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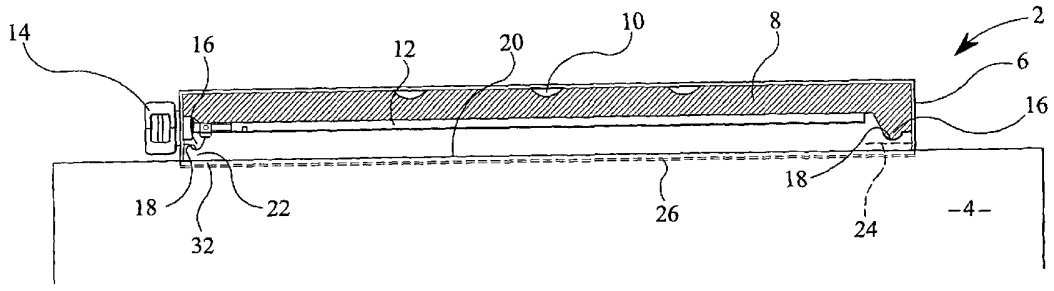
(54) Title: RADIANT ELECTRIC HEATER



(57) Abstract: A radiant electric heater (2) for use in an oven (4) comprises a base layer (8) of thermal insulation material, at least one heating element (12) supported relative to the base layer (8), and a peripheral wall (16) of thermal insulation material. A covering sheet (20) of fabric material overlies the at least one heating element (12) and the peripheral wall (16) and an apertured member (26) overlies the covering sheet (20). Spacer means (22; 24; 32), such as in the form of an air gap or a substantially moisture-impermeable component, or a substantially moisture non-absorbent component, is provided between the covering sheet (20) and the apex (18) of the peripheral wall (16) and/or between the covering sheet (20) and the apertured member (26).

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RADIANT ELECTRIC HEATER

This invention relates to a radiant electric heater of the type in which one or more radiant electric heating elements is or are supported relative to a base of thermal insulation material which may particularly be microporous thermal insulation material. For example, the invention relates to such a heater for use in cooking appliances, such as ovens, especially microwave ovens.

In GB-A-2 331 688, a radiant electric heater is described which is particularly applicable to grills and ovens, such as microwave ovens, and in which a heating element is supported relative to a base of thermal insulation material, such as microporous thermal insulation material, provided in a dish-like support. A peripheral wall of thermal insulation material is provided, which may be integral with the base.

A covering sheet in the form of a fabric comprising glass or ceramic filaments overlies the heater in contact with the peripheral wall and an apertured sheet, such as of metal, is provided overlying, and in contact with, the covering sheet.

The covering sheet serves to prevent particulates, such as splattered food particles, which may be emitted during

cooking of food, from entering the heater and contaminating the heating element and/or the base layer. It also prevents any loose particles of thermal insulation material of the base in the heater from falling into a cooking cavity and contaminating food therein, particularly when the heater is installed in a top wall of an oven or grill.

The apertured sheet, such as of metal, minimises risk of mechanical damage to the covering sheet and internal components of the heater, such as during cleaning of an appliance incorporating the heater. When of metal, it also serves as a microwave radiation screen when the heater is installed in a microwave oven.

A problem has arisen, particularly when such a heater is provided as a grill heater in a microwave oven, or in an oven including convection heating. In practice, a grill heater provided in such an oven may receive infrequent use.

When microwave or convection heating is used without simultaneous operation of the grill heater, the relatively cold grill heater becomes exposed to water vapour issuing from food being cooked. Such water vapour passes through the apertured sheet, such as of metal,

overlying the grill heater and condenses on the inside of this apertured sheet. The apertured sheet is in contact with the covering sheet of the fabric comprising glass or ceramic filaments which is, in turn, in contact with the peripheral wall of the thermal insulation material.

The water vapour condensing on the apertured sheet is wicked by the fabric covering sheet into the peripheral wall of thermal insulation material. Particularly when the peripheral wall comprises microporous thermal insulation, absorption of water therein results in permanent damage to the structure of the insulation material. This is in contrast to exposure of the insulation material to water vapour, which does not result in damage to the structure of the insulation material.

It is an object of the present invention to overcome or minimise this problem.

According to the present invention there is provided a radiant electric heater comprising: a base layer of thermal insulation material; at least one heating element supported relative to the base layer; a peripheral wall of thermal insulation material; a covering sheet of fabric material overlying the at least one heating

element and the peripheral wall; and an apertured member overlying the covering sheet, wherein spacer means is provided between the peripheral wall and the apertured member.

The apertured member may comprise a perforated sheet or a lattice arrangement, of metal, ceramic or other suitable refractory material.

Spacer means may be provided between the covering sheet and the peripheral wall and/or between the covering sheet and the apertured member.

The spacer means may comprise an air gap or a substantially moisture-impermeable or substantially moisture non-absorbent component, such as of a ceramic material. Such component may be of ring or sheet form.

The peripheral wall may have an apex.

The peripheral wall and optionally the base layer may comprise microporous thermal insulation material.

The peripheral wall may be provided integral with the base layer.

The base layer and the peripheral wall may be provided in a dish-like support, such as of metal.

The glass and/or ceramic filaments may be of woven, knitted or mat form in the fabric.

The at least one heating element may comprise one or more heating elements of wire, ribbon, foil or lamp form.

The present invention also provides an oven provided with the aforementioned radiant electric heater.

As a result of the provision of the spacer means, any moisture which comes into contact with the apertured member is prevented from being transferred to and absorbed by the peripheral wall of the heater. Consequential damage to the material, such as microporous thermal insulation material, of the peripheral wall is thereby prevented. Such moisture may result from condensation, on the apertured member, of water vapour emitted by food being heated by other means, such as microwave radiation or convection heating, in an oven containing the radiant electric heater in an unenergised state.

For a better understanding of the invention and to show more clearly how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 is a plan view of an embodiment of a radiant electric heater according to the present invention; and

Figure 2 is a cross-sectional view of the heater of Figure 1 installed in an oven.

Referring to the drawings, a radiant electric heater 2, installed in a wall of an oven 4, such as a microwave oven, comprises a metal dish-like support 6 provided with a base layer 8 of compacted microporous thermal and electrical insulation material. As shown in Figure 2, the dish-like support 6 is formed with a plurality of depressed regions 10 of arcuate form which permit the material of the base layer 8 to engage around the arcuate portions to assist in securing the base layer 8 in the dish-like support 6.

A heating element 12 is provided secured to the base layer 8. As shown, the heating element 12 comprises a corrugated metal ribbon mounted edgewise on the base layer 8. Such a heating element is well known to the

skilled person. The heating element 12 could instead be of coiled wire form, or of other ribbon form, or of foil form, or of lamp form, or of any other suitable form known to the skilled person. More than one heating element, or more than one form of heating element, could be provided in the heater.

A terminal block 14 for the heating element 12 is mounted on the heater and allows the heater to be connected to a voltage supply for operation.

A peripheral wall 16 of microporous thermal insulation material is provided in the heater and has an apex 18. As shown, this wall 16 is integral with the base layer 8. However, it could be provided as a separate member, as is well known in the art.

A covering sheet 20 of a fabric comprising glass and/or ceramic filaments, is provided overlying the heater, including the apex 18 of the peripheral wall 16, and spaced from the heating element 12. Such covering sheet 20 is suitably secured to the metal dish-like support 6 and such that the covering sheet 20 is not in direct contact with the apex 18 of the peripheral wall 16.

Spacer means is provided to ensure that the covering sheet 20 is not in direct contact with the apex 18 of the peripheral wall 16. Such spacer means suitably comprises an air gap 22 provided between the covering sheet 20 and the apex 18 of the peripheral wall 16. Alternatively, the spacer means comprises a substantially moisture-impermeable, or substantially moisture non-absorbent, component 24, such as of a ceramic material, and suitably of flat ring or sheet form, provided between the covering sheet 20 and the apex 18 of the peripheral wall 16.

The covering sheet 20 suitably comprises glass and/or ceramic filaments woven, knitted or matted to form a fabric.

Suitable materials for the covering sheet 20 are described in GB-A-2 331 688.

The fabric of the covering sheet 20 may comprise filaments of E glass, C glass, R glass or S glass or modifications thereof. For example, the boron oxide in E glass may be replaced by magnesium oxide, such a glass being commercially available, under the trade name Advantex, from OCF Corporation.

Alternatively the covering sheet 20 may comprise a fabric of alumino-silicate filaments, or of alumino-boro-silicate filaments, or of zirconia cloth.

In general, the weight per unit area of the covering sheet 20 should be less than 1 kilogram per square metre and typically in a range from 50 to 300 grams per square metre.

The covering sheet 20 is arranged to be at least partially translucent to allow transmission therethrough of visible and infra-red radiation from the heating element 12.

The covering sheet 20 serves to prevent any splattered food particulates from entering the heater 2 during heating of food in the oven 4. It also serves to prevent any loose thermal insulation material of the base layer 8 from falling into the oven 4 and contaminating food being cooked therein. This is particularly relevant when the heater 2 is installed in a top wall of the oven 4.

An apertured sheet 26 is provided overlying the covering sheet 20. Such apertured sheet 26 may serve more than one purpose. It may provide protection for the covering sheet 20 and may also minimise risk of manual contact

with internal components of the heater 2, such as when cleaning the inside of the oven 4 or when using cooking implements inside the oven. The apertured sheet 26 is most suitably of metal, but may comprise a ceramic or any suitably apertured refractory material. When of metal, the apertured sheet 26 can be used to provide electrical screening, such as in respect of microwave radiation generated when the oven 4 is a microwave oven.

The apertured sheet 26 can comprise perforations 28 in a metal or ceramic sheet or the sheet can be of expanded metal form 30, or other appropriate lattice form.

The oven 4 may include other heating means (not shown) in addition to the heater 2. Such other heating means may comprise microwave radiation heating means, or convection heating means. When one of these other heating means is operated alone without the heater 2 being energised, the heater 2, the covering sheet 20 and the apertured sheet 26 remain relatively cool while a food item in the oven 4 is being heated. Water vapour, such as in the form of steam, issues from the food item and condenses on the relatively cool surface of the apertured sheet 26. It also passes through the apertures in the apertured sheet 26 and condenses on the inside surface of the sheet.

If the apertured sheet 26 is in contact with the covering sheet 20 of fabric material, the resulting moisture is readily wicked along and through the covering sheet 20. If the covering sheet 20 had been arranged in contact with the apex 18 of the peripheral wall 16 of microporous thermal insulation material, the moisture would have been absorbed by the microporous insulation material from the covering sheet 20. Such absorbed moisture would have resulted in permanent damage to the structure of the microporous insulation material of the peripheral wall 16. However, the provision of the spacer means of the present invention, comprising the air gap 22, or the substantially moisture-impermeable, or substantially moisture non-absorbent, component 24 such as in the form of a flat ring or sheet of ceramic, prevents such moisture being transferred from the covering sheet 20 to the peripheral wall 16.

In an alternative embodiment of the present invention, instead of or in addition to the spacer means 22 or 24 being provided between the covering sheet 20 and the apex 18 of the peripheral wall 16, spacer means 32 is provided between the apertured sheet 26 and the covering sheet 20. Such spacer means can be an air gap, or a substantially moisture-impermeable, or substantially moisture non-absorbent, component, such as of a ceramic and suitably

of ring or sheet form. Such spacer means 32 prevents contact, and hence transfer of moisture, between the apertured sheet 26 and the covering sheet 20. With this arrangement, the covering sheet 20 could be in contact with the apex 18 of the peripheral wall 16.

CLAIMS

1. A radiant electric heater (2) comprising: a base layer (8) of thermal insulation material; at least one heating element (12) supported relative to the base layer (8); a peripheral wall (16) of thermal insulation material; a covering sheet (20) of fabric material overlying the at least one heating element (12) and the peripheral wall (16); and an apertured member (26) overlying the covering sheet (20), characterised in that spacer means (22; 24; 32) is provided between the peripheral wall (16) and the apertured member (26).

2. A radiant electric heater as claimed in claim 1, characterised in that the apertured member (26) comprises a perforated sheet (28) of material selected from metal, ceramic and other suitable refractory material.

3. A radiant electric heater as claimed in claim 1, characterised in that the apertured member (26) comprises a lattice arrangement (30) of material selected from metal, ceramic and other suitable refractory material.

4. A radiant electric heater as claimed in claim 1, 2 or 3, characterised in that the spacer means (22; 24) is provided between the covering sheet (20) and the peripheral wall (16).

5. A radiant electric heater as claimed in any preceding claim, characterised in that the spacer means (32) is provided between the covering sheet (20) and the apertured member (26).

6. A radiant electric heater as claimed in any preceding claim, characterised in that the spacer means (22; 24; 32) is selected from means comprising an air gap (22), a substantially moisture-impermeable component (24), and a substantially moisture non-absorbent component (24).

7. A radiant electric heater as claimed in claim 6, characterised in that the component (24) comprises a ceramic material.

8. A radiant electric heater as claimed in claim 6 or 7, characterised in that the component (24) is of ring form.

9. A radiant electric heater as claimed in claim 6 or 7, characterised in that the component (24) is of sheet form

10. A radiant electric heater as claimed in any preceding claim, characterised in that the peripheral wall (16) has an apex (18).

11. A radiant electric heater as claimed in any preceding claim, characterised in that the peripheral wall (16) comprises microporous thermal insulation material.

12. A radiant electric heater as claimed in any preceding claim, characterised in that the base layer (8) comprises microporous thermal insulation material.

13. A radiant electric heater as claimed in any preceding claim, characterised in that the peripheral wall (16) is integral with the base layer (8).

14. A radiant electric heater as claimed in any preceding claim, characterised in that the base layer (8) and the peripheral wall (16) are provided in a dish-like support (6).

15. A radiant electric heater as claimed in claim 14, characterised in that the dish-like support (6) comprises metal.

16. A radiant electric heater as claimed in any preceding claim, characterised in that the fabric of the covering sheet (20) comprises glass filaments.

17. A radiant electric heater as claimed in any preceding claim, characterised in that the fabric of the covering sheet (20) comprises ceramic filaments.

18. A radiant electric heater as claimed in claim 16 or 17, characterised in that the filaments are of a form selected from woven, knitted and mat form in the fabric.

19. A radiant electric heater as claimed in any preceding claim, characterised in that the at least one heating element (12) comprises heating elements selected from wire, ribbon, foil and lamp form.

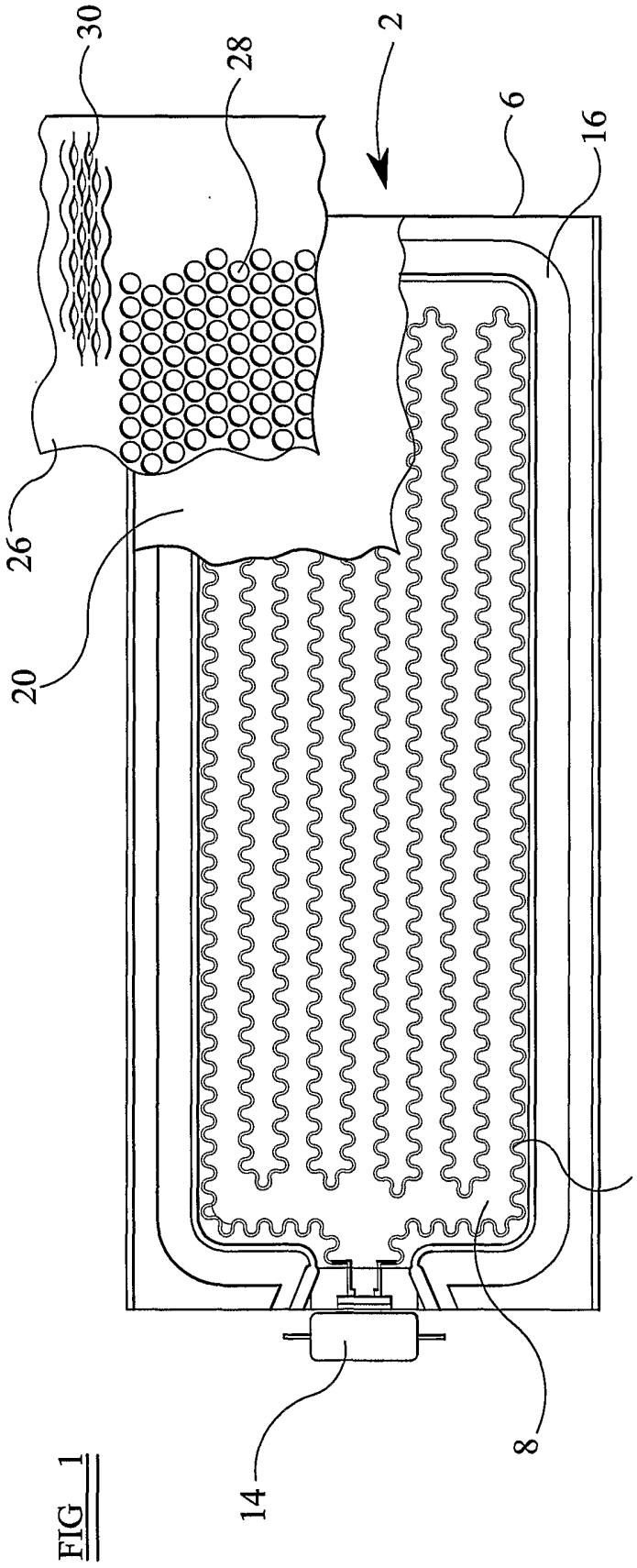

FIG 1

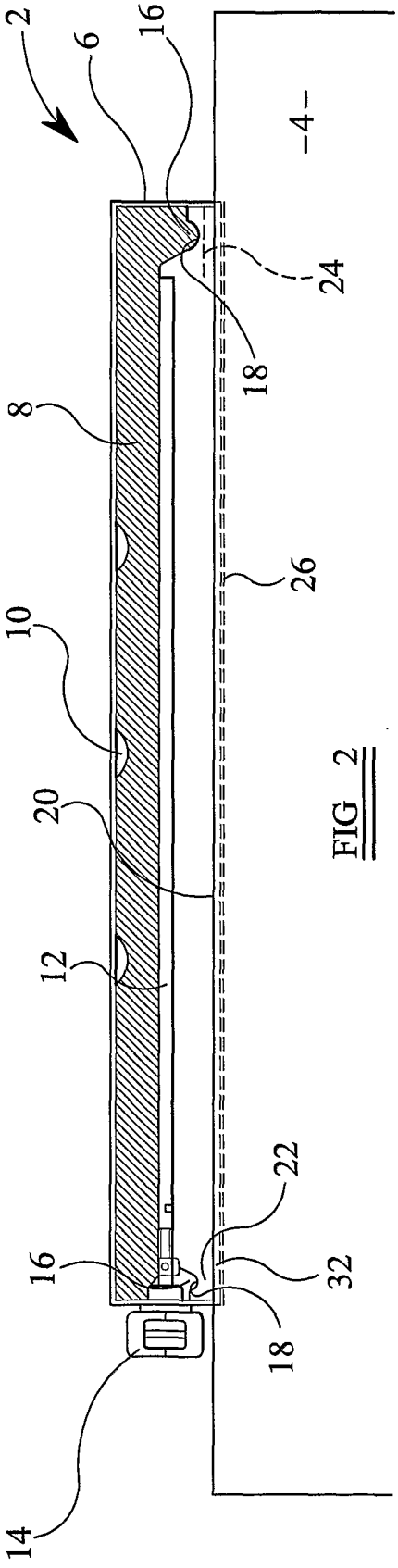

FIG 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 02/01709

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05B3/74

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H05B F24C A47J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 091 177 A (CERAMASPEED LTD) 11 April 2001 (2001-04-11) column 1, line 30 -column 2, line 1 column 2, line 21 - line 29 column 2, line 56 -column 3, line 29; figure 1	1-4,6, 11-19
X	FR 1 391 052 A (LEPELTIER ROBERT) 5 March 1965 (1965-03-05) page 1, paragraph 1 - paragraph 2; figure	1,5,13, 19

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 June 2002	19/06/2002

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 02/01709

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1091177 A	11-04-2001	GB 2355788 A	02-05-2001
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