PATENT SPECIFICATION (11) 1 562 251

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(21) Application No. 5525/77 (22) Filed 10 Feb. 1977
(23) Complete Specification filed 9 Feb. 1978
(44) Complete Specification published 5 March 1980
(51) INT CL³ H05B 3/74, 1/02
(52) Index at acceptance H5H 111 112 132 152 179 199 200 231 233 242 247 274 AH

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(19)

(54) ELECTRICAL HEATING UNITS

(71) We, MICROPORE INTERNATIONAL LIMITED, a British Company, of Hadzor Hall, Hadzor, Droitwich, Worcestershire WR9 7DJ, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electrical heating units for smooth top cooker hobs.

Smooth top cooker hobs have a flat sheet of for example, a glass ceramic which forms the actual heating surface upon which a cooking utensil is placed. A heating unit which includes an electrical heating element is disposed beneath the glass ceramic sheet. This sheet must therefore be capable of transferring the heat from the heating element to the cooking utensil and of withstanding high radiant temperatures without softening or cracking. Such designs have the advantage of easy cleaning as compared with cooker hobs in which the cooking utensil is heated by direct radiation or direct contact with a heating element.

The glass ceramic sheet must be protected from over-heating. Thus while it can withstand normal operating temperatures, for example temperatures not in excess of 700°C, for very long periods without deterioration, at higher temperatures its life becomes greatly reduced. For this reason the energisation of the heating element is usually controlled by a temperature sensor to prevent any overheating of the glass ceramic sheet.

The temperature sensor has to be able to sense localised hot regions in the glass ceramic as well as high overall average temperatures. A temperature sensor which has been used in practice comprises a thin tubular probe which projects across the top of the unit above the heating element and just below the glass ceramic sheet so that in this position it is sensitive both to the total surface area of the heated glass ceramic and to any localised hot spots.

An example of a suitable temperature sensor is of the differential expansion type having a probe consisting of a silica tube within which is an Inconel wire. One end of the tube and wire are joined and the differential expansion between the two is then detected at their other ends by a lever mechanism which controls a microswitch which in turn controls the energisation of the electrical heating element.

It was believed that the probe of such a temperature sensor had to extend across the heating unit over the top of the heating element and immediately below the glass ceramic sheet in order both to be receptive both to the average temperature of the glass ceramic sheet and to localised hot spots. We have now found, however, according to the present invention that the temperature sensor will still operate satisfactorily even when the probe is positioned below the heating element in an open-topped groove in the thermal insulation supporting the heating element.

Therefore according to the invention there is provided an electrical heating unit for a smooth top cooker hop comprising a base layer of thermal and electrical insulation material, an electrical heating element of the bare conductor type positioned above the base layer, and a temperature sensor which includes an elongated temperature sensing probe, the probe being positioned beneath the heating element in an open-topped groove extending across the base layer.

Surprisingly we find that the probe of the temperature sensor can still be sensitive both to high average temperatures of the glass ceramic sheet and to localised hot spots provided of course that the open-topped groove and the probe extend substantially completely across the whole of the heating unit. We believe that a reason for this is that overall high temperatures of the glass ceramic and localised hot spots influence the temperature of the heating element which itself then becomes hotter

and so the probe is indirectly sensing the temperature of the glass ceramic by sensing the temperature of the heating element. Further the heating element can be closer to the glass ceramic sheet than in the case where the probe is positioned above the element, and so the glass temperature has an enhanced effect on the temperature of the element.

It may be necessary for the cut-off temperature at which the temperature sensor reacts to an excessive temperature to be somewhat lower than in the case where the probe is positioned above the heating element by the appropriate cut-off temperatures for operation of the temperature limiter can readily be found by simple experiment.

As noted above the probe should extend substantially completely across the heating unit and ideally it will extend in a groove which is a diagonal in the case of a circular or substantially circular heating unit. However, this may not always be possible since one of the electrical supply leads for the heating element may pass through the centre of the base layer and in this case the probe and groove can be displaced to a small extent from a diameter to the position of a chord.

The temperature sensor can be of the well known design noted above having a probe which includes an outer silica tube within which is an Inconel wire.

The open-topped groove in the thermal insulation preferably has a cross-section in the shape of a V with a rounded apex whose width increases in the direction towards the electrical heating element since this enables the probe to "see" most of the area of the glass ceramic plate heated by the unit.

An important advantage of being able to position the probe of the temperature sensor below the heating element is that the overall depth of the heating unit can be substantially reduced, e.g. the reduction can be of the order of 10 to 12 mm. This can be a considerable advantage in cookers where there is only very limited space available between the hob and an oven or electrical controls positioned beneath the hob.

The electrical heating element is of the bare conductor type, this is in the form of a bare wire, ribbon or strip of electrical conductor which is heated by the passage of an electrical current. Preferably the electrical heating element is in the form of a helically coiled bare wire supported on thermal and electrical insulating material. This material preferably includes a microporous material such as silica aerogel which is present in an intimate mixture with an opacifier and a reinforcing fibre.

In cases where the heating element is liable to sag and distort when in use it may be desirable to support it where it crosses the open-topped groove. This can be achieved by enclosing the probe of the temperature sensor within a tube of electrically insulating and heat-radiation transparent material, e.g. quartz, so that the top of this tube can support the element where it crosses the open-topped groove.

The invention is particularly, but not exclusively, useful in connection with the heating element shown in our United Kingdom Patent No. 1,433,478.

An example of a heating unit according to the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a plan view of the unit, and

Figure 2 is a part-section taken along the line 2—2 of Figure 1.

The heating unit 10 shown in the drawings includes a dish-shaped base 12 having an upstanding annular side wall 14. The base and side wall have been made of thermal and electrical insulating material including microporous silica aerogel. The side wall is topped by a ring 16 of bonded ceramic fibres which abuts the underside of the glass ceramic sheet (not shown) when the unit 10 is in use. The base 12 sits in an outer protective metal pan 18.

The base 12 has a substantially flat upper surface 19 over which is positioned a substantially flat disc 20 of bonded ceramic fibres. Resting directly on the disc 20 is spirally arranged helically coiled bar wire heating element 24. The ends of this element are joined to electrical supply leads 26 which lead to a junction box 27.

Formed in the base 12 is an open-topped groove 28 which extends completely across the unit approximately diagonally. As can be seen best from Figure 2 this groove has a V-shaped cross-section such that its width increases towards the surface 19. Positioned within the groove 28 and beneath the heating coil 24 is the probe 30 of a conventional temperature sensor. As can be seen in Figure 1 holes 34 are provided in the side wall 14 and through the metal pan 18 for the insertion of the probe into the groove 28.

The construction and operation of the temperature sensor is well known and no further explanation is deemed necessary.

In cases where the wire of the element 24 is liable to sag where it crosses the groove 28, the probe 30 can be enclosed within a quartz tube 32 which is electrically insulating and heat-radiation transparent. This tube 32 will then support the wire where it crosses the groove 28.

In operation we find that the probe 30 is capable of sensing localised hot spots or excessive average temperatures of the glass

ceramic sheet as a whole and so it can function in a manner analogous to the case where the probe is positioned between the heating element 24 and the glass ceramic sheet. An advantage of the invention, however, is that the height of the side walls 14 can be very much reduced as compared with the case where the probe 30 is positioned above the heating coil 24 and so the overall depth of the unit 10 can be decreased.

WHAT WE CLAIM IS:—

1. An electrical heating unit for a smooth top cooker hob comprising a base layer of thermal and electrical insulation material, an electrical heating element which is in the form of a bare electrical conductor positioned above the base layer, and a temperature sensor which includes an elongated temperture sensor which includes an elongated temperature sensing probe, the probe being positioned beneath the heating element in an open-topped groove extending across the base layer.

2. A unit as claimed in Claim 1 in which the heating element is in the form of a helically coiled bare wire supported by the base layer.

3. A unit as claimed in Claim 1 or Claim 2 in which the heating element rests on a disc of bonded ceramic fibres and the disc in turn is supported on the base layer of insulation.

4. A unit as claimed in any preceding claim in which the open-topped groove has a substantially V-shaped cross-section, the width of the groove increasing in the direction towards the heating element.

5. A unit as claimed in any preceding claim which is substantially circular and the open-topped groove extends substantially diametrically across the base layer.

6. A unit as claimed in any preceding claim in which the probe is enclosed within an electrically insulating and heat-radiation transparent tube.

7. An electrical heating unit for a smooth top cooker hob substantially as herein described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

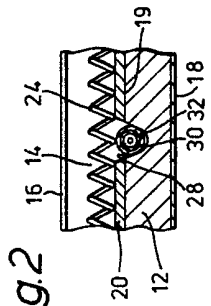

Fig.2

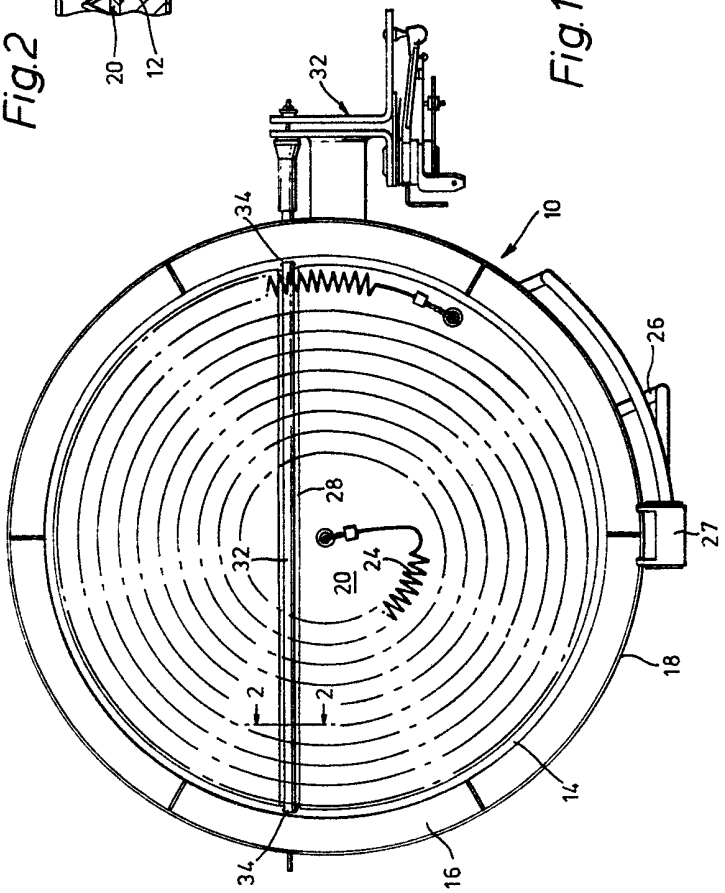

Fig.1