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Andersen

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[54] **THERMOSTAT HAVING IMPROVED TEMPERATURE DRIFT CONTROL MEANS**

[75] Inventor: **Edward O. Andersen,** Rock Falls, Ill.

[73] Assignee: **General Electric Company,** Fort Wayne, Ind.

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[52] **U.S. Cl.** **337/354**

[51] **Int. Cl.** **H01h 37/52**

[58] **Field of Search**..... 337/354, 348, 367

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Primary Examiner—Harold Broome

Attorney—John M. Stoudt, Robert B. Kennedy et al.

[57] **ABSTRACT**

A thermostat is disclosed comprising a support and a thermally responsive bimetallic member having a peripheral section adjacent the support and a central section adapted for movement with respect to the peripheral section in response to temperature changes of the bimetallic member. First and second switch contacts are mounted for relative movement between switch contact open and switch contact closed positions. A spring is provided biasing one of the contacts. An actuating plunger is mounted between the bimetallic member and the spring for movement in response to movement of the bimetallic central section. Temperature drift control means are also provided which means include an energy absorbent dampener disposed between the bimetallic member peripheral section and the support.

31 Claims, 7 Drawing Figures

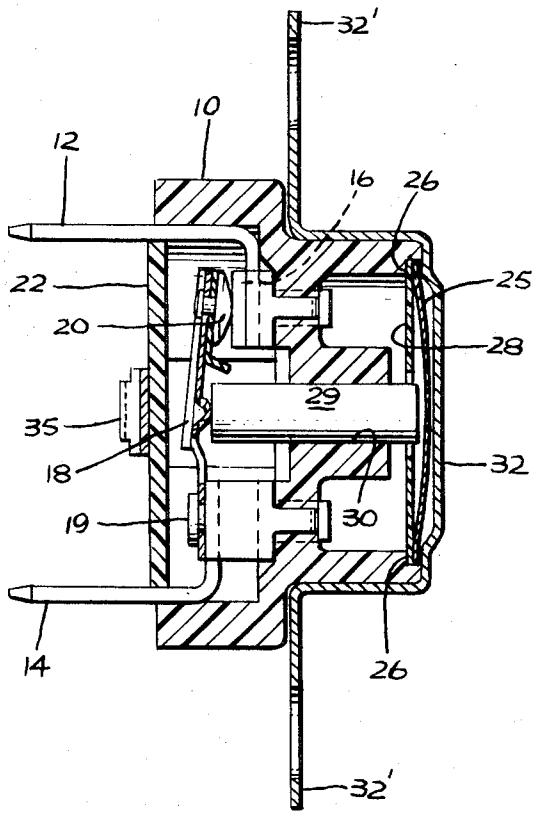


FIG. 2

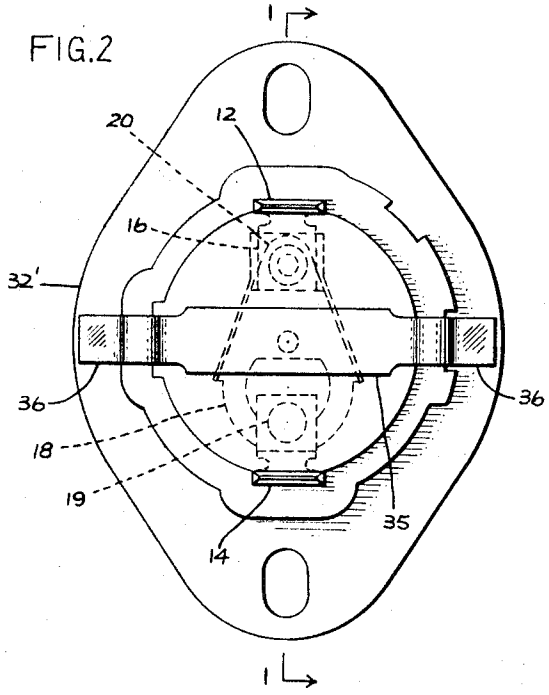


FIG. 1

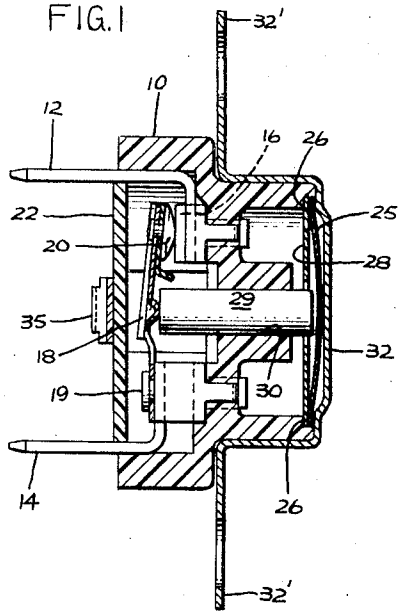


FIG. 3

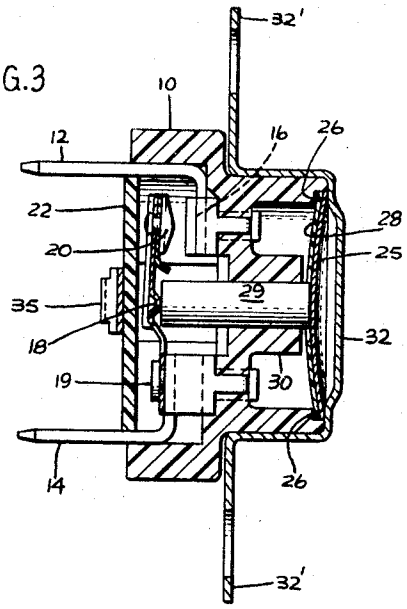


FIG. 5a

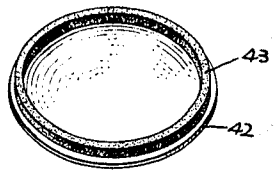


FIG. 5b

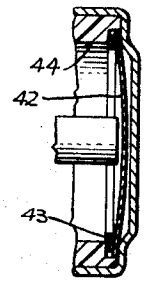


FIG. 4

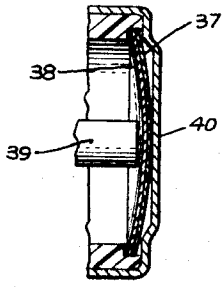
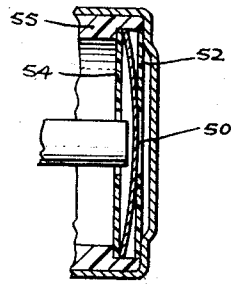


FIG. 6



INVENTOR.
EDWARD O. ANDERSEN,
BY Robert B. Kennedy
ATTORNEY.

THERMOSTAT HAVING IMPROVED TEMPERATURE DRIFT CONTROL MEANS

BACKGROUND OF THE INVENTION

This invention relates to thermostats of the type which employ temperature responsive bimetallic elements. a spherical "two layers

Today, thermostats employing temperature responsive bimetallic elements enjoy wide use in controlling appliances such as dryers, defrosters and the like. Typically, the bimetallic elements comprise two thin sheets of metals having different coefficients of thermal expansion which sheets are bonded together along generally planar, mutually conforming surfaces thereof. The overall shape of such elements is normally that of a disc. In manufacture the bimetallic discs are formed in an overstressed condition. For example, the center section of the disc may be stretched by use of a spherical radius tool more than the peripheral section causing the center section to buckle from the plane defined by the periphery of the disc. Thusly formed, the center section, if forced to the plane of the peripheral section, snaps therebeyond in "oil can" action. Such force may be produced by merely changing the temperature of the bimetallic element itself. This, of course, is attributable to the differential in thermal expansion and contraction rates between the two layers of bonded, dissimilar metal.

The periphery of the bimetallic element is typically mounted to a support within the thermostat body to actuate an electric switch in response to thermal conditions sensed by the bimetallic element. Typically, this is accomplished by means of an actuating plunger mounted with one plunger end disposed adajcent the movable central section of the bimetallic element, and with the other plunger end operatively coupled to one of the switch contacts. Spring means bias either the actuating plunger, the movable switch contact, or both.

Thermostats of the just mentioned type have experienced significant problems with respect to temperature drift. This is to say that the temperature at which such thermostats acutally operate tends, over a period of time, to depart from that at which it is set through calibration to so operate. This deviation in turn adversely affects the operational characteristics of the associated system,appliance, or other apparatus in which the thermostat is employed as a control.

Accordingly, it is an object of the present invention to provide an improved thermostat.

More specifically, it is an object of the present invention to provide improved thermostats of the type which employ a thermally responsive bimetallic element.

It is another object of the present invention to provide thermostats of the type which employ a thermally responsive bimetallic element wwth temperature drift inhibiting means.

SUMMARY OF THE INVENTION

In one preferred form of the present invention a thermostat is provided comprising a support and a thermally responsive bimetallic member having a peripheral section disposed adjacent the support and a central section adapted for movement with respect to the peripheral section in response to temperature changes of the bimetallic member. First and second switch contacts are mounted for relative movement between switch contact open and switch contact closed positions with a spring biasing one of the switch contacts. An actuating plunger is mounted between the bimetallic member and the spring for movement in response to movement of the bimetallic member central section. An energy absorbent member is disposed between the bimetallic member peripheral section and the support.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side view in cross section of a thermostat embodying principles of the present invention in one preferred form with the thermostat switch contacts positioned in a closed position;

FIG. 2 is a bottom view of the thermostat shown in FIG. 1;

FIG. 3 is a side view in cross section of the thermostat shown in FIGS. 1 and 2 with the thermostat switch contacts positioned in an open position;

FIG. 4 is a fragmentary view in cross section of altered portions of the thermostat shown in FIGS. 1–3 and forming another embodiment of the present invention;

FIG. 5*a* is a perspective view of altered portions of the thermostat shown in FIGS. 1–3 forming yet another embodiment of the present invention;

FIG. 5*b* is a side view in cross section of the portions shown in FIG. 5*a* mounted within the thermostat; and

FIG. 6 is a fragmentary view in cross section of altered portions of the thermostat shown in FIGS. 1–3 forming still another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in more detail to the drawing there is shown in FIGS. 1 and 2 a thermostat embodying principles of the present invention in one form. The thermostat comprises a support **10**, preferably made of a phenolic resin, to which is rigidly mounted two electrically conductive terminals **12** and **14** portions of each of which protrude from the support to the exterior of the thermostat where they are accessible for connection to ancillary conductors. A stationary switch contact **16** is rigidly mounted to terminal **12**. A fixed end of a resilient switch blade **18** is mounted to terminal **14** by weld slug **19**. To the free end of the switch blade is secured movable switch contact **20**. Contact **20** is spring biased against stationary contact **16** by the switch blade thereby placing the thermostat switch formed by contacts **16** and **20** in an electrically closed position as seen in FIG. **1**.

The periphery of a disc-shaped bimetallic element **25** is set above an annular step **26** near the top of support **10**. Here the bimetallic element is mounted with the metallic layer of relatively greater thermal expansion disposed facing the bottom of the thermostat and with the layer of relatively less thermal expansion facing the top of the thermostat. The periphery of an annular Mylar washer **28** is set directly upon step **26** beneath bimetallic element **25**. Washer **28** has a central aperture through which a rod-shaped actuating plunger **29** extends with the upper end of the plunger in contact or near contact with a central portion of the bimetallic disc and with the lower end of the plunger in contact or near contact with switch blade **18**. A portion of the actuating plunger intermediate its two ends is journalled through an annular bore **30** in support **10**. As in the case of the support, the actuating plunger is also

made of a phenolic resin. Metallic cap **32**, having integral annular flange portions **32'**, is mounted to the top of support **10** overlaying bimetallic element **25**. A retainer clip **35** is secured about two opposing external sides of support **10** over a disc-shaped cover **22** which cover is lodged in an accommodating annular recess in the bottom of the support. Two flange portions **36** of the retainer clip are spot welded to cap flange portions **32'** thereby securely sandwiching bimetallic element **25** and washer **28** between cap **32** and support step **26.** Thusly assembled, cap **32** serves as a supporting member of the thermostat as does resinous support **10.**

In operation, as the temperature of bimetallic element **25** of the thermostat is slowly elevated the central portion of the element creeps away from cap **32** due to the relative rates of expansion between the two metallic layers of the bimetallic element. As the movable central portion of the bimetallic element approaches disposition substantially coplanar with respect to its peripheral portion sandwiched between washer **28** and cap **32** it passes its overcenter position and snaps to the position illustrated in FIG. **3** in "oil can" like action. The length of actuating plunger **29** relative to the linear spacing between bimetallic element **25** and switch blade **18** preferably is approximately such that when the bimetallic element reaches its overcenter position and commences its snap action movement actuating plunger **29** is positioned with one end in abutment with the bimetallic element and with the other end in abutment with the switch blade. With this dimensional association between the bimetallic element, the actuating plunger and the switch blade the snap action of bimetallic element forces the actuating plunger to move against the movable spring biased switch blade. The resultant movement of the switch blade causes movable contact **20** to snap rapidly away from stationary contact **16** thereby opening the switch. As the bimetallic element cools the reverse action occurs with switch closure occurring with a rapid closure of the two switch contacts due to the fact that the spring bias provided by the switch blade is directed in the same direction as that in which the central portion of the bimetallic element moves.

Temperature drift of the thermostat just described has been found to be reduced and well within current UL specified ranges. While the reasons for such drift control may not, at this time, be fully understood, it is the presence of washer **28** to which the drift control observed is believed directly attributable to a significant extent.

Bimetallic elements of the types generally employed in thermostats have inherent residual stresses therewithin. As these elements are utilized in imparting snap-like switch openings and closings they are subjected to vibrations as kenetic energy is transmitted at their mounting interfaces. It is believed that there repeated vibrations alter the internal stresses of the bimetallic elements. These stress alterations in turn change the temperatures at which the bimetallic elements snap to thereby operate the associated thermostat switch. The inclusion of a compressibly resilient, energy absorbent material such as Mylar apparently serves to dampen these vibrations and thereby stabilize the temperature at which switch operation occurs.

The energy absorbent means employed may, of course, take many forms and be composed of many materials. For example, the size of the aperture of a washer of the type shown in FIGS. **1–3** may vary from one which barely permits the actuating plunger to pass therethrough to one in which merely an energy absorbent ring remains sandwiched between the bimetallic element and the support. Moreover, in another embodiment such as that shown in FIG. **4**, the energy absorbent disc **37** may be devoid of any aperture, the need for such having been eliminated through location of the energy absorbent means on the opposite side of bimetallic element **38** from that of actuating plunger **39** and in pressure contact with support cap **40.** Furthermore, where desired the energy absorbent means may be bonded directly to the bimetallic element. FIGS. **5a** and **5b** illustrate such an embodiment in which a ring of sponge or foam rubber **40** is coaxially cemented to a portion of the peripheral area of bimetallic desk **42.** The bimetallic element and rubber ring assembly here is mounted in thermostat with the rubber ring in abutment with support **44.** As yet another alternative two independent energy absorbent means may be employed with the bimetallic element sandwiched thereinbetween. FIG. **6** illustrates just such an embodiment wherein bimetallic element **50** is sandwiched between compressibly resilient disc **52** and compressibly resilient washer **54** with disc **52** and washer **54** each themselves sandwiched between the bimetallic element and support **55.**

As aforementioned, many materials form suitable energy absorbent means for use in thermostats embodying principles of the present invention. In addition to the aforementioned Mylar, which is a resilient polyester or, more particularly, polyethylene terephthalate, such other materials include, for example, Kapton, a polyimide, Silastic, a silicone, and various rubber material such as sponge, foam, and silicon rubber. Papers may also be employed. These materials are compressibly resilient which characteristic enables them to absorb energy. Metallic materials may also be employed; they preferably should be formed so as to provide compressive resiliency through corrugations or the like.

For economy the bimetallic element itself should be substantially homogenous. Of course, thermostats would function with elements in which bimetallic layers existed only in the movable region.

Other thermostat components may also assume modified configurations. For example, the switch contacts may be spring biased in a switch open position rather than in a switch closed position as herein illustrated. Furthermore, the spring means itself may assume many configurations. For example, the movable contact may be mounted directly to the actuating plunger and the plunger be biased by compression spring means. The thermostat application may also dictate whether concave or convex surface of the bimetallic element faces the actuating plunger, and whether it is the central or peripheral section that is movably mounted.

Many other modifications may, of course, be made to the specific embodiments illustrated and described without departure from the spirit and scope of the invention as set forth in the following claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A thermostat comprising a support member; a stationary contact mounted by said support member; a resilient switch blade having a first blade section and a second blade section; a movable contact mounted by said first blade section for selective travel between

open and closed positions relative to said stationary contact; means for fixedly securing said second blade section to said support member; a thermally responsive member having a bimetallic central section movable with respect to said support member and a peripheral section stationarily mounted by said support member; an actuating plunger mounted for movement with respect to said support member with a first plunger end adapted to engage said resilient switch blade and a second plunger end adapted to engage said thermally responsive member central section in response to changes in temperature of said thermally responsive member; a compressibly resilient washer sandwiched between said thermally responsive member peripheral section and said support member with a first washer planar suface in abutment with said thermally responsive member peripheral section and with a second washer planar surface opposite said first washer planar surface in abutment with said support member to suppress vibrations in said thermally responsive member and thereby damper temperature drift of the thermostat, and terminal means for electrically connecting said stationary contact and said movable contact to electrical conductors extending externally of said thermostat.

2. A thermostat in accordance with claim **1** wherein said thermally responsive member is relatively thin and substantially planar.

3. A thermostat in accordance with claim **1** wherein said thermally responsive member is annular.

4. A thermostat in accordance with claim **1** wherein said thermally responsive member is a disc.

5. A thermostat in accordance with claim **1** wherein said compressibly resilient washer is relatively thin and substantially planar.

6. A thermostat in accordance with claim **1** wherein said compressibly resilient washer is annular.

7. A thermostat in accordance with claim **6** wherein said annular compressibly resilient washer defines an aperture through which said actuating rod may pass in spaced relation with said washer.

8. A thermostat in accordance with claim **1** wherein said annular, compressibly resilient washer is bonded to said bimetallic member.

9. A thermostat in accordance with claim **1** wherein said compressibly resilient washer consists essentially of a material selected from the group of materials consisting of resilient polyesters, polyimides and silicones.

10. A thermostat in accordance with claim **1** wherein said compressibly resilient washer consists essentially of rubber.

11. A thermostat in accordance with claim **10** wherein said compressibly resilient washer consists essentially of silicon rubber.

12. A thermostat in accordance with claim **10** wherein said compressibly resilient washer consists essentially of sponge rubber.

13. A thermostat in accordance with claim **1** wherein said compressibly resilient washer consists essentially of paper.

14. A thermostat in accordance with claim **1** including a second compressibly resilient washer mounted in contact with said thermally responsive member peripheral section with said thermally responsive member peripheral section sandwiched between said compressibly resilient washer and said second compressibly resilient washer.

15. A thermostat comprising a support member; a stationary contact mounted by said support member; a resilient switch blade having a first blade section and a second blade section; a movable contact mounted by said first blade section for selective travel between open and closed positions relative to said stationary contact; means for fixedly securing said second blade section to said support member; a thermally responsive member having a bimetallic central section movable with respect to said support member and a peripheral section stationarily mounted by said support member; an actuating plunger mounted for movement within and with respect to said support member in response to changes in temperature of said thermally responsive member with a first plunger end adapted to engage said resilient switch blade and a second plunger end adapted to engage said thermally responsive member central section; energy absorbent means disposed between said thermally responsive member peripheral section and said support member to suppress vibration in said thermally responsive member and thereby damper temperature drift of the thermostat , said energy absorbent means having a first planar surface in abutment with said thermally responsive member and a second planar surface opposite said first planar surface in abutment with said support member; and terminal means for electrically connecting said stationary contact and said movable contact to electric conductors extending externally of said thermostat.

16. A thermostat in accordance with claim **15** wherein said energy absorbent means comprises a metallic washer.

17. A thermostat in accordance with claim **16** wherein said metallic washer is mounted for restricted movement between said thermally responsive member peripheral section and said support member.

18. A thermostat in accordance with claim **16** wherein said metallic washer consists essentially of a soft metal selected from the group of metals consisting of copper, tin, lead and alloys thereof.

19. A thermostat in accordance with claim **15** wherein said energy absorbent means is compressibly resilient.

20. A thermostat having a support, a thermally responsive member having a planar surface of a first section disposed facing said support and a bimetallic second section adapted for movement with respect to said first section in response to temperature changes of said thermally responsive member, first and second switch contacts mounted for relative movement between switch contact open and switch contact closed positions, a spring biasing one of said switch contacts, an actuating plunger mounted between said thermally responsive member and said spring for movement in response to movement of said bimetallic second section and means for controlling thermostat temperature drift including an energy absorbent dampener disposed between said thermally responsive member first section planar surface and said support.

21. A thermostat in accordance with claim **20** wherein said energy absorbent dampener is compressibly resilient.

22. A thermostat in accordance with claim **21** wherein said compressibly resilient energy absorbent dampener consists essentially of polyethylene terephthalate.

23. A thermostat in accordance with claim 21 wherein said compressibly resilient energy absorbent dampener consists essentially of a polyimide.

24. A thermostat in accordance with claim 21 wherein said compressibly resilient energy absorbent dampener consists essentially of silicone.

25. A thermostat in accordance with claim 21 wherein said compressibly resilient energy absorbent dampener consists essentially of rubber.

26. A thermostat in accordance with claim 21 wherein said compressibly resilient energy absorbent dampener consists essentially of silicon rubber.

27. A thermostat in accordance with claim 21 wherein said compressibly resilient energy absorbent dampener consists essentially of sponge rubber.

28. A thermostat in accordance with claim 21 wherein said compressibly resilient energy absorbent dampener consists essentially of paper.

29. A thermostat in accordance with claim 20 wherein said energy absorbent dampener comprises a metallic washer.

30. A thermostat in accordance with claim 29 wherein said metallic washer consists essentially of a soft metal selected from the group of metals consisting of copper, tin, lead and alloys thereof.

31. A thermostat in accordance with claim 29 wherein said metallic washer is mounted for restricted movement between said bimetallic member peripheral section and said support.

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