

Dec. 10, 1957

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2,816,207

ELECTRIC HEATERS

Filed March 2, 1956

Fig. 1

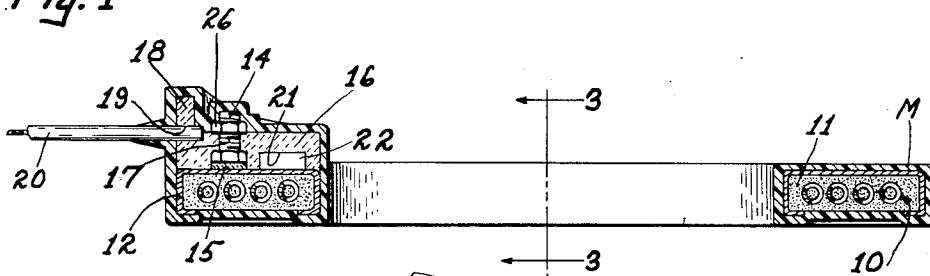


Fig. 2

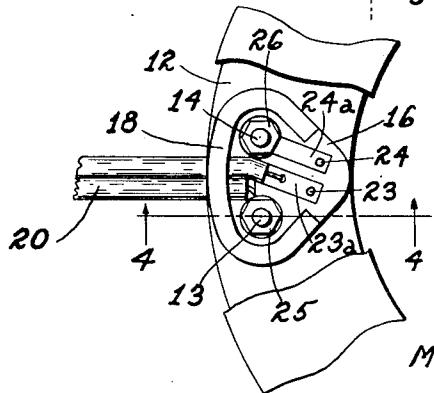


Fig. 3

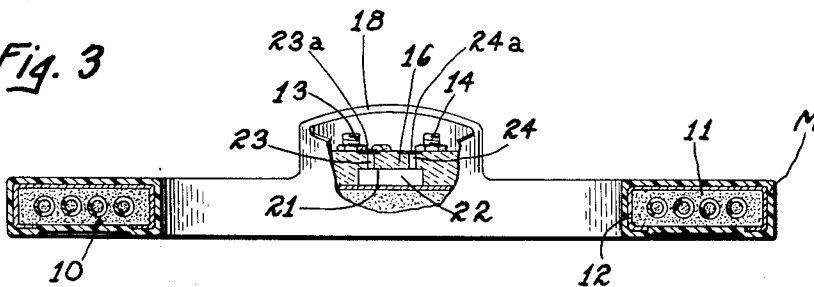
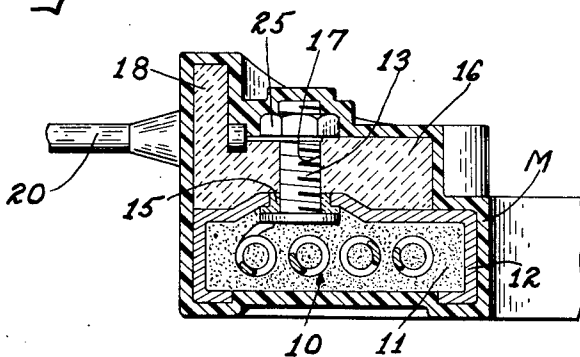


Fig. 4



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ELECTRIC HEATERS

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Application March 2, 1956, Serial No. 569,195

6 Claims. (Cl. 219—41)

The present invention relates to electric resistance heaters and the principal object of the invention is to provide new and improved heaters of such character.

Heretofore, attempts have been made to protect metallic sheathed, electric resistance heaters against the entrance of deleterious substances by enclosing the terminal portion of the heater with a rubber-like boot which extended from the insulation of the lead wire, over the electrical connection between the lead wire and the heater, and which engaged the sheath of the heater adjacent such electrical connection. The foregoing construction is adequate for certain purposes; however, this construction is necessarily limited to heaters having a leak-proof sheath.

Under certain circumstances, it is desirable to form the heating element by merely embedding a resistor conductor in electric-insulating, heat-conductive material. In these cases, the sheath which normally encases the material is partially or completely eliminated. Heretofore, such elements frequently could not be utilized when their application subjected them to moisture or other deleterious fluids.

The present invention provides an embedded electric resistance heater which, while not completely enclosed in a metallic sheath, is nevertheless completely sealed against moisture and the like. This and other advantages will readily become apparent from a study of the following description and from the drawings appended hereto.

In the drawings accompanying this application and forming a part of this specification there is shown, for purpose of illustration, an embodiment which the invention may assume, and in these drawings:

Figure 1 is a transverse section through an electric resistance heater constructed in accordance with the present invention,

Figure 2 is a fragmentary top plan view of a portion of the heater illustrated in Figure 1, the outer covering of the heater being removed to illustrate the underlying structure,

Figure 3 is a sectional view generally corresponding to the line 3—3 of Figure 1, a portion of the heater being broken away to illustrate interior structure, and

Figure 4 is an enlarged sectional view generally corresponding to the line 4—4 of Figure 2.

The present heater is adapted for use in a very humid atmosphere, and, at times, it may be more or less submerged in water. It is to be understood that the present heater may also be subjected to or immersed in certain highly corrosive solutions such as acid and the like without damaging the heater. As best shown in Figures 1 and 3, the present heater is ring-like in form; however, it is to be understood that the heater may take any other suitable shape as required by its specific application.

The heater herein illustrated comprises a heating element formed of a coiled resistor conductor 10 embedded in compacted electric-insulating, heat-conductive refractory material 11. In the present embodiment, a metallic sheath 12 partially encases the refractory material to protect it against rough handling or other physical damage.

To provide for making electrical connections to the resistor conductor, a pair of terminal conductors 13, 14 are embedded in the refractory material and each has one end connected to respective ends of the resistor conductor and each projects outwardly (as shown in Figure 4) through respective apertures in sheath 12. A dielectric bushing 15 is interposed between each terminal conductor and the aperture defining portion of the sheath to insure electrical isolation therebetween. The outwardly projecting portions of the terminal conductors are threaded for a purpose to be disclosed.

To facilitate making electrical connections to the heating element and for other purposes later to appear, a dielectric terminal block 16 is secured to the heating element. Terminal block 16 is provided with a pair of through apertures 17 for passing respective terminal conductors 13, 14 and a portion of the block adjacent the outer periphery of the heating element provides an upstanding protective wall 18 which projects beyond the ends of the terminal conductors. Wall 18 is apertured at 19 (see Figure 1) to pass a two-conductor, insulated lead wire 20.

As illustrated in Figures 1 and 3, the face of block 16 which is adjacent the heating element is provided with a recess 21 for receiving a thermostat 22. This thermostat may be of any commercially available design which is adapted to open an electrical circuit when its temperature reaches a preset value and to close the circuit when its temperature drops below a present value. Thermostat 22 has terminals 23, 24 which pass through apertures in the terminal block and which carry current to the thermostat. Note that the thermostat rests upon sheath 12 so that it will be responsive to the surface temperature of the heating element.

With reference to Figure 2, one of the conductors of lead wire 20 is connected to terminal conductor 13 and held in place by a nut 25 which is threaded on the terminal conductor. The other lead wire conductor is soldered or otherwise secured to a conductor bar 23a which is disposed in a recess in the upper face of the terminal block and is connected to thermostat terminal 23. Thermostat terminal 24 is connected to a conductor bar 24a which is disposed in a recess in the upper face of the terminal block and the conductor bar is secured to terminal conductor 14 by means of a suitable nut 26. It will be clear that as nuts 25, 26 are threaded down on their respective terminal conductors, they will draw terminal block 16 tightly against the heating element.

With the heater assembled as described, it will be coated with a suitable electric-insulating material M which is impervious to the fluid to which the heater will be subjected in its contemplated usage. It has been found that an excellent water-impervious coating is provided by various vinyl dispersion resins. These resins are available under various trade names such as Plastisol, Rigidol and Plastigel. At the present time, this material is applied to the heater in liquid form by a dipping or spraying operation and the material is then cured by placing the coated heater in an oven or the like to harden the material to its final, rubber-like character.

It will be understood that more than one layer of material may be applied so as to build the coating up to the requisite thickness. It will also be understood that the material is applied to the insulation of the lead wire 20 adjacent the terminal block so as to form an unbroken sheath which extends from the insulated lead wire over the entire heater. Since it is important that the material M form a watertight bond with the insulation of the lead wire, it is preferable that such insulation be of a vinyl composition similar to that of the material. In view of the fact the lead wire insulation is subjected to the heat

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employed to cure the material, the wire insulation is selected to have a temperature resistance sufficiently high so that it will retain its shape during the curing operation.

In operation, lead wire 20 will be connected to a suitable source of electric energy. Current will then flow through the resistor conductor 10 to generate heat. When the surface temperature of the heating element has been raised to a sufficient level, which level will be below the maximum permissible temperature to which the coating can safely be subjected, the thermostat will open the electrical circuit and de-energize the resistor conductor. When the surface temperature of the element once again drops, the thermostat will re-energize the resistor conductor. In this manner, the heating element will be maintained at a temperature below that which would damage the coating.

Under certain conditions, it is possible to eliminate the thermostat by utilizing a resistor conductor which is so designed that, even under continuous energization, it will not raise the surface temperature of the heating element above a safe level.

In view of the foregoing it will be apparent to those skilled in the art that I have accomplished at least the principal object of my invention and it will also be apparent to those skilled in the art that the embodiment herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described, hence it will be appreciated that the herein disclosed embodiment is illustrative only, and that my invention is not limited thereto.

I claim:

1. An electric heater comprising a heating element formed of a resistor conductor embedded in electric-insulating, heat-conductive material which increases the latter's heat radiating area, a terminal conductor electrically connected to said resistor conductor and projecting from said material, a dielectric terminal block positioned against said heating element adjacent said terminal conductor, an insulated lead wire electrically connected to said terminal conductor for supplying current to said resistor conductor, means for protecting said heating element against damage by fluids to which the heater may be subjected comprising a coating of electric-insulating, fluid-impervious material totally enclosing said heating element, said terminal block, said terminal conductor, and a portion of said lead wire adjacent to the latter, said coating cooperating with the insulation of said lead wire to provide an unbroken sheath for said heater, and thermostat means disposed in a recess in said terminal block and responsive to the surface temperature of said heating element, said thermostat means interrupting current flow to said resistor conductor and maintaining the surface temperature of said heating element below that temperature which would damage said coating.

2. An electric heater comprising a heating element formed of a resistor conductor embedded in electric-insulating heat-conductive material which increases the latter's heat radiating area, a terminal conductor secured to said heating element and electrically connected to said resistor conductor and projecting from said material, a dielectric terminal block positioned against said heating element adjacent said terminal conductor and having a recess whose mouth is adjacent said heating element, means in part carried by said terminal conductor maintaining said terminal block in position, an insulated lead wire electrically connected to said terminal conductor for supplying current to said resistor conductor, means for protecting said heating element against damage by fluids to which the heater may be subjected comprising a coat-

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ing of electric-insulating fluid impervious material totally enclosing said heating element, said terminal block, said terminal conductor, and a portion of said lead wire adjacent to the latter, said coating cooperating with the insulation of said lead wire to provide an unbroken sheath for said heater, and thermostat means interposed between said terminal block and said heating element, said thermostat means being disposed in said recess in thermal transfer relation to said heating element and said thermostat means interrupting current flow to said resistor conductor and maintaining the surface temperature of said heating element below that temperature which would damage said coating.

3. An electric heater comprising a heating element formed of a resistor conductor embedded in electric-insulating, heat-conductive material which increases the latter's heat radiating area, a threaded terminal conductor secured to said heating element and projecting from said material, said terminal conductor being electrically connected to said resistor conductor, a dielectric terminal block positioned against said heating element and having a recess whose mouth is adjacent said heating element and further having an aperture through which said terminal conductor projects, means threaded on said terminal conductor for maintaining said terminal block in position, an insulated lead wire electrically connected to said terminal conductor for supplying current to said resistor conductor, means for protecting said heating element against damage by fluids to which the heater may be subjected comprising a coating of electric-insulating, fluid impervious, rubber-like material totally enclosing said heating element, said terminal block, said terminal conductor, and a portion of said lead wire adjacent to the latter, said coating cooperating with the insulation of said lead wire to provide an unbroken sheath for said heater, and thermostat means interposed between said terminal block and said heating element, said thermostat means being disposed in said recess in thermal transfer relation to said heating element and said thermostat means interrupting current flow to said resistor conductor and maintaining the surface temperature of said heating element below that temperature which would damage said coating.

4. An electric heater, comprising a rigid heating element including a metal sheath, refractory material within said sheath and a resistor conductor embedded within said refractory material and having a terminal portion extending laterally of said sheath, an insulated lead wire electrically connected to said terminal and extending therefrom for connection to a source of electrical energy, and a protective coating for the foregoing assembly to completely envelop the same in fluid-proof manner, comprising a vinyl dispersion resin applied to said assembly in liquid form to conform to and coat all exterior surfaces of said assembly and effect a fluid-proof seal between said insulated lead and said heating element, said coating thereafter being cured to rubber-like character.

5. The construction according to claim 4 wherein the heating element is flat and ring-shaped.

6. The construction according to claim 4 wherein a thermostat is positioned against a surface of said sheath and controls the temperature of said heating element.

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