United States Patent

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[54] **SELF-RESTORING THERMAL SWITCH WITH MEANS FOR INDICATING PREVIOUS OVERTEMPERATURE CONDITION**
3 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **337/376,** 337/62, 337/66, 337/79, 337/416
[51] **Int. Cl.** **H01h 37/08**
[50] **Field of Search** 337/79, 376, 416, 62, 66

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ABSTRACT: A thermally operated switch which utilizes a bimetallic diaphragm. When an overtemperature condition inverts the diaphragm, the diaphragm pushes up a plunger by a sufficient amount to enable a spring to take over and push the plunger up farther. The spring will then hold the plunger in its up position to provide a visual indication of the existence of the overtemperature condition even after the diaphragm has cooled enough to snap back to its normal position to turn the switch back on.

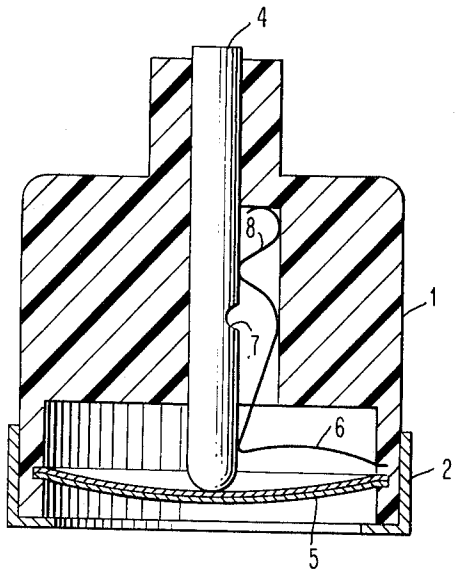


FIG. 1

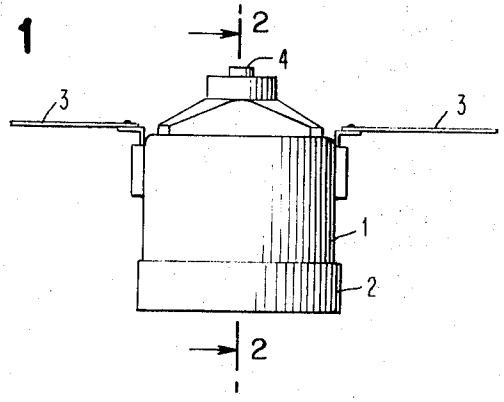


FIG. 2

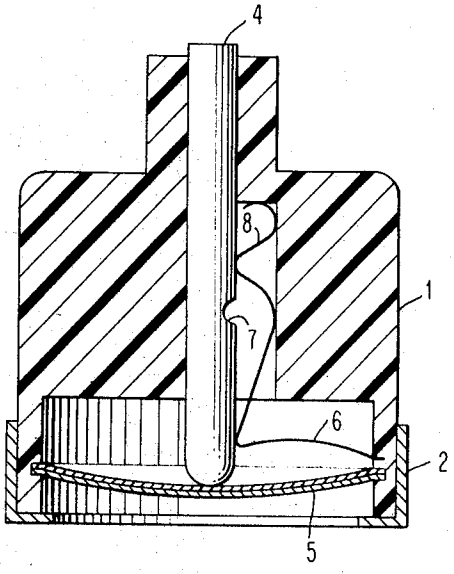


FIG. 3

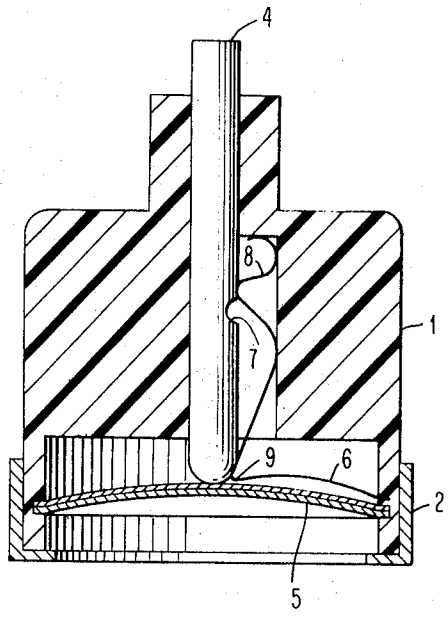
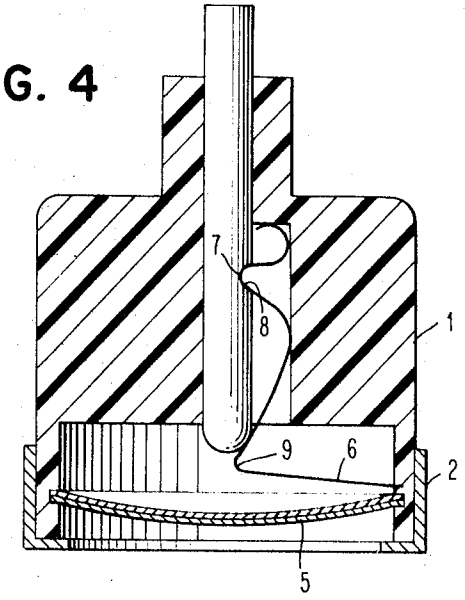


FIG. 4



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SELF-RESTORING THERMAL SWITCH WITH MEANS FOR INDICATING PREVIOUS OVERTEMPERATURE CONDITION

BACKGROUND OF THE INVENTION

This invention relates to thermally operated switches which turn off when an overtemperature condition occurs and which automatically turn on again after the excessive heat has dissipated. More particularly, the invention relates to switches of this type which are provided with visual indicating means to indicate the occurrence of an overtemperature condition.

It is quite common to use, in electrical equipment, switches which will disconnect one or more portions of the equipment from a source of power when the current flowing through the switch exceeds a predetermined limit for a given amount of time. It is also quite common to employ switches which will automatically reconnect the equipment to the source of power after an amount of time sufficient for the heat generated by the overcurrent condition to have dissipated. Such switches are often used in situations where overcurrent conditions (or overtemperature conditions which are due to some other cause) are generally of a transient nature and where it would be wasteful of such resources as time and manpower to require outside intervention to restore power to the unit in question. Systems which utilize the automatically restoring switches also typically have one or more main switches which will permanently disconnect the source of power in the event of an exceptionally heavy or lengthy current (or temperature) overload. This "permanent" disconnection will remain until some outside intervention is supplied to reconnect the source of power after the cause of the overtemperature condition has been remedied.

During the course of routine maintenance of electrical equipment, it is desirable to be able to locate potential problems before the problems become serious. Identification of potential problems would be made easier if a record could be kept of those portions of the equipment wherein overtemperature conditions had occurred during a period of time. However, the self-restoring switches commonly used in the prior art provide no simple means for identifying those switches which had been tripped by a previous transient overtemperature condition.

It is therefore an object of this invention to provide a thermally operated, self-restoring switch which will provide a readily identifiable indication of a previous overtemperature condition.

It is a more particular object to provide such a switch that is simple and inexpensive to manufacture and which will be comparable in size to presently used self-restoring thermal switches.

Another related object of the invention is to provide a switch with the above characteristics wherein the means which indicates the previous occurrence of an overtemperature condition is easily reset after its condition has been noted.

BRIEF DESCRIPTION OF THE INVENTION

The above and other objects are accomplished in accordance with one embodiment of this invention by providing a thermally operated diaphragm-type switch which has a visual indicator which pops up when an overtemperature condition occurs, said indicator remaining in its up position even after the switch has reset itself. When the switch diaphragm is heated excessively, as by an overcurrent condition or component failure, the bimetallic diaphragm inverts and pushes up on the indicating rod. In the preferred embodiment of this invention, there is a single spring within the housing of the switch. When the diaphragm inverts, the indicating rod is raised a sufficient amount so that a portion of the spring will protrude underneath the rod and drive it upward still further. When the indicating rod has travelled upward by a sufficient amount, a bulge in the spring will fall into a notch in the rod to hold it up in its indicating position. During the course of routine maintenance of the equipment, the fact that an excessive heat condition had previously occurred will be shown by the indicating rod which can then be reset by manually pushing it down against the tension of the spring.

The most important feature of this invention is that it provides, in a compact and inexpensive switch, means for detecting the previous occurrence of a transient excessively high thermal condition. A significant advantage of the invention is that it can be implemented by making very small changes in commonly used thermal switches. Thus, manufacture of a switch which embodies this invention would be a relatively simple matter.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

FIG. 1 shows a typical thermal switch embodying the invention.

FIG. 2 is a cross section taken along line 2—2 of FIG. 1 and showing various elements of this invention when the indicator is in its nonindicating position.

FIG. 3 is a view similar to that of FIG. 2 showing the state of the switch when the bimetallic diaphragm has been inverted due to an excessively high thermal condition.

FIG. 4 is a view similar to that of FIGS. 2 and 3 which shows the indicating rod detented by the spring at its point of maximum travel.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a thermal switch embodying the invention. The housing 1 may be made of plastic or other suitable material. The base 2 of the switch is preferably made of metal and contains the bimetallic diaphragm near its bottom. Also provided are conductive terminals 3 which are connected by means (not shown) within the switch housing 1 to the bimetallic diaphragm at the base of the switch. When the switch is used to protect electrical equipment, the terminals 3 are utilized to connect the switch between the equipment to be protected and the source of power. Each of the elements 1, 2 and 3 mentioned above are well known in the thermal switch art and need not be further described herein. Also shown is a plunger 4 which fits within the switch housing and pops up when a high thermal condition occurs. The plunger 4 is shown in its down or nonindicating position in FIG. 1.

FIG. 2 shows a cross-sectional view of the switch shown in FIG. 1 so that additional details of the invention may be seen and described. Details relating to the exact manner in which electrical current flows through the switch and the manner in which the switch functions to disconnect (and then reconnect) the electrical apparatus from its source of power are well known in this art and are not explicitly shown in any of the drawings. The cross-sectional view of FIG. 2 shows the switch housing 1, the base 2, the indicating plunger 4, the bimetallic diaphragm 5 and a spring 6. All of the elements shown in FIG. 2 are shown in their "normal" condition; i.e., the condition that they would be in if no excessively high thermal condition had occurred. In its normal nonindicating position, the plunger 4 rests atop the diaphragm 5. The plunger is held in this position by frictional forces acting between the plunger and the switch housing 1. The frictional forces are enhanced by the pressure of the spring 6 against two points of the plunger. The plunger also has a notch 7 and the spring has a protrusion 8. The notch in the plunger and the protrusion in the spring coact in a manner which will be described below with reference to FIG. 4.

Referring to FIG. 3, the switch is again shown in cross section. In FIG. 3, the bimetallic diaphragm 5 is shown to have become inverted due to excessive heat cause, for example, by an overcurrent condition. The inversion of the diaphragm will have disconnected the electrical equipment from its source of power by means (not shown) which are well known in the art. The inversion of the diaphragm will also have raised the indicating plunger 4 by an amount that is sufficient for a portion

9 of the spring 6 to move between the plunger 4 and the diaphragm 5. The tension in the spring 6 at its curved portion 9 will then tend to push the plunger 4 up still farther so that it will protrude far enough above the housing 1 of the switch to provide a readily identifiable visual indication of the high thermal condition. The extra drive provided by the spring 6 is desirable because the upward motion of the plunger 4 which would be produced solely by the inversion of a typical bimetallic diaphragm 5 would not raise the plunger a sufficient amount to enable easy visual recognition of the fact that it is in its "indicating" position. As is also shown in FIG. 3, the bottom of the plunger 4 may be rounded if desired to facilitate the interposition of the spring 6 between the plunger and the bimetallic diaphragm.

FIG. 4 again shows the switch in cross section. FIG. 4 depicts the condition of the switch after the diaphragm 5 has cooled sufficiently to return to its normal position thereby permitting automatic reconnection of the electrical equipment to its source of power. However, although the switch has been reset (i.e., turned back on) the spring 6 has driven the plunger 4 upward to the position shown in FIG. 4 until the spring protrusion 8 locked into the notch 7 on the indicating plunger. The spring protrusion 8 acts as a detent to hold the plunger 4 in its indicating position to permit easy visual identification of the fact that the switch had once been tripped by a high thermal condition. The visual indicator can be easily reset at any time merely by pushing it down against the spring tension until it again assumes the position shown in FIG. 2.

It will of course be clear to those skilled in the art that various modifications can be made to the above-described preferred embodiment of this invention. For example, it might be desirable to enlarge the bottom of the indicating rod 4 (or to attach a larger flange at or near the bottom of the rod) in order to provide an additional positive means for preventing any possibility of the indicating rod being accidentally pulled out from the switch housing. However, it is worthy to note that the use of such an enlarged or flanged bottom on the indicating rod would probably increase the cost and the complexity of the manufacturing operation of the switch.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In a thermal switch for electrical equipment, said switch comprising (1) a temperature-sensitive curved diaphragm which is normally curved in a first direction, which reverses its direction of curvature when heated to a temperature above a predetermined upper threshold, and which returns to its normal direction of curvature when it cools to a temperature below a predetermined lower threshold and (2) means for turning off said switch when said diaphragm reverses its direction of curvature and for turning said switch back on when said diaphragm returns to its normal direction of curvature; the improvement comprising:

movable indicating means capable of assuming an indicating position and a nonindicating position;

said indicating means, when it is in its nonindicating position, being in close proximity to said diaphragm so that a reversal of the direction of curvature of said diaphragm will drive said indicating means in a direction away from said diaphragm; and

a driving spring mounted within said switch in such manner that, when a reversal in the direction of curvature of said diaphragm drives said indicating means away from said diaphragm, a first portion of said spring is forced between said indicating means and said diaphragm to drive said indicating means to its indicating position.

2. The thermal switch of claim 1 further comprising:

detent means to hold said indicating means in its indicating position when said switch is automatically turned back on.

3. The thermal switch of claim 2 wherein said detent means comprises:

a notch in said indicating means and a tensioned bulge in a second portion of said spring;

said tensioned bulge falling into said notch to hold said indicating means in its indicating position by spring tension.

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