

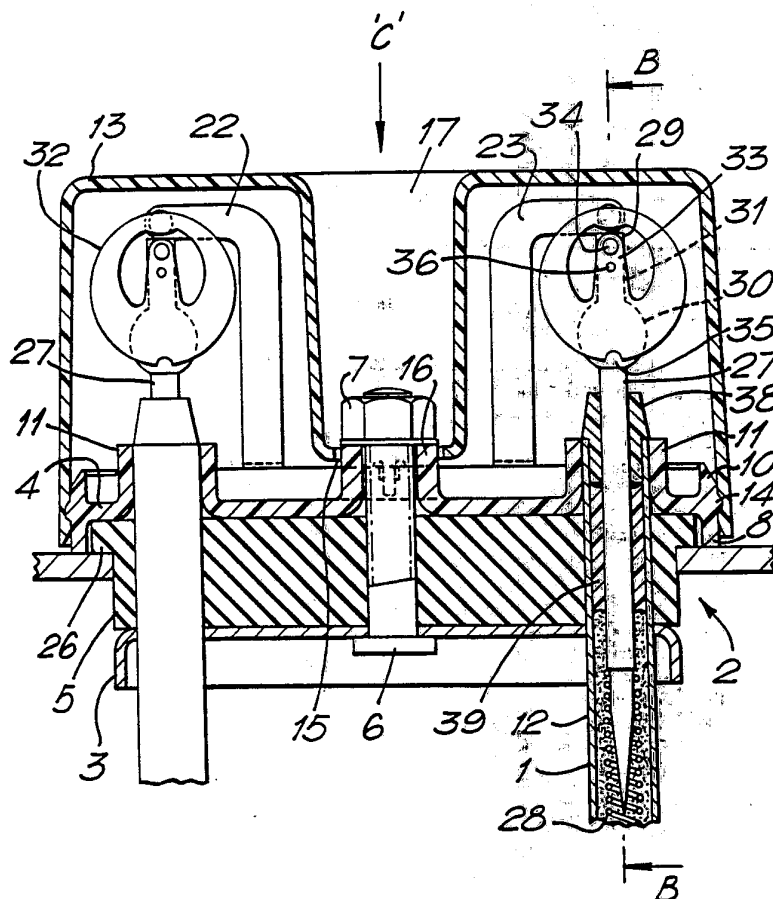


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(54) Title: IMMERSION HEATERS**(57) Abstract**

An electric immersion heater comprises an element (1) having a cold tail (27) of a material having a high thermal conductivity such as copper. The cold tail (27) directly mounts a bimetallic actuator (32) which by virtue of heat transmitted along the cold tail (27) from the element (1) operates a switch in the event of the element overheating. The actuator (32) preferably carries a contact (37) of the switch. Preferably the cold tail (27) is formed with a portion (30) providing an enlarged surface contact area between the cold tail (27) and the actuator (32). Actuators (32) may be mounted on both cold tails (27) of the element to operate respective switches.



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IMMERSION HEATERS

This invention relates to electric immersion
5 heaters of the kind which are used in liquid heating
vessels or containers such as washing machines, urns,
jugs, kettle or the like. Such heaters conventionally
comprise a tubular heater element mounted on an element
head by means of which the heater is mounted in an
10 opening in the vessel or container wall, the element
being disposed within the vessel or container with the
ends thereof however extending through the head and thus
being accessible from outside the vessel or container
for the making of electrical connections to the element.

15 The element of such an electric immersion heater
conventionally comprises an outer tubular sheath usually
but not necessarily of circular cross-sectional shape of
a suitable metal e.g. copper or stainless steel, a
ferrous alloy resistance heating wire in the form of a
20 helically wound coil extending axially through the
sheath and being spaced therefrom by an electrical
insulating material such as magnesium oxide which also
serves to conduct heat from the coil to the surrounding
sheath and thence to the liquid to be heated.

25 The heating coil does not extend to the ends of the
sheath but rather stops short of the ends and is
continued at each end by a so-called "cold tail" i.e. a
metal rod of much greater diameter than that of the
heating wire and offering by comparison with the heating
30 wire little electrical resistance so as not to be
resistively heated in use of the immersion heater to any
significant extent. The cold tails are usually made of
mild steel and are welded to the end turns of the
resistive heating coil. Moreover the cold tails extend
35 beyond the ends of the sheath of the heater element, the
ends of the sheath around the cold tails being sealed by
an electrically insulating and water impervious sealing

material e.g. an epoxy resin. The exposed ends of the cold tails thus constitute the electrical terminals of the immersion heater and electrical connections thereto can be made in any desired manner.

5 If an electric immersion heater is energised not immersed in liquid to be heated, the sheath will become very hot and within a minute or so the heater will fail often violently with potentially catastrophic results. In many applications it is necessary to make provision
10 against the possibility of the heater being operated for longer than a short period not immersed in liquid on account of the hazard which this would represent in use both in itself and the risk of overheating, melting or even setting on fire any adjacent plastic parts such as
15 the vessel. It is thus known for electric immersion heaters to incorporate thermal fuses within the element in series with the heating wire so as in an overheating situation quickly to disable the heater which would thereafter usually need to be replaced. In applications
20 where an overheating situation is very likely to occur, as for example in electric kettles through the kettle being switched on dry or boiling dry, it is known to provide a thermal control unit including an electric switch and a thermally-responsive actuator, mounted on
25 or to the element head of the immersion heater, a portion of the heater element, termed the "hot return" being brazed to the head. The thermally-responsive actuator of the thermal control unit is disposed on the outside of the head opposite the hot return to sense the
30 temperature of the hot return portion of the heater element through the head and thus in an overheating situation to activate the electric switch and interrupt the supply current to the heater. The actuator is often designed automatically to reset after sufficient cooling
35 whereupon the switch is closed and the cycle will repeat until the mains supply connection to the heater is broken or liquid is again surrounding the heater in the

vessel.

Both of the above described arrangements for preventing prolonged overheating of an immersion heater have their disadvantages. On the one hand thermal fuses are relatively expensive, difficult to incorporate within an element, and their efficacy in individual heaters cannot be tested. Moreover once a thermal fuse has operated the heater must usually be replaced. On the other hand the provision of a thermal control unit and the adaptation of the heater to provide a hot return to the element head, very considerably adds to the cost of the basic immersion heater.

According to the present invention it is proposed to substitute a cold tail of high thermal conductivity such as copper for the conventional mild steel cold tail of a heater element and to utilise the temperature of the cold tail to operate a thermal control directly sensing the temperature of the exposed part of the cold tail extending beyond the end of the element sheath in an overheating situation. Thus the invention provides, an electric immersion heater, the heating element of which terminates in at least one cold tail of high thermal conductivity, said cold tail having a first portion connected to a resistance heating coil of said element, and a second portion extending beyond the end of the element sheath, and a thermally-responsive bimetallic actuator mounted on said second portion of said cold tail for operating a switch to interrupt an electrical supply to said element.

Such an arrangement obviates the need for expensive and inconvenient thermal fuses. Also, the provision of a switch associated with the cold tail avoids the need to provide a hot return connection to an element head with consequent cost savings. Furthermore, the switch may be considerably simplified as compared with known thermal control units.

The actuator may be chosen so as to reset

automatically after operating the switch, after its temperature drops to below a desired value, or so as to require external, e.g. manual resetting.

Also it will be appreciated that according to the present invention an actuator may readily be associated with each cold tail thus affording protection against certain element fault conditions which are not safeguarded against by all known thermal control units such as element breakdown to earth in the same pole as the usual single pole protector, possibly with polarity reversed. Also international standards are moving towards specifying dual pole protection on elements. Thus in a preferred embodiment, said element has two such high thermal conductivity cold tails and a thermally-responsive bimetallic actuator is mounted on the respective second portions of both cold tails for operating switches of respective controls. The operating characteristics of both bimetallic actuators are preferably chosen to be substantially the same.

The bimetallic actuator of the invention can take any suitable form. One such form is a snap-action bimetallic element, although others can easily be seen as applicable to the invention,

Although the actuator may act so as to move a movable contact of a switch, in a preferred embodiment, a contact may be mounted on the actuator itself. This provides for a much simpler construction of control.

The exercise of the present invention requires the temperature of the external portion of the cold tail not only to increase sufficiently in an overheating situation to operate the thermal control but to do so within a short prescribed period of time. The rate of increase in temperature and the temperature attained by the external portion of a cold tail of an immersion heater in an overheating situation will be influenced by a number of factors, most notably the heat conductivity of the cold tail and its length. Accordingly the

heating element of the invention has a cold tail or tails of high conductivity such as copper, as opposed to the mild steel cold tails normally provided, so as to increase the heat flow to the actuator. The length of such a cold tail or tails must be carefully determined by experiment to achieve the desired operating characteristics. The longer the cold tail, the slower the rise in temperature and the lower the temperature attainable of the exposed end of the cold tail. If however the cold tail is too short, the quicker reaction time may result in the nuisance of the thermal control operating when not required. When there is liquid surrounding the element, the cold tail will be cooled by the liquid surrounding the element. The longer the cold tail, the less the effect will be of the heat from the element, and the more the temperature of the end of the cold tail tends to approximate to that of the liquid itself. However the longer the cold tail, the larger its thermal capacity will be, so that under dry operating conditions, the response time of the actuator is increased. If the cold tail is too short, however, in normal use, as the liquid is heated to its maximum temperature, then the combination of heat from the heating wire and the heat of the liquid may cause the actuator to nuisance trip. However the shorter the cold tail, the smaller its thermal capacity will be so that in dry operating conditions, the response time of the actuator and the overall temperature reached by the dry element is reduced. The heat flow through the cold tail is thus a dynamic situation, with heat being gained from the heater wire and lost sideways along the length of the cold tail, which length must therefore be determined by experiment for each application. The thermal capacity and length of the cold tail outside the vessel should preferably be kept to a minimum to reduce the response time under dry operation conditions, but without nuisance tripping.

The response of the actuator will also be determined to some extent, by the way in which it is mounted on the cold tail. In a preferred embodiment, the cold tail is formed so as to present a relatively
5 large area of surface contact between the cold tail and the bimetal actuator. This maximises heat transfer between the cold tail and the actuator. Preferably the cold tail is pressed to form this area.

The shape of the contact area will be determined by
10 the shape of the actuator. A common snap-action bimetallic actuator is disc-shaped and comprises a generally U shaped aperture which releases a central tongue. Such an actuator is shown in GB 1542252. A
15 suitable contact area for such an actuator is flat or slightly curved to match the curvature of the actuator and has a first, generally circular portion for contact with the active portion of the bimetal, which is at the base of said tongue, and a second elongate portion for mounting the tongue of the bimetal.

20 If desired, the heat transfer to the actuator may be further improved by replacing the conventional insulating material within the element sheath where it surrounds the cold tail, which is a good conductor of heat, with an insulating material which is a poor
25 conductor of heat in order to reduce loss of heat as it flows along the cold tail towards the thermal control. The mounting of the element in the heating vessel may also be such as to reduce heat loss from the element in this area.

30 The response time of the actuator may also be improved by increasing the area over which the cold tail picks up heat from the heating wire by extending the conductive tail inside the coils of the heating wire. This extension may be a reduced diameter or a tapered
35 cone.

To facilitate construction, the cold tail is preferably formed with means for securing the actuator

in position. A particularly simple form of attachment is one in which the cold tail is formed, in the mounting area, with a pin over which an aperture in the actuator is placed, and which is then riveted over to secure the actuator in position. Means, such as interengaging dimples and recesses or apertures may be provided on the cold tail and the actuator for alignment purposes.

The connection between the copper cold tail and ferrous alloy wire of a heating coil may be accomplished in several manners. It is possible to laser weld the wire directly to the cold tail. Alternatively, it would be possible to spot-weld the coil onto an intermediate sleeve which is pushed over a tapered end of the cold tail and which binds thereto under pressure when the element is being formed. Another manner of attachment would be the crimping of the coil directly onto the cold tail by means of an external sleeve. A variation of this method would be crimping the coil onto an intermediate sleeve which is provided on the cold tail. This list is not exhaustive, and other methods may easily be envisaged.

Two embodiments of the invention will be now be described, by way of example only with reference to the accompanying schematic drawings wherein:-

Fig. 1 shows schematically a section through an electric immersion heater and associated thermal control for mounting in a washing machine tub or container;

Fig. 2 is a section along line B-B in Fig. 1;

Fig. 3 is a view along arrow C in Fig. 1, with the cover removed;

Fig. 4 is a part vertical section through an electric conversion heater and associated control of a hot water jug along the line D-D Fig 6;

Fig. 5 is a section taken along line E-E of Fig. 5; and

Fig. 6 is a horizontal part section taken through the control of Fig. 4.

Figs. 1 to 3 illustrate an immersion heater for a washing machine wherein the element 1 is mounted on a head 2 by which the heater is mounted in an aperture in the washing machine tub or container.

5 The head 2 is of a generally well-known kind but modified for the purposes of this embodiment. It comprises inner and outer clamping plates 3,4 with a resiliently compressible and radially expansible seal 5 sandwiched therebetween. A headed bolt 6 and nut 7
10 enable the plates 3, 4 to be drawn together to compress and expand the seal 5 into contact with a surrounding aperture in the wall 9 of a container so as both to mount the heater in the aperture and to form a seal therewith.

15 The ends of the element 1 extend through the inner plate 3 and are embraced by the seal 5 which when compressed seals around the element ends and also serves to secure the element in the head.

As is conventional, the inner plate 3 is of metal
20 but the outer plate 4 is in this embodiment of the invention a moulding of plastics material and includes a downwardly pointing flange 8 which locates against the container wall 9, an upwardly pointing strengthening flange 10, and raised sleeves 11 which engage with the
25 ends of the element sheath 12. A cover moulding 13 clips over a bead 14 formed around the periphery of the outer plate 4. The cover 13 has an aperture 15 which extends around a mounting boss 16 for the nut 7, and has a well 17 to allow access to the nut 7 for removal of
30 the head 2.

Spade terminals 18,19 which are connected to
respective fixed switch contacts 20,21 by links 22,23
protrude from the cover 13. Likewise an earth terminal
24 protrudes from the cover 13 and is connected to the
35 element sheath 12 via a link 25, the bolt 6 and the inner clamp plate 3. Links 22,23 and 25 are mounted on the outer plate 4 by suitable means.

It will be noted that the seal 5 is formed with a peripheral flange 26 which is sandwiched between the container wall 9 and the outer plate 4. The flange 8 formed on the outer plate 4 prevents over-compression of the seal 5 in this area when the nut 7 is tightened on the bolt 6.

The thickness of the seal 5 where it contacts element sheath 12 may be reduced in order to inhibit the radial loss of heat. Likewise the plastics sleeves 11 also assist in reducing the loss of heat from the ends of the element. The construction of the outer plate 4 of plastics material reduces the thermal capacity of the head and again assists in containing heat within the ends of the element. It would also be possible to space the inner plate 3 from the element sheath 12 where it passes through the plate 3 to again reduce the loss of heat from the ends of the element.

Turning to the construction of the element 1, the cold tails or pins 27 extend beyond the ends of the element sheath 12 and the sleeves 11 of the outer plate 4. An insulating plug 38 closes the end of the sheath 12, above an insulating sealing material 39 such as epoxy. The inner ends of the cold tails 27 are tapered and engage with a helically wound heating wire 28. The heating wire 28 is of a ferrous resistance alloy and may be mounted directly on the cold tail 27 as shown or through an intermediate steel sleeve or indeed by any of the methods discussed earlier. The cold tails 27 are of copper and each is formed, for example in a press, at its outer end to form a tongue 29 having a generally circular portion 30 and an elongate portion 31. Each tongue 29 mounts a thermally-responsive snap-action bimetallic actuator 32, which is generally circular in shape and has a generally U-shaped aperture therein which releases a central tongue 33 which is connected, at 34, to the elongate portion 31 of the cold tail tongue 29. This holds the active area of the actuator,

i.e. the central part in the region of the base of the tongue 33 against the circular portion 30 to maximise heat transfer to the actuator.

The tongue 33 of the actuator 32 is secured to the cold tail by a rivet 34. This rivet is first formed in the pressing operation as an upstanding pin on the cold tail 27. The actuator 32 is provided with a hole which fits over the pin, and once in position the pin is riveted over to secure the actuator 32 in position. The actuator 32 is orientated in the correct position on the cold tail by interengaging locating means provided on the respective components. These are shown diagrammatically at 35,36.

A movable contact 37 is mounted, on the end of each actuator 32 opposite the tip of tongue 33. As can be seen best from Figure 2 each movable contact 37 makes contact with the respective fixed contacts 20,21 under normal operating conditions. When the temperature of the cold tail 27 and, thus of the actuator, rises to a chosen value, the actuator will operate with a snap-action to move the movable contact 37 away from the fixed contact 20,21 to cut the power supply to the element 1. The actuator may be constructed to return to its original position after it cools down. The operating characteristics of both actuators are chosen to be substantially similar whereby equal protection is given to each pole of the element.

Thus the operating characteristics of the actuator 32 may be chosen in relation to the temperature achieved by the cold tail 27 in an overheating situation, as when the heater is energised when not immersed in water, quickly to open the switch contacts. Operation well within one minute has proved possible.

Figures 4 to 6 show a further embodiment of the invention. In this embodiment, a heating element 60 is located in a well 59 in the base of a heating vessel such as a kettle or hot water jug. The element 60 is

supported in a two part head, in this case comprising a resilient seal 61 which engages and seals the element 60, the aperture in the vessel wall, and the base 62 of a control housing which extends into said aperture. The
5 base 62 has a well receiving each end region of the element sheath, with the seal 61 extending into each well and around the outside of the wells to locate and seal the base and element in the aperture. The element is located axially in the aperture by virtue of an earth
10 link 63.

The cold tails 64 of the element 60 project from the element sheath 65 and beyond the housing member 62. The cold tails 64 are of copper and have tapered inner ends to which are connected to a helically wound heating
15 wire in any convenient manner. As in the earlier embodiment, the outer ends of the cold tails 64 are pressed to form a flattened region for the attachment of respective temperature responsive snap-action bimetallic actuators 66 which are also generally similar to those
20 shown in the embodiment of Figures 1 to 3. As in that embodiment, the tongue of each bimetallic actuator 66 is riveted directly to the respective cold tail, at 67, to give a large area of contact between the active area of the actuator 66 and the cold tail 64, and a movable
25 contact 68 is mounted on the end of the actuator 66 opposite the end of the tongue of the actuator 66.

Fixed contacts 69 are provided on extensions 70 of pressed terminal pins 71, which project from cover 72 of the control housing. Further, a pressed earth pin 73 is
30 connected by link 63 to the sheath 65 of the element 60. This link 63 also acts to maintain the element 60 in the correct axial position. As can be seen most clearly from Figure 4, during normal operation the movable and fixed contacts 68,69 are closed, but when the
35 temperature of a cold tail 64, and thus of one of the actuators 66 rises above a given value, the actuator operates with a snap-action to open the contacts. The

operating characteristics of both actuators 66 are substantially the same so that should one fail for some reason, the other will operate at substantially the same temperature. Thus the actuators 66 provide overheat
5 protection in the event that the element is switched on without any liquid in the vessel or the vessel boils dry.

In this embodiment the bimetal actuators 66 not only provide overheat protection, but also form part of
10 a steam or boiling control for the vessel. Referring to Figure 4, a third temperature responsive snap-action bimetallic actuator 74 is mounted adjacent an upper part of the vessel wall, and communicates through passage means, not shown, with an upper part of the vessel. If
15 the vessel is a water jug the actuator 74 is chosen so as to trip at a temperature of substantially 100°C, such that when the water in the vessel boils, steam which accumulates in the upper part of the vessel is conducted through the passage means to act on and trip the
20 actuator 74. The actuator 74 is in contact with an operating lever 75 which is pivotally mounted at 76 in a housing 77. A "C" spring 78 acts between a projection 79 on the housing 77 and the operating lever 75, whereby the lever 75 operates as an over-centre spring
25 mechanism.

The lower end of the operating lever 75 acts on a cap 80, which is slidably mounted on the cover 72 of the control housing, to move a push-rod 81 (Fig. 5). Push rod 81 engages with the central portion of a yoke 82
30 which is slidably mounted in the housing cover 72, and which presses on both bimetallic actuators 66, on both sides of the contacts 68. The construction of the yoke will be discussed in detail later. When the 'steam' actuator 74 trips, it pivots the lever 75 over-centre to
35 press the cap 80, the push rod 81 and the yoke 82 downwards from the position shown in Figure 5 against the resilience of the bimetallic actuators 66 to break

both sets of contacts 68,69. When the steam bimetallic actuator 74 re-sets, the contacts 68,69 will remain open, the "C" spring keeping the operating lever 75 over-centre. The contacts 68,69 will remain open until
5 the lever 75 is pushed back over-centre. The re-make temperature of the bimetallic actuators 66 should be over 100°C so that they will snap shut when the lever is pushed over-centre.

As was stated above, the yoke 82, is slidably
10 mounted in the housing cover 72. To this end the yoke 82 is provided with resilient wings 83 which engage with the inner surface of the control cover 72 above a step 84 provided therein. Under normal operating conditions when the push rod 81 is moved downwardly, it causes both
15 wings 83 of the yoke 82 to move downwardly together, by the same amount, so that the upper edges of both wings 83 remain above the step 84. However, should either set of contacts 68,69 become permanently closed, for example due to arcing, when the push rod 81 moves downwardly,
20 the yoke 82 can pivot on the actuator held by the permanently closed contacts, with the result that the wing 83 on the other side of the yoke 82 from the contacts will move a greater distance downwards than normal. Thus not only will the other contacts be
25 broken, to cut off the power supply to the element 60, but the upper edge of the wing 83 will move beyond the step 84, and by virtue of its resilience will snap in behind the step 84 and be retained there so that it will not be possible to re-make the broken contact even when
30 the steam actuator 74 and operating lever 75 have reset. The control must then be removed to repair the fault. This is a very useful additional safety feature whereby welding of the contacts can be identified before damage is caused to the device.

35 Thus this embodiment provides a combined, boiling and overheat control for an element. The element and control components are advantageously assembled into a

single unit, and the element then inserted through the aperture in the vessel wall from outside to compress the seal and position the element in the vessel. This considerably facilitates manufacture of the heating vessel. If desired means such as bolts or screws may be provided to secure the control housing to the vessel.

It will be appreciated that the device of the second embodiment described above can be easily adapted for use in other appliances, such as showers, by omitting the 'steam' bimetal control parts.

Claims:

1. An electric immersion heater, the heating element of which terminates in at least one cold tail of high thermal conductivity, said cold tail having a first portion connected to a resistance heating coil of said element, and a second portion extending beyond the end of the element sheath, and a thermally-responsive bimetallic actuator mounted on said second portion of said cold tail for operating a switch to interrupt an electrical supply to said element.
2. An immersion heater as claimed in claim 1 wherein said cold tail is of copper.
3. An immersion heater as claimed in claim 1 or 2 wherein said thermally responsive bimetallic actuator is a snap-action bimetal.
4. An immersion heater as claimed in any preceding claim wherein said bimetallic actuator carries a contact of said switch.
5. An immersion heater as claimed in any preceding claim wherein said second portion of said cold tail is formed so as to present a relatively large surface area of contact between the cold tail and the bimetallic actuator.
6. An immersion heater as claimed in claim 5 wherein said second portion is formed with a generally flat contact surface for said bimetal actuator, having a first, generally circular portion and a second, elongate portion.
7. An immersion heater as claimed in any preceding

claims wherein means are provided for inhibiting heat loss from the sheath of the heating element in the region of the cold tail.

5 8. An immersion heater as claimed in any preceding claim wherein said second portion of said cold tail has means for mounting said actuator thereon.

10 9. An immersion heater as claimed in claim 8 wherein said second portion of said cold tail is formed with a pin over which an aperture in said bimetallic actuator engages and which is then riveted over to mount said bimetal in position.

15 10. An immersion heater as claimed in any preceding claim including a head which comprises inner and outer clamping plates between which is sandwiched a seal element, and means for drawing said plates together to radially expand said seal to locate and seal said
20 element in said aperture.

25 11. An immersion heater as claimed in claim 10 wherein said outer clamping plate of plastics materials and includes sleeves enclosing outer end portions of said element sheath extending through said seal.

30 12. An immersion heater as claimed in any of claims 1 to 9 including a head comprising a base member and a seal, said base member having a well receiving each end region of said element sheath and said seal extending into each said well and around the outside of said wells to locate and seal said base member and said element in said aperture.

35 13. An immersion heater as claimed in any preceding claim wherein said element has two such cold tails and a thermally-responsive bimetallic actuator is mounted on

the respective second portions of each cold tail for operating a respective switch.

14. An immersion heater as claimed in claim 13 wherein said bimetallic actuators have substantially the same operating characteristics.

15. An immersion heater as claimed in claim 13 or 14 wherein said bimetallic actuators lie in the same plane and are acted upon by a displaceable yoke member of a boiling control to operate said control switches in order to break the electrical supply to the element when liquid in the vessel boils.

16. An immersion heater as claimed in claim 15 wherein said boiling control comprises a bimetallic actuator which is actuated by liquid boiling in the vessel, a pivotally mounted over-centre spring mechanism actuated by said actuator, said spring mechanism acting via a push rod upon said yoke member.

17. An immersion heater as claimed in claim 16 wherein said yoke member can pivot so as to be capable of operating one actuator even if the other is rendered immovable.

18. An immersion heater as claimed in claim 17 wherein said yoke member is formed with resilient wings, the arrangement being such that should one of the bimetallic actuators mounted on the cold tails of the element not move when said yoke is moved by said push rod, the yoke pivots about said bimetallic actuator, and the one of said resilient wings remote from said immovable actuator snaps into place behind a step, and is retained there even after the over-centre spring mechanism has been re-set.

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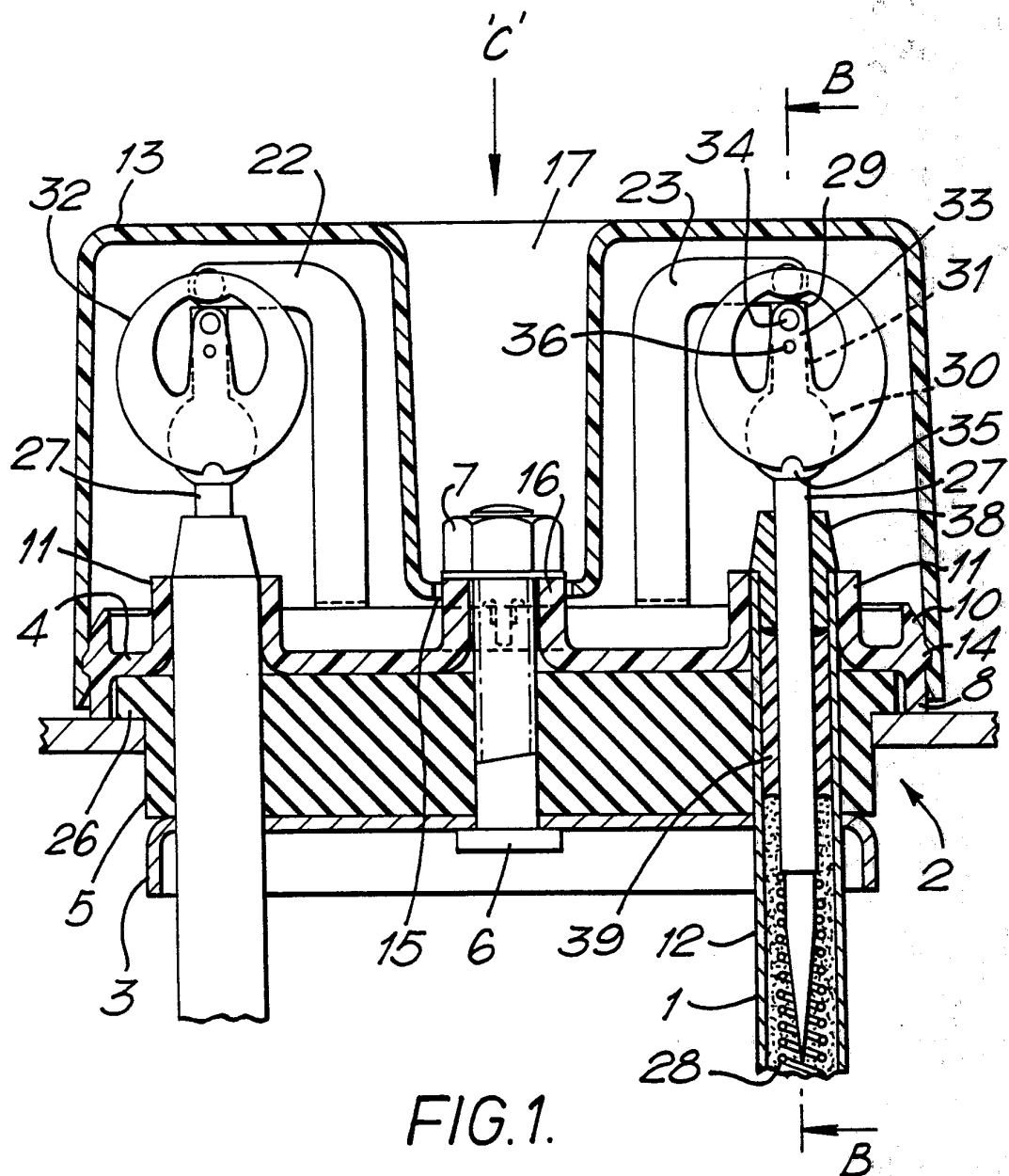
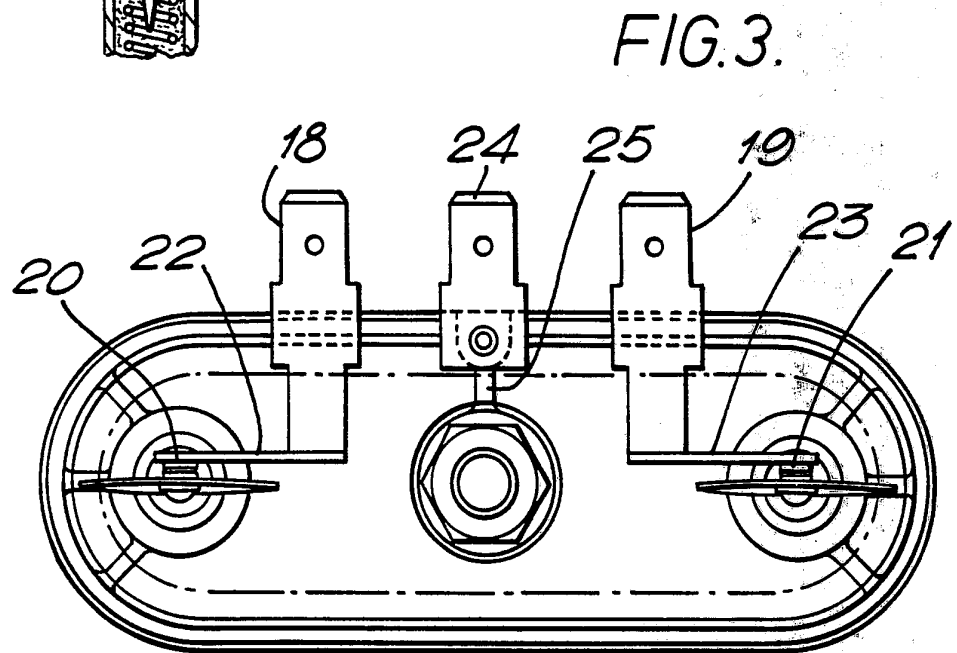
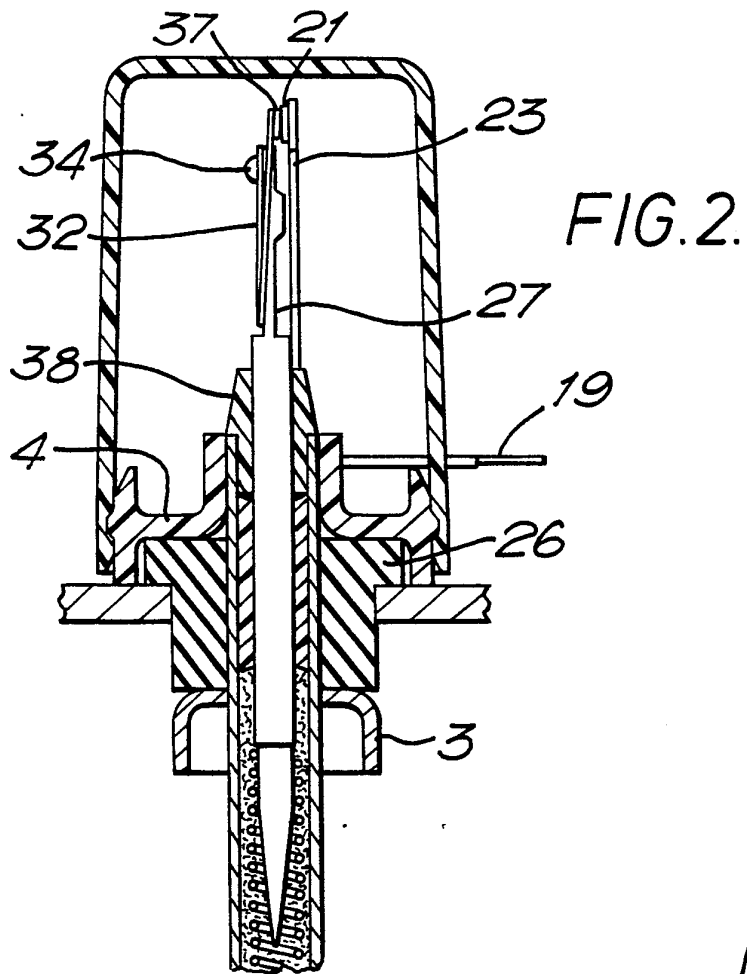


FIG. 1.

SUBSTITUTE SHEET

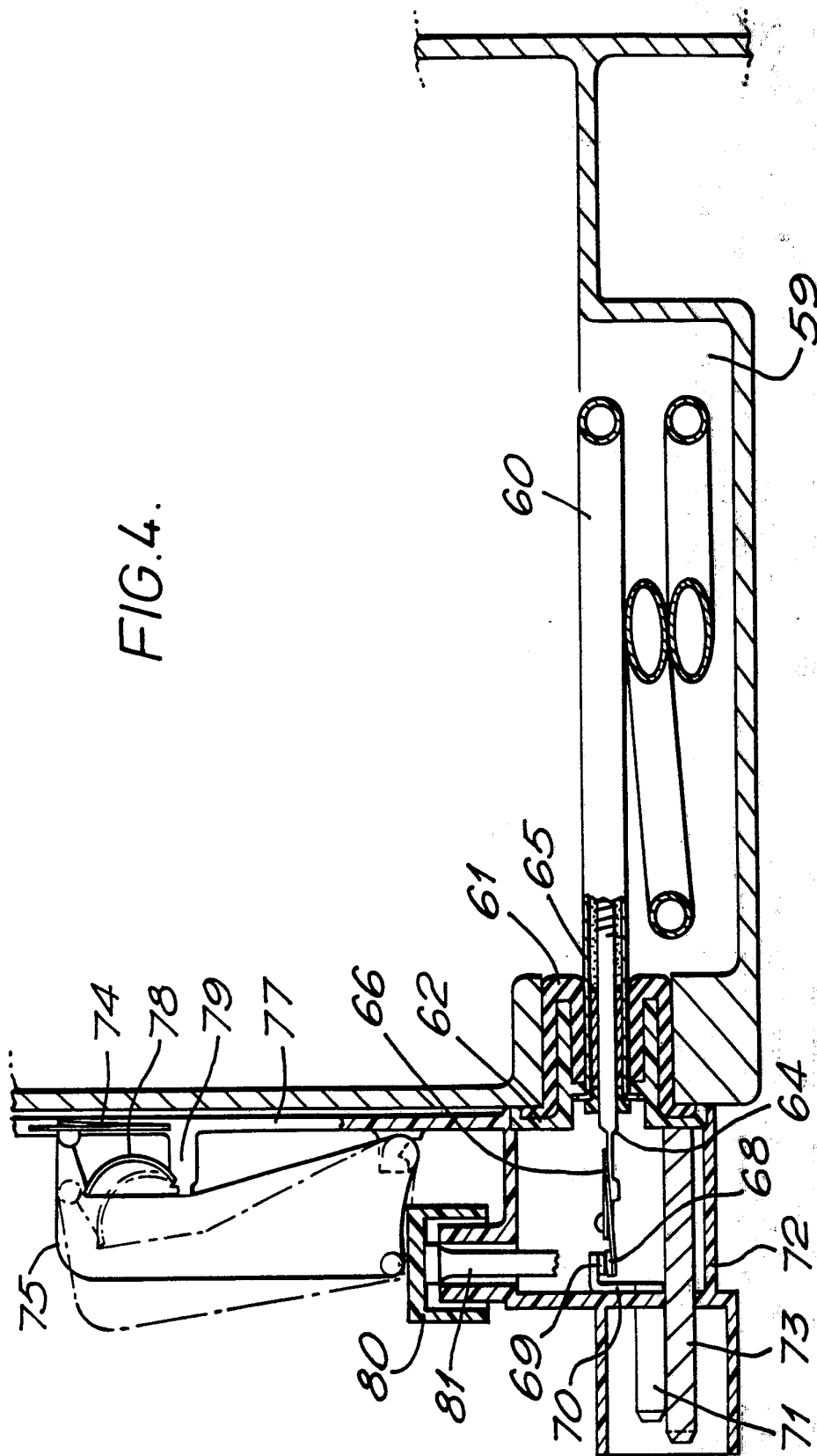
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SUBSTITUTE SHEET

3/4

FIG. 4.



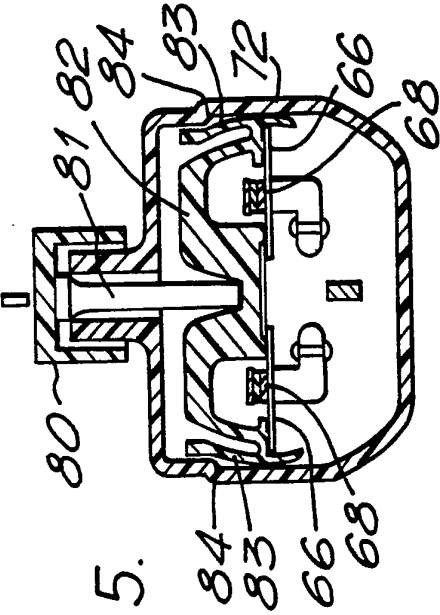


FIG. 5.

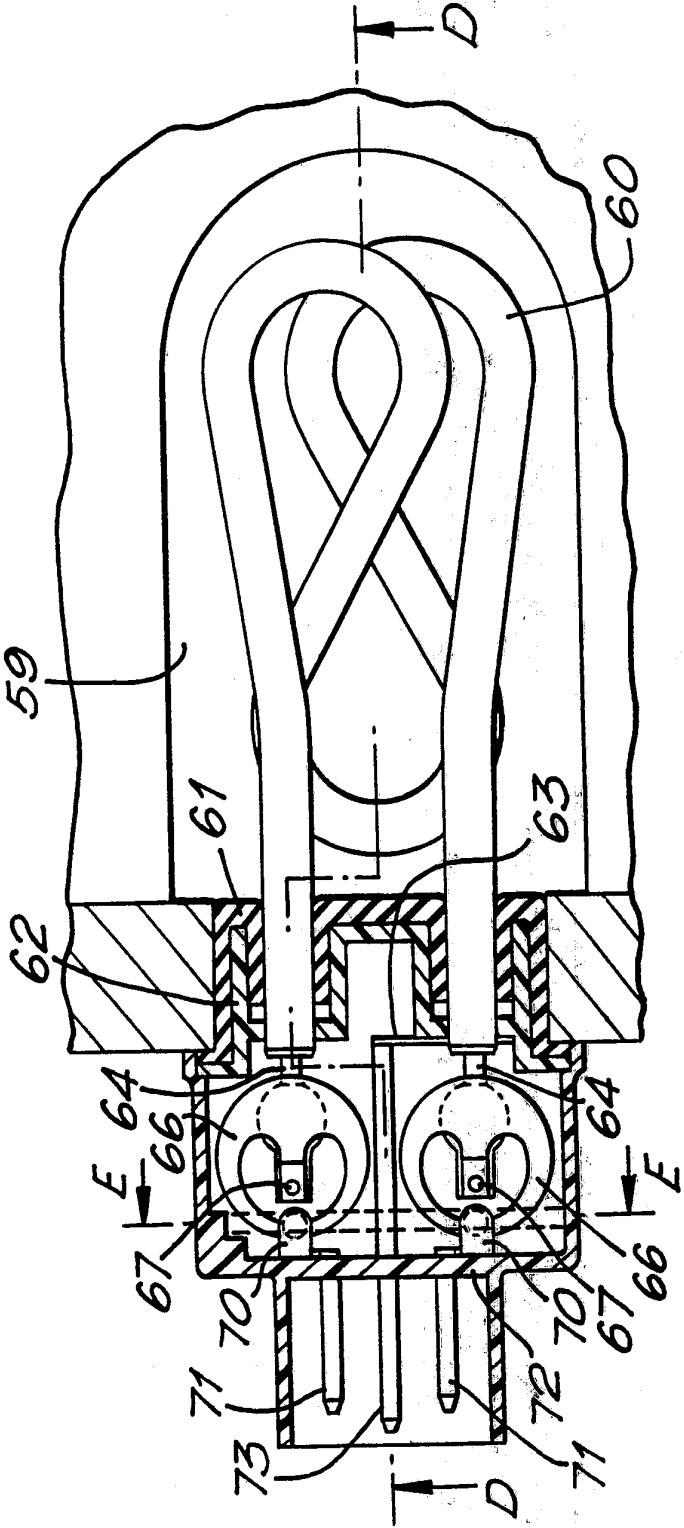
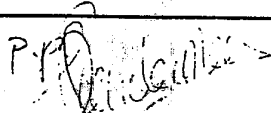


FIG. 6.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 90/00236

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 H01H37/54 ; H01H37/04 ; H05B3/82		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	H01H ; H05B ; A47J	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US,A,3135860 (CZARNECKI) 02 June 1964 see column 2, lines 43 - 52 see column 3, lines 35 - 38	1, 4
Y	---	3, 10, 13, 15-17
Y	GB,A,2111754 (STRIX) 06 July 1983 see page 2, line 111 - page 5, line 64 ---	3, 13, 15-17
Y	EP,A,277551 (I.R.C.A.) 10 August 1988 see claim 1 ---	10
A	GB,A,2046521 (BULPITT) 12 November 1980 ---	
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search 09 MAY 1990		Date of Mailing of this International Search Report 16.05.90
International Searching Authority EUROPEAN PATENT OFFICE		Signature of Authorized Officer DESMET W.H.G. 

ANNEX TO THE INTERNATIONAL SEARCH REPORT
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