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SHEATHED RESISTOR ELECTRIC HEATER

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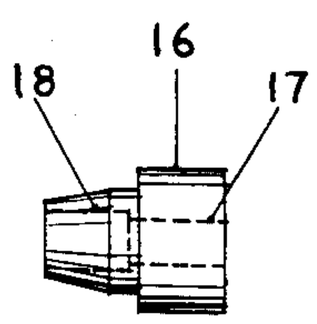

FIG. 3

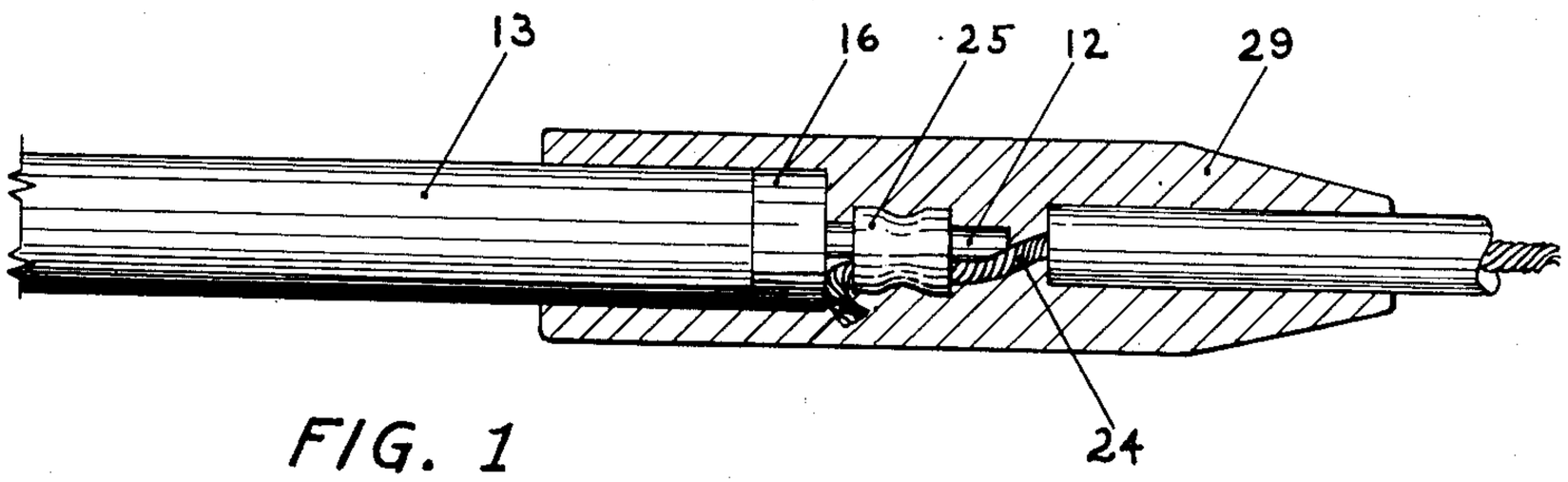

FIG. 1

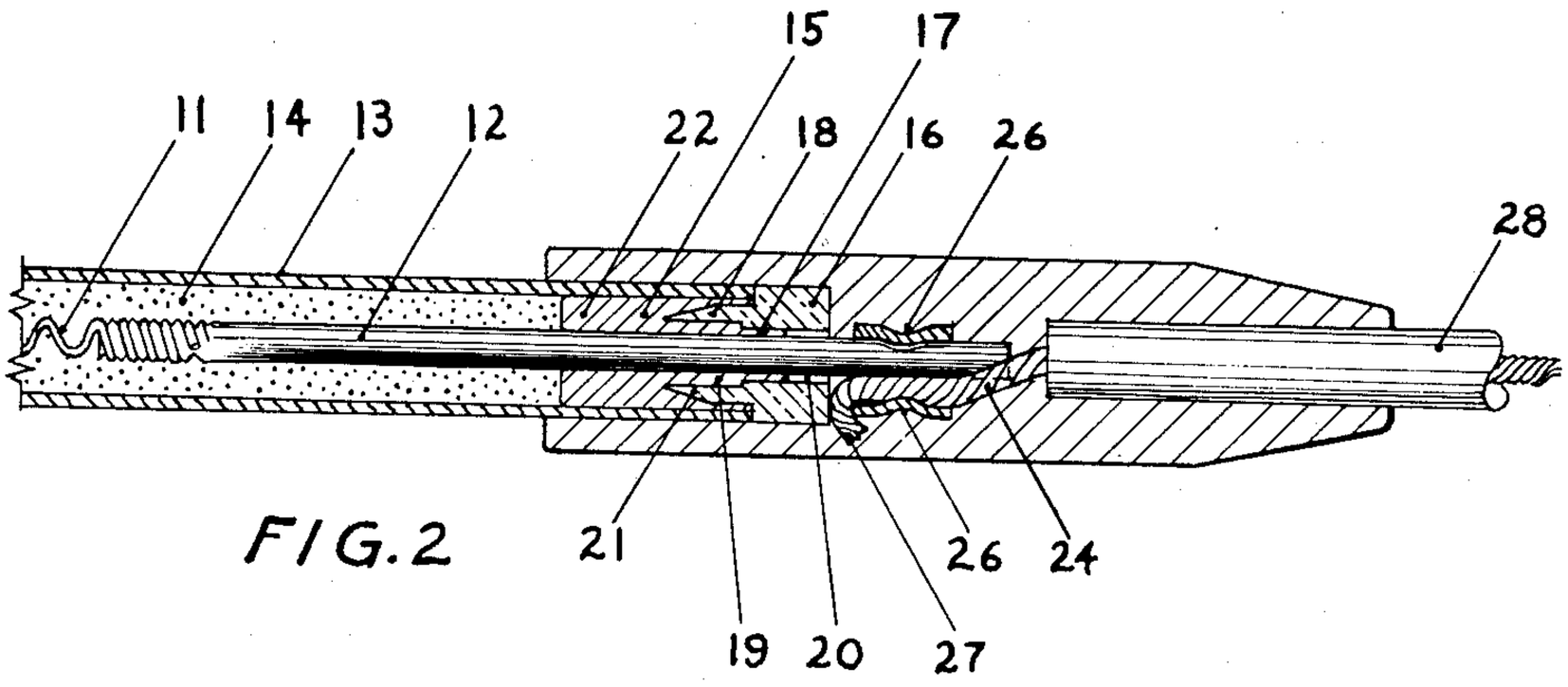

FIG. 2

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SHEATHED RESISTOR ELECTRIC HEATER

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2 Claims. (Cl. 201—67)

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This invention pertains to a sheathed resistor electric heater, and to a method of making such heater.

More particularly, the invention pertains to a sheathed resistor electric heater including a sheath having at least one opening therein, for example, a tubular sheath having one open end, a resistor element disposed in the sheath and having at least one end thereof accessible through the opening in this sheath, such resistor being embedded throughout substantially its length in an electric-insulating heat-conducting material, together with a terminal for the sheathed resistor electric heater of a nature to provide a seal which will be effective to protect the resistor element and the embedding material against fluid or gases such as would have a deteriorating or adverse effect thereon.

That the refractory embedding material must be thoroughly dried and protected against moisture in order to preserve the insulating characteristics of the refractory material is well known, and that the provision of a protective closure or seal has presented a considerable problem is evidenced by various prior patents such, for example, as the patent to Sutton, No. 1,992,787, which discloses the use of a vitreous material such as glass as a closure medium. Another patentee, Abbott, in Patent No. 1,770 824, proposes the use of a material such as Bakelite as the closure medium, and Charbonneau, et al., in Patent No. 2,489,998 proposes the use of a solid rubber plug which is inserted into the open end of a tubular sheath and then placed under longitudinal compression to distort at least one end of the rubber plug into engagement with the internal wall of the sheath and the external diameter of the terminal pin.

The use of vitreous or other material which hardens to become a substantially inflexible solid has several disadvantages, one of which is that the material used as the closure medium must have substantially the same coefficient of expansion and contraction as the material going to make up the sheath and the terminal pin. Otherwise, temperature changes will produce a separation between the sheath wall, the terminal pin and the closure medium. Another disadvantage of a solid practically inflexible closure medium is that such a medium does not have sufficient flexibility to protect the heater terminal against damage from shocks or blows. A solid rubber plug as disclosed by Charbonneau, et al., has the disadvantage that it must be maintained distorted by longitudinal compression, and rubber

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under pressure, and particularly when exposed to the effect of fluids or gases, will generally acquire a permanent set and the sealing qualities will be destroyed.

In accordance with this invention, the refractory material is terminated short of the opening in the sheath to provide a pocket or chamber. To close the opening in the sheath and protect the refractory material from the deteriorating effect of moisture, the pocket or chamber is filled with a preferably initially flowable partially cured or uncured rubber-like adherent material which is or becomes and remains elastic, and which material has the characteristic of expanding under the influence of heat as it cures or polymerizes into a rubbery elastic state. A cover or bushing, having an opening therein through which the terminal pin passes, covers the opening in the sheath in a manner to closely confine the sealing material within the pocket or chamber, and means are provided for maintaining the cover or bushing in close overlying relation with the opening in the sheath to thereby confine the rubber-like material within a predetermined area.

A moldable vulcanizable rubber or rubber-like material is then applied to the exterior of the sheath adjacent the opening therein in such manner as to surround the sheath and to completely cover the closure or bushing applied to the opening in the sheath, as well as the protruding end of the terminal pin, an electric conducting wire attached to the terminal pin, and at least a portion of the length of the usual insulation which covers an electrical conducting wire. This rubber or rubber-like material is then shaped by the use of a mold and the application of heat to form the material into a continuous cover which is adhered to the exterior of the sheath adjacent the opening therein and to at least the leading end of the insulation for the electrical conducting wire, thereby closing the entire assembly against access of vapors or moisture to the refractory embedding material. The heat applied to the rubber or rubber-like exterior covering is conducted to the rubber-like material disposed in the pocket formed adjacent the opening in the sheath and serves to cure or polymerize such material into a flexible rubber-like state, simultaneously causing expansion of the material so that such material, being closely confined in the pocket, will expand into tight sealing engagement with the inner surfaces of the pocket and the external surfaces of the terminal pin extending through the pocket.

Various other objects and advantageous fea-

tures of the invention may be had from the following description when taken in conjunction with the accompanying drawings wherein:

Figure 1 is a fragmentary view, partly in elevation and partly in section, showing a terminal construction for a sheathed heater element embodying the ideas of this invention;

Figure 2 is a view similar to Figure 3 but with the heating element in cross-section to show the details thereof; and

Figure 3 is an elevation showing the cover or bushings forming a part of the terminal seal.

The heater shown in Figures 1 and 2 is of the type commonly used for heating liquids, and comprises a resistor 11 designed for the passage of an electric current and the consequent generation of the desired heat, a terminal pin 12 to which the end of the resistor element 11 is suitably secured, a sheath 13 suitable to the temperatures to be experienced, and commonly of metal, and refractory material 14 embedding the resistor 11 and the inner end of the pin 12 and serving both to electrically insulate the resistor element and pin and also to conduct heat from the resistor element to the sheath.

The heater element illustrated may be bent upon itself providing a body portion suitable to be inserted into the liquid to be heated, with the terminal portions thereof extending through an opening in the wall of a tank or other vessel. It will be understood, however, that the heater element may be of a single length, with one end being formed by a closed sheath and the opposite end including the terminal connection herein illustrated, and that the heater element may be utilized for other purposes than the heating of liquids.

In the illustrated embodiment, the refractory material 14 is not extended to the end of the sheath 13, or is routed out short of the end of the sheath, to thereby provide a pocket or chamber 15 adjacent the open end of the sheath. The open end of the sheath is provided with a closure or bushing 16, preferably of ceramic or similar insulating material. In the embodiment here illustrated, the cover or bushing is provided with an axial bore 17 and a shank 18 which extends into the pocket 15 at the open end of the sheath, the shank 18 being externally smaller than the interior of the pocket and internally larger than the exterior of the terminal pin 12. The axial bore 17 may comprise successively different diameters 19 and 20 and the lowermost end of the shank may be tapered in a direction from the terminal pin 12 toward the interior of the sheath as at 21 for purposes hereinafter made more clear.

Another element of the closure comprises an elastic material 22 filling the spaces between the lower end of the shank 18 and the upper surface of the refractory material 14, between the exterior of the terminal pin 12 and the interior of the shank 18 and the outer diameter of the shank 18 and the interior walls of the pocket 15. This material is formed in position, for example, by placing a proper quantity of the material in the pocket 15 within the sheath terminal portion and then applying the cover or bushing 16, forcing the shank 18 of the cover or bushing into the material, and thus forcing the material to flow upwardly into the spaces between the exterior of the terminal pin 12 and the interior of the shank 18, and between the exterior of the shank 18 and the walls of the pocket 15 in the sheath terminal portion. The different diameters of the axial bore in the cover or bushing, the lowermost diameter being the greater, provides for easier flow of the material between the exterior of the terminal pin 12 and the interior of the shank 18, and also provides for a greater amount of material immediately surrounding the terminal pin 12. The tapered portion 21 at the lower end of the shank provides for a greater amount of the elastic material between the outer surface of the shank and the interior walls of the pocket 15, thereby providing a greater insulating effect for the elastic material at this point.

For this method of application the material 22 must necessarily be in a plastic or flowable condition when it is first placed in the pocket or chamber 15, and the material 22 is such that it is or becomes and remains elastic and of a nature to adhere to the various surfaces with which it is in contact, and particularly to the exterior of the terminal pin 12, the walls of the pocket 15, and the interior and exterior of the shank 18. The material is also such that it expands during the curing or polymerization under the influence of heat, and since it is closely confined in the pocket 15 within a predetermined area, the material will be tightly pressed against all surfaces defining the area. While the complete cause of such expansion of the material 22 on curing or polymerization under the influence of heat is not fully known, it might be assumed that the evolution of gases, during at least the initial stages of curing or polymerization is responsible. Also, at at least one stage of the curing or polymerization, the material assumes a tacky state and closely adheres to the surfaces with which it is in contact.

As one example of a satisfactory material to form that part of the closure indicated at 22, a suitable uncured or slow-curing silicone rubber, preferably having admixed therewith up to twice its weight or more of a substance suitable as a filler, may be used. The preferred proportions of the admixture depend on such factors as the specific ingredients and the specific application, a particular example being approximately equal parts of the silicone rubber known commercially as "Silastic 120," and zircon ground to as fine as minus 400 mesh or finer.

The cover or bushing 16 is held tightly in position in overlying relation with the open end of the sheath 13 in order to closely confine the material 22 within a predetermined area in the open end of the sheath whereby expansion of the material 22 on curing or polymerization will press the material tightly against the surfaces and provide a very tight and effective seal. As illustrated in Figures 1 and 2 of the drawings, an electrical conducting wire 24 is secured to the terminal pin 12 by means of a deformable ring 25 which surrounds the conducting wire 24 and the terminal pin 12 and is crimped as at 26 to secure the conducting wire 24 tightly on the terminal pin 12. The crimped connection between the conducting wire and the terminal pin is so positioned with respect to the cover or bushing that either the deformable ring or the end 27 of the conductor wire is pressed tightly against the cover or bushing 16 to hold it in position with respect to the open end of the sheath. It is to be understood that, if desired, other means such, for example, as a nut threaded onto the terminal pin or a member staked on the terminal pin may be utilized to hold the cover or bushing 16 in position. As is usual, the conductor wire 24 is provided throughout its major length with an in-

sulating cover 26 which is in this instance preferably of rubber, or rubber-like material.

The closure for the open end of the sheath 13 comprises, as a third element, a moldable material 29 which is capable of being molded about the end of the sheath 13 adjacent the open end thereof, the terminal pin 12 and conducting wire 24, and about at least a portion of the length of the insulating material 26 surrounding the conducting wire 24. The material 29 is preferably such that it may be shaped by a mold and cured or polymerized into a flexible elastic covering by being subjected to heat, and also such that the material will vulcanize into tight sealing engagement with the exterior surface of the end of the sheath 13 and with the insulating covering 26 on the conducting wire 24.

As one example, an uncured rubber-like material which is capable of flowing under heat and pressure may be applied to the end of the sheath 13, the protruding end of the terminal pin 12 and the conductor wire 24 connected thereto, and the insulating material 26 in the form of a tube, with the material being such that when it is placed in a mold and subjected to heat the material will flow in a manner to closely engage all of the parts within the tube and will assume a tight sealing engagement therewith.

The material 22 disposed in the pocket formed at the end of the sheath is capable of being cured or polymerized by the use of the heater due to the transfer of heat from the resistor element 11 through the terminal pin 12 and the sheath 13, as well as the refractory material 14, which is effective on the material 22. However, with the construction herein disclosed wherein the outer surface of the open end of the sheath, the protruding end of the terminal pin and at least a portion of the insulated length of the conducting wire 24 is covered by a flexible sheath formed of a material which is flowable and vulcanizable under heat and pressure, the heat supplied to the material 29 to cause the same to flow and vulcanize will simultaneously be effective to cure or polymerize the material 22, thereby forming two flexible, elastic seals simultaneously.

With the construction herein disclosed, and the method of forming a sealed terminal for a sheath embedded-resistor electric heater, there is provided a terminal having numerous advantageous features. For example, an inner and an outer sealing means is provided, both of which are flexible, and both of which will be effective to resist contamination of the refractory material with moisture or vapors. The invention herein disclosed is particularly advantageous for use as, for example, a refrigerator defroster, or in other places where the terminal portion of

the heater element would be subjected to vapors, gases, and moisture.

What is claimed is:

1. An electric heating element comprising a hollow sheath having an opening therein, a resistance conductor member disposed within said sheath and having a terminal end projecting through said sheath opening, a refractory heat conducting material within said sheath for electrically insulating said conductor member and its terminal end from said sheath, an insulated conductor wire having an exposed end electrically connected to the terminal end of said resistance conductor, and a molded protective covering of insulating material enclosing said electrical connection and in hermetically sealed engagement with the defining surface of adjoining parts of said sheath and the insulated end of said wire whereby to restrict foreign material from entering around said protective covering and affecting the operation of said heating element.

2. An electric heating element comprising a hollow sheath having an opening therein, a resistance conductor member disposed within said sheath, a terminal pin disposed within said sheath and projecting at its outer end through said opening, the inner end of said pin being electrically connected to said conductor member, a refractory heat conducting material within said sheath for electrically insulating said conductor member and said terminal pin from said sheath, an insulated conductor wire having an exposed end electrically connected to the end of said terminal pin adjacent said sheath opening, and a protective covering of insulating material molded and vulcanized about and completely enclosing said electrical connection and bonded in hermetically sealing relation to the adjacent insulated end of said wire, said protective covering also extending over and bonded in hermetically sealing relation with the defining surface of an adjoining part of said sheath.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,087,736	Pugh	July 20, 1937
2,379,942	Webber	July 10, 1945
2,460,795	Warrick	Feb. 1, 1949
2,489,998	Charbonneau et al.	Nov. 29, 1949
2,570,800	Hamm	Oct. 9, 1951

FOREIGN PATENTS

Number	Country	Date
557,765	Great Britain	Dec. 3, 1943