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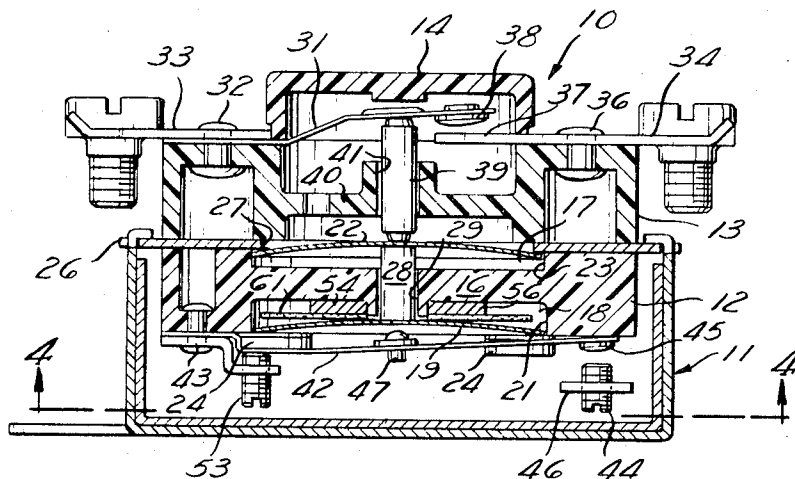
[54] **TIME DELAY RELAY**  
19 Claims, 8 Drawing Figs.

[52] U.S. Cl. .... 337/102,  
337/370  
[51] Int. Cl. .... H01h  
61/013  
[50] Field of Search ..... 337/102,  
354, 86, 370

[56] **References Cited**

| UNITED STATES PATENTS |        |                     |         |
|-----------------------|--------|---------------------|---------|
| 2,203,558             | 6/1940 | Wilson .....        | 337/370 |
| 2,207,422             | 7/1940 | Vaughan et al. .... | 337/86  |
| 2,543,040             | 2/1951 | Mertler .....       | 337/86  |
| 3,489,976             | 1/1970 | Marcoux .....       | 337/102 |

**ABSTRACT:** A time delay relay having a pair of bimetallic snap discs mounted so that they tend to produce movement in the opposite direction when their temperatures are changed in a similar manner. The discs are connected so that they simultaneously move between their snap positions. A heater is located between the discs immediately adjacent to one disc. Insulating means surrounding the other disc restricts the rate of flow to such other disc from the heater during heating operation and resist heat dissipation therefrom after the heater is turned off. The heater creates rapid rates of increase in differential temperature between the discs when operation of the heater is initiated and similar high rates of change in differential temperature occur when the heater is shut off. The discs are selected so that a compressive force is applied to the connecting operator under all conditions normally encountered and snapping of the discs occurs when a predetermined differential temperature exists between the discs. Because the discs apply compressive forces to the operator under all normal operating conditions, a simple bumper-type connector may be used to connect the discs and the discs need not be trapped at their peripheries.



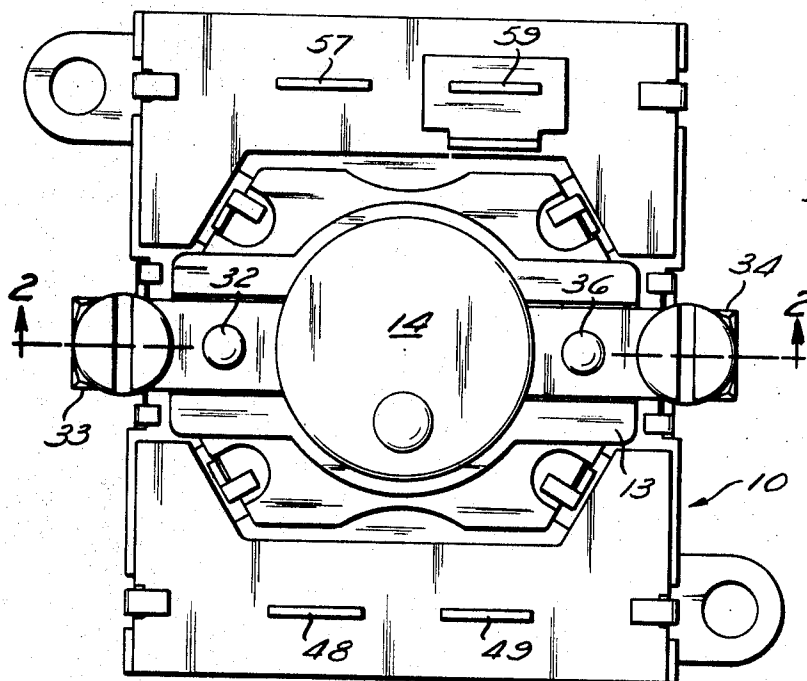


*Fig. 1*

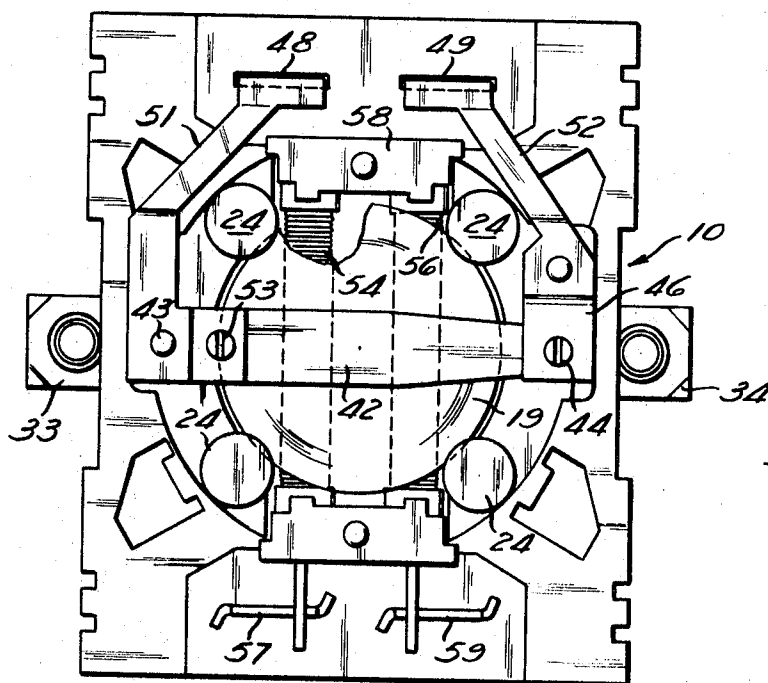


*Fig. 4*

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*Fig. 2*

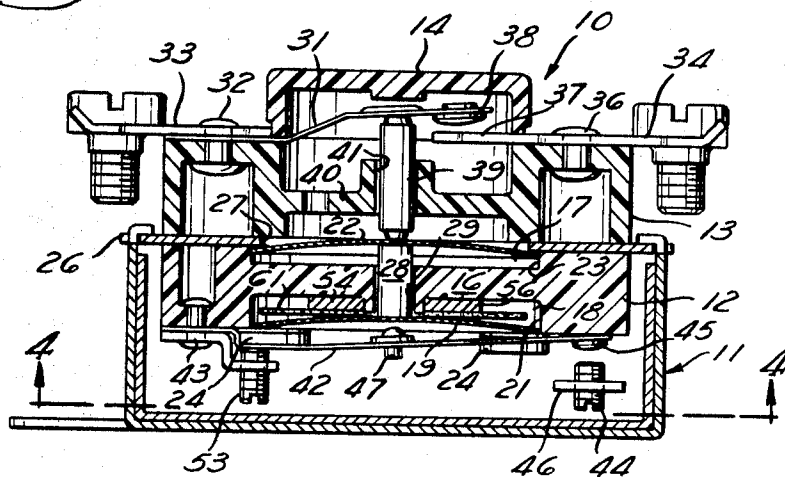
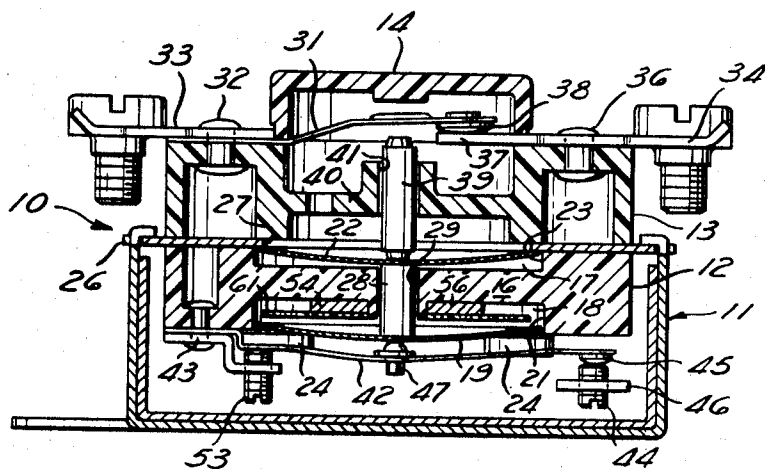


*Fig. 3*

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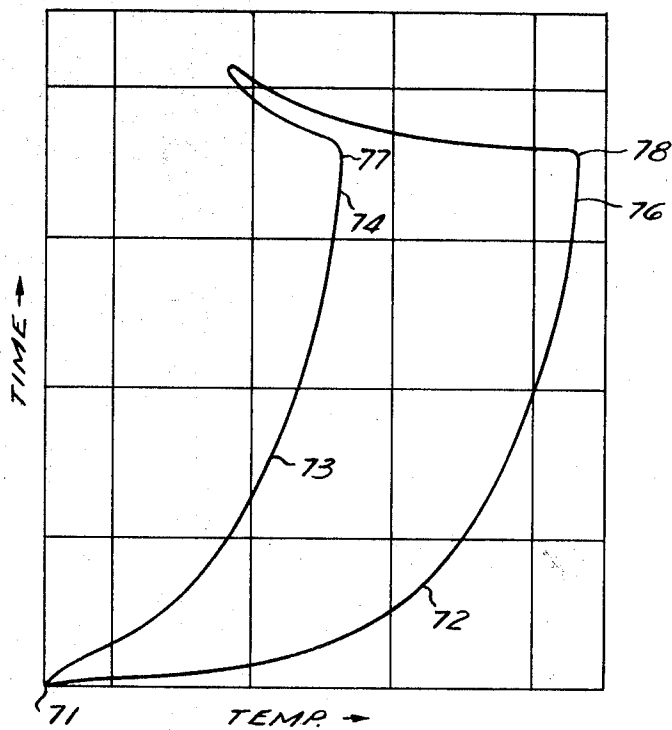


Fig. 5a

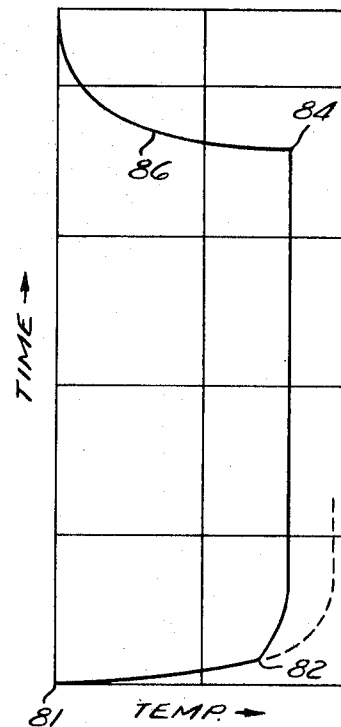


Fig. 5b

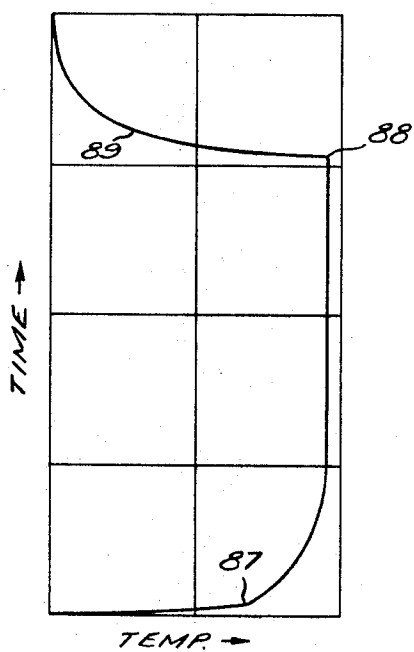


Fig. 5c

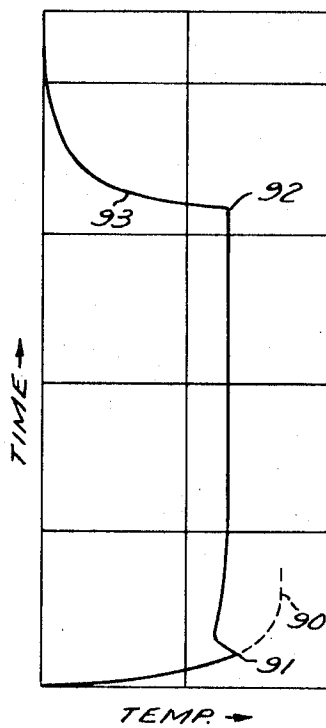


Fig. 5d

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# 1

## TIME DELAY RELAY

### BACKGROUND OF THE INVENTION

This invention relates generally to time delay relays and more particularly to a novel and improved time delay relay utilizing bimetallic snap discs in combination with a heater for the operation of the relay.

### PRIOR ART

Time delay relays have utilized bimetallic snap disc operators in combination with electrical resistance-type heaters arranged to supply heat to the disc operators to cause actuation thereof. In some instances two oppositely acting discs have been connected so that the relay is ambient temperature compensated. Examples of such devices are illustrated in the U.S. Pat. No. 2,203,558 to Wilson and Vaughan et al. U.S. Pat. No. 2,207,422. In the devices illustrated in these patents a pair of snap discs are mounted in opposition and are interconnected so that they snap back and forth in unison. The two discs are selected to have different operating temperatures so that when the two discs are at the same ambient temperatures, one disc provides greater force than the other and maintains the two discs in one position. A heater is arranged to supply heat to the discs and produce a differential temperature therebetween to cause the discs to simultaneously snap to an operated position.

The illustrated devices in these patents utilize a disc mounting arrangement wherein each disc is fully trapped at its periphery in the mounting body and the discs are connected by an operator which extends through an aperture in the center of the disc and grips both sides of at least one of the discs adjacent to its aperture. Such an operator provides a connection for transmitting forces in both directions between the disc and in many instances, because of the gripping of the disc surface, adversely affects the calibration of the disc.

### SUMMARY OF THE INVENTION

A time delay relay incorporating the present invention is provided with a pair of oppositely acting bimetallic snap discs connected by an operator for simultaneous snap action. The discs are selected so that each disc loads the operator only in one direction. In the illustrated embodiment, a simple bumper is positioned between the discs and the combination is arranged so that the bumper is loaded only in compression. Consequently, apertured discs are not required and all lost motion is eliminated. With this arrangement, it is not necessary to provide full trapping of the periphery of each disc since they are always loaded in the same direction.

The illustrated embodiment of this invention is also arranged so that proper operation occurs even when the rate of heat input by the heater changes a substantial amount. The operating heater is located between the two discs so that heat flows from the heater along separate paths to the two discs. The structure is arranged so that operation occurs along a relatively straight portion of the differential temperature curve. Therefore, the operating time of the relay is not severely affected by changes in the rate of heat output of the heaters. Further, the structure is arranged to control the ratios of rates of heat dissipation of the two discs so that the release time of the relay after the heater is deenergized can be accurately controlled.

In the illustrated embodiment, both of the discs are selected so that they have a snap temperature above the temperatures normally encountered. With this structure, the forces of the two discs on the connecting operator are in the same direction at all times, and a simple mounting of the discs and a simple connection therebetween can be used without encountering lost motion and undesirable changes in disc calibration.

### BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a plan view of a time delay relay incorporating this invention;

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FIG. 2 is a cross section taken generally along 2-2 of FIG. 1 illustrating the position of the various elements of the relay before the relay is actuated;

FIG. 3 is a cross section similar to FIG. 2 illustrating the position of the elements after the relay is actuated;

FIG. 4 is a view taken generally along 4-4 of FIG. 2 with the mounting base removed;

FIG. 5a is a graph of the disc temperature vs. time of a relay of the type illustrated in FIGS. 1 through 4;

FIG. 5b is a disc differential temperature vs. time graph corresponding to FIG. 5a;

FIG. 5c is a differential temperature vs. time graph similar to FIG. 5b illustrating the effect on the relay when the heater is operated at a voltage greater than nominal voltage, and;

FIG. 5d is a differential temperature vs. time graph similar to FIGS. 5b and 5c illustrating the effect on the relay when the heater is operated at a lower voltage than nominal voltage.

A time delay relay in accordance with this present invention may be used when a delay is desired between the time an actuating signal is initiated and the actuation of the relay is desired, and where a delay is also desired between the termination of the actuating signal and the deactuation of the relay. The illustrated relay is particularly suited where sequencing is desired since it provides a power switch which may be connected to an associated load and a control switch which may be connected to the heater of a subsequent relay.

For example, such relays may be used in electric furnaces having a plurality of separate heating units. In such furnaces, it is often desired to sequentially turn the heaters on and off so that the total load of the furnace can be connected and removed from the power line in sequential steps. Such an arrangement is often used to eliminate surges in the power line.

Referring to FIGS. 1 through 4, the illustrated embodiment of this invention includes a body assembly 10 including a metallic base assembly 11, a disc support member 12, an upper switch support member 13, and a closure member 14. The members 12, 13, and 14 are molded from a plastic material such as a phenolic resin which is capable of withstanding relatively high temperatures and which has relatively low thermal conductivity when compared to the metal forming the base 11.

The disc support member 12 is provided with an apertured wall 16 and a pair of opposed disc receiving recesses 17 and 18 on opposite sides thereof. An actuating disc 19 formed of bimetal is located in the disc recess 18 and is laterally positioned by the sidewall 21 thereof. The compensating disc 22 also formed of bimetal is positioned in the recess 17 and is laterally positioned by its sidewall 23. Four disc retaining fasteners 24 are mounted on the body member 11 and are provided with heads which extend inwardly beyond the sidewall 21 to engage the underside of the disc 19 and retain the disc in the recess 18. The compensating disc 22 is retained in the recess 17 by a plate 26 secured to the upperside of the body member 12 and formed with a central aperture 27 proportioned so that the plate 26 extends inwardly over the recess 17 a sufficient amount to engage the edge of the upperside of the compensating disc 22.

A bumper or operator 28 is positioned within the aperture 29 in the wall 16 and is guided thereby for lengthwise movement. The upper end of the bumper 28 engages the central part of the compensating disc 22 and the lower end of the bumper 28 engages the central part of the actuating disc 19. The length of the bumper is preferably selected to equal the spacing between the adjacent surfaces of the discs at their periphery. The discs 19 and 22 are selected so that in operation they are both arched in an upward direction when the relay is not actuated and are both arched in a downward direction when the relay is actuated. The selection of the discs to obtain this operation is discussed in detail below. The bumper 28 is loaded in compression at all times during normal operation and the bumper holds the discs apart so that the periphery of the disc 19 is maintained against the heads of the fasteners 24 and the periphery of the disc 22 is held against the plate 26.

A power switch is mounted on the upper switch support member 13. The power switch includes a cantilever spring arm 31 mounted on the member 13 by a rivet 32 and connected thereby to a terminal member 33. The stationary part of the switch is provided by a terminal member 34 secured to the member 13 by a rivet 36 and providing a stationary contact portion 37 underlying a mobile contact 38 carried by the cantilever spring arm 31. A bumper 39 is positioned in a central aperture 41 through a wall 40 provided by the member 13 and is guided for lengthwise movement. The lower end of the bumper 39 engages the center part of the upper surface of the compensating disc 22 and its upper end engages the mobile switch arm 31. The various elements are proportioned so that the mobile contact 38 is spaced from the stationary contact portion 37 when the two discs are arched in an upward direction as illustrated in FIG. 2. When the discs 19 and 22 snap through to the position of FIG. 3, the spring arm 31 causes the power switch to close.

A control switch assembly is mounted on the lower side of the disc support member 12. It includes a mobile contact arm 42, a cantilever mounted at one end by a rivet 43, and a stationary contact 44 on a stationary contact support arm 46. In the illustrated embodiment, the stationary contact 44 is a screw threaded through the arm 46 to permit adjustment of the stationary contact position. A mobile contact 45 is secured to the free end of the mobile contact arm 42 and is located for movement into and out of engagement with the stationary contact 44. A central bumper 47 formed of electrically insulating material is mounted on the mobile contact arm 42 for engagement with the lower side of the actuating disc 19 at its center. Here again, the various elements of the control switch assembly are proportioned so that the switch is open when the discs are arched in an upward direction as illustrated in FIG. 2 and is closed when the discs snap to the position of FIG. 3. The control switch is connected to the terminals 48 and 49 by straps 51 and 52, respectively, as best illustrated in FIG. 4. An adjustment screw 53 is positioned to engage the underside of the mobile contact arm 42 to permit adjustment of the spring force of the arm.

A pair of heaters 54 and 56 are mounted adjacent to the wall 16 immediately above the actuating disc 19. These heaters extend across the recess 18 and are preferably formed of resistance wire wound flat around a support. One end of the heater 54 is connected to a terminal 57 and the other end to a connector 58 which in turn connects the adjacent ends of the heaters 54 and 56. The other end of the heater 56 is connected to a terminal 59 so that the two heaters 54 and 56 are connected in series between the two terminals 57 and 59. An apertured piece of sheet mica 61 is positioned between the actuating disc 19 and the heaters 54 and 56 to electrically insulate the disc from the heater.

In one embodiment of this invention which is discussed in conjunction with the graphs of FIGS. 5a through 5d, the actuating disc 19 is a disc which snaps, from one position of stability to its other position of stability, when it is free, on rising temperature within a range of temperatures between 350° F. and 356° F. On decreasing temperature, it snaps back to its initial position of stability within a range of temperatures between 325° F. and 331° F. Therefore, the disc provides a 25° F. nominal differential temperature in operation. The compensating disc 22 is selected to snap on increasing temperatures within the range between 300° F. to 306° F. and to snap back on decreasing temperatures within the range between 275° F. and 281° F. Here again, the compensating disc has a nominal differential temperature in operation of 25° F. Discs having these high temperatures of operation with relatively low differential temperatures in operation are preferably of a type disclosed in the copending application of Anton Gerich, Ser. No. 859,853, filed Sept. 22, 1969 which application is assigned to the assignee of the present invention.

The disc 19 is mounted in the body assembly 10 with its high expansion side on the top or upward side, and the disc 22 is mounted in the body assembly so that its high expansion side is on the lower side. Therefore, when the two discs are at tem-

peratures below their operating temperatures, the disc 19 tends to curve upwardly and the upper disc 22 would curve downwardly if it were not for the bumper 28. When the two discs are at the same temperatures, usually ambient temperature, the upward force created by the disc 19 on the bumper 28 is greater than the downward force created by the compensating disc 22 so the two discs are maintained in their upward position as illustrated in FIG. 2. This is because the force produced by a disc tends to be a function of the difference in temperature of the disc from its operating temperature. Therefore, since the disc 19 is at a greater temperature differential from its operating temperature than the disc 22, when the two discs are at the same temperature, upward force of the disc 19 is greater than the downward force of the disc 22.

When the heaters 54 and 56 are energized, temperature of the actuating disc 19 is raised at a faster rate than the temperature of the compensating disc 22. This is because the heaters are located immediately adjacent to the actuating disc 19, in good heat exchange relationship therewith, and because the heaters are spaced from and thermally insulated from the compensating disc 22 by the wall 16. When the heaters 54 and 56 are operated for a sufficient time to create a sufficient differential temperature between the disc 19 and the disc 22 to decrease the upward force of the disc 19 until it is smaller than the downward force of the disc 22, the discs simultaneously snap to their downward position as illustrated in FIG. 3. In the relay having the discs described above, this occurs when the difference in temperature between the two discs is about 75° F. Movement of the two discs to the lower position of FIG. 3 causes the two switches to close.

As the heaters 54 and 56 continue to operate, the temperatures of the discs continue to increase until an equilibrium condition is reached. At such time the rate of heat flow to the actuating disc 19 from the heaters equals the rate of heat dissipation from the disc, principally into the lower part of the relay and out through the base 11. Similarly, when the temperature of the compensating disc 22 reaches equilibrium the rate of heat flow from the heaters 54 and 56 through the wall 16 to the disc 22 equals the rate of heat dissipation therefrom.

Because the heat flowing to the compensating disc must flow through the wall 16, which provides a substantial amount of heat insulation, the rate of heat flow to the disc 22 is much less than the rate of flow of heat directly to the disc 19 and relatively rapid rates of increase in differential temperature are obtained when the heaters are turned on. Similarly, relatively rapid rates of decrease in differential temperature are obtained when the heaters are shut off, because the disc 22 is surrounded by materials which are relatively nonconductive and because such materials provide a thermal mass resisting cooling of such disc. Also, the fact that the disc 19 is initially at a higher temperature when the heater is turned off, causes a greater cooling rate in the disc 19 than in the disc 22.

When discs having operating temperatures substantially as described above are used in the relay, the discs remain in the position of FIG. 3 and the relay remains actuated until the difference in temperature between the discs is sufficiently low to return to a force condition in which the upward force of the disc 19 is greater than the downward force of the disc 22 and the discs then snap back to the position of FIG. 2. This tends to occur when the difference of temperature between the discs is about 25° F.

FIG. 5a is a time-temperature diagram of the operation of a relay having discs as mentioned above and having a heater rated for operation at 24 volts. In the diagram of FIG. 5a the heater is turned on and supplied with 24-volt power at the point 71. Immediately before energizing the heaters, the temperatures of the two discs are the same. Immediately after the heaters are turned on, the temperature of the disc 19 increases along a temperature-time curve 72. However, because of the thermal delay created by the wall 16 and the much greater spacing between the heaters and the disc 22, the temperature-time curve of heating of disc 22 is along a curve 73 and the

rate of heating of the disc 22 is much slower. When a point was reached where the difference in temperature between the two discs was about 75° F., the discs snapped through and the relay was actuated. Continued operation of the heater caused the disc temperature to increase until substantial equilibrium was reached at the points 74 and 76. In this particular embodiment, the temperature of the disc 19 was about 265° F. and the temperature of the disc 22 was about 185° F. Both of these temperatures were well below the operating temperatures of the respective discs so the disc 19 continued to produce an upward force on the bumper 28 and the disc 22 continued to produce a downward force thereon. However, the downward force of the disc 22 was greater than the upward force of the disc 19, so the discs remained in the downward position of FIG. 3.

The heaters were shut off at a time point indicated at 77 and 78. Because the heaters had a small thermal mass, the temperature of the disc 19 began to drop almost immediately. Also because the disc 19 was in free air where heat dissipation was substantially unrestricted, its cooling occurred at a fast rate. However, because the disc 22 was surrounded by materials having a relatively high resistance to heat flow, and because such materials had a relatively high thermal mass, the rate of cooling of the disc 22 was much slower. Further, the rate of cooling of the disc 19 was faster because its absolute temperature was higher. Consequently, the temperature of the disc 19 rapidly approached the temperature of the disc 22. When the temperature of the disc 19 was approximately equal to 25° F. higher than the temperature of the disc 22, the upward force of the disc 19 was greater than the downward force of the disc 22 and the two discs snap back to the position of FIG. 2 deactuating the relay.

Referring to FIG. 5b, it can be seen that the differential in temperature to curve of the discs represented by the curve from the point 81 to 82, is relatively flat and the discs snapped at about the point 82. Because the disc 19 moved away from the heaters when it snaps through to the operated position of FIG. 3, the rate of increase in differential temperature decreased after it snapped and equilibrium was reached at a differential temperature in the order of 80° F. If the disc 19 had not snapped away from the heaters, the differential temperature curve would have followed the dotted curve and equilibrium would have been reached at a differential temperature of about 95° F.

After the heater was turned off at the point 84, the differential temperature between the discs dropped at a rapid rate and the discs snapped back to their initial position at about the point 86 while the rate of change of differential temperature is still occurring at a relatively high rate.

FIG. 5c is a time-differential temperature diagram of the same relay excepting that the voltage applied to the heaters 54 and 56 was raised to 26.5 volts instead of 24 volts. The consequence of this change is that the rate of increase in differential temperature was slightly more rapid and the relay was actuated at the point 87. Also, the differential temperature reached at equilibrium was in the order of 95° F. However, since the temperature of the actuated disc 19 at equilibrium compared to the temperature of the compensating disc was higher, the rate of change after the heater was turned off at 88 was greater and the time lag before relay deactuation at 89 was not significantly greater than the time lag under the 24-volt condition of FIG. 5b.

The curve of FIG. 5d was obtained by applying a control voltage of 21.5 volts to the heaters. In this instance the slope of the curve to the operating point at 91 is steeper than the slope of the corresponding part of the curve of FIG. 5b, so the delay was slightly longer. It should be noted that the differential temperature dropped after the discs snapped and stabilized at a differential temperature of about 63° F. This drop in differential temperature occurred because the disc 19 snapped away from the heaters and consequently the rate of heat flow to the disc 19 was less. However, the differential temperature stabilized at a differential temperature well above

25° F., so the relay remained actuated. Operational reliability is insured however, since the differential temperature curve would have followed the dotted line to equilibrium at 90 if the discs had not snapped.

When the heaters were turned off at the point 92, the temperature differential immediately started to drop and the relay was deactuated at about the point 93. A comparison of FIGS. 5b through 5c will demonstrate that relatively wide variations in the control voltage applied to the heaters did not prevent proper operation and only resulted in a change in the time-in or time-out of the relay. This is primarily due to the fact that the relay operation occurs in both instances while the rate of change in differential temperature is high.

It is desirable to arrange the relay so that the relay is actuated at a differential temperature which is substantially below the ultimate differential temperature which would be reached under nominal conditions, if disc snapping did not occur. Preferably, the differential temperature when operation occurs under nominal conditions, should be about 63 percent of such ultimate differential temperature. With such an arrangement, substantial reductions in the rate of heat output, caused for example by low control voltage, can occur without creating a condition in which the required differential temperature either exceeds or closely approaches the differential temperature of equilibrium. An inspection of the three curves of FIGS. 5b, 5c, and 5d, demonstrates that, even under relatively wide variations of heater output, the relay operated along relatively straight portions of the differential temperature curve, and that the time-in and time-out of the relay was not drastically affected by relatively large changes in voltage applied to the heater. This was true even though the heat output of the heater was a function of the square of the heater voltage.

Since the discs are arranged with respect to the heaters so that the actuating disc is very close to the heater before relay actuation, proper functioning of the relay will occur even when the differential temperature at equilibrium is less than the differential temperature required for actuation, as illustrated in FIG. 5d. The adjustment screw 53 provides some adjustment of the relay off-time by permitting adjustment of the force applied to the disc 19 when the relay is actuated. Such adjustment does not affect on-time, however, since the bumper 47 is spaced from the disc 19 when the relay is not actuated.

Because the two discs never reach operating temperatures during normal operation, it is not necessary to provide a structure for fully trapping the periphery of the two discs. Instead, it is possible to mount the discs in the simple manner illustrated where the discs are engaged only on one side at their periphery. Further, it is possible to utilize a simple bumper to connect the discs eliminating the need for apertures through the discs and clamping structures for connections therebetween. Therefore, all lost motion is eliminated, more accurate operation is achieved, and the calibration of the discs is not adversely affected by the mounting. Still further, it has been found that when discs are mounted so that free lost motion is not present, disc calibration does not tend to change as much when the discs are operated through a large number of cycles. The unidirectional loading of the bumper and the advantages derived therefrom can be obtained so long as discs are selected wherein the force of at least one disc on the bumper is always in the same direction and the snap travel of such disc is at least as great as the other disc. However, when both discs are selected so that their forces do not reverse, extremely close tolerances are not required and lost motion does not occur even if the bumper length differs slightly from the spacing of the adjacent surfaces of the discs at their peripheries.

With the preferred structure, the rate of change in differential temperature occurring when the heater is actuated can be increased by providing a greater thermal mass in the wall 16 as by increasing its thickness. This also tends to decrease the rate of heat flow to the compensating disc since it increases the thermal insulation. Further, the structural ar-

range wherein the compensating disc is substantially completely confined by material which has relatively low heat transfer rate, when compared to metal, tends to retain the heat in the compensating disc and increases the rate of differential temperature change after the heater is turned off. Consequently, if a shorter off-time is desired, the thickness of the wall 40 can be increased to reduce the rate of heat flow from the compensating disc and to provide a larger thermal mass to slow the cooling of the disc 22. Also the screw 53 can be adjusted inward to increase the force of the spring arm 42 on the disc 19.

Although a specific embodiment is described in which both of the discs have operating temperatures higher than the temperatures normally encountered in operation of the relay, a similar result can be obtained by selecting discs having operating temperatures which are below the temperatures normally encountered.

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

What I claim is;

1. A relay comprising a body assembly, first and second bimetallic snap discs in said body assembly each having two positions of stability, said discs being positioned in said body so that they tend to move in opposite directions in response to similar temperature changes, operator means connecting said discs maintaining them in the same position with respect to each other and causing them to simultaneously snap between their two positions of stability, one of said discs producing a greater force on said operator means than the other of said discs when said discs are at substantially equal temperatures, heater means positioned between said discs substantially adjacent to said first disc, said body assembly providing thermal insulation means resisting flow of heat from said heater means to said second disc while allowing substantially unrestricted flow of heat from said heater means to said first disc, and switch means connected for operation when said discs move between their two positions of stability, said body including thermal insulating means restricting the flow of heat from said second disc to a rate substantially less than the rate of heat flow from said first disc when said heater means is shut off.

2. A relay as set forth in claim 1 wherein said insulating means provides substantially completely enclosure of said second disc.

3. A relay as set forth in claim 2 wherein said insulating means has a larger thermal mass than said second disc.

4. A relay as set forth in claim 3 wherein said body assembly permits unrestricted flow of heat from said first disc.

5. A relay as set forth in claim 4 wherein at least one of said discs applies a force to said operator means in the same direction under all temperatures normally encountered.

6. A relay as set forth in claim 5 wherein both of said discs apply forces to said operator means in the same direction under all temperatures normally encountered.

7. Relay as set forth in claim 6 wherein said discs are imperforate and said operator means is an elongated bumper positioned between said discs and guided by said body assembly, one end of said bumper engaging each of said discs.

8. A relay as set forth in claim 9, wherein said body assembly includes opposed surfaces with one engaging each of said discs adjacent to its periphery to resist movement of the adjacent periphery in a direction away from the periphery of the other disc, said body assembly being free of means tending

to prevent movement of the peripheries of said discs toward each other.

9. A relay as set forth in claim 8 wherein spring means are provided which are operable to urge said disc toward one position and adjustment means are provided to adjust the force of said spring means.

10. A relay as set forth in claim 9 wherein said discs are in one position when the temperatures thereof are substantially equal and said spring means urges said discs toward said one position only when said discs are in their other position.

11. A relay as set forth in claim 1 wherein said discs have operating temperatures when free of restraint above the temperatures of said discs normally encountered by said relay.

12. A relay as set forth in claim 1 wherein operation of said heater means causes a substantially rapid increase in the difference in temperature between said discs until equilibrium temperatures are reached, the decrease in differential temperature of said discs being substantially rapid after the discs have reached substantial equilibrium and said heater means is shut off until said discs approach the same temperature, said discs snapping in both directions while the rate of change of difference in temperature between said discs is rapid.

13. A relay comprising a body assembly, first and second bimetallic snap discs of said body assembly each having two positions of stability, said discs being positioned in said body so that they tend to move in opposite directions in response to similar temperature changes, operator means connecting said discs and maintaining them in the same position with respect to each other and causing them to simultaneously snap between their two positions of stability, one of said discs producing a greater force on said operator means than the other of said discs when said discs are at substantially equal temperatures, heater means operable to heat said first disc to a temperature higher than said second disc, at least one of said discs having an operating temperature when free of restraint which is not reached during normal operation, said one disc applying a force to said operator means which is in the same direction under all temperatures normally encountered.

14. A relay as set forth in claim 13 wherein both of said discs apply a force to said operator means in the same direction under normal disc temperatures encountered.

15. A relay as set forth in claim 13 wherein both of said discs apply forces to said operator means in a direction toward the other disc under all temperatures normally encountered.

16. A relay as set forth in claim 15 wherein said discs are imperforate and said operator means is an elongated bumper positioned between said discs and guided by said body assembly, one end of said bumper engaging each of said discs.

17. A relay as set forth in claim 16 wherein said body assembly includes opposed surfaces with one engaging each of said discs adjacent to its periphery to resist movement of the adjacent periphery in a direction away from the periphery of the other disc, said body assembly being free of means tending to prevent movement of the peripheries of said discs toward each other.

18. A relay as set forth in claim 13 wherein said discs having operating temperatures when free of restraint above the temperatures of said discs normally encountered by said relay.

19. A relay as set forth in claim 13 wherein said heater means is located between said disc substantially adjacent to said first disc, and said first disc moves away from said heater means in response to operation of said heater means thereby reducing the rate of heat transfer from said heater means to said first disc while said heater means continues to operate.

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,582,853 Dated June 1, 1971  
Inventor(s) Rexford M. Morris

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the ABSTRACT, line 2, insert "are" after "discs".  
Column 5, line 35, delete "to" after "temperature".  
Column 6, line 31, change "changed" to -- changes -- .  
Claim 8, line 61, change the numeral "9" to -- 7 -- .

Signed and sealed this 2nd day of November 1971.

(SEAL)  
Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

ROBERT GOTTSCHALK  
Acting Commissioner of Patents