Nov. 12, 1929. E. N. LIGHTFOOT 1,735,831

ELECTRIC HEATER AND METHOD OF MAKING THE SAME

Original Filed May 7, 1925

Fig. 1.

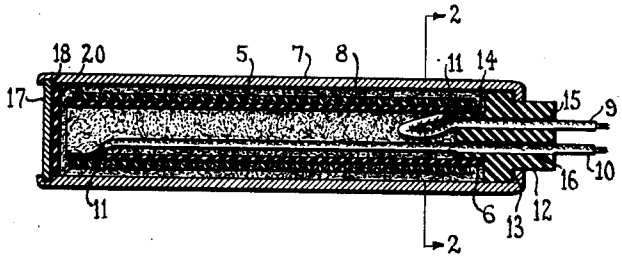


Fig. 2.

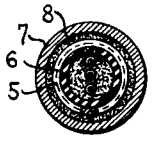


Fig. 3.

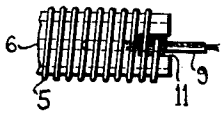
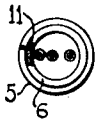


Fig. 4.



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UNITED STATES PATENT OFFICE

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ELECTRIC HEATER AND METHOD OF MAKING THE SAME

Application filed May 7, 1925, Serial No. 28,558. Renewed April 20, 1929.

This invention relates to electric heaters and methods of making the same, and, more particularly, to heaters of the cartridge type.

Cartridge heaters, so called because of design thereof to be slipped into drilled recesses in the parts to be heated, preferably comprise a resistor wound on a core, a cylindrical metallic enclosing casing and insulation interposed between the resistor and its casing. Also, such a heater preferably has both of its terminals arranged at one end thereof, and to facilitate conduction of heat from the resistor to the casing, it is desirable to reduce the interposed layer of insulation to minimum thickness. Accordingly, it will be apparent that satisfactory construction of such a heater presents difficult problems as regards insulation of the current carrying parts, accommodation of the through lead wire, anchorage of the lead wires within the heater, etc., especially where the heater is of small diameter.

It has been proposed to employ in such heaters powdered or granular magnesium oxide to insulate the electrical parts and to compact such material by swaging the casing for better heat conduction, this type of insulation having recognized advantages. However, since the cartridge type heater is closed at its ends and comprises an insulating core, and since the resistor usually comprises a fine wire with closely wound turns, the swaging process has obvious disadvantages as applied to this type of heater.

The present invention has among its objects to obviate, or, at least minimize, the aforementioned and other difficulties heretofore experienced in the production of cartridge heaters.

Another object is to provide an extremely satisfactory heater of the cartridge type utilizing powdered or granular magnesium oxide or the like without need of swaging.

Another object is to provide a cartridge heater wherein the lead wires are firmly anchored.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates a preferred embodiment of the invention which will now be described, it being understood that the heater illustrated may be modified in various respects without departing from the spirit or scope of the appended claims.

In the drawing:

Figure 1 is a longitudinal sectional view through the heater;

Fig. 2 is a transverse sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary view of the heating element; and

Fig. 4 is an end view of said heating element.

As illustrated in Fig. 1, the heater comprises a resistor 5 wound on an insulating core 6 and enclosed in a cylindrical casing 7, preferably metallic, and containing insulating material 8 to support the resistor in a spaced relation with respect to said casing.

The core 6 supporting the resistor may comprise any suitable material and may be either solid or hollow. Preferably, however, the core is in the form of a tube as shown, and, preferably, it comprises a winding of sheet asbestos the layers thereof being glued together with a binder such as silicate of soda making a comparatively thin stiff wall tubing sufficiently strong to carry the resistor. This form of core is particularly adapted to heaters of small diameter, although suitable for heaters of larger diameter.

The resistor comprises any suitable wire wound on the core and preferably covered by a thin coating of cement for preventing shifting of the turns thereof during subsequent steps of manufacture, although it is to be understood that use of this cement is optional. The resistor being wound as shown has its terminals at opposite end thereof, and said terminals are respectively provided with lead wires 9 and 10, both projecting from the same end of the casing. These lead wires may be of any preferred type and may be connected to the terminals of the resistor wire in any preferred manner.

Preferably the lead wires comprise asbestos insulated flexible wires, and preferably such wires are connected to the terminals of the resistor as best illustrated in Figs. 3 and

4. The core is provided at opposite ends with notches 11 such as that shown in Fig. 3 to receive the bared ends of the lead wires which are placed in these notches when the core is placed on the winding mandrel, said wires having the strands thereof separated to lie flush with the surface of the core. Thus, when the resistor is wound on the core it will have a number of end turns in contact with the end of the lead wires, permanent connection being made between the resistor and the lead wires by silver solder or in any other preferred manner. As shown, the lead wires are located within the core, one extending the full length thereof and the other being reflexed for a purpose hereinafter set forth.

The casing 7 is provided at one end with a bushing 12 formed of lava or other suitable material and having an annular shoulder 13 over which the end of the casing is spun for support of said bushing. Also, the bushing 12 has a reduced portion 14 on which the core of the resistor is adapted to be mounted for support thereof in a centered relation with the casing. Further, the bushing 12 is provided with passages 15 and 16 through which the lead wires extend.

At its opposite end the casing is constructed to receive a closing disk 17, said casing having a shoulder 18 constituting an abutment for said disk. As will be understood the disk 17 is inserted in the casing only after assembly of the elements aforedescribed, securement of said disk being effected by spinning thereover the end of the casing. Although perhaps not essential an insulating disk 20 is preferably interposed between the disk 17 and the resistor to obviate possibility of grounding of the resistor on the disk 17, which ordinarily would be of metal.

The insulating material 8 preferably comprises granular fused magnesium oxide which is introduced into the casing and into the bore of the core just prior to closing of the end of the casing by disk 17. The magnesium oxide is preferably packed by vibrating the same when introduced into the casing for the purpose of reducing the voids therein and for affording firm support for the free end of the core member during the treatment of the insulating filling now to be described.

When the heater is thus filled, the magnesium oxide contained therein is subjected to chemical reaction to convert the same into a hydroxide form for further disintegration of its particles with a consequent expansive action which causes the particles to distribute and to fill all appreciable voids within the casing which preferably is designed or confined to withstand the pressures thus produced therein. The magnesium oxide when so treated is then reconverted into its original chemical state whereupon it is rendered satisfactory both as an electric insulator and heat conductor, and, as will be apparent, the disadvantages of swaging are thus obviated. Also, the aforementioned treatment of the magnesium oxide causes the same to grip the lead wires throughout the embedded lengths thereof, thereby firmly anchoring the lead wires within the heater and preventing strains on the connections between the same and the resistor.

The magnesium oxide filling of the casing may be readily converted as aforedescribed by introducing into the casing a quantity of water to fill all voids and then subjecting the filling to the action of heat and pressure. A convenient method of thus treating the filling is to place the heater in an autoclave subjecting the filling to the action of steam in the neighborhood of 330° F. or more for a suitable period of time. This treatment will effect the aforementioned disintegration of the magnesium oxide and thereafter the same may be restored to its original chemical state by subjecting it to a high temperature, preferably red heat, to drive off all moisture. While such reconversion of the material effects a reduction in its weight, the apparent volume of the material is not changed by the reconversion, thus preserving its aforementioned advantages gained by its conversion into a hydroxide state.

It is, of course, to be understood that other insulating materials adapted to the aforementioned treatment may be employed in lieu of magnesium oxide, and that the effects of the reaction may be controlled in various ways, as, for example, by mixing with the active material a suitable quantity of chemically inert material or by controlling the progress of the reaction.

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

1. A heater comprising an insulating core, a resistor wound thereon, a casing enclosing said resistor and insulation between said resistor and casing chemically disintegrated in situ.

2. A heater comprising a hollow insulating core, a resistor wound thereon, a casing enclosing said resistor and insulation within said core and between said resistor and casing chemically disintegrated in situ.

3. In combination a wound resistor, a core supporting the same, a casing enclosing the aforementioned elements and an insulating filling for said casing surrounding said resistor and core, said filling comprising particles multiplied in number by chemical reaction of such filling in situ with consequent expansive action opposed by said casing.

4. In combination a wound resistor, a hollow core supporting the same, a casing enclosing the aforementioned elements and insulation within said core and surrounding said core and resistor, said insulation comprising particles multiplied in number by chemical reaction of such insulation in situ

with consequent expansive action opposed by said casing.

5. A heater comprising a resistor, lead wires connected thereto, a hollow element associated with said resistor and in which portions of said lead wires are located, and insulation within said hollow member chemically disintegrated in situ to produce a mass anchoring said lead wires in said hollow member.

6. A heater comprising a wound resistor, a hollow core supporting the same, lead wires for said resistor having portions located within said core and insulation within said core chemically treated in situ with expansive tendencies to produce a mass anchoring said lead wires in said hollow member.

7. A heater comprising a wound resistor, a hollow core supporting the same, lead wires for said resistor, one of said wires extending through the bore of said core and the other having a reflexed portion within the core, a casing surrounding said resistor and an insulating filling for said casing and core chemically treated in situ with expansive tendencies to produce masses anchoring said lead wires in said core and anchoring said core in said casing.

8. A heater comprising a tubular casing having at one end an insulating bushing, an insulating core engaged at one end with said bushing to be centered in said casing, a resistor wound on said core and having lead wires extending through said bushing and an insulating filling for said casing chemically treated in situ with expansive tendencies opposed by said casing.

9. A heater comprising a tubular casing having at one end an insulating bushing, a hollow insulating core having one end engaged with said bushing for centering said core in said casing, a resistor wound on said core, lead wires for said resistor extending through said bushing, one of said lead wires extending through the bore of said core to the remote terminal of said resistor and the other having a reflexed portion disposed within said core and insulation within said core and surrounding said core and resistor, said insulation being chemically treated in situ with expansive tendencies opposed by said casing.

10. The method of making electric heaters which consists in mounting a helical resistor upon an insulating core, placing said core in a metallic casing, filling the space around said core and resistor with granular heat refractory insulating material, and then chemically treating said insulating material in situ to effect conversion of the same into a coherent mass without change in the apparent volume thereof.

11. The method of making electric heaters of the cartridge type which consists in winding a resistor upon a hollow insulating core, connecting said resistor at each end thereof to lead wires respectively located within said core, attaching said core at one end to an insulating bushing for centering thereby with said lead wires penetrating the latter, inserting said bushing and the parts carried thereby within a metallic casing, filling the space within said core and around said core and resistor with granular fused magnesium oxide, and then subjecting said magnesium oxide to hydration and dehydration treatment in situ to provide masses anchoring said lead wires in said core and anchoring said core in said casing.

12. The method of making industrially useful unswaged electric heaters of the cartridge type which consists in forming a thin walled insulating tube of sheet asbestos, winding a resistor upon said hollow tube, connecting the opposite ends of said resistor to lead wires located within said tube, one of said lead wires extending throughout the length of said tube and the other lead wire being reflexed adjacent one end of said tube, attaching said tube at one end to an insulating bushing through which the lead wires are adapted to pass, placing the parts thus assembled within a tubular metallic casing with a portion of said bushing projecting beyond one end of said casing, inserting a quantity of granular fused magnesium oxide through the other end of said casing to fill the space within said tube and around said tube and resistor, permanently closing said last mentioned end of said casing, and then subjecting said magnesium oxide to hydration and dehydration treatment in situ to provide coherent masses anchoring said lead wires in said tube and anchoring said tube in said casing.

In witness whereof, I have hereunto subscribed my name.

EDWIN N. LIGHTFOOT.