CONSTRUCTION OF RADIO RECEIVING APPARATUS

By The Laboratory Staff

Editor's Note: The apparatus described in this article has been constructed and tested in the *Everyday Mechanics Experiment Station*. The models may be seen at the Publication Offices of the magazine.

IN presenting the two designs embodied in this article, we do not wish to pose as originators of new types of apparatus, and neither do we wish to give the impression that the apparatus we have constructed is superior to anything on the market. The loading inductance presents no startling improvements in design or construction and the receiving transformer is just a good, substantial piece of apparatus that an advanced amateur need not be ashamed to construct and operate.

What we have endeavored to do, however, is this: We have tried to eliminate the defects, principally mechanical, that seem inherent in amateur apparatus; we have attempted to produce a design pleasing to the eye, convenient and smooth in operation, simple and inexpensive in construction, and of correct proportions and specifications from the radio standpoint.

The old "loose coupler" type of receiving transformer has long been a favorite for the very simple reason that it gives such universal satisfaction. The writer well remembers the experience of one of the best known manufacturers of amateur apparatus of the better grade. For years this concern had manufactured and sold great quantities of a certain number—a comparatively simple receiving transformer with sliding contacts and telescoping primary and secondary. True, the workmanship was excellent—as it was on every number turned out by the company—but there was nothing startling about that "loose coupler" to give it such a reign of popularity. However, when the manufacturer tried to substitute a perfect wonder of a tuner, with variometer coupling and a myriad of instrument-switch contacts, offering the new and improved device at the same figure as that asked for the plebeian coupler, the trade appeared to receive the newcomer with indifference and doubt. After several years of pushing and advertising, the little tuner had to be discontinued, relinquishing the field to a revival of the old-fashioned coupler. It is an actual fact that the demand for the old favorite was greater, probably just because of its simple goodness, than that for the improved instrument which was really a much better buy, value considered, than its successful predecessor.

Perhaps the reader will wonder at this digression. It is given merely to justify the publication of the design of a type that has been described many, many times in contemporary magazines. If our readers could but see our models, turn their contact knobs, and listen in to the gratifying results obtained, this justification would be unnecessary. Whatever adverse criticism this article may bring forth, the fact remains that there are probably more of these simple receiving transformers in use, and in *successful* use, too, than there are of any or all other types.

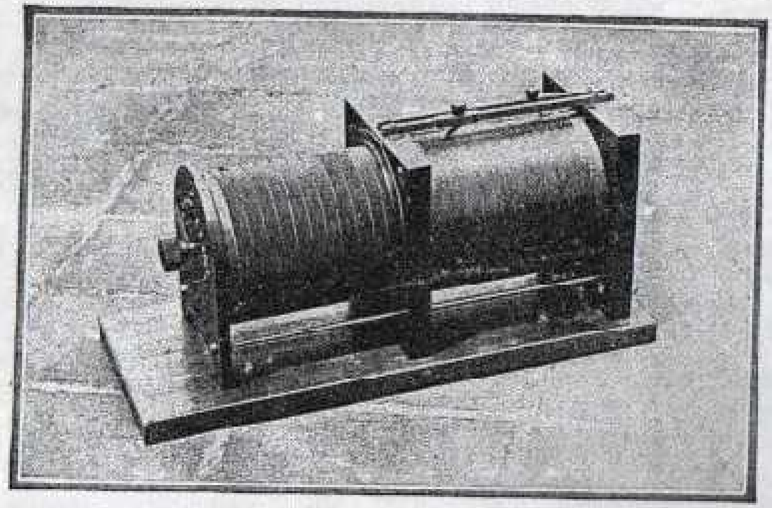


Fig. 1. Receiving transformer completed

THE RECEIVING TRANSFORMER

This transformer has instrument switch adjustment for secondary inductance and sliding contact adjustment for the primary. The construction is such that no metal (supporting rods) is used inside either primary or secondary windings. While the deleterious effect of metal in such cases is perhaps open to question, we have avoided its use as unnecessary in our design.

The transformer responds to wave-lengths as high as 2,500 meters without the loading inductance. This is believed to be the "happy medium" which reduces objectionable "dead ends" to a minimum and still affords a wave-

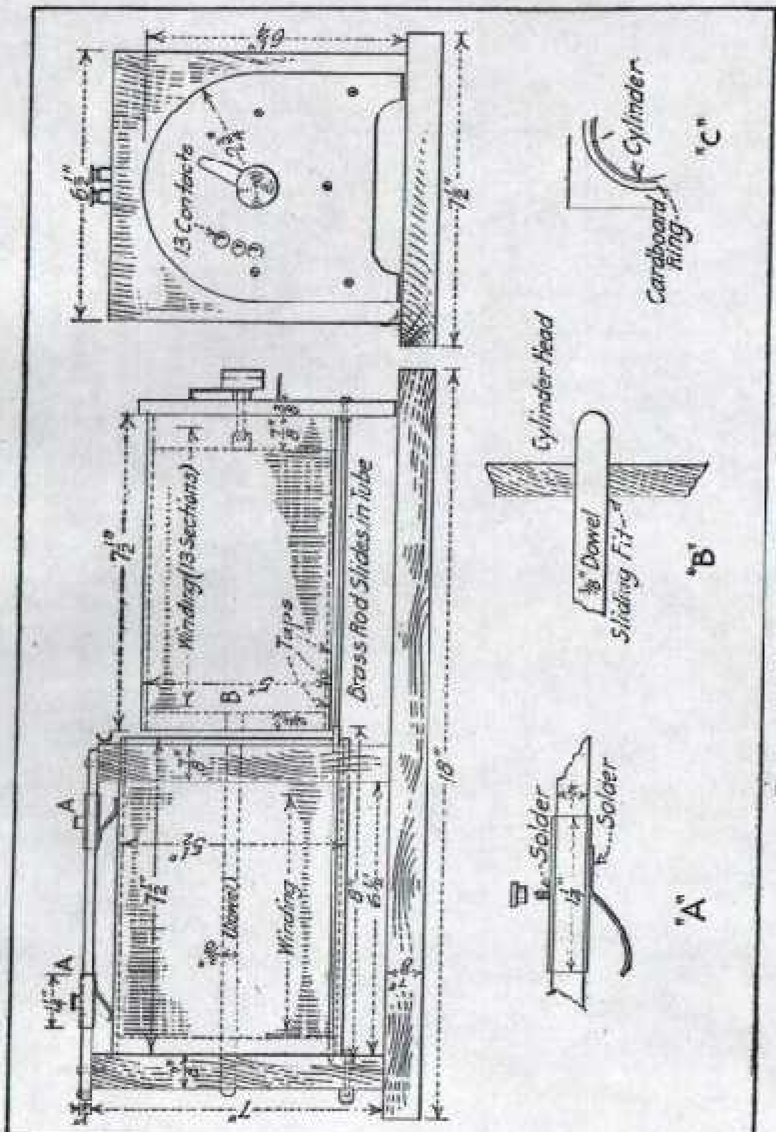


Fig. 3. Detail for construction of transformer

length of great utility. The figure quoted is based upon the use of the instrument with the average antenna of the advanced amateur.

The construction involves some careful but not necessarily difficult wood-working. A lathe is not at all necessary, although it is, as always, desirable. If a jig saw is available, most of the turning can be avoided. The only real, good excuse for a lathe is in turning the wooden heads that fit into the cardboard cylinders, and also in winding the cylinders. substitute for the lathe in both turning and winding operations is an ordinary polishing head that can be purchased for a couple of dollars. The discs may be mounted on the taper thread and a very presentable job of turning done with the broken end of a flat file held on a simple rest.

The jig saw, however, is an essential. If one of the foot-power variety is not available, the hand fret saw frame will answer, although in our experience there is no comparison between the two.

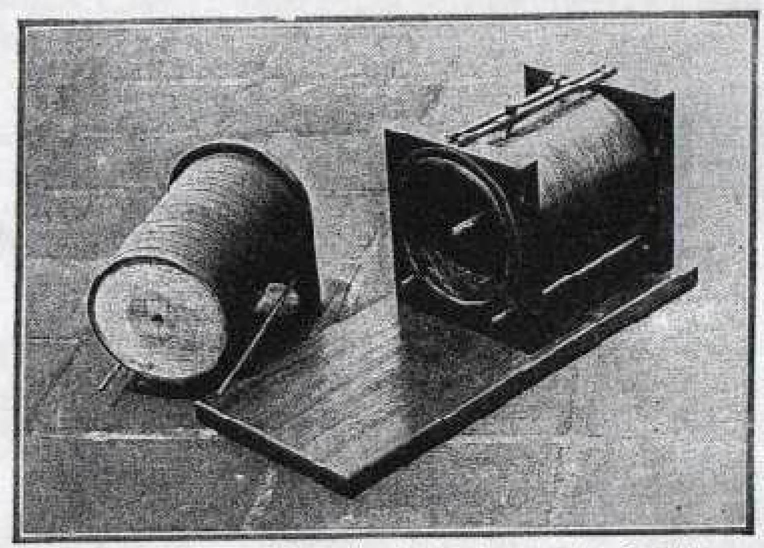


Fig. 2. Receiving transformer showing dowel arrangement for sliding

The latter operation may readily be done, however, by mounting the cylinders between centers on a base board. Another effective

The woodwork had best be done first of all. Figs. 1, 2 and 3 will give a good idea of the appearance and construction of the in-

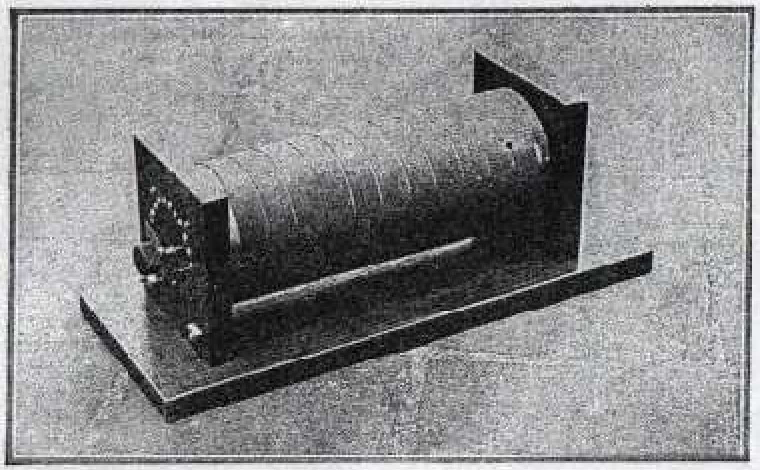


Fig. 4. Loading coil completed

cates, the secondary support is gripped between nuts and washers on the threaded ends of the rods.

We are now ready for the winding. The primary is wound directly upon a cardboard cylinder 5¼ in. diameter and 7¼ in. long. The winding is No. 24 bare copper wire. The winding is done with two wires wound in parallel and then, after the ends are carefully secured by pushing through holes in the cylinder, and plugging with wooden pegs, one wire may be unwound. This will leave a firm, neat winding of bare copper wire with each turn separated from its neighbor by the thickness of the wire. The winding should be made about 5½ in. long, leaving ½ in. of space at either end of the cylinder when the latter is mounted in the wooden supports. After the winding is finished, it should be given two generous coats of shellac, taking care to see that the fluid runs down between turns in order that they may be sealed to the surface of the cylinder. The contact path for each slider is to be scraped in the winding after the shellac is quite hard and dry. This operation, however, need not be attempted until the cylinder is mounted and the sliders are in place on their rods.

The secondary winding consists of a single layer of No. 28 S. S. C. magnet wire wound in 13 sections upon a cardboard cylinder 5 in. diameter and 7½ in. long. The winding amounts to a single layer

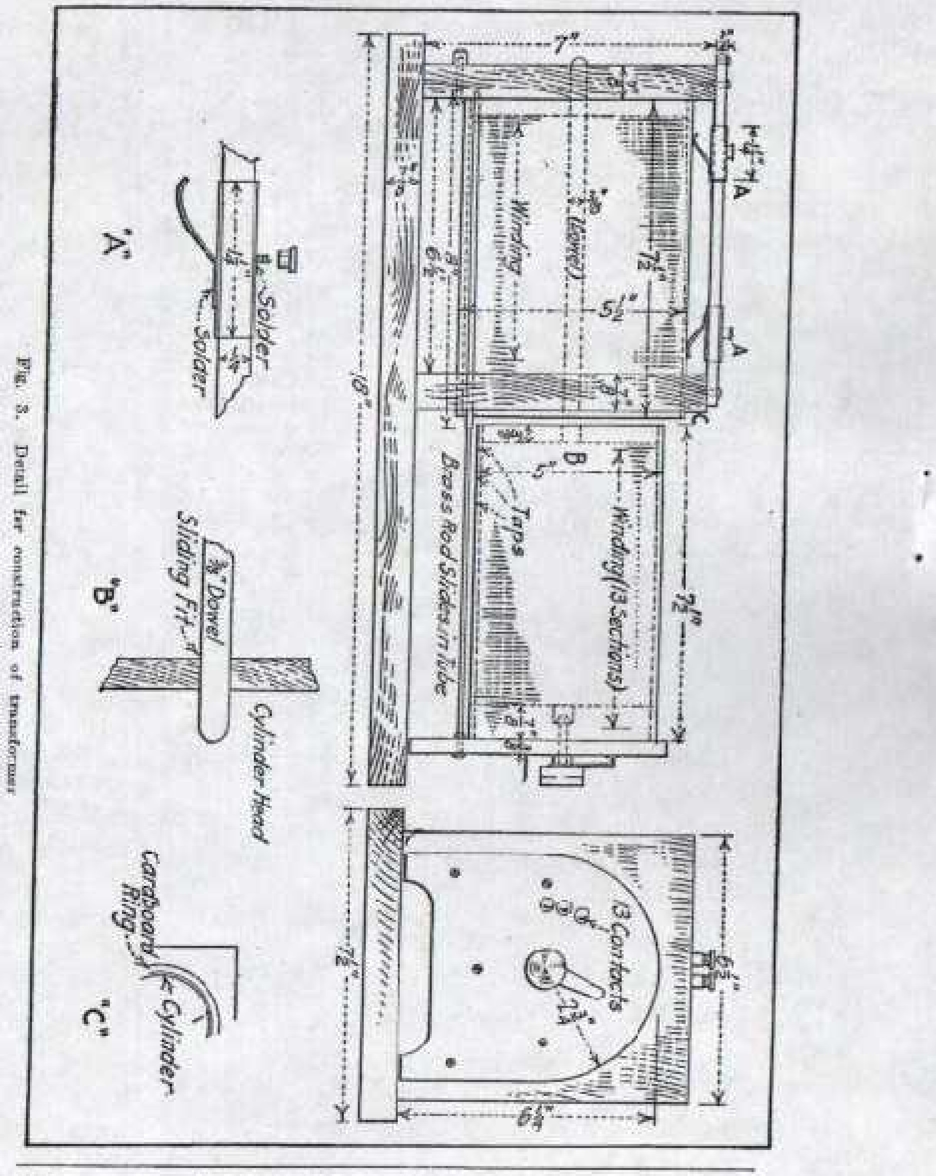


Fig. 3. Detail for construction of transformer

which is wound in the following manner: The winding is started from one end and continued for ½ in., at which point the hand guiding the wire is jumped to a distance which leaves a space of about 1-16 in. between the finished turn of the section just wound and the beginning of the next section. At the point where the "jump" is made, a pin-hole is punched into the cardboard cylinder. Through this hole the tap which leads to the contact point will be made. This process is to be continued until 13 sections have been wound, at which point about 6½ in. of the surface of the cylinder will have been covered with the wire. Care must be taken to see that the holes through which the taps are taken are in a line, which will, of course, be at the bottom of the cylinder when it is mounted on the secondary support.

There are a number of ways of securing the silk-covered wire to the cardboard cylinder, but the best method in our experience is first to coat the cylinder with two or three applications of shellac, allowing the varnish to become "tacky" before placing the winding. This method will firmly secure each turn to the cylinder, and at the same time will obviate the necessity for shellacing the silk after the winding is complete.

The taps are made with lengths of slightly heavier bare copper wire pushed through the holes in the cylinder and soldered with a very fine copper, one to each of the "cross over" wires between sections. These taps should be long enough to extend through the ⅞ in. head to make contact with the points upon which the instrument switch bears. Each tap is to be covered with a sleeve of fine rubber tubing to prevent possible short circuits inside the cylinder.

The next operation, before going further with the taps, is to insert the secondary inside the primary after having wound heavy wrapping paper around the primary until it fits closely into the larger tubing. The secondary support with its brass rods firmly secured to it is then to be brought up to the wooden head of the secondary and holes drilled for the wood screws that secure the secondary to the support. The shrewd reader will at once see that this insures accuracy in assembling the component parts of the transformer and precludes the possibility of uneven space between primary and secondary cylinders. When the screws have been driven home, the secondary may be withdrawn and from this point on the secondary and its supporting piece should not be separated.

The next operation will be to lay out the arc of the circle for the contact points, of which there are 13. The radius of the arc on

strument. The details and dimensions are given in Fig. 3. The choice of wood rests with the individual, but we favor whitewood. The base, 7½ in. wide and 18 in. long, is of ⅞ in. stock and quite simple. The upright pieces that support the primary are each 6½ in. wide and 7 in. high, while the thickness may be ⅞ in. The piece to the right in Fig. 3 is cut out to receive the cardboard cylinder which is 5½ in. outside diameter. The left-hand piece is left solid and it has mounted upon it a disc of ⅜ in. whitewood turned to fit the inside of the cylinder. The latter should not be permanently secured in its supports until after the holes for the brass tubes indicated in the drawing have been drilled. This operation will be detailed later.

The next step will be to get out the two discs for the secondary cylinder. One of these is of ⅝ in. stock, while the other is of ⅞ in. wood. They are, of course, to fit the inside of the cylinder tightly. The latter, as the drawing indicates, is 5 in. in outside diameter. The internal diameters of both cylinders will vary a trifle with different makes of cardboard tubing, but it is of little consequence. The thicker disc may be permanently affixed by means of glue and wooden pegs, but the thinner disc must be left removable until after the winding is finished and connections to the contact points are made.

The front support that holds the secondary may now be worked out with the jig saw, and with this the woodwork proper is finished. This is the time to do the staining and varnishing. If these decorative operations are left until later, the results will be rather unsatisfactory and the task difficult to perform. After the varnish is good and hard, so that handling will not injure the finish, the worker may lay out the centers for drilling the two holes through which pass the supporting brass rods. These holes are 4⅜ in. apart on centers and 1¼ in. up from the base. When the centers have been marked and pricked, the front support may be placed on two pieces which hold the primary, and holes drilled through all three while they are clamped together. This will insure alignment of the holes, which is quite essential to prevent binding when the rods are telescoped into the tubes. The holes in the secondary support may be ¼ in., the same as those in the other pieces, for a trifle of leeway is not objectionable to permit of easing up on any bind that may develop when the apparatus is assembled.

The brass tubing and the rods that enter it may then be placed, and the whole arrangement assembled temporarily to determine whether the work has been successful. As the drawing indi

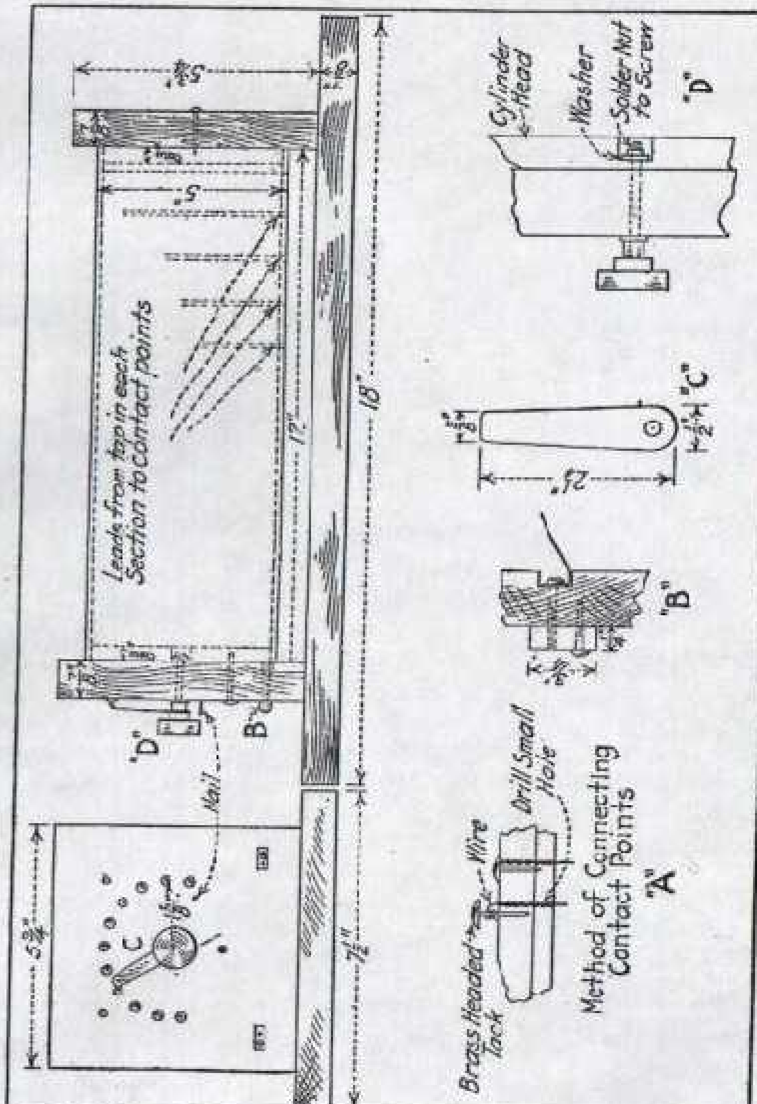


Fig. 5. Detail for construction of loading coil

shape, and soldered to the bottom of the slider.

Binding posts are not specified, for connection may be made directly to machine screws in the ends of the slider rods in the case of the primary, and to small connection blocks electrically connected with the brass tubes that pass through the primary supports, for the secondary.

Loading Inductance

The loading inductance consists of a cardboard cylinder wound in a single layer with No. 24 S. S. C. copper magnet wire in 11 sections. Each section is tapped to a contact point in one of the heads as shown in the illustration. As the construction is identical with that of the receiving transformer just described, in so far as mounting the cardboard cylinder, etc., is concerned, we will not go into a lengthy explanation of the construction. All details are given very clearly in Fig. 5, and Fig. 4 shows well the appearance of the finished instrument.

A few hints relative to the standard products used in the construction of both of these coils may not be amiss. The instrument switch used on each coil is a standard product that may be bought in almost any large supply house. The builder is, however, advised to discard the usual brass contact piece and substitute for it a piece of phosphor bronze sheeting cut to the dimensions shown at *C*, Fig 5, and bent over at the tip so that the contact is made on the edge rather than on the flat surface.

The contact points may be ordinary brass-capped upholstery tacks or they may be oval-head copper rivets. The latter are much to be preferred, but they are more expensive and more difficult to install. If the rivets are used, however, the hole through which the tap wire passes may be made approximately the same size as the shank of the rivet in order that the latter may make contact as the stud is driven home.

If the upholstery tacks are used, the method of connecting shown at *A* should be employed. This insures contact between the wire and the brass head rather than with the steel shank of the tack.

The simple form of connection block that we favor is shown at *B*. This is merely a short length of ¼ in. square brass rod secured to the instrument at the desired point. Connection is made under the heads of brass machine screws in an obvious manner.

The cardboard cylinders for both receiving transformer and loading coil may be obtained from advertisers in this magazine, and the woodwork is best obtained from a local mill which will cut out the pieces to size at a very reasonable figure.

At *D* is shown the method we employ to secure the adjusting knob which carries the switch making contact with the studs. In the standard product a threaded shank is permanently fastened to the composition knob. The obvious way of securing this switch to the instrument would be merely to place a lock-nut over the first nut that goes on the shank. This method, however, is unreliable and unsatisfactory. Constant use will frequently loosen the nuts after the instrument is entirely assembled, and needless annoyance results therefrom. We used the simple expedient of locking the first nut with a drop of solder after we had secured just the tension we desired to make the knob turn with freedom but without unpleasant looseness.

The *Technical Adviser* is at the disposal of readers who require additional advice or instructions, and the *Service Department* will aid those who have difficulty in obtaining needed materials.

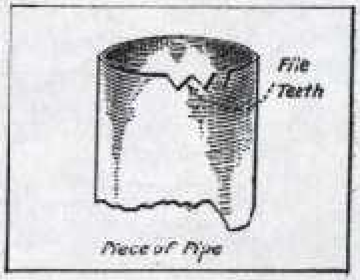
Paint For One Cent Per Pound

To one gallon of hot, soft water add four pounds of crude sulphate of zinc. Let it stand until it dissolves perfectly, and a sediment will settle at the bottom. Turn the clear solution into another vessel. To one gallon of paint (lead and oil) mix one gallon of the compound. Stir into the paint slowly for 10 or 15 minutes and the paint and compound will combine perfectly. If too thick thin the mixture with turpentine.

Contributed by J. C. Gilliland.

Boring a Hole in Brick

Any man who wishes to bore a hole in brick and has not a cold chisel on hand will find this home-made chisel very handy. All that it consists of is a piece of galvanized iron pipe about 7 in. long and the diameter de-



File teeth in one end of the pipe

pends upon the hole you want to bore. In one end of this pipe, teeth must be filed about 1-16 in. apart. You will find that this will bore a clean-cut hole.

Contributed by Fred W. Allen.

If the family is large and the kitchen sink small, try using an oval tin foot tub instead of the round dish pan.—Mary F. Scott.