United States Patent [19]

Hurko et al.

[11] **3,826,898**

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[54] **BORDER TREATMENT OF COMPOSITE METAL PLATE SURFACE HEATING UNIT**

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[73] Assignee: **General Electric Company,** Louisville, Ky.

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[52] **U.S. Cl.** **219/462,** 219/430, 219/436, 219/459, 219/461, 219/463, 219/464, 219/530

[51] **Int. Cl.** **H05b 3/68**

[58] **Field of Search** 219/430, 436, 438, 439, 219/441, 458, 459, 460, 461, 462, 463, 464, 467, 530, 540

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[57] **ABSTRACT**

A low thermal mass, solid plate surface heating unit having a top utensil-supporting surface of composite metal of high thermal conductivity and corrosion and oxidation resisting materials. A metal sheathed electrical resistance heating element is pressed against the underside of the composite plate by a back-up plate. There are two modifications of the manner of spacing the peripheral edge of the inner core of the composite metal plate back from the peripheral edge of the heating unit. In one modification, a margin of the inner core and the bottom skin are cut away so as to be set back from the peripheral edge of the top skin. In the second modification, the top and bottom skins of the composite plate are sealed over the edge of the inner core. Then the peripheral edge of the back-up plate is brought out beyond the peripheral edge of the composite plate and a trim strip is wrapped around the edge of the back-up plate and the edge of the top skin and sealed therebetween.

9 Claims, 2 Drawing Figures

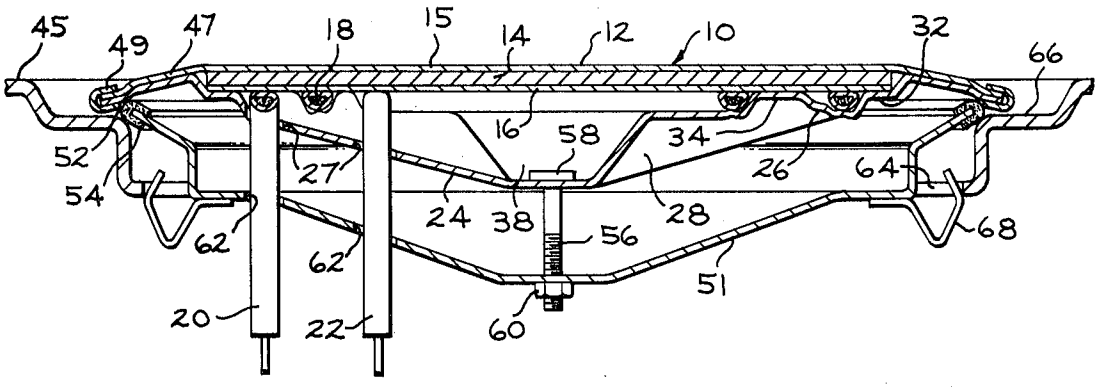
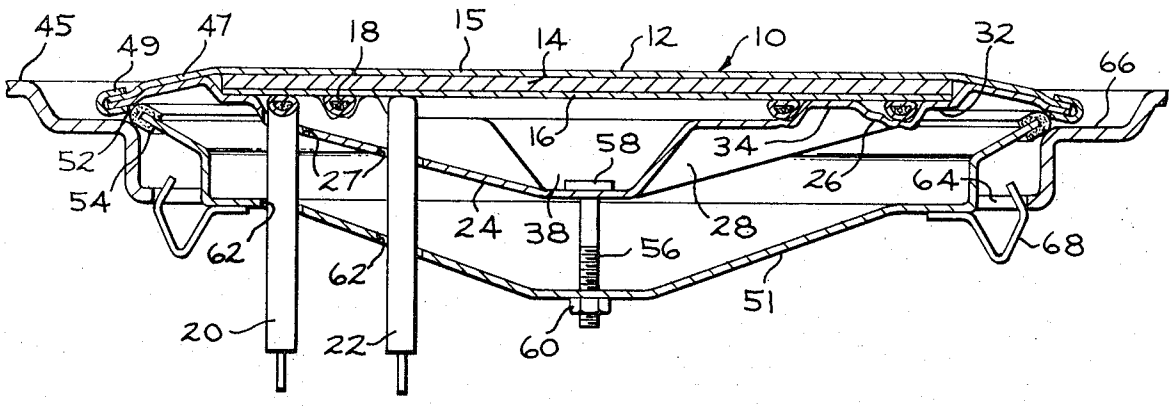


FIG. 1


45
49
47
18
15
14
12
10
32
66
52
54
27
16
58
34
26
64
62
62
24
38
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22
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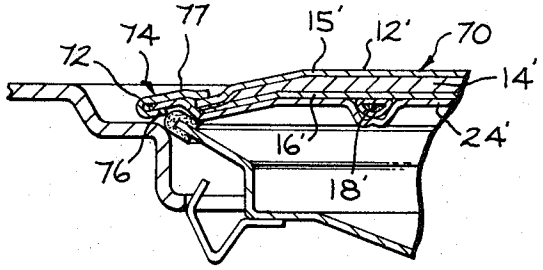

77
74
15'
12'
70
72
14'
16'
24'
76
18'

FIG. 2

BORDER TREATMENT OF COMPOSITE METAL PLATE SURFACE HEATING UNIT

BACKGROUND OF THE INVENTION

For many years, electric surface cooking has been performed on metal sheathed electrical resistance heating elements of spiral configurations. However, in many foreign countries electric surface cooking is performed mostly on cast iron solid plate units where the resistance heating elements are either embedded therein or permanently fastened thereto.

One important advantage of a solid plate surface heating unit is its ease of cleanability, since it forms with the cooktop in which the unit is mounted a solid surface. Hence, there are no holes in the cooktop through which spillovers and boilovers may leak and become difficult to reach for cleaning up. One important shortcoming of the cast iron surface unit plates is their high thermal mass and slow heat-up and cool-down rates, as well as their somewhat unattractive coloration.

An important advance in the art of solid plate surface heating units was introduced in U.S. Pat. No. 3,569,672 of Bohdan Hurko entitled LOW THERMAL MASS, PLATE SURFACE HEATING UNIT. This patent taught the use of a composite metal plate for the utensil-supporting surface of a solid plate surface heating unit for distributing the heat rapidly and uniformly over the plate.

One modification of the present invention is illustrated in co-pending patent application of Bohdan Hurko Ser. No. 419,592 entitled COMPOSITE METAL PLATE SURFACE HEATING UNIT which is being filed concurrently herewith. The invention in that copending application relates to a method of holding a metal sheathed electrical resistance heating element in contact with the underside of a composite plate by means of an embossed back-up plate so as to allow limited sliding movement between the heating element and the composite plate, and thereby prevent warpage of the composite plate.

A principal object of the present invention is to provide a composite metal plate surface heating unit with means to set back the peripheral edge of the inner core of the composite metal plate from the peripheral edge of the heating unit so as to reduce the conduction of heat from the heating unit to its supporting surface.

A further object of the present invention is to provide a composite metal plate surface heating unit with an effective manner of sealing off the inner core of the composite metal plate and at the same time reduce the conduction of heat from the heating unit to its supporting surface.

SUMMARY OF THE INVENTION

The present invention, in accordance with one form thereof, relates to a low thermal mass, solid plate surface heating unit comprising a thin plate of composite metal that has high thermal conductivity, and is also strong and oxidization and corrosion resistant. A metal sheathed electrical resistance heating element of coiled configuration is pressed against the underside of the composite metal plate. A back-up plate serves to press the heating element against the underside of the composite metal plate. The periphery of the back-up plate extends out beyond the extremity of the inner core of the composite metal plate, and a trim strip bridges the edge of the back-up plate and the edge of the composite plate and is sealed therebetween.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention will be better understood from the following description taken in conjunction with the accompanying drawings and its scope will be pointed out in the appended claims.

FIG. **1** is a cross-sectional elevational view through the center of a solid plate surface heating unit embodying the present invention, wherein the unit is shown mounted in an opening in a cooktop by means of spring clips that engage the edge of the opening.

FIG. **2** is a fragmentary cross-sectional elevational view of a second modification of the present invention relating to another method of sealing the core of the composite metal plate and insulating the edge of the heating unit so as to reduce the conduction of heat to the supporting surface.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to a consideration of the drawings, and in particular to FIG. **1,** there is shown a crosssectional elevational view of a solid plate surface heating unit **10** embodying the present invention having a top utensil-supporting plate **12** formed of thin composite metal of high thermal conductivity with a center core **14** of material such as copper, silver, or aluminum for distributing the heat rapidly over the entire plate and obtaining a generally uniform temperature distribution. Copper has very low strength at temperatures ranging in the vicinity of 1,400°F and also it oxidizes very readily. Since this copper sheet **14** is of small thickness, on the order of 0.040 inches, it would also tend to warp easily under normal conditions due to thermal stress caused by uneven temperature distribution when using cooking utensils with warped bottom plates, and also due to the high temperatures to which it is exposed.

The copper core **14** is sandwiched between two thin, integral stainless steel skins **15** and **16,** each of a thickness of about 0.016 inches. The stainless steel skins **15** and **16,** being bonded to the outer surfaces of the composite plate provide strength to the plate. Such a plate would have only slightly lower strength than a solid stainless steel plate of a similar thickness. The composite metal plate **12** resists warpage because it combines high strength with high heat diffusivity, which no single material known to us is able to provide. The thin composite sheet material **12** of central copper core **14** and two outer stainless steel skins **15** and **16** may be formed of individual sheets that are "area welded" together as by a process of explosive welding which causes a bonding of the metal sheets along their entire mating surfaces.

The heat source for this solid plate surface heating unit **10** is a metal sheathed electrical resistance heating element **18** of spiral configuration that is flattened on its topside and pressed into tight contact with the underside of the composite plate **12.** Sheathed heating elements such as this have a helical resistance wire embedded in a layer of magnesium oxide which is in turn covered by a metal sheath. This heating element **18** is of spiral configuration that is arranged in a single plane, and its terminals **20** and **22** are folded down to lie adja-

cent to each other at one side of the surface unit, as is clearly seen in FIG. 1.

Located beneath the heating element 18 is an embossed back-up plate 24 of stainless steel or the like, which is fashioned from a flat sheet that is stamped with a spiral recess 26 which closely overlies the spiral heating element 18. Moreover, the back-up plate 24 has small access openings 27 for receiving the heating element terminals 20 and 22 therethrough. A more complete description of the nature of this back-up plate is given in the co-pending patent application of Bohdan Hurko Ser. No. 419,592, which was cited above. The back-up plate 24 is provided with a deep-drawn bowl formation 38 adjacent to center thereof which includes a series of radial embossments 28 that terminate adjacent the outermost turn of the spiral recess 26 for strengthening the overall assembly of the heating unit.

The area of the back-up plate 24 on both sides of the outermost turn of the spiral recess 26 which received the heating element 18, is in direct contact with the underside of the composite plate 12. These areas are identified by the numerals 32 and 34, and they are permanently attached to the underside of composite sheet 12 as by spot welding at widely spaced points.

It must be understood that if the peripheral edge of the copper core 14 were exposed to the atmosphere under high temperature conditions, it would tend to corrode and oxidize rapidly thereby resulting in premature failure of the surface unit. Moreover, it is important to restrict the condition of heat from the surface unit 10 to the supporting cooktop 45 in which the surface unit 10 is mounted. Thus, it is well to stop the copper core 14 short of making thermal contact with the cooktop 45. In the first modification of FIG. 1, this is done by cutting away or otherwise removing an annular strip or margin of the bottom skin 16 and the copper core 14 for a distance of about one-half inch thereby leaving only the top skin 15 in that area identified by the numeral 47. This annular strip 47 is then seam welded between the top skin 15 of the composite plate 12 and the back-up plate 24. The peripheral edge of this annular strip 47 is in turn sealed by a folded-over trim strip 49 of monel metal or the like that may also be seam welded to the mating parts so that the copper core 14 is well sealed within the composite plate 12.

Another element of this solid plate surface heating unit 10 is a circular reflector pan 51 of deep-drawn configuration that is assembled beneath the composite metal sheet 12 and out of contact with the back-up plate 24 except adjacent the peripheral edge of the composite sheet 12 and the reflector pan 51 as at 52. The edge of the reflector pan 51 is covered by an asbestos gasket 54 which serves to hold the reflector pan 51 away from the adjacent surface of the cooktop 45 as well as supports the entire heating unit thereby holding the composite sheet 12 up off of the cooktop as well as holding the trim strip 49 out of direct contact with the cooktop 45. This insulating gasket 54 is important because it also serves as a sealing means between the cooktop 45 and the heating unit 10, and finally serves as a heat transfer barrier between the cooktop and heating unit.

This reflector pan 51 is assembled with the other parts of the heating unit 10 by a single bolt 56 located adjacent the center of the back-up plate 24 and integral therewith. The bolt 56 has a head 58 that is located within the back-up plate 24 and is welded in this plate. The bolt 56 is threaded and a nut 60 is slipped over the end of the bolt and tightened to hold the reflector pan 51 firmly in place. Notice that the reflector pan 51 has small access openings 62 that are generally aligned with the openings 27 in the back-up plate 24 for receiving the heating element terminals 20 and 22 therethrough, so that electrical connections may be made to the heating element 18 externally of the heating unit 10.

The cooktop 45 is provided with a recessed circular opening 64 for receiving the heating unit 10 therein. An annular recessed ledge 66 surrounds the recessed opening 64 and serves as the support means for the peripheral edge of the reflector pan 51 such that the top surface of the composite plate 12 is almost flush with top surface of the cooktop 45. A plurality of spring clips 68 are attached to the underside of the reflector pan 51 for engaging the edge of the opening 64 and holding the heating unit 10 firmly in place.

In the second modification of the present invention shown in FIG. 2 wherein like elements are given the same reference numeral except primed, as in the first modification of FIG. 1, there is a heating unit 70 having a top plate 12' formed of thin composite metal with a center core 14' such as copper, silver or aluminum, that is sandwiched between two thin, integral stainless steel skins 15' and 16'.

The heat source for this second modification is a metal sheathed electrical resistant heating element 18' that is held in place by a back-up plate 24'. The composite metal plate 12' is placed in a pinch die of a punch press of large force capability which forms an outer strip of the composite plate 12' into a tapered edge that is beveled downward where in effect the outermost edge of the inner core material 14' is reduced merely to a fine line separating the top skin 15' from the bottom skin 16'. The periphery of the back-up plate 24' extends outwardly beyond the extremity of the composite sheet 12' as at 72. This annular extension 72 of the back-up plate is stepped up in order to have it lie in substantially the same plane as the tip of the composite sheet 12'. Then a wide wrap-around trim strip 74 of monel metal or the like is fitted between the peripheral edge of the back-up plate and the peripheral edge of the composite sheet 12' by having the lower flange 76 underlying the back-up plate 24 and a top flange 77 bridging the gap between the back-up plate and the composite sheet 12' with an edge 78 that is in engagement with the top surface of the composite sheet 12'. This trim strip 74 may either be seam welded in place or it may be crimped in place to form a substantial finished product.

Modifications of this invention will occur to those skilled in this art; therefore, it is to be understood that this invention is not limited to the particular embodiments disclosed, but that it is intended to cover all modifications which are within the true spirit and scope of the invention as claimed.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A low thermal mass, solid plate surface heating unit comprising a thin composite metal plate having a core of high thermal conductivity selected from the group comprising copper, silver, and aluminum, and an outer skin of rigid and oxidation and corrosion resisting material sealing the core and selected from the group comprising stainless steel, nickel, and chromium, a

metal sheathed electrical resistance heating element held against the underside of the composite plate to serve as the heat source for the composite plate, a metal back-up plate beneath the heating element for holding the heating element against the composite plate, the periphery of the back-up plate extending outwardly beyond the extremity of the core of the composite plate by a wide margin so as to reduce the conduction of heat from the heating unit to its supporting surface, and a metal trim strip wrapped around the edge of the back-up plate and the top skin of the composite plate and sealed therebetween.

2. A low thermal mass, solid plate surface heating unit comprising a thin composite metal plate having a core of high thermal conductivity selected from the group comprising copper, silver, and aluminum, and an outer skin of rigid and oxidation and corrosion resisting material sealing the core and selected from the group comprising stainless steel, nickel, and chromium, a metal sheathed electrical resistance heating element held against the underside of the composite plate to serve as the heat source for the composite plate, a metal back-up plate beneath the heating element for holding the heating element against the composite plate, the periphery of the back-up plate extending out beyond the extremity of the composite plate by a wide margin so as to reduce the conduction of heat from the heating unit to its supporting surface, and a metal trim strip bridging the edge of the back-up plate and the edge of the composite plate and sealed thereto.

3. A composite metal plate surface heating unit as recited in claim **2** with the addition of a reflector pan assembled beneath the back-up plate, the peripheral edge of the reflector pan being provided with an insulating gasket means which is sandwiched between the reflector pan and back-up plate and serves as a heat transfer barrier therebetween said gasket means also being adapted to serve as the support means of the heating unit on a support surface and thereby adapted to serve as a sealing means therebetween and to prevent direct contact of the composite plate with the support surface.

4. A composite metal plate surface heating unit having a thin multilayer composite metal sheet as its top utensil-supporting surface, said composite sheet having an inner heat spreading core of non-ferrous metallic alloy of high thermal conductivity, the core being sealed in an outer metallic alloy skin of higher strength and resistance to oxidation than the inner core, a metal sheathed electrical resistance heating element pressed against the underside of the composite sheet to serve as the heat source for the heating unit, a metal back-up plate beneath the heating element for holding the heating element in place, the periphery of the back-up plate extending outwardly beyond the extremity of the inner core by a wide margin so as to reduce the conduction of heat from the heating unit to its supporting surface, and a metal trim encircling the heating unit and sealed between the edge of the top skin of the composite sheet and to the edge of the back-up plate so as to stop the heat spreading core short of the periphery of the heating unit and reduce the conduction of heat from the inner core to the peripheral extremity of the heating unit.

5. A composite metal plate surface heating unit as recited in claim **4** wherein the extent of the bottom skin of the composite sheet substantially coincides with the extent of the inner core, and the diameter of the top skin substantially equals the diameter of the back-up plate.

6. A composite metal plate surface heating unit as recited in claim **5** with the addition of a reflector pan assembled beneath the back-up plate, the peripheral edge of the reflector pan being provided with an insulating gasket means which is sandwiched between the reflector pan and back-up plate and serves as a heat transfer barrier therebetween said gasket means also being adapted to serve as the support means of the heating unit on a support surface and thereby adapted to serve as a sealing means therebetween and to prevent direct contact of the composite plate with the support surface.

7. A composite metal plate surface heating unit as recited in claim **4** wherein a narrow annular margin of both the bottom skin and the inner core has been removed from the top skin so that the periphery of the inner core is set back from the periphery of the heating unit.

8. A composite metal plate surface heating unit as recited in claim **4** wherein the periphery of the composite sheet is pressed into a tapered bevelled edge, a narrow strip of the periphery of the back-up plate is formed to lie in substantially the same plane as the bevelled edge of the composite sheet, whereby the said trim strip serves as an extension of the composite sheet.

9. A composite metal plate surface heating unit as recited in claim **8** with the addition of a reflector pan assembled beneath the back-up plate, the peripheral edge of the reflector pan being provided with an insulating gasket means which is sandwiched between the reflector pan and back-up plate and serves as a heat transfer barrier therebetween said gasket means also being adapted to serve as the support means of the heating unit on a support surface and thereby adapted to serve as a sealing means therebetween and to prevent direct contact of the composite plate with the support surface.

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