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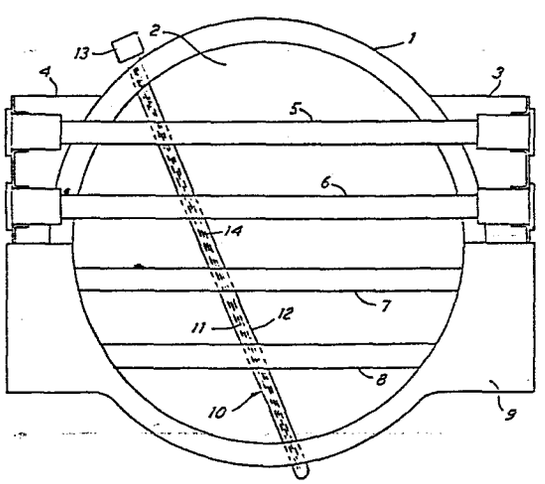
(54) A thermal limiting device.

(57) A thermal limiting device (10) is provided in heating apparatus including four infra-red-emitting, tungsten-halogen lamps (5 to 8) supported above a layer (2) of themally-insulative material. The device (10) consists of a metallic wire (11) arranged to de-energise the lamps (5 to 8) when it is subjected to a predetermined temperature. The wire (11) is disposed within a quartz tube (12), which selectively transmits and absorbs infra-red radiation of different wavelengths. A thermally-conductive tube (14), having an infra-red-reflective outer surface, is located between the wire (11) and quartz tube (12). The tube (14) prevents infra-red radiation transmitted through the quartz tube (12) from reaching the wire (11), whilst infra-red radiation absorbed by the tube (12) heats the wire (11) by thermal conduction and convection.



EP 0 150 087 A1

A THERMAL LIMITING DEVICE

This invention relates to a thermal limiting device and in particular, though not exclusively, to such a device for use in heating apparatus of the kind described in our co-pending European Patent Application No. 83307338.0 incorporating one or more sources of infra-red radiation, in the form of tungsten-halogen lamps.

In one embodiment of the heating apparatus disclosed in 8320717, there is provided a shallow tray member containing thermally-insulative material and supporting four infra-red-emitting, tungsten-halogen lamps. The tray member, usually along with a number of similar members, is preferably mounted beneath a layer of glass ceramic so as to form a cooking hob.

It is necessary to ensure that the operating temperature of the glass ceramic layer does not exceed a value of approximately 700°C, and to this end, the heating apparatus incorporates a thermal limiter comprising a metallic wire enclosed within a quartz tube. The wire is arranged, in use, to activate a microswitch when the maximum operating temperature of the glass ceramic is reached so as to disconnect the power supply to the infra-red lamps.

The afore-mentioned Application also discloses that, in order to render the limiter responsive primarily to the actual temperature of the glass ceramic, the limiter is preferably shielded from incident infra-red radiation, which may be, for

example, directly from the infra-red lamps or reflected from a shiny, reflective base of a cooking utensil placed on the upper surface of the glass ceramic.

It is an object of the present invention to provide an improved thermal limiting device of the afore-mentioned type.

According to the invention there is provided a thermal limiting device for controlling power supplied to one or more sources of infra-red radiation mounted in heating apparatus, said device including a metallic wire member accommodated within a tubular member, said wire member being arranged, when subjected to a predetermined temperature, to disconnect the supply of said power to said source or sources, characterised in that said tubular member is capable of selectively transmitting and absorbing infra-red radiation of different wavelengths, and said device further includes a thermally-conductive tubular structure located between said tubular member and said wire member, said tubular structure being provided with an infra-red-reflective outer surface to prevent infra-red radiation transmitted through said tubular member from reaching said wire member.

Preferably the tubular structure is made from a suitable metallic material, and is preferably concentric with the metallic wire within the tubular member. The tubular structure is also preferably coated on its outer surface with a suitable infra-red reflective coating.

The tubular member of the device is preferably made from a quartz material, which transmits reflected, and directly incident, infra-red radiation in a first band of wavelengths emitted from the source or sources, preferably tungsten-halogen lamps, and this transmitted radiation is subsequently reflected back out of the tubular member by the infra-red reflective outer surface of the tubular structure.

However, it has been found that radiation in a second band of wavelengths, is absorbed by the quartz tubular member, so that the heat within the tubular member causes thermal expansion of the wire member by thermal conduction and convection, thereby

causing the wire member to de-energise the infra-red-emitting lamps, when the maximum operating temperature is reached.

The invention will now be further described by way of example only with reference to the accompanying drawing, the single Figure of which shows a plan view of one example of heating apparatus disclosed in European Patent Application No.83307338.0 incorporating one embodiment of the present invention.

The Figure shows heating apparatus including a generally circular metallic tray 1 having a layer 2 of thermally-insulative material disposed therewithin. Two oppositely-extending flanges, 3 and 4, of the tray 1 support four infra-red-emitting, tungsten-halogen lamps, 5 to 8, disposed in a parallel arrangement across the circular region of the tray 1. A moulding 9 of ceramic fibre material is press-fitted around the ends of the lamps 5 to 8, and the apparatus, preferably together with three similar apparatuses, is mounted beneath a layer of glass ceramic (not shown) to form a cooking hob.

A thermal limiting device, shown at 10, is located within the heating apparatus, either below or at the same level as the lamps 5 to 8. The device 10 consists of a metallic wire 11, preferably formed from a nickel alloy known as Hastelloy X, disposed within a quartz tube 12. The wire 11 is arranged to activate microswitch 13 when the maximum operating temperature of the glass ceramic is attained.

To render the device 10 primarily responsive to radiation absorbed by and re-radiated from the glass ceramic, which radiation is indicative of the actual temperature of the glass ceramic, a metallic tube 14, preferably made from stainless steel, is disposed within the quartz tube 12, around and concentric with the wire 11.

The tube 14 is coated on its outer surface with an infra-red reflective coating, which may, for example, consist of a nickel flash followed by a gold coating of 1-5 μm thickness. Other examples of infra-red-reflective coatings

which may be employed are disclosed in our copending European Patent Application No. 84306455.1

A spider support arrangement (not shown), constructed from a suitable material, may be provided within the quartz tube 12, so as to space the metallic tube 14 from the quartz tube 12 in a controllable manner.

In operation, radiation in a first band of wavelengths of approximately 0.15-3 μm, which is reflected, for example, from a shiny base of a cooking utensil disposed upon the glass ceramic or incident directly from the infra-red lamps, is transmitted through the quartz tube 12 and subsequently reflected back out therefrom by the reflective coating on the tube 14, so that the wire 11 within the tube 14 remains unresponsive to radiation of these wavelengths.

However, radiation in a second band of wavelengths above approximately 4.5 μm, which is absorbed by and re-radiated from the glass ceramic, is absorbed by the quartz tube and the wire 11 is heated by the absorbed radiation by thermal conduction and convection, thereby causing the wire 11 to undergo thermal expansion and activate the microswitch 13 when the maximum operating temperature of the glass ceramic is reached.

The thermal limiting device, in accordance with the present invention, is therefore primarily responsive to radiation absorbed by and re-radiated from the glass ceramic, which radiation is indicative of the actual temperature of the glass ceramic, thereby enabling the device to monitor accurately the operating temperature thereof.

CLAIMS

1. A thermal limiting device for controlling power supplied to one or more sources (5 to 8) of infra-red radiation mounted in heating apparatus, said device (10) including a metallic wire member (11) accommodated within a tubular member (12), said wire member (11) being arranged, when subjected to a predetermined temperature, to disconnect the supply of said power to said source or sources (5 to 8), characterised in that said tubular member (12) is capable of selectively transmitting and absorbing infra-red radiation of different wavelengths, and said device (10) further includes a thermally-conductive tubular structure (14) located between said tubular member (12) and said wire member (11), said tubular structure (14) being provided with an infra-red-reflective outer surface to prevent infra-red radiation transmitted through said tubular member from reaching said wire member (11).

2. A device as claimed in Claim 1 wherein said tubular structure (14) is coated on said outer surface with an infra-red-reflective coating.

3. A device as claimed in Claim 2 wherein said coating consists of a layer of gold overlying a layer of nickel.

4. A device as claimed in any preceding claim wherein a support arrangement is provided within said tubular member (12) to space said tubular structure (14) from said tubular member (12).

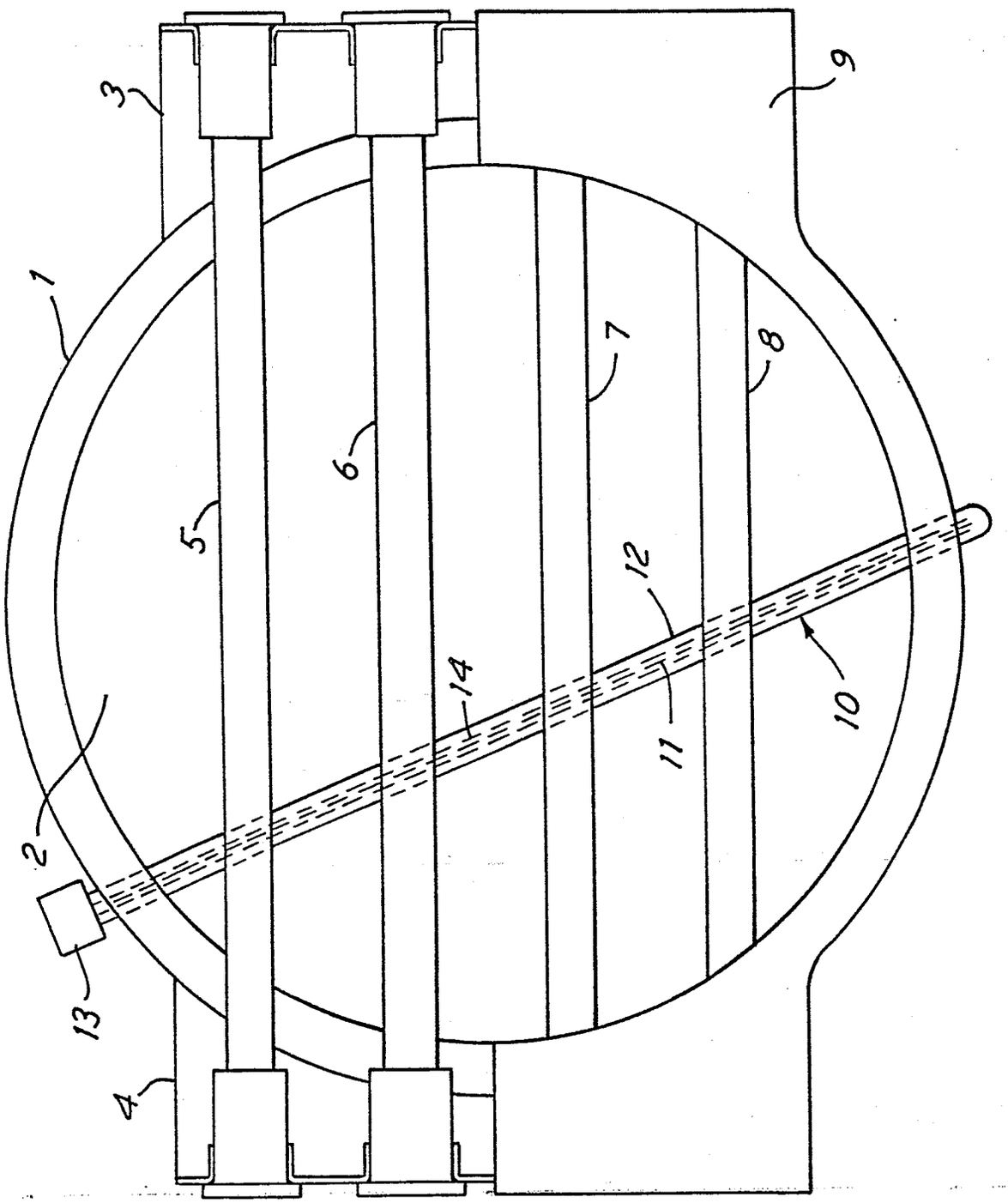
5. A device as claimed in any preceding claim wherein said tubular structure (14) is generally concentric with said wire member (11).

6. A device as claimed in any preceding claim wherein said tubular member (12) is formed from a quartz material.

7. Heating apparatus including one or more sources (5 to 8) of infra-red radiation and a thermal limiting device (10) as claimed in any preceding claim.

8. Heating apparatus as claimed in Claim 7 wherein said one or more sources (5 to 8) each consist of a tungsten-halogen lamp.

9. A cooking hob including one or more heating apparatus, as claimed in Claim 7 or 8, said apparatus being mounted beneath a layer of infra-red-transmissive material and the tubular member (12) of said thermal limiting device (10) being arranged to absorb primarily infra-red radiation of a wavelength indicative of the temperature of said layer.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EUROPEAN SEARCH REPORT

Application number EP 85300161.8

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US - A - 3 355 574 (A.T. BASSETT) * Column 2, line 60 - column 3, line 29; fig. 2 *	1,7-9	H 05 B 1/02 F 24 C 7/08 H 05 B 3/68 H 05 B 3/74
A	DE - A1 - 3 102 919 (MICROPORE) * Abstract; page 12, line 20 - page 13, line 9; fig. 1,2 *	1,6,7,9	
A	GB - A - 1 282 656 (THERMO ELECTRON) * Page 2, lines 8-79; fig. 1,2 *	1,7-9	
D,P,A	EP - A2 - 117 346 (THORN) * Page 3, lines 6-30; page 10, lines 10-33; fig. 1 *	1,2,7-9	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

H 05 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	29-03-1985	TSILIDIS

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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