B. F. GARDNER.
ELECTRICALLY HEATED SOLDERING IRON.
APPLICATION FILED JAN. 19, 1916.

1,279,321. Patented Sept. 17, 1918.

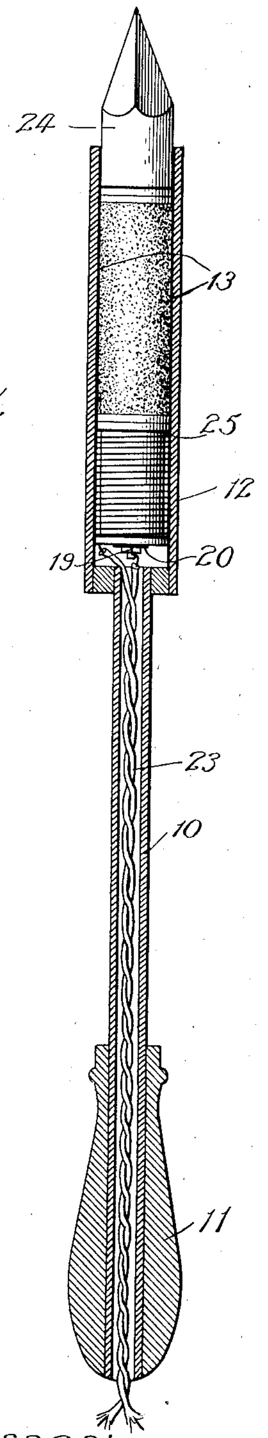
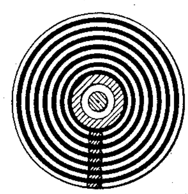


Fig. 1.

Fig. 3.



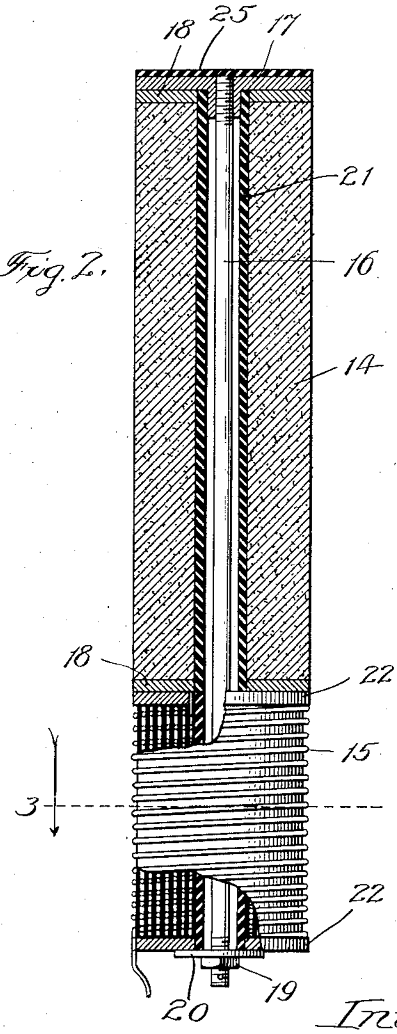


Fig. 2.

Witnesses:
E. C. Gaylord
Irwin C. Bowman

Inventor:
Benjamin Fulton Gardner,
By Dyrenforth, Lee, Chritton and Wiles,
Attys.

UNITED STATES PATENT OFFICE.

BENJAMIN FULTON GARDNER, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO SEYMOUR STEDMAN, OF CHICAGO, ILLINOIS.

ELECTRICALLY-HEATED SOLDERING-IRON.

1,279,321. Specification of Letters Patent. Patented Sept. 17, 1918.

Application filed January 19, 1916. Serial No. 72,959.

To all whom it may concern:

Be it known that I, BENJAMIN FULTON GARDNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Electrically-Heated Soldering-Iron, of which the following is a specification.

My invention relates to improvements in electric heating devices. More particularly the present invention is concerned with the construction of the resistor or heating elements *per se*. The object of the invention is to provide an improved element of a compound nature, embodying two conductors connected in series, the one having a positive temperature coefficient and the other a negative temperature coefficient, whereby an accurate automatic regulation of the heat developed is obtained. A further object of the invention is to provide such a device in a convenient form capable of being readily incorporated in the structure of a heating device such as an electric soldering iron.

Other objects and advantages of the invention will appear from the following detailed description of a soldering iron embodying the invention. In this description reference will be had to the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view of a soldering iron showing my improved heater mounted therein; Fig. 2 is an enlarged longitudinal section through the compound heating element *per se* and Fig. 3 is a section on the line 3 of Fig. 2.

The soldering iron shown comprises a tubular handle section 10 having a grip portion 11 on its outer end and attached at its other end to an open-ended cylindrical metallic shell 12. A sleeve 13 of mica or other heat-resisting insulating material lines the shell 12, and within this liner the heating element proper is housed. As shown in Fig. 2, this element is generally cylindrical in form, comprising an upper section 14 and a lower section 15, of the same external diameter and each having a central aperture through which passes a tie-rod 16 for binding the sections together. At the upper end the tie-rod is threaded into a shouldered disk 17 which seats upon the upper end of the metallic annular end-plates 18 of the section 14, and at the lower end a nut 19 is screwed upon the rod and bears against an insulating washer 20, the two sections being thus locked together end to end.

The section 14 is preferably constructed of some suitable heat-resisting high-resistance conducting material having a negative temperature coefficient, such for instance as carbon or any of the well known refractory earth compositions having the necessary properties. This material is formed into a centrally bored cylinder as shown, capped by the end plates 18, and preferably having an insulating tube 21 in its bore. The section 15 is preferably formed as a spool of wire such as iron or iron alloy having a positive temperature coefficient, the inner end of the wire being grounded to one of a pair of metallic end plates 22, which bears against and contacts with the plate 18 of the section 14, while the outer end is left free for the attachment of one of the current-supplying wires. As shown in Fig. 2, the wire is preferably wound upon the spool with alternate layers of insulating material such as mica, and with a hollow core registering with the tube 21. The complete heating element is mounted within the shell 12 as shown in Fig. 1, the section 14 being at the outer end, and a duplex cable 23 is led in through the hollow handle 10 to supply current to the heater, one terminal of the cable being attached to the outer end of the spool winding and the other terminal to the inner end of the rod 16. A soldering iron tip 24 is secured in the open outer end of the shell and a mica disk 25 is interposed between its base and the face of the disk 17.

The operation of my device is as follows:

Assuming that the heating element is cold, the cable 23 will be connected with a source of electrical energy of the desired potential, and the current will then flow through the length of iron wire upon the spool 15, to end plate 22 from the inner end of this wire, thence by direct contact to the end plate 18 of the section 14, through the length of the latter to the upper end plate 18 and disk 17, and down the tie-rod 16, thence back to the cable 23. When the heating device is cold the wire upon the spool 15 will have a relatively low resistance, while the section 14 will have a relatively high resistance. As the two sections become heated the resistance of the spool becomes greater in proportion to its positive temperature coefficient, while the resistance of the tubular resistor 14 grows less

in proportion to its negative temperature coefficient. Each of the sections therefore acts as a governor, controller or counterbalance for the other, causing the device as a whole to heat up quickly to the desired temperature, drawing a substantially constant current during the entire heating-up period, and then automatically maintaining this current flow and temperature thereafter. A further important advantage of the construction lies in the fact that small variations in the impressed electro-motive force do not effect more than proportionate variations in the current drawn or the temperature developed. Thus commercial service lines in various localities may range from 110 to 120 volts for instance. The heater may be properly designed for 115 volts and the variation of 5 volts on either side of this standard will have no noticeable effect, the positive temperature coefficient of the spool preventing any large increase in current which the negative coefficient of the tubular section would tend to cause with increased voltage, and likewise preventing the great drop of current which a small drop in voltage will effect in the tubular section. Ordinarily the section 14 will be designed to develop a considerably greater quantity of heat than the spool 15, the principal function of the latter being that of a regulator and its heating effect being a secondary reinforcement of the effect of the primary heater 14.

In the assembly shown in Fig. 1 the heat developed by the heating element will reach the tip 24 by the direct contact of the base of the latter with the heater, and also by conduction from the shell 12. The arrangement here shown is simple and durable and therefore peculiarly adapted to the demands of ordinary shop conditions.

While I have shown and described in considerable detail one specific embodiment of my heating element and of a device in which the same is incorporated, it is to be understood that this showing and description is illustrative only and for the purpose of making my invention more clear and I do not regard the invention as limited to these details except in so far as I have included such limitations within the terms of the following claims, in which it is my intention to claim all novelty inherent in my invention as broadly as is permissible in view of the prior art.

What I claim is:

1. The combination of an electric heating element comprising a cylindrical section of resistance material having a negative temperature coefficient and a spool of wire abutting one end of the same, in series therewith, and having a positive temperature coefficient.

2. The combination with a tubular heating element of resistance material having a negative temperature coefficient, a hollow spool of wire in series therewith and abutting the same, and having a positive temperature coefficient, and a tie rod extending through the registering bores of the two members and serving as a conductor for carrying current from the outer end of the said element.

3. The combination with a shell of a tip to be heated secured in the outer end of the said shell, a cylindrical section of resistance material having a negative temperature coefficient abutting the said tip, and a coil of wire in series with the said section, abutting the opposite end of the same, and having a positive temperature coefficient.

4. The combination with a shell of a tip to be heated secured in the outer end of the said shell, a tubular section of resistance material having a negative temperature coefficient abutting the said tip, a hollow spool of wire arranged in series with the said section and abutting the opposite end of the same, and a tie rod extending through the registering bores of the two members and having electrical connection with the tip end of the said section.

BENJAMIN FULTON GARDNER.

In presence of—
A. C. FISCHER,
C. C. BREUER.