

IMPROVEMENTS RELATING TO THERMAL CONTROL UNITS

This invention concerns improvements relating to thermal control units and more particularly, though not exclusively, relates to thermal control units for electric immersion heaters for liquid heating vessels such as kettles, jugs, urns, pans and the like. The invention is especially applicable to protective control devices for use with electrically heated water boiling vessels for interrupting the power supply to the heating element in the event of an element over-temperature condition such as might occur for example if the vessel were to be switched on without there being sufficient water in it or if the vessel were to boil dry.

Described in our British Patent No. 2194099 with reference to Figs. 3A, 3B and 3C of the drawings thereof is a protective control device of the abovementioned type in which a primary control level is achieved by means of a snap-acting bimetallic actuator mounted in a carrier which holds the bimetal in close thermal contact with the rear surface of the heating element head plate, the bimetal being arranged to open a set of switch contacts in response to the

occurrence of such an element over-temperature condition as causes the bimetal to snap to its opposite condition and open the switch contacts through the intermediacy of a push-rod. A secondary or back-up control level is achieved by virtue of the carrier being formed of a thermally deformable material and being employed in the control device to hold live and neutral conductor springs in electrical contact with live and neutral power supply terminals of the control device, the arrangement being such that in the event of failure of the primary control level to respond so that the heating element temperature continues to rise, the carrier deforms and permits the conductor springs to break contact with their respective power supply terminals.

The present invention, in effect, extends the principle of the secondary control level described above and may be used in conjunction with a primary control to protect against failure of the primary control or may be used on its own to provide over-temperature protection. According to the present invention, the condition of a thermally deformable member or of a plurality of thermally deformable members is arranged to determine the electrical contact made by electrical connection means to one or both of the heating element cold tails and preferably, though not essentially, additionally to one or both of the power supply terminals. The

thermally deformable member preferably, but not essentially, constitutes a part of a control for use with an electrically powered heating element.

5 According to the present invention in one of its aspects there is provided a thermally-responsive control for use with an electrically powered heating element for disconnecting the heating element from its power supply in response to an overtemperature condition, the control
10 incorporating an electrically conductive element and a thermally-deformable member arranged to urge the electrically conductive element, in use of the control with a heating element, into electrical contact with a power supply terminal of the heating element for
15 supplying electrical energy thereto, the arrangement being such that in response to an overtemperature condition such as to cause thermally induced deformation of said thermally-deformable member said electrical contact will break so as to interrupt the supply of
20 electrical energy to the heating element.

 According to another aspect of the present invention there is provided in combination, a thermally-responsive control and an electrically powered heating element, the control being adapted to disconnect the
25 heating element from its power supply in response to an overtemperature condition and incorporating an

electrically conductive element which is urged by a thermally-deformable member into electrical contact with a power supply terminal of the heating element for supplying electrical energy thereto, the arrangement
5 being such that in response to an overtemperature condition such as to cause thermally induced deformation of said thermally deformable member said electrical contact will break so as to interrupt the supply of electrical energy to the heating element.

10 Further features of the present invention are set forth in the appended claims.

In an exemplary control device in accordance with the present invention, therefore, the condition of one

or more thermally deformable elements might determine the status of the four connections made to each of the two element cold tails and to each of the two power supply terminals of the control (i.e. the live and neutral terminals) so that, in response to the occurrence of a predetermined elevated over-temperature condition at the heating element head plate, four separate protective disconnections would be effected. Such a four point disconnection system represents the safest option and could be achieved by use of only a single thermally deformable element acting at all four disconnection points, or by separate thermally deformable elements at all four points, or by any other convenient arrangement.

Where plural thermally deformable elements were utilized they could be arranged to operate at different element head temperatures for example by virtue of being formed of different materials, and/or being differently formed, and/or being in different degrees of thermal contact with the element head.

As employed herein the references to a heating element head or head plate and to the cold tails of a heating element are to be understood to refer to the corresponding parts of an electric heating element of the type wherein the heating element proper, that is to say the part of the heating element which

incorporates an electric resistance heating element, is mounted to an element head or head plate which serves inter alia for mounting the heating element as a whole in an aperture formed in the wall of a vessel for example and with terminations of the heating element proper, namely the heating element cold tails, extended through the element head for enabling power to be supplied to the heating element. In use of such a heating element with a protective device designed to switch off the supply of power to the element on the occurrence of an element over-temperature condition, caused for example by switching on the element dry, the protective device is interposed between one or both of the element cold tails and the power supply terminals of the associated appliance. The present invention, however, has application not only to such a heating element but also to other heating element constructions.

In order that the present invention might be more clearly understood, exemplary embodiments thereof will now be described with reference to the accompanying drawings wherein:

Fig.1 is an exploded schematic view of the components required in an exemplary single pole disconnection system according to this invention;

Fig.2 is a side view of the same components,

arranged in a "circuit made" configuration;

Fig.2A is an end view of Fig.2, but showing a two pole arrangement; and

Fig.3 is the same as Fig. 2, but showing the
5 "open circuit" condition following collapse of the thermally deformable element.

Referring to Fig. 1, reference numeral 1 denotes a heating element cold termination (cold tail) fitted with a contact 8, which may be a silver plated
10 ferrule. A thermally deformable component 2 is arranged in use to bear on a resilient connection means 3, for example a leaf spring formed of a suitable copper alloy. Part 3 is supported by a mounting 4 positioned in a suitable part of a
15 surrounding insulating housing, which is not shown. Reference 6 is the innermost end of one of the power supply pins of the respective control device and 5 is an abutment whose function is described below.

Referring to Fig.2 which shows the components in
20 "circuit made" condition and with the thermally deformable means 2 shown in its initial un-deformed state, the leaf spring 3 is forced against the terminal supply pin 6 making an electrical connection. The spring 3 is also forced into contact with the
25 abutment 5 which in turn forces the spring 3 into contact with the heating element cold termination 1

and its contact means 8 also making an electrical connection. The mounting means 4 ensures that the correct spatial relationships are achieved. A part of the heating element head plate 9 provides a convenient reaction point for the thermally deformable component 2, and the heating element 7 is itself arranged to be in reasonable thermal contact with the thermally deformable component 2 through the head plate 9 as shown.

10 Fig.2A demonstrates how two assemblies such as are shown in Fig.2 might be arranged in parallel to provide double pole disconnection through the thermal deformation of a single component 2'.

15 In Fig.3 the thermally deformable component 2 is shown in a collapsed state resulting from exposure to an element over-temperature condition. It can be seen that the natural resilience of the leaf spring 3 has caused it to straighten so that the circuit to the heating element has been broken at the points 10 and
20 11. The support means 4 is arranged to provide a configuration in which the separation of the parts is sufficient to provide a safe electrical disconnection.

Variations from the configuration shown, which is preferred as stated above since it can provide four
25 separate points of disconnection on the action of a single component 2, are of course possible. For

example, the leaf spring 3 may be fixed to the power supply pin 6 which would thus replace the mounting means 4 and allow disconnection only at 11, and this may be adopted for one or two pole disconnection.

5 Furthermore, it is possible that a separate thermally deformable component 2 could be used for each pole, or indeed for each point of disconnection; it is only necessary that the heating element connection point is provided with a surface suitable for an electrical
10 connection, and the contact means 8 could conveniently be replaced by a plating or other coating of suitable contact material, for example silver or a silver alloy, applied directly to the element cold tail 1. Furthermore, the leaf spring(s) 3 could be provided
15 with a plating of silver for example to enhance its switching capability, and such plating could be as described in our British Patent Application No. 9102062.8 namely as a relatively thick (30 to 40 microns) layer of silver with a small amount
20 (typically about 1% and more particularly between 0.3% and 0.7%) of antimony. The control terminal(s) 6 could likewise be formed of copper with such a silver antimony plating. Additionally, the thermally deformable component 2 could be formed as a support or
25 carrier for some other component, such as a bimetal actuator as in GB 2194099 aforementioned, and it could

be arranged to provide the support 4 for the resilient connection leaf spring 3 (in Fig.2 consider 4 removed and the leaf spring 3 affixed to the end of deformable component 2). Other modifications and variations will occur to those possessed of relevant skills without departure from the scope of the present invention.

CLAIMS:

1. A thermally-responsive control for use with an electrically powered heating element for disconnecting the heating element from its power supply in response to an overtemperature condition, the control incorporating an electrically conductive element and a thermally-deformable member arranged to urge the electrically conductive element, in use of the control with a heating element, into electrical contact with a power supply terminal of the heating element for supplying electrical energy thereto, the arrangement being such that in response to an overtemperature condition such as to cause thermally induced deformation of said thermally-deformable member said electrical contact will break so as to interrupt the supply of electrical energy to the heating element.

2. In combination, a thermally-responsive control and an electrically powered heating element, the control being adapted to disconnect the heating element from its power supply in response to an overtemperature condition and incorporating an electrically conductive element which is urged by a thermally-deformable member into electrical contact with a power supply terminal of the



heating element for supplying electrical energy thereto,
the arrangement being such that in response to an
overtemperature condition such as to cause thermally
induced deformation of said thermally deformable member
5 said electrical contact will break so as to interrupt
the supply of electrical energy to the heating element.

3. A thermally-responsive control as claimed in claim
1 or a combination as claimed in claim 2 wherein said
thermally-deformable member is arranged to bear against
10 a part of said heating element so as to be subject to
the temperature thereof.

4. A thermally-responsive control as claimed in claim
1 or 3 or a combination as claimed in claim 2 or 3
wherein said electrically conductive element is
15 resilient so as to resile from the power supply terminal
of the heating element as said thermally-deformable
member deforms.

5. A thermally-responsive control or a combination as
claimed in claim 4 wherein said electrically conductive
20 element comprises a leaf spring.

6. A thermally-responsive control as claimed in any of
claims 1, 3, 4 and 5 or a combination as claimed in any



of claims 2 to 5 wherein said electrically conductive element is urged into electrical contact with said power supply terminal by virtue of reaction forces developed between the electrically conductive element and at least one abutment in the control.

7. A thermally-responsive control as claimed in any of claims 1, 3, 4, 5 and 6 or a combination as claimed in any of claims 2 to 6 wherein the electrically conductive element of the control is arranged furthermore to be urged by said thermally-deformable member into electrical contact with a power supply terminal of the control, the arrangement being such that in response to thermally induced deformation of said thermally-deformable member the electrical contacts effected thereby to both the heating element power supply terminal and the power supply terminal of the control will break.

8. A thermally-responsive control as claimed in any of claims 1 and 3 to 7 or a combination as claimed in any of claims 2 to 7 wherein said control is arranged to effect disconnection of both the live and neutral power supply terminals of the heating element.

9. A thermally-responsive control as claimed in any of



claims 1 and 3 to 8 or a combination as claimed in any of claims 2 to 8 wherein said electrically conductive element is carried by said thermally-deformable member.

5 10. A thermally-responsive control as claimed in any of claims 1 and 3 to 9 or a combination as claimed in any of claims 2 to 9 wherein said thermally-deformable member serves as a carrier for a thermally-responsive element arranged to provide a first level of response to the temperature of the heating element, the thermally
10 induced deformation of said thermally-deformable member providing a second level of response.

11. A thermally-responsive control as claimed in any of claims 1 and 3 to 10 or a combination as claimed in any of claims 2 to 10 wherein the action of coupling the
15 control in operative relationship with the heating element serves to displace the thermally-deformable member and cause it to urge said electrically conductive element into electrical contact with the power supply terminal of the heating element.

20 12. A thermally-responsive control substantially as herein described with reference to any of the accompanying drawings.



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13. A thermally-responsive control as claimed in any of claims 1 and 3 to 11 in combination with an electrical heating element.

14. An electrically powered vessel incorporating a combination as claimed in any of claims 2 to 11 and 13.
