

51-440.LJ

THERMALLY-SENSITIVE SWITCH

5 This invention relates to a thermally-sensitive switch, and relates in particular to a cut out switch which is suitable for use with a heated electrical appliance and which is adapted for "one shot" operation to disable the appliance in the event of over heating thereof e.g. consequent upon the appliance itself, or a control or regulating means thereof, malfunctioning.

10 Such switches are known which include a preloaded spring mechanism held by means of a retaining element in such condition that a pair of switch contacts arranged in series with the power supply to an electrical appliance are closed during normal operation, the retaining element being adapted and arranged to deform in such a way as to release the spring mechanism at a predetermined temperature to open the contacts and disable the appliance in the event of critical overheating thereof.

20 One such switch is described in British Patent Specification No 2181598 which forms part of a thermally-sensitive control for an electrical heater of a container such as an electric kettle or hot water jug and is adapted for operation to disable the heater in the event of serious overheating thereof consequent upon failure of a primary, bimetal-actuated switch means. In the preferred back-up protector switch the retaining element which holds the spring mechanism in a preloaded condition comprises a push rod engaged directly with the heater head and adapted to deform at a predetermined temperature to release the spring mechanism which then cooperates with a pair of switch contacts to open the contacts and disable the heater.

With such an arrangement it is important that the push rod can deform rapidly so that the heater is disabled before the appliance becomes sufficiently overheated to constitute a serious safety hazard.

5 Experience shows that reducing the melting point of the push rod so as to be closer to an expected maximum temperature likely to occur during normal operation of the appliance does not greatly reduce the response time and in practice only leads to a greater likelihood of
10 "nuisance tripping" of the back-up protector switch in the event of e.g. the temperature of the heater of a kettle or jug rising somewhat above the normal expected maximum owing to scale having formed on the element.

Viewed from one aspect the invention provides a
15 thermally-sensitive cut-out switch for a heated electrical appliance, comprising a spring mechanism which in normal use of the appliance is held in a preloaded condition by means of an axially movable push rod a free end of which can be arranged in use in
20 thermal contact with a part of a heater of the appliance or with part of the appliance itself and is adapted to deform so as to release the spring mechanism at a certain critical temperature whereupon the mechanism cooperates with and opens a pair of switch contacts to
25 disable the appliance, wherein the push rod includes a region adjacent its free end of reduced cross-section with respect to the cross-section of the rod at its free end, whereby in use as heat from said appliance or heater is transmitted to said region through said free
30 end so at said critical temperature said region deforms under the force of said spring mechanism to permit axial movement of the push rod and opening of the switch contacts.

Thus the rod includes a region of reduced
35 cross-section or thickness adjacent its free end the effect of which is to improve the response time of the switch to the extent that a region of reduced thickness deforms more quickly under the spring biasing force upon

softening or melting of the push rod in an overheat condition. However, since the free end or tip of the push rod which in use is in direct thermal contact with part of the heater or appliance has a larger
5 cross-section relative to the region of reduced cross-section, such region is spaced from and is thus to an extent insulated from the part of the appliance or heater concerned. In this way the tendency for the rod to "creep", i.e. to be displaced under the force of the
10 spring owing to slight softening of the free end thereof at higher but normal operating temperatures is reduced as compared with a push rod having a region of reduced cross-section extending right up to its free end. Such creep is undesirable because it can again lead to
15 nuisance tripping of the switch.

A switch in accordance with the invention is applicable to any form of heated electrical appliance, and the part of the appliance or heater thereof with which the push rod is mounted in good thermal contact
20 may vary depending on the nature of the appliance; it is however important that such part is itself in good thermal contact with the heater or heaters of the appliance concerned. In the case of a control for a heater of a container such as a kettle or hot water jug,
25 the push rod preferably engages directly a "head" part of the heater itself. In other forms of appliance such as a toaster the push rod may engage e.g. a part of the chassis which would quickly become hot in the event of the toaster thermostat failing.

30 The shape of the push rod and in particular the region of reduced cross-section thereof may vary. For example, the free end portion of the rod could be generally cone shaped, i.e. tapering gradually from a region of maximum thickness at the free end to one of
35 minimum thickness spaced inwardly from the free end. Alternatively, the region of reduced cross-section could be defined by a notch formed in one side of the push rod.

In a preferred embodiment, however, the push rod is generally cylindrical and the region of reduced cross-section comprises an annular recess formed adjacent the free end.

5 The nature of the spring mechanism which is preloaded by the push rod may also vary. For example one or both of the switch contacts might be mounted on a leaf spring or springs tending to break the contacts when relaxed but cooperating
10 with the push rod so as to be preloaded and urged together during normal operation. In this case, it will be appreciated that the "preloaded spring mechanism" referred to above comprises one or both of the leaf springs mounting the switch contacts.
15 In the presently preferred arrangement, however, the contacts are mounted on leaf springs which are so biased normally to close the contacts, and the preloaded spring mechanism includes a separate spring, preferably a compression spring, arranged
20 when released to cooperate with and open the contacts.

A cutout switch in accordance with the invention may comprise essentially a self-contained unit, or it may alternatively form part of a larger control e.g. of a heater for a kettle or hot water jug
25 in which case the switch contacts of the cut-out switch may be common with a further switching means of the control. In one such embodiment, as described in the aforesaid UK patent specification 2181598 the contacts of the cut-out switch are also arranged
30 to be broken to disable the heater in response to operation of an actuating means sensitive to liquid in an associated container boiling.

A preferred embodiment of push rod is formed of glass reinforced plastic having a melting point
35 of approximately 260°C, and a preferred cut-out switch in accordance with the invention has exhibited an overall response time which is improved by 20% as compared with a similar known arrangement.

In certain applications this can very significantly improve the margin for safety between the cut-off time achieved and the time after which overheating of the appliance would constitute a serious safety hazard.

5 Viewed from a second aspect the invention provides a thermally-sensitive control for an electrically heated appliance incorporating a cut-out switch as discussed above.

10 Viewed from a further aspect the invention provides an electrically heated appliance incorporating a cut-out switch as discussed above.

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:

15 Figure 1 is a partly schematic vertical cross-sectional view illustrating a thermally-sensitive control incorporating a cut-out switch in accordance with the invention, the control being secured to the head of an immersion heater; and

20 Figures 2a and 2b are respectively diagrammatic cross-sectional and front elevational views illustrating in more detail the pre-loaded spring mechanism of the cut-out switch.

25 Referring firstly to Figure 1, a thermally-sensitive control 1 is mounted to the head 2 of an electric immersion heater, the control and heater head being interconnected by means of bolts (not shown) and thus being clamped within an aperture formed in the wall 3 of an associated container such as a kettle or hot
30 water jug. The general configuration of the heater will be well known to those skilled in the art, and as is conventional

the heater includes a heating element terminating in a pair of cold leads 4 which extend through the plate-like head 2 and having a so-called hot return part which is brazed to the head in good thermal contact therewith. A resilient annular sealing ring 6 is tightly engaged between the head and the control so as to provide a water-tight seal with the container wall 3.

The control 1 includes first and second body portions 7,8 which interengage axially and are so shaped to define cavities therebetween within which electrical switch means of the control are mounted. The second body portion 8 includes three terminal pins 9 arranged in a triangular configuration and adapted to be engaged with a separate female socket connector for the supply of electrical power to the heater, as is conventional with this type of control. The live and neutral ones of the terminal pins 9 are connected via electrical switch means to the respective cold leads 4 of the element, the free end portions of which extend through apertures 10 formed in the first body portion 7 of the control.

Those skilled in this art will be familiar with the basic components of the illustrated control and will recognise that the general layout could be varied. Similar types of control are known, for example from British Patent Specifications Nos. 1470366, 2149217 and 2170956. The improvement of the present invention is applicable to all of these, to other known controls and to electrically heated appliances generally.

The control illustrated in Figure 1 further comprises a primary overheat protector including a snap-acting bimetallic actuator 11 mounted in good thermal contact with a dimple 12 formed in the head adjacent the hot return 5 of the element. The actuator 11 is of the general type described in British Patent Specification No.1,542,257 and

thus includes a central tongue 13 which is secured to the first body portion 7 of the control by means such as a hammer drive screw, and an upper peripheral portion 14. The upper portion 14 is arranged for engagement with an axially slidable push rod (not shown) extending through an aperture in the first body portion 7 and co-operating with a set of switch contacts (not shown) wired in series between either the live or neutral terminal pin 9 and a respective cold lead 4. The actuator 11 is calibrated with a nominal operating temperature of 140°C so as to undergo snap action when the element overheats, for example having been switched on with insufficient water in the container to cover the element or in the event that the container boils dry. Upon operation of the actuator 11 it reverses its curvature from the configuration shown in Figure 1 and the upper peripheral portion 14 thereof is moved rightwardly ie, away from the heater head, so as to engage the push-rod which in turn opens the switch contacts so as to interrupt the power supply to the element. This general arrangement of primary protector is well known, and the particular configuration illustrated is similar to that described in more detail in British patent specification no. 2170956.

The control illustrated in Figure 1 further comprises a second set of switch contacts 15 arranged in series between the other cold lead 4 of the element and a respective terminal pin 9. The contacts 15 include contact members 16 carried by conductive leaf spring elements 17, 18, one of which 17 is connected to the base portion of the respective terminal pin 9 and the other of which 18 is connected via a further conductive strip element to the respective cold lead 4. Such a contact arrangement is of the same general type as described in British Patent specification no. 2170956, but other similar configurations are possible.

The second set of contacts 15 is arranged to be engaged by a slidable push-rod 20 which in turn co-operates with a lever member 21 forming part of a steam-sensitive over-centre spring mechanism (not shown). The over-centre spring mechanism may take any convenient form, and conventionally comprises a second thermally-responsive actuating means, for example a further snap-acting bimetallic actuator, which is exposed to steam or vapour emitting from the container during boiling and which is adapted to trip the over-centre spring mechanism so as to de-energise the heater. Thus, in the arrangement illustrated in Figure 1, upon boiling the lever 21 is tripped to a second position (not shown) wherein the push-rod 20 is urged leftwardly, i.e. towards the head, and engages a free-end part 22 of the leaf spring 18 whereby the contacts 15 are broken. As is conventional, means (not shown) are provided whereby the over centre mechanism may readily be manually reset.

The illustrated control further comprises a thermally-sensitive cut-out switch comprising a pre-loaded spring mechanism associated with the second set of contacts 15 which is arranged to provide back-up protection in the event that the bimetallic actuator 11 should fail. One form of spring mechanism is shown in more detail in Figures 2a and 2b, from which it will be seen that the mechanism comprises a coil spring 25 which is mounted within a recess 26 formed in the second body portion 8 and which in normal use is held under compression by means of a retaining element in the form of a push-rod 27. Push-rod 27 is formed for example from glass reinforced plastic and extends through and is axially moveable within a bore 28 formed in the first body portion 7. Thus, when the control is clamped to the heater head, the push-rod 27 engages the head and is urged rightwardly relative

to the control so that the spring 25 is placed under compression.

As shown in Figure 2b the spring 25 includes an operating member in the form of an arm 30 formed
5 integrally therewith which extends laterally and which is arranged for engagement with the leaf spring 18 adjacent the free end portion 22 thereof. However, as shown in Figure 1 in normal use when the spring is pre-loaded by means of the push-rod 27, the operating
10 member 30 of the spring is spaced axially from the leaf spring 18 so that normally the contacts 15 are free to open and close in response to operation of the lever member 21 forming part of the steam-sensitive over-centre spring mechanism.

15 However, in event of failure of the actuator 11, the arrangement is such that the consequent overheating of the head causes the free end of the push-rod 27 which engages the head to soften and deform under the force of the spring whereby the spring is released sufficiently
20 to enable the operating arm 30 to engage the leaf spring 18 and open the contacts. The heater is thus disabled, and since the contacts 15 are open under the positive action of the coil spring 25 the possibility of subsequent reclosing of the contacts as a result for
25 example of distortion of part of the control caused by over-shoot heating is avoided.

As shown most clearly in Figure 2, the push rod is formed with an annular recess 100 defining a region of reduced cross-section with respect to the free end part
30 or tip 101 which actually engages the head. As discussed above, such region is effective to shorten the response time of the back-up protector switch to the extent that the thinner region will deform more quickly as the push rod melts or softens. However, since the
35 region 100 is isolated from the head by the free end part or tip of relatively larger cross-section

the tendency for the push rod to "creep" under the spring biasing due to the tip softening slightly is minimised.

5 In a preferred embodiment, the diameter of the end part or tip of the push rod is approximately 2.5mm and its longitudinal extent is approximately 0.7mm. In such embodiment the region of reduced cross-section is recessed to a diameter of approximately 1.3mm such region extending longitudinally over approximately 2mm.

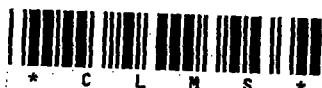
10 Modifications of the control described and illustrated herein will be apparent to persons skilled in this art and the disclosure hereof is intended to encompass all such modifications falling within the scope of the appended claims.

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51-440.520

CLAIMS

- 5 1. A thermally-sensitive cut-out switch for a heated
electrical appliance, comprising a spring mechanism
which in normal use of the appliance is held in a
preloaded condition by means of an axially movable push
rod a free end of which can be arranged in use in
10 thermal contact with a part of a heater of the appliance
or with part of the appliance itself and is adapted to
deform so as to release the spring mechanism at a
certain critical temperature whereupon the mechanism
cooperates with and opens a pair of switch contacts to
15 disable the appliance, wherein the push rod includes a
region adjacent its free end of reduced cross-section
with respect to the cross-section of the rod at its free
end, whereby in use as heat from said appliance or
heater is transmitted to said region through said free
20 end so at said critical temperature said region deforms
under the force of said spring mechanism to permit axial
movement of the push rod and opening of the switch
contacts.
2. A thermally-sensitive cut-out switch as claimed in
25 claim 1, wherein in use said push rod engages directly a
part of the heater.
3. A thermally-sensitive cut-out switch as claimed in
claim 1 or 2, wherein said push rod is generally
cylindrical and the region of reduced cross-section
30 comprises an annular recess formed adjacent the free
end.
4. A thermally-sensitive cut-out switch as claimed in
claim 1, 2 or 3 wherein said contacts are mounted on
leaf springs which are so biased normally to close said
35 contacts, and the preloaded spring mechanism includes a
separate spring arranged when released to co-operate
with and open said contacts.



5. A thermally-sensitive cut-out switch as claimed in claim 4, wherein said separate spring is a compression spring.

5 6. A thermally-sensitive cut-out switch as claimed in any preceding claim, wherein said push rod is formed of glass reinforced plastic having a melting point of approximately 260°C.

7. A thermally sensitive control for an electrically heated appliance, said control including a thermally-sensitive actuating means arranged in use in good thermal contact with a part of the element of the electric heater and coupled to a set of switch contacts of electrical switch means of the control so that the actuating means are operable to open the contacts and de-energise the heater upon over heating of the element, wherein back-up protection for the control is provided by a pre-loaded spring mechanism associated with a further set of switch contacts of the control, the spring mechanism in normal use of the appliance being held in a preloaded condition by means of a axially movable push rod a free end of which can be arranged in use in thermal contact with a part of said heater of the appliance or with part of the appliance itself and is adapted to deform so as to release the spring mechanism at a certain critical temperature whereupon the mechanism co-operates with and opens said pair of switch contacts to disable the appliance, wherein said push rod includes a region adjacent its free end of reduced cross-section with respect to the cross-section of the rod at its free end, whereby in use as heat from said appliance or heater is transmitted to said region through said free end so at said critical temperature said region deforms under the force of said spring mechanism to permit axial movement of the push rod and opening of the switch contacts.

8. An electrically heated appliance incorporating a thermally-sensitive control as claimed in claim 7.



9. A thermally-sensitive cut-out switch substantially as herein described with reference to the accompanying drawings.

10. A thermally-sensitive control for an electrically heated appliance substantially as herein described with reference to the accompanying drawings.

11. An electrically heated appliance incorporating a thermally-sensitive control substantially as herein described with reference to the accompanying drawings.

PATENTS ACT 1977

SPECIFICATION NO 2204450B

The following corrections were allowed under Section 117 on 8 March 1990

Heading (73) Proprietor(s)

after Strix Limited delete (Incorporated in the United Kingdom)

insert (Incorporated in the Isle of Man)

THE PATENT OFFICE

11 April 1991

