appearance among the four stars which make up its "bowl" of a star at all approaching any one of the group in brightness, would be at once noticed as something unusual.

The New Star is a star which suddenly appeared in the middle of a large triangle formed by some of the brighter stars of the constellation Perseus. One of the points of this triangle is formed by the star Algol, one of the longest known and most remarkable of the variable stars. Its exact position is shown by a small circle on the accompanying chart (Fig. 1), which is a copy of one issued by Father Hagen of the Georgetown Observatory, for the convenience of those desiring to observe the star. By holding the chart horizontally, with its top to the left, one will have a good representation of the appearance of the constellation at dark at this season of the year, but he will need a good field-glass to see the New Star.

It was discovered on the evening of Feb. 21, 1901, by the Rev. T. D. Anderson of Edinburg, one of the best known among amateur astronomers, who had already, in 1892, distinguished himself by the discovery of a new star in Auriga, and who has a greater number of discoveries of variable stars to his credit during the last ten years than any other single observer. When first seen, the star's brightness was estimated as 2.7 magnitude; it was evidently brightening rapidly, for on the 22d it had reached the 0.9 magnitude; that is to say, it was twice as bright as on the evening before. The cable message announcing its discovery reached the Harvard College Observatory early in the evening of the 22d, and the observers at once set to work upon the star. Owing to unfavorable weather, observations were made under difficulties, but good estimates, both visual and photometric, were obtained by members of the staff. In the meantime an examination was made of all the photographs of the region taken earlier in the month, resulting in the certainty that as late as the 19th no star so bright as the eleventh magnitude was there. This means that the star had made its upward rush from invisibility in a moderate telescope to a place among the brightest in the heavens in less than three days.

On the 23d the Harvard observations showed the star to have increased to the 0.37 magnitude.

On the evening of the 23d the news had been spread, and other observatories and observers everywhere, both in this country and in Europe, had taken up the work upon the star.

My own observations began on the evening of the 24th, when I found the star brighter than any other star in the sky, Sirius only excepted. I estimated its magnitude at -0.08, twenty-five times brighter than at Anderson's first observation. On the 25th it had begun to fade fast.

A host of observers were by this time watching the

Nova Persei

(1900.0) $3^h\ 24^m.4$. $+43°\ 34'$.

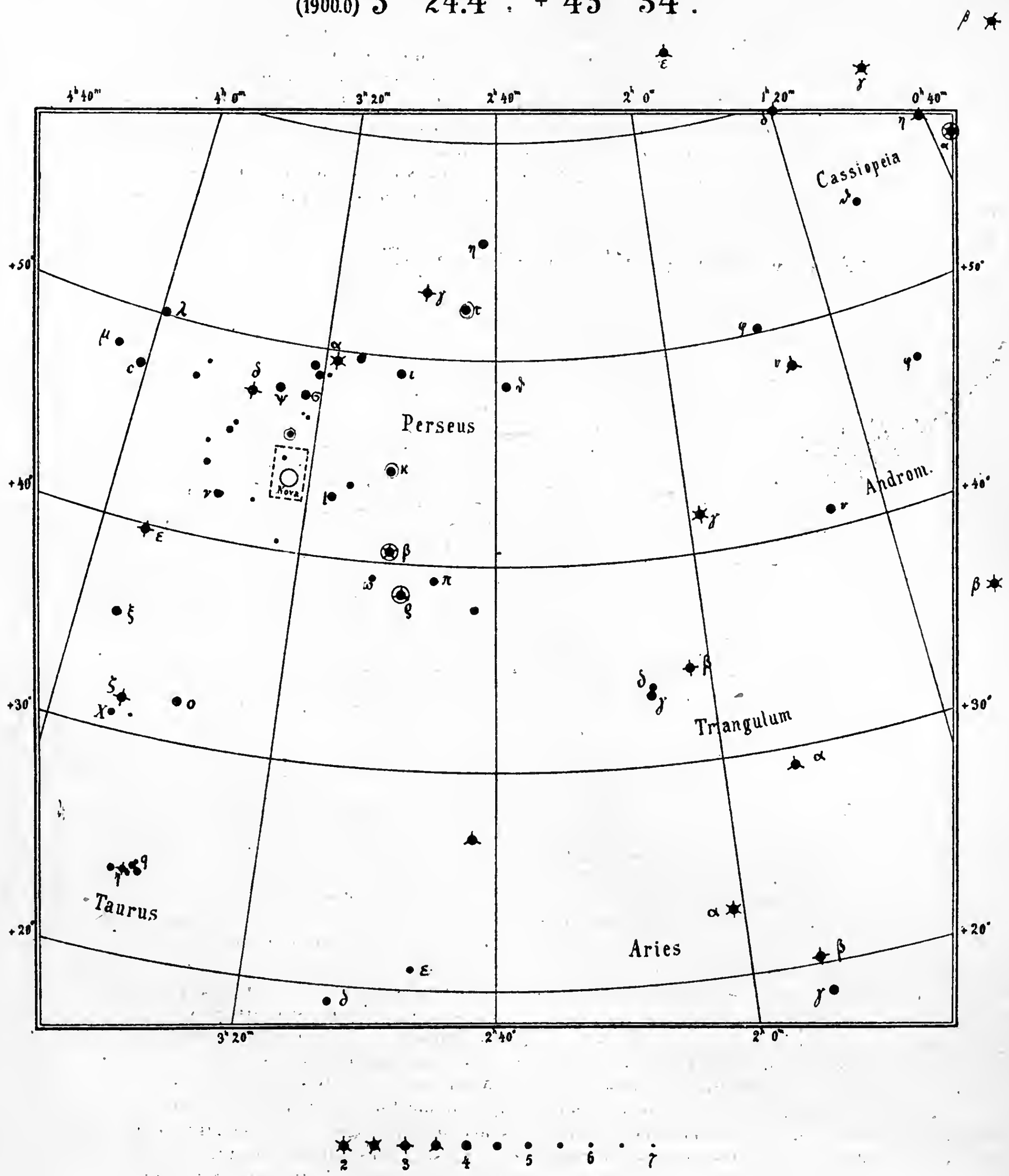


FIG. 1.

star. It continued to decrease rapidly, until in the middle of March it had reached the fourth magnitude, or a hundred times fainter than when at its brightest. After passing the fourth magnitude, its decrease became slower, and when it had passed too low in he northwest and was los in the wilight, about the end of April, it was still of the sixth magnitude, being decidedly slower to wane than most stars of its class.

Observations were resumed early in October, when it was found at about the seventh magnitude; at my last observation, Dec. 12, it was 7.2 magnitude.

The accompanying diagram (Fig. 2) shows graphically the course of the star's light-changes: the dates run horizontally, from left to right, and the course of its variation in brightness is shown by the heavy line, the high magnitudes being at the top and the faint ones below, as shown in the margin. The star's fluctuations are shown in this way very clearly. This is the common astronomical way of showing such changes. It is called the star's "light-curve."

The most remarkable feature of the star's variation is the series of minor fluctuations, beginning with the commencement of the decrease of light, and continuing to a date later than the beginning of May.

mental in its character, and a series of experiments was at once instituted by each of these gentlemen, with the result of independently proving that the appearance was purely photographic, and due to an excess in the star's light of the rays, for which the lense was not corrected.

The star is surrounded by, or projected on, a considerable area of scattered and wispy nebulosity. Changes in this have been announced, but are taken at the observatories with a good deal of reserve, as possibly instrumental in their origin.

The star is now visible only with the aid of a field-glass or small telescope. The small chart (Fig. 3) copied from the *Bonn Durchmusterung* shows its relation to the neighboring telescopic stars, and corresponds to the dotted square on the first chart, being three degrees square. The Nova is represented by the small circle.

These stars have been appearing from time to time,

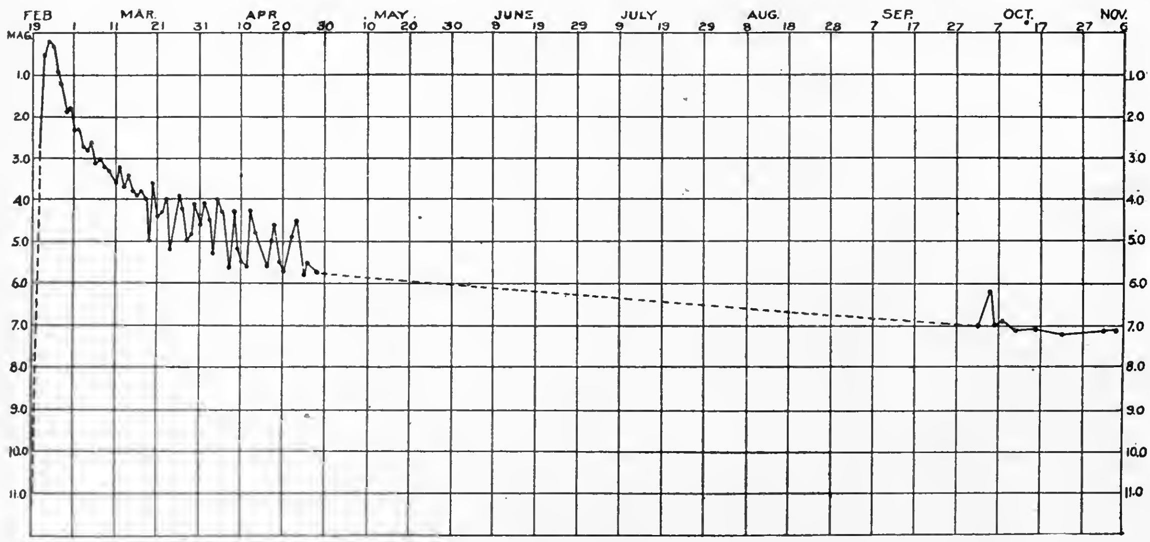


FIG. 2.

The period of these fluctuations was at first less than a day, and the light-range in the neighborhood of half a magnitude, and they increased in both particulars, until at the beginning of May the period was about five days and the light-range about two magnitudes, which is more than double the light-range of any of the ordinary short-period variable stars of similar period.

In the month of August, MM. Flammarion and Antoniadi, at the Observatory of Juvisy, in France, found, on some negatives taken on the 19th of the month, what appeared to be an aureole, or halo, of considerable dimensions surrounding the star and concentric with it; this appeared on at least two negatives, of which copies were immediately sent to a number of the observatories of Europe, with an announcement of the discovery; Wolf, at Königstuhl, and Kostinsky, of Pulkova, at once suspected the appearance to be instru-

during the memory of man. By such an occurrence Hipparchus was led to form the first catalogue of the stars of which we have knowledge. In 1572 the attention of Tycho Brahe, who afterward became a great astronomer, was first called to the study of the heavens by the appearance of such a star in the constellation Cassiopea. Lesser outbursts, says Professor Wilson, may have been frequent, and the fact, to which Professor Pickering calls attention in Circular No. 56 of Harvard College Observatory, that eight new stars have been discovered in the last fourteen years, since photographic processes have been so generally applied to astronomical research, points to this conclusion.

"What is it?" "What is the cause of it?" We simply do not know. Men have theorized; but in the absence of any tangible and certainly ascertained fact about these bodies, all theories have more or less the character of better or worse guesses. What little information we have as to the constitution and actions of these stars comes from the spectroscope only, and are rendered more or less enigmatical by our total ignorance of the conditions of pressure, etc., there existing.

The following, quoted from the article on the New Star by Professor Wilson, in the April number of *Popular Astronomy* for the current year, are the four best known and most plausible theories which have been advanced respecting this class of stars up to the present time. The theories are very clearly stated in the article, but the language in which they are expressed is too technical to be in place in a paper of this character, so they are only given in abstract.

They are: The meeting of two swarms of meteorites moving in opposite directions; the tidal disturbances

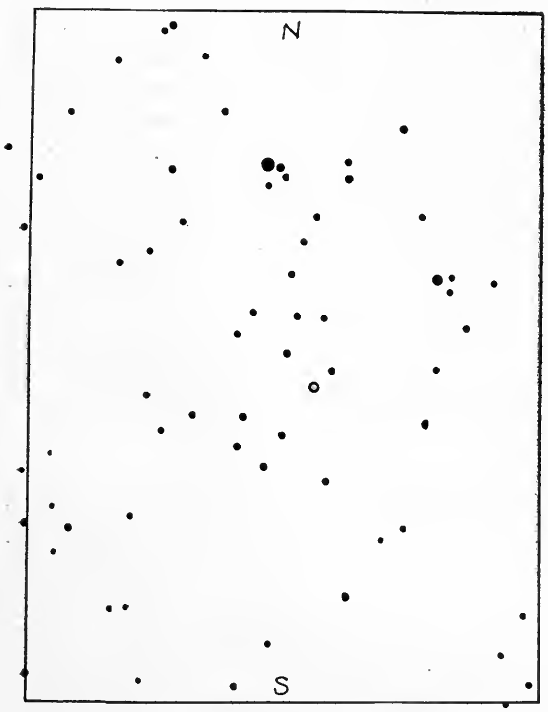


FIG. 3.

in the atmospheres of the component stars of a binary system having an orbit of great eccentricity; an outbreak caused by the shrinkage of a cooling body; the passage of a dark body through a cloud of meteorites. Of these, the second seems to me the most likely, as being the simplest and least out of the ordinary course, in that we have not to suppose a special set of conditions for the case, but are dealing with what must actually and frequently occur in the universe.

The star is now waning very slowly, if at all, and its future behavior is very hard to forecast. In the meantime it is being watched at every observatory in the world, public and private alike, and scarcely a day passes without an observation of it being secured.

VEGA.

CORRESPONDENCE.

OUR readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of AMATEUR WORK, 85 Water Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if direct answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

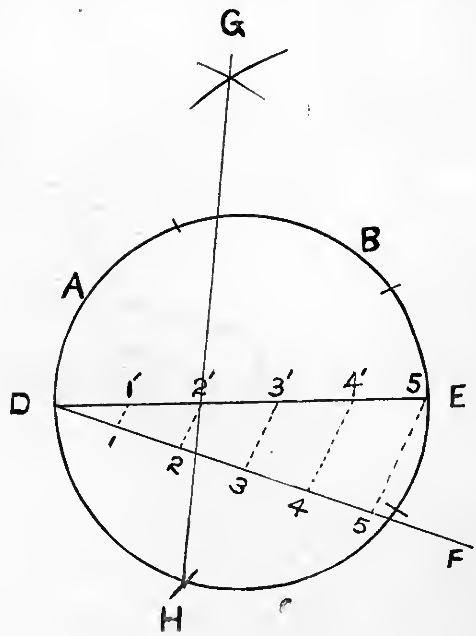
Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

To Divide a Circle into Any Number of Equal Parts.

ROXBURY, MASS., Dec. 10, 1901.

TO THE EDITOR:

I am greatly interested in the lessons on "Mechanical Drawing" and accept your invitation to write of any matters of interest, and so present another method of inscribing a polygon of any number of sides, or,

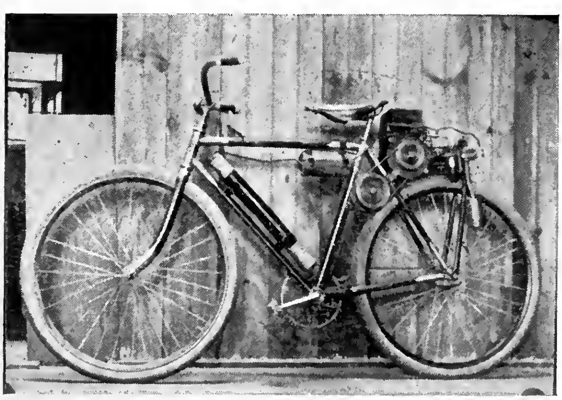


as it is sometimes stated, "to divide a circle into any number of parts." I prefer this method, as I think it quicker and easier. The enclosed sketch will illustrate how it is done. The circle A B C is to be divided into five equal parts. The diameter D E is divided into five equal parts, as given by Mr. Childs. Then with D and E as centers, and D E as radius, describe two arcs intersecting each other at G. From the intersection at G draw the line G 2′, which is continued to the circumference at H. The arc D H is one-fifth of the circle. With the dividers step off the remaining parts. Care must be observed by either method to insure accurate results. Y.

An Amateur's Motor Bicycle.

New York City, Dec. 16, 1901.

I herein send you photographs and description of a motor-cycle which I built and which has been in use for over a year. I have ridden the same over two thousand miles. The photograph shows an Iver Johnson wheel equipped with a P-T motor driving the rear wheel by a friction wheel or roller; also a P-T automatic gasifier, muffler, plug, etc. I use a spark coil and a set of four dry batteries. The tank over the motor holds about two quarts of gasolene, which is sufficient for a run of sixty miles under favorable conditions. The castings were obtained from the P-T Motor Company of New York City. While my method of driving may be called crude, and is open to criticism, I used the same to secure a simple flexible drive without any alteration to the wheel. The friction wheel is pivoted on the clamp that holds the motor on the rear stays, and it is held against the rear tire by a helical spring, the other end of which is fastened to a clamp around the bottom bracket. A lever serves to bring it against, or to draw it away from, the tire at the



will of the operator. The friction wheel has a little lateral play to permit a good bearing, even if the tire of the wheel is not true. A flanged pulley driven by a 1″ belt connects it to the motor pulley. The motor is controlled by a single lever, which holds the exhaust valve open and shifts the spark. The motor can be started in two ways: either by pedaling, and then dropping the friction wheel, or with a crank on the motor pulley, as all gasolene automobiles are started. In crowded city streets I can pedal slowly, the motor running idly, and then drop the friction wheel when I see my way clear. I can climb a six-per-cent grade without any slip of the friction wheel, and the speed is from twelve to fifteen miles per hour on a level road. The above outfit has given me excellent satisfaction, and I use the same every day when the weather will permit.

Hoping that the brief description will be of service to your many readers, I will close.

Yours respectfully,

A. Patdevin.

CORRESPONDENCE SCHOOLS.

Of increasing importance in our educational system are what are termed "correspondence schools." In certain lines, their great value is unquestioned. To the young man deprived of a high or technical school education they provide an opportunity for acquiring theoretical instruction that could not otherwise be obtained. But, like anything else, there are limitations to the benefits that can be derived from this method of education. The theoretical character of the instruction should be remembered by those contemplating a course of study, and, where actual experience and experiment are necessary to a proper knowledge of a subject, a way should be provided to secure it as supplemental to the instruction. The value that such instruction would then have is limited only by the ability of the student.

Care should also be exercised in the selection of the course of study, and advanced or highly technical instruction should not be applied for when the more appropriate and beneficial course would be elementary arithmetic and English. The foundation should be adequate to support the superstructure. A course in civil engineering will be of small value to the man who knows but little of mathematics. To the apprentice in shop or factory who can practically apply the instruction given, such study is valuable and should be warmly encouraged by employers. To the clerk in the office a mechanical course might be useful in giving an insight into the work, but would never make him a mechanic. He would profit more from a course in mathematics or language. All the circumstances should be carefully considered and the course of instruction selected should be appropriate to the present condition and future needs of the student.

The first electric motor was the pendulum of the electric chimes made by Otto von Guericke in 1632.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. I. No. 4. BOSTON, FEBRUARY, 1902. Ten Cents a Copy

STUDIES IN ELECTRICITY.

DONALD M. BLISS.

IV. MAGNETISM AND INDUCTION.

HAVING made the electromagnet and circuit closer, as described in the preceding article, and connected with the battery, it will be noticed that whenever a current is sent through the coils, by operating the circuit closer, the soft iron core will become a powerful magnet so long as the current continues to flow through the coils ; but as soon as the circuit is opened or broken, the magnetism will as suddenly disappear. If the iron core is not very soft or thoroughly annealed, the magnetism will not disappear entirely with the loss of current, but will remain indefinitely. The strength and duration of such residual, or permanent magnetism as it is called, depends upon the degree of hardness and quality of iron used for the core. If hard steel be employed, the first instant the current flows through the coils it will become a permanent magnet, the strength of which may last for years. This may be easily demonstrated by removing the soft iron core and placing a piece of hard steel rod, an old file, or knitting needle in one of the coils and closing the circuit for an instant.

Before taking up the study of the principles embodied in this experiment, the following instructions for making permanent magnets with this apparatus may be noted.

If it is desired to magnetize small round or flat steel magnets from 3″ to 4″ long, leave the soft iron core in the coils, and magnetize by placing the magnets against the poles or ends of the core and closing the circuit for a few seconds. Do not remove the magnetized pieces from the poles while the current is on, but open the circuit first, then pull off the magnets. The reason for this is that if the piece is carelessly pulled off while the core is strongly magnetized, the magnet is liable to slide sideways, and weaken, or possibly reverse, the magnetism in the piece.

If the pieces to be magnetized are quite large or long, the best method is to take out the soft iron core entirely and insert one piece in each coil. Join the ends projecting beyond the coils by laying a piece of iron rod or strip across the ends. Then turn the current on and off a few times, finally opening the circuit and removing the pieces from the coil, when they will be found to be strongly magnetized. For small magnets, Stubbs steel wire or rod answers very well for some cases. Old files, or any piece of good tool steel, will answer most purposes, but it must be hard, not annealed.

The term "poles" invariably applied to a magnet, whether under the action of a current or permanent, is used because the two ends of such a magnet are always attracted towards the earth's north and south poles. Of course, the magnet, as a whole, cannot move towards such a direction unless it is of the proper form and free to move, as in the case of a compass needle. To demonstrate this, magnetize an ordinary sewing needle, stick it through a bit of cork and float it in water, and it will at once move so as to point north and south. If another needle, magnetized in the same direction, be held near the floating needle, it will at once be noticed that any two like poles will repel each other, attraction only taking place between north and south, or unlike poles ; hence, the important and well-known rule, "Like poles repel, and unlike poles attract each other." The earth is a huge magnet whose poles nearly coincide with the true geographical north and south poles. Magnetism is shown in a natural state in a well-known ore of iron, magnetic or magnetic oxide of iron, discovered centuries ago in Magnesia, a city in Asia Minor, hence the name "magnet." The magnetic properties of this iron ore have no commercial value, as artificial magnets of steel are easily made of any desired strength.

The permanent magnet in its most familiar form is shown in Fig. 14. This is made of a steel bar or

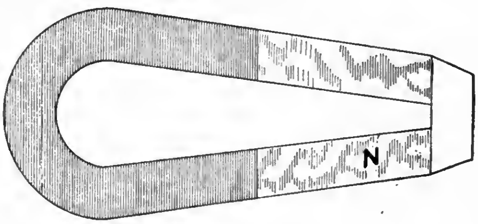


Figure 14.

strip bent into a horseshoe form, then hardened, magnetized, and provided with a piece of soft iron or keeper for connecting the ends or poles when not in use. This helps to prevent loss of magnetism. A magnet with only one pole cannot be made, and a single magnetic pole does not exist in nature. If a long magnet be broken into any number of small lengths, each piece will show north and south poles, and exhibit all the properties of a perfect magnet. Iron is not the only magnetic metal, though it is by far the most powerful. The following metals are also magnetic: nickel, cobalt, manganese, cerium, and chromium. Oxygen gas is also magnetic. All other known substances are so little influenced by magnetism that they are called non-magnetic.

An interesting experiment showing the earth's magnetism may be made as follows: Take a rod of steel or a piece of gas pipe, say two feet long; hold it in one hand, pointing it due east and west. Strike the rod a sharp blow on one end with a hammer; test it for magnetism by touching it to iron filings or small tacks. They will not be attracted. Now repeat the operation, but hold the rod due north and south with the north end pointing slightly toward the ground. After striking the rod in this position you will find it has become magnetized quite strongly, and will attract the small bits of iron, while the usual attraction or repulsion of poles will be found on testing it with a compass, and a knife blade may be magnetized by striking it with one end of the bar.

Referring again to our electromagnet, the result of the current flowing through the coils, and its effect on the iron core, is shown by the powerful magnetic display. As there can be no action without reaction, let us see what effect the iron core and magnetizing coils have on the battery and circuit as a whole.

First, disconnect the electromagnet, and touch the battery wires together for an instant. A slight spark will be noticed when the circuit is broken, and if the wire is bare and held by the fingers, a very slight shock may be felt if the skin is not too dry or oily. Now connect the electromagnet in circuit, and the following changes will be noted: The spark on breaking contact will be much brighter and larger, and a much stronger shock may be felt. If the iron core be removed from the coils, the spark will not be so large or the shock so strong, though both effects will be more intense than with the battery wire or leads only in circuit and coils disconnected. As there has been no change in the strength of the battery during these changes, it is evident that the coils and core are responsible for the effects observed, and this brings us to the interesting and important study of electromagnet induction.

A MEDICAL COIL.

A shocking or medical coil is one of the most interesting pieces of electrical apparatus that can be made by the amateur. The one here described simply requires careful work and attention to the details of construction to operate well. Besides affording considerable entertainment to the owner and friends, it can be utilized to good advantage for medical treatment, when prescribed by a physician.

The base is of maple, walnut, or other suitable wood, 7″ by 5″ and ¾″ thick. The upper edge may be slightly beveled to improve the appearance. The wooden ends of the coil are 2″ square and ⅝″ thick. Holes are bored in the centers for the core and regulating tube as hereafter directed, and other small holes H, D, and F for wires, as shown in Fig. 1. These holes should be bored before putting the parts together.

The core C is made of enough lengths of No. 22

gauge, soft, annealed iron wire 3⅝″ long to give a diameter of ¼″. Particular care must be taken with the wire to make sure that it is all well annealed. If any doubt exists about this point, the wire when cut should be tied into a bundle with some surplus wire and heated to a bright red, and allowed to cool very slowly in hot ashes. The rough surface that results will improve the working of the core. To make the core, gather the wires into a bundle as round and compact as possible, and wind with strong twine, leaving ⅜″ exposed at each end. Solder the ends firmly together for ⅜″, and then file smooth on the ends and around the outside of the soldering. One end is then firmly fitted to a piece of thick brass tubing B, which should, in turn, tightly fit the insulating tube I.

The regulator R consists of a piece of brass tubing ⅜″ outside diameter, and as thin as can conveniently be obtained. It should slip over the core without touching. A handle K is fitted to one end; this may be made out of anything except metal. A part of the end of an old clothes-brush will answer nicely. It should go inside the tube for about ⅜″ and be fastened in place by punching two dents into the tube, one on either side, or glued. The regulator is fitted to a hole bored in E′, with enough play to allow it to be readily drawn in and out, but without being loose enough to drop onto the core. A fret-saw and file will be found convenient in making these holes if the worker is not equipped with the necessary bits.

The insulating tube I, 4″ long, is then made. This can be nicely done on the regulator R by first coating it with a layer of soap to facilitate the removal of the tube when completed. Several layers of smooth writing-paper are wrapped around the regulator tube, until the outside diameter almost equals that of the brass cap B on the end of the core. Over the writing-paper wrap five or six layers of smooth manila wrapping-paper, giving each layer, except the last, a coating of thin glue. This is then allowed to thoroughly dry,

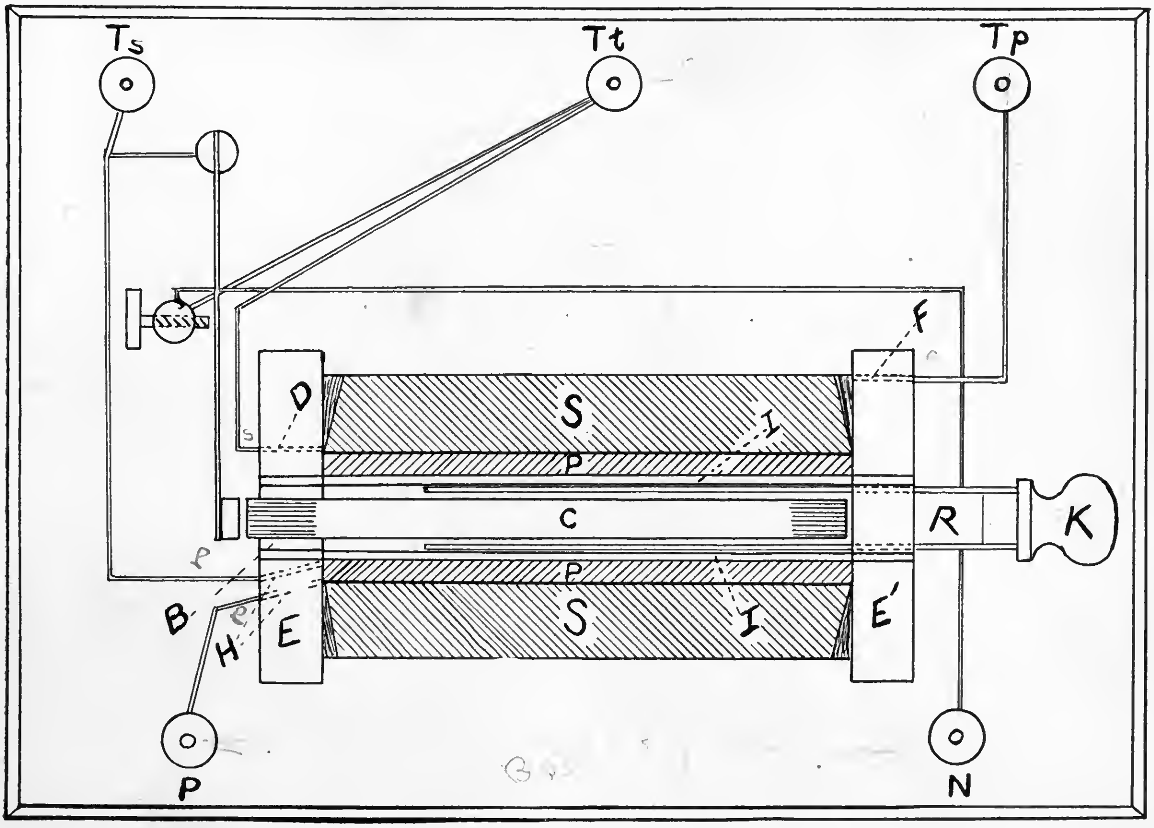


Figure 1.

then removed from the regulator, and the writing-paper lining taken out. It should then loosely fit the regulator, so that the latter can be easily removed. When the insulating tube is quite dry it will form a firm tube on which to wind the wire. Holes are now cut in the end pieces E and E′ of a size to allow this tube to be inserted with a tight fit, and well glued to prevent it from working loose. The tube is then thickly coated with melted paraffin, laid on with a brush, the joints at the ends being given an extra quantity to insure complete insulation from the core.

During the intervals while the glue is drying, a winding frame, Fig. 2, can be made. The base A is a piece of wood 15″ x 10″ and ⅞″ thick. The posts B and B′ are 2″ wide, ⅞″ thick, and 9⅞″ long, allowing ⅞″ for tenons to fit mortises in base A. The mortises for the posts are 1½″ x ⅞″ and are placed in the center of the base, 1″ from each end. One inch from the top of each post a ¼″ hole is bored; in post B′, clear through the post; in the other, leaving ¼″ of wood to prevent the winding rod from slipping through. In the post B′ saw

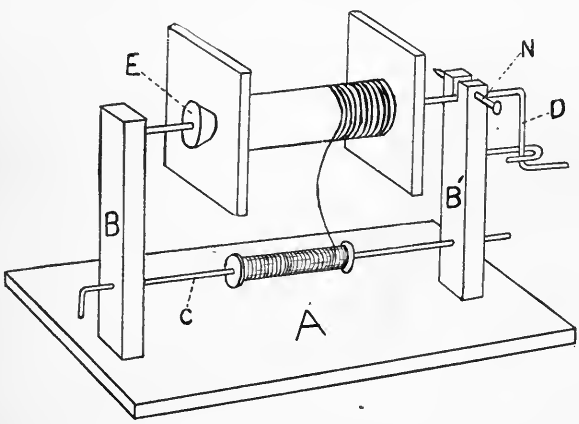


Figure 2.

down from the top to each side of the hole, making a slot which allows the winding rod to be put in or taken out without having to adjust the work. About 2⅞″ from the bottom end of each post bore ¼″ holes for the rod C, upon which the wire feed spool is run. The rod D is 21″ long, with two 3″ turns on one end to form a crank. A small hole is bored in the upper part of the post H to receive a wire nail N, which holds down the winding rod. Two large thread spools are beveled off to form supports for the coil-frame, as shown at E. An extra spool running loose is put on the rod between the coil-frame and the post B′ to prevent the rod from being displaced while winding. A hole is bored in the post B′ in which may be inserted a short piece of iron rod, U-shaped on the end, to prevent the rod from turning when so desired.

Previous to commencing to wind the coil, look the frame over carefully to see that the paraffin coating is without air holes and cracks. If any are found, they should be filled up. It is then mounted on the rod D. First, put on the loose spool and then one of the tapered spools E, then the coil-frame, then the other tapered spool, the tapers being firmly centered in the holes in the end of the coil, and kept in position by paper bushing, wrapped over the rod D at the proper places. The rod and coil-frame are placed in the winder and the primary coil wound. This consists of four layers of No. 22 cotton-covered magnet wire. The end is first passed through the hole H, which ends nearest the tube, allowing about 8″ extra length for connections. It is held by a temporary wedge in the outside end of the hole. By turning the crank with one hand and holding the wire between the fingers of the other, the wire can be evenly and solidly wound. After each layer is in position, a coating of thin shellac, cut in alcohol, is put on. As it dries very quickly, but little time will be required, and in addition by being well insulated, the wire will wind more evenly. The end of the fourth layer will be at the same end of the coil as the first layer, and should be carried through the other hole H, with about 8″ spare wire for connections. These spare ends may, during the winding of the secondary coil, be twisted around a pencil into a small spiral.

Before winding the secondary coil the primary coil should be covered with two layers of thick note-paper, which previously has been well soaked in paraffin. Any unevenness should be smoothed over with additional paraffin, so that the windings of the secondary coil may be regular and level. The joints at the ends should be completely filled with paraffin to prevent short circuits between primary and secondary coils.

The secondary coil consists of 15 layers of No. 36 cotton-covered magnet wire. The end is carried through the hole D, leaving about 8″ for connections. It is temporarily fastened with a plug. Owing to the fineness of the wire and the liability of breaking, the ends are often of larger wire, with soldered connection, well covered with cotton thread and waxed. The secondary is wound in the same direction as the primary coil, each layer being coated with shellac, as previously described. The wire should be carefully watched during the winding to locate breaks or splices. If either are found, twisted joints should be made and well covered with fine cotton thread and wax. Each layer should end one turn further from the end than the one under it, the remaining space being filled with paraffin. If the last layer is likely to be rather uneven, a layer of note-paper over the next to the last layer, coated with shellac, will allow the last layer to be wound evenly. This should be shellacked, the end, with spare wire for connections, being carried through the hole F. A covering of black velvet or bookbinders' leather will give the coil a more finished appearance, as well as protect the coil from being damaged by use. When the winding is completed, the core is then placed in position and strongly fastened with glue. It should fit very firmly and be centered so that the regulator may be pushed in and out without touching it.

Five binding posts are fitted to the base, as shown in Fig. 1. Holes should then be bored in the base to receive the wires from the primary and secondary coils. Six brass-headed upholstering nails are driven into the under side of the base to support it and prevent the wiring underneath from being broken.

The contact-breaker consists of a piece of thin spring steel $2\frac{1}{2}''$ long and $\frac{3}{16}''$ or $\frac{1}{4}''$ wide, on one end of which is soldered a piece of soft iron $\frac{3}{8}''$ square and $\frac{1}{8}''$ thick, which forms the armature. The other end is fastened in a slot in the top of a brass or iron post $1\frac{1}{4}''$ high, so placed as to bring the armature opposite the end of the core. The post can easily be made of a brass bolt, the slot being cut with a key-maker's file or hacksaw. The end of the spring is then placed in the slot and the two sides hammered gently until firmly closed onto the spring. With one nut above the base and one on the under side, the post can then be firmly fastened in any desired position. Another post with a regulating contact-screw in the top is placed 1'' nearer the coil, but outside the spring. A screw-hook may be substituted for the contact-screw and post to save work. It should be about $2\frac{1}{2}''$ long, and screwed through the base far enough to allow the wire connections to be made.

When all the parts are completed, they should be fastened to the base, the armature on the contact-breaker not quite touching the core, and having an outward play of about $\frac{1}{8}''$. The wires from the primary and secondary coils are carried under the base to make the connections shown in Fig. 1, as follows: The outside end of the primary coil is carried to the binding-post P; the inside end of the primary coil to the post carrying the spring and armature. The post with the contact-screw is connected to the binding-post N, and also connected to the binding-post Tt. A splice is made on the wire from the inside of the primary coil and run to the binding-post Ts.

The inside end of the secondary coil is connected to the post Tt, and the outside end to the post Tp. The wire for these connections should be heavier than the coil wire, say No. 18 annunciator wire. The wire plan in Fig. 1 is simply to show the proper connections. The wires are carried as direct as possible. The battery is connected to the posts P and N with No. 18 annunciator wire. Two Leclanche cells connected in series will probably furnish all the current desired. Handles for shocking are made from pieces of thick brass tubing 4'' long and $\frac{3}{4}''$ diameter. Wooden handles are fitted to one end. Flexible wire cord, such as is used on incandescent drop-lamps, makes good connecting wire from coil to handles. It should be soldered to the tubing, and at the outer end a coating of solder will prevent breakage from use in changing terminals. Connecting the wires from the handles to the posts Tt and Tp, the shock will be that given by the primary coil only; posts Tt and Ts give secondary coil only; while posts Ts and Tp will give both primary and secondary. The first connection will be found the weakest, the second much stronger, and the last quite powerful. With the regulator out, each connection will be at its full strength, but by sliding in the regulator, they are reduced. In first testing the coil, do not take the full strength, but work up to what you can stand with comfort. Electricity, like anything else, is to be taken in moderation. Some adjusting of armature spring and contact-screw will probably be necessary before the current-breaker will work correctly.

A HOME-MADE COLONIAL CLOCK.

Henry M. Chadwick.

For convenience I shall divide the woodwork into three sections: the base, or the square box portion at the bottom; the shaft, or long narrow part; and the head, or top.

The base is made of four pieces of mahogany. The front is 1′ 6½″ high and 1′ 6½″ wide. The two sides are 11$\frac{1}{16}$″ wide and 1′ 6½″ high. The back is 1′ 6½″ high and 1′ 4¾″ wide. All four pieces are from stock ⅞″ thick and planed on both sides.

The drawing shows a rabbeted joint at the two front corners. To make this by hand, proceed as follows: Lay the front board on the bench and mark a line exactly where you want the rabbet to be. It is best to make the lines with a knife point or with a hard pencil sharpened to a chisel edge. Next tack a piece of ⅞″ board, whose edges are straight and whose sides are square, close to the line. Place your saw against the straight edge and tack another straight piece close to the other side of the saw. Saw exactly half-way through the board and cut out the wood with a sharp chisel, smoothing up with a small iron plane, or the side cut may be made with the saw by placing the board in a vise and tacking on strips the same as for the top cut. Lay off the rabbet on the other side exactly parallel to the first one, and repeat the operation. Square up the board with the edges of the rabbet.

To the inner side of the front and ends screw six pieces of ⅞″ pine board about 3″ wide, planed on both sides. (See Section C, D.) These pieces serve as cleats to keep the base-boards straight, and also as blocks to which is screwed the shaft after it is slid into the base. Glue all joints before nailing, and fasten with wire nails, setting the heads about ⅛″ into the wood. If you have no nail set, use a large wire nail with the point filed off square.

The stock for the shaft is ½″ thick and planed both sides.

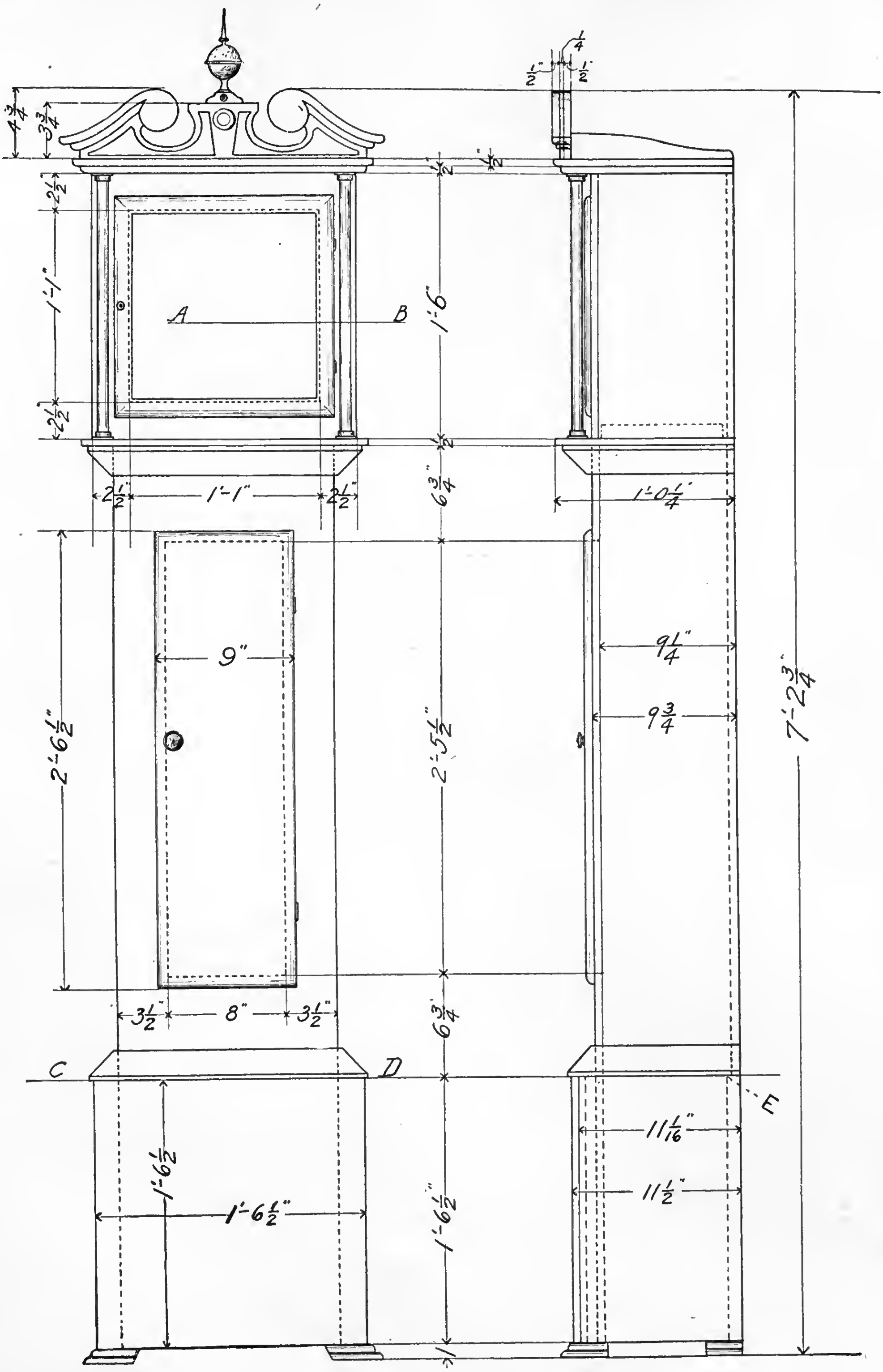
The front board extends from the bottom of the base to the under side of the horizontal board of the head on which the two pillars stand. This makes it 5′ 1½″ long. The two sides are the same length; they are 9¼″ wide above the base, and are notched at E on the rear side to about 8¼″ to admit them into the base. The position and size of the doorway is easily ascertained from the drawing. The back board is even with the tops of the front and sides of the head, and extends down to the top of the back board of the base, and is flush with the outside of the latter. It is placed between the two sides; this makes it 1′ 2″ wide and 3′ 7″ long.

Bore two $\frac{3}{16}$″ holes each in the front and sides opposite each of the six cleats in the base. Glue and brad the front and sides together, slip them into the bases and screw to the cleats with 1″ round head screws. Each screw should have a round iron washer under its head.

It is well, though perhaps not necessary, to put two or three white pine cleats on the sides, and two on the front, one above and one below the door. This will prevent the boards from warping. Do not, however, glue these cleats on, simply use screws. If they are glued on and the boards swell with dampness, you may have a cracked clock in your hall.

The door is a single piece, with rounded edges, 9″ wide and 2′ 6½″ high, with two cleats screwed to the inside. It is fitted with brass hinges, and a brass knob that has a tongue on the inside to engage in a slot in the side of the doorway. Do not fasten the door on until after the clock is finished, as it is liable to become marred during the work.

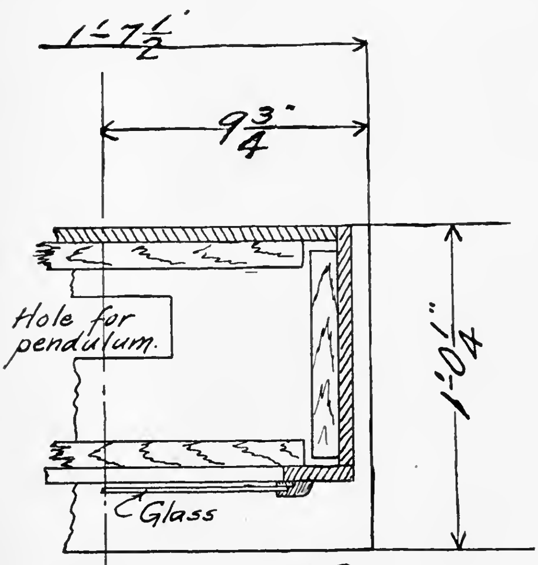
The two moldings are alike, except that one is turned up and the other down. They must be cut carefully in a miter box with a sharp saw. If



4¾
3¾
¼
½"
½"
½
2½
1'-1"
A
B
1'-6"
2½
½
6¾
2½
1'-1"
2½
1'-0¼"
9"
9¼"
9¾
2'-6½"
2'-5½"
7'-2¾"
3½"
8"
3½"
6¾
C
D
E
1'-6½
11 1/16"
11½"
1'-6½"
1'-6½
1"

you do not get a good close joint in the corners, mix some sawdust with a little thin glue and fill the cracks with it. Let it dry well, then sandpaper the joints.

The head is all ½″ mahogany, planed on both sides. The front is a square frame 1′ 6″ outside and 1′ 1″ inside. It is made from four strips 1′ 6″ long and 2½″ wide. The joints are halved together, the upright pieces being on the outside and glued



Section on AB.

and also fastened with two screws to each joint. This can be made nicely with a miter saw if the cuts are first carefully marked.

The two sides are 9¼″ wide and 1′ 6″ high; the back is 1′ 5″ wide and 1′ 6″ high; the top is 1′ 7½″ x 1′ 0¼″ with rounded edges. The second thickness shown on the top is obtained by tacking three mitered strips to the top board, rounding the edges with a plane, and letting them project about ½″.

The bottom board is glued and nailed to the top of the shaft; it has square edges and a hole for the pendulum, otherwise it is like the top board.

The ornament on top is made from three thicknesses. The back piece is ½″ thick and follows the outline of the scrolls. It has no openings.

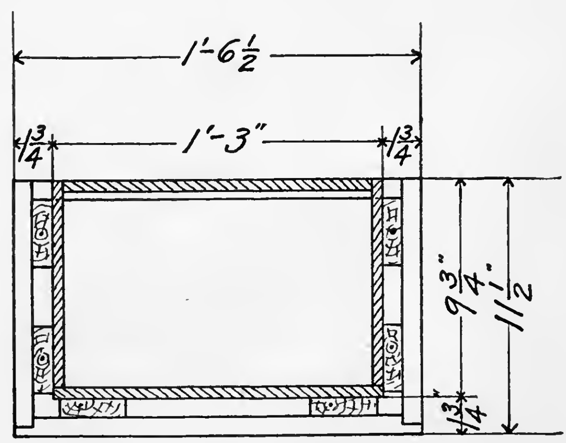
The middle piece is ¼″ thick and has two openings, cut so that when placed against the back it gives the effect of a recess on each side of the center. The front thickness is simply the wing, having the two sweeps carved with a chisel. Of course it is better to do this part of the work with a jig or band-saw, and if you have not access to either, have it got out at the planing mill rather than try to carve it with a chisel.

THE DOOR. The frame is made of mahogany 1″ wide and ½″ thick. With a circular saw cut two rabbets in each of the four pieces, one for the glass and one for the strip to hold it. (See section on A B.) A beveled plate glass adds greatly to the appearance and costs about one dollar. Take the glass frames and strips to a picture framer, and he will miter the corners and put the whole thing together better than you can do it yourself unless you are experienced in that sort of thing.

Mount the door with two small brass hinges and a knob. Drive a brad with the head cut off into the edge of the frame about even with the knob to catch in a hole punched in a piece of spring brass that is turned under the door frame and tacked to the front board.

The pillars were made of a piece of mahogany 1″ square and turned in a lathe to ¾″ diameter. The bases and caps for the pillars, also the sphere on top, are of brass purchased of a dealer. Use round head brass escutcheon pine to hold the bases and caps in place.

On the top side of the bottom board of the head screw four pieces about ⅞″ square, to which to



Section on CD.

fasten the vertical boards of the head. Put ⅞″ square pieces on the under side of the top, the same as were placed on the bottom. The front frame, the two side boards, and the top are then put together, but the back must be left loose, as the clock movement is to be fastened to it. This back should be screwed on, but not glued, after the movement is in place.

There is a wide range of choice to be followed in buying a clock movement, but whatever one you get will have to be fitted to the back board by building up with blocks until the spindles project through the dial. Put two stout hooks or knobs on the back board to facilitate its removal for cleaning or repairing the movement. I finished my clock by applying three thin coats of orange shellac. The first two coats were rubbed down separately with fine sandpaper. The third coat was rubbed with powdered pumice stone and raw linseed oil, and lastly with my bare hand. A darker effect could be obtained by staining the wood before any shellac is applied.

The movement in the clock here described is a Seth Thomas, eight day, and makes eighty beats to the minute. Its cost was $10.00. The dial was made to order and painted on zinc, and cost $2.50. The total cost, including movement and dial, in money was about $33.00. It took me the odd hours and minutes of ten months to complete it.

ASTRONOMY FOR FEBRUARY.

At the opening of this month the great planets will have disappeared, and will not again visit our evening skies until May. Venus alone will still be seen in the west, and she disappears early in the month, coming up with the sun on the 14th.

Mercury will reach his greatest distance east from the sun on the 2d, when he may possibly be seen; at sunset he will be nearly west, but when the sky becomes dark enough for him to be distinguished, he will have moved a little northward. Look for him near the horizon, a little north of due west.

At the beginning of the month the moon will have just passed its first quarter; it is new on the 8th, comes to its first quarter on the 15th, and is full on the 22d.

There will be two occultations this month of stars bright enough to make them interesting to our readers. The first is of the third magnitude star Lambda Geminorum, and the time of the star's disappearance is about two in the morning at Washington, on February 19. On the morning of the 26th the first magnitude star Spica (Alpha) of the constellation of the Virgin is occulted, passing behind the moon at about 4 A. M. Both these disappearances will be at the bright edge of the advancing moon. Perhaps the best way to observe these is to look for the star quite near the front edge of the moon, about half an hour before the predicted time, and keep an eye on it every few minutes until it comes quite close into the edge, and then keep it constantly in view until it disappears. A field-glass should be sufficient to show both of these occultations well.

The first of this month the summer constellations will all be gone.

On the other hand, the Great Bear will have swung eastward and higher, so that in the early evening it will be prominent in the northeast. The Lion will be just rising at 8 o'clock; its first-magnitude star Regulus, being at that time well above the eastern horizon. This star forms the jeweled end of the handle of the great "Sickle," which is the distinguishing group of this constellation, and which will appear in the east with its edge and point forward, about the time indicated. Above it, and between it and the twins, is Cancer, the Crab, the northernmost of the constellations of the Zodiac. It is not conspicuous, containing no bright stars; only the cluster Præsepe (the Beehive) can be easily seen, and is the landmark for this asterism. It is a beautiful object for a field-glass or small telescope.

Vega.

While the average man knows that the coaster brake saves a deal of pedaling in a day's ride or a week's ride, authenticated records of such savings are rare. The most extended record of the sort of which there is knowledge has but just seen the light — the record of Teddy Edwards on a Barwest coaster brake from New York to Buffalo and return, a matter of 996.6 miles. Of this distance Edwards coasted 210.4 miles, or about 22 per cent., say one mile in every four and one-half, or twenty-two miles in every one hundred. It would be valuable if more records of the sort were available; the record of a season's saving, for instance, would be particularly interesting.

Merchant (to new boy): Has the bookkeeper told you what to do in the afternoon?

Youth: Yes, sir; I am to wake him when I see you coming. — *Exchange.*

GAS ENGINES.

Henry C. Miller.

The increasing use of gas, gasoline, and oil engines for small powers, and the probability of a much greater development in the near future, make this subject worthy of considerable attention. The simplicity of construction, the low cost and ease of operation, and wide range of adaptability are the important factors contributing to this popularity. The many faults of the first engines were so objectionable that extended use was out of question. Continued experiment, however, gradually removed the objectionable features, until to-day such engines attain a high degree of efficiency. As an economical source of power for small manufacturing and lighting plants, nothing except water power can approach them. They are practically automatic; therefore the expense of constant attendance, as with a steam plant, is not necessary to their successful operation. Any intelligent person who will give proper attention to the instructions will have little or no difficulty in obtaining satisfactory results. The many avenues still undeveloped are plainly evident when we consider the hundreds of small hotels at seaside and country resorts that still use kerosene lamps for light, and do laundry work and freeze ice-cream by hand power. A still larger number of manufacturing plants using steam power, for which the cost of the engineer-fireman in charge is greater than for the fuel used; would find a change to gas-engine power of decided benefit. Many small country villages could establish a cooperative lighting plant and enjoy the benefits now reserved to larger places.

Accompanying this increase in plants will come a demand for competent men to take charge of them. The young men who are wise and energetic enough to study electrical and engine work now will have no difficulty in securing satisfactory positions when they become competent to fill them. These preliminary observations are inserted for the purpose of enabling the reader to appreciate the importance of the subject and influencing him to more extended study of it, should it prove to be of interest.

We will now consider how such engines are constructed and operated, gas engines being understood, in this article, to include those using both gas, gasoline, and kerosene. A gas engine utilizes the expansive force of the nitrogen in air resulting from the heat developed by combustion. A certain volume of hydrocarbon gas, together with a larger volume of air, are inclosed in a cylinder and exploded. The heat due to combustion expands the nitrogen of the air, and the watery vapor resulting from the union of the oxygen of the air and hydrogen in the gas, as well as the monoxide and dioxide, products of combustion formed by the union of the carbon in the gas and the oxygen in the air. This expansive force is exerted upon the piston and conveyed by the piston-rod to the crank and crank-shaft which revolves and becomes available for transmitting power by belt or other device. As compared with the steam-engine, it utilizes a larger proportion of the heat developed. The steam-engine converts into useful energy from 12 to 18 per cent. of the potential heat units of the coal. A gas engine secures from 18 to 25 per cent. or more.

The gas used in these engines may be the regular illuminating or fuel gas, or may be the vapor of gasoline, naphtha, kerosene, or petroleum. In the latter case the fluid is vaporized, previous to being admitted to the engine, in what is termed a carbureter. This is a device for applying sufficient heat to the fluid to convert it into vapor, and is automatically regulated to supply the vapor only as needed.

In some types of engines the gas or vapor is admitted to the cylinder, and there mixed with a suitable volume of air; in other types this union is effected before being admitted to the cylinder. The method of admitting the charge also varies. In one type, termed the two-cycle engine, the gas and air mixtures are drawn into the cylinder during a part of the outward stroke, exploded and expanded during the rest of the stroke, and the products of combustion exhausted during the return stroke. This type of engine develops about 20 per cent. of the heat value of the gas used. Some engines of this type also compress the gas mixture on the last part of the inward stroke. The four-cycle engine admits the gas mixture on the first outward stroke of the piston, compresses it on the inward stroke, explodes it on the second outward stroke, and exhausts on the second inward stroke, an expansive impulse being given only with every other stroke. In this type of engine the compression of the mixture gives the explosion far greater expansive force than in the non-compression type, thus overcoming the loss due to the less number of explosions.

In all types of engines the explosions and consequent number of expansive impulses are as rapid as is mechanically possible. This means high piston speed, so that the expansive effort shall be exerted on the piston as often as possible. The exhaust should be quick, that the hot gases may not overheat the walls of the cylinder. The rapidly repeated explosions generate a high degree of heat, which is removed by radiation. In small engines this is generally effected by the air, the outside of the cylinder being covered with corrugations similar to a steam radiator, only deeper. With large engines and some small ones, the cylinder is surrounded with a water-jacket, which prevents the excessive heating of the cylinder that otherwise would follow. This is connected to a supply tank, the warm water being of less specific gravity, rising and being replaced by cooler water. A constant circulation is thus maintained, which serves to keep the cylinder at the right temperature. One of the important features of gas-engine design is the regulation of the water circulation so that the cylinder shall be kept at just the right degree of heat to most economically utilize the power developed.

There are several types of devices for firing the charges in gas engines. The direct flame ignition is through a hole in the cylinder wall, which is uncovered by the piston at the proper moment, and the flame admitted to contact with the gas mixture. It is protected so that the explosion will not extinguish the flame.

The tube igniter consists of a metallic tube, preferably platinum, externally maintained at a high heat by a burner of the Bunsen type, into which the gas mixture from the cylinder is admitted and fired, thus firing the mixture in the cylinder. Careful designing and adjustment of this type is necessary to successful working.

Electric ignition is secured by a spark between two platinum electrodes inside the cylinder. The current may be generated from either a primary or storage battery and induction coil, or by a permanent magnet generator driven from the engine shaft by a belt. This latter dispenses with the battery and its care, and also the induction coil, and is increasing in popularity. Some engines are equipped with both tube and electric ignition.

The lubrication of cylinders is a matter of much importance with engines of large size. The intense heat of the exploded gases has a tendency to thicken some kinds of oil and make a gummy deposit on the surface of the cylinder, which would seriously affect the smooth running of an engine. Mineral oils of a high grade should be used, and the oil-feed regulated to the minimum amount that will prevent wear.

The efficient governors now in use on gas engines afford close regulation of speed and allow freedom from constant personal attention. The type most generally used regulates by increasing or decreasing the supply of gas or gas vapor.

Regularity of piston movement is secured by heavy fly-wheels on the crank-shaft which, by the acquired momentum, overcome the violent increase in speed that would otherwise follow the explosions. A heavy bed is also necessary to secure steadiness. A firm foundation is desirable, as with all engines, to prevent vibration.

In the management of these engines cleanliness is the important desideratum. The cylinder, feed, and exhaust pipes should be regularly examined to see that they are in proper condition. The frequency with which this is done depends largely on the service being performed. In dusty workrooms, a separate enclosure would be advisable, otherwise the dust-laden air will cause a deposit of sediment that may be troublesome. When examining an engine see that it is freed from the gas mixture by giving it two or three turns. Do not open valves for examination with a lamp or gas flame near at hand until satisfied that no gas leakage is liable. An electric light may be used with more freedom. The special details of particular makes of engine are fully covered by instructions accompanying them.

The power of a gas engine should approximate that used, as engines largely in excess of requirements are not as economical as when correct power is used. The excessive cost is not prohibitive, but should be avoided if possible. The probability that Texas crude petroleum may soon be available at low cost may serve as an incentive to develop oil using engines. With cheap petroleum, an efficient oil engine would find many uses.

AMATEUR WORK

85 WATER ST., BOSTON

F. A. DRAPER . . . . Publisher

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada, and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post Office, Boston, as second-class mail matter, Jan. 14, 1902.

FEBRUARY, 1902

Contents

OUR readers are invited to submit topics which they would like to have presented in these columns. Those interested in AMATEUR WORK desire to make it the most helpful and interesting magazine that can be published for young men and boys. If readers will write about what interests them, the information thus obtained will be of much value to the editors and guide them in their work of preparing suitable subjects.

"HAVING seen a copy of AMATEUR WORK, I am much pleased with it," and similar statements, appear so frequently in our correspondence that we are led to ask our readers to mention the magazine to their friends. Being a new magazine, many who are interested in the subjects it presents are not aware of its publication. If brought to their attention, they would become regular readers, thus greatly increasing the circulation, which, in turn, would enable the size and scope of the magazine to be enlarged, something the publishers are very anxious to do. If our readers will speak a favorable word to those of their friends whom they think would be interested in it, this result can soon be accomplished.

As many of the things, the construction of which are described in the magazine, are beyond the attainments of younger readers, arrangements have been made to present articles especially adapted to elemental work. This will enable the beginner, as well as the more experienced amateur, to find in each issue something of interest upon which skill may be developed that will lead to more advanced work.

Two or three weeks ago the electric lights in Buffalo went out with a wink and all the street cars stopped. At the same time Lockport and Tonawanda were similarly afflicted, and considerable excitement reigned until the trouble was removed. It was found that a cat, of the common or back-yard variety, had climbed a pole on the transmission line, driven thereto possibly by a dog, and managed to short-circuit the 11,000-volt transmission line. The cat was killed.

THE wave motion of the sea is utilized to run the electric-lighted buoy at the mouth of the river Elbe in the North Sea. The least motion of the water is sufficient to generate the electric current, which, when not needed, passes to storage batteries. The success in this case and in the generating electricity by means of floats off the shore of Los Angeles, Cal., is encouraging to the belief that the power of the waves will later be made valuable to coast towns.

MECHANICAL DRAWING.

Earnest T. Childs.

IV. Objects in Section.

The work which has been taken up thus far by the student covers simply outline drawing, with very few concealed or dotted lines. To make the representation more complete it is often necessary to show the object in section; that is, it is assumed that the object is cut at a certain point, and the drawing is made showing the exact shape of the object where it is cut off. For instance, if all the dotted lines in the upper left-hand view of the tee on page 41 of the December issue were shown full, this view would then represent a cross section of the tee. The use of sections is often very necessary to avoid the confusion of a great many dotted lines. There are several conventional methods of showing that the object is in section. The most common of these consists of parallel lines drawn usually at an angle of 45 degrees across the cut surface. When cross-sections of two different pieces adjoin each other, it is customary to draw the section-lines of one at right angles to those of the other, thus adding to the clearness of the drawing.

The representation of different materials may be indicated by varying the character of the section-line. There is no standard for the line which shall indicate a certain material. Every drawing room has its own standard, which may or may not agree with others, and if there is a possible doubt as to the material required, it should be indicated by a note on the drawing. Fig. 9 shows a very convenient set of conventional sections which are generally used, though they are not positively standard. A represents cast iron; B, wrought iron; C, brass or bronze; D, babbitt metal, which is commonly used to line journal boxes; E shows steel; F, brickwork; G, wood, the upper part indicating that the section is across the grain, the lower showing that the section is with the grain of the wood; H shows stone. There are other graphic symbols showing concrete, earth, and other materials which it is not necessary to describe, the variety here given being sufficient for the needs of the ordinary draftsman.

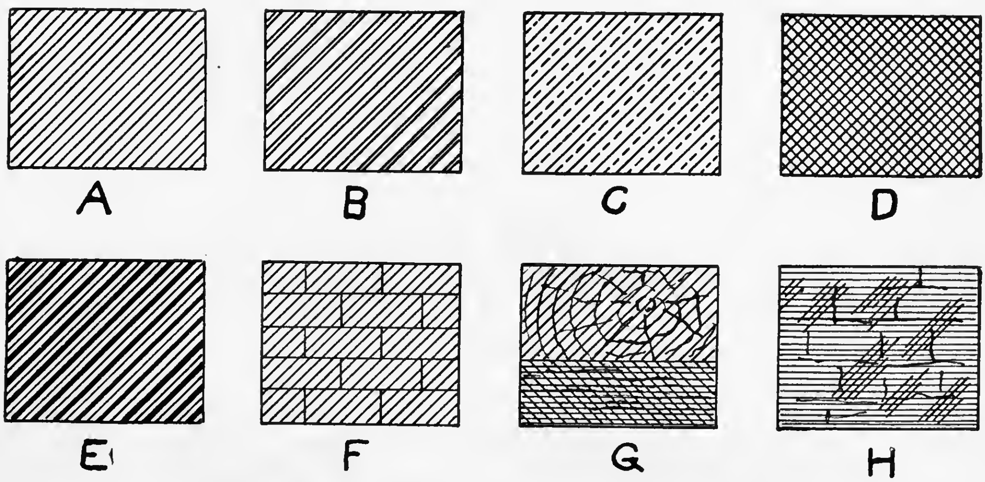


Figure 9.

The spacing of section-lines must be determined by the size of the section, but care must be taken not to space them too close, as this adds to the labor, and often draws undue attention to one particular part of the drawing.

The regulation of the space between section-lines is often left entirely to the eye, but if a great deal of sectioning is to be done, it is more readily and rapidly finished by the use of a section-liner.

There is a great variety of these instruments on the market, all of which are on the same general principle, and cost more than the amateur may care to pay for them. A simple liner may be made by any one by taking four pieces of wood, each about one-eighth of an inch thick and one and one-fourth inches wide, having both its sides parallel. These pieces should be about one and one-half inches longer than the 45 degree triangle, which is to be used for the section work. One side of each piece should be notched for a length varying from $\frac{1}{32}''$ to $\frac{3}{16}''$ longer than the triangle, and for a depth of about one-half inch. This will give four different widths of space, which will be ample for ordinary sectioning. A more convenient arrangement consists of a single strip of wood with an adjustable block on one end, so that by turning a small screw any width of space may be obtained. (See Fig. 10.) In using this arrangement it requires a little practise, but in a short time it will become an easy matter, and the relief to the eyes is very appreciable. The wood strip should be held against the blade of the T square to prevent it from getting out of line. The triangle and wood strip are moved along alternately, the stop limiting the motion and keeping it constant for each line. If it is thought advisable to purchase a section-liner, they may be obtained at any price from $1.00 up to $5.00, or even more. One of the neatest of the liners on the market is on the principle of the

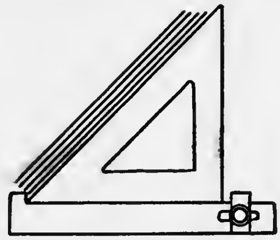


Figure 10.

one shown by Fig. 10, except that the movable strip is secured to the inside of the triangle, and the adjustment is obtained by an eccentric-shaped metal piece, which will vary the width of the motion. This is known as Hill's combination section-liner and triangle, and lists for $1.00. Anything more elaborate will be too expensive for the ordinary draftsman.

An extremely important item in the making of

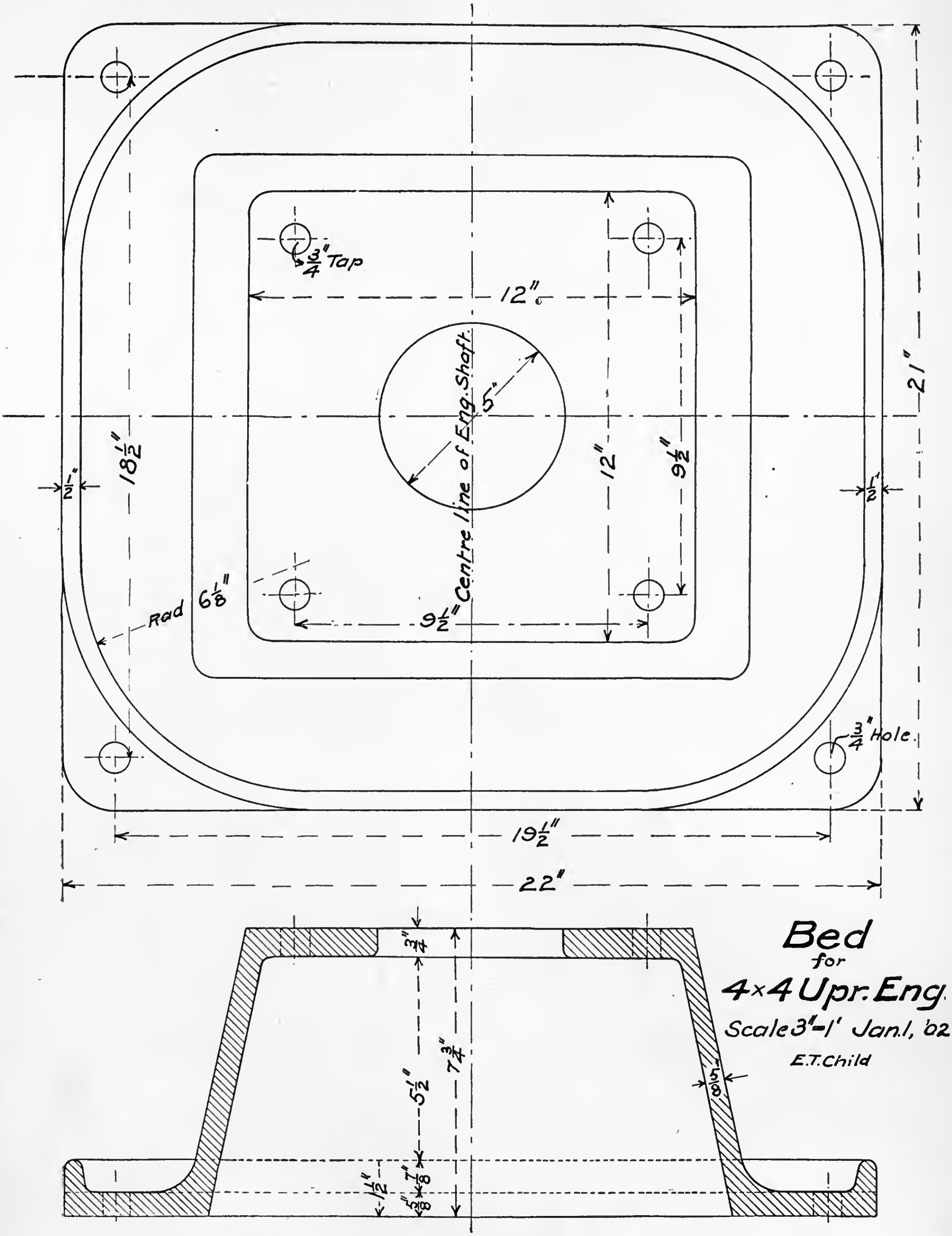

3/4" Tap
12"
5"
Centre line of Eng. Shaft.
21"
18 1/2"
12"
9 1/2"
1/2"
1/2"
Rad 6 1/8"
9 1/2"
3/4" Hole.
19 1/2"
22"
3/4"
7 3/4"
5 1/2"
1/2"
7/8"
5/8"
5/8"
Bed
for
4×4 Upr. Eng.
Scale 3"=1' Jan.1, '02
E.T.Child

FIGURE 12.

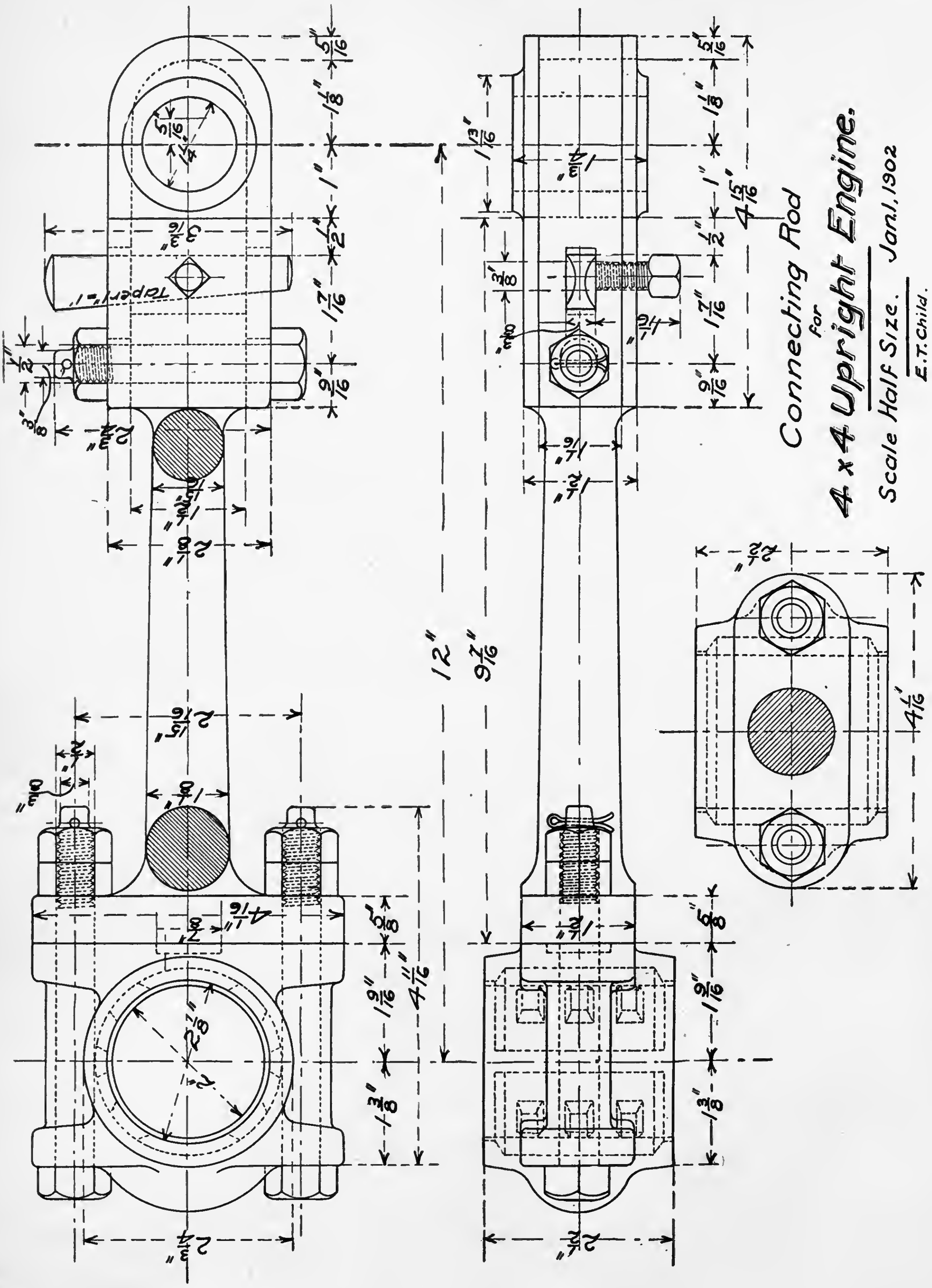

Connecting Rod
for
4 x 4 Upright Engine.
Scale Half Size. Jan. 1, 1902
E. T. Child.

FIGURE 13.

a mechanical drawing is the class of letter to be used. The great majority of draftsmen can make a good line drawing, and can make fairly legible figures; but a great many find difficulty in making the notes and title uniform, and the skilled letterer always commands a good salary. It often happens that perfect lettering is not necessary for the work in hand. This is particularly true in the case of large manufacturing concerns who make drawings principally for shop or field construction. Municipal and private engineers often spend a great deal of time and trouble on their lettering and have specially trained experts who do nothing but this class of work. The ordinary draftsman, however, needs a simple letter which is readily made, and which is clear and legible without taking an unduly long time to learn the use of and to put on the drawing.

As stated in the December issue, the writer's experience goes to show that an Italic Gothic letter, entirely devoid of flourish, is most readily handled by the largest number of draftsmen. With a few day's practise, a draftsman can make a neat looking title, and a new man, absolutely untrained, can be taught the use of this letter within two weeks. In a room of thirty draftsmen, all but two are handling this letter, and there is so slight a variation that it is next to impossible to know by the lettering which man did it. In other words, the individuality of the draftsman is not in evidence with this style of letter. The result is great uniformity in the titles and notations on the drawings and a correspondingly neat appearance of the drawing files. This alphabet, together with the figures appropriate to use with it, is shown by Fig. 11. It will be seen that the capital letters are made by a double stroke and are shaded, and the lower case letters are made by a single stroke of a coarse pen. It will be evident to all that these letters are made free hand. This is purposely done to illustrate to the student the degree of proficiency which is necessary to produce a neat note or title. Whenever any lettering is to be put on the drawing, the lines must be ruled, as shown in Fig. 11, so that the work will be even, as it is next to impossible to keep the work even unless this is done. For notes, etc., the capitals are made with a single stroke, unshaded, and for titles the small letters may be made heavier and the shade lines used. (See detail of Connecting Rod, Fig. 13.) Special attention is called to the lines which form the letters. It will be seen that they are square at both ends and slightly wider than at the center, the bottom being a shade heavier than the top. This gives the lines character and balance, which would be missing if the lines were of the same weight throughout, or were made thicker at the center than at the ends. These letters stand at an angle of 60 degrees, but they may be written in a vertical position if desired. It is found more difficult by the majority of men to handle a vertical line than a sloping one, and the 60 degree angle is to be recommended particularly for this reason.

Fig. 12 shows the bed of the 4 x 4 engine. This illustrates the use of the section showing a symmetrical object. It will be seen that the section is taken on the center line of the base, at right angles to the shaft. The ½ inch head is shown in the plan, and the section shows its height as well as the general outline of the base. The section does not cut through any bolt holes, and they are shown dotted. It does, however, cut through the center of the 5 inch circular hole in the top of the base, and this part, not being cut, is not section lined. It will be seen that very few dimensions are necessary and repetitions are avoided. This drawing is exactly quarter full size and just fills a single standard sheet.

Fig. 13 shows the connecting rod. This is a good study, as it contains several interesting points and will give excellent practise. It should be drawn very carefully on paper, and then traced or inked in. Use tracing cloth if it is available. This gives a good example of the conventional representation of screw threads and bolt heads, and also shows check nuts secured by means of a split pin. This also illustrates one method of showing a section on a side elevation. The cross-hatched circles near the ends of the rod show that the rod is cylindrical at that particular point. Some of the figures are repeated on the various views. This should be avoided as much as possible, but it is better to repeat than it is to omit figures. These two details should be carefully worked up, and when inking do not forget to put in the circles first, and the straight lines afterwards, and use different weight of lines on dotted and full lines. It will also be well to make a practise sheet of cross-hatching after the idea of Fig. 11.

HOW TO BUILD A HOUSEBOAT.

Carl H. Clark.

I. Construction of the Hull.

In this series of articles the writer has aimed to present a set of plans and detailed directions for constructing a small houseboat, — one which will comfortably accommodate six persons and allow good cooking and toilet facilities, and which can be built by an amateur for small cost, or, if this were not desired, could be put together by any ordinary house carpenter in a short time.

The cost of the stock for building the hull and deckhouse, complete, including paint and window-sashes, should not be over $250, and in some localities where lumber is cheap it should be much less.

As may be seen from the sketches, the work is very simple, being all straight work, with no steaming and bending of timbers and plank as in regular boat building. There is no reason why its construction should not be undertaken by any one at all familiar with the use of tools and woodworking. The work must, of course, be carefully done to insure the hull being watertight, but since all the joints are straight, little or no difficulty will be met.

The dimensions chosen — 30′ long, 16′ wide, and 5′ deep — are large enough to give good accommodations, and yet not so large as to make the labor required excessive, or to prevent its being built by two or three persons in a reasonable length of time. The only tools required are the simplest of carpenter's tools.

A general idea of the boat may be obtained from Fig. 1. The accommodations, as shown in Fig. 2, include a large main cabin and living room 6½′ long in the forward end of the house; this room has a seat on each side, which can be made up for a berth. This room is also used for a dining room by the addition of a portable table, which may be taken away at night if desired. Leading from this room is a passage extending through the house, with rooms opening out of it; the first two are sleeping rooms, the larger being 8½′ x 7½′, and containing a full size bed, bureau, washstand, etc. The smaller is 8½′ x 5′, and contains two single berths, one above the other, and bureau, washstand, etc. Next aft are the kitchen and toilet room, the kitchen containing the usual cooking necessities, stove, sink, and closets; the toilet room contains a bowl, tub, and seat.

Forward is a clear space 7′ long covered with an awning, and aft is a similar place, which is to be used as a boat landing and as an approach to the stairs leading to the top of the house, which is fitted with a railing and makes an excellent place for steamer chairs.

There are also hatches in the floor, which allow the hull below to be used for storage of coal and supplies.

Selecting Stock. In ordering the stock it might be advisable, unless one is used to that sort of work, to take the sketches directly to the lumber dealer and let him pick out the necessary stock, as he may be able to select lengths which will cut to better advantage, and so avoid waste. In selecting the stock for the planking of the hull it will be impossible to get it long enough to go the whole length, and it should be selected with the idea of making the joints near the ends and not in the middle. This stock is 2″ thick, and of either white pine or hard pine. Hard pine is the stronger and rather cheaper, although white pine is easier to work. The planks should be at least 6″ wide and a few 8″ wide; it is not necessary to have absolutely clear stock for this, but it should be free from large knots and cracks, which might leak. It should be planed both sides. The framing is made of 2″ x 4″ spruce joists planed on one edge.

For the deck and house ⅞″ stock should be used. It should be tongued and grooved, and preferably of white pine, as it is easier to work, and finishes up better, although spruce or cypress could be used. A small amount of spruce plank about 10″ wide should be gotten for braces and knees. Most of the fastenings in the hull are galvanized nails or spikes about 3½″ long. The window-sashes, doors, and other fittings will be considered later.

Construction of Hull. The general construction is shown in Figs. 3, 4, and 5. Fig. 3 is a cross section showing the framing and planking;

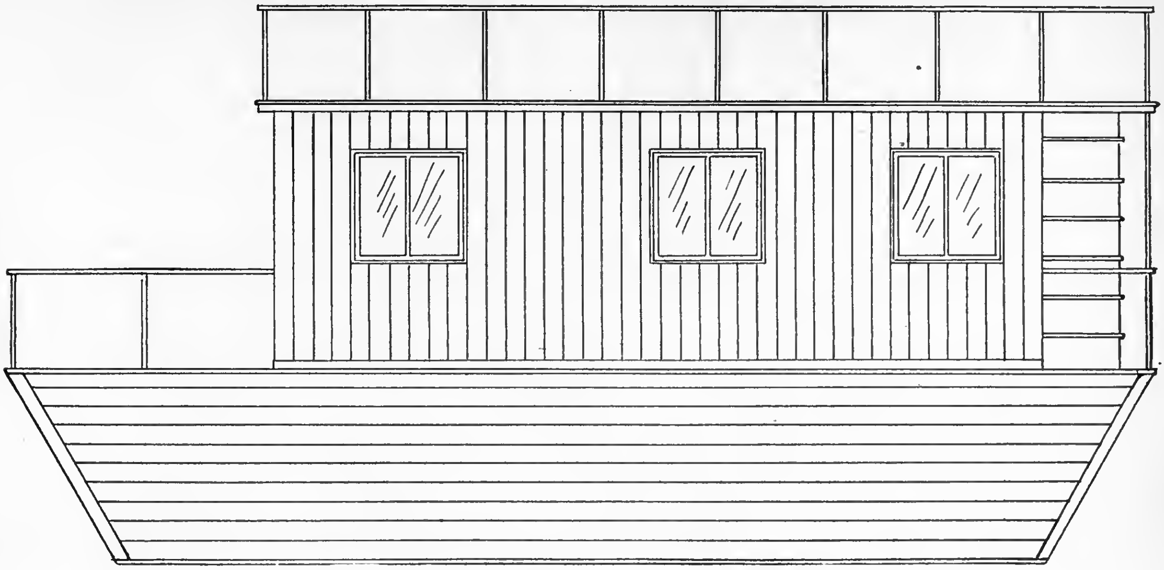


FIGURE 1.

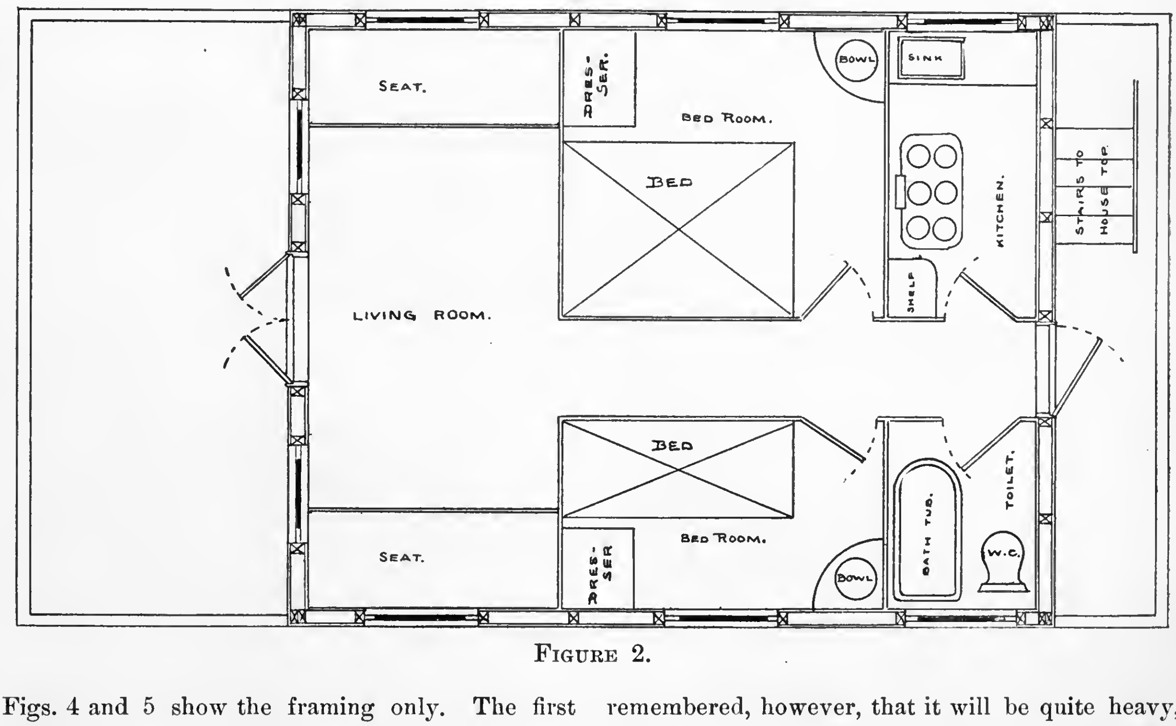


FIGURE 2.

Figs. 4 and 5 show the framing only. The first step is the framing of the bottom. If there is any possible means of turning the bottom over when completed, either by tackle or any other way, it should be built wrong side up if possible, and turned over after being planked; this will simplify the labor, as it will allow the plank to be laid on the top instead of having to work underneath the bottom, which is very tiresome. It must be remembered, however, that it will be quite heavy, and that care must be taken not to strain it and start the joints during the process of turning over.

As will be seen from Fig. 4, the frame is composed of two 2″ x 4″ joists laid on edge along the sides, and cross timbers of the same size laid between them every 2 feet, also on edge, and fastened to them by spikes into their ends through the side timbers. At each end there are two 2″ x 4″ tim-

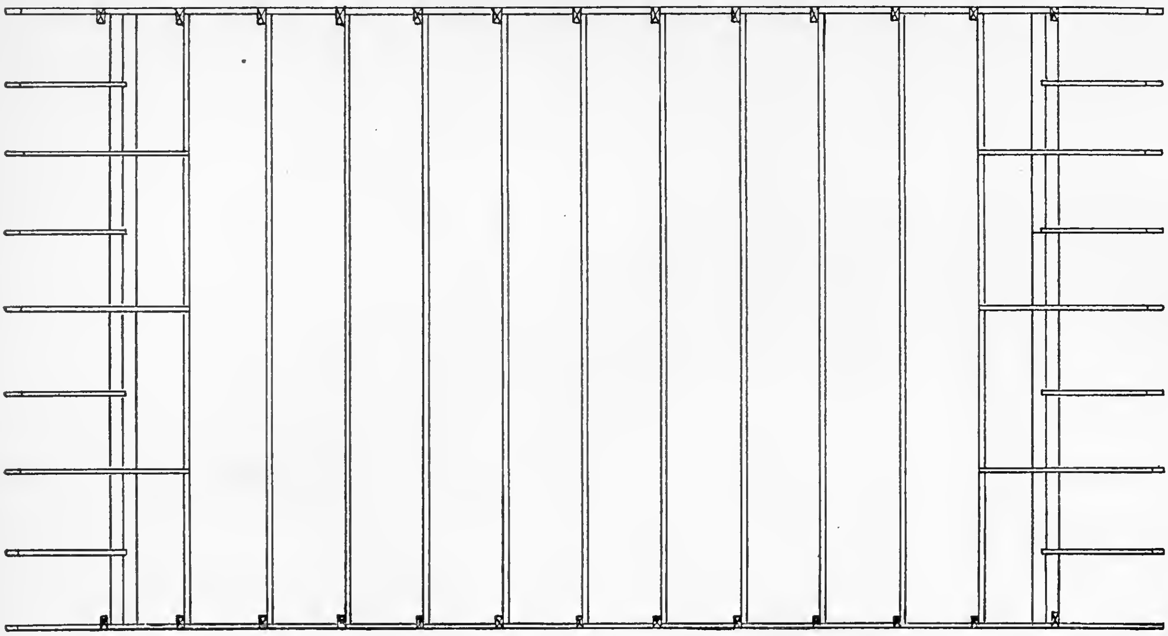


Figure 3.

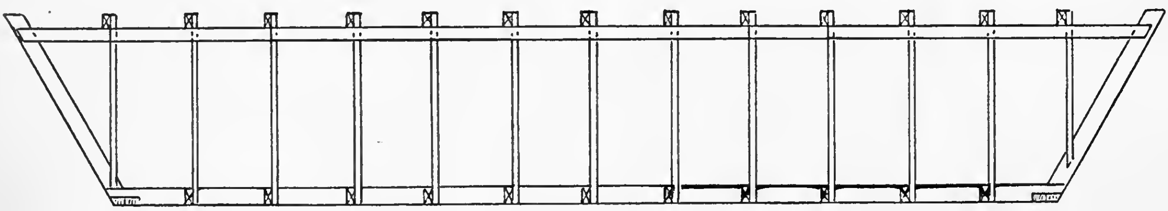


Figure 4.

bers laid flat, edge to edge, and fastened the same way.

The two side pieces should be selected, cut 24′ long, and laid out on a flat floor with the planed edge up; the positions of the cross timbers should be marked by laying the two together and marking across both with a square at equal spaces of 2′. The cross timbers, 15 in number, should now be cut exactly 15′ 4″ long, and put between the side timbers and nailed, each one with two 4″ spikes through the side timber into each end. The planed edge should be uppermost, and care must be taken that they are all even with the side timbers and with each other, so that the plank will lie smoothly. A straight edge laid across them will help in adjusting them, any uneven spots being dressed down with a plane. Before putting on any plank be sure that the cross timbers are square with the side timbers. When this is done, it will be well to fasten the frame to the floor, or else cross-brace it to keep it in shape until it is planked, as the shape of the whole boat depends upon the shape of the bottom. When this has been done, the end of the side timbers and the outer edge of the outer cross timber should be beveled off to the slant of the ends. This angle can be obtained by laying out a triangle, using the depth 5′ as a vertical, and squaring out 3′ from the top, since the boat overhangs 3′ at each end. The line connecting these two and completing the triangle will give the angle of the end, which should be kept, as it will be needed later.

The bottom is now ready for planking, the first step of which is to fasten a piece of planking about 8″ wide across each end, letting it lap about 1½″ onto the inside 2 x 4 joist, and extend 2″ on the ends and other side to cover the ends of the plank. This is shown at "a," Fig. 7. The rest of the

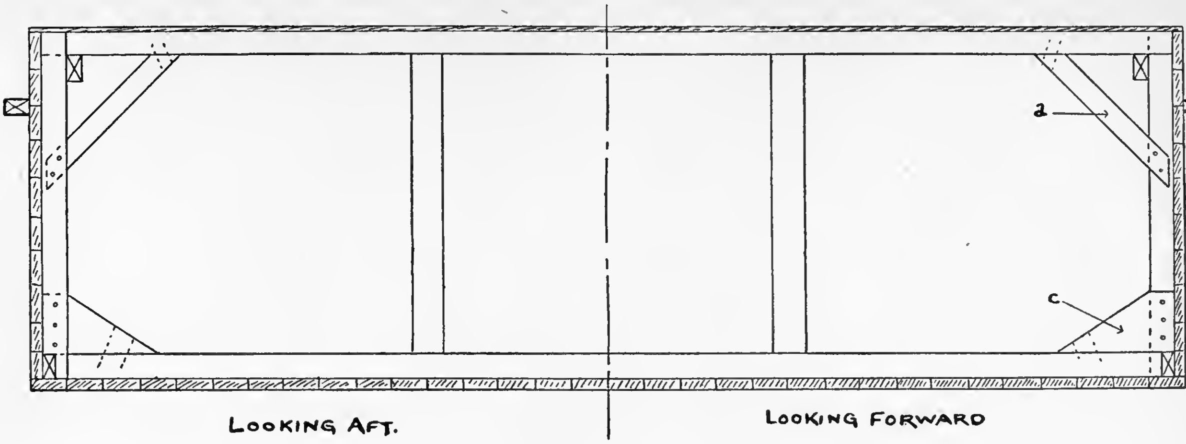


FIGURE 5.

plank are laid the long way, across the timbers; it will be best to begin to plank near the middle and work towards the sides, being sure, however, to have a wide plank at the edge. Before putting on a plank the edges should be slightly beveled towards the outside to allow the insertion of a thread of calking, as shown in rather exaggerated form in Fig. 9. The edges should be about $\frac{1}{8}''$ open when the plank are solid together. The ends of the plank should be squared so as to make a good joint with the end piece, and if the plank are not long enough to go the whole length, the joint should be made to come on a timber, each piece lapping onto the timber half its thickness. The planks are fastened with two $3\frac{1}{2}''$ nails into each timber; these nails should be set down below the

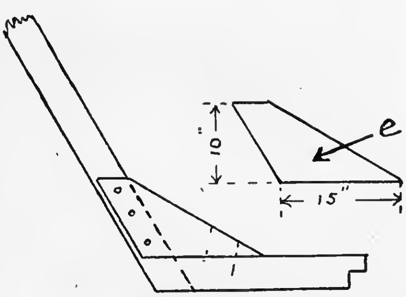


FIGURE 6.

surface about $\frac{1}{2}''$ so that the hole may be filled with cement and protect the head from rust.

It may be best to bore a hole large enough to take the head about $\frac{1}{2}''$ deep; in fact, it may be necessary to bore through with a small bit for the body of the nail if it should show any sign of splitting the plank when driving. All the faces that join should have a coat of rather thick white lead paint before fastening together. The ends of the plank are fastened to the 2 x 4 joist across the end, which forms a bed for them. The butts of adjoining planks must be kept as far apart as possible by making them come at opposite ends, and those in

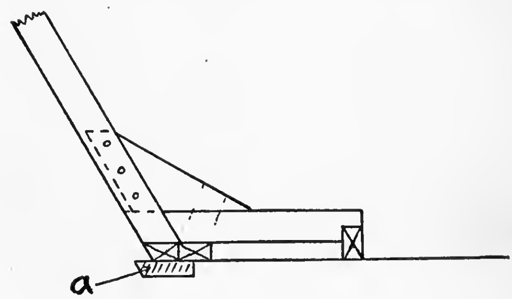


FIGURE 7.

alternate plank on different timbers; this weakens the boat less. It must not be forgotten that the outer plank on each side overlaps the side timber 2″ to take the side planking.

If the bottom has been built wrong side up, it may now be turned over, using care, as before remarked, and set up on blocks or horses about two feet from the floor so that the little work remaining to do underneath may be done easily. The framing of the sides can now be set up. This is of 2″ x 4″ joists; the uprights, 22 in number, should be cut 4′ 9″ long, with a jog 2″ x 4″ to go over the side timber at the bottom. They are put alongside of the bottom timbers, and nailed to them and to the side timber. As will be seen in Figs. 3 and 4 there are four shorter timbers near the corners, which can be put in later. The precaution must also be taken here to have the surfaces of the side timbers all even so that the plank will lie smoothly. The 2″ x 4″ timber, which is shown near the tops of the side timbers in Figs. 3 and 5, should now be worked in place four inches down from the tops, with the planed side up, remembering that it runs the full length of the hull and is nailed in place. This supports the deck beams and keeps the side timbers in place. If the side timbers are not all even, the uneven places should be planed off until all are in line.

The end timbers, of which there are nine on each end, are cut to the proper bevel of the ends, as already obtained, and long enough to reach to the top of the side timbers. The outer ones bed on the bottom side timbers, and at the top are fastened to the fore and aft timber under the deck. The other end timbers bed on the flat joists. Three timbers on each end are made, as in Fig. 6, with a brace extending out to the first cross timber and notched over it, the corner piece "e" being cut from the rough 2″ plank with the grain the long way. The others are brought down without any brace, and all are nailed to the end cross timbers. A board may be nailed across the ends of the timbers to keep them in place temporarily.

A piece of plank 4″ wide is now taken and spiked on to the side of each corner post, letting it lap over two inches to cover the planking on the

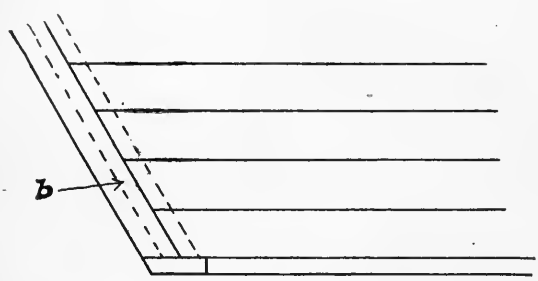


Figure 8.

end, and beveling the lower end against the bottom planking already in place, and with which the surface should be just flush. This serves to butt the side planking against and makes a finish, as shown at "b," Fig. 8. The four extra timbers near the corners, already mentioned, should now be put in place.

The planking of the sides and ends had best be begun at the bottom, the lower strake being fastened to the lower side timber, and also a row of nails being driven into the lower plank through the outer bottom plank. The same precautions about butts should be taken as before; the appearance of the end of the side planking is shown in Fig. 8. Above the waterline, if not all over, holes should be bored for the heads of the nails, and the holes afterwards filled with "knugs," as they are termed: plugs of wood, made for this purpose, cut across the grain, which may be driven into the hole and then planed off, making a perfectly smooth surface. They should be dipped into thick lead paint before driving. In driving the nails it will be found necessary to hold a weight, like a sledge-hammer, behind the timber, to take the weight of the blow, and prevent the timber from recoiling. The top strake of the end plank should be beveled off level to take the floor boards.

The next step is the addition of the deck beams. These are also 2″ x 4″ and are spaced the same as the bottom timbers, and directly over them. They should be cut long enough to just fit inside the

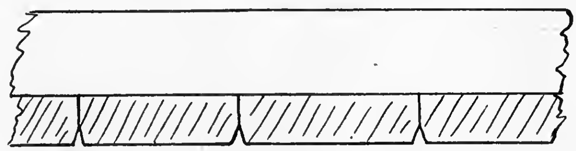


Figure 9.

planking, and should be laid, planed side up, on the fore and aft joist, against the uprights, and on the same side as the bottom cross timbers. This will bring them directly over the cross timbers. They should be nailed to the upright, and diagonally nailed to the joist underneath. This should bring their upper edges flush with the ends of the uprights and side plank. Under each beam there should be two upright braces, about equally spaced, to support the deck. These can be made of any spare lumber, and are diagonally nailed to beam and cross timber, Fig. 3.

There should now be cut some pieces from the 10″ plank, like "c," Fig. 3, 15″ on the lower side. These are laid on the bottom cross timber and alongside of the side uprights, and nailed to both. Also some spare pieces of 2″ x 4″ should be cut, like "d," Fig. 3, and nailed underneath the deck-beams and alongside the uprights. All these will greatly stiffen the hull and make it more rigid.

A piece of 2″ x 4″ should be fastened, as in Fig. 3, about a foot down from the deck, on each side, to serve as fenders. The fastenings should be set well down below the surface, and should go into the side uprights. The ends should be tapered off before being placed.

The laying of the deck is the next thing. Although not absolutely necessary, the deck will be better if laid double; the lower layer of rough stock, as it only forms a bed for the upper layer. Along the sides a rather wide board should be used, as thick as both layers together; this board being fastened to the beams and also to the top strake of plank. The top layer may now be laid. In laying the deck it is well to consider the hatches leading below. These should be about two feet square, and can be placed wherever most convenient, care being taken that they come between beams. There should be one in the living room, one in the kitchen, and one in the passage. By deciding upon these in advance some labor can be saved, as boards can be selected which will extend about to the hatch, and the next board can be laid leaving the opening.

When the hull is completed it must be calked, planed, and painted. In calking, a thread of oakum or cotton is driven into the seams with a calking iron, which is a sort of chisel-shaped iron with a long, flat edge. These may be bought, or made by a blacksmith. If the seam is large, oakum should be used, while cotton is used for small seams. For ordinary use a strand of fibers about the size of a lead pencil is twisted and laid along the seam and driven into place by pounding on the iron with a mallet, lightly at first, and then harder, until it comes to a bearing, and enough should be put in to fill the seam to within about one-half inch from the surface. Care must be used not to force the calking too hard and start the fastenings of the plank. The seam should be well coated with lead paint before calking, using a fine brush. After the calking is completed the surface should be gone over with a smoothing plane, and any roughness or bur removed. If the stock used is not well dried, it may be desirable to delay calking until nearly the last, when the wood will have shrunk all that it will be likely to do. It will probably be advisable to complete the hull before beginning the other work.

All the seams and nail holes should be filled with putty or elastic cement, except above the waterline, where putty must be used, as cement discolors light paint. A coat of linseed oil has a beneficial effect in preserving the wood and preventing shrinking and checking.

The hull should have a priming coat of paint as soon as possible, and in a few days a second coat, leaving the last to be put on just before launching.

The hull is now ready for the deck house, the construction of which will be described in the next issue.

HANDY RECEIPTS.

Furniture Enameling.

Old furniture may be made to present a most attractive appearance by enameling it. The way many do it, by applying one thick coat of enamel paint, is not the proper way, or the way to secure a good effect. The first thing is to thoroughly sand-paper the surface and putty up all holes and deep scratches, so as to get as smooth a surface as possible. Then apply a coat of "flat white," as it is termed. This is simply white lead, ground in oil to remove all lumps, and thinned with turpentine. When dry, the surface should again be sand-papered with fine sand-paper. A second coat may be necessary to secure a very smooth surface, which should also be sand-papered. A coat of enamel paint should now be applied, about the same quantity being taken up on the brush each time and worked in the same direction to avoid brush marks. This will dry smooth and hard, and wear well.

Cleaning Furniture.

Furniture which has become soiled by long use may be cleaned and the appearance greatly improved by the method here described. If a varnished or shellacked surface of natural wood like an office desk or chairs, first clean with the following solution;

Borax	2 ounces
Water	1 quart

The water should be lukewarm when mixing. Apply with a sponge, and clean off with warm water, also applied with a sponge. Then shellac with a thin coat of shellac cut with alcohol. Then go over with polish made as follows:

Acetic acid	1 gill
Alcohol	2 gills

Water to make total of 1 quart.

This should be applied with a sponge, and will give a smooth, handsome surface resembling hand-rubbed polish. When a polished surface is so badly worn that the wood is exposed and dark with dirt, it should first be cleaned with a saturated solution of oxalic acid, which will restore the natural wood color. Follow this with the cleaning solution first given, and then polish as directed.

CORRESPONDENCE.

Our readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of Amateur Work, 85 Water Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if an answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

(No. 3.) Brookline, Mass., Jan. 8, 1902.

To the Editor: Our residence is equipped with electric gas-lighting burners. These do not work well. Will you please advise me what I can do to get better service, and greatly oblige. Yours truly, J. P. H.

In this letter, as with many others we receive, there is an absence of particulars, making it difficult to give a satisfactory answer. Correspondents should send sufficient details, so that a proper answer can be given.

If the trouble with the burners is local, that is, some work and others do not, the sparking terminals may have become bent with use and simply need to be adjusted, so as to give a better spark, or a spark that will pass through the gas when turned on. If no spark can be obtained at a particular burner, the wiring is probably broken at some point along or near the fixture. If all the burners are faulty, and a feeble spark or no spark follows when turning on the gas, the battery probably needs renewing, or repairs of some kind. If a Lalcanche cell is used, examine the zincs. If much eaten away, replace with new ones. Also pour out the liquid, and fill each jar three-quarters full with water in which has been dissolved about a quarter pound of sal-ammoniac. If dry batteries are used, replace with new ones.

(No. 4.) Boston, Jan. 5, 1902.

What do astronomers think of Mr. Battell's discovery of the cause of the motions of the planets, published in the papers yesterday? Ignoramus.

Ignoramus: — They do not think about it at all. The "discovery" is one of a very common class of announcements made by persons who, in making them, simply "give themselves away."

"Those things in it which are true are not new, and those that are new are not true."

Such statements are not entertained at all by astronomers.

The accepted explanation of the planetary motions accounts for all the observed facts, and enables these motions to be predicted with very great accuracy. No theory that does not fill these two requirements stands any chance of consideration, especially when, as in the present instance, it is not only unconfirmed by a single observed fact, but in its logical consequences is flatly contradicted by the evidence we have. Vega.

(No. 5.) Waltham, Jan. 9, 1902.

I notice in the paper on drawing instruments, in your first issue, the statement that the hairspring attachment to the large dividers is not popular among professional draftsmen. Will the writer please explain? Among all those I have met, it has been thought a very desirable feature, and its use only prevented by the additional cost, which, at the rates now paid to draftsmen, is practically prohibitive.

If I might make a suggestion as to another matter touched in the same paper, that of pencils, the best I have been able to find are Hardtmuth's "Koh-i-noor." These cost a little more than Faber's, but the difference is not worth consideration, in view of the excellence of the pencils. Draftsman.

Why the hairspring attachment is not more generally used on large dividers I do not know. The reason cited by the correspondent may be the correct one. I find it of great value in my own work, and think draftsmen, generally, would not be without it after once giving it a good trial. Earnest T. Childs.

PROGRESS IN PHOTOGRAPHY.

Frederick A. Draper.

Photography is too often but a passing fad with many who first embrace it with enthusiasm. Various reasons are advanced to account for the diminishing interest that overtakes so many who start with the brightest of prospects. That it is "expensive" is admitted, where any and all kinds of views are taken, often only to gratify a momentary whim. That it can be made a pleasing and permanent recreation with incidental profit is also a fact, though this may not be generally known by those who have failed. If one will only consider the causes which have contributed to both success and failure and utilize this information, many mistakes will be avoided, and success be more easily achieved. Those who contemplate riding this fascinating hobby will likewise benefit if they but follow the injunction to "look before you leap."

The failure to do good work is the rock that wrecks many an enthusiastic beginner. The finished print is the objective end in photographic work. All the work of focusing, exposing, developing, and printing is here finally shown. This requires that each stage should receive due care. Carelessness or error in one part will surely mar the final result. Satisfactory work can only follow close attention to all details, until experience has shown which is the correct process. This means study and application, especially during the early attempts, and care always. This method of work, however, soon proves its value in the better and more valuable results achieved. When high-grade work becomes the rule and not an accident, then the item of "expense" no longer prevents the enjoyment of photography.

This period of apprenticeship and of study necessary to becoming an artist should be worked out with good and suitable tools. Beginning with the plates, and omitting all question of the brand, the matter of speed is one that receives, from the beginner at least, very little thought. "Instantaneous" is the one kind used, whether suitable or not and "orthochromatic" plates are almost an unknown quantity. The result cannot be satisfactory.

The day, the view, the exposure, the kind of print, all influence the problem of selecting the plate, and the one chosen should be that most likely to produce the desired result. The testing of new kinds should progress slowly, however, and, preferably, those from the same maker should be used until their action is well understood. An instructive experiment is that of taking the same view with time, instantaneous, orthochromatic, and backed plates, and then, with these negatives, printing on various kinds of paper.

The differences in the intensity of light requires study, especially when indoor work is attempted. A familiarity with this important matter will materially lessen the number of failures. The use of an actinometer should be learned, and it should be utilized for about all indoor work. One that will answer for most purposes can easily be made. How to make and use one will be the subject of another paper soon to be presented in these columns.

The variations in the developer should be limited to the least number that will properly provide for the range of work being done. One which is of medium speed and easily controlled is most suitable for the beginner. One-solution developers are largely advertised and possess some good points, but for a wide range of work two-solution developers will be more satisfactory. The particular kind of work in hand and the kind of print to be made regulate the make-up of the developer. For storing the various solutions, choose a bottle of a size that will just contain the quantity on hand, so no air space will be left in the top. Use rubber stoppers. The air in a half-empty bottle will so affect some solutions as to make them useless.

Printing papers are now so numerous and in such variety as to afford ample opportunity for developing the artistic possibilities of a negative to the utmost. The gas-light papers make evening work a delight and enable the daytime leisure to be used in view taking.

Enlargements are a feature that the novice generally is anxious to attempt. Here again the question of light must be carefully studied, not only as applied to the whole plate, but also to different parts of the same plate. "The intensity of the illumination varies inversely as the square of the distance from the source of light." That is, if a certain negative one foot from the light requires five seconds' exposure, at two feet it would require twenty seconds. Correct focusing is also important. The light should be of large area with a large reflector, and negative and paper should be perpendicular and accurately placed to secure even definition. The distance between light and negative varies to suit the necessities of the negative.

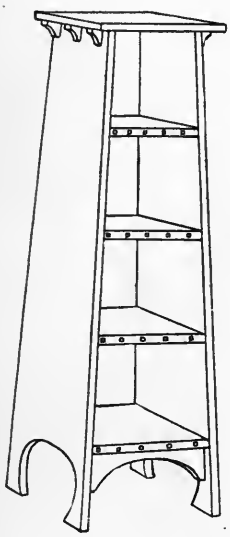
Enlarged negatives are now receiving much attention by progressive amateurs, the claim being that the contact prints secured from such negatives are much more satisfactory than paper enlargements. A paper plate recently placed on the market would seem to be particularly adapted to this work, the cost being much less than for glass plates.

As an example of how some income may be secured from photographic work, the experience of an acquaintance of the writer is here given. He started with the usual 4 x 5 camera, acquired some experience, but soon found that the small pictures were in but little demand. A $6\frac{1}{2}$ x $8\frac{1}{2}$ was the next acquisition. He soon had a small collection of negatives of some fine bits of scenery in his neighborhood, also a few of the public buildings, etc. Prints were made in a variety of tones, mounted on mats of suitable shades, on which calendar pads were fastened. With the assistance of a friend, whose store was well located, he secured a large sale. One manufacturing company took several hundred and had a neat card printed in one corner, the size of the calendar being reduced to allow it. He is now preparing to do a good business with summer tourists, a sample frame with business card being hung in several of the hotels to attract attention. What he has done can be duplicated in hundreds of places throughout the country. The professional photographer in the smaller places very rarely develops local possibilities of this kind, or, if he attempts it, makes poor work of it, so does not require consideration in this field. Artistic views will always meet with a good sale, and our readers will secure satisfactory returns if they can do work good enough to secure the patronage of the public.

OLD DUTCH FURNITURE.

John F. Adams.

IV. Magazine Cabinet.



This very convenient piece of furniture is easily made. All the stock, except the top piece, is selected oak, ¾″ thick. The top piece may be of the same thickness, but will look better if 1″ thick. The two side pieces are 42½″ long, 9½″ wide at the top, and 14″ wide at the bottom. As pieces this width are not easily obtainable, it may be necessary to glue two pieces together. If the worker is not used to this kind of work, it had best be done at the mill, the charge for doing it not being very much. To get the taper at the top, a triangular piece is taken off of each side, which can also be done at the mill, as well as the sawing out of the circular recess in the bottom of each side, the two pieces that go under the lower shelf, and the brackets under the top. All edges should be planed smooth, as the cabinet is open on both front and back. The side pieces are 12¼″ apart at the bottom and 7¾″ at the top, inside measurements. The under side of the lower shelf is 6″ from the floor. This shelf is 12¼″ long and 12″ wide, allowing ¼″ on each end for mortise. On account of the inward slope of the sides, the mortises for all the shelves must be cut at a slight angle. These mortises should be carefully cut to the exact width of the shelves to give a tight fit, so that the cabinet may stand firm when finished. The ends of the shelves must be cut to the same angle as the slope of the sides. To avoid errors, a rough plan may be drawn on the scale of ¼″ equals 1″. The shelves are 8″ apart in the clear, the top shelf being about 9″ from the top piece.

The top piece is 14″ square and 1″ thick, and is fastened to the side pieces by screws, three for each side. It will probably simplify the work if the top and lower shelf are fastened to the sides before sawing out the other shelves, all the mortises having previously been made. The second shelf is 11½″ long and 11″ wide. The third shelf is 10½″ long and 10″ wide. The top shelf is 9½″ long and 9″ wide. The shelves are fastened to the sides by screws from the outside, the heads being countersunk into the wood and covered with putty. Screws of small diameter should be used, so that the holes for them will be as small as possible.

The shelves not being so wide as the side pieces will not quite cover the mortises. The little spaces left outside the shelves should be filled with small pieces of oak glued in. If each piece is clamped when put in, the glue will hold better and cracks will be less conspicuous. Fill all cracks with putty.

The two pieces under the lower shelf are 12″ long and 3″ wide. The arches are 2″ deep, making the pieces 1″ wide at the center. These are fastened by screws, using care not to split the pieces when putting them in. They are set 1″ inside the edge of the shelf, the outside ends being cut to the angle of the sides. The three brackets on each side of the top are cut from pieces 2½″ square and ¾″ thick. Make a paper pattern and have them sawed out at the mill. These are fastened by one screw in each, in addition to being glued. The inside edge must also be cut at the same angle as the side pieces.

When done, sandpaper smooth and stain a very dark brown or green. The edges of the shelves may be covered with a leather border nailed on with square head upholstering nails.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. I. No. 5. BOSTON, MARCH, 1902. Ten Cents a Copy

STUDIES IN ELECTRICITY.

Donald M. Bliss.

V. Electro-Magnetism and Induction.

If the electro-magnet used in the last experiment be removed, and one of the battery wires held an inch or so above a compass needle, or the floating magnetized needle referred to in the last chapter, the wire is in such a position that it is parallel to or runs north and south with the needle, as shown in Fig. 15; as soon as the circuit is closed and a current flows through the wire, the needle will be instantly deflected to the east or west, according to the direction of current in the wire. This simple experiment, first tried in 1820 by Oestred, forms the starting-point of the electro-magnet. Farraday found that this experiment

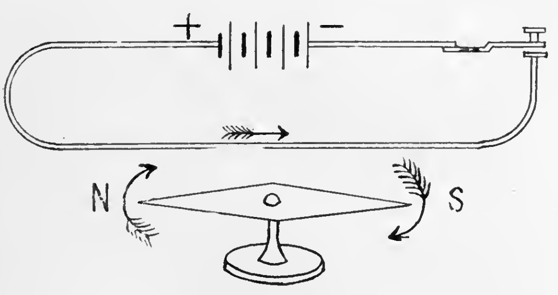


Figure 15.

was reversible; i.e., if the needle be kept from moving and a closed loop or circuit of wire moved across or towards the magnet, a current would be generated in the wire by this movement, and would last so long as the motion continued. These two great discoveries, electro-magnetism and the induced current, have done more to benefit and advance the human race than any other investigations in natural science. Without the electro-magnet and the discovery of induction, neither the telephone, telegraph, electric light or power systems, and a thousand and one practical applications of electrical science, would be known at the present time.

The student should by all means repeat this classical experiment in various ways until he has a clear understanding of the principles involved, and as the little apparatus required may easily be constructed by the amateur worker, there should be no excuse for neglecting this important branch of electrical study.

The most important piece of apparatus required is a simple galvanometer or current detector. This is shown in Fig. 16, and consists practically of a spool of insulated wire in a certain relation with the compass. The spool consists of a block of wood in the shape of a flattened spool with the dimensions as shown. The space between the heads is wound with about three ounces No. 28 cotton-covered magnet wire, the ends of the winding being connected to binding screws on each end of the spool, as shown. A cheap pocket compass is mounted on one side of the spool just over the coil. This may be held in position by screws or pins, which should be of brass, which is non-magnetic, and should be adjusted so that the compass may be turned at any angle desired. When in use, the block should be placed so that the wire or coil is in the same direction or parallel with the needle when at rest, i.e., north and south.

In selecting a compass, see that the needle moves freely in every direction. If the compass is held level and slowly rotated, the needle should show no tendency to follow the movement, but remain pointing north and south. In addition to the galvanometer a small quantity of small iron filings and some pieces of cardboard and stiff paper should be provided; also a small horseshoe and a straight permanent magnet, made as described in previous articles.

Referring to the experiment shown in Fig. 15, it is evident that as the magnetic needle can only be deflected by the presence near it of a magnetic

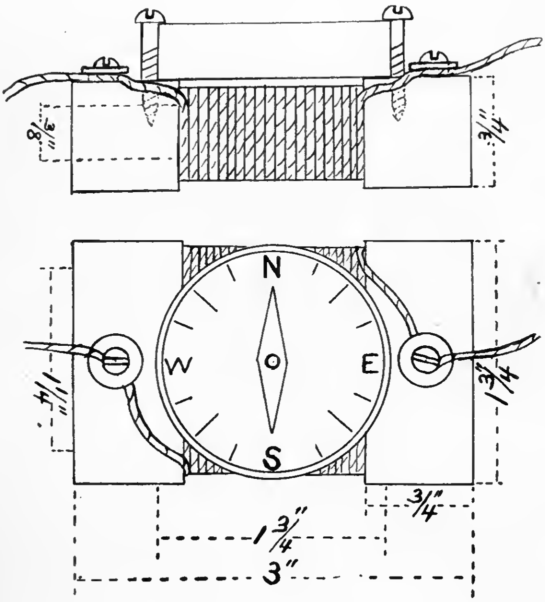


Figure 16.

field or influence, and as there is no iron or other magnetic substance near the needle to cause such a movement, the presence of an electric current in the wire must create a magnetic field outside the wire in such a manner as to tend to force the needle at right angles to the flow of the current. Hence the important rule that a current of electricity, whatever its source, always produces a magnetic field at right angles to its flow.

This fact may always be shown very nicely by sending a current through a wire which has been passed through a piece of cardboard, as shown in Fig. 17, and sprinkling some fine iron filings around the wire. As soon as the circuit is closed and the card tapped gently, the filings will arrange themselves in circles around the wire, and of course at right angles to the current. The magnetic field produced by the current may therefore be conceived as forming spirals or whorls of magnetism, which are generated at the surface of the wire and extend outward in every direction,— something after the idea shown in Fig. 18, but to a much greater distance.

As the magnetized compass needle (Fig. 15) is continually under the influence of the earth's field or polarity, it will not place itself exactly at right angles to the current flowing from it, but will take up a position depending on the relative strength of the two forces, the earth's magnetism and the current; the former tending to keep it

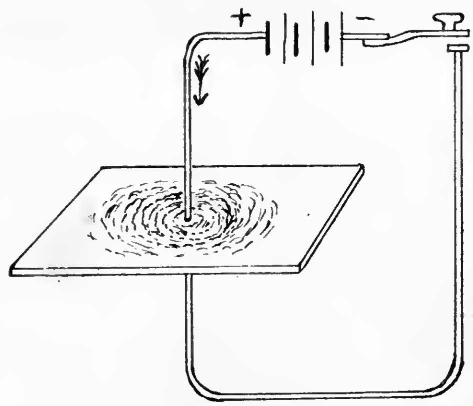


Figure 17.

north and south, and the other at right angles to the current, or parallel to the magnetic lines of force around the wire.

If, instead of surrounding the wire with iron filings as shown in Fig. 17, we reverse the experiment and surround a short rod of iron with insulating wire by winding it as shown in Fig. 19, we have an elementary form of the electro-magnet. And here a convenient way of determining the polarity of a magnet in any given case may be noted. If the wire is wound on in a right-handed spiral, and the positive ends of the battery are connected as shown, or so as to flow in a right-handed direction, the end of the magnet you are looking at will be a south pole. Briefly, as S follows R in the alphabet, so polarity follows right-hand rotation of current.

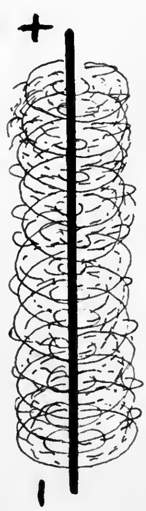


Figure 18.

A practical electro-magnet, of course, has many turns of wire upon it, but so long as the direction of winding is not reversed, it makes but little difference whether the wire be wound uniformly from end to end of the iron core, or whether it is tapered towards the ends, or *vice versa*, the result and strength of the magnet is practically the same.

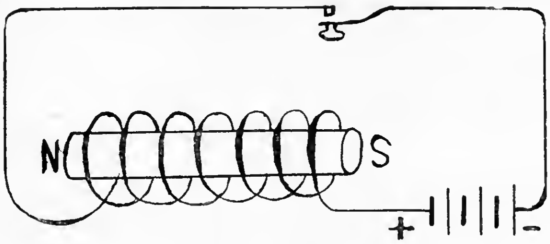


FIGURE 19.

We can now proceed with some interesting and easily performed experiments illustrating the production of induced currents.

Experiment 1. Take a wooden spool having a $\frac{1}{4}''$ or $\frac{3}{8}''$ hole through it (a thread spool will do) and wind it full with No. 28 or No. 30 single cotton-covered magnet wire, leaving the ends of the wire a foot or so long. Connect these ends to the terminals of the compass galvanometer. Then close the circuit through your large electro-magnet and battery described in the January number of AMATEUR WORK. Now move the spool to and from one of the poles of the electro-magnet, or pass it across the ends of it, and you will note that whenever the coil moves towards the magnet the compass needle will swing in one direction, and when the coil is pulled away the needle will swing in the opposite direction ; and so long as the coil is kept in motion near the poles of the electro-magnet, a current will be generated in the little coil and affect the needle, though the coil itself has no visible connection with the battery. This experiment may also be repeated with the permanent magnet, and the same results will be noted, though in a less degree, owing to the comparatively weak magnetic field of the permanent magnet.

These effects show that magnetism, however produced, has the property of generating a current under certain conditions, as well as attracting iron or other magnetic metals. These conditions are present whenever a metal or other conductor of electricity is kept in motion within the influence of a magnetic field, and the more nearly the motion of the conduction is at right angles to this field, or lines of force, as they are now called, the greater the induced current, other conditions being equal.

If, instead of moving the coil across the poles of the magnet, it is held near one of them and the battery current through the magnet be made and broken, it will be seen that when the circuit is closed the needle will be violently deflected one way and then come to rest, and when the battery current is broken it will swing even more strongly in the opposite direction. In this case we have simply reversed the conditions by keeping the coil still and quickly sending the lines of force through the coil on closing the circuit, and as quickly withdrawing them by breaking the current producing the magnetic field.

The current generated in the little coil is called the induced or secondary current, and this is the source of power developed by the dynamo in electric light and power service. These machines are so designed that the coils of wire on the revolving part, called the armature, are rotated within a powerful magnetic field, and the currents so generated led therefrom to the lamps, motors or other devices.

The induction coil and transformer operate under the same conditions as the stationary coil and interrupted current. Here no mechanical movement of the coil takes place, but the magnetic field produced by one winding, called the primary coil, is rapidly interrupted or reversed, and a secondary or induced current is generated in the other coil, or secondary winding, with each change in the magnetic field.

THE officials of the Canadian Pacific Railway have at present under consideration an immense scheme for the irrigation of the northwest of Canada, by which it is proposed to make good farming and grazing country out of the millions of acres which are dry and arid between Calgary and Medicine Hat, on the North Railway line. James Anderson, one of the leading irrigation engineers of the world, has recently traversed this area, and reports that there is nothing to prevent this work being successfully carried out. His report is being considered by the Canadian Pacific authorities, and it is understood that, as an experiment, 300,000 of the 3,000,000 barren acres will be put under irrigation.

A SMALL ELECTRIC MOTOR.

Donald M. Bliss.

The small electric motor illustrated herewith is well adapted for operating model electric cars and light machinery. It will not develop more than $\frac{1}{20}$ horse-power. It can be driven to the best advantage by five or six cells of bichromate battery or ten to twelve cells of gravity battery. It will also operate satisfactorily for short intervals on eight

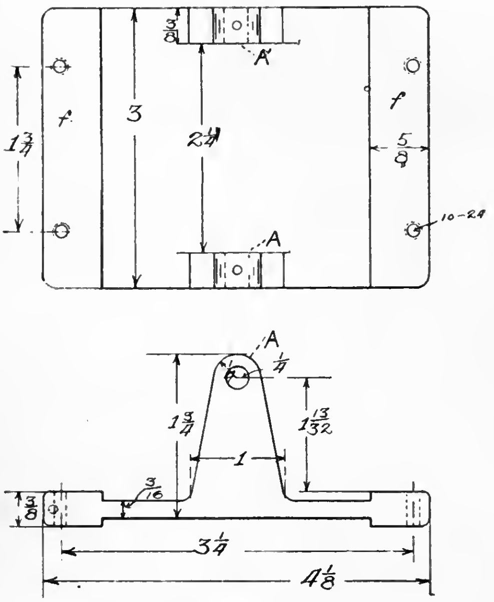


Figure 1.

and ten cells of the Leclanché or a similar type of battery. Of course in the latter case it must be remembered that such a battery is only suitable for intermittent work, and cannot be relied upon to run the motor for more than a few moments at a time. It is exceedingly simple in construction and consists practically of only three parts: the base, magnet frame and armature. The base and magnet frame (see Fig. 1) should be made of soft cast iron. The frame should be secured to the base by four screws, as shown. The holes for these screws in the frame should be about $\frac{1}{16}''$ larger than the screws, to allow for a slight adjustment in any direction. The corresponding holes in the base should be drilled and tapped for a 10-24 round-head machine screw.

The surfaces of the base and corresponding part of the frame may be ground, filed or planed so that when the parts are assembled the holes in the bearing standard A,A′ should be exactly in the center line of the field bore B. If clean, sharp castings can be secured, it will not be necessary to bore out the field frame B. If it is impossible to secure good castings, this base should be bored out, as shown, to the diameter of $1\frac{13}{16}''$. The armature shaft D is simply a straight piece of quarter-inch soft steel rod, which should be filed and polished until it fits easily and freely the bearings A,A′. These bearings should be drilled, using care to see that they are lined squarely across the base. An oil hole in each standard should be drilled at the same time.

The armature E should also be a soft iron casting, and is provided with three poles and coils, as shown. The head of the armature is extended sufficiently on one end to carry a three-part commutator, F, while the other end is prolonged so as to form a bearing shoulder when the armature is placed on its shaft. It may be found necessary to turn the armature, if the casing is not true, to a diameter of $1\frac{3}{4}''$. After the hole in the center of the armature for receiving the shaft has been drilled, it should be mounted on an arbor and accurately turned in a lathe to the required

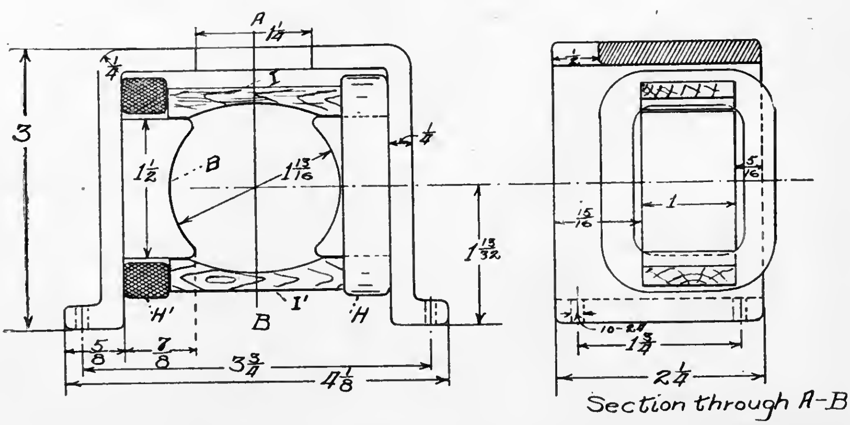


Figure 2.

size. When this is done, go over the castings carefully, file away all sharp points and corners, so that when the wire is wound on there will be no danger of injuring the insulation.

Then cover the three arms of the armature carefully with two layers of thin cotton cloth. This allow for correct adjustment. The commutator itself may be made of a short piece of $\frac{3}{4}''$ brass or copper tubing, sawed apart so as to form the three segments as shown. These segments are mounted on the hard rubber or fiber sleeve, G. In this sleeve is bored a $\frac{3}{8}''$ hole, so that it may

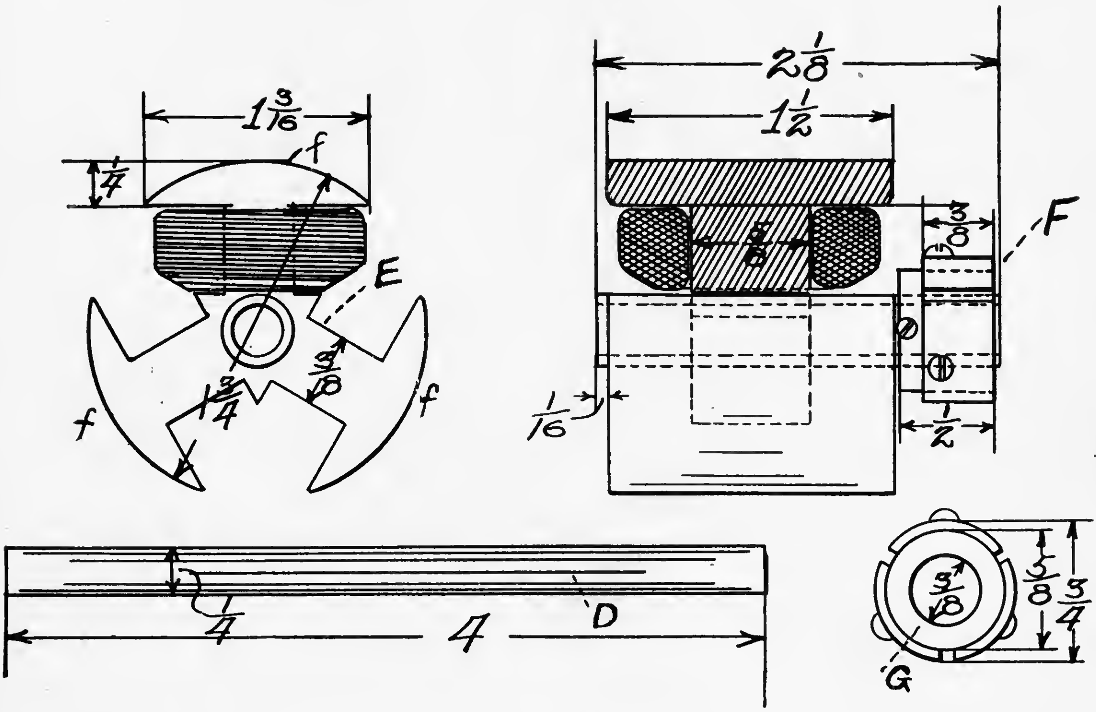


FIGURE 3.

can be held in place by winding a few turns of thread around the various parts and painting them well with shellac varnish. When thoroughly dried, each limb of the armature should be wound with from forty to fifty turns of No. 20 single cotton-covered magnet wire, leaving several inches of wire at each end for connections. The inside ends of the coils thus formed should be twisted together and soldered, while each of the outside ends should be connected to one of the three segments on the commutator. These connecting ends should not run down straight to the commutator, but should be left long enough so as to admit of turning the commutator on its bearing in either direction, to

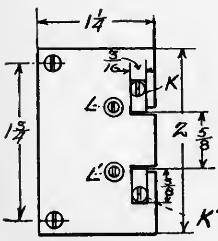


FIGURE 4.

be mounted on the extended hub of the armature, as shown. If fitted tightly on the shaft, it will not be necessary to use set screws to hold the sleeve in place. If necessary to use a set screw, it should be drilled and tapped into the fiber, and not touch one of the segments of the commutator, as this would injure the winding of the armature, and possibly lead to a short circuit or ground.

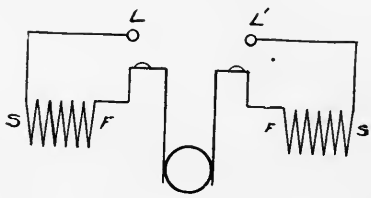


FIGURE 5.

Referring again to the field frame (Fig. 2), the two field coils, H and H′, may be made. Each coil consists of about four ounces of No. 18 single cotton-covered magnet wire. This may be wound upon a wooden arbor about ⅛″ longer and wider than the field coils, which, it will be noted, are 1½″ x 1″ in section. This winding arbor should have two heads turned and screwed thereon, so as to leave a winding space of the same size and section as the coil. A space ½″ wide x ½″ deep will be found sufficient for this. Before starting the winding of these coils, lay three or four strips of thin tape 6″ long across the winding space on the arbor, and wind the wire carefully in even layers

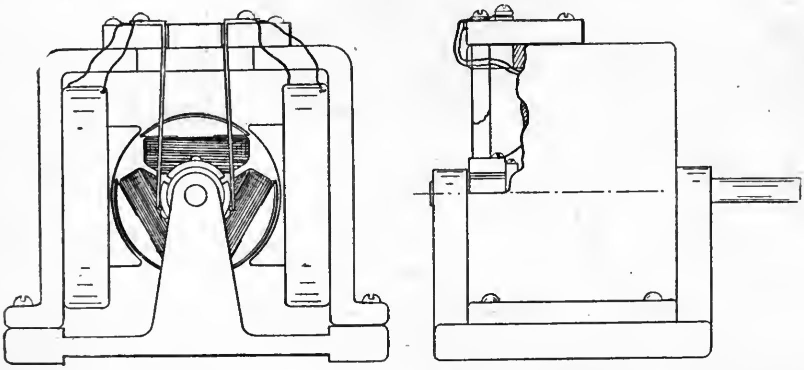


FIGURE 6.

in this space. After the required amount has been wound on, the tape may be tied together tightly, one of the heads taken off, and the coil removed from the arbor. Before fitting the coil on the pole-piece, it should be wrapped all over with two layers of thin cotton tape, so that the wire will not be exposed at any point. The coils should then be well painted with shellac varnish, and allowed to dry before being placed on the frame. The two coils are held in place, when mounted on the pole-pieces, by wooden cleats forced in between them, as shown at I′.

The terminal board and brush-holding device is shown by Fig. 4, and is made of a block of fiber or hard wood, of the dimensions shown. The brushes K,K′ are simply two strips of hard-rolled copper about ¼″ wide and $\frac{1}{32}$″ thick, bent at right angles, and mounted in such a position that when the terminal block is fastened to the top of the frame, as shown in Fig. 6, they will touch on the opposite sides of the commutator in a vertical position. The connecting terminals of the motor L-L′ are simply two short machine screws provided with copper washers. These screws are drilled and tapped into the fiber head, but should be placed so as not to bear on the iron frame, otherwise a short circuit will result.

See that the armature is centered in the frame, so that it will revolve freely with an equal clearance from the pole-pieces at all parts of its diameter. This clearance will not be less than $\frac{1}{32}$″. Adjust the armature on the shaft so that it turns freely and is central with the poles. The armature may be held in position on the shaft by a set screw or by making a snug driving fit.

If the foregoing directions have been properly followed, the motor may be now connected up, as shown in Fig. 5.

The wire is run from the binding-post L, and connected to the inside end of one of the field coils. The outside end of the same coil is carried up and connected to one of the brush-holding screws. Another wire is run from the remaining binding-post to the inside end of the other field coil, and the outside end of the same coil is connected to the remaining brush-holding screw. This connection is clearly shown in Fig. 5, and when so arranged is termed "series" winding. This is the most suitable connection for a motor of this type and size. Any desired form of pulley, or a small gear, may be fitted to the outside end of the armature shaft, and the motor is ready to run.

If it does not start promptly at first, the commutator may be turned slightly on the shaft in one direction or the other until the best position is found which will give the greatest turning power with the least amount of sparking. Being a series-wound machine, the speed will be constant only under a steady load. Great care should be taken to see that all the windings are thoroughly insulated from the frame or other metal parts, and when the machine is completed it should be given a coat of light enamel paint, which will improve its appearance and prevent rust. The commutator and brushes should be kept clean and free from oil.

Do not attempt to run this motor directly from an electric-light circuit. If it is desired to produce such a current, it should be as connected in the series, with a sufficient amount of resistance to cut the current down to an amount equal to that derived from the battery. It is necessary, both for ease of construction and to secure efficiency, that the castings composing the frame and base be of soft iron. If this point is not attended to, you will probably get iron castings so hard that it will be almost impossible to work them, while the operation of the motor will be unsatisfactory. Unless you are familiar with metal working in the lathe, it will be advisable to have the fitting and centering of the parts done by a machinist. The expense for this will not be large and should not deter one from building the motor. If you are the fortunate possessor of a small engine lathe, you can easily do all the work yourself.

The construction and operation of this little motor will give you a good insight into the operation and principles involved in motor construction, and it will be found very convenient in driving model machinery. The battery described in the December number of AMATEUR WORK, with the cells in series grouping, is well adapted for operating this motor at its full output. If gravity battery only is available, it is advisable to wind the armature and field coils with fine wire, No. 24 B & S gauge for the armature and No. 20 for the fields. As the greatest output to be expected from twelve cells of gravity battery would be twelve volts, at less than one-half an ampere or something under six watts, it is evident that only a small amount of power can be derived from a battery of the gravity type. The ordinary open circuit or Leclanche battery with large zincs will deliver fully twice as much current, but, as stated above, only for momentary work, owing to the rapid polarization of this type of battery. The most satisfactory results can be obtained from the bichromate battery, which you can easily make yourself.

AN ELECTRIC QUESTIONER.

WILLIAM SLYKE.

I HAVE here attempted to describe an instrument or rather a scientific novelty, with which I believe many an evening can be passed pleasantly by the readers of AMATEUR WORK. It is certainly a simple instrument and costs less than a dollar to make. It is what might be called "An Electric Questioner." The first thing needed for such an instrument is a box about 15″ long, 6½″ wide and 3″ deep, the wood of which should not be more than ½″ thick. Draw a straight line across the

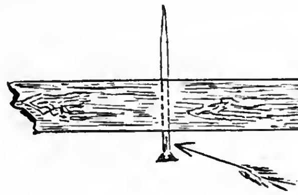


FIGURE 1.

center of the box. On one side of the line will be the questions, on the other the answers. Procure 36 ordinary wire shingle nails. Nail 18 of the nails on one side of the line and 18 on the other side, having the heads of the nails on the inside of the box, and the points sticking through the top of the box. Do not drive the heads of the nails tight against the top, but leave a small space

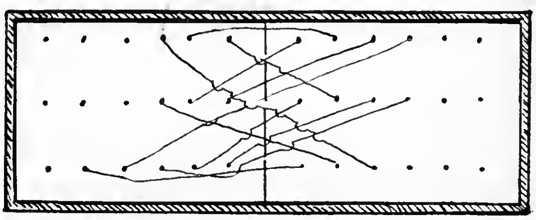


FIGURE 2.

between the top of the box and the head of the nail, as in Fig. 1. When all the nails have been put in, get about 20 feet of cotton-covered magnet wire about No. 20 gauge and cut it into lengths of about 14″. Remove the insulation for about

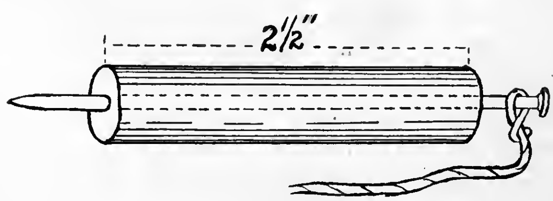


FIGURE 3.

1″ from each end. From the heads of each of the 18 nails on the question side wind the end of one of the lengths of wire and bring it to any one of the heads of the nails on the answer side of the box. Do the same with each nail, as shown in

Fig. 2. Only a few are shown in the illustration, to avoid confusion.

When all the wires are attached, the nails can be hammered all the way in. When completed, the inside of the box will be a network of wires. Now get an electric bell, or, better still, a buzzer, as a bell makes too much noise. Screw the buzzer to the edge of the box in the center, as shown at A, Fig. 4.

Two handles or electrotudes should then be made. These can be made by cutting a piece of wood round about 2½″ long and ½″ thick. Drive a long wire nail through the wood so as to protrude through the other end an inch, as shown in Fig. 3. The wooden handles used by provision dealers for bundles will serve nicely. Solder a piece of flexible insulated copper wire about 1′ long to the head of the nail A, Fig. 3. Do the same with the other handle, and connect the other ends of the wires as follows: Screw the end of the wire attached to one of the handles to the binding-post on the buzzer, screwing it on very tight. The other handle should be screwed to the binding-post of a "dry battery." From the other binding-post of the battery attach a piece of wire, and bring it to the remaining binding-post on the buzzer. (See Fig. 4.)

Now test the working of the instruments. Take one of the handles and hold the metal tip to any of the nails of the 18 on the question side. Take the other handle and tap each of the 18 on the answer side until the buzzer sounds. Do the same way with each of the nails. If your instruments work thus far, you are sure of success.

The next and last thing is to make the cards on which are the questions and answers. Get a sheet of white cardboard that is not too stiff, and cut it the size of the top of the box. The width is taken from the end of the box up to the buzzer, but not covering it. Put dots on the cardboard where each nail strikes, and punch holes where each dot is. Now push it over the nails until it reaches the top of the box. Print or write below one of the "question nails" a question, riddle or conundrum. Hold one of the handles to the nail which has the question; take the other handle and tap the answering nails until the buzzer sounds, then write the answer below that nail. Do the same with all the nails, until one side of the card is filled with questions and the other side with the answers. To work this instrument, you put a card over the nails, take a handle and hold it on the nail which has the question you want answered. Take the other handle and tap the answering nails until the buzzer sounds. You then read the answer to the question. If the instrument is made right, and the insulation of the wires in the box unbroken, you will always get the correct answer. Of course the instrument can be made larger or smaller to suit the taste of the maker. The battery may be put inside the box and a bottom nailed on to prevent it from falling out. This instrument will be found both practical and entertaining. Additional cards can be made with many instructive questions in United States history, geography, or with conundrums, etc. If the nails are all driven in straight, the cards can be put on or removed without difficulty.

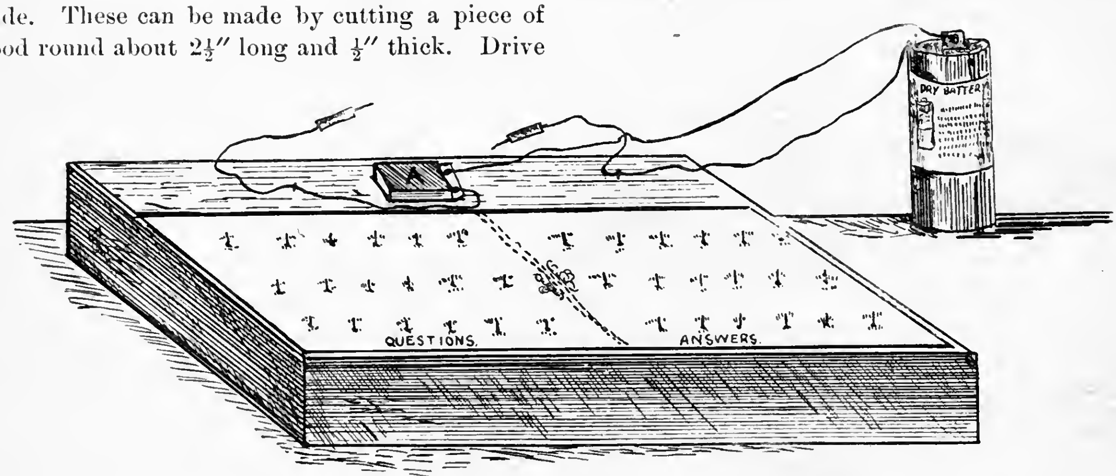


FIGURE 4.

OLD DUTCH FURNITURE.

John F. Adams.

V. Hall Settle.

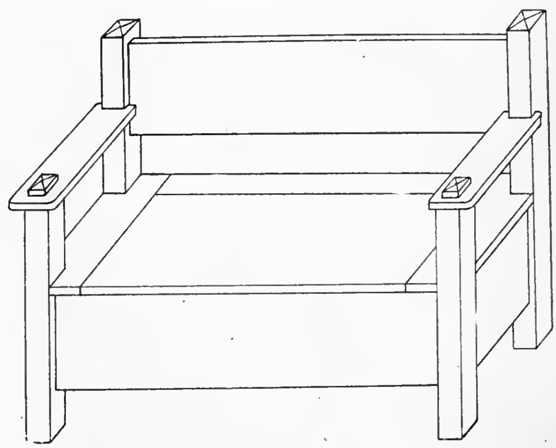
The hall settle here described is a very convenient piece of furniture. The box-seat forms a very handy receptable for rubbers, etc. Like the furniture previously presented, it should be made of oak. The corner posts are $2\frac{1}{2}''$ square, the front ones being 27″ long and the back ones $33\frac{1}{2}''$ long. The boards forming the sides of the seat are $\frac{3}{4}''$ thick and 9″ wide, planed on both sides. The pieces for the front and back are 44″ long and for the sides 12″ long. The lower edges of these pieces are 6″ from the floor.

Mortises $\frac{1}{2}''$ deep are made in the posts to receive these pieces. They should be the full size of the board, and centered in the posts, the lower ends of mortises being 6″ from the bottom ends of the posts. Mortises are also cut $\frac{1}{2}''$ deep for the board forming the back. This board is 44″ long, 10″ wide and $\frac{3}{4}''$ thick. The upper edge should be $1\frac{1}{2}''$ from the top of the posts, which are beveled to a point, as shown in the illustration. The bevels take $\frac{1}{2}''$ of the tops of all the posts. The tops of front posts after beveling are cut down $\frac{1}{4}''$ on each side for $1\frac{1}{2}''$, forming a shoulder, on which rests the front ends of the arms. This may be easily done with a backsaw, and then smoothed with sandpaper. This leaves the tops of these posts 2″ square.

When the work so far described is completed, the frame should be set up, the pieces being glued into the mortises and also fastened on the inside of the seat-box by screws, which run into the posts. The board for the back should be put in at this time. The end pieces for the seat are then fitted. They are 16″ long, 6″ wide and $\frac{3}{4}''$ thick. Pieces are cut out of the outside corners to allow room for the posts, the outside edges and ends being flush with the sides of the posts at front, sides and back. Care should be used in fitting these pieces to get good square fits. The rear inside ends should be halved on the underside, to receive the ends of the rear piece that runs lengthwise of the seat. If a piece 4″ long, 1″ wide and $\frac{3}{8}''$ thick is taken off, the joint will be strong enough.

The rear piece for the seat is 38″ long, 4″ wide and $\frac{3}{4}''$ thick, allowing 1″ on each end for halving to fit the end pieces. See that the inside edge is straight, as should also be the inside edge of the board forming the seat. The seat is 36″ long, 12″ wide and $\frac{3}{4}''$ thick, and should be a snug fit to the seat pieces, already described. If a good board of this width cannot be obtained, the rear piece may be made 6″ wide and the seat 10″ wide, but the dimensions previously given are the best.

The side and back pieces of the seat are attached to the frame by screws, countersunk and covered with putty. The putty should be colored with stain, so that, should it crack or become dented, it will not be conspicuous. The seat is attached to the rear piece by three brass hinges, which should show as little as possible. The arms are 16″ long, 5″ wide and $\frac{3}{4}''$ thick. The front



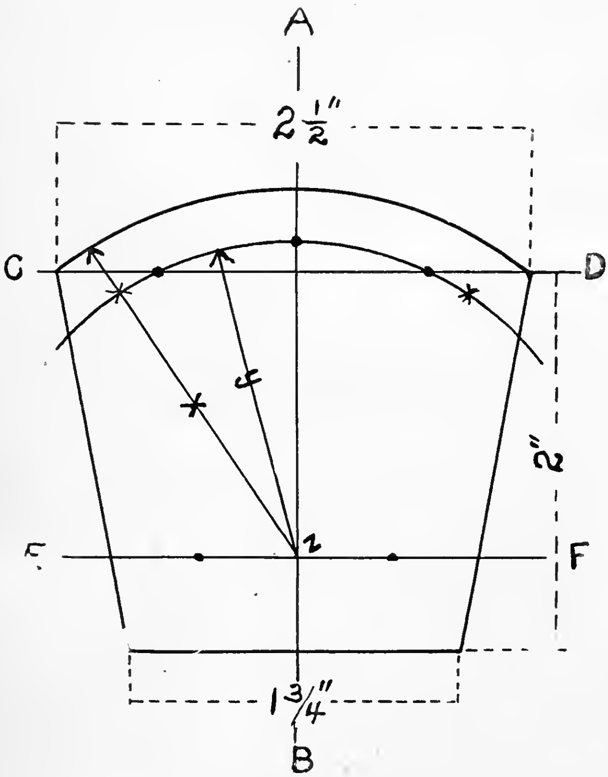
corners are slightly rounded. Holes are cut in the front ends to receive the tops of the front posts. These holes should be 2″ from the front end and 2″ square. The back ends are cut down 1″ to fit around the back posts, as shown in the illustration. The arms should be strongly attached to the posts with glue and screws, the heads being countersunk and covered with the stained putty.

The bottom of the seat-box is made of whitewood $\frac{7}{8}''$ thick. This will require a board $44\frac{5}{8}''$ long and $12\frac{5}{8}''$ wide. The corners will have to be cut out to fit around the posts. It should then be well nailed with wire nails, first drilling holes through the oak side pieces for the nails, to prevent splitting, and covering the holes with putty.

To prevent the seat from splitting, three strips 10″ long, $1\frac{1}{2}''$ wide and $\frac{1}{2}''$ thick may be secured on the underside, with four screws to each strip.

They should be zigzagged, with the heads countersunk.

When completed, go over the whole surface with fine sandpaper, then stain with a very dark stain. When the stain is dry, put on a coat of very thin shellac, and rub over with a coat of polish, applied with a soft cloth. A hair-stuffed velvet cushion of the same shade as the stain adds much to the appearance of the settle. A mirror with clothes-hooks, to hang over the settle, will be described in another article.

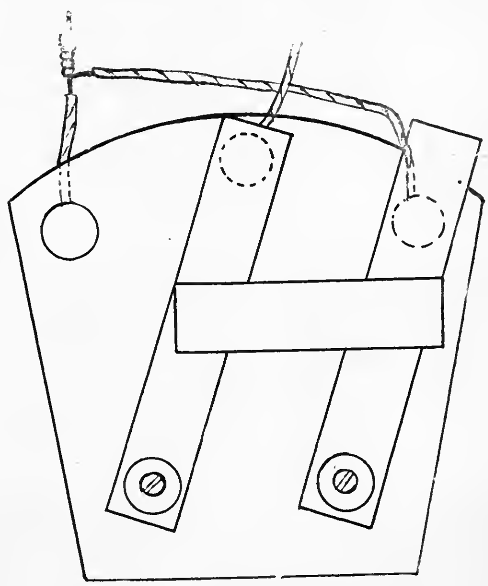


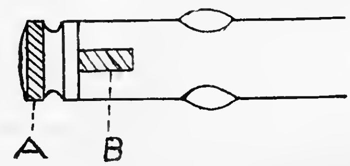
CURRENT SWITCHES.

E. F. Beck.

In experimenting with electricity, one often needs a switch connected in the circuit. It may be a one-point, two-point or a pole-changing switch that is desired. These may be made as follows:

First, get some tops of old battery zincs, A (Fig. 1), which may usually be had for the asking at any telephone central station. Second, a piece of pine wood about 3″ square and ½″ thick. Draw a keystone on it, using the dimensions given in Fig. 2. Place a dot ½″ up on the line AB at Z, and with that as a center, describe the two arcs with x and y as a radius, y being 1¾″. At the points where the arc, made by the radius y, intersects lines AB and CD, place a dot. The base can now be cut out with a jack-knife. At the three dots, drill holes a little smaller than the screw B (Fig. 1) so that they can be made firm. Take three of the zinc tops and screw them in securely. At the side of each, drill a hole large enough to admit a 16 or 18 gauge wire. Next obtain a piece of brass or other conductive substance about 2¾″ long and ½″





wide. About ¼″ from the one end drill a hole and bend, as shown in Fig. 3. Now bore a hole at Z a little smaller than the screw that is going to hold the brass strip in place. Put a screw through holes H and Z, but before screwing down, put the bare end of a copper wire under the brass strip. It might be well to put a washer on top and below the brass strip at H, thus preventing the screw loosening, and insuring a better connection. Then bring the wires up through the three holes and fasten around the grooves in the points. If desired, a hole can be drilled through the other end of the brass strip and a nob attached. Screw holes should be made in the base for the screws that hold it down.

A pole-changing switch will need two strips of brass, three points and a similar base, with few exceptions. The holes drilled on the line CD will be placed further back on the arc (Fig. 2), at the places marked with a cross. Draw a line EF through Z parallel with the back of the switch, and at a point ½″ each side of Z place a dot. Take the two strips of brass, drill a hole in each a short distance from the end, and bend as Fig. 3, and 1″ from the other end drill a small hole in each of the strips. A piece of wood 1½″ long and ½″ square will serve as a handle. Find the center and bore two small holes 1″ apart, and put two round-head brass screws up through the strips into the handle. Now drill two holes on the line Z, at points already marked, and insert screws, as before, through the brass strips into the base, using washers if possible, and putting a wire under each strip. The two outside points must be joined together, forming one line, and the other one will be the wire from the central point. They should be fastened, as before, by twisting around the grooves, and soldered if possible.

WEATHER STUDY.

The ancients personified their winds, the name Boreas, the god of the north wind, being in use to this day, while parts of the Old Testament are full of weather lore. This but shows that from the earliest times man has taken note of the varying conditions of the weather. At the present time this is especially true, and it is an axiom that all are interested in it, from the man who manages large commercial or manufacturing interests, to the washerwoman who is anxious as to whether to-morrow will be a good "drying" day or not. In view of this it is very desirable that all should have a clear understanding of storms, their probable movements from day to day, and their results so far as temperature, precipitation and high winds are concerned. It should be possible for everyone to be able to forecast the weather for himself with the aid of the daily weather map issued by the United States Weather Bureau.

To the writer there appears to be but one feasible way in which to bring about this much desired result, and that is through the medium of the public schools.

Probably one-half of the population of the United States do not attend school beyond the grammar grade; it is therefore necessary, in order to be of benefit, that their instruction begin in the primary grades and be continued through the grammar. As to the method to be pursued, I think, in such a course, the instruction should be centered around the daily weather map. After the pupils have been taught what a storm area is, the course of each, as shown in these maps, should be carefully followed across the country. After its passage, all the maps upon which it appears should be assembled and a careful study made of all the phenomena connected with it. Comparisons should also be drawn between it and other storms. If there are points of similarity, they should be plainly brought out.

This method should be carried on through the whole school course, and in connection with it some knowledge may be gained of what are known as the meteorological elements: the pressure, temperature and humidity of the air; precipitation of its moisture, evaporation, the winds, the clouds, and the electrical and optical conditions of the atmosphere. Unless one wishes to follow the study of the weather as a vocation, it is not necessary to go too deeply into the scientific side of it, as without so doing one can by practice learn to make an approximately correct forecast for the following one or two days. All know how uncomfortable is a warm, "sticky," summer's day, even if the temperature does not reach a high mark, but few know why it is so or can give a lucid explanation of it. Some few facts like these should be understood by everyone. The ignorance on this subject displayed by people, otherwise intelligent and well educated, is truly lamentable, in view of the fact that so much in the way of personal comfort and public and private gain and safety depends upon the weather. There is no doubt but what many of you think that a storm that brings to Boston driving rain and high winds from the northeast really comes from a northeasterly direction, whereas the contrary is usually true, except in the rare instances when a storm moves up the Atlantic coast from the West Indies. METEOROLOGIST.

AMATEUR WORK

85 WATER ST., BOSTON

F. A. DRAPER . . . . Publisher

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

MARCH, 1902

Contents

The recent extensive development of manual training schools, with wood and metal working equipment, is a long-delayed but very welcome addition to school work. Aside from the educational benefit, the training received in the use of tools will be valuable in after lifetime, if to no other purpose than the ability to do constructive and repair work in the home. Such training is not restricted to these narrow limits, however, but embraces the mercantile and manufacturing field as well. The knowledge acquired in such a school broadens and develops the perspective, and fits the graduate for many kinds of business life as does no other form of school work. This is now becoming so well recognized by those interested in educational work, that manual training courses will soon form a part of the curriculum of every school.

To those who are without a complete outfit of tools the plan adopted by several young men in one of the cities adjoining Boston may be of interest. They united to form a work-club or guild. One had a barn which was not in use and which was fitted up with workbench, tool-chests, etc., as a workshop. Each one purchased a part of the outfit of tools, which he owned, but which all used in common. Any one breaking a tool replaced it with a new one, retaining the broken one. A small contribution from each paid for the light and heat. Many of the tools were obtained as premiums for new subscribers for Amateur Work. This plan could undoubtedly be used to good advantage by many of our readers.

The increasing interest in Amateur Work shown by our readers is greatly appreciated by the publishers. Our thanks are extended for the many helpful suggestions received. It is by such means that the usefulness of this magazine can be enlarged and its facilities extended for providing interesting topics. If any reader has constructed any device which would be of general interest to our readers, a description of it would be welcome and the same published as soon as space permitted. Several articles contributed by readers appear in this and the next number.

A limited number of back numbers of Amateur Work may be obtained by ordering from newsdealers or sending direct to this office, enclosing ten cents for each copy desired.

MECHANICAL DRAWING.

EARNEST T. CHILD.

V. CROSS-HATCHING AND SECTIONS.

In our last talk the subject of sections was taken up, and a few of the conventional lines used in showing sections of various materials were given. The proper use of sections is of such great importance that further consideration is necessary, and the student will do well to study the matter of sectional representation very carefully. This is necessary in order that a clear understanding of the subject may be acquired. The best method for attaining proficiency is by constant practice, and this point should be borne in mind by the student who hopes to become a professional draughtsman. One may look at drawings and read books on the subject, but not until he actually learns to use draughting instruments properly, by careful and continuous practice, will he begin to advance towards the desired end.

It is not meant by this that every spare moment should be devoted to practice; but a certain time, say two or three evenings a week, should be set aside by the student and devoted to it. The writer, although a professional draughtsman, devoted two evenings a week for seven consecutive winters to various classes of drawing which were not included in his regular work. And this time was very profitably spent. Students who live in cities have a great advantage, as it is possible to attend evening drawing schools, where they may receive instruction from teachers who have a large experience; but there are many who are not so fortunate, and it is this latter and larger class which it is intended that these talks on drawing may reach and help. As stated above, it is continuous effort which shows results in the long run, just as falling water, drop by drop, will wear away a stone.

But to return to the study of sections. It is often more convenient to show a piece of mechanism in outline, when it is necessary that a section should be made of some particular part. Instead of making a separate section showing this particular detail, it may be shown by dotting the section lining of the part in question. Another method is to merely hatch the outline of the part which is to be shown as sectional. This is shown more clearly in Fig. 14, showing piston. Sections when shown this way are called "dotted sections," and may be used to good advantage when pencilling drawings from which two distinct tracings are to be taken, one showing outline, the other section.

When finished, drawings are made on paper for record work. Sections are often shown in colors, which greatly adds to the clearness of the drawing. Unfortunately, drawings of this class are of little real value for anything except record, as they cannot be given to the workmen, who would certainly deface them, and they cannot be blue-printed. The result is that, in a majority of instances, the tracing constitutes the sole record, and line sectioning has to be resorted to. Tracings possess a great advantage over paper drawings, as they may be blue-printed any number of times, and being thinner, require less room in the files. This may seem a minor matter; but when a manufacturing concern has ten or fifteen thousand drawings on file it amounts to considerable. The proper choice of location for a section is all important, and requires much study and more judgment. As already explained, the function of a section is to add clearness to the drawing, which without it would be more or less confused. The section, or cutting plane, should be so located as to show all the details which need explanation in the clearest manner. In order to do this, it is often necessary to omit certain details of the mechanism which may be beyond the section, but which, if shown, will only confuse the drawing, without helping in any way. For instance, in showing the section of a gear, only the parts which are continuous should be in section, as the hub and the rim. The teeth and arms should be shown in outline. It will not be necessary to dot all the teeth to the gear. This will only add confusion, and increase the labor of making the drawing. If it is desired to show in section a circular flange with a number of bolts through it, all the bolts being equidistant from the center, it will not be necessary to show all the bolts. Only two should be shown, and they should

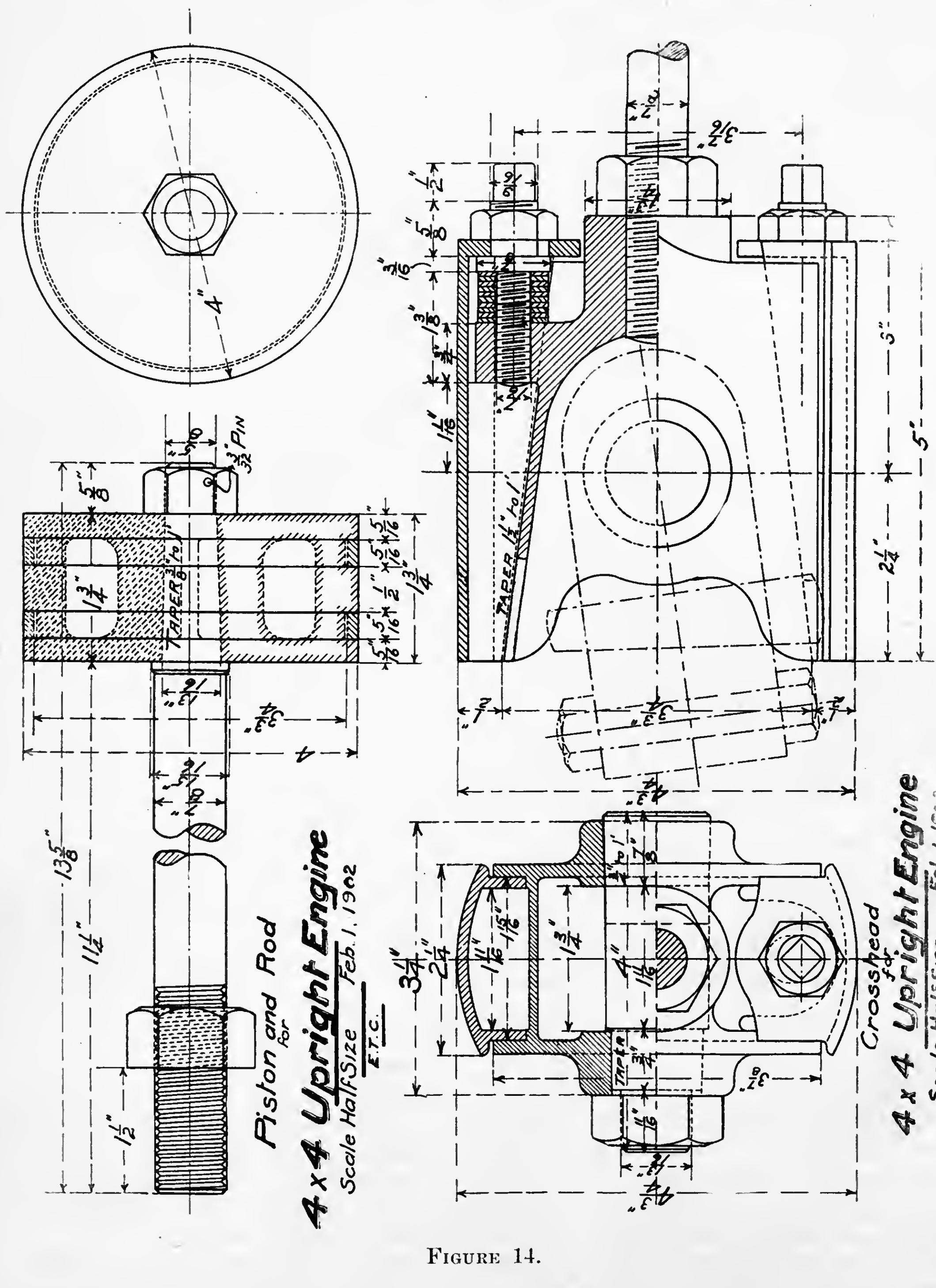

Piston and Rod for
4 x 4 Upright Engine
Scale Half Size Feb. 1, 1902
E.T.C.
Crosshead for
4 x 4 Upright Engine
Scale Half Size

FIGURE 14.

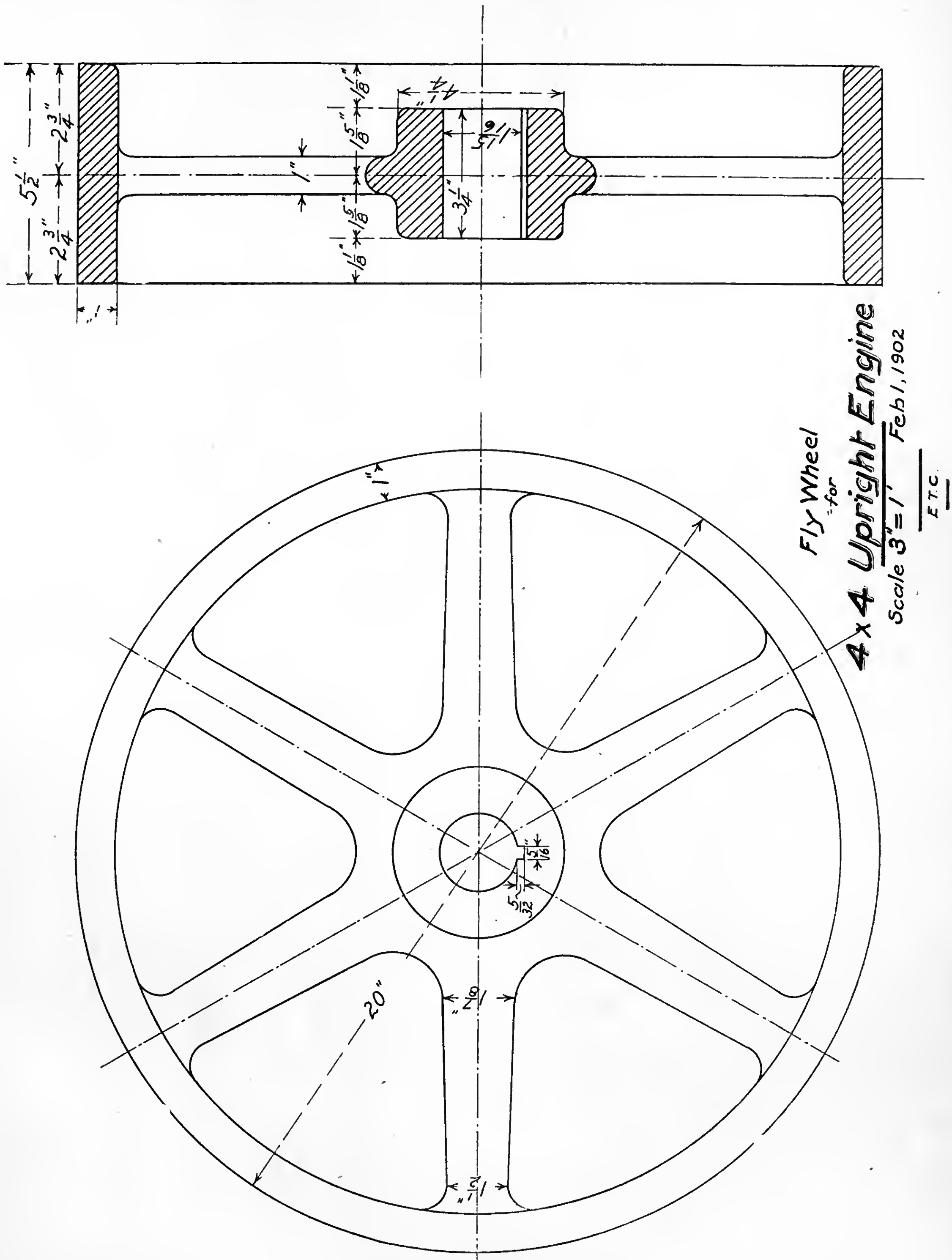


FIGURE 15.

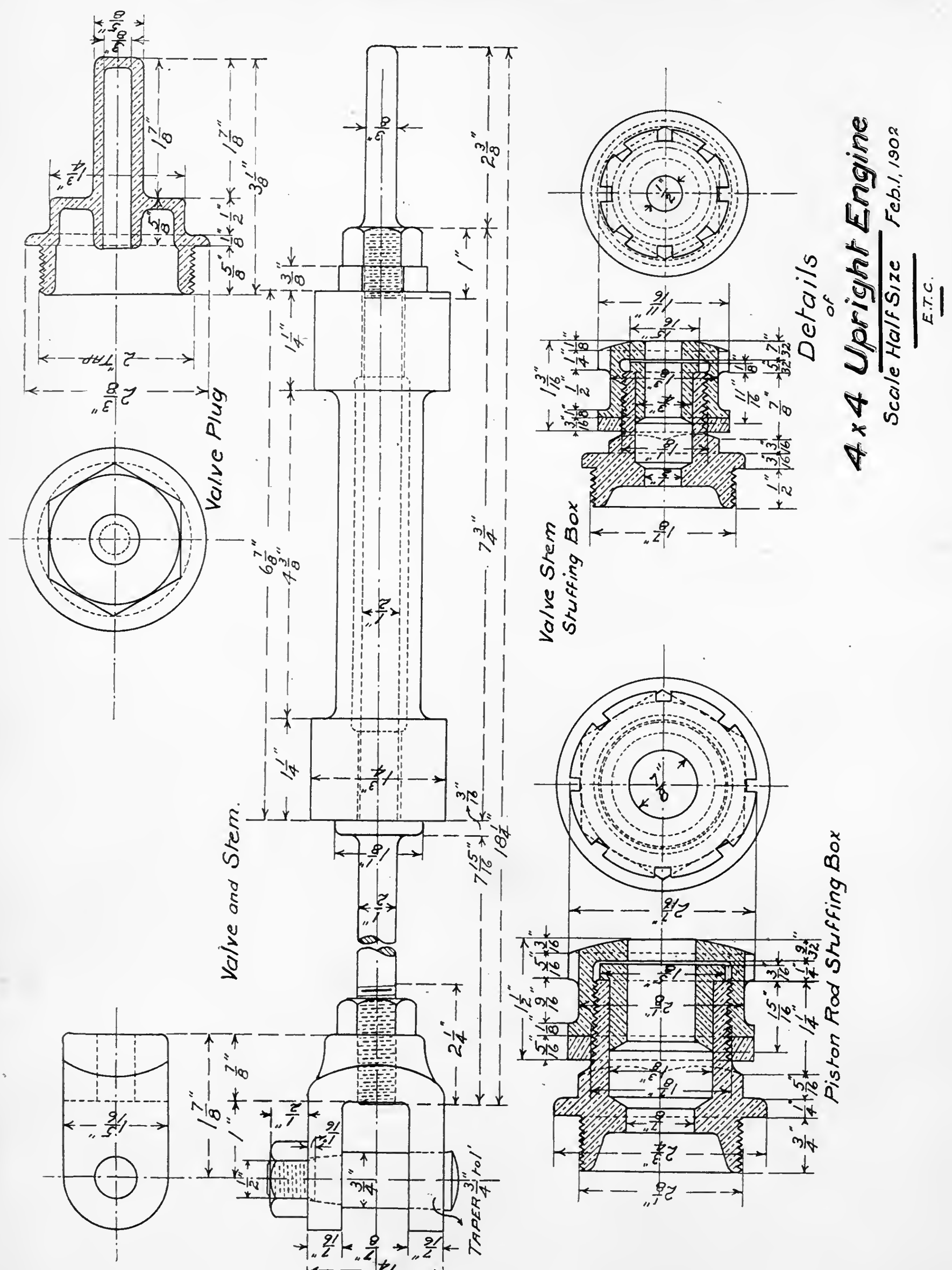

Details
of
4 x 4 Upright Engine
Scale Half Size
Feb.1, 1902
E.T.C.
Valve Plug
Valve and Stem.
Valve Stem Stuffing Box
Piston Rod Stuffing Box
TAP

FIGURE 16.

be located in the section at the proper distance from the center, whether they happen to come exactly so in the section, or not. It is not at all necessary that a section be continuous. If it is found to add to the clearness of the drawing to show one part in section and another part in outline, it may be done, or it is allowable to change the plane of a section in different parts of the same object. When this is done, it is customary to show the line of the section by letters, and mark the drawing section on A B C D, or by any other letters which may be readily seen. If it is necessary to show a section of a piece of mechanism which, while it is symmetrical, may not be cut evenly by a section, as, for instance, a cylindrical piece having an odd number of hubs or ears, it will be found expedient to depart from strictly conventional lines, and either show a complete section which is balanced, both sides being equal, or better to simply show a half section through one lug to the center. If a strictly conventional section were shown, it would be misleading rather than helpful, and the value of the sections would be lost. This is a point which cannot be brought out too forcibly. The section is primarily used to add clearness to the drawing, and should be used only when it is necessary to avoid confusion. Never lose sight of the fact that your drawings must be kept as simple as possible. Every line means extra work, and sections require more time than any other part of the work; therefore they should be used only when necessary. It will not be well to go to extremes and try to dispense with sections, for, when necessary, they would be neglected. The proper use of sections cannot be taught in a minute; it must be acquired by practice and judgment. The latter is acquired by the former, so they really go hand in hand. Fig. 14, already referred to, illustrates two distinct methods of showing sections. The detail of piston and rod is really a side and end elevation, but dotted sectioning has been used, and it will be seen that both classes of dotted sections add clearness to the drawing. The type shown in the lower half of the piston is preferable in that it may be more readily accomplished. The detail of crosshead illustrates the ordinary method of sectioning, so far as the upper part of the work is concerned. This also illustrates a method of saving extra drawings in that the upper part is shown in section, and the lower part is in elevation. This is often done and is allowable when an object is perfectly symmetrical. This method adds to the clearness of the drawing, as it shows at a glance the external appearance as well as the sectional arrangements. If it is found expedient to use this method, it is well to show an elevation of the object on the same sheet with the section, thus giving a clearer conception of the object to be shown. Fig. 15 shows the fly-wheel for the 4 x 4 engine. It will be seen that the same general remarks are appropriate for showing this section as for a gear; that is, only the parts which are continuous should be in section. Even if the wheel were turned so that the section line would come through the spokes, they would not be shown in section, as this would give the impression that they were continuous, forming a web instead of being only six in number, as happens to be the case. It will also be allowable to show the keyway on the center line, if thought necessary, but it is preferable to keep to projection as much as possible in this particular case.

The last two illustrations, Figs. 14 and 15, have been of cast iron so far as the sectional work was concerned, and consequently the section lines have been full and evenly spaced.

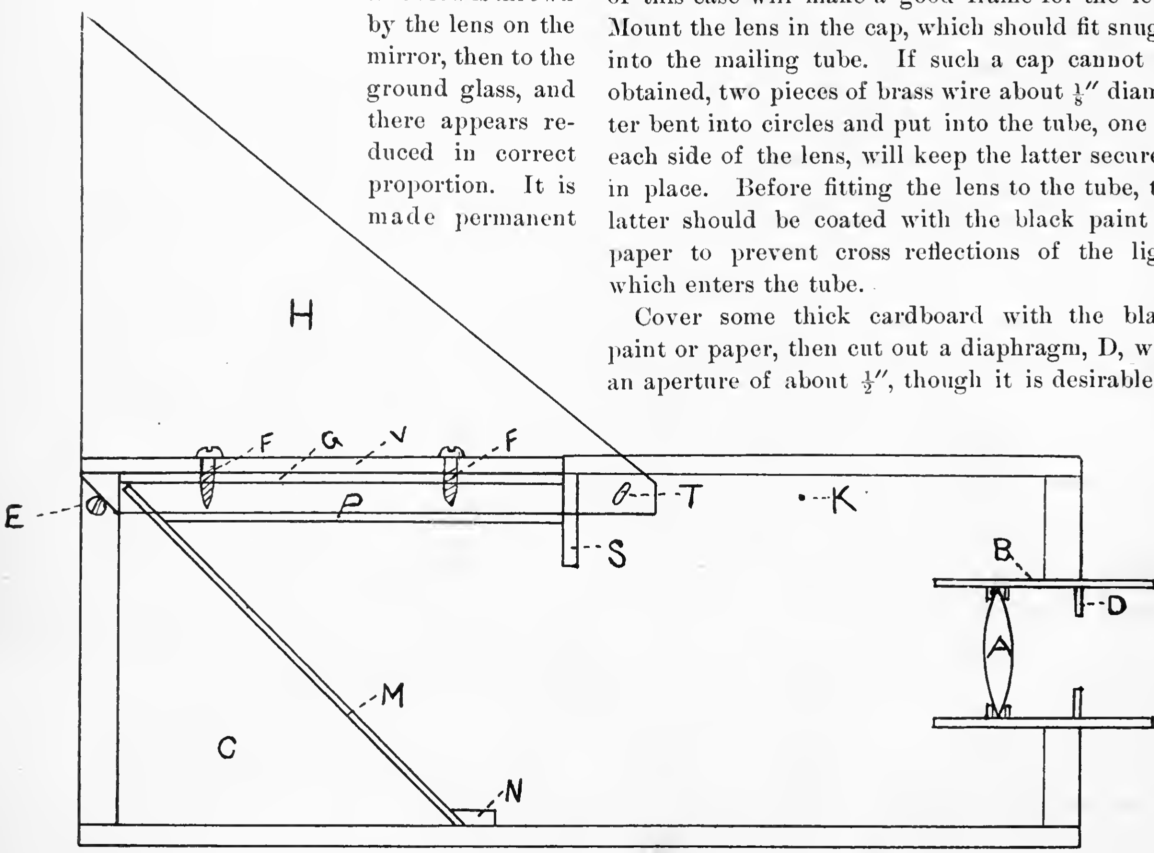
In Fig. 16, showing details of valve and stem, stuffing boxes and plug, is an illustration of the method employed for showing composition, or brass, using the conventional line given in Fig. 9–C. In showing the valve and stem, only one view is necessary, with the exception of the lower end, where the knuckle joint for connecting to the eccentric strap is shown. This has to be shown by two views, as it will be seen that it is not of regular shape, while the remainder of the detail is cylindrical. The valve plug is threaded into the top of the steam chest and guides the end of the valve stem. The stuffing boxes are used to prevent the escape of steam from the cylinder and steam chest, while permitting the rods to slide with comparative freedom.

These details should be carefully copied, and it will be well to enlarge them, making the drawings on a double standard sheet, thus gaining experience in transferring from one scale to another. This will also bring the drawings more nearly to the size and scale required in actual practice.

A CAMERA OBSCURA.

How to Make This Valuable Aid in Landscape Drawing.

To those who find pleasure in landscape drawing, but, from lack of a teacher, cannot master the elementary principles, the camera obscura here described will prove of much assistance. It is easy to make and use, and requires but little expense for the materials used in its construction. The view is thrown by the lens on the mirror, then to the ground glass, and there appears reduced in correct proportion. It is made permanent with pencil or crayon. The practice in drawing thus obtained is valuable to beginners.



The required materials are: a wooden box, a cheap double-convex lens, a piece of mirror and one or more pieces of ground glass, a piece of pasteboard mailing tube, some dull black paint or paper, sheet tin, screws, etc. The first thing to be settled is the lens. The one used by the writer was a discarded photographic lens from a cheap 5″ x 8″ camera that had outlived its usefulness. Any jeweler can supply an ordinary double-convex lens at a small price. One that is 1″ diameter is large enough, though 1½″ would be better. The depth of focus should be as short as possible, and this measurement should be learned when purchasing, as the length of the box depends upon it.

Having secured the lens, get a well-made and smooth piece of mailing tube about 3″ long, the inside diameter of which is a little larger than the lens. From the jeweler also get a case such as the works of watches are shipped in. The cap of this case will make a good frame for the lens. Mount the lens in the cap, which should fit snugly into the mailing tube. If such a cap cannot be obtained, two pieces of brass wire about ⅛″ diameter bent into circles and put into the tube, one on each side of the lens, will keep the latter securely in place. Before fitting the lens to the tube, the latter should be coated with the black paint or paper to prevent cross reflections of the light which enters the tube.

Cover some thick cardboard with the black paint or paper, then cut out a diaphragm, D, with an aperture of about ½″, though it is desirable to have several, with apertures of different sizes. They should be a snug fit to the tube, so as to remain in position. The tube is now ready to be fitted to the box.

The box here described was made for a lens with a 10″ focus, and to give a view on the ground glass measuring 6″ x 8″. The dimensions are easily determined for any other size of lens or ground glass. The box was remade from a pine box secured from a grocer. It measures outside 13½″ long, 8½″ wide and 5½″ deep; the ends being ½″ thick and the sides, top and bottom ¼″ thick.

A few extra pieces of $\frac{1}{4}''$ stock are needed for supports. The top piece does not cover the whole top, but only 7″ of the front or lens end. The inside of the box is coated with the black paper or paint, to prevent absorption of the light rays entering through the lens.

A hole is bored in the front end to receive the lens tube. This should be of such a size as to hold the tube firmly and yet allow it to be drawn out or pushed in for focusing. A good plan is to have this hole large enough to allow a lining of black felt. The tube can then be readily adjusted, and yet no light can leak through around the edges.

The mirror M is placed in the back of the box at an angle of 45 degrees and supported on triangular pieces of wood, C, $\frac{1}{4}''$ thick, and also by a thin beveled cleat, N, glued to the bottom of the box. Two pieces, P, $\frac{1}{2}''$ wide, $\frac{1}{4}''$ thick and 6″ long are screwed to the sides for supporting the ground glass, and are so placed that the glass is even with the top sides of the box at the rear end.

The ground glass should be of medium thickness, to safely support the weight and pressure of the hand while drawing the view. Extra pieces may be provided so that several views may be drawn during a day's outing and carried home to transfer to paper. The glass is held in position by strips of wood, V, $\frac{1}{4}''$ thick and $\frac{1}{2}''$ wide, on the sides and back. These are fastened by screws or screw-eyes.

The hood H is made of tin painted black on the underside and any color desired on the top. A piece $13\frac{1}{2}''$ long and 11″ wide is required. The shape of the sides is shown in the drawing. These are cut out with metal shears and the ends bent over as shown. At J a screw-eye holds the side in place while the back part rests on the round-headed screws E, one on each side, which project sufficiently for this purpose. When not being used, the screw-eye J is removed, the front of the hood moved forward so that the screw-eye may be put in the hole K, thus allowing the hood to be laid flat on the top and protect the ground glass from being broken.

The instrument is now nearly complete. It should be tried by taking it out in the sunlight and focusing on a suitable view. Examine the ground glass to see if the view is correctly and squarely reflected thereon. It may be found desirable to put in a shield, S, made of a piece of wood or pasteboard painted black and of sufficient width to prevent the direct rays which enter the lens from reaching the ground glass other than by reflection from the mirror.

In use it will be necessary to place the camera obscura upon a tripod, camp-stool, or other firm support, as some little time is usually required to draw a landscape and any movement would be troublesome. If the sun should shine, a black umbrella will be useful for a shield, as the less outside light that reaches the ground glass, the more distinct will be the definition. A pencil or crayon, black or colored, may be used for the drawing, doing the upper part of the view first to avoid rubbing.

ASTRONOMY FOR MARCH.

There will be no planets in the evening sky this month, with the exception of Neptune, which does not count for the amateur. Venus will be morning star, rising, at the beginning of the month, two or three hours before the sun, and arriving at her greatest brilliancy, though not at her greatest distance from the sun, on the 20th.

Mercury will be visible in the eastern sky about the 16th, in the morning, an hour or so before sunrise. And the astronomer who cannot get up in the early morning does not amount to much.

Jupiter and Saturn will also be visible in the morning during the month, but Mars is too near the sun, coming into conjunction with it on the 29th.

The moon will enter her last quarter on the 2d, is new on the 9th, comes to the first quarter on the 16th, and fulls on the 23d. She will be in conjunction with Saturn on the 5th, and with Jupiter on the 6th, passing about five or six degrees north of each of them. There will be no occultations of conspicuous stars this month.

The constellations for March will be nearly the same as for February; at 8 P.M. of the 1st the Lion will have wholly risen into the eastern sky, of which he very appropriately occupies the lion's share. The Twins are directly overhead. Sirius has just passed the meridian, and Orion has moved round into the southwestern sky, where he stands nearly upright.

The Great Bear has risen in the northwestern sky to the level of the pole and, with the Lion, is the principal constellation of the eastern heavens.

Eight hours later, at 4 A.M., all is changed. The winter constellations are set: the Great Bear is a little to the west of the Zenith, and the other bright circumpolar groups are near or below the northern horizon; but the Milky Way lies level across from north to southeast, with Cassiopea, Cepheus, Cygnus, Lyra, Aquila and Scorpio scattered along it,— all summer constellations. Above these are Hercules and Ophiuchus; and Boötes, marked by its bright red star, Arcturus (the Bear's Tail), and the beautiful little broken oval of the Northern Crown, nearly overhead.

The two zodiacal constellations, Virgo and Libra, lie in the south, west of Scorpio, and the small quadrangle of the Crow is low in the southwest. Leo is near setting, and the Twins quite so. Capella, the bright white star of the northern winter sky, is just on the northwestern horizon.

Jupiter is just rising, and Saturn already risen, but in very bad position for observation.

VEGA.

DEVELOPING PLATES.

FREDERICK A. DRAPER.

WHILE the topic here presented is an old one and much has been written about it, the large number to whom photography is new and its processes unknown make it suitable for a place in the columns of this magazine. There are many amateur photographers who do not develop their plates or make their own prints, and who, for no sufficient reason, are reluctant to attempt this work. Could they but once experience the pleasure this most interesting part of the photographic process can give, they would hold back no longer. Those of our readers who are thus situated should provide themselves with an outfit and learn to do their own developing.

Assuming that a dark room is available, a ruby lantern is necessary. This should have both ruby and orange glass, and free from any holes that emit white rays from the inside. The equipment should also include three trays of proper size for the plates used, and two glass graduates. Each article should be labeled and used solely for the particular solution assigned to it. A wash-box and drying frame are also desirable. A very useful and inexpensive device recently put on the market is a rocker for keeping the developer moving while otherwise engaged. It is a piece of enameled iron, with a hole in the top in which the tray rests. Two sides are bent down and rounded. A push on one end will give a gentle rocking motion, which continues for some time, and serves admirably to move the developer across the plate in small waves.

The developer should be that recommended by the manufacturer of the plates used, several formulas being generally given. Many plate-makers issue leaflets containing much information valuable to the novice, and which may be read with profit. After some experience has been acquired, and satisfactory results have not been produced, the troubles should be studied to learn their cause. The exposures may not be correct, and herein lies the most common cause of poor negatives; the plates may be old, the camera, plate-holders and plates not properly dusted; the trays changed, or solutions mixed that should have been kept entirely apart. Watchful care is necessary at all times, but not to the extent of making the work tiresome or disagreeable.

For the first trial any standard developer will answer. The water used for reducing, when necessary, should be distilled, although rain-water, gathered in a clean porcelain or enamel dish, will answer nicely. In addition to the developer a bottle of restrainer should always be kept within reach, in case of over-exposure. This is easily prepared as follows: dissolve 1 ounce of bromide of potassium in 10 ounces of pure water. The cork of the bottle should have a piece of quill or glass tubing run through it, so that a few drops of the solution may be quickly thrown into the developer in an emergency.

To make clearer the process of developing, we will assume that the plate has been exposed for a landscape and we are about to develop with a hydro-metol one-solution developer. The exposure was about correct as to time. The dark-room door is locked, the ruby lantern lighted and placed at sufficient distance so that only a dim light is thrown across the trays. The bottle of developer is opened, the quantity specified is poured into a glass graduate, and to this is added the specified quantity of pure water. The plate is removed from the holder, dusted with a camel-hair brush, and placed, gelatine side up, in the tray. The developer is then poured over the plate from one end, so as to send it across the plate in a wave that will cover the whole plate. The tray should be gently rocked to keep the developer moving wavelike across the plate. Many photographers wet the plate with water before developing, to facilitate the flow of the developer. In about 30 seconds, faint lines will begin to appear, growing stronger, till gradually the whole plate is covered. The development is continued until the high lights are quite dark, and the milky white appearance has completely disappeared. The view can now be seen with more or less distinctness from the back of the plate. Do not stop development too soon, — a very common error with beginners, — as loss of detail and contrast results. Different makes of plates work differently, so experience is the best teacher in this matter.

Had the plate been much over-exposed, the image would appear instantly the developer was applied. When this occurs, remove at once from the developer and wash with one change of water. Then add to the developing solution from three to six drops of the restrainer above mentioned, according to the degree of over-exposure, and continue development as before. If you have reason to believe that any plate has been over-exposed, use a larger proportion of water when beginning development, adding more developer later. With a two-solution developer, which will be considered at another time, over-exposed and also under-exposed plates are more easily handled by varying the proportions of the different solutions.

Under-exposed plates, which frequently come with snap-shot work on cloudy days, are slower in developing; the high lights, i. e., the sky, water reflections, and white painted houses, etc., appear long before the darker portion of the view becomes visible. Working with a one-solution developer, the best thing to do is to make a very weak solution with water and take a long time in developing. A drop or two of restrainer should be added when this is done, to prevent fog. Also cover the tray with a piece of black cardboard, so that no light of any kind will reach it.

When you think the plate has been fully developed, hold it before the ruby lantern to ascertain the extent to which detail has been brought out. If fully developed, plate should be quite dense.

After developing, place the plate in the washbox and wash with cool running water for 15 minutes. Do not allow water to run directly down on plate. The water should run only fast enough to carry off the excess chemicals. If running water is not available, change the water six or eight times. It is then ready for fixing. Make a saturated solution of "hypo" and keep it in a labeled bottle. Have a fixing tray similarly labeled and use for no other purpose. Take equal parts of "hypo" solution and pure water to fill the tray one-third full. Place the negative in the tray, film side up, and rock as before directed, keeping it in the fixing bath at least two minutes after the yellowish color on the back of the negative has entirely disappeared.

Another washing for at least 15 minutes, though a half-hour is better, completes the work of developing. The negative should be allowed to thoroughly dry in a drying rack before attempting to make prints. Owing to the time required for the several washings, it is desirable to develop several plates at one time. It is also more economical to do this. The time required in washing one plate can then be used in developing and fixing of others. In changing the work from developing to fixing, or the reverse, wash the hands in water, without soap, and dry with a clean towel. At all times use precautions to keep the hands free from chemicals. After fixing, the negative can be freely exposed to white light.

The process here described may seem, at first reading, complicated and difficult, but a few trials will make it very easy. When it has become familiar, a two-solution developer is recommended, as it gives a greater range of adaptability. The uses of the different chemicals will then become evident, and effects can be gained in negatives that would be otherwise difficult to attain.

In some of the mines in Pennsylvania the owners are providing for the safety and convenience of their employees by installing telephones at regular intervals along the shafts of the mines. In mine accidents it has often happened that the whereabouts of imperiled men could not be found out, and thus the work of rescue was delayed and lives were lost. It is believed that the telephone will remove much of this trouble.

HOW TO BUILD A HOUSEBOAT.

Carl H. Clark.

II. Construction of Deckhouse.

Before starting work on the deckhouse, the doors and window-sashes should be obtained, as the studs in the framing have to be spaced to them. The windows on the sides shown in Fig. 1 are about 3′ square, and those in the ends about 2½′ wide and 3′ high. The doors are about 27″ wide and 1¼″ thick, except the front doors, which are double and together are about 3½′ wide. The front and back doors opening on deck are to have casings and preferably may be rather thicker than the others. These sizes are by no means absolute, and the stock available may govern them somewhat. The general framing of the house is shown in Figs. 9, 10, 11 and 13, 9 being a side view, 10 a front-end view, 11 a rear-end view and 13 a section. The several members (Fig. 13) are as follows: *a* is the lower sill, fastened directly to the deck of the hull; *c* is the studding, which is nailed to the lower sill, and is the framework for the sides of the house; *b* is the

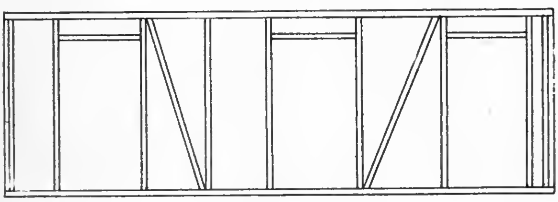


Figure 9.

upper sill, running along on the tops of the studs; *d* the roof beams, their ends resting on, and fastened to, the upper sill; *f* is the outside sheathing; *g* the inside sheathing; and *h* the roof planking. The frame is all of 2″ x 4″ spruce. The sills are to be gotten out first. For the lower one, which runs around the house, there are two pieces 19′ 10″ long, and two 15′ 9″; for the upper one, which is on the sides only, there are two pieces 19′ 10″ long. The four pieces of the lower sill are laid in place on the deck, and the ends joined together, as in Fig. 12, by cutting away half of each. This sill is then to be fastened down to the deck, being sure that it is square and rightly placed. With the lengths given, there should be about 1½″ on each side between the sill and the side of the hull. A coat of thick paint is put on under the sill, and it must be strongly fastened down, as the safety of the house depends in a great measure upon it. About a dozen lag-screws, or bolts, should be used, being driven down into the beams below, with spikes elsewhere.

The cabin arrangement, as in Fig. 2, can be laid out with chalk on the deck, and the positions of the windows and doors located, as the studs are placed directly against the side of the door and window casings. The studs for the sides are cut 6′ 3″ long, 11 for each side. These are set up on the lower sill and nailed in place. Those at the corners are double. The ones at the windows are placed about 2″ farther apart than the width of the sash, to leave room for the frame, and must be straight and parallel. The top side sill is laid along on the tops of the studs, and they are lined up parallel and nailed to it.

The frame of each side must be squared up and braced temporarily from the deck, and the roof beam

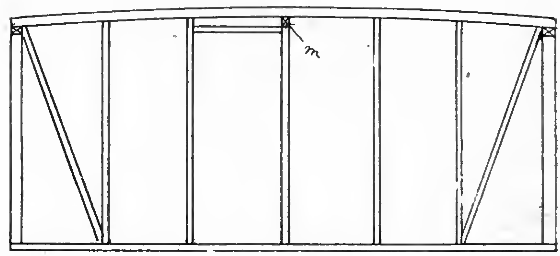


Figure 10.

at each end put in place, as in Fig. 13, at the ends of the upper sills, and fastened to them. A piece of 2″ x 4″, 19′ 10″ long, and planed all over, is placed under the middle of these roof beams to serve as a support to them, as shown at *m*, Figs. 10 and 11. This support, or strongback, as it is called, should be braced up from the deck until the middle of the beam is 3″ higher than the ends; this gives the roof a "crown" and makes it shed water.

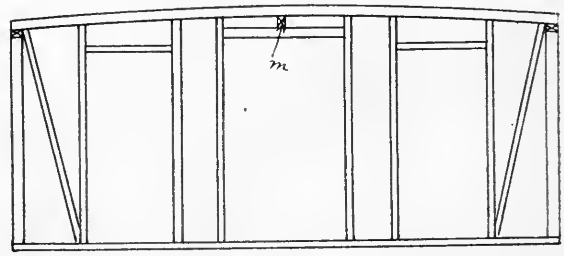


Figure 11.

The rest of the end studs are cut to fit between the sill and the roof beam, those beside the doors being fitted to the door-frames, and the one in the middle of the after end is placed under the strongback, permanently. The diagonal braces are now to be put in place, as shown in Figs. 9, 10 and 11. They should be a tight fit and be strongly nailed, as they stiffen the house and prevent its working. The horizontal pieces just above the windows and doors are cut to fit singly between the studs; those over the windows are so placed that when

$\frac{7}{8}$ inch is allowed for the frame, the window will be in the desired position. In the sketch they are about 6′ above the floor. In any case they must be high enough so that the sash will drop down flush with the window-sill before striking the floor. The pieces over the doors are put just under the fore and aft strongback. That over the front door is double, two 2″ x 4″ on edge, and strongly nailed, as it supports the front end of the strongback, as shown in Fig. 10.

The roof beams are spaced about 18″, and there are 12 beams evenly spaced. They rest on the strongback and are bent down and fastened to the upper sill. It will be necessary to brace the strongback from the deck in two or three places to prevent it from sagging in bending the roof beams. The two lower edges of

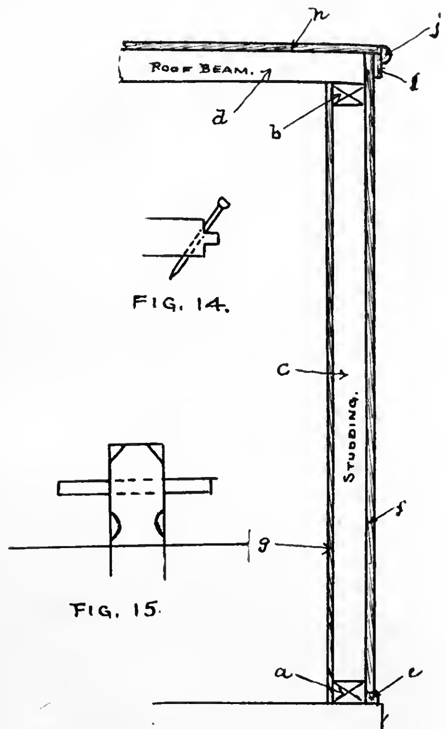


FIG. 14.

FIG. 15.

FIGURE 13.

both beams and strongback are to be beveled off, or, if a beading plane is at hand, a bead can be worked on the two lower edges for a finish. This had best be done before putting into place.

The roof is covered with $\frac{7}{8}$″ matched sheathing, which is laid beaded side down. It must be remembered that this is not covered on the underside, so that all the joints must be good. At the ends and sides this sheathing should extend over about 2″. An opening should be left for the stairs.

If it is desired to have the house especially strong, a $\frac{1}{2}$″ iron rod can be run near each corner from the upper sill down through the lower sill, and a deck beam below with a nut and a washer at top and bottom. This ties the house down securely. A strip $1\frac{1}{4}$″ x 1″ is gotten out and laid flat on the deck all around the lower sill, as shown at *e*, Fig. 13, forming a bed for the outside sheathing, being mitered at the corners. The front and back door-frames are now put into place and carefully nailed to the studs, being fitted over the sill at the bottom, and just under the joist at the top. They should be of such a width that their edges will come just even with the outer surface of the sheathing when it is in place. This width is about $5\frac{1}{2}$″.

The window-frames are made of $\frac{7}{8}$″ stock about $5\frac{1}{2}$″ wide, fitted in between the studs. The top is fitted first, and the sides are fitted against the top and should extend to the floor, to ensure the windows running smoothly. As described, no allowance has been made for window weights. If these are desired to balance the windows, the studs must be put enough farther apart to admit them, and pulleys must be fitted at the top of the frames. The windows will probably be fully as satisfactory without them, however, as the sash is not heavy.

Just under the window-sill, two pieces are fitted between the casings, on edge, as in Fig. 16, to hold the ends of the sheathing, leaving a space between for the sash to run. If desired, the door-frames can be built up in the same way as the window-frames, of $\frac{7}{8}$″ stock, and a strip fastened around to form the door-jamb.

If the house is to be used in other than warm weather, a layer of paper, such as is generally used for building purposes, should be put on before sheathing; it comes in rolls, and can be tacked to the studs to hold it in place. It will add much to the warmth of the house.

The sheathing is $\frac{7}{8}$″ thick, matched, and put on with the beaded side outwards. The joints with the bottom strip must be good, but at the top, under the roof, it is not as important, as the joint is covered. At the sides of the door and window frames the sheathing has to be fitted, but extreme care is not necessary. The grooves in the joints should all have a coat of lead before putting up, and the nails should be "set" $\frac{1}{4}$″. A strip, *i* (Fig. 13), about 4″ wide is worked around just under the roof boards, to cover the joints at the top and make a finish. At the corners it is mitered.

The roof sheathing is trimmed off even with this strip all around. The opening for the stairs is also trimmed out square and even, and a coaming about 3″ deep fitted around underneath at the edge. The opening should be about 3′ long and 2′ wide.

The roof and the decks at the end are covered with canvas; about 6-oz. duck, or even heavy drilling, will answer the purpose. It comes in rolls, usually 30″ wide. The several strips are laid fore and aft, beginning with one down the middle, and working towards the edges, lapping each one over the next outer one, like the shingles on a house, and tacking with small copper tacks. Each length should be laid in a heavy coat of paint and should be stretched somewhat, to be sure of its lying smoothly. At the sides and ends, and also in the opening for the stairs, the canvas is turned down over the edge and tacked, and then trimmed off just under the row of tacks. A piece of molding, or a half-round strip, as shown at *j*, Fig. 13, is nailed around just even with the edge, to cover the canvas and keep it in place. The top will need at least two coats of lead paint to wear well. The decks at the ends are covered in the same way, except that where the canvas comes against the house it is turned up and a $\frac{3}{4}''$ quarter-round molding worked into the corner. The edge here is best covered by a 2″ half-round, which can run the full length of the hull, and adds somewhat to the appearance, especially if varnished. Although the house is best when sheathed inside, for some purposes, as for a hunting or shooting camp, this may not be necessary; in which case the studs and sills ought to be planed all over. If inside sheathing is desired, it may be $\frac{1}{2}''$ thick and matched. It is jointed to the floor, and may, if desired, be stopped at the lower edge of the roof beams, and a molding carried along the top; or, if a little better finish is wished for, it can be carried up to the roof, being cut out around the beams, in which case the molding is put up against the roof. This sheathing ought to be blind nailed, as in Fig. 15, so as to leave no nail holes. A fairly good joint around doors and windows is all that is necessary.

The windows are to be finished by fitting a window-sill on both inside and outside, as shown in Fig. 16, leaving a slot for the window. These sills should be neatly fitted between the frames, and be wide enough to extend out over the sheathing and fit against the casing. This casing is about 4″ wide, worked around the window, as in Fig. 1, $\frac{1}{2}''$ thick on the inside and $\frac{7}{8}''$ on the outside. Above each outside casing there is a strip of lead or zinc turned at a right angle and laid along on the top of the casing, and tacked to the sheathing. This prevents rain leaking down behind the windows. The sashes are put in place and a strip nailed around to hold it in place and make a groove for it to slide in.

As balance weights have not been provided, some kind of binding arrangement must be used to keep the sash in place. There are little eccentric arrangements sold for this purpose. The bottom of the sash should fit tightly against the sill, and a piece of rubber weatherstrip should be tacked on the sill to bear against the sash and prevent from running down between the sill and sash. The partitions are single, of $\frac{7}{8}''$ matched stock, finished both sides. They are held in place by a quarter-round molding each side, both top and bottom. The lines of the partitions are marked out on the deck, making the middle one just inside the strongback under the roof beams. The inner quarter-round is nailed down, and the sheathing nailed to it and the floor. The outside molding is put on after the partition is all up. This partition ought to extend up to the roof, and be fitted around the beams. At the doors short pieces are used above, and the opening trimmed out to fit the door. Care must be taken not to drive any nails through the roof to cut the canvas. There are also moldings in the corner between the partitions and the side sheathing. An ornamental molding like the one already run at the side under the beams, if carried around the partitions at the same height, will take away the bare effect, and add to the appearance. The openings for the doors in the partitions have to be fitted with casings the same as the windows. These are about 5″ wide, except that the outside casing projects about an inch into the opening, making a jamb for the door to shut against. The door-sill is about 6″ wide, beveled off on the sides, and joined to the molding already put around the bottom of the partitions. The doors can be hung, using butt hinges, which do not show. Some kind of latch or knob should be fitted, to hold the doors shut, and locks if desired.

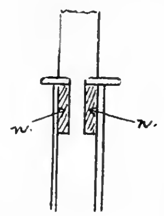


FIG. 16.

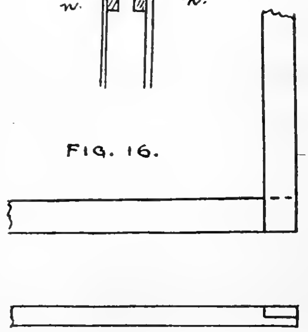


FIG. 12.

The hatches in the deck are trimmed out about 2′ square, cutting out the top layer first and allowing the lower layer to project 1″ to support the cover. The cover is made of two layers, the upper one of the same stock as the floor boards, and cut to fit accurately. The lower layer is nailed across the upper, and the two being crossed, the cover cannot warp. A sunken handle or ring should be attached for lifting.

The stairs to the roof run from about the middle of the boat diagonally up to the opposite side of the opening above. They are made of two planed 2″ planks about 8″ wide, resting on the deck and against the edge of the opening. The steps are about 8″ apart, dividing the distance equally. A cleat about 2″ wide is nailed under each end of each step to support it. If thought necessary, a hand-rail on the outer edge of the stairs can be provided.

The railings are 2″ x 4″ planed joists, with a post of the same material every three or four feet apart. They are about 3′ high, and should run around the top of the house, around the opening for the stairs and around the decks at the ends. The posts at every corner are braced with a diagonal brace or a bracket of iron fastened into the corner. It will be necessary to nail these posts through the canvas to the deck, and care must be taken not to injure the canvas more than necessary. These parts should also be placed just over a roof beam when possible. At the after end a piece of rail about 3′ long should be hinged to allow a landing-place.

Some arrangement must be made for mooring the boat, either ringbolts or bitts, one near each corner. If the former are used, they should be driven through a deck beam, and have a nut screwed up tight on the underside. A tight-fitting washer should be slipped on first to bear on the canvas and prevent tearing.

The bitts are rather more satisfactory on the whole. They are made of pieces of timber about 4″ square, running through the deck and fastened to the bottom timbers. The top end is about 10″ above the deck, and is champhered off, as in Fig. 15. A $\frac{3}{4}$″ rod is driven through and allowed to project about 5 inches each side. Either arrangement must be strongly made, as there is considerable strain in a heavy wind and in towing. Another and probably easier way of doing this is to make cleats out of oak or other strong wood, about 12″ long and 4″ high. These are bolted down to the deck with two bolts each, one bolt passing through a beam. If preferred, these can be purchased at a ship chandler's, in either iron or wood.

An awning framework is made of 2″ square spruce. There is an upright in each forward corner of the forward deck, a few inches shorter than the height of the house; there is a piece of similar size connecting the tops of these uprights, and also a piece extending back to and fastened to the house. This makes a framework on which the awning will lie evenly. Or a rather neater frame is one of galvanized iron pipe, which is readily done, and is not expensive. An ornamental awning of striped duck will add to the attractiveness of the boat.

The house, as soon as completed, must be painted on the outside, and should have two coats, leaving a third to put on just before launching. The inside may be painted or finished natural, as desired; the latter is perhaps the best, as it is more durable. The surface should be first treated with a coat of oil, and then whatever finish is desired, put on after that. There are several kinds of oil finishes on the market, or shellac and varnish can be used. The canvas on the roofs and decks must be kept well painted, so that the wear will come on the paint and not on the canvas, as this would soon wear it through and cause leaks.

CORRESPONDENCE.

(No. 6.) ELKHART, IND., Jan 27, 1902.

I would like to know whether it is possible to make a call-bell telephone out of the following materials suitable for a line one mile long:

Two ordinary electric bells,
Two telephone receivers,
Two push-buttons,

and wire and batteries sufficient for one mile. Also give a diagram showing the method of connecting the wires. C. H. W.

The materials you mention are suitable only for a short line. If you want to run a line for a distance of one mile, you would need 10 or 12 cells to your battery to get sufficient energy. These would cost more than would a cheap magneto-telephone. You would also need double-contact push-buttons. A series of articles on telephony are in preparation which will give complete information about the equipment of short lines.

(No. 7.) MENDOTA, ILL., Feb. 5, 1902.

I wish to make an induction coil which will give a spark about one-fourth of an inch long. What sizes of wire are best for each coil, and how much of each is necessary? Is it necessary to have a condenser? Will such a coil operate the apparatus for wireless telegraphy described in the November number of AMATEUR WORK? M. E. F.

The following are the dimensions for a coil giving a one-half-inch spark, this size being given as it requires but little more work or material than the smaller size, and is much more satisfactory in operation.

Length of coil,	5½ inches
Length and diameter of core,	6 x ⅝ inches
Condenser, 40 sheets tinfoil,	6 x 3 inches
Primary coil, 2 layers cotton covered,	No. 18 wire
Secondary coil, 1 pound, silk covered,	No. 40 wire

A condenser is desirable when a large, fat spark is desired. It would not be advisable to make the apparatus described in the November issue, other than to illustrate the apparatus used by Dr. Hertz, which was the idea in view in that article. The description of how to make a wireless telegraphy apparatus that will operate over water for a distance of about two miles is now in preparation.

(No. 8.)

Can you tell me the process used for finishing mahogany to obtain the very dark, rich crimson and black colors seen on the best of mahogany furniture, etc.? Also, can birch be finished in the same manner to imitate mahogany? F. W. P.

To finish mahogany, maple, birch, white wood and other woods so as to obtain the dark, rich mahogany colors mentioned by this correspondent, proceed as follows: Make a solution of bichromate of potash, using about two ounces of potash to a pint of water. Apply this to the wood before staining. If a very dark tint is desired, several coats may be necessary. It would be well to take a small piece of the wood used and experiment to determine the necessary coatings. The solution may be made either stronger or weaker; the stronger the solution, the darker the tint. After the coating of potash is dry, smooth the wood with fine sandpaper, then apply the stain, which may be red or brown as desired, and finish with varnish or polish. A weak solution of nitric acid is sometimes used in place of the potash.

MARCONI claims to have perfected his telegraphy apparatus so as to avoid interruptions by other systems.

LEECHMAN'S LECTURE.

His Topic, "Motor Bicycles," attracted Record-breaking Attendance.

At the last session of that admirable institution, the Cycle Engineers Institute,— of which America might profitably have a counterpart,—"Motor Bicycles" was the topic, G. Douglass Leechman, M. C. E. I., being the lecturer. The subject was of such interest that it served to attract a record-breaking attendance, nearly three hundred members being present.

After remarking its uses and economies, Mr. Leechman asserted that the motor bicycle cannot be regarded as a single entity, but as consisting of two separate and distinct parts — the bicycle and the motor. In nearly all cases it is a bicycle to which a motor has been supplied, and the people who bought and used motor bicycles were those who had already become expert in riding the ordinary safety bicycle. The motor can be placed in almost any position on the machine that the designer pleases,— in the front, the middle or the rear,— and the bicycle will go and keep upon its keel.

The two points to decide were (1) which wheel to drive and (2) where to place the motor so as to drive the bicycle easily and avoid sideslip. Some people supposed it was an advantage to have the center of gravity low, but from a purely balancing point of view on a bicycle, it is desirable to have the center of gravity as high as possible, in order to avoid sideslip.

There are two causes of sideslip. First, from riding over uneven, greasy surfaces; and in this case, if the center of gravity is low, the rider will not have a chance to recover himself. The higher the center of gravity, the slower the oscillation and the more chance there is of correcting any disturbance. The second cause of sideslip is the endeavor to overcome centrifugal force when turning a corner. Take the case of a rider coming fast around a corner; the rider wants to go one way, but the machine would much rather go off at a tangent; but in this case the position of the center of gravity makes no difference, and need not enter into the calculations.

As regards the durability and successful working of the motor, as a rule it will be found that the higher it is from the ground, the less likely it is to be influenced by mud, dust, etc. This is a small point, but a practical one. Another point in favor of keeping the motor high is that when it is placed low it does not allow of much clearance from the pedal cranks, and things have to be cut very fine to get a proper length of crank-shaft, bearings, and sufficiently large fly-wheels, etc. Thus it is not advisable to get any part of the motor within the line of the chain wheel. A good deal of attention has been paid in recent years to the width of tread, but this is not a point that should worry the designer of a motor bicyle. If the motor is a good one it will not need much pedaling, and so far as sitting still is concerned, it is quite as comfortable to sit with feet a little wider apart than is the case upon the pedal-propelled safety. It is also necessary to get the motor in a position where it will secure a draft of cool air, but not so as to cook the rider.

Another point requiring careful consideration is the inclination of the cylinder. It is much better for the motor to be run vertical, and it is certainly much preferable for the valves to be in an upright position, since in that position they are much more reliable in their action. When the inclination is great, it is possible that the motor will run all right for a time, but it cannot be expected to give continued satisfaction. There is certainly some scope for ingenuity in the arrangements of the various taps and levers, etc., and all electrical apparatus should be worked from the handle, since it is often very awkward for one to loose the grip of the handle in order to attend to taps arranged along the top rail or elsewhere. After some remarks upon the necessity of good brakes, Mr. Leechman spoke of the tendency in some quarters to substitute chain driving for belt, and when one remembers the high pitch to which the art of chain-making has been brought, it is easy to see that good results are possible. Upon an ordinary cycle the chain is good, but upon the driving gear of the motor there is no dependence upon muscular energy, so that if the belt is quieter it is preferable.

—*The Bicycling World.*

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. I. No. 6. BOSTON, APRIL, 1902. Ten Cents a Copy

A WIMSHURST INFLUENCE MACHINE.

E. H. Williamson, Jr.

Almost the first piece of apparatus which the amateur in electrical experiments wishes to construct is a machine to generate statical electricity. It used to be called "frictional" electricity, and the term was no misnomer. I distinctly remember how my arm used to ache while grinding away at the first machine I constructed, with the amalgamated cushion screwed tightly against the old wine bottle which served as a cylinder. But such a primitive instrument soon ceased to satisfy my ambitions, and, after numerous experiments and failures, I at last succeeded in making a Wimshurst Influence machine which, although crude in appearance, worked well and seldom refused to generate even in the dampest weather. It was built with such tools as are usually to be found in the amateur workroom, and without using a turning lathe. This invaluable accessory to the workroom I did not then possess, and it can be dispensed with in constructing this electrical machine, although it would simplify the making of some of the parts considerably.

The tools that are absolutely necessary are as follows: a cross-cut saw, compass saw, hack saw for cutting metal, breast drill to hold drills up to $\frac{1}{4}''$, $\frac{1}{4}''$ and $\frac{1}{2}''$ twist drills, square screwdriver, large rough file for wood, small flat file, small vise, a bit brace and one each $\frac{3}{4}''$, $\frac{1}{2}''$, $\frac{3}{8}''$ bits, wire pliers and pincers, shears for cutting thin sheet metal, soldering iron, solder and flux. The directions given here below are for a machine with plates 15″ in diameter as, in my opinion, there is no economy in smaller sizes.

I will endeavor to give the reader full detail for each portion of the work, thus avoiding the difficulties which I had to overcome by experiments. In the first place, hunt up an old cardboard box, such as the tailors use for sending home suits, selecting one with a heavy lid and bottom and at least 15″ across. Take a pair of pencil dividers and lay out a circle 15″ in diameter on each piece of card, marking the center plainly with a pencil or pen for future reference. Cut out the two circles, following the pencil lines carefully, and, armed with a tube of photo-paste, carry them to the nearest paint and glass store. Select two sheets of

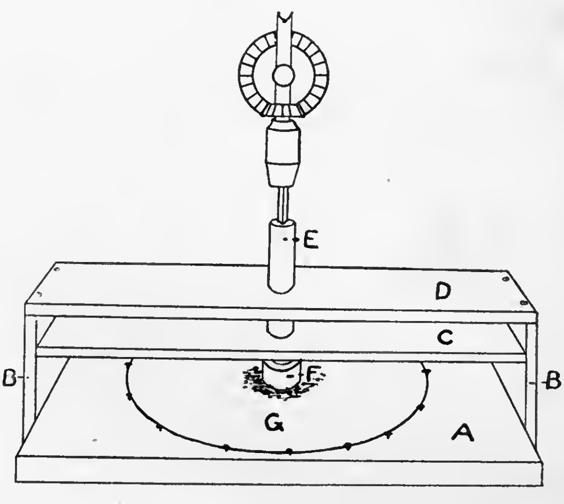


Fig. 1.

clear window glass, lay them on the counter and paste on the cardboard circles, one on each glass. The glass should be of such size as to leave an inch margin at least, around the card pattern. Now get the glazier to cut smoothly around the card with his diamond, and break away the surplus glass. This makes a better job than trying to do it yourself with a steel wheel glass cutter.

Having carried home the plates, we will prepare for the hardest part of the work, that is, cutting the holes in the center of the plates. The best method to accomplish this is that suggested by Mr. George Hopkins in his book "Experimental Science." (Fig. 1.) Set a piece of $\frac{3}{4}''$ board 18″ square, also two pieces 4″ wide and 6″ high, B 13. These are nailed to the ends of A. Two pieces 4″ wide, one 16″ long, C, and one 18″ long, D, are nailed across from B^1 to B^2, as shown in the figure. In the center of D, bore a perpendicular hole $\frac{3}{4}''$ diameter, straight down through D and C, but not into A. The board C should be fixed 2″ above A. Buy a piece, F, of copper pipe $\frac{3}{4}''$ diameter and 1′ long. File both ends square. Select a broomstick $\frac{3}{4}''$ thick and from this cut a piece, E, 7″ long and cut away one end until it can be forced firmly and square into the end of the copper pipe for half an inch.

This is the drill for the glass, and the best method of revolving it is to put a dull bit in your breast drill and start boring a hole in the center of the upper end of the broomstick standard E. If a breast drill is not available, a bit stock will answer, but much care must be used. Detach one of your cardboard discs from the glass plate and with your compasses strike a $\frac{3}{4}''$ circle, using the old center. Lift the copper tube F, and slide the cardboard on to A, until the tube rests exactly on the small penciled circle, and fasten the card in that position. Now lay your glass circle upon the card so that the edges coincide exactly, and fasten the glass immovably with small screws at the edge. Get some fine emery powder (No. 80) and turpentine, and having wet glass and tube with the latter, scatter some emery on the glass under the drill, and commence turning the breast drill slowly. Do not press too hard, but let the drill cut slowly and steadily. Renew the turpentine and emery frequently, and, with care, the plate can be perforated in about twenty-five minutes, leaving a smooth round hole a little over $\frac{3}{4}''$ across. Just before the drill breaks through is the critical moment, and exceptional care must be used at this time.

Cut the second glass the same way, and when both are bored take a small file, and having wet it well with turpentine, cut a little niche on opposite sides of each hole, working very gently. The plates may be put aside now for the present, while we turn our attention to the frame of the machine.

The base, H (Fig. 2), is of 1″ white pine, 8″ wide and 20″ long. The uprights, I^1 I^2, are of 1″ pine, 10″ high and 6″ wide at the bottom, cut as shown, with sloping sides and a rounded top. The lower ends of these standards are to be cut perfectly square and are screwed firmly to the base, H, in a central position as to the length of the base, and 5″ apart from between the inside faces. A $\frac{3}{16}''$ hole, J, is bored in each, $8\frac{1}{2}''$ from the bottom of each standard. When the latter are screwed in place, the holes should be exactly in line. At each end of the base, H, a $\frac{3}{4}''$ hole is bored in the center, 1″ from the end.

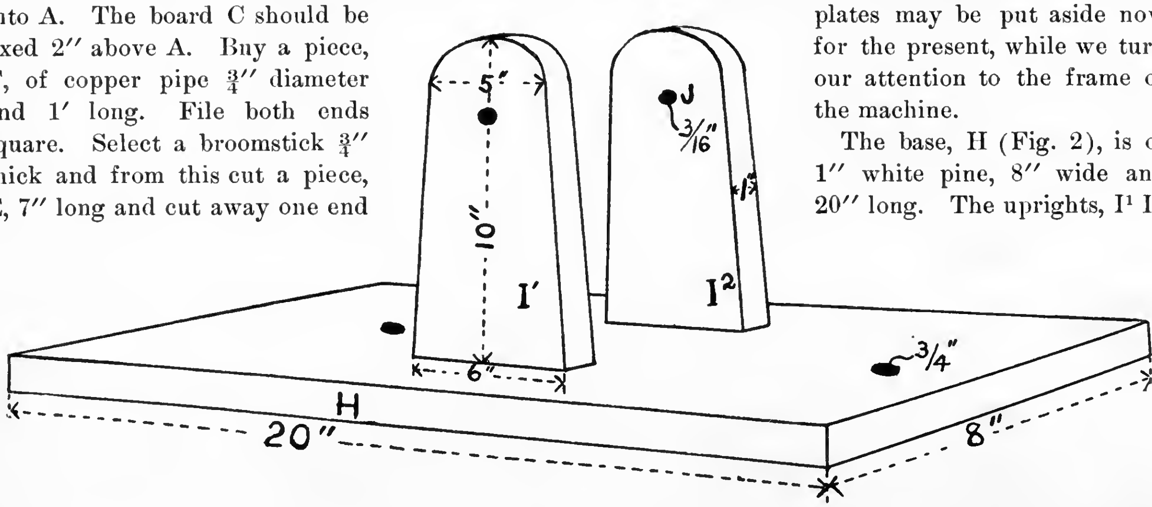


Fig. 2.

Before assembling the frame finally, it is well to put the wood into a moderately hot oven for half an hour and thoroughly bake it. After doing so, while the wood is still hot, coat it all over with white shellac. Let this coat dry thoroughly, and then give it another. This portion of the frame may now be laid aside for the present, and the mounting of the glass plates considered. Procure two large spools, such as patent thread is sold upon, and some cigar-box wood, which should be a little thicker than the glass of the plates. Also get a piece of thin sheet brass, about No. 26 stubbs gauge, 10″ x 4″, a piece of ¼″ steel rod, smooth and round, 9″ long, and 10′ of No. 10 brass wire. At a store where they sell iron bedsteads get 9 of the ½″ and one of ¾″ round brass balls such as are used to ornament the bedsteads. From an electric supply house get two pieces of hard rubber tubing ¾″ outside diameter and 9½″ long.

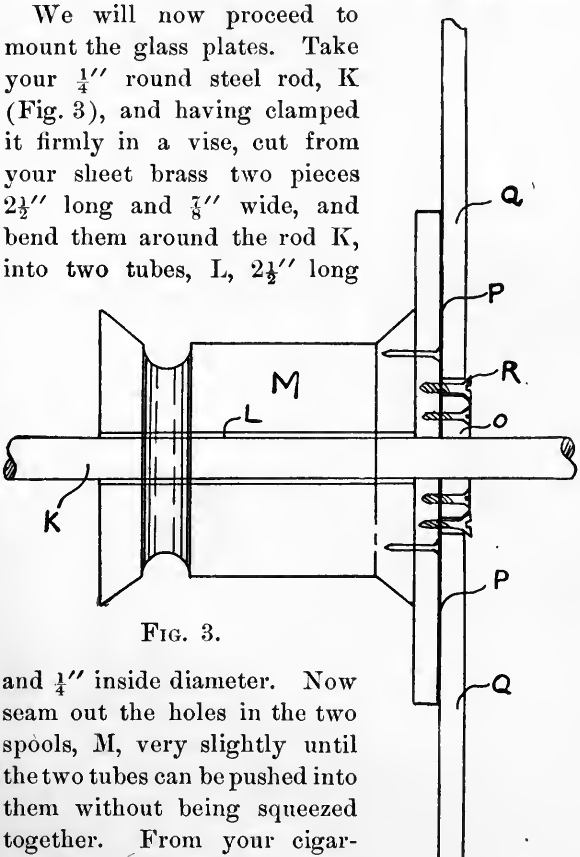


Fig. 3.

We will now proceed to mount the glass plates. Take your ¼″ round steel rod, K (Fig. 3), and having clamped it firmly in a vise, cut from your sheet brass two pieces 2½″ long and ⅞″ wide, and bend them around the rod K, into two tubes, L, 2½″ long and ¼″ inside diameter. Now seam out the holes in the two spools, M, very slightly until the two tubes can be pushed into them without being squeezed together. From your cigar-box wood cut out with a sharp knife two circular pieces of 3″ diameter and two of ¾″. Mark the centers, and bore a ¼″ round hole in the exact center of each. Take one of the spools and nail one of the 3″ pieces, N, on one end, so that the hole in N corresponds exactly to that in M. The ¾″ piece, O, is then fastened to the face of N, observing the same precautions to get the hole in O opposite that in N. This is very important, as any eccentricity in O will make the plate turn unevenly. Glue a ring of paper, P, on the face of N, and slipping the glass plate into place so that it rests against N with the circle O projecting through the hole in the glass, take two very small screws, R, and screw them into N through the notches in the plate mentioned earlier. These will prevent the plate from turning.

To test the mounting for accuracy, slip the spool and plate over the rod K, for an axis, and spin the former gently round. It should turn easily, but not be loose enough to rattle, and the glass must revolve smoothly and evenly without wobble or eccentricity. If any such defects appear, the plate should be loosened from the spool and adjusted by shifting until it runs truly. When this position is found and marked, remove the plate, and coat both paper ring and plate with Van Stan's cement, and replace the glass, pressing the cemented surfaces together and putting in the screws again to hold all firm. The use of the paper is to allow the thorough adherence of the glass to the wood, the paper acting as a connecting link between the two. The other plate having been mounted in a similar manner, both should be laid away until the cement sets, which will take a couple of days.

We will now take up the making of the collecting combs and dischargers, shown in Fig. 4, in perspective. Take the hard rubber tubes, S, and fit to them two round plugs, T, ¾″ long and thick enough to fit tightly into the tubes. Through the center of these plugs bore $\frac{3}{16}$″ holes and drive a ¼″ machine screw 1¼″ long through the holes, so that ½″ of thread projects from the end of the plugs. Cut from the No. 10 brass wire two pieces of 9½″ long and bend them as shown in U, with a partly closed ring at the center, ¼″ inside diameter, and then out in opposite directions at an angle of 45 degrees for 1″, then straight again for 3¼″. The bends should be made symmetrically, so that the 3¼″ arms are parallel and 2″ apart. The four ends of these arms are scraped bright with a file, and wet with soldering fluid, and four of the ½″ brass balls are soldered on the ends by the following method: Heat the ball for a few moments, place in a vise and pour melted solder in the hole until the ball is full. While the solder is liquid, insert the end of one of the arms for ¼″ and hold until the solder sets. Smooth all roughness from the joint with a fine file and emery paper. The combs, V, are made from strips of brass 3″ long, 1″ wide, with saw teeth ¼″ deep cut in the edges, as shown. The strips are folded lengthwise over the ¾″ arms, so that the teeth of the two sets face each other, and are soldered to the arms.

For the arms, W, two pieces 6″ long are cut from the No. 10 wire. One end is bent in a ring ¼″ inside diameter, and the joint of the ring is closed with solder and smoothed. In constructing the machine throughout, care must be taken to avoid sharp edges and corners, to prevent the escape of electricity, excepting of course the teeth of the combs. The other end of the arm, W, is turned up for ¼″ and holds a ½″ ball, X, soldered to it, as before described. In the top of the ball

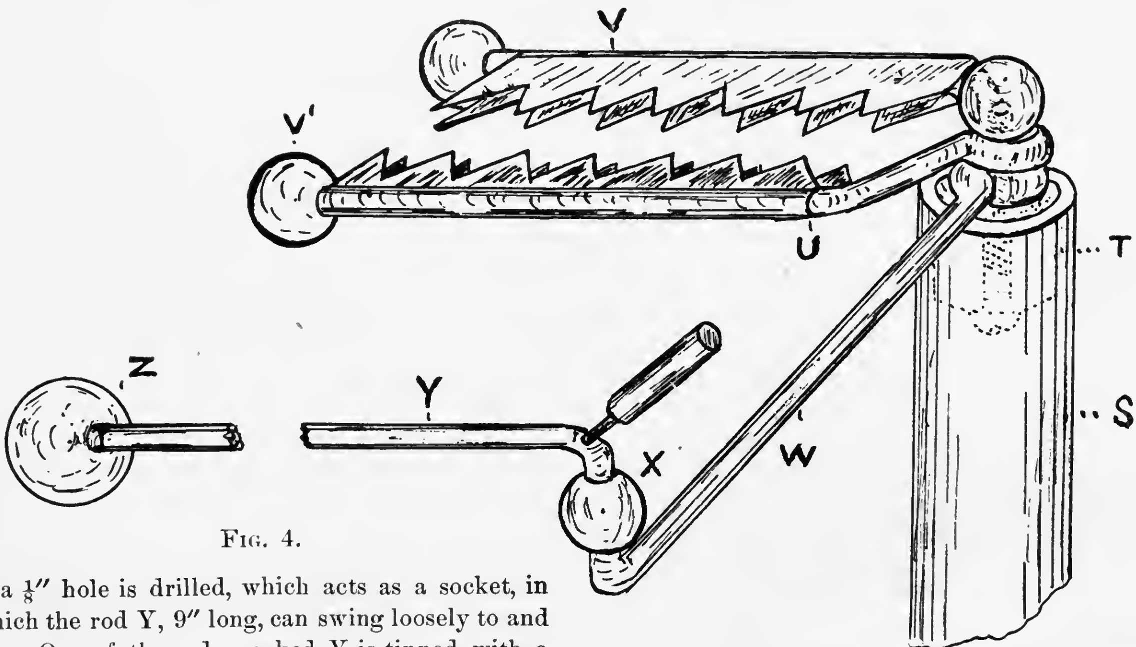


Fig. 4.

X a ⅛″ hole is drilled, which acts as a socket, in which the rod Y, 9″ long, can swing loosely to and fro. One of the rods marked Y is tipped with a ½″ ball, the other with the ¾″.

We will now make what are called the neutralizing bars. Cut two pieces 24″ long from your brass wire, A′ (Fig. 5), and bend them into half-circles 10″ in diameter. Solder strips of brass, B′, 1″ long x ½″ wide across each wire at its center, and drill a small hole at each end of the strips. From your broomstick cut two sections ½″ long, C′, and bore a $\frac{3}{16}$″ hole through the center of each. The wires A′ are now fastened by the strips B′ to the end of the wooden blocks C′, as shown in Fig. 5.

Our next job is to make 64 sectors of tin foil to be placed on the glass plates. Fig. 6 gives the size and shape sector required. The best way to cut these sectors is to make a die stamp of sheet tin 1″ wide nailed to a piece of wood corresponding to the outline of Fig. 6. The ends of the tin should be soldered and the cutting edge filed away until fairly sharp. A block of wood 3″ x 4″, sawed square across the grain, is used for a cutting board. Buy seven or eight sheets of heavy tin foil (it comes about 6″ x 8″) and fold it into a package 3½″ long x 1¼″ wide, having ten layers of foil in it. Lay this package on top of the cutting block and place the die stamp, sharp edge down, on it, leaving a margin all around. If a flat piece of wood is now laid on top of the stamp and struck gently with a hammer, the stamp will drive through the layers of foil, cutting the ten sectors out neatly. This operation must be repeated seven times, which will give us several extra sectors in case we spoil any. We will now take one of the 15″ circular cardboard patterns and, from the original center, draw two circles, one 14″ and one 11″ in diameter. Divide the outer circle into 32 equal parts, and draw lines from the center of the circle, cutting these divisions. The glass plates should now be laid on the cardboard discs, spool side up, so that the edge of plate and edge of card coincide. The lines on the card will show plainly through the glass and are used as guides for attaching the tin-foil sectors. These are wet on one side with shellac, and attached to the upper side of the glass, upon the space between the 14″ and 11″ circles, with the center of each sector over one of the 32 radial lines.

We will now take up the method of revolving the two plates in opposite directions. Purchase two cast-iron screw wall pulleys 4″ diameter and remove the grooved wheels by knocking out the pins. Get a piece of iron rod 12″ long which will fit tightly into the holes in the wheels. Bend the rod in the middle at right angles for 3″ and then straight again for 3″, making a crank. Take a piece of pine 5″ wide and 10″ long and 1″ thick, D′ (Fig. 7), and screw it to the bottom of the base

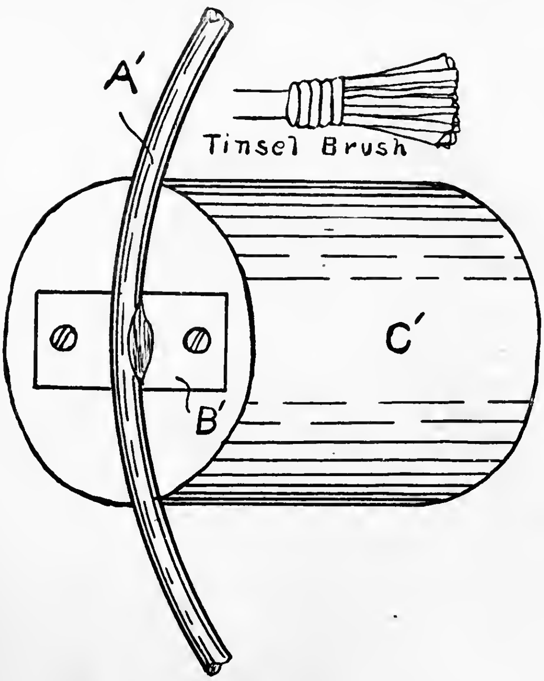


Fig. 5.

H, allowing it to project 6″ beyond the end of the base. Two upright supports, E′ (Fig. 7), 3″ wide, 5″ high and $\frac{1}{2}$″ thick are now screwed to the sides of D′ at the far end, and $\frac{1}{4}$″ round notches are cut in the center of the top edges to hold the axle of the pulleys. The pulleys are now driven on the iron rod, the first two within 1″ of the crank and the second 1″ from the other end with 4″ between them. A 3″ piece of broomstick is now bored and forced on the crank for a handle. The whole thing can then be placed in the notches provided, and held in place with small strips of wood, previously notched, screwed over them.

Having revolved the pulleys with the crank and found that they turn truly and easily, we will remove them from the standards and put them aside while we assemble the machine. Take the base H (Fig. 7) and screw the rear standard I firmly in its place. The steel axle K (Fig. 3) is now slipped into the hole in I, and the two glass plates and spools are slipped onto the rod K, with enough cardboard washes between them to separate them $\frac{3}{16}$″. The plates are set face to face with the spools outward. Support the loose end of K and guide it into the hole in the front standard I′, which is then moved into position and screwed in place. The ends of K should project 1″ beyond the outside faces of the two standards.

The two neutralizing bars must now be tipped at each end with a small metallic brush. This can be made of either tinsel from a card of pearl buttons, or of very thin sheet copper. The tinsel or copper is cut into strips $\frac{1}{16}$″ wide and $1\frac{1}{2}$″ long, about 15 being needed for each brush. They are bunched together and $\frac{1}{2}$″ of the length is fastened to the ends of the bars by whipping them with fine wire. The bars having been thus prepared, the wooden block C′, to which they are attached, is thrust onto the end of K until the tinsel brushes just touch the tin-foil sectors on the plates. They

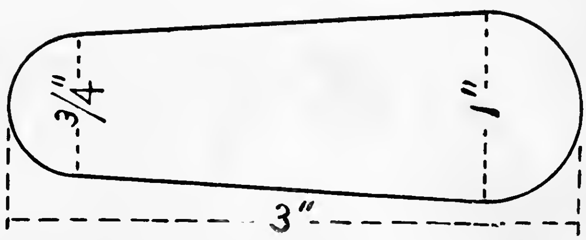


Fig. 6.

should touch the middle of the sectors, and any adjustments should be made by bending the wire arms. The lighter they touch the sectors, the better, so long as they are in contact during the entire revolution of the plates.

The blocks C′ should be turned on the axle K until the bars lie at an angle of 45 degrees from the perpendicular and 90 degrees with each other. The front bar should slant from right to left and the rear bar vice versa. The hand rubber rods S (Fig. 4) are now set in the holes at each end of the base, H, being forced to the bottom and glued. When these are dry, insert the two plugs T (Fig. 4) in the tips of the tubes, allowing the end of the machine screw to project $\frac{1}{2}$″. Slide the combs U,

Fig. 4, into place, so that they embrace the sides of the glass plates, and slip the rings of U over the projecting ends of the screws. The rings in the ends of the arms, W, are set on top of those of the combs, and one of the brass balls is screwed down on both, clamping all firmly.

A convenient method of swinging the arm Y is shown in Fig. 7. A small hole is drilled at the bend of Y, and a copper wire having a short cylinder of wood attached, is inserted in this hole and soldered. One handle is sufficient. In order to take the strain off the arms, W, they may rest on a length of ½″ glass tube, as shown in (8)

stick the point of a large double-pointed tack through the holes, and bend the points together with a pair of pliers. The belts may now be sprung back onto the grooved pulleys, and should then be fairly tight, but not so much as to spring the shaft K. As the belts must remain parallel to the plates while running, it is desirable to cut round grooves in the spools with a half-round file to keep the belts from wandering from the center. The machine itself is now completed, but as in experimenting it is much more satisfactory to have condensers, I will describe a simple method of making them.

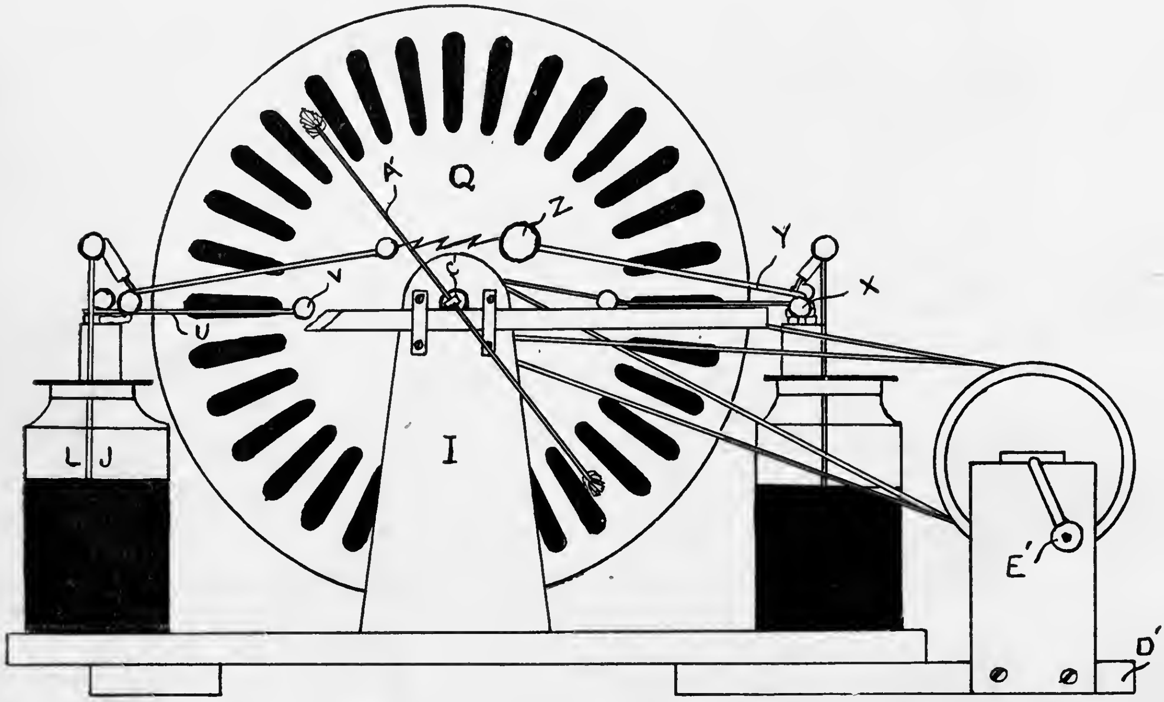


Fig. 7.

Fig. 7, the tube being clamped to the face of the standard, I, with a strip of brass.

The only thing that now remains to be done to complete the machine is to connect the spools and pulleys by belts. Get two pieces of ¼″ round sewing-machine belt 32″ long each. String the belt around the spools and in the grooves of the pulleys, and draw the ends of each belt together until within an inch of each other, having the rear belt crossed. Punch a little hole ¼″ from the two ends of each belt, and, having thrown them off the grooved pulleys, put the ends together and

Get two wide-mouth pint jars, such as candy dealers use for storing stick candy. They should be of white glass and fairly thick. These jars should be washed clean and then shellacked all over and covered with tin-foil inside and outside, including the bottoms, up to ⅔ of their height. Two flat, thick corks to fit the mouths of the jars are now procured, and two circular pieces of cigar-box wood, a little larger than the mouths of the jars, are cut out. The wooden circles are glued to the tops of the corks, and both are shellacked.

(Continued on page 147.)

3-4 H. P. GASOLINE ENGINE.

C. E. Spaulding.

It is the object of this article to furnish the reader with a design and description of a gasoline engine for light stationary use, in as few and plain words as possible, in order that every part of the work may be thoroughly understood.

The engine here described is of the two-cycle type; that is, the working cycle is divided into two parts, getting an impulse at each revolution of the crank. The general working of this engine is as follows: The gasoline (which to give satisfactory results should be of the 74° quality) is fed from the tank to the vaporizer, where it is mixed with the proper amount of air and then drawn into the crank case by action of the piston on the upward stroke. It is compressed by the downward stroke, and, as piston uncovers the transfer or inlet port, the compressed charge is forced into the cylinder and again compressed by the upward stroke, and ignited by an electric spark when piston is nearly at top of stroke. The expansion of the ignited charge forces the piston downward, the burnt gases being expelled through the exhaust, which is uncovered by the piston in advance of the inlet port.

It would be well, perhaps, to divide this description under different headings and describe each separately, as follows:

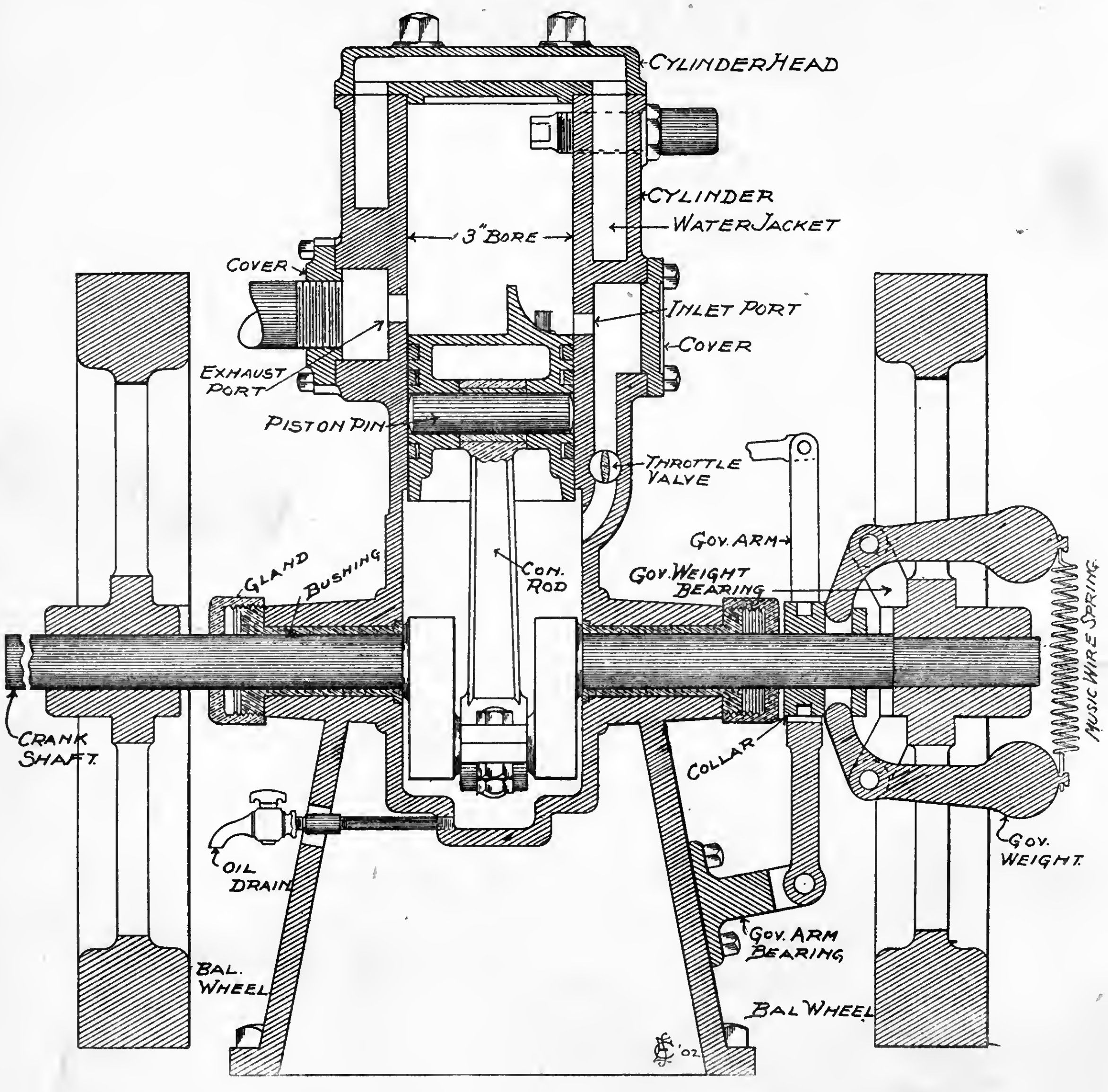
The cylinder, cylinder case, cylinder head, governor, throttle valve, ignition mechanism, piston and piston rings.

The cylinder (as well as case, head, governor, piston, etc.) is made of cast iron, is bored and reamed 3″ in diameter. The top and bottom are rough-turned to allow tight fit for cylinder head and bottom half of crank case. The port faces are also planed to allow for fitting of covers. The cylinder contains a water jacket, or space of $\frac{1}{2}$″ between outer and inner walls to allow for circulation of water. The reason for this can be better understood with a few words of explanation. The explosions in the cylinder vary from 100 to 500 per minute, so it can be readily seen that the heat to which the cylinder walls are subjected is very great. Should these walls reach a temperature above boiling point, the charge of gas would explode at the wrong moment, causing premature firing; therefore it is essential to use a circulation of water to keep the cylinder cool. It would be well to mention the fact that the boring of cylinder is the most important of all the machine work, as it is essential that the cylinder should be perfectly true and smooth. The cylinder contains two oblong openings, front and rear, to allow for use of tools in cutting ports to the required sizes. The inlet port has two openings, $\frac{1}{2}$″ by 1″, and a $\frac{3}{16}$″ web in center. The exhaust port has two openings, $\frac{5}{8}$″ by 1″, and also a $\frac{3}{16}$″ web in center. At the top of the cylinder are two bosses; one is drilled ($\frac{3}{8}$″ in diam.), to allow for spark pin, while the other is tapped out with a $\frac{5}{8}$″–20 thd. for bushing of igniter lever.

The cylinder case, while answering the purpose of a reservoir for gas, also performs another important function. There is placed in this case a sufficient amount of oil to cover the end of the connecting rod, which becomes lubricated by splashing in the oil. This is considered the best way of ensuring perfect lubrication of this part of the engine; furthermore, it is the safest, as it takes no thought upon the part of the operator. In the side of case is a $\frac{1}{8}$″ pipe tap, for the drawing out the oil.

Gas Engine.

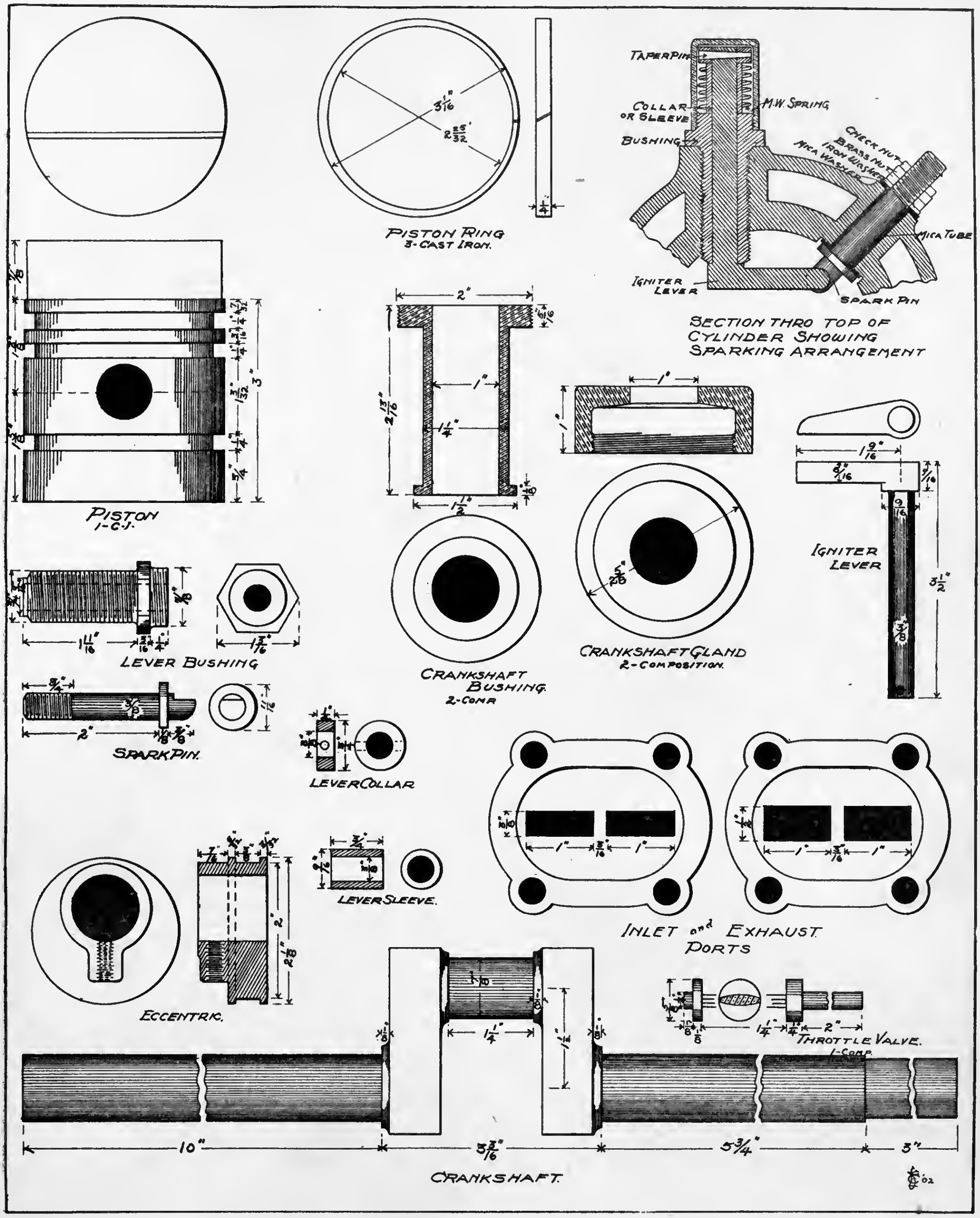
The cylinder head needs but very little description. It contains a water jacket similar to the jacket in cylinder. Two holes are drilled through the face of head, to correspond with holes drilled in top of cylinder, into the jacket to allow for the circulation of water. It is just as important that



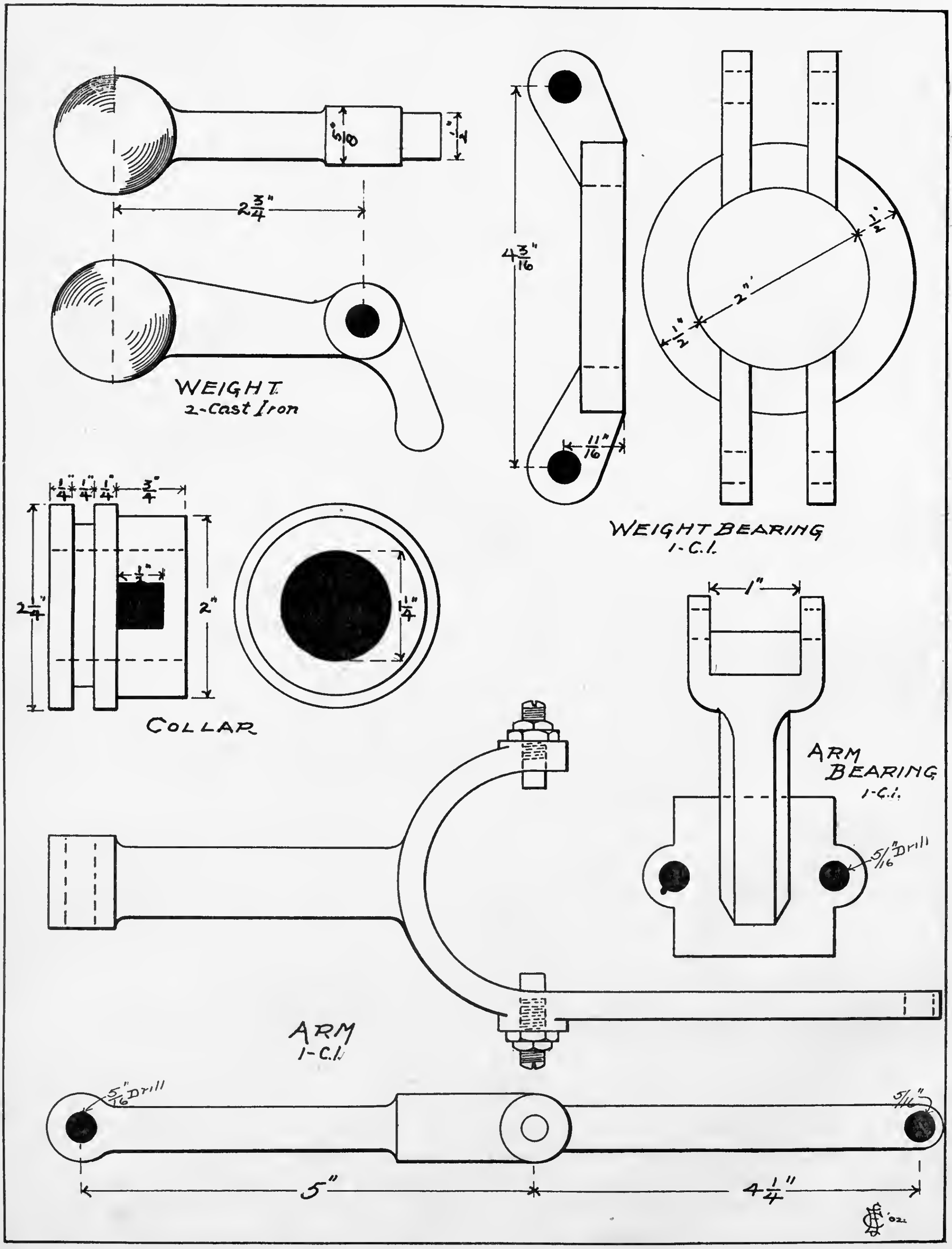
the head should be kept cool as the cylinder, as the explosion takes place at this point. The cylinder head should be given a rough cut, as was specified in regard to the corresponding surface on the end of the cylinder. This is done to make the packing hold better and save blowing out. The head is tapped for $\frac{3}{8}''$ pipe for water outlet, and is fastened to cylinder by four $\frac{5}{16}''$ by $\frac{7}{8}''$ cap-screws.

The above is a general description of the main parts of the engine; we will proceed with the finer and more important portions, drawings of which accompany this description. Before taking up the description of the governor it would be well to explain the construction and action of the throttle valve. The valve is turned to $\frac{3}{4}''$ diameter, and a corresponding hole is drilled in the transfer port, also tapped for bushing, to which a stuffing nut is attached. This valve, termed a "butterfly valve," controls the amount of gas to be admitted to inlet port. Attached to the lever arm of valve is a connection running to governor arm.

The governor comprises two weights, weight-bearing, collar, governor arm and arm-bearing, as shown in drawing. The governor weights are attached to the weight-bearing by means of $\frac{3}{8}''$ steel



pins with split pins on each side, or with cap-screws with nuts. The bearing is fastened to the hub of the balance wheel. On the collar, which is bored out to a sliding fit on crank shaft, is cut a $\frac{1}{4}''$ groove. When the weights are in their normal position, the nose of each rests in corresponding holes, which are cored in collar when casting is made. In the yoke of the governor lever are



WEIGHT.
2-Cast Iron
2 3/4"
4 3/16"
11/16"
2"
1/2"
WEIGHT BEARING
1-C.I.
COLLAR
2 1/4"
2"
1 1/4"
1"
ARM BEARING
1-C.I.
5/16" Drill
ARM
1-C.I.
5"
4 1/4"
'02

fastened two steel pins to fit in groove of collar. Fastened to the extension on the arm is a rod running to valve handle. As the speed of the engine increases, the weights are forced out by centrifugal force. With this momentum the collar is drawn outward, thereby drawing the governor lever and closing the throttle valve. The decreasing of speed would consequently allow the valve to assume its former position.

The piston and rings, which should be carefully turned to ensure perfect fit, are made of fairly hard gray cast iron, and will hardly need any description.

The crank shaft bushings are a very important part of the engine, and also the stuffing gland attached to same. These glands, or stuff nuts, not only ensure perfect tightness of crank case, but also add to the length of bearing of shaft.

The sketch of the eccentric can hardly be considered in this description, as it is used only when the circulation of water is forced by pumping. The eccentric is used in connection with the eccentric strap, which operates the pump.

One of the most difficult problems in designing a gasoline motor is the sparking mechanism. It is usually found to be very intricate, made up of numerous levers, cams, etc., which are easy to get out of order. The igniter of this engine has been used and found to be very satisfactory. The method of exploding the gas in the cylinder is known as the "make and break" type igniter, and is so designed that the two points (usually platinum), one on the insulated pin, and one on the arm of the lever, are held together, and then separated with a jerk, by the small pin on piston striking the igniter lever. This makes a quick break in the circuit, so that the spark may have the highest possible voltage at the moment of the break. As the drawings fully show the construction of this part, it will be only necessary to explain the operation of the igniter itself, in order that the action may be fully understood. The spark pin or electrode is set stationary, and insulated by mica tubes and washers, which form the terminus of one side of the circuit. The other electrode or igniter lever is free to rotate on its axis, and is made gas tight, by being ground pointed at the shoulder, against the end of the bushing. This is held in place and under tension by means of the piano-wire spring, which is fastened, one end on the collar, and the other end on the bushing. The collar, if so desired, may be fastened to the lever by a taper pin. The tension of the spring also holds the arm of the lever against the spark pin. The spring is made extra long, as the tendency would otherwise be to shorten when wound and cause an uneven tension, which might cause the lever to bind against the bushing. The small pin, set in the top of the piston to strike the igniter lever, should be adjusted so that it will lift the lever to make the break in the circuit just as the piston has reached the top of the stroke.

It might be well to assure the reader that the dimensions on drawings and in descriptions are correct, and the results obtained from engines which have been built from this design have been more than satisfactory.

BOOKS RECEIVED.

Bookbinding, and the Care of Books. Douglas Cockerell. Appleton & Co., 156 Tremont Street, Boston. 342 pages, 5 x $7\frac{1}{2}$ inches. Cloth, $1.20 net; postage, 8 cents.

Those who are interested in bookbinding will welcome the publication of "Bookbinding, and the Care of Books," by Appleton & Co. The author, Douglas Cockerell, treats the subject in a full and practical way, that will be very helpful to those amateurs who desire to learn to do this work. The professional worker, librarians and book-owners generally, will find in it much valuable information. Numerous illustrations supplement the text very completely, nearly every tool and process being adequately shown. This is the first of a series of "Technical Handbooks on the Artistic Crafts." A volume on "Cabinet Making and Designing," by C. Spooner, is in preparation.

A cable dispatch from Paris of March 1 to a New York daily newspaper reports a curious lawsuit pending between the Nice Observatory and a local electric tram car company using the Thomson-Houston system. The observatory authorities say that the electric instruments in their magnetic department were so much disturbed by the electricity of the tram cars that they were obliged to transport all the instruments to another observatory on Mount Mounier, at a cost of $20,000. They contend that the company ought to pay the cost, and the company is fighting the case.

AMATEUR WORK

85 WATER ST., BOSTON

F. A. DRAPER . . . . Publisher

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

APRIL, 1902

Contents

THE METRIC SYSTEM.

The rapid expansion of the foreign trade of the United States seems likely to produce what years of argument have failed to do; that is, the adoption of the metric system as the general standard for measurements. A bill now before Congress provides that this system shall be the official standard for the various departments of the government. If the bill becomes a law, and it has the support of many influential, commercial and scientific bodies, the general use of the system would follow as rapidly as existing business conditions could be adapted to it.

While the business of this country was almost entirely local, no great necessity seemed to require the change, but with the great increase in trade with foreign countries, most of which required custom and other trade documents expressed in the metric system, the difficulties accompanying the use of two systems have multiplied and given a new aspect to the question.

As the change is towards increased simplicity and ease in calculations and enumerations, commercial necessities will undoubtedly influence a more general recognition of its advantages. The younger generation, with the general training received by technical and other schools, will have no difficulties to contend with, and will undoubtedly welcome and assist in its adoption.

The recent receipt of several interesting articles from readers of this magazine, dealing with subjects already in preparation by regular writers, leads us to request those who contemplate contributing such articles to advise the editor of their title and scope before writing and sending them, thus avoiding duplication of the work. New articles are desired, and will be accepted when treating of subjects not already provided for. The method above indicated will avoid the rejection of articles that cannot be used for the reasons stated.

Several interesting articles that were to have been presented in this issue are omitted, owing to lack of space. They will be inserted in the May number. The size of the magazine will be enlarged at an early date, enabling an increased number of topics to be presented with each issue.

MECHANICAL DRAWING.

Earnest T. Childs.

VI. ORIGINAL STUDIES.

The subject of sections and section lining has been generally discussed in the last two chapters, and the student needs merely to apply the principles contained therein to obtain satisfactory results. As previously stated, constant application is the price of success, and while the illustrations which are given herewith are good examples for the student, it will be advantageous to go outside and apply these principles on original studies. Let the student take some article which is in daily use, and work up a drawing of it or some of its parts.

For instance, a lawn-mower is familiar to all, but how many know just how it works? This will make an excellent subject for practice, and by the time the student has made a set of detail drawings and an erection drawing, working from the machine itself, he will have acquired a good fund of experience which could be obtained in no better way. The work of measuring up must necessarily be accomplished first, and this will necessitate a sketch or note book, on account of the impossibility of making a neat drawing when working from a dirty, oily piece of machinery. A lawn-mower is, however, no dirtier than many pieces of machinery which have to be oiled. A sketchbook is preferable to a block, as all sketches may be preserved, and oftentimes an old sketch may save time and trouble for the draughtsman. The sketches should, of course, be made free-hand, and as clear and accurate as possible. Due attention must be paid to the relative sizes, so that the sketch will be in good proportion. In other words, make sketches look as much like the object as possible.

In sketching a gear, it will not be necessary to outline every tooth. Simply show two or three and give all the necessary figures for drawing the teeth in detail, covering the number of teeth by a note. It will be found impossible to keep the sketchbook as clean as a drawing, but neatness adds greatly to the ease of reproducing the work on the drawing. If a lawn-mower is not available, a very interesting subject will be a doorknob and lock. Every one can get one of these, and it will be the best possible practice to work up details of the lock and latch complete. These are merely given as illustrations of what may be done.

The important point which must be borne in mind is that original work and original research will be of more help than any amount of copying. When one is working from an object, he can more readily tell just what is most necessary in a drawing to represent that object. The making of free-hand sketches is an important item, and every draughtsman should make it a point to become proficient along this line, as stated above. Care must be taken to preserve the proportions of the object in the sketch.

The novice will experience a great deal of difficulty in making his first sketches, but a little persistence will soon reward him with more and more success. Really, a thorough knowledge of isometric and perspective drawing is necessary, but these are subjects which are to be taken up later. In making sketches of a piece of mechanism, first take the machine to pieces, and then sketch, piece by piece, from the various parts, making one, two or three views of each piece, as may be required. These sketches should be made without touching the parts, in order that the sketchbook may be kept as clean as possible. When the sketches are complete in outline, look them over, and fill in the various witness marks and dimension lines which are required. Then measure the pieces, jotting down the figures in their proper places. This method not only gives as a result a neater sketchbook, but it helps in the making of the working drawing. In making sketches, be careful to do no slack work; make them so that any one acquainted with drawing could use them, and do not trust anything to the memory.

There is one class of sections which has not been described in the foregoing chapters, namely, broken sections. If a portion of a symmetrical object is to be shown, as in the piston rod shown in the last chapter, it is customary to show the broken rod in such a manner as to suggest its shape. This is illustrated by the free-hand sketches (see Fig. 17). These illustrations have been drawn free-hand, to show the character of work necessary for free-hand sketching.

When a surface is to be finished, it is sometimes helpful to indicate in some manner on the drawing

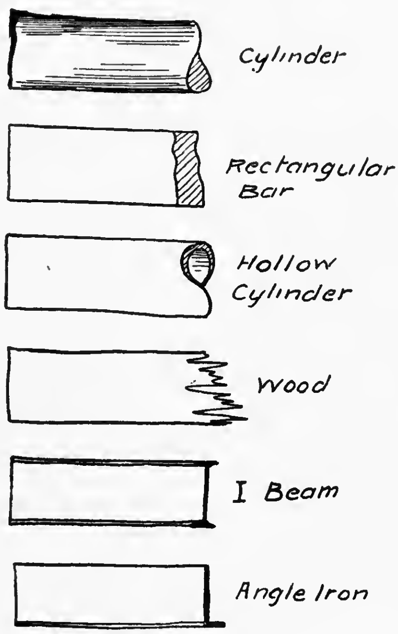


Fig. 17.

that this is the case. The customary way of doing this is to mark a letter "f" through the line which shows the surface to be finished, or to write out the word "finish" in full. The former is the more common. In some shops this is entirely omitted, and it will be seen by referring to the detail drawings accompanying that they have no finish marks. This may be accounted for, in the present instance, by the fact that over one thousand engines of this size have been built from these drawings, and the workmen are sufficiently familiar with the work to render this information superfluous. On new work this detail should never be omitted, and it is particularly essential on drawings from which patterns are to be made, as the pattern-maker has to make a special allowance on work which is to be finished.

In making drawings for structural steel work, it is customary to distinguish on the drawing just what part of the work will be done in the shop and what will be done at the time of erection, or "in the field," as it is termed.

The accompanying sketch (Fig. 18) shows one method which is used by one of the largest steel manufacturers in this country — the Pencoyd Iron Works. This shows at a glance whether a rivet is to be driven in the shop or on the ground, and shows the style of head and which side the head is to be on. The standard dimensions of rivets are as follows:

Diameter shank = 1.

Diameter head = 1.5 + 1/8″ }
Depth head = 0.45 } Finished heads.

Depth head = 0.50 }
Bevel of head = 60 degrees } Countersunk heads.

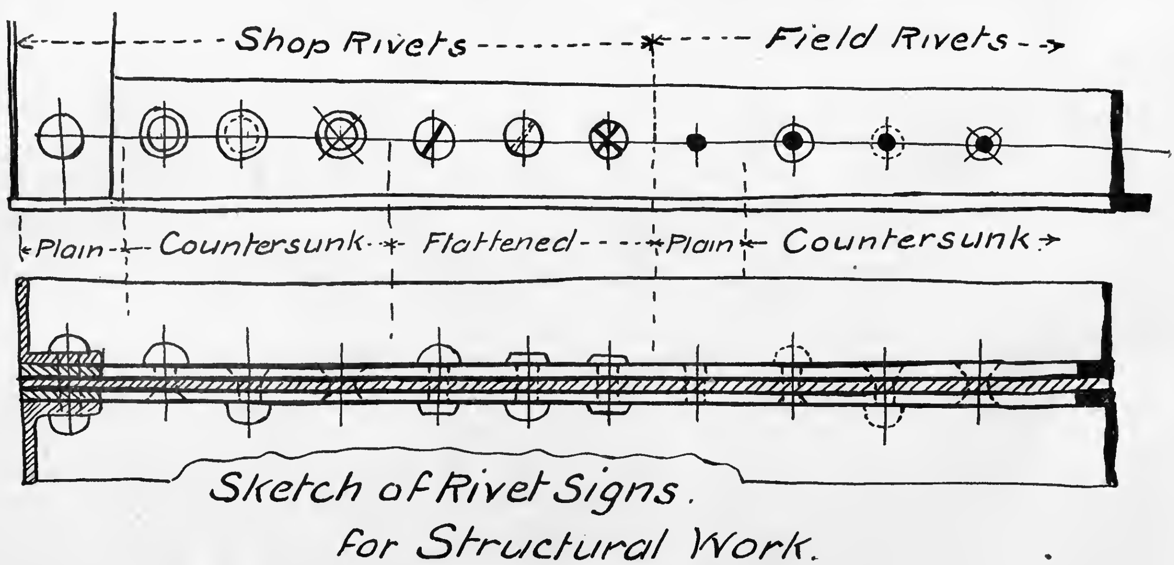


Fig. 18.

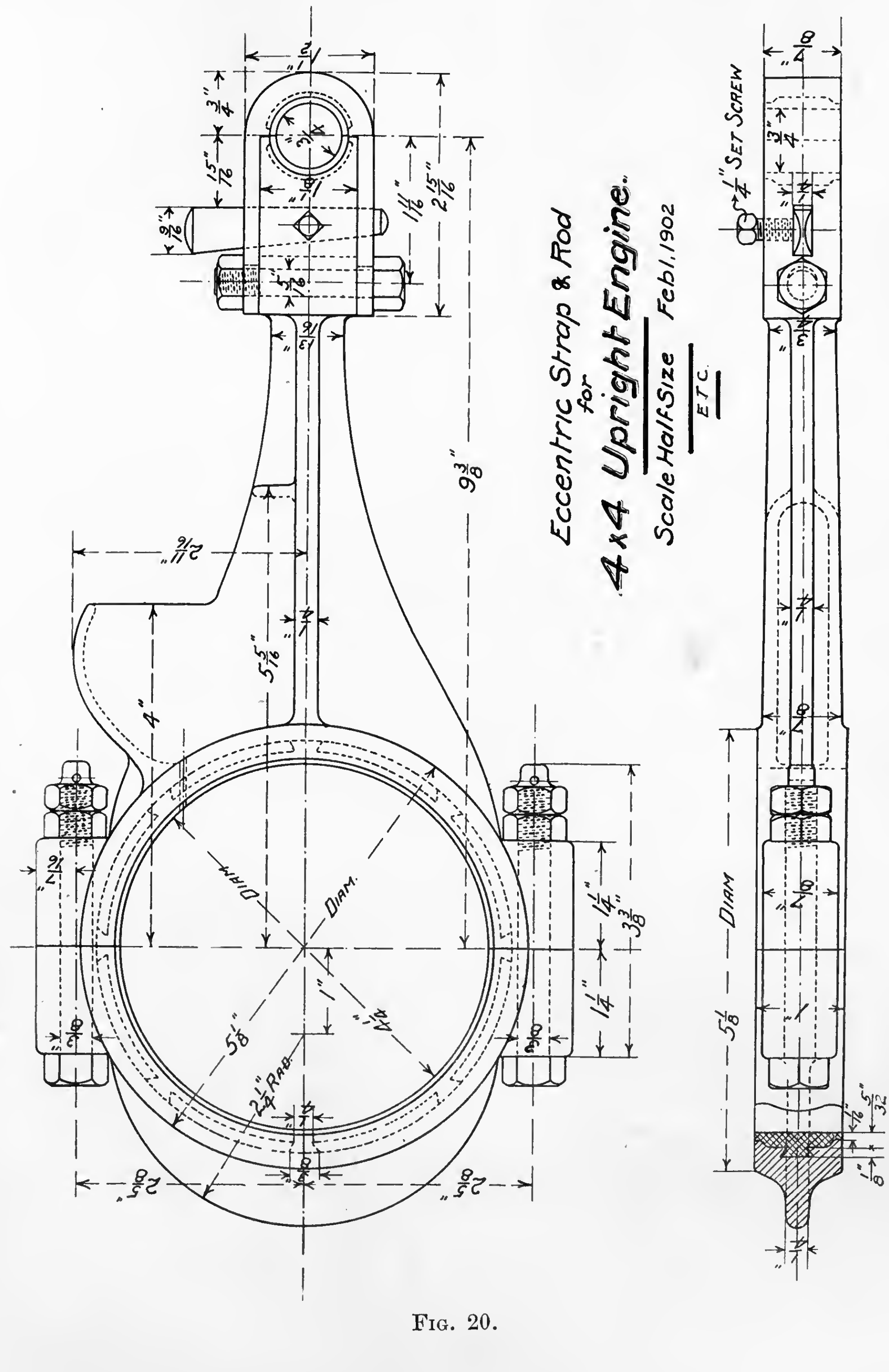

Eccentric Strap & Rod
for
4x4 Upright Engine.
Scale Half Size Feb. 1, 1902
E.T.C.
1/4" Set Screw
DIAM.
DIAM.
DIAM.
2 1/4" RAD.

FIG. 20.

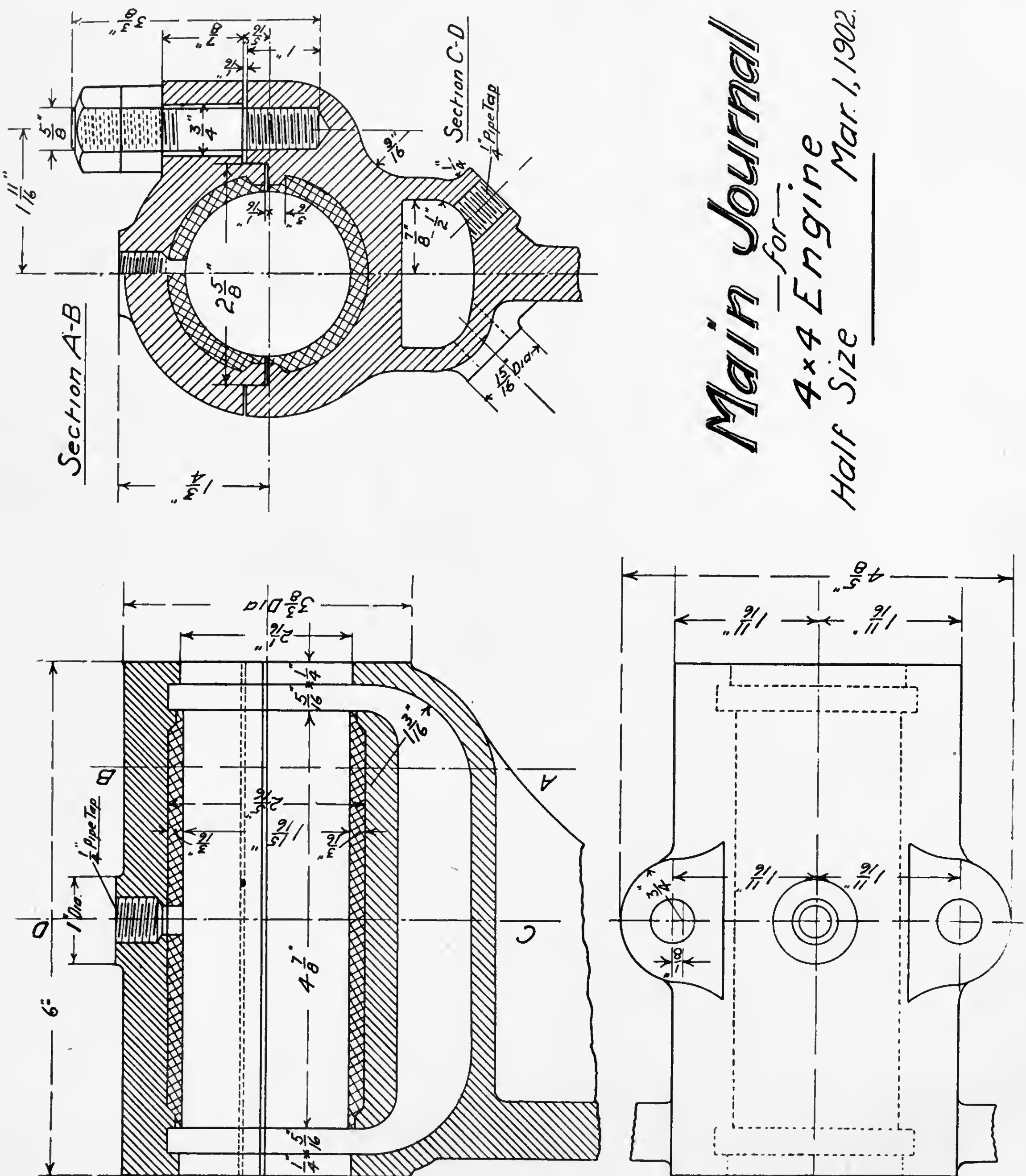

Main Journal
for
4 x 4 Engine
Half Size
Mar. 1, 1902
Section A-B
Section C-D

Fig. 21.

Approximate allowance in length of shank for forming finished head over and above length of grip:

½″ = 1″.	⅞ = 1½″.
⅝″ = 1¼″.	1″ = 1⅝″.
¾″ = 1⅜.	

Approximate allowance in length of shank for forming countersunk head over and above length of grip:

½″ = ⅝″.	⅞″ = ⅞″.
⅝″ = ¾″.	1″ = ⅞″.
¾″ = ¾″.	

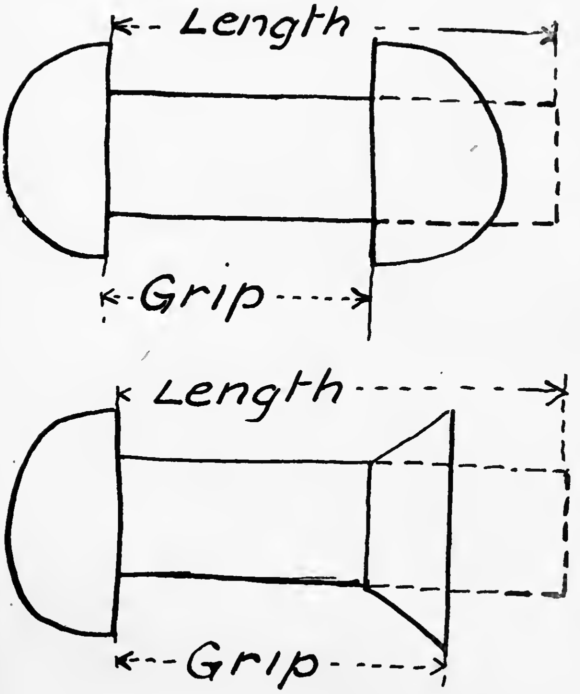


Fig. 19.

For round head add ⅛″ to length for each additional inch of grip; for countersunk head add ⅛″ to length for each additional two inches (2″) of grip. (See Fig. 19.)

The examples for practice in this chapter comprise details necessary before presenting the assembly drawing complete, which will be given in the next chapter. The eccentric strap (Fig. 20) is shown entirely in outline, except that a partial section is shown of the lower half. This was necessary to show the method of holding the Babbitt metal. This will give excellent practice in the use of an irregular curve, and also in the representation of nuts and threads.

Fig. 21, showing the main journal, is a very interesting study. This journal is cast directly to the engine frame, as is indicated by the broken lines; and it is of cast iron, as is indicated by the character of section line. The longitudinal section is shown on the center line, and no special note is necessary. The cross section is broken, the left-hand half being on line AB, and the right-hand half on line CD, thus giving in one drawing three distinct sections.

MAKING PRINTS.

Frederick A. Draper.

The amateur photographer will have made but little progress towards artistic results if the making of prints is not included in the work attempted. This is because the wide range of effects obtainable from a single negative, by using different printing papers, enables the operator to experiment until the desired result is secured. This experimental work with prints also affords valuable information regarding the making of the negative; these two parts of photographic work being dependent upon each other for the final result, the finished print. The amateur who is desirous of doing artistic work should certainly attempt print making as soon as possible after good negatives are being secured.

The necessary equipment includes printing frames, two or three trays, printing paper and the solutions required for toning and fixing. For those who have little or no leisure time during the day, a "gaslight" paper will be the most satisfactory to begin with, and this kind will be considered first. That known as "velox" will probably be most easily obtained by readers of this magazine, as it is for sale by almost every dealer of photographic supplies. It is made by the Nephera Chemical Company, which issues a pamphlet giving directions for its use, and also manufactures the necessary solutions for working it. It is always well to use the chemicals prepared by the maker of a paper, as the responsibility for good results is then solely with one party, in addition to the advantage that the chemicals used were intended for that particular kind of paper.

Of the many varieties of velox, the "regular carbon" and "special carbon" will answer for the first trials. Care should be taken to secure fresh paper, and paper that is thought to be old should not be accepted.

If gas is used, a Welsbach burner is very convenient, as it gives a large volume of light, and varies but little in intensity at different times. A central draught lamp with a glass reflector gives a good light. A table or other support is necessary, with some arrangement for holding the printing frames so that the negative will be exactly in line with the light, and always the same distance from it. The essential point is *uniformity of exposure* to the light, after the necessary time and distance has been once determined.

The package containing the paper should be opened in dim light, and the sheets not used kept covered. A book may be used to hold the necessary sheets previous to printing, thus avoiding the necessity of opening the original package each time. With the first few trials, and until one is quite familiar with the paper, a piece may be cut into narrow strips, with which exposures are made, and the strips developed until the correct exposure is learned. In handling the paper, the sensitive side of the paper should not be touched with the hands, as marks are likely to appear on the print if this is done.

Velox is a paper on which the image is not visible until developed. The process is quite similar to that for developing a negative. After the paper has been exposed, it is immersed edgewise and face up, in a tray containing the developing solution. The tray should be somewhat larger than the print to facilitate handling. The print should be evenly covered with the developer as quickly as possible, so that its action may be uniform. This should be done in a dim light.

If the exposure has been right, the image will appear gradually; and if "regular" paper is used, will be fully developed in about 15 seconds. "Special" paper takes about twice as long. If the print flashes up and grows black rapidly, it has been overexposed. Remove at once and add a few drops of bromide solution to restrain the action of the developer. Rinse once in clear water and continue the development.

When development is completed, rinse in clear water for a short time to remove the surplus developer, and then immerse in the fixing bath. When in this bath, the prints should be kept moving to secure uniform and thorough fixing, and to prevent stains resulting from uneven action of the bath on different parts of the print. Remember that the hands should always be washed without soap and well dried when changing work from developer to fixing bath or the reverse. A tilting holder for trays can be purchased for a small sum, or can easily be made of wood, and, with a glass rod for moving the prints in the bath, the necessity for often washing the hands avoided.

The prints should remain in the fixing bath for 10 to 15 minutes, then placed for an hour in a tray into which water is running slowly from a faucet, or which is changed eight or ten times. The prints should be changed around so that all parts may be cleaned of the fixing solution. In warm weather the time for fixing may be shortened somewhat, or else the tray containing the bath be placed in a larger tray containing water kept cool with small pieces of ice. Use plenty of the fixing bath, and then wash it off very thoroughly. If the washing is not complete, the prints will fade in time. The prints are most conveniently dried by placing them between layers of blotting paper, but this paper must be free from chemicals. Suitable paper may be secured without difficulty. Cut and folded into a book, a few sheets will answer for quite a number of small prints.

The peculiarities of one kind of print being learned, other kinds can be attempted. Bromide, platinum, carbon, blue-prints and bichromate prints all afford interesting possibilities, limited only by the time and inclination of the worker. They all have their special advantages, and are used to produce special effects. The general process of printing one kind having been well learned, the taking up of the others presents but few problems. The increased interest and knowledge resulting from doing one's own work, more than compensates for the short time required to master the essentials of the process.

A STONE which a workman was dressing exploded recently at the Cartnell quarries, Thorold. Several accidents of similar character have occurred there. The quarry is leased by the National Contracting Company of New York. It is thought moisture had got into the blocks, which, freezing, caused them to burst with great force.

PING-PONG, OR TABLE TENNIS.

How to make the Necessary Parts.

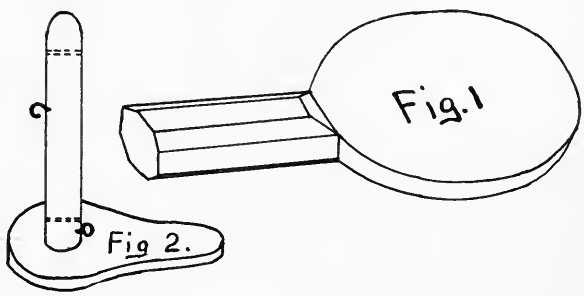
While not a new game, it is only during the last two seasons that table tennis has become well known and generally played in this country. Probably no indoor game affords more healthy exercise, together with sustained interest, than does this one. As the necessary parts, with the exception of the balls, are easily and cheaply made, every one desiring to play the game may do so at little expense. The balls may be obtained from any dealer of sporting goods at 50 to 75 cents per dozen. One-half dozen will last for quite a long time.

The dining-room table will answer nicely provided the leaves are level. A cover of billiard cloth may be used if desired, but the bare board is better. The required space is 9′ long and 5′ wide, and the height should be about 2′ 6″. The rules of the game are the same as for lawn tennis, with the exceptions that no volleying is allowed, and the service should be underhand and from behind the table.

If a dining-room table is not available, a table can be made after the plan of a drawing-board and in two sections. Wide matched pine or whitewood will be the most suitable, the division coming in the center, where the net crosses. The joints of the boards should be carefully smoothed, all the cracks puttied, and then a coating of dull, dark paint applied. The service lines are then painted across each half, parallel with the ends and 31″ from the center. These should be ½″ wide and are connected by a center line, the same width and parallel with the sides. This divides the table in sections of the same shape as for lawn tennis.

If a dining-room table is used, the divisions can be made with tape, the end of which may be temporarily fastened onto the underside of the table top with small tacks. If the table is wider than necessary, side tapes should be placed so that the playing width will measure only 5′.

The battledores or rackets are made of whitewood in the shape shown in Fig. 1. They are ⅜″ thick, 7″ long and 5″ or 5½″ wide. The handles are built up by gluing on extra pieces of the same thickness, and then worked out round or octagonal as preferred. The body should be perfectly flat and smooth. A coating of thin shellac will give a good finish. After the shellac is dry, smooth the body with fine sandpaper. The supports for the net are shown in Fig. 2. The base is ½″ thick, the bottom being covered with leather or felt, which is glued on, to prevent scratching the surface of the table. The post is a round piece of wood ⅞″ in diameter and 8″ high, firmly set in a hole in the base. An old broom handle can be cut up for posts. One inch above the base a hole ⅛″ in diameter is bored through to receive the lower cord of the net. Another hole 6″ above the base receives the top cord. A screw-hook on the out-



side of the post is used for fastening the ends of the net cords. Two cheap iron or wood clamps are used to hold the posts firmly to the table during the game.

The net, which is 5′ long and 6½″ wide, is made of bobbinet, or any coarse curtain lace. The top is bound with inch-wide tape, and the bottom finished with a narrow hem through which a heavy cord is drawn. Also draw a heavy cord through the tape at the top, leaving ends on each cord long enough for tying to the posts. The net is supported by the cords, and the top edge should be 6½″ above the table. This height may be varied between 5″ and 7″.

Rules of Ping-pong.

1. The game is for two players. They shall stand one at each end of the table. The player who first delivers the ball shall be called the server, and the other the striker-out.

2. The server shall stand behind the end and within the limits of the width of the table.

3. The service shall be strictly underhand, and from behind the table; that is to say, at the time of striking the ball the racket may not be over the table, and no part of the racket, except the handle, may be above the waist.

4. The ball served must drop on the table top beyond the net, and is then in play. If it drops

into the net or off the table, it is called a "fault," and counts to the striker-out.

5. There is no second service, except when the ball touches the net or posts in passing over and drops on the table, beyond the net, when it is called "a let," and another service is allowed.

6. If the ball in play strikes any object above or around the table before it drops on the table (net or posts excepted), it counts against the striker.

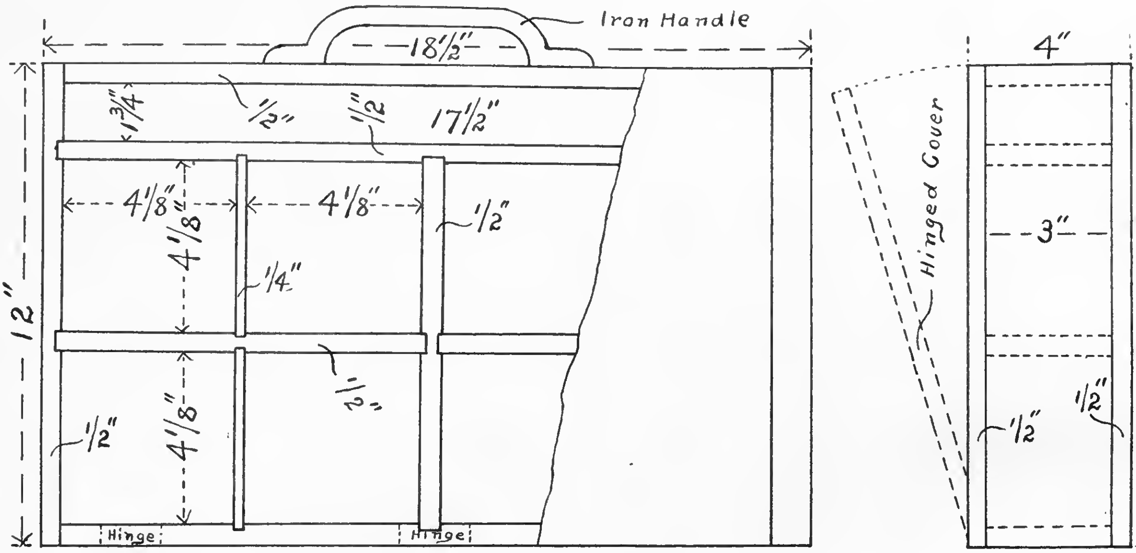
7. The server wins a stroke if the striker-out fails to return the service, or the ball in play.

8. The striker-out wins a stroke if the server serves a "fault" or fails to return the ball in play, or returns the ball in play so that it falls off the table.

CASE FOR SHOTGUN SHELLS.

J. A. Phillips.

The little wooden case for shotgun shells which I have just made for my own use is a very handy article, and if a person can make it himself, is an inexpensive one also. I made my box of white pine, carefully gauged as to thickness, so as to make a nice job. It is snugly grooved together and fastened with screws to make it perfectly secure. The cover has grooved strips across the ends, as shown on the right of the illustration. These strips are to keep the cover from warping. Three hinges are used on the cover, and a lock at



Shotgun Case.

Scoring.

On either player winning his first stroke, the score is called 15 for that player; on either player winning his second stroke, the score is called 30 for that player; on either player winning his third stroke, the score is called 40 for that player; and the fourth stroke won by either player is scored game for that player, except as below.

If both players have won three strokes (40 all) the score is called "deuce," and the next stroke won by either player is scored "advantage" to that player. If the same player win the next stroke, he wins the game; if he loses the next stroke, the score is again called "deuce," and so on until either player wins the two strokes immediately following the score of deuce, when the game is scored for that player. The player who first wins six games wins a set.

the top for fastening. The handle is of iron or brass, as preferred.

If preferred, the box can be made of mahogany, maple or other wood, and finished natural with brass ornaments. Whitewood stained a cherry or mahogany color also would look well. It is important to have the wood of exact thickness, so that the fitting of all the joints will be snug and strong. The outside corner joints can be dovetailed to good advantage.

The case will hold two hundred 12-gauge shotgun shells and has space at top for wiping rod, oiler, cleaning materials, tools, etc.

STUDIES IN ELECTRICITY.

VI. Magnetic Field and Polarity.

The space all around a magnet over which the magnetic forces extend is termed the "field." These forces vary in strength, being strongest near the poles and growing weaker as the distance from the poles increases. The direction in which these forces act also varies with the different parts of a magnet, but this variation is along certain well-known and regular lines. This may be shown in a very interesting way by the following experiment: Over a bar-magnet place a sheet of smooth writing paper; on the paper, dust some fine iron filings. As they settle down they will form lines similar to those shown in Fig. 20. It may be necessary to gently tap the paper a few times to have the lines clearly shown.

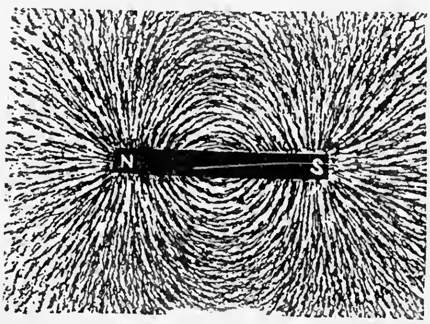


Fig. 20.

This figure may be made permanent by using gummed paper, which may be moistened by steam, after the filings are arranged, and then allowed to dry. When dry, the filings will be firmly attached to the paper by the gum. Attention is directed to the way in which the lines diverge from each pole, and those along the magnet curve toward each other. These lines are known as the "lines of force," and are a visible illustration of these lines, which act in all directions from a magnet.

Other instructive experiments are made by replacing the bar-magnet with the N and S poles of two bar-magnets slightly separated, as shown in Fig. 21; also using the two N poles and a single N pole, and, with the iron filings, determine the lines of force developed on the sheet of paper. How the lines of force are utilized in dynamo, motor and other electrical devices will be considered later.

In the last chapter we learned that the magnetic polarity, in the several experiments, was dependent on the direction of the current. It is important that this should be clearly understood

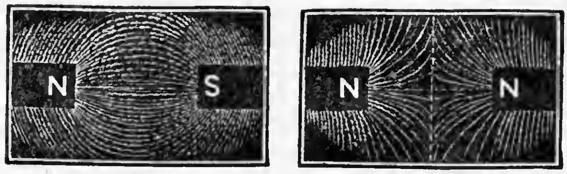


Fig. 21.

and remembered by the student. Referring to Fig. 15 and the experiments connected therewith, the following rule, suggested by Ampere, should be memorized: "Suppose a man swimming in the wire with the current, and that he turns his head so as to face the needle, then the N-seeking pole of the needle will be deflected towards his left hand." Another convenient rule, known as the "corkscrew" rule of Maxwell, is, "The direction of the current and that of the resulting magnetic force are related to one another as are the rotation and forward travel of an ordinary (right-hand) corkscrew." (See Fig. 19.)

The experiments previously described show that the magnetic attraction is variable and dependent upon several factors, which are: *a*, the amount of the current flowing; *b*, the number of turns of wire; *c*, the size of the conductor.

There is a limit, however, beyond which the magnetic force of a coil cannot be developed. This is known as the saturation limit or saturation point.

If a core of soft iron be wound with one layer of wire carrying a current of one ampere, a certain weight of iron may be lifted thereby. If another layer of wire be added, the current may be reduced nearly one-half without diminishing the lifting power. Another layer of wire will enable a still further reduction in the current. Successive layers of wire may be added with proportionate reductions in the current, until eventually the final layers produce little or no addition to the magnetic force developed, because the resistance of the wire equals or exceeds the magnetic force developed. It is because of this fact that the secondary winding of an induction coil cannot be increased indefinitely, but bears a fixed relation to the size of the primary winding and core; hence the expression of "ampere turns" as applied to wiring of electrical devices.

From this also arises the necessity of calculating the relation of battery strength and force, and the number of turns and size of wire. With a battery of high E. M. F., but low current, more turns and finer wire are necessary than with a battery of large current or high amperage, with which fewer turns and larger wire may be used. The saturation capacity of the wire regulates the maximum number of turns to be given a coil.

Though extremely rapid, a certain time is required for magnetic action, and also for demagnetization to take place. If an electro-magnet is to be rapidly excited, it should be short and thick, as the action of such a form is quicker than with a long one. If a strong, slow action is required, a long electro-magnet is the better.

Referring again to Fig. 19, if the iron core be omitted from the coil or spiral of wire, the coil will, when excited by a current, act as an electro-magnet, though with much less power than with the core. Such a coil is termed a "solenoid," and will attract and repel other solenoids, electro-magnets, and, in fact, present the same phenomena as do electro-magnets. The magnetic field of a solenoid is strongest within the coil, and the core is most strongly magnetized when placed therein, though more or less magnetized whenever within the lines of force of the coil. Certain electrical instruments are simply one solenoid within another. When the interior one is movable, it is termed a "sucking solenoid," the inner one always tending to move into the position in which it best completes the magnetic circuit. If a solenoid be suspended so that it can turn freely, it will, when influenced by a current, set itself in the direction of the magnetic meridian, the same as does an ordinary compass.

Castings for the motor described in the March number are being made, and will be offered as a premium for new subscribers.

HOW TO MAKE CABINET FITTINGS.

Handycraft.

The amateur woodworker, especially in the small towns, generally has trouble in procuring fittings, such as escutcheons, hinge-plates, etc., and it is the purpose of this article to show how they can be made at home at a very small expense. For the purpose will be required some 24 to 30 gauge sheet brass and some pieces of hard thin wood, say about $\frac{3}{16}''$ thick, such as is used for fret-sawing. First, draw on one piece of the wood the design, as shown in Fig. 1 at A. Then

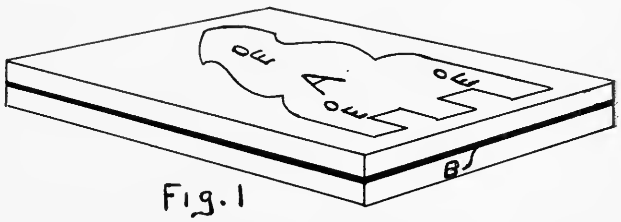


Fig. 1

place a piece of brass of suitable size between two pieces of wood, as indicated at B. Drill the holes, E, through the top piece of wood and the brass, which will be the holes for screws in the finished escutcheon, and put small screws through into the bottom piece. With the two pieces of wood and brass fastened between them, it is an easy matter to saw out with a strong fine-toothed fret-saw the keyhole and around the edge, and, with a little filing and polishing, a very nice-fitting ornament can be made.

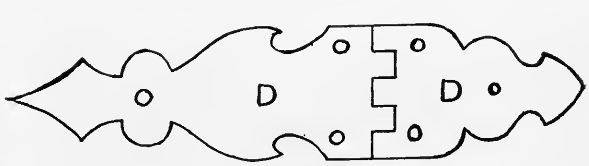


Fig. 2

In Fig. 2 D represents a folded hinge made in the same manner as described for Fig. 1. If the amateur is handy with a graver, scrolls can be cut on the surface which will add to the looks, but a nicely polished surface looks neater than poorly cut scrolls.

The above is just a hint, and may interest some of the readers of Amateur Work to the extent of making some very pretty additions to their cabinet work.

WIMSHURST INFLUENCE MACHINE.

(Continued from page 130.)

From the remainder of your No. 10 brass wire cut two pieces 8″ long, and tip with the two remaining brass balls, as described before. A hole is pierced in the center of each cork and cap, and the brass rods are pushed through the holes to a depth of three inches. The rods should fit tightly in the corks, so that they cannot drop down. A piece of thin, bare copper wire about 8″ long is now soldered to the lower end of each brass rod, and the corks and rods are set in the mouths of the jars, taking care that the copper wires touch the inside coatings of the jars. The condensers being now completed are set on the base H, as shown in Fig. 7, the brass rods being in contact with the arms W, and the bottoms connected with each other by a strip of tin foil pasted on the base.

Let us now try the machine and learn if it will work. In the first experiment we will remove the condensers temporarily, and setting the discharge balls within 1′ of each other, we turn the crank of the machine from left to right. After about twenty turns of the crank the machine will run harder, which shows it is generating, and a stream of sparks will flow between the discharge balls. These may now be separated to about $1\frac{1}{4}$″, and the sparks will still continue to flow. A separation of more than $1\frac{1}{2}$″ will stop the sparks, and what is called the "brush" discharge begins. This consists of a stream of pale blue electricity bursting out from the right-hand discharge ball, and is accompanied by a strong smell of ozone. This discharge is quickly attracted by the approach of any conductor, such as the hand, and the sensation when the brush touches the latter is like the feeling of fine cobwebs.

As the machine is found to generate correctly, we will replace the two condensers and proceed to discharge them. See that the brass rods of the condensers touch the arms, W, leading to the discharging rods, and that the bases of the jars are in good contact with the tin-foil strip on the base. Now turn the machine again, having set the discharge balls about 3″ apart. A much larger operation of the machine is necessary in this case; but very soon a decided resistance is felt, and a thick white spark will strike between the balls with a quite startling report, and this will be repeated about every fifteen turns of the crank as long as the machine is in motion. On cold days I have been able to get as much as five inches of spark from my own machine.

I would say here that care should be taken not to approach the face or hands near the bare metal of the machine, as it is quite possible to get a very powerful and unpleasant shock from it when the condensers are attached. Use the wooden handle shown in Fig. 4 to regulate the length of the spark gap. There are hundreds of experiments which can be performed with this machine, but a description of them is not within the scope of this article, as they can be found in any elementary book on physics. I have appended a list of the prices of the various materials used in building this machine, and have set a maximum cost on each article, to be on the safe side. The list could, no doubt, be scaled down by most amateur workmen by the use of materials to be found in almost every household. I hope that the directions given in this article will enable the aspiring amateur to build the machine to his satisfaction, and that he will have as much pleasure from its use as I have had from mine.

List of Materials.

Wood for frames of glass drill and machine	$ .60
Three-quarter-inch copper tube for drilling glass	.10
Emery powder and turpentine	.10
Two 15″ glass plates, cut to order	.50
Nine feet of No. 10 brass wire	.10
Sheet brass 10″ x 4″ No. 26 Stubbs gauge	.10
One-quarter-inch smooth round-steel bar 10″ long	.15
Two hard-rubber tubes $9\frac{1}{2}$″ long	.50
Nine $\frac{1}{2}$″ brass balls	.27
One $\frac{3}{4}$″ brass ball	.05
Ten sheets 6″ x 8″ tin foil	.75
Shellac varnish (white)	.10
Van Stan's cement	.05
Two 4″ screw pulleys	.30
Iron rod for axle for pulleys	.10
Six feet $\frac{1}{4}$″ round belt at 10c.	.60
Tinsel or sheet copper for brushes	.05
Two pint jars (white glass) for condensers	.20
Corks for jars	.10
Screws, nails, copper, wire, etc.	.25
	$4.97

HOW TO BUILD A HOUSEBOAT.

Carl H. Clark.

III. Interior Furnishings.

The carpenter and joiner work on the hull and house previously described about completes that portion of the work. All that remains is to put in the inside fittings and furnish according to one's taste.

While the arrangements as laid out in the preceding chapters seem to give the best accommodation, the positions of the various articles of furniture can be changed around to suit individual preferences.

If preferred, the rooms can be left plain, and all the furniture set into place as in a house; but it will be better to build certain things in place, on account of its being cheaper and allowing a better economy of space, which is most important on a boat.

In the living-room the two seats shown are designed to be used as seats during the day and as berths at night, the bed linen being stored under them in the daytime. They should be about 2′ wide and about 15″ above the floor. The front is a 2″ x 4″ joist on edge, supported from the floor by pieces of board at each end; the top is covered with short pieces of board, and it is sheathed up in front with short pieces of sheathing. A cleat on the side of the house will hold up the back of the seat, and one on the floor will hold the lower end of the sheathing. A piece of the top is left loose to give access to the locker below. A piece about 2½″ wide and ½″ thick is nailed on edge across the top to cover the rough ends of the boards. The upper edge projects about ½″ above the seat and holds the cushions in place.

The beds are designed to be of ordinary springs supported on a framework of 2″ x 4″ joists; that in the large room being a full-size spring, while those in the small room are single springs. It will be well to sheathe up around this framework and to fit in large drawers, as this makes excellent storage space for clothes, etc.

In the smaller room, where two berths are shown, the lower is built as above, but the upper is best made to fold up when not in use. A box about 6″ deep is made to just fit the spring, which is set into it; it is then fastened to the wall by strong strap-hinges, and supported by chains at the front corners when down for use. A strong hook on each corner will hold it up when not in use.

Of course one may use regular bed-frames, but the room under them cannot be used to such good advantage. It will be better to put in ready-made dressers, as they are cheaper and neater than those built into place.

The washbowls, sink for the kitchen, bathtub and closet can be bought from any dealer in plumbers' supplies. In setting the sink and bowls, all that is necessary is to build a frame at the proper height with a hole to fit the bowl, which is then set into it. The space under the bowls in the rooms should be sheathed in and a door fitted, making a convenient locker.

The drains are, of course, made of lead pipe soldered to the outlet from the bowls, and led down outside the hull through a hole, coming out just under the guard. The lead pipe must be allowed to project out from the hull at least 2″ to prevent the drip running down and discoloring the paint. If running water is to be fitted, a faucet must be provided and pipe connections leading to the supply-tank.

The water-tanks are to be put in the hull below deck. Unless the tank is put in before the deck beams are in place, two or three small tanks will have to be used. Whatever the shape of the tanks, they must be placed with their longest dimension fore and aft. For convenience, a filling pipe can be led from each tank to the deck. Unless water is easily obtainable, it will be necessary to have tanks large enough to hold several days' supply, to avoid the inconvenience of frequent filling.

Running water may be provided by a small tank on the roof, large enough to hold at least a day's supply. The pipes from the faucets all lead to this tank, which is filled as necessary, either by hand or with a force-pump below.

Another way, which is better and not expensive, is to have a heavy tank in the hold large enough to hold a day's supply and capable of standing some pressure. The pipes to the faucets are connected directly to the lowest point of this tank, and a connection is also made near the top for an air-pump, with a valve on the tank. A large bicycle foot-pump will answer for this, with a rubber connection. By pumping air into the pump, the pressure can be raised enough to force the water through the pipes to the faucets. It may be filled by a direct connection to the main tanks, the water flowing in by its own weight. It must, of course, not be filled full, as some space must be left for the air. This way is much neater than the other, besides being less laborious, but care must be taken not to leave the taps open and the water running when not wanted. If it is not considered desirable to furnish running water, the closets under the washbowls can be fitted to hold a water jar, which is filled when necessary.

It will probably be best to fit the kitchen with a hand-pump leading to the main tanks, as the large amount of water used here would be a tax on either of the systems described.

The best way to supply the bathtub is by an independent hand-pump. There should be two pipes leading from this pump, with a valve in each, one leading to the tanks below, and the other leading overboard on the opposite side from the water-closet discharge.

Opening one valve and closing the other, water can be drawn from either source. The drain from the tub can be led out under the guard.

The closet should be of the marine type, with pump connected. Directions for setting come with the closet. The discharge should be below the water line. Where the plank is cut for this discharge, a re-enforcing piece should be fitted on the inside of the plank between the frames, and the opening cut through both this and the plank. Great care must be used in making the joint where the discharge comes out. The pipe will probably be about 4″ in diameter, and the hole should be cut to fit it as closely as possible. A circle should then be drawn around the hole about 1½″ larger, and the plank cut away to a depth of about ⅛″. The lead pipe is then bent to shape and allowed to project about 2″ from the hole. With a light, round-nosed mallet, the end of the pipe can be flanged out to a right angle all around, and then trimmed off to fit the circle. It can then be drawn out enough to put a thick coat of white lead underneath, and then put back and closely tacked with copper tacks. This is a rather fussy piece of work, and must be carefully done, or it will always leak and be a source of great annoyance. The discharge from the closet must be as straight as possible, with no sharp bends, to avoid clogging, and should be in as inconspicuous a place as possible.

The several shelves and lockers in the kitchen are to be conveniently arranged for cooking purposes. The stove is an ordinary range, although there may not be room for one of a large size. Where the stovepipe passes through the roof, the planking must be cut out enough so that the heat will not char it. Either a close-fitting piece of zinc or a ring which is sold for that purpose, will serve to fill up the opening around the pipe. Some kind of ornamental cap is fitted over the top of the pipe.

Some means must be taken to get rid of any water which may enter the hull. A bilge-pump can be arranged on the after-deck. It might be advisable to have one at each end, as the water will run to the lowest place. A good pump for this place is one which is attached to a brass plate with a screw top; the plate is set into the deck flush, and by unscrewing the cap, the rod and bucket can be inserted and the pump is ready for use, one rod and bucket serving for both pumps. The pumps may be set in place, and a piece of hose used for the lower connection, which may be shifted about to wherever the water may lodge.

When the boat is afloat, she will probably not float evenly, being lower at the after-end, and ballast will be needed to bring her down even. It will be well to put in considerably more than is necessary for this alone, as it will make the boat much stiffer and less sensitive to the movements of those on board. Flat stones will answer very well for ballast, and should be placed in a rough board box.

No arrangements have been made for steering, as this has not been thought necessary for the little the boat is likely to be moved, especially as, by using a bridle for towing, she will follow all right. This bridle is a piece of rope leading from each forward bitt and meeting about 30′ ahead, where the towline is attached. This makes the boat tow steadily and prevents sheering off.

For flying a flag, a pole on the forward end of the house may be desirable; it must, however, be as light as possible, on account of its height above the water. If it is wished to hoist a tender aboard, a pair of davits can be fitted on the after-end. Just before being put into use, the outside of the boat should have a thin coat of paint, and it must be remembered that paint does not last as long on the water as on shore, and it will need renewing oftener.

When she is first put into the water, she will probably leak some, but in a few days she will swell up tight. If these directions are followed, and the work done with even a reasonable degree of care, there is no reason why both hull and roof should not be perfectly tight and cause very little trouble.

VENTING COOKED CORES.

Boston, Mass., March 7, 1902.

As all foundry-men know, the making of a successful core requires a lot of time and patience. I speak now of crooked cores which require venting in every direction. A way is herewith suggested which ensures a perfect vent in every core, and takes far less time than the method often used.

While the core is being "rammed up" a small wax wire is laid in; it makes absolutely no difference how crookedly it is put in, so long as it is all inside the core, with the ends only projecting. The core is then put in the oven and baked, after which process it is ready for the mold. In baking, the wax wire has melted and disappeared, leaving nothing in its place but a free and open venthole. It is even better for straight venting than an iron wire, because the walls of the hole are, of course, lined with the wax, and no particles of sand can fall in to plug the vent, let alone the risk of breaking the whole core by pushing, or trying to push, an iron wire through it.

This process is not theoretical; it has been tried and proved very successful.

The wax wire is made by squeezing beeswax through a hole of suitable size drilled in a piece of sheet steel.

H. D. W.

A dispatch from Memphis, Tenn., says that the Southern Pacific Railroad is making elaborate preparations for the use of oil as fuel through that system. The company intend to establish steel tanks of 50,000 barrels average capacity along their lines. It is stated that the company intend to use oil for generating power on the locomotives from one end of the line to the other, and eventually on their engines, ferryboats and steamboats.

CORRESPONDENCE.

Our readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of Amateur Work, 85 Water Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if an answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

(No. 9.) Humber Bay, March 3, 1902.

(*a*) Could an induction coil be used to ring a magnet bell one mile distant instead of a magneto-machine, using two batteries for primary?

(*b*) If the current going through the primary winding of an induction coil is two volts and three amperes direct current, would the results given by the secondary be different if the current was alternating at the same amperes and volts?

I am pleased to say that the induction coil made from instructions in the magazine works finely. B. C.

(*a*) While never having tried to ring a bell over a long distance, by increasing the voltage with an induction coil I should think it could be done. A magneto-machine is better and no more expensive.

(*b*) The only difference in the current given by the secondary, as above stated, is that in the first case the curve illustrating the drop in voltage between impulses is sharp, while with the alternating current it rises and falls at about the same rate.

(No. 10.) Bristol, R. I., March 9, 1902.

In the correspondence column of the March number you state that for an induction coil giving a one-half-inch spark one pound of No. 40 covered magnet wire is required. This costs $20, which is more than a complete Ruhmkorff induction coil can be purchased for. I do not understand how this difference in price comes. C. B. R.

The coils you mention are probably imported German or French instruments, and usually are not made with covered wire, but with bare wire with thread between and shellac or some other insulating material used to replace the wire covering. It would not be advisable for any one who was not very experienced to attempt to make a coil in this way. The directions given in this magazine are those thought most likely to produce successful results and most suitable for the amateur.

(No. 11.) Boston, Mass., March 15, 1902.

Will you please publish a description and drawings of wooden works suitable for the clocks recently described in the magazine? A. S. W.

A descriptive article on wooden works for these clocks is now in preparation, and will be published as soon as completed.

(No. 12.) Toronto, Ont., March 10, 1902.

Where and at what approximate price can one procure the works for the clock described in the December number by John F. Adams? I am building the frame, and desire to know where to get the works. F. C. S.

The best movement that can be purchased at low cost is probably the one made by the Seth Thomas Clock Company, Thomaston, Conn., No. 85A; cost, $7.50. It is eight-day, pendulum 39½ inches, ten-inch swing, sixty beats, strikes the hours, twelve-inch hands, wood rod and two-pound ball. A letter to this firm will secure the name of the nearest jeweler handling their goods.

Sir W. H. Preece, formerly chief electrician to the British post-office, has been engaged for some time on the study of the magnetic influences upon the compass of the Manacle rocks, off the coast of Cornwall, Eng., upon which the steamships *Mohegan* and *Paris* were wrecked, and, as the result of his investigations, he states that if any navigator sets his compass from Cherbourg to the Lizard, without knowing the variations of the magnet that have occurred during the last five or six years, he would run upon the Manacles. The variation is bringing the needle nearer to the north pole, and in ten years it has varied a whole degree. A difference of a degree in a compass signifies an error of one mile in a course of sixty miles.

According to *Electricity*, an experiment designed to have an influence on the horticultural industry was recently made in California, where electricity was used as a pumping agent for irrigation. The experiment was a success in every respect, and it was announced at its conclusion that there would be an immediate extension of the electric wires throughout the whole Berryessa district. The experiment and the success attending it are believed to have solved the water question for orchards, as far as the Santa Clara Valley is concerned.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. I. No. 7. BOSTON, MAY, 1902. Ten Cents a Copy

WOODEN TURNING-LATHE FRAME.

A TURNING lathe adequate to the needs of most amateur workers costs more than many can afford to expend for this very desirable tool. By making the bed, drive-wheel and treadle here described, and purchasing the head and tail stocks and rests, a very serviceable lathe can be obtained at comparatively small expense. At the request of several readers of the magazine, the description here presented is designed for the lathe set offered as a premium in the April number. It can easily be altered to the lines of other lathe sets, by slight changes in the bed and drive-wheel. The same kind of wood should be used for all parts except where a special wood is specified. Before making the lathe, a drawing one-half size should be made on some large sheets of smooth Manilla wrapping paper. This will greatly simplify the work to one who is not familiar with it.

For the bed will be required two pieces, A, of maple or hard pine, 4′ long, 3¾″ wide and 1¾″ thick. These should be very carefully planed down at the lumber mill from larger stock, so that all sides will be square and true. Between the pieces A at each end, are placed pieces of maple or oak, B, 4½″ long, 3″ wide and 1 3/16″ thick. These are bolted together by two bolts at each end, 5″ long and ½″ in diameter, the heads on the front side being countersunk to make them flush.

The top edge of the bed should be exactly even and square, so that, in moving the tail stock, the latter will not be out of line at any point. The legs, C, are 2′ 5½″ long, 4″ wide and 3″ thick. This length brings the top of the bed 30″ from the floor. The lower ends are beveled, as shown in Fig. 1, and the upper ends cut to fit the bed-pieces. The vertical cut at the top is 2½″, and the horizontal cut 1¼″ long. The crosspieces, D, are made from the same stock as the legs, and on the lower side are 13½″ long. This allows for tenons 2″ long, on each end, to fit mortises in the legs C. These mortises are 2″ wide and 2½″ high,

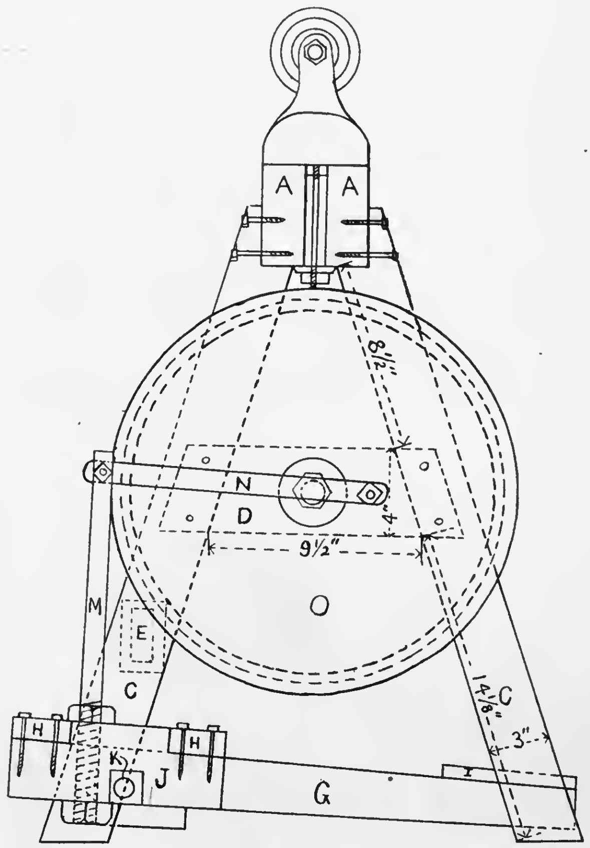


Fig. 1.

and should be well fitted so that the frame will be as rigid as possible. The pieces D are fastened at each end by gluing and also with ⅜″ dowel-pins. Mortises 2″ by 1″ and 2½″ deep should also be cut in the two rear pieces, C, for the tenons on the cross-piece, E. The crosspiece, E, is 3′ ½″ long, 3″ wide and 2″ thick, with tenons on each end 2″ long, to fit mortises in pieces C. The lower edge of the crosspiece is 7½″ from the floor. The ends are fastened to pieces C by gluing and two ⅜″ dowel-pins in each end.

The centers of the holes are 2½″ from the floor on the center line, and one-half of the holes should be in each piece. Great care must be taken to see that they line correctly, to prevent binding. A 1″ hole is also bored through the center of the piece D, on the left side of the frame, to receive the bolt which holds the drive-wheel. The center

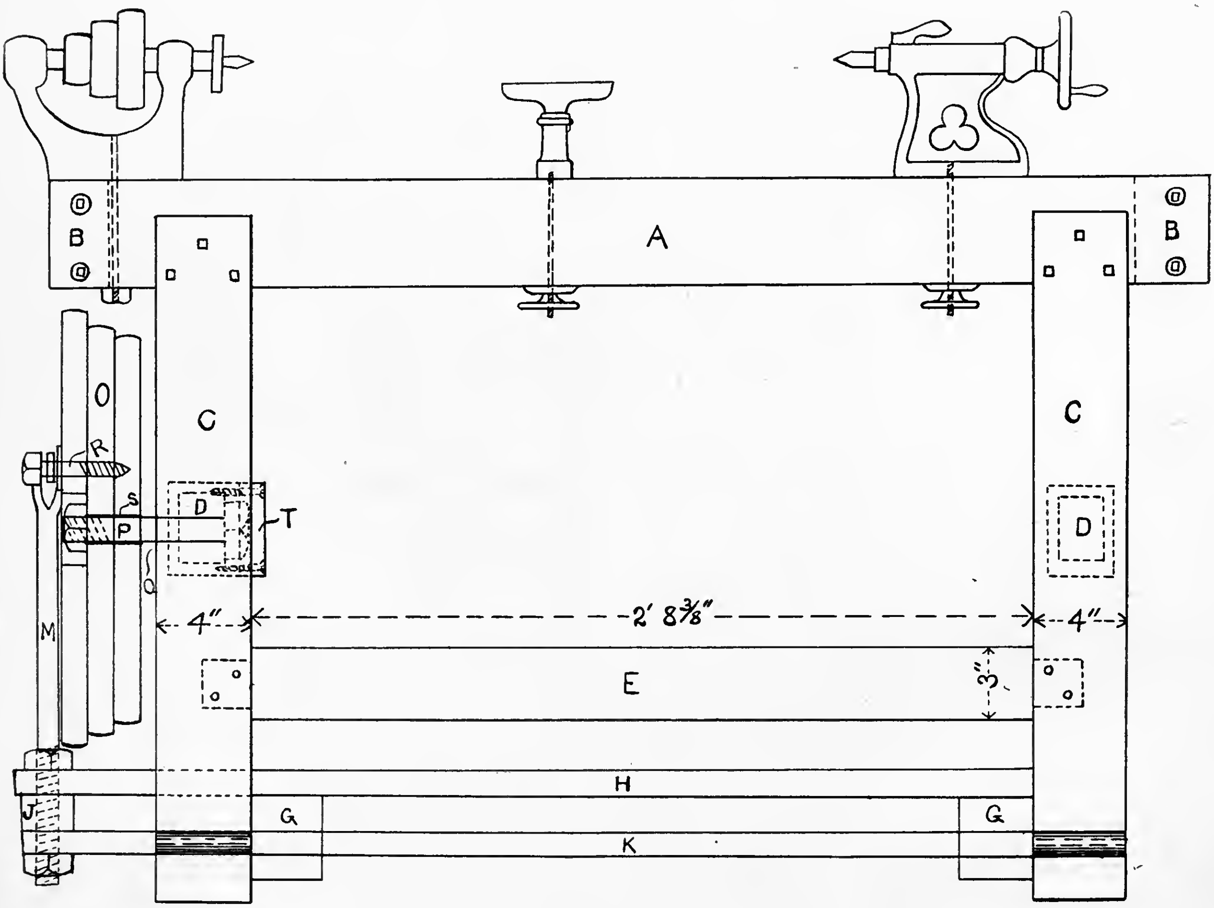


Fig. 2.

At the bottom and on the inside of the two rear pieces C, are two pieces, F, which are 5″ long, 4″ wide and 2″ thick (Fig. 3). The lower ends of these pieces are cut to the same bevel with the legs. They are bolted to the legs with two bolts 5″ long and ⅜″ diameter, the heads being countersunk. The faces of both legs and pieces should be smooth and true, as they make the bearing for the treadle-shaft. After the frame is finally set up, holes, 1″ in diameter, are bored through the center of the joint.

of this hole is 15½″ from the floor. If a straight piece of wood be laid across the tops of the pieces D, over where the hole is bored, it will assist in getting the hole correctly lined. This is very essential, as if not true the drive-wheel will wabble when running, causing the belt to slip off.

The treadle is made of two pieces, G, 25″ long, 3″ wide and 2½″ thick on the rear ends, tapering down to 1½″ thick on the front ends. The two pieces H are 4½″ long, 2½″ wide, 1″ thick, and are finally screwed to pieces G. The front piece

H is $4\frac{1}{2}''$ from the rear piece. The foot piece, I, is $32''$ long, $6''$ wide and $1''$ thick, and preferably should be of oak, the better to withstand the wear. It is firmly screwed by the two pieces G. The piece J is $9\frac{1}{2}''$ long, $3\frac{1}{2}''$ thick and $2''$ wide, and is cut to the shape shown in Fig. 2. It is attached to the pieces H by two $\frac{1}{4}''$ lag-screws in each end. On the under side of pieces G and J are cut sockets $1\frac{1}{2}''$ square to receive the treadle-shaft, K. This shaft is a piece of steel $1\frac{1}{2}''$ square and $45\frac{1}{2}''$ long. At the right end, for $4''$, it is turned down to $1''$ diameter, and the same from $6''$ to $10''$ from the left end, to fit the bearings previously described.

The fitting of this shaft should be left until the frame is completed, so that exact measurements can be taken of the places where it is to be turned down. On the under side of pieces G and J are screwed strips of wood $6''$ long and $1''$ thick, to hold the treadle to the driving-shaft K. A $1''$ hole is bored through J, to receive the round iron rod M. This rod is $15\frac{1}{2}''$ long. The lower end is threaded for $6''$ to allow for the two nuts, one above and the other below the piece J. Having turned the upper one to the right place, the lower one is firmly screwed up, holding the rod rigidly in place. The top of the rod is split with a hack-saw, each side being opened out $\frac{3}{8}''$, to form a U-shaped top. A $\frac{3}{8}''$ hole is drilled $1''$ from the end, to receive a small bolt which holds the rod N.

The rod N is of bar iron, $13\frac{3}{4}''$ long, $1''$ wide and $\frac{1}{4}''$ thick. Holes are drilled in each end, the center of the rear one being $\frac{3}{4}''$ from the end, and is $\frac{7}{16}''$ in diameter. The front one is $\frac{11}{16}''$ diameter, the center being $1''$ from the end. These measurements may have to be changed slightly from those given, to secure correct running of the treadle, but no difficulty will be experienced on that account.

The drive-wheel, O, is made of three layers of matched maple, or birch, each layer being $1\frac{1}{8}''$ in thickness. It should be carefully planed and of well-dried stock. The grain of each layer should be crossed and all well glued and screwed together. The diameter of the largest wheel is $18''$, the next size $17\frac{1}{16}''$, and the smallest $16\frac{1}{8}''$. It can

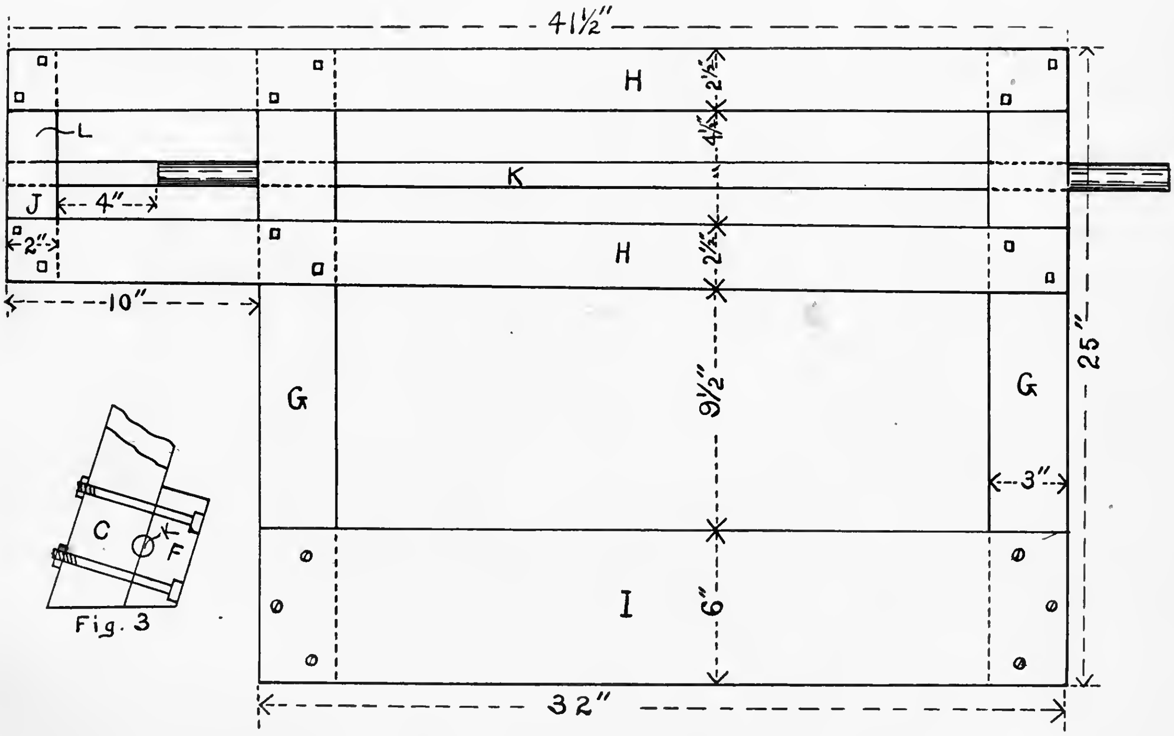


Fig. 3

Fig. 4.

be completed and mounted and then turned down, thus seeming a perfectly true wheel. A slight crown is given each step, to correspond with that on the cone on head stock. This makes the belt run better. In the center of the outside layer a hole 3″ in diameter is cut through to the next layer, to form a recess for the nut on the bolt P. A 1¼″ hole is bored through all the layers, to receive the bolt and also a bushing of brass tubing, S, ⅛″ thick and 1″ inside diameter. This bushing of brass tubing should fit the hole in the drive-wheel tightly, and can be used to remedy any tendency of the wheel to wabble by trimming out the hole in the wood and shimming up with thin strips of wood secured in place with cement or glue.

The lag-screw, R, is 3″ long and ⅝″ diameter, and is screwed into a hole, the center of which is 2½″ from the center of the bolt P. Any burr around the head should be filed off, so that it will work smoothly in the hole in the rod N. A thin washer should be placed between the rod N and the drive-wheel. The bolt P is 6½″ long and 1″ diameter. It is advisable that this be specially made of smooth steel shafting, to secure a good smooth bearing that will not rapidly wear out the brass bushing. Any machine shop will supply one at small cost. A 1″ collar is set between the piece D and the drive-wheel, and may run loose. The thread on the end of the bolt should go only far enough to receive the nut, which should be screwed up tight to prevent it from turning off. The head of the bolt is sunk into the crosspiece D, and by regulating the depth the head is sunk in, the nut can be brought to just the place where it will not bind and yet stay tight. A piece of sheet steel between the drive-wheel and the nut will prevent the wood from wearing away. Over the head of the bolt, when finally adjusted, screw a piece of wood, T, to the piece D, to hold the bolt in place.

The frame being completed, assembled and any needed adjustments made, the head stock may be placed in position and bolted to the bed. The tail stock is placed on the other end, and each looked over to see if they are correctly lined. A flat belt 1″ wide is then cut and fitted. If the treadle, by reason of its weight, runs unevenly, a hole can be bored at an angle in the rear piece H, and a bolt placed in it and loaded with iron to balance the treadle.

HOW TO BUILD A ROWBOAT.

C. R. Sawyer.

No doubt many of our young friends are looking forward to the coming summer, and some are even planning what they will do. If a boy has a mechanical turn of mind, nothing will give him more enjoyment and satisfaction than to build a boat. The following description will give all the instruction necessary to build a boat 12′ long. All the articles required are ten boards ⅞″ thick and about 14′ long, two boards 14″ wide, ⅞″ thick and 13′ long, free from knots; a piece of oak 2′ 6″ long, 10″ wide and 1″ thick; a piece of oak 2½″ thick, 8″ wide and 16″ long; some galvanized iron nails and some white lead or thick paint.

The first thing to make is the stem. Take the piece of oak 16″ long, 8″ wide and 2½″ thick, and cut grooves of the shape shown in Fig. 1. This can be easily done with a backsaw, smoothing over with a rabbet plane, or it may be made of two pieces firmly screwed together.

Then proceed with the piece for the stern (Fig. 2), which is made of oak, 1″ thick, 10″ wide, cut slanting on the ends, so that the top measures 28″ and the bottom 22″ long. Make a similar piece of pine for a cross-board, 4′ on the top, 3′ 6″ on the bottom and 1′ wide. For the side boards take the two pieces 14″ wide, which should be of pine or cedar and perfectly sound and free from knots, so they will bend evenly. The ends of the side boards should be sawed off like the cross-board, making it 8″ shorter on the bottom, as shown in Fig. 3, for the bow. Beginning 4′ from the other ends, cut a bevel down to 10″ wide; also bevel on the ends, as shown in Fig. 3. Place the ends of the side boards in the grooves of the stem, have the bottom end of the stem flush with the bottom of the side boards, taking care that the ends fit nicely in the grooves, and screw them securely to the stem with the brass screws. Then place the cross-board about midway between the ends of the two side pieces, with the longest side on the top, as shown in *a*, Fig. 4, and fasten lightly with nails. With the aid of a rope and a stout stick, draw in the ends of the side piece by twisting the rope until they join the stern board shown at *b*, and nail securely. Then carefully turn the boat over and plane the bottom edges of the sidepieces so that the bottom will have a flat and smooth bearing. The bottom boards can now be nailed on. All joints should be coated with lead paint before finally fastening together. A bottom board about 8″ wide and $\frac{7}{8}$″ thick should then be placed

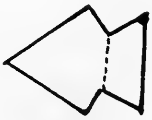
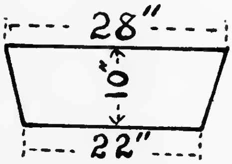


Fig. 1

Fig. 2



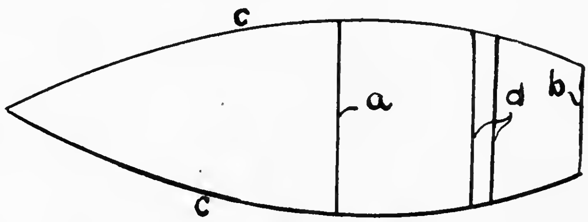
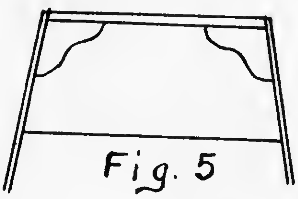


Fig. 4



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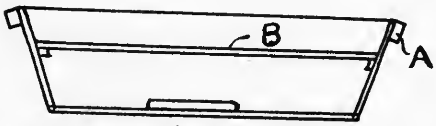

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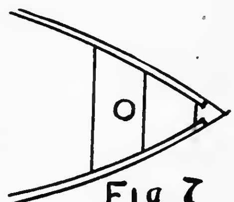

Fig. 7

Fig. 8

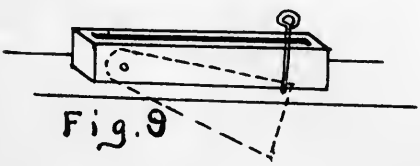

Fig. 9

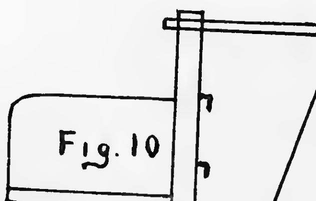

Fig. 10

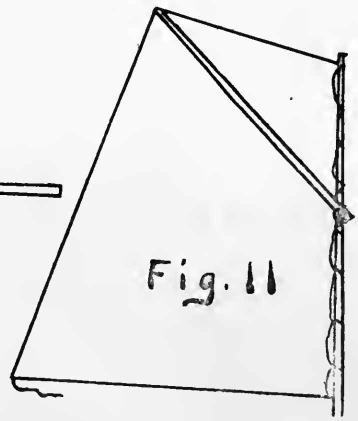

Fig. 11

inside, extending the whole length of the boat, to stiffen the bottom. The nails should be driven from the inside, and the ends turned over. Of course the cross-board will have to be removed before you do this. It will be well to put brackets in the corners where the stern board joins the side boards, as in Fig. 5. A piece of wood can be nailed temporarily across the top edges, to keep the sides in place until the seats are put in.

In the stern, about 4″ from the top edge, nail a cleat on each side parallel to the top for the seat. The boards for the seats should be 14″ wide. Also put a seat the same distance from the top edge, 5′ from the stern, and another halfway between this and the bow. Fill in the bow of the boat for 2′ from the stem, as shown in Fig. 7. Then fit the two gunwales, $2\frac{1}{2}$″ wide, the entire length of the boat and across the stern, as shown in A, Fig. 6, care being taken in fitting the strips so as to give a finished appearance to the whole boat. If it is not convenient to secure rowlocks, holes may be bored in the gunwales about 3″ apart and 9″ astern of each seat. The holes should be ⅞″ in diameter, and fitted with oak pins 6″ long, so that when the pins are in they will project about 4″ above the gunwales. It will be preferable to secure rowlocks, as they cost but little and are easily fitted. The boat should have an oak keel, to make the boat row steadier, ⅞″ thick and 2″ deep, reaching from stem to stern, with a triangular piece at the stern, as shown in Fig. 8.

This boat can be made into a sailboat by putting in a centerboard. To do this, make a centerboard box 4′ long, 10″ high and 1″ wide inside, as shown in Fig. 9. Then cut a hole lengthwise in the bottom of the boat 3′ 8″ long and 1″ wide through the bottom keel and inside board, after which screw the box securely in place, after having covered the bottom edges with lead paint. The centerboard box should easily take a ¾″ centerboard. The board can be hinged by a bolt, as shown in Fig. 10. An iron rod should be placed at the other end to raise and lower the board as needed. Make a rudder and tiller as shown in Fig. 11. The rudder should be 17″ long and 12″ wide, with a tiller 15″ long, all made of oak ¾″ thick.

Cut a hole 4″ in diameter 1′ from the bow, as shown in Fig. 7, and put a step in the bottom directly under this hole to support the mast, which should be about 10′ long, 4″ in diameter at the base, tapering slightly to the top. The sail can be made of No. 1 duck, and should be cut as shown in Fig. 12, which will give ample sail for a boat of this kind. All the material for this boat can easily be purchased for about $12. Not including rudder, mast, sail and centerboard, the cost would be about $6.00. Much will depend upon the ability of the one who builds the boat as to what the boat looks like when it is done, but if care is used and the foregoing directions closely followed, you will have a good boat and a fast sailer in smooth water. If not experienced in sailing, however, the sail had best be omitted.

The United States government has decided henceforth to put its trust in electrical alarm devices rather than in bolts and bars and steel safes as means of protecting the public funds from the enterprising and up-to-date burglar. It is well known that by the use of electricity and certain secret compounds known to expert burglars, any vault or safe can be opened in a short time. The solution of this question seems to be in installing electrical alarm systems, whereby it will be impossible for burglars to enter or even make an attempt to disturb vaults without an alarm being given that will instantly call police or other protection. Devices have already been invented and put in use which demonstrate the entire practicability of electrical protection. Not only do they give instantaneous alarm whenever the safes or vaults are tampered with, but they report automatically every minute or two that everything is all right. Even if communication were interrupted so that an alarm could not be given, the fact that the regular automatic report is not received would cause the sending of men instantly to ascertain if there were any trouble.

Lieut.-Col. R. E. B. Crompton, the well-known English electrical engineer, is the author of the following very interesting sketch, published in the London financial paper, *Electrical Investments*:

"On one occasion Dr. Wm. Siemens was lecturing on arc lamps at the Royal Institution, and in those days it was the custom to work lamps with very short arcs. Owing to the fact that it was not appreciated that 45 volts were necessary for arc lamps, makers only allowed 35 volts, so that the lamps were always fizzing and hissing and forming 'mushrooms' or 'cauliflowers' on the negative carbon. Dr. Siemens was lecturing on the arc lamp, when one of these cauliflowers fell off one of his own lamps on to the center of his head — which was bald — and produced a most remarkable effect. I do not think the Royal Institution ever witnessed a more pleasing experiment."

The German ministers of war and agriculture have offered several prizes, 10,000 marks being the highest, for military automobiles using alcohol fuel.

STUDIES IN ELECTRICITY.

VII. RESISTANCE.

We have now to consider one of the most important laws of electrical science. It is known as Ohm's Law, being first formulated in 1827 by Dr. G. S. Ohm, a German mathematician, and is as follows: "The strength of a current is directly proportional to the electro-motive force and inversely proportional to the resistance."

In the first chapter of these studies the flow of water through pipes was used to illustrate the flow of the electric current. This comparison will again be utilized in studying that property of materials by virtue of which they obstruct the flow of electricity through them, and which is termed "resistance." In the water or gas pipes this obstructing force is known as friction. The reservoirs and standpipes of a water-supply system serve the purpose of giving a pressure adequate to overcoming the friction of long lines of pipe and forcing the water to distant places. A large short pipe will deliver water much faster than a long, small pipe. The higher the reservoir, the greater the pressure on the water-pipes and the faster the flow of the water.

The greater the initial pressure, the stronger is the current of electricity; and also, the greater the resistance, the less the current.

The ohm is the term used to measure and express in definite numbers the comparative resistance of different materials. As adopted by the International Congress of Electricians which met at the Columbian Exposition in 1893, the ohm is "represented by the resistance offered to an unvarying electric current by a column of mercury, at the temperature of melting ice, 14.4521 grammes in mass of a constant cross-sectional area and of the length of 106.3 centimeters." A little easier to remember is the fact that 100 yards of ordinary iron telegraph wire has approximately a resistance of 1 ohm.

The resistance of a conductor depends upon several conditions:

1. Its length.
2. Its cross-section.
3. The material of which it is composed, including the purity and density of such material.
4. The temperature.

To this may be added the resistance due to imperfect contact, but this is more properly a matter of construction than a property of the materials. It is made valuable use of, however, in telephone transmitters and coherers of wireless telegraphy apparatus.

Considering the first of these conditions, we find that the resistance of a conductor is proportional to its length. If the resistance of a certain length of wire is 5 ohms, then the resistance of a wire ten times as long, would be ten times as great, or 50 ohms.

The resistance of conducting wires is inversely proportional to the square of their diameters, or to the area of their cross-sections. A wire $\frac{1}{4}''$ in diameter would conduct four times as well as a wire $\frac{1}{8}''$ in diameter; if of the same length, the larger wire would have only one-quarter the resistance of the smaller one. The necessity of a careful calculation of the capacity and requirements of the wiring for electric plants is evident.

Some materials offer greater resistance to the electric current than others. Silver, copper, aluminum, platinum, iron and lead are the metals most commonly used in electrical work, and are given in the order of relative resistances, the lowest first. Iron offers about six times the resistance of copper. Annealed wire gives less resistance than hard-drawn. An alloy of two metals will have a higher resistance than either alone has. Nearly all pure metals increase their resistance with an increase in temperature at the rate of about .4 per cent for each degree Cent. Carbon is an exception to this rule, the resistance diminishing on heating.

Some materials, having such a high resistance as to be practically nonconductors, are called insulators. Glass, porcelain, marble, slate, mica, shellac, wax, paraffin, hard and soft rubber, various oils and fats are those most commonly used. With these materials the resistance decreases rapidly with the increase in temperature. The property of resistance is utilized in electrical measurements and in rheostats to regulate the flow of currents to motors. In a rheostat a number of coils of wire are so arranged that, by moving a switch, the resistance is gradually reduced, allowing more of the current to flow till all the resistance is cut out and the full current passes directly to the motor.

The energy of the current in overcoming this resistance is converted into heat. Those who have witnessed a break in a wire carrying an electric current of high potential, such as trolley wire, have seen that, when the broken wire comes in contact with the ground, it soon becomes red hot. This heat is developed by the resistance of the wire. Fires in buildings have been caused by a wire carrying a heavy current becoming "crossed" or in contact with another wire carrying a small current, such as a telephone or bell wire, and causing the latter to become highly heated. Hence the necessity of protecting all wiring from an excessive current. This is commonly done by interposing, at some suitable place in the wiring, a short length of metal similar to solder called a "fuse," which melts at the maximum temperature the circuit is capable of sustaining without danger. The melting of the fuse breaks the circuit, thus preventing the flow of the current. In electric welding and heating the resistance is so arranged as to heat the metal to the required degree.

This property of resistance is also important in considering the composition of batteries, and also upon their arrangement or grouping. The metals and chemicals that are used in the various cells differ greatly in the potential force they produce, and likewise in the resistance they offer to the flow of the current. A comprehensive consideration of chemical composition of cells requires a considerable knowledge of chemistry, and is outside the scope of these studies. A separate article on "Batteries," soon to be published in this magazine, will describe the more common types in use and the properties peculiar to each. A brief statement of the general characteristics of all cells is desirable at this time, to enable a proper summary of this and the previous chapters.

A cell is commonly composed of two metals of different potentials which are acted upon by an acid. A current flows when, by means of a wire or other substance, a complete circuit is established. The force of a current is termed the electromotive force (abbreviated E. M. F., or E.), and is expressed in *volts*. As applied to batteries, this difference of potential or pressure or voltage is dependent upon what metals are used rather than on their size. The greater the difference in the tendency of the metals to combine chemically with the acid, the greater the E. M. F.

The *anode* is the metal in the cell by which the current enters and which is dissolved during the action of the cell. The *kathode* is the metal by which the current leaves the cell, which remains constant or receives a deposit of some residium of the chemical action of the cell. These two terms have other applications analogous to these, which will be considered in the appropriate place.

The E. M. F. produced by a cell is rarely the exact difference in potential of the metals composing it. This is due to the resistance which the current meets and overcomes, mostly in the liquids of the cell. This resistance may be reduced by using larger pieces of metal or placing them nearer together. It is increased by the continued action of the cell, which causes a change in the chemical composition of the liquids, and also generates gases which attach to the surface of one of the metals, reducing the surface which may be acted upon. This is termed "polarization."

These chemical changes continue so long as the current flows, and are proportional to the volume of the current flowing.

With the information which has been presented in this and previous studies clearly in the mind, the relations existing between the E. M. F., resistance and current flow should be evident, and, knowing any two of these factors, the other can be found. Briefly, the E. M. F. (volts) divided by the resistance (ohms) will give the current (amperes).

The current (amperes) multiplied by the resistance (ohms) will give the E. M. F. (volts).

The E. M. F. (volts) divided by the current (amperes) will give the resistance (ohms).

These fundamental laws of electrical work should be studied until thoroughly memorized and understood, as this will do much to simplify many features of electrical study hereafter to be presented.

THE CONSTRUCTION OF A SMALL STORAGE CELL.

H. F. Shepherd.

The accompanying sketches and description apply to a small storage cell which has been found to give excellent results in practice. One of these cells, built by the writer, has been used for igniting the charge of a gas engine, and had a capacity of a trifle over 2 volts and about 12 amperes. For the construction of the cell there are required about $1\frac{1}{2}$ sq. ft. of sheet lead $\frac{1}{16}''$ thick; 1 lb. of red lead; 1 lb. of yellow lead or litharge; 1 lb. of sulphuric acid; 6″ of lead wire $\frac{1}{4}''$ in diameter; two brass nuts, and a binding post.

The outside shell of the cell is of sheet lead, and forms part of the negative electrode. This is made by cutting out of the lead sheet a piece $9\frac{5}{8}''$ wide in one direction, and 6″ wide in the other, with a lug or ear at one corner 2″ long and 1″ wide, as shown by Fig. 1. This is rolled into the form of a cylinder 3″ in external diameter, which will give a lap of about $\frac{3}{16}''$. The edge that is 6″ wide should lap on the outside of the edge 8″ wide, and the joint should be soldered, taking care not to fuse the lead any more than is absolutely necessary.

The bottom of the cell consists of a disc 3″ in diameter, to which the edges of one end of the cylinder should be fitted rather carefully and soldered. Next cut out a sheet of lead $5\frac{1}{2}''$ by 8″, and punch this full of holes not larger than $\frac{1}{4}''$ in diameter, and as close together as possible without making the lead so weak that it cannot be safely handled. The holes can be cut with an ordinary belt punch. This perforated sheet should be rolled into a cylinder $2\frac{1}{2}''$ in outside diameter and 5″ long, the lap being soldered in three or four places, but not necessarily throughout its length.

This cylinder should be set inside the first cylinder so as to leave an annular space of $\frac{3}{16}''$ uniform width between it and the interior wall of the main cup. This annular space should be filled with a paste made of litharge or yellow lead and dilute sulphuric acid, the acid being diluted by mixing it with ten times its weight of water. After packing the paste into position, let it dry thoroughly. The struoture thus far obtained constitutes the negative plate of the cell.

Next take the piece of $\frac{1}{4}''$ lead wire, thread it through a countersunk hole in the center of a wooden disc $2\frac{5}{16}''$ in diameter and $\frac{1}{2}''$ thick, beating a burr on the end of the lead wire which will fill the countersink in the wooden disc, as indi-

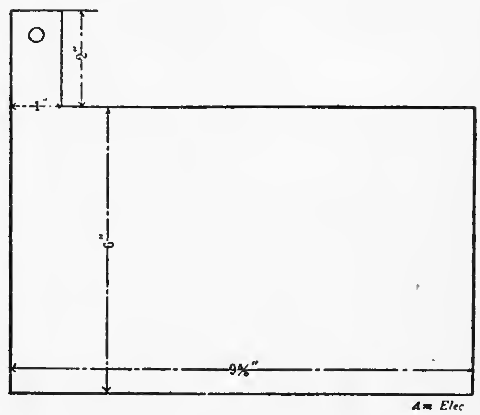

Fig. 1.

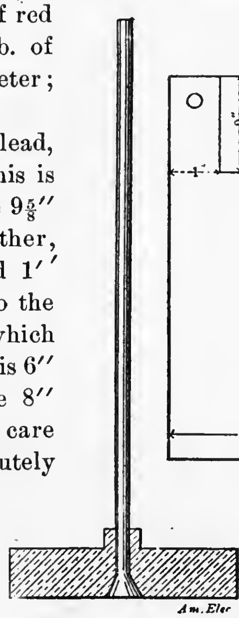

Fig. 2.

cated in Fig. 2. This disc must be thoroughly boiled in paraffin. Then cut out ten lead discs, $2\frac{1}{4}''$ in diameter, and drill a hole $\frac{1}{4}''$ in diameter in the center of each disc. Flute the edges of each disc with a pair of pincers, so as to convert each one into a very shallow dish, as indicated by Fig. 3, and punch the bottoms of these dishes full of holes not over $\frac{3}{16}''$ in diameter. Thread the first dish on the wire, letting it rest on the shoulder of the wooden disc, and fill it with a paste made of red lead and dilute sulphuric acid. Next thread another dish on the lead wire, taking care not to push it entirely down on top of the first dish, and fill it also with red lead paste.

It will be found a good plan to set two strips rubber or thoroughly dry wood across the top of the first dish for the second dish to rest on until its paste has hardened. The holes in the center of the dishes should be a tight fit on the lead wire, so that the friction there will tend to prevent the dishes from slipping down. The succeeding dishes are slipped on the wire and filled with paste one by one, until the whole ten are in position, and the cell may then be assembled, as shown by the cross-sectional view (Fig. 4), the electrolyte being put in before the cover is put on, of course. The electrolyte consists of dilute sulphuric acid, exactly like that used in mixing the paste, and the level should be well above the topmost dish.

The cover of the cell may be made of hard wood or of rubber, preferably the latter, and should be of the shape shown by Figs. 4 and 5, the lower part of the cover fitting snugly the interior diameter of the outer lead shell. If the cover is made of hard wood it must be boiled in paraffin. The hole in the center of the cover, through which the lead wire passes, should be tapered, as indicated in Fig. 5, and filled with coal tar or pitch, so as to prevent the acid fumes from passing up through the hole and attacking the brass nuts on the outside.

The binding post should be of the wood-screw variety, and its screw should not be long enough to go entirely through the cover. The ear, 1″ by 2″, shown in Fig. 1, is bent over on top of the cover, and the binding post passed through the hole in the ear, the post being screwed down hard on the ear to form connection with the outer shell. The cover must have a venthole about $\frac{1}{16}$″ in diameter, in order to allow the escape of liberated gases. Fig. 6 shows the cell with the outer shell and the litharge paste cut away to reveal the perforated inner shell.— *American Electrician.*

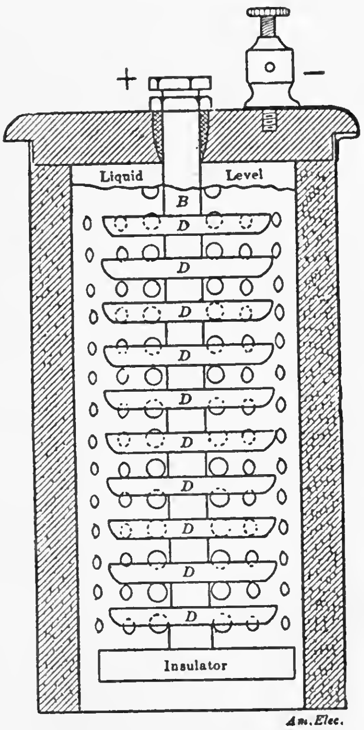

FIG. 4.—CROSS SECTIONAL VIEW OF STORAGE CELL.

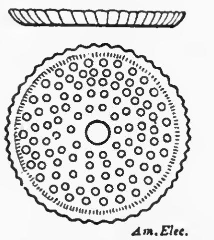

FIG. 3.—LEAD DISHES PUNCHED WITH 3-16THS IN. HOLES.

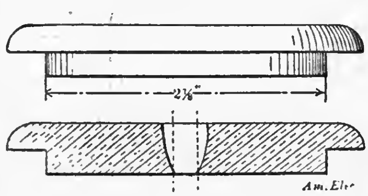

FIG. 5.—COVER.

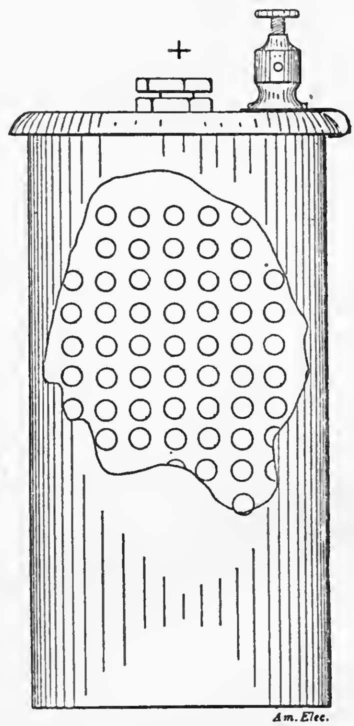

FIG. 6.—STORAGE CELL COMPLETE.

REAR-ADMIRAL BRADFORD, chief of the Bureau of Equipment, is investigating, through his agents abroad, all the systems of wireless telegraphy of any merit, with a view of ultimate adoption of one of them for the use of the navy. Thus it is to be presumed that the ships-of-war of the United States will have the best system.

EVERY MAN HIS OWN WEATHER PROPHET.

Prof. Willis L. Moore, the chief of the Weather Bureau, in a recent address, published in the *Marine Review*, says:

"Any intelligent person, by studying the few simple principles on which the daily weather-map is founded, can make an intelligent estimate of the general character of the weather for his region, one, two, and at times, three days in advance.

"You may ask: Why has not this been done by the laymen, whose crops, whose perishable produce in transit, whose vessels exposed to the fury of wave and tempest, and whose health and pleasure are so dependent upon the weather and upon the sequence in which weather changes occur? In answer it may be said that many members of commercial associations, knowing the fluctuations in value of soil products that often result when rain falls on a parched district, when frost smites the corn in the milk, when hot south winds wither the crops in the great central valleys, or when clouds and moisture affect the condition of cotton, make a fairly accurate forecast of the weather from the large daily weather-maps displayed on blackboards before all the important commercial exchanges of the country, and in a pecuniary way largely profit therefrom. . . .

"By preserving the weather-charts each day and noting the movements of the highs and the lows, any intelligent person can make a fairly accurate forecast for himself, always remembering that the 'lows,' as they drift toward him from the west, will bring warmer weather and sometimes rain or snow; and that as they pass his place of observation, the 'highs' following in the tracks of the 'lows' will bring cooler and probably fair weather.

"He can closely forecast the temperature for his region by remembering that the weather will be cool so long as the center of the predominating high, i. e., the high enclosing the greatest area within the 30-inch isobar, is north of his latitude — either northeast or northwest; and that it will be warm so long as the high is south of his latitude. . . .

"To get a rough idea of the difference between storms, we might classify them according to the diameter of the gyrating masses of air under their influence, as follows:

"Cyclones, 1,000 to 2,000 miles; hurricanes, 100 to 500 miles, and tornadoes, 100 to 1,000 feet. We might imagine their vortical action and their destructive force to increase in some ratio as their diameters of rotation decrease.

"The tornado is always an incident and a sporadic outbreak of the cyclone, and usually occurs in the southeast quadrant of a cyclonic storm.

"The thunderstorm, instead of rotating about a vertical axis, like the cyclone and tornado, has a horizontal roll, caused by cold and heavy air from above breaking through into a lighter and superheated stratum next to the earth. This rolling motion throws forward the cool air in the direction in which the cloud is moving. In general, thunderstorms move from the west toward some eastern point, the same as tornadoes, which mostly move from the southwest toward the northeast. If any part of the horizontally rolling air in the thunderstrom drops down toward the earth and adjusts its rotation about a vertical axis it at once becomes a tornado, and its destructive force is increased a hundredfold.

"Large owners of marine property estimate that one severe storm traversing our Atlantic coast in the absence of danger warnings would leave not less than $3,000,000 worth of wreckage. On two occasions a census was taken immediately after the passage of severe hurricanes, to determine the value of property held in port by the danger warnings sent out in advance of the storms. In one case the figure was placed at $34,000,000, in the other at $38,000,000. Of course this does not represent the value of property saved. It simply shows the value of property placed in positions of safety as a result of the danger-signals displayed and the warning messages sent to vessel masters."

Consul Haynes of Rouen, under date of Aug. 26, 1901, says that the metric system is to-day compulsory in twenty countries, representing in all more than 300,000,000 inhabitants,—Germany, Austria-Hungary, Belgium, Spain, France, Greece, Italy, Netherlands, Portugal, Roumania, Servia, Norway, Sweden, Switzerland, Argentine Republic, Brazil, Chile, Mexico, Peru and Venezuela,— and advises American exporters in dealing with any of these countries to adopt the system.

AMATEUR WORK

85 WATER ST., BOSTON

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A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

MAY, 1902.

Contents

IN the June number will appear the first chapter of a complete description of how to make a wireless telegraphy apparatus. All the different parts will be fully described, so that any one desiring to make an outfit will have no difficulty in doing it. The item of cost has been carefully considered, and the expense will be the least at which workable instruments can be made. The same writer will also contribute articles on the making and operating of X-ray apparatus, and other instruments of interest to those engaged in electrical experimental work.

NUMEROUS inquiries from our readers regarding directions for making an automobile at low cost lead us to request contributions on this subject. Any reader who has constructed a serviceable automobile at a cost of not over $100, and can give a clear and comprehensive description of how it was done, together with the necessary sketches, is requested to communicate with the editor in reference to contributing such a description for publication in this magazine. Such descriptions are desired for vehicles using steam and gasoline motor power, but must not be too complicated in design. If suitable arrangements can be made, such descriptive articles will be published with the expectation that many of our readers will utilize the information in constructing a carriage.

OUR readers are invited to contribute to the correspondence column their experiences in making things described in this magazine. Many valuable suggestions would be obtained in this way which would be helpful to all.

THE tables intended as a part of this month's chapter of Mechanical Drawing are omitted, but will appear in the next number.

IT is reported from Vienna that a resident of that place, named August Matitsch, has devised a lace-making machine, which is said to produce lace which is indistinguishable from the hand-made article.

MECHANICAL DRAWING.

Earnest T. Childs.

VII. THE ASSEMBLY.

The amateur who has closely followed these talks on mechanical drawing, and who has applied himself sufficiently to have completed reproductions of the specimen drawings which have been shown, will have attained by this time a fair knowledge of what is required of the mechanical draughtsman as a copyist. By this is meant that he will have learned the necessary details which must be acquired in order that he may draw lines correctly on tracing cloth or paper, at the same time working from some predetermined outline or dimensions. This is the first step in the development of the mechanical draughtsman, and is extremely important. A person capable of making accurate copies with reasonable celerity has the foundation upon which the future draughtsman may stand. Without doubt accuracy is most important, but rapidity follows a close second. The ability to make free-hand sketches in a clear, concise manner, as described in the last chapter, is also a valuable requisite.

All the above requirements are, however, those of the copyist only, and it is on this basis that the young draughtsman generally starts his work in the drawing-office. As his ability to comprehend increases by practice in copying or tracing, and as he profits by his observation of work with which he comes in contact, just so fast will he advance. Once started in the work, it depends upon himself alone just how fast and how far he will be able to go.

There are other things required, however, for the production of the first-class mechanical draughtsman. He must be well posted on engineering subjects, must understand the principles of mechanics, must know about the strength of materials, and must have a working knowledge of steam and electricity, not to mention a dozen other kindred subjects.

These requirements are enumerated, not to discourage the student, but rather to direct the course of his study into the proper channels. The draughting board is not a thing to which every draughtsman expects to be tied throughout his natural life. It may be looked upon as a stepping-stone to something broader and higher. And it is an extremely essential stepping-stone. It would surprise many, if statistics were available, as to the number of superintendents and chief engineers who started their careers over the drawing-table.

But aside from the future possibilities of the man who actually works over the board in the drawing-office, a thorough knowledge of drawing is of vast importance to every artisan, no matter whether he be journeyman or apprentice. Let us consider for a moment a few of the trades in which a knowledge of and an ability to read plans will be absolutely necessary. Imagine, if possible, a machinist starting to build an engine without plans to work from, or a patternmaker making a pattern for a cylinder by guesswork. The result may be a thing which will run, but it can be obtained only by a cut and try process, and when the machine is complete there will be no record to show what it is like. The same will apply to a motor or any other piece of mechanism. Ask a carpenter to build a house, and the first thing he does is to make a plan, even though the house be only a beach cottage. A mason must be able to read plans to lay out foundations, walls, etc. A plumber or a steam-fitter always makes a diagram before piping a job.

In fact, there is hardly a trade where a knowledge of drawing will not be useful to the workman, and it is more particularly to help the apprentice and the young journeyman that these talks have been given. If a young man is anxious and ambitious to become something more than an ordinary workman, the first step will be to learn to read drawings, and this will be succeeded by courses of study along the lines of his chosen occupation.

This chapter will close the present series of articles on mechanical drawing, and the assembly drawing of the engine, together with the last details, are given herewith. It has been necessary to draw the assembly to a very small scale ($1\frac{1}{2}'' = 1'$) on account of the size of the sheet; but

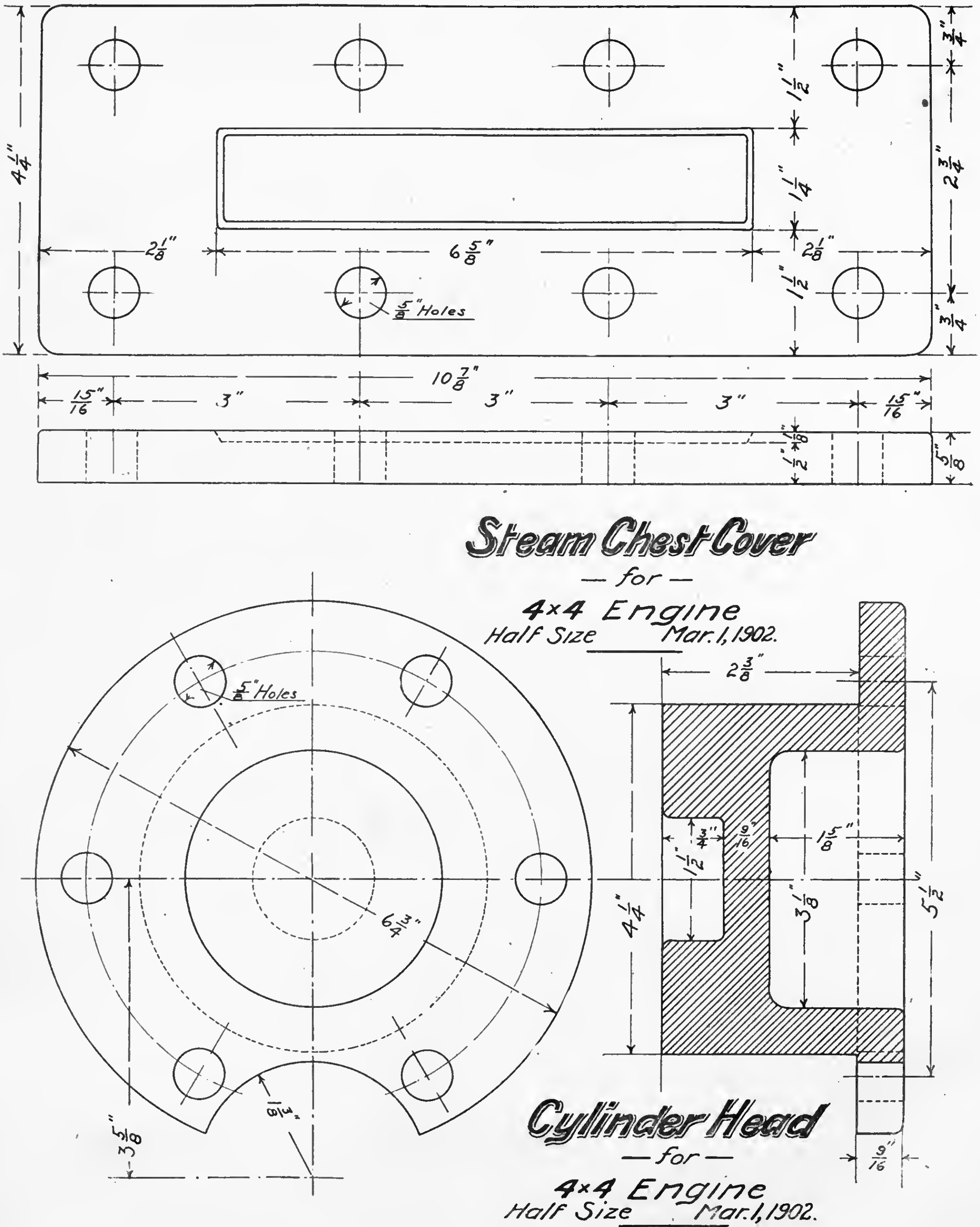

Steam Chest Cover
— for —
4×4 Engine
Half Size Mar. 1, 1902.
5/8" Holes
Cylinder Head
— for —
4×4 Engine
Half Size Mar. 1, 1902.
5/8" Holes

FIG. 22.

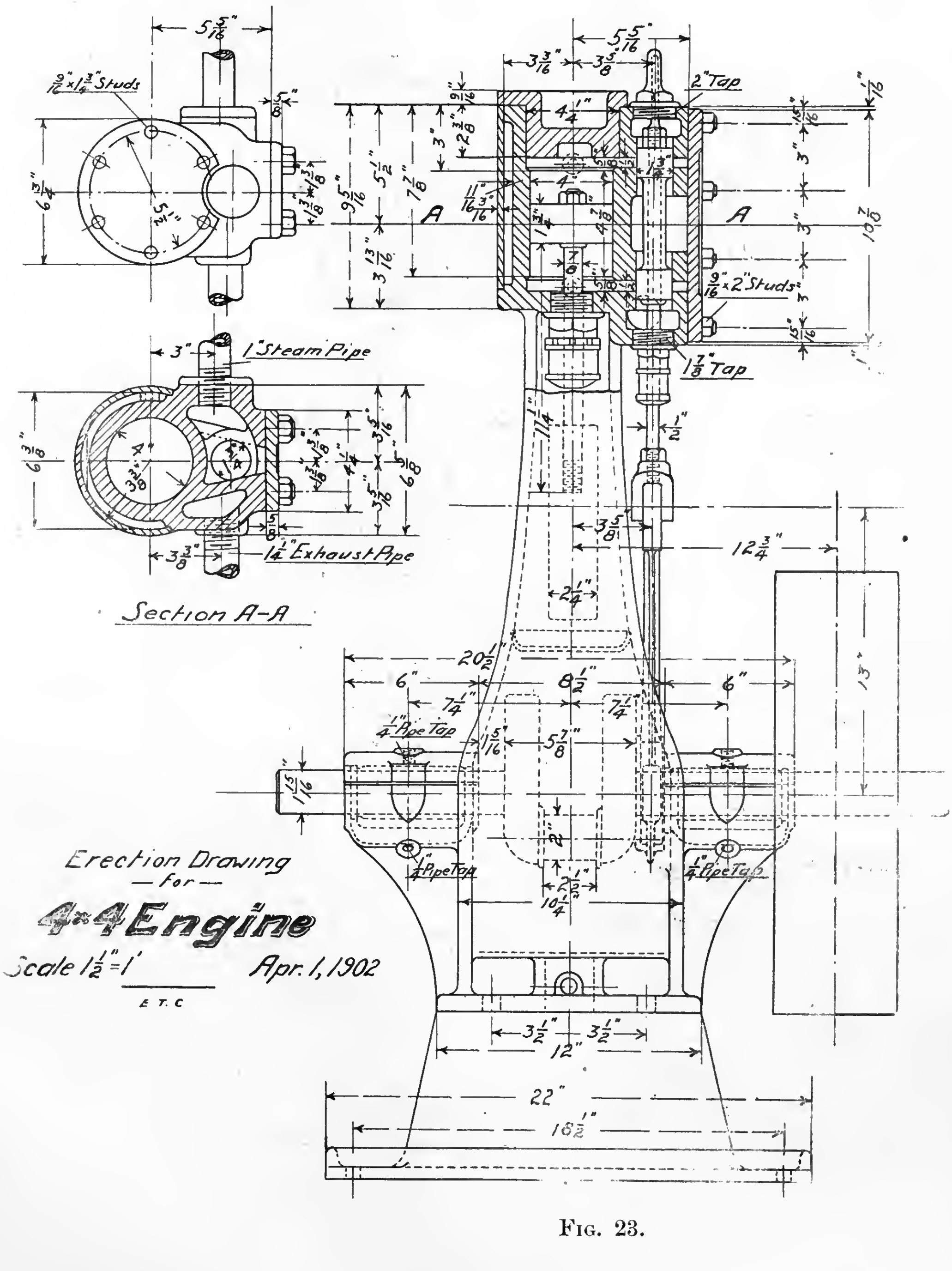

Section A-A
Erection Drawing
— for —
4×4 Engine
Scale 1½"=1'
Apr. 1, 1902
E.T.C.
1" Steam Pipe
1¼" Exhaust Pipe
2" Tap
1⅞" Tap
¼" Pipe Tap

Fig. 23.

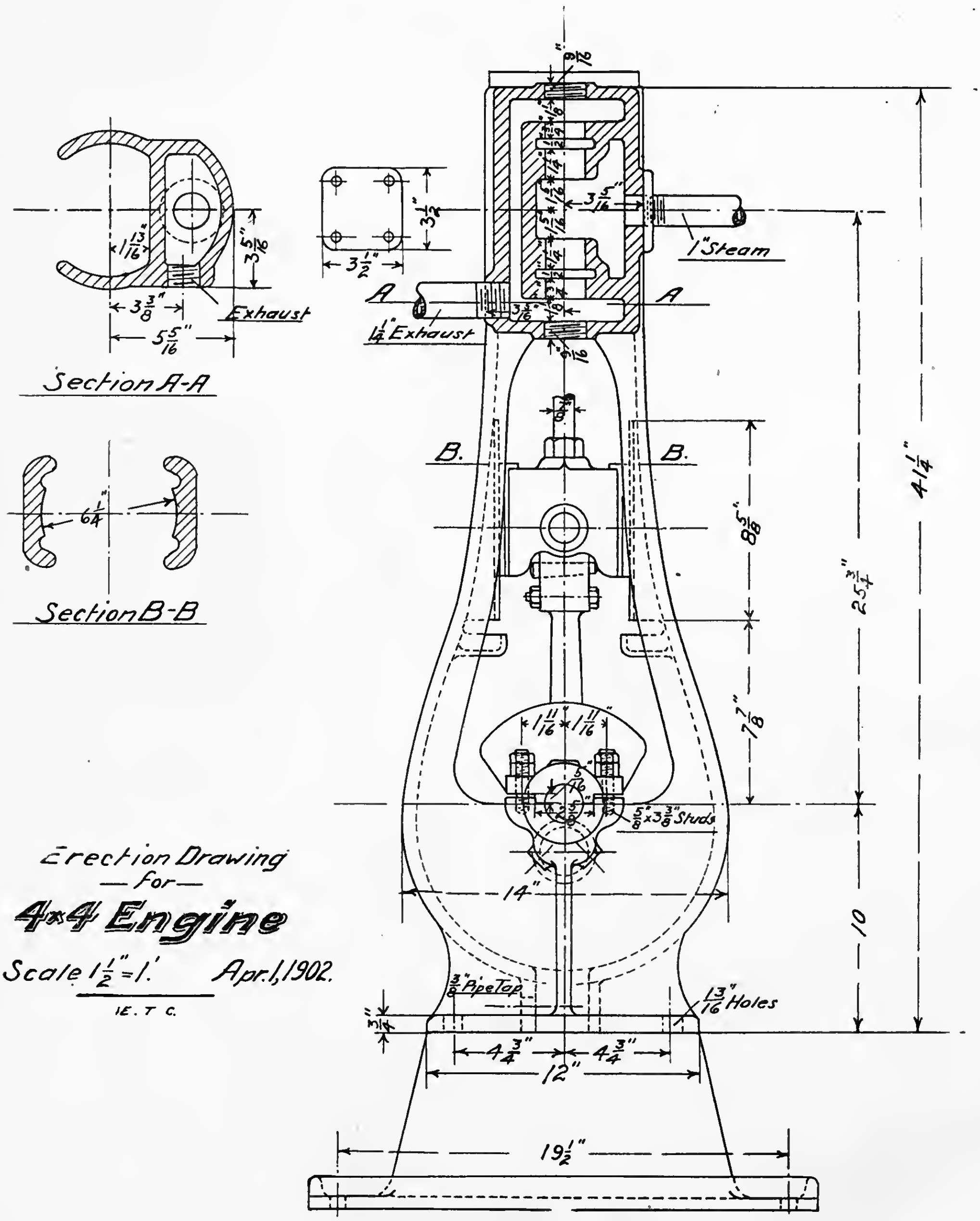

Section A-A
Section B-B
Exhaust
1¼" Exhaust
1" Steam
A
A
B.
B.
5/8"×3 3/8" Studs
3/8" Pipe Tap
13/16" Holes
Erection Drawing
—for—
4×4 Engine
Scale 1½"=1'
Apr. 1, 1902.

Fig. 24.

in redrawing, this should be enlarged to half size in order to better show the various details. Particular attention should be paid to the choice of sections of the engine to full scale. There is little to be said regarding the sheet showing the cylinder head and steam chest. These are necessary to complete the final details of the engine. It will be seen that in this course we have drawn every detail of this 4 x 4 engine, and the complete work is attained in the assembly drawings.

Incidental to the acquisition of a knowledge of mechanical drawing, it has been possible to obtain also a small idea of the drawing required for the parts which go to make up a small upright engine. This series will not be complete, however, without a little additional data. In Chapter III is given an outline of the various common types of screw threads. The United States standard screw thread is one with which all draughtsmen should be familiar. This thread is slightly flattened at the apex, and the angle is 60°. The standard dimensions of threads from $\frac{1}{4}''$ to $2''$ are given in the accompanying table (see Table No. 1) and the load which each will hold is given, based on a tensile strength of 5,000 lbs. per square inch of cross-section. It will be observed that the rough iron sizes vary slightly from the standard, the latter being smaller, due to the flattening of the V to prevent injury to the thread.

Supplementing the data on screw threads, it is essential that one should possess some knowledge of nuts and boltheads. With this in mind, a table has been made giving the most important dimensions for hexagonal nuts, in sizes from $\frac{1}{4}''$ to $2''$ in diameter. (See Table 2.)

In connection with these tables it will be found convenient to have one giving decimal equivalents of fractions of an inch. (Table 3.) These tables will do to start a reference notebook, which every draughtsman should have and should add to it the scraps of information secured from time to time. The best kind of a book for handy reference is one which is indexed, thus making it possible to classify the information the more readily. Later, when the notebook may become overcrowded, the information may be transferred to a card index, alphabetically arranged. This is, however, rather beyond the range of the present subject, and is given as a hint for future work. Part II, Projection, will be the subject of continued talks.

Details of a contract between Signor Marconi and the Canadian government, by virtue of which the Canadians have been promised a new transatlantic telegraphic rate of 10 cents a word for ordinary messages, with a press rate of 5 cents a word, have just been made public. The Canadian government will contribute $80,000 toward the erection of a Marconi station in Nova Scotia, according to the plans and specifications made by Marconi himself. Should the station cost more than that amount, the additional expenditure will be borne by the company. It is agreed that there is to be no discrimination on Marconi's part in favor of the United States.

M. L. Cailletet has presented to the French Academy of Sciences a process for frosting and engraving on glass and crystal by the use of gelatine. The process consists of simply painting on a strong, hot solution of glue, which is allowed to dry. As it drys, it contracts, and the adhesion of the glue to the surface of the glass is sufficiently strong to tear off layers of the surface, leaving a beautifully frosted design. By a mixture of 6 per cent or less of potash, alum or various other crystalline chemicals, very beautiful crystalline patterns are obtained.—*L'Industrie Electrique.*

A steamship using oil for fuel recently made a voyage from Borneo to Great Britain, a distance of eleven thousand miles, in splendid time, and at a reduced cost of handling. Three firemen did the work of twenty, with less discomfort and more efficiency. This has practically demonstrated the utility of fluid fuel, and now three oil depots are to be erected at Dover in the English Channel. Like facilities are to be strung along the sea lines of other coasts where ocean travel has its established highways. It takes but three hours for a liner to load up 1,500 tons of oil-fuel, and this and other economies will count in its favor for marine purposes. Will King Coal yet have a royal competitor, or did nature make a mistake in providing "gushers"? A steamship recently loaded 157,871 cases, each case containing ten gallons of refined petroleum, for Japan. The value of the cargo was estimated at $146,000. The United States is building up a splendid foreign trade in this line.—*Age of Steel.*

PHOTOGRAPHY.

INTENSIFICATION AND REDUCTION.

The conditions under which photographic plates are exposed and developed vary so greatly that rarely is it possible to secure a perfectly satisfactory negative. Some will be thin in opacity, with contrasts so weak that the prints made therefrom will be soft and flat, the remedy for which is Intensification. Or the negative may have the reverse of these faults: have too great opacity, or give excessive contrasts, for which the remedy is Reduction. The former faults usually result from over-exposure and under-development; the latter from under-exposure and over-development, or the use of a developer which worked too rapidly, producing opacity without detail.

In Intensification the object sought is to increase the opacity in such a way as to give deeper and sharper contrasts in the print without the loss of detail, and should immediately follow development when possible. Old negatives can be successfully treated, however, and are good subjects for study in learning this work. Having decided that it is desirable to intensify a negative, the first thing necessary is to give it a thorough washing, whether it be old or newly made. It is absolutely necessary to good results that all "hypo" and other free chemicals be completely removed; also that the negative has been properly fixed. If any uncertainty exists on this point it is advisable to refix in a fresh fixing solution; previous to which the negative, if an old one, should be soaked in water for a few minutes, to soften the film. After fixing, again wash in running water until all traces of hypo are removed. A half hour will be none too long a time for this washing.

There are numerous formulas for accomplishing the desired result, but the one here given is reliable, and will give a good insight into the process, and enable other formulas to be tried when desired. The first part of the work consists in bleaching the negative, which is done with a saturated solution of mercuric chloride (corrosive sublimate, *Poison*). In warm weather, or if the negative does not require to be much intensified, the strength of the solution may be reduced. A few trials will soon enable the worker to determine the most suitable strength to be used. In bleaching, the film will gradually whiten, and this should be continued until the under side of the film is affected. When bleaching has been carried far enough, the negative should be well washed in cooled boiled or distilled water, remaining in the last change of water for a few minutes soaking. When washed, the film is again blackened by immersing in a solution made as follows: To five ounces of a saturated solution of potassium oxalate, to which has been added a few drops of oxalic acid, add one ounce of a saturated solution of ferrous sulphate, and then add three ounces of distilled water. This solution gives considerable density, and has the advantage that it may be repeated if desirable to do so.

Those who do not care to prepare their own solutions may purchase of photographic supply dealers prepared solutions for this work, which will give good results and improve many a negative that would otherwise be of but little value.

After the process has become familiar, it may be utilized for improving parts of a negative by local application with a soft brush. Considerable skill is required, however, to do this satisfactorily.

Reduction is the reverse of the above process. Here the desire is to remove the surplus density, to render the contrasts more subdued and bring out detail. It is especially valuable for lantern slides and for clearing foggy negatives. In this work, with the formula given below, hypo is very objectionable, and the preliminary washing to remove it must not be omitted. If reduction immediately follows development, which is desirable, as the film is then well moistened, the washing should be thorough enough to remove all traces of hypo. If it be an old negative, it should be soaked in water until the film is thoroughly moist, and all hypo removed.

The reducing agent recommended to amateur photographers, and especially the beginner, is a three per cent solution of persulphate of ammonium, or say fifteen grains to each ounce of water. When reduction has been carried to the desired point, the plate is rinsed in water and then immersed for a short time in a ten per cent solution of sulphite of soda, followed by a good washing.

This reducer has the peculiar property of working more rapidly on the denser portions of the plate than on the thinner parts, just what is usually desired. With it clouds, draperies and similar details that are often lost, can be restored, greatly enhancing the printing qualities of a plate.

As persulphate of ammonium is quite unstable, it should be prepared only a short time before use, and worked under a subdued light. There are other formulas which have their special uses, a knowledge of which is desirable as progress is made. It will need but little experience to show their value to the photographer who is desirous of producing good work, and willing to do some experimenting to achieve it.

WATER FOR PHOTOGRAPHY.

In photographic formulas, and many of the processes, the requirement of pure or distilled water is general. To secure good results, it is absolutely necessary that this condition be observed; and it easily may be, if the following directions are observed.

The best water is that which has been distilled and bottled as soon as cool enough. Some druggists will supply this at a very moderate cost, but in purchasing such water make sure that it has not been exposed to the air, so that it has again absorbed oxygen. With some chemicals, the oxygen in the water will cause oxidization that will be harmful. Hence the necessity of keeping the water used in making up solutions in full bottles, well corked. A few bottles of various sizes will enable this to be done without excessive trouble.

If distilled water is not available, rain water collected in porcelain or glass vessels may be used. It should be collected in an open space, after sufficient rain has fallen to clean the air, and not from the roof of the building or waterspout, for such water contains dust and other impurities. It should then be boiled for at least ten minutes in an earthenware vessel, to expel all the air, and bottled when cool enough to avoid breaking the bottles.

At times the weather bureau may not provide an opportune rain, and resort must be had to other sources. If the regular water supply is not too "hard," that is, has in solution much lime or other mineral impurities, it may be used after boiling and bottling, as above directed.

Bottling should follow boiling as soon as possible, as the water, if left in an open vessel, soon absorbs oxygen in considerable quantity.

PHOTOGRAPHIC SCALES.

The photographer who does his own developing and printing has frequent use for a pair of scales. Following is the description of how a very serviceable pair can easily be made at slight expense.

For the stand is required a piece of hard wood 10″ long, 7″ wide, and $\frac{7}{8}$″ thick. In the center of one side cut a socket 2″ long and 1″ deep, to which fit an upright piece 12″ long, 2″ wide and 1″ thick. One inch from the top of the upright drive a stout wire nail, leaving about $\frac{1}{2}$″ protruding, upon which to hang the arms of the scales. With a file, sharpen the upper side of the nail to a knife-edge, to prevent friction and secure a finer adjustment.

About 36″ of galvanized iron telegraph wire or steel wire will be needed for the arms. In the center make a $\frac{1}{2}$″ loop by bending around a bolt or large nail. Then bend the wire downward on each end at points 6″ each side of the center of the loop. Again bend each end outward 9″ from the first bends. On these projections, which will be a little over 2″ long, solder the tops of tin spice boxes. These should be of the same size and weight. If soldering is not convenient, the wire may be a little longer, and two circles made at the ends, upon which the spice-box tops or porcelain plates can rest.

When the bending is completed, file a nick in loop where it rests on the nail, to keep the arms in the same relative position. Then place the arms on the nail and bend them until they hang evenly. It may be necessary to add a little solder on the under side of one of the pans to get a correct balance. For weights, cut a piece of solder or lead into different sized pieces, and with a file and the assistance of a set of correct weights adjust until they are correct. For the smallest weights pieces of tin will be handier to handle.

A SUNDIAL.

In these days of church clocks and dollar watches a sundial may not be necessary as a means of learning the time of day, but as an ornament for the lawn and as a reminder of days long past it serves a useful purpose. The following directions will enable any one to make a sundial that will give fairly correct sun time, which differs in most places from standard time.

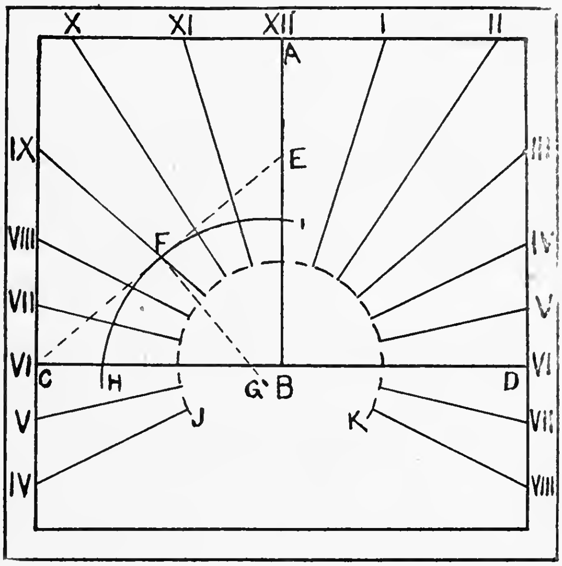


Fig. 1.

For the base, procure a piece of well-dried wood 13½″ square and ⅞″ thick. This should be planed perfectly smooth, with a small bevel around the edge of the upper side; mark with a sharp point a line around each side of the top ¾″ from the edge. This will give a square measuring a foot on each side. Four inches from the bottom side draw the line C-D for the six o'clock time (see Fig. 1). From the centers of this line and the top line draw the line A-B. Then draw the line C-E at an angle corresponding to the latitude of the place where the dial is to be erected. This angle is also used in making the gnomon. Divide the line C-E in the center and at a right angle to it draw the line F-G, which is one-half the length of the line C-E. Using the point G as the center and the line F-G as the radius, describe the arc H-I. Divide this arc from the points where it crosses the lines C-D and A-B into six equal parts, marking lightly each division. From the point B draw lines through these divisions to the lines along the edges, omitting them for a space of about three inches around the point B. These are the hour lines, and both sides of the dial are alike, one side being taken from the other. The lines below the six o'clock line, C-D, are but continuations of the opposite lines above.

The gnomon is the projection above the face of the dial which casts the shadow. (See Fig. 2.) Preferably it is made of stiff sheet brass, which may be polished to increase the ornamental effect. If made of wood, the grain should run perpendicularly and the hour markings on each side should be separated by a space equal to the thickness of the wood. The line A-C is at an angle with the line A-B corresponding to the latitude, as before mentioned. This upper edge is called the style; the base is the substyle. A piece of brass or wood 8″ square is required for the gnomon. The base, A-B, is 8″ long. The angle of the line A-C determines the height of the side B-C. If of brass, two projections, D and E, are left on each end of the base. These are 1″ square, the pieces D being bent to one side and the pieces E to the other. A hole is bored in each piece to receive a round-headed brass screw with which to hold the gnomon firmly erect.

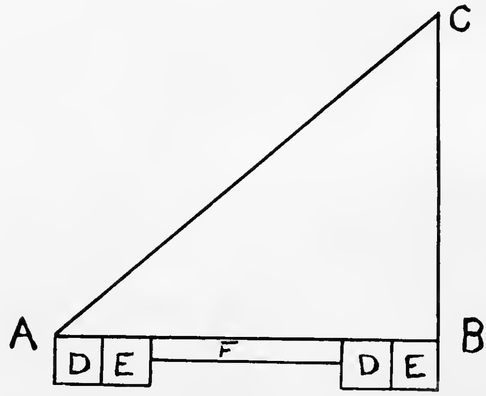


Fig. 2.

If of wood, leave an extension, F, ½″ deep, which should be well fitted to a socket cut in the base-board, centering on the line A-B. It may be held in place by wire nails, carefully driven from the under side to avoid splitting. When the gnomon is fitted, the base should be well oiled with linseed oil and then painted with two coats of outside white paint. A tube of black paint and a small brush are required for marking the hour lines, which should be about $\frac{1}{8}''$ wide. First paint the bevel of the edges, then the lines marking the square, then the hour lines. The letters giving the hours complete the marking.

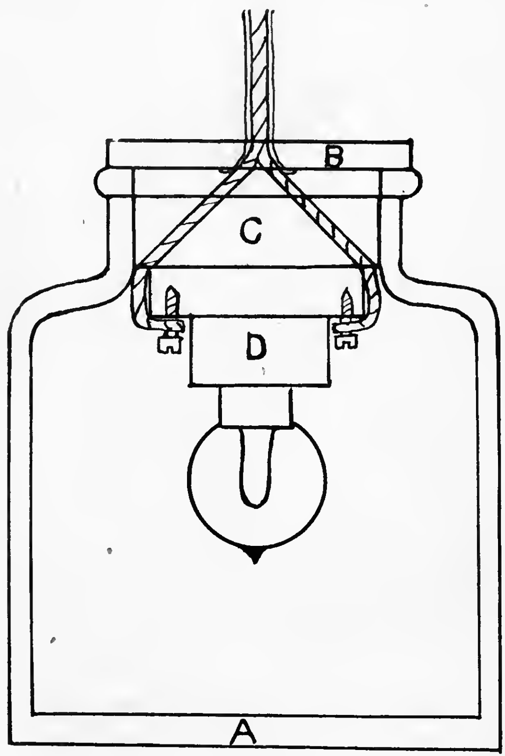
The dial is erected on a firm post and should be perfectly level, with the gnomon or line A-B pointing due north. A compass or the north star may be used to set the dial. If the post is ornamental, it will add to the general appearance.

FISHING BY ELECTRIC LIGHT.

The electric light equipment here described will add much to the interest, and, if the fish are in the right mood, to the length of the string of an evening's fishing. The necessary materials are: a small incandescent electric globe and porcelain base of about three-candle power and three volts; a dry battery for same, of the kind used in bicycle or night lamps; several yards of two-way flexible covered wire of small diameter, some rubber tubing to cover the flexible wire, a glass bottle with large mouth, and rubber cement.

The neck of the bottle should be large enough to easily admit the porcelain base. Cut a circular piece of wood, B, from a cigar box, large enough to cover the top of the bottle, and in the center bore a hole to admit the rubber tubing with a tight fit. The porcelain base, D, is screwed to the cork, C, with two screws which should be long enough to reach into the wooden piece B. The flexible wire is then covered with the rubber tubing. An easy way to do this is to take a nail which will easily pass through the tubing, tie to it a strong thread, and from an upper window lower the nail into the tubing until it comes out the other end. With the thread, a string is then pulled through, and with the string, the wire in the same way. Firmly attach the string to the wire without any large knots, and also see that the ends of the wire are not likely to catch on the tubing. The wire on the lamp-end should extend about three inches to allow for connections in the bottle.

Through the cork, bore two holes from the center of the top side to the edges of the porcelain base. The wire and tubing are then put through the hole in the wooden piece B, the end of the tubing being attached with bicycle or other cement to the underside of this piece. The two strands of the wire are then put through the holes in the cork and connected with the terminals of the lamp. The upper side of the cork is then covered with cement and pressed firmly against the piece B. When dry, the water will not reach the wire when the cork has been inserted in the bottle.

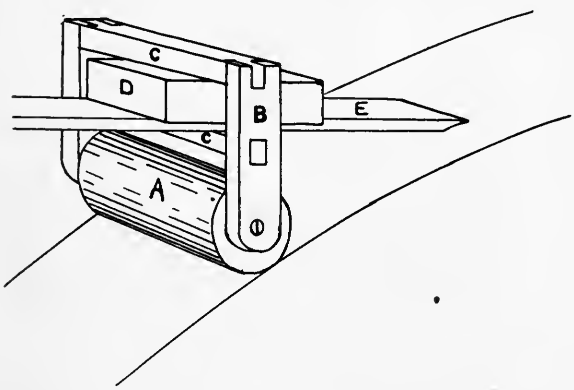


The other ends of the wire are, when ready to use, connected to the battery, and the lamp will then light. The battery is kept in the boat. The wire not in the water does not require to be covered with tubing. In use, the bottle is weighted so that it will sink to the required depth. The battery is then connected to light the lamp. The light will attract many kinds of fish. The fisher and a properly baited line will do the rest.

The wave motion of the sea is utilized to run an electric-lighted buoy at the mouth of the river Elbe in the North Sea. The least motion of the water is sufficient to generate the electric current, which when not needed passes to storage batteries.

HOLDER FOR GRINDING TOOLS.

The little devices shown in the accompanying illustration will be found of much assistance when grinding chisels, planes and similar tools. This holder keeps the tools always at the same angle, and also assists in keeping them even, so that the edges may be ground square. It is easily made, as follows: The roller consists of a spool or piece of round, hard wood, 2½″ long and 1¼″ to 1½″ diameter. Two upright pieces, B, are 2¾″ long, ¾″ wide and ½″ thick, the lower ends being rounded. Two pieces, C, are 3½″ long, ¾″ wide and ⅜″ thick, the ends being fitted to mortises in the pieces B, as shown. These pieces are ¾″ apart. Holes are made in the lower ends of the pieces B, for the bearings of the roller. If



a spool is used for the roller, a wooden skewer well smoothed with sandpaper and fitting loosely will answer. If a solid piece of wood, the exact center of each end must be marked, and holes made for screws, which serve as the bearings.

In using this holder, the chisel or other tool is placed between the pieces C, and temporarily fastened with a wedge, D. This wedge may be placed above or below the tool as desired, for the angle at which the tool is to be ground. The angle is also regulated by the distance the tool projects beyond the holder. Before using, the holder should be well oiled, so that the water from the grindstone will not soak into the wood and injure it. This holder is not intended for use on an emery-wheel.

The casting of motor described in March number has been delayed at the foundry, and cannot be offered as a premium until next month.

THE OSMIUM LAMP.

The Welsbach osmium incandescent electric lamp was shown for the first time in public at a recent meeting of the Electrotechnical Union in Vienna. Osmium is a metal of the platinum group, and is found almost invariably in combination with iridium. It has the high specific gravity of 22.5 and is the heaviest known body. It is very hard and melts at the temperature of 2,500 degrees Centigrade. It can be brought to a high state of incandescence, emitting a brilliant light before this temperature is reached. Until recently the only uses of the metal have been in the iridium alloy, which has been employed for the tips of gold pens, and for some of its salts, which are used in microscopy and as chemical reagents. In making the lamps the gray osmium powder is reduced to a pasty mass by a suitable mixing ingredient and squirted into filaments. These are about the size of sewing thread. They are wound into their proper form and heated to redness in an atmosphere of ordinary illuminating gas. The heating is accomplished by electricity. The filament contracts considerably and rapidly while hot, and is reduced to metallic osmium in a few minutes. It has not been stated whether the bulbs in which these filaments are placed are exhausted of air or not. The consumption of the lamps is stated to be one and one-half watts per candle-power. It is also claimed that this efficiency is retained throughout the life of the lamp. In some curves which were shown, a lamp beginning at 14.8 candle-power at the end of 200 hours of burning showed 16.5 candle-power and slowly diminished until, after 1,000 hours of burning, it showed 15 candle-power. The light from the lamp is very white. It is stated that the commercial manufacture of the lamp is already well started. They are made for low voltages, twenty-five volts seeming to be standard.—*L'Electricien.*

An English contemporary states that the government of India has definitely decided in favor of electric lighting and punkah-pulling for a number of military barracks in that country.

Enlarge your outfit of tools by securing the premiums offered for new subscribers.

VOLTMETERS.

How to Connect and How to Use Them.

Professor Tell, in *Steam Engineering*.

A voltmeter is an instrument that indicates the voltage, or electro-motive force, that acts in a circuit. Electro-motive force is the force that impels a current through the circuit — that pushes it along, so to speak. It is substantially equivalent to pressure in steam, and in fact is sometimes spoken of as electric pressure. Electro-motive force is measured in volts, and thus it has come to be common practice to speak of the electromotive force acting in a circuit as the voltage.

Voltmeters are only made in the form of indicating and recording instruments; no other form is necessary, because all we require to know is what the voltage may be at any instant, which we ascertain by looking at the dial of an indicating instrument; or what the voltage has been at every instant of time during a certain period, which we can find by inspecting the chart of a recording voltmeter.

Recording voltmeters are similar in construction to recording steam gages, and are provided with either a roll of paper or a circular disk, upon which a line is traced showing the voltage at all instants of time within a certain period. In this article we will discuss the indicating voltmeter only. The way in which a voltmeter is connected in the circuit is illustrated in Fig. 1, in which *a* and *m* represent the armature and field coils of a generator, and *V* the voltmeter. As will be seen, one of the wires from the instrument is connected with line *p*, and the other with line *n*; thus the voltmeter short-circuits the entire external circuit. If an ammeter were placed in this position, there would be an enormous rush of current through it, sufficient to stall the generator and probably do great damage if a circuit breaker were not connected in the circuit. With a voltmeter, however, the case is very different, the difference being due to the fact that while the resistance of the ammeter is very low, that of the voltmeter is very high. The ammeter is provided with a coil of very large wire consisting of only a few turns — in large instruments, only one turn. The voltmeter, on the other hand, has coils wound with many turns (running up into the thousands) of very fine wire. Owing to this difference in the resistance, while the current passing through an ammeter connected in the position shown in Fig. 1 would be very great,— only limited by the capacity of the generator,— the current passing through the voltmeter would be very small, so small as to be measured in thousandths of an ampere. The actual strength of the current that passes through a voltmeter depends upon the resistance of its coils and the voltage that acts to force a current through them. The resistance does not change, hence the only way in which the strength of the current can be changed is by varying the voltage; therefore the instrument will show variations in voltage if properly calibrated.

From the foregoing it will be seen that ammeters and voltmeters act in precisely the same manner, that is, by the variation in the strength of the current that passes through them. The only difference between the two instruments is that the ammeter is constructed so as to be traversed by very strong currents, and is calibrated so as to show the number of amperes that pass through it; while the voltmeter is constructed so as to be traversed by very weak currents, and is calibrated so as to indicate the voltage that forces the current through it.

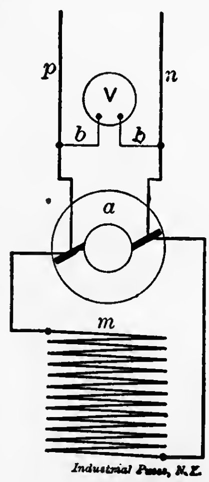


Fig. 1.

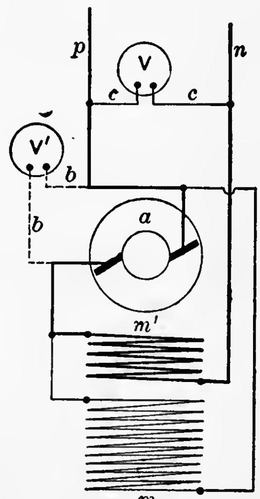


Fig. 2.

If a voltmeter is connected as in Fig. 1, it will indicate the highest voltage acting upon the external circuit, and will show a greater number of volts than if connected across the circuit at any other point farther away from the generator. The reason for this difference is that it requires electro-motive force to drive a current through even the shortest length of conductor, and therefore the voltage left after passing through a portion of the circuit will be less than before passing through it.

In Fig. 1 the generator shown is of the simple shunt type, this being used so as to simplify the diagram. When a compound-wound generator is used, it is necessary to be more particular in connecting the instrument, for if it is connected directly with the armature terminals, it will show a greater number of volts than actually act upon the external circuit. This fact is illustrated in Fig. 2, in which a properly connected voltmeter is shown at *V*, while one that only spans the armature is shown at *V′*. As can be seen at once, the current in wire *n* cannot reach the armature until it has passed through the field coil *m′*, and, as already stated, a certain amount of electro-motive force is required to drive the current through *m′*; hence the voltage between the wires *p* and *n* cannot be as great as that between *b b*, so that instrument *V′* will indicate higher than instrument *V*.

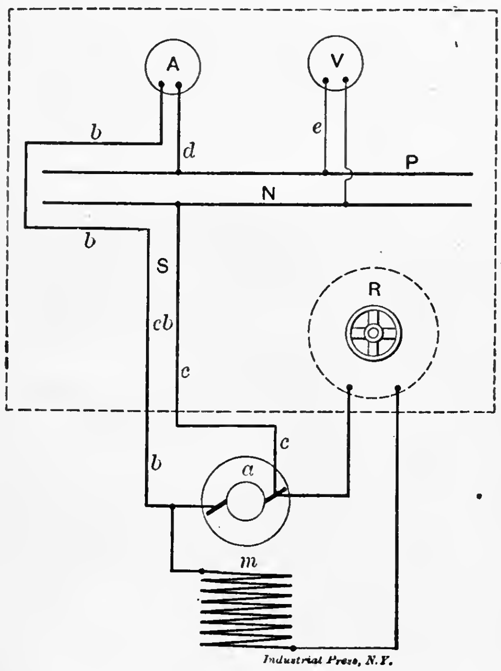


Fig. 3.

The connection of voltmeters, as in Fig. 2, is commonly used in testing generators. If an ammeter is connected in one of the *b* wires, then by dividing the volts indicated by *V′* by the number of amperes shown in the ammeter, the resistance of the armature is obtained in ohms. In this way we can determine what the armature resistance is when it is heated by the current. If we note the difference between the volts indicated by the instrument at *V* and the one at *V′*, and divide this difference by the number of amperes indicated by an ammeter connected in wire *n*, we will obtain the resistance of the field coil *m′*. The ammeter connected in *n* will not show as many amperes as that connected in the *b* wire, for a portion of the current passing through the latter instrument goes through the shunt field coil *m* and does not enter wire *n*. The difference between the readings of the two ammeters will show the current that flows through the shunt coil *m*. If we divide the volts indicated by the instrument *V′* by the amperes of current passing through *m*,— which is the difference between the readings of the two ammeters,— we will obtain the resistance, in ohms, of the coil *m*. From this it will be seen that by connecting two voltmeters, as in Fig. 2, and an ammeter in wire *b* and another one in wire *n*, we can measure the current flowing through the armature, through the series field coils *m′* and through the shunt coil *m;* and we can also measure the resistance of these three parts of the machine when they are traversed by the normal working currents. Such measurements are taken for determining the efficiency of a generator and likewise its regulating qualities.

The connections of a voltmeter on a switchboard are very simple and easily traced out, but for the purpose of making the matter perfectly clear Fig. 3, which shows the connections in the plainest possible manner, is presented. The generator armature and field are shown at *a* and *m*. The rectangle in broken lines indicates the switchboard; the lines *P* and *N* are the bus bars; an ammeter is shown at *A* and a voltmeter at *V*. The latter is connected with both the bus bars, these taking the place of the wires *p* and *n* in Fig. 1. The spaces marked *S* and *cb* show the position of the main switch and the circuit-breaker. The distributing circuits are taken off from the two bus bars, generally with a small switch in each circuit, so that it may be disconnected independently of all the others. Such switches are not provided, however, unless required.

Fig. 4 is a diagram which will enable us to make clear several uses to which voltmeters are put, and also the meaning of a number of terms very commonly used. In this diagram, *a* represents the armature of a generator, and *m* the field. The wires *p* and *n* represent a distributing circuit from which a number of lamps or motors, *l*, are operated. If a voltmeter is placed at *V*, and is connected with the points *s s‴* by means of the wires *b b*, it will show the electro-motive force, or voltage, acting to force the current from *p* to line *n* at the points *s s‴*. This voltage is the total electro-motive force acting upon the circuit, and it acts to drive a current through the first lamp, *l*, which is also connected with the points *s s‴*.

As already stated, the current cannot be driven through wire *p* from *s* to *s′* without the expenditure of some electro-motive force, and hence if we place a second voltmeter at *V* and connect it with the points *s s′* by means of the wires *c c*, the indications upon its dial will show the number of volts required to force the current from *s* to *s′* through wire *p*. The electro-motive force acting at the point *s* to force a current through the lamp *l* to point *s‴*, or through wire *p* to point *s′*, is called the potential of the point *s*. In like manner the electro-motive force acting at point *s′*, to drive the current to point *s″*, is called the potential of the point *s′*. The voltage indicated by the instrument *V′* is called the difference of potential between the points *s* and *s′*, or the fall of potential from *s* to *s′*. It is also spoken of as the line drop between *s* and *s′*, or simply the drop between *s* and *s′*.

The difference of potential between the points *s* and *s‴*, as indicated by the voltmeter *V*, is referred to as the electro-motive force of the circuit, but the voltage acting between the points s' and s'', to force a current through the right-hand lamp l, is generally referred to as the difference of potential between the points s' and s'', and it will be equal to the number of volts indicated upon the voltmeter at V''.

The current flowing through wire n from s'' to s''' will absorb a certain amount of voltage, in the same manner as wire p, and this voltage will be indicated upon an instrument placed at V''' and connected with the points s'' s''', or the difference of potential between these points. As the sum of all the parts cannot be more than the whole, we will find that if the voltage indicated upon the three instruments, V', V'', V''', are added, they will be equal to the voltage indicated by

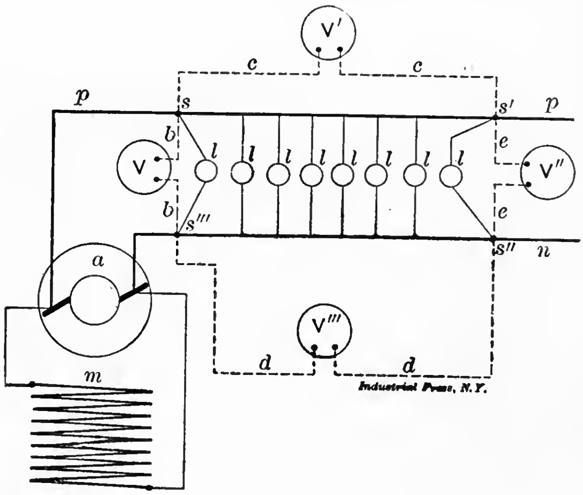


FIG. 4.

the instrument V. If we add the voltages indicated by instruments V' and V''' and deduct it from the reading of V, we will get the volts indicated by V''. From this it will be seen that when we speak of line drop, or line loss, we refer to the voltage absorbed in overcoming the resistance of the circuit wires; that is, to the voltages indicated by the instruments V' and V''' in Fig. 4. The voltage indicated by the voltmeter V' cannot be properly referred to as the line drop as it only shows the drop on one side of the circuit, and it must therefore be called the drop in line p, or the drop on one side of the circuit.

The voltage indicated by the instrument V'' cannot be spoken of as a drop or fall in potential, for it is the electro-motive force acting in the circuits between the points s' and s'', and the active electro-motive force is never referred to as a drop in voltage. Strictly speaking, it would be correct to speak of the indication of voltmeter V'' as the fall of potential between the points s' and s'', but it is not customary to refer to the difference of potential between points on opposite sides of the line in this manner. The word "fall" is used to indicate that the electro-motive force absorbed, or balanced, between two points is lost in overcoming a dead resistance, and not in performing useful work. In some cases, however, this rule is departed from. For example, if we had four or five lamps, of low voltage, connected between the points s' and s'', so as to be in series (that is, so that the current would flow through one after the other from the first one to the last one), we would speak of the electro-motive force absorbed by each one of the lamps as the "fall of potential" through the lamp. We would also speak of it as the "difference of potential" between the terminals of each lamp. To avoid making mistakes in the use of terms it is well to remember that the electromotive force lost between two points in the circuit wires, such as s s', can be referred to as the drop or fall of potential between these points, or we can call it the difference of potential between the two points; but the electro-motive force acting between opposite sides of the circuit, to perform useful work, must be spoken of as a difference of potential or as the electro-motive force, or voltage, acting between these points.

SOMETHING like a sensation has been created in the German metallurgical world by a new process for hardening steel, which is said to be as great an advance upon the Harvey and Krupp methods as these were on those preceding them. The inventor is a steel manufacturer at Mechlenberg. His name is Griebeler. As the result of years of experiment, he claims to have produced a steel which gives double the resisting powers at 50 per cent less cost. Wedges made of the new steel split ordinary steel like so much wood. Projectiles fired at 7¾ millimeter plate make an impression of a millimeter, (a millimeter is equal to $\frac{1}{25}''$), while the same projectile would easily penetrate a Krupp plate of 11¾ millimeters. Experiments carried out at the High School of Charlottenburg a few days ago are stated to have caused the greatest astonishment.

A WIRELESS telegraph system is being installed between Banana and Ambrizette, and the cable terminals, in the Congo region, by Mr. Paul de Bremaecker of Brussels. At present, telegrams have to be transported by boat to and from Saint Thomas, or Saint Paul de Loanda,—the cable terminals,—and Banana and Ambrizette, on the coast some distance north of these terminals.

TO WRITE on glass: moisten the surface with strong vinegar and write with an aluminum point. Infinitesimal particles of the soft metal are left adhering to the glass, and the writing is fairly permanent.

CORRESPONDENCE.

Our readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of Amateur Work, 85 Water Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if an answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

(No. 13.) Providence, R. I., April 1, 1902.

Can you tell me where I can get the numbers like those used on the "old Dutch clock" described in the December number of Amateur Work?

J. J. B.

The hardware dealers of your city should be able to supply you with these figures; they are the kind used for numbering doors, and come in several sizes. The dealer should be able to send and get them if he does not carry them in stock. It would not be a difficult matter to make drawings and saw them out of sheet brass, as described in the April number.

(No. 14.) Malden, Mass., April 10, 1902.

Please advise what kind of stain to use on the Dutch furniture described in the magazine, to get the dark effects seen on similar furniture sold by furniture dealers.

C. E. P.

The dark effects are probably secured by using aniline colors, which may be obtained from any large dealer in paints. The dark green is a mixture of black and yellow; the dark brown, by adding a little black to the brown ordinarily sold. An ounce package of aniline costs from 15 to 25 cents, according to color, and will be sufficient for several pieces of furniture. It is mixed with alcohol and put on with a brush and, when dry, the surplus color is rubbed off with a piece of cloth. A coating of wood stain is sometimes added after the aniline color, but this is a matter of personal choice. A little experimenting with waste pieces of wood will enable the correct color to be ascertained. A final coating of thin shellac is given to prevent wearing.

(No. 15.) Providence, R. I., April 11, 1902.

1. Will you kindly explain what is the principle on which Nicola Tesla's "condensing oscillator" works? He claims that it does away with the induction coil. He says: "My oscillator involves the use of vibrations of an electrical condenser which stores electrical energy. This energy is of an explosive nature. When this energy is suddenly released, as in my machine, it produces quickly vibrating oscillations. Though this energy may be enormous in amount, it is not harmful in nature. By means of this machine I may pass *half a million volts* of electricity through a man without injury." Will you explain what he means by quickly varying oscillations? Does electricity oscillate or travel spirally in this case?

2. Can you tell me if Marconi has a ground or water connection in his wireless telegraphy apparatus?

O. L. L.

1. An "oscillator" consists of a secondary coil in which a current of electricity is induced by a primary coil, through which a current of electricity from a condenser (Leyden jar) is passing. There is no iron core required, and the primary and secondary coils have few turns of wire. When electricity accumulated in a condenser, for instance a Leyden jar, is caused to pass through an insulator, i. e., when a disruptive discharge takes place, the current does not simply flow, but appears to oscillate to and from very rapidly, according to the size of the condenser. The high frequency current spoken of appears to travel on the surface of the conductors, and therefore is harmless when passing over the body.

2. Marconi in his wireless telegraphy apparatus has one side of his coherer connected with the earth, also one side of his transmitter.

(No. 16.) Providence, R. I., April 17, 1902.

I am making a dynamo of 1¼ H. P., but have not been able to get the discs for the armature core at a reasonable price. Can you tell me where I would be likely to get them? I want discs 6″ in diameter, $\frac{1}{32}$″ thick, with 1½″ hole in center.

H. M., Jr.

Carlisle & Finch Co., Cincinnati, Ohio, sell discs for armatures, but I am not advised whether they have the size you desire or not. In the event of their not having them, they can be cheaply made as follows: Procure sufficient soft sheet iron, have same cut on a shearing machine into pieces a trifle over 6″ square. Drill 1½″ holes in the center of each piece. When drilled put them on a 1½″ bolt long enough to contain them all, and fasten firmly together by screwing the nut tight. On the top piece scribe a circle 6″ in diameter, and along this circle, but partly inside of it, drill holes for the wiring. These holes are of the size and number which the wiring requires, according to design. The discs are then mounted on an arbor, put in a lathe and turned down. In this way, armature discs can easily be made of any size.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES.

Vol. I. No. 8. BOSTON, JUNE, 1902. Ten Cents a Copy

WIRELESS TELEGRAPHY APPARATUS.

How Made and Operated.

R. C. Browne.

I. THE SPARK COIL.

When robbed of technicalities, wireless telegraphy consists of simply creating a disturbance or vibration of the electric ether of the universe and detecting the same at some distant place by suitable instruments.

When vibrations or disturbances, commonly called waves, of electricity are caused by the passage of electricity through an insulating medium, such as air, the passage of the current must be in the form of an explosion spark, which can be produced by the instrument herein described; namely, an induction coil. For this description, a 1″ induction coil has been selected; that is, a coil capable of giving an inch spark when operated by a battery of three or four bichromate or six or eight dry cells.

First make a pasteboard tube 10″ long and 1″ outside diameter by winding several layers of tough brown paper covered with glue or paste around a broom-handle. The broom-handle, before winding, should be freely covered with soap, so that the tube may be easily removed. When dry, give the tube a coating of shellac varnish. On this tube wind two layers of No. 14 double cotton-covered magnet wire, giving each layer a plentiful coating of shellac. A good grade of white shellac cut with alcohol will be found suitable. This winding forms the primary coil. Leave about 3″ of free wire on each end for connections.

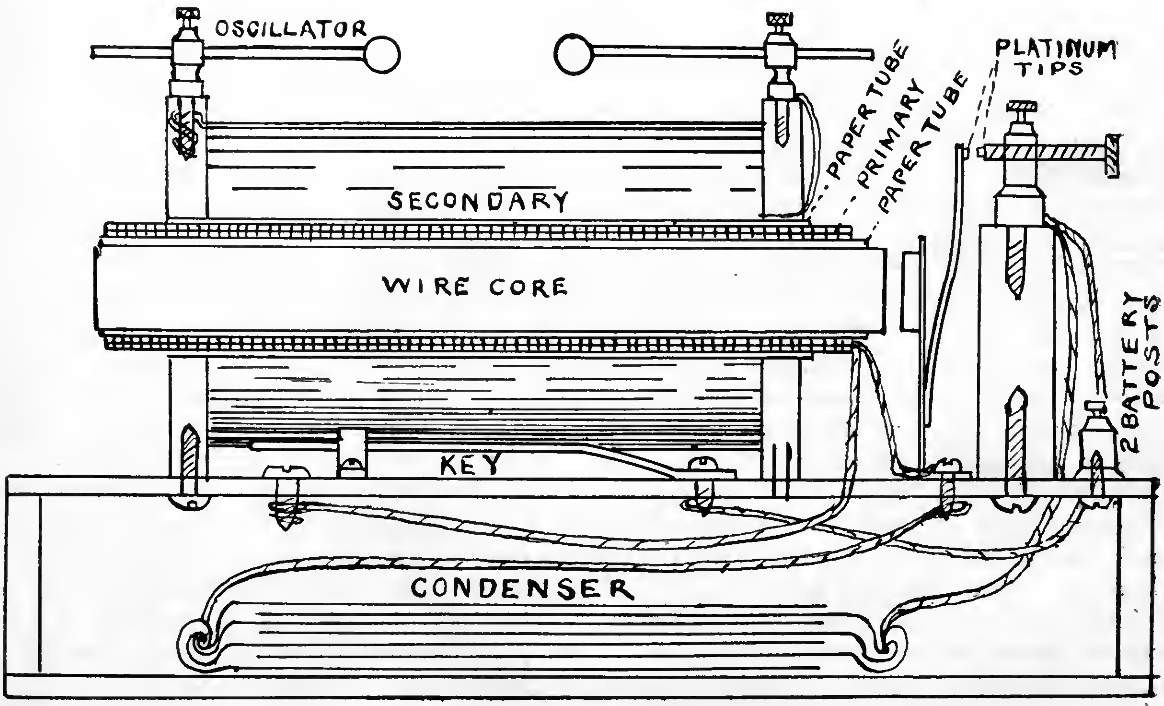
Make another paper tube by winding several layers of the paper over the primary winding. The outside layer should be smooth and even, so that the secondary coil may be easily wound. When dry, glue firmly on to each end a piece of mahogany or other suitable wood 5½″ square and ½″ thick. Holes are bored in the center, of a diameter to make a snug fit on the outside paper tube. This makes a spool 6″ long between the ends. After this is done, commence to wind the fine wire coil, known as the secondary coil. This should be wound in the same direction as the primary coil. For this purpose 1¼ lbs. of No. 36 single cotton-covered magnet wire will be required.

Make a small hole through one of the wooden ends close to the paper tube; put one end of the fine wire through it from the inside, and commence to wind on layer after layer, coating each layer with hot paraffin and putting between each layer of wire two thicknesses of paper which has been dipped in hot, melted paraffin. Select strong white paper free from printing and holes and not very thick. For those who are not fortunate in owning a lathe the following is a simple way to wind the coil. First wind the primary by hand, then put on the ends of the coil ready for the fine wire, and push the reel or spool so made over a piece of broom-handle. Then mount it across a wooden box, so that by pushing the ends of the coil lightly with the hand it may be made to revolve quite rapidly. A heavy wooden or metal wheel driven on the end of the broom-handle spindle will act as a balance wheel and cause it to revolve more evenly. To hold the broomstick in place cut two notches, and on the edges of the box drive two nails, one each side of the broom-handle.

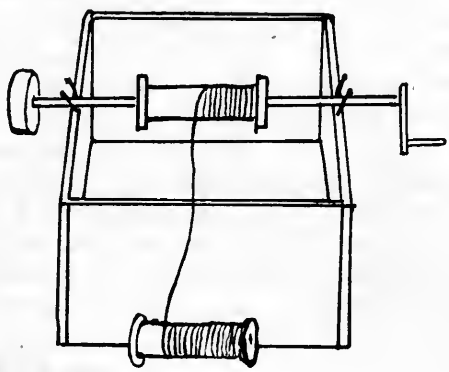
In winding do not wind up to the wooden ends, but leave at least ½″ of paper beyond each layer of wire. Also do not cut holes through the paper or bring the wire up over the end next to the wooden pieces, but put the edges of the paper under the wire when a layer of wire is completed; that is, put the paper between the wire, as it comes from the coil, and the coil itself, and wind both on so that the wire will come out on the top ready for another layer. The strips of paper should be large enough for a lap of about ⅜″. The success of the coil depends to a great extent upon the evenness of the winding, so be careful to wind the wire as evenly as possible, never letting one turn of the wire lap over another. Also avoid all kinks; if any are found, straighten out, using care not to break the wire. Examine the wire during the winding to locate breaks, and if any are found the covering should be removed, a connection made by soldering, and the joint carefully covered with waxed thread to thoroughly insulate it.

When all the wire has been wound, connect the two ends to two binding-posts, one being screwed to the top of each of the wooden ends of the coil. The holes in the binding-posts should be opposite each other. After the coil is wound it may be covered with rubber, paper or velvet to give it a neat appearance.

For the core, cut sufficient wire into pieces a trifle over 10″ long (old rusty hay wire will answer), to fill the center of the primary coil. The ends of the wire should be trued up with a file. The coil is then attached with screws to a wooden base about 14″ long, 8″ wide and 2″ high. A cigar or wooden candy box can be made over to the proper size. The interrupter or vibrator, which is simply an instrument very similar to an electric bell, for breaking the flow of the battery current in the primary coil, should next be made.



From a suitable piece of brass — a piece from an old alarm-clock case will answer — cut a spring 3¾″ long and ½″ wide. Drill a hole $\frac{3}{16}$″ in diameter, ¼″ from one end, and bend that end at right angles to the spring so as to make a foot ½″ square for fastening to the base. On the other end of the spring solder a piece of iron weighing about $\frac{3}{4}$ oz., to form a hammer which will work against the end of the wire core in the primary coil. A piece $\frac{1}{4}''$ thick cut from the end of a $\frac{3}{4}''$ round iron rod will be about the right size. Cut out another piece of brass spring, wedge-shaped, $\frac{1}{2}''$ wide at one end and $\frac{1}{4}''$ wide at the other, and $2\frac{1}{4}''$ long. Solder the wide end to the back of the spring, carrying the iron hammer about $1''$ from the base, and rivet a small piece of No. 14 platinum wire or sheet platinum $\frac{1}{4}''$ from the narrow end. The best way to solder these pieces is to separately coat the parts to be joined with solder and then place them together and heat until the solder just melts. When completed, screw the foot of the hammer to the base so that the hammer will be opposite and $\frac{3}{8}''$ from the end of the wire core.



Take a binding-post and have a thread cut through the hole for the wire so as to carry a brass thumbscrew having a small piece of No. 14 platinum wire about $\frac{1}{8}''$ long riveted to the end of it. This screw can easily be made by threading a piece of brass wire about $2\frac{1}{4}''$ long. Bend one end to form a handle to turn it by, or solder on a brass nut.

Mount this binding-post on a block of wood and screw it to the base of the coil so that the platinum tip will press against the platinum on the spring of the hammer when the iron is away from the wire core.

We are now ready to make a key for regulating the signals. An ordinary telegraph key may be used, but a simple one can be made as follows: In a piece of brass spring $6''$ long and $\frac{1}{2}''$ wide drill a hole in one end, and bend it slightly, so that when screwed to the base of the coil, the other end of the spring will be raised about $\frac{1}{4}''$. Put a brass screw through the base, directly under the end of the spring, so that when pressed down, the spring will come in contact with the head of the screw, which should be fastened with a file to give a good contact. A small piece of brass spring $\frac{1}{2}''$ wide, $1\frac{1}{2}''$ long, should be bent and then screwed over the key spring, so that when the key is open or raised it will be held about $\frac{1}{4}''$ from the contact screw.

The condenser, which is used to intensify the power of the coil, is placed in the base and is made as follows: Cut out 60 sheets of tin-foil about $6''$ wide and $10''$ long, and 61 sheets of white paper $7''$ wide and $9\frac{1}{2}''$ long. Thoroughly soak the paper with hot paraffin wax in a shallow pan, and commence to build the layers of the condenser.

Lay a sheet of prepared paper on a board, and on top of the paper place a piece of foil, allowing one end to project over the paper $1\frac{1}{2}''$ on the right side. Put on another piece of paper and then another piece of foil, this time letting the end project on the left side, and so on, being sure to alternate the projecting end of each sheet of foil.

When finished, there should be thirty ends of foil at each end of the condenser. Fold all the foil projecting on each end into a roll so as to make a good electrical contact and fasten a connecting wire to each roll of foil. This may be done by soldering the bare end of the wire to a piece of thin lead and folding this into the roll. A piece of glass or thin wood is placed on the top and bottom of the condenser and wound with tape until firmly bound together, the end being sewed.

The remaining part is known as the oscillator. This consists of two brass balls $\frac{1}{2}''$ to $1''$ in diameter mounted on two brass wires held in the binding-posts on the ends of the coil. The balls and wires should be smoothly joined and have no rough places. The balls should be placed about $\frac{1}{8}''$ apart, and when signaling to any distance one ball should be connected by a wire to the earth (water pipe), and the other wire connecting with a kite or high pole, the higher the better. Two binding-posts should be placed on the base for connecting with the battery.

All the parts of the coil having been described, the connections will now be considered. For these connections, use covered No. 16 copper wire.

One battery binding-post is connected to the screw that holds the long key spring to the base, either by soldering or by twisting it under the spring. The screw that the key makes a contact with when pressed down, is connected with one end of the primary coil. The other end of the primary coil is connected to the spring of the vibrator. The post of the vibrator is connected to the other battery binding-post. The condenser should be put inside the base and one end connected to the post of the vibrator and the other end to the vibrator spring. All connecting wires should be carried inside the base, small holes being bored in the top where needed.

AN ELECTRIC WIND-VANE.

Paul M. Benedict.

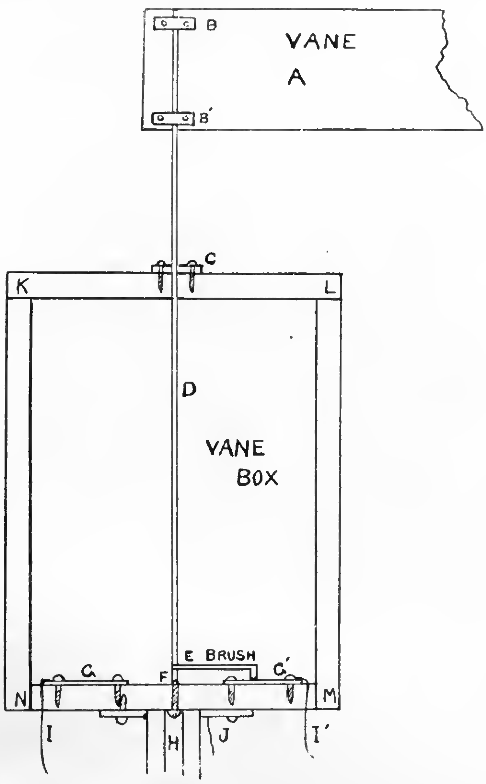
If one takes any interest in meteorology it frequently happens that it would be very convenient to be able to know the direction from which the wind is blowing without going out-of-doors to look at a wind-vane. At night, and especially if the wind is light, it is rather difficult to ascertain the direction of the wind. I constructed, some time ago, for my own use, an instrument which will show at any time the "wind direction," and for want of a better name I have called it an electric wind-vane. The vane will not tell the wind direction to a degree, but it will tell it to eight points of the compass, and by the expenditure of a little more time and money, can be made to show sixteen points, but eight is, as a rule, quite close enough. The instruments used in most of the meteorological stations only show eight points.

The material needed is as follows: Enough planed board ⅞″ thick (white wood or pine will do) to make a box 6″ x 6″ x 8″, inside measurements, a thin board ¼″ thick and 3½″ x 12″, or, failing this, a piece of heavy sheet iron or tin of the same size, also a piece of heavy sheet brass 5½″ square and about $\frac{1}{16}$″ thick, a Stubbs steel rod ¼″ diameter and 14″ long, which must be quite straight, eight round-head brass screws ¾″ long and about ⅛″ diameter, about two dozen screws for making the wooden box mentioned above, a small strip of thin spring brass 2″ long and ¼″ wide, and an ordinary paraffin candle. This completes the materials for the wind-vane part of the apparatus.

For the "indicator," which is in the house and is in electrical connection with the wind-vane, the following materials are needed: Measure the approximate distance from where you will set the vane on the roof of the house to where you will put the indicator, and get enough insulated copper bell wire, No. 16, to reach five times the distance; 250′ will usually be ample. Also about ¼ lb. of double covered copper magnet wire, No. 18; five small binding-posts; a small magnetic compass (see that the needle swings freely); four round-head iron rivets ¼″ diameter and 1″ long; also the metal case of an old alarm clock, six small round-head brass screws about ½″ long, some rubber tape (piping), a small one-point switch, and two cells of any good open-circuit battery.

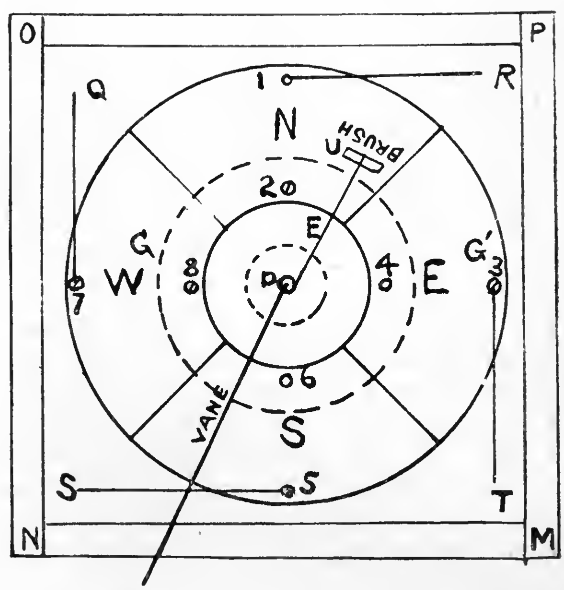
Take the 5½″ square piece of sheet brass and strike a circle on it 5½″ in diameter (Fig. 2). Mark out a diameter and another at right angles with it; drill holes at the places marked 1, 2, 3, etc. (Fig. 2), large enough for the eight round-head brass screws to pass through. Now saw the corners off with a hack-saw and file smooth until you have a nice circle 5½″ diameter. Next cut the circle into four parts; along the diameters previously marked, cut off the surplus metal inside of the 2″ circle and finish smooth with a file. Saw out and plane up the pieces of wood for the box, which is to measure 6″ x 6″ x 8″ inside.

After the pieces have been planed, they must be soaked in melted paraffin for ten minutes, or lay some lumps of the paraffin on the wood and pass a hot iron over it. This is done to prevent the box from warping. A varnished or painted box will be useless in a couple of months. Take the piece which is to form the top of the box, and drill a hole exactly in the center a little over ¼″ diameter, to allow the steel rod to slip through it easily (see Fig. 1). On the bottom piece of the box strike two circles, 2″ and 5½″ in diameter. Drill a hole in the end of the steel rod about ⅛″ deep and the same in diameter. Get a round-head brass screw 1″ long and file the point so that it will slip into the hole in the end of the rod, making an easy fit and letting the rod turn freely. This forms one



of the bearings of the steel rod (Fig. 1). Now take the square piece of brass and drill a ¼″ hole in its center, enlarging with a round file if necessary, so that the steel rod will turn easily in it. This forms the other bearing (Fig. 1). Screw to the top of the box, so that the hole in the brass will coincide with the hole in the wood. Then screw the four brass sections, N. E. S. W. (Fig. 2), on the bottom of the box, so as to fit the 5½″ and 2″ circles previously marked, taking care that the pieces do not touch each other at any point. Leave the outside screws loose. Drill four small holes through bottom piece of box, near the outside screws in the brass pieces, to receive the connecting wire. Run a piece of the bell wire about 1′ long up through each of these holes, turning a bare end under the head of each outside screw. Connect another piece of wire to the brass screw (Fig. 1) and see that it does not touch any of the brass sectors or screws in them.

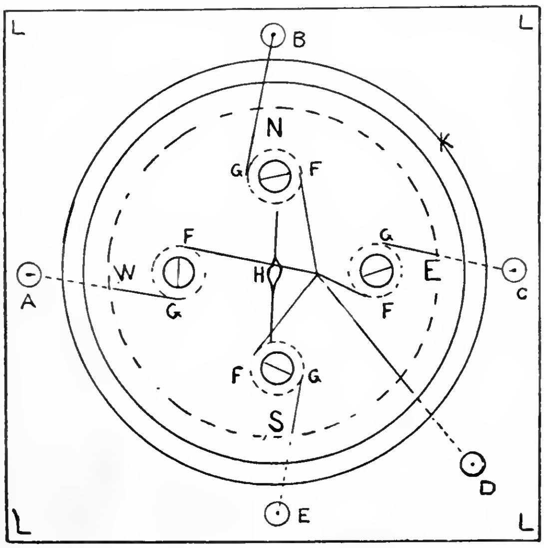
Now take the piece of thin spring brass and solder it at right angles to the steel rod (E, Fig. 1), about 1″ from the end which has the small hole drilled in it. To do this, make the rod rough with a file and then rub a piece of brass over the rough piece. The rod will take a thin coating of brass, and by using strong chloride of zinc as a wash, or a soldering paste, it is easy to solder the brass to the steel. Bend the brass spring again at right angles about ½″ from the free end with a slight upward curve at the outer end, so as to form a "brush" or "shoe" (U, Fig. 2), which, when the steel rod is in place, will slide around on the brass sectors, as the rod turns in either direction, without hitting the screws in the sectors and without



catching in the slots between them. Slip the top piece of the box, with the square piece of brass screwed to it, on to the steel rod and proceed to put the box together, leaving out one side. If the box cannot be set on something flat on the roof of the house, a firm, level support should be made for it. Attach the vane (the piece of thin wood or sheet iron) to the steel rod by small cleats (B and B′, Fig. 1), and the vane is completed.

For the indicator obtain the metal case of an old alarm clock and make a baseboard ¼″ thick to fit the bottom of it. The side of the clock may be cut down with a hack-saw so that it will not be over 1¼″ high. Screw it to the baseboard with small round-head brass screws. Make a second baseboard 5½″ square and mark a circle in the center of the diameter of the clock case.

Take the four rivets and anneal them, which may be done by putting them in the kitchen fire and leaving them to cool slowly as the fire goes out at night. When annealed, wind the shank with one

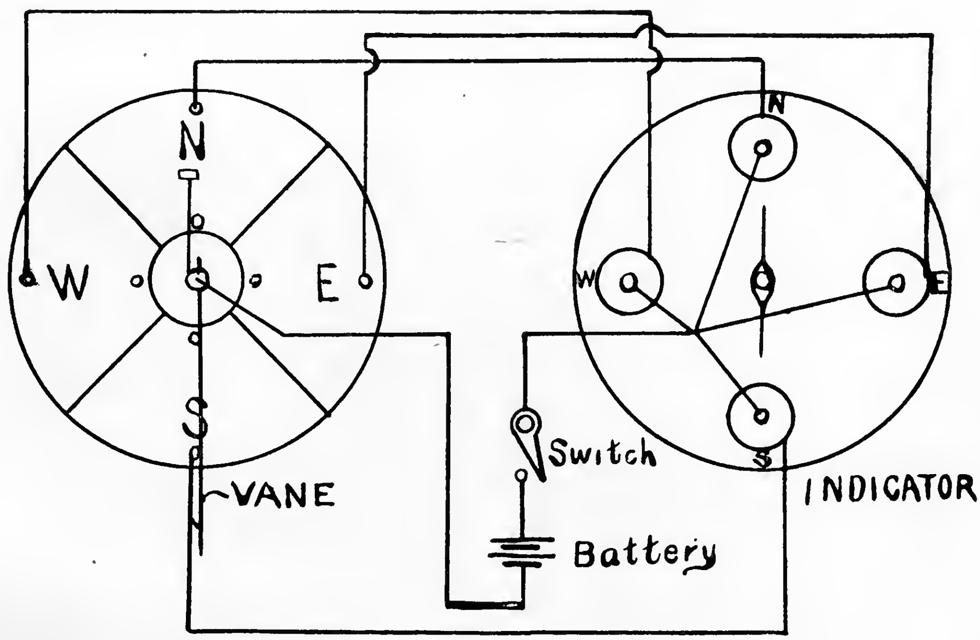


thickness of rubber tape or four thicknesses of waxed paper, and then wind on four layers of the No. 18 cotton-covered magnet wire, beginning at the head, leaving 6″ of free wire on each end for connections. Tie down the outside ends with twine. We now have four small electro-magnets. Mark a circle on the upper baseboard 2″ in diameter. Mark out a diameter and one at right angles, and where they meet the circle bore four holes through both baseboards just large enough to receive the magnets, which should be pushed into the holes with the heads on the upper side. If necessary, wrap a little paper around them to make them fit tightly. The ends for connections should be on the underside. Put the five binding-posts on the outside baseboard, one in each corner and one in the center of one side, and run the outside end of the wire on each magnet to a post. Connect all inside ends together and run a wire from them to the fifth binding-post. Take the glass top off the little compass and then stick a sharp needle point up in the center of the baseboard, so that when the compass needle is placed on it, the top of the pivot will be about ⅜″ from the baseboard.

The needle must stand straight and the compass needle swing freely on it. Get some good white cardboard and cut out a circle which will just fit inside the case. Mark two circles near the edge in ink, one about ½″ inside the other, and then divide the circles into four equal parts and mark each line N. E. S. W. like a compass. Push the disc of cardboard down over the needle and turn it until the mark N. is opposite one of the magnets, then push it down so as to rest on them.

To connect the two parts, cut five pieces of the bell wire the necessary length, and mark four of the wires at each end with tags on each for N. E. S. W. Different colors of bell wire may be used if obtainable and the tagging avoided. Twist the five ends together and fasten to a nail or any convenient support, and at every two feet or so wind a few turns of rubber tape or twine around them. In this way a very good cable may be made. Set up the indicator in the house on a level support. Set up the vane-box on the roof of the house; it should be above anything on the roof. If necessary, put it on a pole and secure it by guy wires. The box must be level and the rod perpendicular or the vane will not swing true in a light wind. Turn the box on its support so that two of the brass sectors are in the N. and S. lines, and the narrower spaces between them lie N.–E., S.–E., etc. Turn the steel rod so that the little brush is on the center of the sector on the north, and then turn the wooden or sheet-iron vane on the rod so that it will be just opposite the brush, and clamp it there, so that when the wind causes the vane to point north, the brush will point N. and make contact with the N. sector (Fig. 2).

Connect one end of wire marked N. to the sector N. and the other end to the binding-post which is in connection with the magnet opposite N. on the cardboard dial. Connect the other wires and sectors in the same way. Connect the fifth wire in the cable to the screw forming the lower bearing of the steel rod, and somewhere near the other end connect it to one pole of the battery of two dry cells. Lead a wire from the other pole of the battery to the switch and one from the point of switch to the fifth binding-post on the indicator which is in connection with all the inside wires of the electro-magnets. If everything is rightly made and connected, on closing the switch the compass needle will swing around and point on the dial to the direction from which the wind is blowing. If the needle keeps jumping from N. to E. or E. to N., the wind direction is N. E., etc. If the wrong end of the needle points to the magnets, reverse the connections at the battery. Now go outdoors and note the direction of the wind, and if you find the indicator shows it correctly, well and good; if not, go over the connections again and the way the vane is set in relation to the brass brush or shoe. When everything is correct, screw on the side of the box which was left out, and close all cracks with shellac.



The pivot of the compass needle must not touch the glass. Oil the bearings of the steel rod in the vane-box occasionally. The only part of the instrument which will wear to any extent is the little brass brush or shoe, but even this will last a year or so. By making eight brass sectors and eight electro-magnets and having nine wires, the vane can be made to show the wind direction to sixteen points of the compass.

SCIENCE BREVITIES.

Infected Rats and Plagues.— The discovery that the plague is disseminated by rats will necessitate a new international congress to discuss the matter of infectious diseases, declares a contributor from the Institute of Infectious Diseases in Berlin. The rulings of the conference of 1897 are now obsolete. Rats are to the spread of the plague, the writer declares, what water is to cholera. The principal preventive measure is to destroy all the rats on a ship leaving an infected port. A single infected rat escaping to shore is infinitely more dangerous to the community than plague patients, as contagion from the latter can almost certainly be controlled. Ships can be cleared of rats by means of poisonous gases, without injury to the cargo. The ship "Pergamon" recently arrived at Hamburg from an infected port with dead rats, but no cases of plague on board. Prompt extermination of the rats before unloading prevented any infection of the crew or workmen unloading the ship.

The highest lighthouse in the world has been installed at Vierge Isle, on the Road de Brest. The light is 330 feet above the sea, and is visible for a distance of 39 miles.

HOW TO MAKE A POWERFUL BICHROMATE BATTERY.

J. Pike, in the *Model Engineer*.

Although bichromate cells are easily made and put together, as a rule — however suitable they may be for lighting purposes — if there is heavy work to be done, as in driving a small motor, or running a model electric car, they quickly fall off in power. The following method of construction may be followed with considerable advantage: Briefly, the elements are made up of two zincs and three carbons for each cell, and I propose to describe two such cells, made to fit the well-known "Hartley" jam jars. These jars vary a little in capacity, and it will be well, therefore, to select them (referring to the 2-lb. size) of widest internal diameter.

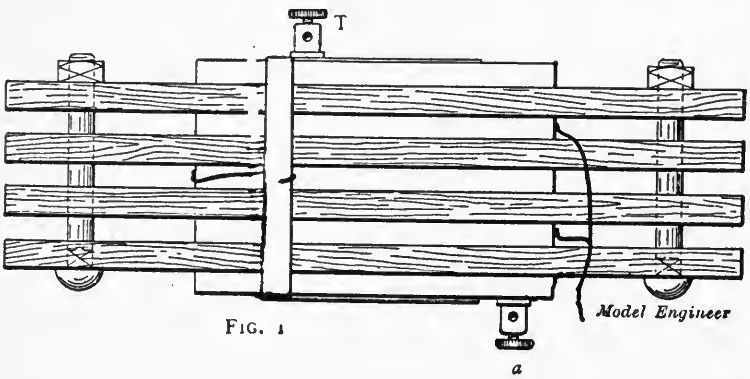


Fig. 1

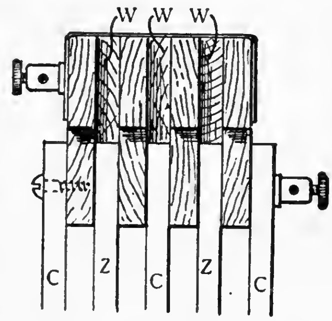


Fig. 2.

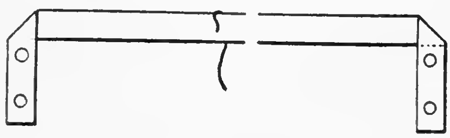


Fig. 3.

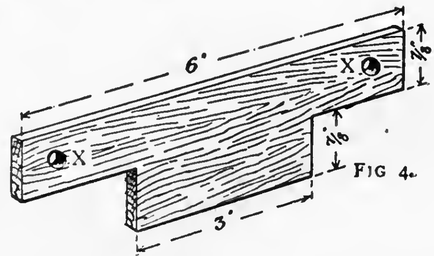


Fig 4.

Procure from electrical stores six carbon plates, $5\frac{1}{4}''$ by $2\frac{3}{4}''$; this appears to be a stock size. I have tried to get larger plates, but without success. They should have two holes drilled in one end. Get from a dealer in iron and metal four pieces of stout zinc, $\frac{1}{8}''$ thick, and of size similar to the carbon plates — I find it easier and probably much cheaper to get these cut to order; they require to be drilled at one end, a hole $\frac{1}{8}''$ in each, centrally, and about $\frac{1}{4}''$ from the end; and they must then be amalgamated.

To amalgamate the zinc plates effectively, provide an ounce or two each of strong sulphuric acid and quicksilver; put a little water into an old soup plate, add sulphuric acid to make a strong acid solution (say about one part to two or three of water), and by the aid of an old toothbrush rub the zincs all over with this acid solution. Now pour the mercury into the dish, bring one edge of the zinc plate up to it, and with the brush sweep a little of the mercury on to the zinc plate. If the acid has been strong enough to really clean the surface of the zinc, the mercury will attach itself rapidly, and may be brushed all over, the amalgamation being completed very easily and effectively. Rinse the zincs in water, and set up to drain; pour off the acid from the mercury (if any remains), wash this in water, and bottle for future use.

In order to insure that as large a surface as possible of zinc and carbon is available to the action of the bichromate solution, I provide pieces of wood (holders, in fact) of the shape in Fig. 4. Eight pieces are required of strong wood, that is to say, wood not easily split, and it should be at least $\frac{5}{16}''$ thick, but need not be more. Having cut the eight pieces, clamp four of them together, and carefully bore a hole at each end, as shown in Fig. 4 at X. This may be done with a brace and small bit, or by the primitive method of a red-hot iron rod. The hole should be just large enough to take a 2½″ small iron bolt, the thickness of which is rather under ¼″. An attachment of wire to the top of each zinc must now be made, and to do this, clean about an inch of the top edge with a file, and solder thereto one end of a 6″ length of No. 16 copper wire; bring the wire out straight, as it is to be bent up afterwards. Provide next four terminals, those with a sharp-pointed screw; and also two strips of thin brass cut and bent over as in Fig. 3, the holes in the ends being drilled to coincide with the holes in the outside carbon plates.

We may now proceed to build up the battery. By means of short wood screws attach a zinc plate to the tongue of one of the wood holders; cut a piece of thin wood the thickness of the zinc, and 3″ long by ½″, and attach it with a drop of seccotine just above the zinc, bringing it up flush with the top. Now place another holder (adjust a carbon plate this time) and insert underneath the screws before making tight the end of a 6″ length of wire. The end should be turned roughly around each screw, and the other end brought out in the opposite direction to the zinc wire. Fill up the space above the carbon with another piece of thin wood; adjust another holder and screw on a zinc plate; see that the attached wire comes out similarly to that on the other zinc, and fill up the space above as before. Now another holder, and we may insert the bolt at each end and screw up. The small wood insertions at the top of each central zinc and carbon are, of course, to take up the pressure when the bolts are screwed tight —a reference to the Figs. 1 and 2 should make this quite plain. The two outside carbon plates are screwed on from the outside, the thin strip of brass being adjusted and bent over to make the connection. One of the terminals should be used in place of a brass round-head screw (see T in Fig. 1); the screw inserted into the zincs is central, and never near the screws used in the carbons, and of course must not be long enough to go right through the wood. The wire from the central carbon is brought up, turned around the brass strip, and soldered; and the two wires from the zincs also brought up, coiled around each other, soldered, and connected to a terminal, which may be screwed in on the opposite side to the carbon terminal,—a sectional view is shown in Fig. 2,—and looking down, the top of battery has the appearance of Fig. 1. Finally, soak the whole of the woodwork in shellac varnish,—perhaps hot paraffin wax would be better,—and when thoroughly dry and the battery dropped into chromic acid solution, they work admirably.

The measure introduced in Parliament a couple of seasons ago by T. M. Healy to make possible the utilization of the vast and wasted water power of Ireland will be brought up again at this session. The measure, though a most admirable one in every respect, was for some reason opposed by the landlord interest, and it accordingly received its quietus in the House of Lords. Interest in it is revived by a plan now being discussed in France for the exploitation of the resources of the Pyrenees. The mineral wealth of these mountains, particularly in zinc, aluminum and iron, has been esteemed highly since 1874. The problem has been to work them at a profit, owing to the difficulties of transport, on the one hand, and the absence, on the other, of coal to smelt the ores on the spot. The idea now is to use for this latter purpose the water power of the mountain torrents. It is claimed that in the adoption of a plan of this sort lies the industrial regeneration of France and Ireland. It is computed that the wasted water power of the Pyrenees is equal to the whole of the steam power employed in all the factories of Europe. In Ireland the conditions are similar. That large tracts of territory in Ireland contain mineral wealth of various kinds is undeniable, and if some such measure as the Healy bill became law, a long stride would have been taken toward the industrial regeneration of the country.

"While M. Santos-Dumont was inflating the balloon of his No. 6 airship at Monaco," says *The Scientific American* (April 5), "he was commanded by the authorities to cease immediately the process of hydrogen-making, on account of the extraordinary effect that the drainage of refuse acids and chemicals into the bay was having on the water, which had turned a brilliant orange, and which it was feared might have an injurious effect on residents near the sea-front, besides poisoning the fish.

STUDIES IN ELECTRICITY.

VIII. RESISTANCE IN CIRCUITS.

In the last chapter the resistance offered by conductors to the passage of the electric current was considered. If we examine different points of a circuit by means of suitable instruments, we will discover that there is a gradual fall in the potential, proportionate to the distance from the source, where the potential is highest. This fall in potential is directly due to the resistance of the conductor. In an electric-light system, the lighting circuits are maintained at a substantially uniform potential by means of feed wires, which convey additional current to suitable points in the circuits, to restore the loss in potential due to the resistance of the circuit.

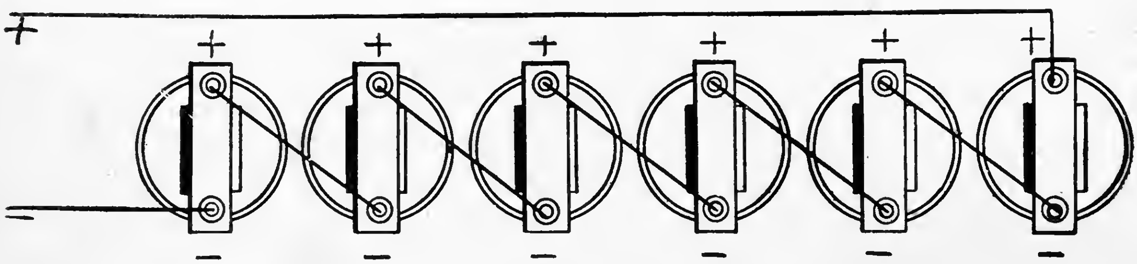


Fig. 22.

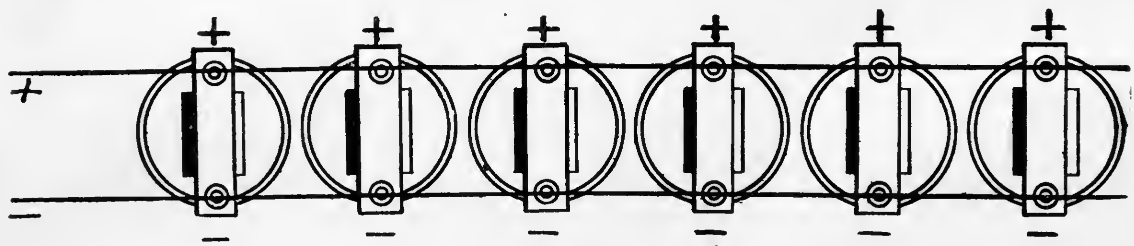


Fig. 23.

The fall in potential of a large current is usually measured with a voltmeter. With smaller currents, an instrument known as a wheatstone bridge is often used. A description of the construction of such an instrument will be given in the next number of this magazine, together with the method of using it.

The loss of potential due to resistance represents the amount of energy converted into heat. In addition to the resistance of a conductor may be that of a counter E. M. F., such as is developed by the rotation of the armature of a motor. This opposing current reduces the available E. M. F., acting as so much additional resistance to the flow of the current, and is also converted into heat. Joule found the heat developed in a circuit to be proportional to the resistance, to the square of the strength of the current, and to the time the current flows.

Many important uses are made of this property of developing heat by resistance. In blasting, a charge is ignited by heating a wire of high resistance, which is in contact with a fuse. Torpedoes may be exploded beneath the water, at any desired distance from the operator. In electric welding, a large current of low voltage is passed through the two pieces of metal to be welded. At the points of contact the resistance is very high, the current having but a very imperfect path. The heat developed at the point of contact soon brings the adjoining ends of the metal to a high heat, the increase in temperature increasing the resistance. Cooking by electricity is but another use of heat developed by the resistance of conductors arranged for that purpose.

In addition to a simple circuit, with but one path for the flow of the current, are those known as divided circuits, in which the current is divided between two or more paths. If an additional path serves simply as a by-pass for only a small portion of the whole current, it is termed a *shunt.* This is a device much used in motor construction and will be considered later. The resistance of each path of a divided circuit determines the current flowing through it, the relative strength of current in two branches being proportional to their separate conductances, or inversely proportional to their resistances. The joint resistance of a divided circuit will be less than that of either path alone, as the current has two paths through which to travel, in place of one. If the resistances of two paths are equal, then one-half of the whole current will pass through each path. If one path has twice the resistance of the other, then only one-half as much current will pass through the path of greater resistance as will pass through the path with the lesser, or one-third of the total current.

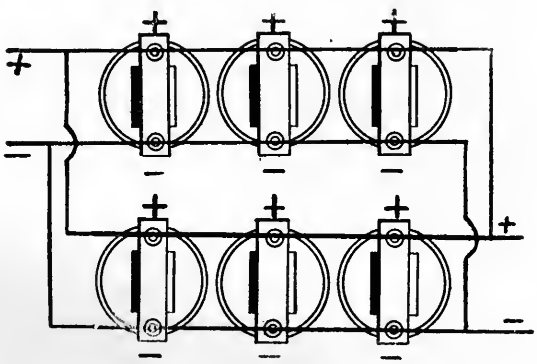


FIG. 24.

The joint resistance of a divided circuit is determined by dividing the product of the two separate resistances by their sum. This is known as the law of shunts, and should be studied until fully understood. To illustrate, suppose one branch of a divided circuit to have a resistance of 3 ohms, and the other a resistance of 6 ohms. The product of the two is 18, their sum 9; dividing, we find the joint resistance to be 2 ohms, or less than that of either branch singly. When the division is into more than two branches, the formula is a little more complicated, but a little study will make it plain. The joint resistance of any number of branches of a divided circuit is the reciprocal of the sum of the reciprocals of the separate resistances. The reciprocal of any number is the quotient obtained by dividing 1 by that number. To illustrate, assume a divided circuit of three branches of 10, 20 and 25 ohms resistance respectively, the problem would be as follows :

The reciprocal of 10 is	.10
The reciprocal of 20 is	.05
The reciprocal of 25 is	.04
Sum of the reciprocals	.19

Dividing 1 by .19 gives 5.26 ohms, the joint resistance.

With battery circuits, the grouping of the cells differs with different uses. If a current of high E. M. F. or voltage is desired, the cells are arranged in series, as shown in Fig. 22. In this arrangement the current of each cell passes through those following, the positive terminal of one cell being connected to the negative of another. But while this arrangement increases the E. M. F., it also increases the internal resistance, as the current has to travel through the resistance of each cell following. So for that reason this arrangement is subject to limitations which have to be considered in ascertaining the most desirable way of grouping a battery. The usual method is to have the internal resistance of the cells equal the external resistance of the circuit. If the external resistance be small, however, the parallel grouping is employed. In this arrangement (Fig. 23) the positive poles are all connected with each other and the negative poles together. The internal resistance is thus much reduced, the current having several paths in place of one. The E. M. F. of this arrangement is but that of one cell.

It is sometimes necessary to make a combination of the two forms of grouping; one which will be partly in series and partly in parallel, as shown in Fig. 24, which represents two groups of cells in parallel with three cells in series in each group. In general, it may be said that the best grouping to secure *economy* is that in which the internal resistance is small compared with the external; to secure the *greatest current*, when the internal resistance equals the external; to secure the *quickest action*, when the internal resistance is higher than the external.

"IN spite of its enormous size," says *The Scientific American*, "the Cathedral of Nôtre Dame in Paris has hitherto been lighted by wax candles, as gas, it was thought, would damage the walls and valuable paintings. Now it is to be electrically lit.

AMATEUR WORK

63 KILBY ST., BOSTON

F. A. DRAPER . . . . Publisher

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

JUNE, 1902

Contents

USEFUL RECREATION.

How much thought do you give to the use of leisure time,—to the minutes and hours given to recreation and sport? Have you ever considered that this time, or a portion of it, could be made more useful and permanently profitable than you, perhaps, are now making it? The old adage, "All work and no play makes Jack a dull boy," is quite true; but, on the other hand, do we not too often give to pastime a greater portion of time than is advisable? Would it not be better if we changed the character of our recreation to something more instructive, and yet quite as enjoyable, as continued play and sport?

Many of our readers will soon begin the "long vacation," when school cares and studies will be laid aside and almost forgotten. Undoubtedly many have already formed plans for some of the time, but others have not. To this latter class the importance of so doing is brought to their attention, if they desire to find themselves as all progressive boys should, better in mind and body when school work is again resumed. Some plan for developing useful recreation lies within the possibilities of everyone. Heedless is he who lets pass the opportunity for improving it.

IT might be thought that a glacier would be the last place to search for microbes. According to a note presented to the Paris Academy of Sciences by Janssen, the celebrated French astronomer, however, M. Binot, chief of the Pasteur Institute laboratory, has lately been studying the Mont Blanc glaciers from the bacteriological standpoint by taking borings at different points, so as to bring up specimens of ice from various depths. An examination shows that in all layers of the glacial ice colonies of microbes of different species are present.

PROF. CHARLES WILSON has announced to the Royal Society a new determination of the temperature of the sun, which, with due allowance for slight unavoidable errors, is placed at 6,200 degrees Centigrade (11,192 Fahrenheit). If the probable absorption of the sun's radiated heat by its own atmosphere is allowed for, the mean temperature of the sun's body is placed at 6,600 degrees Centigrade. Professor Wilson started his calculations almost ten years ago.

MECHANICAL DRAWING.

Earnest T. Childs.

VIII. DRAUGHTSMEN'S SCALES.

In the first talk on Mechanical Drawing under the heading of "Instruments, Their Use and Care," a brief description was given of one class of scale, commonly known as the Architect's scale. As therein stated, the common scales have subdivisions which are divided to a scale of $\frac{1}{8}''$ to 1′ up to 3″ to 1′. This class of scale is used most commonly on architectural and machine drawing. There is another style of scale used by civil engineers which is entirely different from the architect's scale, which is generally called the Engineer's scale. The scale is divided into inches, and each inch is divided into a certain number of parts, from 10 to 100. That is, in a triangular scale having six edges, the common subdivisions will be 10, 20, 30, 40, 50 and 100 to the inch. To make the outfit complete another scale is necessary, giving 60, 70 and 80 divisions to the inch, and perhaps repeating some of those on the first scale. Some draughtsmen prefer to have a collection of flat scales instead of a triangular scale. If expense is not to be considered this is a good idea, as it lessens the liability to error, as the draughtsman uses only the scale needed for the drawing on which he is working.

While the use of scales is familiar to all draughtsmen and to all mechanics who are accustomed to read drawings, there are many who have only the faintest idea of the use of scales as applied to drawing work, or as applied to everyday work of any sort. The primary function of the draughtsman's scale is to produce on a small area a representation having the exact proportion of a much larger object or area.

For instance, suppose that a man has a tract of land, and wishes to build on it a house of a certain size. He also wishes to know the most satisfactory arrangement or location for the house on the land. Also suppose the lot to be irregular, and not quite level. He may be able to take a tape and measure off the ground, locating the corners of his house by stakes; but when this is done he cannot take a comprehensive view of the situation and be sure that he has the best location. For illustration, assume the lot to be 100′ deep, 60′ wide at the front and 50′ wide at the back; and the house to be 25′ by 40′. A man standing in front and looking at four stakes cannot accurately judge the situation. By drawing a plan of the land, on a scale of 8′ or 10′ to 1″, he can draw in his house plan to the same scale, and readily determine just how much room he has to spare, and just where he wants the house located, to best utilize the spare land.

The same principle applies to larger work. A large group of buildings may be laid out on a 24″ by 36″ drawing board so that the eye can grasp the association of the various buildings, even though they cover several acres. Should the attempt be made to study out the arrangement by staking off the ground, nothing but confusion could result. A drawing of this type may be made to a very small scale, perhaps 50′ to the inch; but since it enables the eye to grasp the entire situation, it is better and more comprehensive than if it were drawn four times the size.

This illustrates the use of the scale on preliminary work where it is necessary to determine the most desirable location. After this preliminary work has been settled, it becomes necessary to prepare details for the construction. Here, for the sake of accuracy, it is necessary to use a relatively larger scale. Building plans are usually drawn on a scale of $\frac{1}{4}''$ to 1′; that is, 1′ on the drawing equals 48′ in the building. A building 50′ by 100′ may be shown on a plan 15″ by 30″, and the arrangements of partitions, doors, windows and equipment may be predetermined, thus preventing mistakes and conflictions. Small details of construction are often worked out on quarter-size, half-size, or even full-size detail sheets, for the sake of greater accuracy.

This illustrates the relation between the draughtsman's scale and the building trade, the scale being a very important factor in the design and erection of the building. Too little attention is given to the importance of the scale, and few who use them continually, realize their importance.

The scale, like the pencil and triangle, is part of the draughtsman's equipment, and that is all the thought given to it.

On machine drawing the scale is equally invaluable. While a large amount of work has to be laid out to full scale, by far the larger part is drawn to scale varying from ½″ to 1′ up to 3″ to 1′, the latter being quarter size. By means of the scale the relative proportions of the machine may be shown, and the eye can detect at a glance any inaccuracies which might be overlooked until the machine was about complete, or if the scale drawing had not first been made. It is necessary to learn how to use a scale accurately, as a scale drawing should be correct in every detail, even though figures are given for all important dimensions.

Thus it is evident that the scale is one of the draughtsman's most important instruments, as by its use he is enabled to see comprehensively what otherwise would be absolutely impossible.

Wireless Telegraphy for Scotch Lighthouses. — It has been decided to adopt the Marconi system of wireless telegraphy in connection with the lighthouses round the north and west coast of Scotland. The commissioners of the northern lighthouses of Scotland have the matter in hand. They propose to carry out the first installation at the Flannan Islands, which are about sixteen miles off the west coast of Lewis. This is practically the first land sighted by vessels coming from America, and a wireless telegraphy station at such a point will doubtless prove of great value.

PROPORTIONS FOR U. S. STANDARD V. THREADS.

U. S. STANDARD THREAD.				STRENGTH.	THREAD FOR ROUGH IRON SIZES.			
Diameter Screw.	Threads per inch.	Diameter at Root of Thread.	Diameter of Tap Drill.	Tensile Strength at 5,000 lbs. per square inch.	Diameter Screw.	Threads per inch.	Diameter at Root of Thread.	Diameter of Tap Drill.
1/4	20	.185	3/16	134 lbs.	1/4 + 1/64	20	.179	7/32
5/16	18	.240	1/4	226 "	5/16 + 1/64	18	.232	17/64
3/8	16	.294	5/16	339 "	3/8 + 1/64	16	.282	5/16
7/16	14	.344	23/64	465 "	7/16 + 1/64	14	.329	3/8
1/2	13	.400	13/32	625 "	1/2 + 1/64	13	.382	7/16
9/16	12	.454	15/32	809 "	9/16 + 1/64	12	.434	1/2
5/8	11	.507	17/32	1,009 "	5/8 + 1/64	11	.483	17/32
11/16	11	.569	37/64	1,271 "	11/16 + 1/32	11	.561	39/64
3/4	10	.620	5/8	1,500 "	3/4 + 1/32	10	.608	21/32
13/16	10	.674	11/16	1,780 "	13/16 + 1/32	10	.671	23/32
7/8	9	.731	3/4	2,100 "	7/8 + 1/32	9	.714	25/32
15/16	9	.793	13/16	2,470 "	15/16 + 1/32	9	.776	27/32
1	8	.837	27/32	2,750 "	1 + 1/32	8	.815	7/8
1 1/8	7	.940	31/32	3 460 "	1 1/8 + 1/32	7	.909	31/32
1 1/4	7	1.065	1 3/32	3,900 "	1 1/4 + 1/32	7	1.034	1 3/32
1 3/8	6	1.160	1 3/16	5,300 "	1 3/8 + 1/32	6	1.117	1 3/16
1 1/2	6	1.284	1 9/32	6,400 "	1 1/2 + 1/32	6	1.243	1 5/16
1 5/8	5 1/2	1.389	1 13/32	7,650 "	1 5/8 + 1/32	5 1/2	1.341	1 13/32
1 3/4	5	1.491	1 1/2	8,800 "	1 3/4 + 1/32	5	1.435	1 1/2
1 7/8	5	1.616	1 5/8	10,150 "	1 7/8 + 1/32	5	1.560	1 5/8
2	4 1/2	1.712	1 3/4	11,500 "	2 + 1/32	4 1/2	1.646	1 23/32

DECIMAL EQUIVALENTS.

1/64 .015625	17/64 .265625	33/64 .515625	49/64 .765625
1/32 .03125	9/32 .28125	17/32 .53125	25/32 .78125
3/64 .046875	19/64 .296875	35/64 .546875	51/64 .796875
1/16 .0625	5/16 .3125	9/16 .5625	13/16 .8125
5/64 .078125	21/64 .328125	37/64 .578125	53/64 .828125
3/32 .09375	11/32 .34375	19/32 .59375	27/32 .84375
7/64 .109375	23/64 .359375	39/64 .609375	55/64 .859375
1/8 .125	3/8 .375	5/8 .625	7/8 .875
9/64 .140625	25/64 .390625	41/64 .640625	57/64 .890625
5/32 .15625	13/32 .40625	21/32 .65625	29/32 .90625
11/64 .171875	27/64 .421875	43/64 .671875	59/64 .921875
3/16 .1875	7/16 .4375	11/16 .6875	15/16 .9375
13/64 .203125	29/64 .453125	45/64 .703125	61/64 .953125
7/32 .21875	15/32 .46875	23/32 .71875	31/32 .96875
15/64 .234375	31/64 .484375	47/64 .734375	63/64 .984375
1/4 .25	1/2 .5	3/4 .75	1 1.

PROPORTIONS FOR NUTS.

Diameter Bolt.	Short diameter Hexagonal Nut.	Long diameter Hexagonal Nut.	Thickness Nut.
1/4	1/2	37/64	1/4
5/16	19/32	11/16	5/16
3/8	11/16	51/64	3/8
7/16	25/32	9/10	7/16
1/2	7/8	1	1/2
9/16	31/32	1 1/8	9/16
5/8	1 1/16	1 7/32	5/8
3/4	1 1/4	1 7/16	3/4
7/8	1 7/16	1 21/32	7/8
1	1 5/8	1 7/8	1
1 1/8	1 13/16	2 3/32	1 1/8
1 1/4	2	2 5/16	1 1/4
1 3/8	2 3/16	2 17/32	1 3/8
1 1/2	2 3/8	2 3/4	1 1/2
1 5/8	2 9/16	2 31/32	1 5/8
1 3/4	2 3/4	3 3/16	1 3/4
1 7/8	2 15/16	3 13/32	1 7/8
2	3 1/8	3 5/8	2

A revolution is being worked in woodcarving. For years it has been the dream of inventors and woodworkers to devise a machine which would do for furniture makers what the labor-saving machinery has achieved in the manufacture of shoes. A certain amount of preliminary carving has been done for several years. The rough carving of the ornamental woodwork of sleeping-cars is done by machinery, but has to be guided by a skilled man and finished by hand. The *Furniture Journal* for April 10 contains a full description of a machine built by S. Waupen & Bros. of Chicago. This machine when once started carves eight pieces at one time without any attention from the operator until the operation is finished.

A Jamestown, N. Y., dispatch states that Capt. F. P. Cobham of that place has invented a system of wireless signaling between railway trains which, it is stated, has worked satisfactorily in tests. The instruments, which are placed on the locomotive, give notice when the engine is within two thousand feet of another engine on the same track, and at the same time indicate in which direction each locomotive is moving. If one of the locomotives is stationary the fact is also indicated.

PHOTOGRAPHY.

ORTHOCHROMATIC PLATES.

To THE beginner in photographic work the use of other than an ordinary plate seems surrounded with difficulties which deter many from making trials that would be exceedingly profitable as well as interesting, and lead to more satisfactory results in the print. Many who have acquired the ability to make, and do make, good exposures, have been disappointed with the prints, which fail to correctly represent the view. The sky in a landscape is too white, and clouds are barely discernible which, in the original view, were strongly outlined. The tints and colors of a building are not correctly represented in the shadings of the print. And so we are disappointed with our work and, too many times, come to look upon photography as a subject beyond reach of those who would engage in it as a pleasure and means of developing the artistic side of our nature.

And why is this? The answer is simple. Because we have neglected to use the proper materials for securing the results we are seeking. A few words of explanation regarding the action of the light rays upon the plate will make this clearer. All of us have some knowledge of the spectrum; that sunlight is composed of a combination of seven primary colors. The rainbow is but a division into the original colors of the light of the sun. The eye receives a correct impression of the hues and colors in view. Not so with the photographic plate, which is subject to chemical action when exposed to light. In the ordinary plate this action is not in true accord with the colors in the view, for the reason that some colors do not produce action which is quick enough, while others work too quickly to be in correct proportion to the view as an entirety.

The blue of the sky and the white in clouds are of about equal rapidity in their action upon the ordinary plate, thus producing a bare and unbroken sky effect in the resulting print. Red, orange and yellow, on the other hand, reflect much less light, and so do not sufficiently affect the plate, and consequently appear much darker in the print than to the eye. It is these variations from a true representation of the view that cause so much disappointment to the beginner and yet is a condition which is easily remedied by using orthochromatic plates. This does not mean that such plates should be used at any and all times, but there are many occasions when such plates will enable one to secure effects which would be entirely lacking should an ordinary plate be used. A few trials will plainly show the difference in the two kinds of plates. An instructive experiment is to take exposures of the same view on the two kinds and study the difference in the prints made therefrom. The difference between an orthochromatic and an ordinary plate is, that the former is specially sensitized to the red and yellow rays, which act more quickly on these plates and so are more nearly reproduced in their correct values.

A necessary adjunct to orthochromatic plates is a ray screen, though it is not always used when making exposures with such plates. A little study of the conditions of light at the time of exposure will determine the advisability of using it or not. The ray screen serves the purpose of reducing the intensity of action of the blue and violet rays, and fittingly supplements the use of plates that will correctly reproduce the red and yellow values. At certain times of the day, as at sunset, the blue sky is subdued by the brilliant orange or red tones of the setting sun, thus dispensing with the necessity of the screen.

In using an orthochromatic plate without a screen, the time of exposure is about the same as with an ordinary plate of the same sensitiveness. With the screen, the exposure should be increased from four to eight times, according to the degree of light. A few trials will enable one to ascertain the correct time. In one important particular orthochromatic plates differ somewhat from ordinary plates. Being very sensitive to red and yellow light, they should be loaded into holders in very dim light, which should be so shielded as not to shine directly on the plates, and the supply box should also be kept well protected. Also, in developing the same care should be used until the developer has been applied, when a little more light may safely be used. The greatest care should be used, however, in all handling until developing is well under way. The developer used should be that recommended by the manufacturer of the plates, if obtainable, and is used the same way as with an ordinary plate.

The cost of these plates is slightly more than for the ordinary kind, but the difference is not great enough to be a serious consideration, in view of the results to be secured by their use. If kept in a dry, cool place, they will keep well, though fresh plates are desirable, whichever kind are used.

PINHOLES IN NEGATIVES.

The inexperienced amateur often finds in his negatives small pinholes, which cause dark spots to appear in the print. As careful workers are rarely troubled by them, the cause must be one which may be avoided by the exercise of proper care. We will here consider their causes and the remedies for them. The larger number are due to dust, which collects in the bellows and frame of the camera and in the plate-holders. This is especially true if the camera has not been used for some time. The camera should be gone over at suitable intervals with a damp, but not wet, cloth, and the plate-holders in the same way. This may easily be done when plates are taken out for development, but after the developing is finished. Before loading, the holders should always be dusted with a camel's-hair brush, and likewise the plates. When in a hurry one is very apt to neglect this, but will generally regret having done so.

Before developing, the plates should be brushed, and with plates that have been in the holder for some time before exposure, a gentle cleaning with wet absorbent cotton just before developing will help matters. The developer sometimes forms air bubbles, which may be prevented by blowing the developer so that it fully covers the plate with one sweep. In addition, a swab of absorbent cotton may be gently passed over the plate to insure all parts being thoroughly reached by the developer; but this should be done immediately after immersion in the developer.

If, after using due care, such spots are still found in the negative, they may, if not too numerous, be removed by "spotting." This consists in applying a suitable pigment, such as India ink or water-color, with a fine camel's-hair brush. The negative should be inclined on a framework, back of which has been placed a sheet of white paper, so that the lines of the negative will be quite distinct. The light should come from the back of the stand, with the worker facing it. A reading-glass may be used to good advantage in this work, as it enables the color to be applied with a greater nicety, which is very desirable.

The color used should match as closely as possible that of the film, so that the printing quality will be uniform. The color should be of considerable consistency, and very little taken into the brush at one time. If too moist, it will very likely make a bad matter worse. It should be applied very delicately and slowly, that the surrounding film may not be injured, and should be free from dust. Clean water should be used for mixing it. After applying a little color to a spot, work on another while the first is drying; returning to it later, if necessary. If too much is put on, let it dry and then remove with the point of a fine needle rather than with a wet brush. A little practice will enable one to greatly improve a negative, the printing qualities of which are injured by pinholes.

The Vancouver Power Company will soon undertake a novel piece of hydraulic engineering work in connection with an electric transmission project. A water-power electric generating station is located near the headwaters of the Coquitlam River, and to add to the supply of water furnished by a dam it is proposed to tap a lake at an altitude of 2,500 feet above the sea. Instead of laying a pipe line, the company will drive an inclined tunnel through a mountain of solid rock. The bore will be 3 feet by 8 feet, and 2½ miles in length. The cost of the tunnel is estimated at $350,000. The cities of Vancouver, B. C., and New Westminster will be supplied with current from this source.

Coal in China.— A coal-field of great extent, yielding fuel of a high quality, will shortly be in full operation within a few hours' steaming of Shanghai. The new fuel lies in the province of Anhui, near Ngankin, the capital, on the Yangtse.

A MODEL STEAMBOAT.

Wm. M. Francis.

When I was a boy I made several small boats which were propelled by steam or clockworks, some using paddle wheels and others were propellers (screw). I have recently made one for my own boy and think it may interest some of the readers of this magazine to know how it was built. The first thing to obtain is a set of works from an old alarm clock. A cheap one of the kind sold in most every jewelry store will do. An old one can often be obtained of a jeweler who will give it away to get rid of it. Of course it must be in good enough order to run when wound, after removing the escapement. Other works would perhaps do, but would probably require a larger boat. The size of the works governs the construction to quite a degree. To prepare the works, remove all spindles and gears except the large one carrying the mainspring and two or three spindles which run in train with it. By referring to Fig. 4 it will be seen what is meant, and if the gear in the works does not come so that it will drive the propeller gear at the top, as shown, it may be driven from the underside.

For the hull obtain a clear straight-grained piece of white pine 3″ x 3¾″ x 1′ 3″ long. Lay out the curve for the lines or shear of the deck by driving in a brad at the edge of the top side at about the position of the center section in Fig. 1. Bend a thin piece of wood, taking it by both ends and bending it against the brad, while some one marks the curve on the block to be sawed.

Also mark the piece to be sawed out on the under part of the stern. Any one who has a band-saw will saw these out in a few minutes. Otherwise, cut away with a saw and chisel or draw-knife. Or a templet can be made of thin wood, and one side of the boat marked out. Then turn the templet over and mark the other side, as shown in plan, Fig. 2. If a center line has been drawn from end to end of the boat, and the templet applied to it, both sides of the boat will be of the same curve, which may now be sawed out on this curve. Next make templets for the different sections of the boat as shown in Fig. 3. These can be drawn on thick cardboard or thin wood and cut out with a knife. By applying the templets to each side as the work progresses they may be exactly alike, though much of the boat will have to be judged with the eye. With these templets for guides, cut out the lines of the boat with a chisel or gouge. During this work the block should be clamped to the bench, using thin pieces of wood to prevent the clamp from jamming the block. A set of carving tools will be very useful for this work.

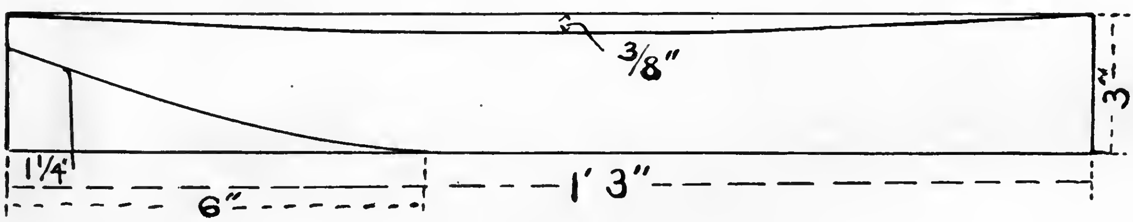


Fig. 1.

After finishing one side, additional templets can be made of curves at different points in the length of the hull and the other side finished to these templets. One who has a good eye can dispense with the templets and, in the absence of other tools, fashion the whole hull with nothing but a jackknife. All the curves of course gradually merge into one another so that the eye can scarcely perceive the change. The lines of a large boat or ship are laid out in exactly the same way, but there is a templet for every rib. If the person has never made a boat before, he had better examine some boat that is drawn out of water or one that is being built.

The next step is to hollow the boat. Take a pencil and draw a line around the deck about $\frac{3}{8}''$ from the edge, following the outline of the hull. The line is shown in plan, Fig. 2. Take two pieces of board and cut them out like Fig. 6 to fit the bottom of the boat at points near the ends and nail them to the bench as shown. The boat may now be placed in them, right side up, and clamped, again using a piece of wood to keep from bruising the wood. Go around this line with a sharp knife or carver's V tool, taking care not to split the side anywhere. Remove what of the boat, but may be more toward the bow and stern. The depth should be about $\frac{1}{8}''$, or sufficient to receive the piece of thin board of which you make the deck. A piece of a long cigar box will answer nicely and makes a nice appearance when finished.

A piece of pine about $\frac{1}{2}''$ square section is now to be inserted across the hull to carry the end of the propeller shaft. This piece has to be let down flush with the top of the ledge so that the deck will lay down on it. Also insert another piece a little forward of the works to help hold up the forward part of the deck. These pieces should be fastened by small nails or screws, as shown in

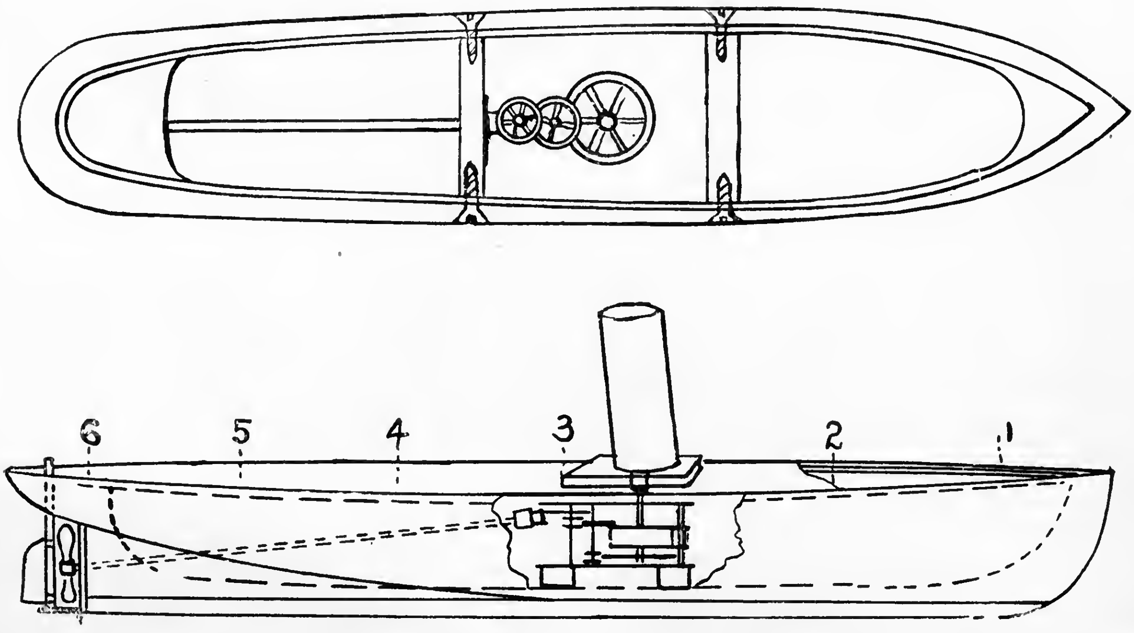


Fig. 2.

wood can safely be done with a bit, and then take a gouge or narrow chisel and hollow out the boat about to dotted lines shown in elevation, Fig. 2. Great care must now be used that a hole is not cut through the side, and the work must be carefully gauged to have about an equal thickness at all similar points of the sides. The clockworks must be fitted at a point about midships, and more wood may have to be taken out in places to accommodate them. After the inside of the hull is done, a ledge must be cut, on which to lay the deck. This should be about $\frac{3}{16}''$ wide at the sides Fig. 2. The deck may now be fitted, using care in springing it down when trying it. It is to be fastened with small, countersunk screws to the ledge and the pieces across the hull, taking care to put no screws where the propeller shaft is to be. We now want a piece of brass $\frac{1}{16}''$ x $5\frac{1}{16}''$ x $3''$ long for stern shoe, another piece $\frac{1}{23}''$ x $\frac{3}{8}''$ x $2''$ long for blades of the propeller, and a piece about $\frac{1}{32}''$ x $\frac{1}{2}''$ x $1''$ long to go on the crosspiece for propeller gear to run against. These may be cut from the metal case of the clock if not otherwise obtainable. Also a piece of straight steel wire about

$\frac{3}{32}''$ in diameter, 8'' or 9'' long, for shaft. Also a piece of brass tube about the same length, in which the wire shaft will fit quite loosely. These articles may all be obtained at any large hardware store and would probably not cost over 15 cents. Also get a piece of lead $\frac{1}{16}''$ x 1'' x 15'' for a lead keel, which is doubled in the middle lengthwise and hammered together on a smooth piece of iron or an anvil so as to make a keel $\frac{1}{2}''$ wide and $\frac{1}{8}''$ thick.

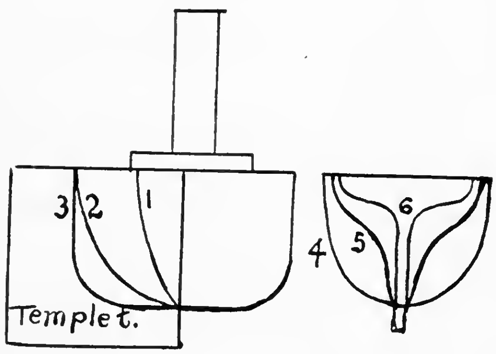


Fig. 3.

Open it a little at five or six points in the length, and with an awl or small drill put some holes through so that the keel may be bradded to the hull, but do not put the keel on until the boat is completed (see Fig. 2).

was inserted across the hull. Also bore a hole through this piece to the same angle. This is shown in elevation, Fig. 2. The piece of tube is to fit in this hole and must not be sprung to put it in, but rather than spring it, the hole may be a loose fit and any leaks around the tube afterwards stopped with putty or thick lead paint. The reason the shaft is put in at this angle is to bring the inside end always above water, so that none will leak into the boat. If it had been put in level with the keel, it would have to be packed to keep out the water, making a lot of needless friction. Next take the piece of brass $\frac{1}{16}''$ thick, and make the stern shoe, as shown in Fig. 4 and in Fig. 2. The hole in this is not to fit the shaft, but the tube, which should be left projecting astern $\frac{1}{16}''$ for the hub of the screw to run against. The shoe, besides having holes in it for the tube and rudder post, is to have two or three screw or brad holes in it to fasten it on to the hull. The tube is also to be soldered to it.

Now take the piece of brass 1'' long and drill a hole in the center for the shaft, which should revolve freely but without any rattle. Also drill two screw holes in it for screws, and fasten it to the crosspiece. The crosspiece will have to be beveled a little on the stern side, so as to bring the brass piece at right angles with the shaft. Put in the tube far enough to butt against the brass

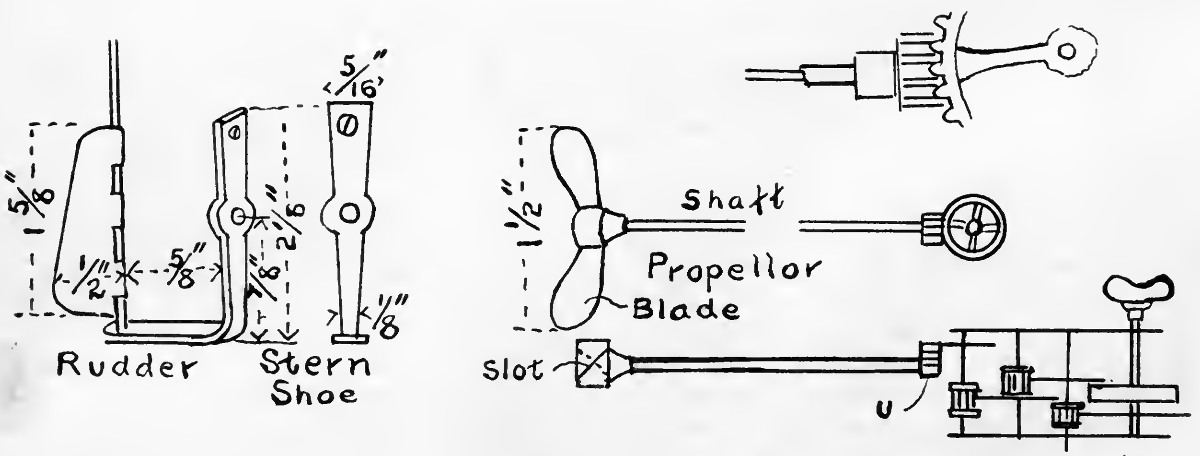
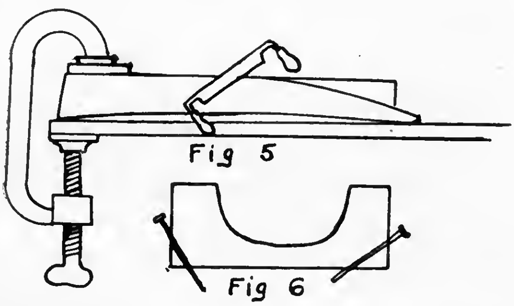


Fig. 4.

With a small drill or gimlet bore a hole about $\frac{1}{2}''$ from the bottom of the boat and in the center of the sternpost, at an upward angle so as to line with the center of the after piece of wood that

piece and cut off to the right length by going around it with a three-cornered file. Now putty and wedge the outside end of the tube, if necessary, to prevent leaks; also fasten on the shoe for the rudder and solder the tube to it. To make the propeller, take one of the keys of the clock that was used to wind up the alarm, remove the flat part that is hinged in it. In the hub, saw two slats with a backsaw on opposite sides at an angle of nearly 45 degrees with the shaft and about $\frac{1}{16}''$ deep. It is necessary to determine from the direction in which the works or last gear meshes with the propeller gear, which way the shaft will turn, as the cutting edge of the propeller should be nearest the stern. If the shaft will turn in the direction of the arrow near the hub shown in Fig. 4, the slots will have to be cut as there shown. If not, the slots will have to be cut as shown by the dotted lines. Cut out the two blades of about the shape shown in sketch and solder them in the slots in the hub. Take the tip of each blade in the jaws of a pair of plyers or vise and twist the blades so that they will not have quite as much angle as the sawcuts, say 30 degrees.



Now insert the propeller shaft in the hole in the hub and solder it in. It is better to separately tin the hole and the end of shaft, and then hold both over a spirit or naphtha torch and when hot shove the two together. Put the shaft in the stern tube and cut to the right length. One of the gears of the hand movement of the clock can be used for the propeller gear. By pointing the teeth of the small gear a little with a thin file, it will run very nicely when meshed with the driving gear of the works as shown. When the shaft is in place, solder the propeller gear to the inside end in the same way the hub was soldered.

Two pieces must be now fitted in the inner bottom of the boat and trimmed so as to bring the works to exactly the right height that the gears may properly mesh. They should not bind, but revolve quite freely. When fitted, screw the pieces to the bottom and then screw the works to these pieces. This must be done firmly, to prevent any jar or dropping of the boat from bringing the gears out of mesh. Wind up the spring and see if the works run freely. In the deck piece cut an oblong hole through which to oil and inspect the works. Around the hole put some pieces of wood about $\frac{1}{8}''$ x $\frac{3}{8}''$ for a combing. For a cover, I used an oblong stamped cover of a mustard box with rounded corners, making the hatch of the size to fit. This should fit snugly, so that it will not drop off if the boat is turned over. To this cover, solder a piece of thin brass tube or tin speaking-tube to represent a smokestack. Bevel the ends a little so that the stack will lean aft a little. The hatch, of course, has to be so placed that the key to wind the works can be reached. Fasten on the lead keel, and the boat is ready for trial in the water. If it does not trim just right (owing to the works being set to one side to work the gears), a small lead weight may be screwed inside the boat so as to make it trim right. Wind up and try the boat in the water before putting on the deck. If it runs all right, give the joint of the deck ledge a thin coat of putty or white lead and screw it permanently in place. Putty all cracks around the joint of the deck and combing of hatch, and after the boat is thoroughly dry, paint to suit the taste. The rudder is made of a piece of tin cut and bent as shown in sketch, and soldered to a piece of the wire used for the propeller shaft. A hole is bored in the hull at the stern so that the wire fits tight enough to keep the rudder in any position in which it is placed. Owing to the bottom half of the propeller having a more solid body of water to work on than the top half, the boat will have a tendency to turn in a circle. The rudder should be placed to steer against this, and the boat will then run straight. The boat here described will run a quarter of an hour at one winding, is quite speedy, and will tow quite a large boat or plank. It should be run in water clear of weeds, as if anything gets around the propeller it may take considerable trouble to get the boat.

THERE is some talk of operating all the principal railways in Switzerland by electricity instead of steam. It is thought that the power which could be derived from Swiss waterfalls would be sufficient to provide enough electrical energy for the entire railway system of the country.

AN EASILY MADE ICE-CHEST.

M. H. Warren.

The ice-chest here described was made for a summer camp. Ice had to be carried three miles in a boat, and without ice the provisions spoiled. A box sunk in the ground had previously been used, but as it was wasteful of ice and not very handy, something better was needed. This chest proved to be quite as efficient as a purchased one, costing but little, and quite easy to make. Here is a description of how I made it:

The materials used were two shoe cases and a packing case, a sheet of zinc 24″ x 36″, hinges, handles, screws and nails. The lining was chopped

cork used for shipping Malaga grapes, a kegful being purchased of a fruit dealer for ten cents. If it cannot be obtained, sawdust may be used, but it is not quite as good. The edges of the boards should be matched, to make joints as tight as possible and well driven together before nailing. The shoe cases were carefully taken apart and used to make the outside of the chest.

The packing case, used for the inside walls, was in such good condition that no changes were made in it, thus saving some work. It measured, inside, 25½″ long, 14½″ wide and 18″ deep, but any other size may be used. Around the bottom, sides and ends were nailed strips of wood 2″ wide and 1″ thick to form a space for the cork lining. The pieces for three edges were put on first, the bottom boards then nailed on; the cork put in and the fourth strip then put on, nailing it through the bottom board. The cork should be firmly rammed down with a stick, so that it cannot settle and leave a vacant space. The bottom being finished, the ends and then the sides are made in the same way. The illustration clearly shows the construction. The top pieces forming the cork spaces are not nailed until the cork has been packed. The side pieces of the outside sheathing lap the ends, and should not be sawed until the correct length can be ascertained, after making the ends. The top of the chest was finished by strips mitered at the corners as shown, giving the chest a finished appearance.

The cover was made of well-matched pieces from one of the shoe cases, the top layer running lengthwise, and a lower layer, which loosely fitted the top of the chest, running crosswise. By taking measurements and marking the underside of the top pieces, the location of the lower layer can be determined without difficulty, and then the two parts are well nailed together with short nails. Around the front of the cover and the two ends, a strip 1½″ wide and ½″ thick was nailed, thus preventing any chance for air to circulate around the joints between cover and chest. The top layer of cover should be a trifle larger than the chest, so that these strips will not bind anywhere. The two hinges at the back are well sunk into the wood to make a tight joint when closed.

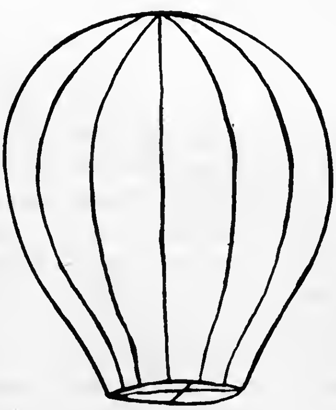
The legs were pieces of wood 2″ square and 6″ long. Around the outsides of the tops were nailed short pieces of board which were nailed to the bottom of the chest. A piece of zinc 24″ x 36″ was used for lining the bottom and about 5″ up on the sides and ends. The inside of the chest was carefully measured, and the dimensions marked on the center of the piece of zinc, the lines being extended to each edge. The corners were then cut off with metal shears, the pieces cut off being saved to be used as will be mentioned. The sides were then bent up, so that a shallow box was formed, considerable careful hammering being needed to get square edges. The corner joints were then carefully soldered. A plumber would probably make the box lining for a small sum if any one did not care to do this part of the work. The drip-pipe was made of one of the corner pieces cut from the sheet of zinc. It was bent around a piece of broom-handle and then cut so that the edges just met, the edges being trued up with a file. It was then fastened to the broom-handle with tacks at each end, so that the joint would be held firm when soldering. This formed a piece of zinc pipe about 5″ long and 1″ in diameter. A slight flange is made to one end with pincers, so that it may be soldered to the lining.

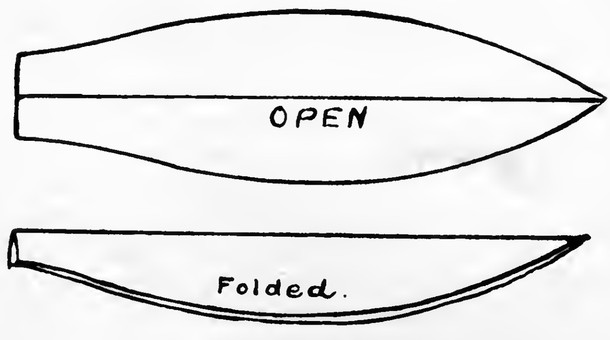
A 1″ hole was bored in one corner of the bottom of the chest. The bit was put through until the screw-point projected through the bottom, then withdrawn, the zinc tube inserted, and the hole finished by boring from the underside, the zinc tube being pushed through as the bit was withdrawn. This prevents the cork lining from falling out. The lining was then put in, a hole having been previously made where the drip-pipe comes. The top edge of the lining was fastened by tinned tacks. A strip of wood 1″ wide and ½″ thick was then nailed along each side, about half-way between top and bottom, for holding shelves, which were made of ½″ boards. A wooden frame of 1″ oak was made for the bottom, so that when putting in the ice the zinc would not be dented or broken. The inside woodwork was then given two coats of shellac, cut with alcohol. Paint should not be used, as the turpentine and oil in it are objectionable for this purpose. The outside was stained a dark brown, after puttying up the cracks, and shellacked.

HOT-AIR BALLOONS.

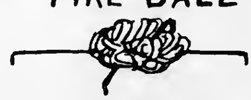
M. I. Jones.

For several years I have concluded my 4th of July celebration by sending up several hot-air balloons, and as my companions have found the event one of much enjoyment, I presume many of the readers of Amateur Work would be interested to know about them. The balloons were homemade and inexpensive, the latter item being one that will appeal strongly to boys who always have so many uses for money on our national holiday.





FIRE BALL



I usually make two sizes, the smaller ones of tissue paper, and the larger ones of white newspaper, which I get from a newspaper office where large rolls are used on what is called a web-press. These rolls are taken from the press before all the paper is used, from five to twenty yards remaining on the roll. Enough of this paper can be obtained for a small sum to make several large balloons. Such paper can be obtained from any newspaper office where web-presses are used. If this paper cannot be secured, thin manilla wrapping paper will answer.

A cigar-shaped pattern should first be made of thick manilla paper. For a balloon 6′ high, the pattern should be 9′ long, 18″ wide in the middle and 5″ wide at the bottom, coming to a point at the top. To make the pattern, paste enough paper to form a rectangular piece of above outside dimensions. Fold lengthwise in the center, and draw with a pencil the curved line of one side. A long strip of wood may be bent so as to secure an even curve and held in place by nails while the pattern is marked. The natural curvature of the wood will give the correct shape. The pattern as marked is then cut out, using care to cut both layers of paper alike.

For a balloon 4′ high the pattern should be 6′ 3″ long, 12″ wide in the center and 4″ at the bottom. Thirteen stripes are made for either size, the dimensions given allowing a $\frac{7}{8}$″ lap for seams on the larger size and $\frac{1}{2}$″ lap on the smaller one. Examine each strip after cutting, for holes, and if any are found, pieces of paper should be pasted over them. Use a good grade of photography paste for joining the seams. Mucilage dries too hard and is apt to crack in handling when dry. A quick and convenient way to paste up the seams is on a wooden mold. One end of a piece of 2 x 3″ joist 8′ long was clamped to the workbench. A flexible piece of wood was bent to conform to the shape of the paper strips, being held in place by nailing to it, and the joist strips of wood placed about 18″ apart.

The edge of one piece of paper is then covered with paste and placed on the form, and the edge of another piece laid over it, beginning at the center and working towards each end. The strips were joined in pairs, then the pairs were joined, and so on, this giving time for a seam to dry before again working on the same piece. At the top a loop of small but strong twine was attached with a darning needle. This loop is used to support the balloon when inflating. For the bottom of the balloon, make a loop of old telephone wire or a piece of cheese box of the size of the opening; in the larger size about 18″ and the smaller size 15″ in diameter. Two strong cross-wires are connected to the loop, forming an X-shaped support for the fire-ball. The hoop is then attached by lapping over the bottom of the paper strips and pasting.

The fire-ball is made of cotton twine, which must be untwisted so as to be loose and soft. It is loosely coiled into a flattened ball about 4″ in diameter and attached to the top of an X-shaped wire frame, the ends of which are bent down so as to twist around the crosspieces to the hoop of the balloon, when ready to light.

Supposing the eventful evening to have arrived, we would send up the balloon in the following manner: In an old tomato-can put some shavings well covered with kerosene. On two bricks or stones support a short length of stovepipe, in the bottom of which is placed the tomato-can. Light the kerosene, and as soon as it has stopped smoking and the hot air is coming up the pipe, hold the balloon over the pipe and it will quickly become filled with hot air. The top of the balloon is supported with a long stick with a wire hook on the end, which holds the string loop in the top of the balloon. As soon as the hot air has well filled the balloon, it will tug strongly to rise, and should be removed from the stovepipe. The fire-ball is now saturated with kerosene, quickly placed on the top of the crosspieces of the hoop and fastened in place. It is lighted, and as soon as it is blazing well, the balloon should have enough lifting power to rise well. If this be the case, it may be released and will undoubtedly soar rapidly aloft and away in the direction the wind is blowing.

An open field should be selected for sending up the balloon, and care should be taken to see that it has plenty of lifting power before being released. If much wind is blowing, a sheltered place will be necessary, otherwise the balloon is very likely to heel over so far as to become ignited and the labor and pleasure lost.

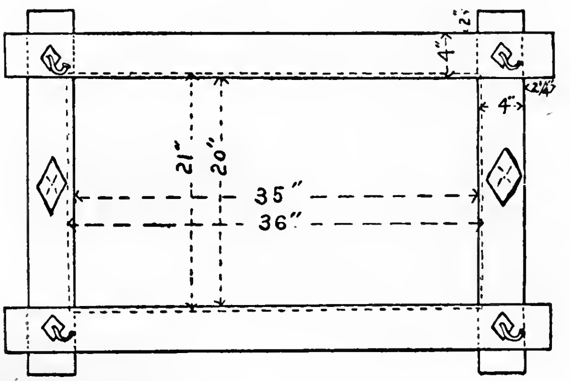
Referring to the recent enactment of the New York Board of Health, to prevent contagion from the promiscuous use of brushes, scissors, razors, etc., in barbers' shops, *The Lancet* (London, April 5) says: "The question arises whether the barbers will endeavor to meet these new exigencies. Historically speaking, the barbers, whose precursors used to be barber-surgeons, should readily appreciate the advantage of antiseptic surgery, and be willing to apply its principles to the minor and painless operations which they now perform.

OLD DUTCH FURNITURE.

John F. Adams.

VI. Hall Mirror.

The hall mirror here described is designed as a companion piece to the settle given in the March number of this magazine. The frame should be made of selected quartered oak $\frac{7}{8}''$ thick and 4″ wide. Two pieces 48″ long and two pieces 32″ long are required. The joints are made by halving, care being taken to make them a snug fit and perfectly square. The rabbet or recess on the inside edges for the mirror may easily be made with a backsaw. They are $\frac{1}{2}''$ wide and $\frac{3}{8}''$ deep. Mark the line to be sawed; bore a hole at each end with a $\frac{1}{4}''$ bit. Then lightly nail a thin $\frac{1}{2}''$



square strip of wood on each side of the line, having just room enough between them for inserting the blade of the saw. Before beginning to saw, mark on the saw blade, with a pencil, a line showing where the saw will be when the right depth of cut has been made. When one cut has been made, take off the strip and repeat the process for the other cut. Smooth up any rough places with a sharp chisel or rabbet plane, and see that the depth is uniform, so that the mirror will rest evenly at all parts. The ends of the long pieces extend on the sides $2\frac{1}{4}''$, and the side pieces extend 2″ at top and bottom, as shown in the illustration.

Fasten the joints together with glue and by $\frac{3}{4}''$ screws from the back, countersinking the heads. Bore holes for the screws, using care not to bore through to the front of the frame. Put the screws in the corners of the joints, so as to leave a clear space for attaching the hat-hooks or other ornaments. A mirror of this size is quite heavy, necessitating a strong frame to securely hold it. The size is 36″ long and 21″ wide. If desired, the upright pieces may be made 3″ longer, allowing 3″ greater width for the mirror. The backing is made of thick picture-frame backing or any wood $\frac{1}{8}''$ thick, and should be securely nailed in. A piece of thick manilla paper is put between the mirror and the backing, to prevent scratching the former.

The hat-hooks are put one in each corner, and may be of brass or black iron, the latter being most in harmony with the design, though probably difficult to obtain in many places. In the center of the side pieces candle brackets may be added and escutcheon ornaments in other places, as may suit the fancy. Two brass pieces, with screw holes for attaching to the wall, are firmly screwed to the back of the top piece and one to the bottom piece, so that the weight of coats will not cause it to fall. The frame is finished with stain to match the settle. If the work is well done, a substantial and quite ornamental piece of furniture will result.

An electrical fly-trap has been patented by an inventive genius residing in Providence, R. I., Mr. Edwin R. Greene, by name. A frame is employed which is constructed of insulating material, and comprises a central longitudinal plate and top and bottom bars, the whole being connected by intermediate strips. Around this frame are wound sets of positive and negative wires spaced a slight distance apart to form a grid, the spaces between the wires being such that should a fly alight on the grid it will necessarily touch two wires. Bait is placed upon the center plate within the grid, and the arrangement is connected up with an electric current. A horizontal platform is suspended beneath the trap to catch the flies that may be electrocuted. The operation of the device will be apparent. The insects attracted by the bait within the grid will alight upon the wires and be electrocuted, whereupon they will drop down upon the horizontal platform, this platform being so arranged that it may be cleaned as often as desired.

How to Color Electric Lamps.— Very often much effectiveness can be worked out in a window trim with the aid of colored lights, says the *Dry Goods Reporter*. Colored lights are expensive. The following formula will explain how to color electric lamps, thereby saving a big part of the expense. Take a little white shellac, thin it down with alcohol, and by dipping the bulb in this it produces a splendid imitation of frosted glass when a clear white light is required. Care must be taken to have the shellac very thin, otherwise it will not run smooth. If you use green, purple, red, blue or any other color, buy a package of egg dye of the color required, dissolve it in wood alcohol and pour it into the shellac. By using this or any transparent coloring a vast number of beautiful tints can be made that will blend with your color scheme.

To go about it properly and to get the best results, after preparing your shellac pour it in a vessel deep enough to immerse the lamp. Take a piece of wire and fasten it around the socket of the lamp, then bring one end of wire back over the end of the lamp to opposite side of lamp to form a loop, then dip it in the solution and hang it up to drip and dry. While mixing your color bear in mind that the more dye and the less shellac the deeper the tint will be, and *vice versa.* Any of these colors can be removed with wood alcohol.

M. Edward Brauly, the well-known French electrician, who has lately been interested in the problem of wireless telegraphy, says *The Scientific American*, has perfected a device which will considerably develop communication by this means. It is called the improved Brauly radio-conductor. The Brauly coherer is already employed in wireless telegraphy, but the value of the new device is the discovery that any two pieces of metal, provided one of them be polished or oxidized, will serve all purposes of the tube. Any metal will suffice for this object. The result has even been secured with a common needle. The new radio-conductor consists of a horizontal plaque of polished steel connected with one pole of the circuit, on which rests a small metallic tripod connected with the other pole, the three points of the tripod being oxidized.

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Dr. Gunsaulus, President of the Armour Institute of Technology, is the head of the Advisory Board of the American School, and the professors of the Armour Institute are associated with the faculty of the American School in the instruction of American School students. All examination papers from students in the vicinity of Chicago go directly to the faculty of the Armour Institute for correction and criticism. American School students also receive *full credit toward a degree* in the Armour Institute for all work done in the American School, and students are earnestly recommended to continue their studies at the Armour Institute. All students wishing further information concerning the splendid opportunities offered by the Armour Institute can obtain a catalogue upon request.

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AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES.

Vol. I. No. 9. BOSTON, JULY, 1902. Ten Cents a Copy

WIRELESS TELEGRAPHY APPARATUS.

R. C. Browne.

II. RECEIVING INSTRUMENTS.

For detecting the messages that are sent out by the apparatus described in the last article, we will have to build a set of receiving instruments consisting of the well-known telegraph sounder, and relay of 250 or more ohms resistance. The higher the resistance of the relay the more sensitive the apparatus. In addition to these we must make what is known as a coherer and decoherer. The coherer is simple in construction, and based upon the property the electrical waves have of causing loose particles of iron filings to attach themselves together, somewhat similar to the action of iron filings when magnetized.

From a glass tube of about $\frac{1}{8}''$ bore and medium thick walls, cut a piece $2''$ long. This can easily be done by scratching the tube at the proper place with a file, and then applying pressure on each side of the scratch by holding it firmly in the hands with the two thumbs just opposite the scratch, and boldly pressing the tube over them.

From a piece of round brass rod cut or turn two little plugs about $\frac{3}{8}''$ long and of a diameter to snugly fit the hole in the glass tube. Brass rods can easily be cut with a hack-saw. To one end of each plug solder the eye of a long, slim needle, first breaking off or blunting the points, to avoid pricking the fingers.

A small hole can be drilled in one end of each plug, to facilitate soldering of the needle. Obtain two double binding-posts and mount them on a baseboard $7''$ long, $5''$ wide and $\frac{3}{4}''$ thick. They should be placed $1''$ from one side of the board, $2\frac{1}{2}''$ apart and $2\frac{1}{2}''$ from one end, as shown in Fig. 1. Have the holes facing each other, so that the needles passing through them will enter the glass tube and hold it firmly. Before putting the plugs into the tube make a small quantity of rather coarse iron filings by forcibly filing a piece of clean, dry iron with a coarse cross-cut file which is perfectly clean and dry. These filings are to be placed in the glass tube between the two

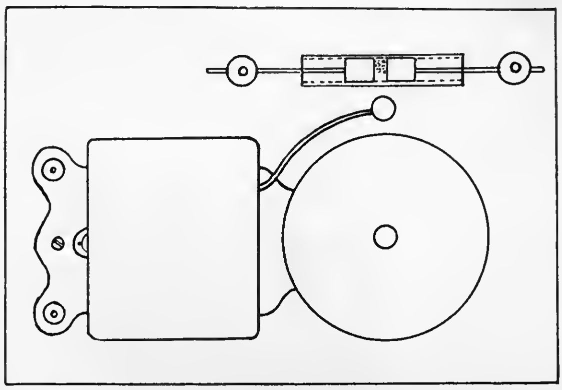


Fig. 3.

brass plugs, care being taken not to get too large an amount, and to avoid handling them with the fingers or squeezing them between the brass plugs.

The best way to get the filings into the tube is to make them over a clean piece of paper with a fold across it, so the filings can easily be poured into the tube. The plugs should be from $\frac{1}{16}''$ to $\frac{1}{8}''$ apart, and the space between them not over half full of filings. A rubber band on the outside of the tube, where the hammer of the bell rests, will prevent breakage from too heavy a stroke of the bell.

The decoherer, as its name implies, is an instrument to counteract the work done by the coherer; that is, it destroys the coherence or clinging together of the filings which follow the passage of the wave impulses. This is accomplished by shaking the filings in the tube; and an excellent decoherer is obtained by mounting an electric bell (any box bells which work well will answer) on the baseboard so that the hammer of the bell, when at rest, lays against the glass tube of the coherer, as shown in Fig. 3.

I should advise the student or amateur to purchase the relay of some reliable firm. It should be of at least 250 ohms resistance; and 500 or 1,000 will work better and receive at greater distance. But as a relay of such high resistance is rather expensive, the reader may obtain a cheap instrument of low resistance, and rewind it with finer wire. The size and amount of wire necessary for rewinding can easily be estimated by weighing the wire taken off of the coil, and looking up in a wire resistance table the size of wire having a resistance of 500 ohms or more for the same weight of wire. For most purposes the No. 36 gauge wire used in winding the induction coil described in the last paper will be found to work well.

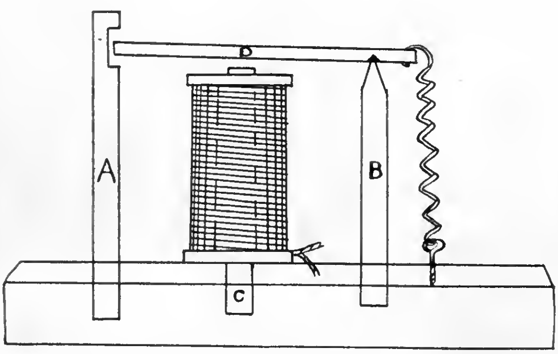


Fig. 4.

The sounder may also be purchased, but a simple one may be made as follows: Two upright brass posts $\frac{1}{4}''$ diameter (see Fig. 4), A being $2\frac{3}{4}''$ long and B $2\frac{1}{4}''$ long, are driven into the base board $2\frac{3}{16}''$ apart. Post A has a notch $\frac{1}{4}''$ long filed $\frac{1}{8}''$ from the top; B is filed wedge-shaped, as shown. Post C is of soft iron $\frac{1}{4}''$ in diameter and $2\frac{1}{4}''$ long, and is driven into the base exactly in the center, between the other two posts. The wooden base is $4'' \times 5''$ and $\frac{3}{4}''$ thick, $\frac{1}{4}''$ holes being bored in it for the posts. A selenoid, which is simply a paper or wooden spool wound with ten or twelve layers of No. 26 cotton-covered magnet wire, should be slipped over the iron center post. An iron lever, D, $\frac{1}{8}''$ thick, $\frac{3}{8}''$ wide and $2\frac{3}{4}''$ long, having a notch filed $\frac{3}{8}''$ from one end, should be placed over the coil, so that when the wedge-shaped post supports the notch in the lever, the other end of the lever should be free to move in the slot in post A. A small brass spring, made by winding thin brass wire around a wire nail, should be fastened to the base and to a hole in the short end of the lever, so as to hold the latter up against the top of the notch in A.

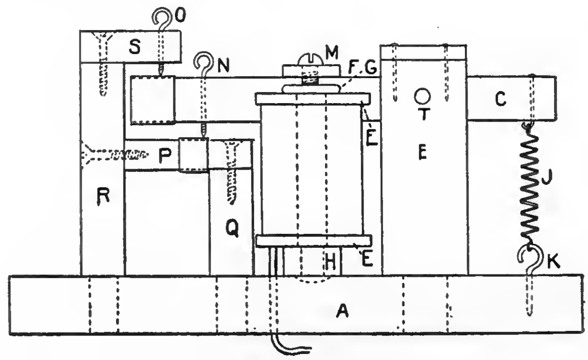


Fig. 5.

The iron post of the coil should be driven into the base until the top is a trifle lower than the notch in the post A. The top of post B should be $\frac{1}{16}''$ higher than the iron post. A more elaborate sounder is described in the November, 1901, number of Amateur Work, the construction being plainly indicated by Figs. 5 and 6.

The instruments are connected as shown in Fig. 7. The coherer should be put in series with the relay and a battery of one cell. The decoherer and sounder are to be placed in multiple and then in series, with the local side of the relay and a battery of six or eight cells. One side of the coherer must be connected to the earth and the other side to an elevated wire.

For those not acquainted with the terms series and multiple, the following directions are given for making the various connections. One side of a cell of battery should be connected by wire *a* to one of the posts of the coherer. The other post of the coherer should be connected by *b* to one end of the coil of the relay; the other end of the relay coil should be connected by *c* to the other pole of the battery. One post on the decoherer bell should be connected by wire *m* to one post on the local side of relay; the other post on local side of relay connect by wire *n* to one side of a battery of six or eight cells connected in series; i.e., the zinc on

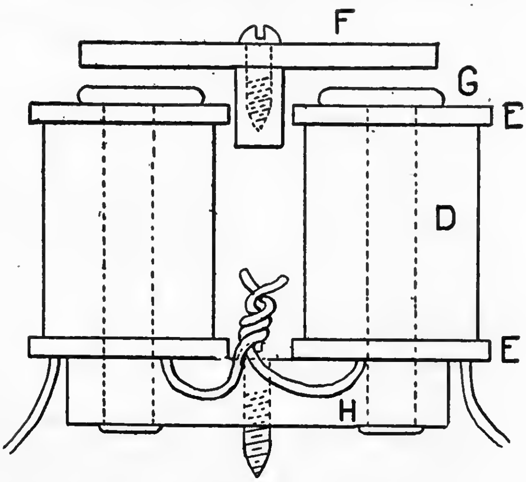


Fig. 6.

one battery connected with the carbon of another. The other side of the battery is connected by *o* to the other post on decoherer (bell). The sounder should be connected to the two posts on the decoherer by wires *f* and *p* or to the wires *m* and *o*, as may be most convenient.

The elevated or receiving wire should be as straight as possible. Galvanized iron telephone wire will answer. A pole or kite may be used to secure the necessary elevation; the higher the terminal end the greater the distance over which signals may be transmitted. Elevated places with sharp slopes are preferable for land operations. Over water height is desirable, but not so necessary. The ground wire should connect to an adjacent water-pipe, though it is better to have a direct wire connection with a copper plate buried deep enough to be in earth, which is always damp. If the instruments are to remain in connection for any length of time during the season of thunder-storms, a lightning arrester should be connected between the elevated wire and the ground wire at the point where they both enter the building, the wiring being arranged to allow this. The ground wire in this case should be as large as No. 6 gauge galvanized iron.

Choking coils have not been included in the apparatus here described, but they may be added if desired. According to some experimenters, they increase the sensitiveness of the instruments. They are made by filling a small glass or rubber tube say 1″ long and ⅛″ inside diameter, full of pieces of very fine iron wire, and then winding on the outside of the tube two layers of No. 36 cotton-covered magnet wire, coating the layers with shellac to hold them in place. The ends of the outside wire are connected in series with the wire connecting the coherer and relay.

When all the apparatus is completed and the various connections made, a trial may be made to see if it will work over a short distance. The coherer, sounder and relay should "click" when a common electric bell is rung within two or three feet of them. Some adjusting will undoubtedly

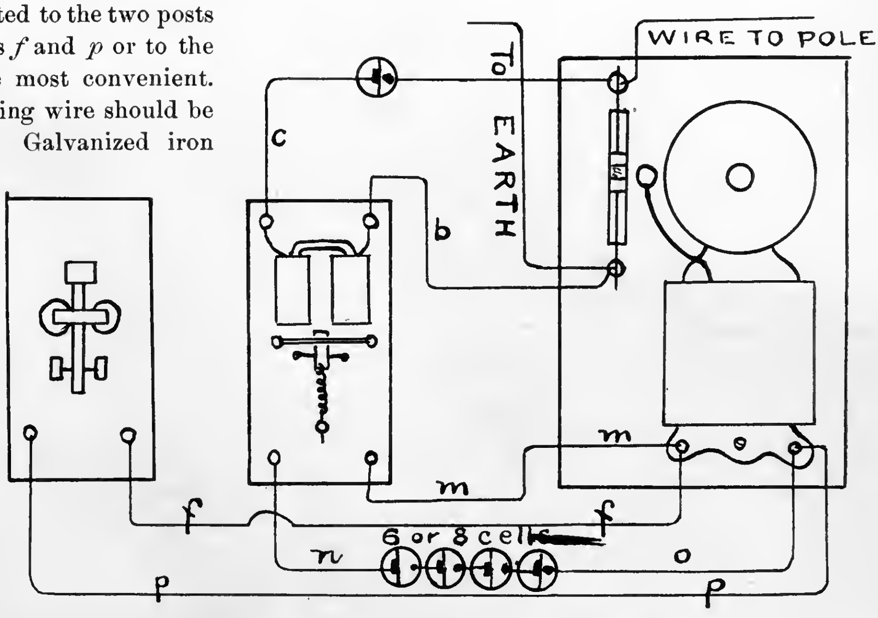


Fig. 7.

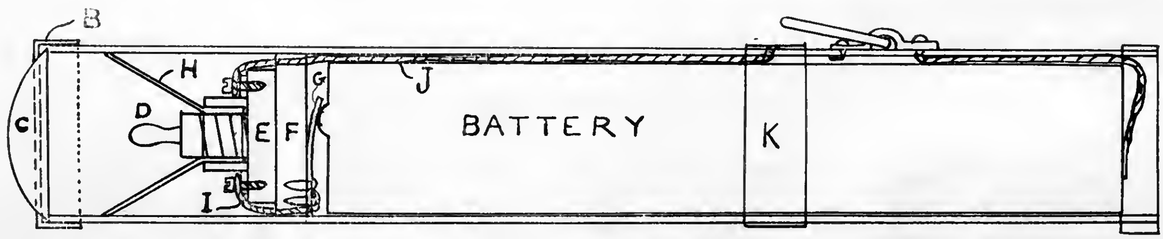
be necessary before satisfactory results are obtained. This is true of the most expensive and delicate outfits, so we should not expect this apparatus to be an exception. Tap the coherer, to see that the filings are not packed. The relay must be adjusted very delicately, the armature as close to the poles as possible, yet not touching them. The spring should be adjusted so the tension will be sufficient, but not too strong. If the bell continues to ring after a signal, either the hammer does not strike hard enough to decohere the filings, or the armature of relay needs adjusting. The battery between coherer and relay may also be wrongly connected. A little experimenting will, however, soon get the parts into working order, and then longer distances can be attempted. One important point should always be kept in mind: Never let the spark from the coil pass through the coherer. The filings in the coherer will need renewing at intervals.

AN ELECTRIC FLASH TORCH.

The electric flash torch here described is easily made at an expense of about $1.00. The materials required are a miniature lamp of three or four candle-power, with porcelain base; dry battery for same; a piece of strong pasteboard mailing tube 9½″ long and 1½″ diameter; a piece of zinc for reflector; a cheap plano-convex lens 1½″ in diameter—although this is not absolutely necessary; a shipping case for No. 12 size works of a watch, with glass top and bottom, to be obtained from any large jeweler for the asking; a little annunciator wire, screws, etc.

lens. To a round piece of wood, F, ¼″ thick, fasten the porcelain base, E, of the lamp by screws. Two small holes are bored through this wooden piece for the wire connections I and J. When completed, three round-head screws are put through from the outside to hold it firmly in place.

The reflector, H, is a cone-shaped piece of bright tin, held in position by projections at the base that fit tightly between the outside of the screw socket of the lamp and the porcelain base. It should be brightly polished on the inside, but need not be soldered at the joint. It is easily cut out



The shipping case for watch-works above mentioned is used by manufacturers in sending out the works to retailers, who have no further use for them, and will undoubtedly give one to any customer who asks for it. The size used for No. 12 works is just right for the torch here described. This is mentioned as, if obtainable, a more finished appearance is the result, but the cover of a round spice-box may be cut out and will answer about as well. It is used for the end, and holds the lens C in position, as shown at B, in the illustration. The lamp D should be so located that the outer end will be about ⅜″ from the inner side of the

of thin sheet tin with metal shears, if a cardboard pattern is previously made. An examination of the illustration in connection with the lamp and socket will make this clear.

On the inner side of the piece F, attach with brads a piece of spring brass 1″ long and ⅜″ wide, and connect with the wire from one of the terminals of the lamp. The inner end of the spring should be bent so that, when the battery is in place, it will be in firm and constant contact with a small projection forming one terminal of the battery. The other terminal of the lamp is connected by wire with a thin metal ring, K, around the outside of the tube, a hole being put through the tube for that purpose. The metal ring may be made of a thin strip of zinc or brass $\frac{1}{2}''$ wide, and should be located about 3″ from the rear end of the tube. A small curtain pull, L, is attached to the outside of the tube, which when pressed forward will rest on the ring K, and complete the circuit required to light the lamp. A piece of wire connects the ring L with the base of battery, the battery end being bare and resting loosely between the zinc end of battery and the metal end of the tube, the latter being made from the cover of a round spice-box of suitable size to tightly fit the end of the tube. If such a cover cannot be secured, a round piece of wood may be cut out and held in place by three screws, the paper tube being made enough longer to receive it. Care should be taken to see that the battery makes a good contact with the spring G and with the wire connecting with the ring L.

When completed, the outside of the tube may be covered with dark-colored paper or leatherette. This torch is not suitable for continued lighting, but is intended for service requiring light only at intervals. It is a very handy device for use about the house or on the street at night when a light is needed for temporary use. In time, depending upon the extent it is used, the battery will give out, and is then replaced with a new one at a cost of about 30 cents.

THE WHEATSTONE BRIDGE.

For rapid and accurate comparison of known with unknown resistances of various lengths of wire, lamps, etc., an instrument known as a "Wheatstone bridge" is employed. It was invented by Christie, but has received the name of the more widely known scientist. As it is easily made, and of much value in electrical experimental work, many readers of this magazine will be interested to learn how it is constructed and used.

The materials required are: A piece of well-seasoned hard wood, 41″ long, 6″ wide and $\frac{7}{8}''$ thick; one piece of brass rod 37″ long, $\frac{1}{2}''$ wide and $\frac{3}{8}''$ thick, and two similiar pieces 5″ long; 10 binding-posts with screw points; a piece of German silver wire, No. 26 gauge, 45″ long, and a small piece of brass for a pointer. It is quite important that the wire be of perfectly uniform gauge throughout, and without kinks or nicks.

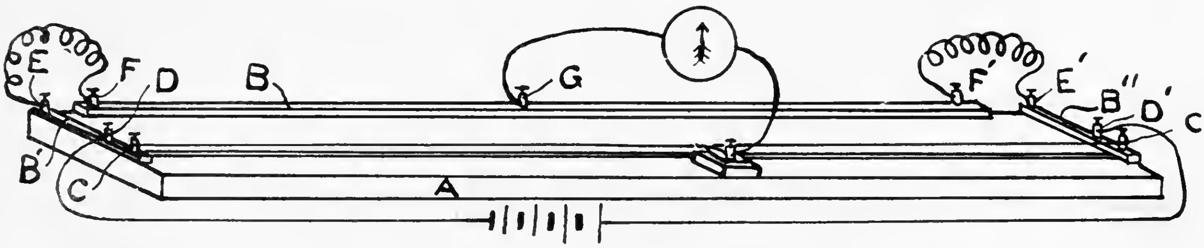
The illustration shows the arrangement of the pieces of brass and binding-posts. Holes are drilled in the brass pieces large enough for the screw points of the binding-posts. The end brass pieces B′ and B″ are then carefully located, so that the space between the binding-posts C and C′ will measure exactly one meter. This in English measure is a trifle less than $39\frac{3}{8}''$. The binding-posts C and C′ are then screwed down and the remaining binding-posts placed, thus fastening the brass pieces to the base. A space 1″ wide is left between the ends of B and the sides of B′ and B″.

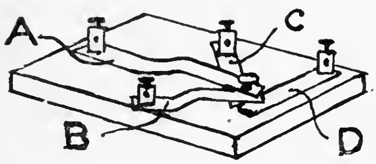
The German silver wire is strung between the binding-posts C and C′ so that it will be taut, but without tension, so the resistance of the wire will be uniform. To a small block of wood is attached a brass pointer, J, with a binding-post, H. The tip of the pointer should be slightly curved, to give a good contact with the wire, and be kept brightly polished with fine emery-cloth or a file. In moving the pointer always lift it free of the wire, so that the latter will not be scraped or bent.

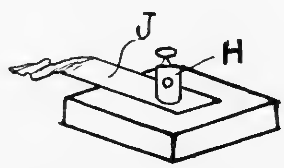
Under the wire the baseboard may be marked into divisions, preferably those of the metric system. A drawing pen and india ink will be found convenient for this purpose. The ink will not "run" if the wood is sandpapered and then a little talcum powder rubbed over it before marking.

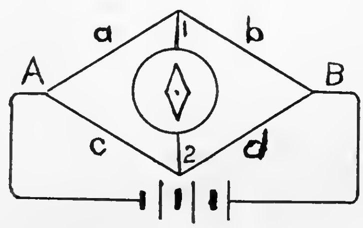
In using this instrument more satisfactory results are secured if a bridge key is used. This is made as follows: On a baseboard 7″ long, 5″ wide and $\frac{3}{4}''$ thick, four binding-posts are attached with a strip of flexible brass leading from each, so that the free ends of each will rest over one point. These strips are bent so that they will not be in contact except when pressed by the hand. A piece of rubber or cardboard is attached to the upper side of the strip C, so that no connection can be made between the strips B and C. This allows a circuit to be made first through the pieces A–B and then with more pressure through the pieces C–D.

The Wheatstone bridge utilizes the form of a divided circuit in which the current in one branch









may be adjusted to equal or "balance" the current of the other branch, and which will be more clearly understood by examining the illustration.

The current flowing through A divides, through the branches a–b and c–d. The potential at any point in the branch a–b will equal the potential at some point in the branch c–d. If these two points (1 and 2) in the branches be connected through a galvanometer, the needle will not be deflected, which would not be the case if the potentials differed.

This instrument is so arranged that in dividing the circuit, known resistances may be utilized to secure a balance with an unknown resistance, thus determining the latter. The known resistances are usually made in the form of coils of insulated wire, of such lengths and size as will make comparisons easy; such as 1, 2, 3, 5, 10, 25, 50, 100 ohms and higher when desired. A table of resistances of copper wire will give the quantity necessary to secure any resistance required. The winding is done in a peculiar manner to avoid self-induction, the wire being doubled upon itself before being wound.

The bridge key is used to send the current through the branches of the bridge before allowing it to pass through the galvanometer; the former, together with the coils, etc., becoming saturated with the current, thus creating no violent deflections in the galvanometer when brought into circuit. The posts A and B are connected to the battery circuit and the posts C and D to the galvanometer circuit. A slight pressure on the knob makes the contact between A and B, and more pressure makes that between C and D. The pointer is moved along the wire and coils are changed until a balance is obtained, the unknown resistance then being easily determined. Much interesting experimental work can be done by the amateur with this instrument in the way of testing the resistance of the wiring of toy motors and of batteries.

STUDIES IN ELECTRICITY.

IX. ELECTRIC ENERGY.

The water stored in a reservoir is conveyed by a pipe to a mill, where it may be converted into mechanical energy. The quantity of water passing depends upon the rate of flow and the time during which it flows. The gallon is a unit of liquid measurement, and the gallon-per-second could be applied to express the quantity flowing. The electrical unit of quantity is called the coulumb, and is the amount of electricity of a strength of one ampere passing through a conductor in one second. At one ampere flowing for 15 seconds, or 15 amperes for one second, the quantity of electricity delivered will be 15 coulumbs. An ampere-hour therefore equals 3,600 coulumbs. The capacity of storage batteries is frequently expressed in coulumbs.

If the water in a reservoir is delivered under sufficient pressure to turn a turbine, the energy stored in the water is converted into power depending upon the quantity of the water and the height through which it falls. Similarly, an electric current flowing through a circuit conveys electric energy from a battery or dynamo to some point in the circuit, where it is converted into work by means of a motor, battery furnace or lamp. The motor transforms it into mechanical work; a battery utilizes it for electro-plating or chemical work; the furnace and lamp produce heat and light.

Mechanical energy is expressed in foot-pounds, one foot-pound being the amount of work performed in raising a mass weighing one pound through a distance of one foot. The unit of electrical energy is the joule, which is the work done in sending one coulumb through a difference of pressure or potential of one volt, and equals .7372 foot-pounds approximately. If three coulumbs flow through a circuit at a distance of potential of one volt, the expenditure of energy would be three joules.

Power is the rate at which work is done, and the reader must carefully distinguish between the amount of work and the rate or time of doing it. When electrical work is done at the rate of one joule per second, the power exerted is called a watt, which equals .7372 foot-pounds per second, or 44.23 foot-pounds per minute, approximately. Mechanical energy being expressed in horse-power, which is equal to 33,000 foot-pounds per minute, or 550 foot-pounds per second, one watt equals $\frac{1}{746}$ of a horse-power, and 1,000 watts, or one kilowatt, equals 1.34 horse-power; or roughly, 1$\frac{1}{3}$ horse-power. If the meanings of these terms are remembered, the estimating of the power of a dynamo or battery will not be difficult. To find the number of watts of power a dynamo supplies, multiply the number of amperes of current by the number of volts at which the current is driven.

Previous mention has been made of the necessity of having a complete or closed electric circuit in order to maintain a steady electric current, such circuits consisting of two essentially distinct parts. In one part, as illustrated by the electric light mains along the streets, the potential constantly decreases as the energy is converted into heat, light, or mechanical power; in the other, illustrated by the dynamo, the electricity is raised from a low to a high potential, to maintain the power available in the circuit. The electrical transmission of energy is somewhat analogous to an endless driving belt running on two pulleys. The driving pulley corresponding to the dynamo gives energy to the belt, corresponding to the wire circuit which conveys it to the driven pulley, corresponding to the electric light or motor. The backward pull of the driven pulley also illustrates the counter electromotive force (C. E. M. F.) of a running motor, the rotation of the armature generating an opposing current to that which excites it.

When by means of an electrical machine such as a dynamo, one form of energy is transformed to another form, there is always some loss. Besides the losses due to mechanical causes, such as friction, there is an electrical loss due to resistance, heat being produced even when this is not the form of electrical energy wanted. The useful energy is consequently less than the amount of energy used up to produce it. The value of an electrical machine for converting one form of energy into another depends, therefore, upon the proportion of useful energy produced to the amount used up in the process, this being known as the "efficiency."

We are all more or less familiar, at least in a general way, with those forms of electrical machines known as the dynamo and motor. The former converts mechanical energy into electrical energy, and the latter converts electrical energy into mechanical energy. Both are forms of electro-magnetic machines; that is, a magnetic field and an electric current are characteristics of both. As they exist to-day, they may be considered as especially efficient machines for the conversion of energy.

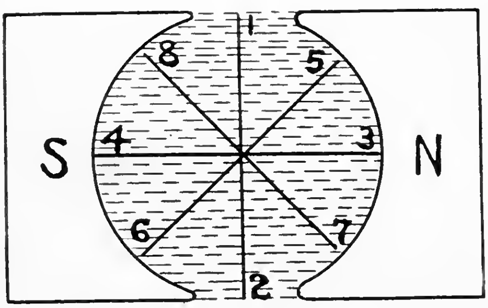


Fig. 25.

The causes which operate to produce an electric current from a dynamo will first be considered. The power of attraction and repulsion of some forms of electro-magnets has already been considered. The space surrounding such magnets in which this influence is active is known as the magnetic field, which is made up of magnetic lines of force. These lines of force emanate from the positive or north pole, towards the negative or south pole, as illustrated in Fig. 25, which shows the magnet field of a dynamo. These lines of force never cross each other, but tend to follow the shortest path from the positive to the negative pole, each line repelling every other line, and tending to get as far away as possible.

The operation of a dynamo depends upon the principle that an electric conductor, if moved in a magnetic field so that it cuts a constantly varying number of lines of force, will induce an electric current, provided there is a closed circuit through which it may flow. This current is proportional to the rate at which these lines of force are cut, which in turn depends upon the density of the magnetic field, the area of the conductor and the speed with which the conductor moves. In Fig. 25 this is illustrated in a general way. The space between the north and south poles of an electro-magnet forms the magnetic field filled with the lines of force. The armature is represented by a single coil of wire in four positions, which, as it revolves, successively cuts the lines of force, thus inducing a current. The direction and strength of the current constantly changes as the coil revolves, and this we will now consider. Assuming that the movement begins with the coil in the position 1–2, it will be seen that to reach the position 3–4 it cuts an increasing number of lines, and then a decreasing number in reaching the position 2–1. During this movement the current increases to its maximum and then decreases to nothing. Continuing the movement until the coil again reaches the position 1–2, the current increases and diminishes as before, but is in the reverse direction. To obviate this fluctuation in the strength and direction of the current the armature of a dynamo is made up of many coils of wire, the terminals of which are so arranged that a continuous current in one direction is secured. How this is done will be considered in the next chapter.

Lampblack, which for hundreds and hundreds of years has been the chief ingredient in dark pigments, may perhaps be eventually displaced by acetylene-black. The chief merit of the new substance lies in its freedom from grease, and therefore in its more ready manipulation. It is said that acetylene-black is admirably adapted for the uses of the manufacture of printing inks. The high cost of acetylene-black is the only obstacle that bars its general introduction. A field is therefore opened to inventors in devising a method of producing the substance cheaply in large quantities.

A Marconi wireless telegraph station is to be established at Sagaponack, L. I., and will probably be the central station of the United States.

A factory is to be started in Philadelphia for making cloth, resembling silk, from wood pulp.

AN EASILY MADE WARDROBE.

S. Vokes.

To make this piece of furniture get the following material, all whitewood:

2 boards	1′ 3″	wide	7′ long	and	$\frac{7}{8}$″ thick.
2 "	1′	"	8′ "	"	$\frac{7}{8}$″ "
2 "	10″	"	8′ "	"	$\frac{7}{8}$″ "
16 "	6″	"	7′ "	"	$\frac{1}{2}$″ "

the latter being matched for sheathing the back. Also 88′ of $\frac{7}{8}$″ molding and 8′ of 3″ molding for cornice.

the remaining board (now 9″ wide), and cut two strips $2\frac{1}{2}$″ wide, leaving 4″ strips. Plane up the edges of three of the 3″ strips, the 4″ one, and two 3″ short strips 8″ long. Then fit them all in their places, which can easily be determined by referring to A, Fig. 2. The 4″ piece is fitted 1′ 2″ from the top, and forms a rail for clothes-hooks, and is continued on the sides to form ledges for shelf to rest on. The two $2\frac{1}{2}$″ pieces are used

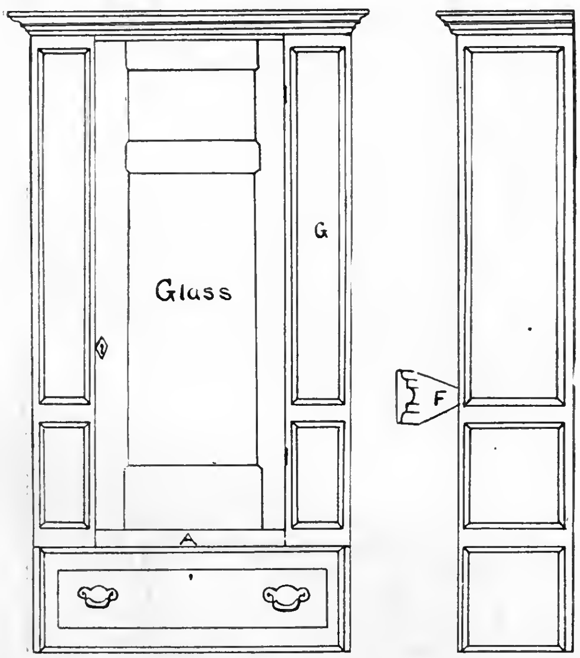


Fig. 1.

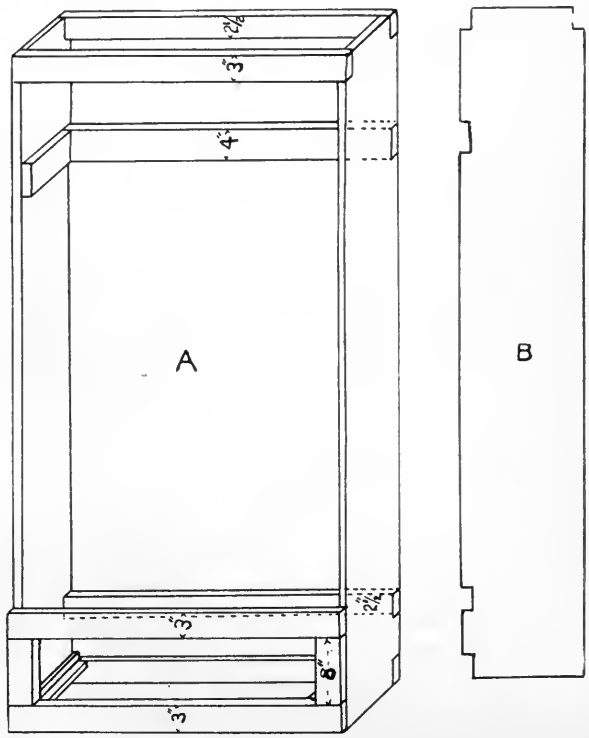


Fig. 2.

Take the boards 1′ 3″ wide and cut them as shown in B, Fig. 2. To do this and so as to get them both alike, I screwed them together with a screw at top and bottom, planed the edges, marked the places for the saw-cuts, and cut out the mortises before taking the boards apart. Then take the 12″ boards and cut strips 3″ wide the whole length. Cut these strips into lengths of 3′ 6″, making four of them. Cut 3′ 6″ off one end of

in the back. At this stage be sure to get everything square, or you will have trouble later on. Now put in ledges for the drawer to run on, and the wardrobe will look like A, Fig. 2.

You can now put in the floor, which is cut from the $\frac{1}{2}$″ match board, and should be put in so as just to clear the top of the drawer. The shelf can then be fitted, and top and back nailed on; all of which are of the ½″ match boards. Take the remainder of the 12″ board and cut two pieces 8½″ wide by 5′ 10″ long, and fit them to the front to form the doorway (G, Fig. 1). The best way to do this is to cut them about 8⅝″ in width and nail them in place, using small-headed wire nails for this purpose. Leave an opening for the door 2′ 1″ in width, and what projects over the sides can easily be planed off when finishing up the work, making a smooth joint.

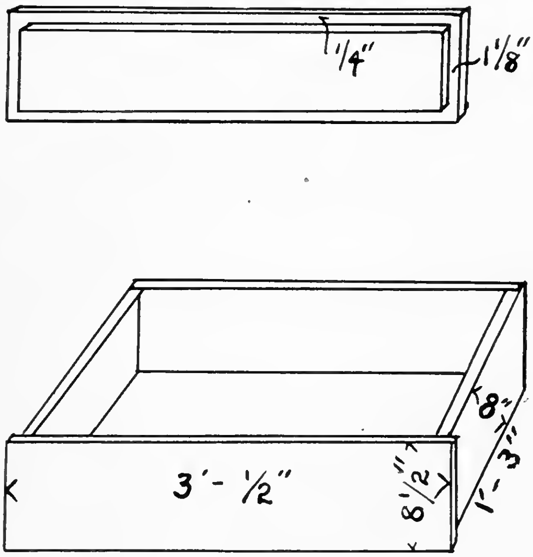


Fig. 3.

The drawer is now to be made. It is 3′ long, 1′ 3″ wide and 8″ in depth outside. For the front, take a piece 3′ ½″ long by 8½″ wide, which has to be rabbeted ¼″ on the top inside edge to the depth of 7/16″, bottom edge ⅞″, and ends ⅛″, all to the same depth. (See Fig. 3.) Then take the two side pieces 1′ 3″ by 8″ and rabbet the inside bottom edges to take the bottom board, and rabbet the back ends to take the back board (Fig. 3), which like the bottom of the frame, is ½″ match boards. The drawer should be put together temporarily, and fitted so as to slide easily before being glued up. When correctly fitted, glue and nail together.

To make the door, saw two strips 4″ wide by 6′ long, two 4″ x 2′ 2″ and one 8″ x 2′ 2″; rabbet the two long strips, one 4″ short strip and the 8″ short strip on one edge, and the other short strip on both edges, ½″ wide and 7/16″ in depth. Mark the long strips slightly longer than the length you want your door to be, and the short strips slightly longer than the width of your door, so as to allow for fitting, then mark and cut your tenons and mortises as in Fig. 4, which is drawn to scale.

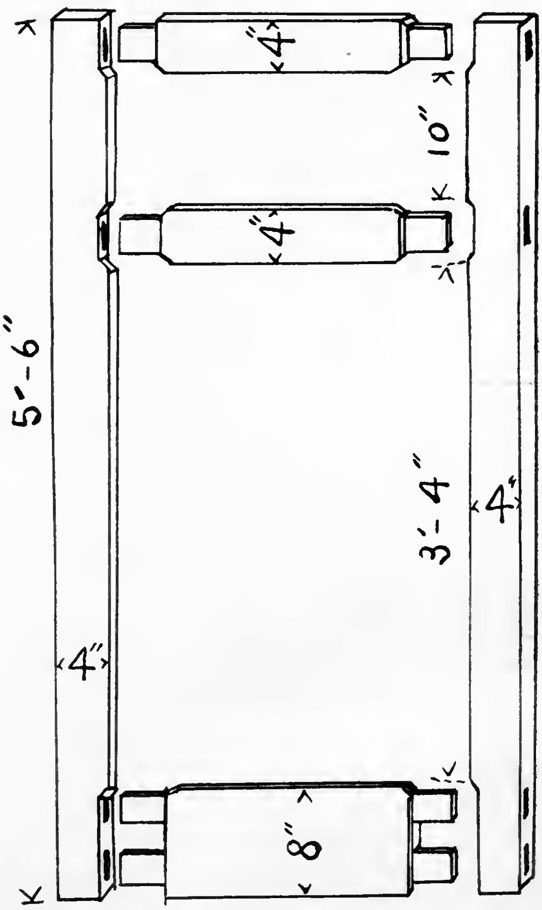


Fig. 4.

The best way to cut your mortises is to mark them and then bore them out with a brace and bit, boring half way through from each side, so as to get them quite square and true. To mark the cross-pieces, I centered them and marked 9″ each side of the center line. This gave me my inside measurement for mirror. Now glue up your door and fit and hang it. Then fit cornice and molding on front and sides, as shown in Fig. 1.

F is the pattern of a small molding which will give a very neat and finished appearance, but any similar pattern may be used. Now fit your mirror 3′ 4″ x 1′ 6″, put in wood or glass panel at top of door, fit your locks and handles, and the wardrobe is ready for staining. I stained mine walnut, for which take burnt umber — ½ pound will be plenty; thin it down considerably with turps. Try it on a piece of the waste wood till you get the proper color. The stain can be put on with a brush and rubbed off again with a rag, or it can even be put on with a rag. If properly done it makes a very pretty stain, only be sure to get it thin enough. The nail-holes have now to be puttied up with putty stained with burnt umber, to the same color as the wood. Then give two coats of varnish, and the work is finished.

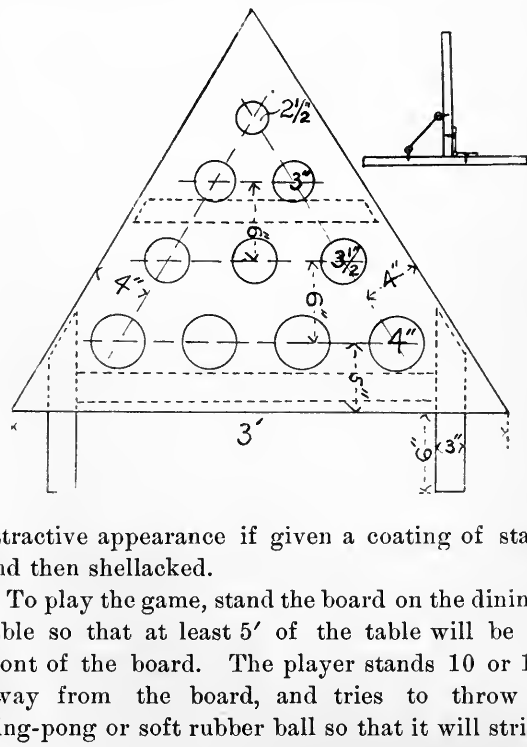
PYRAMID — A NEW GAME.

How to Make and Play It.

Frank N. Wilson.

This game is designed to afford amusement in the limited space of a dining-room, the dining-table being used as part of the equipment. The illustration will show the general design of the board. The wood used should be about ½″ thick, the sides of a shoe packing-case serving nicely for the purpose, provided the joints are even and well closed up. Spare parts of the box are used to make the necessary cleats and supports. The board is in the form of a triangle, the base being 3′ and the height 2½′. To lay out the location for the holes, lightly draw a line parallel with the base and 5″ above it, a second line being drawn 6″ above the first one and a third line 6″ above the second. On each side, 4″ from the edge, draw lines, the top hole being placed where they meet.

The lower row of holes are 4″ in diameter and the centers 7″ apart, the second row 3½″ in diameter and 7″ apart, the third row 3″ in diameter and the centers are where the side and the cross-lines meet. The top hole is 2½″ in diameter. The holes are most easily cut out with a key-hole saw, a hole being bored with a bit, from which to start sawing. Cleats are screwed to the back, under the lower and third row of holes. Upright supports 1′ long and 3″ wide are screwed to the back so that 6″ will project below the bottom. A strip of wood 1′ long and 3″ wide is attached to the bottom of each support with a hinge on the rear side, so that when not in use they may be folded, thus requiring less room for the board. A large hook is screwed into each of the supports and the eyes to the bottom piece, to hold the board upright when playing. Back of each hole may be fastened a cigar-box with the upper side removed to catch the balls entering the holes, or a single large box may be placed under the lower row and a piece of cloth tacked into a framework of wood fastened 3″ back of the board to pieces of wood nailed to the cleats. The board will have a more



attractive appearance if given a coating of stain and then shellacked.

To play the game, stand the board on the dining-table so that at least 5′ of the table will be in front of the board. The player stands 10 or 12′ away from the board, and tries to throw a ping-pong or soft rubber ball so that it will strike upon the table and rebound into one of the holes. Five or six balls are thrown by one player, and the next one then tries it. Each ball entering one of the holes in the lower row counts 5; the second row 10; the third row 15, and the top hole 20; the player with the highest total winning. This game may seem rather simple, but a trial will show that it can be made decidedly interesting for young people when they are confined to the house by inclement weather.

AMATEUR WORK

63 KILBY ST., BOSTON

F. A. DRAPER . . . . Publisher

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

JULY, 1902

Contents

THE June issue of this magazine, by an unfortunate mistake, was printed upon the wrong kind of paper. A reprint has been made upon the regular paper. Any of our readers who contemplate binding the magazine when the volume is completed, may obtain a correct copy free by mailing us the old one, with name and address written upon the cover, so as to identify the sender.

THIS magazine will have an exhibit at the forthcoming exhibition of the Massachusetts Charitable Mechanics Association, opening Sept. 22 next. To add to the interest, and show the general public what AMATEUR WORK readers are capable of doing, those interested in this magazine are invited to send for exhibition suitable objects which they have constructed, and which would be suitable for this exhibit. Before doing so, however, it will be advisable to communicate with the editor, sending particulars, and a photograph, if possible, to avoid duplication or overcrowding. Applications for space have been so general that the exhibition promises to be one of the best held for many years. All readers of this magazine who may visit it should not fail to see what AMATEUR WORK will present.

THE regular chapters on Mechanical Drawing will be omitted in this and the next number, as the subject is not one of general interest during the summer months. In the September number the first chapter of the series on Projection will be given. The chapters previously given have been of much interest to many of our readers. All those who desire to become proficient in mechanics should follow these studies as they appear, and will find themselves well repaid for so doing.

A NEW device for taking soundings will be used in determining the route of the projected Pacific cable. It consists of a large iron cylinder, topped by a cone and containing air. It is hermetically sealed, except when the cylinder is immersed. Then water flowing into the cylinder and through a tube has access to the cone containing the air. Working on the principle of hydraulics and gravitation it is possible to drop the cylinder to a reasonable depth, and the pressure is indicated on a dial attached to the cone. When the cylinder is drawn up, by taking the pressure and the depth and making the proper computations, the total depth of the sea at that point is determined.

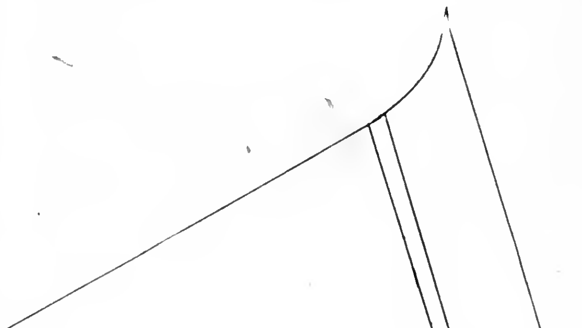
A HOME-MADE GRAMAPHONE.

R. A. Warner.

The object of this article is to tell how the writer constructed, from material costing less than one dollar, a talking-machine, using the disc records, with which many a pleasant evening has been spent. It is of such simple construction that our youngest readers can build one like it. It consists principally of four parts: the motor, the sound-box, sound-box holder and regulator, each of which will be briefly but fully described.

First, make from ½″ pine a box 10″ x 12″ outside measurement and 3″ deep. This is to be fastened to a base having a molded edge, by screws driven from the under side and countersunk. (See A, Fig. 1.) Cut a notch 3″ from corner 2, Fig. 2, 1″ wide, ¾″ deep. A cover is now to be made that fits inside the box and rests on four posts 2½″ long and ¼″ square, glued in each corner. (See A, Fig. 1.)

With cover in place, but not fastened, lay out a center line, and also 5″ from corners 2 and 4, the line bisecting it. At the intersections of these lines (B, Fig. 2,) bore a hole in which a smooth, straight lead pencil will turn easily. Lay off a diagonal from 1 to 4, and 1″ from corner 1 make a similar hole.



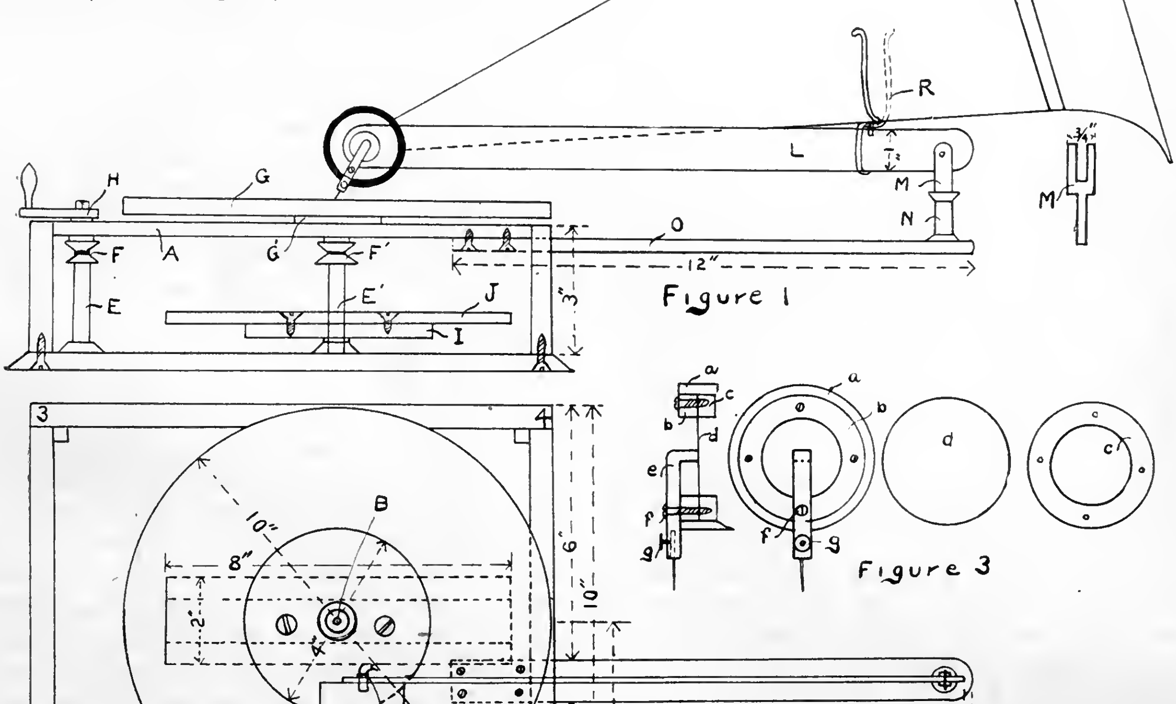


Figure 1

Figure 3

Figure 2

Directly under these holes on the bottom of the box fasten the flaring ends cut from a spool (D, D′, Fig. 1). These must be reamed out with a round file, so the lead pencil will turn without binding. Cut two pieces of a very hard round lead pencil (E and E′, Fig. 2,) 4″ and 4½″ long, respectively; the lower ends should be bluntly pointed, to reduce the friction, and one end of the 4″ length being squared to receive the crank (H, Fig. 1).

Procure two large spools such as linen thread is wound on, or a large spool of any kind, the size being immaterial, the holes in the spools being a tight fit for the lead-pencil shafts; fasten them so the tops will be ⅛″ below the cover, as shown at F, F′, Fig. 1. Loose wooden washers made from sections of a spool should be put between the spools and cover, to prevent the shaft from jumping out of the bearings in the bottom of the box. Cut grooves with a round file on the spools for the belt to run in. Take a thoroughly seasoned piece of hardwood ½″ thick and cut a disc 10″ in diameter (G, Fig. 1,) and a smaller disc of ¼″ wood 4″ in diameter; fasten the latter to under side of G, and carefully bore a hole through both pieces to tightly fit shaft E′, so the disc G will turn as true as possible. A cardboard washer may be put under this to reduce friction. Cover the top of disc with felt or baize, to provide a friction hold for the record disc. Make a small wooden crank (H, Fig. 1,) which will clear the disc G, and fasten to the squared end of shaft E. The regulator, I–J, consists of a wooden disc (I, Fig. 1,) ⅜″ thick, 4″ in diameter, to which should be fastened, with two screws, a strip of iron (J, Fig. 1,) ¼″ thick, 2″ wide, 8″ long, a hole being bored in the center for the shaft. Fasten as shown at E′, Fig. 1, with a washer under the disc. Connect the spools with a belt,— a leather shoestring makes an excellent one,— and the motor is complete.

Now comes the sound-box (Fig. 1), on the construction of which will depend the clearness and volume of the tones produced. It must be remembered that to secure the best results all parts must be constructed so as not to jar or rattle, and this applies particularly to the sound-box. Fig. 3 shows detail of parts. Procure from a druggist a round wooden pill-box 2″ in diameter and 1″ or more deep. (See a, Fig. 3.) b and c are two wooden rings ⅜″ thick, made to fit the inside of the box a; these may be cut out with a knife or fret-saw. d is an isinglass diaphragm, the same size as the rings. This should be placed between the rings and all fastened with three fine screws (the fourth screw also holds the needle-holder in place). The thickness of the isinglass is best ascertained by experimenting until the best results are obtained. The diaphragm should now be glued securely in the box a, with the outside ring flush with the edge of the box. e is a piece of steel bent or filed to shape as shown, and should have a hole bored at f for a long, slender screw, that binds both rings together. A $\frac{1}{16}$″ hole should be bored in the end ⅜″ deep; a small thumbscrew at g holds the needle in place. This part of the apparatus can be made up by a jeweller at small cost, if the reader has not the necessary equipment for making it. The end that rests against the diaphragm should be smooth and rest flat, being kept in contact by melting a little sealing-wax and pouring around it. Get two short gas-pipe nipples and a ¼″ elbow, and fasten by screwing into the bottom of box a, in hole previously made. (See O, Fig. 2.) This completes the sound-box.

Take a piece of hard wood (L, Fig. 1,) 1″ wide, ¼″ thick and 14″ long, and bore a hole in one end, fastening to the sound-box by screwing nipple through it to sound-box. (See L, Fig. 1.) Make another piece ¼″ thick, 1″ wide and 12″ long (see O, Fig. 1), on one end of which fasten another spool, N, by nailing up through strip into spool Make a fork, M, as shown in Fig 1. This should be connected to arm L, and should turn easily in spool N. The height of the spool and fork should be such as to cause the arm L to rest parallel with disc G. This completes the machine; but before fastening, it should be adjusted. Turn the sound-box so the needle slants about the angle shown in Fig. 1. The arm O should now be pushed forward or backward in notch until the needle-point rests on a line with B on disc G, and the two arms L and O are in line with each other. (See Fig. 2.) The arm O may now be screwed to under side of cover. The records come in two sizes: 7″ at 50 cents each, 10″ at $1.00; the 10″ record producing much the louder tones and longer pieces. Also get a package of needle-points: 100 for 10 cents. A horn may be made of heavy paper, or a metal one can be bought for 50 cents to $1.00. It should be fastened securely to the nipple and be supported by wire, R, attached to the arm L, resting under the horn. To operate, place a record on disc G, swing the sound-box by the arm L, so the needle-point rests on the outside edge of the record; then turn the crank, and if you have followed these directions you will be well repaid for the time and trouble you have used.

The description of this machine has intentionally been as simple as a cheaply made machine will allow, and outside of the cost of the records should be built for less than one dollar for materials. After the success of the machine has been assured another may be constructed as elaborately as the builder may wish. Made with hardwood and metal parts, it will compare favorably with a machine of many times its cost. If several are made in one neighborhood, records may be exchanged, thus getting a variety of pieces at little cost.

HOW TO BUILD A SHOP FAN.

Charles Herrman.

Wherever there is shafting running, thus supplying a source of power, and the summer heat is felt, thus calling for an artificial breeze, there is room for the ingenuity of the amateur worker in the making and the driving of a fan. The one here described can easily be made, costs very little, and once properly assembled and put up, will last for years, with only an occasional oiling. One of the foremost machine shops in the world has over one hundred of them, and considers them unbeatable for their cost.

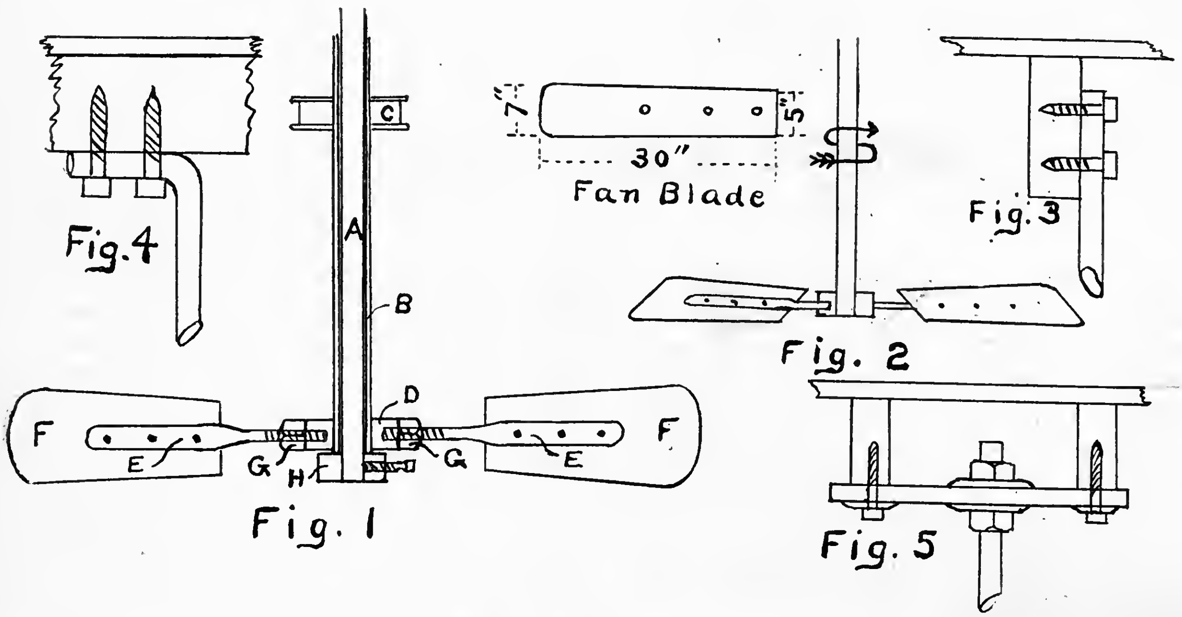
The fan completely assembled is shown in Fig. 1, partly in cross-section, to simplify explanation. A is a piece of 1″ shafting of the proper length; B is a piece of 1″ pipe of suitable length (it must be remembered that piping is measured by the internal diameter). C is a split wooden pulley (preferably flanged, though this is not absolutely necessary), which when drawn tightly together takes firm hold of pipe B. D is a wrought or cast iron collar, held securely at the bottom of pipe B by means of a set screw, and has two $\frac{5}{8}$″ holes tapped through it (diametrically opposite) for the wings or fan blades to screw into. E E are two $\frac{5}{8}$″ rods or shafts, threaded for $1\frac{1}{2}$″ of their length at one end, so as to enable their being screwed into collar D, the rest of the length being flattened (either filed, shaped, or, best of all, blacksmith-hammered), to allow of a flat contact with sheet iron blades F, to which they are joined by rivets or screws through three holes drilled in E. The two lock nuts G G are carried on the rods E E, which, though allowing of any angular adjustment of the blades when firmly jammed against the collar D, lock the wings securely in place and keep them from working loose. H is a 1″ wrought or cast iron collar, held by a set screw at the bottom of shaft A, which serves to keep the whole fan arrangement — which revolves around the shaft A and upon itself — from falling down.

The bottom of the fan should be at least 7′ from the floor, so as to allow of the safe passage of a tall person. With the blades as set and the shaft turning as shown in Fig. 2, a downward current is had. If the shaft motion be reversed, be sure to reverse the angle of your fan blades, or you will only be fanning the ceiling. When erecting the fan the shaft A must go up first. Be sure to have it plumb *both* ways, or the belt will run poorly or not at all.

Figs. 3, 4 and 5 show three ways of fastening to the ceiling. In Fig. 3 it is fastened to one of the ceiling-supporting rafters by two lag screws or bolts running through the timber. The shaft need not be flattened where it comes in contact with the rafter or where the bolt-head touches it. It will hold the more firmly if not weakened by filing. Fig. 4 is self-explanatory, lag screws being used to hold the shaft to the timber.

In Fig. 5 the shaft is threaded sufficiently to allow two 1″ nuts (with washers if a wooden plate, or without them if an iron plate is used) to be placed one above and one below the plate, to lock the shaft into position. To bring the shaft plumb both ways in this case the plate must be shimmed level both ways.

Assuming that we have got our fan up and plumbed (we have, of course, placed it in such relation to the driving shaft as will give us a clear space on the driving shaft for the driving pulley), it is now necessary to drive it at between 200 and 250 revolutions per minute (R. P. M.). Our main shaft runs, we will say, 125 R. P. M. Pulley C of the fan is 4″ diameter; then our main shaft pulley must be an 8″ diameter to give the necessary speed to the fan. This pulley should be a split wooden, and preferably flanged, though it may be iron and unflanged; if the latter, it must be crowned.



A WEALTHY Russian died not long ago and his heirs could find no will. One day a young man seeing a graphophone in the library, put into it what he supposed to be the record of a song. The words which came forth were those of the missing will in the dead man's voice. The will thus curiously recorded has been submitted to the courts.

GENERAL FUNSTON says that there is no war in the Philippines; it is true that murders are of frequent occurrence; that assassins lurk in ambush and shoot down their victims passing by; but there is no war, no more than there is war in Kentucky.

WANTED.— Something besides spruce and white pine wood pulp from which cheap paper can be manufactured. These sources of supply are so rapidly becoming exhausted as to threaten the existence of the one-cent daily newspaper and other large consumers.

At present, as one manufacturer said, "paper is made from nearly every old thing." Linen and cotton rags and waste flax make the best. Old grass ropes, coffee sacks, banana peels, waste wheat and oat straw, hemp fiber, and in fact nearly everything that is thrown away, are used in its manufacture, but still the source is not equal to the demand. Experiments are now being made with all kinds of grasses, bamboo fiber, banana stalks, dis grass from the north coast of Africa, leaves of the dwarf palm, sugar-cane bagasse, hop plant, ramie, agave, nettles, sea grass, etc., and some promise well of success.

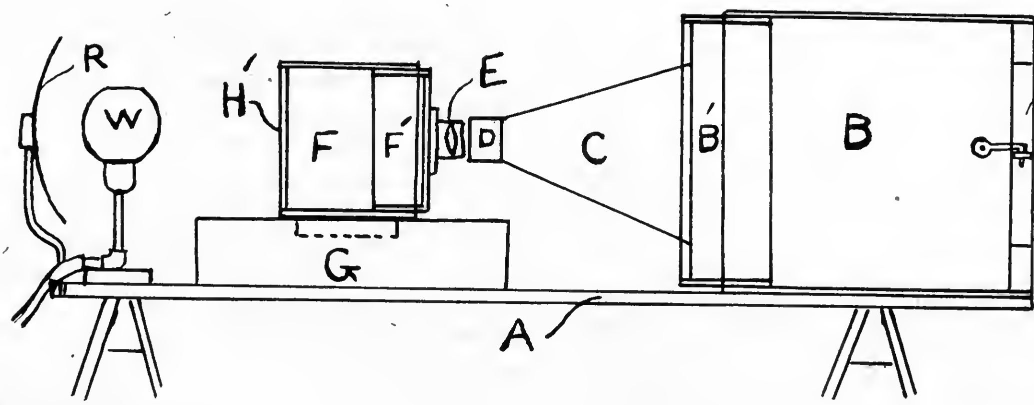
Says the *Southern Industrial Review*: "A material which nature may renew yearly must be discovered and adapted to the trade, and the most natural sources must be sought in the field of agriculture or among the fibers and grasses which have annual growth."

SIXTY new storm-warning towers, equipped with the latest improved lanterns, have been installed at the Great Lakes by the U. S. Weather Bureau.

PHOTOGRAPHY.

A Home-made Enlarging Apparatus.

The amateur photographer, with a 4 x 3 camera, who has reached the ability to make good negatives, usually has a growing desire to make enlargements. The cost of an enlarging apparatus is often more than many care to expend on what to them is but a pastime. Those who are in this predicament may find this description of an enlarging apparatus a solution to their difficulties. It is easily made by anyone possessing a little skill, and possesses about all the desirable features of an expensive outfit. Various sizes of enlargements can be made, as the focus can be easily adjusted. The sizes here given can be modified to suit the necessities of any size of plate or enlargement.



A well-seasoned baseboard, A, 5′ long and 12 to 15″ wide is the first requirement. Two wooden horses similar to those used by draughtsmen are very handy, but a table may be used for the work if it is not convenient to have the horses. Procure from your grocer two packing-cases in good condition, made of thin planed wood. Those used for shipping cereals are just the thing. Make a square box, B, without ends, 18″ square inside and the same in length. Reinforce the ends by cleats 1″ wide around it, nailing with short brads from the inside. Make another box, B′, which will snugly fit the inside of the first one, but only 6″ long, with a front made of wood ½″ thick. Before fastening in the front, cut with a fret or key-hole saw a circle large enough to receive the large end of a cheap pasteboard megaphone, C, which forms a cone-shaped connection with the lens. This can easily be made of pasteboard if desired, by gluing several layers of flexible pasteboard together, and finishing with a coating of leatherette or paper, to be obtained of any bookbinder. The cone should be well fastened to the wooden front of the box B′ with upholstering tacks, and should be lined and all cracks covered with dull black paper.

The interior of each of the boxes should also be covered with black paper to prevent the reflection of light, which would injure the quality of the enlargements.

The front end of the cone may be fitted with a tin tube made from a spice-box of suitable size to fit the lens, E. This can be omitted and a thick pasteboard end with a hole in it for the lens, used, if no great amount of work is to be done.

If the camera has not a removable back, two additional boxes, F and F′, are required. These are made in exactly the same way as were the boxes B and B′. The box F should be 9″ square inside and 8″ long, the box F′, which is 3″ long, fitting it snugly. One end of the box F′ is made of wood ¼″ thick with a hole in the center for the lens. The lens, when used for enlarging, is removed from the camera and attached directly over this hole. A camera with removable back, and a bellows, may be used in place of these boxes. Two boards, G, 20″ long, ¾″ thick and of the necessary height to bring the box F to the position so the lens will exactly meet the mouth of the cone, are nailed to a bottom board 6″ wide. If the boxes are made on the under side of the box F, nail from the inside two ½″ square strips of wood, so that they will be parallel with the pieces G, and keep the box F centered and in position when focusing.

For the outside end of the box B make a shallow box, H, like a single plate-holder, or a large plate-holder may be purchased and the dividing partition removed, in one side placing a ground glass, for focusing, and when ready to make the enlargement, placing the paper in the other. If a holder is made the ground glass should be separately mounted in a wooden frame, both holder and ground glass being kept in position by brass hooks on the sides and top of the box B and eyes in the holder and frame. For holding the negative a plate-holder with the partition taken out will serve nicely, having the advantage of allowing the light to be shut off at any time with the slide. It is fastened to the box F with hooks and eyes.

If enlarging is to be done at night and gas is available, a Welsbach burner, W, with thin ground-glass globe, apple shape, is excellent, but must be moved carefully to avoid breaking the mantle. If a low wall-bracket is to be had, the apparatus can be placed at a suitable height for using it. If not, have a gasfitter connect two short lengths of ½″ pipe to an ell, one end connecting with a hose supply pipe and the other having a nipple, on which is placed the burner. The center of the burner should be exactly in the center of the negative and about 10″ away from it. A 10″ or 12″ glass reflector, R, is mounted on an iron rod, the lower end being bent so as to fit a hole bored in the end of the baseboard A. If enlarging is by daylight, fit a small mirror in place of the lamp, so that it may be adjusted to reflect the light squarely on to the negative. The position has to be changed at intervals as the sun moves towards the west.

In operating, place the negative and ground glass in position, adjust the position of the boxes until a clear image of the required size is shown on the ground glass. Remove the ground glass, and place in position the holder containing the print paper, the holder being filled in the dark-room. Give the necessary exposure, previously determined by exposing small strips of paper until the right interval has been ascertained. A little practice will soon enable one to produce very satisfactory enlargements.

PICTURE PHOTOGRAPHY.

To many beginners in photography there eventually comes a time when a sufficient number of negatives of friends, the interior and exterior of the home, the cat, dog and other household pets, etc., have been accumulated, and the mind craves for work in a field which has less of the personal and more of the artistic character. This impulse is often quickened by some print in a window, or reproduction of a beautiful landscape, or shore scene in a photographic or other magazine, and fills one with a desire to produce similar work. This is not so much due to a wish to be an expert in photography as it is a craving for the artistically perfect, the presentation in the finished print of a view with character and sentiment possessing an intrinsic charm over which we delight to linger and return to with pleasure.

Before we can attain this degree of skill, however, we must learn enough of the processes by which these results are accomplished, to intelligently plan our work, and then be able to follow the plans so that guesswork and chance are eliminated as far as possible.

A proper equipment is the first essential. This does not necessarily mean that it shall be very expensive, but does rule out the so-called fixed-focus cameras, many of which are made mostly for selling purposes. A well-made camera, capable of taking at least a 5 x 7 plate (6½ x 8½ is better), equipped with a good rapid rectilinear lens, reversible swing back, adjustable front, rack and pinion-focusing movement, and a well-made leather extension bellows, are all necessary features. A strong, rigid tripod, ray screen and extra plate-holders should also be included, together with various other devices required for special occasions.

Assuming that practice has made familiar the uses of all these fixtures of the camera, and that the holders contain the plates best adapted to the work in hand, we start afield. It should not be an aimless trip, with the expectation that the right view will be found about the time the load becomes so heavy that a rest seems desirable. Quite the contrary. Not only should the objective point of our excursion be previously determined, but the kind of day and the time be carefully considered, so that all the conditions of light and shade will be appropriate to the scene. A well-known artist photographer, whose prints enjoy a world-wide reputation, told once in an interview of a trip during which he waited over two weeks for just the right conjunction of the elements, that he might secure the effect he desired. How many of us have developed the patience and discernment this implies; and yet the results are well worth it. This example also illustrates the necessity of making a careful study of the "make-up" of the scene, usually expressed as the "composition" when applied to pictures. This can perhaps be better understood if we assume that instead of taking a photograph, a water-color or crayon was to be made. Before commencing work careful study would be made of the scene from several viewpoints; the direction of the light, the location of trees, shrubbery, rocks or water would all be carefully noted. The slope of the land, the line of a fence or wall, the angles of a building, and the position of a road or path are all to be selected so that the grouping will be harmonious and well balanced.

The subject of "composition" has been repeatedly written up, and in the minds of some writers is subject to many rules and more exceptions. To the amateur who pursues photography as a pleasure, the reading of a treatise on this subject would be likely to leave only a confused jumble of ideas, far from helpful. After some experience and a study of results, such works can be taken up with profit. One of the best methods for the beginner is the making of three or four negatives of some attractive scene, from as many different positions, and then making a comparative study, that the strong and weak points may be clearly discerned and utilized for future guidance. Also to study the grouping, both as a whole and in part, of photographs by artists of note, which seem attractive. Many a photograph is improved by a judicious trimming of a part. A very common fault with beginners is their desire to include too much in a view. More strength and character is to be found in a picture in which the motif is a single feature, and all the rest a suitable setting or support for it. To summarize: study your own work, and as much as possible the work of those artists which most nearly appeals to your own tastes.

Do not try to find pleasure in work which to you seems unnatural or contrary to your own temperament. We all have our individual peculiarities, and should try to develop them along correct lines. Any attempt to work counter to our natural disposition will but delay, and perhaps destroy, a full development of the artistic side of our nature. Let our work be true, and represent as nearly as possible our best ideals; only in this way will we achieve results that will accord with our highest capability.

Directions for making luminous photographs, published originally in a German paper, are thus translated in *Popular Science News:* "It is done by means of calcium sulphide, otherwise luminous paint. A sheet of transparent celluloid is coated with an emulsion of nine parts of gelatin, one of potassium bichromate, five of calcium sulphide, and one hundred of water. The gelatin is soaked in the water and melted in a water-bath, the other ingredients being added afterward. When the coated film is thoroughly dry it may be printed upon from a positive through the celluloid film. This precaution is necessary to prevent the image washing off during development, which is done by hot water, as in the case of a carbon positive. Backed up by black velvet or paper the print will appear as an ordinary black-and-white positive by daylight, to which it should be freely exposed, and will be self-luminous in the dark."

An electric railway was built on the ice across the river Neva at St. Petersburg, Russia, last winter, and cars crossed in safety for several months. There are few bridges at this point, says the *Tramway World* of London, and the ice railway did a big business. The river is nearly a mile wide at this point. The trolley poles were set by chopping holes 18 inches deep in the thick ice, and pouring in water around the frames. When the water froze the poles were as firm as if set in the earth.

MAKING HAMMOCKS.

E. H. Perkins.

I. A NET HAMMOCK.

In making a hammock, a little practice in tying the knots is advisable as the first step. The peculiar yank which brings it to the desired position, and also pulls it taut, is soon gained by a little practice. It is best, therefore, to make trial meshes until they can be made evenly and the knot properly tied on the top of the mesh-stick. Make the knot slowly at first, until both speed and exactness are possible.

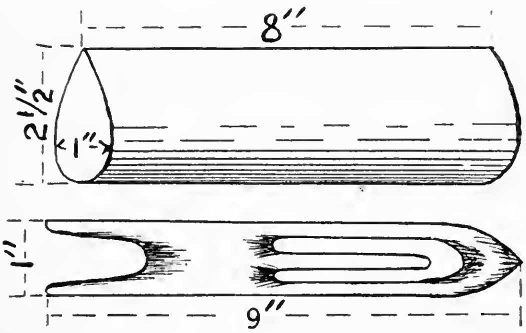


Fig. 1.

The materials required for a hammock the bed of which is 8′ long, will be two balls of No. 16 soft finished cotton cord, two iron rings 3″ in diameter, a hardwood mesh-stick and a netting needle. The mesh-stick is preferably of the shape shown in the illustration, but may be round or flat, and should be 8″ long and 2½″ wide to make an average-sized mesh. It must be held under the palm of the left hand in such a way that the thumb and forefinger are free to guide the knot.

The needle is 9″ long, 1″ wide and ⅛″ thick. After cutting it out with a fret-saw or knife, it must be smoothed with sandpaper, that it may work easily. To wind the needle, pass the twine alternately through the fork and around the tongue and over the shank on either side of the needle, so that the turns of the twine are kept on by the tongue and fork. Fill the needle as full as possible, to prevent too frequent joinings. Hold the needle flat in the palm of the hand, using the forefinger to guide it.

To make the knot shown in Fig. 2 pass the twine from the last formed knot over the front of the mesh-stick and through the mesh above, holding the twine about the mesh-stick firmly with left thumb. Throw a loop of the twine over the stick and left wrist, as shown in Fig. 2, and push needle between 1 and 2, and pull knot tight, as shown. But little study and practice will be necessary in order to get the knot firm and in position on top of the mesh-stick.

To begin the hammock place one ring on a stout hook or anything strong enough to stand the strain of continued pulling, and set up about thirty leaders. Ten more will make a large hammock. In making these leaders, a thin board 3′ long and 5″ wide is held close to the bottom of the ring, and

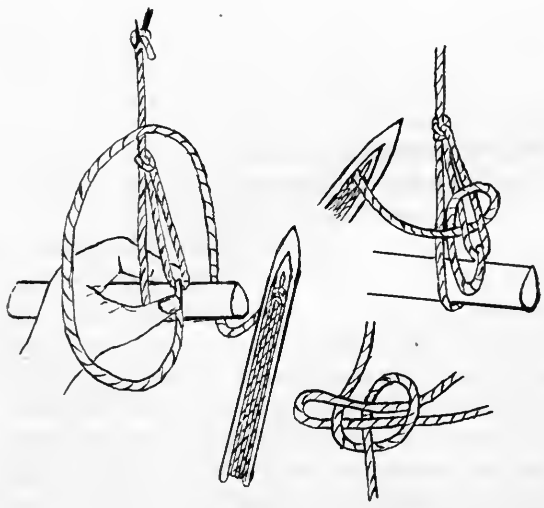


Fig. 2.

presses against the body at the other end. Make the first knot on the ring, then passing the twine around the board make a second knot in the ring, and continue until the forty leaders are made.

To make the body of the hammock, turn the ring over so that the last leader made will be at the left, and with the small mesh-stick in position, pass the cord in front, then back through the first long mesh or leader, making the knot as previously directed. Make as many knots in the corresponding leaders as the mesh-stick will hold; then pull off all but three or four, and go on across the row. In beginning a new row place the top of the mesh-stick at the bottom of the last row, winding the cord from the last loop around the mesh-stick and up into the loop above for the first knot. Make as many rows as desired, and finish the hammock by using the long mesh-board, as in the beginning, to make the leaders of the other end, tying the knots in the second ring.

When the hammock becomes too heavy to handle easily, run a cord through a row of meshes about five rows back and tie to form a loop, hanging it upon the hook. This may be done to advantage several times in making the hammock.

When joining becomes necessary, the weaver's knot is the most desirable to use; but care must be taken to leave ends long enough, that the weight of the body will not pull them out. To still further strengthen these joined places the ends may be wound about the meshes with twine.

A CHEST MACHINE.

M. L. Bell.

The chest machine which I have described may easily be made by any one at a very slight expense. The wooden parts of this machine were made from pine and then varnished; but if preferred, some hard wood might be used, and would make a much nicer looking apparatus.

For the headboard, select a piece of lumber 20″ x 4½″ x ¾″. As a support for the upper ends of the guide rods, take a block 5″ x 1¾″ x 1¾″, and in the middle of one side bore two ¼″ holes 3″ apart. Midway between these holes put an ordinary screw pulley, such as may be bought at any hardware store for about five cents. The diameter of the wheel should not be over 1½″. Secure this block, pulley downward, to the center of the head, and the headpiece is complete. (Fig. 1.)

The support for the lower ends of the rods is made from a block 8″ x 4″ x 1″, in which two ¼″ holes 3″ apart and 1¾″ from the back edge are bored. The rods which guide the weight are made of ¼″ brass curtain rods, and should be long enough to reach from your shoulders to the floor.

Next comes the weight-carrier (Fig. 2). It is made from two boards 5¼″ x 3″ x ½″, in each end of which is cut a socket 1″ x ½″. Two ⅜″ holes, 3″ apart, are put through the centers of both boards, as when finished they are to run up and down on the rods.

In one board, midway between the two holes, is fastened a pulley. These boards are now fastened together by two pieces of hard wood 7″ x 1″ x ½″, these sticks fitting into the sockets in the ends of the boards.

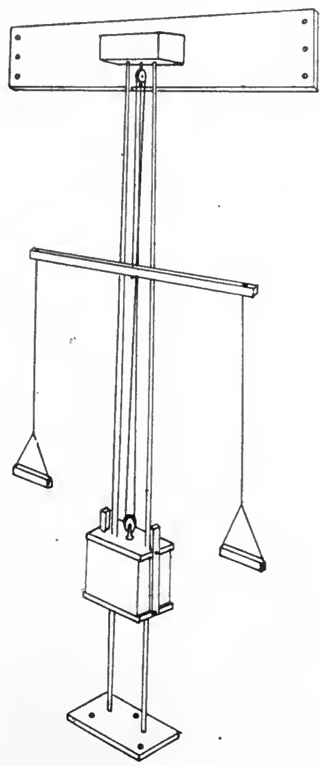


Fig. 1.

As a mold for the weights, I made a box, the inside dimensions of which were 3″ x 5″ and deep enough to hold several pounds of melted lead. At one side of the box I nailed at angles to the side, two pieces of ½″ board so that they extended a little beyond the center of the box. To the middle of the ends I also nailed a strip of wood 1″ x ½″. Both the boards and the strips extended from the top to the bottom of the box. Hot lead was poured into this mold, making a casting as in Fig. 3. If at any time it is desired to add more weight, it can easily be done by simply unfastening the upper board of the carrier and slipping on additional weights. The side pieces of the carrier are to fit into the notches in the ends of the weights and thus prevent their sliding on each other, while the deep notches in the sides allow the weights to be taken off or put on the rods without removing them from the machine.

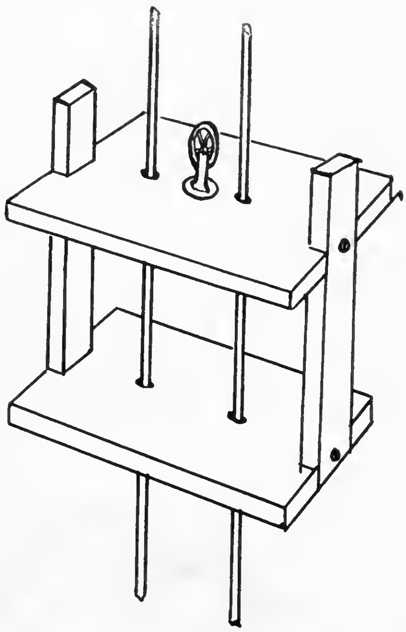


Fig. 2.

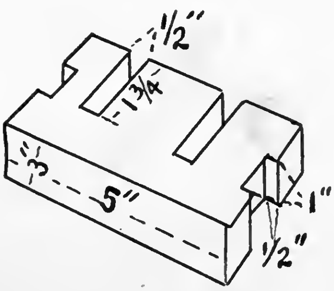


Fig. 3.

The parts are now put together as in Fig. 1. The headboard should be pushed on far enough to prevent the rods working loose, and then both head and foot boards securely fastened to the wall and floor, respectively.

For the rope, take small-sized window-cord, and having fastened one end to the headboard by a screw-eye, pass the other, from the back, through the lower pulley, and in the same direction, through the upper one. Cut off the rope, leaving an end about 8″ long and fasten the end to a wooden bar 17″ x 1″ x 1″ by passing it through a hole in the middle. From Fig. 1 it will be seen that the handles are attached to each end of this bar by ropes about 30″ long. The machine will be found excellent for those who need exercise.

CALCIUM CARBIDE AS AN INSECTICIDE.

For several years past the vineyards in the important wine-growing district of Beaujolais have suffered greatly from the attacks of numerous flying insects, the most important of which is known as the pyralid. Last year a series of experiments was carried out in one of the large vineyards, to see if the insects could be caught by bright lights burning at night. An apparatus was constructed, consisting of an acetylene generator holding about six ounces of calcium carbide. Over this was a circular metal dish about twenty inches in diameter, and over this at a height of about eight inches a single acetylene jet giving a small, bright light at about ten candle-power. This light the carbide was sufficient to keep burning for six or eight hours. In a basin a layer of water was placed, and on top of this a layer of kerosene or some other cheap oil, of which about two fluid ounces were required. These machines were set up about 550 yards apart, and were set in action at dusk, preferably on dark nights. On the first night one lamp caught 4,600 pyralids and 218 moths of other kinds. During July the lamps averaged 3,200 insects per lamp per night. The expense of the lamps is reported to have been two cents per night each, or about two and one-half cents per night per acre. It is said that this method of catching noxious insects is more efficacious than any method which has been tried before.—*Electrical Review.*

Information comes from Cairo, Egypt, of interesting scientific discoveries in the Fayum made by the Egyptian geological expedition. Remains of large vertebrate animals of the lower miocene were found, which indicate the early forms of rhinoceros and elephants. A representative of the geological department of the British Museum has gone to examine the remains.

NEW THEORY OF WIRELESS TELEGRAPHY.

THAT wireless telegraphy depends on disturbances of potential in the earth, regarded as an electrically charged sphere, rather than on Hertzian waves, as is usually supposed, is maintained by Rankin Kennedy. This physicist, says a writer in *The Electrical Review* (May 31), "has been unable to swallow or digest the usual statement that the workings of wireless telegraphy depend upon Hertzian waves, since he has been unable to see why such waves should be able to bend around the curved surface of the earth through many degrees of arc. . . . In effect his suggestion is very plain. The earth may be regarded to all intents and purposes as an electrically charged sphere whose charge is at zero potential. If a disturbance is set up in this charge — which we are led to believe resides upon the surface of the earth — through the connection of an insulated capacity and a spark-gap with the earth, surges of current are caused to flow; then, inevitably, ripples of electrostatic disturbance will radiate out from the disturbing point, and these may be detected at great distances by means of appropriate apparatus sensitive to electric waves. It makes no manner of difference whether the sending and receiving circuits are parallel. A somewhat curious corollary of this hypothesis is that at the antipodal point from the sending-apparatus there ought to be a maximum of effect. If the earth were a smooth sphere having a uniformly disturbed charge, the ripples radiating away from the disturbing influence in widening concentric circles would come together again at the other end of the diameter of the sphere, where their mutual interference and addition would create a point of maximum effect. It would not be extremely difficult to test this assumption. If it is found true, the explanation of wireless telegraphy is evidently at hand. It may be remarked here that the antipodal point to Mr. Marconi's powerful sending-station in Cornwall is to be found in longitude 175 degrees east, and latitude 50 degrees 30 minutes south. This point is in the South Pacific Ocean, very near Auckland Island, which lies immediately to the south of New Zealand. There the British Government maintains an admiralty supply depot. It would be very interesting to know if messages which have faded out and become no longer sensible to the receiving instruments at 23 degrees away from the sending-station would not be again easily received 180 degrees away at the antipodes. All that would be needed to try the experiment would be to send a ship provided with a receiving apparatus to the point indicated, and wait for results."

ENSIGN NELSON, expert in charge of the torpedo station at Fort Royal, has given remarkable testimony before the House Committee on Naval Affairs relative to the merits of submarine torpedo boats, which many have condemned because of the great danger of explosion. He declared that a submarine boat of the Holland type could drive an entire hostile fleet out of a harbor, because the enemy, if wise, would put out to sea to avoid attack which could not be prevented, because it would be delivered entirely out of sight. A fleet dare not approach the harbor near enough to cover the landing of troops or to make effective use of small calibered guns against shore defenses. The moral effect of a submarine boat, he declared, was even greater than its destructive ability. He predicts that the submarine boat is destined to produce as vast a change in naval architecture as that which followed the success of Ericsson's "Monitor," and urges that the United States at once develop a fleet of submarine boats of the latest and best types.

A SALT lake, the water containing 25 to 30 per cent salt, is described by the English Consul at Buenos Ayres. This lake lies in the southern portion of the Province of Buenos Ayres, Argentina, near San Blas. The rock-salt deposit underlying the lake is pierced by several springs; a syndicate is now working the deposit by running the water from these springs into banks, allowing it to settle, and then forcing it through iron pipes to the coast, 26 miles off. At the coast the water runs into evaporating pans. The syndicate is now turning out 25,000 tons of salt per annum, but the output could be increased to 100,000 tons. The Bay of San Blas is 800 miles south of Buenos Ayres; it has a deep channel and sheltered anchorage, and the syndicate is building a pier to facilitate loading.

An Inquest on a Mummy.—"Our British friends can sometimes do the unconsciously humorous thing to perfection," says the Philadelphia *Medical Journal.* "They have lately been holding an inquest on a Peruvian mummy. But this 'crowner's quest' was no more funny than the gravity with which the *British Medical Journal* assures its readers that the coroner did right. The British public have finally awakened to the fact that the coroner should be laughed at, and the mummy has been pronounced dead, because the coroner 'sat on it.' The innocent cause of all the trouble was a Peruvian mummy which some one was sending by express to a museum in Belgium. The unfortunate relic was discovered in a box in a railroad station in Liverpool. It was undoubtedly dead, but the coroner was sent for to certify to the fact. . . . He succeeded in spoiling the mummy; and a lawsuit followed, with big damages."

"While it may sound strange, it is nevertheless true, that inquiries for automobiles are being made in Syria," says *Cassier's Magazine.* "Only one specimen, an inferior second-hand French machine, so says United States Consul G. Bie Ravndal, at Baireut, has been seen there; but it is thought that in Syria and Palestine, with their lack of railways and street-cars, and with their rapidly developing carriage-road systems, automobiles would do well. A new road is now being built between Sidon and Baireut, and will soon replace the ancient bridle-path. While this road will be level, others throughout the region are steep, and make numerous sharp turns. Vehicles in use, therefore, must be strong and durable. The tourist traffic has more than doubled in Syria during the last ten years."

Searchlights are to play a conspicuous part in American coast defenses. Extensive experiments with the lights are soon to be made by General Gillespie, chief engineer of the army. The Fortifications Act of last year appropriated $150,000 for the installation of the lights in New York harbor. It is now proposed to install the same system at Portland, Me., Boston, the eastern entrance of New York, and Puget Sound. It is planned to use the target and most effective searchlights, those having a range of 2,500 yards. It is proposed this year in the manœuvers at Narragansett Bay to multiply the searchlights in such way as to determine definitely whether the main channels in the four harbors named can be lighted up.

A heavy rainstorm occurred in Cincinnati, Ohio, about 10.45 a.m. on May 20, giving a precipitation of 2.31 in. in 38 minutes, according to the report of the local office of the Weather Bureau. This exceeds the precipitation of the storm of May 14, 1881, which was 1.14 in. in 20 minutes. The heaviest rainfalls in 24 hours were 2.98 in., May 25, 26, 1879; 2.47 in., May 27, 28, 1882, and 2.43 in., May 1, 1894. Since 1871 all the record storms have occurred in May, with the exception of 1897, when 1.99 in. fell during one hour on July 5.

An old oaken chair, which is said to be the most perfect specimen of ancient British carpentry extant, has been found by Dr. James Johnson in the village church at Stanford Bishop, Eng. It is believed to have been used by St. Augustine at the synods held between A.D. 590 and 603. The chair is made entirely of wood, without any form of iron work.

The proposal to develop the power of the great falls of the Zambesi River, in South Africa, is said now to be taking definite shape, the consulting engineers of the Rhodesia railways having been retained in connection with the development. These falls are the largest in the world, being larger even than Niagara. They are about a mile wide and 420 feet high, and even in dry seasons the water is from two to three feet deep at the crest of the falls. It is proposed to erect electrical transmission lines to cover the district within a radius of 150 miles, a distance which work at California has shown to be entirely practicable. In the territory covered by this radius the Wankie coal fields and some rich copper deposits are found, as well as all the materials necessary for the manufacture of calcium carbide.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES.

Vol. I. No. 10. BOSTON, AUGUST, 1902. Ten Cents a Copy

HOW TO MAKE AN ASTATIC GALVANOMETER.

R. C. Browne.

The herein-described instrument if carefully made will be found extremely useful in detecting minute currents of electricity, and for use in connection with the Wheatstone bridge described in the last number of this magazine. It is so named because the arrangement of the needles is such as to neutralize the earth's magnetism. It is constructed on the principle that a wire through which a current is passing, will deflect a magnetic needle towards a position at right angles with the wire.

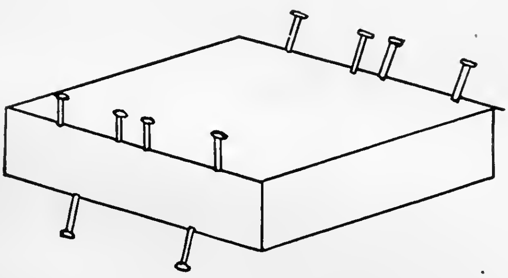


Fig. 1.

A small coil of cotton or silk covered magnet wire should first be made. About one-half ounce of No. 30 gauge, white preferred, will be required, and should be wound over a block of wood 1½″ square and ⅜″ thick. The ends should be smooth to facilitate the removal of the coil when completed. The coil should be wound so that the top layer will be divided into two sections, having the same number of turns in each section. This can easily be done by driving into the block before winding, twelve strong pins, or small gauge wire nails, as shown in Fig. 1. The outer pins in the top row are ¾″ apart, the inner pins ⅛″ apart; the pins on the under side are ⅝″ apart. No wire should be wound in the space between the inner pins of the top row. Wind the coils evenly and firmly by hand, leaving ends about 6″ long for connections. When the winding is completed, dip the coils in hot paraffin. When cool, but not

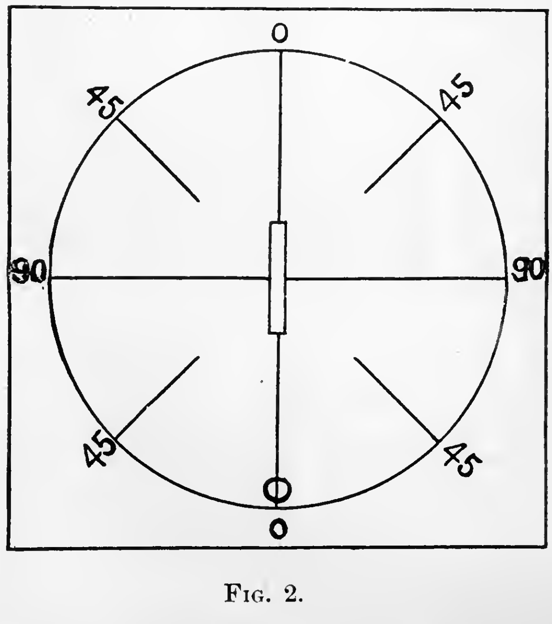


Fig. 2.

hard, remove the pins and lightly press the coils between two flat pieces of wood, to make them smooth and flat on the top and bottom. Then lay aside until the paraffin is quite hard, when the block is carefully removed.

The coil is mounted on a baseboard 7″ square and ⅞″ thick, two binding-posts being placed 1″ from the corners on one side, and the ends of the coil connected to them. The coil is attached to the center of the baseboard with sealing-wax, the divided part being on top.

A dial is next made of a piece of white cardboard 6″ square. With dividers draw a circle 5″ in diameter, then draw lines through the center at right angles, dividing it into four equal parts, as shown in Fig. 2. The ends of one of the lines mark O, the ends of the other 90°. Other divisions may be made at 15, 30, 45, 60 and 75°. Cut a slot in the center of the dial on the O line 1¼″ long and ⅛″ wide, and then attach it with sealing-wax to the top of the coil, so that the slot will be over the dividing space in the coil. Pieces of wood or cork may be cemented between the base and the dial, to more firmly hold the latter. Nails or iron should not be used anywhere in this instrument.

The support for the needles is made of a piece of ¼″ brass rod 10″ long. Bend 1½″ or 2″ of one end to a right angle, and to the short end affix a binding-post, either by soldering or by threading the end of the rod. The hole in the binding-post should be 2½″ from the longer section of rod. Make a ¼″ hole through the dial and into the baseboard, 2½″ from the center of the dial and on the O line, as shown in Fig. 2. Drive the long arm of the brass rod into the hole in the base, and through the hole in the binding-post on the other arm put a long, flat-headed brass nail. Place the arm so the brass nail is directly over the center of the dial.

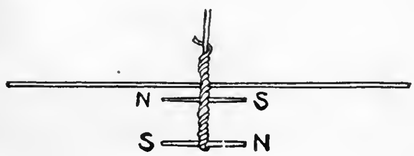


Fig. 3.

The needle magnets are next made. Two medium-sized sewing needles are required. Break off each end, using the center portions, which should be 1″ long. Use care to get them alike in size and length. They should be magnetized by winding wire around them and sending a current from a battery through the wire for a few minutes, or by rubbing them with a permanent or electro-magnet. The needles are then put through holes in a short length of fine straw, far enough apart so that when suspended they will just clear the coils, one needle being above and the other below the upper layer of the coils. In place of the straw, a stirrup of fine copper wire may be made by twisting it around the needles, the N pole of one needle being on the same end with the S pole of the other, and as evenly adjusted as possible. An index needle of fine brass wire 4½″ long should be put through the straw or stirrup, just above the

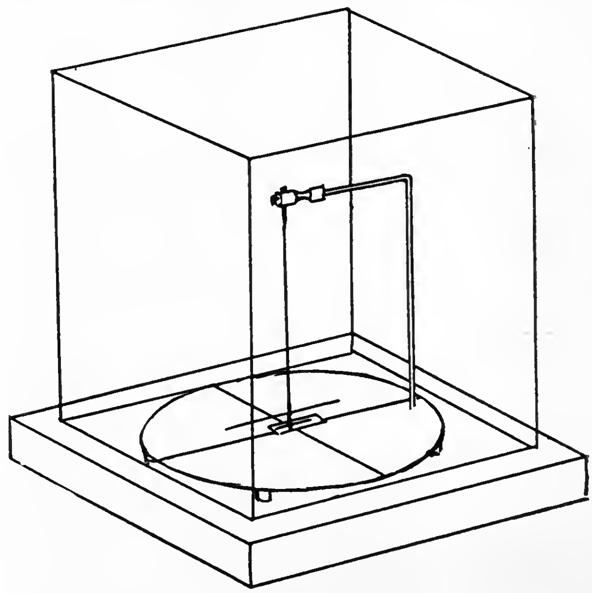


Fig. 4.

upper needle, as shown in Fig. 3. The needles are suspended from the brass nail in the binding-post by means of a fine fiber of cocoon silk, or fine human hair attached to the straw or stirrup by a drop of sealing-wax, so that the lower needle will turn freely inside the coil and the upper needle just clear the dial without touching it.

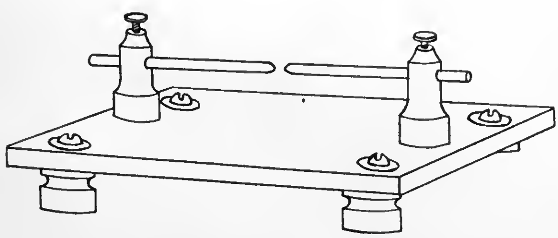
A glass case for covering the instrument may be made by taking four pieces of window glass 10″ long and 6″ wide, and one piece 6″ by 6¼″, and cementing them together with fish glue in the form of a box with one open end (see Fig. 4). Narrow strips of cloth or leather on the edges will add to the strength.

To test the instrument, when completed, twist pieces of iron and copper wire together at one end, connecting the free ends to the binding-posts on the base. Upon holding a lighted match to the twisted joint, the electricity generated by this heat will deflect the needle. Even the heat of the hand is sufficient to produce a movement of the needle. A piece of copper in one hand and a piece of zinc in the other, applied to the binding-posts, will cause the needle to oscillate freely. In using the instrument the index needle must be adjusted by turning the brass nail so that it rests on the O line.

A LIGHTNING ARRESTER.

R. C. Browne.

The lightning arrester here described can easily be made, and will work well in connection with the wireless-telegraphy apparatus recently described in this magazine. To make it, procure a piece of thick roofing slate, or what is better, a piece of slate from a discarded icechest. It should be 4″ long and 2″ wide. Slate can be cut with an old saw, and the holes made with a diamond drill. Drill a ⅛″ hole in each corner and two holes in the center, 3″ apart, the latter to receive the screws in the bases of two binding-posts. Enlarge the holes in the binding-posts to ¼″ diameter, and mount them on the slate with the holes facing each other. Two pieces of ¼″ brass or German silver rod, each 2″ long, are needed. Slightly



round one end of each piece, and then put them through the holes in the binding-posts with the rounded ends toward each other, but about ¼″ apart, as shown in the illustration. This space is suitable for the wireless-telegraphy apparatus. For other uses it may be lessened.

When made, the instrument is mounted at the point where the wire likely to be charged by lightning enters the building. Under the holes in each corner place small porcelain insulators, and secure to the house with round-headed brass screws. Use care in putting in the screws, as the slate is easily broken at the corners. When in place, connect one end of a heavy copper wire, No. 6 or larger, to the lower binding-post, the other end of the wire being carried on insulators to some good ground, such as a piece of sheet copper 1′ square, the wire being soldered to it. The copper plate should be buried deep enough to be in earth which is always moist. The overhead or line wire is connected to the other binding-post before it is carried to the telegraph instruments inside.

Any incandescent electric light will burn under water at any depth if the wires and the lamp are protected from getting wet.

The lifting power of any gas is the difference between the weight of the gas and the weight of the same volume of air. One cubic foot air at normal pressure weighs 1.29 ounces avoirdupois; one cubic foot pure hydrogen under the same conditions weighs 0.089 ounce avoirdupois. The difference is 1.2 ounces, which is the weight that one cubic foot of hydrogen will balance in the air. It will lift any weight less than that.

The Cauvery Falls electrical power transmission works in India, which have taken just under two years to construct, will be brought into operation this month, says the London *Electrical Engineer.* The plant is designed to generate 4,500 horse-power for transmission over a distance of more than ninety miles to the heart of the Kolar gold fields, where it will be distributed among ten gold mines, the best-known of which are Mysore, Ooregum, Nundydroog and Champion Reef. The transmission line, consisting of telegraph posts carrying six strands of copper wire, runs through extremely hilly jungles infested by the tiger, panther and bear, from which may be gathered some idea of the difficult nature of the work which had to be accomplished. The fact that the nearest railway station to the power station is some thirty miles distant, also led to considerable trouble in getting supplies, and tame elephants were requisitioned to help to convey the machinery from the railway to the center of operations. With the completion of the work this month, it is hoped that the greater part of the mining machinery on the Kolar gold fields will be worked by electricity.

AN ELECTRIC SHOCKING MACHINE.

William Slyke.

A strong "shocking machine" can be made from an ordinary electric bell in the following manner: Remove the gong from a good size electric bell and then screw the rest of the bell to a hardwood base of sufficient size to give a margin of 1″ on one side. Two holes are then bored in this margin, for receiving two binding-posts with screw base. To the arm from which the gong was removed screw a piece of fine magnet wire, twisting the other end to the screw of the nearest binding-post. One end of a similar piece of wire is twisted around the screw of the vibrator at A, Fig. 1, and the other end is twisted to the screw of the remaining binding-post, both of which can now be screwed down.

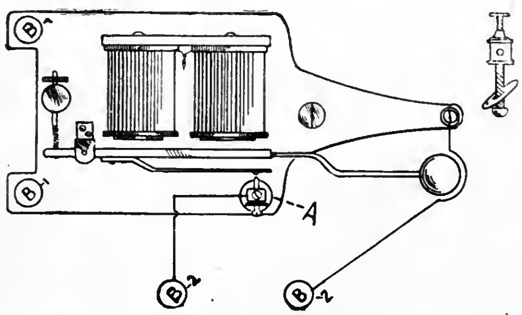


Fig. 1.

For the electrodes, two pieces of brass tubing about 3½″ long will be required. Make two wooden plugs to fit tightly in the end of each tube, boring a hole through the center of each plug large enough to receive pieces of flexible covered wire, each about 3′ long. Cut the covering from each end of the wire for about an inch. Push one end through the hole in one of the plugs, turn it back over and around the sides of the plug and carefully push the plug into one of the tubes, as shown in Fig. 2. The bare wire is thus in good contact with the tube. The other tube is prepared in the same way. The other ends of the wire are inserted in the holes in the binding-posts, using care not to force the screw too hard and so twist off the ends of the wire. With this arrangement the electrodes can easily be removed when not in use.

A battery of two or three dry cells in series is then connected by insulated copper wire to the binding-posts of the bell frame. Upon taking the electrodes, one in each hand, a powerful shock will be felt. A small one-point switch on one of

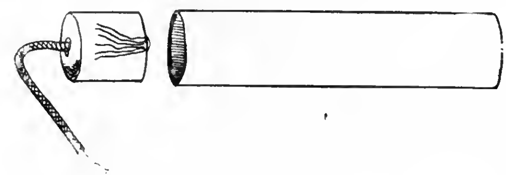


Fig. 2.

the battery wires will be found convenient to throw the battery out of circuit when not in use, and so avoid running it down, or one wire may be disconnected.

A regulator for changing the strength of the current may easily be made.

Procure a piece of glass tubing about 3″ long, with fairly thick walls, also two corks which will fit tightly in the ends of the tube. Two pieces of straight copper wire, one 1½″ long and the other 2½″ long, are each twisted on one end into loops.

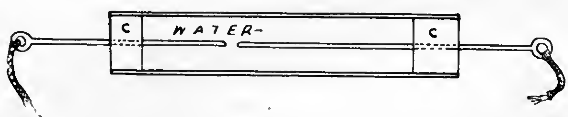


Fig. 3.

Holes are punched in the centers of the corks to receive the wires, which should fit tightly. (See Fig. 3.) Put one of the corks into the tube, fill the tube nearly full of pure water and put in the other cork. Seal each end with sealing-wax, using care not to get any on the wire. Connect the regulator by soldering to one of the battery wires, and fasten to the base by strips of brass or leather. The regulation is secured by changing the position of the longer wire; the nearer the ends of the wire in the tube, the stronger the current. By increasing the space the current is reduced. The writer has a machine made in the way here described, which, with a battery of three cells, gives a current almost impossible to hold.

STUDIES IN ELECTRICITY.

X. THE DYNAMO.

In the last chapter the generating of a current by means of a dynamo-electric machine was briefly considered. The reversal of the direction of the current induced by the motion of the coil of wire, as illustrated in Fig. 25, is true of all the coils of wire comprising in part the armature of a dynamo. This is further illustrated in Fig. 26, which shows the ends of the wire coil C — C′ connected with two semicircular pieces of brass, A and B, representing the commutator, which are in contact with flat pieces of copper, E and F, representing

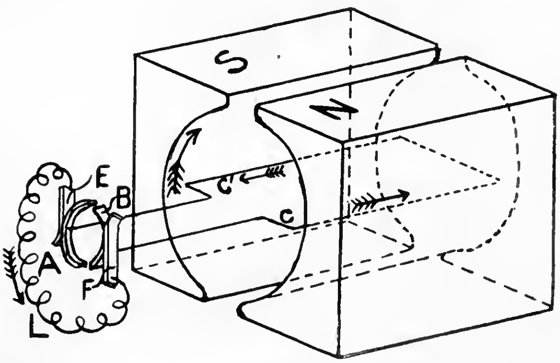


Fig. 26.

the brushes of a dynamo. Assuming that the coil of wire is revolving clockwise, and cutting the lines of force from the N to the S poles of the magnet, a current induced in the part of the coil C is in the reverse direction from that in the part C′, and only requires a closed circuit to flow around the coil in the direction shown by the arrows. As the coil continues to revolve until the position of the parts C and C′ are reversed, the current still flows around the circuit L in the same direction. The direction of the current in the coil has been reversed, but the pieces E and F are now in contact with different brushes, so the current still flows in the same direction around the main circuit. By having a large number of coils of wire in the armature and a corresponding number of sections in the commutator, the current in the main circuit is made practically uniform, the current from one coil rapidly succeeding that from the preceding coil.

In commercial dynamos the practice is to have from 24 to 50 coils, each coil having several turns of wire, or the equivalent to several turns, as, to save labor, several lengths of insulated wire are wound together and the ends soldered at the proper section of the commutator. The greater the number of coils the more uniform the current, but the size of the machine and its uses regulate the number that are mechanically desirable.

The sections of the commutator are insulated from each other by mica or other nonconductor.

In addition to the coils of wire in the armature of a dynamo is an iron core, the purpose of which is to make a good magnetic path for the lines of force passing through it from the N to the S pole of the field magnets, as the core concentrates these lines of force, so increasing the number cut by the coils of wire, and consequently increasing the efficiency of the dynamo. The magnets be-

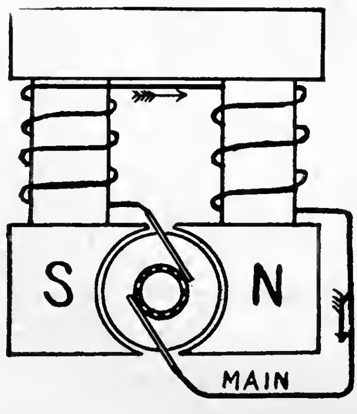


Fig. 27.

tween which the armature revolves are called the *field magnets.* The function of the field magnets is to provide the magnetic lines of force, through which the armature coils revolve. They may be permanent magnets or electro-magnets, the latter being universally used when other than very light work is required. The reason for this is that electro-magnets are capable of giving a much more powerful current than permanent magnets.

In the earliest forms of dynamos the field magnets were excited by a current from an outside source; but this form was soon superseded by the self-exciting dynamo. One form, known as the *series dynamo*, is shown in Fig. 27. The iron cores of the field magnets, after being once excited, retain a certain amount of magnetism, termed residual magnetism. While small in amount, it is yet sufficient to produce some electro-motive force, so that when the armature revolves, a feeble current is produced, which, passing through the field coils, increases the magnetism, which, in turn, increases the magnetic lines of force and the resulting current from the armature coils. This continues until the armature core and field cores are thoroughly saturated with magnetism, and the dynamo reaches its maximum efficiency. By experiment and calculation the size and wiring of the several parts of a dynamo are carefully determined, tha the greatest output may be obtained from a given expenditure of power, and yet not reach a point where excessive or injurious E. M. F. is generated.

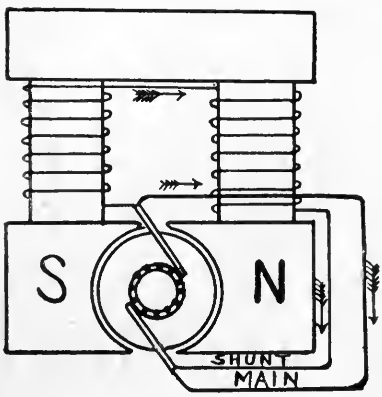


Fig. 28.

The series dynamo is a form not much used, as it is not self-regulating under a varying load. If underloaded, the E. M. F. increases excessively; if overloaded, it decreases rapidly,—the reverse of which is desirable under those conditions.

The wiring of the field coils is in series with the outside circuit, and the armature and the whole current passes through them. This necessitates a few turns of large wire for the fields. The load of a series dynamo is usually connected in series.

Another form of wiring which overcomes certain of the objections of the series dynamo is that known as the *shunt-wound dynamo*, shown in Fig. 28. In this type the field coils form a shunt to the main circuit, only a portion of the current from the armature passing through them. The current, therefore, is divided or shunted, the larger part going directly to the outside circuit, and the balance around the field coils. As this latter current is small in amount, the wire for the

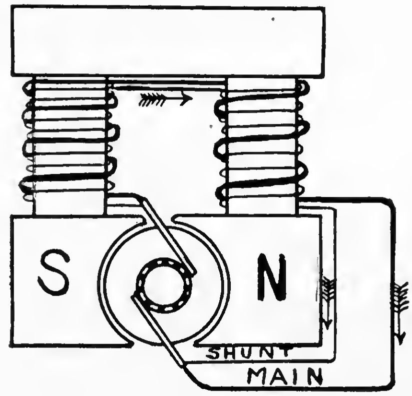


Fig. 29.

field coils of a shunt-wound dynamo is small in size, but consists of many turns. The magnetism produced by the field coils is proportional to the current and the turns of wire, *ampere turns*, as they are called. Thus 10 turns of a large wire carrying 10 amperes is the equal of 100 turns of smaller wire carrying 1 ampere, and each will exert the same magnetizing force. By reducing the size of the wire, the ampere turns of a shunt-wound dynamo is made equal to the ampere turns of a series dynamo of the same size. The amount of energy required to magnetize the fields, and the efficiency of the two types of dynamos under a normal load, should be the same.

The shunt dynamo is more nearly self-regulating under a varying load than a series dynamo, the load being usually in parallel. Therefore, as additional branches in parallel in the main circuit are closed, the resistance falls, and more current is supplied by the armature. This decreases the amount received in the shunt or field coils, thus reducing the magnetism, which in turn slightly reduces the current of the armature, and so regulates the output of the dynamo. A low resistance in the armature is desirable in this type, and also an even strength of magnetism in the fields. To regulate the voltage of a shunt dynamo, a rheostat is generally inserted in the shunt circuit. A rheostat is an instrument containing circuits of varying resistance, with a switch for disconnecting any or all of them.

Another type of dynamo which is self-regulating under wide variations of load is that known as the *compound dynamo*, shown in Fig. 29. This is a combination of the two previous forms of winding. In addition to the shunt winding of the fields, a few coils of thick wire in series with the main circuit are added. The effect of this is to make the current in the field winding, and consequently the magnetism produced proportional to the current flowing from the armature. The shunt winding maintains the proper voltage and the series winding the volume of current. It is customary, when using this form of dynamo for electric lighting work, to have the series winding slightly in excess of the theoretical requirements, that the voltage of the current may be fully maintained at all parts of the main circuit. This is called *overcompounding*. The various parts of the above types of dynamos will be more fully considered in subsequent chapters.

The great pendulum, weighing twenty-seven kilogrammes, installed by Léon Foucalt in the Pantheon to afford a proof of the rotation of the earth, will soon be in an experimental state after having been laid aside since May 3, 1832, under decree of Louis Bonaparte.

Many of the steam railroads of the country are fully awake to the growing importance of electrical transportation, and have organized electrical engineering staffs to study the question as it affects their interests. It is the wise management that takes up this problem now and keeps in touch with this branch of electrical development that is moving forward with such rapid pace.

ARE SHIPS' RUDDERS TOO LARGE?

Have shipbuilders for years past been making the ship's rudder too large? If so, no man can estimate the thousands of tons of coal which have been wasted on our ocean steamer lines. The *American Shipbuilder* describes the discovery made by the late Captain Albers of the "Deutschland," who died suddenly while on his last voyage to Hamburg. While the speed of the "Deutschland" under the most favorable conditions had never before exceeded twenty-three and a half knots, Captain Albers observed upon this last voyage that she was logging twenty-five knots an hour, and for a full day was consistently maintaining that extraordinary speed. Investigation into the causes disclosed the fact that the vessel had lost all but a small portion of her rudder, and that thereby a considerable surface of resistance to the sea had been done away with. The result of this loss of resistance had been an increase of speed to the extent of, on an average, two knots an hour, and with no added expenditure of energy or coal consumption. In other words, a large vessel of the "Deutschland's" capacity, with a small rudder, it would seem to have been proven, could, without added expense, shorten in time the distance between port and port by something like two hundred miles. When, in addition to this fact, it was found that on the high sea the vessel was easily directed by the use of the twin screws for steering purposes, and that in the harbor and narrow waters of any port so huge a vessel could be steered with the assistance of the propellers, by a rudder which was a mere shadow of its former self, a principle seemed to be established which may work a revolution in the construction of the steering gear of our ocean greyhounds. There may prove to be, on further consideration, serious objections to the changes which the incident suggests, and what chance has appeared to demonstrate may in the cold light of reason and of experiment prove to lack permanent value, but the episode is an interesting one.

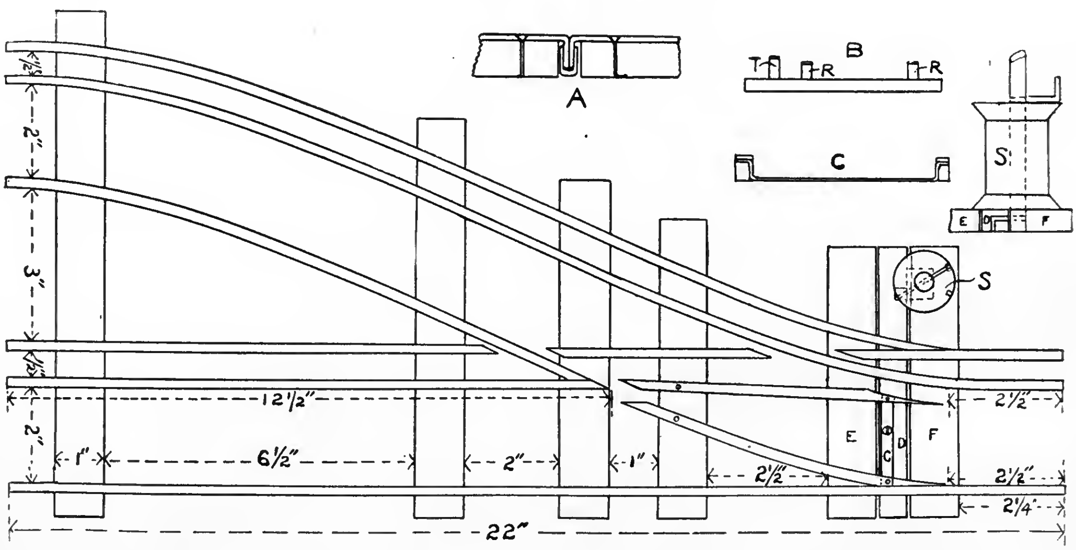
If it proves of enduring value it will not be the first time that sheer accident has resulted in the discovery of principles of great scientific importance, as well as of practical commercial value.

A MODEL ELECTRIC RAILWAY.

I. THE TRACK.

A MODEL electric railway probably affords more pleasure and instructive occupation for leisure time than anything which an amateur can make. Many of the readers of this magazine will undoubtedly be interested to learn how to make one which will work well and yet be inexpensive and simple in construction. The one here described is of this description, yet any one so desiring can elaborate these designs to quite an extent by putting in more detail than is here given. The system is that known as the "Third Rail," so named from a third rail which conveys the current to the motor, the track forming the return circuit. The parts to be described will include the track, switches, cross-track, bridges, turn-table, etc., also motor car and other rolling stock, and other fixtures of a regular railway. The aim in the preparation of these designs has been to keep the cost of making them at the lowest point consistent with serviceable results.

The materials for the track include several pieces of Venetian iron $\frac{3}{16}''$ wide. This is sold by hardware dealers in coils of 50′ at fifteen cents. It is easily worked with drill and file, and with proper care no difficulty will be met in shaping it. It is fastened with small wire nails to strips of whitewood, maple, spruce or other suitable wood $\frac{3}{16}''$ wide and $\frac{1}{4}''$ thick. When the length of track has been determined, the necessary number of wooden strips can be ordered from any woodworking shop for a small sum. The pieces for the third rail are $\frac{3}{8}''$ thick, and the strips for the sleepers should be $\frac{1}{2}''$ wide and $\frac{1}{4}''$ thick, with a few pieces 1″ wide for switches and cross-track. A hand-drill will be needed for drilling holes in the iron for the nails, which should be about 4″ apart. Fluted drills are better than diamond-pointed ones for this work; twist drills are too easily broken. Punching the holes is not desirable, as it bends the iron so much that it is difficult to get it straight again. Countersink each hole slightly with a drill of the size of the nail head.



To make a section of track, cut two pieces of iron, allowing $\frac{3}{4}''$ extra length for the fastenings at the ends, and two pieces of wood for the rails, and a suitable number of pieces for the sleepers, which are spaced not over 6″ apart, and as much closer as one may desire. Drill and countersink the holes for all the nails, bend $\frac{3}{8}''$ of one end at a right angle, as shown at A, Fig. 1. Place the same on one of the strips of wood and carefully nail with $\frac{3}{8}''$ wire nails, of the kind used in making cigar boxes, clinching the end on the under side. This prevents the nail from working loose. Do the same with the next hole, and then with a light hammer tap the rail until it is perfectly level. Continue until the whole rail is nailed and leveled, the other end being bent down for the joint, as previously mentioned. Then file down the heads of the nails until level with the track. But little filing should be required if the nails are the right size and the holes have been countersunk, and the rail should present a firm, level surface, well suited for even running of the cars. When both rails have been thus prepared, place them parallel and 2″ apart, with the iron on the under side; a 2″ gauge will probably suit most requirements, that is, 2″ between tracks. This allows the use of equipment made in Germany, and also by Carlisle & Finch, Cincinnati, Ohio, which is for sale in most of the larger cities throughout the country, and may be purchased by those desiring to do so.

The sleepers are $\frac{1}{2}''$ wide, $\frac{1}{4}''$ thick and 4″ long One running rail is placed $\frac{1}{2}''$ from one end of the sleeper, and the sleeper then carefully nailed to the wooden strip of the rail. The sleeper is then nailed to the other rail, the sleepers at the ends of each section being about $\frac{1}{2}''$ from the ends, as the wooden strips of the rails are liable to split if the sleepers are at the ends. A cross-section of the track is shown at B, Fig. 1; R R are the running rails, and T the third rail. The third rail is made in the same way that the others are, with the exception that ribbon brass $\frac{3}{16}''$ wide is used in place of the iron. This costs about thirty-five cents per pound, and one pound will do for about 50′ of track. Brass nails should be used for fastening to the wood, which should be about $\frac{1}{8}''$ higher than the track, so that the collector shoe on the motor car will not touch the track at switches and crossings and short-circuit the current. Sections of the third rail are joined with U-shaped pieces of brass, the ends of the third rail being bent over the same as with the iron rails. The third rail is placed $\frac{1}{2}''$ from the inside running rail.

In making curves and switches, the best results will be secured if a full-size pencil drawing is first made on manilla paper. To curve the iron or brass, hold it edgewise on two pieces of hard wood about 1″ apart, and hammer the upper edge until the proper curve is secured. After bending, it will probably be necessary to level it with a hammer, as previously directed. The wood for curves should be slightly green, as it bends better if in that condition, while well-seasoned wood will be more easily broken. The best way is to nail the curved iron or brass to a piece of wood of the proper thickness, and wide enough to permit surplus wood to be cut away with a fret-saw or draw-knife, leaving only that needed for the rail. In this case the wood pieces are 8″ to 12″ long, and it will be found much easier to make curves this way than trying to bend long strips; but care must be used in driving the nails to avoid splitting the wood. The nails should be about 3″ apart on curves. If the curve is a sharp one, the rails may be fastened to a piece of thin board, instead of to sleepers.

The way to make a switch is clearly shown in Fig. 1. It will be noted that the outside rails are continuous, the inner ones being broken. The points are connected by a piece of the rail iron C, which is bent as shown at C, Fig. 1, the projection on each end fitting into a recess cut in the wood, and has a hole drilled through it. The nail which fastens down the iron rail goes through this hole. A hole is drilled through the center to receive a round-head screw, which fastens it to a piece of wood, D, which slides between the two sleepers, E and F. The other ends of the points are held by screws which are put through from the under side into the wood of the rails, holes being drilled in the sleeper to allow the screws to turn easily. A spool 1″ in diameter is nailed to the sleeper, as shown at S, a small square section first being cut out of both sleeper F and the switch-piece D, as indicated by the dotted lines. A wooden skewer is then cut to suitable length, and in the lower end, and also at the point where it projects above the spool, holes are bored to receive L-shaped pieces of steel wire. The lower one, moving in the slot in the switch-pieces, D, causes the latter to move whenever the upper one, representing the lever, is moved. To the upper end of the skewer is attached a small piece of wood, painted to represent a switchboard, and so placed that when the switch is open it will be at right angles with the main track, or a block may be used to represent a switch light, green showing when the switch is closed, and red when it is open.

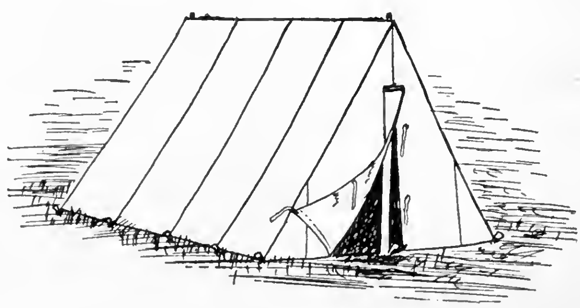
The outer ends of all rails are bent down as previously described, to form the joints with other sections. The ends of the third rail at switches and cross-tracks are depressed slightly, so that the shoe will pass over them without catching. Sections of the third rail at such places are connected by lengths of insulated wire, which should be soldered to the third rail. A blow-pipe will be the best for such connections, the rail and wire being first carefully cleaned with a file. Any inquiries that readers may find necessary will be answered through the correspondence department of this magazine.

HOW TO MAKE A TENT.

T. C. Prentiss.

A tent suitable for a small camping party or for children to play in can easily be made by any one who can run a sewing-machine. The shape here described is known as an A, or wedge, tent, 9 to 9½′ long, 7′ wide, and the pole 7½′ high. The dimensions will vary a little, due to the variation in the width of duck or drilling, either of which may be used, though duck is more serviceable and will shed rain better than drilling. The material used depends largely upon the service required. For ordinary shelter, drilling will answer nicely and is less expensive than duck. For a tent of the size above mentioned 31 yards of cloth 30″ wide are required. First cut four pieces 17′ long and sew them together with a lap seam ½″ wide, stitching each seam twice; that is, lay the edge of one piece of cloth upon the edge of a second piece, so that the edges overlap for ½″, and run the stitching ⅛″ from the edges of the cloth. Use heavy linen thread and a heavy machine needle, taking care to see that the overlays are in a uniform direction.

When the four strips are sewed together make the end pieces, the front one differing slightly from the rear one on account of the opening. For the rear end cut a piece 10′ 1″ long. Mark a point on one side of the piece 2′ 5″ from the end, and on the other side 7′ 7½″ from the end, and with a pencil draw a straight line between these points. Cut the cloth along this line. Put the long edges of the two pieces thus obtained together and sew with a ½″ lap-seam, as previously mentioned. Cut another piece of the cloth 2′ 5″ long and 14″ wide, and then cut this piece diagonally across to make triangular pieces, which should be sewed, one on each side of the two pieces previously mentioned, with a ½″ lap-seam. These four pieces form the back and are sewed to the sides with a ½″ lap-seam, the edges of the back being turned under the sides. All seams should be double stitched. The front is made in nearly the same way as the back, with the exception that the center seam is sewed last, and then only runs 1′ 7″ at the top, the remaining 6′ being open. A strip of the



cloth, 6′ 2″ long and 6″ wide, is hemmed on the right edge and at the top with a 1″ hem, and then sewed with a lap-seam to the center edge of the left strip, and at the top forming a fly opening. The front is then sewed to the sides with a ½″ lap-seam, the edges of the front being turned under the sides.

The bottom of the tent is then trimmed evenly, and a 1″ hem made around it. Through this hem, at each seam, cut small, round holes, and overcast the edges firmly with cotton twine. Similar holes are made in the top, 1″ from each end, through which project the iron rods in the upright tent poles. Pieces of clothesline about 15″ long are put through these holes and firmly knotted on the inside. These are used to tie to the tent pegs, to hold the tent upright. From waste pieces of the cloth make six strips 1″ wide and 12″ long, double thickness, and stitched along the edges, and fasten same, three on each side, to the inside of the opening. These are used for tying on the inside at night.

The poles may be made of 2″ round oak curtain rods, or if these are not obtainable, spruce poles may be shaped with a draw-knife and plane from stock 2″ square obtained from a lumber dealer. In the latter case it is not necessary to make them round, octagonal will answer; in fact, military tent poles are often of this shape. The upright poles should be nearly 8′ long, the length of the cross-pole being obtained by carefully measuring the length of the tent. Tent-pole irons can be obtained from any large hardware dealer, who will order them if he has not them in stock. It would be well to order them along with the rest of the materials, to avoid possible delay. The irons needed are two iron rings for the cross-pole, with holes for the iron rods; two iron rings without holes, and two short iron rods for the upright poles. The iron rods are sunk for about one-half their length in holes bored in the upper ends of the uprights, and then the rings are snugly fitted on. The rings with holes are likewise fitted to the cross-pole, and holes bored through the pole to receive the iron rods. Be sure these holes are both bored through in the same line. By putting a small stick in one hole to indicate its direction, the other hole can easily be bored to match it.

To erect the tent, fasten one side to pegs in the ground, join the poles together, and put them flat inside the tent. Lift the poles and tent to an upright position, and holding the tent, pull out the other side to the proper place and attach to pegs previously driven in the ground.

The announcement cabled from Europe a few days ago that Professor Marckwald of the University of Berlin had discovered a new element, is another link in a chain of discoveries which has been made chiefly by French and German scientists. Professor Marckwald is said to have separated a morsel of metal from uranium ore which emits radiation of a very active nature. The new metal, which evidently has not yet been named, has certain electrical properties, and is so very scarce that one gram of it is found in a ton of uranium ore. One might wonder how such an infinitesimally small amount of matter could have any wide significance, but it has, nevertheless, when taken in connection with other discoveries of a like nature. It concerns such an important matter as the production of light without heat and its commercial application.

Electro-chemical reactions depend upon the fact that the salts of metals are dissociated when in solution. When potassium chloride is dissolved in water, what actually exists in the water is a succession of free atoms of chlorine and potassium, with great electrical charges. Similarly, when silver or gold cyanide is dissolved in potassium cyanide solution, the atoms are free; the weaker the solution, the more perfect such free condition. As soon as the atoms of gold or silver lose their charge of electricity (as they do when an electrical current is passed through), gold, with its ordinary properties, is at once produced and precipitates itself in the solid form.

A short time ago it was stated that steps were being taken looking to the establishment of a system of wireless telegraphy on the Congo River in South Africa, as a result of experiments carried out in England at Withernsea. The London *Electrical Engineer* learns that fairly good progress has been made with the installation, but that the work has been greatly delayed by the loss of the vessel which was taking out some of the apparatus to South Africa. While awaiting the arrival of more material, however, the mast at Bahama has been fixed, and it is hoped to have the service in operation very soon.

Schmidt, in comparing the economical value of coal and electricity as sources of energy, arrives at the conclusion that on the average only 30 per cent of energy is utilized in the former case, whereas in the latter case this percentage is 90 per cent. For this reason he recommends that electrical heating be used in the manufacture of water gas, instead of the usual process of supplying the necessary heat by direct combustion under air blast. He bases his calculations on the economical conditions existing in Switzerland, and expresses the opinion that it would be easy to adapt carbide furnaces to the manufacture of water gas.

AMATEUR WORK

63 KILBY ST., BOSTON

DRAPER PUBLISHING COMPANY, PUBLISHERS

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month, for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

AUGUST, 1902

Contents

Many readers of this magazine who are now enjoying their summer vacations have utilized a portion of their time in securing new subscribers, obtaining premiums, and thus adding many useful tools to their equipment. Undoubtedly there are many others who could profit in the same way, did they but make the attempt. The premiums offered for this work are all of excellent quality and well worth working for. Should any one desire any special tool not yet mentioned, by advising the publishers the same will be offered as a premium. In this way the present stock of tools can be supplemented by those most desired.

Our sincere thanks are extended to the many readers who, in their correspondence, have so warmly commended the magazine and expressed their appreciation of its contents. This evidence of the welcome which has been extended to it from all sections of the country, will serve as an added incentive, if any be needed, to make the future issues even more interesting than those already published. We are pleased to announce that several new subjects of general interest will be presented at an early date.

Several responses have already been received from our invitation to submit articles for the Amateur Work exhibit at the forthcoming exhibition of the Massachusetts Charitable Mechanics Association. This invitation is not confined to articles which have been described in the magazine, but includes anything which any reader has made, likely to be of interest to the general public.

The receipt of several excellent descriptive articles leads us to again call attention to the invitation previously extended to our readers to submit such articles, for which suitable remuneration will be given. They should be as complete as possible, and accompanied with the necessary drawings or photographs to properly illustrate them.

This number has been unavoidably delayed. The September number will be issued promptly on time.

HOW TO MAKE A KITCHEN CABINET.

JOHN F. ADAMS.

ONE of the greatest step-savers for the housewife is a kitchen cabinet, and but comparatively few know its value. It places within easy reach all the necessary utensils and articles needed for the larger part of the cooking, is easily kept clean, and can be located or moved so as to afford an abundance of light. The cabinet described here, while seemingly a rather elaborate piece of furniture, is easily made by any one having ordinary skill in the use of woodworking tools. For convenience in describing, the work will be divided into two parts: the base and the cupboard. The general design of these two parts is shown in Fig. 1. The base contains a large bin for bread-flour on the right, a compartment for cooking dishes and pans on the left, two large drawers on the right end for sugar and flour, and a large front drawer for knives, spoons, etc. At the right, even with the top, a bread or meat board, in the form of a drop leaf, gives additional space.

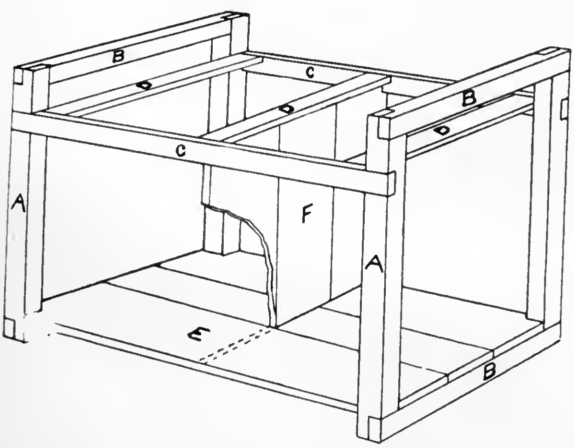
The upper part, or cupboard, has a molding-board which drops down and exposes three shelves for spices and other supplies. Over this is another compartment with two doors. In the upper right corner is a closet with a door, and below this two or three drawers, as preferred,—the design showing three,—in which articles in bulk may be stored. The wood used for the outside work may be oak, cypress or whitewood. Unless an experienced woodworker, either of the two latter kinds had best be used, only be sure to get thoroughly dried stock.

The first work in the construction of the base is the frame shown in Fig. 2. This requires four corner posts, A, 30″ long and 2″ square; four crosspieces, B, 27″ long and 2″ square; two crosspieces, C, 36″ long, 2″ wide and ⅞″ thick; three pieces, D, 25¼″ long, 2″ wide and ⅞″ thick; matched boards to cover floor, E, 30″ long, 27″ wide and ⅞″ thick, and additional matched boards for partition, F, 21″ high and 27″ deep; also, for an additional partition not shown, between the drawers and the flour-bin, which is 21″ high and 17″ deep. The frame may be made of any suitable wood other than pine, which is too soft. For the flooring and partitions whitewood or pine may be used. The construction of the frame is clearly shown in Fig. 2, so no detail directions are necessary. The top of crosspiece C is 4″ below the top of posts A. The piece D, over the partition F, is centered, and simply nailed through pieces C. The outer pieces D are nailed snug up against the posts A, and form the ledges for the drawer. The floor E is nailed to the bottom piece B, and the partition F is nailed at the top through the piece D and at the bottom through the floor. The joints for posts A and pieces B are "halved," and pieces C are mortised into posts A. These joints should all be well made, and care used to erect the frame perfectly square, that the drawers and doors will open easily. Strips of wood 1″ square and 25″ long should be nailed to the end pieces D, about 30⅞″ apart, to hold the drawer in position when closing it.

The frame being completed the casing will be considered,—that for the right end varying a little from the left. The method of joining is shown in Fig. 3. The pieces G are 30″ long, 2½″ wide and ⅞″ thick, the left one being grooved on the inside the whole length; the right one having a mortise 5½″ long at the top, 3½″ long at the bottom, and another 2″ long, centered between those on the ends.

The piece J is 2″ wide and 20″ long, not including the tenons at top and bottom, which are each ½″ long, making the length of this piece 21″ over all. The left side has a groove running the whole length; the right side has a mortise corresponding to the one in G. A second piece of the same dimension as J, with grooving on both sides, is also required, as will be seen from Fig. 1. Two panels of ¼″ stock are required for the right end and three for the left end. They are 21″ long and 6½″ wide for right end, and 6⅝″ wide for left end. The piece H is 6″ wide and 22½″ long, with ½″ tenons on each end, and grooved on the under side. The piece I is 4″ wide and 22½″ long, with ½″ tenons on each, and grooved on the upper side. The grooving can all be done

at the lumber mill at little expense if, when the order for the lumber is given, the pieces to be grooved are specified. When all the pieces are cut out and accurately fitted they are put together, being firmly glued, and held tight with clamps while the glue dries. If no regular clamps are available, temporary ones may be made by screwing two blocks of wood to a strong, level board, far enough apart to allow a wedge to be driven in between one block and the frame. When completed the size should be such that, with the left side even with the front of piece A of the frame, the inside of the right piece G should be even with the inside of the post A of that corner, thus allowing the drawers to be easily fitted. The left end is made the same as the right, with the exception that a panel takes the place of the drawers, and the pieces G and J are grooved for the extra panel. Additional drawers may be made on the left end if desired, but the capacity of the cupboard in front will be just that much less.

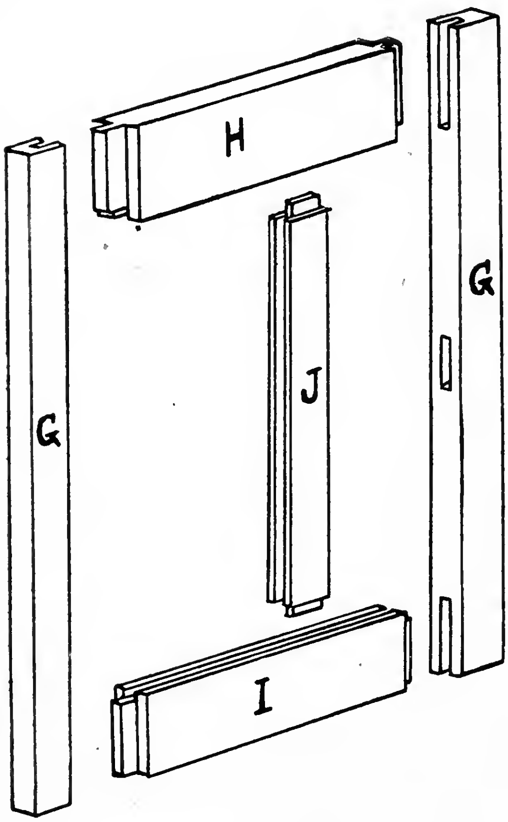


The front is easily made. The two upright pieces on the ends are 30″ long and 3½″ wide, with mortises, 4″ from the top, 2″ long for the tenons on the crosspiece under the drawer. (See Fig. 1.) At the bottom ends 4″ mortises are made. The crosspiece under the drawer is 2″ wide and 30¾″ long, not including the tenons on each end, ¾″ long, making 32¼″ over all. The bottom crosspiece is the same length and 4″ wide, with tenons. In the center of each crosspiece make 2¾″ mortises for the upright centerpiece between the cupboard and flour-bin, which is 2¾″ wide. The ends and front being completed, they are fastened to the frame with some 2″ wire nails of small gauge. Nail and glue the ends to the frame, and then the front, strongly gluing and nailing the joints between the front and ends. Any roughness of the joints should be carefully removed with a plane. This done, make the door of the cupboard and front of the flour-bin, the two being alike and are 20″ high and 14″ wide. With the experience already gained in framing, these will be easily made. The upright pieces are 20″ long and 2½″ wide; the crosspieces 9″ long, with ½″ tenons on each end, making them 10″ over all. Both upright and cross pieces are grooved on the inside edge for the panel pieces, which are of ¼″ stock, 14¼″ long and 9¾″ wide. They should be well glued together, using clamps as previously directed for all glued work whenever possible to do so.

The drawer is 30¾″ long, 4″ deep, and 18″ or 20″ wide. The front piece is rabbeted on each end to receive the side pieces, only about ¼″ of wood being left on the front side. The side pieces are nailed into this rabbet, the rear ends of side pieces having a ¼″ rabbet for the back piece. A ¼″ rabbet is run around the lower edge of all the pieces, to receive the bottom pieces. This makes a firm drawer, which will retain its shape. Use care to see that, when cutting out and fastening together, the work is square.

The flour-bin is at the front, the height of the door 20″, but at the back only 14⅞″. The side pieces are 10¼″ wide, with curved top, as shown, and the back piece 14″ wide, and should be of smooth, clear stock ⅞″ thick. The lower ends should have a rabbet ¼″ deep for the bottom board, which is 12¾″ x 10¾″. The bin should be well glued, and nailed with wire nails, that the weight of the flour when it is full will not force it apart. It swings on two strong brass hinges at the bottom, and is held at the top by a small piece of wood which is screwed to the under side of piece C of the frame, after the hinges are on. The door to the cupboard has two brass hinges at the left side and a catch on the right. Two draw pulls are desirable for the drawer.

The two drawers on the end are 9″ high, 6½″ wide and 15″ long. They are framed the same as the front drawer, but have, in addition, a face board of ½″ stock, which is firmly glued to the front board of the drawer. It overlaps the front board ¼″ on all sides, and the outside edges are made quarter-round, to add to the appearance. Strips 1″ square are nailed to the partition on the left and framework on the right, to form ledges for the drawers.



The top of the cabinet is 40″ long, 30″ wide and ⅞″ thick. Clear, well-matched boards should be used, and preferably should be tongued and grooved, but may be simply glued up. Care should be used to see that the joints on the top side are perfectly even, and any projecting edges should be taken off with a plane after the glue is thoroughly dried. The top is nailed and glued to the piece B of the frame, projecting evenly at each end and front.

The drop leaf on the right is 18″ long, 12″ wide and ⅞″ thick. The ends should have cleats with tongued and grooved joint. Two hinges are screwed to the under side, fastening it to the top. It is held up when in use by a strip of wood 10″ long, 2″ wide and ⅞″ thick, with a hinge at the upper end, the lower end resting on a triangular block, as shown in Fig. 1. Each end of this piece is beveled to fit well, the angle of bevel being best determined by trial.

The back is sheathed with ½″ matched sheathing nailed to the floor and the back piece C. A 1″ square strip may be nailed to the under side of the top, and the sheathing also nailed to it, making a tight joint between top and back.

With strong castors — preferably the kind having a flat plate, and attach with three screws — the base is complete and ready for the cupboard, although it may be used without the latter.

The general plan of the upper section, or cupboard, is shown in Fig. 1. The boards for the sides are 33″ long, 12″ wide and ⅞″ thick; for the partition between the drawers and shelves, another piece ⅞″ less in length. The top is 40″ long, 13″ wide and ⅞″ thick; the bottom 37″ long, 12″ wide and ⅞″ thick. The piece under the double closet on the upper left side is 26″ long, 11½″ wide and ⅞″ thick. The two shelves back of the drop leaf are 26″ long, 10½″ wide, and ¾″ or ⅞″ thick. The three pieces over the drawers on the lower right side are 9⅜″ long and 11½″ wide. The top, sides and bottom pieces should have ½″ rabbets on the back to receive the sheathing. Careful nailing with wire nails will answer for this part of the cabinet. The top projects 1″ on each end and in front. The bottom piece is fitted to ⅜″ rabbets in the bottom of the two side pieces. The upright partition is 9⅜″ from the right side piece. The three pieces over the drawers on the right side are 4½″ apart. The crosspiece over the drop leaf is 21″ above the bottom piece. The shelves back of the drop leaf are 7″ apart between centers, but may be otherwise spaced if preferred, giving more space to the lower ones. The drop leaf, which forms the molding board, is 26″ long and 21″ wide. This will probably have to be made up by gluing, with 2″ clamps on each end, which should be tongued and grooved. A 2″ strip may be nailed on top of the lower edge, that flour will not be spilled into the cupboard back of it. The doors of the upper left cupboard are each 12″ wide and 12⅜″ high, the frame for them being 2½″ wide, with grooving ⅜″ deep on the inside for the panels, which are 7⅝″ by 8″, and ¼″ thick. This makes the upright pieces 12⅝″ long, and the crosspieces 7¾″ long, allowing ⅜″ on each end of the latter for the tenons.

A piece 2″ wide divides the two doors. The door to the cupboard on the upper right side is 19″ high and 9⅜″ wide; the side pieces for the frame being 19″ long and 2″ wide, and the top and bottom pieces 6⅛″ long and 2½″ wide, allowing ⅜″ on each end for tenons, with grooving ⅜″ deep on the inside of each piece for the panel, which is 15¾″ by 6⅛″.

The three drawers on the lower right side are 9⅜″ wide, 4½″ deep and 10″ long, outside measurement. The front and back pieces are rabbeted on the ends for the side pieces, and on the lower edges for the bottom pieces, and are well glued and put together with wire nails. With the necessary hinges and catches in place, the cabinet is now complete, with the exception of staining or other finish, which is left to the fancy of the maker. While there is considerable work in making such a cabinet, it is not at all difficult, if proper care is used. It is one of the most useful pieces of furniture that can be added to the household, and only requires to be used to be thoroughly appreciated.

HAMMOCK MAKING.

E. H. Perkins.

II. CANVAS HAMMOCKS.

Hammocks made from this material are by many people considered the most satisfactory. A stout piece of denim may also be used if a colored hammock is desired. They may be made with or without a stretcher, but when one is used it is placed inside the hem at each end and sewed in. A curved is better than a straight stretcher.

To make a comfortable hammock a stout piece

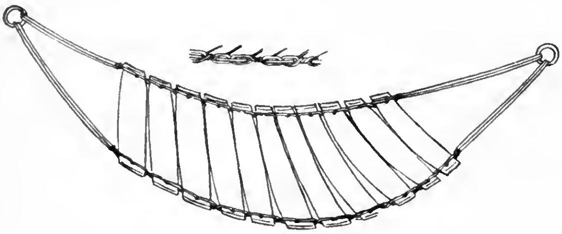
of canvas 6′ long and 3′ wide is necessary. If the material is not wide enough, make a seam in the center by overlapping the two selvages ½″, and stitch each edge flat to the cloth. The sides and ends are hemmed. A small rope or cod line placed inside the hem on each side gives additional strength. The hems at the ends are 3″ wide, and in the middle of each are placed the eyelet-holes, which are made for the leaders, or clews, as they are called on navy hammocks. There are twenty-four eyelet-holes on each end, at equal distances apart. A small ring, made of closely woven cord about ⅛″ in diameter, is placed in each eyelet-hole and thickly sewn over all the way around with twine. The leaders may be made of cod line or any stout line, and should be about 3′ long. Two rings similar to those used in the netted hammocks are needed.

To make the leaders pass the line through the first eyelet-hole, making a stout knot at the end, which must be on the under side of the hammock. Pass the leader through the iron ring, which should be placed 3′ from the eyelet-hole, and make a tight knot at the ring. Carry the line to the second eyelet-hole and cut off the line, leaving enough to make a stout knot, which, like the first, must be on the under side of the hammock. Pass the line through the third eyelet-hole, making a knot on the under side, then through the iron ring with a tight knot and into the fourth eyelet-hole, cutting and knotting as in the second eyelet-hole. Continue until all the eyelet-holes are filled, and the hammock is done.

III. Barrel Hammocks.

A barrel hammock has the advantage that rain does not harm it, and there is therefore no necessity to take it in every night, as with most hammocks. Sugar barrels are the best to use, but almost any barrel will answer. Two barrels are needed, as twenty-four or twenty-five staves are used in an ordinary-sized hammock.

Break the barrels apart carefully, and after removing all the nails, smooth the edges of each stave with a draw knife or plane. This done, bore a hole $\frac{5}{8}''$ in diameter $2\frac{1}{2}''$ from each end of the staves.



For supporting the staves, 80′ of quarter-inch rope or strong clothesline will be required. This rope is divided into four lengths of 20′ each. Taking two of these pieces, tie them together with a strong knot 4′ from the ends. Pass the loose ends through the hole in the end of one of the staves, one through the upper side and the other through the lower, pulling the cords through until the stave is firm against the knot. Give the cords a half-twist and then pass them through the hole of the second stave; the rope which passed downward through the first stave now passes up through the hole in the second stave, and the other rope reversing to correspond. Continue lacing each successive stave in the same manner, with the half-twist between each, and tying a firm knot outside the last stave.

Lace the staves on the other side in the same way.

The loose ends of the ropes are then spliced to a strong iron ring, although knots may be tied if the maker does not care to take the time for splicing.

A coat of enamel paint will add much to the attractive appearance, and will enable it the better to withstand exposure. A piece of an old comforter covered with pretty cretonne or denim, with flounces to hang over the sides, and a pillow to match, makes a comfortable and pretty addition.

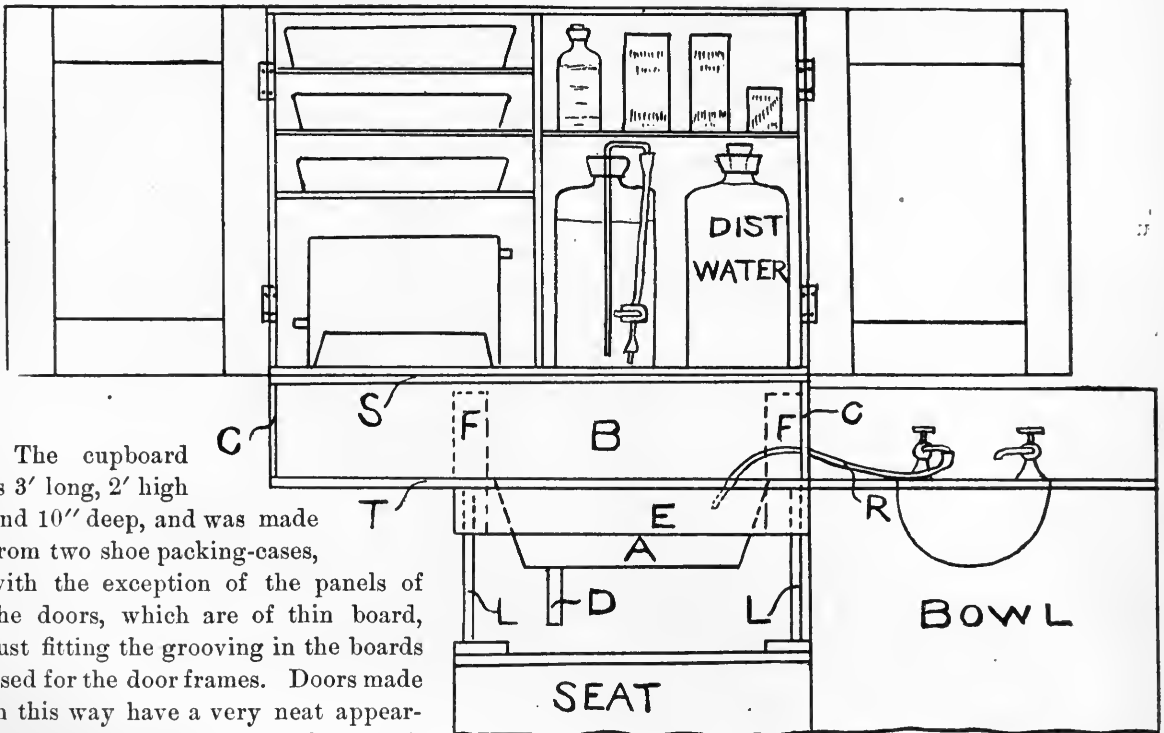
PHOTOGRAPHY.

THE DARK-ROOM.

The dark-room, to the amateur, is frequently a difficult matter to secure, if the appointments are to be handy of access and use. If a bathroom is available, a little work and a small expenditure for materials will enable one to have a room which will allow day or night work to be readily done without inconvenience to the rest of the household, or "slopping around," which would make it objectionable. The great advantage in using a bathroom is that water, the prime necessity of photographic work, is already at hand, and a little rubber tubing or piping is all that is necessary to make it available. The arrangement here described is adapted from a similar one, designed to be quickly put in place and removed. In the bathroom where it is used the seat and bowl are adjacent, so the sink, A, is mounted on short legs which rest upon the woodwork of the seat, as shown in the illustration. If the plumbing is open, the framework should have legs reaching to the floor. The sink is porcelain lined, 24″ long, 18″ wide and 6″ deep, but other sizes may be used. A short length of lead pipe, D, allows it to drain into the bowl underneath.

The framework, E, was made from the pine boards of a packing case, the top, T, being made as level and smooth as possible. It measures 36″ long and 24″ wide. At the back an upright board, B, 10″ wide, is well fastened by two cleats, F, 3″ wide and 15″ long. Square pieces of board, C, at each end of the back board support a shelf, S, 10″ wide, upon which the cupboard is placed when in use. Only general dimensions are here given, as the arrangements of bathrooms vary, so that anyone desiring to make a similar equipment will of necessity be obliged to make it in accordance with the room to be used. The flanges of the sink rest in a hole of suitable size cut in the top, T, of the frame. The running water is conducted by a short length of rubber tube, R, of a diameter which allows it to be easily slipped over the end of the faucet. In winter another piece of tubing allows warm water to be used for heating solutions, etc.

for controlling the flow of water. The syphon is easily changed from one bottle to the other by removing the stopper. The glass and rubber tubing can usually be purchased of a druggist. The wash-box when in use is placed in the sink or on the right side of the top of table, connected with the rubber tube from the faucet and the water allowed to run as long as desired. The framework was painted first with white lead paint and then with white enamel paint, which allows all chemicals to be quickly wiped up, and also makes the various articles in use more conspicuous in the dim light of the room.



The cupboard is 3′ long, 2′ high and 10″ deep, and was made from two shoe packing-cases, with the exception of the panels of the doors, which are of thin board, just fitting the grooving in the boards used for the door frames. Doors made in this way have a very neat appearance and are easily made. On the left side of the cupboard are three shelves for trays and a larger place for the wash-box. On the right side one shelf in the upper part gives a place for small bottles and chemicals, and below is room for two large bottles for distilled water. One of these bottles is fitted with a syphon, which is easily made as follows: A heavy glass tube with two bends at the top is put through a rubber stopper, the latter having a second hole in it, fitted with a short length of glass tube to admit air when drawing the water. This is closed with a plug when not in use. The inner end of the syphon tube reaches nearly to the bottom of the bottle, the outer end having a rubber tube attached which is long enough to reach the sink when the bottle is placed on top of the cupboard. The lower end of the rubber tube is also fitted with a short length of glass tubing, and also near the end with a pinch cock

PIN-HOLE PHOTOGRAPHY.

"F. C. Baker in Western Camera Notes."

One of the most interesting phases of photography to the amateur who happens to be of an experimental and pottering turn of mind is pin-hole, or, as it is called by Mr. J. B. Thomson, the author of the clever and exhaustive monograph on the subject in the *Photo-Miniature*, "lensless" photography. There seems to be a peculiar fascination connected with the production of pictures without the aid of the lens, so generally looked upon as the all-important and indispensable feature of a photographic outfit; and when the resulting negatives and prints are of an excellence such as to make them compare favorably with the results obtained by the employment of a good lens, the experimenter experiences a glow of satisfaction and a feeling that he has achieved something worthy in spite of unfavorable conditions and primitive apparatus.

It is not certain, however, that this feeling is entirely warranted by the facts, for we should place the credit for successful results where it is due, and there seems to be no reason to doubt that a pin-hole, if well made, is for certain pictorial qualities and purposes a really very efficient instrument.

Among its good qualities may be mentioned the fact that the image produced is absolutely truthful, unlike that formed by even the best lenses.

Another good feature of the pin-hole camera is that there is no necessity for focusing: the image is in focus at all distances between pin-hole and plate that will be required for general use, and the angle of view is varied by simply varying that distance, and thus obtaining at will extreme narrow angle effects as well as anything desired between the two.

This advantage will be found to be at times an important one, as, for example, in architectural work, when several exposures may be made under varying conditions and from different viewpoints, and just the most appropriate angle selected for each case without further trouble than changing the distance between plate and aperture of the camera.

And then the cheapness of it! If you are not the possessor of a camera already, all you need do is to get a cigar box, make it light-tight, rig some arrangement for inserting the plates conveniently, and fit the front of the box with a bit of thin metal pierced by a tiny hole, and you will have, at practically no expense, an outfit which, if intelligently used, and with due regard for its limitations, will enable you to produce the very best of work.

To one who already has a camera, the fitting of it for pin-hole work is a very simple matter.

If the camera is one with a removable lensboard, an extra one may be made, carrying the pin-hole and substituted for the regular lens-board.

A shutter is not a necessity, as the exposure may be made either by pulling and replacing the slide of the plate-holder or by keeping the front of the camera covered, say by the focusing cloth, until the slide is pulled, and then recovering the front with the cloth while replacing the slide.

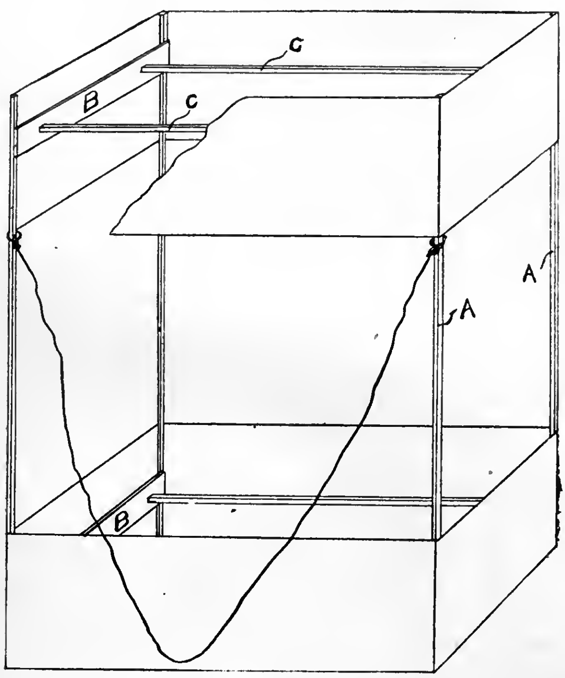
My own experience has been with a 5 x 7 long-focus bellows camera, fitted as above described, and while I have not, of course, discarded the lens, I have found much pleasure and satisfaction in the employment of my extra lens-board, and would not think of leaving it behind when starting on a picture-hunting trip.

Of course the making of the pin-hole itself is an important matter, and care should be taken to get it perfectly round and its edges as smooth as possible. I used a needle. I do not know what number, but it was about an inch and a half long, and only the point was used in piercing the thin copper. The needle point, after being driven by light blows of a hammer through the copper, was inserted in the hole thus made, first from one side and then from the other, and twisted about. One of the results of this procedure was to raise a portion of the metal in the form of a burr at the edge of the hole, and this was shaved away with a sharp knife, and the twisting operation gone through with again. Then more shaving and twisting alternately until the hole seemed perfect, even when examined under a magnifying glass. The side of this small copper sheet that was to be placed towards the inside of the camera was then blackened by being held for a moment in the flame of a match. My extra lens-board was made of several thicknesses of cardboard, cut to fit exactly the opening in the camera front, and built up to the proper thickness by pasting the pieces together. A hole about one-half inch in diameter was cut in the center of this board, and the pin-hole attached by pasting with strips of black paper sufficient to insure the front's being perfectly light-tight.

There are now 8,660 less horses than five years ago in New York City. Trolley cars and autos did it.

A FOLDING BOX-KITE.

A box-kite is one of the most entertaining forms of kite which can be made, and is of special value in wireless telegraphy where a pole is not available. A very convenient size, with a pull which will not be tiresome in a moderate breeze, is 30″ high, 20″ wide and 9″ deep. Four pieces of light, strong wood are required for the corner posts, A, 30″ long and ¼″ square. Four pieces of thin wood, B, 9″ long and 2″ wide, are carefully nailed to the posts A, 3″ from the ends. The side pieces of a long cigar-box are suitable for these pieces. In the center of the pieces B, and 1½″ from the ends, cut holes ¼″ by ⅛″, to receive the ends of the pieces C. The crosspieces C, 19½″ long and ¼″ square, have tenons cut on the ends to fit the holes in the pieces B.



Folding Box-kite.

The covering consists of two bands of light, firm cloth 58″ long, not including the extra cloth required for the seam, and 9″ wide. The seam should be stitched on a machine, using care to have it square with the edges. To erect the kite, place the bands on each end of the frames, with the crosspieces B on the inside, and then put in the crosspieces C. These should require some bending, but should be nearly straight when in place, so that the cloth belts will be stretched taut and the surfaces remain flat when in the air. The seams of the belts should be at the corners, and the belts should be adjusted until all the angles of the kite are square. The belts are then tacked to the posts A with small tacks. A loop of strong, light cord 6′ long is then tied to front posts A, just below the lower edge of the upper band. The line is then tied to the center of the loop and the kite is ready for flying. If the kite dives, or does not fly properly when well up in the air, adjust the loop until satisfactory results are secured. Smooth-finish mattress twine is the most desirable for kite-flying, having great strength for the weight. It may be purchased at most upholstering places. For wireless telegraphy a larger kite of the same proportions, but with fine piano wire for the line, may be used, the instruments being connected when the kite has reached an altitude where it remains steady. The wire should be wound on a reel made from a large wooden twine-spool mounted on a wooden base, which may be fastened to the ground by wooden tent-pegs, care being taken to see that the wire does not touch the ground. Do not use the wire upon the approach of or during a thunderstorm.

Violins and mandolins made of clay are now being placed on the market in Europe and America. Many declare them to be superior to the time-honored wooden instruments. The clay is made into a high-grade porcelain, which forms the body of the mandolin or violin. The porcelain body, it is claimed, is better capacitated for producing sound than a wooden one, since it co-operates in the making of sound, causing the notes to become soft and full. A further advantage claimed is that the porcelain instrument is totally insensible of the influence of the weather.

A SUMMER BUNGALOW.

Dr. C. Gilbert Percival in the Brown Book.

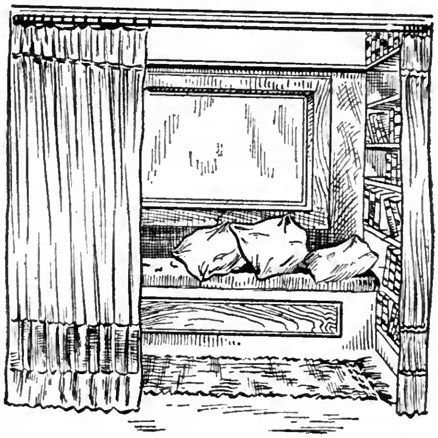
It is because a great many persons suffer themselves to live in stifling cities throughout the hot weather, who, if they did but know it, could possess an attractive summer home for a mere song, that I am prompted to tell herewith how I recently built a pleasant and enjoyable little affair of a cottage that did not cost me over one hundred dollars.

First of all, select your land. Whether it be by lake, pond, river, bay or shore, or whether you buy or lease it, be sure of three things. These are: that first it is in a healthful district, free from malaria; second, that there is pure drinking water available, and thirdly, that it can be easily reached from your business.

A Summer Bungalow.

After having seen to all three of the above, then proceed to the erection of your house. Select a knoll or elevated spot, and here clear and level away the ground for the foundation of your summer abode. Sills of 4 x 5 timber are strong and sufficient. If there are any available stones or rocks, you can use some to put under your sills, but they are hardly necessary unless your site is very sandy I consider a house of 18 x 14′ just about as big as needed, though the size can be varied to suit the individual fancy and requirement.

This summer camp I am about to describe is a fair example of what can be done for less than one hundred dollars. By referring to the ground sketch, it will be seen that the small camp, or shanty, as I call it, is capable of comfortably housing a small family, there being two sleeping rooms. If more beds are required, the couches running around three sides of the camp can be turned into beds at night, they being 30″ wide. There are two ample verandas 8′ wide and 20′ long, each placed so that some portion of it catches the breeze, no matter from which direction it comes.

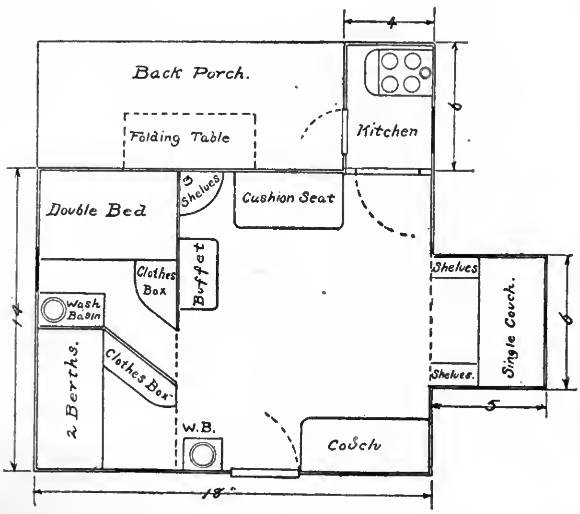


Cosy Corner.

Build your cottage near where your well is to be dug, as the shorter distance you have to carry the water the better. In my own case I have rigged up a trolley arrangement, by which I can run a pail down to the well by its own gravity, fill it and return it to the cottage without much exertion. Water for toilet purposes is furnished from a homemade tank, on the roof of the kitchen. The extermination of insect pests is another important consideration. The cheapest form of exterminator is sulpho-napthol or even pure carbolic acid. When you are applying your heavy roofing paper to sides, floors and roof before shingling or clapboarding, you will find if you will paint lightly or brush over with a strong solution of sulpho-napthol, thoroughly saturating the paper, that you will never be bothered with insects. It drives away ants and is sure death to fleas. Before putting down a matting in the cottage, paint the floor with a strong solution of sulpho-napthol or carbolic acid. The odor goes away in a few days, but the death-dealing properties stay in the wood and matting. In the kitchen and on the verandas paint the walls with a hot solution of alum (2 ounces of alum to the pint of water) and you have banished all fears of cockroaches, water bugs, ants and moths.

As can be seen by reference to the floor plan, there is a bay on one corresponding to another bay on the same side, which is used as a kitchen. This kitchen is separate from the rest of the camp by an arrangement of two doors, which is very important in keeping the most generally obnoxious odors of cooking and the heat from the rest of the house. The other bay projects onto the veranda and can be fitted with a broad couch and shelves for books and magazines, as per sketch, and with a portière or two at night can be converted into a very cosy and comfortable sleeping-room for extra guests.

The kitchen has a large sink, a good cupboard for utensils, and can be entered from the side veranda, which in pleasant weather can be used as a dining-room, it being far more preferable to eat out of doors on the cool veranda in hot summer weather; and for this purpose I have provided my house with a table 7′ long, which, when not in use, is hinged so as to fall flat against the side of the house out of harm's way, and giving free use of the veranda for hammocks and easy-chairs.



Plan of Bungalow.

To those who contemplate building a summer residence similar to the one described in this article, the following statistics as to cost and materials may not be amiss:

MATERIALS AND COST

Material	Quantity	Cost
Hemlock boards	1,000 ft.	$18.00
Pine boards	400 ft.	9.00
Framing lumber	500 sq. ft.	10 00
Flooring lumber	400 ft.	8.00
Shingles	4,000	10.00
Laths	1,000	1.00
Canvas	30 yds.	3.00
Paper	2 rolls	5.00
Nails	25 lbs.	2.00
Hardware		2.00
Paint		2.00
Windows	5	5.00
Sinks	3	3.00
Incidentals		6.00
Carpenter's wages	1 week.	16.00
Total		$100.00

As can be seen by the plan, every inch of the available room is taken advantage of, and some very unique bedrooms are the result. The principal bedroom is 6′ 6″ in width and 11′ long. In this, without crowding, is placed a 4′ bed, a washbowl with running water drawn from a rain cistern on the roof, a clothes-closet 6′ long by 2½′ wide, and another one over 2′ long by 2′ wide. This room has one window opening over the washbowl, and is really the most comfortable room in the house. The next room adjoining is for the children, and is 6½′ square and contains two beds, each 30″ wide, arranged one over the other, like a steamship stateroom.

The partitions between the general rooms and the sleeping-rooms are made of light canvas nailed over laths.

For boarding I prefer hemlock, because it is cheap and easily handled. These should be covered with heavy building paper, which is both wind and mosquito proof, and then clapboarded. The roof can be done with the same, the paper being given a coat of paint before shingling. I have shingled my entire cottage, treating each shingle with creosote stain and the whole a coat of moss-green stain. For my floor I use first a floor of hemlock, then a covering of heavy building paper, and then a floor of hard pine laid the other way across.

Rear Admiral Rogers and the naval board, of which he is chairman, have selected a site for a government wireless telegraph station on the Navesink Highlands. The tower is to be placed near the north beacon of the famous Twin Lights and close to the Postal Telegraph Observatory.

According to *Electricity*, a novel departure in boat-race reporting was introduced last month by F. B. Howard, the agent of the Associated Press in Poughkeepsie, N. Y., with the co-operation of the Hudson River Telephone Company. Mr. Howard and Manager Rupley of the telephone company were on board of the judge's boat at the finish, with a telephone connected by under-water cable with the telegraph station of the Associated Press at the finish line on shore. In this way the positions of the crews crossing the line and the official time were telephoned to the shore, and immediately telegraphed all over the country. The telephone was also used to receive the progress of the crews as they came down the course, and this information was megaphoned from the judge's boat to the yachts anchored in the neighborhood. It was a very clever arrangement, and successfully carried out.

CORRESPONDENCE.

OUR readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of AMATEUR WORK, 63 Kilby Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if an answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

(No. 17.)

BUFFALO, N. Y., June 29, 1902.

Can you tell me who manufactures steam engines and boilers of ¼, ½ and 1 H. P. A. M.

B. R. Wicks, Bridgeport, Conn., and Sipp Electric and Machine Company, Paterson, N. J., make such engines, and the latter firm make boilers. They will send circulars and prices upon application.

(No. 18.)

ALBANY, N. Y., July 11, 1902.

In the article descriptive of an "Electric Wind Vane," a steel rod is used as an axis for the vane. As this part of the instrument is put on top of the house, would it not be dangerous in case of thunderstorms? If so, can you tell me a way to avoid the trouble? W. S.

Little fear need be felt that lightning will be attracted by such a small rod as is required for the weather vane. A lightning arrester can be added if desired, a description of one being given in this issue of the magazine.

(No. 19.)

CAMBRIDGE, MASS., July 11, 1902.

Will you please tell me where and at what price a wire gauge can be purchased? V. J. B.

A wire gauge, English standard, 5 to 36, list price, $1.00; American standard, 5 to 36, $2.00. You should be able to get such gauges at any large hardware store. If desired for electrical wire, you should get the American gauge.

(No. 20.)

ANTIGO, WIS., July 7, 1902.

Please inform me the weight of wire required for the primary and secondary coils of the medical coil described in the February issue. K. G. M.

About one-half pound of each size will be required for the coil.

(No. 21.)

BOSTON, MASS., July 22, 1902.

I have completed the spark coil which was described in the June number, but cannot make it work satisfactorily. The amount of current passing through the secondary coil was very light. It was even so small that one would have to place the wires on his tongue to be able to detect the current. Please advise what I may do to improve it. E. A. W.

First test the primary coil, and if this is found to be all right, there is undoubtedly a break somewhere in the secondary coil. It may be in the leading-out wires, as these are quite likely to get broken when mounting the coil. If a careful examination does not locate the fault here, the best thing to do is to rewind the secondary, making careful tests of the wire before doing so. Several readers of the magazine have made these coils from the directions given, and are getting good fat sparks over an inch long, one reporting a spark over 1½″ long.

NOTICE.

ROBERT THISTLEWHITE, Dover, Morris County, N. J., writes that the sets of motor castings offered free to readers of this magazine, who should write for them, were so quickly applied for that the supply became exhausted. Another supply will soon be ready, and all requests on file will be filled.

THE *Electrical Review* says: "The fact that the rooms of the King of England were cooled and ventilated during his severe illness by means of the electric fan was deemed of sufficient interest to be cabled to numerous daily papers in this country. The electric fan is purely an American invention, and its usefulness is becoming more and more appreciated in all countries."

AN invention which is likely to revolutionize the watchmaking industry has been perfected by a Swiss watchmaker, David Perret of Marin, near Neuchatel. It is a watch which goes by electricity. It was severely tested by experts, and it was found that it gained only seven-tenths of a second in five weeks. The expert at the observatory at Neuchatel declares the watch to be equal in precision to an expensive chronometer. The watch resembles an ordinary gentleman's lever, and will run, so it is claimed, fifteen years without being rewound.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. I. No. 11. BOSTON, SEPTEMBER, 1902. Ten Cents a Copy.

HOW TO MAKE A TELEGRAPH RELAY.

R. C. Browne.

A relay, carefully made according to the following directions, will prove a serviceable and extremely sensitive apparatus, suitable for many experiments in wireless or line telegraphy. The general construction is shown in Fig. 1, A being a piece of brass $\frac{1}{2}''$ x $\frac{1}{4}''$ and $6\frac{1}{2}''$ long. It is bent in a vice as shown, the several angles being made as accurate as possible. Drill a $\frac{1}{4}''$ hole at a, which should be countersunk to receive the head of a brass screw, which holds the rod to the base, and another $\frac{1}{4}''$ inch hole at b. Drill $\frac{1}{8}''$ or $\frac{3}{16}''$ holes at c and d, which should be threaded to receive the thumb-screws e and f. See that the threads are the same in the hole as on the thumb-screws, the latter being the top screws from two binding posts, though brass machine screws may be used. The thumb-screw e should have a small piece of platinum soldered to the end, and the end of f should be covered with a piece of thin cardboard or rubber. The rod A is then screwed to the center and at one end of the base board B, which should be of hard wood $\frac{7}{8}''$ thick, 5″ wide and 7″ long.

For the magnet M there will be needed a piece of soft Norway iron C, $1\frac{1}{2}''$ x $\frac{1}{2}''$ x $\frac{3}{16}''$. Drill three $\frac{1}{8}''$ holes h through it, one in the center and one $\frac{1}{8}''$ from each end. The hole in the center is threaded to receive the $\frac{3}{16}''$ machine screw D. The cores E are round, soft bar iron, $\frac{3}{8}''$ diameter and $2\frac{1}{16}''$ long. In one end of each core drill holes, and thread them to receive a machine screw (g, Fig. 2). After the cores are wound with wire they are fastened to the ends of the iron yoke C by these screws, thus forming a horseshoe magnet. Another way of fastening the cores to the yoke is to have the core pieces $\frac{1}{4}''$ longer, file down this extra length so that it will snugly fit the hole in the end of the yoke, and rivet firmly in place.

The cores being prepared, they are fitted at each end with round, hard rubber or fibre washers F, $\frac{3}{16}''$ thick and 1″ in diameter, the hole in the center being $\frac{3}{8}''$. These washers are held in position by shellac or glue, thus forming two spools for holding the wire. The wire should be No. 36 cotton covered magnet wire. First cover the cores with three thicknesses of firm writing paper laid on with shellac. Bore a small hole in the rubber washer, on the yoke end, to receive the inside end of the wire, about 3″ being left outside for connections. Wind the wire in even layers until the coil is nearly 1″ in diameter. Coat each layer with shellac, and use great care to prevent

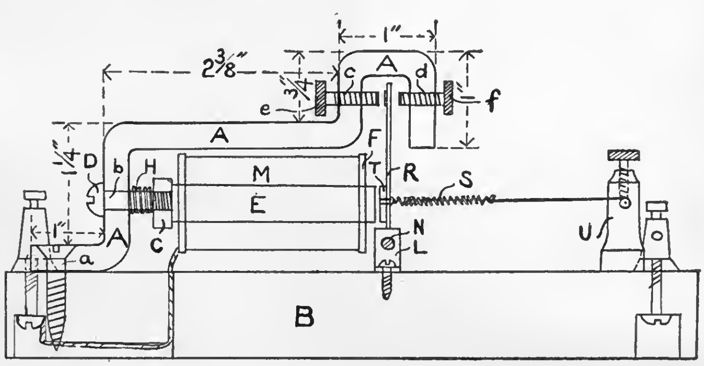


Fig. 1.

kinks or breaks in the wire. One coil is wound in the opposite direction to the other, so that the poles will not be the same. Cover the outside of the coils with a layer of dark-colored paper or binding leather, both for appearance and protection; then fasten to the yoke, and connect the inside ends of each coil. The magnet is then complete, and should be placed in position on the brass standard A, as shown in Fig. 1. A compression spring H, about $\frac{1}{4}''$ long, is fitted over the screw D, between the frame A and the yoke of the magnet. This allows the position of the magnet to be adjusted. The outside ends of the coils are carried through two holes bored in the base-board to the screws holding the binding-posts, which have been placed one in each corner of that end of the base-board, as shown in Fig. 1.

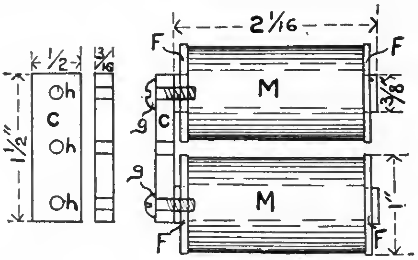


Fig. 2.

The armature or moving lever next demands our attention. Exceptional care must be taken in making it, as it is a very important part of the instrument. Obtain the works of an old clock of the square frame kind. These may generally be obtained from any clock repairer for the asking, the writer having secured about a dozen works recently at one place. Cut out with a knife-blade file that part of the frame having the bearings for the balance wheel (see J, Fig. 3). Save the balance wheel K, Fig. 3, shaft and bearings, to form the pivot for the armature. With a flat file smooth the edges of the pieces of the frame, and then bend them as shown at L, Fig. 3. Use care to have the centers of the bearings N exactly the same height above the base-board. Drill $\frac{1}{8}''$ holes in the parts resting on the base, to receive the screws O.

Remove the rim and spokes of the balance wheel, and cut a slot in the brass hub P, into which solder the wider end of a wedge-shaped piece of sheet brass R, $\frac{1}{16}''$ thick, $\frac{3}{8}''$ wide at the base, $\frac{1}{4}''$ wide at the top, and $1\frac{1}{2}''$ long. At a point directly opposite the cores in the magnet drill a hole in the piece R, and rivet on a piece of soft iron, T (thick stove-pipe iron will answer), $\frac{3}{8}''$ wide and $1\frac{1}{2}''$ long. Under the head of the rivet twist a short piece of steel wire, the end projecting to form a small hook, to which is attached the spring S. Mount the armature on the base-board so that the iron armature, T, will be directly opposite the cores of the coils and the shaft of the balance wheel moves easily but not loosely on the bearings N. Mark the point at the top of the lever R, where the thumb-screw e touches, and solder a small piece of sheet platinum, being sure to get it on the proper side of the lever.

The regulator for regulating the tension of the spring S, which holds the lever away from the magnets, is easily made. A large binding post, U, is placed as shown in Fig. 1, with the hole parallel to the armature and the post a little to one side of the center. Through the hole in the post put a piece of brass wire to one end of which has been soldered a round head so that it may be carefully turned. Make a small, light spring, S, by winding No. 30 brass wire around a wire nail, with a hook at each end. One end is placed on

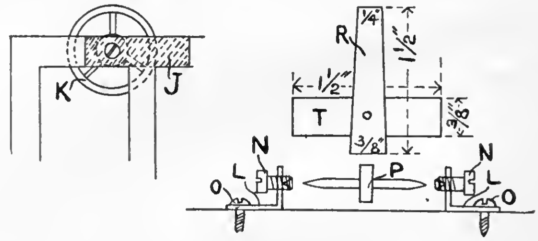


Fig. 3.

the hook of the armature and the other is fastened by a short length of silk thread to the brass wire in the binding post. To adjust the tension, turn the wire in the binding post, winding or unwinding the thread until the correct tension is obtained, then fasten with the screw in the binding post. Two binding posts are screwed to the remaining corners of the base-board, one of them being connected by No. 14 or 16 covered wire to the brass frame A, the other to one of the bearings N, holding the pivot R. These connecting wires are carried through holes bored and grooves cut on the under side of the base-board.

AN ELECTRIC INDICATOR.

William Slyke.

In a house where there are several entrances and rooms, and electric connections are desired to ring a call bell, an instrument called an annunciator or indicator is used. Bells of different tone are sometimes used, but when the number of bells is more than three or four, it is very hard to distinguish between them. An indicator, which shows from what room or place the call comes, is desirable. Indicator movements take a variety of forms, but may be divided into two distinct forms, viz.: Those which drop a shutter or move a disc, in which the shutter or disc requires to be reset each time a signal is sent in; and those which require no resetting, depending for their action on a swing or pendulum movement, which, when started, continues for some time. The latter kind are called pendulum indicators, and is the kind to be here described.

Of the two kinds, the pendulum indicator is much to be preferred, as an extensive use of the former has proved that persons cannot be relied upon to replace the shutter, so that when the bell rings there are two or more shutters down, thus causing more or less delay in answering the call. As there are a number of magnets used in the construction of an indicator, the builder is advised to buy the magnets, as they will be cheaper to buy than to make; but if one wishes to make them, a full description will be found in the November, 1901, number of Amateur Work.

A magnet is needed for each call, to be connected to the indicator, and another for a relay. (See Fig. 1.) Two magnets are fastened to a soft iron base, L, Fig. 1. One or two magnets may be used, but two are better. A piece of soft iron about 1/8″ in thickness by 1/2″ wide, and just long enough to reach from one end of one core to the end of the other core of the magnets (M, Fig. 1) forms the armature. To the top of the armature solder a very thin piece of steel or other springy metal, about 1¼″ long and 1/8″ wide (N, Fig. 1). A binding-post, J, with a hole and set screw, is inserted into base B of the indicator. The end of the steel spring is made small enough to fit tightly in the hole of the binding-post. To the other end of the armature is soldered a piece of stiff wire about 1¼″ long. To the end of this wire is soldered a piece of tin or other light metal, about 1″ long and 3/4″ in width; this is the vane upon which the name or number is placed. In many of the commercial forms a piece of silvered glass (looking-glass) is fastened to the wire instead of metal, as this can be readily seen in a dim light.

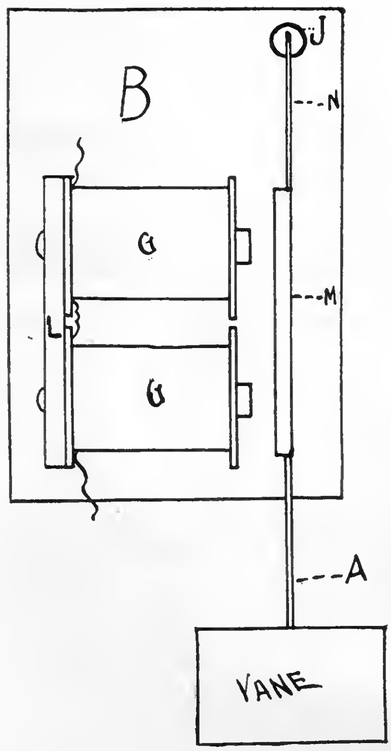


Fig. 1.

Push the end of the spring in the binding-post until it just reaches the other side of the hole, and fasten it down with the screw. The binding-post is put in a position so that the armature hangs as shown in Fig. 1. The armature should hang 3/8″ from the top of the cores of the magnets. Now test the vane by fastening it in a vertical position so the vane hangs down. Connect one wire of the magnet to the pole of a battery; the other end of the wire is just touched to the other pole of the battery. As soon as the second wire comes in contact with the battery the armature will, if the vane is all right, be attracted to the magnet G G and held there until the circuit is broken. As soon as this occurs the vane and armature is released and will swing to and fro for some time, finally stopping in its normal position. Make as many of these vanes as there are rooms or other places to be connected with the indicator; three are shown in Fig. 2.

may be fixed the same way as the armature of the vane. To the other end of the armature is soldered a strip of metal 1¼″ long and ¼″ wide, and should be as thin as a medium-sized clock spring. Two binding-posts with small holes and set screw are inserted in the base, as shown at B and C in Fig. 3. To the post B is fastened a piece of wire 10″ or 12″ long, No. 20 gauge, to be used for connections. A piece of a wire nail ¼″ in length is inserted in the hole of each binding-post, the top screw is then screwed down to firmly hold the nail. It is very important that there should be only a very small space between the armature and the cores of the magnet, and the metal strip should

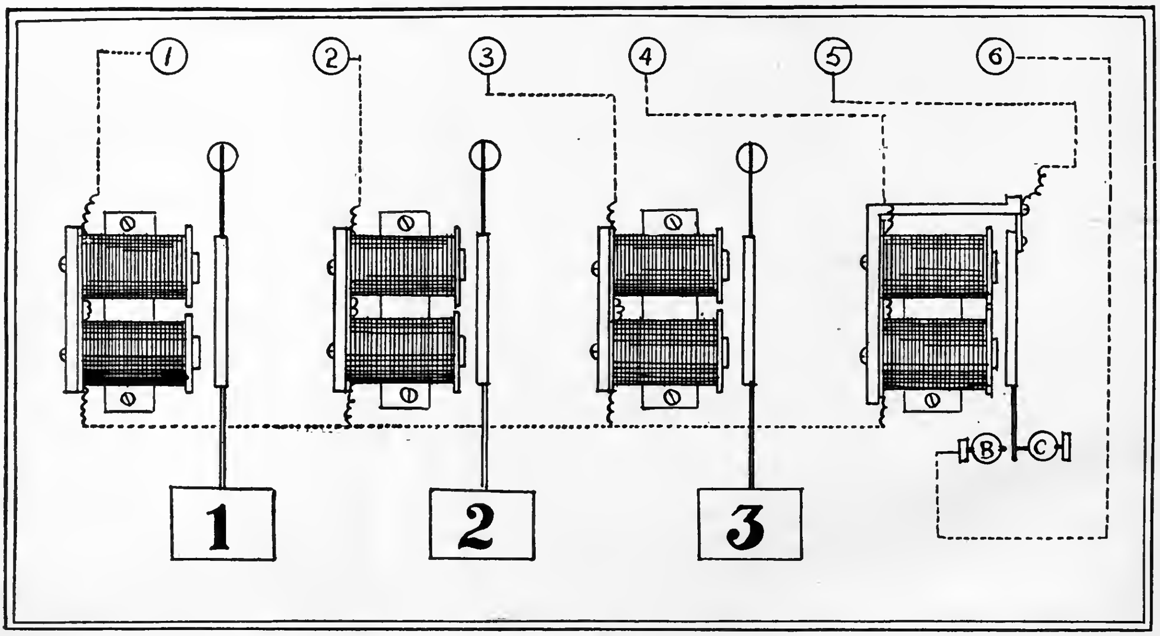


Fig. 2.

rest lightly against the post C but not quite touch the post B when the relay is at rest. If a speck of platinum can be soldered to the nail in post B, and another speck on the metal strip just where the strip touches the nail, a better contact is made, but if all the parts are kept clean it is not absolutely necessary.

As an electric bell is used with the indicator to tell when a signal is sent in, a relay is frequently employed in conjunction with the pendulum indicator, as the continual make and break of the circuit by the bell sometimes interferes with their satisfactory working. As its name implies, it relays another battery into the circuit. A relay is used in telegraphy and many other forms of electrical apparatus. It is made as follows: A magnet is fastened to a soft iron base just like the vane. The armature is made also in the same manner as the armature of the vane. It should be pivoted at the top, as shown at J, Fig. 3, but

A piece of planed board is now procured, large enough to hold all the vanes and the relay. Three binding-posts are needed for the relay, and one for every vane put on the board, as shown in Fig. 2. The inside connections are as follows: Fasten all the vanes to the board, and place the relay in the right-hand side as in Fig. 2. From post B of the relay a piece of annunciator wire is brought to binding-post 6, Fig. 2. A piece of wire is soldered to the armature of the relay and carried to post 5. The end of the lower magnet wire of the relay is connected with the bottom wire of each vane magnet. (See Fig. 2.) The upper wire of magnet on the relay is carried to post 4, and the upper magnet wire of each vane is carried to a separate binding-post. The outside connections can be readily seen by examining Fig. 4. Post 6 is connected to post on bell. A piece of wire is carried from zinc of battery to the other post of the bell. A wire is carried from post 5 of indicator to carbon of battery Z. The connections of battery X are: Carry a piece of wire from zinc of battery to post 4; from carbon of battery carry a length of wire to each push-button in the different rooms, and from push 1 a piece of wire to post 1 on indicator, etc.

holds it until the push is released, when the armature is released also and begins swinging. The armature of the relay is also attracted, and in coming to the magnet it brings the metal strip in contact with the nail in post B; this closes the circuit of the bell, which rings until the push is released.

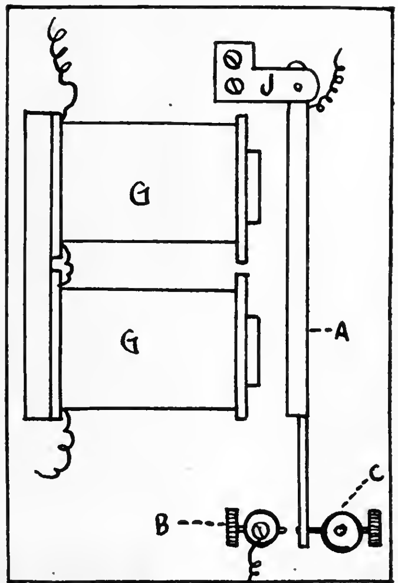


Fig. 3.

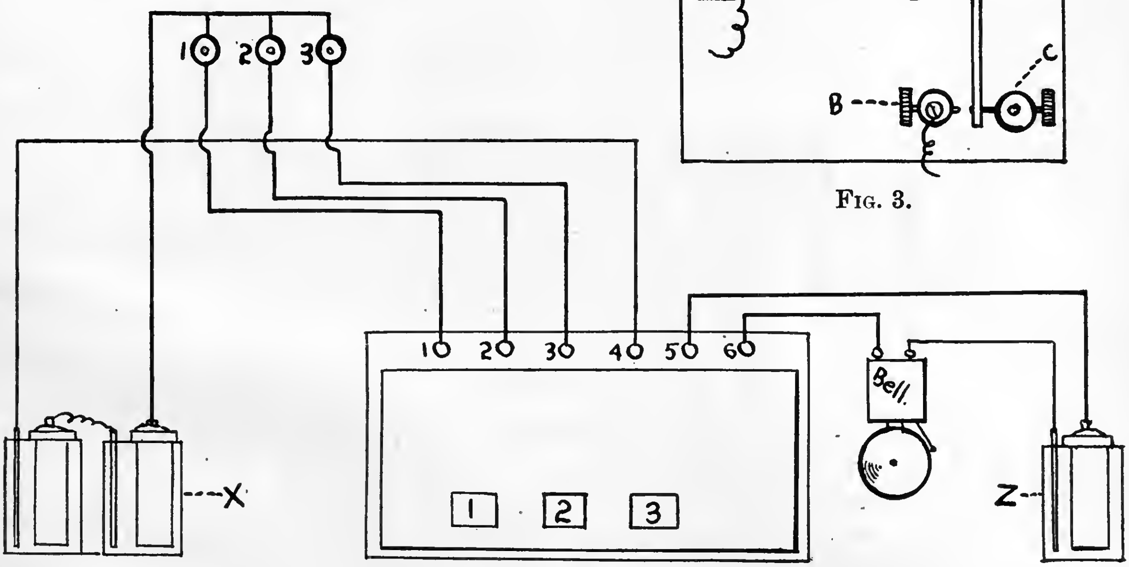


Fig. 4.

A top can be put over the vanes and relay with holes through which to see the numbers of the rooms. If a single-stroke bell is used, a relay is not necessary, and the bell is connected just like the relay, cutting out the wires of binding-posts 5 and 6. The working of the indicator is as follows: A person in room 1 pushes the button in that room, this closes the circuit of vane 1 and the relay. The magnet attracts the armature and

In the construction of a municipal electrical generating plant for the city of Geneva, Switzerland, the engineers found themselves confronted with a great difficulty in the constantly-varying water level of the river Rhone. In order to overcome this inconstancy of the water supply, a two-story station was constructed, with two turbines built one above the other on the dynamo shaft. The plant comprises 18 sets of these turbines.

STUDIES IN ELECTRICITY.

XI. PARTS OF THE DYNAMO.

As mentioned in previous chapters, the field of a dynamo provides the lines of magnetic force in which the coils of the armature revolves, cutting these lines of force and thus generating an electro-motive force. In the earliest forms of dynamos permanent magnets were used for the field, but these have long been discarded, except in the smallest sizes and for special purposes, such as the magnet ringing device of the telephone, spark generators for gas engines, and the hand-power dynamo of the laboratory. In these forms of the dynamo the permanent magnet is used, but in the larger forms of direct-current machines the fields are self-excited electro magnets.

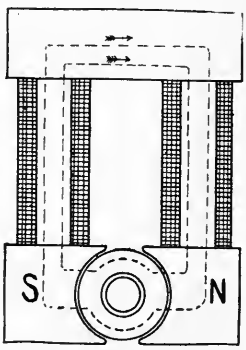


Fig. 30.

The designs of the different manufactures differ greatly in form, the aim in all being to secure an easy and short path for the flow of the magnetic lines of force in as compact and cheaply constructed a form as possible. The work to be done also regulates to quite an extent the design of a dynamo. A complete magnetic circuit must be provided to secure a flow of the magneto-motive force (M M F), just as a complete outside circuit is necessary to the flow of the electric current. This is shown in Fig. 30, which is an upright horseshoe type of single circuit bipolar field magnet, the magnetic circuit being shown by the dotted lines.

The Edison dynamos were of this type, but have for many uses been supplanted by other forms, which are mechanically more desirable, such as the form shown in Fig. 31. This has two magnetic circuits, and is also known as "iron-clad," from the fact that the poles are enclosed. This is the popular form for small dynamos, hav-

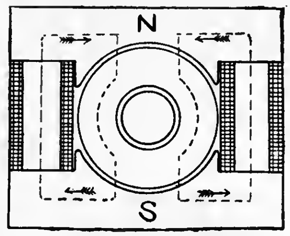


Fig. 31.

ing great mechanical strength and well protected from injury. This general design with two extra poles, one on each side, makes a four-pole dynamo, thus introducing the type known as a multipolar dynamo, illustrated by Fig. 32. Large machines are generally of this type, the number and size of poles differing greatly with different manufac-

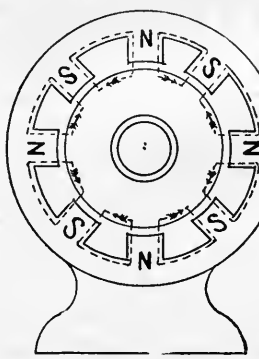


Fig. 32.

tures. This type requires less iron and wiring than do the others, weighs less for a given output, and is more easily transported and erected, all of which are of much importance when we consider the immense size of the machines now being used

The reader is advised to inspect as many different dynamos as he conveniently can, and observe carefully how they differ in form and design. In doing this, much incidental information of value will also be acquired.

As explained in the previous chapter, the armature of a dynamo is the part which generates the electric current. There are two forms commonly used, known respectively as the Gramme or ring pattern, and the drum armature. The armatures of all commercial dynamos are of either of these two kinds, or modifications of them. In the

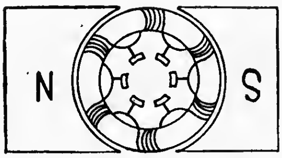


Fig. 33.

Gramme type the core is an iron ring upon which the coils are wound, as illustrated in Fig. 33. The forms for winding and the methods of connecting the coils vary widely, but may be grouped into two classes, known as *closed coil*, in which the coils are all connected, as shown in Fig. 33, and *open coil*, in which each coil performs its work entirely independent of the others.

The armature core, in all types of armatures, serves not only as a support for the wire coils, but also acts as a conductor for the magnetic lines of force in their passage from pole to pole. It is very essential that they be well adapted to perform this latter function. If made of a single piece of iron, it would, while rotating in the magnetic field, induce currents, known as eddy currents, which not only cause a waste of energy but develop heat, which would be injurious. To avoid this, the cores are made of thin sheets of soft iron, insulated from each other, and so arranged that while still providing a suitable path for the magnetic flux between the poles, no eddy currents are set up.

In the ring armature the core is made of strips of thin iron arranged in concentric rings. In the drum armature the core is made of numerous thin circular discs, insulated from each other usually with paper, and having on the circumference a suitable number of slots, as shown in Fig. 34, in which are wound the wire coils. This enables the space between the armature and the poles, known as the *air gap*, to be only great enough to prevent contact between the two. In the smaller sizes of dynamos the discs are attached directly to the shaft and secured firmly in place, usually by end plates made of brass held by nuts threaded to the

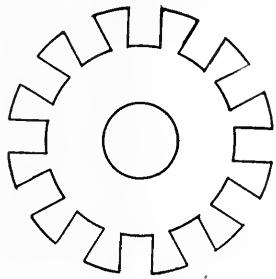


Fig. 34.

shaft. The number, size and shape of the slots cut in the discs for the coils vary widely, and likewise the wiring of the coils. This subject will receive more extended attention when the construction of some particular form of dynamo is presented. In the larger sizes of dynamo the cores of the ring, and the larger sizes of the drum type, are attached to the shaft by what are known as "spiders." They consist of a hub, which is keyed to the shaft, and has arms which are attached to the core by bolts.

The high price of coal will undoubtedly spur inventors towards perfecting oil burning furnaces for household use.

An important paper has recently been published by Dr. Selim Lemstrom, of Helsingfors, on the use of electricity as a plant fertilizer. His experiments show that for plants growing on arable land of medium quality an increase of 45 per cent. in the crops is obtainable, the better the field is tilled the greater the increase; on poor soil the effect is trifling. Certain plants, such as cabbages and turnips, do not respond to electrical treatment until after being watered. Electricity applied when the sun is shining strongly is almost invariably injurious.

WOOD TURNING FOR AMATEURS.

F. W. Putnam, Instructor Manual Training School, Lowell, Mass.

I. HISTORY OF THE LATHE.

The amateur who is anxious to learn something of the art of wood turning has doubtless found, in hunting for information, that there is very little literature on the subject, when one considers the importance of the topic. The student who is fortunate in being able to attend a high school having, as one of its electives, a course in Manual Training, will obtain in the Wood Turning part of the course instruction and drill in lathe work, covering practically the ground to be covered in this series of articles. I shall, then, address myself first of all to the boy who has not been so fortunate as to have this chance.

As I have said, very little has been written on this subject, and there is in consequence little chance for arriving at conclusions as to the best method for performing any particular operation; so, also, there is a wide variation in the use of the different tools by which different operators arrive at the same results. While some turners use one tool almost entirely for a given operation, others will make use of a variety of tools. The exercises which follow are designed to give the operator command of the more commonly used tools, using each for the operations for which it is best fitted.

In the following brief history of the turning lathe, and in the subsequent articles, I have drawn from the Encyclopædia Britannica, Woodward, Hodgson, Golden, and Holtzapfel.

Before starting to study the operations of the wood turner, let us first learn something of the history of the lathe, its mechanism, and the tools to be used in the work.

HISTORY OF THE LATHE.

In its simplest form — a form which is still employed by the natives of India — the lathe consists of two upright posts, each carrying a fixed pin or dead centre, between which the stock to be turned is made to revolve by an assistant, who pulls alternately the two ends of a cord passed around it. A cutting tool is held firmly in a bar which forms a "rest"; this attacks in succession the projecting parts, and in this way the entire surface is brought to an equal distance from the central axis. In other words, the cross section becomes somewhat circular.

In its rudest form this sort of a lathe consists only of two stakes driven into the ground, through which sharpened nails are driven to support the work. The stock is revolved, as in the first case, by means of a cord in the hands of an assistant.

The first illustration of anything in the shape of a turning lathe was published in a German work in 1568, the picture showing a man at work turning a sphere. The lathe shown is of the most primitive kind, yet the picture shows a number of turned articles, such as tops, vases, balusters, spindles, etc., giving evidence of the practical results obtained by its use.

The turner stands with his back against a rail, a custom that is practiced to this day in some parts of Austria and Hungary, where the finest of children's toys are made, equal in many respects to the famous wooden ware of Tunbridge Wells. The manner by which this lathe is driven is not very clear, but from all indications it is probably driven by a pole, as there appears to be one with one of its ends inserted in the wall at the back of the lathe. The stock to be turned was rotated by means of a cord, which was wound around the work two or three times, having one end attached to an elastic pole, and the other formed like a stirrup, into which the foot of the workman was inserted.

When the foot was forced downwards the work would be rotated in the direction of the cutting tool, and the end of the pole bent downwards toward the work. When the foot reached the floor the work would cease to revolve, and the turner was compelled to draw the cutting tool back while the foot was raised, the spring in the pole drawing the stirrup up, thus causing the work in the lathe to rotate in the opposite direction.

When the pole recovered its straight form the operation would be repeated and continued until the job was completed. By this method the stock in the lathe rotated alternately, first in one direction and then in the other, and the operator was compelled to withdraw the cutting tool at every change of motion,—something that must have severely taxed his patience and skill.

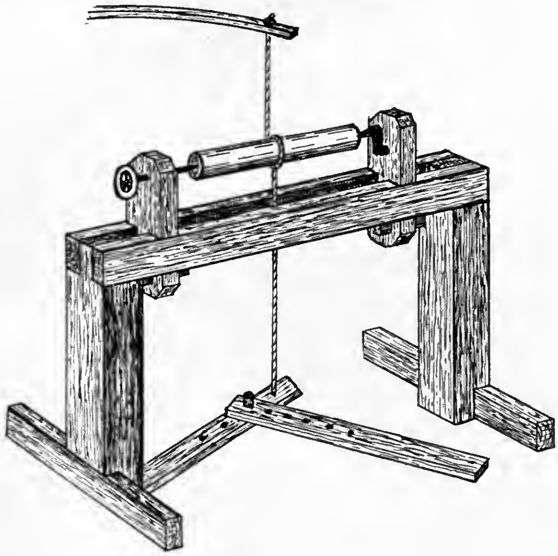


Fig. 1.

Fig. 1 shows a "dead-centre lathe" of the kind used in Europe during the eighteenth century, in which the centres are carried by "poppets," which can be adjusted to suit the length of the work, the turner giving the rotation by means of a treadle and spring lath attached to the ceiling. This lath, having immortalized itself by giving its name to the "lathe," has now almost entirely disappeared, the waste of time in its upward stroke (during which time the work revolves in the wrong direction) being a fatal objection to its use in an age in which economy in that respect is of such importance. Dead centre lathes themselves are now almost things of the past, though within their own limits,—which are of course confined to such articles as are turned on the outside only, and can be supported at the ends,—they offer a steadiness of support and a freedom of rotation which others seldom equal and never surpass. The system, however, still survives in the small lathes, or "throws," used by watch and clock makers; and for their purposes it is not likely to be superseded.

Another method of operating the early lathe was by the aid of a bow. This instrument generally had several strings to it, which were fastened to a sort of roller or pulley at their middle point. This roller had a cord attached to it which was wound several times around the material to be turned and, extending down, was fastened to a treadle under the lathe, similar to that shown in Fig. 1.

The bow was an improvement on the pole, as it equalized the force and was not so hard on the operator. The power was more uniform, enabling him to work with greater accuracy on the most delicate jobs. The bow was so constructed that it could be attached to the frame of the lathe, to the ceiling, or to the side wall, as might be most convenient.

Travellers tell us that this kind of lathe is still in use in many parts of India and China, where the itinerant mechanics carry with them their tools, including one of these lathes, and do a job of turning wherever their services may be required. It is stated that their skill in turning with the aid of this rude machine is something marvelous.

It seems to have taken a long time to develop this "treadle-lathe" into the "foot-lathe," the application to it of a fly-wheel worked by a crank and treadle having been exceptional rather than usual even in the early part of the last century, though a separate fly-wheel turned by an assistant had long previously been employed, and must have made possible the turning of heavy work which could not have been attempted without it.

The early attempts at modifying the dead-centre lathes so that articles, such as bowls, vases, and the like, could be turned without the support of what was then called the "back-centre," (corresponding to what we now call the tail-centre or dead-centre) were not very encouraging. A spindle or mandrel was after a time introduced, carrying a pulley for the lathe belt and having a rude form of screw thread at one end so that the work could be attached to it. This of course gave a rude sort of "head-stock" resembling Fig. 2. Unfortunately however the discarding of the dead-centre point and the substitution of a front bearing,—a step which was necessary in order to free the end of the spindle, and so enabling it to carry the work,—must have been accompanied by a loss of power and an amount of unsteadiness which quite account for the tenacity with which the simple bow-lathe and the very similar "spring-bow lathe" survived.

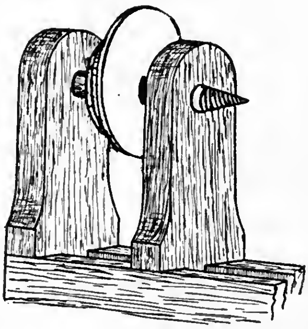


Fig. 2.

A careful study of the history of the lathe as given here shows us that the principal features essential to all lathes are, 1st., an axis of revolution for the material being operated on, and 2nd, some means for supporting and guiding the cutting-tool.

MODERN LATHES.

The types of modern lathes are as varied as are the occupations of those who use them. The mechanic, the soft-wood turner, and the amateur, for instance, differ so greatly in their requirements that lathes which would be well suited to one would be very poorly adapted, if not practically useless, to another.

Thus the professional turner of soft wood, with a lathe of which the frame and even the fly-wheel are of timber, will use a high rate of speed, sharp tools, and light cuts, thus obtaining results with which the owner of an elaborate lathe cannot at all compete. A modern mechanic's lathe, on the other hand, has very different demands made upon it. For this the greatest possible steadiness in all its working parts is the main requirement, and it is of great advantage to have the means of obtaining a slow speed, so as to be able to take the heaviest cuts which its strength and the power available warrant. As a result, timber has given way to cast iron or gun-metal or steel in almost every part of a lathe. In nearly all these modern lathes a metal spindle revolving in metal bearings determines the axis previously referred to, and as this spindle turns in one direction, the revolving wood has a movement that is steady, smooth, and continuous. The cutting tool is supported on an adjustable rest, and the speed of revolution may be varied within comparatively wide limits.

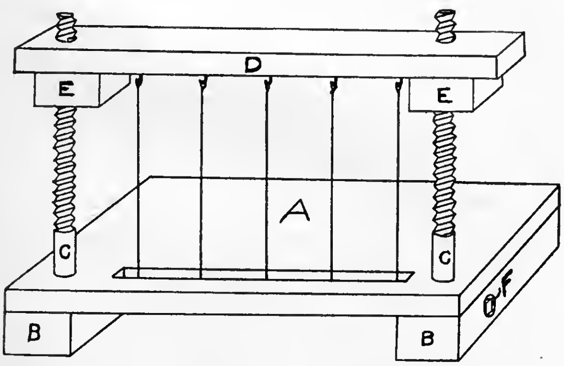
The next paper will take up the modern lathe somewhat in detail, with illustrations, and a description of its parts, together with a description of the tools to be used in the work.

An instance of non-familiarity with simple scientific facts, says Cassier's Magazine, is illustrated by an article that goes the rounds of the press once or twice annually, namely, the story of the electrified house. The article usually states that some one has discovered that everything he touches in his house—the radiators, picture frames, banquet lamps, etc.—give him an electric shock. Hence, he fears that there is some connection between the arc-light wires and the water near his residence. The electric light inspector is therefore summoned, and reports that the wires of his company are intact, and that the electricity must come from another source. It does not dawn on any of the people consulted that the discoverer of the phenomenon is unconsciously performing one of the simplest and oldest of electrostatic experiments, the shuffling of his shoes over the dry carpet raising the potential of his body to several thousand volts, which discharge at every opportunity. One may even get electrical discharges from his knuckles to the brass lock of a handbag which he may be carrying while walking on a stone pavement during cold, dry weather. But, dismissing newspaper science, it is somewhat astonishing, in view of the many ways in which in cold, dry countries electricity is unintentionally developed and manifested by sparking, that the first knowledge concerning this phenomenon did not come to the ancients in this way rather than by the attraction of light substances by amber. The explanation of this, however, may be that the scientists of bygone days did not reside in cold, dry climates.

BOOKBINDING AT HOME.

I. SEWING FRAME.

In many a household there accumulates magazines and other printed matter which the possessor does not wish to throw away, and yet does not care to go to the expense of sending them to the bindery to be bound. A satisfactory solution to such a condition is to bind them at home. Not only can home binding be done cheaply, but many times sufficient skill can be developed at the work to enable one to make fine bindings. The writer recently saw the works of a popular author which had been rebound in leather by an amateur, which showed a proficiency not common in professional work. As an occupation for inclement or winter weather, bookbinding is both interesting and profitable. The work can be continued as opportunity permits, is clean, and may be made as artistic as the purse and inclination permits. The simpler forms are quickly learned, and it is this work only which will be included in these directions, leaving the more difficult work to be learned from books already available, or under the instruction of professionals.



Sewing Frame.

As certain tools are necessary to even the most simple styles of binding, the construction of those which can be made by the amateur will first be described. The sewing frame, as shown in Fig. 1, is easily made. A large wooden clamp with screws about 15″ long, can be purchased at a hardware store for a small sum. A base-board, A, 1′ 10″ long, 14″ wide and 1″ thick, should be planed level and smooth. It is supported upon two pieces of wood, B, 14″ long, 3″ wide and 2″ thick, one at each end, which are glued and screwed to the baseboard. The heads of the screws are countersunk and covered with putty. In each of the front corners of the baseboard bore a hole, the center of which is 2½″ from the front edge and 1½″ from the ends, and of a size to snugly receive the handles of the wooden screws, C, of the clamp. The handles of the screws are then put in the holes, and ¼″ holes, F, are bored through the supports and the handles of the screws C, through which are put ¼″ bolts. This method of making the frame enables it to be taken apart and laid flat when not in use, thus requiring less space for storage.

A wooden crosspiece, D, is 1′ 10″ long, 2½″ wide and 1″ thick. Bore holes, the centers of which are 1½″ from each end, large enough to receive easily, but not loosely, the screws C. The pieces E are cut one each from the jaws of the wooden clamp, only one hole in each jaw having a thread cut in it. About 1″ of wood is left on each side of the hole. Another way to make the crosspiece D is to take the pieces of the clamp jaws having the smooth holes, cut off the ends, leaving about 1½″ of wood each side the holes; bore 1″ holes in one end of each piece, and in these holes glue the ends of a piece of 1″ round oak curtain pole 1′ 5″ long. This form possesses some advantages over the form first given. Between the screws C a long slot is cut through the baseboard A, ½″ wide and 1′ 4″ long, to receive the strings used in binding, the lower ends of which are tied through holes in flat pieces of wood 3″ long, 1″ wide and ¼″ thick, and kept in place by the tension on the string. The upper ends are tied to hooks on the lower side of the crosspiece D if the first form is used, or tied over the round rod if the second form is used. The press will be described in the next chapter.

AMATEUR WORK

63 KILBY ST., BOSTON

DRAPER PUBLISHING CO., PUBLISHERS.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

SEPTEMBER, 1902.

Contents

The delay in receiving material necessary to the equipment of our own publishing plant, has delayed the issuing of this number. With the excellent facilities now possessed for the work, future numbers will be issued promptly. We know how eagerly many of our readers await the receipt of the magazine, and are sorry the vexatious delays have occurred on the last two numbers. The many interesting articles now in hand will greatly increase the interest already manifested.

Many of our readers residing in the smaller towns have found it difficult to obtain the supplies necessary to make some of the things described in this magazine. For their accommodation, premiums will be offered consisting of the parts of any apparatus for which there is sufficient demand to make this premium plan feasible. On account of the expense of mailing or expressage, such offers will be confined to parts which can be sent at reasonable expense. Our readers will be expected to advise us of the parts they are desirous of obtaining in this way so that we may learn what to offer. If replies are desired a stamp must be enclosed.

Attention is called to the advertisements of prominent tool manufacturers appearing in this issue. These firms are well known to the trade as being leading concerns in their respective lines, and the tools made by them are of superior workmanship and accuracy. The readers of tnis magazine will greatly profit by obtaining the catalogues or descriptive circulars of the tools thus brought to their attention, as a working knowledge of all kinds of tools is desirable alike to professional or amateur. With such knowledge, the tools desirable for any particular work can be purchased more judiciously than would otherwise be possible.

The consul-general at Yokohama, Japan, reports to the state department at Washington that the postal authorities are considering American automobiles for transporting the mails at Tokio.

According to Electricity, the New York Central Railroad Company has formally notified Mayor Low of New York city that electricity as a motive power will be substituted for steam on all trains passing through Park avenue tunnel.

PROJECTION.

Earnest T. Childs.

I. PLANES.

Projection, or descriptive geometry, treats of the delineation of solids, that is objects having length, breadth and thickness are represented on the flat surface of a sheet of paper in such a way that their form becomes evident at a glance. The subject may be subdivided into three branches, known as Orthographic projection, Isometric projection, and Perspective. The first, which treats of the representation of objects placed in any given position by means of parallel lines drawn from given plans, elevations, etc., is the one which requires the greatest attention.

will travel through the arc of a circie as shown by points F^1, F^2 and F^3 (Fig. 2). When the plane stands at E F^3, the elevation becomes a line, AB. When it stands at E F^2, the elevation becomes A B C^2 D^2; when at E F^1, the elevation becomes A B C^1 D^1, and at E F it is the same as Fig. 1. It will be readily seen that the width of the elevation depends upon the distance that point F has moved along the arc F–F^3, and is obtained in each instance by drawing construction lines from the points in the arc up to the elevation.

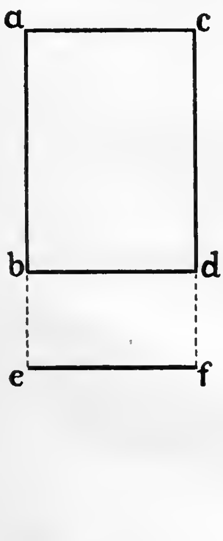


Fig. 1.

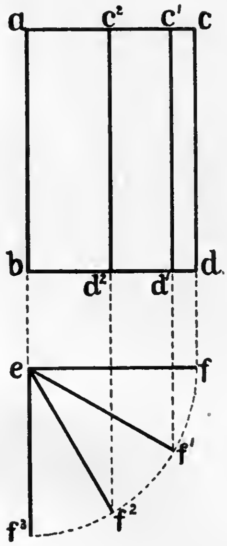


Fig. 2.

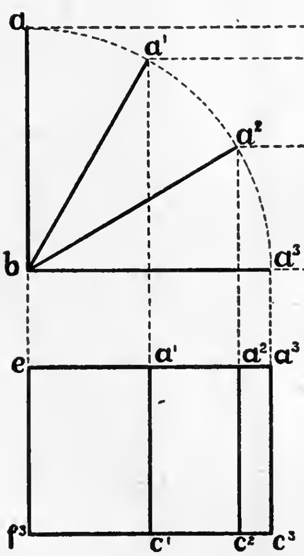


Fig. 3.

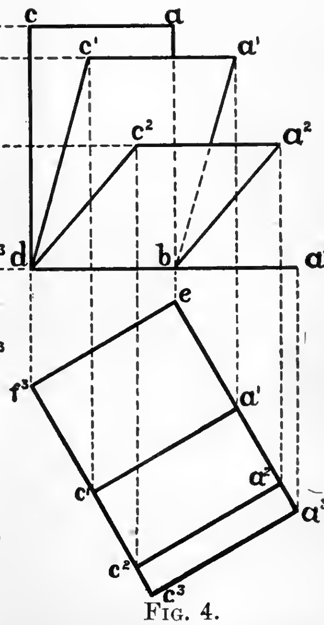


Fig. 4.

The student who has carefully followed the course in Mechanical Drawing, and completed all the plates shown therein, will be well equipped to continue his studies along the lines of Projection.

The first problem which presents itself is the projection of planes.

Assume a plane, A B C D, shown in elevation, and represented in plan by the line E F (Fig. 1). If the plane is turned on its axis A B, point F

If the plane be turned to E F^3, with elevation shown by line A B (Fig. 3), and with E F^3 as a center, and the plane be swung through arc A–A^3, the elevation will in each instance be shown by a line, B A^1, B A^2 and B A^3. The plan will be obtained by drawing perpendicular lines from points A^1, A^2 and A^3, forming figures E F^3, A^1, C^1 from A^1; E F^3, A^2, C^2 from A^2, and E F^3, A^3, C^3, which is the same as A B C D from A.

Let it be next assumed that the plan E F^3 A^3 C^3

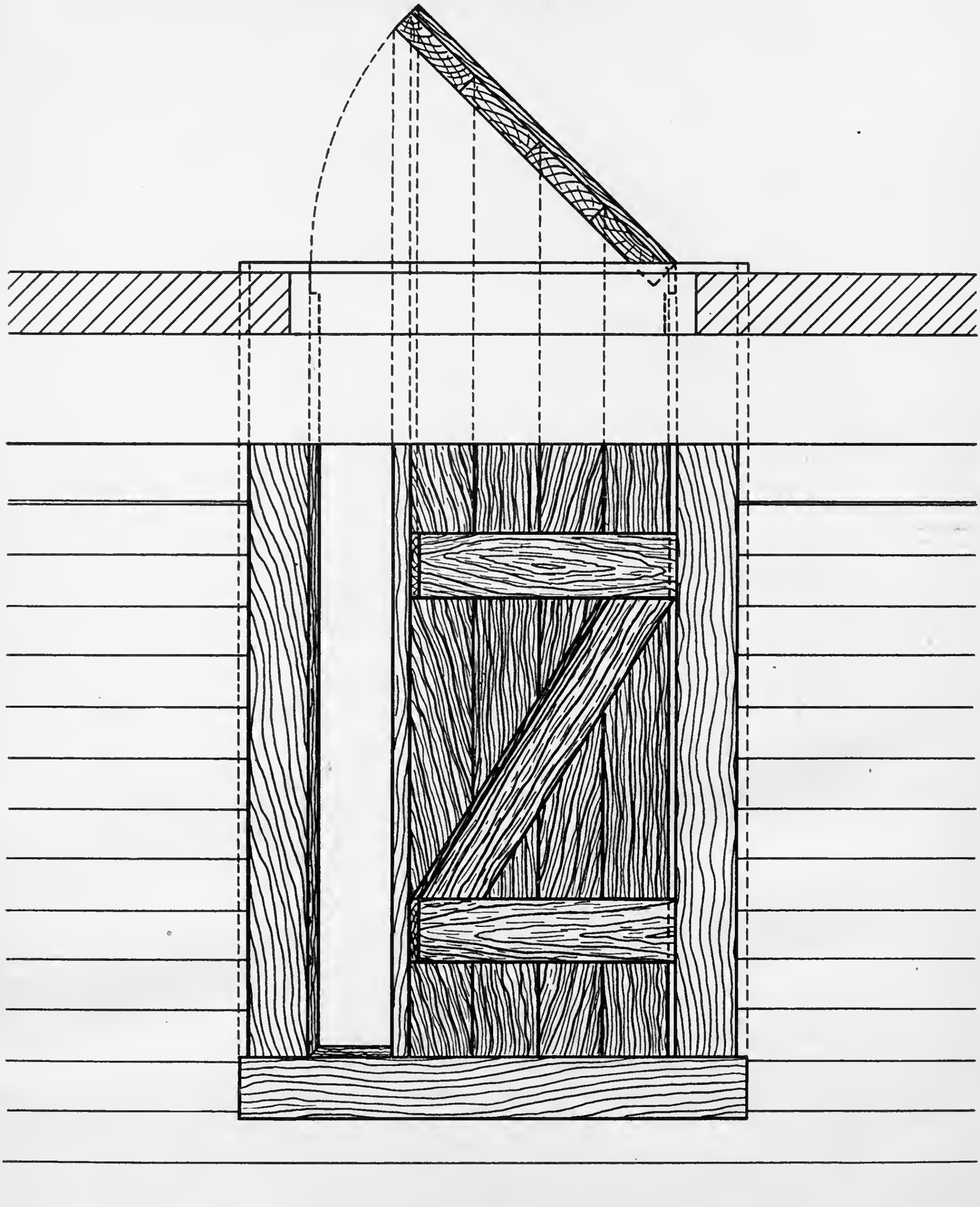


Fig. 5.

is turned at an angle, as shown by Fig. 4, and assume that the plan is to be shown as stopping at points A^1 and A^2 on arc A A^3. Plan E F^3 C^3 A^3 will be shown by line D A^3 in elevation. The plane B A^2, as shown in plan by figure E F^3 C^2 A^2, will be shown in elevation by figure A^2 C^2 B D, and plane B A^1, as shown in plan by the line E F^3 C^1 A^1, will be shown in elevation by figure A^1 C^1 B D; and plane B A, as shown in plan by E F^3, will be shown in elevation by figure A C B D.

This wil! be a practical application of the problem shown by Fig. 2. It will be necessary to first draw a plan showing the wall and doorway, and also showing the door swung open at 45°. Having this information, it is simply necessary to know the height of the door to be able to make the necessary drawing. The doorway will, of course, be shown of its full width and height. On account of the door being swung at an angle, it will appear foreshortened, that is it will appear

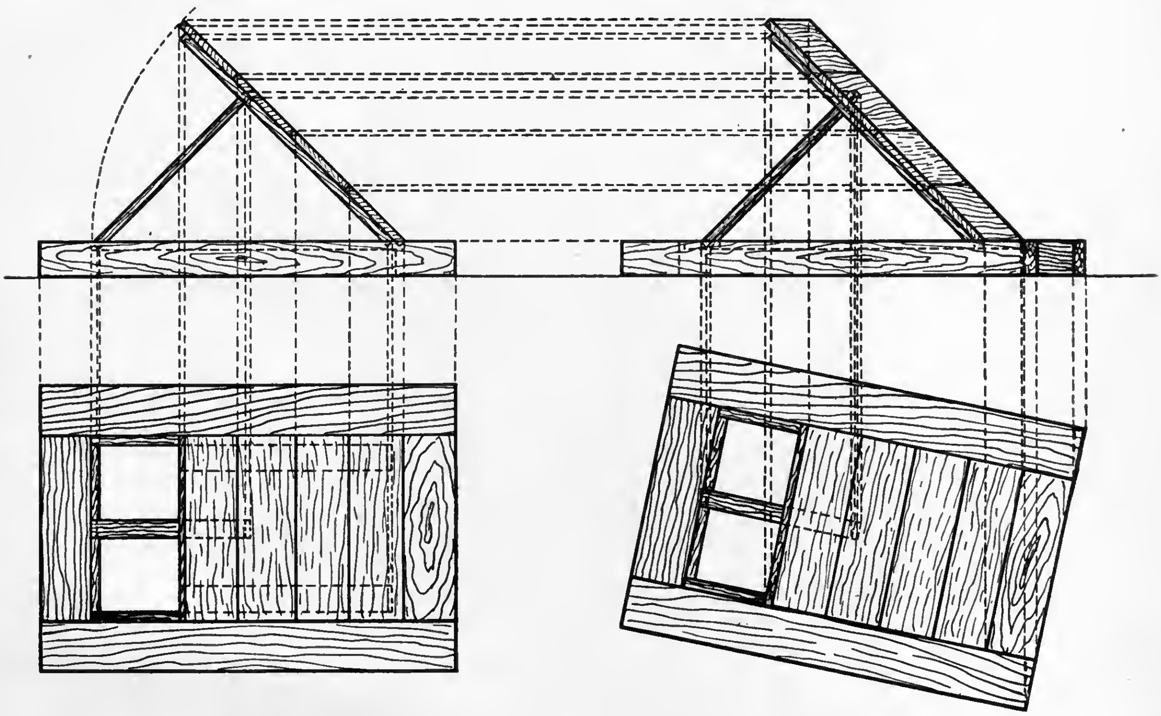


Fig. 6. Fig. 7.

narrower, and parallel lines must be drawn from the plan up to the elevation to determine the appearance of the door. This is very clearly shown in Fig. 5.

This first illustration may be taken as an index to the character of the work which is to be covered under the first heading of "Orthographic Projection." It will be immediately perceived that accuracy in construction and careful forethought are both essential to obtain helpful and satisfactory results.

Having completed the plane projection shown by Figs. 1, 2, 3 and 4, it will be advisable to make a practical application of the principles. This method will be found most helpful in fixing principles in one's memory.

Let it be supposed that we wish to represent a door of common boards, standing partly open.

A practical illustration of the application of Fig. 4 may be made by the representation of a trap door. Fig. 6 shows the trap door partially open, exactly the same as Fig. 5, except that the observer is directly above, instead of directly in front of the object. If we assume that the trap door is turned at an angle, as shown in Fig. 7, the plan view will be identical with Fig. 6; but the elevation will be materially different, as may be seen by the dotted projected lines drawn from the plan up to the elevation. It will be readily seen that the character of the elevation view is determined entirely by the angle at which the door is turned.

In order to complete the study of planes, it is necessary to present one more series of problems. Assume that we have a square, A B C D, which in elevation will be represented by the line A^1 D. Assume that this plane be elevated so that it stands at an angle of 45° to the horizontal plane. The elevation will now be represented by the line A^1 D^1, and by projecting downward it is found that the plan will be represented by the outline A B^2 C^2 D^2, which is diamond shaped. (See Fig. 8.)

Let the angle of 45° be maintained, and let the plane be turned through an angle of 45° as shown in the plan view of Fig. 9. By projecting upwards from points A, B, C and D, it is found that the elevation now becomes a parallelogram, A^1 B^1 C^1 D^1.—Fig. 9.

If the plane be revolved through 90° and the angle of 45° from the horizontal be maintained as before, the plan view will be represented by Fig. 10—A B C D, and the elevation will be identical, as shown by Fig. A^1 B^1 C^1 D^1.—Fig. 10.

These exercises should be thoroughly mastered by the student before attempting to advance to the representation of solids, as they contain the fundamental principles which may be applied to all line projections.

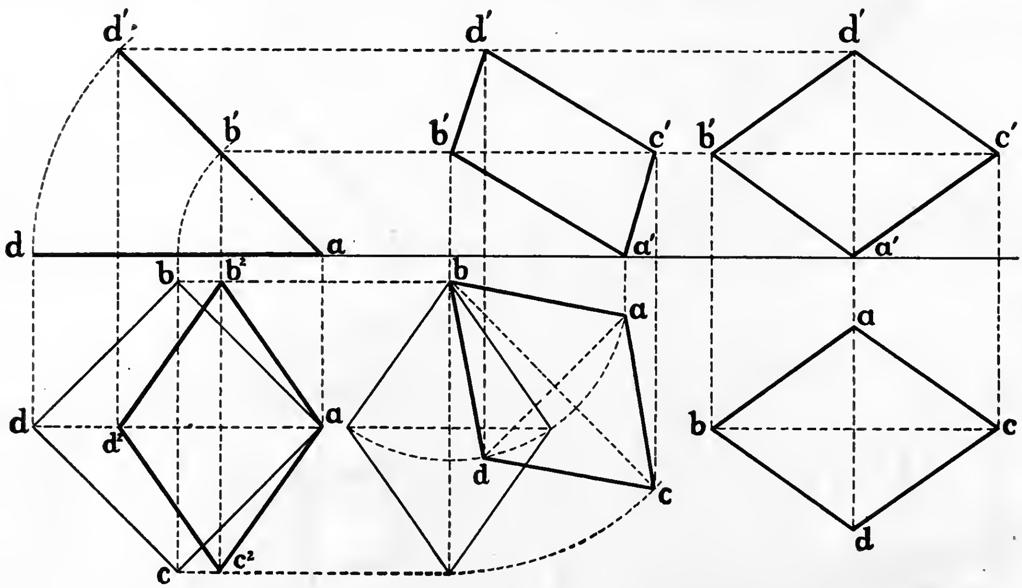


Fig. 8. Fig. 9. Fig. 10.

Mr. Thomas A. Edison is building a special electric car, fitted with his new storage batteries, to be used in the 500-mile reliability run in October under the auspices of the Automobile Club of America. The journey will be from New York to Boston and return.

In a gas engine, when coupled to a dynamo, the gas used to drive it for the production of electricity, it is claimed by the Electrical Review, yields three times as much light in incandescent lamps, and about 11 times as much in arc lamps, as the same amount of gas would give off if burned directly at gas jets.

The Great Northern Railway Company in England has recently made provision, at the locomotive works at Doncaster, for a new locomotive-erecting shop 580 feet long, and equipped throughout with electrically-driven machinery. The overhead electric cranes are capable of lifting a weight of 35 tons.

A RECLINING CHAIR.

John F. Adams.

Anyone making the reclining chair here described will find it a very comfortable one and requiring only ordinary skill to make. Care should be taken to lay out the work accurately so that all joints will be true and well fitted. Oak, maple or birch may be used but oak will be the most affective in appearance as well as the most durable. The four corner posts are $2\frac{1}{4}$″ square and $23\frac{3}{4}$″ long. The top ends of each are cut down $\frac{1}{4}$″ on each side and $1\frac{3}{4}$″ from the end to form the joint with the arm pieces, $\frac{1}{2}$″ of the top being beveled as shown in the illustrations. The front cross piece of seat is 27″ long, 6″ wide and $\frac{7}{8}$″ thick; $2\frac{3}{4}$″ of each end being cut down for 1″ at both top and bottom to form tenon joints with the corner pieces. The ends of the cross piece also have a $\frac{1}{2}$″ bevel. The mortises for this cross piece are 4″ long and $\frac{7}{8}$″ wide, the lower end being $7\frac{1}{2}$″

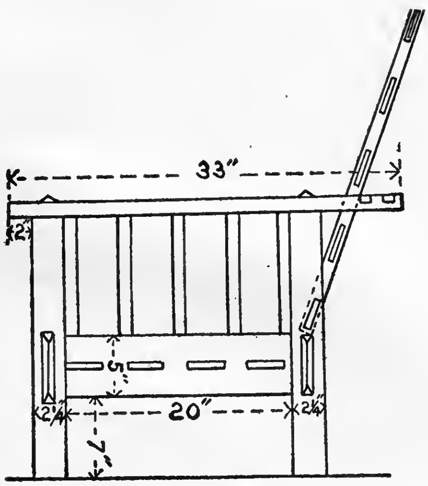


Fig. 1.

from the floor end of the corner pieces. A similar cross piece at the back is 5″ wide, the mortises for same being 3″ long and 8″ from the floor ends.

The arm pieces are 33″ long, $1\frac{1}{4}$″ thick and $5\frac{1}{2}$″ wide except for 6″ at the rear ends which are cut in with curved turns to a width of $2\frac{1}{2}$″, the inside edge being perfectly straight. The mortises for the corner pieces are $1\frac{3}{4}$″ square. Those at the front end are $\frac{1}{2}$″ from the inside edge and $2\frac{1}{2}$″ from the end, those for the rear posts being $20\frac{1}{2}$″ from the front ones. When the fitting is completed, drill $\frac{1}{4}$″ holes from the inside edge of the arms through the tenons of the posts and drive dowel pins, after coating the holes with glue.

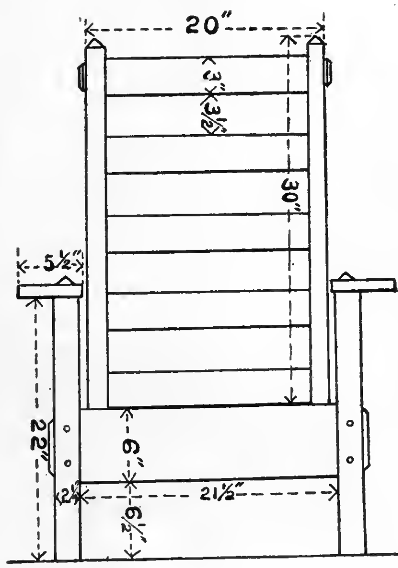


Fig. 2.

The cross pieces are also secured with $\frac{1}{4}$″ dowel pins glued in. The side cross pieces are $21\frac{1}{4}$″ long, 5″ wide and $\frac{7}{8}$″ thick, $\frac{5}{8}$″ of each end being cut down $\frac{1}{2}$″ on each edge to form the tenons; the corresponding mortises in the posts being 4″ long and $\frac{7}{8}$″ wide and cut through to the mortises for the front cross pieces. The mortises for the side pieces are centered in those for the front and back pieces, thus bringing them 8″ from the floor. In the upper edges four mortises are cut in each piece for the upright side pieces which are $3\frac{3}{4}$″ wide, 11″ long and $\frac{1}{2}$″ thick. A piece $\frac{5}{8}$″ wide and $\frac{1}{2}$″ long is cut from each corner, making the size of the mortises $2\frac{1}{2}$″ long, $\frac{1}{2}$″ wide and $\frac{1}{2}$″ deep. The space between each upright piece and also the posts is 1″, which can best be laid out after cutting out the upright pieces. Each arm piece requires to have similiar mortises on the under side. Also on the rear upper sides of the arm pieces are cut two sockets for holding the cross piece which retains the back in position. These sockets are ¾″ wide and deep and 1″ long and 1″ apart. The outer one is ¾″ from the end.

The seat may be made in two ways; cross pieces of wood may be used or a softer seat with webbing and wire springs. If the former is chosen the cross pieces should be 24″ long, 3½″ wide and ⅝″ thick. Mortises of full size to receive the ends are cut on the inside of the side pieces 2″ from the lower edge and placed as shown in Fig. 1. If springs are used, four strips of 3″ webbing are run both across and front and back, the ends being securely held by cleats 1″ square which are screwed to the inside lower edge of the cross pieces. Short spiral wire springs are then sewed where the webbing crosses, 16 being required. The tops of the springs are then secured by additional strips of webbing or by a piece of strong canvas, the latter preferred. Allowance must be made for the depression of the springs and canvas caused by the weight of the person occupying the chair.

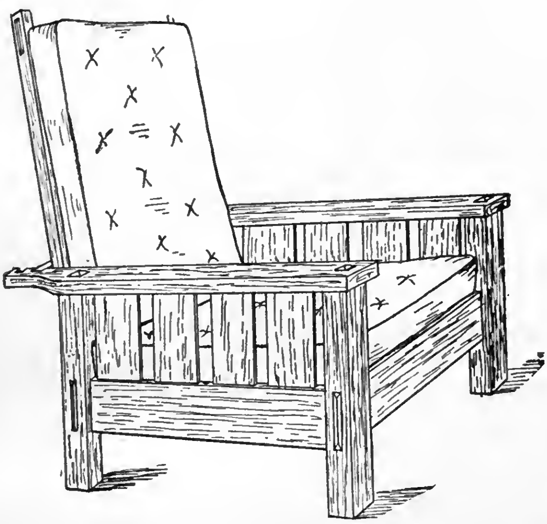


Fig. 3.

The back of the chair is framed as shown in Fig. 2, and attached to the rear cross piece by two strong hinges. There are devises for attaching the back but they are not generally obtainable but are preferable if they can be had as they allow the back to be brought forward over the seat which is handy when moving the chair about the house. With hinges, the back cannot be folded forward in this way. The side pieces of the back are 30″ long and 1¼″ square, the tops being beveled as shown. Five cross pieces are required 3″ wide, ½″ thick and 18½″ long except the top one which is 21″ long, the ends of the latter being beveled. The upper edge of the top cross piece is 1″ from the end of the side pieces, and the others are 3½″ apart, which brings the lowest one flush with the ends of the side pieces. The mortise for the top piece is 2″ long and ½″ wide and cut clear through the side pieces. The others are the same size but are cut only ½″ deep and are 4½″ apart. A piece of selected wood 1¼″ square and 22½″ long is used to retain the back at the desired angle. The ends of this piece are cut away for 1″ on the ends so they will fit the sockets cut in the rear ends of the arm pieces. The staining and finishing should be in harmony with the other furniture of the room in which the chair is to be placed and no description of that part of the work will be given. The cushions for the chair should be purchased unless the maker has had sufficient experience to make them. They are to be had of any large furniture dealer in wide variety and varying cost.

Rear-Admiral Rodgers and the naval board, of which he is chairman, have selected a site for a government wireless telegraph station on the Navesink Highlands, says Electricity.

The first trackless trolley in America will be in operation in Franklin, N. H., says Electricity, the City Council having granted permission to a company to erect poles and wires for the system between the railroad stations. Work on the new line is to be begun at once. In Germany a line of the sort has been in operation for some time from the old fortress of Konigstein through the Biela valley, the cars running over the highway and street pavements.

Moulding and Casting Type Metal Patterns.

F. W. Putnam.

Type metal has been used with good success by the writer in the casting of small patterns, the castings obtained being generally very smooth and with very few blowholes.

The purpose of this article is to explain as clearly as possible the processes of molding and casting a simple pattern in type metal. For the pattern we will take a small car wheel. Fig. 1 is a drawing of the wheel, giving all the necessary dimensions. The pattern should be made of clear dry pine, and can be obtained at small cost from any wood turner.

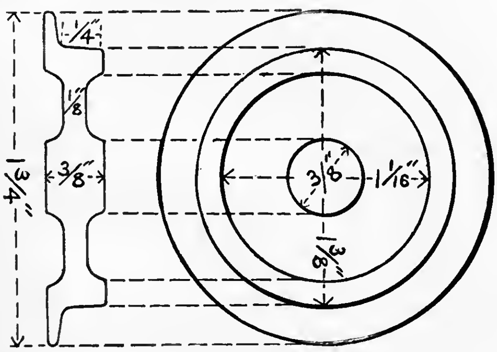


Fig. 1.

The following terms are the ones most common to founding, and will be used frequently in this article.

Flask. A flask is a frame or box that keeps the sand in place while the casting is being made, holding both pattern and sand. In its simplest form a flask may be described as a pair of boxes of similar shape and size, but without top or bottom. These boxes are prevented from separating horizontally by suitable pins, which however permit ready separation vertically. Two flat surfaces made of boards with cleats in one side complete the apparatus. Generally both boxes or "halves" are of the same depth. The lower half of the flask is called the "nowell" or "drag," and contains the holes for the pins. The upper half is called the "cope," and contains the pins which fit into the holes bored for them in the nowell. The nowell rests on the bottom boards.

The two flat surfaces spoken of above are alike, one being called the "molding board," and the other the "bottom board." The molding board is the board or plate upon which the pattern is placed while "ramming" the sand into the nowell. The bottom board is the board or plate which is placed on the top of the nowell before turning it over, and hence it becomes the bottom of the mold during subsequent molding and casting operations.

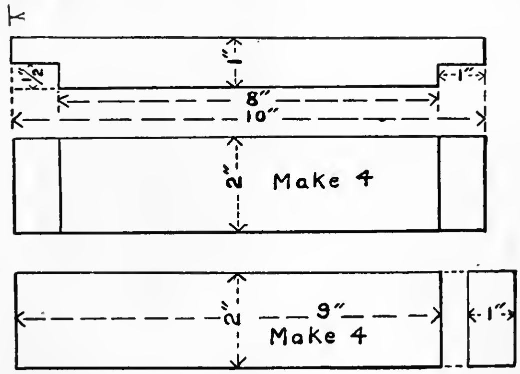


Fig. 2.

Fig. 2 shows the pieces used in making the flask. Clear well seasoned spruce should be used for this, as it will stand the moisture of the sand better than pine, though the latter may be used if spruce cannot readily be obtained. After these pieces have been cut out, cuts about 3-16 in. deep and 1-2 in. wide are made with a carpenter's gouge on the surfaces which will be the inside surfaces of the finished flask. These cuts are of use in holding the sand in place after the flask has been rammed up.

Fig. 3 shows the cope after being put together. The pieces should be fastened with 1½ in. wood screws No. 10 guage. A steel wire nail should be carefully driven down through the two side pieces at each of the points marked "X" in Fig. 3. Be sure that the nails are driven perfectly straight, otherwise there will be difficulty in lifting off the cope easily from the nowell. These nails should be either 10 penny (3 in.), or 12 penny (3½ in.), the latter being preferable. The nowell, which is made exactly the same as the cope, must have a hole bored through each of the two sides corresponding to those of the cope, into which the nails are to fit. The hole should be ¼ in. diam. so as to give a little freedom of movement to the nails or pins as the cope sets down on the nowell. These holes should be bored clear through the sides so that the sand, which is very likely to clog the holes, can be readily punched through with a small stick.

In looking at Fig. 10 it will be noticed that four strips marked "d," two on each half of the flask, are screwed to the sides containing the pins and tne pin-holes, being flush with the top of the cope and the bottom of the nowell. These pieces, which aid in lifting the cope from the nowell, are ¾ in. x 10 in., and are fastened with 1½ in. wood screws No. 10. Care should be taken in making a good joint between cope and nowell. When the cope has been fitted to the nowell and found to work easily, mark plainly the corresponding surfaces of the cope and nowell in two places.

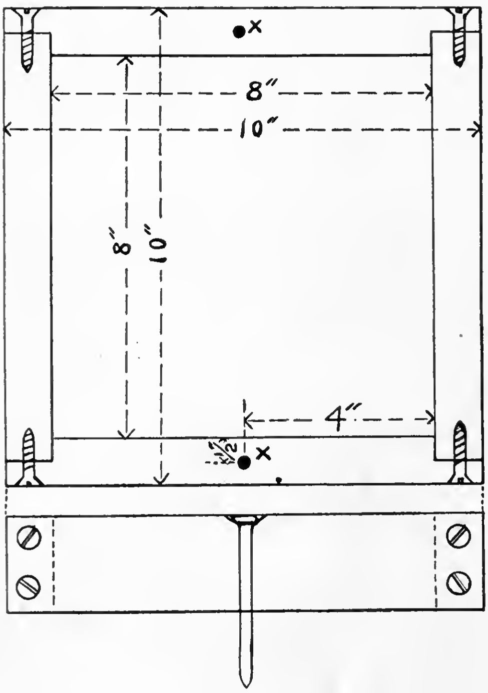


Fig. 3.

The molding board and bottom board should be made of clear dry spruce matched boards ¾ in. to ⅞ in. thick. They are of the same size as the flask, and have two pine or spruce cleats on one side, as shown in Fig. 8 to prevent the boards from warping.

The above is a description of a flask which will serve admirably for the molding of almost any small pattern, the thickness of which does not exceed 1½ in. if the pattern is molded wholly in the nowell, or 3 in. if pattern is molded part in each half, as would be the case in a split pattern.

If the amateur does not care to take the time to construct such a flask, he can easily make something temporary to answer the purpose, but if one intends to do much molding I should advise the making of a flask of suitable size for the work to be attempted.

Fig. 4 shows sketches of a rammer. For work with this flask the rammer may be made from pine, though maple will wear much better. For light work but one is necessary. A rammer is a tool used for tamping the sand in the mold. One end has a flat rectangular point called a "peen," and the other end has a large flat surface called a "butt."

A Draw Nail is a metal piece used in drawing a pattern from the mold. A long wire nail filed down to a long point, as in Fig. 5, will answer the purpose.

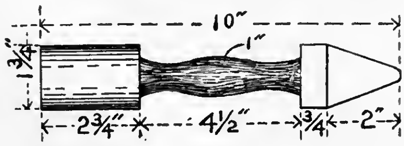


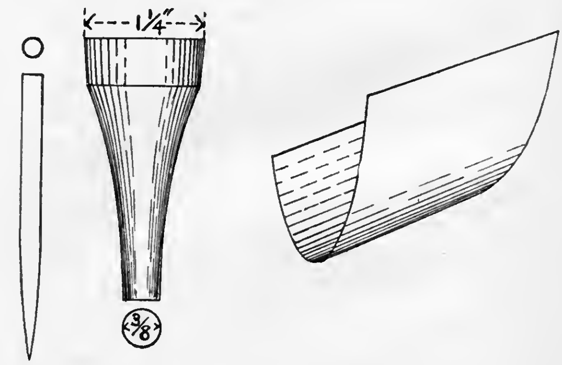
Fig. 4.

A Sprue Pin is a wooden or metal pin, used for making an opening through the cope, through which the metal is poured. Fig. 6 shows a sketch of a sprue pin which can be made of pine. It should gradually taper downwards so that it can be readily removed from the sand. The position of the sprue pin with relation to the pattern will be described later.

A Gate Cutter. Fig. 7 is a bent piece of sheet metal employed for cutting the gates from the bottom of the sprue hole to the edge of the mold.

A Vent Wire is a small wire used for making openings through the cope to provide for the escape of gases, and thus preventing blow holes in the casting.

Sand. Sand of the quality known as molding sand possesses in a large degree two desirable elements,—that of being porous, and of sticking together when moderatety moist. For small castings a fine grade of sand should be used. Fine grained sand suitable for such castings is rather difficult to obtain, so the amateur had best get the sand from a foundry.



Figs. 5, 6, 7.

Parting Sand is a general term applied to any material used to prevent two surfaces of a mold from adhering. It is usually made from sharp or burned sand.

A Riddle is a coarse sieve used for sifting sand. The hand sieve is composed of a circular frame, the bottom of which is covered with wire cloth.

The Pattern should be finished with at least two coats of shellac varnish, made by dissolving gum shellac in alchol. The first coat should, when dry, be rubbed smooth with a piece of well worn sand paper.

The second coat should be somewhat thinner than the first. This will protect the pattern so that it is not affected by the moisture of the sand, and insures a smooth surface which draws easily from the sand.

Draft. A small allowance for draft is always made in the pattern to aid the withdrawing of the pattern from the mold. For small patterns a taper of ⅛ in. per foot is sufficient.

Mixing the Sand. If the sand obtained from the foundry has not been used for several days it is dry and must be mixed or "tempered" several times before being used for molding. The sand must be dampened with water and thoroughly mixed with a shovel. To test it, take a handful and press it together. If the sand be right to use it will form a lump showing the impression of the fingers, but should not be damp enough to stick much to the figers when the hand is opened.

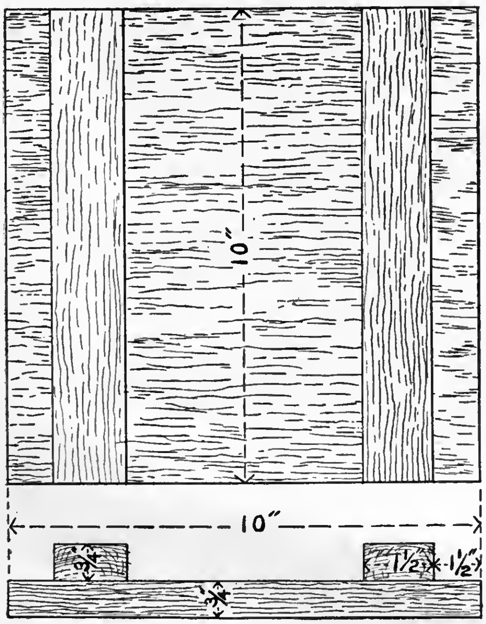


Fig. 8.

To Mold the pattern, first lay the molding board on a bench and place the nowell on it bottom up. The pattern is then laid on the molding board, as shown in Fig. 9, and the sand is sifted from the riddle into the nowell until the pattern is covered to a depth of at least ½ inch. With the hand pat the sand down evenly over the pattern, being sure that none of the molding board is left uncovered. Next fill the nowell heaping full of sand with the shovel, and "ram up" the sand, care being taken to have plenty of sand, to ram uniformly and thus avoid layers. The peen end of the rammer is used to ram into the corners and next to the sides of the nowell, the rammer being held obliquely instead of straight up and down as is the case when the butt end is used. When somwhat more than full, the upper surface is scraped off with a straight edge and the bottom board laid on.

Now comes the second step. The whole is carefully turned over and the molding board removed. Be sure that in turning over the nowell the fingers grasp both the molding board and the bottom board firmly, so that the former will not move away from the nowell.

It will be seen in looking at Fig. 10 that all of the pattern comes in the nowell; but there will be an impression made in the cope of the hub and a portion of the pattern, as shown in the shaded part a. Fig. 9 represents the nowell rammed up with the two boards in place, before the nowell has been turned over.

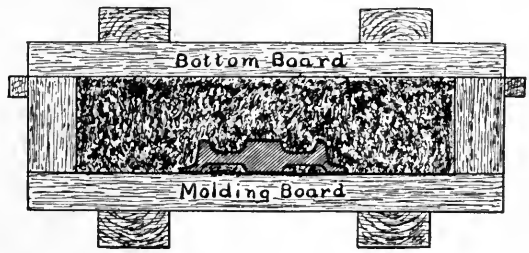


Fig. 9.

Having turned the nowell over and taken off the bottom board, dust over the whole a thin layer of parting sand. Carefully blow off all parting sand from the pattern itself, and then set up the sprue pin within about 3 in. of the pattern, and force it down into the sand for ½ in. to hold it in place. Put on the cope, being sure that the pin holes are free from sand; also that the cope lifts off readily, and that the surfaces previously marked come together. Riddle on sand until the top of pattern is covered with at least ½ in. of sand. Fill the cope with sand and ram it up as the nowell was done, being very careful not to hit the sprue pin. Fig. 10 shows the flask rammed up with the pattern and sprue pin removed.

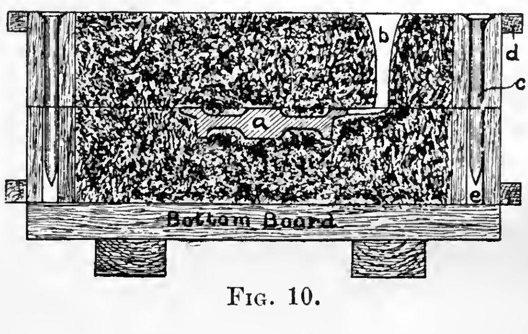


Fig. 10.

Next lift off the cope being careful to lift directly upwards. When the pins are free of the nowell, set the cope down on the bench, on one end, the top of the cope being toward the molder. If the top of the sprue pin is covered with sand, scrape it away until top is clear, aud then turn the sprue from the back, gradually forcing the sprue pin out from the mold. The sprue pin is tapering so it will slip out easily after it is started. Be sure that the sprue hole is free from loose particles of sand. A draw pin is then driven into the middle of the top of the pattern, which is in the nowell, and the pattern loosened by gentle raps of the draw pin which is held by the left hand. The pattern is then lifted from the mold by means of the draw pin. As this particular pattern is circular in shape, it can be turned round by means of the draw pin, thus making sure that it is freed from the sand. A gate or channel about ⅜ in. wide and ¼ in. deep, is now cut from the hole formed by the lower end of the sprue pin to the edge of the mold, using the gate cutter. Next run a vent wire several times through the cope, at points near the mold, so as to give vent to the gases.

Replace the cope, being sure that the marked surfaces come together, otherwise the two halves of the mold may not be directly over each other.

Pouring the Casting.

In the manufacture of type metal, one part of antimony is used to four parts of lead, the antimony hardening and whitening the alloy and causing it to contract but little while cooling. Old type metal is readily obtained at almost any printing office, and can be bought for about eight cents a pound, being about one half the price of good babbit metal. Its melting point is not very high, and it can be melted in an iron melting pot over a bunsen gas flame in from 20 to 30 minutes time. For this small pattern the metal can be melted in a medium sized skillet. When the type metal is all melted, pour a little into some of the molding sand. If it sputters badly it is too hot for pouring. If it does not sputter, but pours freely without cooling in the skillet too quickly, it is ready for use. Take a stick and quickly skim off the top of the molten metal, or slag, as it is called. Take the skillet, or whatever article the metal is to be poured from, carry it quickly to the mold, and pour the metal into the sprue hole in a steady stream, until the sprue hole is filled up with the molten metal. After five minutes the mold may be broken, and the casting examined, though care should be taken not to touch the casting with the hands until it is thoroughly cooled.

It is reported, says Railway and Locomotive Engineering, that the Boston and Maine and the Boston and Albany railroads are about to discontinue oiling their roadbeds, after a three years' trial. Several roads are ballasting the permanent way with broken stone, which, after the rain has thoroughly washed it, gives no further trouble from dust. Elsewhere the oiled roadbed is giving every satisfaction.

PHOTOGRAPHY.

A Retouching Desk.

A negative is rarely so free from defects that some retouching is not necessary. Pin holes caused by dust or air bubbles during development are the most conspicuous faults common to the amateur photographer. In a previous article the treatment of these troubles was presented. In this one, the making of a simple desk will be described, and anyone making one will find it very useful in removing the blemishes that are so frequently met with in negatives of home production.

As will be seen from the production, the desk consists of three parts connected by hinges and so arranged that they may be adjusted for light and height. The lower part consists of a frame, supporting an adjustable mirror. The mirror should be 9″ or 10″ square, with a flat frame, and may be purchased at a dealers. If made, obtain for the frame some 1″ flat picture moulding, bevel the joints and put in a piece of mirror in exactly the same way that a picture would be framed. Make a supporting frame, the end pieces being

2½″ high, ⅛″ thick and 12″ long. The side pieces are ⅞″ thick, 1″ high and 12″ long, joined to the end pieces as shown. In the centre of the side pieces, bore holes to loosely receive round headed screws which are screwed into the centre of the mirror frame. This allows the mirror to be adjusted to the proper angle to reflect the light upon the negative. On the upper side of the side pieces and in the rear half, bore ¼″ holes about ¼″ deep at a slight angle. These holes should be about 1″ apart and receive the lower ends of pieces of round wood or brass rods about 6″ long which support the centre section of desk.

The centre section is made of picture moulding about 1″ square, of the same dimensions as the lower frame. The rabbeted side of the frame is placed on the upper side however and holds a piece of ground glass, which is fastened in place by thin strips of wood. A piece of wood ¼″ thick, 3″ wide and just long enough to fit inside the frame, is placed upon the ground glass to form a support for the hand when retouching. The negative is also placed upon the ground glass, the lower side resting upon the wooden strips just mentioned. Another strip of wood about 12″ long, 2″ wide and ¼″ thick is placed upon the frame and supports the hand when working upon the upper part of the negative. Holes are bored in the under side of the side pieces of this section opposite those in the lower frame, to receive the upper ends of the supporting rods. These holes should be of the same size as the others and also at an angle.

The upper section is made of moulding and is of the same dimensions as the other frames, but the moulding may be somewhat lighter. The rabbeted side of the moulding is placed towards the centre section, and the frame is fitted with a piece of thin board. The under side of this board is covered with black paper or paint to prevent reflection or direct light from reaching the worker. On larger frames pieces of black cambric are sometimes hung between the upper and centre sections thus shutting out side light. The upper section is adjusted and secured in position by hooks and eyes. The hooks should be about 4″ long and three eyes should be put on each side of the centre frame at such an angle as to prevent the hook from slipping out except when so desired.

MODEL ELECTRIC RAILWAY.

II. The Motor Car.

The design for the motor car here given is quite plain so that those who desire to make it will have no difficulty in procuring the required materials. It consists of a wooden floor and body, type metal wheels and bearings for same made of brass strips; a small motor and clock work gearing. The method of casting the wheels is described in a separate article in this magazine, excellent wheels being easily secured if reasonable care is taken to follow the directions. The axles are straight iron wire 2″ long and about ⅛″ in diameter. Holes ate drilled in the centres of the wheels to receive the axles, the former being fixed in place with a little soft solder, put on with a blow torch. On one axle, before the second wheel is put on, is soldered a small brass pinion, which may be obtained from an old clock or purchased of any hardware dealer who carries brass gears. The size and pitch of the pinion is left to the choice of the maker as it is determined by the pitch of the gear in the connecting clockwork to be mentioned later.

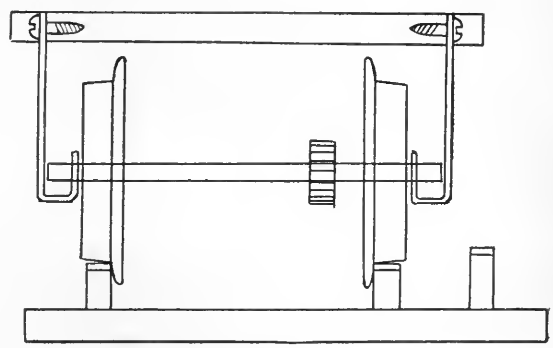


Fig. 2.

The bearings for the axles are made of strips of brass about 1-16″ thick, ½″ wide and 2″ long. In the top ends, drill two holes for the screws which are used to attach the bearings to the car floor. The lower ends are bent to the shape shown in Fig. 2, first drilling a ⅛″ hole, ¼″ from the end, to receive the axle, the end of which rests against the outside part of the bearing as shown. This arrangement allows the axle to turn freely but prevents side movement.

The floor of the car is 8″ long, 3¾″ wide and ¼″ thick. Each end is slightly rounded so that connected cars may be taken around sharp curves. A piece of wood ½″ high, ¼″ thick and 3⅝″ long is nailed ½″ from each end. The body of the car is made of thin wood (cigar boxes are well suited for it), doors and windows being cut out with knife or fretsaw. It is 3¾″ high in the centre and 2″ high at the ends. When completed, it should fit snugly over the wooden pieces nailed to each end of the floor, to which it may be attached with small screws. It should not be permanently fastened as it will have to be frequently removed so that the interior fittings may be inspected or repaired.

strip it of all gears and other parts except the gear on the shaft carrying the hands and the large one connected with it. A pinion will usually be found in such a clock which will mesh all right with the large gear of the works, and this pinion should be placed on the axle of the wheels underneath the works, after the works have been correctly located. On the shaft carrying the hands fasten another spool pulley similar to the first. The works are then placed so that the two pulleys will be in line and the big gear mesh in the pinion on the axles. The floor of the car will have to be cut out to allow the works to be set low enough to reach the pinion on the axle. The proper posi-

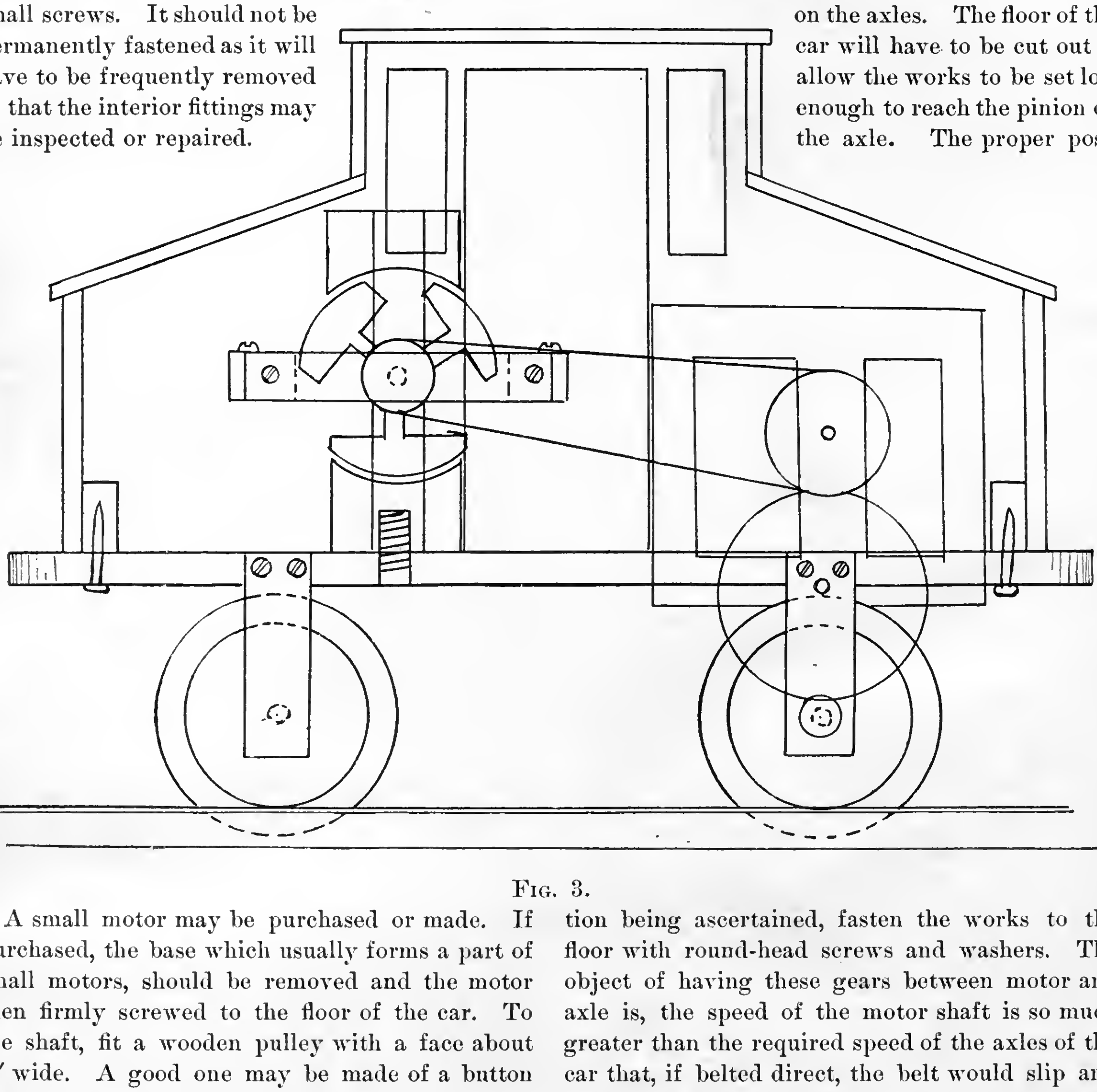


Fig. 3.

A small motor may be purchased or made. If purchased, the base which usually forms a part of small motors, should be removed and the motor then firmly screwed to the floor of the car. To the shaft, fit a wooden pulley with a face about ⅜″ wide. A good one may be made of a button hole twist spool. A flat rubber band is used for a belt which will run well on a spool pulley as described. Obtain the works of a small clock;

tion being ascertained, fasten the works to the floor with round-head screws and washers. The object of having these gears between motor and axle is, the speed of the motor shaft is so much greater than the required speed of the axles of the car that, if belted direct, the belt would slip and make considerable trouble or the car run too fast to stay on the track.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. I. No. 12. BOSTON, OCTOBER, 1902. Ten Cents a Copy.

HOW TO MAKE A TELEPHONE.

Newman N. Holland.

I. THE TRANSMITTER.

While the electric telephone is probably the most wonderful instrument that has ever been produced, it is so simple in construction that it can be readily made without the necessity of having many tools or any great expense. By following instructions here given, the amateur can construct a telephone set that will give practically as good service as those in commercial use.

A telephone set consists of really three separate instruments, the transmitter, the receiver, and the signalling bell. We will take up each part separately, commencing with the transmitter, and explain how they can be made with little difficulty and with parts easily procured.

The Transmitter.

The first thing to procure is the casing or box to hold the parts, and an old cigar box (Puritanos size) is admirably suited for the purpose. This box should be first cleaned of all paper labels, etc., and brass hinges substituted for the cloth one usually employed. In the exact centre of the corner of this box a hole should be cut about $\frac{7}{8}''$ in diameter. This hole should have its edge bevelled, which can readily be done with a pocket knife, and a piece of pasteboard F, glued inside so as to form a bell shaped funnel such as is shown in the drawing. On the inside of the cover should be pasted a thick cardboard ring H, concentric with the opening. This ring can be readily cut out by means of a compass and a pair of scissors, and should be about 1-8″ thick and $\frac{1}{4}''$ rim, the outside circumference being $2\frac{1}{2}''$. An important part of the transmitter is the diaphragm E. This can be made of a piece of smooth tin or ferrotype plate such as is used in taking tintypes, and can be cut out with an ordinary pair of large scissors. The diameter of this should be the same as the paper washer refered to ($2\frac{1}{2}''$). Before cutting the diaphragm the circle should be struck out with a pair of compasses and the centre marked; through this centre marking, a hole should be made that will allow a 4-32 screw to freely pass. At equal distance around the circumference and $\frac{1}{8}''$ from the edge, four other holes should also be made in the diaphragm so that it can be screwed to the box; make these holes same size as that in the centre. It is now necessary to procure two pieces of carbon which are called respectively the back and front electrode. The front electrode C, is fastened directly on the diaphragm and consists of a circular disk $\frac{1}{8}''$ thick and $1\frac{1}{8}''$ diameter. The centre of this disk is also bored for 4-32 screw and is secured to the diaphragm by passing a screw of that size $\frac{1}{4}''$ long through both carbon and diaphragm, having the head of the screw next the cardboard and using a small brass nut to hold it to the diaphragm.

The next step is to construct a bridge to hold the back electrode D, in its proper position. This may be made of wood. Two blocks should be accurately made of the following dimensions to form posts to hold the cross piece, cut to $\frac{3}{4}'' \times \frac{1}{2}'' \times \frac{1}{4}''$. Next make a strip of wood $3\frac{1}{2}''$ long x $\frac{1}{2}''$ wide x $\frac{1}{8}''$ thick. Fasten the two posts which you have already made at the extreme ends of this strip by means of two $\frac{1}{2}''$ No. 4 round head wood screws in each block. In the bridge thus made, a hole is to be bored in the exact centre of the cross piece.

This hole should be large enough to allow an 8-32 machine screw to pass through it.

We now come to probably the most difficult part of the instrument for the amateur to make. This is the back electrode, and should consist of a carbon block ⅜″ in thickness and 1⅛″ in diameter.

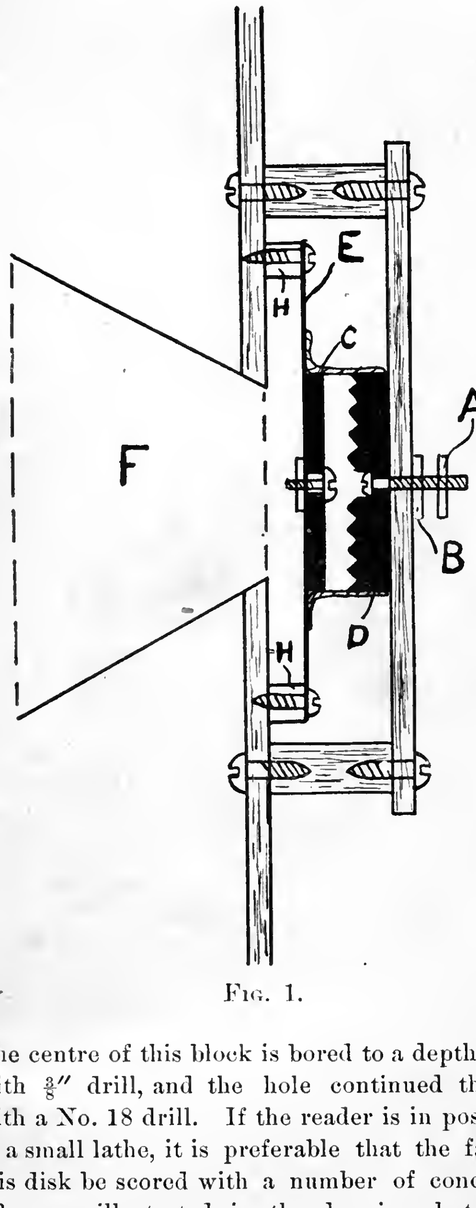


Fig. 1.

The centre of this block is bored to a depth of ¼″ with ⅜″ drill, and the hole continued through with a No. 18 drill. If the reader is in possesion of a small lathe, it is preferable that the face of this disk be scored with a number of concentric ridges as illustrated in the drawing, but while such construction is much better it is not absolutely essential for the working of the instrument.

After the back electrode has been made it should be surrounded with a piece of cloth, allowing the edges to project around the front side about ¼″. Almost any kind of woolen cloth will do for this purpose, but it should not be too thick or stiff. The cloth can be glued to the carbon and then should be further secured by winding some stout thread around the outside a number of times quite tightly, and then tying the thread securely. The portion of the cloth which has been allowed to project beyond the outer surface of the carbon should now be frayed by pulling out the threads which run around parallel to the face of the carbon. This will give a light fringe sticking up beyond the carbon, and this fringe should be given a tendency to flare outwardly by pressing the carbon block, fringe end down, onto a smooth surface and seeing that all the threads of the cloth are projected outwardly.

The carbon block is now already to screw on the wooden bridge already constructed. This should be secured by passing an 8-32″ screw through the carbon block and the hole in the centre of the bridge, binding them together with a nut in a manner very similar to that which we employed with the front electrode. The screw in the back, however, should be at least 1″ long as we will use it also to form one of the terminals for connection, and should carry an additional nut beside that used to hold it to the bridge.

We are now ready to assemble our instrument, and although it is necessary to put some granulated carbon between the back and front electrodes, it is better to assemble the instrument first without the carbon to get each part in proper position and then take it apart when such positions have been correctly found and insert the necessary amount of carbon granules.

The bridge with its back electrode should be laid so as to span the diaphragm we have already mounted on the box and adjusted until back and front electrode are exactly opposite one another and the fringe of the cloth fully covers the front electrode. When this position is obtained, carefully mark the position of the posts with a pencil mark all around them, and then after removing same, in each of the spaces obtained drill two holes in such a manner as to allow of putting through two No. 4 wood screws. The bridge can then be replaced carefully and the wooden screws inserted from the front side of the cover.

After the instrument has been assembled in this manner, the four screws holding the bridge to the cover of the box should be removed and the cover itself taken from the box by unscrewing the hinges. It is then ready for inserting the granulated carbon. The granulated carbon should be of the size which is called No. 40 mesh; that is, the particles should be of a size that will just go through a screen having forty holes to the inch. This carbon should be purchased, rather than attempt to make it, and should your local electric supply man not have any in stock, he can doubtless readily procure for you what you require.

Now to fill the transmitter with carbon, the back electrode mounted on its bridge should be held with fringe side up so as to form a shallow cup. This cup should be two-thirds filled with the granulated carbon, that is, so that the carbon grains will cover about two-thirds of both electrodes when the instrument is assembled and held in the position in which it will be used.

The important point to guard against is not to have so much carbon in the space between the electrodes that it will not allow a free movement of the particles.

Next the cover bearing the diaphragm should be laid on top of the bridge, the carbon on the diaphragm coming centrally over the carbon on the bridge. By replacing the screws in the same holes in the bridge posts the exact position would be obtained and the instrument will be completed.

The connections are taken, one wire being placed between the two nuts, A, B, the top nut being screwed tightly down upon same. The other connection is obtained by putting a washer under one of the screws holding the diaphragm, and bending a wire between this washer and the diaphragm, then screwing the screw tight. If the box and mouth piece is now given a good coat of shellac, we can now put it away and construct the rest of our apparatus.

STUDIES IN ELECTRICITY.

XII. PARTS OF THE DYNAMO.

The Commutator of a dynamo, of which previous mention has been made, is a very important part of the machine. Its function is to convey in part the successive pulsations of the currents generated by the coils of the armature to the brushes so that the current in the line shall be practically a continuous one. To make the line current as uniform as possible, it is necessary to have the number of coils in the armature, and consequently the number of segments in the commutator, as great in number as is mechanically possible, when cost and facility of construction are considered. As the mechanical and electrical difficulties encountered are considerable, they determine to quite an extent the design of the armature and commutator.

Each segment must be insulated from those adjacent to it and all of them must be securely held in position on the shaft and yet insulated from it. This involves careful work in the making and assembling of the parts. The material used for the segments is generally hard copper of as great a purity and uniformity of texture as can be obtained. The latter feature is a necessary one, to ensure its wearing evenly. A cross section, as illustrated in Fig. 35, shows each segment to be of a wedge shaped form. Mica, because of its excellent insulating properties and power to resist great heat and pressure, is almost entirely used as the insulating material. Between each segment and also at the surfaces of the ends where they bear on the wedge shaped clamps holding them in position on the shaft, are placed strips of mica free from cracks or ridges. This is shown in Fig. 35.

The Brushes are in contact with the commutator and convey the current to the line. The materials usually employed are woven copper gauze or carbon sticks. The former consists of several layers of fine copper gauze rolled into a suitably shaped bundle and then firmly cempressed and stitched to retain the shape. Excellent contact is secured with this kind of brush, as it is somewhat flexible and has numerous points bearing upon the commutator. It is made of softer copper than the commutator, so that the wear between the two parts will be on the part of the machine most convenient and inexpensive to renew.

The carbon brush is, however, the kind most generally used, having several advantages over the copper ones. It wears a better surface on the commutator, the dust is less injurious to other parts of the machine, being less liable to cause a short circuit; no injury results should the armature be run backwards for any reason. It also causes less sparking, resulting in less heating and therefore less wearing of the segments and insulation. The size of the brushes is determined by the maximum current to be carried with a liberal addition for safety, as with brushes too small, the current generated would develop excessive heat in the armature with very injurious results.

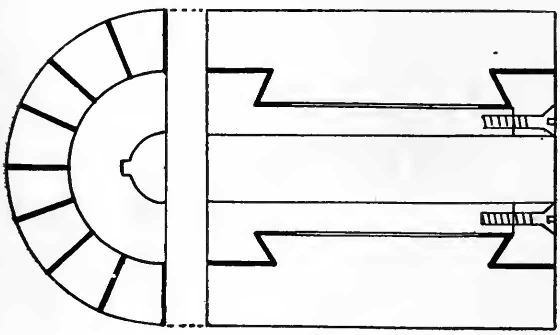


Fig. 35.

The Brush Holders are so constructed and attached to the machine that the position of the brushes and the point of contact with the commutator may be altered as occasion requires. Adjustable springs are attached to the brush holders, the pressure of which give the brushes a firm contact with the commutator. These springs are attached in such a way that little or no current passes through them.

The Field Magnets are made of wrought iron, cast steel and cast iron, the desirability of these metals being in the order named. Wrought iron has the highest permeability and is used when a small cross section is required of the field cores. In designing a dynamo it is customary to allow about 90,000 lines of magnetic flux per square inch for wrought iron. Certain grades of soft steel, having a very low percentage of carbon, are almost universally used in dynamo construction owing to its lower cost. It has a permeability almost equal to wrought iron and about 80,000 lines are usually allowed per square inch. Cast iron is the least adapted for dynamo parts, but where size is not important, is on account of its low cost, used for yokes, bases and some other parts. About 45,000 lines per square inch are usually allowed in designing.

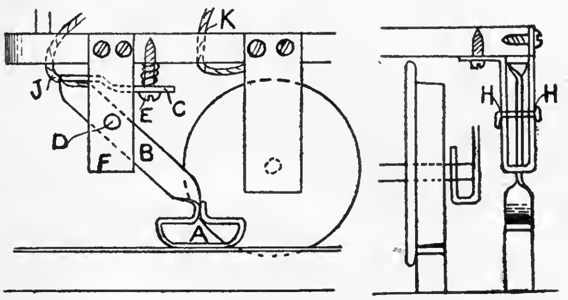
The Field Coils are usually wound on separate forms and when complete, placed on the core. If a metal form is used, such as brass or tin, it is necessary to insulate the coil from the form. In any case the coil must be insulated from the core. Firm paper is usually used for such insulating, being shellaced to keep it from being affected by moisture. The ends of the coil wires, called "leads," are carefully insulated, so that a short circuit will not be formed with any part of the machine which they touch. In large machines with series winding the necessary size of the wire would be so large as to make the work of winding a difficult one, so ribbon copper is used or several smaller wires are used, these being connected in parallel, and serving to secure about the same results as would the larger wire. In shunt windings the shunt wire is wound over the series winding, usually on a separate form to facilitate ease in construction and repair, though it may be wound on one form.

The United States is fairly running away from the rest of the world in the production of iron and steel. For the first half of the present calendar year, the production was 8,803,574 tons, an increase of 1,130,000 tons, or 14 per cent. over the same period a year ago. A noticeable feature about the industry is that it has made this wonderful increase in the output while the export of iron and steel has very considerably fallen off. The decrease in iron and steel export the last fiscal year is placed at $20,000,000. So enormous and rapid has been the growth of the home demand, that it not only offset the partial loss of the foreign markets and the huge increase in domestic supplies, but also drew heavily upon what may be called the home reserve supply.

MODEL ELECTRIC RAILWAY.

III. EQUIPMENT AND CONNECTIONS.

The equipment of the motor car provides a collector for taking the current from the "third rail" and conveying it to the motor, and a current reverser which will enable the direction of the car to be reversed. The design of the collector is shown in Figs. 4 and 5. The car should have two of these, one on each side, so that at crossings and other places where it may be necessary to place a section of the third rail on the opposite side of the running rails, there will be no break in the feed of the current.



Figs. 4 and 5.

The collector shoe, A, which bears on the third rail, and the shoe arm, B and C, are made from a single piece of ribbon brass 5″ long, ⅜″ wide and $\frac{1}{16}$″ thick, bent as shown in Figs. 4 and 5. This can easily be done by placing it in a vise and bending the turns with a small wrench; a bicycle wrench answering nicely. Care should be used to make the bends in the right direction, and a cardboard model may first be made to serve as a guide. A hole, D, is drilled in the part, B, to receive a small wire nail, the inside end of which is bent over to hold it in position. Another hole is drilled near the end of the part, C, to receive a screw, E. Around the screw, E, is placed a small spring made by bending brass wire around a large wire nail. This spring serves to keep the shoe firmly in contact with the third rail, and yet allows the shoe to give when meeting joints in the track or obstructions. The screw, E, prevents the shoe from dropping down at switches or crossings, and by touching the running rails, making a short circuit. A little experimenting will enable this screw to be rightly adjusted to secure proper contact with the third rail and yet not reach the running rails.

The support, F, is made from a piece of brass 3″ long, ½″ wide and 1-16″ thick, bent as shown in Fig. 5. Two holes are drilled at the outer end for small screws which fasten it to the car floor; one hole is drilled on the inner end for the same purpose. Holes, H, are drilled through the sides to receive the nail which serves as a bearing for the shoe arm. A slot is made in the side of the car floor to receive the outer end so that it will be flush with the side of the car floor. When the collector is complete and ready to be attached to the car, an insulated copper wire connection, J, 6″ long, is soldered with soft solder to the joint between the parts, B and C, of the arm. The other end of this wire is connected to one of the terminal posts of the motor. Similar wires, K, connect the other terminal of the motor with one of the supports for each pair of car wheels. Use care to see that good contact is secured for these connections.

The current reverser is shown in Fig. 6. A piece of maple or other fine grained wood 3″ long, 2″ high and ⅜″ thick is needed. This, when all complete, is firmly screwed to the car floor. It may be placed at one end of the car, in which case, a slot for the end of the lever, L, is cut in the top of the car body; or it may be placed near the centre of the car and the lever changed through the doors. In the latter case, the wooden piece must be made shorter or slots cut in one end of it for the belt connecting motor and clock work. Five brass machine screws with nuts are required, though ordinary brass screws may be used; also one piece of brass 2½″ long, ⅜″ wide and 1-16″ thick, and a similar piece 1¾″ long. Bore ⅛″ holes ¼″ from the lower ends of each piece, and make bends ¼″ above these holes so that the upper parts will be ⅛″ away from the wooden support but parallel with it. Bore $\frac{1}{8}''$ holes in each piece 1″ from the lower ends to receive screws holding in place the wooden cross piece, M, which is $1\frac{3}{8}''$ long, $\frac{1}{2}''$ wide and $\frac{3}{8}''$ thick, this cross piece being on the outside of the brass strips and the screws put through from the inside. The screws should work easily in the holes so that the lever will not be hard to move.

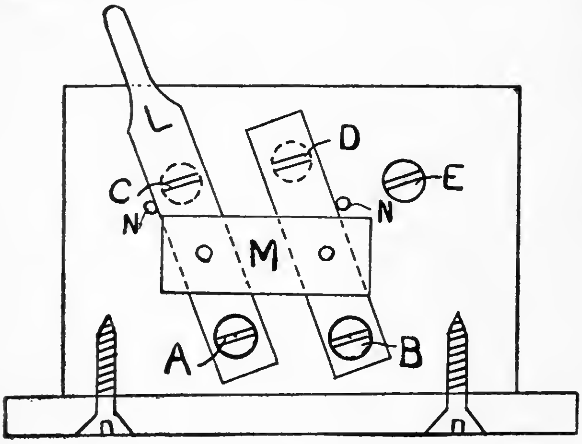


Fig. 6.

In the piece of wood $\frac{1}{8}''$ from the bottom side and $\frac{3}{8}''$ each side the centre, bore holes to receive tightly the machine screws, A and B, Fig. 6, which are put through the lower holes in the brass strips. In the centre and $\frac{3}{8}''$ from the upper edge, put another machine screw, D, and $\frac{7}{8}''$ to each side of it and $\frac{5}{8}''$ from the upper edge put the two remaining screws, C and E. Small nails, N, are driven into the wood to keep the lever from being pushed over too far to either side. After the screws are in position, file the heads a little to make them flat, thus securing a better contact. When this has been done and the lever is in the position shown in Fig. 6, the screws, A C and B D, are connected. If the lever be pushed to the other side, the screws, A D and B E are connected, thus reversing the polarity of the current at the brushes. This result is secured by connecting this switch with the wires leading to the brushes of the motor. An examination of the motor will show that wires are connected to the brushes, one leading to a terminal post and the other to the field winding. Carefully cut these wires, leaving enough wire for new connections on each side of the cuts.

In some forms of motors these cuts can be made several inches from the brushes. Connect these ends with insulated wire, soldering the joints with soft solder, to the switch as follows: A wire from the brush end of one brush wire is connected to screw, D; the other end of same brush wire being connected to screw, B. Connect the brush end of the other brush wire by a branched wire to screws, C and E, and the remaining end of the brush wire to screw, A. The action of the switch should be quite evident.

The current should be supplied by some form of closed circuit battery, a bi-chromate probably being the most practicable to the majority of readers. Descriptions for making this form of battery were given in the December and June numbers of this magazine. If circumstances do not permit of the making of a battery, Leclanche cells with cylindrical zincs may be used, replacing the sal-ammoniac with bi-chromate of potash solution and amalgamating the zincs as directed in the descriptions above mentioned. Several cells will be required, the number depending upon the weight and construction of the motor car and train to be moved. The several cells are connected in series or series-multiple as may be found by experiment to produce the best results with the motor used in the car.

The battery is connected to the rails with insulated copper wire, No. 12 or 14 guage, the zinc pole being connected to the third rail and the carbon pole to each of the running rails. If a considerable length of track is used, two or more connections with the battery are desirable to reduce the resistance of the rails. All rail connections should be made with soft solder, a soldering fluid or paste being used to enable this to be easily done. A switch in one of the battery feed wires for shutting off the current will be found desirable. This can easily be made, with a small strip of brass and two brass screws, using a small block of wood for a base. The zincs should always be taken from the above battery when not in use, as the zinc is consumed while in the solution, whether any current is flowing or not.

The way to make additional equipment for this simple railway, will readily suggest itself to the reader of these chapters.

CHLORIDE OF SILVER BATTERY.

R. C. BROWNE.

As the amateur electrician is usually interested in making small and compact batteries, which may readily be carried in the pocket or used for experiments, the following description of making a chloride of silver battery may prove useful.

The chloride of silver may be purchased all prepared, but a good grade well adapted for the battery, is not difficult to make. A silver coin or piece of scrap silver (not plated ware) is placed in a clean glass tumbler and slightly diluted nitric acid is carefully poured over it in sufficient quantity to completely disolve the silver. A little pure water is added occasionally and the solution should be frequently stirred with a glass rod. When completely disolved, put strips of sheet copper into the solution and the silver will be precipitated. Continue the copper in the solution until all precipitation stops. Pour off the liquid carefully and redisolve the silver in fresh nitric acid as before.

Make a strong solution of common salt and pure water and add slowly to the silver nitrate solution until all precipitation ceases, and then allow it to settle. Pour off the liquid or filter to secure the precipitate which is chloride of silver, and after being washed with pure water, is ready for the battery. The latter part of the above operations should be done in a dim light or a dark room with a ruby lantern, as chloride of silver is sensitive to white light. The washing with water is most easily done by stirring with a glass rod and then allowing it to settle, after which the water is poured off or filtered.

Obtain some pure sheet zinc $\frac{1}{16}''$ thick or, if possible, a few inches of zinc tube $\frac{1}{2}''$ in diameter. If the sheet zinc is used, it must be rolled around a piece of $\frac{1}{2}''$ round wood to form a cylinder and the edges soldered together with a butt joint. Cut the tube into sections $1\frac{1}{2}''$ long with a file and solder a round piece of zinc into one end so as to form a small cup $1\frac{1}{2}''$ by $\frac{1}{2}''$, open at one end. This cup is to form the retaining cell for the battery and also serve as one pole.

Obtain a piece of sterling silver $1\frac{3}{4}''$ long and $\frac{1}{8}''$ or $\frac{3}{16}''$ wide, by rolling or pounding silver wire or by cutting up a discarded spoon or other article, as it is not necessary that it be very thick. A longer piece may be used and the battery will give more current, but in such a case, the strip should be bent back to form two thicknesses $1\frac{3}{4}''$ long. Make a small paper tube about the size of a lead pencil and $1\frac{1}{4}''$ long, closing one end with sealing wax and after putting the silver strip in the centre, ram the remaining space with the chloride of silver. This constitutes the other pole of the battery and should be placed in the centre of the zinc cup; the space between it and the sides being filled with cotton wool or blotting paper.

Moisten the contents of the zinc cup with a strong solution of common salt and water and seal the top of the cup with sealing wax. After soldering connecting wires to the zinc cup and silver strip, the cell will be complete, giving one volt and current enough to ring a common electric bell.

The above dimensions may be changed to meet the requirements of anyone making the battery. I have made them, measuring not over $\frac{1}{2}''$ high. The chloride of silver can be melted and cast around the silver electrode but this is probably beyond the scope of the average reader. Use great care that none of the silver solution gets on the hands or clothing, as it is a caustic poison and will make indelible black stains. Remember to keep the chlroide of zinc in the dark, in fact, it will be well to keep all the chemicals in dim light.

Over 200,000 telephones are reported in use by farmers, connecting their homes with neighboring villages. The wire fencing is frequently utilized for the lines. Many of our readers could easily construct such lines.

PROJECTION.

II. CUBES AND SHADING.

In the projection of solids, the dimensions of length, breadth and thickness, make necessary the use of more than one view for the presentation of an object, that its form and dimensions may be shown in the correct proportions and relation to each other, to enable it to be constructed without other data. It is in this important particular that Mechanical Drawing differs from Perspective or picture drawing.

The plan is assumed to be of the same plane as that of the paper upon which it is presented, and the other planes or elevations are at right angles with it, but revolved as though on a hinge until brought to the same plane as the plan. If the reader will construct from a piece of cardboard, a figure with three flat surfaces to represent the above named views of a cube, and then lay this figure flat upon the drawing board, the relation

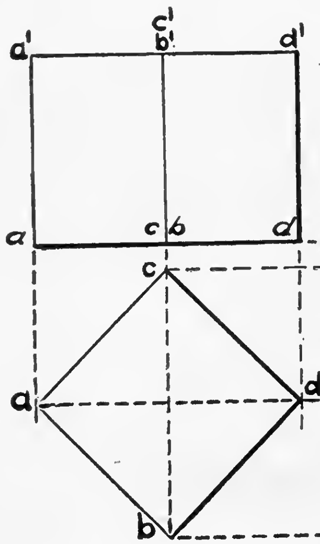


Fig. 11.

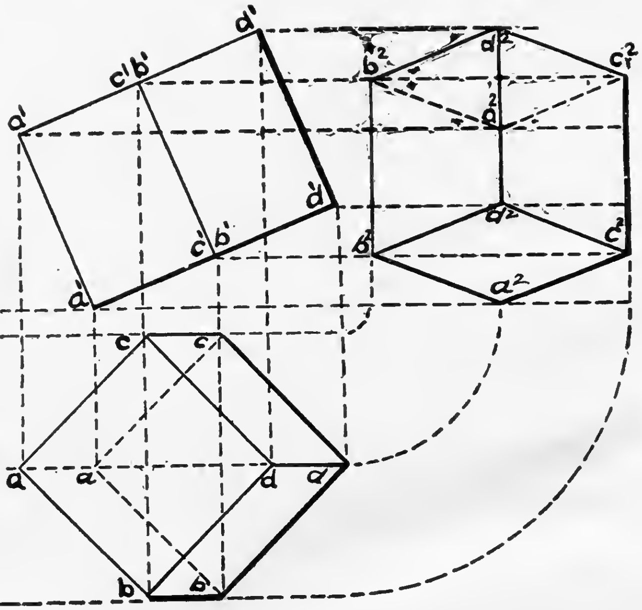


Fig. 12.

these views have to each other will be more easily understood. The joints or hinges between the surfaces of such a figure would represent the lines of intersection of the several planes, which are called the "Axes of Projection."

The first form to be considered is a cube or solid square which we know has six equal sides or squares, each one being parallel to the one opposite. These different surfaces are shown most conveniently for the required purposes by three views known respectively as the Front Elevation, or front view; Side Elevation, or side view (usually the right side), and the Plan, representing a top view; all of these assumed to be from an indefinite distance, great enough to give to the views a plane surface.

The three views of a cube so placed that the nearest side was parallel to the front vertical plane would be alike. If it were turned so that the sides were at an angle of 45° from the vertical plane, the Plan and Elevations would be as shown in Fig. 11; the Side Elevation being the same as that of the Front Elevation. Draw the Plan of the cube a b c d. From each of the angles of the Plan, draw perpendiculars of a length, above the intersecting line, equal to the side of the Plan. Draw the top line, a^1–d^1, completing the elevation.

Assume that the cube be inclined until the plane of the base is at an angle of 25° from the horizontal plane, as shown in Fig. 12. The Elevation shown in Fig. 11 is placed so that the plane of the base, *a–d*, is at the given angle and as the edges are at right angles (90°) to the base, they will be at 60° from the horizontal plane. From the angles of this elevation, draw perpendiculars intersecting them by horizontal lines drawn from

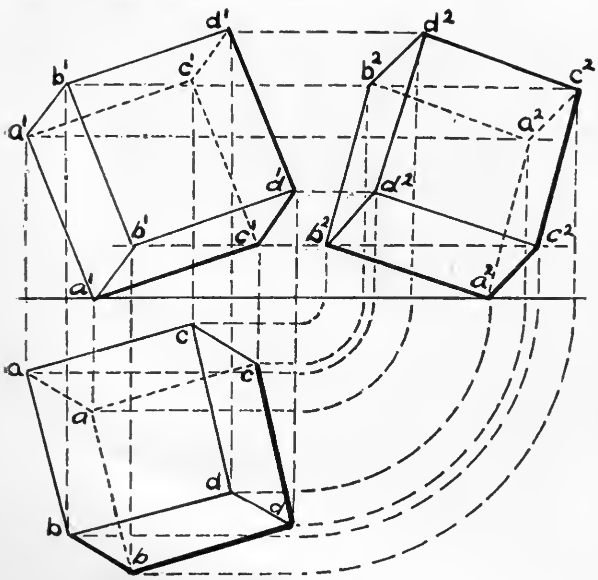


Fig. 13.

the Plan in Fig. 11, and then, drawing the necessary lines to obtain the Plan for the inclined cube. To obtain the Side Elevation, draw horizontal lines to the right from the angles of both the Front Elevation and the Plan. Taking the point where the lines of intersection cross as a centre, describe arcs from the horizontal lines of the Plan and draw vertical projecting lines from these arcs, intersecting the horizontal projecting lines from the Front Elevation. The points of intersection are connected by the lines necessary to complete the Side Elevation.

Assume that the cube, in addition to being inclined 25° from the horizontal plane, is inclined 30° from the vertical plane. Draw the Plan with the lines representing the vertical planes at an angle of 30° from the line of intersection, as shown in Fig. 13. Draw perpendiculars from the angles of Plan and horizontals from the Elevation in Fig. 11. The intersections thus obtained give the points necessary to draw the Front Elevation. By continuing the horizontals to the right, and describing arcs from horizontals drawn from the Plan, using the line of intersection as a radius, and drawing verticals from these arcs, the points necessary to the Side Elevation will be obtained.

The reader who is following these studies without the aid of a teacher, may experience some difficulty in clearly and quickly understanding them, but if several additional problems are tried by varying the angles at which the cube is inclined, the experience thus gained will be valuable and interesting.

Shading.

In a chapter of the series on Mechanical Drawing, the use of shade lines was mentioned, and it was there stated that the light was assumed to fall upon the object from the upper left side at an angle of 45°. In applying this rule to projections however, it is desirable to modify this rule to the extent that shade lines are used only on the right hand and lower edges, as will be noted from the illustrations for this chapter. If the rule were arbitrarily adhered to, the determining of whether shade lines were required or not would so frequently require a nicity of decision and the use of so much time in making it, as to make quite desirable the modification above mentioned. If this is done, the use of shading soon becomes a matter of habit. The lettering adopted for this series makes use of the vertical letter for upper planes and italic for the lower ones. All drawings made by the student should be carefully lettered, both for the practice and clearness of the drawing.

Those who use, in the process of intensification, or bromide print toning, the ill smelling ammonium sulphide, will be glad to hear, on the authority of R. Blake Smith in *Photogram*, that the sodium salt answers the various purposes quite as well, and is almost odorless. The *Photogram* cautions purchasers to be sure they get the sulphide, and not the more generally used sulphite.

A SMALL BOOKCASE.

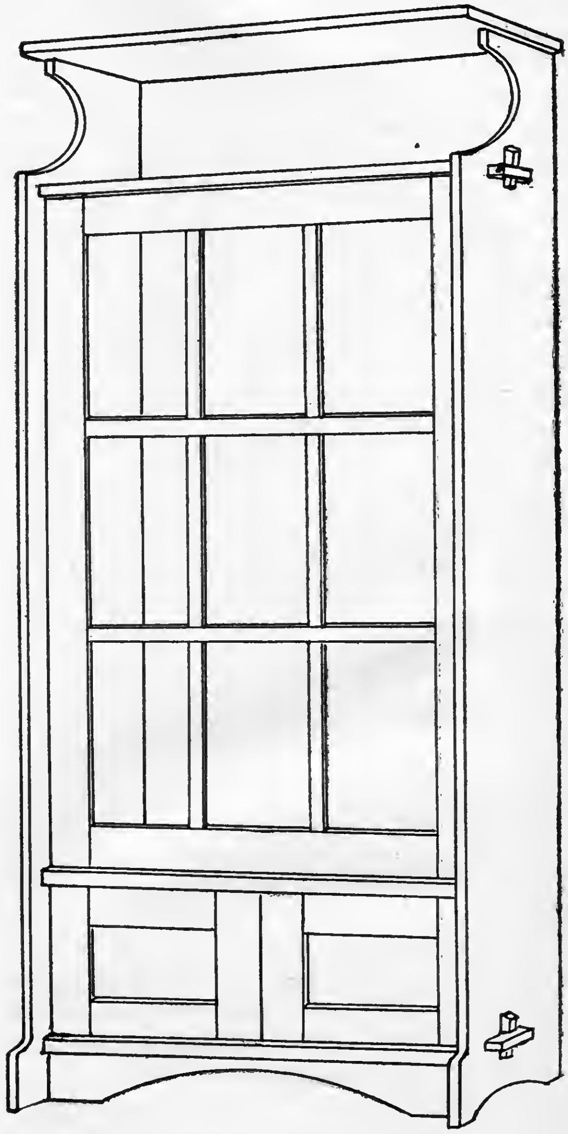
JOHN F. ADAMS.

The bookcase here described may easily be made by anyone of ordinary skill, and will be found both attractive and convenient. The cupboard in the lower part gives a good place for the storage of pamphlets, magazines, and other matter which is not of a form desirable to expose to view. Oak is the most suitable wood for this design but other fine grained woods may be used.

The necessary material is as follows:—2 pieces 62″ long, 11″ wide, ⅞″ thick; 2 pieces 33¾″ long, 10″ wide, ⅞″ thick; 1 piece 33½″ long, 8″ wide, ⅞″ thick; 1 piece 30″ long, 10″ wide, ⅞″ thick; 1 piece 30″ long, 3″ wide, ¾″ thick; 2 pieces 30″ long, 8″ wide, ¾″ thick; 2 pieces 34½″ long, 2″ wide, ¾″ thick; 2 pieces 30″ long, 2″ wide, ¾″ thick; 2 pieces 31½″ long, 1″ wide, ¾″ thick; 2 pieces 27″ long, 1″ wide, ¾″ thick; 8 pieces 12″ long, 2″ wide, ¾″ thick; 2 pieces 12″ long, 9″ wide, ½″ thick; and several strips of ½ clear matched sheathing 48″ long for the back.

The side pieces are cut out at the top and bottom as shown in the illustration; the width at the top being 8″. The proper curve is easily marked out with a pencil, and cut with a compass saw; the saw marks being removed with a draw knife. Mortises are cut in the side pieces to receive the tenons on the ends of the boards at the top and bottom of the cupboards. These mortises are 5″ long and ⅞″ wide, and placed in the centre of the side pieces; the bottom one being 3″ from the end and the upper one 47⅝″ above the lower one. The cross boards 33¾″ long and 10″ wide, have tenons cut on each end, 5″ wide and 1⅞″ long. After trying the fit of these tenons to the mortises in the side pieces, cut mortises in the tenons for the wedge shaped pegs shown in the illustration. These pegs are 1½″ wide, 2¾″ long and ½″ thick at the centre; the mortises for them being cut to bring the pegs snug against the side pieces, and beveled to the shape of the peg on the outer side.

The cross piece between the two sections is 12″ above the lower cross piece and fastened with three strong wood screws, the heads being countersunk deep enough to be covered with putty. The top cross piece is attached in the same way. The doors for the lower cupboard are made as



follows: A ½″ rabbet is cut on the inside edge of all the pieces. The ends of the cross pieces are then halved to fit the rabbet, using care to see that the halving is done on the right side. The joints are then fastened with glue and $\frac{5}{8}''$ screws slightly countersunk. The panels are then put in with glue and screws. A small block of wood is screwed to the centre of the under side of the cross piece above these doors to hold the doors in the right place when closed. Two small hinges are placed on each door and wooden pulls in the centre of the two centre vertical pieces. The piece under the lower cross piece is fastened with glue and screws, and may be cut out as in the illustration or a straight piece, as desired. Pieces 1″ wide and $4\frac{1}{2}''$ long are glued to the lower front edges of the side pieces to make the entension as shown. The tops are slightly rounded.

The door frame for the book compartment must be carefully made. The joints between the side and top and bottom pieces are preferably mortised but may be halved, the inner edges of these pieces having a $\frac{1}{2}''$ rabbet cut in them. The narrow cross pieces in the door are 10″ apart between centres, the ends being halved to fit the rabbets in the side pieces and halved 9″ from each end to receive the vertical strips which are halved at the ends and where they cross the other pieces. The inner edges of the narrow strips are rabbeted $\frac{1}{4}''$ wide and $\frac{1}{2}''$ deep for the glass, this being done before halving. A screw is put into each joint from the inside. The glass, which measures 10″ x $8\frac{1}{2}''$, is held in place by narrow strips of wood, held by small nails, the strips being wide enough to make the outer edges flush with the front width of the pieces to which they are fastened.

The sheathing at the back is nailed or screwed to the cross pieces and reaches only to the cross piece at the top of the book compartment. The shelves are held by large screw-eyes put into the side pieces, or cleats $\frac{3}{4}''$ square, held by screws. The staining and finish should be quite dark, and is left to the selection of the reader.

According to information published by the United States Treasury Bureau of Statistics, there are 1,750 submarine telegraph lines in the world, the aggregate length of which is nearly 200,000 miles. The number of messages annually transmitted over these lines exceeds 6,000,000.

PEAT DEVELOPMENT IN ONTARIO.

A. G. Seyfert, U. S. Consul at Stratford, Ont., writes that hundreds of thousands of dollars have been expended during the past few years in experiments by the different companies in the Province for the perfection of machinery to turn out a fuel that will compete with coal. Under the old process, the bog was cut and sun dried. With new machines, the crude peat is run through the apparatus as fast as dug from the bog. Part of the moisture is evaporated by the heat of the process and the balance removed by the immense pressure the material undergoes, until it drops from the machine in cubes, ready for the market. This process of converting the raw material into marketable fuel is a great improvement over the old method, but further improvements are expected.

The whole question of making the inexhaustible beds of bog commercially valuable lies in the drying process. The genius who will invent a machine to satisfactorily extract the moisture from crude peat will not only make a fortune, but will be a public benefactor.

Thus far, the nearest solution to the problem lies probably in the machine invented by Mr. Dobson, now in use at his peat works at Beaverton, near Lake Simcœ, in northern Ontario. This machine consists of a press, drier, and spreader, and is a most ingenious contrivance, for it cuts, pulverizes, and spreads the material at the same time. This reduces the moisture 50 per cent, and the balance is taken out by the drying process.

Canada annually consumes nearly 3,000,000 tons of anthracite coal, all of which comes from Pennsylvania. The prolonged strike has changed the situation to such an extent that this summer no coal was delivered, and a serious fuel famine confronts the people of this latitude. This condition of affairs has given a tremendous impetus to the manufacturing of peat for fuel all over the Province.

The use in the vinyard district of France of specially constructed cannons to bombard approaching storms and prevent destructive hail, is considered to still be in the experimental stage.

AMATEUR WORK

63 KILBY ST., BOSTON

DRAPER PUBLISHING CO., PUBLISHERS.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

OCTOBER, 1902.

Contents

How do you like the new cover?

THIS number completes the first volume of this magazine. The cordial reception which has been accorded it by numerous readers in all sections of this country, have been most encouraging to the publishers, and our thanks are extended to those who, by their patronage and kindly expressions of approval, have shown that a magazine of this kind was in sufficient demand to warrant its publication. The many interesting articles which are in preparation cover such a wide field and are so numerous, that no attempt will be made to forestall them, but our readers can rely upon finding, during the coming year, quite enough to keep their leisure time fully occupied with useful and instructive work.

OUR readers are invited to suggest subjects which they would like to have presented in this magazine. It is the desire of the publishers to make the magazine as interesting and helpful to as large a number as possible, and any suggestions which may be offered in this line will be favorably acted upon provided the topics are thought to be sufficient interest to warrant.

ATTENTION is called to the following subscription offer: About two hundred complete sets of the first volume of this magazine are being bound in a strong cloth cover and, while they last, will be offered, together with a subscription for volume two (one year), for Two Dollars. As this offer is limited to the above supply, those desiring them should send their order at an early date.

THE users of anthracite coal who are obliged, because of the scarcity of that kind of coal, to make use of bituminous coal, should use care to see that chimneys are cleaned at regular intervals. The latter kind of coal forms considerable quantities of soot, which, if not removed by sweeping, will unite and burn with considerable flame and sparks. Chimneys should be examined and any defects repaired, and arrangements made for quickly reaching shingled roofs with water should sparks fall upon them during a chimney fire.

WOOD TURNING FOR AMATEURS.

F. W. Putnam, Instructor Manual Training School, Lowell, Mass.

II. DESCRIPTION OF THE LATHE.

First class lathes are now made by a number of concerns, and sold at very low prices, yet are not within the means of every amateur who might wish to own one. The May number of "Amateur Work" contained a very good article on the making of a modern turning lathe frame. This frame can be made at a small cost and, when fitted with a suitable lathe set, will serve admirably for the turning of exercises which follow.

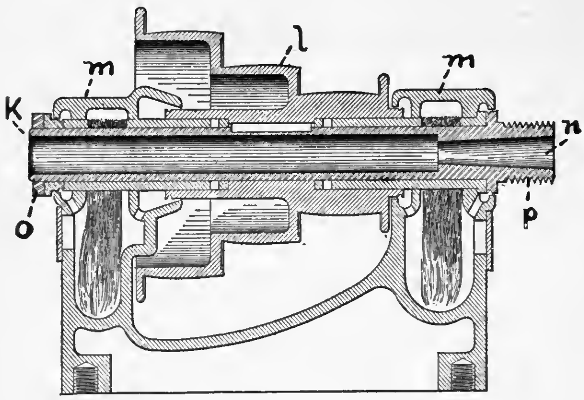
Among the many excellent smaller wood lathes now in the market is the lathe shown in Fig. 3, made by the Washburn Shops of the Worcester Polytechnic Institute, Worcester, Mass. As all modern lathes are practically alike in general construction, let us examine Fig. 3, and learn some thing of the parts of a lathe.

Every lathe has four principal parts:— the shears, the head-stock, the tail-stock, and the rest. The head-stock is stationary, while the tail-stock and the rest are movable along the shears, and may be fastened temporarily at any desired place by means of clamps. The office of the shears or ways is to support the head-stock and the tail-stock in such a position that the axes of their spindles will be in the same straight line, in whatever position on the shears the tail-stock may be fastened. The end of the shears is shown at D, Fig. 3. The shears include the legs E. Sometimes lathes are mounted on wooden benches, and are then known as bench lathes, in which case the legs are very short. The shears have generally two parallel grooves or tracks cut in on or the top surface, in the direction of the line of centres of head-stock and tail-stock. These grooves are V-shaped, corresponding exactly to bosses which project from the under side of the head-stock, tail-stock and the rest. The head-stock, shown at A, Fig. 3, is fastened rigidly to one end of the shears. Fig. 4 shows a longitudinal section through the head-stock.

The live spindle is shown at K, Fig. 4, to which the cone pulley L is fastened. The live spindle is used to revolve the stock which is to be turned. A driving belt passes over the cone pulley from a counter F, Fig. 3, placed above the lathe, the belt thus turning the spindle to which the cone pulley is fastened. A fork or live centre is placed in the end of the spindle, and one end of the stock that is being turned is driven into this fork and

Fig. 3.

revolves with the spindle. The spindle turns in bearings or boxes shown at M, Fig. 4. This lathe has self-oiling boxes, but generally small oil holes are drilled through the top cap of each box, through which oil is supplied to the rubbing surfaces. A few drops of oil should always be put into each oil hole when the lathe is first started. Removable caps or plugs are generally used to keep dust out of the oil holes.



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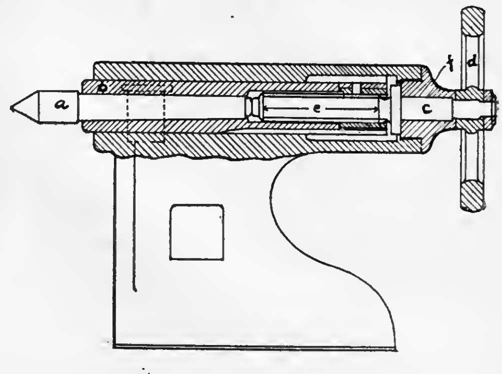

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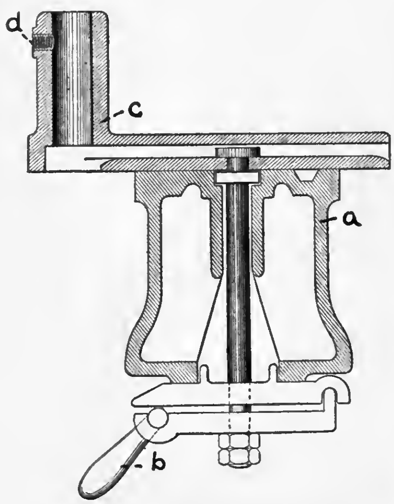

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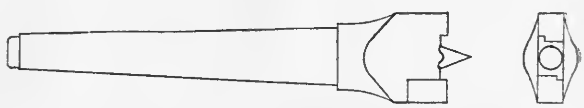


Fig. 7.

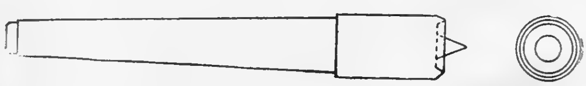


Fig. 8.

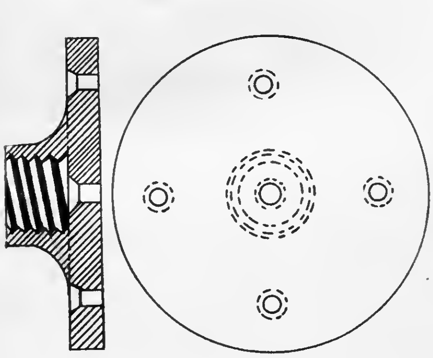


Fig. 9.

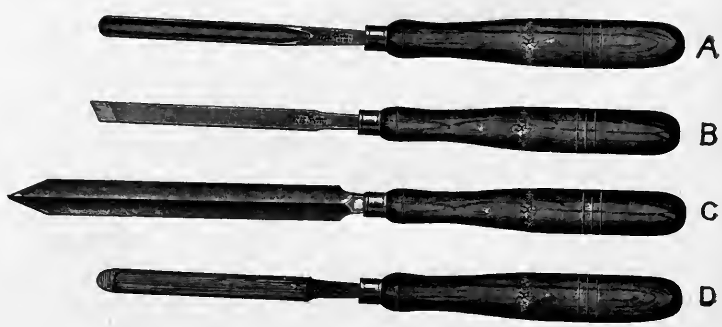


Fig. 10.

The live spindle is usually made hollow, with a tapered hole, N, at one end. into which the live centre, which is cut to a corresponding taper, is placed. The live centre can be removed from the spindle by a smart rap from an iron rod passed through the back end of the spindle which is generally hollow. After continued use the spindle may move back and forth somewhat, giving what is known as "end movement." An adjusting screw or collar, O, will prevent this. The screw thread shown at end of the spindle at P, Fig. 4. is used for the attachment of face plates shown at H and J, Fig. 3.

The tail stock, shown at B, Fig. 3, and in section in Fig. 5, supports the tail spindle. The tail spindle holds the dead centre, so called because it does not revolve, as does the head centre. The stock to be turned revolves between this dead centre and the head centre of the head stock.

The tail stock may be fixed in any desired position on the shears by means of a clamp. The spindle B, Fig. 5, may be forced out from, or drawn back into, the tail stock by means of the screw thread on the shaft, C, Fig. 5. This screw thread on the shaft C, which fits exactly a tapped hole in the tail spindle, takes up the space E, Fig. 5. The hand wheel, D, is used for this movement of the psindle. The spindle can be clamped so as to prevent further movement by a clamp handle, shown just above the letter B, Fig. 3. If the handle, D, be turned until the back end of the dead centre, A, Fig. 5, strikes the front end of the screw on shaft, C, the dead centre will be loosened in the spindle, and may then be taken out. An oil hole, F, is used for oiling the shaft, C.

The rest, shown in Fig. 6, supports and assists in guiding the cutting tool. The casting, A, is adjustable along the shears in the same manner as the tail stock; being fastened, together with the tee holder, C, in any desired position by means of the clamp handle, B. As can be seen from Fig. 6, the tee holder, C, can be moved in any direction desired, and as the tee, G, Fig. 3, is movable in the tee holder, the rest has practically universal adjustment. The distance of the tee from the work is thus regulated, and its height and angle with the stock to be turned are regulated by the set-screw which fits into the tapped hole at D, Fig. 5. Fig. 7 shows two views of a fork centre, or head centre, and Fig. 8 shows two views of a cup centre, or tail centre.

The head centre is used in the live spindle to make the work revolve, one end of the wood being driven onto this head centre by a mallet, the tail centre being brought up against the other end. This tail centre is held in the spindle of the tail stock, and as this spindle does not revolve, the tail centre is often spoken of as the dead centre. Fig. 5 shows that the end of the tail spindle has a tapered hole to fit the taper of the tail centre.

Fig. 9 shows one form of a face plate. This is used when the stock to be turned cannot be held between centres. At one end it is tapped out to fit the thread at the end of the live spindle, P, Fig. 4. It is used in turning cups, balls, and such hollow pieces as require that turning tools be used on one end. Generally this class of work is not fastened directly to this face plate, but is held in a block of wood, or disc, fastened to the face plate by wooden screws, and hollowed out so as to hold the work. This wooden disc is called a chuck. The face plates are of various sizes to accommodate different classes of work.

The size of a lathe is determined by two things, the swing, and the length of the shears. The swing of a lathe is twice the distance from the centre of the spur of the live centre to the nearest point of the shears. For instance, a lathe is advertised as having an 11″ swing and a 4″ bed. Nothing over 11″ in diameter could be turned on such a lathe, while the greatest distance obtainable between centres would probably be not over 27″.

TOOLS.

As advancement in wood turning must be made step by step, a few simple tools are all that is necessary for the first efforts. These will consist of a few gouges and chisels, and a parting tool, shown in Fig. 10. These are made purposely for such work, and may be obtained from any well equipped hardware store.

The following tools make a very satisfactory set: 1 skew chisel and 1 turner's gouge, each 1″ wide; 1 skew chisel and 1 turner's gouge, each $\frac{3}{4}$″ wide; 1 skew chisel and 1 turner's gouge, each $\frac{1}{2}$″ wide; 1 skew chisel and 1 turner's gouge, each $\frac{1}{4}$″ wide; 1 round nose chisel $\frac{1}{4}$″ wide; 1 parting tool $\frac{1}{8}$″

wide; 1 pair wing calipers, 6″; 1 pair wing dividers, 6″; 1 wooden mallet, light weight; 1 oil can; 1 oil stove; 1 oil-stone slip.

The gouges, chisels, and parting tool should be fitted with good stout handles in about the proportion shown in the illustrations. For large sizes the handles should be long so as to give good command of the tool when taking a heavy cut. Generally turning tools are sold with the handles already fitted.

The gouge, A, Fig. 10, is the most valuable tool to the wood turner. Any piece that is to be turned is first rapidly brought to a cylindrical form by means of the gouge, and many surfaces having double curves are shaped by its use. Gouges must be well rounded on the cutting edge, and the bevel should be perfectly straight as it is the guide by means of which the depth and shape of curves are regulated. The edge should be a smooth curve, elliptical in shape, so that the gouge may be turned in a small space. The size of a gouge is measured by the width across the concave side, and varies from $\frac{1}{8}$″ to 1″ by eighths of an inch, and from 1″ to 3″ by quarters of an inch.

The skew chisel, or side tool, B, Fig. 10, as it is often called, is a most effective tool, and is used in finishing straight outlined work, such as the cylinder and the cone, and for making convex curves and beads. These chisels are ground with a bevel on both sides, and at an angle of 35° to their edges. The cutting edge, instead of being at right angles with the side of the tool, is skewed somewhat. This gives better command of the cutting, as it allows a better position of the handle. The bevel must be even all its length, and not made more obtuse as it approaches the cutting edge, as by this is regulated the depth of the cut. This is a very important point, and the beginner must not fail to attend to it. The best of wood turners find it difficult to obtain good results by the use of tools that are not properly ground, and this being the case, how much more difficult it must be for the beginner to do even a passable job if the tools are in bad condition. The size of the skew chisel is measured by the width of the blade. The large sizes should have long handles. The bevel on both sides permits of the reversing of the tool. This will be found to be of great value, a they can then be used in either direction.

The parting tool, or cutting off tool, C, Fig. 10, is used for cutting off finished work. The parting tool is measured by the width across the face, the ordinary parting tool being $\frac{1}{8}$″ wide. This tool is very often used for making narrow grooves having, at the bottom, diameters equal to some of the more important dimensions of the finished work, the measurements being taken by a pair of calipers. Later on the general outline is brought down to these grooves.

The round nose chisel, D, Fig. 10, is generally made by grinding an ordinary carpenter's chisel to the elliptical form of a gouge. This tool is used in place of the gouge for most face plate work, and especially for cutting recesses where the gouge would be apt to catch in the wood, and so spoil the work.

The next article will take up the sharpening of the tools, and the first one of a series of exercises, in which I hope to make plain the elementary principles of wood turning.

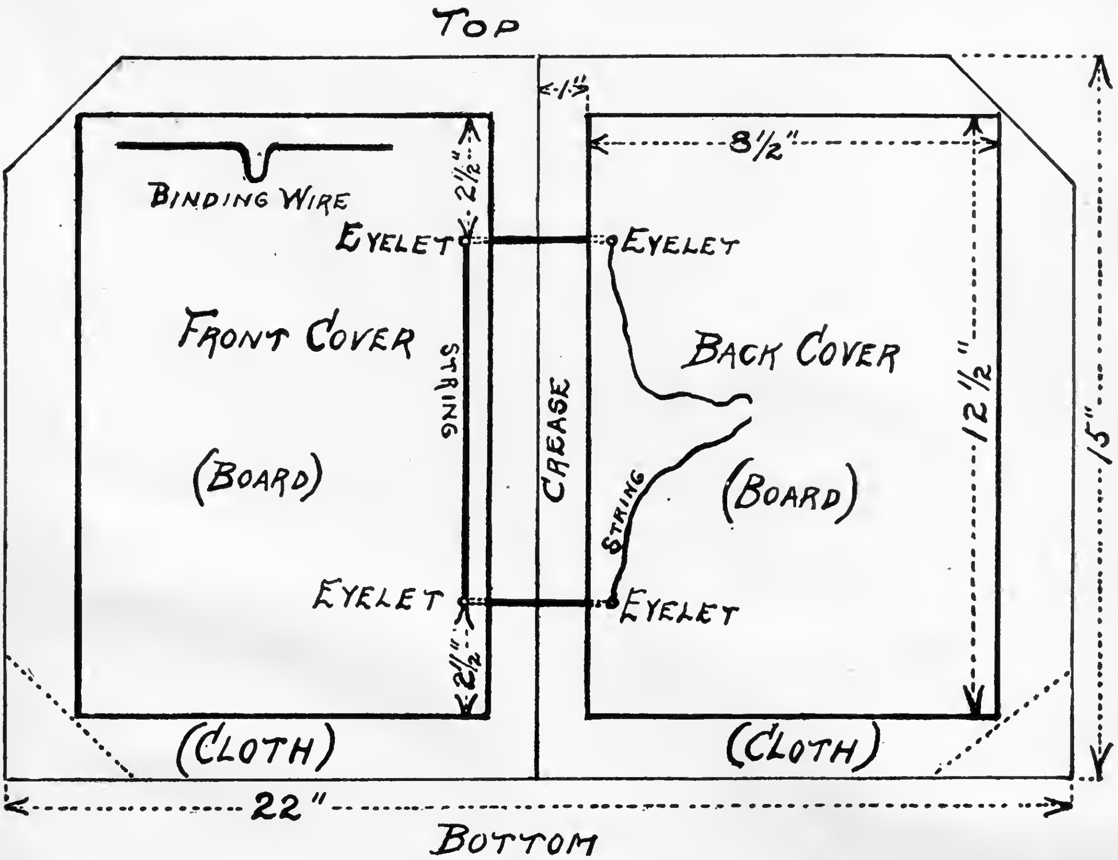
A German electrical journal describes a new galvanic cell which "inhales" the oxygen of the air. The cell contains, in a saturated ammonium chloride solution, a zinc rod and a porous pot provided with a semi-porous membrane. Within the porous vessel is placed a retort carbon, and the vessel contains a special depolarizing liquid. This depolarizing liquid constitutes a sort of chemical sponge, which, when in the air, absorbs the oxygen thereof, and gives it off again in the process of depolarization. The depolarizer consists of ammonium cuprate.

Consul-General O. J. D. Hughes reports from Coburg, that experiments were recently carried out at a colliery, near Saarbrucken, Germany, with lime, tar, and carbolineum to determine the respective value thereof as preservatives of mine timber against rot. Lime was found to be of the least value, while coal tar, although insuring perfect perservation of the surface of the timber, failed to protect the interior, which in every instance was found to be seriously attacked by rot. Carbolineum, however, gave excellent results, provided the timber coated had been previously barked and well dried.

A BINDER FOR MAGAZINES.

Charles J. Bagley.

Those who prefer to keep their numbers of Amateur Work in a cover, in book form, rather than to leave them loose, can make a convenient binder to take each number as it comes from the publishers, thus keeping the file complete and doing away with the chances of losing any of the magazines.



The measurements given are suitable for Amateur Work, and the reader will understand that they can be changed so as to make a cover to hold sheet music, or anything of a similar nature.

Get two pieces of millboard, such as is used for book covers, 12½" by 8½", and a little less than ⅛" thick. Photographic mounts can be procured which will answer the purpose. In one long side of each piece punch two holes and put in two open metal eyelets, about 2½" from each end and ½" from the edge (your family lawyer or the shoemaker will have the machine with which to do this). Get from a book binder or a binders' supply house a piece of book cloth 22" by 15". The lighter grades of keratol, pegamoid or other imitation leathers, to be obtained at an upholsterers, will answer admirably in place of book cloth. Fold and lightly crease the cloth across the short way in the middle, with the right side of the cloth out. Open the cloth again and make four lines parallel with the crease, on the wrong side of the cloth, two of them one inch from the crease on each side of it and two of them two inches from it; also mark the boards an inch from the edge where the eyelets are. Quickly put good paste on one of the boards up to this line and on half the wrong side of the cloth up to the two inch line. Join the two pasted surfaces, placing the eyelet edge of the board on the line one inch from the centre crease of the cloth, and leaving an equal amount of the cloth above and below the board. Turn over the cloth and board and rub the cloth down tight so as to remove any bubbles and have the cloth smooth and fast to the board. Turn over again, and treat the other half of the cloth and the other board in the same way. Then cut the corners of the cloth on an angle, as shown at the top of the drawing, escaping the corners of the board about $\frac{1}{8}''$. Fold over top and bottom of cloth all the way across and paste down, then the ends the same. Be sure the cloth is pasted tight to the board, especially at the edges, where it is most likely to loosen when being folded over. After all is dry, the cover will look more finished if a piece of tinted or fancy paper is pasted on the inside of each cover nearly to the edges and over the edges of the cloth.

These measurements will make a cover which will have a capacity of two inches in thickness (about three volumes of Amateur Work) and will leave a space of about $\frac{3}{4}''$ around the edges of the magazine for protection. Each number of the magazine will require two pieces of wire to hold it in place. Get a spool of flexible wire, brass or tinned iron, about No. 22, and cut off several two inch pieces. With pliers make a U loop in the centre, 3-16″ deep and $\frac{1}{8}''$ across the opening. Open the magazine in the middle, and cut two slits a trifle over $\frac{1}{8}''$ long in the fold of the paper through the back, the length of the slits pointing up and down the magazine. These slits must be cut at such points as will be directly opposite the eyelets when the magazine is in the centre of the cover. Open the cover; pass the ends of an ordinary new shoe string down through the eyelets in the front cover of the binder. Pass the U loop of the wires through the slits in the paper so that they protrude through the back of the magazine when it is closed. Put the string through these loops from the front of the magazine toward the back, and then up through the opposite eyelets in the back cover, pull them tight and tie the two ends together.

Any single number of the magazine, when several are fastened in the binder, can easily be taken out without disturbing the others, by loosening the strings, opening the desired number in the middle, pulling the string up through the slits and slipping the wire from under it. Or in the opposite manner a number may be placed in the binder between others, by pulling the loosened string up through the slits, introducing the wires under the loops of string, and then drawing the string tight.

An appropriate title can be painted on the cover with enamel paint, which dries quickly and will not easily wear off.

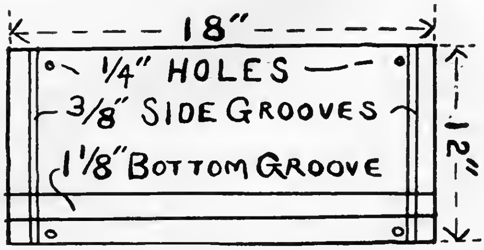
HOW TO MAKE AN AQUARIUM.

Frank Balsh.

Few things are more interesting to the young lover of nature than a well stocked and properly cared for aquarium. I trust, therefore, that the following directions for making one, will not be without interest to the readers of Amateur Work.

The tank is constructed of slate and plate glass and is not beyond the powers of the ordinary amateur mechanic.

First procure some slate free from flaws. The three pieces which will be wanted can be bought from any slate dealer at small cost. A slab 36″ long, 18″ wide and about 1″ thick, will be required for the bottom, and pieces 18″ by 12″ for the two ends. At 1″ from the broad part of the ends, cut a groove $1\frac{1}{8}''$ wide and $\frac{1}{2}''$ deep. This groove can be cut with a saw as follows: First mark where you wish to cut with an awl, then lay the slate on a table or bench, and screw two strips of hard wood in such a manner that the mark on the slate will come between the strips; their distance apart should be the thickness of the saw. When both lines have been sawed to the right depth, the slate between them can be cut out with an old chisel and hammer. These grooves are for the ends of the bottom.



End of Tank.

After you have cut the above grooves, you can cut grooves ½″ deep and ⅜″ wide along both sides of the bottom, and of each end piece, at a distance of ⅞″ from the edge, for the plate glass sides. Now bore four holes ¼″ in diameter in each end piece. Two of these holes should be placed about 1¼″ from the edge and ⅜″ below the groove first made to receive the bottom, and two quite near the top, just inside the groove for the glass.

These holes are for the brass rods which hold the tank together. The rods or bolts should be ¼″in diameter and about 38¼″ long. They should be threaded for about 1″ on both ends, and fitted with nuts.

The finished end is shown above.

You can now proceed to put the tank together. First partly fill all the grooves with cement made as follows:—1 pint of plaster of paris, 1 pint of best litharge, 1 pint of fine white sand, ⅓ pint of powdered resin.

The above when used should be mixed with boiled oil and driers to a stiff putty.

After placing a little of this cement in all the grooves, raise the bottom on blocks of wood, and with the help of a friend, you can easily slip the glass, ends and brass rods into position. And when you have done so, screw up the nuts on the rods with your fingers only. Carefully fill all grooves, empty spaces and cracks with cement and your aquarium is finished.

It will be noted that this aquarium makes no provision for running water, as for most purposes this is not necessary, the oxygen being provided by plant life which may easily be secured from nearby ponds.

RULES FOR MAKING GLUE.

Glue, being an animal substance, must be kept sweet. To do this it is necessary to keep it cool after it is once dissolved and not in use. In all cases keep the glue kettle clean and sweet by cleaning it often.

Good glue requires more water than poor, consequently you can not dissolve six pounds of good glue in the same quantity of water that you can six pounds of poor. The best glue will require from one-half to more than double the water that is required with poor glue, which is clear and red, and the quality of which can be discovered by breaking a piece. If good it will break hard and tough, and when broken will be irregular on the broken edge. If poor it will break comparatively easy, leaving a smooth, straight edge.

In dissolving glue it is best to weigh the glue and weigh or measure the water. If not done there is a liability of getting more glue than the water can properly dissolve. It is a good plan, when once the quantity of water that any sample of glue will take up has been ascertained, to put the glue and water together at least six hours before heat is applied, and if it is not soft enough then let it remain longer in soak, for there is no danger to good glue remaining in pure water even for 48 hours.

The advantage of frozen glue is that it can be made up at once, on account of its being so porous. Frozen glue of same grade is as strong as if dried.

If glue is of first-rate quality it can be used on most kinds of wood work very thin, and make the joint as strong as the original. White glue is made white by bleaching.

If you entertain the supposition that any real success, in great things or in small, ever was or could be wrested from Fortune by fits and starts, leave that wrong idea here.—*Bleak House.*

PHOTOGRAPHY.

TURNING PHOTOGRAPHS INTO SKETCHES.

ALLEN DEBEVOISE.—In the Photo-American.

The essential parts of a photographic print are often wanted in preparing advertisements and other matter partly in type, and though I cannot draw very well I am making all needed sketches by an old process that answers very well and is quickly done. Sometimes we print on such rough paper that half tone engravings such as are used in many magazines, would not show detail at all, but be a mere blotch of black, and then we have recourse to line work if at no other time. Tell you how 'tis done? With pleasure. I buy sheets of salted and sized paper (Clemons) at the stock house. I mix the following sensitizing solution, and as it keeps well, ten ounces will do no harm; so into ten ounces of distilled water I drop one ounce of silver nitrate and half an ounce of ammonium nitrate, the whole bath, bottle, water and chemicals costing me sixty cents.

With a tuft of cotton fastened to a glass tube by drawing a loop over the cotton and through the tube I make a good brush. I don't want to get any of it on my fingers for it will turn them black as night, hence I use the Buckles brush, as this cotton and tube is called.

Now, pinning a sheet of paper to a soft pine board I daub about a quarter of an ounce of the sensitizer all over it with the brush, being careful to cover the paper evenly by first stroking down and afterwards going over the whole job crosswise. I do this in a weak light way back from any windows, and when coated, I just hang the 18x22 sheet up and fan it a few minutes till bone dry. Now I have a lot of paper and I cut it up and put it in a tin box where it will keep a few days without discoloring, if a lump of calcium chloride, done up in cotton in a perforated tin pill box, is also placed in the box.

Print this paper as you would aristo. Mark the back of the sheet with crosses in lead pencil before sensitizing, for one can't tell the sensitized side from the other after dry. The print being made, I merely fix it in hypo, wash and dry it, and then trace out the parts I want with a pen charged with Higgins' water-proof ink. Follow all important lines closely, but ignore the rest merely suggesting rather than drawing any detail by hatching or wriggles (I don't know any other name for that stroke), being careful not to block up any part to a dead black. This being completed, and it usually takes me four or five minutes only, the print goes into a bleaching bath made of 10 ounces of water, 100 grains of bichloride of mercury and a good pinch of salt. I never weigh or measure this bath, any strength will do. In this bath all traces of the silver image fade away, leaving nothing but my drawing, and presto! 'tis done. Wash a few moments, dry, add a touch here and there that was forgotten, and the line drawing or sketch is ready to use. The engraver makes me a block of it to print as an illustration to my advertisement or other text, but those who do not want blocks can copy the sketch with the camera and develop the plate to great density and then reproduce as many of the sketches as fancy dictates.

If the negative is printed on CC platinotype it will be hard to say what it is, for it cannot be told from a pen and ink drawing. Much amusement and a good knowledge of drawing can readily be had by enjoying this simple process for a change, and the results ought to please. The sensitizer can be kept in any light; it don't spoil it to be in the light; in fact a frequent sunning does it good. If one wishes to tone the prints on this paper some very beautiful effects can be had with a simple bath of gold just neutralized with chalk and a grain of soda bicarbonate. Clemons' formula (to be had at the stock house selling his paper) for the toning bath also gives the best of black or purple black tones. There's a whole lot of fun in this thing, it's cheap and—well what more need be asked?

NEW FOOD PLANTS IN YUCATAN.

"The gardens and fields of Yucatan are filled with succulent vegetables and odorous herbs unknown to the outer world," writes Edward Thompson, U. S. Consul at Progresso. He also advises that in the cultivated fields, at the proper seasons, are grown classes of Indian corn, beans, squashes, and tubers for which we have no name, for the reason that we have never seen or heard of them.

The forests and jungles contain fruits that, excellent even in their wild state, could be made delicious by scientific care and cultivation. There are half a score of wild fruits that offer more promising results than did the bitter wild almond, the progenitor of the peach.

These promising subjects for cultivation should attract the attention of those interested in this line of research and practical work.

The consul holds himself in readiness to supply any person who, or society which, desires the seeds or roots mentioned in these reports for the purpose of study, making only such charges as will cover the actual expense incurred.

The most important of the large cereals is the maize of the Mexicans—the indian corn of the Americans and the ixim of the Mayas of Yucatan. Yucatan has six varieties of this grain, and the Maya Indian reverently speaks of it as the "grace of God." The large stalked, large grained class known to the natives as xnuc nal (pronounced shnook nál) is the most prominent and has by far the greater acreage devoted to its cultivation on the peninsula (Yucatan). It is planted in May, is fully matured in January, and then is left to harden and season until gathered as needed. This class most nearly resembles our indian corn. It has both the white and yellow grains. Under the haphazard methods of the native Indians, the corn produces in the limestone soil of Yucatan from 20 to 30 bushels to the acre. Under favorable conditions, this yield is often doubled.

The "xmehenal" (shmehenál) is a small, quick growing variety, about the size of our pop corn. The plants are rarely 4 feet high. One variety matures within sixty days of its planting, and the second needs but fifteen days more.

The xmehenal xtup (shtoop), planted in May, can be gathered in July, and, while the production per acre does not quite reach the figures of the xnuc nal, it has a greater capacity of resisting the extremes of heat and dryness.

The natives of Yucatan prefer the native corn to that imported from the United States, and will cheerfully pay the higher price demanded in times of scacity.

The plant, or rather the running vine, known as the macal box (makal bosh), produces a tuberous root of great nutritive value. Entire families have lived upon this root for weeks at a time and were healthy and well nourished. This plant is very productive. About the middle of May the green shoots first appear above the earth. They grow rapidly and in November are ready to be dug. The tuber is about the size of a large Irish potato and is of a purplish color, like a certain class of sweet potato. It can be cooked in the same way as the sweet potato. The plant is hardy. A long drought may cause the vine to wither, but with the lightest rain it springs up anew. The roots left in the ground, as too small for food, propagate the plant, and each year the yield increases. It seems to be a kind of native yam; it grows in almost any kind of moderately rich soil, and when cultivated intelligently should be of certain value as a food plant. The xmakin macal (shmakeén makál), like the macal box, appears in May and is gathered in November, but it yields only one or two tubers to the plant. These, however, are of large size, resembling enormous Irish potatoes. I have seen four of these great roots fill a bushel basket. The interior is white and seems to be nearly pure starch. It is planted as we set out potatoes. The plants grow close together, and, while I have no exact figures, the yield per acre should be phenomenal.

Xmehen chi-can (shmehen chi kan) seems to be a kind of artichoke, weighing when mature about a pound. The plants are running vines, rarely more than a yard long. An acre will yield an immense crop under favorable conditions. The plant, sown in August, can be gathered in November.

Xnuc chi-can is a larger root, weighing when mature about three pounds. It is a hardy plant and produces well. Both of these roots are eaten roasted or boiled, and many like them raw.

A SIGNAL TELEGRAPH SYSTEM.

A. G. Holman, M. E.

The proposed system is not an electric telegraph. It occupies a field of its own, and although not having the capacity or refinements of electric devices, it has the honor of an illustrious past and of many respectable modern applications. As compared with electric systems for amateur use, it will be found that it has "legs" in a practical sense, far beyond the financial reach of the average boy in electric fields. For purposes of amusement, and also of practical usefulness and moderate profit, a well arranged signal telegraph still has a place.

The requirements for an acceptable system are easy and cheap construction, a simple alphabet and considerable speed. A signal apparatus fulfilling these conditions and manned by a combination of energetic and trustworthy young men, has a fighting chance for commercial existence, as well as entertainment, even in this electric age. It should not be forgotten when estimating the possible benefits from a semi-business operation organized by young men, that if properly conducted, it will bring them to the favorable notice of business men and lead to desirable engagements that may be fairly counted among the assets of the combination.

A description of the proposed signal system will cover:—

1. An explanation of the necessary characters.
2. The translation of characters into signals.
3. The construction of a miniature apparatus for purposes of practice.
4. The construction of a full-sized apparatus.
5. Details of organization and operation for a group of stations.
6. Organization of a Trunk line service.

First. The characters necessary for a convenient and satisfactory miscellaneous business cannot be less then about forty two. These include the letters of the alphabet, the numerals, several punctuation signs and a few special signals for special purposes. It is important that the first step of choosing the characters should be carefully taken, so that it may become a standard code suitable for all future extensions of the system.

The forty two characters may be conveniently arranged in tabular form as shown in Fig. 1.

Second. Translation into signals. If a number is given to each line and to each vertical column, the character at the beginning of each line may be expressed by a single figure, as 1 for A, 2 for E, 3 for I, etc. All the other characters may be expressed by two figures each, giving first the number of line and secondly the number of column, 1–2 for C, 3–3 for L, etc.

Therefore by this expedient of tabulating the characters, the necessary separate signals required to express the entire list has been reduced to six. It will also be noticed that the vowels which are of most frequent occurance, are placed at the beginning of the lines, so that they are expressed by one figure.

Signals → ↓		1	2	3	4	5	6
1	A	B	C	D	?	-	1
2	E	F	G	H	&	.	2
3	I	J	K	L	M	N	3
4	O	P	Q	R	S	T	4
5	U	V	W	X	Y	Z	5
6	SPACE	7	8	9	0	The	6

Fig. 1.

As the Morse telegraph alphabet, used on electric lines and in flag signals, requires one signal for E, two signals for I, and a greater number for all other letters, it will be seen that if a method can be provided for indicating each of the six figures mentioned by a single signal, much has been accomplished in the line of speed and simplicity.

Third. A miniature apparatus for expressing the six figures by single signals is shown in Fig. 2. Cut from a piece of thin wood the piece marked A, consisting of the main portion, 3 in. square and a handle 3 in. long on one side of the square and formed from the same piece. At the centre a common spool, B, is fastened to the board with a round head screw of proper size so that when firmly in the board, the head will allow the spool to turn. In the side of the spool a wire or small wooden rod, C, about 4 in. long, is firmly fixed, so that when the spool is turned the rod will be swung to different angles. Finally, mark on the board the position of the rod when at the upper and lower left corners and four other positions equally spaced between, and number these marks from 1 to 6 as shown, and drive small nails partially into the board at corners 1 and 6 to serve as stops for the rod, so that it may be quickly swung to the extreme positions without passing beyond. When not in use the rod can be sprung over the cover nails and placed over the handle for convenience of carrying in the pocket.

With this pocket apparatus, which can be made in a short time and at trifling expense, messages according to the tabulated code, may be rapidly sent as far as the signals can be seen, and will give valuable practice in familiarizing the work while within speaking distance so that suggestions can be exchanged.

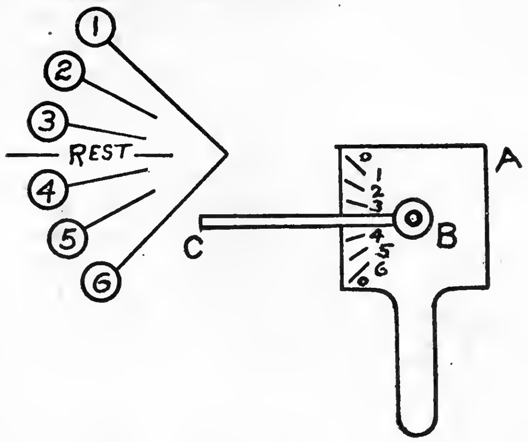


Fig. 2.

To signal the letter A, swing the rod quickly to position 1, and keep it there long enough so that it can be observed, but no longer than necessary. If the next letter to be sent is F (to be indicated by 2–1) swing the rod to 2 and then back to 1. If the next letter following A should be C (indicated by 1–2) bring the rod to the horizontal position of "rest" to show that the previous letter is finished, and then turn successively to 1 and 2. Be careful to leave a distinct space or pause between letters, so that the signals will not be confused. Double figures, like 3–3 for S, are made by swinging rod to 3, then back to "rest" or horizontal position, and again to 3. At the end of each word drop rod to 6, indicating "space." This is more distinct than to depend upon a longer pause to indicate the space, and it also saves time. The signals for the nine numerals and zero all include the signal 6 in the combination, which is a help in recognizing these characters. The word "the" occurs so frequently that time is saved by assigning to it a separate combination, 6–5, requiring two signals instead of spelling it out with five.

The group included within the small square in the table contains all the characters necessary for practical use. "&" may be used in addresses and also for "and" in messages.

The question mark, 1–4, in addition to its ordinary use, is convenient for indicating "what?" if a remark by signals is not understood. The dash, 1-5, is used for commas and other stops in a sentence less prominent than the period, 2–5. The period may also be used without confusion as a decimal point. In making the signals be sure to give the line signal first, followed by the column signal, and make a slight pause between letters.

Sending messages. Confusion will be avoided by acquiring a habit at the outset of following the ordinary telegraph custom in regard to the proper order.

The necessary details are these:—

Begin each message with abbreviation H R (meaning hear?) to indicate that a regular message is coming. Next give successively the number of message, initials of sender, the "check" or number of words in body of message, place sent from, full address, the message and the signature.

The name of sending place should be preceded by "Fm," the address by "To," the message by a period, the signature by "Sig," and the message should end with a period after the signature.

The proper order is indicated in the following line:— Hr. No, Sender, Check, Fm, To – Message, Sig –

At end of message the receiving station says "O K," followed by initial of the receiving operator.

When an informal message or remark is sent it should always begin as well as end with a period.

The signals to attract the attention of another office may be one of the vowel letters, several times repeated, with the "space" signal between. This will provide five separate "calls" which will accommodate as many stations as would probably ever be within range. If not, a combination of letters, like A E, A I, etc., will supply the necessary number.

When the station called answers "II," proceed with the message.

Messages can be taken before the alphabet is memorized, by simply writing down the figures and afterward filling in the translation.

By forming a small club for practice, stations may be arranged in different rooms or around buildings so that the original sender is out of sight of some of the receiving officers.

A sending instrument which is simply an enlargement of that here described, could be used between neighboring houses or in field work for considerable distances, but for long range certain modifications are desirable, which will be described in another article.

Without any apparatus this alphabet may be used with the swinging of the hand or a cane, to carry on a conversation much beyond speaking distance, and at a higher speed than by the "wig-wag" code.

Regular stations may be established to reach summer resorts, temporary camps, etc., and the curiosity awakened by the unusual operations will be good advertising, and the fad of telegraphic conversation at a [illegible] ner message will bring change into the

HOW TO SHAKE CHESTNUT TREES.

The chestnuting season is now at hand, and gathering chestnuts will be one of the pleasures of many readers of this magazine. The simple device here described will make easy the shaking of the long, high branches of the tree, where nuts always seem to be thickest and most difficult to get.

Obtain an iron or lead ball, the latter prefered, about two inches in diameter, and drill a quarter of an inch hole in it. In this hole put one end of a piece of iron rod a quarter of an inch in diameter and eight inches long, and solder securely. Bend the other end of the rod into a small eye. About 150 feet of strong cord will also be needed, one end of which is fastened to the eye in iron rod, and the "shaker" is complete.

To use it, take hold of the cord about two feet from the shaker, and twirl it in a verticle circle until it is moving rapidly, the hold being released so that it will rise over the branch and drop to the ground on the further side. This action has thrown the cord over the branch, and if the two ends are then brought together, the branch can be violently shaken, and the chestnuts will drop to the ground. Before throwing the shaker the cord should be loosely coiled so that it will not snarl when rising. When through shaking, the shaker end of the cord is pulled until all the cord is again on the ground, when it is coiled for another throw. But little practice is required to enable one to direct the shaker quite accurately. Use care that companions are not struck with the shaker, as a most violent blow would result if it was moving rapidly.

The total production of domestic copper in the United States in 1901 was 268,782 long tons.

TRADE NOTES.

Draftsmen who appreciate fine instruments will find it to their interest to secure the catalogue of Kolesch & Co., 138 Fulton St., New York. This firm make a specialty of Swiss instruments, which they offer in a wide variety and at very reasonable prices.

The amateur or professional workman who delight in having tools of the [illegible]

in the [illegible] for E, 3 for I, All the other characters may be expressed by two

manufactured by the Brown & Sharpe Mfg. Co., Providence, R. I., a tool which will satisfy their highest ideals of what a tool should be. Descriptive circulars may be obtained of leading hardware dealers or direct upon request.

The screw pitch guage, 4 to 60, manufactured by the Sawyer Tool Mfg. Co., Fitchburg, Mass., is a compact and convenient arrangement of this important tool, and sold at a price which puts it within the reach of all.

The "Bed Rock" planes of the Stanley Rule and Level Co., New Britain, Conn., are designed so that the cutting tool, while adjustable, is held absolutely rigid, and the throat is of less width than with an ordinary plane. These important advantages will be greatly appreciated by those who require high grade tools.

The new line of hand saws now being manufactured by the Simonds Mfg. Co., Fitchburg, Mass, have already established a reputation for quality and finish which will be greatly extended as their sale increases.

A serviceable, well made telephone at a low price has at last been offered for sale by the Atwater Kent Mfg. Wks., Philadelphia, Pa., which may be purchased with confidence by anyone desiring to erect a private line which will stand up under continued service. The rapidly increasing sale of this instrument is evidence that it is meeting the demand which has long been felt for such a telephone. The firm is sending out an artistic card bearing a handsome face of the Gibson tpye, enclosed in a dark card frame with cord for hanging on the wall, making a very attractive ornament for an office.

For artistic design and finish and the highest grade of workmanship and service, the telephone manufactured by the S. H. Couch Co., Summer St., Boston, is a leader. It must be seen to be fully appreciated. It is specially applicable for private line residence or office use, where an attractive appearance is desired. The price is very reasonable when the quality of the instrument is considered. Electrical supply dealers should find it a good seller.

The L. S. Starrett Co., Athol, Mass., are sending out a supplement to their regular catalogue, which presents several new and important tools, for mechanics. Steel measuring taps, folding steel rules with large figures for blacksmiths, folding steel pocket rules, metric screw pitch guages, a variety of new shapes of micrometers, spirit levels, hack saws and blades, a universal test indicator, are described with prices. The tools made by this company are so well known and universally used that new tools of their manufacture are sure to meet with a ready sale.

The amateur or professional who resides where it is difficult to purchase tools and supplies at prices prevailing in large cities will find it desirable to communicate with The Frasse Co., 38 Cortlandt St., New York. This company make a specialty of mail order business and carry a large variety of tools and supplies which are offered at city prices.

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