

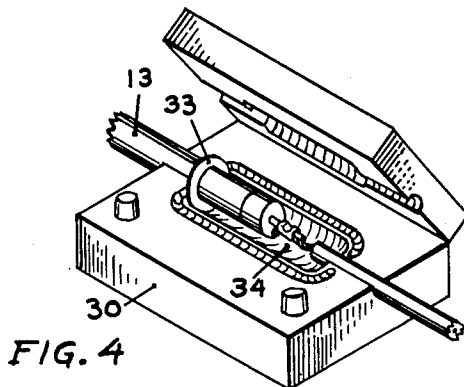
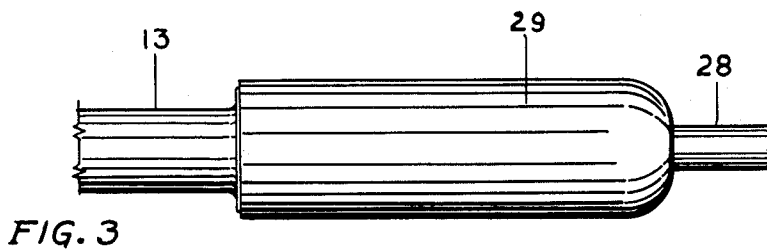
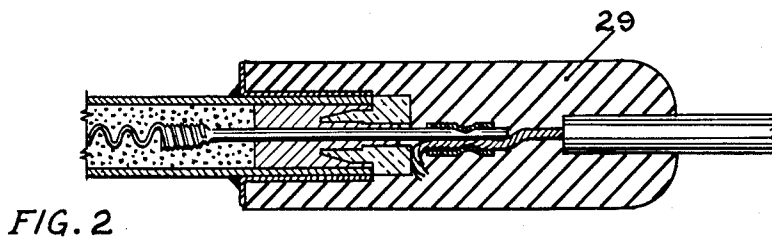
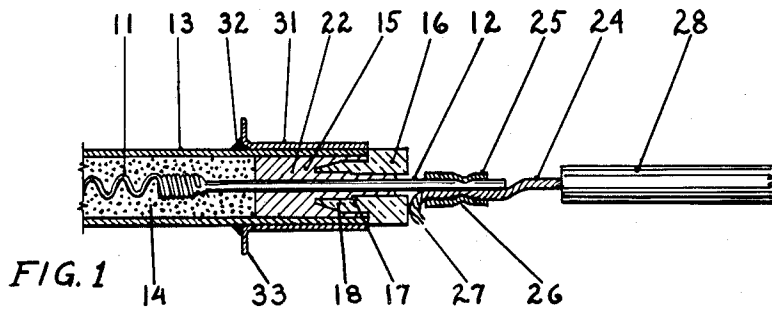
Dec. 13, 1955

A. C. BOGGS
ELECTRIC HEATERS

2,727,120

Filed March 8, 1952

2 Sheets-Sheet 1



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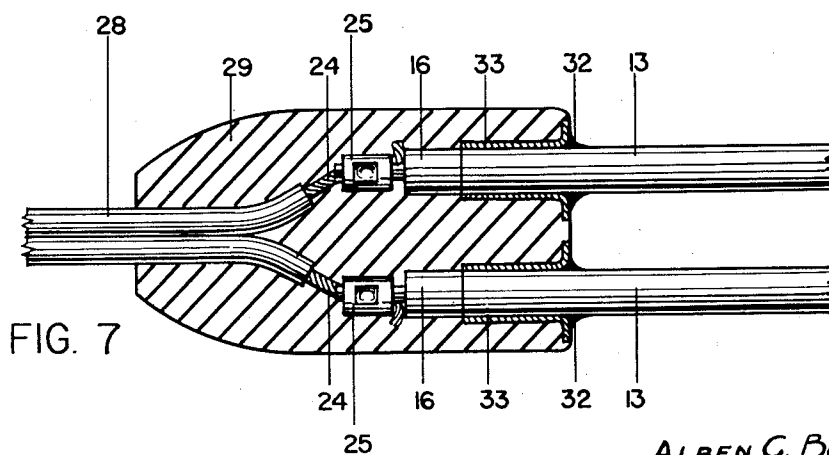
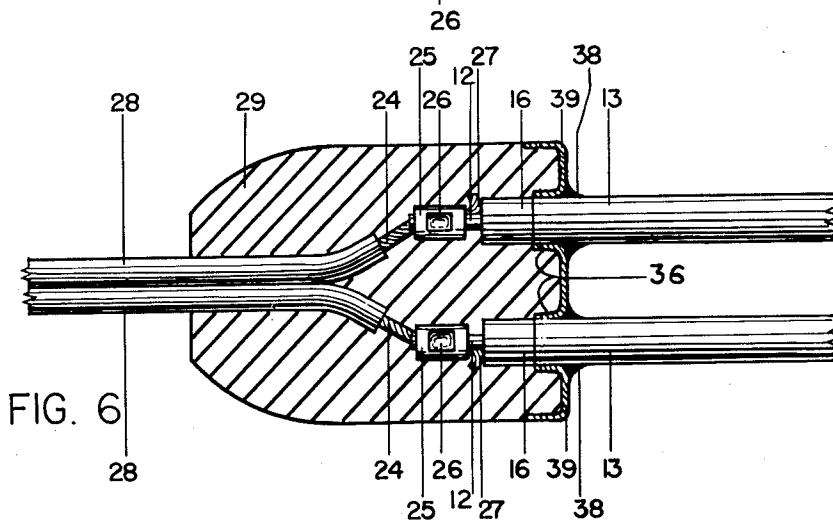
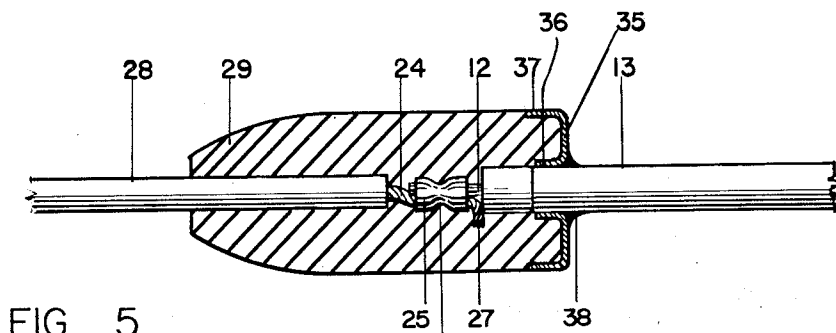
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2 Sheets-Sheet 2



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ELECTRIC HEATERS

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Application March 8, 1952, Serial No. 275,627

11 Claims. (Cl. 201—67)

This invention pertains to electric heaters, and to a method of making such heaters, and the principal object of the invention is to provide new and improved electric heaters, particularly in respect to the terminal portions thereof.

The invention is particularly adapted for use with a sheathed embedded-resistor electric heater wherein the resistor element is disposed within the sheath and is embedded in an electrical insulating heat conducting refractory material, and for illustrative purposes only the invention will hereinafter be described in connection with an electric heater comprising a tubular metallic sheath having a resistor element therein embedded in an electric insulating heat conducting refractory material, and in which the terminal of the resistance element extends outwardly from an open end of the tubular sheath.

That the refractory embedding material must be thoroughly dry 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 art patents illustrating, for example, the use of materials such as glass, Bakelite, and solid rubber plugs as a closure medium.

In the embodiment herein illustrated, the refractory material is terminated short of the opening in the sheath to provide a pocket or chamber, and such opening is sealed in some satisfactory manner. As herein illustrated, the seal provided to close the opening in the sheath and protect the refractory material from the deteriorating effect of moisture is preferably initially flowable partially cured or uncured rubber-like adherent material which is or becomes and remains elastic. A cover or bushing having an opening therein through which the terminal pin connected to the resistor element passes, covers the opening in the sheath in a manner to closely confine the sealing material within the pocket or chamber, means being provided for maintaining the cover or bushing in closely 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 electrical 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 to vapors or moisture to the refractory embedding material.

In order to facilitate tight sealing engagement of the

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moldable vulcanizable rubber with the exterior of the sheath adjacent the opening therein there is provided a sleeve or ferrule of a material, for example, brass, which is compatible with the moldable vulcanizable rubber insofar as the moldable vulcanizable rubber tightly adhering thereto when molded thereabout and subjected to heat. Such sleeve or ferrule surrounds the outer circumference of the sheath adjacent the opening therein and is secured to the exterior of the sheath in a manner to prevent leakage of moisture between the inner circumference of the sleeve and the outer circumference of the sheath. Such sleeve or ferrule is also provided with an annular flange or shoulder adjacent the end thereof away from the opening in the sheath, the flange or shoulder cooperating with the mold for shaping the moldable vulcanizable rubber in a manner to prevent extrusion of the moldable vulcanizable rubber outwardly of the mold and along the length of the sheath, and also acting as a stop to prevent extrusion of the heater sheath out of the cavity by pressure developed in the cavity during the molding cycle.

Various other objects and advantageous features 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 embodying the ideas of this invention;

Figure 2 is a view similar to Figure 1, but showing the covering of moldable vulcanizable material applied to the terminal end of the heater;

Figure 3 is an elevation of the fragmentary portion of the heater shown in Figure 2;

Figure 4 is a perspective view illustrating a form of mold for applying the moldable vulcanizable cover to the terminal portion of the heater;

Figure 5 is a view, partly in elevation and partly in section, showing a modified form of sleeve or ferrule;

Figure 6 is a view similar to Figure 5, but showing the idea of this invention applied to the opposite ends of a hairpin bent heater; and

Figure 7 is a view similar to Figure 6, but showing sleeves or ferrules as shown singly in Figures 1, 2, and 3.

The heater shown in Figures 1, 2, and 3 is of the type commonly used for heating liquids and comprises a resistor 11 designed for the passage of an electric current and 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 terminal pin 12 and serving both to electrically insulate the resistor element and the terminal 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 construction 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 open 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 electric insulating material. In the embodiment here illustrated, the cover or bushing is provided with an axial

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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. If desired, the axial bore 17 may comprise successively different diameters, and the lowermost end of the shank may be tapered in a direction away from the terminal pin 12.

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 between 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.

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 preferably 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 22 is also preferably 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, will be tightly pressed against all surfaces defining the area.

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, one 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 tight and effective seal. As illustrated in Figures 1 and 2 of the drawings, an electrical conductor wire 24 is secured to the terminal pin 12 by means of a deformable ring 25 which surrounds the conductor wire 24 and the terminal pin 12 and is crimped as at 26 to secure the conductor wire 24 tightly to the terminal pin 12. The crimped connection between the conductor wire and the terminal pin is so positioned with respect to the cover or bushing that either the deformable ring 25 or the end 27 of the conductor wire 24 is pressed tightly against the cover or bushing 16 to hold the cover or bushing in position with respect to the open end of the sheath. As is usual, the conductor wire 24 is provided throughout its major length with insulating covering 23 which is in this instance preferably of rubber, or rubber-like material, or at least a material which is sufficiently compatible with a moldable vulcanizable outer cover to provide a tight sealing joint.

The closure for the open end of the sheath 13, as illustrated herein, 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 extending beyond the cover or bushing 16, and about at least a portion of the length of the insulating material surrounding the conductor wire 24. The ma-

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terial 29 is preferably such that it may be shaped by a mold such as illustrated at 39 in Figure 4 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 28 on the conductor wire 24. The material is also such that after being placed in the mold and subjected to heat it will flow in a manner to closely engage all of the parts heretofore mentioned. 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.

In order to insure sealingly tight adherence of the material 29 to the end of the sheath 13 adjacent the opening therein there is provided a sleeve or ferrule 31 which may be of any material compatible with the material 29 insofar as the material adhering thereto and forming a tight seal therewith, surrounding the exterior of the sheath 13 adjacent the opening therein and closely secured in tight sealing engagement with the exterior of the sheath to prevent leakage between the inner circumference of the sleeve or ferrule and the outer circumference of the sheath 13 as, for example, where the sleeve or ferrule is of brass, by means of solder 32. Such sleeve or ferrule 31 is also preferably provided with an annular outwardly extending flange or shoulder at the end thereof furthest removed from the opening in the sheath 13. As shown in Figure 4, such flange or shoulder 33 may be such that it will cooperate with one end of the mold cavity 34 through which the sheath 13 extends to prevent extrusion of the moldable vulcanizable material out of the mold and along the length of the sheath 13. It will be understood that the amount of moldable vulcanizable material initially placed in the mold recess must be sufficient so that when the material is subjected to heat such material will be caused to flow about all parts which it is to cover and will completely surround such parts as shown in Figure 2. It is understood, however, that various types and shapes of molds may be utilized, as well as various methods of applying the moldable vulcanizable cover to the various parts of the electric heater, and the sleeve or ferrule may be made of various materials as long as such material is compatible in forming a tightly adherent bond with the material 29.

In Figure 5 there is shown a modified form of the invention wherein in place of the shouldered sleeve or ferrule 31 there is provided an annular U-shaped ring 35 having a hub 36 provided with a central opening for receiving the heater sheath 13, and also having an outer wall 37, thus forming a cup-shaped cavity facing toward the terminal end of the sheath 13. Assuming the ring 35 to be of a metal, for example, brass, which is compatible with the moldable material 29 insofar as forming a tightly adhering seal therewith, the ring 35 is positioned on the sheath 13 adjacent to terminal opening and secured thereto by soldering or otherwise as indicated at 38 to provide a sealingly tight relation between the hub 36 and the sleeve 13 that will prevent leakage of moisture therebetween. Otherwise, the method and steps of the assembly of the parts is the same as hereinbefore described, with the moldable material 29 forming a sealingly tight joint with the surfaces of the ring 35 with which it is in contact and forming a continuous covering from the ring 35 to and including the leading end of the insulation 28 on the electrical conductor 24. The mold 30 may be such as to accommodate this construction.

Referring to Figure 6, the invention herein disclosed is shown as being applied to a sheathed embedded-resistor heater in which the sheath is bent in, for example a U-shape with the two ends of the sheath lying adjacent each other and in substantially parallel relation. As shown in this figure, the ring 39 is provided with two spaced hubs 36, each provided with a central opening through which the respective ends of the sheath 13 extend. With

this construction, the insulated portions 28 of the electrical conductors 24 may lie side by side, and the material 29 is molded about the entire assembly to provide a continuous covering from the ring 39 to at least the leading ends of the insulation on the respective electrical conductors 24. The material 29 also flows between the respective ends of the sheath 13 and associated parts to provide insulation between the respective ends of sheath 13 as well as a fluid tight covering.

In Figure 8 of the drawings it is illustrated that the construction described in Figures 1 and 2 is adaptable to use with an arrangement of heater sheath wherein the heater sheath is bent, for example, in U-shape and wherein the adjacent ends of the sheath lie relatively closely to each other and in substantially parallel relation. As shown in this figure, the material 29 is molded about the sleeves or ferrules 33 on the respective ends of the sheath 13 in a manner to provide a single complete covering for the pair of sleeves or ferrules 33 on the respective adjacent ends of the sheath 13.

What is claimed is:

1. A sealing closure for the terminal end of an electric heating device having a resistor means including a terminal and sheath means generally enclosing said resistor means, and provided with a tubular portion defining an opening through which said terminal extends, said closure comprising a moldable material surrounding and forming a sealed joint with the exterior of the tubular portion of the sheath adjacent the opening therein and with the resistor terminal extending outwardly of said opening, a sleeve surrounding the tubular portion of the sheath means defining said opening and of a material compatible with said moldable material to the extent of forming a tight sealing joint therewith, and a radially extending flange on said sleeve adjacent the end thereof removed from the opening in said tubular portion and against which said moldable material abuts.

2. A sealing closure for the terminal end of an electric heating device having a resistor means including a terminal and sheath means generally enclosing said resistor means, and provided with a tubular portion defining an opening through which said terminal extends, said closure comprising a moldable rubber-like material surrounding and forming a sealed joint with the exterior of the tubular portion of the sheath adjacent the opening therein and with the resistor terminal extending outwardly of said opening, a sleeve surrounding the tubular portion of the sheath means defining said opening and of a material compatible with said moldable material to the extent of forming a tight sealing joint therewith, and a radially extending flange on said sleeve adjacent the end thereof removed from the opening in said tubular portion and against which said moldable material abuts.

3. In combination with a sheathed resistor-type electric heater having a resistor terminal electrically connected to an insulated conductor wire and a fluid-tight seal extending from the insulation of said conductor wire to the sheath of said heater, said seal enclosing the electrical connection between the resistor terminal and said conductor wire and protecting said connection from contact with foreign matters, a covering surrounding the sheath, said covering being of a material compatible with said sealing material to the extent of forming a fluid-tight joint therewith, and a radially extending flange on said covering and against which the sealing material abuts.

4. A closure for the resistor terminal opening of a sheathed-embedded resistor electric heater, comprising a sealing material disposed in the terminal opening and surrounding the resistor terminal, an exterior covering for the sheath and the resistor terminal including a moldable material surrounding and forming a sealed joint with the sheath and the resistor terminal, and a sleeve surrounding the sheath, said sleeve being of a material compatible with said sealing material to the extent of forming a fluid-

tight joint therewith, and a radially extending flange on said sleeve and against which the sealing material abuts.

5. A sealing closure for the terminal end of an electric heating device having resistor means including a terminal and also having sheath means generally enclosing said resistor means and provided with a tubular portion defining an opening through which said terminal extends, said closure comprising moldable rubber-like material and a sleeve of material sealingly compatible with said moldable material, said sleeve engaging and surrounding said tubular portion and said moldable material engaging and surrounding and forming a sealed joint with said sleeve and with the terminal extending outwardly of said opening.

6. A sealing closure for the terminal end of an electric heating device having resistor means including a terminal and sheath means generally enclosing said resistor means and provided with a tubular portion defining an opening through which said terminal extends, said closure comprising a sleeve surrounding said tubular portion and fixed thereto in fluid-tight relation, and a moldable material engaging and surrounding said sleeve, said sleeve being formed of material which is compatible with said moldable material to the extent of forming a tight sealing joint therewith.

7. In combination with a sheathed resistor-type electric heater having a resistor terminal electrically connected to an insulated conductor wire, comprising rubber-like moldable material, and a sleeve of material compatible with said moldable material and securely engaging and surrounding the terminal end of said heater, said moldable material being molded to enclose the electrical connection between the resistor terminal and the conductor wire and extending from sealing engagement with the insulation of said conductor wire to sealing engagement with said sleeve to protect said electrical connection from contact with foreign matter and to seal the terminal end of said heater against entrance of foreign matter.

8. In an electric heating device including resistor means having a terminal, sheath means enclosing said resistor means and provided with an opening through which said terminal extends, and a conductor wire having electrical connection with the extending portion of said terminal and having an insulating covering, the method of forming a seal at the terminal end of said heating device which comprises, surrounding the exterior of the sheath adjacent said opening with a sleeve formed of material which is compatible with a heat moldable material to the extent of forming a fluid-tight joint therewith, securing said sleeve to said sheath in fluid-tight relationship and molding a heat moldable material about said sleeve and said electrical connection and the insulation of said conductor with application of sufficient heat to form a sealed joint between said heat moldable material and the surfaces with which it is in contact.

9. A sealing closure for the terminal end of an electric heating device having resistor means including a terminal and also having ferrous sheath means generally enclosing said resistor means and provided with a tubular portion defining an opening through which said terminal extends, said closure comprising a sleeve of non-ferrous material engaging and surrounding said tubular portion and a moldable material engaging and surrounding said sleeve covering, the latter being formed of material which is compatible with said moldable material to the extent of forming a tight sealing joint therewith.

10. A sealing closure for the terminal end of an electric heating device having resistor means including a terminal and ferrous sheath means generally enclosing said resistor means and provided with a tubular portion defining an opening through which said terminal extends, said closure comprising a brass sleeve surrounding said tubular portion and fixed thereto in fluid-tight relation, and a rubber-like material molded about said tubular portion and in compatible sealing relation with said sleeve.

11. A sealing closure for the open end of an electric

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heating device having a resistor conductor encased in a tubular protective sheath, the combination comprising a terminal conductor electrically connected to said resistor and extending outwardly of an open end of said sheath, an insulated conductor wire having an electrical connection with the extending portion of said terminal conductor, insulating material enclosing said electrical connection, said insulating material being contiguous to the open end of said sheath and extending therefrom and into sealing engagement with the insulation of said conductor wire, and metallic means in sealing contact with a peripheral

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surface adjacent to the open end of said sheath and with the contiguous insulating material and interposed therebetween to insure compatible sealing relation thereof.

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