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METHOD OF MAKING ELECTRIC HEATERS

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Fig. 1

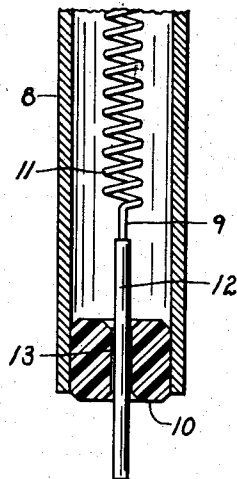


Fig. 2

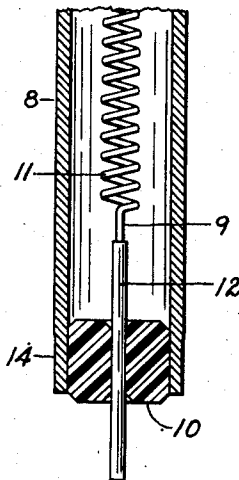


Fig. 3

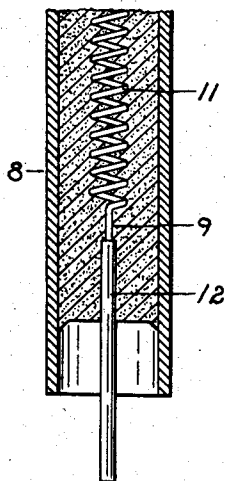
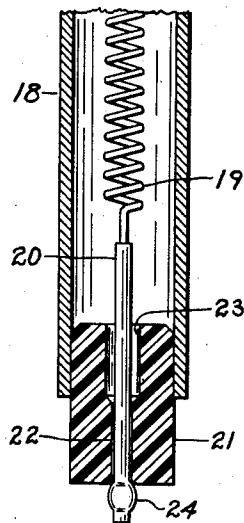


Fig. 4



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METHOD OF MAKING ELECTRIC
HEATERS

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3 Claims. (Cl. 29—155.5)

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This invention relates to a method of making electric heaters, such method being especially advantageous for making heaters of the tubular sheath type.

An object of the invention is to overcome difficulties encountered in preparing heaters of the tubular sheath type for filling from one end of the sheath.

Another object is to facilitate and expedite completion of such heaters, particularly the terminal portions thereof.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawing exemplifies certain of the ways in which the instant method may be carried out, it being understood that the method is not to be regarded as limited by the drawing.

In the drawing:

Figure 1 is a longitudinal view in section of a portion of a so-called tubular heater at one stage of its construction,

Fig. 2 is a similar view showing the heater at a later stage of its construction,

Fig. 3 is a similar view showing the heater at a still later stage of its construction, and

Fig. 4 shows at a stage in construction corresponding to that depicted in Fig. 1 a modified assembly.

Referring to Fig. 1 it shows at an initial stage of assembly a tubular metallic sheath 8, a heating element 9 and a plug 10. Plug 10 which is preferably relatively hard and preferably formed of polystyrene is inserted into one end of sheath 8 with a pressed fit, substantially all of the plug being contained within the sheath. Then the heating element shown as comprising a helical resistor 11 with an end terminal 12 attached thereto in any preferred manner is inserted in the opposite end of sheath 8 and terminal 12 is inserted into a central passage 13 extending through plug 10. The aforementioned terminal 12 is then drawn outwardly of the plug 10 so as to project a selected distance beyond the end of sheath 8. It may be assumed that the resistor 11 has at its opposite end, not shown, another terminal like terminal 12.

The sheath 8, after having the heating element 9 and plug 10 assembled therein as aforescribed, is preferably subjected to swaging confined to that portion of the sheath surrounding plug 10. Such swaging contracts the sheath and compresses plug 10 about the terminal 12 and is continued until the terminal is tightly gripped by the plug. The assembly at this stage is shown in Fig. 2, the end portion 14 of sheath 8 being shown

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slightly deformed inwardly and the plug 10 being shown as having a tight fit with respect to terminal 12. As will be apparent the terminal 12 is now anchored in the proper position in the sheath.

It may now be assumed that the assembly shown in Fig. 2 is placed in one of the well-known types of filling machines which are adapted to effect the filling of the sheath 8 with a suitable granular insulating material such as magnesium oxide. The assembly would be positioned in the filling machine vertically with the end containing the plug 10 lowermost. The opposite end of the heating element 9 (not shown) would be suitably positioned centrally of the bore of sheath 8 and so that the opposite terminal 12 (not shown) would extend the proper distance outwardly of the corresponding end of sheath 8, the granular insulating material would be introduced into sheath 8 with intermittent compacting of the same in a well-known manner. Sheath 8 would be filled to a point below the aforementioned opposite end so as to leave an open recess therein to receive a plug like the plug 10 aforescribed. Assuming use of such a second plug 10, it might be secured and compressed as aforescribed.

Then it may be assumed that the assembly is subjected to well-known swaging operations over the entire length of sheath 8 to effect further compacting of the aforementioned insulating material and to reduce the sheath 8 somewhat in cross section. It may further be assumed that upon completion of the swaging operations the assembly would be placed in an annealing furnace and subjected to annealing temperatures to remove the stresses incurred in the aforementioned swaging operations and to soften the metal forming the sheath.

During the aforementioned annealing treatment the plugs 10 in the ends of sheath 8 would completely volatilize and disappear, polystyrene being of such character that it will completely volatilize and disappear as gaseous combustion products at temperatures attained during annealing treatment without leaving carbon residue. The assembly would then be in the state depicted in Fig. 3 with the sheath open at its ends to receive any preferred terminal devices to be attached to the terminals 12 or to receive any preferred sealing material capable of withstanding high temperatures and affording protection of the compacted granular insulation from ingress of moisture.

Polystyrene will completely disappear as aforescribed when heated in an inert atmosphere.

Certain preferred annealing treatments of sheath type electric heaters are carried out in inert atmospheres, such as in an atmosphere of hydrogen or illuminating gas so as to prevent oxidation of the metallic sheath.

Referring to Fig. 4, it shows an assembly comprising a tubular sheath 18, and a resistor 19 having a terminal 20, the latter projecting through a plug 21 which is inserted in one end of the sheath 18, the assembly shown being at a stage of construction corresponding to that depicted in Fig. 1.

Plug 21, which is also preferably formed of polystyrene, is made with a greater overall length than plug 10 aforescribed. It is provided with a central bore comprising a portion 22 which extends from one end of the plug inwardly a limited extent and connects with an enlarged portion 23 which extends to the opposite end of the plug. The portion 22 of the bore is of such diameter that it will just provide clearance for the terminal 20 while the portion 23 is made so that appreciable clearance is provided for terminal 20.

To produce the assembly shown in Fig. 4 plug 21 is partially inserted into the end of sheath 18 with a pressed fit, the inserted end of said plug being the end with the larger diameter bore 23. Then the resistor 19 with its attached terminal 20 is inserted into the opposite end of sheath 18 and the terminal 20 is inserted into the plug to project therebeyond. Then the portion of terminal 20 immediately adjacent the outer end of plug 21 is squeezed or flattened in any preferred manner to provide a widened portion 24 such as will prevent the withdrawal of terminal 20 from the plug 21 inwardly of sheath 18.

The assembly thus effected and shown in Fig. 4 is ready for subsequent operations as aforescribed in connection with the heater assembly depicted in Fig. 2. However it is not desirable with the modified assembly to subject sheath 18 to the special swaging operation on the end adjacent the plug 21. As will be apparent, the enlarged portion 24 on terminal 20 provides for anchoring the lower end of the heating element during filling of sheath 18. A plug like plug 21 on plug 10 may be inserted in the opposite end of sheath 18 or omitted as preferred.

The assembly after swaging and annealing would appear as depicted in Fig. 3 except in respect of the outer end of terminal 20. That portion of the terminal 20 having the widened portion 24 may be cut off so that the length of the terminal extending beyond the end of the sheath will be substantially the same as that shown in Fig. 3.

The larger bore 23 of plug 20 provides for flexure of that portion of terminal 20 which extends inwardly of sheath 8 from the juncture of the bores 23 and 22. Flexing of the terminal 20 is desirable in order that the heating element may be suitably aligned within the bore of the sheath prior to the filling operation.

What I claim as new and desire to secure by Letters Patent is:

1. The method of making a sheathed electric heater wherein a resistor with a terminal end portion is surrounded by a tubular sheath containing granular refractory insulation in which said resistor is embedded and which is to be compacted by contracting said sheath, comprising inserting into an open end of said sheath prior to contracting the same a formed plug perforated to re-

ceive said terminal end portion of the resistor, said plug consisting of a material which in formed condition is compressible and which breaks down and evacuates from the sheath as vapor when subjected to heat both in air and in an inert atmosphere, then effecting anchorage in said sheath of said plug and the terminal end portion surrounded by said plug, then contracting the sheath laterally over its entire length, and then annealing the sheath to remove the stresses incurred during contraction thereof and to effect evacuation of the plug from the sheath to thereby provide a recess to accommodate a terminal end seal.

2. The method of making a sheathed electric heater, which comprises inserting a resistor with terminal end portions into a tubular sheath, then inserting into an end of said sheath a formed plug, perforated to receive a terminal end portion of said resistor, said plug consisting of a material which in formed condition is compressible and which breaks down and evacuates from the sheath as vapor when subjected to heat both in air and in an inert atmosphere, then effecting anchorage in said sheath of said plug and the end terminal portion surrounded by said plug, then filling the sheath to a point adjacent its other end with granular insulating material, then contracting the sheath laterally over its entire length, and then annealing the sheath in an inert atmosphere to remove the stresses incurred during contraction thereof and to effect evacuation of the plug from the sheath to thereby provide a recess as for accommodation of a terminal end seal.

3. The method of making a sheathed electric heater, which comprises inserting a resistor with terminal end portions into a tubular sheath, then inserting into an end of said sheath a formed polystyrene plug perforated to receive a terminal end portion of the resistor, then effecting anchorage in said sheath of said plug and the end terminal portion surrounded by said plug, then filling the sheath to a point adjacent its other end with granular insulating material, then contracting the sheath laterally over its entire length, and then annealing the sheath to remove the stresses incurred during contraction thereof and to effect evacuation of the plug from the sheath to thereby provide a recess as for accommodation of a terminal end seal.

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