United States Patent [19]

Schmitt et al.

[11] **3,852,698**

[45] **Dec. 3, 1974**

[54] **DUAL TEMPERATURE THERMOSTAT**

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[52] **U.S. Cl.** **337/354,** 337/348

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

[58] **Field of Search** 337/39, 40, 42, 44, 78, 337/336, 371, 380, 354, 348

[56] **References Cited**

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2,707,763	5/1955	Kurtz	337/354 X
3,322,920	5/1967	Morris	337/365

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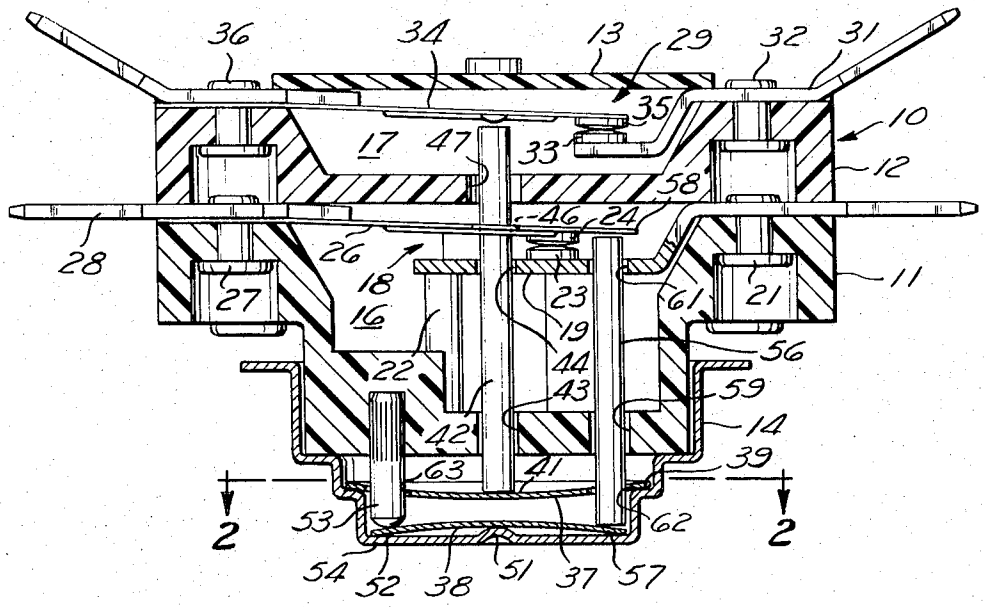
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Assistant Examiner—Fred E. Bell
Attorney, Agent, or Firm—McNenny, Farrington, Pearne & Gordon

[57] **ABSTRACT**

A dual temperature thermostat is disclosed in which two separate bimetallic snap discs are connected to independently operate separate switches. One snap disc is supported at its periphery and provides a central portion movable with snap action to operate the disc. The other snap disc is supported at its center and one peripheral location to provide an opposite peripheral portion which snaps back and forth to operate the other switch. In one embodiment, the bumper connecting the peripheral portion and such other switch engages the mobile contact arm at its end and extends through a lateral clearance opening in the first disc. A locating pin cooperates with a mounting cup to insure that frictional engagement does not exist between the bumper extending through the disc opening. In another embodiment, one bumper engages the center of one disc and extends through a central opening in the other disc. The center of such other disc engages an adjustable tubular screw at its center.

23 Claims, 4 Drawing Figures



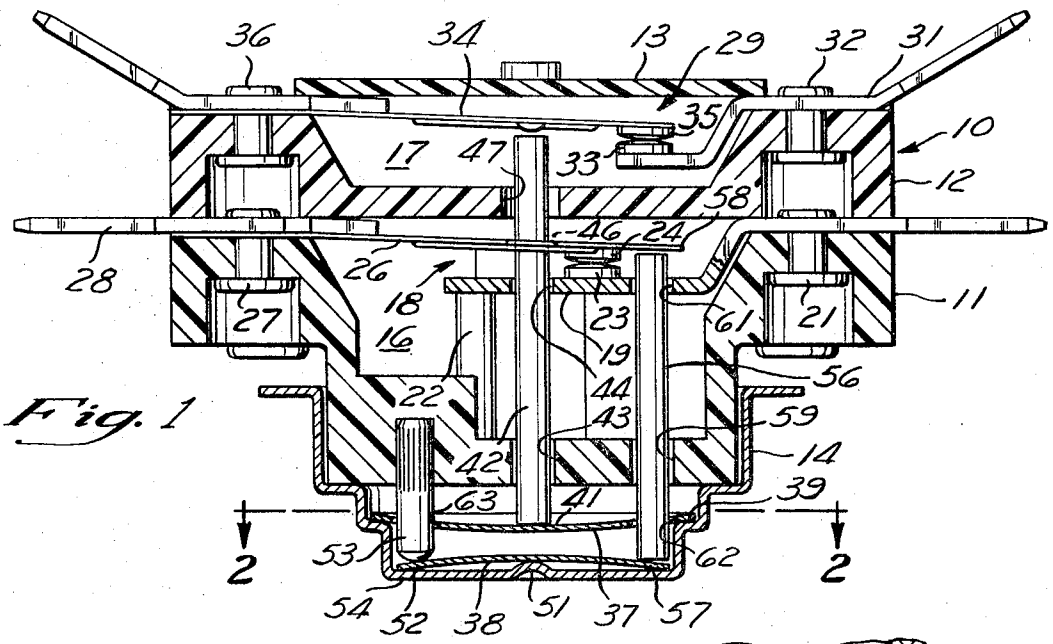


Fig. 1

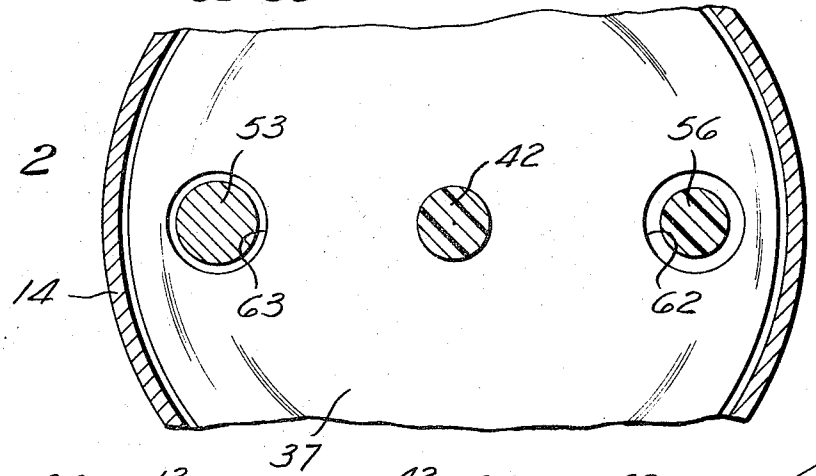


Fig. 2

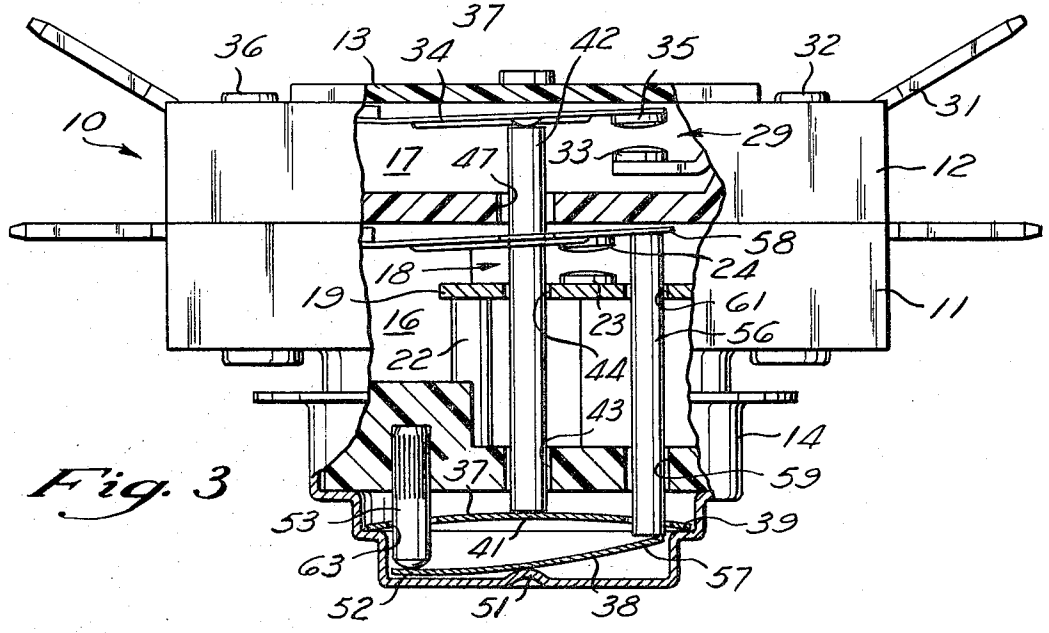


Fig. 3

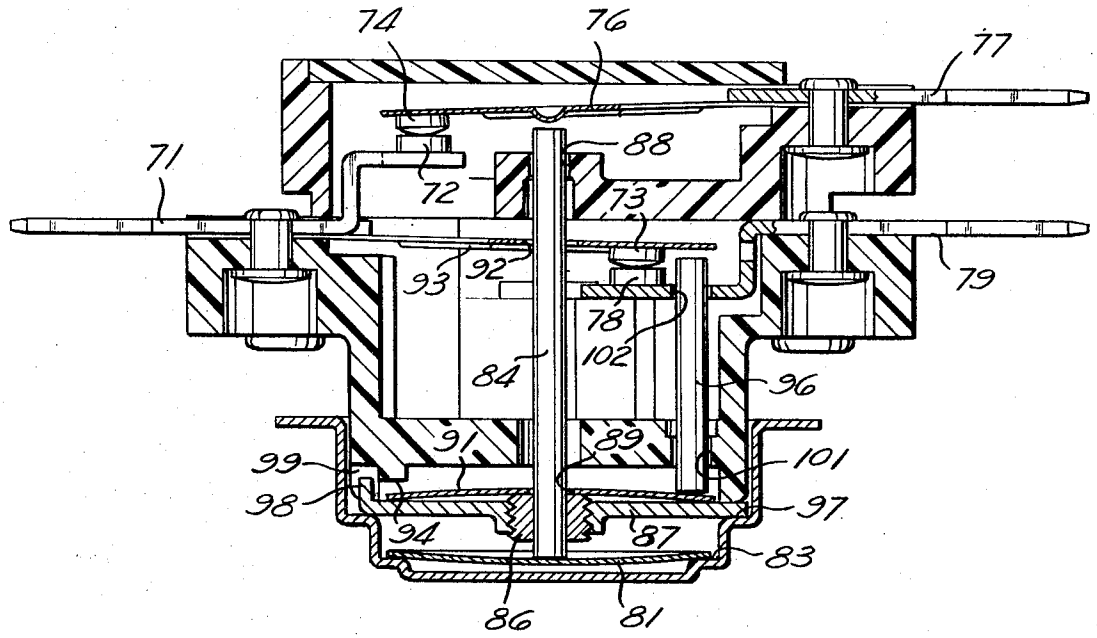

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Fig. 4

DUAL TEMPERATURE THERMOSTAT

BACKGROUND OF THE INVENTION

This invention relates generally to bimetal operated thermostats and more particularly to a novel and improved thermostat in which two separate switches are operated at separate predetermined temperatures.

PRIOR ART

It is sometimes desirable to provide a thermostat which in effect combines two separate thermostatic devices in a single assembly. Examples of such devices are illustrated in the U.S. Pat. Nos. 3,493,911 and 3,500,277. Additional examples are illustrated in the British Patent Number 1,214,252 published Dec. 2, 1970 and the French Patent Number 1,391,692 filed Mar. 9, 1963. In each of these patents, a thermostatic device is illustrated in which two or more bimetallic snap discs are connected to operate an associated one of a similar number of switches. Further in each instance, the discs are supported at their periphery and the central portion of each disc is connected to operate the associated switch. In the U.S. Pat. Nos. 3,322,920 and 3,660,793, a disc is supported so that the associated switch is operated by movement of a peripheral portion.

SUMMARY OF THE INVENTION

In the illustrated embodiments of this invention, a thermostat is provided with a body assembly on which two separate switches are mounted. Each switch includes a stationary contact and a movable contact supported by a cantilever-mounted contact arm. Also mounted on the body assembly in a metal retaining cup are a pair of bimetal snap discs. One of the snap discs is supported at its periphery and provides a central portion movable with snap action in response to first predetermined temperature conditions. A bumper extends from such central portion to operate the movable contact arm of one of the switches in response to movement of the center portion of the disc.

The other disc is supported on the body assembly at its center and at one peripheral location. The peripheral portion diametrically opposite the supported or peripheral location of the second disc moves with snap action in response to second predetermined temperatures and is connected to operate the movable contact arm of the second switch through a second bumper.

In one illustrated embodiment, the one peripheral location of the second disc is positioned by a pin which extends through an opening in the first disc and the second bumper also extends through an opening in the first disc. The diameters of the openings and of the second bumper and the mounting pin are arranged so that the second bumper does not engage the edge of the opening through which it projects.

In the second illustrated embodiment, the lower or disc most remote from the switches is supported at its periphery, and the center portion is movable with snap action to operate its associated switch. The bumper extends through a central opening in the disc closest to the switches and an opening in the first mobile contact arm. In this embodiment, the upper or disc closest to the switch is supported at its center by an adjustable tubular screw and is engaged at its periphery by its associated bumper. The upper disc is positioned by a projection formed on the body at a location opposite to the edge operated bumper.

In both embodiments, the switch which is operated by the edge operated disc is arranged so that the second bumper engages the very end of the mobile contact arm beyond the mobile contact. With this structure, the switch operating force is applied so that a minimum force is required to operate the second switch.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross section of a preferred embodiment of this invention illustrating the thermostat elements in the position they assume when both switches are closed;

FIG. 2 is a lateral section taken along 2—2 of FIG. 1 with the center bumper eliminated for purposes of illustration;

FIG. 3 is a partial cross section very similar to FIG. 1, but illustrating the elements in the switch open position; and

FIG. 4 is a cross section of another preferred embodiment of this invention illustrating the thermostat elements in the position they assume when both switches are closed.

DETAILED DESCRIPTION OF THE DRAWINGS

The illustrated thermostat of FIGS. 1 to 3 provides a body assembly **10** which includes first and second body elements **11** and **12** molded of an electrically insulating material such as a phenolic resin, a cover member **13** and a metallic disc retaining cup **14.** The two body members **11** and **12** cooperate to define a first switch chamber **16** and the second body member **12** cooperates with a cover member **13** to define the second switch chamber **17.** A first switch **18** located in the first switch chamber **16** includes a fixed contact support arm **19** secured to the body member **11** by a rivet **21** and engaging a positioning post **22** at its inner end. A fixed contact **23** is mounted on the arm **19.**

A movable contact **24** is mounted on a movable contact arm **26** which is in turn cantilever mounted on the body member **11** by a rivet **27.** The rivet also secures a terminal extension **28** which is electrically connected to the movable contact arm **26.** The contact arm **26** is biased in a direction maintaining contact between the movable contact arm **24** and the stationary contact **23** but is sufficiently flexible to allow movement of the movable contact **24** away from the fixed contact **23** when the switch operates.

A second switch **29** is provided in the chamber **17** in alignment with the first switch and is provided with a structure which is functionally the same as the switch **18.** Here again, a fixed contact support arm **31** is secured through the body member **12** by a rivet **32** and is provided with a fixed contact **33** at its inner end. A movable contact arm **34** is cantilever-mounted by a rivet **36** and is provided with a contact **35** at its inner end. Here again, the arm **34** is biased to normally maintain the two contacts **33** and **35** in engagement.

The operation of the two switches **18** and **29** is provided by a pair of bimetal snap discs **37** and **38.** The snap disc **37** is supported at its periphery by a shoulder **39** formed in the retainer cup **14.** The center portion **41** of the disc **37** moves back and forth between the two positions of stability with a snap action when the calibration temperatures of the disc **37** are reached. The disc **37** operates the switch **29** through a bumper **42** which is engagable at one end with the center portion **41** of the disc **37** and at its other end with the movable

contact arm 34. The bumper 42 extends through a guide opening 43 in the body member 11 and a guide opening 44 in the fixed contact arm 19 so that it is accurately guided at spaced locations for its longitudinal movement. The bumper 42 also extends through an opening 46 in the movable contact arm 26 and an opening 47 in the body member 12. These openings are provided with sufficient clearance so that they do not perform any guiding function.

The bumper 42 is preferably selected to provide clearance when the switch 29 is closed snd the snap disc 37 is in the position of stability illustrated in FIG. 1. With such clearance, lost motion is provided to insure that the disc is in snap movement at the time the bumper commences to open the switch 29. This insures that full contact pressure is present until the instant the disc operates to open the switch.

The disc 38 is supported, in the position of FIG. 1, along its periphery by an end wall or shoulder 54 of the cup. A locating pin 53 is positioned adjacent the opposite side of the disc 38 at one peripheral location 52 to cooperate with the end wall 54 and axially locate the peripheral location 52. A dimple or projection 51 is formed in the end wall 54 to engage and position the center of the disc when it snaps through to the position of FIG. 3. A bumper 56 is positioned to engage the disc 38 adjacent to its periphery at a peripheral portion 57 which is diametrically opposite from the peripheral location 52. The opposite end of the bumper 56 is engagable with the inner end 58 of the movable contact arm 26.

When the disc 38 is in the position of stability illustrated, the peripheral portion 57 is substantially adjacent to the end wall 54, and clearance is provided between one end of the bumper 56 and the surface engaged thereby. When the thermostat is in the position of FIG. 1, gravity maintains the bumper 56 against the disc 38, and the clearance is provided at the end adjacent to the movable contact arm. Here again, such clearance insures that the disc will be in snap movement before the switch 18 is operated.

The bumper 56 is guided in an opening 59 formed in the body member and a second opening 61 formed in the support arm 19. An opening 62 is formed in the disc 37 through which the bumper 56 extends with clearance. Similarly, the locating pin 53 extends through an opening 63 in the disc 37. As best illustrated in FIG. 2, the locating pin 53 is sized with respect to the opening 63 so that the clearance therebetween is less than the clearance between the bumper 56 and the associated opening 62. The various elements are proportioned so that the retainer 14 and the locating pin 53 cooperate to position and orient the disc 37 with sufficient precision to prevent engagement between the bumper 56 and the associated opening 62. This insures that the disc 37 will not produce any frictional engagement with the bumper 56 which could produce inaccuracies in operation. Preferably, the two openings 62 and 63 are the same size so that the disc does not have to be selectively positioned, and the diameter of the bumper 56 is smaller than the diameter of the locating pin 53.

FIG. 3 illustrates the position of the elements when both of the discs have operated. It should be understood that normally the two discs will be calibrated to operate at different temperatures and that the discs will not snap through to the operated position at the same temperature. However, when both of the discs have operated, the condition of FIG. 3 will exist. In this condition, the center portion 41 of the disc 37 has snapped through to its other position of stability and through the bumper 42 has caused the upper switch 29 to open. The switch 29 will remain in the open position until the disc 37 snaps back to the position of FIG. 1.

In FIG. 3, the disc 38 is also illustrated in its other position of stability in which the peripheral portion 57 has moved away from the wall 54 and causes the bumper 56 to open the switch 18. In this instance, the center portion of the disc 38 and the peripheral location 52 remain substantially fixed during the snap movement. Consequently, the peripheral portion 57 moves through a greater distance than the center portion of the disc would move if it were peripherally located in the same manner as the disc 37. Since the operating portion of the disc is moving through a greater range of movement, the force of the disc available for switch operation is not as great as it would be if the operating force were removed at the center portion of the disc. On the other hand, because the bumper 56 is located at the end of the movable contact arm 26 rather than at a central location, the force required to operate the switch is not as great as it would be in a structure of the type provided by the bumper 42 and movable arm 34. With the illustrated structure, the required force to operate the switch 18 is reduced and the force travel is increased in a manner substantially matching the available output of the disc 38. As long as the disc 38 remains in the position of FIG. 3, the switch 18 remains open. However, when the disc returns to a temperature at which it snaps back to the position of FIG. 1, the switch 18 closes.

The embodiment illustrated in FIG. 4 is similar to the first embodiment in most respects. The principal differences are discussed below. In this embodiment, a switch structure is illustrated in which both switches are provided with a common terminal 71. A fixed contact 72 of one switch is connected to the terminal 71 and the movable contact 73 of the other switch is also connected to the terminal 71 by a movable contact arm 93. The upper switch is completed by a movable contact 74 supported by a cantilever mounted arm 76 which is connected to a terminal 77. The second or lower switch is completed by a fixed contact 78 which is connected to a terminal 79.

In this embodiment, a first disc 81 is supported at its periphery in a metal retaining cap by a step 83 formed in the cap. The center portion of the disc 81 operates through a bumper 84 to open and close the upper switch by moving the mobile contact arm 76. The bumper 84 is guided at its lower end by a tubular adjusting screw 86 threaded into a disc retaining plate 87 and at its upper end by a guide opening 88 formed in the body assembly. An opening 89 is formed in the upper disc 91 through which the bumper projects, and a clearance opening 92 is formed in the lower movable contact arm 93.

The upper disc 91 is positioned at its periphery against the disc retaining plate 87, and a first peripheral portion is located after snap by a projection 94 on the body assembly. The projection 94 is located opposite a second bumper 96 which engages the opposite peripheral portion. The center of the disc 91 is located by the tubular adjusting screw 86 so that when the disc 91 snaps from the illustrated position, it is supported at its center in the proper position relative to the projection

94, determined by the adjustment of the screw 86, so that it causes the bumper 96 to raise up into engagement with the end of the support arm 93 and open the two contacts 73 and 78.

The support plate 87 is preferably formed of a good conducting material such as metal and is held against a shoulder 97 in the disc retaining cap by the body assembly. In order to insure that the plate 87 does not rotate and is properly oriented with respect to the body assembly, it is formed with a projection 98 which projects into a recess 99 in the body assembly. The bumper 96 is guided at its lower end by an opening 101 formed in the body assembly and at its upper end by an opening 102 formed in the fixed contact support portion of the terminal 79.

The embodiment of FIG. 4 provides two discs of equal size and eliminates the necessity of rotationally orienting or locking of either disc 91, thus both discs are free to assume any rotational position. With this structure, the tendency for disc warpage of the disc 91 during use is minimized.

With the illustrated structure, a very compact, two-temperature thermostat is provided in which one switch operates at the calibration temperatures of one disc and the other switch operates at the calibration temperatures of the other switch. Good sensitivity of the thermostat is obtained since the discs are both in good thermal contact with the metal retaining cup. Further, with the illustrated structures, the switches are efficiently operated by the discs to minimize the tendency to fail because of sticking or welding. Still further, with the illustrated structures, the existence of friction is minimized, and accurate operation is achieved.

Although preferred embodiment of this invention are illustrated, it is to be understood that various modifications and rearrangements of parts may be resorted to without departing from the scope of the invention disclosed and claimed herein.

What is claimed is:

1. A thermostat comprising a body assembly, first and second switches mounted on said body assembly, first and second bimetal snap discs on said body assembly, said first disc being supported at its periphery and providing a central portion movable with snap action in response to temperature changes, said first switch providing first means operating said first switch in response to movement of said central portion, said second disc being mounted at its center and at one peripheral location and providing a peripheral portion movable with snap action in response to temperature changes, said second switch providing second means operating said second switch in response to movement of said peripheral portion.

2. A thermostat as set forth in claim 1 wherein said discs are substantially circular and coaxially mounted in said body assembly.

3. A thermostat as set forth in claim 2 wherein said first means includes a first elongated bumper movable along the axis of said first disc, said first bumper being sized to provide lost motion to insure that said first disc is in snap movement before said first switch opens.

4. A thermostat as set forth in claim 3 wherein said second means includes a second elongated bumper movable along a line of action extending between said peripheral portion and said second switch, said second bumper being sized to provide lost motion and insure that said second disc is in snap movement before said second switch opens.

5. A thermostat as set forth in claim 4 wherein said second switch includes a movable contact support arm cantilevermounted on said body assembly and providing a free end, and said second bumper is engagable with said free end.

6. A thermostat as set forth in claim 5 wherein both of said bumpers move along substantially parallel lines of movement.

7. A thermostat as set forth in claim 6 wherein a locating pin is mounted on said body assembly to support said one peripheral location, and said first disc is provided with a first opening through which said locating pin projects.

8. A thermostat as set forth in claim 7 wherein said first disc is provided with a second opening, and said second bumper extends through said second opening.

9. A thermostat as set forth in claim 8 wherein said first opening provides less clearance with respect to said locating pin than said second opening provides with respect to said second bumper.

10. A thermostat as set forth in claim 9 wherein both of said openings through said first disc have the same diameter, and said locating pin has a larger diameter than said second bumper.

11. A thermostat as set forth in claim 1 wherein said second switch includes a movable contact support arm cantilever-mounted on said body assembly and providing a free end, and said second switch also including an elongated bumper movable along a line of action extending between said peripheral portion and said free end.

12. A thermostat as set forth in claim 1 wherein a locating pin is mounted on said body assembly to support said one peripheral location, and said first disc is provided with a first opening through which said locating pin projects.

13. A thermostat as set forth in claim 12 wherein said first disc is provided with a second opening, and said second switch includes an elongated bumper extending through said second opening and operable to open and close said second switch in response to movement of said peripheral portion.

14. A thermostat as set forth in claim 1 wherein said discs are the same size, and retainer means formed of a material having good heating conducting properties supports both of said discs.

15. A thermostat as set forth in claim 14 wherein said retainer means includes a disc cup formed with a shoulder supporting said first disc and a support plate supporting said second disc.

16. A thermostat as set forth in claim 15 wherein said support plate provides a central projection operable to engage and locate the central portion of said second disc when it snaps.

17. A thermostat as set forth in claim 16 wherein the position of said central projection is adjustable.

18. A thermostat as set forth in claim 17 wherein said second disc is formed with a central opening through which said first operating means projects.

19. A thermostat as set forth in claim 1 wherein said second disc is formed with a central opening through which said first operating means projects.

20. A thermostat comprising a body assembly including a disc retaining means formed of thermally conduc-

tive material, first and second switch means mounted on said body assembly, a first surface in said retaining means, a bimetal snap disc supported at its periphery on said first surface, a second surface on said retaining means, a second bimetal snap disc supported at its periphery against said second surface when in one of its snap positions, said first disc operating said first switch means, said second disc providing a peripheral portion movable with snap action and away from said second surface when predetermined temperatures are reached, said second switch means being operated in response to snap movement of said peripheral portion.

21. A thermostat as set forth in claim **20** wherein a locating means is provided on said body assembly engaging said disc at a peripheral location opposite said peripheral portion on the side thereof opposite said second surface, and support means are provided to engage the center part of said second disc on the side thereof opposite said locating means.

22. A thermostat as set forth in claim **21** wherein said first disc is provided with a first opening through which said locating means projects.

23. A thermostat as set forth in claim **22** wherein said second switch means includes an elongated bumper extending between said second switch and said peripheral portion, and said first disc includes a second opening through which said bumper projects with clearance.

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