United States Patent [19]

Dills

[11] **3,885,128**

[45] **May 20, 1975**

[54] **GLASS-CERAMIC PLATE HEATING UNIT CAST-IN HEAT SPREADER**

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

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[52] **U.S. Cl.** **219/462**; 219/457; 219/463; 219/464; 219/530

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

[58] **Field of Search** 219/439, 449, 457, 458, 219/459, 461, 462, 463, 464, 467, 530

[56] **References Cited**

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3,632,983	1/1972	Dills	219/464
3,805,023	4/1974	Waimer et al.	219/464 X
3,816,704	6/1974	Borom et al.	219/462

Primary Examiner—Volodymyr Y. Mayewsky

[57] **ABSTRACT**

A glass-ceramic plate surface heating unit has a high thermal conductivity layer such as aluminum or copper cast in a recess formed on the underside of the plate, a metal sheathed electrical resistance heating element with an underlying reinforcing member is cast into the high conductivity layer, so that the said layer serves both as a mechanical and thermal coupling means between the heating element and the plate as well as a heat spreader means across the plate. The underside of the plate is shown with a plurality of cavities so as to increase the area of contact between the high conductivity layer and the glass-ceramic plate.

3 Claims, 2 Drawing Figures

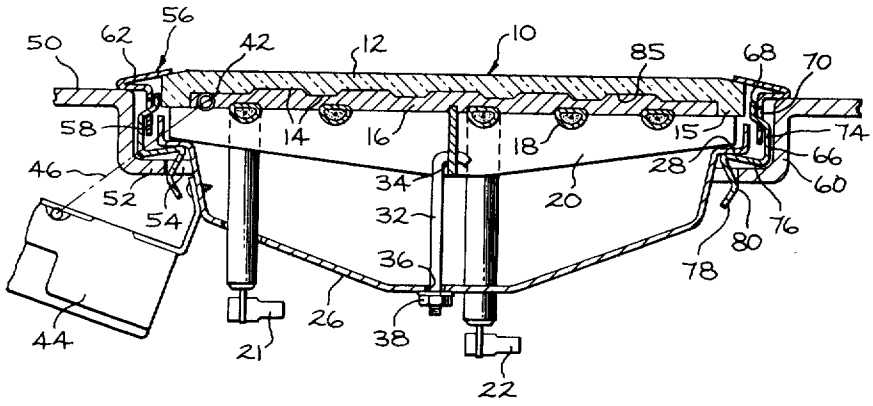
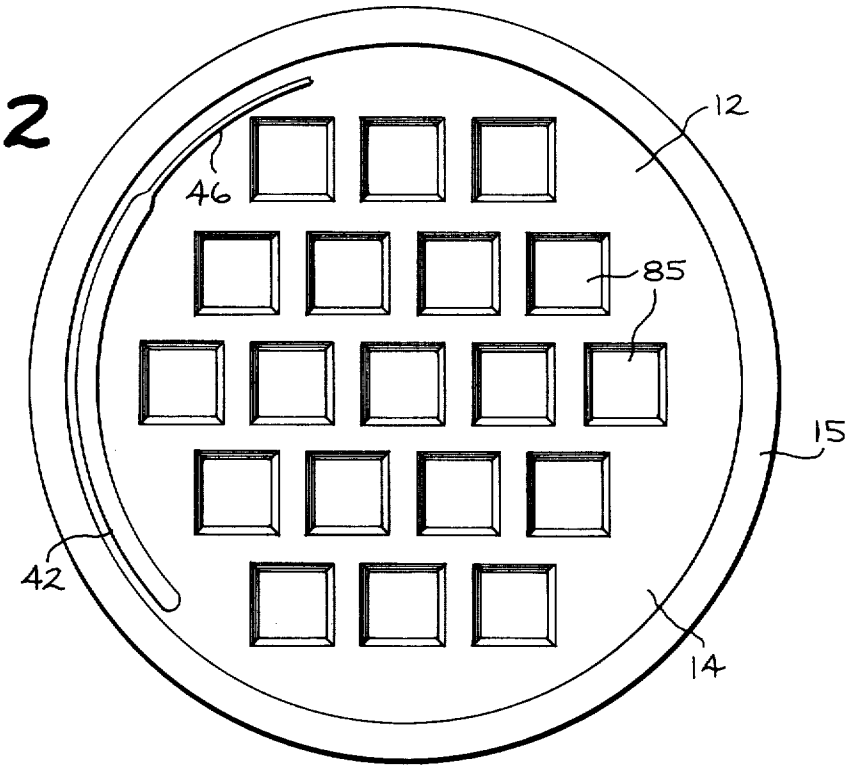


FIG.2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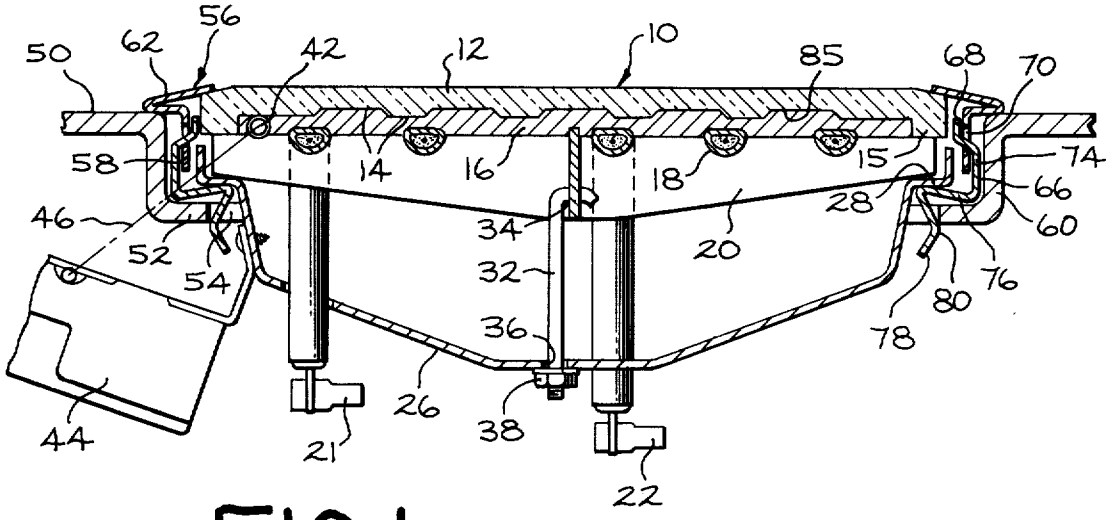
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FIG.1

GLASS-CERAMIC PLATE HEATING UNIT CAST-IN HEAT SPREADER

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The invention relates to glass-ceramic plate surface heating units or cooktops with a metal sheathed heating element cast into a heat spreading layer on the underside of the plate.

2. Description of the Prior Art:

In order to improve the cleanability of cooktops of domestic ranges as well as built-in countertop 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 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. The continuous top 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 the present inventor, which is also assigned to the assignee of the present invention.

Present day glass-ceramic surface units and cooktops are less efficient thermally than standard porcelain enamelled steel cooktops having metal sheathed electrical resistance heating elements of spiral configuration. This is mainly because the glass-ceramic material has a high thermal mass, thus a slow thermal response requiring a longer time to heat up and cool down. The heat is stored in the glassceramic plate as well as in the sheathed heating element and in 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 glassceramic 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 and liquids should pass through the crack and contact the open coil heater.

Another difficulty encountered in glass-ceramic plate heating units is the rather poor quality of thermal conductivity through the glass-ceramic material. Such material is used widely in other arts as a thermal and electrical insulating material, rather than as a thermal conductor in the present invention. Heat does not readily diffuse laterally through the glass-ceramic plate, and during a cooking operation heat will flow to the utensil only near the point of contact. The remainder of the heated area may become very hot.

One solution to this problem of low thermal efficiency in glass-ceramic plate heating units is taught in U.S. Pat. No. 3,622,754 of Bohdan Hurko, which is also assigned to the present assignee. This Hurko patent employs a metal sheathed heating element that is attached to the underside of a thin composite plate having a core of high thermal conductivity such as copper, silver or aluminum. The composite plate is pressed against the underside of the glass-ceramic plate.

The principal object of the present invention is to provide a glass-ceramic plate surface heating unit or cooktop with a cast-in heat spreader plate which also serves as a mechanical and thermal coupling means for the heating element.

A further object of the present invention is to provide a glass-ceramic plate heating unit or cooktop of the class described with an enlarged area of contact between the cast-in heat spreader plate and the glass-ceramic plate.

SUMMARY OF THE INVENTION

The present invention, in accordance with one form thereof, relates to a solid plate surface heating unit comprising a glass-ceramic plate having a recess formed on the underside thereof, the recess being substantially filled with a high conductivity cast-in heat spreader layer. A metal sheathed electrical resistance heating element with a reinforcing member of open framework is fastened across the underside of the heating element that is in turn cast in the said heat spreader layer so that the layer serves both as a mechanical and thermal coupling means between the heating element and the glass-ceramic plate, as well as a heat spreading means of good thermal conductivity across the heated area of the 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, cross-sectional, elevational view through about one-half of a solid glass-ceramic plate surface heating unit embodying the present invention, showing an aluminum or copper casting held in the underside of the glass-ceramic plate, with the heating element confined therein.

FIG. 2 is a bottom plan view of the glass-ceramic plate of FIG. 1 showing a pattern of a plurality of cavities formed on the underside of the glass-ceramic plate so as to increase the surface area of contact between the heat spreader casting and the glass-ceramic plate.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to a consideration of the drawings and in particular to FIG. 1, there is shown a cross-sectional, elevational view of a solid plate surface heating unit **10** having a thin glass-ceramic plate **12** which is a molded part of generally circular configuration having an inverted pan-shape by virtue of a recess **14** created on the underside of the glass-ceramic plate due to the presence of a down-turned peripheral wall **15**. In other words, this glass-ceramic plate is not a simple plate of uniform thickness throughout, as in most, if not all, glass-ceramic cooktops sold widely on the market today. While this invention is shown incorporated in a single solid plate surface heating unit, it should be understood that it is equally applicable in a cooktop having a plurality of heated areas, where each heated area would have its own heat spreader layer **16**.

This glass-ceramic material is electrically insulating and thermally transmissive as well as being highly wear and thermal shock resistant, and resistant to the physical and chemical attacks of foods and liquids which may come in contact with the plate at relatively high temperatures. While the term glass-ceramic material or crystalline glass material is used throughout, it should be understood that this invention encompasses other materials with similar characteristics, such as quartz, high-silica glass, high-temperature glasses and different ceramic materials.

It would be extremely difficult to maintain an even temperature distribution across this glass-ceramic plate **12** if it were heated directly by an open coil resistance heating element or a metal sheathed resistance heating element of looped configuration. Heat diffuses very slowly laterally through the glass-ceramic material, and hence, hot spots would be created on the plate surface nearest the areas of contact between the heater and the glass, as well as between the glass and the warped bottom of a cooking utensil. This type of glass cannot exceed an operational temperature of about 1300°F at any point, hence, the total heat output of a glass-ceramic surface heating unit would be reduced if the plate is provided with an uneven temperature distribution. In the absence of a temperature-limiting means, the plate would have to be underheated in order to avoid damaging the glass-ceramic plate.

The present invention contemplates the casting of an aluminum or copper layer **16** within the recess **14** on the underside of the glass-ceramic plate **12.** Before this metal casting is poured and solidified, a sub-assembly of a metal sheathed electrical resistance heating element **18** of spiral configuration is first staked or otherwise mounted on a reinforcing support **20** of open framework. This sub-assembly is placed in contact with the molten metal **16** such that as the metal solidifies the heating element and a portion of the reinforcing framework **20** will be cast into the heat spreader layer **16.** The sheathed heating element **18** is shown with two vertically-arranged electrical terminals **21** and **22** for joining the heating element in an electrical circuit.

A reflector pan **26** of rather deep configuration is positioned beneath the heating unit **18** and reinforcing framework **20.** The upper perimeter of the reflector pan **26** has an outwardly extending ledge **28** on which the supporting framework **20** is seated. A J-bolt **32** is hooked to the reinforcing frame **20** at its upper end **34,** while the lower threaded end of the J-bolt extends through an opening **36** in the bottom of the reflector pan **26** and a nut **38** is tightened on the bolt until the surface unit **10** is tightly held in the reflector pan **26.**

It is important to limit the operating temperature of the glass-ceramic plate **12** to a temperature below about 1300°F. This can best be done by introducing a temperature-limiting means to the solid plate surface unit of the present invention such that the power to the heating element **18** is cut off if the temperature of the heat spreader casting **16** rises to a predetermined temperature. This temperature-limiting means comprises a temperature sensor **42** in the form of an elongated bulb which is positioned outside the outermost coil of the heating element **18** and is positioned on the reinforcing framework **20** and cast in the heat spreader layer **16.** This sensor **42** is a bulb-like member that is filled with a high temperature thermostatic fluid such as sodium potasium (NaK) or the like. The sensor communicates with a temperature responder **44** by means of a capillary tube **46,** which is shown diagrammatically as a long dash line. This temperature responder **44** is a single-point, temperature-limiting switch or thermostat that is set at a critical temperature of about 1250°F. This temperature responder **44** would include switch means (not shown) in a series circuit with the heating element **18** such that if the critical temperature of the heat spreader casting would be reached the power circuit to the heating element **18** would be broken and the heating element de-energized. A similar arrangement is utilized in the Hurko U.S. Pat. No. 3,622,754.

This solid plate surface heating unit **10** is shown mounted in a cooktop **50** by means of a depressed circular ledge **52** that encircles a cut-out opening **54.** It is best to provide some means for holding the surface unit **10** down in place, and this function is provided by a trim ring **56** which has a transverse T-shaped cross-section with a first vertical shank section **58** which is insertable into the narrow gap between the periphery of the heating unit **10** and the vertical side **60** created by the recessed ledge **52.** The upper edge of the vertical shank **58** is provided with a folded-over crown **62** which overlies both the edge of the cooktop **50** and the edge of the glass-ceramic plate **12.**

Releasable means must be provided for holding the trim ring **56** in place. For this purpose a series of widely spaced clip members **66** are attached to the shank portion **58** of the trim ring **56** at widely spaced positions around the trim ring. Each clip member **66** is of thin spring material of narrow width, and at its upper end it is provided with an offset finger **68** which is adapted to extend through a mating slot **70** formed in the shank portion of the trim ring **56.** The only way to insert the finger **68** through the slot **70** is to remove the surface unit **10** from the cooktop **50** and insert the fingers at a generally perpendicular angle with respect to the shank portion **58** of the trim ring, and then pivot or lower the clip member down against the side of the shank portion, as is best seen in FIG. **1.** These fingers **68** become captured in place in the slots **70** due to the small clearance between the shank portion **58** and the vertical side **60** of the cooktop edge. Each clip member **66** is generally of Z-shape in side view having a generally vertically upper flange **74,** a generally horizontal mid-portion **76** and a wide V-shaped lower portion **78.** This lower V-portion **78** has an apex **80** that is directed generally toward the edge of the ledge **52** of the cooktop **50** to serve as a detent member, such that when the surface unit **10** is lowered onto the recessed ledge **52** of the cooktop **50,** the apex **80** tends to engage the innermost edge of the ledge **52** until additional force causes the clip member to spring away from the ledge and then the apex to snap back beneath the ledge to serve as a tight hold-down means.

There is a tendency for the metal casting **16** to contract slightly from the glass-ceramic plate **12** as the casting solidifies. This effect can be counterbalanced by providing a pattern of concavities **85** in the glass-surface in the recess **14,** as is best seen in the bottom plan view of FIG. **2.** This increases the surface area of contact between the metal casting and the glass-ceramic plate to improve the thermal coupling between these two parts. Other patterns of concavities **85** may be substituted such as a corrugated surface, a pebbled embossed or textured surface.

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 surface heating unit comprising a glass-ceramic plate having recess means formed on the underside thereof, the recess means substantially covering a large area of the plate and being substantially filled with a metal casting of high thermal conductivity such as aluminum or copper that is formed in place, a metal sheathed electrical resistance heating element with a reinforcing member of open framework fastened across the underside of the heating element, the heating element and reinforcing member being partially embedded in the said metal casting, whereby the metal casting serves as both a mechanical and thermal coupling means between the heating element and the glass-ceramic plate as well as the heat spreader means across the plate.

2. A glass-ceramic plate as recited in claim 1 wherein the said recess means on the underside of the glass-ceramic plate is formed with a plurality of cavities that are also filled with the metal casting so as to increase the area of contact between the glass-ceramic plate and the metal casting.

3. A surface heating unit as recited in claim 1 wherein there is a reflector pan positioned beneath the glass-ceramic plate and having a peripheral edge near the top portion of the pan on which the said reinforcing member is seated, and fastening means joining the reflector pan to the reinforcing member, the area of the glass-ceramic plate in contact with the metal casting being provided with a textured surface having a plurality of cavities for increasing the area of contact between these two parts and hence the thermal coupling action.

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