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Hurko

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[54] **GLASS-CERAMIC COOKTOP WITH FILM HEATERS**

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

[22] Filed: **May 10, 1974**

[21] Appl. No.: **468,753**

[52] **U.S. Cl.** **219/464;** 219/462; 219/463; 219/543; 219/552; 338/217

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

[58] **Field of Search** 219/385, 441, 450, 458, 219/460, 462, 463, 464, 522, 543, 552, 553; 338/317, 318

[56] **References Cited**

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3,496,336	2/1970	Hingorany et al.	219/464
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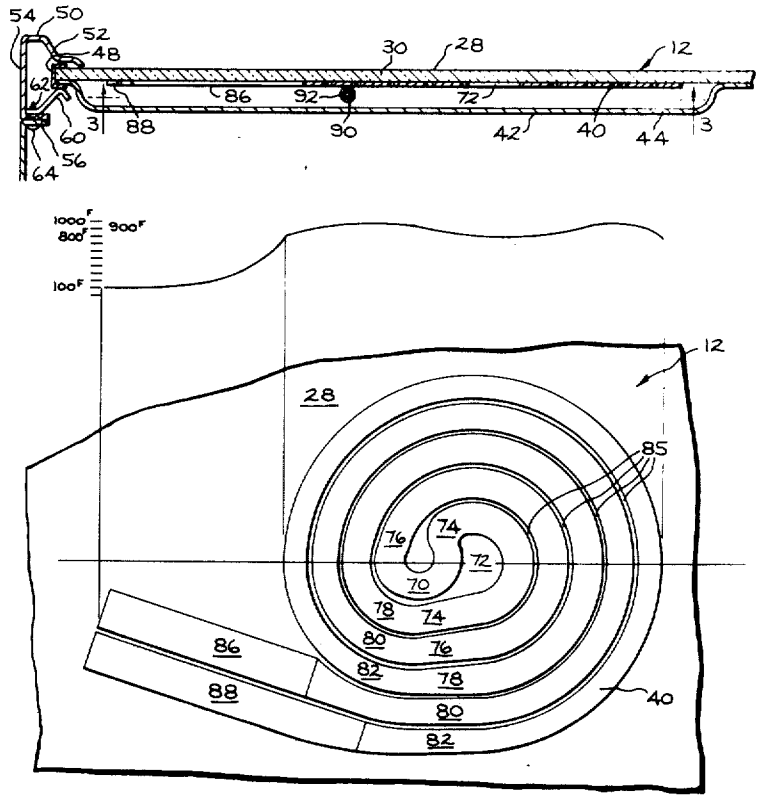
Primary Examiner—Volodymyr Y. Mayewsky

[57] **ABSTRACT**

A glass-ceramic cooktop with a plurality of metallic film heaters of circular pattern bonded to the underside thereof. Each turn of the film heater has a generally uniform electrical resistance per unit of length throughout its length and is shown of constant width. The resistance per unit of length of each turn increases from each turn to the next from the centermost turn of the circular pattern to the outermost turn so the widest turn is at the center, and each turn decreases in width from the centermost turn to the outermost turn. The spacing between turns is minimal and substantially uniform throughout. The film heater has a pair of adjacent terminal sections of relatively low resistance per unit area to reduce the temperature of the portion sections. the glass-ceramic plate in the vicinity of the terminal section.

13 Claims, 5 Drawing Figures



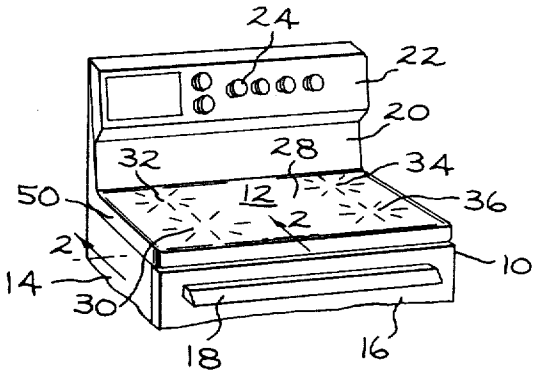


FIG. 1

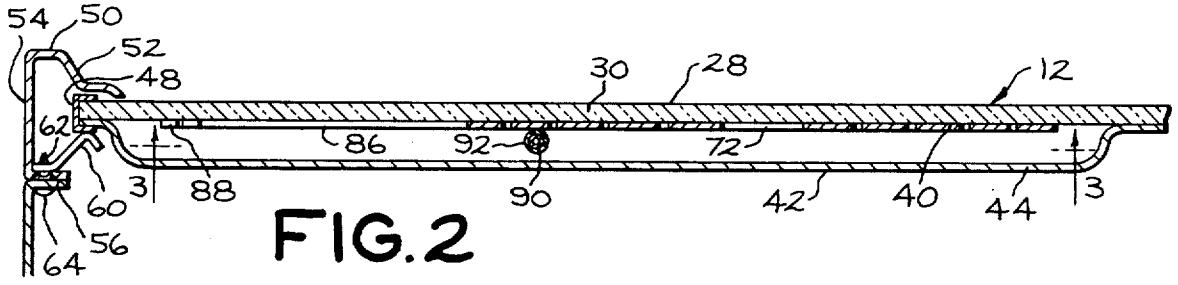


FIG. 2

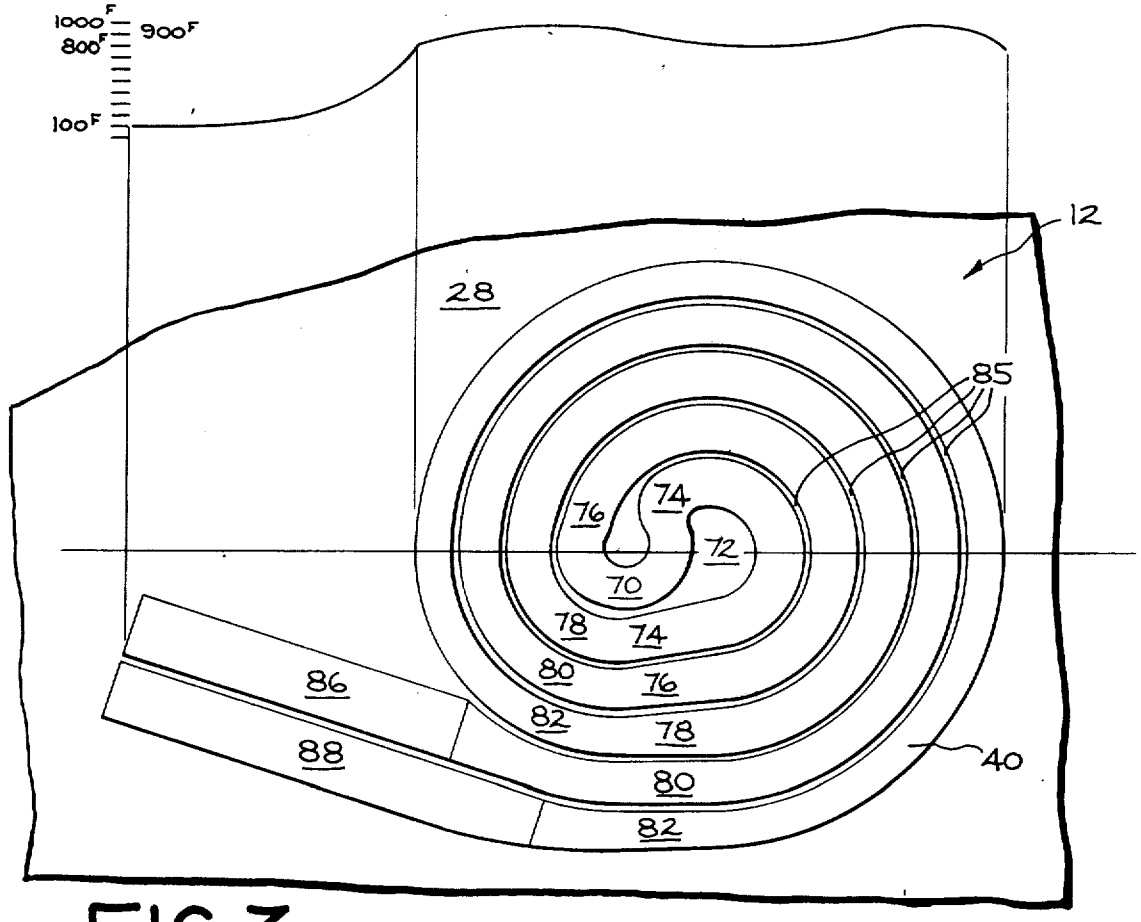


FIG. 3

FIG. 4

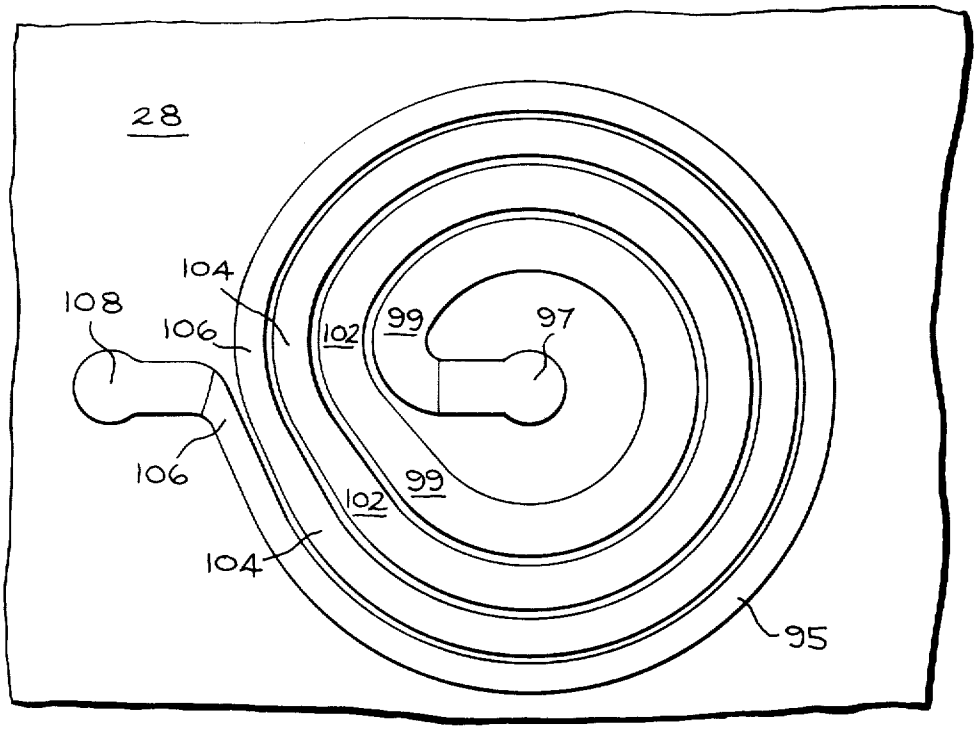

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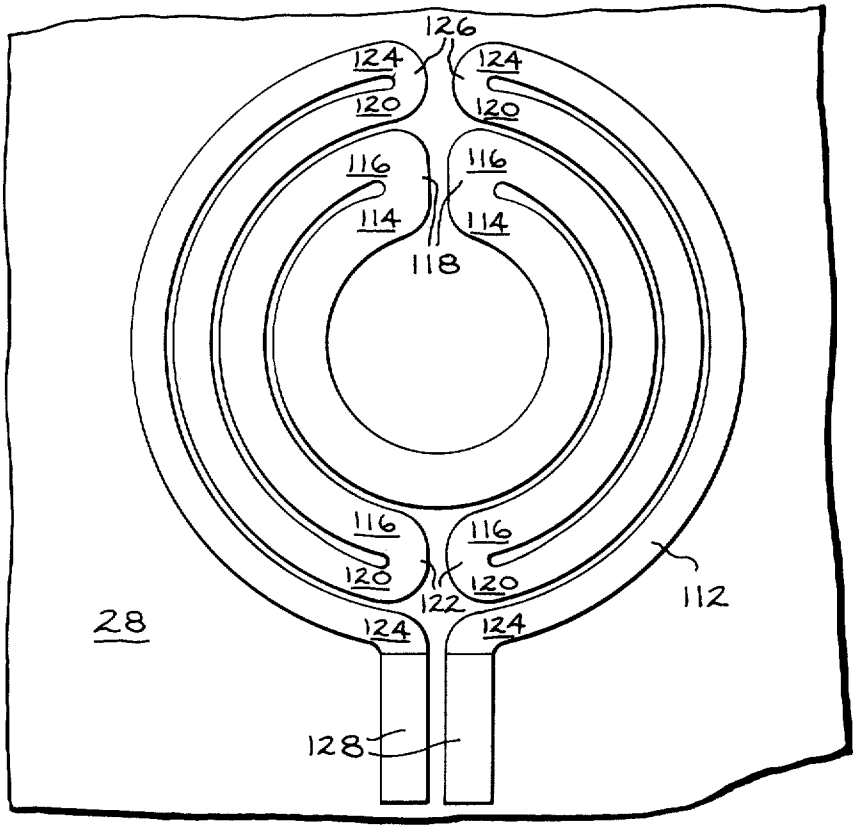
FIG. 5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GLASS-CERAMIC COOKTOP WITH FILM HEATERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to glass-ceramic plate surface heating units and cooktops which are provided with a metallic film heater bonded to the underside thereof.

2. Description of the Prior Art

In order to improve the cleanability of cooktops of domestic ranges as well as built-in counter cooktops, the standard porcelain enamel cooktop surface with separate electrical heating elements or gas burners has been replaced in certain models of appliances by high resistivity glass-ceramic plates, which are heated by either electricity or gas. Such plates are of generally milk-white, opaque, glass-ceramic or crystalline glass material sold under such trademarks as "PYROCERAM," "CER-VIT," and "HERCUVIT." This glass-ceramic material has a low thermal expansion coefficient, and it has a smooth top surface of almost ground glass finish or texture that presents a pleasing appearance and is also readily cleanable, and the continuous surface prevents the drainage of spillovers underneath the cooktop.

One such electrically heated glass-ceramic cooktop design is shown in U.S. Pat. No. 3,632,983 of R. L. Dills, which is assigned to the same assignee as is the present invention.

Present day glass-ceramic surface units and cooktops are less efficient thermally than standard cooktops with metal sheathed electrical resistance heating elements of spiral configuration. This is so because the glass-ceramic material has a high thermal mass thus a slow response requiring a longer time to heat up and cool down. The heat is stored in the glass-ceramic plate as well as in the sheathed heating element or the insulating support block or pad for the heating element. When open coil heaters are used at a spaced distance below the plate there is also a poor thermal coupling between the heater and the glass-ceramic plate. In order to transfer the heat from an open coil heater to the glass-ceramic plate, the heater has to operate at higher temperatures than otherwise, which creates several problems such as poor efficiency of the system, high heat losses, overheating of components, and high cooktop temperatures. Glass-ceramic cooktops and surface units with open coil heaters also present a safety hazard in the event the glass-ceramic plate is broken.

An early patent in the art of glass-ceramic plate surface heating units with film heaters is my U.S. Pat. No. 3,067,315 which is also assigned to the present assignee.

A part of the prior art is the Hadaway U.S. Pat. No. 563,032 which issued June 30, 1896 and shows a solid plate surface heating unit with a pair of open coil heaters each in the form of a graduated helix having its smaller end located adjacent the center of the plate. Each heater is fastened together at the center and wound in a spiral pattern to obtain even heat distribution. This is not comparable to the present invention which teaches the use of film heaters with an uneven heat distribution in order to obtain even temperature distribution on the top utensil-supporting surface of the solid plate.

The principal object of the present invention is to provide a flat plate surface heating unit or cooktop with a metallic film heater of a pattern with a biased watts density to provide an even temperature distribution across the top surface of the flat plate.

A further object of the present invention is to provide a glass-ceramic plate surface heating unit of the class described with a film heater pattern that has a biased heat distribution which increases from the center of the pattern outwardly to the periphery so as to afford an even temperature distribution on the top utensil-supporting surface of the heating unit.

A further object of the present invention is to provide a solid plate surface heating unit of the class described with a circular film heater, where each individual turn of the heater is of generally uniform electrical resistance per unit area throughout its length, while the resistance per unit area increases in steps from one turn to the next from the centermost turn to the outermost turn.

A further object of the present invention is to provide a solid plate surface heating unit of the class described wherein the spacing between turns of the spiral heater is minimal and substantially uniform so the film heater covers as large an area of the glass-ceramic plate as is possible while keeping the temperature of the film heater at the lowest level for a given power rating.

A still further object of the present invention is to provide a solid plate surface heating unit with a film heater of the class described where the film heater has a pair of cold terminal sections of relatively low resistance per unit area that are located outside the main heated portion of the film heater in a relatively cool area of the solid plate.

SUMMARY OF THE INVENTION

The present invention, in accordance with one form thereof, relates to a solid plate cooktop or surface heating unit that is provided with a metallic film heater in welding strip form on the underside thereof. This film heater has a heated portion with an electrical resistance per unit area that varies in increasing proportion to the distance of the given area from an imaginary center of the film heater pattern to give a biased heat distribution toward the outside of the film heater pattern to obtain an even temperature distribution on the top utensil-supporting surface of the solid plate.

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 fragmentary perspective view of a top portion of an electric range for use in the home, where the cooktop is represented by a single, large glass-ceramic plate, on the underside of which is provided a plurality of film heater patterns of the present invention that are bonded to the plate to provide a plurality of distinct heated areas of the cooktop.

FIG. 2 is a fragmentary, cross-sectional, elevational view on an enlarged scale taken on the line 2—2 of FIG. 1 showing the film heater pattern of the present invention bonded to the underside of the glass-ceramic plate.

FIG. 3 is a bottom plan view taken on the line 3—3 of FIG. 2 showing in detail the preferred embodiment of the film heater pattern of the present invention showing a double spiral pattern. Superimposed on this

FIG. 3 is a top surface temperature profile across the center of the film heater pattern showing the substantially even temperature distribution across the top surface of the glass-ceramic plate, as well as the quick falling off of temperature in the area adjacent the adjacent pair of terminal sections of the film heater pattern.

FIG. 4 is a bottom plan view similar to that of FIG. 3 showing a second modification of film heater pattern of the present invention having a single spiral pattern with an inner and an outer terminal section.

FIG. 5 is a bottom plan view of a third modification of film heater pattern of the present invention showing a folded, concentric circular design.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to a consideration of the drawings and in particular to FIG. 1, there is shown only the top portion of an electric range 10 having a horizontal cooktop 12 at generally counterheight. The present invention relates to the particular nature of the cooktop 12, but it is not necessary that this cooktop 12 be mounted as part of an electric range. The present invention is broader in scope to also include a single surface heating unit or houseware appliance known as "hotplates" having either a single surface heating means or a double surface heating means. Moreover, the cooktop could be a built-in cooktop that would be mounted flush in a kitchen countertop (not shown). The present invention relates to a glass-ceramic surface heating unit, but this invention is illustrated as it would be applied in groups of four to an entire cooktop 12. This cooktop 12 is mounted on the top of a range cabinet 14 in which would be mounted an insulated oven liner (not shown). The front wall of the range cabinet 14 is provided with a front-opening, drop door 16 having a door handle 18 arranged along the top edge of the door. Arranged along the back edge of the cooktop 12 is a backsplash 20 having an elevated control panel 22 in which are mounted a plurality of control components 24 such as surface heating unit control switches, oven control switches, and oven thermostat, as well as a clock-timer and the like, as is conventional in the range art.

The main element of the cooktop 12 is a large, flat glass-ceramic plate 28 that has a thickness ranging from ⅛ to ¼ inch, and is nearly of the same size as the top area of the range cabinet 14. At four different locations 30, 32, 34 and 36, a metallic film heater 40 of generally uniform thickness throughout of the present invention is bonded to the underside of the plate. Positioned beneath the glass-ceramic plate 28 is a large metal plate 42 of reflective material, such as aluminized steel, which is provided with a shallow pan formation 44 which underlies each film heater 40 and reduces the heat losses. The peripheral edge of the metal plate 42 coincides with the peripheral edge of the glass-ceramic plate 28. These two plates 28 and 42 are fastened together by a wrap-around channel strip 48 which slips over the edge of the two plates and prevents them from becoming separated.

The cooktop 12 is furnished with a narrow channel-like side frame 50 which extends from the backsplash 20 along the two sides and across the front of the range and surrounds a large opening for receiving the glass-ceramic plate 28 therein. This side frame 50 has a top flange 52, a vertical base portion 54 and a shortened bottom flange 56. To join the subassembly of the glass-ceramic plate 28 and the metal reflector plate 42 with their wrap-around strip 48, it is best to invert the combined backsplash 20 and side frame 50 on a work bench (not shown). Then lower the two plates 28 and 42 into place. A plurality of thin S-shaped spring clips 60 are located around the side frame. One end of each clip is fastened by a screw 62 to the bottom flange 56 so that the other end is compressed against the bottom of the wrap-around strip 48 for holding the subassembly firmly in place. The cooktop 12 is assembled to the range cabinet 10 by screws 64 fastened from beneath the bottom flange 56.

Turning now to a consideration of the bottom plan view of the cooktop 28 of FIG. 3, the film heater 40 is shown arranged in a double spiral pattern, which is doubled back on itself as at 70 near the center of the spiral pattern, leaving a circular opening 72 at the center. This circular pattern has a first centermost turn 74, a second turn 76, a third turn 78, a fourth turn 80, and a fifth outermost turn 82. Each individual turn 74 - 82 has a generally uniform resistance of ohms per unit area throughout its length so that each individual turn operates at a substantially uniform temperature. This is accomplished by having each individual turn of substantially uniform width. The resistance per unit area of each turn increases from the innermost turn 74 to the next turn 76, to 78, to 80 and finally to the outermost turn 82. This is accomplished by reducing the width of each turn in steps, with the innermost turn 74 being the widest and the outermost turn 82 being the narrowest.

It is likewise important to obtain the lowest average temperature on the film heater 40 because extended life tests of both film heater surface units and cooktops substantiate that film failures occur at the hottest spots on the film. This objective is accomplished by having the film heater pattern cover as much area of the glass-ceramic substrate 28 as is possible for a given area. Looking at FIG. 3, the various turns 74 - 82 are separated by a minimal spacing 85 which is substantially uniform between all of the turns.

The film heater pattern 40 represents a biased heat distribution which is lowest at the center 72 and increases gradually as the distance from the center increases toward the periphery of the film heater pattern. This results in a top surface temperature profile, as seen across the top of FIG. 3, with a film heater rated at 1,250 watts, of a temperature of about 800°F at the center 72 and also adjacent the periphery. There is a slight rise in temperature to about 1,000°F in an annular area between the center 72 and the periphery. However, this slight variation in temperature is considered as being of substantially even temperature distribution as distinguished from a saw-tooth temperature curve in phase with each turn of the heater.

The two outermost turns 80 and 82 are terminated by a pair of elongated, tangential cold terminal sections 86 and 88, respectively. These terminal sections are coated with a low resistance silver coating so that the terminals are substantially non-heating, cold terminals so as to lower the temperature in the area of the glass-ceramic plate 28 adjacent the terminals. Moreover, these two terminals 86 and 88 are located together and in a relatively cool area of the glass-ceramic substrate so that they do not derive much heat from the spiral heated portion of the heater. Hence, soft solder may be used for attaching lead wires (not shown) to the terminals 86 and 88. Notice the temperature profile curve in

FIG. 3 where the temperature drops suddenly from 800°F at the outermost turn 82 to near 100°F at the free end of the terminal sections 86 and 88.

In order to prevent the film heater 40 and the glass-ceramic plate 28 from overheating, a single-point temperature limit control probe 90 is pressed against the underside of the film heater 40. To prevent a short circuit, the probe is electrically insulated by an outer insulating sleeve 92 or the probe would be spaced out of contact with the film heater 40.

The film heater 40 may be made of layers of gold and platinum as is taught in my earlier U.S. Pat. No. 3,067,315 entitled, "Multi-Layer Film Heaters in Strip Form," while the terminal sections 86 and 88 include a layer of silver to provide a low resistance path so that these terminals remain relatively cool.

Efficiency tests indicate that when using flat bottomed cooking utensils, the present invention has an efficiency of greater than 72 percent, while glass-ceramic cooktops with open-coil heaters have an efficiency of less than 62 percent. The results of using the present invention compare favorably with an efficiency of about 75 percent for metal sheathed electrical resistance heating units such as are sold under the General Electric registered trademark CALROD unit.

FIG. 3 shows the preferred embodiment of the present invention, but other modifications may be feasible under certain circumstances. The modification of FIG. 4 shows a glass-ceramic plate 28 having a film heater 95 arranged in a single spiral pattern. At the center of the pattern is a first terminal section 97 from which the first turn 99 originates. A second turn 102 surrounds the first turn. A third turn 104 surrounds the second turn. Finally, a fourth turn 106 surrounds the third turn and also serves as the outermost turn which ends up as the second terminal 108.

Each individual turn 99, 102, 104 and 106 has a generally uniform resistance per unit area throughout its length. This is accomplished by having each individual turn of substantially uniform width throughout its length. The resistance per unit area of each turn increases from the innermost turn 99 to each succeeding turn until the final turn 106. This is accomplished by reducing the width of each turn in steps, with the innermost turn 99 being the widest and the outermost turn 106 being the narrowest.

FIG. 5 shows a third modification of film heater 112 having a non-spiral pattern of folded concentric circular design having an innermost circle 114, an adjacent second circle 116 after the 180° folds at 118, a third circle 120 after the 180° folds at 122, and finally the outermost circle 124 after the 180° folds at 126. The outermost circle 124 has a pair of cold terminals 128 which are arranged adjacent to each other and extend radially from the imaginary center of the film heater pattern 112.

Having described my inventions of several film heater patterns for use with a glass-ceramic plate, surface unit or cooktop it will readily be apparent to those skilled in this art that a metallic plate substrate could be employed in place of the glass-ceramic plate if the metallic plate were properly insulated from the film heater by a high resistivity layer of porcelain enamel or the like so there would not be an electrical current leakage hazard upon operation of this modified plate surface unit.

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 this invention as claimed.

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

1. A solid plate surface heating unit comprising a flat plate having an electrical film heater in winding strip form of generally uniform thickness bonded to the underside thereof, the resistance per unit area of the heated portion of the film heater varying in increasing proportion to the distance of the given area from an imaginary center line of the film heater pattern to give a biased heat distribution toward the outside of the film heater pattern so that the temperature distribution across the top surface of the solid plate is substantially uniform, the resistance per unit area at a given distance from the center being substantially constant, while the resistance per unit area varies in steps on an ascending curve as the distance of a particular area increases from the center of the film heater pattern.

2. A solid plate surface heating unit as recited in claim 1 wherein the said film heater strip is wound in a circular pattern.

3. A solid plate surface heating unit as recited in claim 1 wherein the said film heater strip is wound in a spiral pattern.

4. A solid plate surface heating unit as recited in claim 3 wherein the said film heater strip has terminal portions outside the main heated area of the film heater, said terminal portions being of relatively low resistance per unit area so as to obtain a relatively low temperature at the terminal portions of the film heater strip.

5. A solid plate surface heating unit as recited in claim 2 wherein the said film heater strip has a pattern with a plurality of adjacent turns that are spaced apart a minimal distance that is substantially uniform throughout so that the film heater strip substantially covers a maximum area of the solid plate within a given area so as to obtain the lowest temperatures of the film heater strip for a given power rating.

6. A solid plate surface heating unit as recited in claim 3 wherein each individual turn of the spiral film heater strip is of generally uniform electrical resistance per unit area throughout the length of each individual turn.

7. A solid plate suface heating unit as recited in claim 6 wherein the resistance per unit area of each turn increases from one turn to the next from the centermost turn of the spiral pattern to the outermost turn.

8. A solid plate surface heating unit as recited in claim 7 wherein each individual turn of the spiral film heater strip is of substantially uniform width throughout, while the width of the turns decreases in steps from the centermost turn to the outermost turn.

9. A solid plate surface heating unit as recited in claim 4 wherein the said spiral film heater strip is a double spiral pattern which is doubled back on itself adjacent the center of the spiral pattern, the film heater strip terminating in an adjacent pair of elongated terminal sections of relatively low resistance per unit area compared to the main heated portion of the film heater pattern so that the electrical terminations are made remote from the heated portion of the film heater.

10. A solid plate surface heating unit as recited in claim 9 wherein the said solid plate is a high resistivity glass-ceramic plate, and the said film heater is of multi-layers of noble metals such as platinum and gold, and the said terminal sections include a layer of silver.

11. A solid plate surface heating unit as recited in claim 9 wherein the said solid plate is a metallic plate having a high resistivity porcelain enamel layer interposed between the film heater and the metallic plate, the said film heater comprising multi-layers of noble metals such as platinum and gold, and the said terminal sections include a layer of silver.

12. A solid plate surface heating unit as recited in claim 2 wherein the said circular pattern of the film heater strip is a folded concentric circular pattern having an adjacent pair of cold terminal sections.

13. A solid plate surface heating unit as recited in claim 3 wherein the said spiral pattern is a single spiral having one terminal section located adjacent the center of the film heater pattern and a second terminal located adjacent the outermost turn of the pattern.

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