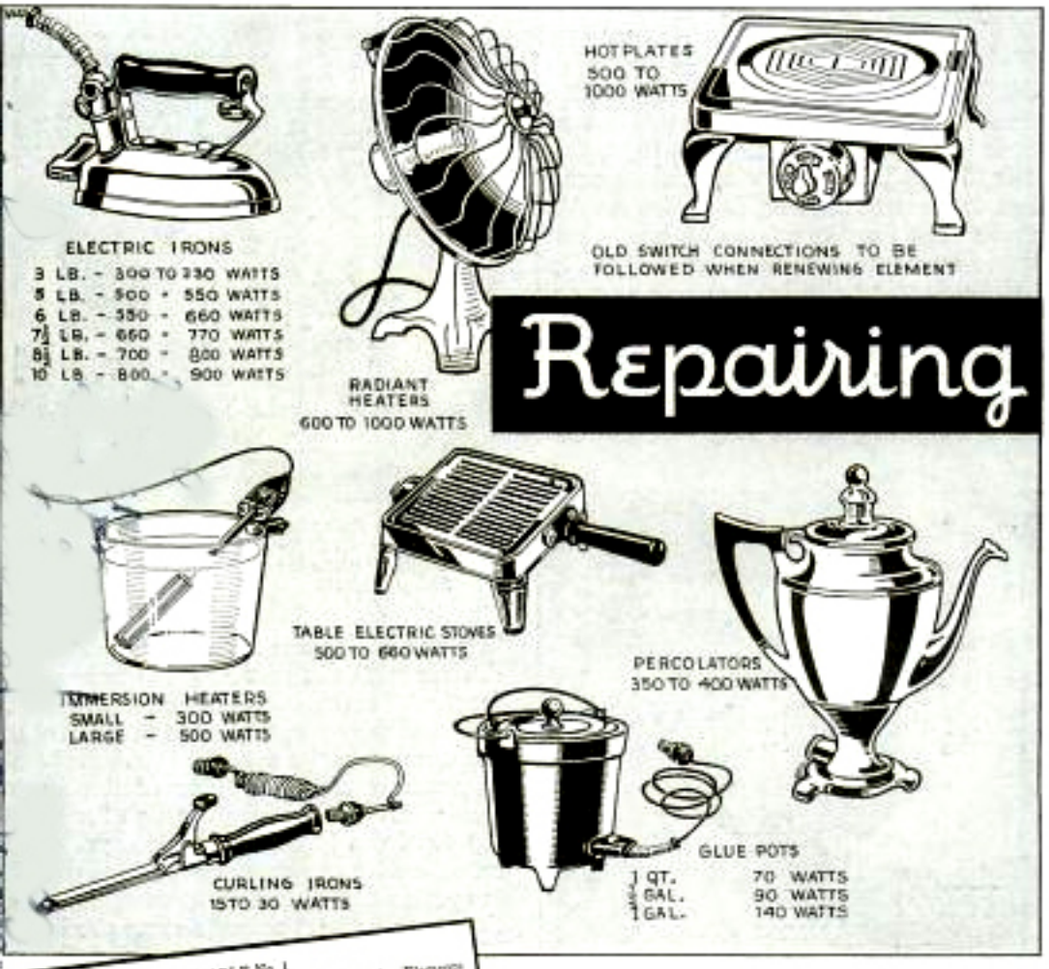
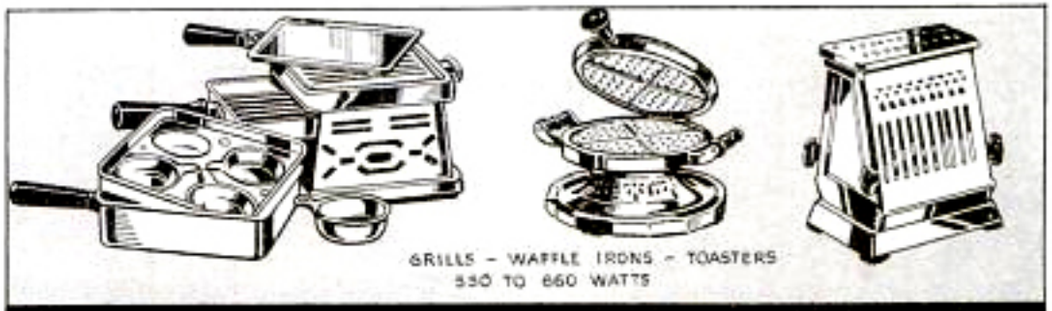




Electric Appliances

By CLYDE A. CROWLEY

TABLE No. 1

Length of Nichrome Resistance Wire Required for Heating Elements

Watts	115 to 120 Volts Wire Size B & S	115 to 120 Volts Length Required	220 to 250 Volts Wire Size B & S	220 to 250 Volts Length Required	32 Volts Wire Size B & S	32 Volts Length Required
25	34	25' 4"	38	47' 2"	30	6' 3"
50	32	24' 7"	36	39' 9"	27	6' 4"
75	30	23' 7"	34	40' 8"	25	6' 4"
100	29	22' 7"	33	41' 3"	24	6' 5"
125	28	23' 10"	32	43' 3"	23	6' 8"
150	27	24' 11"	31	44' 3"	22	6' 10"
175	27	21' 5"	31	37' 2"	21	5' 6"
200	26	23' 6"	30	41' 2"	20	6' 6"
250	25	23' 10"	29	43' 7"	19	6' 9"
300	24	24' 10"	28	47' 2"	18	6' 10"
350	24	21' 5"	28	40' 10"		5' 9"
400	23	22' 10"	27	42' 10"		6' 0"
450	22	23' 0"	26	45' 3"		6' 3"
500	22	20' 7"	26	38' 8"		5' 5"
550	21	21' 9"	25	40' 10"		5' 8"
600	21	23' 0"	25	43' 7"		6' 0"
650	20	24' 5"	24	46' 10"		6' 5"
700	20	22' 7"	24	42' 10"		5' 11"
750	19	23' 6"	23	45' 3"		6' 2"
800	19	24' 11"	23	47' 8"		6' 5"
850	19	26' 5"	23	50' 3"		6' 8"
900	19	27' 10"	23	52' 10"		6' 11"
950	19	29' 4"	23	55' 5"		7' 2"
1000	18	25' 10"	22	48' 8"		6' 8"
	18	27' 7"	22	51' 2"		7' 1"
	18	29' 3"	22	53' 9"		7' 5"

ELECTRIC heating elements for flatirons, toasters, soldering irons and other appliances may be repaired by anyone with a few tools, the most important of which are a screwdriver and a pair of pliers. In this article we are going to take the mystery out of Nichrome wire so that you can figure just how much and what size wire will be needed for any particular job. And, information is also included to enable you to design rheostats and resistors as well as heating units for almost any type of application.

Before you can repair a burned-out electric appliance, it is necessary to find the size of element which will be required. Sizes for electric heating elements are rated in terms of the number of watts of electricity they consume. As an illustration, the average household electric flatiron takes 550 watts. This is usually stamped on the nameplate and is therefore not difficult to locate. The watt is the electrical unit of measurement which tells how much electricity is being used. It is figured by multiplying the volts by the amperes. Also, if the wattage and voltage are known, the amperes (units of electric-current measurement) can be found by merely dividing the wattage by the voltage. By doing this you find that the electric flatiron, which consumes 550 watts and is designed to operate on a 110-volt circuit, passes 5 amperes, when in use. The resistance of the heating element in ohms (units of electrical resistance measurement) is found by dividing the volts by the amperes, or in this case we have 110 volts divided by 5 amperes, which gives us 22 ohms. Table No. 2 shows the lengths and wire size in gauge numbers of $\frac{1}{10}$-in. Nichrome ribbon, or flat wire as it is sometimes called, which is required for various sizes of heating elements. The lengths of wire shown in the table have been figured to allow for the fact that the resistance of wire changes as it gets hot; therefore it is both easier and more accurate to use these values than to figure out the ohms from some of the other tables. In the case of the flatiron, we have been using as an example, we find, opposite 550 in the watts column, that No. 36 ribbon should be used. In the last column the proper length of wire is shown to be 11 ft. 11 in. To repair the iron, it is only necessary to remove the old element from the mica form and replace it with the new ribbon. The ends of the new element are carefully twisted around the terminal screws between washers and tightened in place. In making connections with Nichrome wire it should be remembered that solder cannot

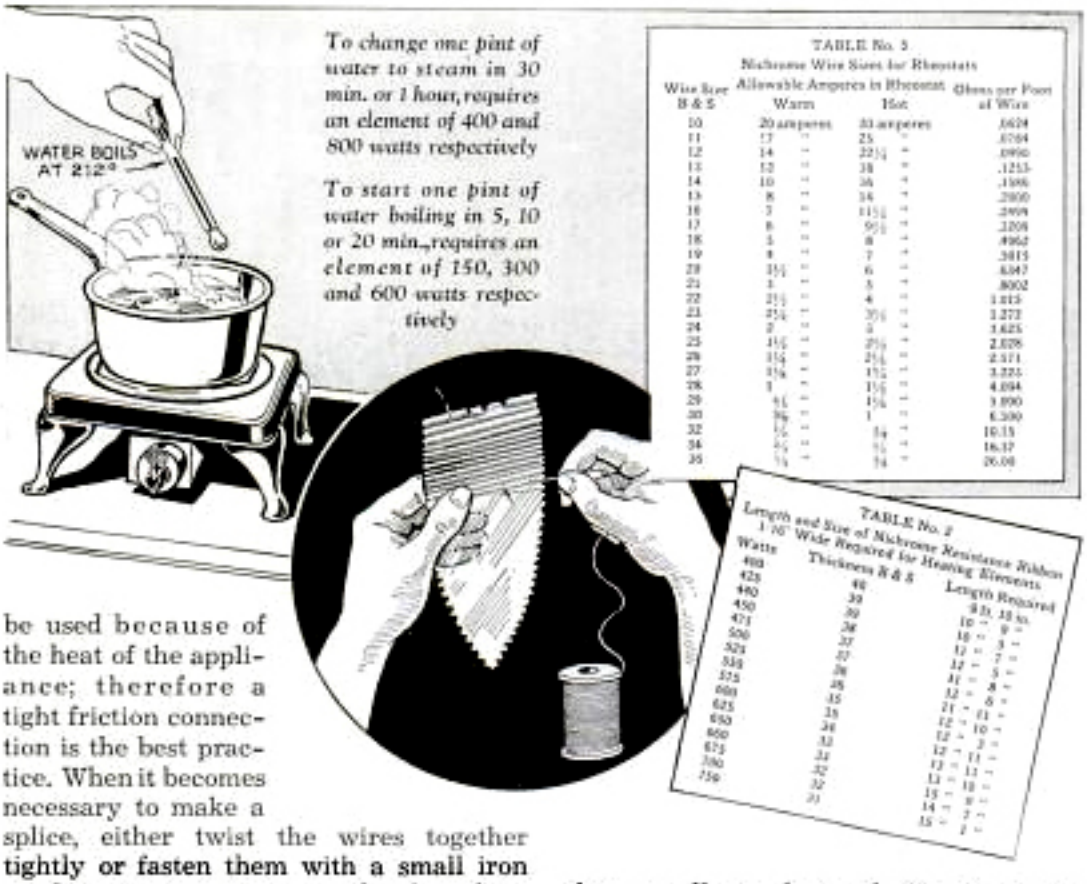


TABLE No. 3
Nichrome Wire Sizes for Rheostats

Wire Size B & S	Allowable Amperes in Rheostat Warm	Hot	Ohms per Foot of Wire
10	20 amperes	33 amperes	.1024
11	17 "	25 "	.1294
12	14 "	22½ "	.1990
13	12 "	18 "	.1253
14	10 "	16 "	.1588
15	8 "	14 "	.2000
16	7 "	11½ "	.2499
17	6 "	9½ "	.3208
18	5 "	8 "	.4062
19	4 "	7 "	.5015
20	3½ "	6 "	.6347
21	3 "	5 "	.8002
22	2½ "	4 "	1.015
23	2¼ "	3½ "	1.272
24	2 "	3 "	1.625
25	1½ "	2½ "	2.078
26	1¼ "	2¼ "	2.571
27	1¼ "	1½ "	3.225
28	1 "	1½ "	4.094
29	¾ "	1¼ "	5.100
30	⅝ "	1 "	6.300
32	½ "	¾ "	10.15
34	⅜ "	½ "	16.37
36	¼ "	¼ "	26.08

TABLE No. 2
Length and Size of Nichrome Resistance Ribbon 1/16" Wide Required for Heating Elements

Watts	Thickness B & S	Length Required B.D. 18 in.
400	40	10 ft. 9 in.
425	39	10 " 9 "
440	39	10 " 9 "
450	39	10 " 9 "
471	38	12 " 3 "
500	37	12 " 7 "
525	37	12 " 7 "
550	36	11 " 5 "
575	36	12 " 8 "
600	35	12 " 8 "
625	35	13 " 6 "
650	35	12 " 11 "
660	34	12 " 10 "
675	33	12 " 3 "
700	33	12 " 11 "
750	32	13 " 11 "
	32	13 " 11 "
	31	14 " 8 "
		15 " 7 "
		15 " 7 "

be used because of the heat of the appliance; therefore a tight friction connection is the best practice. When it becomes necessary to make a splice, either twist the wires together tightly or fasten them with a small iron machine screw using a couple of washers to grip the wire. When installing the element, the mica separating the element from the metal must be carefully replaced to prevent short circuits or grounds.

A simple method of making a ground test is shown on the last page of this article. Two testing points are connected to a couple of lamps as shown in the left-hand detail. One of these is touched to the body of the iron and the other to one of the terminal posts. If the work has been carried out properly and there is no ground, the lamps will not light. If they do light, part of the element of the iron must be touching the shell and this condition must be corrected before the iron is used. The center detail shows a convenient test for an open circuit or break in the element which will be the case if the element is burned out. The testing points are touched to the two terminals of the iron and the lamps will light if the wiring is continuous. After assembling a repaired iron, it frequently happens that it still refuses to heat after testing out O.K. The trouble is then usually in the cord. You may confirm this by testing the cord as shown in the right-hand detail. The two testing points are inserted into the plug and the prongs of the socket plug are connected together. If the cord is in good condition the lamps will light. If they do not light one or both of the wires are broken and should be replaced with a new cord. The tests may be made on defective appliances before repairing to locate the source of the trouble. On some electric irons the element is buried in a cement composition. In this case, the cement should be chipped away and the element replaced as already explained. New cement, of the kind used by dentists, is applied over the new ribbon. The cement should be allowed to dry out for two or three days before connecting the iron to the current supply.

The electrical consumption of the most commonly used electric appliances is shown at the head of this article. If the appliance has a nameplate giving the watts, this value should be used. If this is miss-

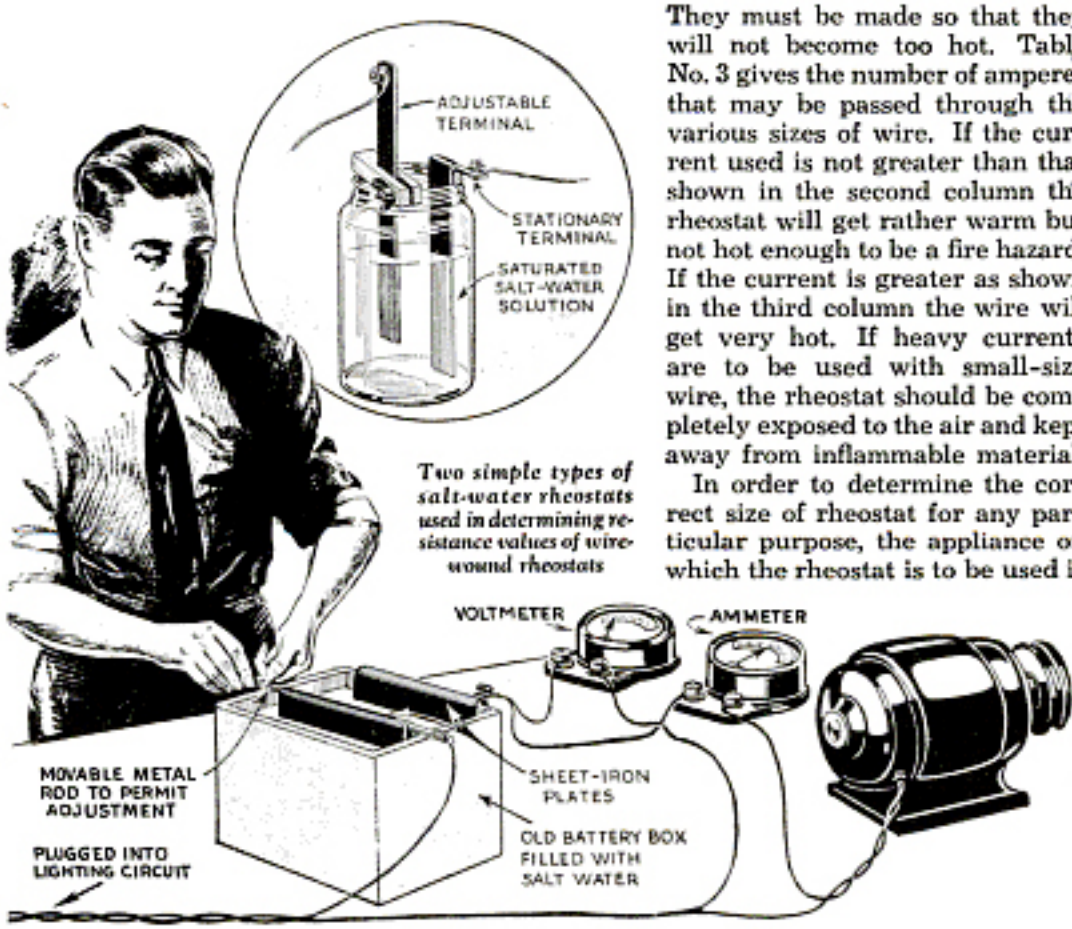
ing, the old element should be removed and the length of the wire for replacement can be measured by winding string into the winding grooves. One of the sizes of elements as listed should then be selected. As an illustration, suppose that the unit is a toaster and that there is room on the mica forms for ribbon 11 ft. 6 in. long. From the information given, a toaster may be wound for 450 to 550 watts. Referring to Table No. 2, we see that, opposite these wattages, the nearest length to 11 ft. 6 in. is 11 ft. 8 in. opposite 500 watts, so we will use this size ribbon. The extra 2 in. will be just about right for reaching the terminals. If the appliance happens to be one wound with round wire, Table No. 1 should be used. This table also gives values for 32 and 220-volt appliances.

Rheostats for controlling the speed of motors, dimming lights, for regulating electric fans and many other purposes may be constructed from the details that show both a tubular and a flat type of rheostat.

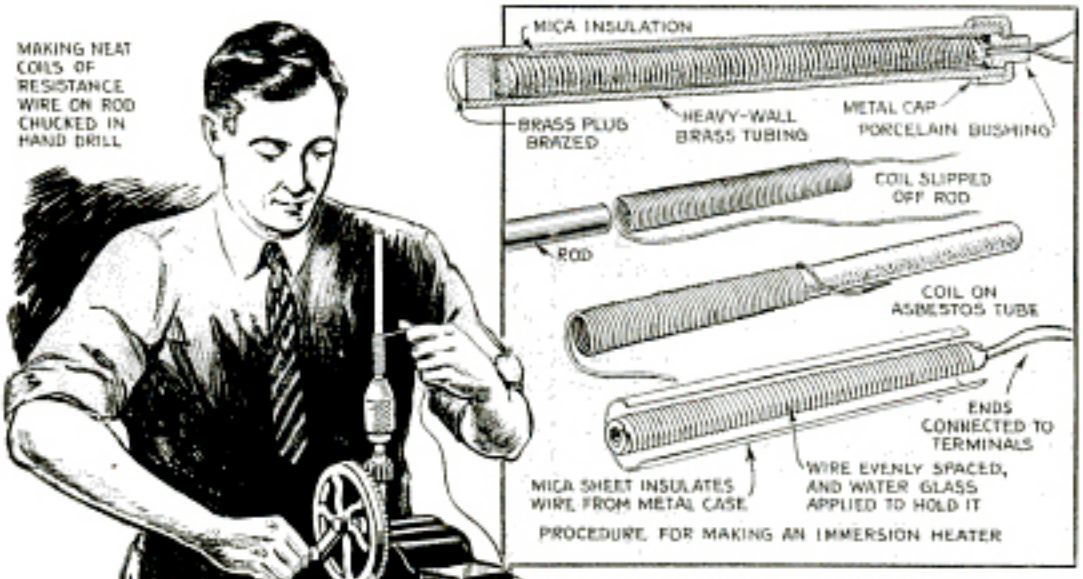
To determine the cost of operating an electric appliance, divide the wattage of the appliance by 1000, and then multiply the resulting number by the rate per kilowatt hour

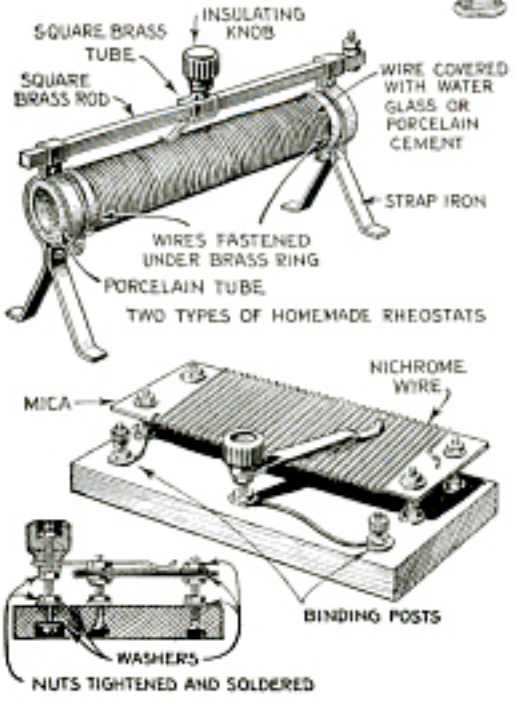
They must be made so that they will not become too hot. Table No. 3 gives the number of amperes that may be passed through the various sizes of wire. If the current used is not greater than that shown in the second column the rheostat will get rather warm but not hot enough to be a fire hazard. If the current is greater as shown in the third column the wire will get very hot. If heavy currents are to be used with small-size wire, the rheostat should be completely exposed to the air and kept away from inflammable material.

In order to determine the correct size of rheostat for any particular purpose, the appliance on which the rheostat is to be used is

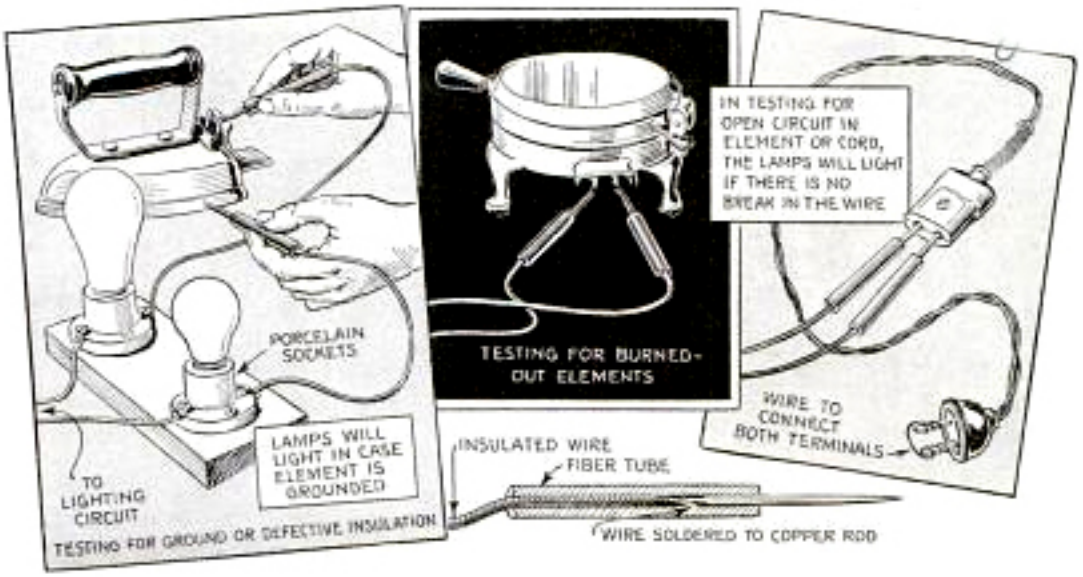


Two simple types of salt-water rheostats used in determining resistance values of wire-wound rheostats





connected to a 0-150 voltmeter, an ammeter of suitable range, say one reading from 0 to 15, and a makeshift salt-water rheostat as shown. The meters need not be high priced; the type sold for around a dollar each are quite satisfactory. The plates of the water rheostat are touched together and the ammeter read to find the highest current passed. The plates are next separated and adjusted until the appliance operates as desired. With a fan, the plates in the rheostat are adjusted until the fan runs as slow as is desired, while for dimming lights the plates are adjusted until the maximum dimness is obtained. The meters are then read and the resistance needed is figured as follows: For example, suppose that you wish to make a lamp dimmer. Touching the plates together the ammeter will read 3 amperes. When the lights have been dimmed properly, by adjusting the plates of the salt-water rheostat, the voltmeter will read 60 volts and the ammeter will read 2 amperes. Subtracting 60 from 110 (the voltmeter reading and the voltage of the lighting circuit) you get 50 volts. Dividing this 50 by 2 amperes as indicated on the ammeter, you get 25 ohms as the required resistance for the rheostat. Now consult table No. 3 to find the proper wire size and length. If you want to make a rheostat that will not get hot, look down column 2 until you come to 3 amperes, or the first meter reading. You will find this opposite No. 21 wire, so this size is to be used for making the rheostat. Following across the table to the last column you find that No. 21 wire has a resistance of .8002 ohm per foot. As you need 25 ohms divide 25 by .8002, which gives 31.2 or 31 ft. 2 in. If the rheostat is to be adjustable, it would be a good idea to use 32 ft. of wire. The rheostat may be built by either of the methods shown in

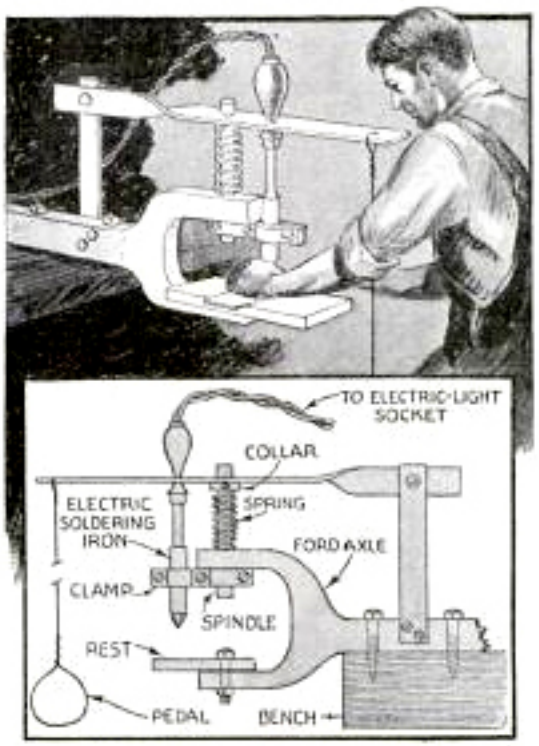


the illustrations. If it is not to be adjustable, and no sliding contact is used, it is not a rheostat but is called a resistor.

Immersion heaters may be constructed from the details shown. In use, they are set in the liquid to be heated. In making immersion heaters, be sure to insulate the element safely from the tube that incloses it. Also be careful that the individual turns of wire are not short-circuited by touching adjacent turns, or by touching the wire that is brought back across the turns. Use a mica sleeve directly over the coil, then run the return lead over the mica, after which a second piece of mica is wrapped around the assembly.

Soldering Iron Operated by Foot Leaves Both Hands Free

Owners of tin shops and other shops where considerable soldering is done will find this soldering-iron holder handy as it is foot operated, thus leaving both hands free to handle the work. It consists essentially of one half of a front car axle, which is bolted to a bench top so that the end of the axle projects over the edge of the bench. The soldering iron is clamped to the lower end of a spindle which slides through the upper spindle hole in the axle and is controlled by a coil spring. The latter is held in place by the axle at one end and by a collar and set screw at the other end. A rest, bolted in the lower spindle hole, supports the work while it is being soldered. The holder is operated by a wire pedal, which is fastened to a lever carrying the soldering iron as shown.



Some leather dyes, such as mahogany and dark brown colors, make wood stains that can be applied to a varnished surface without damaging the finish, if applied with a camel's-hair brush.

Age Cools Electric Heaters as Wires "Grow" in Length

If your toaster, percolator or iron seems to take longer to heat than it did when first purchased, it may be the result of "growth" of the alloy wires used as heating elements. This growth occurs in all resistance wires, but is more pronounced in certain alloys used in inexpensive heating elements. The wire lengthens, building up resistance and cutting down wattage and heat.