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2,094,480

ELECTRIC HEATER

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Fig. 1.

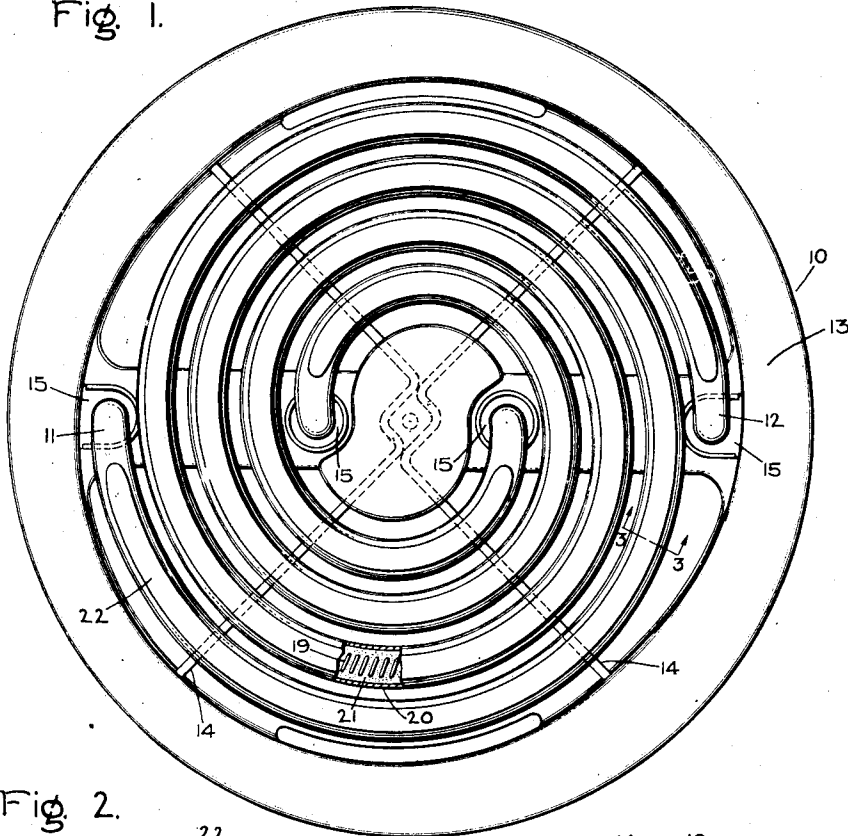


Fig. 2.

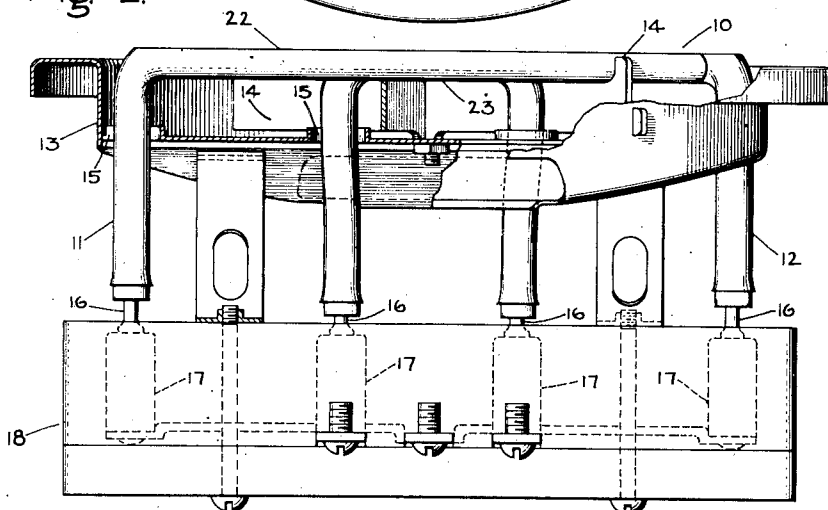


Fig. 3.

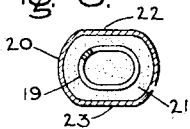
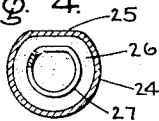


Fig. 4.



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UNITED STATES PATENT OFFICE

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ELECTRIC HEATER

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7 Claims. (Cl. 201—66)

This invention relates to electric heaters, more particularly to electric heaters of the encased type, and it has for its object the provision of an improved heater of this character.

5 This invention has particular application to sheathed electric heaters of the type described in the U. S. Patent to C. C. Abbott, No. 1,367,341, dated February 1, 1921. It is to be understood, however, that this invention is not limited to the
10 specific sheathed heater disclosed in this patent, but is generally applicable to electric heaters having a resistance conductor encased in a metallic sheath.

These sheathed or encased heaters comprise
15 a resistance heating element enclosed in a metallic sheath or casing, and embedded in and supported in spaced relation with respect to the sheath or casing by a densely packed mass of heat refractory and heat conducting, electrically
20 insulating material, such as magnesium oxide.

Heating units of the type described in the Abbott patent when used in electric ranges and like applications where it is desirable to obtain a concentrated heat generation in a limited area are
25 generally given a curved, spiral, or similar non-rectilinear shape. The unit is initially made into straight lengths and is then given the desired shape.

It has been found that the formed heaters,
30 that is, the non-rectilinear heaters do not have as long a life or as great a dielectric strength as do the straight length heaters.

The loss of life and dielectric strength apparently is due to the fact that cracks or fissures
35 are set up in the insulating mass when the heater is shaped. These cracks are the most prevalent at the bent or curved sections of the heater, and become increasingly great the sharper the bend.

Now when sheathed heaters are operated at elevated temperatures, such as 1200° to 1600° F.,
40 both the sheath and resistance conductor tend to vaporize. The metallic vapors apparently penetrate the refractory insulating material through the cracks and react either with the refractory material, or with the impurities therein
45 that are always present to a more or less extent, or with both to form conducting paths. This not only weakens the heater dielectrically, but also reduces its life.

50 I have found that if the sheath, after the heater has been given its final shape, be distorted at the formed sections, as by a flattening operation, the insulation will be redistributed and re-
55 arranged and more densely compacted so as to

substantially eliminate cracks present in the insulating mass. I have found that formed electric heating units arranged in accordance with this invention can be operated at very high temperatures, such as 1200° to 1600° F., and that the life
5 of the heater has been materially extended over the heaters used prior to this invention. I furthermore have found that the initial dielectric strength of the heater is greater and that it maintains a greater dielectric strength through-
10 out its life.

For a more complete understanding of this invention, reference should be had to the accompanying drawing in which Fig. 1 is a top plan
15 view of an electric range heating unit embodying this invention; Fig. 2 is an elevation of the heating unit shown in Fig. 1, parts being shown in section and parts being broken away so as to illustrate certain details of construction; Fig. 3
20 is a sectional view taken through the line 3—3 of Fig. 1; and Fig. 4 is a sectional view similar to Fig. 3 but illustrating a modified form of this invention.

Referring more particularly to Figs. 1—3 of the drawing, this invention has been shown as applied to an electric range heating unit of the type
25 described in the United States patent to C. F. Mallett, No. 1,837,975, dated December 22, 1931. It is to be understood, however, that this invention is not limited to electric range heaters, but
30 has application in general to sheathed electric heaters which are intended to be used in various other electrically heated devices that are to be operated at elevated temperatures such as temperatures ranging as high as 1200° to 1600° or
35 more Fahrenheit. Moreover, it is to be understood that this invention is not limited to the specific sheathed heater of the above Abbott patent, but is generally applicable to incased heaters.

As shown in the drawing, the electric range heating unit 10 comprises a pair of sheathed heating elements 11 and 12. Each heating element
40 has a spiral form, and the ends of each unit are turned downwardly, as shown in Fig. 2. The two spiral heating elements 11 and 12 are supported
45 in a suitable pan-like receptacle 13 on suitable truss-like supports 14 mounted in the pan.

The coils 11 and 12, as shown, are nested one within the other, and moreover, are arranged so
50 that the down-turned ends respectively of the units are positioned on opposite sides of the center of the pan. The down-turned ends of the two coils pass freely through apertures 15 provided for them in the bottom of the pan 13. The
55 ends of these down-turned ends have suitable

terminals 16 which are received in contact springs 17 mounted in a suitable terminal block 18.

Each heating element 11, 12 is of the sheathed type, such as described and claimed in the United States patent to C. C. Abbott, No. 1,367,341, dated February 1, 1921. As described in this patent, each heating element comprises a helical or sinuous resistance conductor 19 mounted centrally of a metallic sheath 20. The resistance conductor 19 is embedded in and supported in spaced relation to the sheath by means of a highly compacted mass 21 of heat refractory and heat conducting, electrically insulating material, such as powdered magnesium oxide. The powdered magnesium oxide may be highly compacted by reducing and elongating the metallic sheath 20 after the resistance conductor has been mounted in the sheath and the sheath has been loaded with the oxide, as fully pointed out in the above-mentioned Abbott patent.

It will be understood that these heating units are formed in straight sections, that they can be bent into any desired form and when so bent form a structure sufficiently rigid to stand frequent handling without loss of shape. Thus, in forming the spiral heaters 11 and 12, each heater will be made initially as a straight rod-like element. This element will then be wound spirally by any suitable means into its final form shown in Fig. 1, and its terminal ends will be bent as indicated.

While the sheath 20 may be formed of any suitable metal that is capable of operating for relatively long periods of time at very high temperatures, it is preferable that the sheath be made in accordance with the disclosure in the United States patent to J. C. Sharp, No. 2,034,539, dated March 17, 1936.

As pointed out previously, it has been found that the formed heaters do not have as high a dielectric strength and do not have as long a life as do the same heaters in their straight form. As also pointed out previously, when the windings are formed, that is, when they are turned or bent from their rectilinear shape, small fissures or cracks are set up in the insulating mass 21 in the bent portions of the unit. When the metallic sheathed heater is operated at very high temperatures, such as 1200° to 1600° F., the metals of the resistance conductor 19 and of the sheath 20 tend to vaporize, and the metal vaporization penetrates the magnesium oxide 21 through the cracks and fissures. Apparently, the metal vapors react with the oxide and with impurities therein so as to weaken the heater dielectrically, and to reduce its life materially. In other words, it is believed that paths are set up having a comparatively low electrical resistance and other undesirable characteristics.

To obviate this difficulty and thereby to increase materially the dielectric strength of the heater and also its life, I deform the metallic sheath 20 after the heater has been given its desired shape. In the form of the invention shown in Figs. 1, 2 and 3, the deforming of the sheath is accomplished by subjecting the opposite sides of the unit to a suitable operation so as to form flattened portions 22 and 23 on the top and bottom portions of the sheath. The flattening operation may be accomplished in any suitable manner, such as by means of a suitable hammering or pressing machine.

It has been found that this reshaping of the sheath after the heater has been formed redistributes the insulating material 21 and gives it a greater density so that a substantially

uniform homogeneous layer of insulating material is provided around and about the conductor. All cracks and fissures that might have been formed when the heater is given its curved shape are eliminated. The elimination of the fissures and cracks prevents the emission of vapors into the insulating layer.

If desired, and in certain cases it has been found preferable to do so, the sheath may be deformed on one side only, as shown in Fig. 4. In this figure, the sheath 24 is deformed on its upper side only so as to provide the flattened portion 25. This flattening redistributes the insulating material 26 around and about the conductor 27 as in the previous case, but in certain cases to even a greater extent. Moreover, it has been found that the over-all density of the insulation is greater in the form of Fig. 4.

In each case, it will be observed that the resistance coils 19 and 27 take substantially the general cross-sectional form of the finished heater, as shown clearly in Figs. 3 and 4. This has the advantage that substantially the same thickness of insulating material is maintained between all parts of the resistance conductor and the adjacent walls of the sheath.

It is not necessary to deform the terminal sections of the heater, because these portions of the heater operate at relatively low temperatures.

This invention may be used with success in encased heaters of certain types where the heater is given the desired shape initially, that is, the heater is not given a final bending or shaping step. For example, it is applicable to those heaters which are provided with casings having a shape substantially the shape that the finished heater is to have; often-times in these heaters, the insulating material is not uniformly distributed throughout the casing with the result that the heater has a relatively low initial dielectric strength, a falling dielectric characteristic as the heater ages and a relatively short life. If the casing in such cases be given a final compressing or impacting operation in accordance with this invention, the insulating material will be redistributed and will have a uniform and substantially greater density throughout. This, as pointed out before, increases the life of the heater and improves its dielectric characteristics.

Also I have found that in the case of the above Abbott heater, the sheath need not be given a normal complete swaging operation, but may be partially swaged, and then subjected to the impacting or compressing step of this invention. In other words, the heater in straight form, after being loaded and swaged to partially compact the insulating material, is then given its final curved or non-rectilinear shape. Then the insulating material is redistributed and compacted in accordance with this invention. This insures a densely packed uniformly distributed layer of insulating material around and about the resistance conductor.

As a result of this invention, I have found that the life of encased heaters has been materially increased. Moreover, I have found that the initial dielectric strength of the heater has been greatly improved and that the dielectric strength is maintained throughout the life of the heater to a far greater extent than before.

This invention may be used to advantage in high temperature metallic encased electrical heaters in general, particularly is it useful in those cases where the insulating material and resistance conductor are loaded in the casing and

the heater thereafter completed in the normal manner. The subsequent deforming of the casing in accordance with this invention insures a densely compacted mass of insulating material around and about the conductor, and thereby increases the life and dielectric strength of the heater.

Moreover, in electric range heating units and the like where the cooking utensil to be heated is placed upon the unit, my invention has the further advantage that the flattened top side of the sheath provides a relatively large surface for the conduction of heat to the utensils placed on it. This increases materially the speed of the cooking operation and the efficiency of the heating unit.

While I have shown particular embodiments of this invention, it will be understood, of course, that I do not wish to be limited thereto since 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:

1. The method of making an electric heater having a predetermined non-rectilinear form and capable of operating at relatively high temperatures, such as 1200° to 1600° F., during a relatively long life, which comprises inserting a resistance conductor in a metallic casing, filling the space around said conductor with heat refractory electrically insulating material, compacting said material to a hard dense mass so that it readily conducts heat from said conductor to the walls of said casing, shaping said casing to give it said predetermined form, and then deforming said casing sufficiently to redistribute said insulating material in the shaped sections of the casing to eliminate any cracks or fissures that are formed in said hard dense mass when said casing is shaped, and thereby obviate paths in said mass through which metallic vapors may pass.

2. The method of making an electric heater having a predetermined non-rectilinear form and capable of operating at relatively high temperatures, such as 1200° to 1600° F., during a relatively long life, which comprises inserting a helically wound resistance conductor in a metallic casing, filling the space around said conductor with heat refractory electrically insulating material, compacting said material to a hard dense mass so that it readily conducts heat from said conductor to the walls of said casing, shaping said casing to give it said predetermined form, and then compressing at least a wall of said casing in the shaped sections thereof to flatten it sufficiently to redistribute said insulating material in the shaped sections to eliminate any cracks that are formed in said hard dense mass when said casing is shaped to give it said predetermined form and also, to flatten the portions of the turns of said resistance conductor opposite said wall so as to insure a layer of insulating material of substantially uniform thickness between all parts of said resistance conductor and casing.

3. The method of making an electric heater capable of operating at relatively high temperatures, such as 1200° to 1600° F., during a relatively long life, which comprises inserting a resistance conductor in a metallic casing, filling the space around said conductor with a heat refractory electrically insulating material, highly compacting said material around said conductor

to a hard dense mass so that it readily conducts heat from said conductor to the walls of said casing, and then flattening at least a wall of said casing to insure a substantially uniform distribution of said insulating material around said conductor and the elimination of any cracks or fissures that might be generated in said material after it has been compacted to said hard dense mass and through which metallic vapors may pass.

4. The method of making an electric heater having a section of predetermined non-rectilinear form and capable of operating at relatively high temperatures such as 1200° to 1600° F. during a relatively long life which comprises mounting a resistance conductor in a metallic sheath, filling the space around said conductor with a powdered, heat refractory electrically insulating material, reducing and elongating said sheath sufficiently to highly compact said insulating material around said resistance conductor, bending said sheath to give it said section of predetermined non-rectilinear form and then flattening said sheath at said section on opposite sides of a diameter to redistribute said insulating material in said section and thereby eliminate cracks that are formed during said bending step.

5. The method of making an electric heater having a section of predetermined non-rectilinear form and capable of operating at relatively high temperatures such as 1200° to 1600° F. during a relatively long life which comprises mounting a resistance conductor in a metallic sheath, filling the space around said conductor with a powdered, heat refractory electrically insulating material, reducing and elongating said sheath sufficiently to highly compact said insulating material around said resistance conductor, bending said sheath to give it said section of predetermined non-rectilinear form and then flattening said sheath at said section on one side to redistribute said insulating material in said section and thereby eliminate cracks that are formed during said bending step.

6. The method of making a heating unit for electric ranges and the like having a predetermined curve form substantially throughout its length and capable of operating at elevated temperatures, such as 1200° to 1600° F., which comprises mounting a helical resistance conductor in a metallic sheath, filling the space around and about said conductor with powdered heat refractory, electrically insulating material, reducing and elongating said sheath sufficiently to compact said insulating material into a hard dense mass, then shaping said sheath to give it said predetermined curved form substantially throughout its length and then flattening a wall of said sheath at least throughout the length of the curved portion of the sheath so as to eliminate any cracks in said mass of insulating material developed in the shaping step.

7. A high-temperature high-speed heating unit for electric ranges and the like wherein the utensil to be heated is placed upon and in contact with the unit comprising a heating rod-like element in the shape of a flat helix and consisting of an outer metallic sheath, a helically wound resistance conductor within the sheath, and powdered heat conducting, electrically insulating material insulating the helically wound resistance conductor from said sheath, the insulating material being compacted to a hard dense mass, and the sheath thereafter being shaped into said spiral form, and the top wall of said

sheath being flattened after said insulating material has been compacted and the sheath has been given said spiral form to compress the insulating material so that it completely fills the
5 space between said helically wound resistance conductor and sheath to avoid any fissures which might permit metallic vapors to provide conducting paths between said resistance element and

said sheath when the energy supplied to the heating unit raises the temperature of the sheath to the order of 1200° to 1600° Fahrenheit, and further, so that the flattened exterior of the element provides a relatively large surface for con-
duction of heat to the utensil adapted to be placed
upon and in contact therewith. 5

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