July 26, 1932. W. F. GELINAS 1,869,140

ELECTRIC HEATER

Filed Aug. 8, 1930

Fig. 1

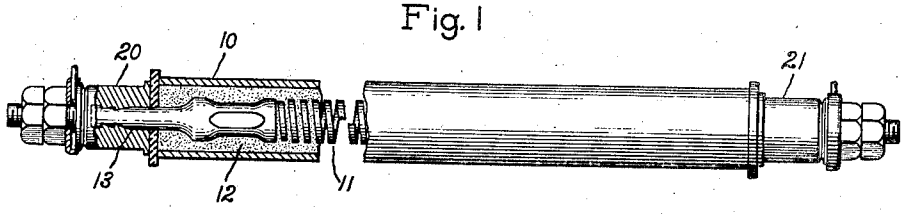
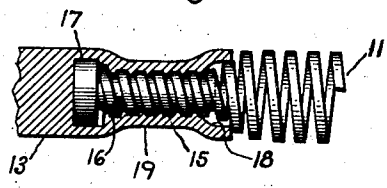


Fig. 2



Inventor:
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by Charles E. Mullen
His Attorney.

Patented July 26, 1932 1,869,140

UNITED STATES PATENT OFFICE

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ELECTRIC HEATER

Application filed August 8, 1930. Serial No. 473,943.

My invention relates to electric heaters, more particularly to electric heaters of the sheathed type, and has for its object the provision of an improved heater having a relatively low resistance.

My invention has a special application to sheathed electric heaters provided with a sinuous resistance element which is embedded in the sheath in compacted, powdered or granular electrically insulating material, such as described and claimed in Patent No. 1,367,341 to Abbott, dated Feb. 1, 1921. Heretofore the resistance conductor in a heater of this type has been formed from a circular wire which has the desirable characteristic of giving the greatest possible rate of heat generation for a given surface area. As pointed out in the Abbott patent, when the unit is reduced as by rolling or swaging to compact the insulating material, the helically formed resistance conductor is apparently upset to a certain extent so that its diameter is actually increased somewhat. This feature is mentioned to give some idea of the force applied to the wire and tending to decrease the diameter of the helix.

For certain types of service, however, a low resistance heater is desirable especially where a relatively large heat output is required from a low voltage supply source. In such cases it is necessary to increase the diameter of the resistance conductor to decrease its resistance and give the increased heat or wattage output. This increase in diameter, however, increases the stiffness and rigidity of the wire, and consequently, it does not readily yield during the reducing operation. As a result the sheath itself is reduced in thickness in the vicinity of the turns of the resistance conductor, whereby its strength is very materially impaired. Weakened portions in the sheath following the helix seem to be formed. The sheath is, therefore, very likely to crack at the weakened portions when the heater is bent to form it in various shapes. This tendency to weaken the sheath may, of course, be offset by increasing the diameter of the sheath so as to provide a thicker layer of insulating material between it and the turns of the resistance conductor, but this is an obvious disadvantage since the heater then occupies more space and cannot be as conveniently applied to the parts to be heated, nor as easily bent into various shapes. It is, therefore, advantageous to use a resistance conductor of low resistance in a sheath of conventional diameter in which the customary thickness of heat insulating material is provided.

One method of obtaining a low resistance heater of this type is to use a plurality of helical resistance conductors formed from wire of conventional diameter but connected in parallel to give the desired low resistance as described and claimed in Patent No. 1,751,416 to Musgrove, dated March 18, 1930. It has been found, however, that this construction also has its limitations, it being impossible even with this method to manufacture resistance heaters having sufficiently low resistances for certain heating purposes without unduly increasing the diameter of the sheath.

I have found that heaters of the sheathed type having still lower resistances for a given wattage output, may be satisfactorily constructed by forming the sinuous resistance conductor from a resistance conductor of oblong section, such as a ribbon-shaped resistance conductor, having a cross-sectional area sufficient to give the desired low resistance, but by reason of its oblong shape, having sufficient flexibility or yieldability to permit the reduction of the sheath in accordance with conventional manufacturing processes without detrimental effects on the sheath.

For a more complete understanding of my invention reference should be had to the accompanying drawing, in which Fig. 1 is a plan view, partially in section, of an electric heater embodying my invention; while Fig. 2 is an enlarged sectional view showing the connection between the resistance conductor and the terminals.

Referring to the drawing, the heater as shown comprises an outer cylindrical metallic sheath 10 with a sinuous resistance conductor 11, shown as a helix, extending centrally of the sheath and embedded in compacted, powdered or granular electrically insulating material 12, such as magnesium oxide. The re-

sistance conductor 11 made of a suitable metal, such as an alloy of nickel and chromium, adapted to withstand relatively high temperatures, is formed from a resistance conductor of oblong cross-section, as shown, a ribbon shaped resistance conductor, for example, by winding the resistance conductor flatwise on a mandrel. This ribbon is relatively thin with respect to its width so that the formed helix is relatively flexible and yieldable as compared with a helix formed from a circular wire having the same cross-sectional area.

In the form shown, the resistance conductor is provided with metallic terminals 13 at its ends, respectively, made from a suitable material which will withstand the swaging or other reducing operation, such as a magnesium-nickel or nickel-silver alloy. An electrical and mechanical connection is provided between the terminals and resistance conductor. As shown in Fig. 2, this connection is substantially of the form described and claimed in a copending application of Charles C. Abbott, Serial No. 452,750, filed May 15, 1930, assigned to the same assignee as this invention. In forming the connection a plurality of turns 15 at the ends of the resistance helix are reduced in diameter so as to closely surround the metallic pin 16 which is inserted in these turns and is provided with an inner head 17. The pin 16 and the reduced turns of the resistance conductor are inserted in a longitudinal bore 18 in the terminal, the head 17 of the pin being somewhat smaller than the bore so as to slip into it easily. The terminal is then swaged or compressed onto the turns 15 as indicated by the reference numeral 19. As more clearly indicated in Fig. 1, the wall of the terminal may be depressed on four sides onto the resistance conductor. As a result the turns 15 are secured firmly between the wall of the terminal and the pin 16, a good electrical as well as mechanical connection being formed. Further security of the connection is provided by the head 17 on the pin which holds the pin securely in place, preventing withdrawal.

The unit is assembled in substantially the manner described in Patent No. 1,494,938 to Abbott, dated May 20, 1924. Briefly stated, the resistance conductor, with the terminals secured thereto, is inserted in the sheath and the terminals secured temporarily as by clips or pins and suitable star and solid washers at the ends of the sheath, the resistance conductor being stretched to separate its turns. As thus arranged it will be observed that the greater dimension or flat side of the resistance conductor is presented to the wall of the sheath. The sheath is then filled with the powdered insulating material 12, it being suitably vibrated at the same time to partially compact it. The sheath is then closed by suitable washers and passed through a swaging or rolling machine whereby its cross-sectional area is reduced to compact the insulating material, preferably to a hard dense mass which is a good electrical insulator and also a good conductor of heat. This operation reduces the diameter of the unit and also increases its length somewhat. After the swaging operation the terminal lugs 20 and 21 are secured to the terminals in the manner described in the aforesaid patent to Abbott, the ends of the sheath being cut off to expose the terminals and remove the temporary washers used in securing the terminals.

By reason of its ribbon-shaped cross-section, the resistance conductor is sufficiently flexible or resilient to yield during the reducing operation and thereby avoid weakening of the wall of the sheath. The heater may therefore be manufactured in accordance with the practice heretofore employed with resistance conductors of much higher resistance and smaller cross-section formed from round wire. If a resistance conductor having the same cross-sectional area formed from round wire were used, a much larger sheath would be required in order to provide a thicker layer of insulating material between the resistance conductor and the sheath to prevent weakening of the sheath during the reducing operation. By means of my invention, therefore, sheathed electric heaters in which the sheath is reduced to compact the heater are commercially practicable in conventional cross-sectional sizes with greatly decreased resistances for a given wattage output.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric heater of the sheathed type in which the sheath is reduced in cross-section to compact the insulating material, comprising in combination with a metallic sheath, granular insulating material in said sheath, and a sinuous resistance conductor embedded in said insulating material, said resistance conductor having a cross-section of oblong shape and being thereby yieldable to provide for a reduction in cross-section of said sheath sufficient to compact said insulating material without the detrimental effects on said sheath produced by a resistance conductor having a round cross section and the same area.

2. An electric heater of the sheathed type in which the sheath is reduced in cross-section to compact the insulating material, comprising in combination with a metallic sheath, powdered insulating material in said sheath, and a helically formed, ribbon-shaped resistance conductor embedded in said insulating material, said resistance conductor having a relatively large cross-sectional area to give a low resistance and being yieldable by reason of its ribbon shape to provide for a reduction in cross-section of said sheath

to compact said insulating material to a hard dense mass without the impairment of the strength of said sheath resulting from the use of a resistance conductor having a round cross section and the same area.

In witness whereof, I have hereunto set my hand this 1st day of August, 1930.

WILFRED F. GÉLINAS.