

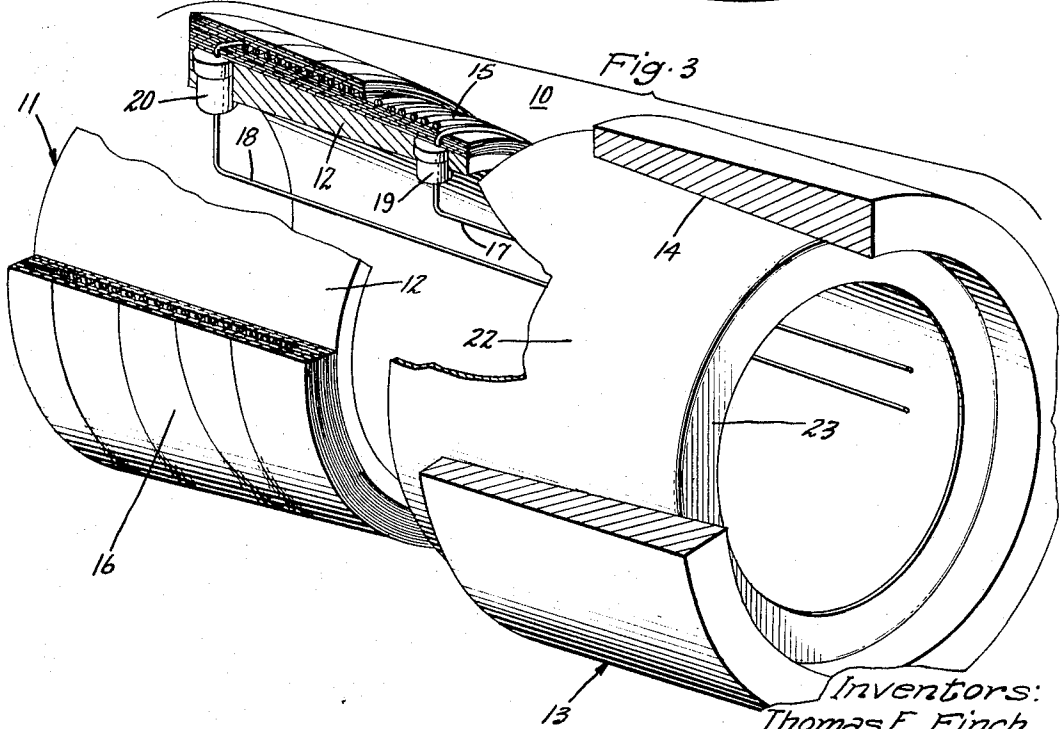
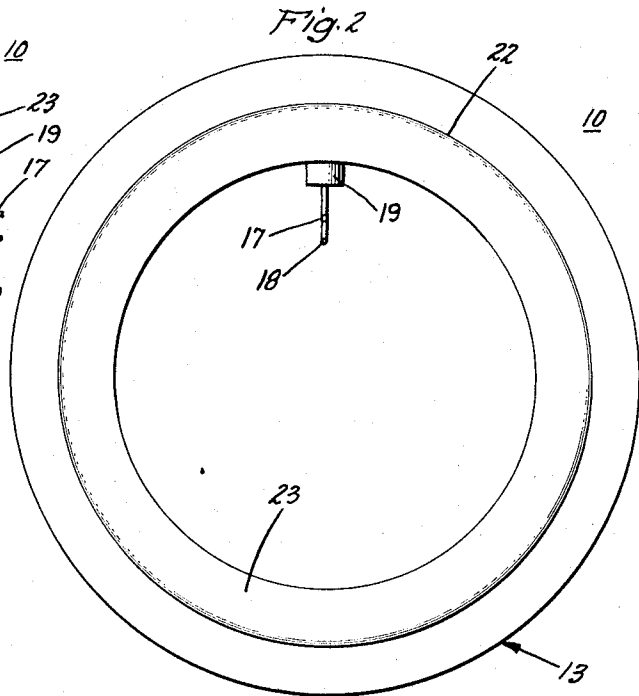
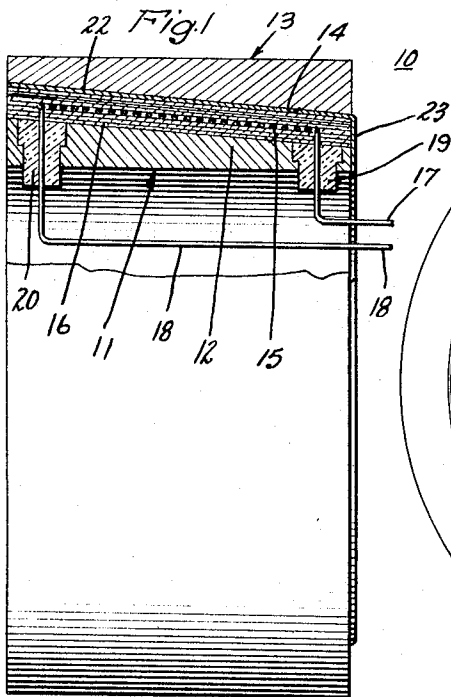
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T. E. FINCH ETAL

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ELECTRIC HEATING DEVICES

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Inventors:
Thomas E. Finch,
Thorbjorn Skogland,
by Henry J. Mainwile
Attorney.

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ELECTRIC HEATING DEVICES

Thomas E. Finch and Thorbjorn Skogland, Shelbyville, Ind., assignors to General Electric Company, a corporation of New York

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The invention relates to electric heating devices and more particularly to electric heating devices of the annular or ring type.

To provide a heat distribution over a cylindrical surface, it is frequently desirable in some electrical heating applications to use an electric heating unit or device with an annular or a ring-like shape. It has been the usual practice in such applications to form a conventional sheathed resistance heating unit into a helix with the number of turns depending on the axial length over which a circular distribution of heat is desired.

In a well-known sheathed heating unit construction, an electrical resistance heating element is embedded in a compacted mass of electrically insulating and heat conducting material. This compacted mass is, in turn, enclosed by an elongated outer metallic sheath. When such a heating unit is formed in the shape of a helix to provide the desired heat distribution, the heating is generally not distributed uniformly over a cylindrical surface. It will be appreciated, of course, that in a helical heating unit arrangement, the distribution of heat is not uniform because the heat is generated essentially along a helical path. In some heating applications it is desirable to provide a heating device arrangement that is capable of providing even heating along an annular or cylindrical surface. Further, it is desirable that the construction be mechanically rugged and include some provision wherein the resistance heating element can be effectively compacted in a mass of electrically insulating and heat conducting material to insure that the resistance heating element does not laterally move as it is heated and cooled.

Accordingly, it is a general object of the present invention to provide an improved annular type of electric heating device.

A more specific object of the present invention is to provide an improved annular heating device wherein a coil of resistance wire is effectively maintained in compressive engagement in a mass of electrically insulating and heat conducting material as the heating wire undergoes temperature changes.

Another object of the present invention is to provide an improved annular type of heating device that is capable of providing substantially uniform heating over a cylindrical surface.

Briefly stated, the improved heating device, in accordance with one form of the invention, is comprised of an inner ring member having an external tapered surface and a coaxially positioned outer member having an internal tapered surface. For the purpose of generating heat a length of resistance wire is wound around the external insulated surface of the inner ring member. Also, concentrically disposed around the external surface and the resistance heating wire is a shim means. An electrically insulating and heat conducting material is interposed between the shim means and the external tapered surface. The internal tapered surface of the outer member is disposed in compressive engagement with the annular shim thereby to compressively sandwich the coil of resistance heating wire in the material and firmly embed the resistance heating wire therein. The compaction of the insulating material is effected by a wedging action rather than by reducing the diameter of the outer ring by swaging or by the use of an inner ring with a relatively large

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diameter that will provide a tight fit. An important advantage resulting from the improved electric heating device construction is that the assembly and compaction of the resistance heating element between the metal ring members are facilitated.

The subject matter which we regard as our invention is set forth in the appended claims. The invention itself, however, together with further objects and advantages thereof, may be best understood by referring to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a front elevational view, partly in section, of an annular type of electric heating device embodying one form of the invention;

FIGURE 2 is a side elevational view of the improved heating device; and

FIGURE 3 is an exploded view, partly broken away to show the assembled relation of various parts of the improved heating device.

Referring now more specifically to the construction of the improved electric heating device 10 embodying one form of the invention, it will be seen that the electric heating device 10 is comprised of an inner ring member 11 having an external tapered surface 12 and an outer ring member 13 formed with an internal tapered female surface 14. Sandwiched between the tapered surfaces 12 and 14 is a resistance heating element 15, preferably a coil of resistance wire, firmly embedded in an electrically insulating and heat conducting material 16. In the illustrative embodiment of our invention an asbestos paper was used as the electrically insulating and heat conducting material 16.

It will be seen that terminal leads 17 and 18 of the helical resistance coil 15 extend through insulators 19 and 20 and are brought out externally for connection to a suitable power source (not shown). The insulators 19, 20 may be formed of any suitable nonporous electrically insulating and heat refractory material such as ceramic.

It will be understood that the taper of the frusto-conical surfaces 12 and 14 and the thickness of the conducting material 16 are exaggerated to more clearly illustrate the relationship between these parts. A metallic shim 22 is interposed between the outer surface of insulating material 16 and the internal tapered surface 14 of the outer member 13. It was found that with such an arrangement the outer member 13 could be pressed over the shim 22 to cause the material or mass 16 to be compacted and the resistance coil 15 to become firmly embedded therein. To securely position the shim 22 and prevent displacement of the shim, a flanged portion 23 extending along the edge of the inner ring member 11 may be provided.

As is best seen in FIGURE 3, when the outer member 13 is assembled over the shim 22, a compressive force is exerted against the shim 22. The insulating material 16 and the resistance coil 15 are sandwiched between the shim 22 and the tapered surface 12 of the inner ring member 11. The initial thickness of the insulating material 16 is greater than its final compacted thickness so that when the outer ring member 13 is axially moved into position over the shim 22, the desired amount of compaction is provided.

An inherent advantage in the improved construction shown in FIGURES 1, 2 and 3 is that the desired amount of compaction can be readily achieved by simply pressing the ring member 13 in assembled relation over the shim 22. The compressive force exerted by the outer ring member 13 insures that lateral movement of the resistance coil 15 is restrained as the resistance coil 15 undergoes temperature changes. Further, the compac-

tion of the insulating material 16 promotes heat conduction between the heat resistance coil 15 and the metallic ring members 11 and 13.

In manufacturing the improved electric heating device a preselected thickness of the insulating material 16, which in the illustrative embodiment of the invention was asbestos paper, is first wrapped around the tapered surface 12 of the inner ring member 11. The start lead 18 of resistance heating coil 15 is threaded through the ceramic insulator 20 and the coil 15 is wound over the layer of insulating material. The finish lead 17 is threaded through the insulator 19, and the leads 17, 18 are brought out so that they can be connected in circuit with a suitable power source. Preferably, a ceramic cement is brushed into the spaces between the turns of the resistance heating coil 15 in order to securely position the coil 15. Another asbestos layer of predetermined thickness is then formed over the resistance coil 15 so that it is completely covered and insulated from the metallic shim 22. The metallic shim 22 is placed over the asbestos insulation 16.

Although a unitary shim 22 is illustrated in FIGURE 3, it will be appreciated that the shim may be formed by wrapping thin metallic shim material directly over the asbestos insulation. It will be noted that the angular collar or flange 23 maintains the axial position of the shim 22 with respect to the inner ring member. With the shim 22 in position, the outer ring member 13 is then pressed into assembled relation over the inner ring and compressively engages the shim 22 to provide the desired degree of compaction of the insulation 16. Although in the illustrative embodiment of the invention, the forced fit of the outer ring member 13 was sufficient to hold it in assembled relation, it will be appreciated that in some applications it may be desirable to provide some mechanical means for securing the outer member in fixed relation with the inner ring member.

From the foregoing description of the improved annular type of construction for an electric heating device, a mechanically rigid heating device is provided in which a resistance heating coil is compressively embedded in insulation sandwiched between an outer and inner ring member. Although the invention has been explained by describing a particular embodiment thereof, it will be apparent that many modifications and changes may be made without departing from the scope of the invention. It is therefore intended in the appended claims to cover all such changes and modifications that fall within the true spirit and scope of the invention.

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

1. An electric heating device comprising an inner ring member having an external tapered surface, an outer ring member formed with an internal tapered surface, means for generating heat including a helical coil of resistance wire disposed around the external tapered surface of said inner ring member, shim means disposed around said helical coil, and electrical insulating and heat conducting means interposed and compressively sandwiched between said shim means and said external tapered surface of said inner ring member to embed said resistance wire in said electrical insulating and heat conducting means.

2. An annular electric heating device comprising: an inner ring member having an external frusto-conical surface, an outer ring member formed with a mating internal frusto-conical surface and concentrically disposed around said inner ring member, a heating coil formed of resistance wire disposed around said external frusto-conical surface of said inner ring member, an annular metallic shim means disposed around said helical resistance heating coil and having an annular flange for axially positioning said annular metallic shim with respect to said inner ring member, a first layer of electrically insulating and heat conducting material interposed between said helical resistance heating coil and the external frusto-conical sur-

face of said inner ring member and a second layer of electrically insulating and heat conducting material disposed between said helical resistance heating coil and said annular metallic shim, said internal frusto-conical surface of said outer ring member compressively engaging said annular metallic shim to compressively sandwich said helical resistance heating coil between said first and second layers of electrically insulating and heat conducting material as said electrically insulating heat conducting material is compacted between said inner and outer ring members, thereby to embed said helical resistance heating coil in said material for promoting heat conduction between said heating coil and said inner and outer ring members.

3. An annular electric heating device comprising an inner ring member having an external tapered surface and an internal cylindrical surface, an outer ring member disposed concentrically around said inner ring member and having an internal tapered surface and an external cylindrical surface, means for generating heat including a resistance heating element disposed coaxially around the external tapered surface of said inner ring member, shim means disposed around said resistance heating element between said inner and outer tapered surfaces, electrically insulating and heat conducting material interposed between said resistance heating element and said external tapered surface and also between said resistance heating element and said shim means, said external tapered surface of said outer ring member compressively engaging said metallic shim means to cause said electrically insulating and heat conducting material to be compacted thereby to embed said resistance heating element therein.

4. An electric heating device comprising an inner ring member having an external tapered surface, an outer ring member having an internal tapered surface, a resistance heating element disposed around the external tapered surface of said inner ring member, shim means disposed around said resistance heating element, a first layer of electrical insulating means interposed between said shim means and said resistance heating element, a second layer of electrical insulating means interposed between said resistance heating element and said external tapered surface of said inner ring member, said inner tapered surface of the outer ring member engaging said shim means when assembled to compressively sandwich said resistance heating element between said first and second layers of electrical insulating means.

5. An electric heating device comprised of an inner ring member having an external tapered surface, an outer ring member having an internal tapered surface, means for generating heat including a helical resistance heating coil wound over the external tapered surface of the inner ring member, an annular shim disposed around said helical resistance heating coil, electrically insulating means interposed between the annular shim and the external tapered surface of said inner ring member, said internally tapered surface of the outer member surrounding said annular shim to compressively engage said helical resistance heating coil in said electrically insulating means between said annular shim and said inner ring member.

6. An electric heating device comprising an inner ring member having an external frusto-conical surface, an outer ring member formed with a mating internal frusto-conical surface and concentrically disposed around said inner ring member, a heating coil of resistance heating wire wound around the external frusto-conical surface of said inner ring member, shim means disposed around said coil, and electrically insulating and heat conducting means interposed between said helical resistance heating coil and the external frusto-conical surface of said inner ring member and also between said helical resistance heating coil and said shim means, said internal frusto-conical surface of said outer ring member being wedged against said metallic shim means to compressively sandwich said elec-

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trically insulating and heat conducting means between said inner and outer ring members thereby to compact said electrically insulating and heat conducting means and to embed said resistance heating wire therein.

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RICHARD M. WOOD, *Primary Examiner.*

V. Y. MAYEWSKY, *Assistant Examiner.*