

[54] **PROTECTOR/INDICATOR USING PTC HEATER AND THERMOSTATIC BIMETAL COMBINATION**

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[57] **ABSTRACT**

An indicator and/or protector uses a PTC heater and a bimetallic device in combination. As an indicator, power is passed through a PTC pill, the pill being thermally coupled to the bimetallic device. Upon sufficient transfer of heat from the pill to the bimetallic device, a spring biased flag which is latched by the bimetallic device becomes unlatched and provides an indicator of this condition. The flag must be manually reset. A further embodiment includes the bimetallic device as a portion of a switch wherein, when the snapping temperature of the bimetallic device has been reached, the switch can be opened, thereby providing a protection function in addition to the indicator.

[52] U.S. Cl. 337/79, 337/77

[51] Int. Cl. 337 107, H01h 71/04, H01h 61/02

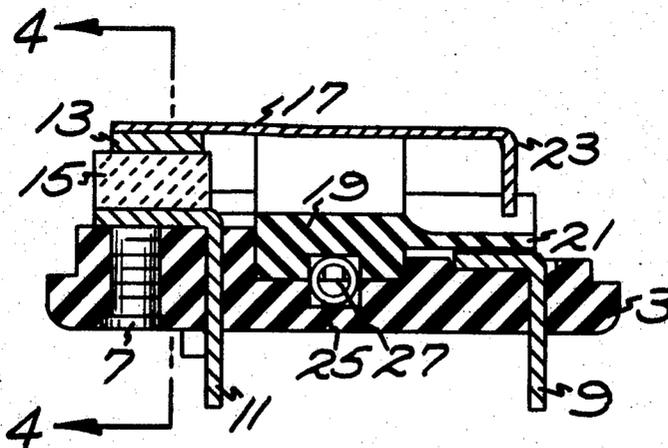
[58] Field of Search 337/77, 78, 79, 107, 332,
 337/376, 417

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7 Claims, 9 Drawing Figures



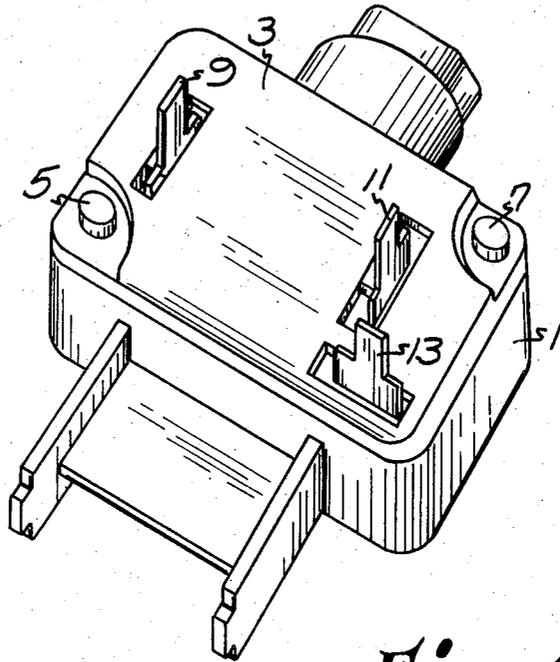


Fig. 1.

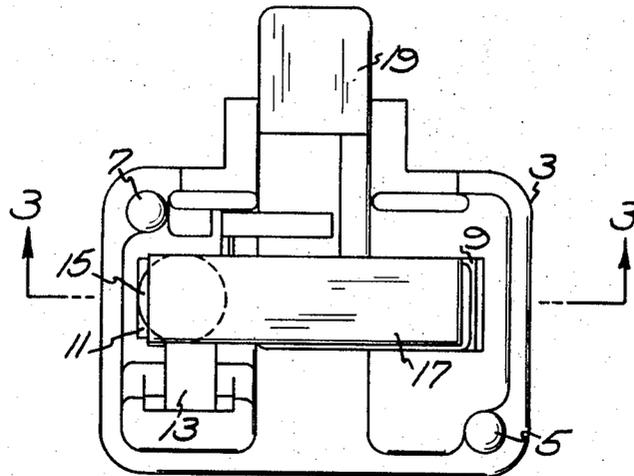


Fig. 2.

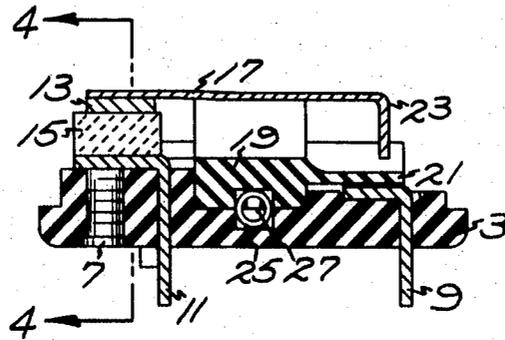


Fig. 3.

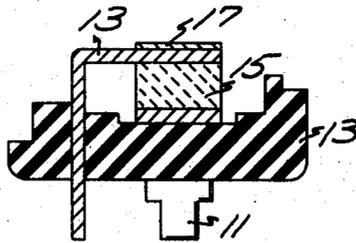


Fig. 4.

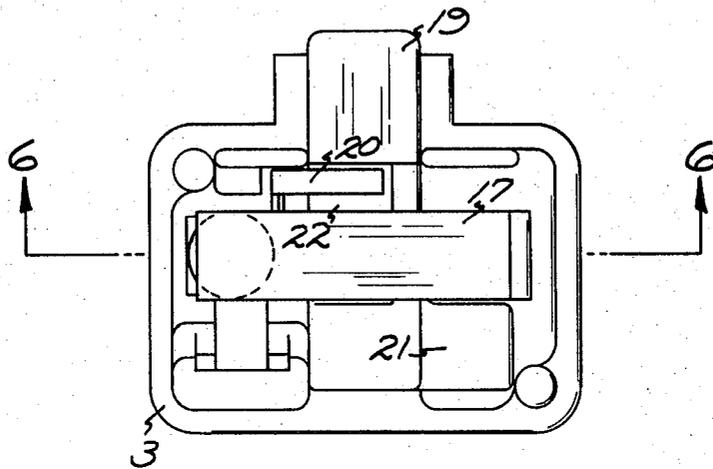


Fig. 5.

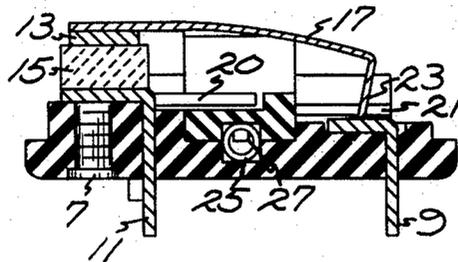


Fig. 6.

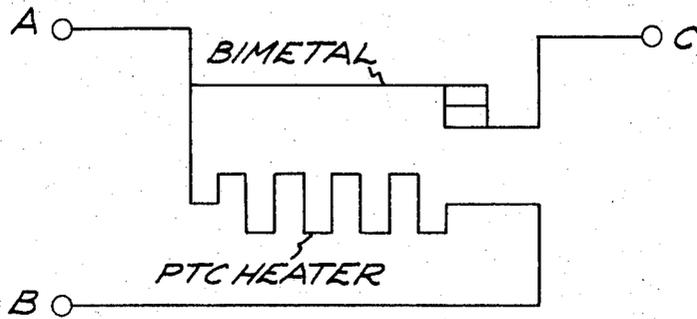


Fig. 7.

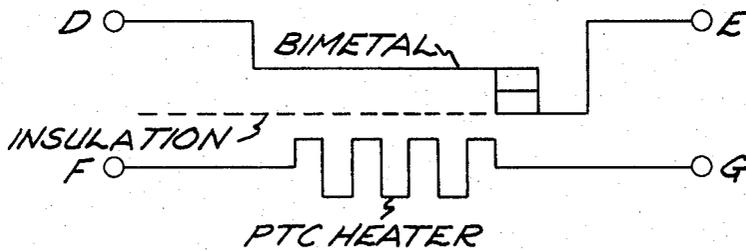


Fig. 8.

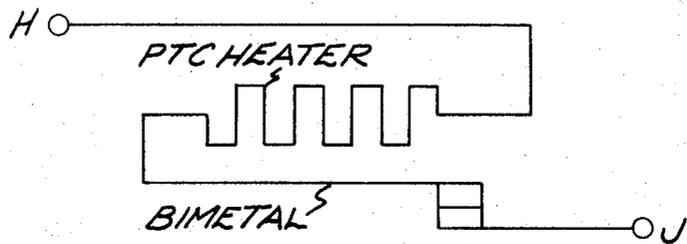


Fig. 9.

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PROTECTOR/INDICATOR USING PTC HEATER AND THERMOSTATIC BIMETAL COMBINATION

This invention relates to an indicator and/or protector for use in conjunction with electric circuits and, more specifically to a bimetallic element controlled by a PTC pill for unlatching a latched spring biased indicator and/or providing a protection function.

In protection circuitry and particularly motor protection circuitry, it is desirable to provide manually resettable indicators and/or protection devices. Manually resettable indicators are desirable in protective circuits having an automatic reset capability so that it can be determined whether an alarm condition was present at any time. The manually resettable protection circuit is desirable in conjunction with the indicator so that the location of the alarm condition is readily apparent. In accordance with one prior art device, the above was accomplished by providing a voltage responsive heating element, the heater requiring the use of many turns of relatively fine resistance wire. This wire was not only difficult to handle, but also lacked physical stability when placed next to a bimetallic element. Devices of this type, though operative, were difficult to manufacture and of relatively high cost. It was also not possible to place a sufficient length of resistance wire within the enclosure to allow full line voltage to be applied across the heater. This necessitated an external ballast resistor of sufficient wattage to dissipate the excess power. Also, fragility of the resistance wire and maintaining of its physical position within the enclosure caused a problem.

In accordance with the present invention, the above problems of the prior art are minimized by the use of a PTC heater used in conjunction with a bimetallic element, the bimetallic element providing a latching function for a spring biased flag. Upon a predetermined movement of the bimetallic element due to heating by the PTC heater, the latching action ceases and the flag or indicator is biased into its indicating position. The indicator is reset by manually relatching it after the bimetallic element has cooled sufficiently. As an alternative embodiment, the bimetallic element can also be a portion of a switch wherein sufficient movement of the bimetallic element also opens the switch to provide a protection function.

It is therefore an object of this invention to provide an indicator and/or protector for use in protective circuits and the like.

It is still a further object of this invention to provide a normally latched indicator which is unlatched by a PTC heater controlled bimetallic element.

It is yet a further object of this invention to provide an indicator and/or protector having a heating element which maintains its physical position relative to a bimetallic element.

The above objects and still further objects of the invention will become immediately apparent to those skilled in the art after consideration of the following preferred embodiments thereof, which are provided by way of example and not by way of limitation wherein:

FIG. 1 is a view in elevation of the protector/indicator in accordance with the present invention;

FIG. 2 is a top view of the protector/indicator of FIG. 1 with the cover removed in the unlatched condition;

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FIG. 3 is a view taken along the line 3—3 of FIG. 2;

FIG. 4 is a view taken along the line 4—4 of FIG. 3;

FIG. 5 is a view as in FIG. 2 in the latched condition;

FIG. 6 is a view taken along the line 6—6 of FIG. 5;

FIG. 7 is a circuit diagram of one embodiment of a protector and indicator circuit in accordance with the present invention;

FIG. 8 is a circuit diagram of a second embodiment of a protector and indicator in accordance with the present invention; and

FIG. 9 is a circuit diagram of a third embodiment of a protector and indicator in accordance with the present invention.

Referring now to the figures, there is shown a protector and/or indicator having a cover secured to base 3' by means of stakes 5 and 7. A plurality of terminals 9, 11 and 13 extend through apertures in the base 3, the terminals then being staked to permanently affix them in the base. The terminals 11 and 13 are utilized for the indicator operation, terminal 9 being used only for the protector function.

Referring now to FIGS. 2-4, there is shown the protector/indicator with the cover 1 removed, the indicator being in the unlatched state. The terminal 11 is coupled to one side of a PTC pill 15, the other side of the PTC pill being coupled to terminal 13. A bimetallic blade 17 is bonded to the pill or heater 15 and is thermally coupled thereto. The blade can be either of the creep type or snap action type, these being well known in the art. A flag 19 is positioned in a groove in the base 1 and is slidable in the groove. The flag is shown in its extended position in FIGS. 2-4. The flag 19 includes a dog leg portion 21, better shown in FIG. 3 which is normally latched by the finger 23 of blade 17 but is shown in the unlatched position. This will be explained in more detail hereinbelow. The flag 19 is moved into the extended or alarm position by means of a spring 25 positioned in a groove in the base 3 by urging a protrusion 27 depending from the flag 19. The flag 19 is held in the groove by means of a finger 20 positioned in a depression 22, the finger 20 being integral with the terminal 11.

Referring now to FIGS. 5 and 6, there is shown the protector/indicator in the latched condition. When in the latched condition, the flag 19 is pushed inwardly into the base 3 whereupon the finger 23 of blade 17 latches against the dog leg portion 21 of the flag. In this condition, the spring 25 is pushing against the protrusion 27 and the finger 23 is contacting the terminal 9 for use in the protection embodiment of the invention.

In operation, the flag 19 is normally set in the latched state as shown in FIGS. 5 and 6. The finger 23 contacts the terminal 9 in the event current is to pass through the bimetallic element 17 as will be explained hereinbelow. The spring 25 is positioned in a groove in the base 3 to force the protrusion 27 and the flag 19 outwardly. Upon sensing of an alarm condition the PTC heater 15 heats up the bimetallic element 17 until it either creeps above or snaps above the dog leg 21, as the case may be. At this time, the latch on the dog leg 21 by the finger 23 is removed and the flag is urged forwardly by the bias on the protrusion 27 by the spring 25. The flag can

now only be manually reset. Also, in the protector embodiment, since the dog leg 21 has now moved beneath the finger 23, the finger cannot make contact with terminal 9 without manual reset. It should be noted the creep type element 17 will normally be used when only the indicator function is desired. Otherwise the snap type device would normally be used.

Referring now to FIG. 7, there is shown a circuit diagram of one embodiment of a protector/indicator in accordance with the present invention. In this embodiment, current to a load would flow from A TO C through the bimetal element and some current would flow from A to B through a PTC heater. When excessive current is flowing to A, the PTC heater will cause the bimetal element to curve upwardly and open the circuit from A to C. Referring to FIGS. 1-6, A could be terminal 13, B could be terminal 11 and C could be terminal 9.

Referring now to FIG. 8, there is shown a second circuit diagram. Here current to a load flows from terminals D to E through a bimetal element. Current to the PTC heater flows in a separate circuit from F to G. The heater and bimetal element are electrically but not thermally isolated by insulation placed therebetween.

Referring now to FIG. 9, there is shown a third circuit diagram. Here the PTC heater and the bimetal element are connected in series between H and J. In all of the embodiments of FIGS. 7-9, the bimetal element and PTC heater are thermally coupled.

It can be seen that there has been provided a protector and/or indicator which readily accomplishes the objects set forth above.

Though the invention has been described with respect to specific preferred embodiments thereof, many variations and modifications will immediately become apparent to those skilled in the art. It is therefore the intention that the appended claims be interpreted as broadly as possible in view of the prior art to include all such variations and modifications.

The PTC heater not only avoids the limitations of the prior art resistance wire but additionally is more efficient since once it heats up it goes into a high resistance mode where an equilibrium is achieved with the current passing therethrough limited to a trickle.

What is claimed is:

1. An alarm indicator which comprises,

- a. a base member,
- b. indicator means positioned in said base member biased to extend out of said base member,
- c. latching means secured to said base member for normally latching said indicator means in said base member, said latching means being a bimetallic device,
- d. a PTC heater, thermally coupled to said latching means, for causing said latching means to unlatch said indicator means responsive to a predetermined condition of said heater,
- e. means to apply current across said heater,
- f. a load terminal, and
- g. a switch connected in series with said load terminal, said latching means forming a portion of said switch.

2. An alarm indicator which comprises,

- a. a base member,
- b. indicator means positioned in said base member biased to extend out of said base member,
- c. latching means secured to said base member for normally latching said indicator means in said base member,
- d. a PTC heater, thermally coupled to said latching means, for causing said latching means to unlatch said indicator means responsive to a predetermined condition of said heater,
- e. means to apply current across said heater, and
- f. a load terminal and a switch connected in series with said load terminal, said latching means forming a portion of said switch, said load terminal being electrically isolated from said PTC heater.

3. An alarm indicator which comprises,

- a. a base member,
- b. indicator means positioned in said base member biased to extend out of said base member,
- c. latching means secured to said base member for normally latching said indicator means in said base member, said latching means being a bimetallic device,
- d. a PTC heater, thermally coupled to said latching means, for causing said latching means to unlatch said indicator means responsive to a predetermined condition of said heater,
- e. means to apply current across said heater, and
- f. a load terminal, and a switch connected in series with said load circuit, said latching means forming a portion of said switch, said switch being electrically isolated from said PTC heater.

4. An alarm indicator comprising:

- a base member,
- indicator means mounted on said base member for reciprocal motion and biased to extend out of said base member,
- a thermally responsive latching means disposed on said base member and adapted to prevent said indicating means from extending out of said base member when said latching means is in a latched position,
- a PTC heater thermally coupled to said latching means for causing said latching means to unlatch said indicating means responsive to a predetermined condition of said heater, and
- terminal means to apply current across said PTC heater.

5. An alarm indicator according to claim 4 in which said latching means comprises a bimetal member having two ends one end of which is electrically connected to one of said terminal means, a stationary contact mounted on the base, the other end of the bimetal member engageable with said stationary contact when the indicator means is latched.

6. An alarm indicator according to claim 5 in which the indicator means includes at least a portion of electrically insulative material which is interposed between the other end of the bimetal member and the stationary contact when the indicator means is unlatched.

7. An alarm indicator according to claim 6 in which the PTC heater is electrically isolated from the stationary contact and bimetal member.

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