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R. J. SUTTON

1,992,787

ELECTRIC HEATER

Filed Aug. 5, 1932

Fig. 1.

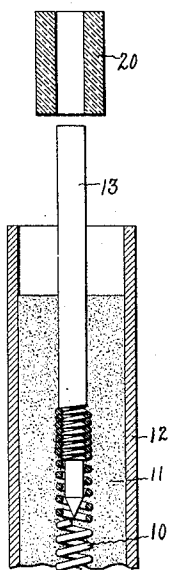


Fig. 2.

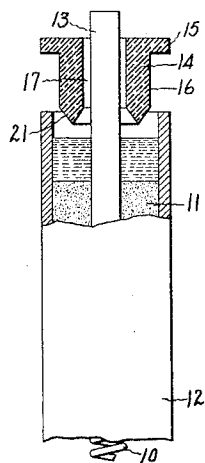


Fig. 3.

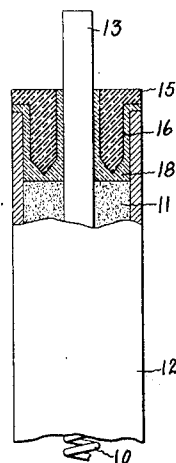
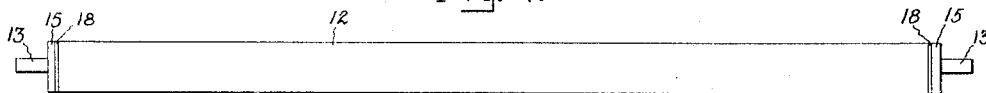


Fig. 4.



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UNITED STATES PATENT OFFICE

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ELECTRIC HEATER

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6 Claims. (Cl. 201—63)

My invention relates to electric heaters and the like, and has for its object the provision of improved method and means for sealing the terminals of heaters of this type.

5 Although not limited thereto, my invention has particular application to electric heaters of the incased or sheathed type wherein a resistance conductor embedded in an insulating material is inclosed by an outer metallic protective casing.

10 In one of its aspects, my invention contemplates the provision of improved means for sealing the terminals of electric heaters of the sheathed type whereby the heaters are rendered

15 impervious to moisture, oil, gas and like fluids. In carrying out my invention in one form thereof, I surround each terminal member of the heater with an electrically insulating body formed of some suitable material, such as lava. Preferably, this body will be arranged in substantially concentric relation with the terminal and in spaced relation with it and also with the sheath which incases the terminal. The insulating body is embedded in a mass of vitreous material which

20 fills the spaces between the body and the terminal and the body and the sheath. The vitreous mass, which preferably will be formed of glass, is arranged to make fluid-impervious joints with the terminal, insulating body and the inclosing casing.

25 For a more complete understanding of my invention, reference should be had to the accompanying drawing in which Fig. 1 is a fragmentary sectional view of an electric heater of the sheathed type, and illustrating one step in my improved method of making a terminal seal for the heater arranged in accordance with my invention; Fig. 2 is a fragmentary view of the electric heater of Fig. 1, parts being shown in sections,

30 and illustrating the terminal seal at a more advanced stage in its construction; Fig. 3 is a view similar to Fig. 2, but illustrating the terminal seal at a still more advanced stage in its construction; and Fig. 4 is an elevation of the complete sheathed heating unit of Fig. 1 provided with terminal seals arranged in accordance with my invention.

Referring to the drawing, I have shown my invention as applied to a helical coil sheathed electrical heating unit of the type described and claimed in U. S. Patent No. 1,367,341 to C. C. Abbott, dated February 1, 1921.

As shown, the heating unit comprises a helical

55 mass of powdered heat refractory insulating ma-

terial 11, the conductor and insulating material being incased by a metallic sheath 12. The insulating material 11 may be any suitable substance, but preferably will be formed of powdered magnesium oxide. This material may be compacted to a hard dense mass having a good heat conductivity in any suitable manner, such as by reducing the diameter of the sheath after the unit has been assembled and the sheath has been loaded with magnesium oxide. The sheath may be reduced by swaging or rolling.

The resistance conductor 10 extending through a considerable portion of the length of the sheath 12 has its two ends connected to terminal members 13, which, as shown, project from the ends of the sheath. The inner ends of the terminals are supported by the compacted insulating material 11.

While the resistance conductor may be connected to its terminals 13 in any suitable manner, I prefer to connect them in the fashion described and claimed in U. S. Patent No. 1,494,938 to C. C. Abbott, dated May 20, 1924. As there described, the terminal members 13 have their inner ends threaded and are electrically and mechanically connected with the resistance conductor by screwing a number of the end turns of the conductor onto the threaded ends of the terminals. In this arrangement, the terminals have a diameter slightly greater than the diameter of the helix of the conductor 10.

In making the heating unit thus far described, the terminals 13 are attached to the conductor 10 and then the conductor with the terminals attached is threaded through the sheath 12. The sheath is then loaded with the oxide in any suitable manner, and then its diameter is reduced as by swaging or rolling.

In order to render the terminals absolutely impervious to the leakage of fluids into the sheath, I surround each terminal with a body 14 formed of some suitable fluid-impervious electrically insulating material, such as lava (Figs. 2 and 3). The insulating body is provided with a flange 15 and with an extension 16 preferably formed integrally with the flange and having a diameter somewhat less than the outside diameter of the flange.

The body 14, as shown, is provided with a centrally arranged aperture 17 for the terminal 13. The diameter of this aperture is somewhat larger than is the diameter of the terminal, and, as shown, the outside diameter of the extension 16 is somewhat less than is the inside diameter of the sheath 12. The body 14 is assembled with its extension

16 in substantially concentric relation with the terminal and with the sheath so that spaces are left between the terminal and insulating body and between the insulating body and the sheath.

5 The extension 16 is substantially completely embedded in a mass 18 of a suitable vitreous material, such as glass (Fig. 3). As shown, the mass of material 18 completely fills the space between the terminal 13 and the insulating body 10 14 and between this body and the sheath 12. The mass of glass 18 forms fluid-impervious joints with the terminal 13, insulating body 14 and the inclosing casing 12. It is preferable to use a glass having a relatively high electrical resistance at 15 the operating temperature of the heating unit.

Preferably, the glass 18 and the terminals 13 and casing 12 will have substantially the same coefficient of expansion. I have found that a terminal made of nickel manganese alloy having 20 a nickel content of approximately 98% is satisfactory; the casing 12 may be formed of similar material. I have also found that satisfactory results are obtained if the terminal and casing are formed of steel or other metals having substantially the same coefficient of expansion as the 25 vitreous sealing material 18.

In making the terminal seal, I square off the terminal ends of the sheath after the heating unit has been formed and then remove the insulating 30 material from each terminal end for a short distance, as shown in Fig. 1.

The exposed walls of the sheath and terminals 13 are then cleansed in any suitable manner, and then, if necessary, these walls of the sheath may 35 be sized to accommodate the insulating body 14 and the embedding mass of glass 18.

Then I thread each terminal 13 with a tube 20 (Fig. 1) formed of the glass, referred to above, and with an insulating body 14.

40 After this, the heating unit is preheated at a temperature high enough to expel the air and moisture present in the insulation and sheath. Satisfactory results will be obtained if the unit is heated at a temperature of 1600° to 1650° F. for a 45 period of 15 to 18 minutes. During this operation the temperature of the terminal ends should not be allowed to exceed 1200° F.

After the unit has been preheated, as above described, the terminal ends of the unit are heated 50 to a temperature of 1725° to 1750° F. at which temperature the glass will become fluid. When this has been accomplished, the heating will be discontinued and the unit allowed to cool until the glass becomes fairly stiff. Usually a cooling period 55 of but a few seconds is necessary to accomplish this. The insulators 14 are then pressed firmly down into the glass. Preferably, the lower edge of the extension 16 of each insulator will be tapered, as indicated at 21, to facilitate the movement 60 of the insulating body into the molten glass. As the insulating body 14 is thus pressed down into the glass, some of the molten glass will be forced upwardly into the aperture 17 surrounding the terminal 13 and into the annular space between the extension 16 and the sheath 12, as 65 shown in Fig. 3. It will be understood that the glass cylinder 20 will have a volume sufficiently large so that when the insulating body 14 is pressed into place, there will be sufficient glass 70 to completely fill the spaces between the terminal and the insulating body and between the insulating body and the sheath 12. The insulating body should be forced down into the glass so far that 75 the flange 15 will press firmly against the adjacent

edge of the sheath 12. Usually a thin film of glass will remain between the edge of the sheath and the flange 14, as shown in Figs. 3 and 4.

After the insulators have been positioned, as above described, the unit is allowed to cool slowly 5 in air so that the glass will be annealed by the residual heat.

As previously pointed out, it is preferable to thoroughly cleanse the inner surfaces of the sheath 12 before the glass is applied. Likewise, 10 it is advisable to thoroughly cleanse the terminals 13. These surfaces should be cleansed so that they will be "wetted" by the glass when it is rendered plastic, whereby when the glass hardens upon subsequent cooling, moisture proof and gas 15 tight joints will be provided between these surfaces and the glass. The surfaces of the sheath and terminals may be cleansed by machining operations or by sand blasting or by any other suitable cleansing process.

After each terminal has been sealed, as above described, suitable terminal connector members (not shown) may be attached to the protruding 20 portions of the terminals.

It is to be understood that it is not necessary 25 to use glass for the sealing material 18, but that other similar substances, such as vitreous enamel, or suitable organic compounds, may be used.

It will be observed that by my process, a terminal seal is provided for each terminal of the 30 heater which comprises an insulating body 14 surrounding the terminal and spaced from it and from the inclosing casing 12, these spaces being completely filled by the mass of glass 18. The glass 18 adheres to the terminal 13, the insulating 35 body 14 and the walls of the inclosing casing 12 so as to form fluid impervious joints with these members. The insulating bodies 14 function to increase materially the electrical strength of the terminal ends of the unit. The body 14 having 40 its portion 16 extending deeply into the sealing compound with its flange 15 overlapping the edge of the sheath gives a considerable length of path from the terminal to the sheath. In other words, the insulating bodies increase materially the electrical clearance of the heater at its terminals. 45

The terminal seals of my invention effectively prevent the admission of fluids into the sheath. It is to be understood that they may be used just 50 as effectively to retain a selected atmosphere in the sheath, such as an atmosphere for preserving the life of the resistance heating element. Thus, for example, the seals may be used to retain a non-oxidizing or reducing atmosphere in the sheath to protect the heating element. 55

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since 60 many modifications may be made, and I therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is: 65

1. An electric heater comprising a resistance conductor, a terminal secured to said resistance conductor, a metallic sheath encasing said resistance conductor and terminal, the end of said terminal projecting from the end of said 70 sheath, an electrically insulating sleeve within said sheath surrounding said terminal in spaced relation with said terminal and said sheath, and a vitreous sealing material having substantially the same coefficient of thermal expansion as said 75

terminal and sheath arranged within said sheath so as to fill the spaces between said sleeve and said terminal and sheath respectively and having fluid impervious joints with said members.

5 2. An electric heater comprising a resistance conductor, a metallic sheath incasing said conductor, a terminal for said conductor and means sealing said terminal comprising a substantially homogeneous layer of electrically insulating material between said terminal and said sheath
10 substantially filling the space between these members but spaced from each of them, and substantially homogeneous layers of glass having a relatively high electrical resistivity at the operating temperature of said heater arranged in the spaces between said insulating material and said terminal and sheath and adhering to said terminal, insulating material and sheath to form fluid-impervious joints therewith.

20 3. The combination with an electric heater provided with a resistance conductor embedded in an insulating material inclosed by a metallic sheath and a terminal secured to said conductor and projecting from said sheath of an electrically insulating body in said sheath surrounding
25 said terminal in substantially concentric relation therewith and with said sheath and in spaced relation with these members, said body projecting from said sheath and having a flange exteriorly of said sheath and overlapping the adjacent end of said sheath, and a substantially homogeneous mass of glass having a relatively high electrical resistivity at the operating temperature of said heater filling the spaces between
30 said insulating body and said terminal and said sheath.

4. An electric heater comprising a metallic sheath, a resistance conductor within said sheath, terminals secured to the ends of said
40 resistance conductor and projecting from the

ends of said sheath, masses of glass covering said terminals and the inner walls of said sheath surrounding said terminals and adhering thereto to form fluid impervious joints therewith, said glass having a relatively high electrical resistivity at the operating temperature of said heater and having a thermal coefficient of expansion approximately equal to that of said sheath and terminals, and insulating sleeves projecting into the ends of said sheath about said terminals and embedded in said masses of glass. 5

5. The method of making a fluid impervious terminal for an electric heater provided with a resistance conductor, a terminal and a metallic sheath incasing said conductor and terminal
15 which comprises placing a mass of glass in said sheath about said terminal, threading an insulating sleeve on said terminal, heating the heater assembly to approximately 1600° to 1650° F. for a period of approximately 15 to 18 minutes so as to drive out air and moisture from said sheath and so as to prevent the temperature of the terminal portion of said heater rising above approximately 1200° F., then heating said terminal end to approximately 1725° to 1750° F. to soften said
20 glass, then pressing said insulating sleeve into said mass of softened glass so as to embed it therein, and then allowing said glass to cool. 25

6. The method of making a fluid-impervious terminal for an electric heater provided with a
30 resistance conductor and terminal which comprises heating the heater assembly to drive out air and moisture, placing a mass of glass in said sheath about said terminal, heating to soften said glass, inserting a body of electrically insulating material in the space between said terminal and said sheath so as to be embedded in said
35 softened glass and then allowing said glass to cool in air at a comparatively slow rate.

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