

Electrical controls incorporating thermally-responsive
actuators

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This invention relates to electrical controls incorporating thermally-responsive actuators for use as boiling controls for liquid heating vessels particularly water heating
10 vessels such as jugs and kettles. More particularly the invention relates to electrical controls incorporating thermally-responsive actuators (hereinafter termed controls or actuators of the kind referred to) incorporating an actuating member
15 of sheet bimetal of dished or domed configuration such that it will reverse its curvature with a snap action upon a sufficient rise in temperature consequent upon exposure to steam or vapour. Such an actuating member may be constructed automatically
20 to reset with a fall in temperature but more usually it requires to be reset by a force being applied thereto to cause it to snap back to its original state.

Actuators or controls of the kind referred
25 to are commonly employed in so-called automatic electric kettles or jugs for interrupting the electric supply to the heating element of such a kettle or jug upon the water in the kettle or jug boiling. The force generated by the actuating member may
30 be used directly to move a switch contact or it may be used to operate a switch actuating mechanism such as a sprung over-centre lever mechanism. An electrical control of the kind referred to may incorporate an electrical switch for interrupting the power supply
35 to the heating element.

The space available in liquid heating vessels for actuators or controls of the kind referred to
5 is often limited both on account of the limited size of such vessels and particularly as regards domestic household appliances on account of styling considerations. Further there is always the problem associated with the use of such actuators or controls of providing
10 for access of steam or vapour thereto whilst avoiding as a consequence thereof penetration of vapour or condensation into the electrical system of the vessel.

It is therefore one object of the present invention to provide a construction of thermally-responsive
15 actuator of the kind referred which lends itself to compactness and to the exclusion of vapour or condensate from an electrical system with which the actuator may be associated.

Thus according to the present invention there
20 is provided an electrical control of the kind referred to comprising a thermally-responsive actuator and an electrical switch for interrupting power to a heating element of a liquid heating vessel operable by said thermally-responsive actuator, said thermally-
25 responsive actuator including first and second mouldings of plastics material, the mouldings being superimposed and defining between them a shallow enclosure housing said actuating member, one moulding having an inlet opening therein opposite said actuating member providing
30 direct access for vapour to enter said enclosure and contact said actuating member, the other moulding having an outlet opening therein for the egress of vapour from said enclosure after it has passed through apertures in and/or around said actuating member,
35 both said mouldings being adapted to enable sealed connections to be made thereto with respect to said inlet and outlet openings whereby said actuator may

be connected for the flow of vapour through said enclosure without escape of vapour or condensate at said openings, the mouldings making sealing contact at their interface around said enclosure to prevent escape of vapour
5 or condensate therebetween from within said enclosure, and a push rod slidably and sealingly mounted in an aperture extending through one moulding, said push rod being coupled with said switch and disposed to be acted upon by said actuating member upon operation
10 thereof with rise in temperature thereby to operate said switch.

An actuator incorporated in a control according to the invention being of sandwich construction may be made relatively thin and therefore easily accommodated within a confined
15 space.

To form an electrical control according to the invention the two mouldings may also co-operate to define therebetween a switch housing, the mouldings again preferably making a sealing contact at their
20 interface around said housing to prevent the entry of moisture into said housing.

A second push rod may extend slidingly and sealingly through an aperture in one of said mouldings into said housing to act upon a movable contact of a pair
25 of switch contacts therewithin. The contacts may be carried by leaf springs which extend out of said housing and have integrally formed therewith electrical terminals. The second push rod will then serve to open the switch contacts by displacing the movable
30 contact against the resilience of the leaf spring which will ensure the remaking of the switch contacts once the force acting on the second push rod is removed.

A switch actuating mechanism may be mounted on the control and can conveniently take the form
35 of a sprung over-centre lever mechanism pivotally mounted to one moulding in which both push rods are

slidably mounted, said mechanism overlying both push rods and being operated by displacement of the first push rod by the actuating member thereby to displace the second push rod and open the switch. Preferably
5 the switch actuating mechanism is such as to require resetting e.g. manually, to allow the switch to close. Resetting of the actuating mechanism may also serve

to reset the actuating member through the agency of the push rod associated therewith.

Although resilient seals or sealing compounds could be provided between the mouldings at the aforesaid interface or interfaces, it may be sufficient to form the mouldings with interengaging ribs and grooves to form labyrinth seals adequate for the purpose of preventing escape of vapour or condensate.

The mouldings may conveniently be formed with integral parts resiliently interengageable so as to be connectible simply by being pressed together i.e. as a so-called "click-fit". Alternatively the moulding could be assembled together in other ways as by welding or gluing.

The adaption of the said openings in the plastic mouldings for making sealed connections thereto may be of various kinds both as to the form of mechanical connection and as to the nature of the seal provided. Thus, for example, the adaption may be for the provision of "click-fit" or screwed mechanical connections. As to the nature of the seals to be provided these may for example involve the use of resilient seals e.g. O-rings or gaskets, sealing compounds, labyrinth seals or the like.

Actuators or controls of the kind referred to operate upon exposure to steam or vapour. The necessary exposure may be achieved by having the actuator or control form the closure for a steam chamber, the steam chamber itself communicating with the vessel in which the liquid is heated. In a preferred arrangement said one moulding having an inlet opening therein forms at least part of the closure for the steam chamber. This arrangement provides access for steam or vapour in the steam chamber to pass through said inlet opening into said enclosure and contact said actuating member. The steam chamber may either be formed as part of the actuator or control or may alternatively be formed as part

of the vessel, preferably as part of the handle of such a vessel.

The communication between the steam chamber and the liquid being heated may be an opening into the interior of the vessel formed in the walls of the steam chamber. Preferably the opening and the steam chamber are so arranged that any condensate formed in the steam chamber will drain into the vessel.

In a preferred arrangement of control and steam chamber, provision is made for through flow of cooling air into the steam chamber to increase the rate of cooling of the actuating member after the actuator has switched off the current to the heating element and so reduce the minimum time after which the actuator resets, or may be manually reset. This through flow of cooling air may be provided by an inlet chimney or inlet chimneys which provide a path for cooling air to flow from outside the vessel into the steam chamber and out through a funnel-shaped outlet opening in said other moulding of the control.

The compact nature of the actuator or control of the kind referred to is such that the actuator or control may be conveniently mounted on top of a handle of the liquid heating vessel in a generally horizontal orientation.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a side elevation in longitudinal cross-section on the line I-I of Figure 7 of an electrical control of the kind referred to in accordance with the invention;

Figure 2 shows a transverse cross-sectional view on the line II-II of Figure 1;

Figure 3 shows in vertical cross-section, the handle of a jug kettle incorporating a steam chamber, the control of Figures 1 and 2 forming the closure for said chamber;

Figure 4 shows a perspective view (partially cut away) of the jug kettle handle of Figure 3;

Figure 5 is a top plan view of the jug kettle handle of Figure 3;

5 Figure 6 is a cross-sectional view along line VI-VI of Figure 5;

Figure 7 is a top plan view of the control of Figure 1;

Figure 8 is a side elevation of the control
10 in a first position;

Figure 9 is a part side elevation of the control in a second position;

Figure 10 is an underneath plan view of the control;

15 Figure 11 is a top plan view of a lower moulding of the control;

Figure 12 is a top plan view of an upper main moulding of the control; and

Figure 13 is an underneath plan view of the
20 upper moulding of the control.

The body of the control comprises upper and lower plastic mouldings 1, 2. The upper main moulding 1 is shown from above in Figure 12 and from below in Figure 13. The lower moulding 2 is shown from
25 above in Figure 11 and from below (with actuating member 3 in place) in Figure 10. There is, on the underneath surface of the main moulding 1, a circular groove 4 and within said groove 4 a circular depression 5 surrounded by an annular wall 5a. Located within
30 the circular depression 5 are outlet opening or funnel 6 and first aperture 7 both of which extend through the main moulding 1. The end of the main moulding 1 remote from depression 5 defines a rectangular cavity 8. Disposed within the rectangular cavity 8 is a
35 second aperture 9 which extends through the main moulding 1. Disposed between the rectangular cavity 8 and circular depression 5 is an elongate slot 10 with

rounded ends. The slot 10 extends through the main moulding 1. Disposed on the opposite side of the circular depression 5 to the rectangular cavity 8 is a first fixing hole 11 which extends through the main moulding 1. Adjacent the first fixing hole 11 is a projection having a rectangular aperture 43 therein. As shown in Figure 12 the main moulding 1 has two upstanding shoulders 12 which extend upwardly from its upper surface and are disposed symetrically on either side of the median line of the main moulding 1.

As shown in Figure 11 the lower moulding 2 has a circular rib 14 protruding from its upper surface. The circular rib 14 is dimensioned so as to be a close fit within the circular groove 4 of the main moulding 1 to form therewith a labyrinth seal. Disposed within the circular rib 14 is inlet opening 15 which has a generally circular shape but with a number of scallops 16 being cut from its edge. At one end of the lower moulding 2 there is a raised rectangular rib 17 which is dimensioned to fit within the rectangular cavity 8 of the main moulding 1 (Figure 7). Intermediate the rectangular rib 17 and the circular rib 14 is an upstanding pillar 18. This is dimensioned so as to pass through the slot 10 in the main moulding 1 when the main moulding 1 and lower moulding 2 are brought together. A second fixing hole 19 is provided in the lower moulding which registers with the first fixing hole 11 in the main moulding 1 when the main moulding 1 and lower moulding 2 are assembled together. Adjacent the second fixing hole 19 is a latching post 44 which is dimensioned and positioned so as to snap into engagement with the rectangular aperture 43 in the main moulding 1 when the main moulding 1 and lower moulding 2 are brought together. Also for the purpose of interconnecting the main

and lower mouldings 1, 2, the upper main moulding 1 has an apertured ear 65 depending from each side thereof opposite the respective shoulders 12, which ears are spaced to embrace the lower moulding 2 and
5 resiliently to snap over lugs 66 respectively provided on opposite side edges of the lower moulding 2 so that the lugs locate in the apertures in the ears (Figure 8). In this way together with the latching post 44 and aperture 43, the mouldings 1, 2 are located
10 relative to one another and firmly held together.

As shown in Figure 10 the lower moulding 2 has protruding from its lower surface a generally elliptically shaped skirt 20 which encloses the inlet opening 15 and the second fixing hole 19. Disposed on either
15 side of the end of the lower moulding opposite the cavity 8 of the main moulding are depending electrical terminal housings 21, 22 whose upward openings are blocked off by the upper main moulding 1 when the mouldings 1, 2 are interconnected save for gaps to
20 accommodate contact carrying leaf springs 25, 26 formed integrally with the said electrical terminals and extending into the rectangular cavity 8 (Figure 2).

When the main moulding 1 and lower moulding 2 are interconnected as shown in Figure 1 a shallow
25 cylindrical enclosure or housing 23 which encloses the actuating member 3 is formed by the circular depression 5 and the lower moulding 2. Likewise the rectangular cavity 8 engages the lower moulding around the rectangular rib 17 to define a moisture tight switch housing 24
30 which encloses a switch comprising leaf springs 25, 26 carrying contacts 25a and 26a which are integral with electrical terminals 21a, 22a housed within the terminal housings 21, 22. As shown in Figure 2 mouldings 1, 2 are shaped to hold and locate between them the
35 leaf springs 25, 26.

A knob 27 for actuating the switch is pivotally mounted on the shoulders 12 of the main moulding 1

by means of V-shaped pivots 27a on each side of knob 27 which engage V-shaped notches 12a in shoulders 12 (Figure 8). The knob 27 is sprung into position on shoulders 12 by a wire spring 28 which is held
5 in compression between V-shaped notches 12b in shoulders 12 and an end support on the knob 27 where it overlies the first aperture 7 in main moulding 1. The relative positions of notches 12a and 12b and the end support provide an over-centre lever mechanism. The upper
10 end of the pillar 18 terminates just short of the under surface of the knob (Figure 1) and is spaced from an abutment 18a depending from the under surface of the knob. Pillar 18 and abutment 18a serve as a stop to prevent displacement of the knob to the
15 left as seen in Figure 1 against the action of spring 28 so as to disengage pivots 27a from notches 12a and thus remove the knob. Knob 27 is thus mounted on main moulding 1 before mouldings 1, 2 are assembled, the pillar 18 then serving to prevent removal of the
20 knob in use of the control.

A first push rod 29 is slidably and sealingly mounted in first aperture 7 so that its bottom end engages actuating member 3 (Figure 1).

The actuating member 3 is a domed circular disc
25 of sheet bimetal from which a U-shaped portion has been removed (Figure 10) to leave a tongue 3a. Such an actuating member is described and claimed in U.K. Specification No. 1542252. The member 3 is constructed to reverse its curvature with a snap action upon a
30 rise in its temperature and the end of the tongue 3a, which the push rod 29 engages, then displaces push-rod 29 to cause the knob 27 to move to the position shown in Figure 1.

A second push rod 30 is mounted slidably and
35 sealingly in second aperture 9 so that its bottom end engages leaf spring 25 (Figure 2). In use the knob 27 has two stable positions. In the first stable

position illustrated in Figure 8 the knob 27 pushes down on the push rod 29 which in turn pushes down on the actuating member 3. In the second stable position illustrated in Figures 1 and 9 the knob 27 pushes
5 down on second push rod 30 which in turn pushes down on leaf spring 25 thereby holding the switch contacts 25a, 26a open. Thus if one manually actuates the knob 27 into its first position with the push rod 29 pushing down on the actuating member 3 then the
10 contacts 25a and 26a will close. If the actuating member 3 is then heated by, for example, exposure to steam, then upon a sufficient rise in temperature it will reverse its curvature pushing the first push rod 29 upward against knob 27, thereby causing knob
15 27 to snap into its second stable position in which the switch contacts 25a and 26a are opened and held open by push rod 30.

Actuating member 3 is heated by steam entering the shallow cylindrical enclosure 23 through inlet
20 opening 15. Excess steam escapes through outlet opening 6. If the control is used in a kettle then when the water boils the steam generated may be used to heat the actuating member 3 causing knob 27 to change position thereby opening contacts 25a and 26a and switching
25 the kettle off. When the actuating member 3 has cooled sufficiently then it is possible to reset the control by manually moving knob 27 to its first stable position thereby moving push rod 29 downwards and thus reversing the curvature of actuating member 3. This would
30 allow contacts 25a and 26a to close thereby switching the kettle back on.

A preferred application of the control is for use in a jug kettle when it can be mounted in the flat top of the handle of the jug kettle. Figures
35 3 to 6 illustrate this application of the control.

As shown the jug kettle has a handle 45 including a vertical hollow portion 46 opening into a flat top

portion 47. In the base of the top portion 47 there is a steam chamber 33 which communicates with the interior 48 of the jug via a slot 49 in the jug wall 50 which extends downwardly from the top of the jug and also extends through the side wall 32 of steam chamber 33. The base 51 of steam chamber 33 runs through slot 49 into jug interior 48 so that condensate within steam chamber 33 drains into the jug.

A handle cover 52 (Figure 3) has a depending finger portion 53 which is a close sliding fit within slot 49 but terminates short of the bottom thereof to define a steam opening 34 connecting the interior of jug 48 with the steam chamber 33.

Extending through base 51 of chamber 33 are two air inlet chimneys 36 and 37. The inlet chimneys 36 and 37 provide communication between the interior of the chamber 33 and the space 35 between the jug container and handle portion 46. Also disposed within the chamber 33 is an upstanding fixing post 38. The inlet chimneys 36 and 37 extend well above the base 51 of the chamber 33. A rebate is provided in the open end of side wall 32 so as to form a shoulder 39. The chamber 33 corresponds in shape to the skirt 20 of the lower moulding 2 which closely fits within wall 32, an O-ring seal 40 being seated on shoulder 39 so as to produce a good seal between lower moulding 2 and the chamber 33. When in place the lower moulding 2 of the control provides a closure for steam chamber 33. The cover 52 and control are securely attached to the handle 31 by a fixing screw 42 which passes through aperture 41 in the cover 52, first and second fixing apertures 11, 19 in the control and into the fixing post 38.

In use with contacts 25a and 26b closed and the jug kettle switched on, water is heated. When the water boils the steam produced passes from the kettle interior 48 into steam chamber 33 via opening 34. From steam chamber 33 the steam passes through

inlet opening 15 into cylindrical housing 23 where it heats actuating member 3. Outlet funnel 6 of the control makes a sealing connection with venting opening 54 in cover 52 to atmosphere.

5 The heating of actuating member 3 causes the control to switch the kettle off in the manner previously described. Any condensate forming within the cylindrical housing 23 or the steam chamber 33 drains back into the vessel through opening 34. The inlet chimneys
10 36 and 37 provide for a flow of cooling air into the steam chamber 33 which will pass through and, by virtue of scallops 16, around the actuating member 3 and out to atmosphere through outlet chimney 6 thus enabling the actuating member 3 to cool rapidly, thereby speeding
15 the time at which the control may be reset. The dimensions of the outlet or funnel opening 6 and the inlet chimneys 36 and 37 can be determined empirically so that the control operates to switch off the kettle quickly once the water has boiled without an unduly long delay
20 before the control can be reset.



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Claims:

1. An electrical control of the kind referred to
5 comprising a thermally-responsive actuator and an
electrical switch for interrupting power to a heating
element of a liquid heating vessel operable by said
thermally-responsive actuator, said thermally-responsive
10 actuator including first and second mouldings of
plastics material, the mouldings being superimposed and
defining between them a shallow enclosure housing said
actuating member, one moulding having an inlet opening
therein opposite said actuating member providing direct
15 access for vapour to enter said enclosure and contact
said actuating member, the other moulding having an
outlet opening therein for the egress of vapour from
said enclosure after it has passed through apertures in
and/or around said actuating member, both said mouldings
20 being adapted to enable sealed connections to be made
thereto with respect to said inlet and outlet openings
whereby said actuator may be connected for the flow of
vapour through said enclosure without escape of vapour
or condensate at said openings, the mouldings making
25 sealing contact at their interface around said enclosure
to prevent escape of vapour or condensate therebetween
from within said enclosure, and a push rod slidably and
sealingly mounted in an aperture extending through one
moulding, said push rod being coupled with said switch
30 upon operation thereof with rise in temperature thereby
to operate said switch.

2. An electrical control as claimed in claim 1 wherein
the first and second thermal mouldings co-operate to
35 define therebetween a switch housing.

3. An electrical control as claimed in claim 2 wherein



the mouldings make a sealing contact at their interface around said housing to prevent the entry of moisture into said housing.

- 5 4. An electrical control as claimed in claim 2 or 3 including a second push rod extending slidably and sealingly through an aperture in one of said mouldings into said housing to act upon a moveable contact of a pair of switch contacts of said switch therewithin.
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5. An electrical control as claimed in claim 4 wherein the contacts are carried by leaf springs which extend out of said housing and have integrally formed therewith electrical terminals.
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6. An electrical control as claimed in any of claims 1 to 5 including a switch actuating mechanism mounted on the control to couple said first push rod with said switch.
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7. An electrical control as claimed in claim 4 or 5 including a switch actuating mechanism mounted on the control to couple said first push rod with said switch in the form of a sprung over-centre lever mechanism
- 25 pivotally mounted to one moulding in which both push rods are slidably mounted, said mechanism overlying both push rods and being operated by displacement of the first push rod by the actuating member thereby to displace the second push rod and open the switch.
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8. An electrical control as claimed in claims 6 or 7 wherein the switch actuating mechanism is such as to require resetting e.g. manually, to allow the switch to close.
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9. An electrical control as claimed in claim 8 wherein resetting of the actuating mechanism also serves to



reset the actuating member through the agency of the push rod associated therewith.

- 5 10. An electrical control as claimed in any preceding claim wherein the mouldings are formed with interengaging ribs and grooves to form labyrinth seals adequate for the purpose of preventing escape of vapour or condensate therebetween.
- 10 11. An electrical control as claimed in any preceding claim wherein said mouldings are formed with integral parts resiliently interengageable so as to be connectible simply by being pressed together, i.e. as so-called "click-fit".
- 15 12. An electrical control as claimed in any preceding claim in which the actuator or control forms the closure for a steam chamber which communicates with the interior of a liquid heating vessel.
- 20 13. An electrical control as claimed in claim 12 wherein said one moulding having an inlet opening therein forms at least part of the closure for the steam chamber.
- 25 14. An electrical control as claimed in claim 12 or 13 wherein the steam chamber is formed as part of the actuator or control.
- 30 15. A liquid heating vessel including an electrical control as claimed in claim 12 or 13 wherein the steam chamber is part of the vessel.
- 35 16. An electrical control as claimed in claim 13 or 14 or a liquid heating vessel as claimed in claim 15 wherein the communication between the steam chamber and the liquid being heated is an opening into the interior



of the vessel formed in the walls of the steam chamber and the opening and the steam chamber are so arranged that any condensate formed in the steam chamber will drain into the vessel.

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17. An electrical control or liquid heating vessel as claimed in any of claims 14 to 16 wherein provision is made for through flow of cooling air into the steam chamber to increase the rate of cooling of the actuating member after exposure to steam or vapour.

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18. An electrical control or liquid heating vessel as claimed in claim 17 including an inlet chimney or inlet chimneys which provide a path for cooling air to flow from outside the vessel into the steam chamber and out through said outlet opening in said other moulding of the control.

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19. An electrical control or liquid heating vessel as claimed in claim 18 wherein said outlet opening is funnel shaped.

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20. A liquid heating vessel as claimed in any of claims 15 to 19 wherein the control is mounted on top of a handle of the liquid heating vessel in a generally horizontal orientation.

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21. An electrical control of the kind referred to substantially as hereinbefore described with reference to Figures 1, 2 and 7 to 13.

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22. A jug kettle having a steam chamber and an electrical control constructed therewith substantially as hereinbefore described with reference to Figures 3 to 6 of the accompanying drawings.

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