

Adjustable GROWLER

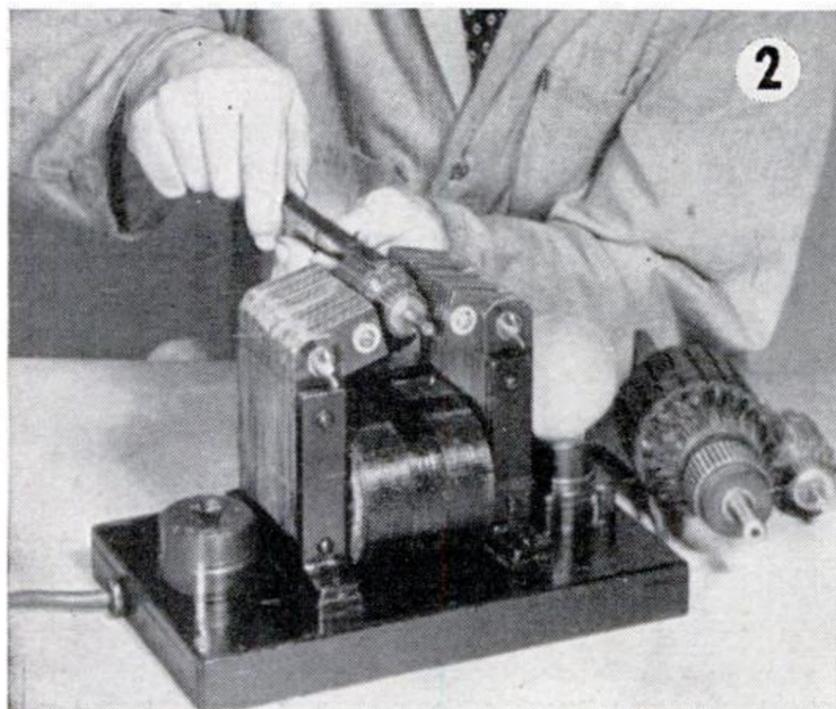
*Tests Large and
Small Armatures*

By HAROLD P. STRAND

FOR testing the armatures of vacuum-cleaner, electric-drill, or other commutator-type motors, "universal" fans and motor-driven kitchen appliances, and automobile starters and generators, what is called a "growler" is generally used. With this device it takes very little time to find a short-circuited coil, a "short" between coils, and other defects that are not visible to the eye but may cause sluggish operation or possibly complete failure of the motor.

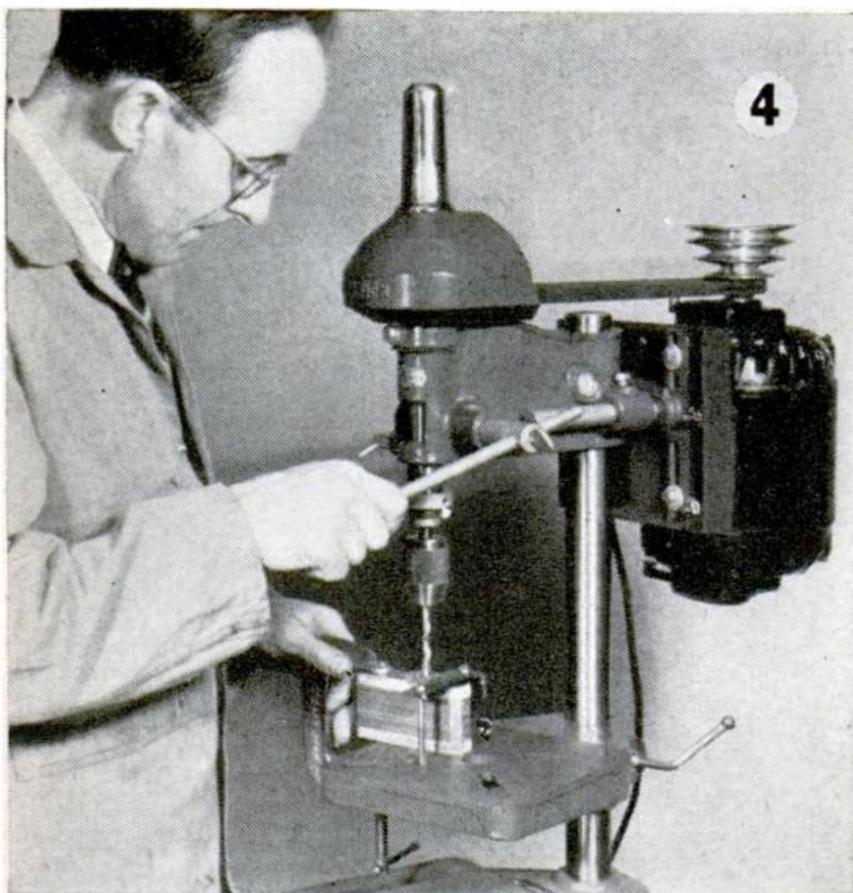
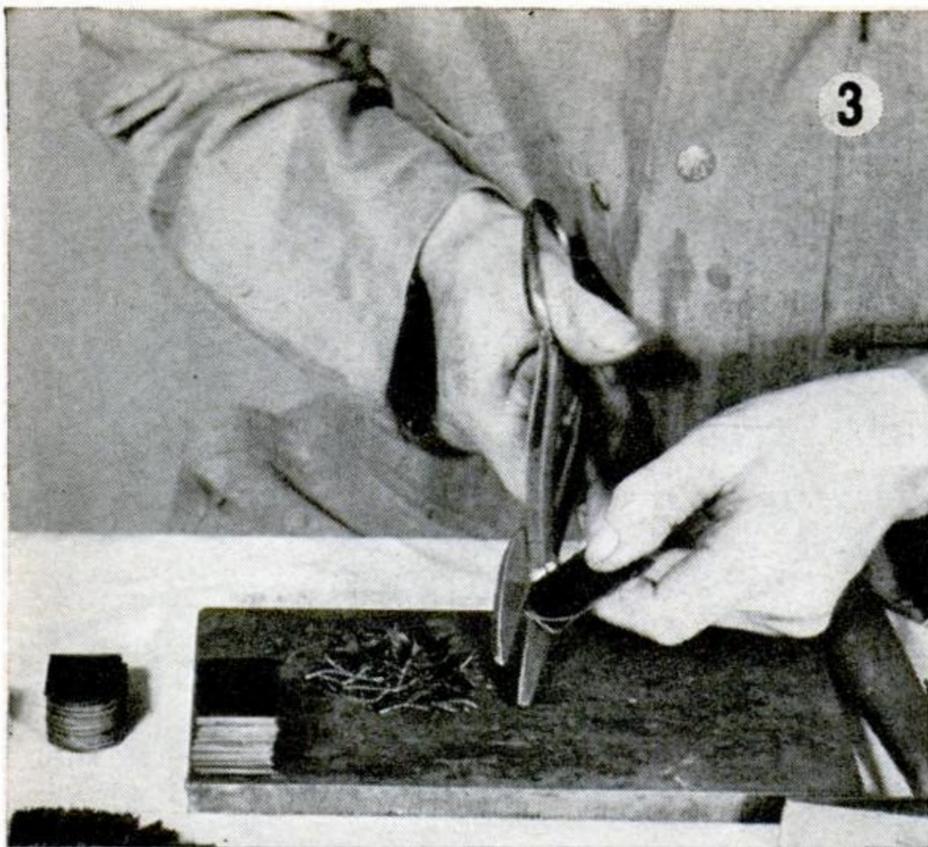
Any armature having commutator bars or segments separated by insulating strips, whether from a direct- or alternating-current motor, can be tested on a growler. It is necessary, of course, to remove the armature and place it on the growler, which, in principle, works much like an ordinary transformer.

The laminated core of the device is open



at the top, forming two poles. A 110-volt A.C. source is connected to the growler winding, and the armature to be checked is placed between the poles so that its iron core closes the magnetic circuit. Now the armature coils act as a secondary winding. A current is induced in them, but cannot flow unless a short circuit exists. If this is the case, an old hack-saw blade or other thin piece of steel will be attracted to the armature core where the defect occurs. If the armature is electrically in good condition, the blade will not be attracted. Fuller directions for the use of the growler will be given later on.

Besides being of the most efficient design, the shopmade growler illustrated has the great advantage of being adjustable. It will accommodate armatures from about $1\frac{1}{4}$ " to 5" in diameter (see Fig. 1 and Fig. 2). This is possible because the ends of the laminated poles are hinged in such a way that they can be moved to vary the gap between them. Because of its wide range, the growler should be found very useful in the electrical repair shop. Even the home mechanic who does not intend to rewind armatures himself will find it convenient for diagnosing motor troubles quickly. Its usefulness in the com-

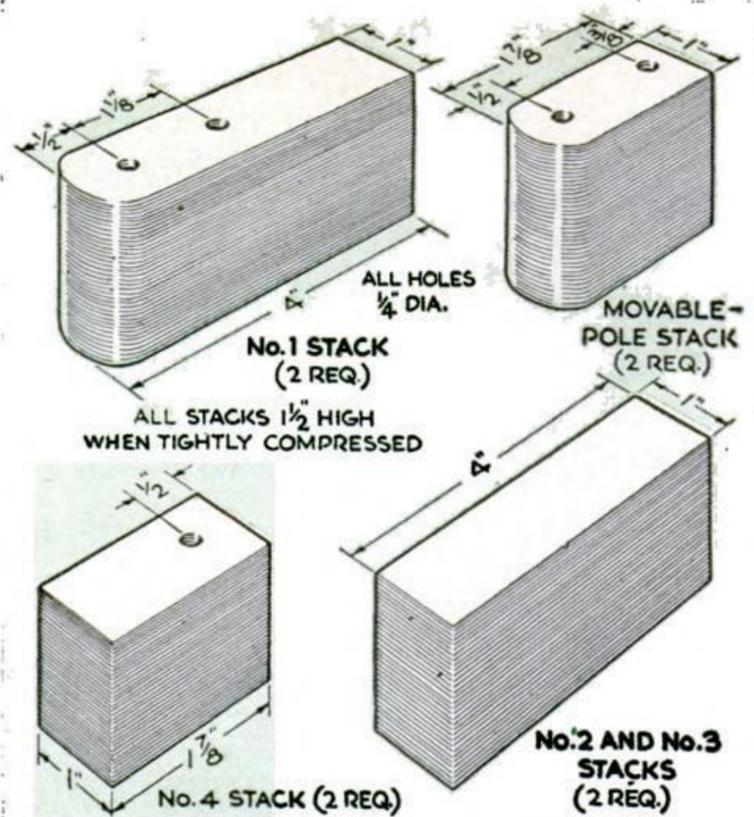


mercial garage is, of course, quite obvious.

To make the core, have a tinsmith cut some 28-gauge black stovepipe iron into strips 1" wide with his foot-power shears. Machine cutting is necessary to insure straight and square edges. About 11 lb. of metal will be required. The strips should then be cut by machine into pieces of the size shown in the drawings. Four stacks of 4" pieces and four stacks of 1 $\frac{7}{8}$ " pieces are required, each stack being 1 $\frac{1}{2}$ " high when compressed tightly.

Using hand shears, round one end of each piece in two of the short and two of the long piles. One carefully shaped piece may be employed as a template for cutting the others (Fig. 3).

The holes must be accurately located and carefully drilled, as any inaccuracy here will cause difficulty in assembling the core.

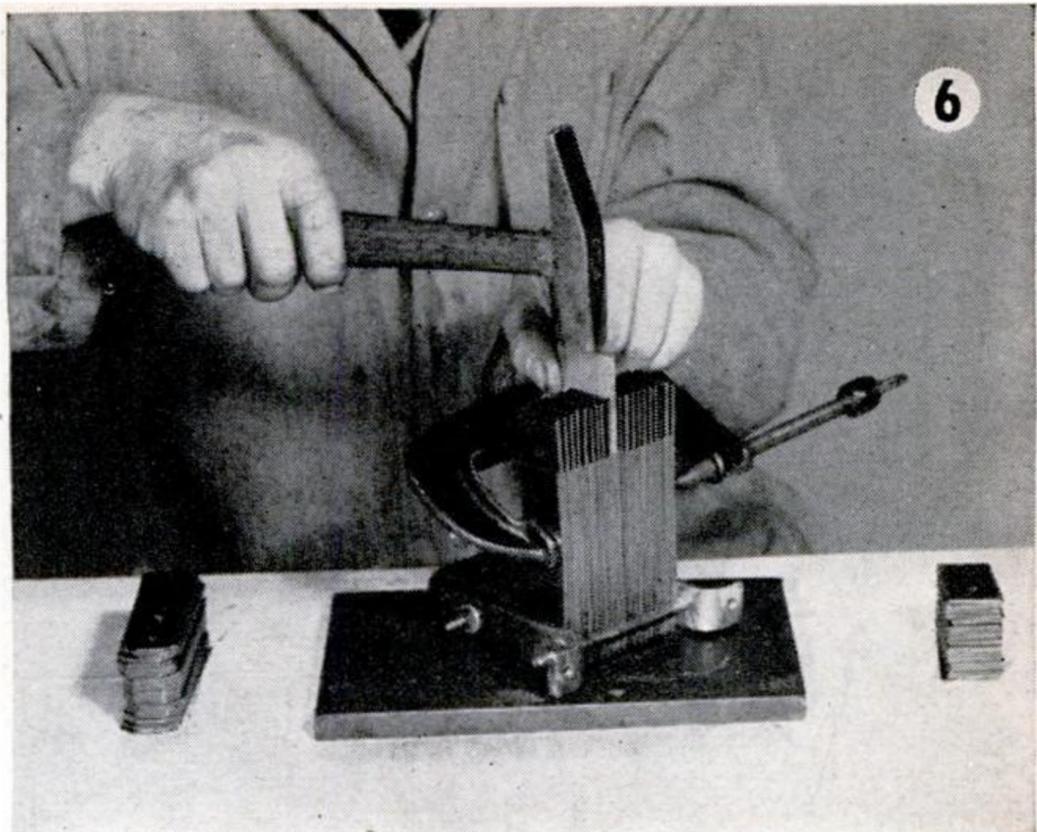
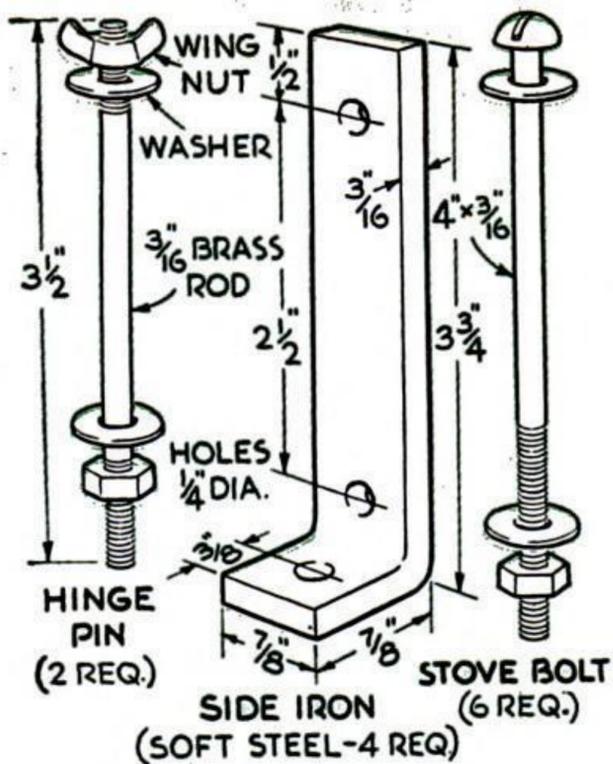


Each stack may be clamped between two pieces of $\frac{3}{8}$ " thick hardwood, cut to the same size as the laminations. Tap the metal pieces to align their edges and secure them to the drill-press table. One of the side irons, two of the 4" stove bolts, and a C-clamp may be used for this, as shown in Fig. 4.

Check the stack carefully to see that it is precisely square with the table. Use a new drill, preferably one made of high-speed steel, at the lowest speed possible. Avoid forcing it, which may tear the sheet iron.

LIST OF MATERIALS

- About 11 lb. of 28-gauge black stovepipe iron
- 3 $\frac{1}{2}$ lb. of No. 15 S. C. E. (single cotton, enamel) magnet wire
- 4 pc. 4 $\frac{3}{4}$ " by $\frac{7}{8}$ " by $\frac{3}{16}$ " soft steel or iron
- 6-4" by $\frac{3}{16}$ " roundhead stove bolts
- 2 pc. 3 $\frac{1}{2}$ by $\frac{3}{16}$ " brass rod
- About 90 iron washers, $\frac{3}{16}$ "
- 4-1" by $\frac{3}{16}$ " roundhead stove bolts
- 1 surface lamp receptacle
- 1 surface-type toggle switch
- 2 composition bushings, $\frac{3}{8}$ "
- 8' No. 18 two-wire rubber-type SJ (constant service) cord
- 6' No. 18 flexible insulated wire
- 10" No. 10 rubber-covered solid copper wire
- Miscellaneous: small pieces of $\frac{1}{2}$ " or $\frac{3}{8}$ " oak, maple, or plywood; attachment plug cap; varnished cloth; wing nuts and hexagon nuts; screws; paint; rubber tubing.

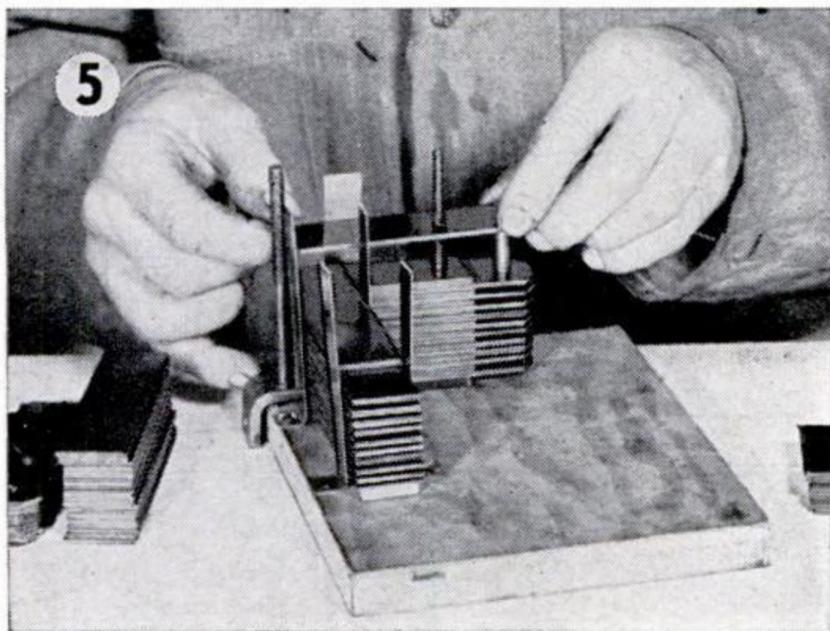


The location of the holes should be marked in advance on the upper wood piece, and the drilling should be continued into the lower piece.

After the short pieces also have been drilled, inspect the laminations and file off any rough spots or burrs so that all the surfaces are perfectly flat. Prepare a stacking guide by laying one of the side irons, with two of the stove bolts pushed through the holes in it, on a small board so that the bolts stand upright. Holes drilled in the board for

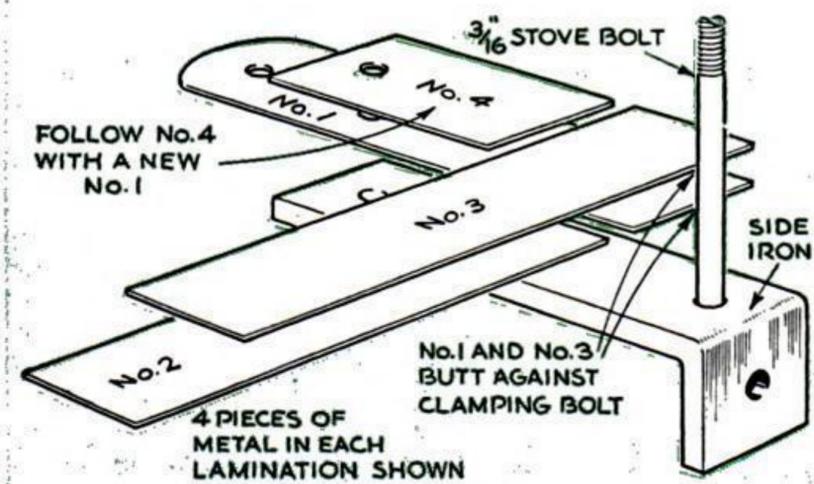
the boltheads will allow the side iron to lie flat. Tack several 1/2" wide sheet-metal strips in place to keep the stacked pieces aligned, as shown in Fig. 5.

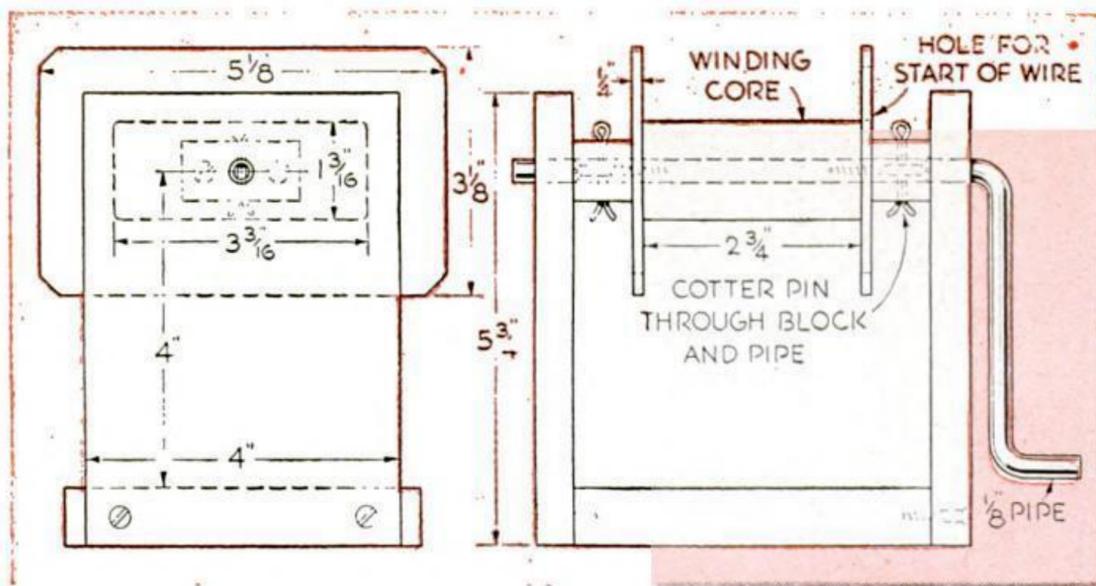
Start with four of the 4" core pieces having rounded ends and two holes. Lay these pieces parallel to the side iron so that the upper bolt in the latter passes through them. Four of the undrilled long pieces are then laid at right angles to the first ones, forming a butt joint. A wood strip is placed underneath to hold these level with the others. Four identical long pieces are now laid to cover the butt joint between the first two groups, and four of the short pieces with square ends complete the first core layer. Continue stacking four pieces at a time in this way (Fig. 5), until the core is 3" high when tightly compressed; then place a second side iron on top and tighten nuts on the bolts to draw the assembly together firmly. A C-clamp may be used as an aid in making a tight stack.



Remove the clamped stack from the board and drive all joints tightly together with a hammer and a piece of 1/8" thick flat steel (Fig. 6). Use a try-square to check the angle formed by the two legs of the core; it should be exactly 90 deg. Wind a single layer of friction tape over the open leg (shown held with a C-clamp in Fig. 6), over which the coil will fit, and lay the core aside temporarily.

Dimensions for the winding core are given in the drawings, but they should be checked against those of the actual iron core. It will save time and insure better work to make the simple winding jig shown in the drawings and in Fig. 7. Apply four layers of varnished cloth over the wooden core, then wind with No. 15 S. C. E. (single cotton, enamel) magnet wire, of which 40 turns may be laid

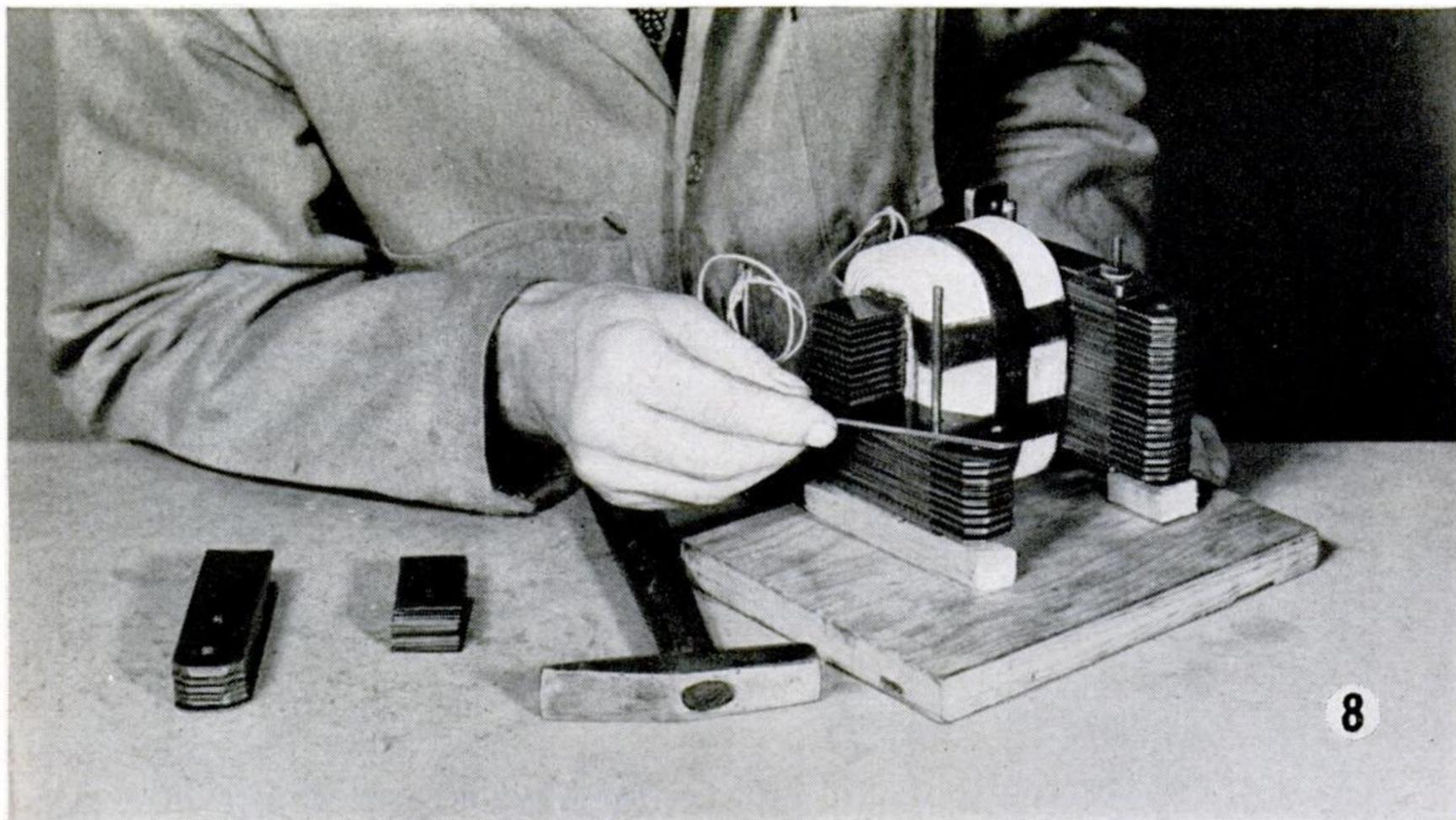
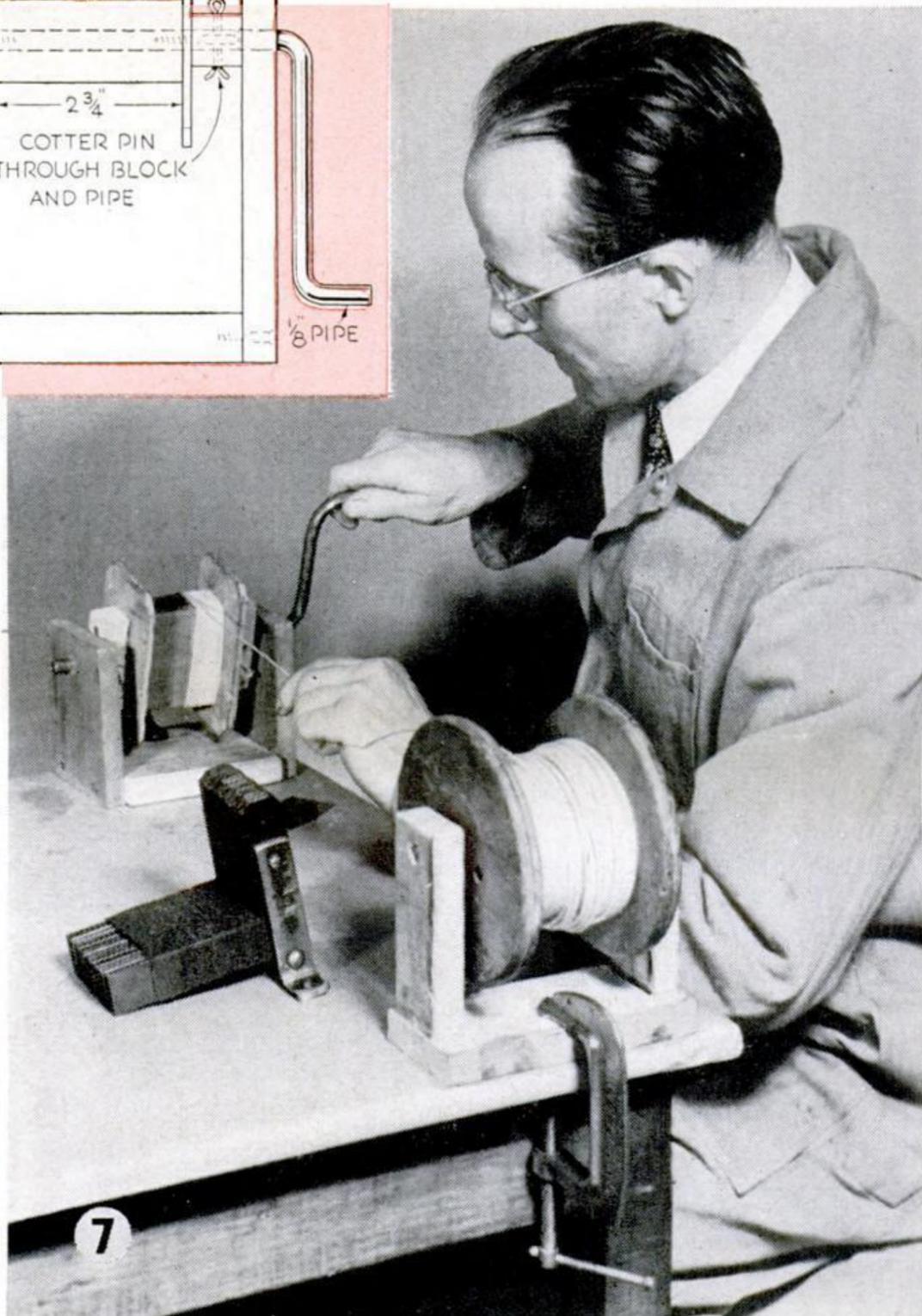


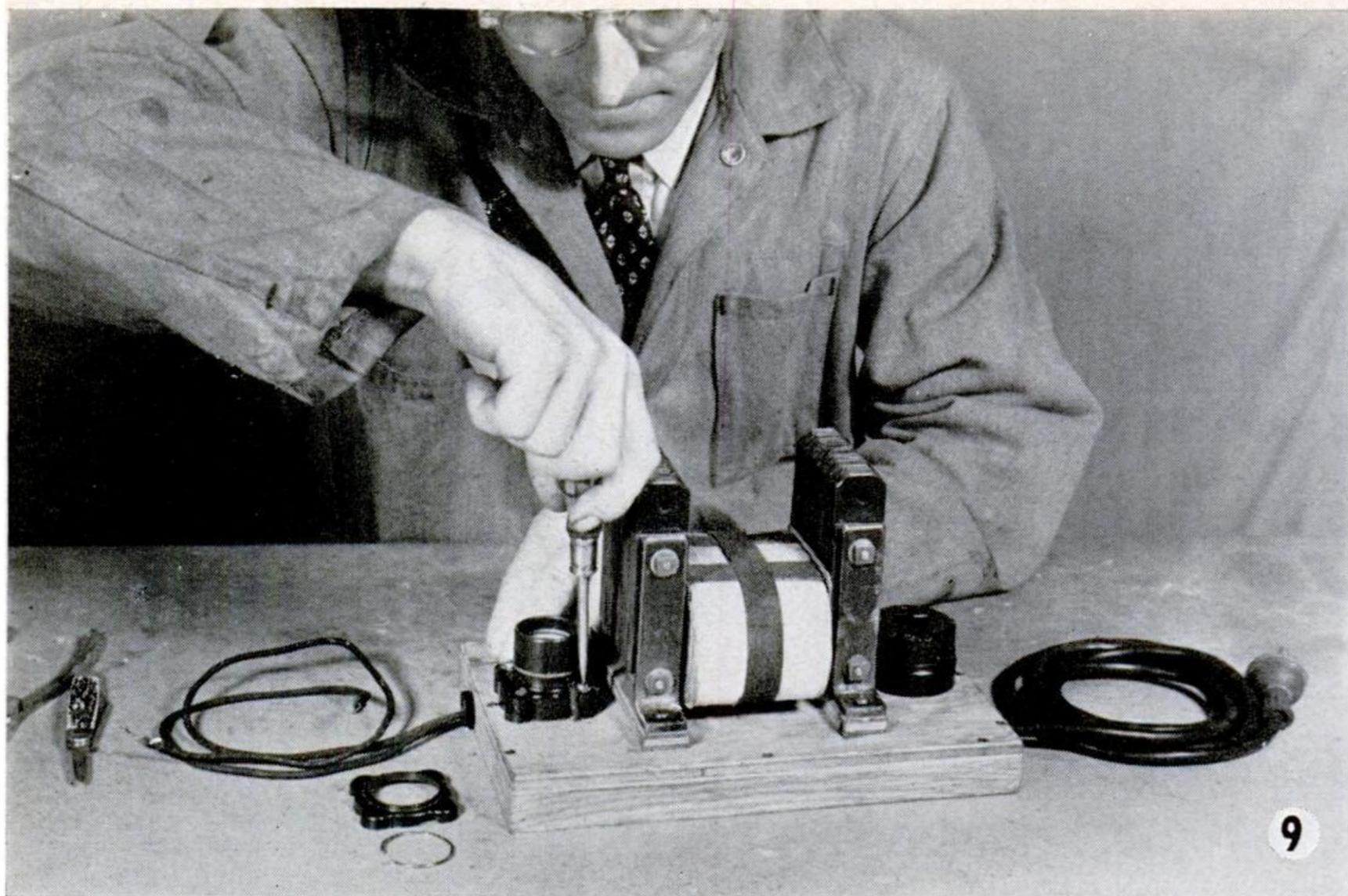


in the $2\frac{3}{4}$ " winding space. Eight layers, or a total of 320 turns, should be wound. Brown wrapping paper may be laid between the layers for additional insulation.

When completed, the coil is carefully removed and taped so that the windings cannot open (see Fig. 8), and put on the core, leads at the bottom. The other side laminations are then woven in as in Fig. 8, first four long pieces, then four short ones, and so on, to form a solid joint with the laminations first laid. The third side iron is used under this leg of the core, and the fourth finally laid on top of it. The clamping bolts are then tightened so that the assembly is firmly secured.

(TO BE CONCLUDED)





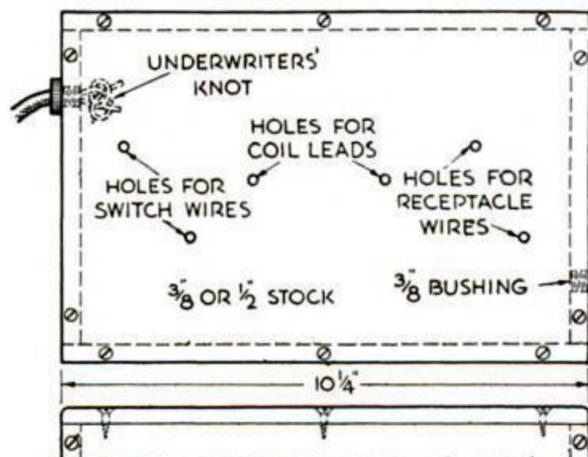
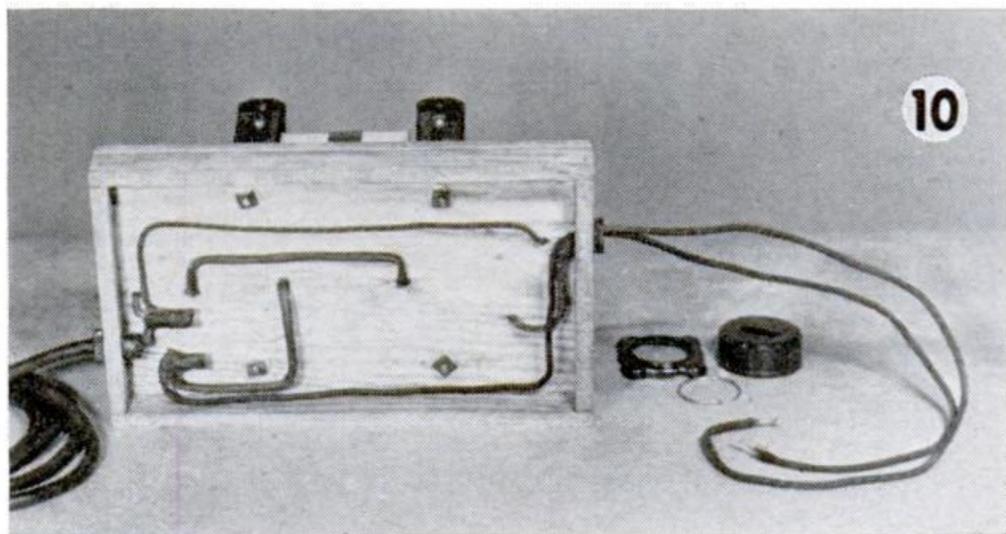
How to Complete and Use Our Adjustable GROWLER for Testing Armatures

By **HAROLD P. STRAND**

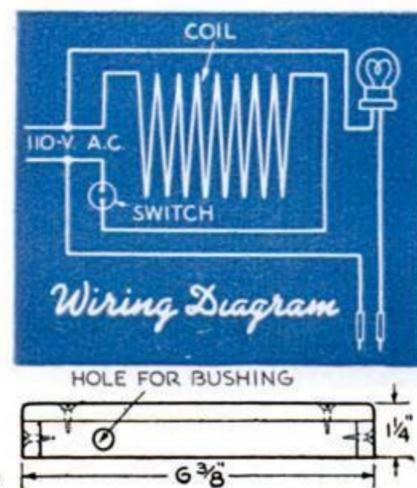
TO SIMPLIFY the work of fitting the pole pieces to the core of the growler, the construction of which was described in the first part of this article (P.S.M., Dec. '41, p. 193), the finished parts may be mounted upon the baseboard. This is preferably a shallow box made of $\frac{3}{8}$ " or $\frac{1}{2}$ " thick oak or other hardwood. Dimensions are given in the drawings, and Fig. 9 shows the arrangement of the three units on the baseboard.

Both the receptacle and the toggle switch are of the surface type, and may be composition or porcelain. The test leads and the line cord enter through hard-rubber bushings. Four short $\frac{3}{16}$ " bolts secure the growler to the base.

Figure 10 shows the base wiring. The taps for the series lamp



Baseboard Details



are soldered and taped. Use No. 18 flexible insulated wire for all connections, as well as for the two test leads. Slip rubber tubing over the winding leads where these pass through the base.

The baseboard and core brackets are finished with two coats of black enamel, but the core is best left unpainted. Insulating varnish is applied over the coil. Allow 24 hours for drying.

Eliminate any burrs in the slots by using a fine-cut file as in Fig. 11, which shows one pole assembled. Great care must be taken to construct the joints so that they work freely. Start by fitting four short round-end laminations into the first slot of the core leg. Push the brass hinge pin through just far enough to hold these while the next group is inserted (Fig. 12). Select pieces to fit each individual slot as closely as possible. If four laminations are too tight, the slot may perhaps be filed slightly, or three laminations used instead. The thickness of the completed joint, when it is drawn tightly together by means of the wing nut, should be equal to that of the core leg, and it should be possible to move the pole pieces when the wing nut is loosened.

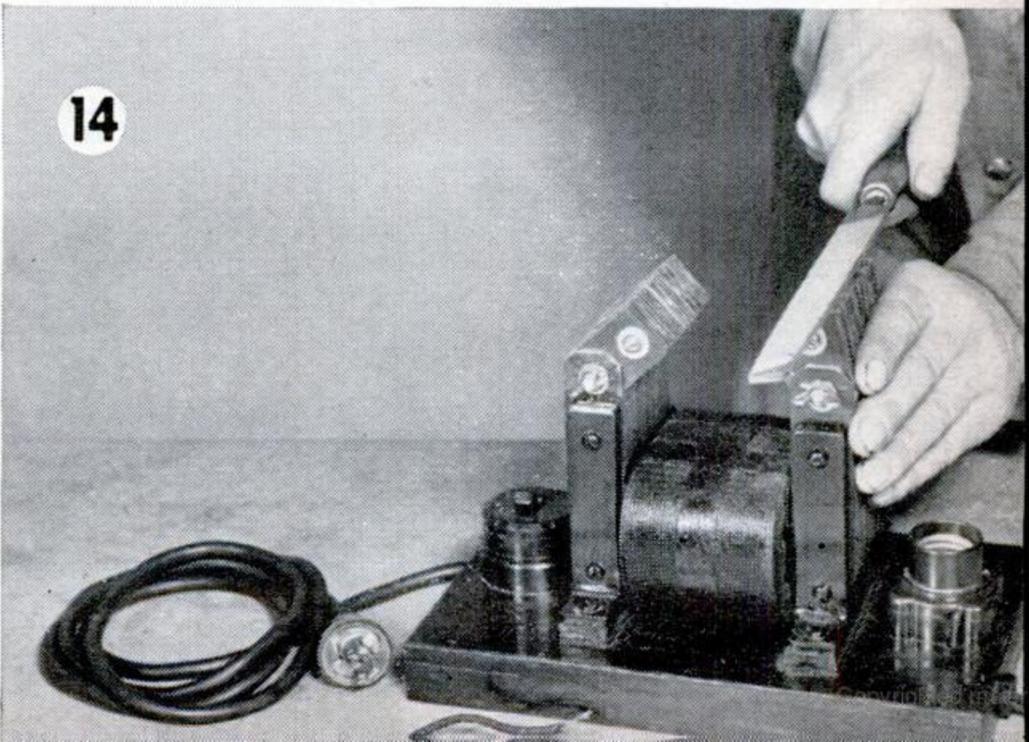
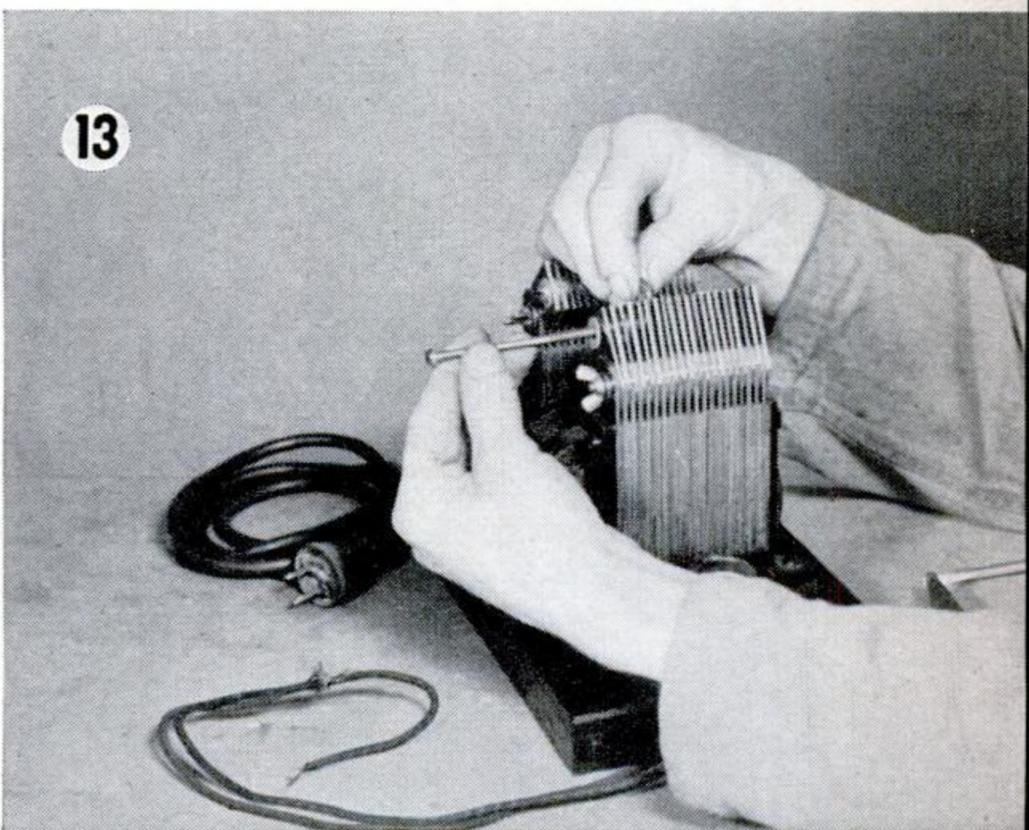
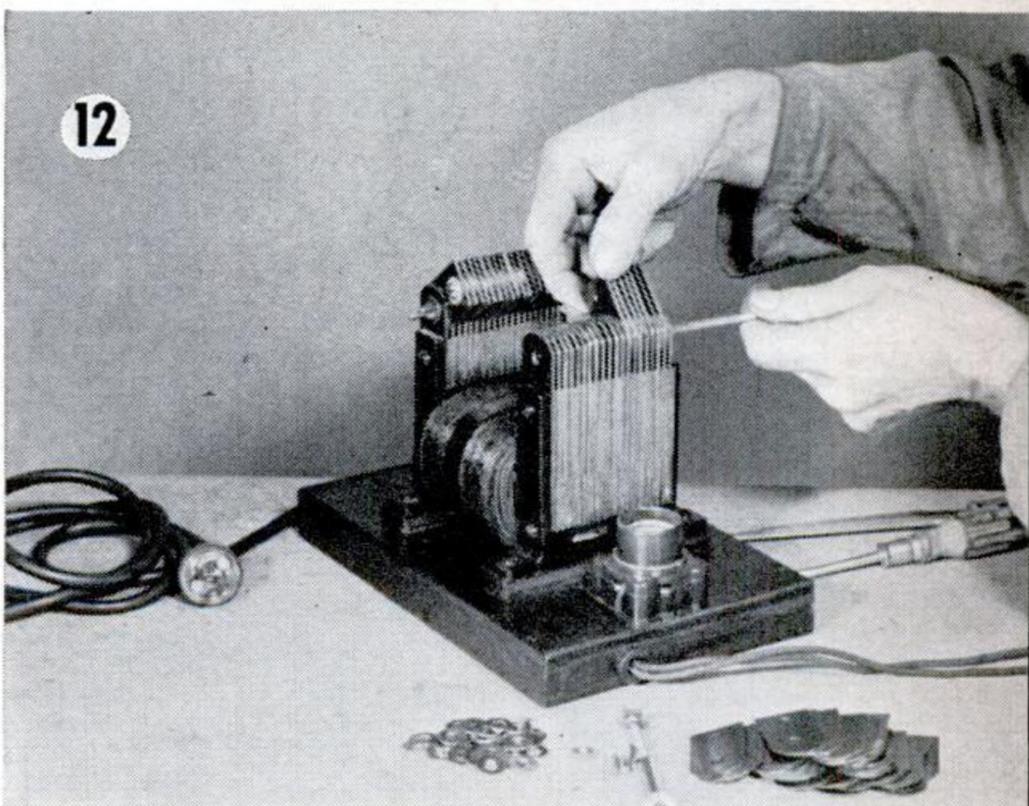
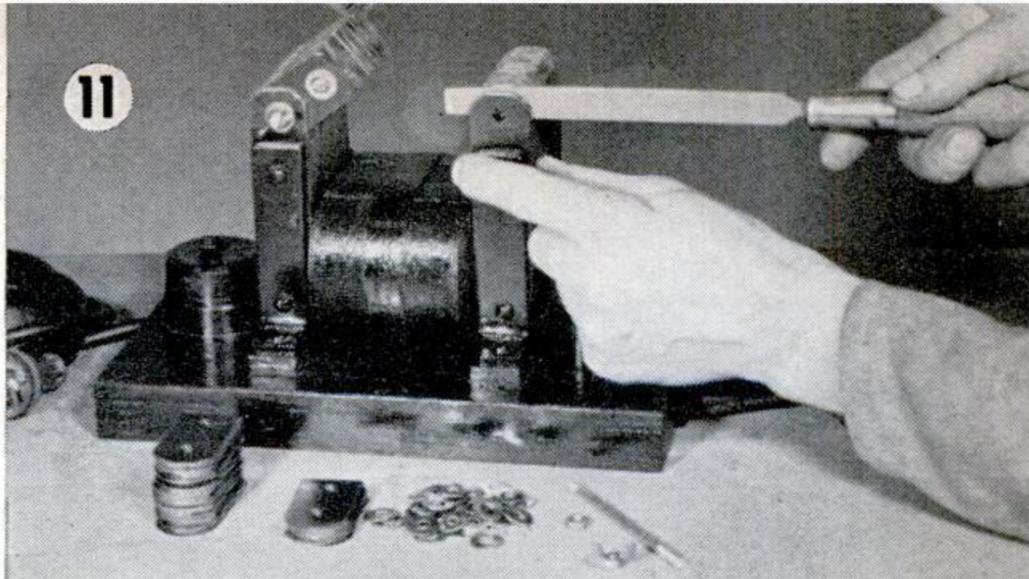
The upper ends of the pole pieces are locked together by fitting two small iron washers into each slot and passing a $\frac{3}{16}$ " by 4" stove bolt through the parts. File the washers individually, if necessary, to maintain correct spacing. Figure 13 illustrates this part of the assembly.

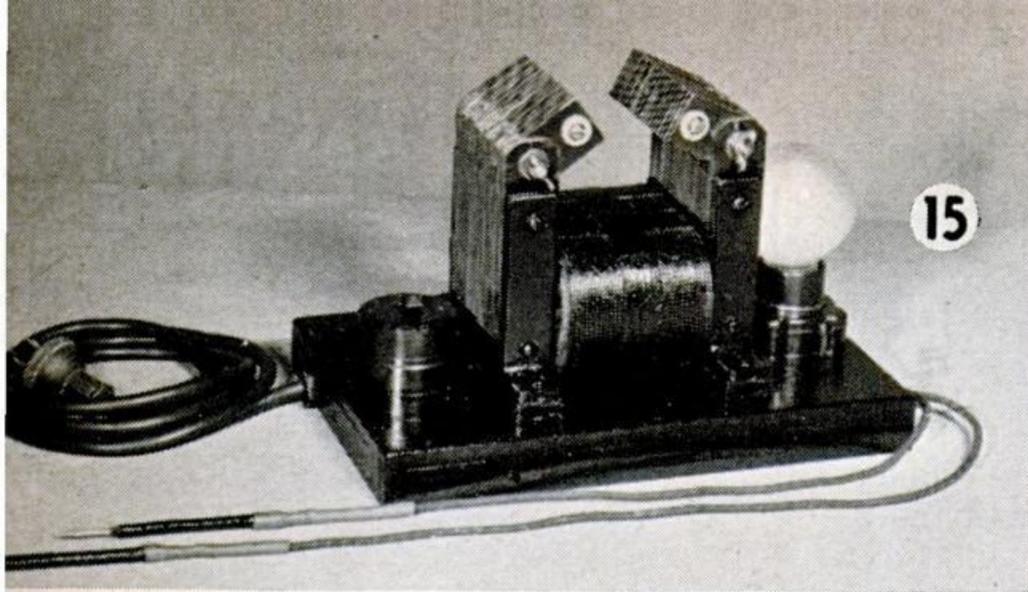
The ends of the pole pieces should be filed smooth and flat across as shown in Fig. 14. This completes the growler (Fig. 15).

Suitable test prods should be soldered to the leads connected with the series lamp. An easy way to make the prods from ordinary No. 10 rubber-covered solid copper wire is shown in one of the drawings. Leave one lead somewhat longer than the other so that the prod tips will be less likely to touch each other accidentally.

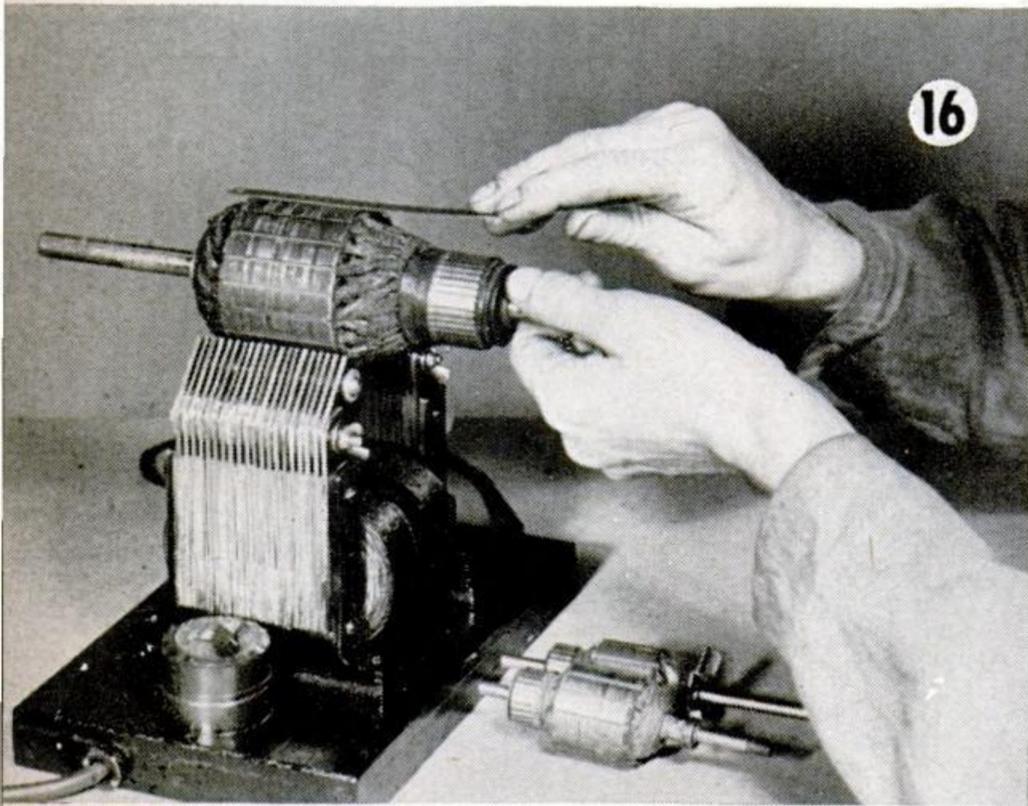
To test an armature, place it on the growler as in Fig. 16, adjusting the pole pieces to suit, and only then turn on the switch. A loud hum, from which the device derives its name, may now be heard. Hold a hack-saw blade at the top of the armature, and slowly turn the latter through at least one complete revolution, keeping the test blade at the top. If the winding is intact, no magnetic attraction will be felt. Avoid testing on the side of the armature, as the growler poles may attract the blade there.

Should there be a short-circuited coil, it will cause the blade to be attracted to the armature when that coil is directly beneath. Mark the spot and continue rotating the armature. If attraction is evident at more than one point, either more than one coil

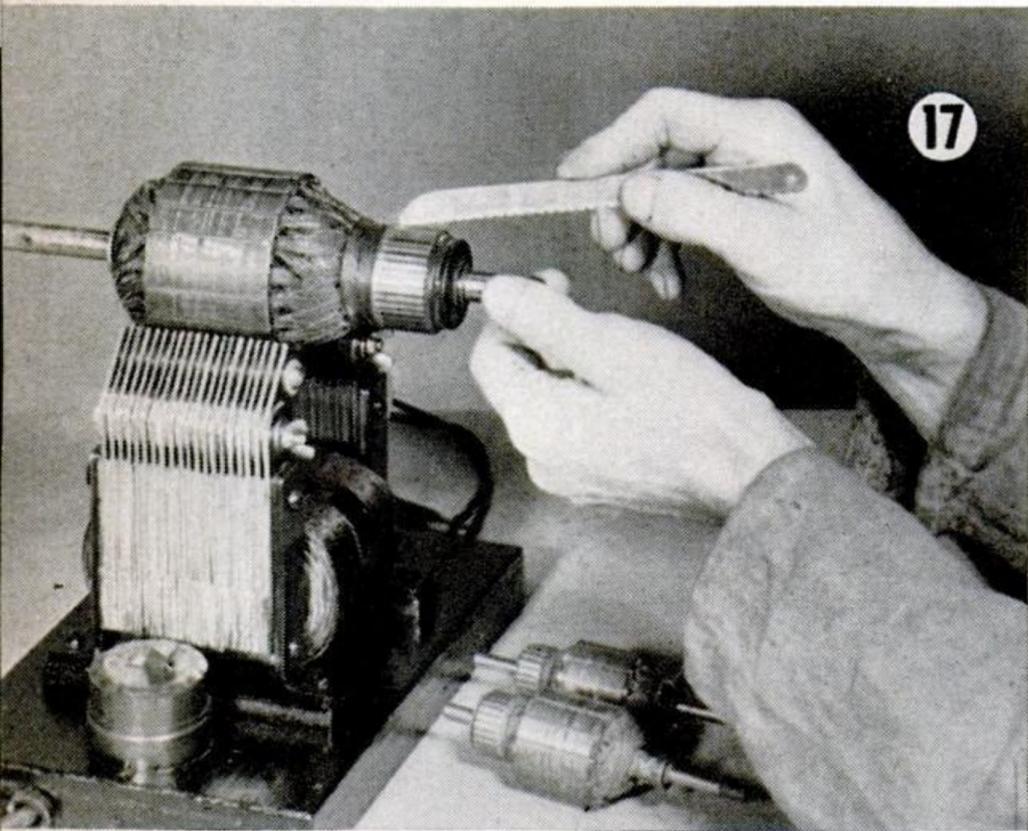




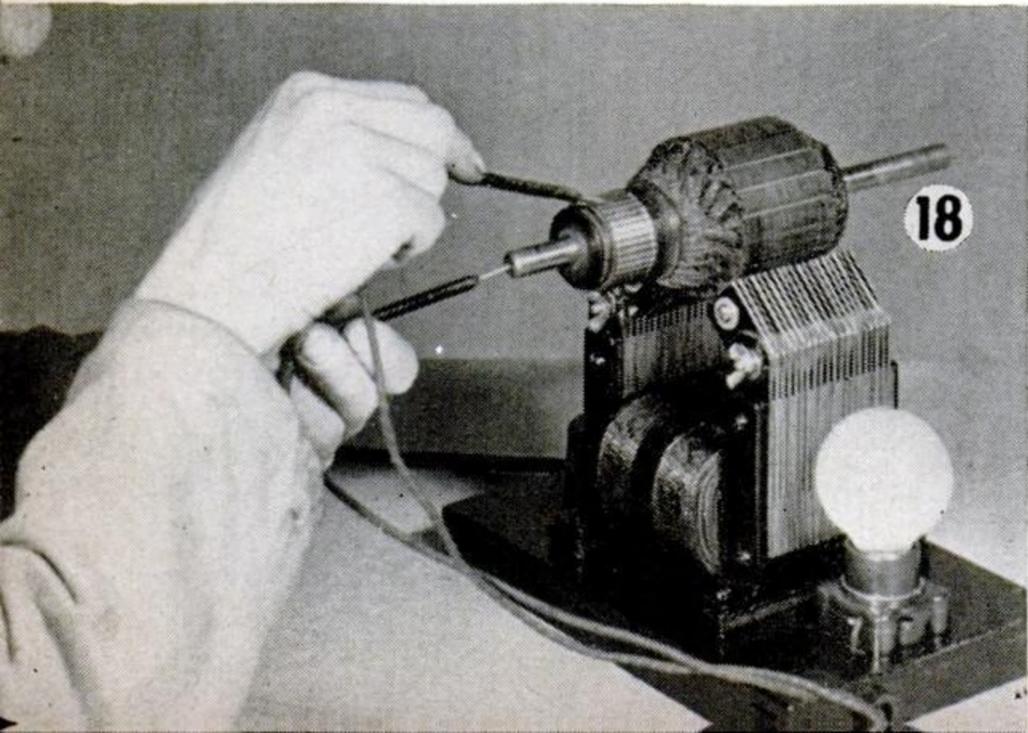
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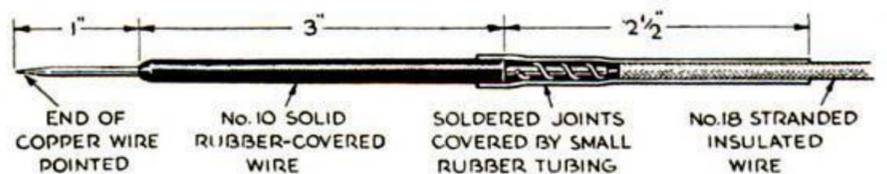
is short-circuited or there is a short between coils.

Before deciding upon a rewind job, examine the commutator. The bars may be deformed enough at one or more points, due to long wear, to bridge the mica-insulated gap between them. Particles of copper or of carbon from the brushes may have lodged in these gaps. To remedy either condition, undercut the mica at each gap slightly with an old hack-saw blade as shown in Fig. 17. Grind one end of the blade off, and grind back both sides of the toothed edge to remove all set and reduce the thickness. Use the blade with the rake of the teeth toward you, so that it cuts on the backstroke. This operation should remove all deposits, and the armature should then be tested again.

If the insulation between the bars is already deeply cut, it may be advisable, after the final test, to fill the gaps with a paste made of powdered mica and water glass or shellac. When this has hardened, undercut each division slightly and smooth up the commutator in the lathe with fine sandpaper. Should the armature still fail on test after undercutting, check the coil connections to each commutator segment for shorts between the leads, and see that all are tightly soldered and that no shorts exist between the risers.

To continue testing the armature on the growler, bridge the two adjacent bars at the top of the commutator with a tool or short piece of thick wire and turn the armature until all the bars have been at the top and have been tested in this way. A spark should be obtained on each pair. A low-reading A.C. voltmeter may be used for this test, and should give the same reading across all pairs. No spark or voltmeter reading indicates a short between coils or a short-circuited coil, or else a short between commutator bars. A low reading may indicate the same faults, but a high reading or an unusually heavy spark between two bars means an open circuit. A 75-ohm telephone receiver may be touched across the bars for this test; the same hum should be heard across each pair. If the pitch is lower at one point, a short circuit is indicated; if higher, an open circuit.

Many repair men test for a grounded winding before using the growler, as a ground may invalidate other tests. With the growler current shut off, touch one test prod to the

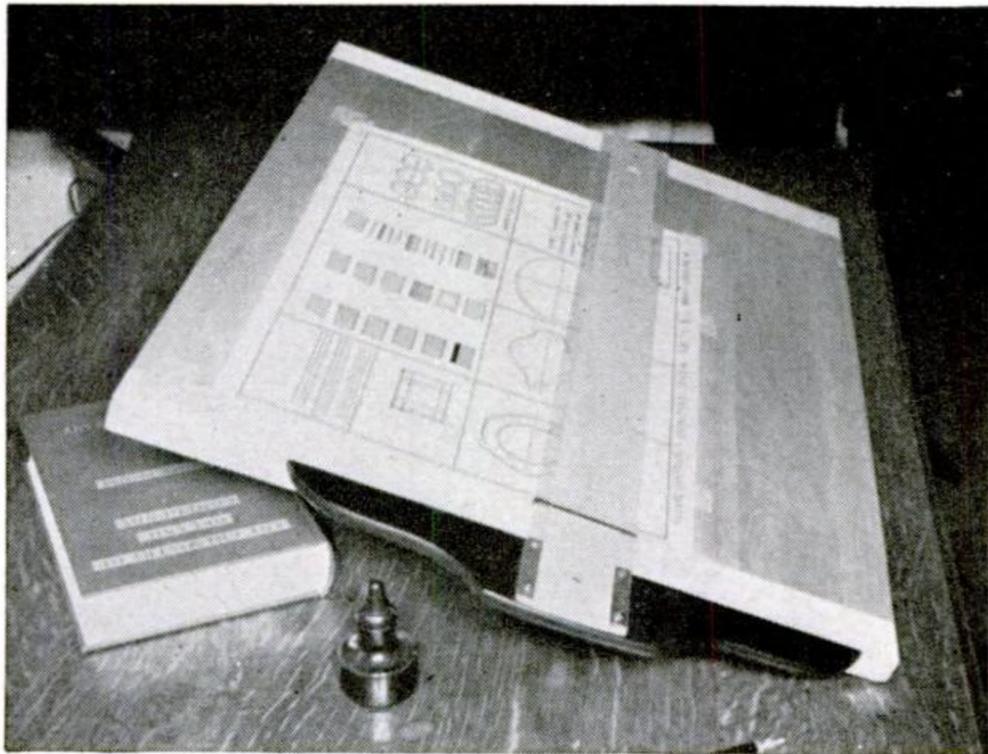


shaft and the other to the commutator. If the series lamp lights, there is a ground in the armature and it will be necessary to unsolder all the leads from the commutator risers in order to test the winding and the commutator separately, thus determining which is grounded. Figure 18 illustrates this test being made.

Armatures from repulsion-induction A.C. motors also may be tested, but as they are fitted with various short-circuiting devices necessary to their operation, care must be taken that these are not bearing on the commutator during the tests just outlined. Such automatic contacts are usually fitted inside the hollow of the commutator, and should not touch the latter when the armature is at rest. As the motor gains speed, a centrifugal governor pushes them out to short-circuit the commutator at the same

time the brushes are lifted off the latter, so that the motor continues to run as a squirrel-cage induction motor. Check the moving parts for dirt or pitted surfaces that might cause them to stick in operation, and see that the contacts cut in and out as they should.

Because of the relatively large amount of copper and iron in its core, the growler does not draw an excessive amount of current even with no armature in place. It may therefore be used for demagnetizing tools and watches. Simply move the article between the poles, allowing it to touch neither of them, and any permanent magnetism will disappear. The current draw on such an open magnetic circuit is about 4 amperes; with a small armature in place it is about $2\frac{1}{2}$ amperes, and with the large one shown, it is only 2 amperes.



Small Rubber Band Keeps T-Square from Sliding

WHEN used on an inclined drawing board, a T-square is likely to slide down at inconvenient moments, causing delay and annoyance, and perhaps smudging wet ink on a finished drawing. This can be prevented by slipping a rubber band on the blade as shown. The additional friction is enough to keep the T-square from slipping, yet it can be moved up and down the board with a light touch of the fingers.—BRIAN A. LOVERIDGE.

ELECTROPLATING, PART 7

[ELECTRICAL]

Plating will not adhere to work that is not chemically clean; any trace of grease, tarnish, or oxides will result in a spotty deposit or one that will peel during subsequent handling. After washing the work with benzine to remove most of the grease film, it should be scrubbed in a hot solution of soapsuds fortified with a little washing soda.

The work may also be cleaned electrically by suspending it, as if it were the cathode, in an iron container which serves as the anode, with the following solution: 1 gal. water, 3 oz. lye, and 5 oz. laundry soap chips. The brass rod from which the work is suspended must, of course, be insulated where it rests on the edges of the iron container.

No rheostat is required in the circuit, but use a double-pole, double-throw switch connected so as to reverse the current, which is used full strength. First throw the switch to make the work the cathode. A quantity of hydrogen bubbles will then be generated around the work. After three minutes, reverse the switch for *only five seconds* to dispel the hydrogen bubbles.

Do not handle the work with bare hands after it has been cleaned. Rinse with water. If this flows over the entire surface, without dry spots, it indicates that all grease has been removed. If the work appears not to have been entirely cleaned of oxides, it should be pickled before being transferred to the plating bath.

POPULAR SCIENCE MONTHLY SHOP DATA FILE