

IMPROVEMENTS RELATING TO THERMAL CONTROL UNITS

This invention concerns improvements relating to thermal control units and has particular, though not exclusive, application to the kind of control unit
5 that is described in our British Patent Specification No. 2 194 099 and which comprises a bimetal mounted in or on a collapsible carrier and wherein the action of the bimetal is arranged to provide a primary control function and the thermally-induced collapse of the
10 carrier is arranged to provide a secondary or back-up control function.

Described in GB 2 194 099 abovementioned with reference to Figs. 3A, 3B and 3C of the drawings thereof is an early prototype of our X1 or Gemini
15 control which is designed to be used with an electrically powered heating element, for example the heating element of a water boiling vessel. This control is adapted to protect the heating element against excessive temperatures such as might arise if
20 the element were to be powered with the vessel empty or insufficiently filled. In use of the control, the bimetal and its carrier are urged into contact with the rear surface of a head plate of the heating element so as to be subject to the operational
25 temperature of the heating element. The bimetal is

arranged to disconnect the heating element from its power supply in the event of the heating element overheating and, in the event of the bimetal failing to achieve its primary control function, on account
5 for example of the welding together of switch contacts within the control, the continued rise in the element temperature will cause the carrier, formed of an appropriate thermoplastics material to begin to collapse thereby initiating a secondary control
10 function. More particularly, the carrier is arranged such that when the X1/Gemini control is affixed to the element head, it biases spring terminals within the control into contact with the electrical supply terminals of the control, and when the carrier is
15 heated to the point of collapse it permits the spring terminals to resile from the power supply terminals thereby disconnecting the heating element from its power supply.

The X1/Gemini control abovementioned is designed
20 to be mounted in contact with the element whose temperature is to be monitored in order, as aforesaid, that the bimetal carrier urges the spring terminals within the control into contact with the electrical supply terminals of the control. Without such
25 physical contact between the control and the element being controlled, the electrical contact between the

spring terminals in the control and its power supply terminals would not be established. This dependence upon physical contact with the element being controlled limits the wider application of the X1/Gemini control since it precludes the use of the device as a free standing control such as for sensing the temperature within a hot air appliance, such as a domestic tumble clothes drier for example.

Accordingly, it is the object of the present invention to overcome this limitation of the range of utility of a control of the subject type and to extend its range of usefulness to domestic and industrial laundry appliances, such as tumble driers, and to immersion heaters and domestic and industrial water storage tanks for example.

In accordance with the present invention therefore there is provided a thermally-responsive control wherein a thermally-deformable member serves to urge at least one spring conductor in the control into contact with an electrical power supply terminal of the control such that thermally-induced deformation of such member will enable the spring conductor to resile from the power supply terminal, and wherein the control further includes preferably as an integral part thereof a member which predetermines the cold-condition position of said thermally-deformable member, the thermally-responsive member comprises a thermally-collapsible member which is interposed between said spring conductor and said cold-condition position predetermining member, and the thermally-collapsible member is formed as a carrier for a bimetal (or bimaterial) element of the control, said bimetal (or bimaterial) element being arranged to be responsive to a predetermined temperature condition for effecting a control function.

As applied to the X1/Gemini control of Figs. 3A, 3B

and 3C of GB 2194099 abovementioned, the present invention thus requires the provision of an integral means of limiting the range of movement of the collapsible carrier such that the internal connections between the spring terminals and the power supply terminals will be made when the carrier is in its cold (as formed) condition without necessitating the attachment of the control to another member such as an element head portion. Of course, the means provided for limiting the range of movement of the collapsible carrier must not be such as to impede the function of the collapsible carrier as a secondary or back-up protection element and must not prevent or impede the resiling of the spring terminals from the power supply terminals when the carrier suffers thermal collapse. In one embodiment of the X1/Gemini type control modified according to the present invention, a moulded plastics body part of the control is formed with a pair of retaining lugs, one on each side of the thermally-collapsible carrier, and a retaining member is engaged with the lugs and extends across the carrier thereby serving to hold the carrier, in its cold condition, in a position such that it urges the spring terminals within the control into contact with

the electrical supply terminals. In another embodiment, the function of the retaining member is performed by the bimetal itself, extension portions of the bimetal engaging with the retaining lugs. Other
5 arrangements are of course available within the ambit of the present invention.

The invention together with further features and advantages thereof will best be appreciated from consideration of the following more detailed
10 description of the abovementioned and other exemplary embodiments given with reference to the accompanying drawings wherein:

FIGURES 1 and 2 are views corresponding to Figures 3B and 3C of the drawings of our British
15 Patent Specification No. GB 2 194 099 abovementioned and illustrating an X1/Gemini type of control;

FIGURE 3 is a modified version of Figure 1 illustrating a first embodiment of the present
20 invention;

FIGURE 4 is an isometric view of the retaining member of the first embodiment;

FIGURE 5 is a modified version of Figure 1 illustrating a second embodiment of the present
25 invention.

FIGURE 6 is an isometric view of the retaining

member of the second embodiment; and

FIGURE 7 is a modified version of Figure 1 illustrating a third embodiment of the present invention.

5 The numerals used throughout the Figures are those used in GB 2 194 099, to which reference should be made for a fuller description of the construction and operation of the device according to Figures 3A, 3B and 3C of that patent. Numerals above 100 are
10 utilized to designate components unique to the present invention.

Referring to Figures 1 and 2, which will be briefly described in order better to explain the present invention, reference 24 designates the head
15 plate of an electric heating element which provides a mounting for the thermal control. A bimetal actuator 22 rests in partial thermal contact with the rear surface of head plate 24 and is located by a collapsible carrier 21. The collapsible carrier 21 is
20 in close thermal contact with heating element head plate 24. A projection 51 of the carrier 21 determines the position of a fixed contact mounted on a resilient connecting component 31 which in turn makes electrical connection with a cold tail 54 of the
25 electric heating element. A push rod 23 has one end fixed to the bimetal actuator 22 and its other end is

proximate to a moving contact mounted on one limb 59 of a further resilient connecting component 32 which has a further limb 58 which is forced into contact with a power supply terminal pin 28 of the control by the action of a second projection 52 that is provided on the collapsible carrier 21. A further resilient connecting component 33 has a limb 60 which is forced into contact with a second power supply terminal pin 29 by the projection 53 of the carrier 21, and a second limb of this component makes a connection with the other cold tail 55 of the electric heating element. Thus an electric power supply circuit is made through the control which follows the path 28, 58, 32, 59, 31, 54, heating element, 55, 33, 60 and 29.

In "normal" operation of the control, the bimetal component 22, which at low temperatures has a curvature which is convex towards the heating element, reverses its curvature at a higher temperature, becoming concave towards the heating element. By interaction with the push rod 23, the contact pair mounted on conductors 31 and 59 are separated, thereby de-energising the heating element. It can be seen that since the bimetal component 22, the push rod 23, and the carrier 21 are constructed as a unit, therefore the position of the mounting part of the

heating element 24 relative to the contacts mounted on conductors 31 and 59 makes little difference to the action of the control, within a designed range, as the pair of contacts will move in unison with the carrier 21. Figure 2 shows the control after "abnormal" operation, that is to say when the element temperature has risen substantially above the normal operating temperature of the bimetal. It can be seen that the legs of the carrier 21 have collapsed (melted or softened), thereby allowing the body of the carrier to move towards the heating element. The two projections 52, 53 of the carrier, which hitherto held the resilient connection means 58 and 60 in contact with the terminal pins 28 and 29, can no longer do so and the electrical circuit is broken at two points irrespective of the status of the switching contacts mounted on conductors 31 and 59. The construction and action of this device is more fully described in GB 2 194 099, but the foregoing should be sufficient to enable the following embodiments of the invention to be well understood.

In a first embodiment of the present invention, shown in Figure 3, a retaining member 101 (shown more clearly in Figure 4) is fitted over the bimetal component 22 and is secured to the control by means, for example, of hooks 102 provided on a body part 103

of the control. The position of the carrier 21 is such as to ensure that electrical connections are made at 58 and 60, whilst allowing further movement towards the control if required, thus retaining the desirable
5 resilient features of a device in accordance with GB 2 194 099. In this way a device according to this embodiment could directly replace a device according to GB 2 194 099, provided the retaining member 101 is of a sufficiently low profile, and further would allow
10 independent operation of the control, with the action described above, but with the retaining member 101 fulfilling the supportive and reactive functions of the head plate part of the heating element 24 in Figures 1 and 2, and with the control mounted by some
15 other means such that the bimetal component 22 and the carrier 21 are exposed to the temperature or heat source to be protected.

In a second embodiment of the present invention, shown in Figure 5, the retaining member of the first
20 embodiment is replaced by the provision of lugs directly formed as part of the bimetal component as shown at 104 in Figure 5 and in Figure 6. Such a device would function in the same manner as the first embodiment, but with the advantage of fewer components
25 and possibly better compatibility with a device according to GB 2 194 099.

In a third embodiment of the present invention as shown in Figure 7, the retaining lugs 105 are formed on the carrier and extend from the carrier feet in order that the collapsing action of the carrier is not inhibited. Again, the operation of the control is the same as in the first two embodiments. However, because the embodiment as shown in Figure 7 does not include a feature against which the bimetal component may act in "normal" operation (a function provided by the retaining member or the element part 24) it may only be employed in an application wherein the mounting face performs this function. In order that this embodiment may be utilised in a free standing control, it would be necessary to provide retaining parts, mounted on the carrier, to provide an abutment against which the bimetal component may act. Such a retaining means is illustrated in broken lines in Figure 7 at 106. If the retaining means is of low profile or if a depression is formed in the element part 24, then such a device could be used in the same way as the first two embodiments.

In general, in the Figures illustrating the embodiments of this invention there are shown two retaining hooks, for example, 102, 103. It should be understood that there may be any suitable number of means of retention as required by the application.

CLAIMS:

1. A thermally-responsive control wherein a thermally-deformable member serves to urge at least one spring conductor in the control into contact with an electric power supply terminal of the control such that thermally-induced deformation of such member will enable the spring conductor to resile from the power supply terminal, and wherein the control includes a member which predetermines the cold-condition position of said thermally-responsive member, the thermally-responsive member comprises a thermally-collapsible member which is interposed between said spring conductor and said cold-condition position predetermining member, and the thermally-collapsible member is formed as a carrier for a bimetal (or bimaterial) element of the control, said bimetal (or bimaterial) element being arranged to be responsive to a predetermined temperature condition for effecting a control function.
2. A thermally-responsive control as claimed in claim 1 wherein the bimetal (or bimaterial) is arranged to operate a set of switch contacts.
3. A thermally-responsive control as claimed in claim 1 or 2 wherein the bimetal (or bimaterial) element



serves also as said cold-condition position predetermining member.

4. A thermally-responsive control as claimed in claim 1 or 2 wherein said cold-condition position predetermining member overlies the bimetal (or bimaterial) element.

5. A thermally-responsive control as claimed in claim 4 wherein the said cold-condition position predetermining member is removable from the control.

10 6. A thermally-responsive control as claimed in claim 1 or 2 wherein said cold-condition position determining member is formed as an integral part of the thermally-collapsible member which co-operates with an abutment member formed in a body part of the control.

15 7. A thermally-responsive control substantially as herein described with reference to Figs. 3 and 4, Figs. 5 and 6, or Fig. 7 of the accompanying drawings.

8. A thermally-responsive control as claimed in any of the preceding claims installed in a hot air apparatus.
