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H231 H233 H250
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GB 2308921 A GB 2296847 A WO 97/04694 A1

(58) Field of Search
UK CL (Edition P) **H1N NBG NDP NDQ NDT NDX**
NDY , H5H HAFX HAF1 HAF3 HAH HBG2
INT CL⁶ **A47J , H05B**

(54) Abstract Title
Electric heating elements

(57) An integrated control device, for use in an electric kettle or jug having a planar heating element in the form of a substrate having a resistance heating track printed on one side thereof, comprises control and/or indicator devices which have spring contacts (10, 15) adapted to make direct electrical contact with respective ones of sets of terminal portions that are provided in the track of the heating element. A carrier member (1) has compartments (2, 3, 4) for accommodating an element protector control (5), an electrical inlet connector (6) and a steam sensor (7) with the steam sensor compartment (4) well segregated from the element protector compartment (2). The carrier member (1) accommodates the various components (5, 6, 7) in snap-fit manner and can readily be redesigned to suite any particular heating element design. More particularly, any particular arrangements of the terminal portions of the heating element track to suit desired locations for the element protector control (5) and the steam sensor (7) can readily be achieved simply by correspondingly designing the layout of the printed resistance heating track. A simmer control may also be mounted on the heating element.

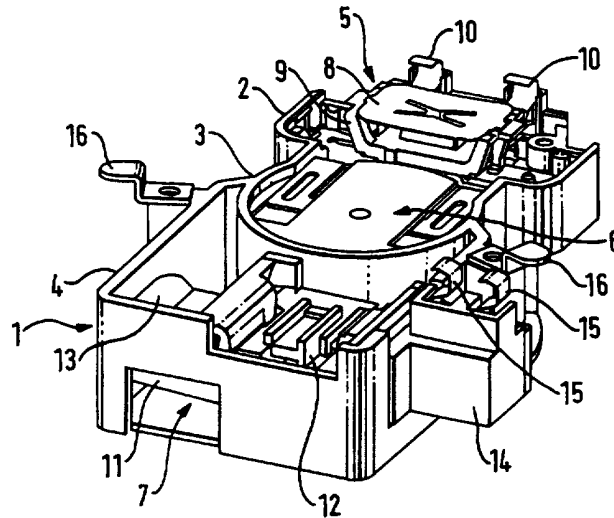


FIG. 1

GB 2 329 759 A

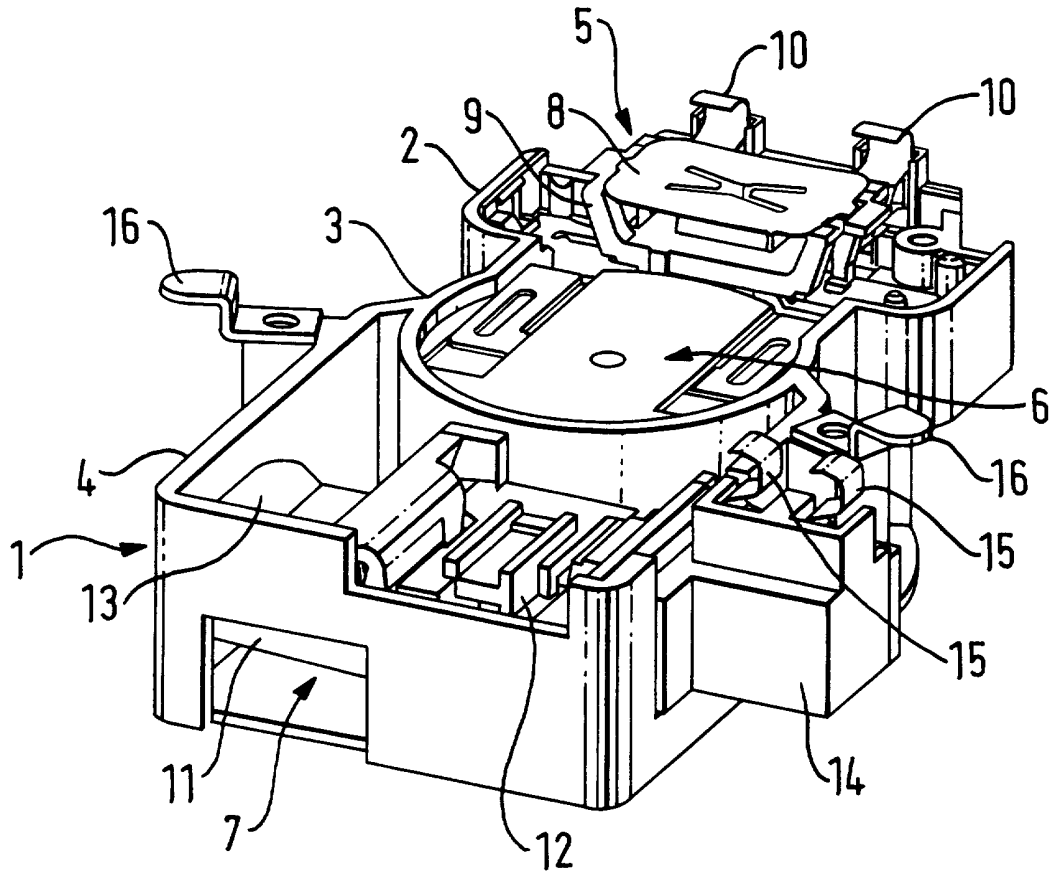


FIG. 1

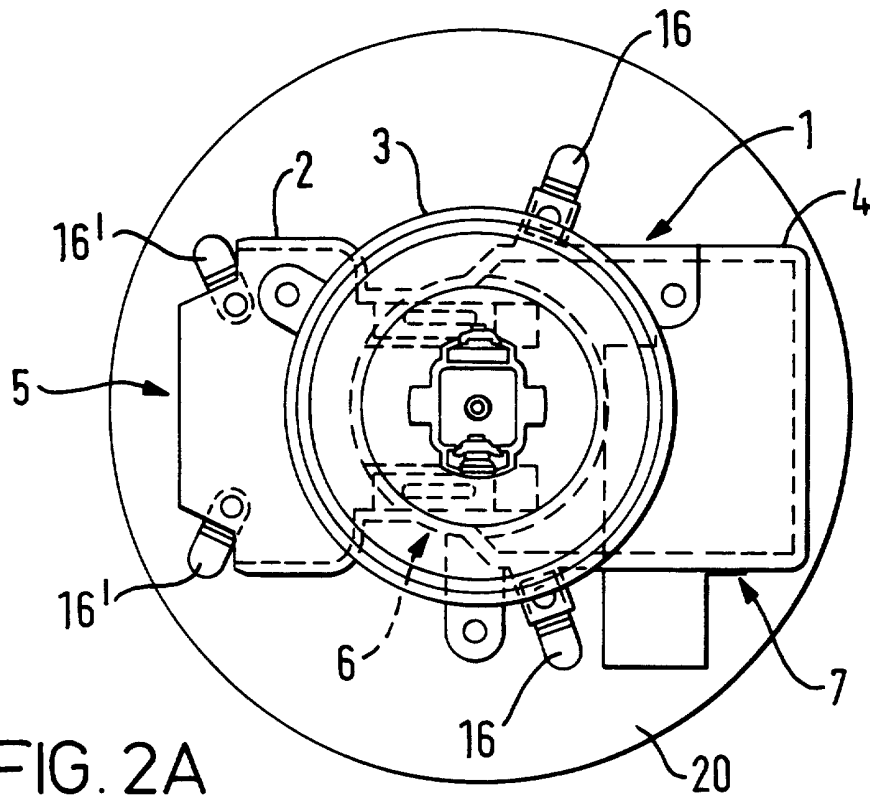


FIG. 2A

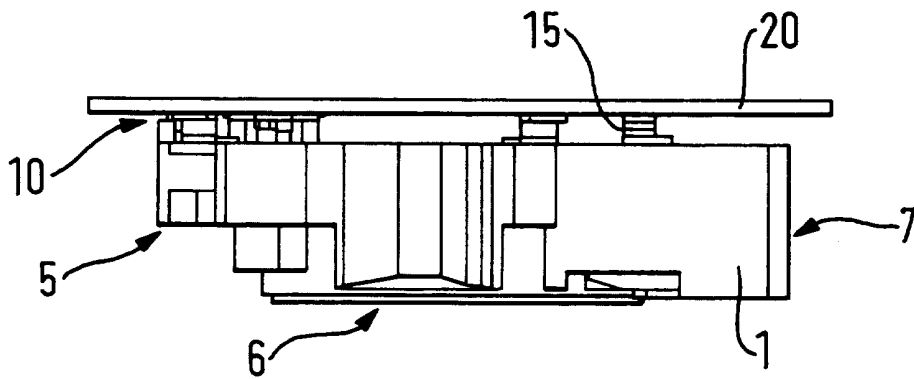


FIG. 2B

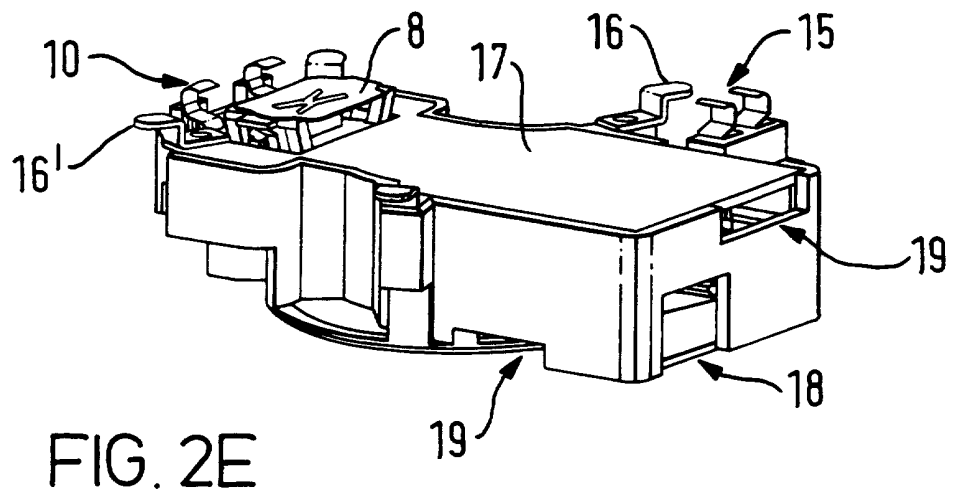
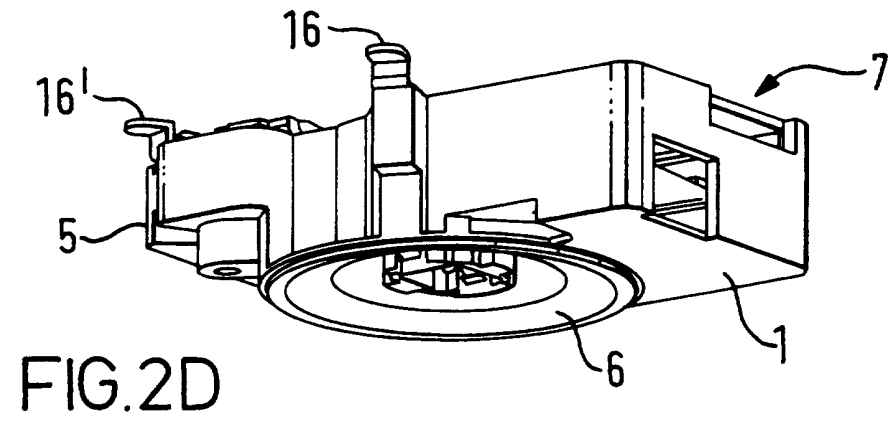
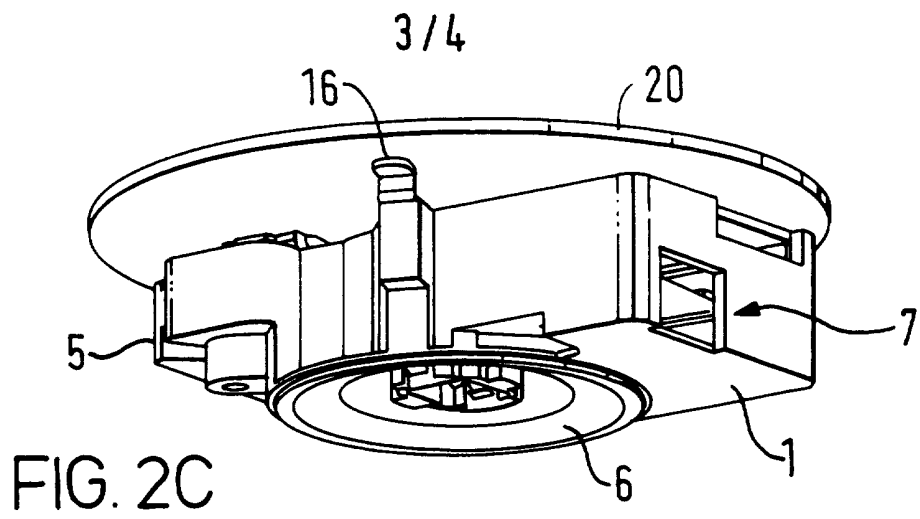


FIG. 3A

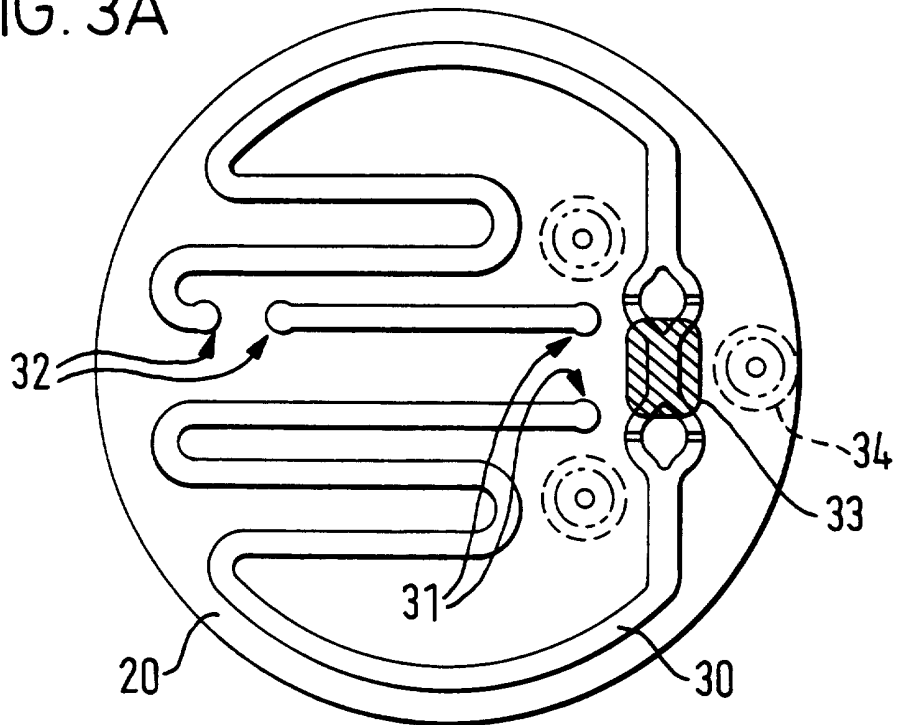
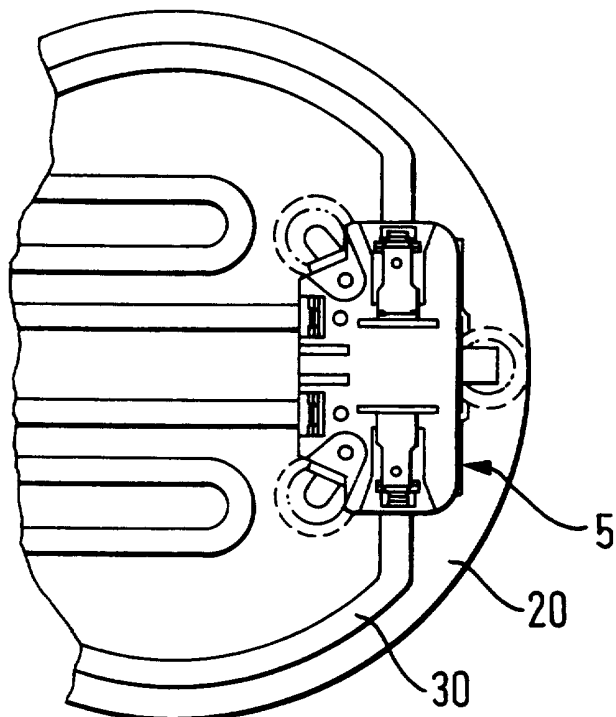


FIG. 3B



Improvements Relating to Electrically Heated Water Boiling VesselsField of the Invention

This invention concerns improvements relating to electrically heated
5 water boiling vessels such as electric kettles and hot water jugs for example.

Background of the Invention

Electric kettles and hot water jugs and the like have conventionally
incorporated electric immersion heating elements in the form of a wire
10 wound, mineral insulated, metal sheathed heating element proper affixed to an
element head plate serving for the attachment of the heating element to the
vessel with the heating element proper within the vessel; such a conventional
immersion heating element is described for example in GB-A-2222025.
Another conventional form of heating element, not an immersion heating
15 element, has a wire wound, mineral insulated, metal sheathed heating element
proper as aforementioned clamped or clenched to the underside of a metal
plate; such a conventional electric heating element is described in
WO95/34188 for example.

More recently, so-called thick film electric heating elements have been
20 proposed which comprise a substrate on one side of which there is provided a
resistance heating element in the form of a printed or otherwise formed
resistive track or layer. The substrate might for example comprise a thin sheet

of stainless steel on one side of which there is formed an electrically insulating dielectric layer, of glass or ceramics for example, and the resistance heating element might be formed on the dielectric layer with another protective electrically insulating dielectric layer, also of glass or ceramics for example, formed on top of the resistance heating element.

It has been common to provide electric kettles and hot water jugs and the like with an element protector control adapted and arranged to switch off the power supply to the heating element in response to a sensed element over temperature situation, and it has been common also to provide a steam sensor arranged to switch off the power supply to the heating element in response to the generation of steam when water is boiled in the vessel. Element protector controls have commonly comprised one or more bimetallic elements arranged in close heat transfer relationship with the heating element and arranged to operate an electric switch in the control in response to the element temperature rising above a predetermined normal operating range; an exemplary element protector control is the X-type control manufactured and marketed by us which is described in GB-A-2194099 with reference particularly to Figures 3A, 3B and 3C of the drawings thereof. Steam sensors have commonly comprised a bimetallic or other thermally sensitive element, a shape memory effect (SME) device for example, arranged at a location of the vessel whereat steam will impinge upon the thermally sensitive element when

water boils in the vessel; an exemplary steam sensor is the J-type steam sensor manufactured and marketed by us which is described in GB-A-2212664.

5 GB-A-2222025 aforementioned and WO-A-95/34187 both describe arrangements in which an element protector control and a steam sensor are
10 mounted in the base of a water boiling vessel and a steam pipe is provided in the vessel for conveying steam from the upper part of the vessel to the location of the steam sensor in the base of the vessel. As described in our British Patent Application No. 9621517.3, the arrangements of GB 2222025 and WO-A-95/34187 exhibit poor segregation between the steam control and
15 the element protector control and this, in our opinion, could lead to premature failure due to water vapour contaminating the element protector control. To overcome or at least substantially reduce this problem, the invention of our British Patent Application No. 9621517.3, the disclosure whereof is incorporated herein by reference, proposes to compartmentalise the bottom
20 part of the vessel so as to segregate the potentially wetted environment of the steam sensor from the element protector control.

The present invention results from further work that we have undertaken to develop a safe and convenient mounting arrangement for an element protector control and a steam sensor in operative relationship with an
25 electric heating element of the aforementioned thick film type.

Summary of the Invention

In accordance with a first aspect of the present invention, both the element protector control and the steam sensor are arranged to be juxtaposed with an electrical heating element of the aforementioned thick film type with spring contacts of the element protector control and of the steam sensor making direct electrical connection with respective terminal portions of the thick film heating element. We have previously proposed in GB-A-2308921 to provide spring contacts on an X-type of element protector control which make direct contact with a pair of printed contact pads of a printed element track and, according to the present invention, in one of its aspects, we are now proposing to provide the printed element track with a second pair of printed contact pads and to juxtapose a steam control with the heating element with spring contacts of the steam control making direct electrical contact with the second pair of printed contact pads. With such an arrangement, the electrical power supply may be supplied to electrical terminals of the element protector control and therefrom, via the spring contacts of the element protector control, to the printed element track of the heating element. At another point in the printed element track there may be a second break which has the second pair of contact pads to which the spring contacts of the steam sensor, for example in appropriately modified J-type of steam sensor, may be directly connected.

By virtue of the present invention, the connections between the element protector control, the steam sensor and the heating element are

considerably simplified. As compared with the complex arrangement of WO-A-95/34188 for example, all the metal busbars of that device are eliminated and replaced, in accordance with the present invention, by a simple feature provided in the printed element track. Whereas significant tooling costs would result if the device of WO-A-95/34188 had to be changed to suit one vessel manufacturer or another and whereas the metal busbars of that device are not without cost penalties, the present invention enables virtually any configuration to be accommodated with very little cost since all that requires to be changed is the layout of the printed element track which requires no more than the printing of the track to be changed.

The operation of the steam sensor could be arranged to initiate the operation of a simmer control arranged to switch the heating element on and off in cyclical fashion so as to maintain the contents of the vessel at a set temperature, and the simmer control in such an arrangement could be coupled directly with the heating element track by virtue of spring contacts of the simmer control making direct engagement with further printed contact pads of the printed element track. Alternatively, the vessel itself might have a manually settable selector switch enabling the vessel to be set selectively into a "boil" mode, in which the steam sensor was in circuit and the simmer control was out of circuit, or a "simmer" mode in which the steam sensor was out of the circuit and a cycling thermostat monitored and controlled the temperature of the vessel contents. Other printed circuit contact pads could be

provided in the printed circuit track of the heating element for accommodating the direct connection of on/off switches and/or indicators to the heating element track and some of such additional contact pads could be in the form of spurs, for example for the connection of indicator lamps, which could be in parallel with the heating element track rather than in series as controls would be.

In accordance with the teachings of our British Patent Application No. 9621517.3, the mountings of the element protector control and the steam sensor to the heating element are preferably compartmentalised to avoid the wet environment of the steam sensor adversely affecting the element protector control. In an exemplary embodiment of the present invention which will be described in detail hereinafter, this segregation of the element protector control and the steam sensor is achieved by provision of a carrier member having spaced-apart and segregated compartments for receiving an X-type element protector control and a J-type steam sensor. The carrier member has provision furthermore for its mounting to a compatible thick film type element such that spring contacts on the element protector control and steam sensor directly engage with contact pads provided in the heating element track. As yet a further feature, the carrier member is formed to accommodate the female connector part of the CS2/CP7 cordless connector system that we manufacture and market and which is described in GB-A-2285717, this

connector system enabling the vessel part of a cordless electrically heated kettle or jug to set upon its base in any relative rotational orientation.

The present invention, in another aspect, extends also to a thick film type of electric heating element having a plurality of sets of contact pads
5 formed in the printed circuit track thereof for accommodating the direct electrical connection thereto of two or more of the following, namely an element protector control, a simmer control, a steam sensor, an on/off switch and an indicator or indicators.

The above and further features of the present invention are set forth in
10 the appended claims and will be described hereafter with reference to the accompanying drawings.

Description of the Drawings

Figure 1 is a perspective view showing an X-type element protector
15 control, a J-type steam sensor and a CP7 cordless connector inlet mounted in a carrier to be juxtaposed with a planar heating element of thick film type;

Figure 2A is an underplan view of the arrangement of Figure 1 mounted to a heating element;

Figure 2B is a side elevation view of the arrangement of Figure 2A;

20 Figure 2C is a perspective view illustrating how the arrangement of Figure 1 mounts to the underside of the heating element;

Figure 2D is the same as Figure 2C but with the heating element removed and

Figure 2E is a perspective view of the Figure 1 arrangement taken from one side thereof; and

5 Figures 3A and 3B are plan views of the printed circuit track of a thick film printed heating element having provision for the direct connection thereto of an element protector control and a steam sensor.

Detailed Description of the Exemplary Embodiment

10 Referring to Figure 1, a moulded plastics carrier member 1 has separate compartments 2, 3 and 4 for receiving, respectively, an X-type element protector control 5 as described in GB-A-2308921, a CS7 cordless connector inlet 6 substantially as described in GB-A-2285716 and a J-type steam sensor 7 substantially as described in GB-A-2212664. Since the
15 element protector control 5, the connector inlet 6 and the steam sensor 7 are all current products of Otter Controls Limited of Buxton, Derbyshire, England, no detailed description will be given herein of these components and they will be described only to the extent necessary to understand and appreciate the present invention.

20 The three compartments 2, 3 and 4 are designed to receive their respective components 5, 6 and 7 in snap-fit manner and to retain these components separate from each other. In particular, the compartment 4 for the

steam sensor 7 is well spaced apart from the compartment 2 for the element protector control 5, so as to minimise the risk of the latter being affected by moisture from the former. The positioning of the connector inlet compartment 3 between the element protector control and steam sensor compartments 2 and 4 is of benefit in this regard.

The element protector control 5 includes a bimetallic element 8 which is mounted in a plastics material carrier 9. The bimetallic element 8 is arranged to be juxtaposed with the surface of a heating element in close thermal contact therewith and is set to operate in the event that the heating element temperature exceeds a predetermined level. The carrier 9 is arranged to provide a secondary level of protection which is operable in the event of failure of the bimetallic element 8 to operate effectively, the material of the carrier 9 being selected to soften at a temperature in excess of the normal operating temperature of the bimetallic element 8 so that the carrier deforms under spring pressure from within the control and allows a set of switch contacts, separate from those which are arranged to be operated by the bimetallic element 8, to open. The element protector control 5 serves to determine the supply of electricity to an associated heating element and a pair of contact springs 10 are provided for making direct electrical contact with terminal pads of the heating element.

The appliance inlet connector 6 is directly coupled electrically with the element protector control 5 for supplying electricity thereto and is of a kind

permitting a cordless water heating vessel to be set down onto its base throughout 360° of relative rotational orientation. The present invention does not contemplate any modification of the connector 6 or of its mating CS2 base connector part which also is a current product of Otter Controls Limited.

5 The steam sensor 7 is, again, a current product of Otter Controls Limited. A bimetallic element 11 is mounted between a trip lever 12 and a resilient mounting 13 and, depending on the condition of the bimetallic element 11, determines the position of the triplever 12 which, in turn, determines the condition of a set of switch contacts (not shown) provided in a
10 switch sub-assembly 14. The switch contacts are coupled to a pair of contact springs 15 designed to make direct electrical contact with terminal pads of a heating element.

 When the arrangement of Figure 1 is operatively juxtaposed with a suitable electric heating element, mounting brackets 16 being provided on the
15 carrier member 1 for this purpose, the electrical circuit of the resulting arrangement is from the inlet connector 6 to the element protector control 5 and thence to the heating element by way of the contact springs 10, then by way of the resistance heating track of the heating element to the steam sensor
7 by way of the contact springs 15, and back through the heating element
20 track to the element protector control 5 and the inlet connector 6. As will readily be appreciated, operation of the element protector control 5 or of the steam sensor 7 will break the electrical circuit of the heating element. Since

operation of the element protector control 5 is indicative of a fault condition, occasioned for example by the switching on of an associated water heating vessel without first filling the vessel with consequent overheating of the heating element, no manual reset is provided on the element protector control.

5 The steam sensor 7 is however manually resettable by appropriate manipulation of the trip lever 12.

Figures 2A to 2C show various views of the arrangement of Figure 1 juxtaposed with an exemplary circular disc type heating element 20, and Figures 2D and 2E show additional views of the Figure 1 arrangement. As shown most clearly in Figure 2E, a cover plate 17 is designed to be fitted into

10 the carrier member 1 which has apertures 18 and 19 respectively for the admission of steam to the bimetallic element 11 of the steam sensor 7 and for ensuring venting of steam from the steam sensor compartment 4. Figures 2A, 2D and 2E also show the provision of mounting brackets 16' on the element

15 protector control 5.

Figures 3A and 3B show an exemplary printed circuit track in accordance with the teachings of the present invention, Figure 3A showing the track layout without showing any element protector control and steam sensor, and Figure 3B showing in fragmentary view how the element protector

20 control interfaces with the heating element. As shown, the heating element 20 has a convoluted track 30 defining a first pair of terminal pads 31 for being contacted by the spring contacts 10 of an element protector control 5 such as

that of the Figure 1 arrangement, and a second pair of terminal pads 32 for being contacted by the spring contacts 15 of a steam sensor 7 such as that of the Figure 1 arrangement. It is to be noted that the track layout of Figures 3A and 3B is not designed for use with the Figure 1 arrangement, but rather is illustrative of the kind of track layout that can be employed.

The portion 33 of the printed element track 30 between the terminal pads 31 and the terminal pads 32 may be resistive to add to the power of the heating element or may be of an electrically conductive material so as simply to constitute a circuit link. This part of the track could even be of a different resistivity to the remainder of the track if this was required, for example to modify the thermal response of the element protector control 5. The positions of the terminal pads 31 and 32 in the track layout and relative to each other can readily be changed so that the element protection control and the steam sensor can be located substantially as desired.

The shaded area 33 shown in Figure 3A illustrates the area of the heating element which co-operates with the bimetallic element 8 of the element protector control 5 and, in accordance with the teachings of GB-A-2283156, an opening may be provided in the insulative covering of the heating element in this region to ensure close thermal coupling of the bimetallic element 8 with the heating element. The carrier 9 of the element protector control 5 can be arranged to seat upon the heating element outside of

this opening so as to be slightly more remotely thermally coupled with the heating element.

Mounting points 34, such as weld points or mounting posts, can be provided for the element protector control.

5 Having thus described the present invention with reference to exemplary embodiments, it is to be appreciated that modifications and variations are possible to the described arrangements without departure from the spirit and scope of the invention. For example, the fact that the trip lever 12 of the steam sensor 7 of the Figure 1 arrangement is directed downwardly
10 when the arrangement is secured to the underside of a heating element as shown in Figures 2A, 2B and 2C gives rise to the possibility of providing a cordless water heating appliance in which placement of the vessel part of the appliance onto its base and/or lifting of the vessel part from the base causes the steam sensor to go open circuit and switch off the heating element, a
15 manual reset arrangement being provided for switching the steam control back on. The base part of the appliance could for example include a cam feature designed to interact with the trip lever of the steam sensor.

CLAIMS:

1. An electric heating element in or for an electric water heating
5 vessel, said heating element comprising a substrate having a resistance heating
track formed on one side thereof and said track including a plurality of sets of
terminal portions such as to enable control and/or indicator devices to be
assembled with the heating element with spring contacts of the said devices
making direct electrical contact with respective ones of said sets of terminal
10 portions.

2. An electric heating element as claimed in claim 1 wherein the
resistance heating track of said heating element has a first set of terminal
portions for the assembly with the heating element of an element protector
15 control such as to terminate the supply of electricity to the heating element in
response to the temperature of the heating element as sensed by the control
exceeding a predetermined level, and a second set of terminal portions for the
assembly with the heating element of a steam sensor for terminating or
reducing the supply of electricity to the heating element when steam is
20 generated as the result of water boiling in an associated vessel and is caused to
impinge upon a thermally sensitive element of the steam sensor.

3. An electric heating element as claimed in claim 1 or 2 wherein the resistance heating track of said heating element has a set of terminal portions for the assembly with the heating element of a simmer control adapted to maintain the temperature of water in an associated vessel at or
5 substantially at a predetermined temperature.

4. An electric heating element substantially as herein described with reference to Figures 3A and 3B of the accompanying drawings.

10 5. An electric heating element as claimed in any of the preceding claims in combination, in or for an electric water heating vessel, with a plurality of control and/or indicator devices assembled therewith, said control and/or indicator devices having spring contacts making direct electrical contact with respective ones of the plurality of sets of terminal portions
15 provided in the resistance heating track of the heating element.

6. A combination as claimed in claim 5, wherein said plurality of control and/or indicator devices are commonly mounted in a carrier member which is assembled with the heating element.

20

7. A combination as claimed in claim 6 wherein an element protector control and a steam sensor are mounted in said carrier member, the

steam sensor being in a compartment of the carrier member which is adapted and arranged to segregate the wet operating environment of the steam sensor from the element protector control.

5 8. A combination as claimed in claim 7 wherein said carrier member has a plurality of separate compartments for accommodating different said devices.

10 9. A combination as claimed in claim 8 wherein the carrier has a first compartment accommodating the steam sensor and, spaced apart from said first compartment, a second compartment accommodating said element protector control.

15 10. A combination as claimed in claim 9 including an appliance inlet connector mounted between said first and second compartments.

 11. A combination as claimed in claim 10 wherein said appliance inlet connector is such as to enable mating with a complementary connector
20 throughout 360°, or substantially 360°, of relative rotation between the two connectors.

12. An electric water heating appliance including a combination as claimed in any of claims 5 to 11.

13. An electric water heating appliance as claimed in claim 12,
5 said appliance being of a cordless type comprising a vessel part, a base part and a connector set for making electrical connection through the base to the vessel when the vessel is seated on the base.

14. An electric water heating appliance as claimed in claim 13
10 wherein a steam sensor associated with the vessel is arranged to be switched into open circuit condition whenever the vessel is removed from the base or is set down upon the base.

15. An integrated control device for use with a heating element
15 comprising a substrate having a resistance heating track formed on one side thereof, said integrated control device comprising an element protector control and a steam sensor and/or simmer or keep-warm control arranged to interconnect with the resistance heating track and, via the track, with each other by means for spring contacts engaging respective terminal pads of the
20 resistance heating track.

16. An integrated control device as claimed in claim 15 and further comprising the features claimed in any of claims 6 to 11.



Application No: GB 9720458.0
Claims searched: 15 and 16

Examiner: Peter Corbett
Date of search: 21 August 1998

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.P): H1N (NBG,NDP,NDQ,NDT,NDX,NDY)
Int Cl (Ed.6): A47J; H05B
Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	WO 97/04694 A1 (STRIX) see page 33, line 33 to page 35, line 20 and page 38, line 23 to page 39, line 10	15 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9720458.0
Claims searched: 1-14

Examiner: Peter Corbett
Date of search: 27 February 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H1N (NBG,NDP,NDQ,NDT,NDX,NDY);
H5H (HBG2,HAF1,HAF3,HAFX,HAH)

Int Cl (Ed.6): H05B

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2308921 A (OTTER CONTROLS) see Fig 3B	1 at least
X	GB 2296847 A (STRIX) see Figs 7 and 8	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.