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December, 1910

# ELECTRICIAN & MECHANIC


PUBLISHED MONTHLY BY

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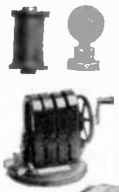
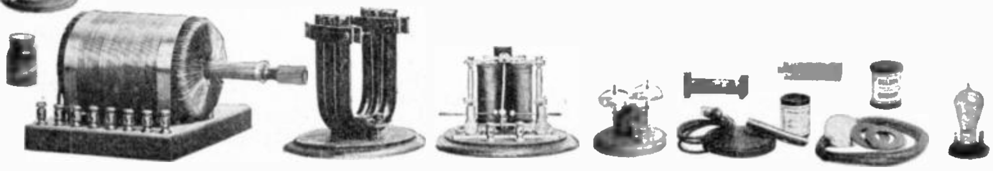
BOSTON, MASS.



# Christmas Outfit



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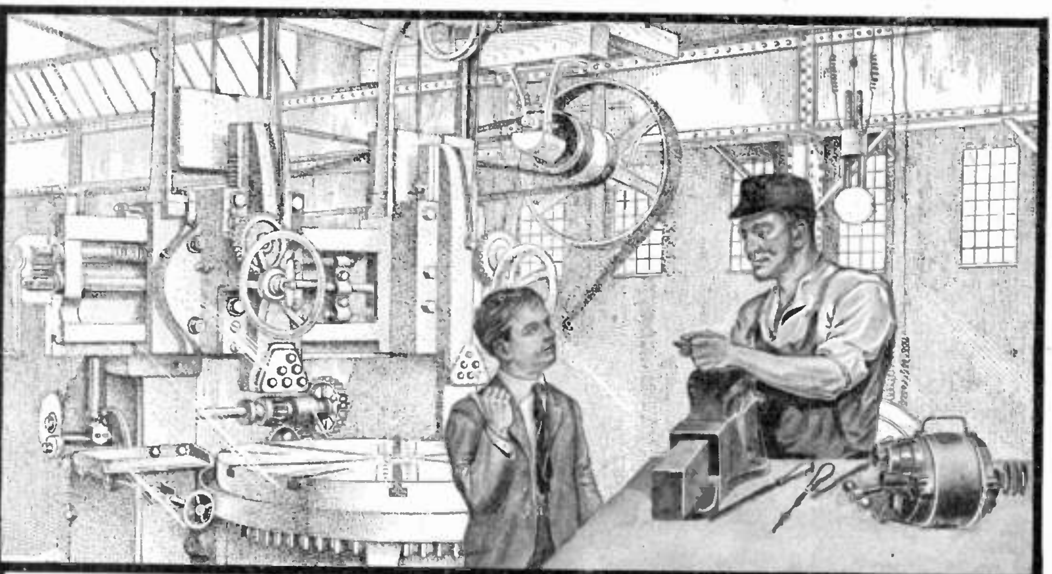

# ELECTRICIAN AND MECHANIC

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F. R. Fraprie, M. Sc. Chem., F.R.P.S.
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M. O. Sampson
*Editors*

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Electrician and Mechanic

VOLUME XXI DECEMBER, 1910 NUMBER 6

## THE MOTION PICTURE—Part II

STANLEY CURTIS

### THE PROJECTING MACHINE

Let us refer to Fig. 2, which gives an excellent view of a modern "Powers Cameragraph" machine. The complete outfit consists of a hand-power mechanism, with automatic shutter and motion-picture objective lens; fireproof magazines; stereopticon lens; lamp-house

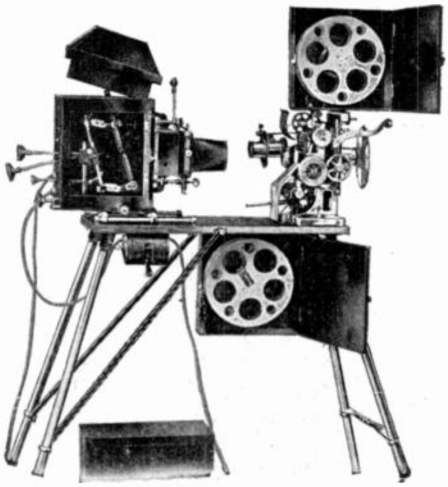


FIG. 2

with arc lamp; rheostat; slide carrier; condenser lens; double pole knife switch; asbestos-covered wire and baseboard, with telescopic legs. We will first consider the mechanism, a detailed view of which is given in Fig. 3. The reel of film to be exhibited is placed in the upper magazine, with the end of the film put through the small slot in the bottom of magazine. After closing magazine door the film is drawn through the slot, carried over the upper sprocket and here formed into a loop. (See illustration.) It is then passed over the framing plate and from there to the intermittent sprocket. From this it is again looped before passing over the lower sprocket. After leaving the lower sprocket it passes through a slot in the top of the lower or "take-up" magazine. A reel in the lower magazine is connected by belting to a shaft of the mechanism. The action of this lower reel or "take-up," as the complete device is called, is automatic; and it winds up the film, with just the right amount of tension, after it passes through the mechanism. Fig. 4 clearly shows the take-up device and also the "shutter" directly in front of the objective lens. (See also Fig. 5 for view of shutter.)

Fig. 5 *A* clearly shows the method of threading up the Pathé machine. In this mechanism, the idler rollers, holding

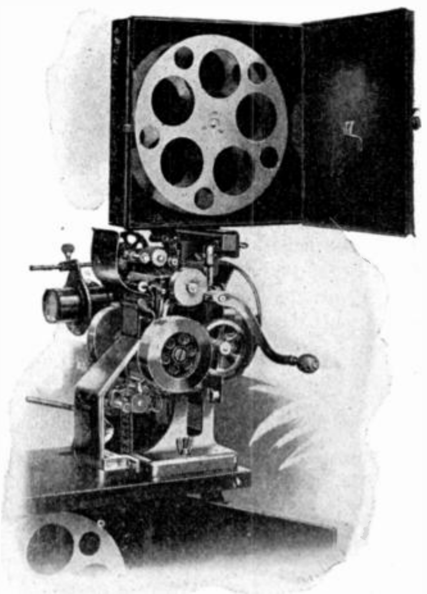


FIG. 3

the film against the sprockets, are attached to the film gate instead of running on independent arms as in the Powers machine. Various methods of passing the film through the machine are employed by different manufacturers, but the principle is the same in every case.

The reader will observe that the projecting machine works on exactly the same principle as the camera, the shutter on the projector serving to hide the movement of the film as it is drawn down by the intermittent sprocket.

Notice that there are three blades in the shutter. Only one of these blades is actually used to obscure the movement of the film, the other two acting as a sort

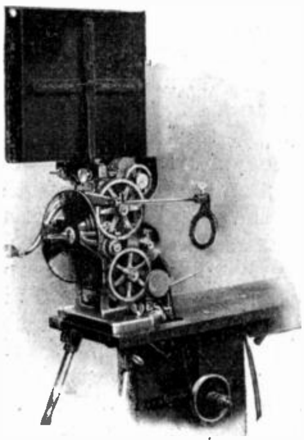


FIG. 4

of light balance, which greatly diminishes the "flicker" of the projected picture.

Most modern machines have a groove or other guide on the shutter shaft, which considerably simplifies the operation of "setting the shutter," should it get out of alignment. The effect on the eyes is most unpleasant when the shutter is not set correctly. The defect shows up very plainly on the title of a picture or in any other place where black and white appear in contrast. The high lights appear to have a decided "haze" dancing up or down from them, depending on whether the shutter is set "high" or "low." (Also expressed "slow" and "fast.")

In setting a shutter, a piece of white paper or other light-reflecting substance should be placed in front of the objective lens. Placing himself so that he has an unobstructed view through the aperture and objective lens, when the film gate is open, the operator carefully turns the balance wheel in the direction of rotation, until the intermittent sprocket starts to move. At this point, the fan-shaped blade of the shutter should have completely covered the objective lens. Continue turning the balance wheel until the sprocket has ceased to move. This is the place where the shutter blade should start to uncover the objective. It is comparatively easy to watch the combined movements of shutter and sprocket; and if they are not in harmony, the shutter may be placed in just the right position by first loosening the set screws.

In threading up a machine the film will often be "out of frame,"—that is, the little photograph may not come in the exact centre of the aperture. An attachment known as the "framing device" enables the operator to instantly shift his picture up or down, even while running, so that it appears neatly framed on the screen. This adjustment is effected by merely raising or lowering a small lever.

Now, on some of the older models of machines, this framing device plays havoc with the adjustment of the shutter, under certain conditions. For instance, if the shutter is set while the framing lever is all the way "up," it will

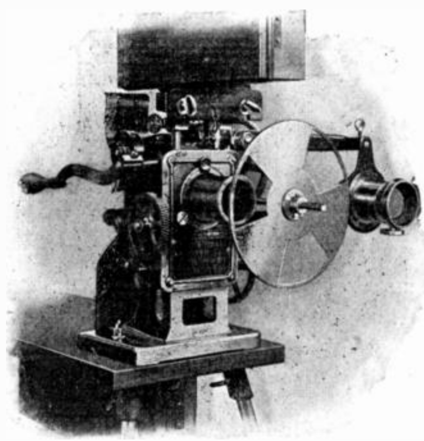


FIG. 5

be considerably out of adjustment if the lever is placed in the "down" position. The only suggestion which seems to fit this situation, is to set the shutter while the lever is in a "neutral" position,—midway between up and down. If this is done, the disarrangement will not be so pronounced; and if, when threading up, the operator will take the trouble to place his film on the sprocket, so that the lever may remain

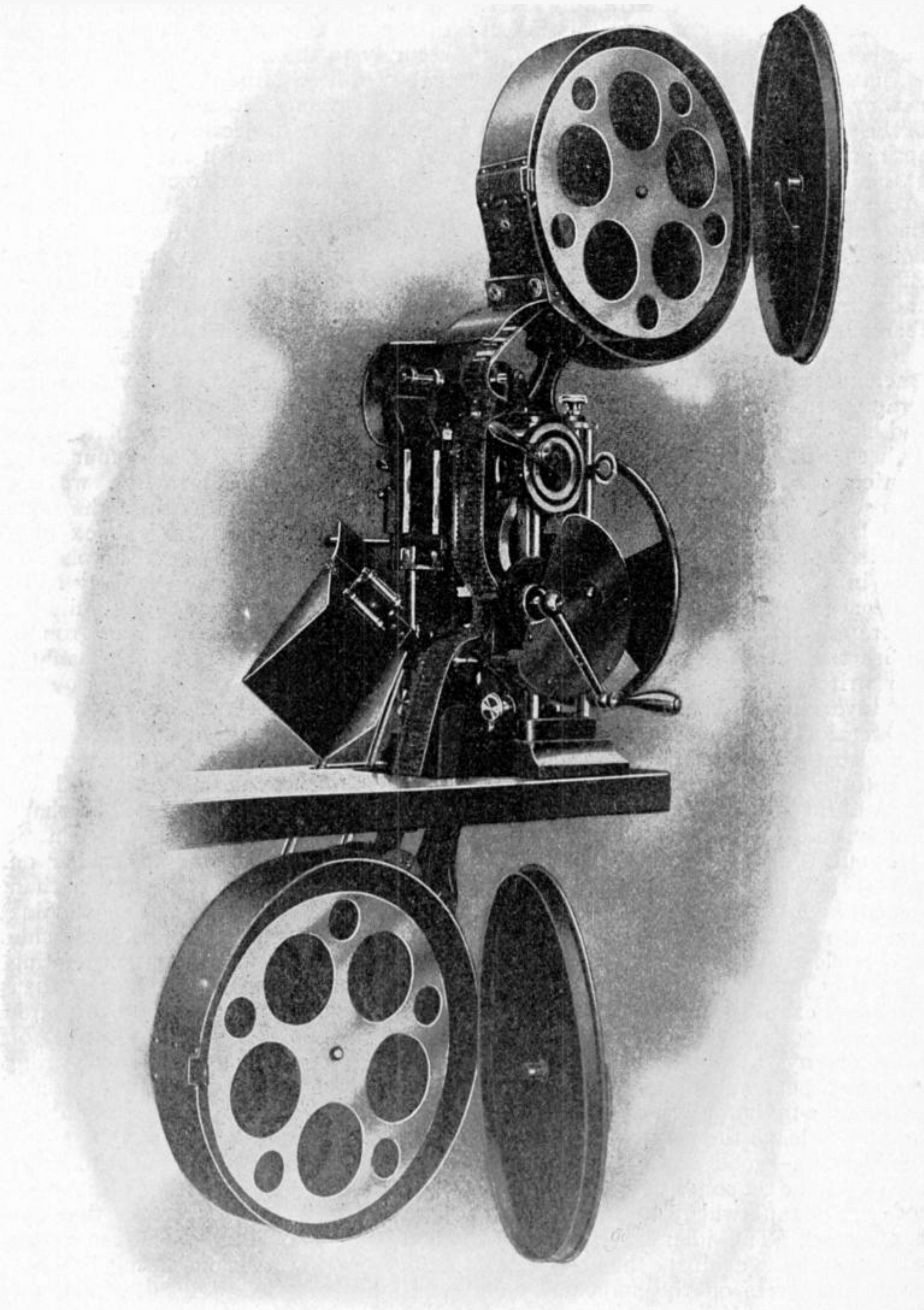


FIG. 5A.

"neutral," his shutter will "pull" only when a jump in the film necessitates a decided movement of the framing lever. In most of the new models this defect has been eliminated.

Quite frequently, during the run of a new or "first run" film, minute particles of the emulsion will adhere to the tension springs. If this occurs at the opening of the reel, the emulsion may accumulate so rapidly as to seriously interfere with the passage of the film. Considerable noise attends this evil, and its harmful effects on the film may be seen in strained and broken sprocket holes. Rather than run the risk of completely ruining a reel of film, it is advisable to stop the machine for a few moments, carefully scraping the emulsion from the springs and applying a small quantity of oil with the tip of the finger. If the precaution is taken to clean and oil the springs before running each reel, this trouble will seldom appear, although with some makes of film it will show itself in spite of all the operator can do. In regard to the instrument to be used in scraping the springs, some authorities advise the use of a sharp knife blade. The writer's experience has been that this invariably roughens the surface of the tension spring. The bone handle of a discarded tooth-brush may be filed up into the shape of a chisel at the end and will furnish a most efficient tool for this purpose. Care should be taken to wipe out the aperture in the framing plate before threading up, as a dirty, ragged edge surrounding the picture does not speak well for the operator.

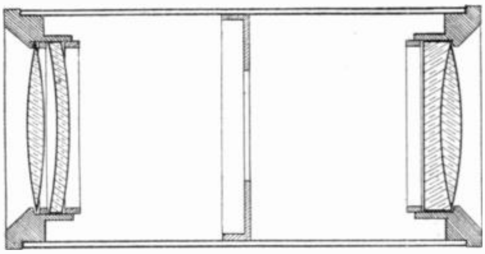
A carelessly made patch will almost invariably jump off the lower sprocket. Carefully examine *every patch*, where time will permit, before running your show. Many a break-down will, in this way, be avoided. If the tension on the take-up is too tight, it will cause the film to leave the sprocket at almost every patch,—good or bad. The tension should be set so that the film is only moderately taut when nearing the end of the reel. The idler rollers, which hold the film against the sprocket, should not press on the sprocket, but should set almost 1/32 in. away from it.

See that the slots, through which the film passes, in both upper and lower magazines, are exactly in line with upper and lower sprockets. If trouble is experienced with the heads of screws in the reel catching under the spring in upper magazine, solder a washer securely to the face of the spring. The screws will be found to pass under this washer without catching.

In case the projecting machine is not exactly on a line with the centre of the screen, the projected rectangle of light will be larger on one side than the other. There are two ways of overcoming this. One, the most commonly used perhaps, is to tilt the screen so that its surface is at right angles to the line of projection. For various reasons this method may not be convenient in certain places; and in this case we may have recourse to the following method: Let us carefully examine the framing plate. We find that it is held in place by four small screws. Now, the operation we are about to perform is based on the same principle as the adjustable back of a camera, by means of which the photographer is able to take a perfectly rectilinear photograph of a high building, with his camera setting on the ground. We know that the nearer our machine is set to the screen, the farther out of its jacket our lens must be, in order to secure a sharp focus. Let us assume that the screen is placed squarely across the end of the room or theatre and our projecting machine is located perhaps 8 or 10 ft. to the right of the centre. The projected view will be smaller on the right-hand side of the screen than at the left. The angle of the machine to the screen brings the right-hand side of the screen closer than the left. Acting upon the above principles, if we loosen the screws in the framing plate and carefully "back it up" with thin strips of metal on the *right* side, we will bring the entire aperture into correct focus. A very small amount of packing is needed, as the adjustment of 1/64 to 1/16 in. will be found sufficient to fill most requirements. In fact the adjustment should not be carried more than 1/16 in. without making a corresponding change in the tension spring on that side.

It may be of interest to note that most standard makes of projecting machines pass just 12 in. of film to each complete revolution of the crank. This knowledge may come in useful in measuring a piece of film, and it will also give the operator an accurate method of determining how long a particular reel of film will run if he turns the crank at a given speed. The average rate of speed is 60 turns per minute, which tells us that 60 ft. of film are being passed through the machine in one minute. We know, therefore, that the average reel of 1,000 ft. will run approximately 17 minutes.

The objective lenses furnished with most modern machines are mounted in tubes, which fit into a "universal jacket," containing the rack and pinion adjustment for focusing. This method permits a quick and easy change of one lens for another of a different focus.



POSITION OF LENSES IN TUBE
STANLEY CURTIS '10
FIG. 6

The lenses should be carefully cleaned before each run and should be taken out of the tube occasionally for a thorough cleaning. Fig. 6 shows the correct position of each lens in the tube. An easy rule by which the operator may remember the exact location of the lenses is this: "All convex surfaces (out curves) should face toward the screen." The front or "achromatic" combination consists of two lenses cemented together with a transparent cement. One of these lenses is composed of "crown" glass while the other is "flint" glass. By this combination we are able to secure a projected light free from prismatic color. We can easily remember that the "cemented" lens goes in the front of the tube. Now, in replacing the back combination, we have only to remember that the convex side of one goes next to the concave side of the other. No danger of confusion, for there is only one concave surface in the entire set. If the operator will memorize this little rule, it will save him many an hour of annoyance. It is hardly necessary to say that a single misplaced lens will throw the picture badly out of focus.

It may appear superfluous to say that a motion-picture machine should be kept clean and well oiled. However, it is surprising to note, as one makes a round of the various operating booths in a city, how few machines are kept *clean*. They are, as a rule, well oiled, for if they were not it would take too much "elbow grease" to turn the crank,—in fact the majority of them are simply overflowing with oil. But with this abundant lubrication we find the choicest collection of dust and grit. It is only the work of a few minutes to wipe off the mechanism after finishing the day's run, and another wiping off in the morning before oiling up will keep a machine in first-class condition. It is well to give the gearing a thorough cleaning with a tooth-brush and oil frequently. If the machine is one of the older models, in which the star and cam wheels, which impart the intermittent motion to the sprocket, are exposed, these vital parts should be carefully cleaned several times a day, as they are the very life of the machine and a very small quantity of dirt or grit between them will work untold injury. In the new machines this movement is enclosed in a dust-proof casing, which is kept full of oil. The oil used on the machine should be the very best procurable, the "non-gumming" quality being quite essential.

The condensing lenses are used to concentrate the rays of light from the arc lamp in the lamp-house on the film at the aperture. These lenses are subjected to a terrific heat, and frequently break, causing the operator great annoyance. In placing the condensers in their holder, make sure that they fit loosely, as otherwise they will have no room to expand when the heat strikes them, consequently breakage ensues. A sudden cold draught striking the hot lens will often cause it to crack.

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Recently, when three French naval lieutenants were required to take a course at the Buc Military Aviation School, no fewer than 109 candidates came forward, a sufficient proof of the interest taken in aviation by the French navy.

## A LINEN CHEST

RALPH F. WINDOES

In the olden days it was the custom for each prospective bride to own a dower chest, wherein to receive articles of usefulness from friends and relatives. It was a sort of gift ship with which to start her out on the stormy seas of matrimony. This pretty custom, like many another, is beginning to return, and the design of the chest here shown is a good one for a dower chest.

Quarter-sawed white oak is the best wood to use, but plain-sawed for the body and a quartered top will do very well and is much cheaper. The bottom may be of any soft wood. If possible secure some cedar, that would serve the best. Much time and labor can be saved by having the stock cut to exact dimensions at the mill, planed and sanded on all sides.

The stock list to submit for this is as follows. The cover will have to be glued up and the sides would be much better if they were also. The legs can be purchased solid if plain-sawed, but in all probability quarter-sawed would have to be glued up from three pieces.

| | | |
|---|---|---|
| 4 pieces | 3 in. x 3 in. x 18 in. | oak |
| 2 pieces | ⅞ in. x 15 in. x 43¾ in. | " |
| 2 pieces | ⅞ in. x 15 in. x 16 in. | " |
| 1 piece | ⅞ in. x 20 in. x 42 in. | " |
| 2 pieces | ⅞ in. x 4 in. x 24 in. | " |
| 1 piece | ⅞ in. x 4 in. x 50 in. | " |
| 4 pieces | 1 in. x 1 in. x 13½ in. | " |
| 2 pieces | ½ in. x 2½ in. x 43 in. | " |
| 3 pieces | ½ in. x 2½ in. x 11 in. | " |
| 4 pieces | ½ in. x 2½ in. x 17 in. | " |
| 2 pieces | ⅞ in. x 1 in. x 42 in. | soft wood |
| 12 pieces | ½ in. x 4 in. x 16 in. | soft wood |

In the ½ in. panelling stock, 1 in. has been added for waste, but the other dimensions are exact.

In addition to the above the following supplies will be needed:

2 butt hinges, 4 in. wide, with screws.
16 flat head steel screws, 2 in., 12s.
12 flat head steel screws, 3½ in., 14s.
12 flat head steel screws, 1½ in., 9s.
4 casters.
½ pt. oil stain (color to suit builder).
½ pt. shellac.
Prepared wax.
Paste wood filler.
Glue, finishing nails, etc.

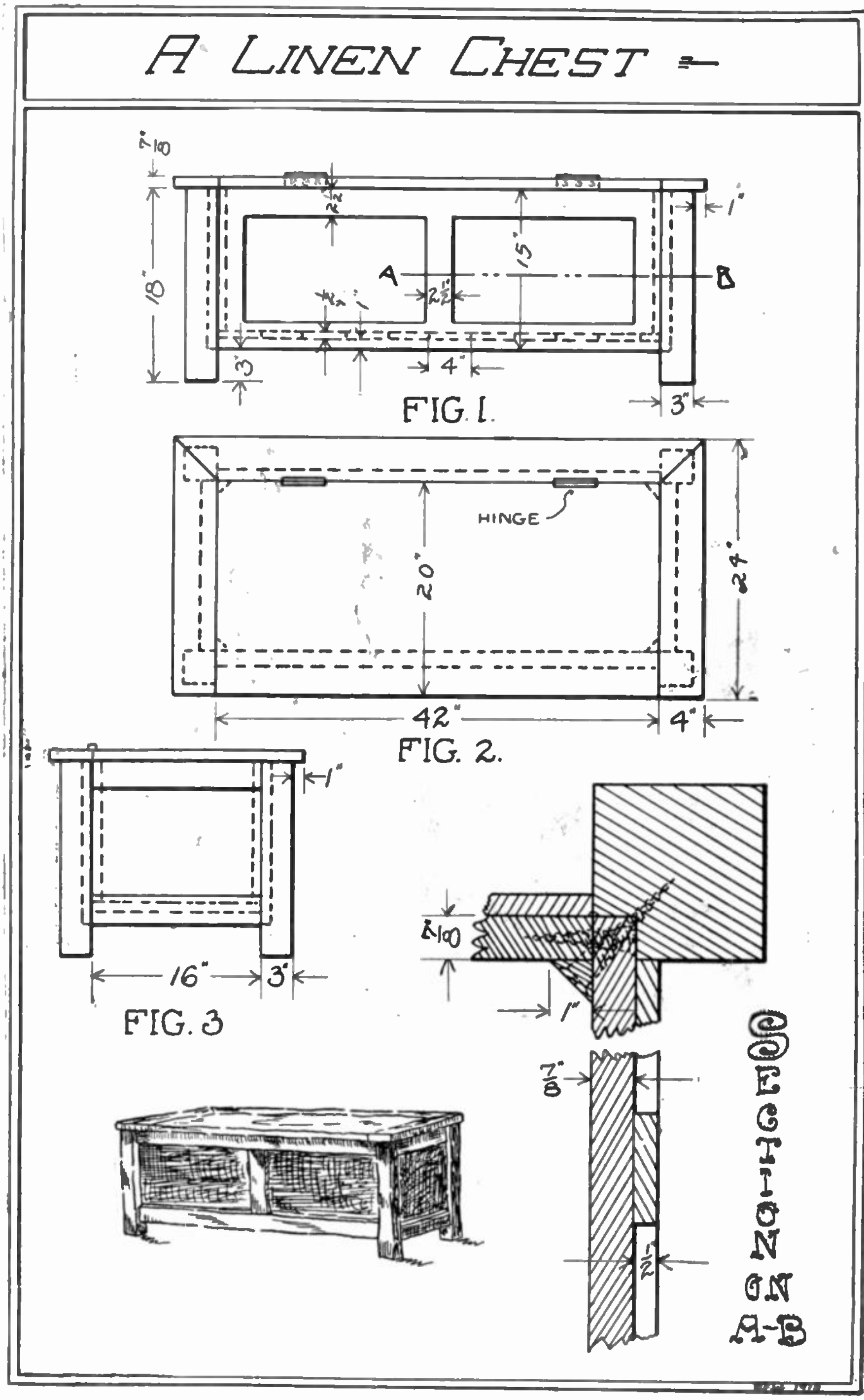
Fig. 1 is the front elevation; Fig. 2 the plan, or top, and Fig. 3 the elevation of an end.

To begin the work, take the 15 in. pieces and screw the sides and ends together according to the section shown. Use four of the 2 in. 12s in each corner. When this is completed the inside should measure 16 x 42 in. Next take the posts and cut out a groove ⅞ in. square and 15 in. long in the corner of each post. The box should then set in these grooves, the bottom of it coming 3 in. from the bottom of the posts. Plane the 1 in. square stock until it is triangular and nail a piece in each corner of the box, as shown in the detail. Now screw, diagonally, through each corner of the box into the corner posts, as shown, using three of the 3½ in. 14s. in each. Countersink all heads.

Next, put in the panels of ½ in. stuff. The back is not to be panelled. Start by gluing the top and bottom strips, using clamps to hold while drying. When they are set, fit in the cross pieces on the front and glue them securely.

Now comes the bottom. Screw the soft wood strips onto the front and back, making them flush with the bottom of the sides. Fit in the matched pieces. If the diagonal corners have been run down too far, fit in around them. Nail the pieces in place.

We are now ready for the top. Lay the 20 in. piece on a flat surface and fit the 4 in. stuff around it, mitring two of the corners, as shown in Fig. 2. Fasten this framework over the posts and sides, making it flush with the inside of the box. There are a number of ways of fastening this. You could nail and glue it and putty up the head holes; you could dowel it all the way around with ⅜ in. dowels; you could screw it diagonally from the inside of the box; or you could use ½ in. pins in the following manner: Nail the mitred corners fast and place the frame. With a ½ in. bit bore down through the frame into the posts to a depth of about 4 in. Take some ½ in. dowel pins, without the groove in the side, and round off one end of them very neatly. Put



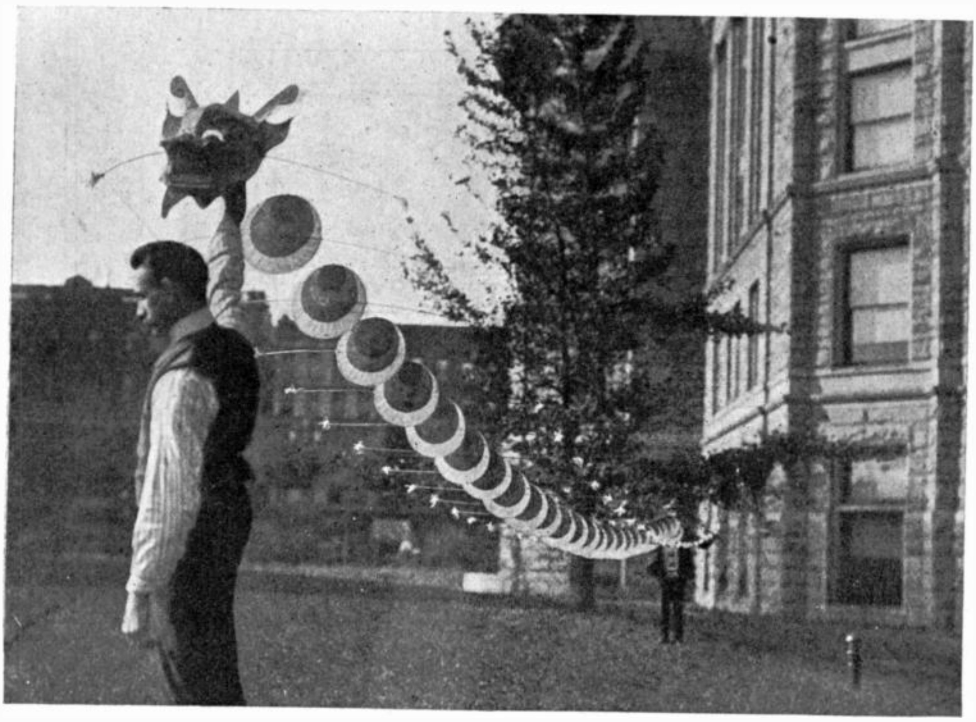

Detail Drawings for Construction

glue in the holes and pound the pins in with the rounded end up. Use a mallet to do the pounding. When in place they form a very neat button on the top. It would be well to use two pins at the mitered corners, as one pin might spread the miter. Put the cover in place and hinge it. A chain, or two, fastened from the inside of the cover to the sides would keep it from swinging back too far. Put the casters on the legs, unless you prefer neat drawer pulls on the ends, as you should have some means of moving it about easily.

Before attaching these fittings though, it would be well to finish the chest. Scrape off all glue in evidence and sand over the entire piece. Shellac and sand the inside, and put a coat of stain on the outside. When the stain is dry apply a coat of filler. Wait a day or two and put on two coats of wax, according to directions found upon the can.

If desired, an inside lining of cloth could be put on, but this is not necessary.

## GIANT CENTIPEDE KITE



In the accompanying illustration (contributed by L. E. Zeh) is shown one of the fantastic efforts in kites familiar to us as coming from China. As a characteristic offering to The American Museum of Natural History (New York City) it is *the longest kite in the world.*

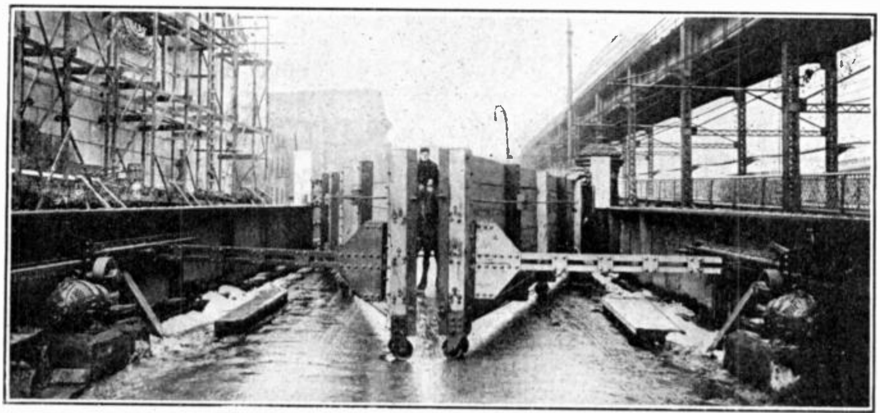
The Chinese are remarkable for their imitation of nature, and this kite shows how cleverly such a thing as the reproduction of the "hundred feet" of the centipede is managed in this light structure, which is to soar aloft by aid of the segments of the body alone, instead of by wings. The head of this kite-insect, however, seems of a far more startling appearance than that of our own centipede—possibly because the Chinese variety *has* a head like a dragon. It is a fact that both China and Japan have very fantastic insects, presenting a wider range of "trimmings," than our own. So it may be that the maker of this kite religiously imitated a centipede with a crested and horned head—a Chinese insect quite unlike the pale creature of our own country. But probably the author of this object aimed to have a striking head in keeping with the amazing character of "the longest kite in the world," and so adopted that of the well-known national dragon.

## NEW RUNAWAY GATE ON WILLIAMSBURG BRIDGE

O. M. KELLEY
*Assistant Engineer in Charge*

Shortly after the roadways of the Williamsburg Bridge were opened to vehicular traffic, it was found that the number of runaways was far in excess of those occurring on the Brooklyn Bridge, principally on account of the ample room on the 20 ft. roadways, and the absence of trolley cars from them.

During the four years ending March 31, 1910, the following is a summary of the runaways on the Williamsburg Bridge:—(a.) Runaways reported, 185; stopped by gates, 127—or 68.6%. (b.) Horses involved in runaways, 246; killed, 53—or 21.5%; injured, 47—or 19.1%. (c.) Persons injured, 96.



Williamsburg Bridge, showing Runaway Gate in use

It was found that the old style of gate which was used on the Brooklyn Bridge and served its purpose in that location was entirely inadequate to handle the runaways on the Williamsburg Bridge without a great mortality among the horses and injury to the occupants.

About two years ago one of the laborers employed on the Williamsburg Bridge, viz., James Conners, showed the writer a model of a two-leafed gate, and the new gate is a development of that idea to a practical design.

The gate is composed of two leaves of equal dimensions, namely, 40 ft. in length and 6 in. in height, the leaves being supported on casters and the tops of the leaves being 6 ft. 9 in. above the roadway level.

These leaves are hinged at the sides of the roadway, and, when not in use, lie parallel to the roadway. When closed for use they form a V, with the wide end facing the direction from which the traffic approaches.

The two leaves do not come actually to a close, there being an opening of about 11½ in., through which a man can pass.

The leaves are constructed of long leaf Oregon pine plank, 12 ft. by 3 in., and laid closely. Under an impact they can deflect about 18 in., being restrained from further bending by three ⅞ in. round rods secured along the back.

The leaves are operated electrically by 7½ h.p. motors, one for each leaf. The moors are connected in multiple and act synchronously.

The leaves are operated by means of arms attached to the free ends, these arms being moved by racks and pinions operated by the motors.

The gate can be closed in about five seconds and opened to full roadway in about six seconds.

The gate is controlled by a double throw switch, and the gears are protected from injury, in case the gate be struck by the runaway before the arms are in a right-angle position, by follow-up racks and pawls which take the thrust off the mechanism.

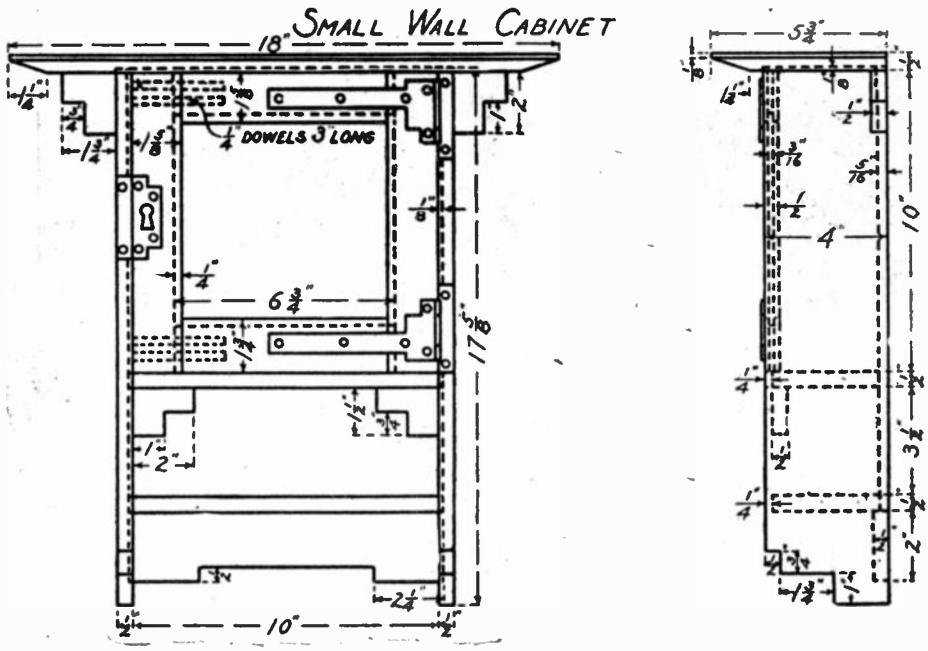
The first and greatest advantage which this gate has over the barrier previously used is in the elimination of the 90 degree impact and the opportunity which it gives for the wagon to bind on either side, thus preventing the crushing of the horse or horses.

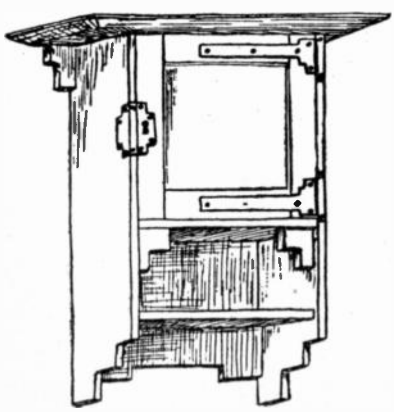
Since the gate was put into operation on April 14, 1910, there has only been one runaway on the roadway, and the horse took fright only about 150 ft. from the gate. The officer on post threw the switch and the leaves were almost closed when the runaway struck them. The horse broke away from the harness and passed through the opening, absolutely uninjured, the wagon, of course, being wedged in the V. The horse was walking down the roadway when caught by one of the laborers.

## SMALL WALL CABINET

As an example of cabinet construction the small wall cabinet made in Mr. Weick's classes at Columbia University furnishes an interesting illustration. Considerable opportunity for choice on the part of the student is offered as the dimensions given are merely suggestive.

The shaping of the bottom of the sides and the corner blocks can be made a problem in design, while most interesting of all is the designing and making suitable hinges and door pull or escutcheon from sheet brass.



If care is exercised in the design, it will be found possible to make the hinges with the simplest of tools. A point worthy of notice in this model is the use of reinforcing corner blocks at every opportunity. Small triangular blocks, not shown in the drawing, may be used inside of the cupboard, and if sawed off the right length will serve as a stop for the door. The tongue on the door rails is made just long enough to fit into the panel groove on the stiles. To strengthen this joint two ¼ in. dowels are used at every corner.

*Manual Training Magazine.*

## A SECTION LINER

C. W. WEBBER

The beginner in mechanical drawing and in fact many advanced students, if asked what a section liner is, would be at loss for an answer. This time-saving machine for doing section lining or "cross hatching," as it is called, should be known by every student, as it enables one to do quicker and better work than by the methods taught to beginners.

I will first describe a very simple instrument which I have seen used by students in a large scientific school.

The method of using is shown in Fig. 2. The piece, 1, and the 45 degree triangle, 2, are placed on the square as shown at *a*, and a line is drawn with the triangle as a guide. 1 is then held firmly, and 2 is slipped to position shown at *b*, when the second line is drawn. 2 is then held firmly and 1 slipped to position shown at *a*, after which 2 is again slipped to position *b*, when the third line is drawn. The parts 1 and 2 are always moved from left to right, so that by repeating the above motions

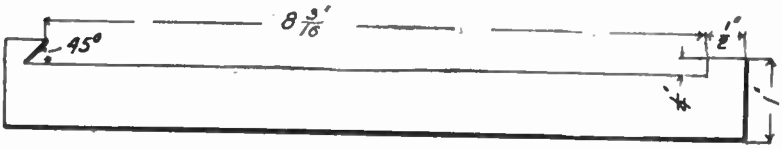



Fig. 1

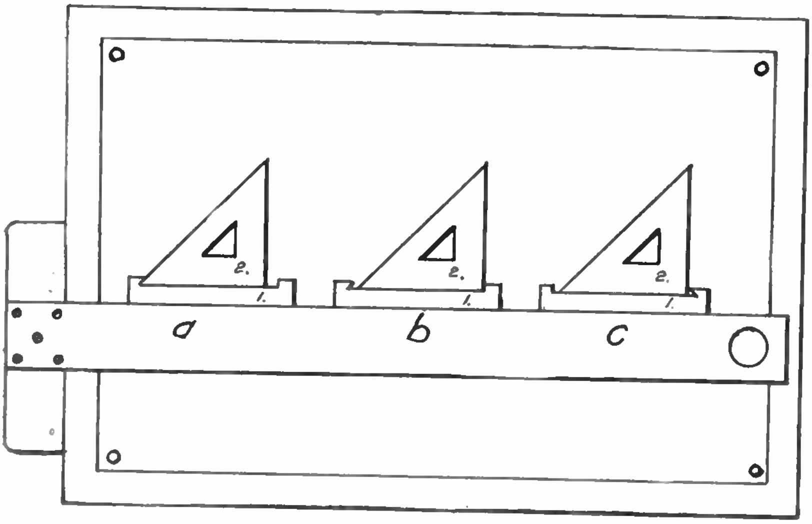



Fig. 2

The instrument, although crude, can be used with surprising rapidity and accuracy with a little practice.

A piece of hard wood is cut out as shown in Fig. 1, and of about the thickness of a triangle. A piece of an old T square will do nicely.

The dimensions given are taken from a triangle in the possession of the author, but they may be varied at will, to suit different triangles.

any distance can be covered. Care should be taken, however, that a part does not slip when it should be firmly held.

By turning 1 and 2 into the positions shown at *c*, a narrower cross hatch can be obtained. Still another width can be obtained by cutting off the apex of one of the angles as shown in Fig. 3.

To make a section liner such as is used by professional draftsmen is not a hard task and it will well pay for the time thus spent.

Obtain a block of hard wood about 11 in. long by 2½ in. wide by ¼ in. thick, and plane square. Next make from square brass rod ⅜ in. square three pieces as shown in Fig. 4. This will require about 2½ in. of rod. Care should be taken to drill the hole *a* square with the sides of the piece. The hole *b* is drilled with a No. 29 drill, and then tapped with an 8-32 machine screw-tap, care being taken not to drill into hole *a*.

The block is laid off as shown by the dash line, in Fig. 5, which is ⅜ in. from the edge. 3/16 in. holes are drilled at *a*, *b*, *c*, and *d*, and countersunk from the under side so that an 8-32 flat head machine screw can be put through from the bottom. The three pieces above described are then bolted to the block at *a*, *b* and *c*, with their holes along the line *ac*, using ⅜ in. 8-32 flat-head machine screws.

Get a piece of sheet brass 2 in. wide, 2½ in. long and 1/16 in. thick and cut and bend as shown in Fig. 6. The slot is cut by boring 3/16 in. holes at *a* and *b*, and ⅛ in. holes along the dotted line between *a* and *b* and finishing with a file. At *c* a 3/16 in. hole is drilled and at *d* holes are drilled, as shown, with a No. 45 drill and tapped with a 3-48 machine screw-tap.

Next in order is the straight edge. This is best made by buying a ruler ⅛ in. thick and cutting it down to 8½ in. long. ¾ in. from the 0 end a 3/16 in. hole is bored and countersunk from the back side, and a ⅝ in. 8-32 flat head machine screw is passed through and clamped in place with a nut ⅛ in. thick. ¾ in. from this, or 1½ in. from the zero end another like screw is clamped.

Now comes the trigger which is only a piece of brass 3/16 in. thick cut to shape shown in Fig. 7.

Get a piece of 5/32 in. round brass rod 18 in. long and bore three holes with a No. 40 drill through it and exactly parallel to one another at distances 8 in., 7¼ in. and 6½ in. respectively from one end. Now bolt the piece of Fig. 6 to the rod, having the longer part of the rod to the left. In drilling the holes in the rod it would be better to file a flat place 2 in. long to aid in starting the drill, but the cut should not be made deep enough to weaken the rod.

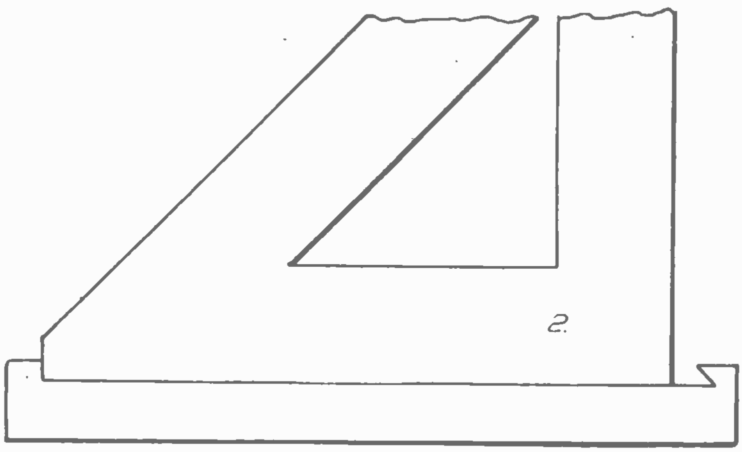



Fig. 3

For the spacer a piece of brass ⅜ in. wide, 2¾ in. long and ⅛ in. thick is needed. Cut to shape shown in Fig. 8. The slot is 3/16 in. wide and is made in the same manner as described above.

There is still another part, the binder, which is made of thin spring brass bent and drilled as shown in Fig. 9.

Two springs 1¼ in. long are made of No. 24 spring brass wire by winding it around the brass rod. All parts are now made and ready to assemble. This is done as shown in Fig. 5, which explains itself, a few details excepted.

The ruler is clamped to the piece of Fig. 6 in such a manner that it swings

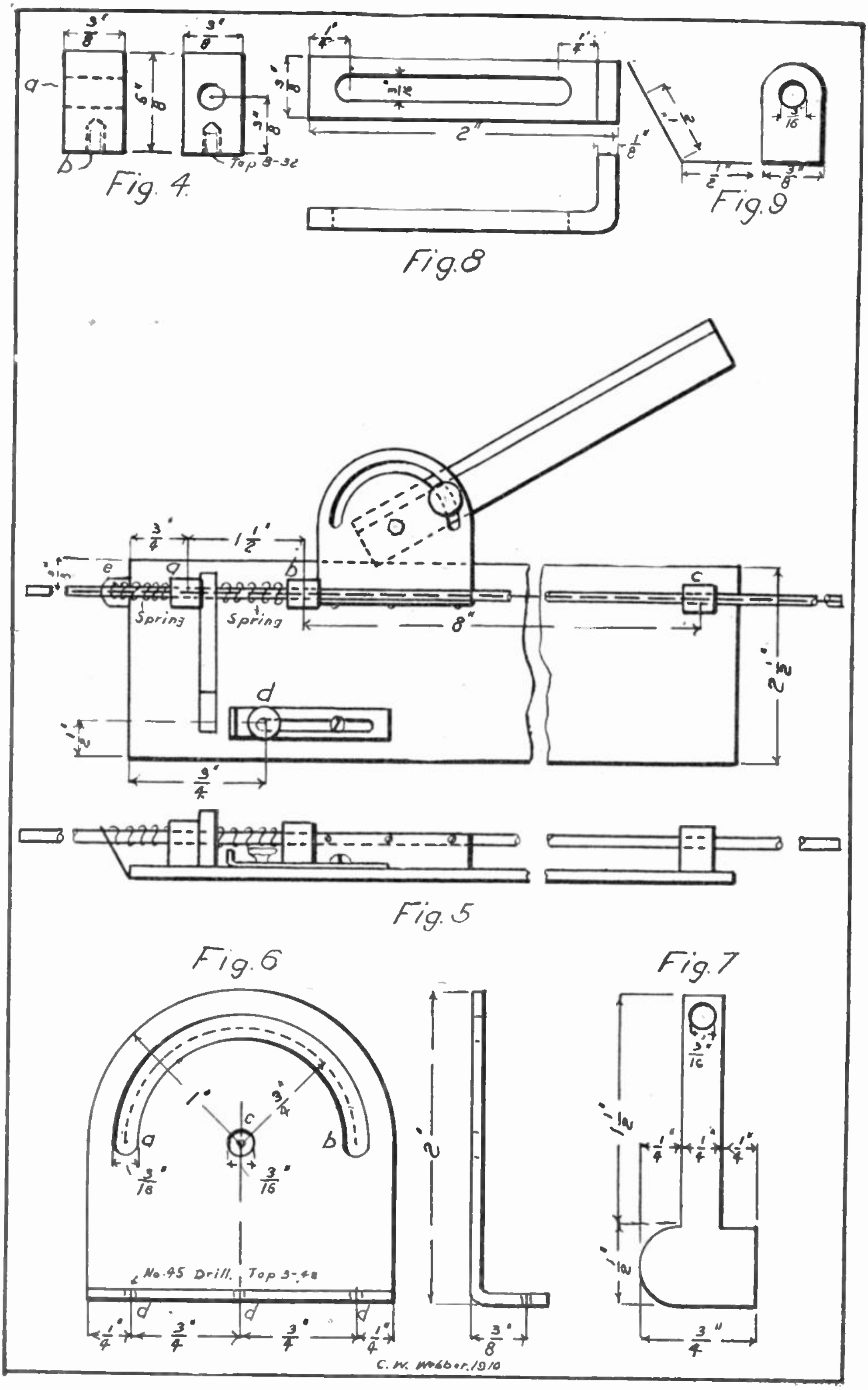


Fig. 4
Top 8-32
a
b
Fig. 8
2"
Fig. 9
Fig. 5
Spring
Spring
a
b
c
d
e
8"
Fig. 6
Fig. 7
a
b
c
d
1"
No. 45 Drill, Top 3-48
2"
C. W. Webber. 1910

about *c* as an axis. The ruler is placed under this piece so that one bolt projects through hole *c* and the other through the slot. A nut is screwed on the bolt at *c* and the screw is sawed off and riveted, being careful that the pivot is just loose enough not to bind. A washer is put over the other bolt and it is clamped by means of a thumb-nut so that the angle of the ruler may be varied.

The binder is shown at *e*, Fig. 5, and is screwed to the under side of the block, enough of the wood being cut away to allow it to be flush with the bottom surface.

A 5/8 in. flat-head machine screw is passed through the hole *d* from the bottom and held in place by a nut 1/8 in. thick. The slot of the spacer is placed over this bolt and clamped by a thumb-nut. A wood screw is also passed through the slot to keep the spacer from moving out of line.

When all is assembled two fine needles are driven through the base at the two upper corners near *a* and *c*, so that the points project beyond the bottom about 1-16 in. The heads are then broken off close to the wood. These are to prevent the instrument from slipping while in use.

To use the instrument, place it on the drawing and swing the ruler and clamp it at the angle the cross hatching is to be. Starting with the parts in the position shown in Fig. 5, a line is drawn, using the upper edge of the ruler as a guide. The trigger is then pressed to the right until it hits the spacer. This moves the rod and thus the ruler a certain distance to the right. The trigger is then released and it springs back to its original position, but the rod is held in place by the binder. Another line is now drawn, and so on, completing the work. When the ruler reaches the extreme right position it is restored to its original position by pressing the binder to the right and at the same time pushing the rod to the left.

The instrument can be greatly improved in appearance by polishing the wood and brass work before assembling.

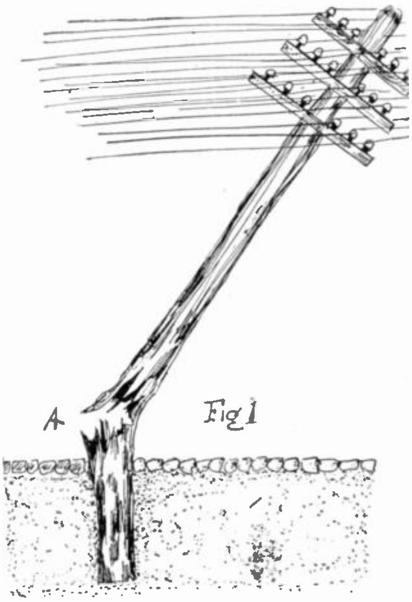
## UTILIZATION OF PARTIALLY DECAYED POLES

GEORGE RICE

Since the use of concrete for strengthening the base of telegraph, telephone, electrical light wire and other poles, a great many poles which were formerly abandoned as useless for supporting wires have been utilized. Poles which were condemned early in their career as lacking substantial support at the butt are now used with a cement supporting base and made to last for years. Poles which have been snapped off by the high winds are now restored to place in an upright position in the original holes by first removing the broken stub and forming a casting of concrete for the base. Poles which were not suitable for use in carrying heavy lines of wire systems are now available because of the powerful re-inforcing made possible by the utilization of the concrete mixtures. In the making of the concrete for furnishing a form for holding poles in place, a mixture is usually made of about the following proportions: 1 barrel of packed Portland cement to 1½ barrels of loose sand to 3 barrels of loose gravel or broken stone. Broken stone is easily obtained from concerns which deal in this article in any city. The sand is also readily procured from the dealers in building materials. Soft sandstones and soft slate, lime and the like should be avoided. The water used for the concrete ought to be clear. That is, the water should not be taken from some pond where the drainage from a mill on the bank contains chemicals. Refuse from barns should be avoided.

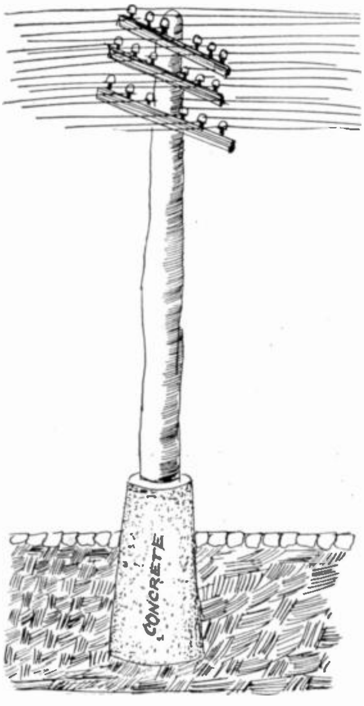
I saw foundation forms ruined because of the use of sea water, on one occasion. Get common clear water, direct from the city hydrants and this water will be all right. In making the wooden forms for moulding the set pieces or for filling in the earth about the bore in the ground where the base of the pole is placed, green timber can be used, providing the timber is seasoned under your supervision. White pine and yellow spruce can be used to advantage.

Grease the inside of the forms with cheap soap, and this will prevent the forms from sticking. In the placing of the broken poles in position in the hole made for the purpose, there are times when the block is made by simply filling in the space about the foot of the pole. The mixed cement stock is passed into the opening and tamped to place. As soon as the cement dries, a very solid supporting factor is obtained. Then again, we observe that regular apparatus is used for laying the concrete about the butt of the pole. First, the earth is excavated from around the lower end of the pole, so as to make room for the circular thickness of concrete. The pole is properly braced and straightened, as the pole will remain fixed where held by the concrete. Iron supports are used in retaining the pole in a perfectly perpendicular position until the concrete gets hard. Sometimes a concrete base is first made in the bottom of the hole, thereby forming a resting place for the foot of the pole before the sides are filled in.




A great many poles can be saved by using the concrete re-inforcing, and when a pole is broken off as at *A*, Fig. 1, the pole is not rendered unserviceable as heretofore. The pole is made a little shorter than before, as the broken or decayed portion must come off.

Fig. 2 shows the pole when provided with the concrete seat. This concrete seat serves as a very substantial anchor for the pole, owing to the shape of the cone. The mould for laying the concrete can be shaped to harmonize with a cone or other pattern. The device is made in sections, and the bolted sections can be opened for removal, after the concrete is set. When the apparatus is withdrawn, the space formerly occupied by it is filled in with earth, thereby finishing the job. The upper part of the concrete form shows above the level of the ground. This part is smoothed off and made to appear even and neat to look upon.




Traffic on the streets of Buenos Ayres, the most enterprising and up-to-date city in South America, has increased to a point at which some radical relief is necessary; and a comprehensive scheme for electrically operated subways has been passed by the city government. The concessions have been secured by the Anglo-Argentine Tramway Companies and the tramway company of Buenos Ayres, whose headquarters are at Brussels, Belgium.

# DESIGN AND CONSTRUCTION OF MODEL AEROPLANES—Part V

EXPERT

## AEROFOILS

That the supporting surface of model aeroplanes should be correctly shaped and strongly constructed is an important point in aeroplane construction, and it is equally so in the case of wooden and fabric-covered aerofoils.

We have pointed out in previous articles that a suitable shape for aerofoils has been determined by experiment, and proved by actual practise, so that we may take the shape, already shown, as a standard pattern to work by. It is not always possible to get exactly the same shape in every aerofoil, but the shape suggested should be followed, as far as possible. As lengths and widths of aerofoils differ, and the aspect ratio of the planes of large machines and models is up to the present a matter of opinion, it is only possible to suggest the average as being the most suitable. If it were possible to get it light enough, wood is by far the best material for aerofoils, but above 3 ft. the planes should be fabric, or at least framed up in wood or metal, and covered with fabric.

Plain wooden aerofoils for small models answer very well; the wood should be about 1/8 in. thick, either American whitewood, pine or cedar being suitable. The necessary camber, about 1/4 in. in 3 in. should be given by playing a jet of steam on the convex or upper portion of the wood. This method, although handy, is not always satisfactory, as so much depends on the straightness of the grain. To ensure the shape being quite regular it is advisable to construct a rough clamp, made of two pieces of thick wood planed down to the required curve. The clamp should be heated, and the steamed aerofoil placed between them and weighted or clamped down with G clamps. The wood should not be touched until quite cold, and will be found that the wood is quite even in shape and perfectly stiff.

Another method, by which the stream line form required, Fig. 2, may be more accurately made is shown at Figs. 3 and 4. A piece of wood, 3/8 in. thick for a 3 in. wide foil, is planed on one side to the shape shown at Fig. 3. A round plane is now required; this may be máde from a block of beech and an old chisel, or from an old rebate plane and iron rounded to a radius of 1 1/2 in. or so. The surface should be finished with round scraper and glass paper, and then turned over on a board, planed to the same surface as shown at Fig. 4, and clamped down for planing to required shape.

Although it is possible to plane the under surface against a stop, it is not possible in planing the other side to do this, as it is more than probable that the wood, when thin, would break .

The third method, and by far the best, is to build up the shape in the same way that large mouldings are made. Two pieces of wood should be planed to a wedge shape, as shown at Fig. 5, the side piece about 1/8 in. at the thickest end, and the narrow piece about 1/4 in. thick in front. These two pieces should be glued together and placed under pressure until the glue is quite set; at least 12 hours should be allowed for this.

When ready the inside curve should be worked with a small round plane or a scraper, finished with glass paper, and then it may be placed on a board similar to that shown at Fig. 4, but planed to fit shape exactly.

The top should be carefully planed to the correct shape with a smoothing plane, and finished with glass paper.

By this method the exact stream-line form is not obtained, but the difference is so slight and the advantage gained in time and labor so much, that the slight deviation may be well allowed. It will be found that the difference in shape is not appreciable in a small model, such as it is suitable for.

For larger planes than 3 ft. it is advised to have fabric-covered frames, and this is by no means a simple piece of construction.

There are two forms of fabric-covered aerofoil: the single and the double surface; the former is lighter and easier to make, but owing to the unevenness of the under side, the double surface is much more effective.


FIG. 1


FIG. 2.

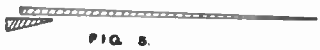


FIG. 5.

1. Wooden aerofoil, steamed to shape.
2. Wooden aerofoil, planed to shape.
3. Method of planing under-surface of wooden aerofoil.
4. Method of planing top surface of wooden aerofoil.
5. Method of shaping wood for built-up aerofoil.
6. A built-up wooden aerofoil.
7. A single surface aerofoil.
8. Plan showing round end.
9. Another single surface aerofoil.
10. Plan showing strengthened square end.
11. Double surface aerofoil. 12. Plan showing wire end.
13. Another form of double surface aerofoil. 14. Plan.

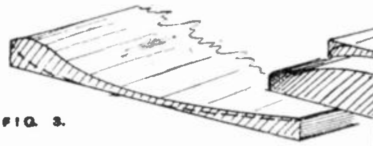


FIG. 3.

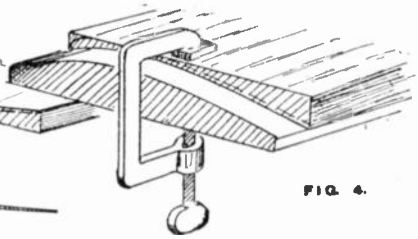


FIG. 4.


FIG. 6.


FIG. 7

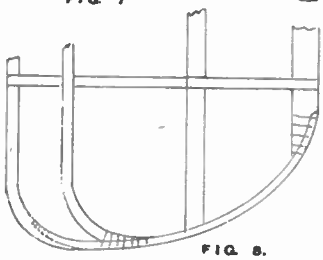


FIG. 8.

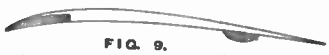


FIG. 9.

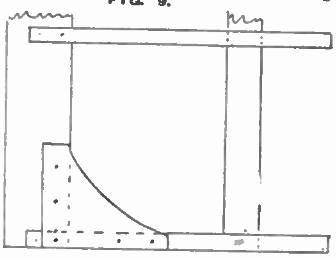


FIG. 10.


FIG. 11.

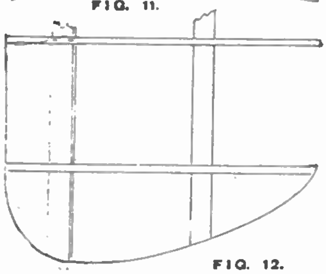


FIG. 12.


FIG. 13.

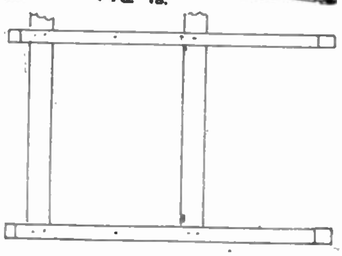


FIG. 14.

Sections of the former type of fabric-covered aerofoil are shown at Figs. 7 and 9. At Fig. 7 the ribs, made of 3-16 in. square or so birch, are steamed to shape, and then glued and tacked to the main spars. The main spars should be of American whitewood or spruce, and as stout as possible. The number of ribs may be left to choice, but a good rule is to make the distance between them equal to the width of the foil. The fabric is secured from the second spar to the back spar, and is stretched from end to end, either sewed or stuck with solution or glue. If tracing paper, cartridge paper or linen or silk is used, the material should be slightly damp before putting on; it will then dry tight.

Double surface aerofoils are not more difficult to make, but take longer than single surface, and being free from unevenness underneath, are more satisfactory in use. Two methods are shown;

the first illustrated at Fig. 11, is built up of ribs sawed out of American white-wood to shape, and notched to the main spars by means of the lapped halving joint. This is a very simple method, and there is no need for the use of steam. It has the advantage of being light and strong and is very suitable for small frames.

For large models, the method shown at Fig. 13 is most suitable. Here it is possible to have comparatively stout spars, and have very thin ribs made of birch, American whitewood, French horn, or imitation whalebone, or three-ply fretwood. The ribs, if of wood, should be steamed to the correct camber and should be attached by glue, brads or screws to the main timbers.

The fabric should be stretched from end to end, and is best done by previously stretching the fabric on shaped boards, and placing the framed aerofoil on, with the touching surfaces covered with seccotine or solution.

Various methods of finishing the ends are shown in the plans of the foil. That at Fig. 8 being formed of bent wood or cane, tied with glued string at the joints. Fig. 10 shows an aluminum strengthened end, a similar angle piece being placed on the other spar, if necessary. Fig. 12 shows a wire end, over which the fabric may be stretched; the wire should be stiff, and may be further strengthened by brackets attached to the main spars.

Fig. 14 shows a perfectly plane end, useful for biplane aerofoils.

### PROPELLERS

The propeller is obviously a most important part of an aeroplane, and the choice of a suitable kind is a matter for careful consideration.

A knowledge of propeller mathematics is necessary when designing a scientifically correct helix, but the rule of thumb enters very largely in construction of most model propellers. It will be sufficient for the model maker if we consider some of the many types in common use, for the main point of interest in propeller design is to determine the particular type which will drive the machine the farthest.

It is certainly somewhat bewildering to the novice to know which is the best type when one considers the great variety in propeller designs, more particularly so, when each inventor or user can, more or less, prove that his propeller is far in front of the other one and can bring mathematical proof to support his claim.

There is no doubt that much experimenting is still necessary to devise a perfect propeller for small models, and those model makers who have plenty of time on their hands will be doing useful work if they direct their energies and inventive powers on the design of an efficient propeller. The. points to bear in mind are lightness, strength and a good thrust.

### PROPELLERS IN GENERAL USE

The propellers in general use for models may be ranged in five classes: first, there are those made of wood bent to shape by steam; next, those carved out of the solid wood or built up of small pieces and then shaped with a rasp and file; thirdly, there are the metal propellers, cast in aluminum or bent out of sheet metal; the fourth class contains those of the paddle type, including those with blades fixed in a conical, spherical or cylindrical boss; and, lastly, there are those made of wire or cane and covered with fabric, silk or parchment.

In each of the above classes there are several types, and as they all have their devotees, it will be as well to illustrate them in turn and point out the particular good point of each.

The most simple form of wooden propeller is undoubtedly the bent type shown at Fig. 1. It has a narrow blade and may be driven at a high speed; but unless great care is taken in bending both ends of the wood to the same angle, a considerable amount of energy will be lost. The only disadvantage the steamed wood propellers have, is that in damp weather they are very liable to resume their original form. Apart from this, the type is light, gives a good thrust, and may be quickly and easily made.

Another type of bent wood propeller is shown at Fig. 2. In this case the wood may be cut to shape either before or after bending. A much wider blade is the result, and this type is more suitable for a slow running propeller or

ILLUSTRATIONS OF PROPELLERS.

Fig
1. A simple steamed wood propeller.
2. A shaped steamed wood propeller.
3. Another form of bent wood propeller.
4. A built-up or carved wood propeller
5. Method of setting out block for carving.
6. Method of building up with small pieces.
7. The Cochrane Propeller.
8. The Turner propeller.
9. The Beadle propeller.
10. The Antoinette type.
11. The Bleriot type.
12. A Simple tractor.
13. A Fabric propeller.

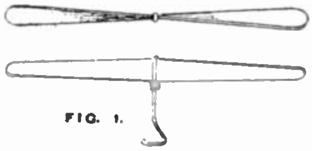


FIG. 1.


FIG. 2.

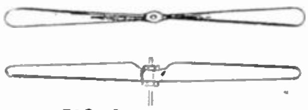


FIG. 3.

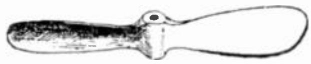


FIG. 4.


FIG. 5.


FIG. 6.


FIG. 7.

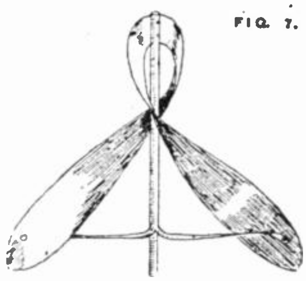


FIG. 8.

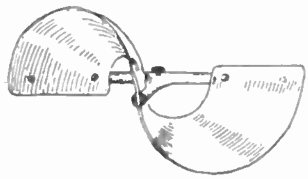


FIG. 9.


FIG. 10.


FIG. 11.


FIG. 12.


FIG. 13.

tractor with a fairly large aspect ratio. The above propellers being made out of thin wood are not always convenient to use, for they must have the shaft secured directly to the middle of the blade. To utilize bent wood propellers for ball-bearing thrusts, it is necessary to have a boss through which the shaft may be passed, but by using thicker wood shaped down as shown at Fig. 3, exactly the same effect may be gained.

The next type illustrated is in the second class, the carved or built up propeller, Fig. 4. This type is practically a true helix and has proved a most efficient screw for model work. The two ways of making it are shown at Figs. 5 and 6, the first one being the method of setting out a block of wood to give the correct pitch and shape for carving. The other method is a much easier way of doing the work, but the greatest care is required in planing up and gluing the wood or else the joints will give way under the strain involved in rasping and filing away the surplus material.

For a 10 in. built up propeller the strips should be about 10¼ in. long, ½ in. wide and 3-16 in. thick, the number of glued strips depending on the width or aspect ratio of the finished screw.

Each piece should have a central hole and then glued in pairs first, the lengths being kept in position by a brad awl or length of wire.

THE MAXIM PROPELLER

In the above type we have the propeller most favored by Sir Hiram Maxim, and although it takes a long time to make, compared with steamed wood, it so nearly approaches the ideal that it is well worth the trouble. The only thing against it is its liability to break, but with care taken in construction, to keep a considerable amount of thickness near the boss, this danger may be lessened. In its favor is its lightness and efficiency, and when made sufficiently stout it will stand a considerable amount of strain.

The metal propeller is next on the list, and we have a large number of forms. The well-known Cochrane propeller is of corrugated sheet aluminum, shaped as shown at Fig. 7. It has the advantage of being very light and strong, is not easily broken or bent out of shape, and it gives a remarkably good thrust. There are several other types of sheet aluminum propellers, but they do not fulfill the necessary conditions, are not so effective as a wooden propeller of the same diameter and pitch, and they soon get out of shape.

Two curious forms of metal propellers are shown at Figs. 8 and 9. The Turner propeller shown at Fig. 8 is of sheet metal, secured to a long, hollow spindle by which it is attached to the propeller shaft. The Beadle Gold metal propeller shown at Fig. 9 is also of peculiar design, but its likeness to a screw may be more clearly seen than in most metal propellers. Neither of these propellers are much in demand for models, but there is no reason why the model maker should not experiment with similar ones, and test them with other types as to weight and thrust.

The next class of propeller is the paddle type, the blades in this class being fitted to a shaft or boss. The best known type is the Antoinette, shown at Fig. 10; the blades are let in a slot cut in each end of the spindle, and they are set at an angle of about 60 degrees to each other. This type is most suitable for a tractor or front screw, and although it is easily made, it is not so effective for models as a helical type.

Another well-known form of tractor screw is shown at Fig. 11. This is the original type used by Bleriot in his earlier monoplanes. The blades are let at an angle of 60 degrees or thereabouts, and fixed in a conical boss. It is more effective for models than the Antoinette type, is easily made, and although it is advisable to shape or steam the blades to a helical form, very good results may be attained with straight blades.

A very easily made tractor screw is shown at Fig. 12, the blades of thin wood, celluloid, vulcanite or metal being fixed in slots cut in a cylindrical boss at an angle of 30 degrees to the shaft.

The last class of propeller is the fabric-covered one. A wire or cane frame is secured to a wire shaft, bent to shape and covered with a bag of fabric, rubbered cloth, silk or parchment, Fig. 13. There are several ways of making them, but the only thing in their favor is lightness, and they are practically unbreakable. They are used in making toy flyers, and although they approach in form the true helical shape, they are hardly suitable for machines of any size or pretensions.

All the screws illustrated are drawn to a uniform diameter of 10 in., so that the proportions may be easily gauged.

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Much interest is being shown by officers of the French Colonial Army in the project for establishing aerial transportation across the Desert of the Sahara, which would link the French North African possessions with those of the Congo. Capt. M. Cortier of the French Colonial Infantry, who has just returned from a visit of inspection of the military posts along the Sahara, is enthusiastic over the plan.

He is convinced of the feasibility of such an aeroplane service and says that there are two routes which could be followed. The only peril that he foresees is that sand may work itself into the motor. The sand, however, does not rise above 900 ft., and he thinks that the airmen could easily maintain a higher level than that.

# MACHINE SHOP
## THEORY AND PRACTICE

Edited by OSCAR E. PERRIGO, M.E.

## THE DEVELOPMENT OF THE LATHE

The article on the "Origin of the Lathe," published in the last issue, brought the history of this machine up to a comparatively modern form of a foot power lathe. Its use, however, was confined to such turning of wood, ivory, metals, etc., as might be done by means of hand tools, and although much fine and comparatively accurate work was done upon it by the old-time mechanic who usually worked upon it, not eight or nine hours per day, but "from sun to sun," from daylight till sunset, turning out a great variety of work from a larger number of different materials; the machine had not yet reached the stage of a power feed which would have rendered it, to some considerable degree, at least, an automatic machine.

The particular device which the machine lacked was the application of the screw. It is quite true that the screw had been known for years and had been used in many different forms, yet it had not as yet found its place in the construction and operation of the lathe. Let us consider for a few minutes this matter of the origin of the screw, which was later to have such an important effect, not only upon the lathe, but upon the entire mechanical world.

The origin of the screw thread, or the threaded screw, reaches so far back into ancient times that it is impossible to determine when, where, or by whom it was first conceived or used. That it was known in one form or another as far back as the use of iron for tools is altogether probable. Holes must have been made in wood by some kind of an iron instrument which was the predecessor of the gimlet. This instrument was most likely square or of some form nearly approaching that form. In order to be at all effective it must have had sharp corners.

As the straight-edged sharp knife was first accidentally and then purposely hacked into notches and became the first saw, so may the corners of the early boring instruments have had notches formed in them to facilitate their action upon the material to be bored. These notches may have been gradually deepened for the same purpose, with the idea that the deeper they were the more useful they would become. We can readily conceive that in making these notches the tool was laid on its side and gradually revolved as the notches were made, beginning at the point and working upwards as the tool was revolved. This, of itself, would have a natural tendency to produce a semblance of a screw thread, which would increase the efficiency of the tool by drawing it into the wood to be bored. When this tendency was noticed it was also natural to see why it acted in this manner and to increase this action by more carefully making these notches. In time the "worm gimlet" was undoubtedly evolved.

The form of a screw thread having once been arrived at, the realization of its usefulness for various purposes was only a question of time. It is altogether probable, however, that for the purpose of holding parts of a machine together, or for similar mechanical purposes, screws were first made of wood. It is also pretty certain that they were first made in a very crude form without much regard to the exactness of the pitch or form of the thread, although the V-thread would be the most natural because the most simple form. It is also generally conceded, of course, that they were made by hand and probably with the rude knives then used, as hand tools were the only ones in use.

As to the methods used in making the first nuts for use with the screws, it is probable that they were quite thin as compared with the pitch of the thread, possibly containing but two or three complete revolutions of the thread, which was worked out by sharp-pointed instruments, as the point of the knife or by similar means. This method may have led to the insertion of a metal tooth in a wooden screw and the cutting of the thread in the nut in this manner.

We do know for a certainty that a somewhat similar means was used many years later, as the author saw in a collection of old-time appliances once used by a maker of spinning wheels, a device for this purpose and which did its work much better than might be supposed.

This device consisted of a hand-turned and threaded screw of very hard wood, having about 3 in. of fairly well-formed thread, and beyond this the piece turned down to the diameter at the bottom of the thread, while the opposite end was formed much larger and had a hole bored through it at right angles for a lever, as in the old wooden vise screw.

A large wooden nut had been fitted to the screw. Through the turned-down end of the screw and close to the termination of the thread, was inserted a steel cutter or "tooth" of the same form as the thread.

We do not know how the thread in the nut had been made, but it is more than probable that the screw was made first. The manner of cutting threads in nuts with this device was as follows: The block of wood that was to form a new nut was bored with a hole the diameter of the end of this screw, that is, the diameter of the bottom of the thread. This block was clamped to the wooden nut with the holes in line, or in prolongation of each other. The screw was now turned through its nut and as the cutter or tooth came in contact with the wood of the new block it began its cutting process, being turned by the lever in the end of the screw and forced forward at the proper rate to reproduce a thread like that in the nut. The cutter being held in place by an iron key suggested the idea that it could be adjusted so as to make a light cut the first time through, and could be set further out so as to cut deeper at each operation until the thread was complete.

The author had no means of ascertaining the origin of the device, but the wood of which it was composed was black with age and the man who possessed it could not tell how many years his father had owned it or where he got it. It was certain, however, that both of them had been mechanics who had made and repaired the old-time wooden spinning-wheels in which a wooden screw about 1 in. in diameter had been used for tightening the round band by which the twisting mechanism was operated.

Thus this old wooden screw in combination with its crudely formed nut performed the identical office of the present lead screw and nut of the modern engine lathe.

Archimedes, the most celebrated of the ancient mathematicians, certainly had a good idea of the screw thread, as is shown in his famous screw made of a pipe wound helically around a rotating cylinder with which he raised water, fully two hundred years before the Christian era. Still it was doubtless a long time after this period before the screw was constructed so as to be applicable to the uses of the present day. Of the progress and development of this and other similar mechanical matters in these early times we have little authentic information. The development of such simple machines as the lathe preceded much that was mechanically important, and to its influence we owe a great deal of the early advancement in the mechanic arts.

We know that a Frenchman by the name of Jacques Berson, in the year 1569, built a lathe that seems to have been capable of cutting threads upon wood. An old engraving of his machine shows it to have been a large, clumsy and cumbersome affair, considering the work it was to perform. While the various parts of the machine were not very clearly shown in this crude print, enough is represented to show us that he had a wooden lead screw to give the pitch of the thread by means of a half nut which appears to have been fixed to a wooden frame, to which in turn the piece to be threaded was attached by being journaled or pivoted upon it.

The lead screw and the piece to be threaded were both revolved by means of cords wound around spools or drums upon a shaft overhead, and held taut by weights instead of the flexible spring pole described in the former article. These cords were fastened to a vertical frame, also balanced by cords and weights, and to which was attached a sort of stirrup adapted to the foot by which the machine was operated.

Considering the early time at which this lathe was constructed, it shows a good deal of ingenuity and may well have been the forerunner of the developments in this line which came after it.

It is a matter of record that in 1680 a mechanic by the name of Joseph Moxan built lathes in England and sold them to other mechanics, but we do not possess any certain or authentic knowledge of their design, as to whether or not screw threads could be cut with them, or whether they were designed for work on wood or metals, or both. In all probability they were foot lathes and used on all materials that had been formed in a lathe up to that time.

In the year 1772, the French Encyclopedia contained the illustration of a lathe which was provided with a crude arrangement of a tool block or device for holding a lathe tool and adapting it to travel in line with the lathe centres. By this it would seem that the inventor had some idea of the slide rest as it was known at a later day, by its invention in a practical form by John Maudsley, in England, in the year 1794. Whether Maudsley had seen or heard of the invention shown in the French Encyclopedia or not, it would seem fair to assume that he must have seen that or something akin to it, as the twenty-two years elapsing between the one date and the other must have served to make the earlier invention comparatively well known in the two nearby countries, both of which contained, even at this early day, many mechanics. It is interesting to observe that the slide rest invented by Maudsley over a hundred years ago has been so little changed by all the improvements since made in this class of machinery.

There seems to have been an early rivalry between the French and English mechanics in the development of machines and methods for advancing the mechanic arts. The next development of the screw-cutting idea seems to have been of French origin. In this lathe there was an arbor upon which threads of different pitches had been cut. These threads were on short sections of the arbor and by its use the different pitches required could be cut. While the exact manner of using this arbor was not described, its probable method of use will readily suggest itself to the mechanic, and was, no doubt, used at an earlier period, and, in fact, was what led up to the use of a lead screw or arbor with a multiplicity of different pitches. The principle is analogous to that used in the "Fox" brass finishing lathe, so well known and extensively used not only in finishing plain surfaces but in "chasing threads."

This machine was constructed with bed timbers and legs similar to those used later in wood-turning lathes. The head and tail stock were of the crude form of iron casting, in use at that period. The piece to be threaded and an equal length of lead screw or "master screw," as it was called, were placed end to end in the lathe, the outer ends supported on lathe centres, and their inner ends fixed to each other by some form of clutch or coupling, and supported in a device which was substantially a centre rest.

Fixed to the front of the bed timbers was a cast iron bar of T-shape, extending nearly the entire length of the bed. Upon this bar was fitted a sliding block of iron about half the length of the bed. Upon the top of this sliding block, at each end, was fixed a clamping device similar to the old-fashioned tool clamp on a lathe carriage. In one of these clamps was fixed a thread cutting tool similar to those in use now and capable of making a cut when placed in contact with the bar to be threaded. In the other clamp was fixed a somewhat similar piece of steel, so shaped as to fit in the thread of the master screw, and thus be made to travel along its length when the screw was revolved. By this combination of the simultaneous revolution of the piece to be threaded and the master screw with the guiding piece engaged by the screw fixed at one end of the sliding block, and the cutting tool clamped at the other, it was possible and practicable to produce a thread on the bar of the same pitch as the thread of the master screw, and of any form, V or square, according to the form of the cutting tool.

While the threads thus cut were probably rather poor specimens of mechanical work, they answered the requirements of the times, and as usual better means were devised for making them as the need of better and more accurate work created new demands and a higher standard of workmanship.

As will be seen in the above example, the idea of the slide-rest is used. In this case some such device was a necessity. Doubtless threads had been cut with some sort of a "chaser," or tool with notches shaped to the form and pitch of the thread. These were very extensively used later and for many years in brass work, and the old-time machinist was very expert in their use.

The slide-rest, as we know it, while it relieved the workman from the fatigue of holding the tool firmly in his hands and depending entirely upon them for the position of the tool, with the exception of such *support* as the fixed rest gave him, was comparatively slow in coming into general use. While its usefulness must have been apparent to the average mechanic, the conservative ideas then in vogue must have retarded its prompt adoption, as they did many other meritorious inventions.

By the use of the device above described, it is plain that a different "master screw" was needed for each different pitch of thread to be cut, although the diameter of the work might be anything within the range of the lathe to hold the drive, so that provision was made for supporting the inner ends of the piece to be cut and the "master screw," and for driving the latter by the former. The idea of driving the "master screw" or lead screw at a different speed from that of the piece to be threaded had not yet been thought of, and it was years before this development took place.

But before proceeding to this phase of the development of thread cutting, and consequently with the further development of the lathe, let us look a little further into the method of generating threads. That is, of producing the "master screw," from which other screws might be made. This interesting subject will be further explained in the next issue, in which the development of thread cutting will also be further discussed in its relation to the development of the lathe.

## WEIGHING LARGE CASTINGS ON SMALL SCALES

It has often been said that while "the poor workman always found fault with his tools, the good workman could do good work with poor tools." It is a trite saying, and one that might have been quite proper in "ye goode olde tyme," but in these later days when the demand is so insistent, not only for a good quality, but a good quantity of work, we believe in providing the best tools possible for the work, and then demand that we shall have a good workman to use them.

But, we sometimes unexpectedly find ourselves in such a situation that the demand for immediate results is so insistent and the means for supplying the demand so limited that we must have recourse to various expedients in order to accomplish the results demanded of us.

This condition tests the resourcefulness of the man and puts him in the condition of the workman who is expected to turn out good work with poor tools. The foreman and the superintendent of a machine shop or manufacturing plant are frequently confronted with such conditions and whatever may be the circumstances of the case or the obstacles encountered, it is "up to him" to solve the problem successfully, and usually to "do it quick, too."

Here is an actual example of this character that occurred in the routine duty of a superintendent of a machine shop. This machine shop had a number of large castings made in a nearby foundry, weighing from twelve to fifteen tons each.

It so happened that neither the machine shop nor the foundry had scales that would weigh a piece of over ten tons. About two miles away there was a scale that would weigh up to thirty tons. The natural inference was that the foundry must pay for the carting of these large castings to this scale and back so that they might be weighed and properly charged.

But it was an expensive proceeding, as there were no regular facilities for transporting weights as great as these, and some special arrangements would have to be made.

In this dilemma the superintendent, who was a practical engineer who had often solved similar perplexing problems, was appealed to as a last resort.

"Just lay a bar of steel," he said, "about 1 in. thick, round or square, across the middle of the scale platform, and balance the scale correctly. Place another similar bar on the floor at a distance equal to the length of your casting. Let the casting rest on these two bars as near the ends as possible, weigh the casting and note the weight. If the casting is of equal dimensions all the way through, as a lathe bed, multiply this weight by two and you have the correct weight. If it is unequal in this respect, weigh one end, then run the casting across the scales so that the opposite end rests on the bar on the platform and weigh that end. Add the two weights together and you will have the proper weight."

The foundry man afterwards made the remark, "that trick of weighing those castings saved me nearly a hundred dollars' carting expenses."

Many seemingly very difficult problems may be solved by equally simple means if we are ever ready to fall back on fundamental principles and natural laws and apply these in a practical manner to the subject in hand.

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## A READING ROOM IN THE MACHINE SHOP

Much discussion has been going on in the technical and trade journals in reference to the costs of the product of the machine shop and the relation of these costs to the rate of pay of different classes of workmen, and reference has been made to the fact that high-salaried workmen will frequently do a given piece of work for less actual cost for labor than the same work would be done by a man earning only one-half the daily wages.

The matter was followed up with the additional advantage of employing good workmen by the fact that the more highly paid men occupied only the same space, used the same machine, and as he did his work in less than half the time, the burden of shop expenses was less than half that of the work done by his less experienced shopmate.

The natural inference to be drawn from these conditions, which may be met with every day in the machine shop and manufacturing plant, is that it pays to have skillful workmen.

In the present days of advanced thought on mechanical as well as many other subjects, it is one of the necessities of the times that if a workman is to get to the head of his class in a proper understanding of his work and the conditions under which he labors and by which he is surrounded, he must make an effort to become better educated, not only in his chosen line, but in other branches related to it.

This education cannot always be obtained in schools, since there are today in the shops many men who have not enjoyed the advantages of a technical education, and there are likely to be many of the same class in the future. Again, while the advantages gained by a technical training in the excellent schools of the present day are many, there are other and important advantages that should not be neglected, even by the technical graduate. These are the advantages gained by the systematic reading and study of technical and trade publications. They are for the most part filled with not only the newest, but the most practical articles, descriptions and essays that it is possible for their editors to obtain by a liberal outlay of money. They are not the compilations of what was thought of years ago, but emanate from the brain and practical experience of men active in mechanical affairs, and selected for their practical utility by editors with a practical knowledge of the subjects of which they treat. They are, therefore, rich in theory, but richer still in live, up-to-date practice, and while the bright mechanic of today usually subscribes to one or more of these publications relating particularly to his own trade or specialty, this is not sufficient to give him the broad-minded view of conditions and the experiences of others that he should have.

Still, the expense necessary to obtain a number of these often will deter him from gratifying his desire for the broader outlook that their possession might give him. For these reasons it would seem to be not only a matter of much benefit to the employees, but in an indirect though perfectly practical way an advantage to the employer, to institute a Reading Room for the employees, where they may have all the advantages to be desired by a free opportunity to read and study the best there is published in their particular lines.

It is true, as everyone will doubtless admit, that one's reading has much influence on one's thoughts and opinions. Surely the same may be said in respect to its influence upon one's everyday work, and the more liberal are the conditions in this respect the more will be the actual benefit both to employee and employer. Every employer has it in his power to do something in this respect for the men that he employs. And the slight expense which he thus undergoes will have many and far-reaching effects.

He will not only have better men, so far as their work is concerned, but better men in their knowledge of all that relates to it. He will have men more loyal to his interests; better satisfied with their positions and with more pride in the fact that they are a part of an establishment managed upon a scale of intelligent liberality and consideration of the circumstances and conditions under which they labor. And the spirit of loyalty thus engendered will go far towards the success of the establishment, in so far as it lies with the employees.

When organizing a shop reading room, the first requisite is a good, light, clean room, in the office building, if one there is available. It should be furnished comfortably but plainly, and with such furniture as will make it a pleasant place for the men to congregate. The room should be open during the noon hour and for two or three hours in the evening.

In reference to the class of literature to be provided, it may be said that it should not be confined to technical publications, but may well include the best local papers, excluding, of course, those of a sensational kind, which do vastly more harm than good among all classes of the working men of today. Good magazines of general literature should be on hand, as well as books of history, biography, and technical works bearing upon the industries in which the men are engaged in their daily work.

Political questions should be eliminated as far as possible both by choice of literary matter and the discouragement of discussions of this nature. This should be particularly the case in view of the fact that there might be among the men a suspicion that the employer was endeavoring to impress *his* political opinions and prejudices upon them.

Referring to the expense of providing all the literature for a shop of two hundred men, it ought not to cost over eight or ten dollars a month. Many publishers will furnish their publications free of expense if their use is explained to them, and in various other ways may good and valuable periodicals and books be acquired for the use of the men.

Still, there is another important use of the material in the reading room. This is that of circulating the books and periodicals among the employees for home reading, thus giving them free the advantages of reading matter that might not otherwise come in their way. It will generally be found that there are men in the shop who will act as librarian of the reading room, under the direction of the firm.

A man of studious nature will naturally enjoy such a position, and by various plans and his own personal interest in the scheme will do much to insure its success and to make it popular with the employees, and thus foster a fraternal spirit between shopmates.

If we carry out the idea of education of employees still further, there may be instituted among the men during the winter months a series of shop talks or lectures on mechanical and kindred subjects, not only by public-spirited citizens outside the shop, but particularly by the owners and officers of the establishment, that will go far towards the enjoyment and practical education of the men, but also, what is of considerable practical importance, foster a spirit of interest, not to say common interest, between the owners and their workmen, that will bear fruit in increased loyalty and to the best good of all.

These lectures may also be profitable when concerned with subjects of public good and town improvement, whereby the workmen may gain enlarged views of the duties of good citizenship and many other important duties not directly connected with the shop.

Another subject which will commend itself to the consideration of the younger mechanics is a course of lessons in mechanical drawing and the use of plane geometry. These subjects are of great practical utility to young mechanics, and at the present time every young man who aspires to become a first-class machinist is expected to be more or less proficient in them.

Such lessons can usually be given by the chief draftsman or one of those working under him who possesses an aptitude for this kind of work. While he is imparting to the members of a class the information that is always sought by the ambitious young mechanic, he is receiving from the work much of benefit to himself.

Still further, the effect will be to foster a certain feeling of interest between the drafting room and the machine shop, which in many shops is not as strong as it should be, but which is always necessary and valuable to the successful running of the establishment.

This same spirit of unity of interest among the men of different departments is a very desirable condition, and the wise manager or superintendent will always aid and encourage it in every legitimate manner. There is no one condition more conducive to the success of a manufacturing establishment than that all, from the owners to the youngest employee, shall realize and work for the common and mutual interest of all concerned, and no one condition that will go as far toward the avoidance of labor difficulties and the elimination of all disagreeable and adverse conditions as a feeling of mutual respect between owners and employees, and between one class of employees and another, and a feeling that in case of any real difference of opinion as to shop conditions, each side is perfectly willing to listen to the reasonable arguments and explanations of the other in a perfectly friendly and mutually interested spirit.

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The principle of the Heilman electric locomotive, which was tried in France in 1894, is to be given a more complete test in the Reid-Ramsay turbine-electric locomotive, which has been built in Scotland. The boiler supplies steam to a turbine running at 3,000 revolutions per minute, and directly coupled to a dynamo, which furnishes 200 and 600 volt current to motors on the driving axles of the locomotive. The exhaust steam is condensed, and returned to the boiler by means of a feed pump, the hot circulating water being cooled by a radiator placed in front of the locomotive. The object aimed at with this engine is to obtain the advantages of electric traction without the heavy expenditure of capital involved in electrifying the whole line. Practical railroad men will ask whether this costly locomotive can compete to advantage with the highly developed, efficient, and low-cost steam locomotive.

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The dam which the United States government is planning to construct at Troy across the Hudson River will wipe out a number of factories and mills in that region using water power. The head furnished by the dam will be utilized to generate about 6,000 h.p., and this will be sold to the mills and factories at cost. However, the companies will be required to pay the cost of building the power house. It is estimated that the amount of power utilized will be three times as much as has heretofore been employed.

## Table from article on "The Design of a 10 K.W. Electric Plant," in the November issue.

### WIRING TABLE FOR LIGHT AND POWER CIRCUITS

Multiply current in amperes by single distance and refer to the nearest corresponding number under column of Actual Volts Lost, to find size of wire.

| Volts | Percentage of Loss | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2000 | 1.7 | 1.5 | 1.4 | 1.2 | 1.1 | 1.0 | 0.75 | 0.5 | 0.45 | 0.4 | 0.35 | 0.3 | 0.25 | 0.2 | 0.15 | 0.1 | 0.05 |
| 1000 | 3.4 | 2.9 | 2.7 | 2.4 | 2.2 | 2.0 | 1.5 | 1.0 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 | 0.4 | 0.3 | 0.2 | 0.1 |
| 500 | 6.5 | 5.7 | 5.2 | 4.8 | 4.3 | 3.9 | 2.9 | 2.0 | 1.8 | 1.6 | 1.4 | 1.2 | 1.0 | 0.8 | 0.6 | 0.4 | 0.2 |
| 220 | 13.7 | 12.0 | 11.0 | 10.3 | 9.3 | 8.3 | 6.5 | 4.4 | 3.9 | 3.5 | 3.1 | 2.7 | 2.2 | 1.8 | 1.4 | 0.9 | 0.45 |
| 110 | — | — | 20.1 | 18.5 | 17.0 | 15.4 | 12.0 | 8.4 | 7.6 | 6.8 | 6.0 | 5.2 | 4.4 | 3.5 | 2.7 | 1.8 | 0.9 |
| 52 | — | — | — | — | — | — | 22.4 | 16.1 | 14.7 | 13.3 | 11.8 | 10.3 | 8.8 | 7.1 | 5.5 | 3.7 | 1.9 |

**Actual Volts Lost**

| Carrying Capacity Amperes | Size B. & S. | 35 | 30 | 27.5 | 25 | 22.5 | 20 | 15 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 300 | 0000 | 345800 | 296400 | 271700 | 247000 | 222300 | 197600 | 148200 | 98800 | 88920 | 79040 | 69160 | 59280 | 49400 | 39520 | 29640 | 19760 | 9880 |
| 245 | 000 | 274400 | 235200 | 215600 | 196000 | 176400 | 156800 | 117600 | 78400 | 70560 | 62720 | 54880 | 47040 | 39200 | 31360 | 23520 | 15680 | 7840 |
| 215 | 00 | 217525 | 186450 | 170912 | 155375 | 139837 | 124300 | 93225 | 62150 | 55935 | 49720 | 43505 | 37290 | 31075 | 24860 | 18645 | 12430 | 6215 |
| 190 | 0 | 172550 | 147900 | 135575 | 123250 | 110925 | 98600 | 73950 | 49300 | 44370 | 39440 | 34510 | 29580 | 24650 | 19720 | 14790 | 9860 | 4930 |
| 160 | 1 | 136850 | 117300 | 107525 | 97750 | 87975 | 78200 | 58650 | 39100 | 35190 | 31280 | 27370 | 23460 | 19550 | 15640 | 11730 | 7820 | 3910 |
| 135 | 2 | 108500 | 93000 | 85250 | 77500 | 69750 | 62000 | 46500 | 31000 | 27900 | 24800 | 21700 | 18600 | 15500 | 12400 | 9300 | 6200 | 3100 |
| 115 | 3 | 86100 | 73800 | 67650 | 61500 | 55350 | 49200 | 36900 | 24600 | 22140 | 19680 | 17220 | 14760 | 12300 | 9840 | 7380 | 4920 | 2460 |
| 100 | 4 | 68250 | 58500 | 53625 | 48750 | 43875 | 39000 | 29250 | 19500 | 17550 | 15600 | 13650 | 11700 | 9750 | 7800 | 5850 | 3900 | 1950 |
| 90 | 5 | 54250 | 46500 | 42625 | 38750 | 34875 | 31000 | 23250 | 15500 | 13950 | 12400 | 10850 | 9300 | 7750 | 6200 | 4650 | 3100 | 1550 |
| 80 | 6 | 43050 | 36900 | 33825 | 30750 | 27675 | 24600 | 18450 | 12300 | 11070 | 9840 | 8610 | 7380 | 6150 | 4920 | 3690 | 2460 | 1230 |
| 60 | 8 | 26985 | 23130 | 21202 | 19275 | 17347 | 15420 | 11565 | 7710 | 6939 | 6168 | 5397 | 4626 | 3855 | 3084 | 2313 | 1542 | 771 |
| 40 | 10 | 16975 | 14550 | 13337 | 12125 | 10912 | 9700 | 7275 | 4850 | 4365 | 3880 | 3395 | 2910 | 2425 | 1940 | 1455 | 970 | 485 |
| 30 | 12 | 10675 | 9150 | 8388 | 7625 | 6862 | 6100 | 4575 | 3050 | 2745 | 2440 | 2135 | 1830 | 1525 | 1220 | 915 | 610 | 305 |
| 22 | 14 | 6720 | 5760 | 5280 | 4800 | 4320 | 3840 | 2880 | 1920 | 1728 | 1536 | 1344 | 1152 | 960 | 768 | 576 | 384 | 192 |
| 15 | 16 | 4235 | 3630 | 3328 | 3025 | 2723 | 2420 | 1815 | 1210 | 1089 | 968 | 847 | 726 | 605 | 484 | 363 | 242 | 121 |

NOTE—In case a larger loss than any given in the table is required, proceed as follows: divide the ampere feet by 10 and then refer to column of Actual Volts Lost divided by 10, from which we find the size wire as before.

This table should have been with the article, "Design of a 10 K.W. Electric Plant," by Henry Townsend, Jr., in the November number, instead of the table there given. The above table is from H. C. Cushing's manual "Electric Wiring."

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The first entry for the elimination race for the Gordon Bennett international trophy, at present held by Glenn Curtiss, was received on August 30th by the contest committee of the international aviation contest. The entry was received from Harry Harkness, son of the Standard Oil magnate. Mr. Harkness is the owner of two Antoinette machines.

# EDITORIAL

The January issue of ELECTRICIAN AND MECHANIC will mark the inauguration of several new departments. One of these under the heading "Practical Hints," will be devoted exclusively to the interests of the practical electrical and mechanical worker. In its columns will be found easy ways to do hard things.

It is our desire to make this department an exchange of ideas from our readers; therefore, we shall offer cash prizes to those who contribute the best suggestions, preferably illustrated with at least a rough pencil sketch, to these columns each month. The articles should not contain more than five hundred words and should be clear and concise accounts of actual machine-shop, work-shop, or laboratory experience. All contributions should be addressed to "Practical Hints Editor," ELECTRICIAN AND MECHANIC, 221 Columbus Ave., Boston.

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The enlargement of future issues of the magazine, as stated in our editorial for the November number, makes it necessary to bind in two volumes a year hereafter. For this reason, we give the July-December index at the end of this issue and call these *six numbers* Volume XXI. In succeeding years, beginning January, 1911, indexes will be prepared every six months, and the volumes will be numbered accordingly—January to June, 1911, inclusive, constituting Volume XXII, and so on.

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It was stated in the November issue that a notice of Chavez's wonderful flight over the Simplon Pass and unfortunate end was given. The description and notice was omitted, by mistake, from that issue and appears in this number of the magazine.

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Target for the ridicule of hundreds of impatient critics, a few days previous, because of repeated delays in beginning his flight in the airship *America*, Walter Wellman, journalist and explorer, and his five brave companions, who abandoned the giant dirigible balloon and were rescued in mid-ocean early on the morning of October 18th, a few hours later arrived at New York on the Royal Mail steamer *Trent*, to receive the plaudits of a nation.

After seventy-two hours in the air and with only sufficient gasoline to last a few hours longer, the crew of the *America* sighted the *Trent* and commenced to signal "Help! Help!" by means of the white signal light and Morse code. After an exchange of messages by this means, it was ascertained that both air and sea craft were equipped with wireless, and then followed a series of messages that will stand in history as the first wireless communication between a ship at sea and a ship in the air.

Here are the messages copied from Operator Ginsberg's record on the *Trent:*

*Trent*: "Do you want our assistance?"

*America:* "Yes; come at once. In distress. We are drifting. Not under control."

*Trent:* "What do you want us to do?"

*America:* "Come ahead full speed, but keep astern, as we have a heavy tail."

*Trent:* "O.K. Am standing by wireless in case of trouble."

*America:* "You will pick us up at daylight. You will be better able to see us then."

*America:* "Come in close and put bow of your ship under us, as we will drop a line; but do not stop your ship as you will capsize us."

*America:* "Who are you and where are you bound for?"

*Trent:* "Steamship *Trent* for New York."

*America:* "Have one of your boats ready to launch, as we will probably capsize when we launch our boat."

*Trent:* "O.K. Boat manned."

*Trent:* "Are we gaining on you?"

*America:* "Yes; we are getting ready to launch."

*Trent:* "Should we stop for you?"

*America:* "Don't stop. We will drop a sea anchor and try to check our ship."

*America:* "We have a motor going above me. Can't hear your signals now. Will say when I can. We are pumping air into airship ready to bring her down level."

*Trent:* "We are going full speed waiting for your orders."

*America:* "We are going to launch boat. Stand by to pick us up."

This ended the exchange of wireless messages.

# EDITORIAL

We take pleasure in announcing that we will shortly issue a catalogue making very attractive offers of ELECTRICIAN AND MECHANIC in connection with other magazines. This catalogue will be sent to all regular subscribers as soon as it is issued. Other readers may obtain a copy by making application to us. The advantages of the clubbing system are probably well known to most of our readers, but to those who are not familiar with the system we might say that when two, three or four magazines are subscribed for at the same time, the decided reduction in price on the whole is well worth while.

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Our new book catalogue is now ready and contains many works of interest to the electrical and mechanical worker. These books range in price from twenty-five cents to five dollars and among the titles will be found all of the latest books on aeronautics, wireless telegraphy and telephony, electrical and mechanical engineering, carpentry, mechanical and architectural drafting, concrete working and an endless variety of subjects interesting to the handy man. We will be pleased to send this catalogue to any of our readers on request.

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It is becoming to the new president of the Massachusetts Institute of Technology that he should favor a course in aeronautics in that progressive school of engineering. The thousands of graduates and tens of thousands of friends of "Tech" throughout the country would be disappointed if the institute were not among the earliest to recognize the importance of aviation and to make suitable provision for its study. President Maclaurin mentions as an incident related to this matter, the fact that while he was recently in Paris a gift of $100,000 was made to the university there for the establishment of a professorship of aviation, and the fact, also, that a larger amount was subscribed to equip a department in this branch of engineering. Aeronautics, he declares, will command much attention in the future, and he adds: "With our facilities and situation here at Technology I do not see why the institute should not lead in the exposition of it."

There is no reason why it should not. The Massachusetts Institute of Technology is in a position to start at a point whereto it would require years for a younger school to attain. All the advantage of prestige will come to it by taking up the proposed course at once.

There is something more than passing enthusiasm behind the proposition that the study of aeronautics is bound within a very short time to command as many students as any other branch of modern engineering. It will neither supersede nor supplant any of the other engineering studies. There will be students who will elect to follow it as there are students now who elect to follow the study of civil, electrical and mechanical engineering, and the process of development will be much the same in this as in all other lines of technical work.

But the thing is to identify the Massachusetts Institute of Technology with aviation at the earliest date practicable, and President Maclaurin seems to have this point well in mind.

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We shall publish in our January issue a most interesting and enthusiastic article by Hudson Maxim, the well-known inventor, on "The Past, Present and Future of Aeronautics." The article sketches briefly the advance of aeronautics to its present stage of perfection, discusses the reasons for its rapid advance in the past few years, and indulges in some prognostications of its probable advance in the future, giving especial attention to the military side, in which Mr. Maxim is particularly interested. The article is a distinct contribution to the literature of the subject, and we feel that we are highly privileged in being able to present this to our readers.

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It has always been our desire to present to the mechanical and electrical worker something to help, advance, and better him, as well as to interest him. In our new and larger magazine, we shall have far more space to devote to this purpose, and a partial list of the departments to appear in future issues, will be found among the advertising pages of this number.

# WIRELESS TELEGRAPHY

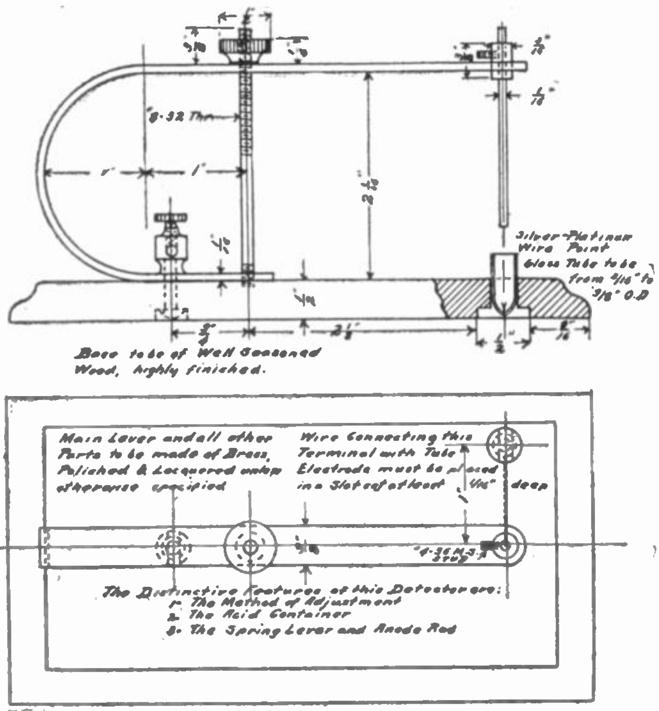
**In this department will be published original, practical articles pertaining to Wireless Telegraphy and Wireless Telephony**

## TWO TYPES OF EFFICIENT DETECTORS

W. C. GETZ

Many of the wireless experimenters who are now first starting in find it hard to choose which of the various detectors to use. Of course, it is assumed that they will really try out all the different types, but what the average experimenter wants is a detector combining a substantial, neat design and a high efficiency of operation.

In looking over some of my drawings I found several tracings of designs for detectors, from which I first had my No. 103 and No. 104 types of detectors made, when in business selling wireless apparatus; and as the designs in question are based on the above-mentioned points of taste and efficiency, I therefore feel sure that they will prove of use to the readers of this magazine.




#103 Detector-Electrolytic
SEPT 9, 1908 W C GETZ

The electrolytic detector, while undoubtedly a source of trouble, owing to the use of acid, is nevertheless regarded by many as the most sensitive and efficient type. That is, where the design together with the electrolyte and the platinum silver wire are of the right proportion.

In Fig. 1 is given the working drawings for constructing an electrolytic detector, that is an ornament to any wireless station. The drawing practically explains itself to the experimenter, but we will go over the essential features, in order to be perfectly familiar with the construction of same.

A wooden base, which may be readily made, or obtained from any electrical supply house, similar to the "mat" bases on which gas-lighting push-button sets are mounted, is bored, so that the lamp-bulb, binding-posts and regulating screw may be mounted as shown. The lamp-bulb is the standard size used in telephone exchanges, on the answering or supervisory circuits, and a burnt-out one can usually be obtained free of charge from the wire-chief.

A sharp-edged file is then drawn around the body of the lamp, about ¾ in. from the end, so that a slight nick is made all around in the glass. With care, the top of the lamp can then be removed with your hand, leaving the lower part intact, and with an even edge. The portion of the burned-out filament serves as the bottom electrode for our detector.

The main lever is made of ⅜ in. x 1/16 in. spring brass, the holes being bored in the proper places before the lever is bent into shape. The bending should be carefully done in order to, preserve the symmetry of the detector, as nothing ruins an otherwise good-looking piece of apparatus as an irregular or "kinky" bend in any of its parts.

The regulating screw may be easily made if the experimenter has a set of machine dies, and if he is not so well equipped, he can obtain it for a few cents from any nearby machine shop.

An ordinary battery thumb-nut will do to go on this screw, if the experimenter does not care to go to the trouble of having a knurled thumb-nut made, as shown on the design.

In the end of the main lever is soldered a section of ¼ in. brass rod, with a 1/16 in. hole through the centre. At right angles to this hole, is bored another hole to be tapped for a small set screw. This set screw is of the No. 4–36 size, and can be easily obtained, when purchasing the other material.

Through the sleeve thus described is fitted a length of 1/16 in. brass rod on which a small piece of silver-platinum wire is soldered. In soldering this wire it should first be made fast to the brass rod by winding around it and the rod for about ¼ in. some bare No. 36 magnet wire. Many experimenters waste valuable silver platinum wire, especially the fine sizes, in trying to solder it, as the heat of the solder will usually melt the wire unless this precaution is taken.

The two binding-posts having been affixed as shown on the plan diagram, the detector is now ready for use. The electrolyte used consists of 1 part nitric acid to 4 parts water.

Before finishing with this detector, we consider the silver platinum wire. Many cheap concerns sell a low-priced detector with very coarse wire upon it, which the experimenter cannot get any sensitive results from. I always advise the experimenters to get a medium grade, say, .005 – .0004 and a very fine grade as .0011 – .00002, using the first for nearby work, and the finer for long distance work. Some notes upon the adjustment of this detector will be given further on.

The silicon detector has always been a favorite with me, as aside from the fact that there is no acid or water necessary, in many cases it can be used and gives excellent results, without the use of local battery.

In Fig. 2 is shown the plan, elevation and details of the No. 104 silicon detector, manufactured and sold by me for a short while in 1908. This detector has a rigid construction that contrasts well with the electrolytic detector previously described.

A metal upright or standard of ⅜ in. x ⅛ in. brass is cut and bent as shown at *A*, the proper holes being drilled. In this, at the top end, is soldered the tube *B* of brass. The upper end of this tube is tapped for an 8-32 thumb-screw, and the lower portion is bored out more, to allow a coiled spring and a copper or zinc point *C* to be inserted. The spring is shown at *D*.

Directly under the tube in the end of this standard is placed a metal plate *F* held fast by a binding-post, on which the silicon button *E* is placed. *E* is made of a brass ring in which is soldered a lump of silicon, the ring being held on some flat surface, and the piece of silicon held in the right position, while melted lead is poured around it. The silicon is then smoothed down on a dry oil stone until it presents a highly-polished surface. A good grade of silicon should be obtained, and with it, this detector will give surprising results.

The base is similar to that used with the electrolytic detector, and a suitable recess is made in the base to allow the silicon button to be placed when not in use.

Both the electrolytic and the silicon detectors should be given a high polish and lacquered, or should be nickel-plated.

In use, the adjustment of these detectors will be only had by experience, but a few hints given herein may save the experimenter much trouble.

The electrolytic detector *must be used* with a *potentiometer*. It is impossible to get any results from this with a voltage variation of 2 per cent. from the proper value, and the experimenters who go at the thing haphazardly, trying in your telephone receiver. Then, move the slide a little back, so that the hissing just ceases. Now gradually raise the silver platinum wire, by turning the thumb-screw so that the point is barely touching the solution. If the hissing sounds come back, move the potentiometer slide a little further back, so as to just lose them.

Where the silicon detector is used, a testing buzzer must be procured. If battery is used with the silicon detector, first slide the button around so that you will hear the buzz in the telephone re-

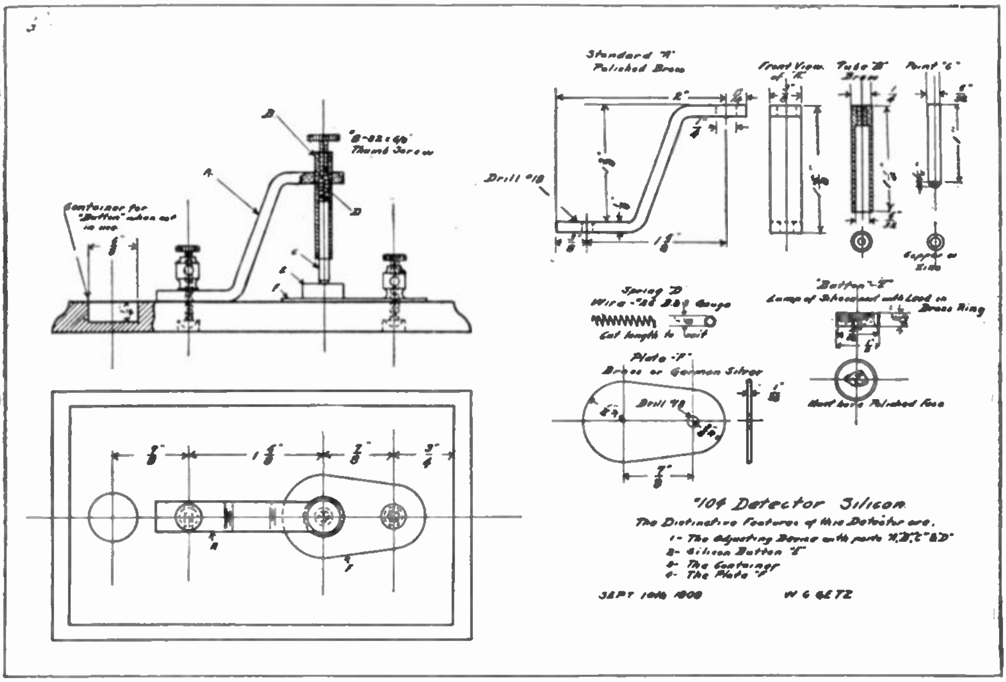



Fig. 2

to make it work with 3 cells of dry battery and an 80 ohm receiver, only get nothing for their carelessness. The receiver should be at least 750 ohms resistance and over. Do not think a 35 cent telephone receiver will give efficient results. And another thing, *don't* try to make the silicon or electrolytic detector work a tape recorder. There are some things that even amateur wireless apparatus won't do.

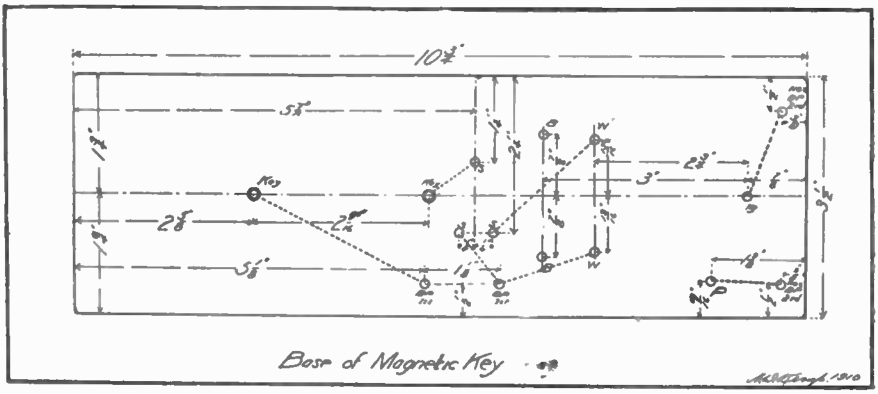
In adjusting the electrolytic detector, place the platinum point into the electrolyte, and vary the slide on the potentiometer until a hissing sound is heard ceiver, when the buzzer is placed a little distance away and operated. Then vary your potentiometer slide, so that the buzz comes in loudest. Without battery, all that is necessary to adjust this detector, is to move the button around until a sensitive spot is reached. Sometimes, regulating the pressure with the thumb-screw will give a little better adjustment.

In a later issue I will describe the construction of the models of potentiometer and tuning coil I have used successfully, and that have given excellent results in different parts of the country.

## MAGNETIC KEY

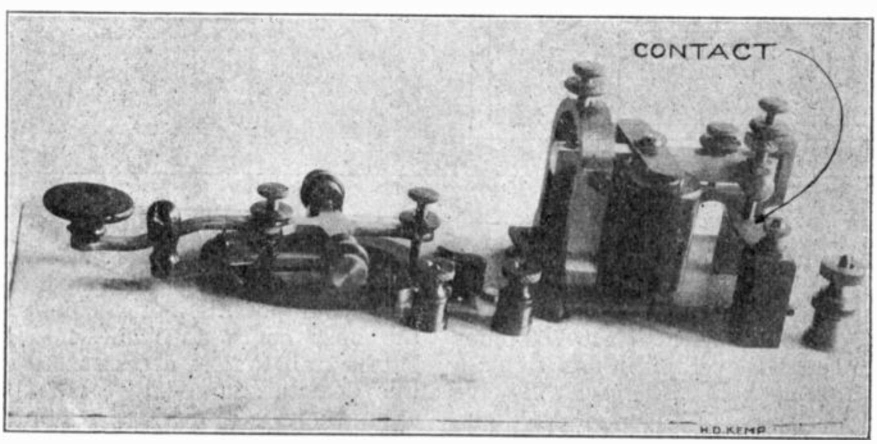
H. D. KEMP

Doubtless, many amateurs possessing transformers of from 1 to 3 k.w. capacity have had some trouble with the contacts of their keys arcing. A key handling a heavy current cannot always be adjusted to suit the users' taste as well as a small ordinary telegraph key. A well-constructed magnetic key will do away with all these troubles and also place the 110 volt alternating current circuit at least 5 in. from the operator's hand, thereby obviating any possibility of shock.




This key will stand a constant load of from 25 to 30 amperes, and is, of course, capable of a considerable overload. The construction can be slightly altered so that it can safely handle a much heavier current. It can be constructed with comparatively little labor at a cost of not more than $4, which includes the price of everything but the base, the cost of which varies with the material used. This is much less than the price of any key at present on the market that the author has heard of which will handle so heavy a current.

This key works on the relay principle using, instead of a telegraph relay to make and break the curcuit, a telegraph sounder with a special contact mechanism. Practically, all the work which needs to be done is the construction of a base and the contacts.



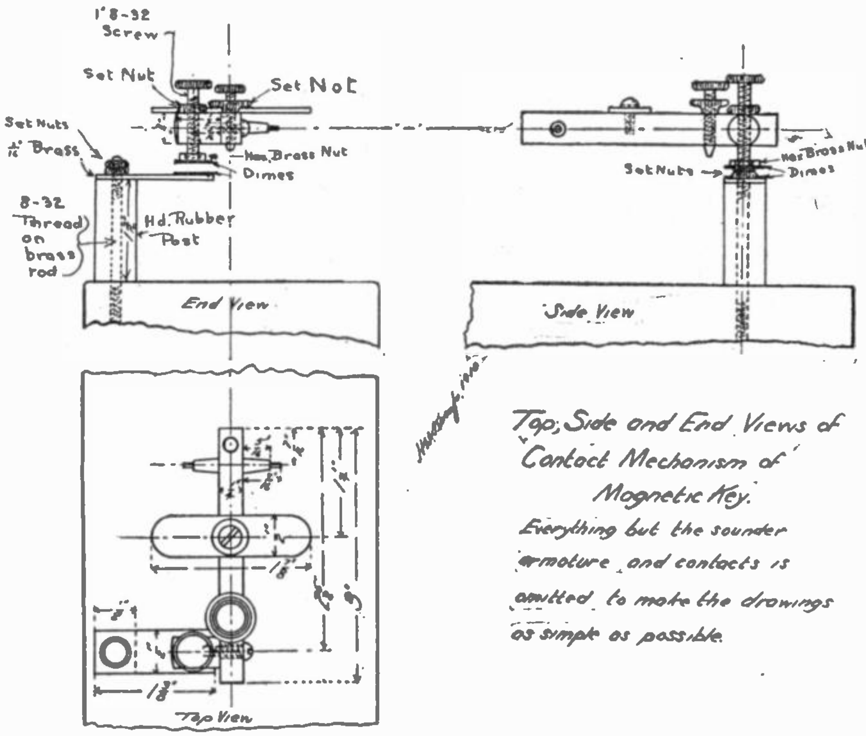

The author made his key of the following materials: Bunnel's best quality 20 ohm aluminum armature sounder, $1.80; Bunnel's best quality leg key, $1.05; a two-point wood base switch of which nothing but the arm and points are used, 20 cents.

The drawings are dimensioned for the above standard instruments.

A marble base 10¾ in. × 3½ in. × 1¼

in. was used. This base may be made a little larger thereby changing slightly the whole key. The size as given is, however, perfectly satisfactory.

If it is desired to lower the price of the key, this could be done by obtaining a cheaper combination set of sounder and key, which can be bought for from $2 to $2.50. However, the dimensions given are those needed on the standard best quality material and would not hold on the cheaper goods. Before drilling holes in the base it is best to verify all these measurements with the dimensions of the instruments to be used, as even standard goods vary slightly sometimes.




Top, Side and End Views of Contact Mechanism of Magnetic Key. Everything but the sounder armature and contacts is omitted to make the drawings as simple as possible.

The first step in the construction is to make the

CONTACT MECHANISM

This can be done with no lathe work whatever, if the maker so desires, although, of course, a neater job can be done if a machine is at hand.

The drawings are nearly self-explanatory, but a few words concerning them may not be amiss.

It will be seen that a small brass circular pillar projects from the side of the aluminum armature of the sounder. This pillar is ½ in. long and ⅜ in. in diameter. In the centre of one end it is drilled and tapped about ¼ in. for an 8-32 screw. Perpendicular to the axis of this pillar, and 5-16 in. from the end above-mentioned, it is drilled and tapped all the way through for an 8-32 screw.

The square hard rubber pillar is ½ in. square and 1 3/16 in. tall. It is drilled the entire length to pass an 8-32 thread, *i.e.*, large enough to allow the threaded rod to pass through it easily. The brass rod is from 2 to 2½ in. long, depending on the thickness of the base, and is threaded ½ in. on each end with an 8-32 thread.

The piece of strip brass is 1⅜ in. long, ½ in. wide and 1/16 in. thick and has one hole in it large enough to pass an 8-32 screw, at a distance of ¼ in. from the end and in the middle of the width of strip.

Dimes are used for the contacts because of their high conductivity and because they do not corrode as rapidly as brass. Platinum, of course, would be the ideal contact, but it is rather hard to procure, and is very expensive, so dimes are used as the best substitute. One dime is soldered to one side of a hexagonal brass nut tapped for an 8-32 screw so it may be screwed on to the end of the set screw which is used for adjusting the contact. The other dime is soldered to the brass strip with its centre ⅛ in. from the hole already in the strip. The two dimes should then come together nearly concentric. The two faces that meet should be carefully and thoroughly smoothed with a file. This completes the contact mechanism and then we come to the

#### BASE

The drawings of the base are self-explanatory with the exception of the size of the holes. The two holes marked "key" should be drilled to pass a No. 12 screw, which is the size of the legs of the key. All the other holes may be drilled to pass a No. 8 screw. Although some of them could be made smaller it is simpler to drill them all the same size. If the base is to be raised from the table the holes will not need to be countersunk on the bottom. If, however, the base is to lie flat on the table they will need to be. A ½ in. drill will be found very satisfactory for the countersink. As it would give more room, a ⅝ or ¾ in. drill would be better, but are harder to use and procure.

#### ASSEMBLY

The first thing to do is to cut off the legs of the key to the desired length, depending on the thickness of the base. If the holes are countersunk it will be necessary to either cut off the wings on the nuts or to obtain some hexagonal or round nuts to fit the legs of the key.

The short steel screws, used to hold the sounder on the wooden base it came on, should be replaced by some brass ones. The size is 8-32.

The 3 holes marked "S" in the centre of the drawing are for a switch. When the arm of the switch is pulled towards the key it will be seen that the key can be used alone for light current work. When the arm is on the point nearer the sounder, the sounder is thrown into the circuit. This is using the binding posts marked "*BP* first."

The wiring of the key, switch and from the sounder magnets should be done with No. 16 or No. 18 B & S copper wire, as that will carry nicely any current for which it might be desired to use the key alone.

The wiring from the binding posts marked "110 volts *B P* 2 rd," should, however, be done with wire as large as No. 8 or No. 10 B & S. It will be seen that the frame of the sounder and the brass strip and rod through the hard rubber post form the circuit for the 30 ampere 110 volt current. The only thing that limits the current to 25 to 30 amperes is the screw to the base. This is a 6-32 screw which is about equivalent to a No. 10 B & S wire. A No. 10 B & S wire has a safe capacity of 32 amperes. The pivots of the armature might be another source of trouble, so it is well to connect the screw governing the tension of the spring and the screw on the armature used as a lower stop with a piece of flexible wire of capacity 25 amperes. The current will then have ample path.

If it were desired to change the key to carry a load of from 50 to 65 amperes the set screw, with a dime on the end, might be changed to a 12-24 screw. A flexible wire of 50 to 65 amperes capacity direct from the binding post "110 volts *BP* 2 rd" to the screw on the armature and a similar one to the brass strip would complete the alterations. The author, however, cannot vouch for the working of the key under these new conditions, as he has not tried it on such a heavy current.

If three or four dry cells are used in the local circuit with quite a stiff spring on the sounder armature, it will be found almost impossible to "beat" the sounder it responds so quickly, so that an operator may adjust his telegraph key to his liking and send a great deal faster than with a large, awkward key handling the heavy current.

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A novel application of wireless telegraphy in the field of engineering is the installation which the Pennsylvania Railway has made for testing the usefulness of air messages for railroad operation. The mast used in the tests is located on the mountain near Altoona at an elevation of 1,655 ft. above sea level. Communication has already been opened with the stations on the Atlantic coast, and also with ships at sea.

# IN MEMORY OF GEORGE CHAVEZ

AUSTIN C. LESCARBOURA

All our readers must have read of the sad death of George Chavez, the Peruvian aviator. It is one of the most deplorable accidents encountered in aviation thus far.

The Society of Aviation of Milan, Italy, offered a large prize for the aviator who succeeded in crossing the Alps following the famous Simplon Pass, and thence, across the Maggiore Lake to Milan. Among the aviators who were at the starting place, are Cattaneo (Italian), Weymann (American), Paillette (French), and poor deceased Chavez. Cattaneo and Paillette gave up the attempt without any noticeable effort, but Weymann flew to an altitude of 4,000 ft. in his Henri Farman. He descended after being in the air 27 min., probably owing to the fact that he has had little experience in high flights. Chavez climbed into his Bleriot monoplane and was soon soaring at about 7,000 ft. altitude, and then began to disappear over the mountains.

Almost an hour later, the crowd on the northern shores of Lake Maggiore, witnessed a speck in the heaven, growing larger every moment, as Chavez glided from 4,000 ft. to the earth. He was now gracefully floating down with his motor shut off. The masses of people were wild with enthusiasm. When 30 ft. from the ground he restarted his Gnome engine, when—a crash! the machine seemed to split in half! A mass of ruins contained the aviator and that laurel-bearing Bleriot machine.

At the hospital his wounds and injuries did not seem fatal at first, and the skilled corps of doctors assured the anxious public that Chavez would recover. The succeeding days witnessed the entire world with eyes centered on that youth who duplicated Napoleon's feat a century later, in a new mode, and fulfilling the general's prophecy anew, "There shall be no Alps." Like a thunderbolt, the world was informed of the death of Chavez, the man who had succeeded in crossing the Alps, a territory of where a descent meant death, intense cold and treacherous winds, then, within 40 miles of the goal, with but a smooth one hour flight to fame and fortune, the calamity occurred.

The reason of the failure at the critical moment will never be known. The French experts claim that by gliding down and restarting the motor, Chavez caused the stays to strain and give way and the framework to collapse.

Of that eventful trip which led Chavez to the doom of Delagrange, Le Blon, Capt. Fabre, Lefebrve, Gaechter, Rolls and the other martyrs of that wonderful machine, the aeroplane, the world will never know. During his moments of delirium the attendants heard him saying: "Snow, more snow, what a mass of snow," evidently describing the scenes and cold experienced.

The writer trusts that these words will be read and in each reader's mind will be a remembrance of "George Chavez, brave, fearless, the first man to cross the Alps in a power-driven flying machine, who at the height of success, died September 27, 1910. Another martyr added to the ranks of the immortal heroes."

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M. Quinton, a distinguished biologist, has recently made experiments for devising means to protect air-men in falls from great heights. A model car was constructed of such elasticity that when dropped from a height of 40 ft. articles in it so fragile as Bohemian glass were not broken. But, experimenting with rabbits, in some cases the animal was uninjured, while in others, the animal died within half an hour. The autopsy showed that the stomach, which at the time of the fall was full of food, had struck against the liver and caused it to burst. In other cases the heart was affected, and there was a rent at the point where the blood vessels begin.

M. Quinton explains the phenomenon by the fact that all the organs have not the same density. The apparatus protected the animals outwardly, but by the law of inertia, certain organs continued the fall within, and hence, for instance, the tearing of the heart.

## STERILIZATION BY ULTRA-VIOLET LIGHT

Many investigations are now being carried out in France on the employment of ultra-violet light for the sterilization of liquids, since this method seems to offer a neat solution of the difficult and important problem of sterilized drinking water. The cost of sterilization by it promises to be less than that involved in the use of ozone, and hence a great number of appliances are being studied for the practical application of the process. For the most part mercury vapor lamps are utilized, the favorite types being the Cooper-Hewitt, made by the Westinghouse Company, the Heræus, and that of the Quarzlampengesellschaft.

Some experimenters, such as MM. Courmont and Nogier, immerse the lamp in the liquid which is to be sterilized. This arrangement has the advantage that, as the ultra-violet rays are strongly absorbed by air, it assures the greatest efficiency of the apparatus. On the other hand, in these conditions the lamp is exposed to sudden changes of temperature that are apt to break the quartz tubes, which are relatively expensive on account of the difficulty of manufacture.

An elaborate investigation by M. Victor Henri on the action of the ultra-violet light, says the Paris correspondent of the *London Times*, will serve as a technical foundation for the new industry which seems likely to be founded on this method of sterilization. In the first instance, his studies have referred to transparent liquids, such as ordinary town water, water of the Seine, and water infected with various microbes. The bacteriocidal action of the rays varies greatly with the distance at which the bacteria are placed from the lamp. Thus, in order to sterilize water containing *Bacillus coli* with a Westinghouse Cooper-Hewitt lamp of 110 volts, an exposure of 300 seconds was required at a distance of 60 c.m., of 180 seconds at 40 c.m., of 20 seconds at 20 c.m., and of 4 seconds at 10 c.m. With a lamp of 228 volts the time of exposure was 30 seconds at 60 c.m., 20 seconds at 40 c.m., 4 seconds at 20 c.m., and less than 1 second at 10 c.m. The temperature has scarcely any effect, the time necessary for sterilization not being sensibly reduced, even if the microbial liquid is frozen, provided that the ice be transparent. The rapidity of the action is not the same for different bacteria.

The Westinghouse Company of Paris is actually constructing apparatus for the domestic sterilization of water. This works with a lamp of 110 volts 3 amperes, and can yield from 400 to 1,200 litres of sterilized water per hour. The lamp is not immersed, but is arranged within an enameled vessel, the water circulating beneath it in fan-shaped tubes, which bring it three times under the influence of the radiation.

For opaque liquids, such as milk, wine, or beer, a very thin layer of which is sufficient to absorb the ultra-violet rays entirely, sterilization can only be effected if the liquid is exposed in very thin layers. In the case of milk, for example, the thickness of the layer must not exceed 25 mm.

M. Billon-Daguerre keeps the liquid in immediate contact with the quartz tube. He has also constructed an apparatus in which the ultra-violet rays are produced by the electric discharge in a rarefied atmosphere of carbon monoxide, carbon dioxide, sulphureted hydrogen, or sulphurous acid. In this case the lamp is not immersed.

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Experiments are to be undertaken at both the Atlantic and Pacific ends of the Panama Canal to determine the effect, if any, of sea water on the concrete of the lowest locks at Gatun and Miraflores. The tests will determine if it is necessary to place any special protection on the concrete. Slabs of concrete will be allowed to remain in the water for many months. Some of them will be left in their natural state. Some will be treated with sodium silicate in the form of soluble glass, solutions of different strengths being used. Other slabs will be treated with alum and soap; ¾ lb. of soap in 1 gal. of water being applied, boiling hot, for the first wash, the second wash, applied 24 hours later, consisting of a solution of alum, 2 oz. to the gallon, applied cold.

# QUESTIONS AND ANSWERS

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

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

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

1498. **Temperature rise—Telephone bell.** A. B., St. Lucia, British West Indies, asks: (1) What temperature will a given wire attain when conveying an electric current if in addition heat is provided by applying a gas flame? (2) Is not the operation of an ordinary polarized telephone bell identical with that of the primary coil of a transformer, and that if it were not for core losses no current at all would get through? If this is the case, then the operation of the bell ought to be improved by increasing those losses, say by putting a short-circuited winding on the core. Ans.—(1) The problem, though easily stated, is incapable of solution by calculation. The temperature which a heated body attains is determined by the point at which the heat losses by conduction, convection and radiation just equal the rate of supply. As you could not put these three quantities into any workable equation, the problem is as difficult to solve as the one, "How hot will a room get when the steam is turned on?" (2) While only a small current gets through the primary of a transformer when the secondary is open-circuited, that current is sufficient to give the full degree of working magnetism. Though considerable current may flow in both windings, when load is on, the difference between the primary and secondary ampere-turns is always sufficient to produce just this same degree of magnetism. Only small power is needed to maintain this difference, for the angle of lag of this component is practically 90 degrees. The reason for the great lag is found in the closed character of the magnetic circuit. In the case of the polarized bell, there is an air gap in the magnetic circuit, and this factor at once allows more current to pass. A short-circuited winding would not at all increase the difference between the ampere turns of the two windings, but would merely demand more, yet useless, power from the magneto generator. You could probably increase the power of the ringer by using laminated instead of solid cores in the bobbins.

1499. **Static Electric Machine.** M. K., New Lenox, Ill., asks if such a machine can be made to give a steady current, say for stimulating plant growth? He proposes one of the frictional sort, to be driven by a gasoline engine. Ans.—The discharge can be led off from a large number of fine points, and give a practically continuous "brush" discharge. Frictional machines are now certainly out of date, for they give an exceedingly small output in return for the power expended in driving them. You will find an "influence" machine much more practical. Write to the Baker Electric Co., Hartford, Conn., for one of their circulars. You will get an idea of the construction, too, from any modern text-book on physics.

1500. **Locomotive.** C. N., Davenport, N.D., says there is a kind of locomotive that puffs only half as often as the ordinary kind. What is the construction? Ans.—It is a "compound" engine, and when in regular operation the high pressure cylinder exhausts into the low pressure one, and therefore you do not hear it. At starting, both exhaust into the open air, so then you hear the usual number. Still, some locomotives are made with four cylinders, and you will observe no difference in the number of puffs, even when starting.

1501. **Open Core Transformer.** R. M. L., Kenosha, Wis., asks for the dimensions of an open core 110 to 20,000 volt transformer for wireless telegraph operation. Ans.—We have not published an article on this particular subject, but you will find a very complete description of one of the closed core type in the June and July, 1909, numbers of the magazine. Of course this latter sort is adapted for use with alternating currents only. In the case of the open core type, the estimate is not made on the basis of the voltage, for that is largely a matter of guess-work, but the length of spark is taken for measurement of power. If you can tell the length of spark you desire, we could advise you more definitely.

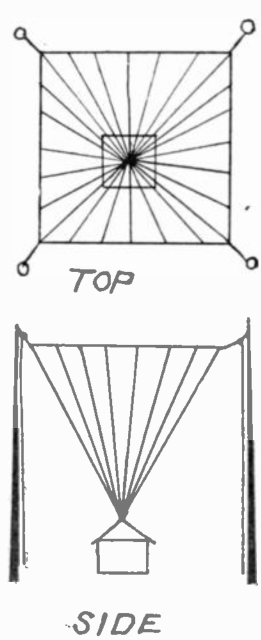
1502. **Paralleling Generators.** J. H. R., Rend, Ill., has charge of a station that is equipped with two compound wound generators, each for 250 volts and 250 k.w., and desires to operate them in parallel, but one machine persists in assuming all the load. (1) What is the reason, and can the desired condition be realized? (2) How close can a No. 16 copper telephone wire be placed to a 250 volt trolley wire, in a mine, without giving trouble? Ans.—(1) The adjustment to allow satisfactory parallel operation is not a haphazard affair, but must be worked out intelligently, the conditions first being carefully obtained by independent tests. Both machines must work on the same part of the "magnetization curve." If one has cast-iron field magnets, the other cast steel or wrought iron, the former will saturate first, and parallel operation may be possible for only particular ranges of load. You must take observations for securing this data, and then by plotting the results, see if both curves have the same bend, but preferably both machines should confine their working range to the first or nearly straight portion of the curve. To get the data, put a low scale ammeter in the shunt field circuit, and then, by gradually turning out the field rheostat, observe the voltage for every desired value of the current, say for every ampere. If you find that one curve is much flatter than the other, you must increase the speed of that generator or reduce the speed of the other until agreement of these curves is obtained. First, however, you should observe if there are the usual low resistance shunts across the terminals of the series coils. These are usually crimped and taped and attached to the connection board. If you increase the length of this strip on the "flat" machine, and shorten it on the other you may be able to make the adjustment without altering the engine speeds. Even when you have succeeded in this particular, parallel operation will not be secured unless you have a large and short equalizing connection between the inner ends of the series coils. It is not now customary to run this connection to the switchboard. A helpful article on the conjoint operation of generators appeared in the June, 1907, magazine. (2) In a mine, the distances are everywhere too small to prevent interference, and your best plan will be to run a complete metallic circuit for the telephone, letting these two wires be as close together as possible, even twisted together.

1503. **Alternating *vs.* Direct Current Dynamos.** L. O. B., Independence, Ia., asks: (1) How many more lights to the ampere will an alternating current machine light than a direct current machine? (2) Give a rule for calculating the size of a wire to use for so many lights on a direct current dynamo wiring system. (3) In an electric railroad locomotive, what is the advantage of electricity? Why not run the machine with the power direct to the drivers that runs the dynamo? Ans.—(1) A direct current generator of a given capacity will supply the same number of lights as an alternator of the same output. (2) We refer you to the wiring tables to be found in every electric wiring handbook. A simple rule is to take the sum of the amperes required by the total number of lamps on a circuit, refer to a table of safe carrying capacity of wires, and use a wire sufficiently large to carry the current. Other considerations, such as voltage-drop, etc., are taken up in the handbook. (3) The advantages of electric-drive are so well known and numerous that they need not be given in this column.

1504. **Small Dynamo Heating.** A. J. M., Westfield, N.Y., says: I have tried to run an E. I. Co. 1 in. coil on a K. & D. No. 9 generator. The coil sparks all right, but the generator heats up. (1) Does the abrupt making and breaking of the circuit cause this? (2) Would a lamp in parallel remedy the trouble? (3) If not, what instrument in the circuit would? Ans.—(1), (2), (3) You are probably overloading the little dynamo. Place some resistance in series with dynamo and coil. This will reduce spark-length and thickness somewhat, but should stop the heating. Do not be afraid of slight heating; this is almost bound to show in such a small machine. If you can bear your finger tips on the winding you need not be alarmed.

1505. **Glue for Paper and Metal.** R. G. H., Chicago, Ill. A glue which will keep well and adhere tightly is obtained by diluting 1,000 parts, by weight, of potato starch in 1,200 parts, by weight, of water, and adding 50 parts by weight, of pure nitric acid. The mixture is kept in a hot place for 48 hours, taking care to stir frequently. It is afterwards boiled to a thick and transparent consistency, diluted with water if there is occasion, and then there are added in the form of a screened powder, 2 parts of sal ammoniac and 1 part of sulphur flowers. **For Pasting Wood and Cardboard on Metal:** In a little water dissolve 50 parts of lead acetate and 5 parts of alum. In another receptacle dissolve 75 parts of gum-arabic in 2,000 parts of water. Into this gum-arabic solution pour 500 parts of flour, stirring constantly, and heat gradually to the boiling point. Mingle the solution first prepared with the second solution. It should be kept in mind that owing to the lead acetate this preparation is poisonous.

1506. **Improvement of Antenna.** H. M., Blandinsville, Ill., asks: (1) I have an aerial consisting of 4 copper wires each 50 ft. long and 45 ft. above the ground. The wires are 10 in. apart and suspended between trees *a* and *b*, as per sketch sent. My receiving



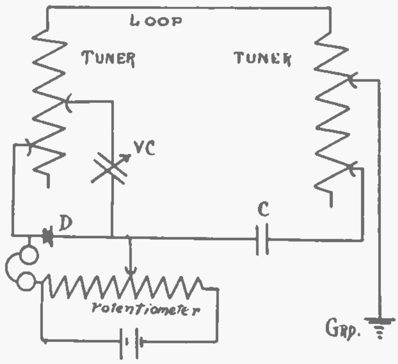
instruments being at the base of tree *b*, as shown at *r*. There are two other trees *c* and *d*, each 50 ft. apart and 50 ft. from aerial. Now could I improve my receiving radius by making use of the other trees? If so, what would be the best way to extend the wires making use of all four trees to get best results for *receiving only*. (2) What types aerial (generally speaking) is considered the most efficient for receiving when the height is limited to 50 ft. (3) Does increasing the capacity of an aerial, the height and length remaining the same, increase the receiving range? If so, in what proportion? Ans.—(1) I would suggest that you make your antenna according to the above diagram. Your instruments, to prevent any directional effect, should be directly beneath the centre of the square if possible. If it is not possible to move your instruments to the centre of the square, I would suggest that you run an aerial such as you have now, to each of the three furthest trees. (2) A T-aerial is the best, next to the one described in question No. 1. (3) Yes, within certain limits. The proportion has not been determined.

1507. **Resistance of Copper Wire.** N.L.R., Gravity, Pa. (2) What is the size of wire sent, and how many feet of same would it take to make a resistance of 1 ohm? (3) How many feet of No. 23 copper wire would it take to make a resistance of 20 ohms? Through an error in proof reading in the November issue, the decimal points were omitted in the figures given in answer to question 1489. The answer should be (2) No. 35. About 3.045 feet. (3) About 984.20 feet.

1508. **Aerial Connections.** H. L., New Haven, Conn. (1) I have an aerial 67 ft. high, four strands 105 ft. long, and I would like to know whether it is best to use Fig. 1, using the wire connected in multiple, or Fig. 2 with the wire connected in series to get the best results. (2) What is the wave length of the above aerial? Ans.—(1) If you cannot tap your aerial from the centre, extend a wire down from each wire at one end, joining the four together in a V shape. (2) Your wave length is about 129 meters.

1509. **Rating of Tuning Coil.** J. D. J., Jacksonville, Fla., asks: (1) Will galvanized iron wire give as good results as copper? (2) What will be the capacity in meters of a "loose couple" coil, whose dimensions are as follows: primary, 4½ in. long and 3 in. in diameter, wound with No. 28 silk C. copper? Will I be able to get good results with it? (3) Please give diagram for connecting the following instruments: silicon detector, 2 variable condensers, 1 fixed condenser and double slide tuning coil; one pair 1,000 ohm phones. Ans.—(1) Copper wire is better than galvanized iron wire. (2) A tuning coil is rated by its inductance in centimeters or henries. See article in December, 1908, issue on the calculation of wave lengths by W. C. Getz. Your diameters are a little small, but you should get good results. (3) Below is a diagram for your instruments. If needed, you may put your other condenser parallel with the variable condenser.

1510. **Transformer.** I. R. G., Fitchburg, Mass. (1) I have two secondaries, one a "half inch," and the other a "one inch," or about that; also one of E. I. Co. transformer coils. How may I go to work and fix the secondary on same? Must I have all equal amount of wire on each one? (2) In a loop aerial must both tuning coils be the same wave length or capacity? Please give good diagram for my instruments. Two coils, one small, one large; both two slide fixed condenser, variable condenser; detector (eight in one) with potentiometer, battery, 1,000 ohm head phones, sending helix, two clip, brass wound from 70 ft. No. 10, glass plate condenser, spark gap, coil, key, condenser around key, Gernsback interrupter, 110 volts a.c., 60 cycle. Ans.—(1) The three secondaries are probably wound with No. 34 bare wire; therefore could only be used as described in article you mention. You might put two "½ in." secondaries on one leg and the "1 in." secondary on the other leg, of the transformer, providing all of the wire is of the same size. The wire in the secondary of the transformer coil is probably No. 30 enamelled, therefore could not be used in connection with the No. 34 wire. You could use it in the construction of another transformer of the closed core type, if you prefer that to the open core. (2) The two tuning coils need not be of the same capacity. Below is a diagram for your instruments.




1511. **Spark Length.** A. C., Chicago, Ill, I have a spark coil made up as follows: core 8 in. by 1 in. in diameter, 2 layers No. 14 wire. ⅛ insulation over primary; secondary made of 22 sections 3½ in. in diameter, with No. 40 wire. (1) How much of a spark can I get out of it, and what kind of condenser should I use? (2) What sizes are the wires I am sending in order, silk enamelled? Ans.—(1) As you do not state the thickness of sections, we cannot tell how much wire you will have in your secondary; therefore, the spark length cannot be calculated. An approximate rule is to figure on one pound of No. 36 wire for every inch of spark; if you use No. 40, you should get rather more than 1 in. spark to the pound of wire. Make condenser of 70 sheets of tinfoil, 6 x 8 in. Two sheets of thin paraffin paper between each tinfoil sheet. (2) Silk, Nos. 29, 30, 31, 36 B. & S. gauge; enamel, Nos. 24 and 25 B. & S. gauge.

## TRADE NOTES

E. S. Ritchie & Sons' latest catalogue of Wireless Transformers deals quite fully with the theoretical explanation of the Loose-Coupled Resonance Transformer which they manufacture exclusively. By a unique arrangement of circuits, a clear and smooth musical note is attained and, furthermore, the Power Factor is practically 90 per cent, so that the amount of current passed through the transmitting key is about one-half that used in the ordinary wireless circuit for a given amount of power delivered to the oscillating circuit.

We are in receipt of an attractive booklet from the B. F. Sturtevant Co., of Hyde Park, Mass., which gives, in a most entertaining manner, a brief biography of the founding and subsequent development of this company. The booklet is entitled "Personality in Business,"—a fitting name for the biography of Mr. B. F. Sturtevant, whose striking personality and perseverance laid the foundation of and started on the road to success the business which today occupies a floor space of twelve acres and gives employment to fifteen hundred men.

Up to the present time the company has conducted its business on a capitalization of half a million dollars; but as this business runs to from three to four million dollars a year, and occupies a plant that alone represents one and one-half million dollars, an ampler organization is now required. Hence, the announcement is made of an increase of capital to $2,500,000, which means a corresponding increase in the field of service.

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The Crescent Tool Co., Jamestown, N.Y., have sent us a catalog of adjustable wrenches and combination pliers, in which many new and novel improvements are embodied. This company will be pleased to send a copy of their catalog to those who are interested.

## BOOK REVIEWS

*Wireless Telegraph Construction for Amateurs.* By Alfred Powell Morgan. 147 illustrations. New York, D. Van Nostrand Co., 1910. Price, $1.50 net.

This book is designed to be a manual of practical information for those who desire to build a set of experimental wireless instruments, which can be considered as something more than toys, but are still considerably less expensive than a high grade commercial set. The style of the book is simple and readable, and it can be recommended as thoroughly practical throughout. The book pays no attention to the history of the art, and is not padded with unimportant detail. Instead it has been esteemed desirable to give, besides structural details, short explanations of the function of the various instruments.

*The Boys' Book of Model Aeroplanes.* How to Build and Fly Them: With the Story of the Evolution of the Flying Machine. By Francis A. Collins. Illustrated with many photographs and diagrams by the author. New York, The Century Co., 1910. Price, $1.25 net.

The literature of flying is rapidly taking on respectable proportions, yet among the various departments, that of building model machines appears to have been somewhat neglected. As much valuable knowledge of the principle of flying can be obtained from the operation of these models, it is a subject worthy of full consideration. In this book we have the best treatment of the subject which has yet come to our knowledge, and we can cordially commend it, not only to the younger readers, for whom it is primarily intended, but to everyone interested in the art of flying. While the instruction is so simple as to be within the comprehension of every intelligent boy, it is thorough enough to be valuable to the scientific investigator. The illustrations clearly show the good and bad features of various models, and the working directions are most thorough and complete.

*The Tesla High Frequency Coil.* Its Construction and Uses. By George F. Haller and Elmer Tiling Cunningham. 56 illustrations. New York, D. Van Nostrand Co., 1910. Price, $1.25 net.

Since the spread of experimentation in wireless telegraphy, there has been considerable demand for information on the construction of Tesla coils, and it has been rather difficult for the reader to obtain practical information on the subject. This book, therefore, fills a vacancy in scientific literature, and does so in a most thorough fashion. The book is naturally intended for the advanced experimenter, and does not give space to the elementary details of electrical construction. It goes straight to the point and gives full and explicit directions for the construction of a good sized coil, and the other pieces of apparatus needed for experimenting with alternating currents of high potention and high frequency. The builder who makes the 12 in. coil described in this book will have a most valuable piece of apparatus.

*Electricity Experimentally and Practically Applied.* A book for the beginner and for the practical man. Principles, experiments, practical applications and problems. By Sidney Whitmore Ashe, B.S., E.E. New York, D. Van Nostrand Co., 1910. Price, $2.00 net.

The number of books on electrical engineering already in existence is not inconsiderable, but one which treats the subject thoroughly from an experimental point of view does not fall within our knowledge. The author of this book has taught the subject experimentally for many years, and has been able to present the subject to his students without the use of much mathematics. Applying his experience he has written a book in simple language, well adapted both for those engaged in actual electrical work, and for students in high school and college courses.

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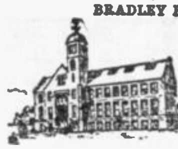

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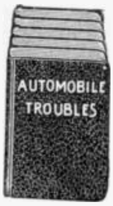


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