

Oct. 4, 1927.

1,644,255

A. J. KERCHER ET AL

ELECTRICAL HEATING DEVICE

Filed Sept. 2, 1926

3 Sheets-Sheet 1

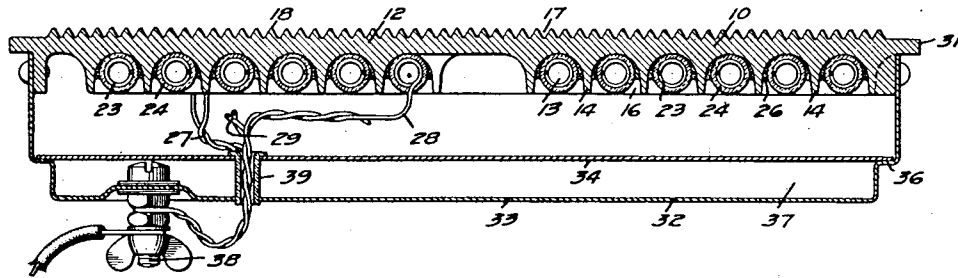


FIG. 1.

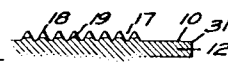


FIG. 2.

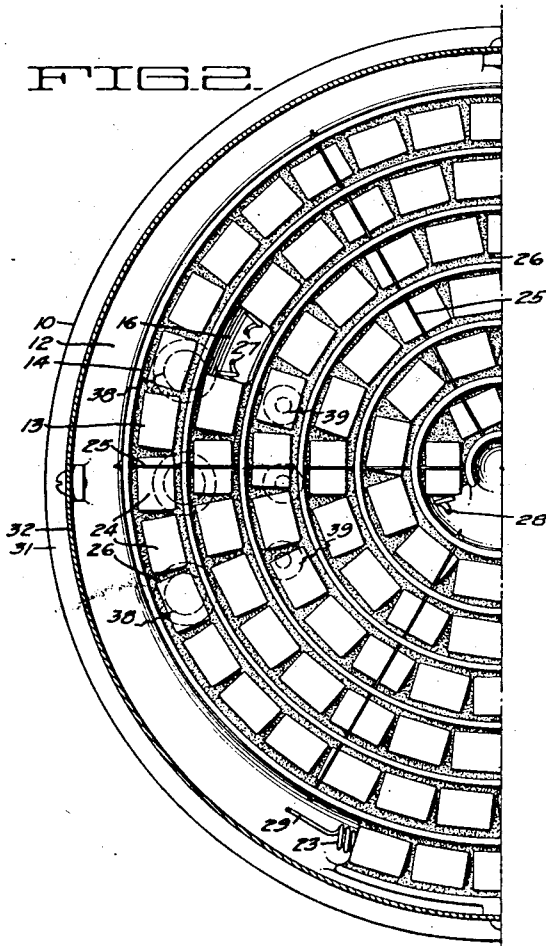


FIG. 3.

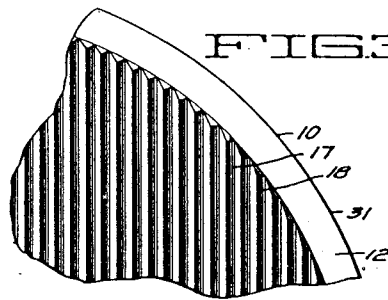


FIG. 4.

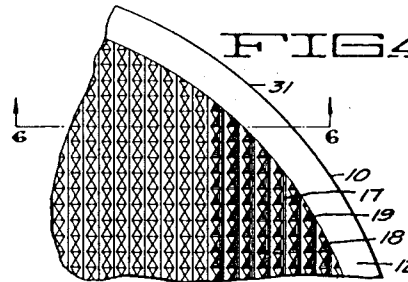
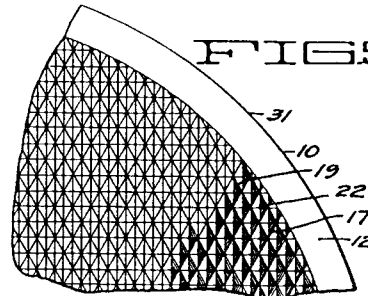


FIG. 5.



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FIG. 7.

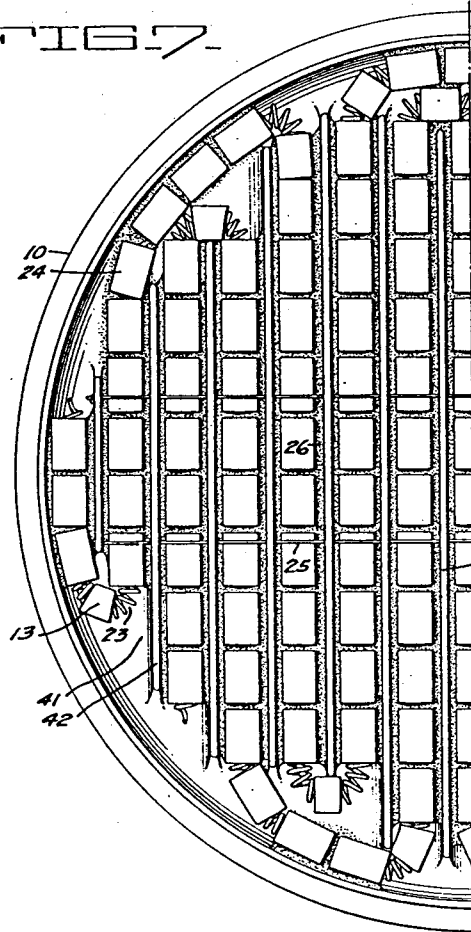


FIG. 8.

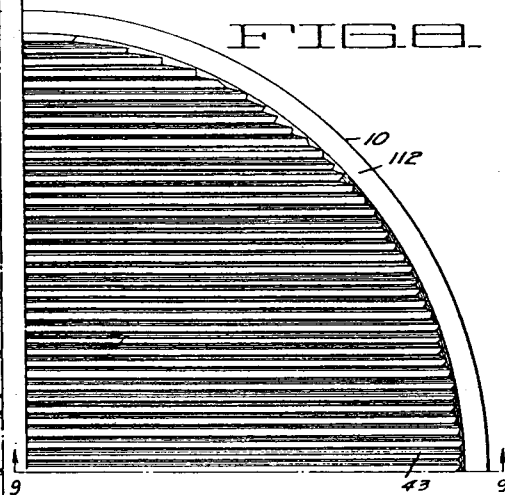


FIG. 9.

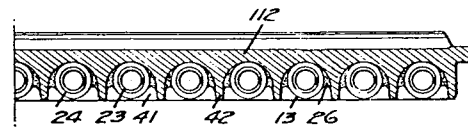


FIG. 12.

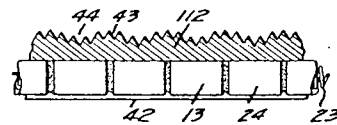


FIG. 10.

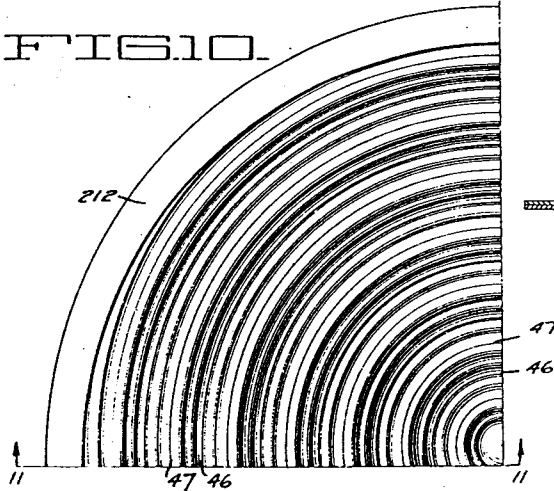
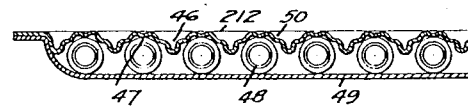


FIG. 11.



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FIG. 13.

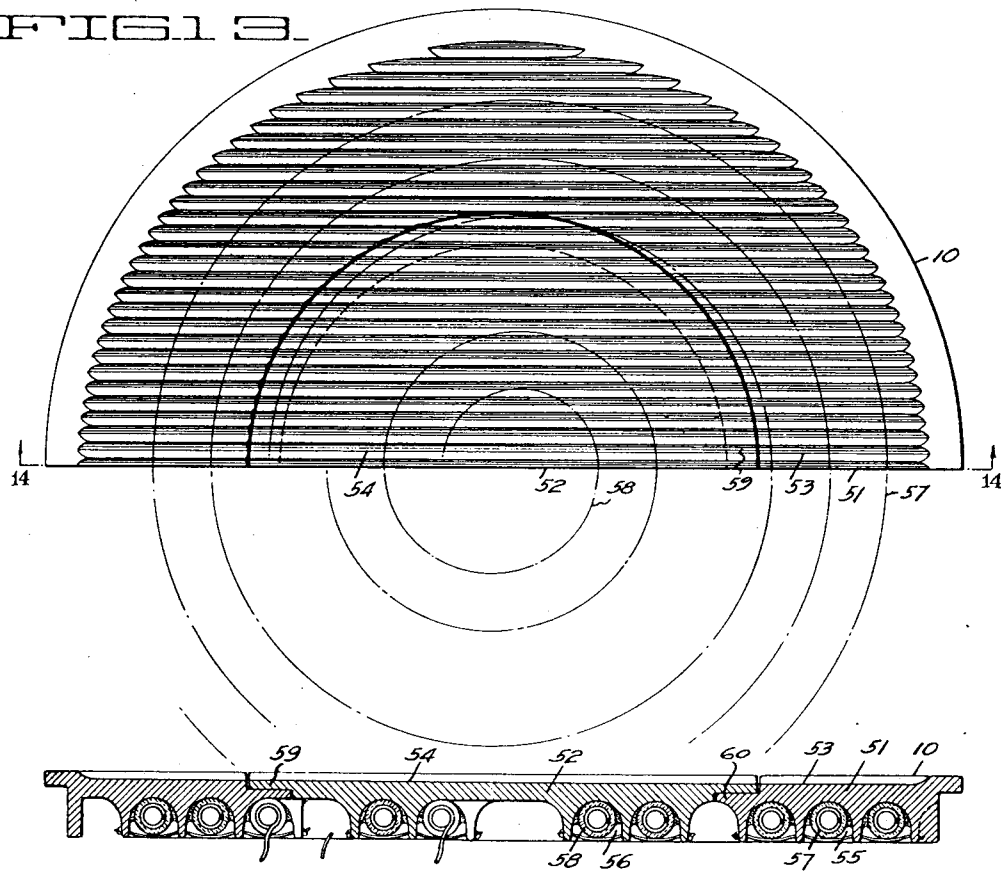


FIG. 14.

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Patented Oct. 4, 1927.

1,644,255

UNITED STATES PATENT OFFICE.

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ELECTRICAL HEATING DEVICE.

Application filed September 2, 1926. Serial No. 133,130.

This invention relates generally to electrical heating devices such as are used for cooking purposes.

Electric hot plates may be grouped in two general types according to the location of the resistance conductors. In the open face type, the resistance wires are disposed within grooves provided in a refractory body so as to heat by direct radiation. Plates of this kind, while being cheap to manufacture, are unsatisfactory in that the grooves are difficult to keep clean and the refractory body may be readily broken.

In the closed face type the resistance wires are in close thermal contact with the lower side of a metal plate. These closed top metal plates possess many inherent advantages in the way of cleanliness, but in the past have been unable to withstand the severe conditions to which they are normally subjected. For example, it is not uncommon for such plates to be suddenly chilled from a red heat by spilt liquids. The ordinary form of hot plate with a smooth upper surface will frequently crack under this treatment and will buckle and warp with even the best of care. This buckling and cracking has been so pronounced at high wattages that prior to this invention manufacturers have been unable to supply a metal hot plate which can be successfully operated at capacities exceeding 1500 watts. Other disadvantages prevalent in hot plates of this kind are their low electrical efficiency caused by a high heat lag, and the nature of the resistance element which makes them difficult to repair.

It is an object of this invention to devise a hot plate of the closed face metal type which will obviate all tendency to buckle or crack.

It is a further object of this invention to devise a hot plate which may be operated at higher wattages than previously possible with plates of a given size.

It is a further object of this invention to devise a hot plate which will have a low heat lag and a correspondingly high electrical efficiency.

It is another object of this invention to devise a novel and simple means for retaining the resistance element within a hot plate.

It is another object of this invention to devise an improved form of resistance ele-

ment and process of making the same which will have low heat lag and will obviate danger of short circuiting of adjacent convolutions of the wire.

Further objects of this invention will appear from the following description in which has been set forth the preferred embodiment of this invention. It is to be understood that the scope of the invention is to be determined from the appended claims and the state of the prior art.

Referring to the drawings:

Figure 1 is a transverse cross sectional view of a heating device incorporating certain features of this invention.

Fig. 2 is a bottom plan view of a portion of the hot plate shown incorporated with the heating device of Fig. 1.

Figs. 3, 4 and 5 are fragmentary plan views showing three different ways for indenting or grooving the upper surface of the hot plate.

Fig. 6 is a fragmentary cross sectional detail taken along the line 6—6 of Fig. 4.

Fig. 7 is a bottom plan view of a portion of a modified form of hot plate.

Fig. 8 is a top plan view of a portion of the plate shown in Fig. 7.

Fig. 9 is a cross sectional view taken along the line 9—9 of Fig. 8.

Fig. 10 is a plan view of a portion of a hot plate constructed of pressed sheet metal.

Fig. 11 is a cross sectional view taken along the line 11—11 of Fig. 10.

Fig. 12 is a fragmentary cross sectional view taken at right angles to the section plane of Fig. 9.

The invention comprises generally a hot plate having augmented absorption and radiating areas upon its lower and upper faces respectively, the absorption area being in thermal contact with a suitable resistance element. The radiating area is obtained by indenting or grooving the upper surface, these grooves preferably running in a direction angular to grooves upon the lower face within which are disposed the resistance elements, whereby the hot plate is reenforced against buckling.

Referring to Fig. 1 of the drawings there is shown a heating element 10 comprising a metal plate 12 provided with an electrical heating element 13 adjacent its lower face. The lower face of the plate 12 is grooved to provide a relatively large area which is in

thermal contact with the heating element 13. In that particular embodiment of the invention shown in Figs. 1 and 2, this augmented absorption area is obtained by providing one or more spiral ribs 14 projecting from the lower face of the plate, these ribs being preferably cast integral with the plate. In order to concentrate the heat toward the upper face of the plate, I prefer to form the ribs according to the principles disclosed and claimed in the patent to Kercher and Hicks, No. 1,492,540, issued April 29, 1924. Thus the rib 14 is formed of gradually increasing thickness as it merges into the body of the plate 12 so as to form a spiral groove 16 which is substantially arcuate in cross section.

Since the heating element 13 is placed within the groove 16, the surface of the groove 16 forms an absorption area which is in close thermal contact with the heating element. The upper surface of the plate is formed so as to dissipate substantially all of the absorbed heat by direct radiation, this radiating area being formed by grooving or indenting the upper surface. Thus as shown in Fig. 3 the upper surface is formed by a number of parallel grooves 17 defined by a series of parallel ridges 18. The depth and spacing of the grooves 17 is made such that the total radiating area thereby provided is at least as great as the absorption area on the lower face of the plate which is represented by the surface of the grooves 16. In practice good results have been obtained by making the radiating area substantially equal to the absorption area. The ribs 18 not only serve to provide an augmented area but also tend to reinforce the plate against buckling.

The radiating area may be formed in a number of different ways other than by the use of parallel grooves. For example, as shown in Figs. 4 and 5, the parallel grooves 17 may be crossed by a similar series of grooves 19 running substantially at right angles to the grooves 17. Preferably however, one set of grooves is made more shallow than the other as shown in Fig. 5, so that the ridges 18 will still tend to reinforce the plate against warping or buckling. The object of having the grooves 19 in addition to grooves 17 is to further augment the radiating area without increasing the depth of the grooves. In Fig. 6 we have illustrated the use of a plurality of grooves intercepting each other at angles differing from 90 degrees so as to form a plurality of diamond shaped projections 22.

The resistance element 10 is preferably in the form of a convoluted resistance wire 23 of suitable material such as chromium nickel alloy. In order to insulate the resistance wire and in order to serve as a means for placing the same in close thermal contact

with the lower face of the plate, there are provided a plurality of tubes or beads 24 of suitable insulating material such as porcelain, with which the convoluted wire 23 is strung. The heating element thus formed is positioned within the helical groove 16 and is retained in place as by means of a suitable refractory cement 26 which is subsequently applied to the spaces between the tubes 24 and the adjacent rib 14. Additional means for retaining the resistance element within the groove has been shown in the form of wires 25 strung through apertures provided in radially aligned rib portions. For convenience in controlling the heat developed by the plate the resistance element is preferably divided into two parts which may be electrically connected in series, in parallel, or connected separately to the line. Thus for example, the resistance element is tapped off as indicated by the terminal wires 27, this tap being taken off intermediate the inner terminal wire 28 and the outer terminal wire 29.

While any form of resistance wire 23 will give good results, we preferably employ coiled wire which will not readily short circuit between adjacent convolutions. This result is accomplished by coating the coiled resistance wire with a refractory substance before it is strung with the insulating tubes 24. In practice the resistance wire is coiled to form a long helix with adjacent convolutions held in spaced relationship by their own resilience. This wire helix is then dipped into a suitable wash of finely divided refractory material such as alundum or other aluminum oxide. The alundum adheres to the surface of the wire and fills the spaces between adjacent convolutions. When the wash has dried the insulating tubes 24 are placed over the coiled wire as explained above. When the resistance wire has been treated according to this process it will more readily transmit its heat to the insulating tubes 24 both by direct radiation and convection. Furthermore, adjacent convolutions will be effectively insulated from each other even after the resistance wire has been bent to conform with the grooves.

The electrical hot plate as described above may be incorporated with any suitable arrangement to form a complete cooking utensil or other electrical appliance. For example, it has been shown as being circular in shape and provided with a peripheral flange 38 to permit it to be removably positioned in the usual plate openings of electrical ranges. In most instances it is desirable to enclose the lower face of the plate to facilitate making the necessary electrical connections. As shown in Fig. 1, the lower face of the plate has been enclosed by a relatively shallow metal pan 32 having its upper edge secured to the plate 12. In order

to minimize direct transfer of heat from the lower face of the hot plate to the bottom 33 of the pan, there is provided a shield or false bottom 34 which is retained in spaced relationship to the bottom wall 33 as by means of a pressed shelf 36 extending about the periphery of the pan. This shield 34 forms an air pocket 37 which serves as a thermal insulation for the bottom of the pan. It is also proposed to have a relatively smooth reflecting surface upon the upper face of the shield 34 so as to reflect back heat radiated from the lower face of the hot plate. For making the necessary electrical connections suitable terminal connectors 38 are shown as mounted upon the bottom wall 33. In the particular type of hot plate shown three terminal connectors 38 are employed, these connectors being connected respectively to the outer terminal wire 29, intermediate tap wires 27 and inner wire 28. The wires are shown as doubled back and twisted upon themselves in order to maintain them at a relatively low operating temperature where they make electrical connection with the terminal connectors 38. For insulating the terminal wires suitable bushings 39 may be extended through the metal bottom wall 33 and shield 34.

While the groove for positioning the resistance element has been described above as being helical in shape, it is obvious that the resistance element can be positioned within a series of aligned or parallel grooves. Thus as shown in Figs. 7 to 11 inclusive, the resistance element has been shown as disposed within a plurality of parallel grooves 41 formed by means of a plurality of parallel ribs 42. In this instance the radiating area upon the upper face of the plate 112 has been formed with what may be termed a series of compound grooves. Thus a series of closely spaced grooves 43 have been provided upon another series of grooves 44, grooves 44 being spaced farther apart than the grooves 43. The advantage of this construction is that the grooves 44 serve to materially reinforce the plate against buckling while the grooves 43 serve to provide an augmented or relatively large radiating area. The grooves 44 preferably run at an angle to the ribs 42 in order to reinforce the plate against buckling in any direction.

In the constructions as described above the plate 12 is preferably constructed of cast metal of high heat conductivity such as iron or aluminum. It is also possible to construct a plate incorporating the principles of this invention out of pressed sheet metal. Thus as shown in Figs. 10 and 11 there is shown a plate 212 made of pressed sheet metal which is formed so as to provide a spiral groove 46 on its upper face and a complementary spiral groove 47 on its lower face. The insulated resistance

element 48 may be conveniently disposed within the groove 47 and may be retained in this position as by means of a retaining plate 49. To further augment or increase both the upper radiating area, and the lower absorption area in thermal contact with the resistance element 48, another series of smaller grooves 50 may be superimposed upon the grooves 46, thereby forming a compound groove effect somewhat as shown in Figs. 7 to 9. A hot plate of this type constructed of pressed sheet metal is advantageous in that a relatively small amount of metal is employed with the result that the heat lag is relatively low. In other words, the plate will come to full operating temperature within a short interval after energizing the resistance element.

In place of constructing the hot plate of a single integral member it may be formed of two or more parts removably assembled together. Such a plate is shown in Figs. 13 and 14 in which there is provided an outer ring-shaped portion 51 and a central portion 52. As in case of the plates shown in Figs. 1-5 the upper surface of each portion is provided with grooves 53 and 54 to provide an augmented radiating area and each of the lower surfaces is provided with a spiral groove 55 and 56 for receiving the separate resistance elements 57 and 58 respectively. By providing a peripheral flange 59 upon the central portion 52 to seat upon the flange 60 extending from the outer portion 51, either portion may be removed for renewal in case a resistance element should fail. Furthermore, each portion may be energized independently of the other to secure a maximum of electrical efficiency. This arrangement also has certain mechanical advantages in that since the portions are smaller than an integral plate, they are less apt to buckle or crack.

A hot plate incorporating the principles of this invention may be operated at high wattages without buckling or cracking the plate even when suddenly chilled by water. The grooved upper face provides many points of contact with the bottom of the cooking utensil, and if desired this upper face may be made perfectly plain in place of the hollowed faces usually resorted to in prior forms of hot plates which employ smooth upper surfaces. Because of the augmented radiating area provided, the heat is evenly distributed over the top of the plate and even when no cooking utensil is resting upon the upper face, sufficient heat is dissipated from the plate to prevent the same from reaching an excessively high temperature. By making the radiating area at least as large as the absorption area the major portion of the heat is caused to traverse paths substantially normal to the face of the plate, as this upper surface is always capable of dissipating substantially all of

the absorbed heat by direct radiation. In practice it has been found possible to operate a plate of approximately nine inches in diameter at a capacity of 2000 watts without buckling or cracking. In prior hot plates having smooth upper surfaces a certain amount of buckling or cracking was experienced even when operating at wattages in the neighborhood of 1500 and when this capacity was exceeded the buckling and cracking became so serious as to render such plates commercially impractical. By means of this invention we have also been able to materially decrease the weight and heat lag as the use of an augmented radiating area permits the use of a thinner metal plate which may be brought more quickly to maximum operating temperature.

We claim:

1. In an electrical heating device, a metal plate, ribs on the lower face of said plate forming grooves, and resistance elements disposed in said grooves, the upper face of said plate being grooved to provide an augmented radiating area whereby the rate of radiation of heat from the upper surface is substantially equal to the rate of absorption of heat from the resistance element.

2. In an electrical heating device, a metal plate having its lower face formed with one or more grooves, and a resistance element disposed in said grooves, the upper face of the plate also being provided with grooves extending angularly with respect to the grooves on the lower surface.

3. In an electrical heating device, a metal plate having its lower face formed with one or more grooves forming a relatively large heat absorption area, and a resistance element disposed in said grooves, the upper face of the plate also being provided with grooves extending angularly with respect to the grooves on the lower surface to form an exposed radiating area substantially as great

as said absorption area whereby warping of the plate is minimized.

4. In an electrical heating device, a metal plate having ribs upon its lower face defining one or more grooves, a resistance conductor disposed in said grooves, a plurality of refractory beads strung upon said conductor, and a refractory cement for securing said beads to said ribs.

5. In an electrical heating device, a metal plate having ribs upon its lower face defining one or more grooves, a resistance conductor disposed in said grooves, a plurality of refractory beads strung upon said conductor and adapted to fit within said grooves, and means secured to the bottom edges of said ribs for retaining said beads and conductors within the grooves.

6. In an electrical heating device, a metal plate having ribs upon its lower face defining one or more grooves, a resistance conductor disposed in said grooves, a plurality of refractory beads strung upon said conductor, and adapted to fit within said grooves and metallic means strung between successive ribs for retaining said beads and conductors within the grooves.

7. In an electrical heating device, a relatively flat metal plate having a series of ribs substantially covering its upper face to provide an augmented heat radiating area, ribs substantially covering the lower face of the plate to provide an augmented heat absorbing area, and an insulated resistance element disposed between the ribs upon the lower face, the ribs on one face extending angularly to the ribs upon the other face whereby buckling and cracking of the plate is prevented.

In testimony whereof, we have hereunto set our hands.

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