United States Patent

[11] **3,573,696**

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[21] Appl. No. **679,003**
[22] Filed **Oct. 30, 1967**
[45] Patented **Apr. 6, 1971**
[73] Assignee **Sylvania Electric Products Inc.**

[54] **THERMOSTATIC SWITCH**
9 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **337/89,** 337/75, 337/359
[51] **Int. Cl.** **H01h 37/04,** H01h 37/54
[50] **Field of Search** 337/362, 75, 27, 356, 359, 55, 70, 75, 89, 342, 343

[56] **References Cited**

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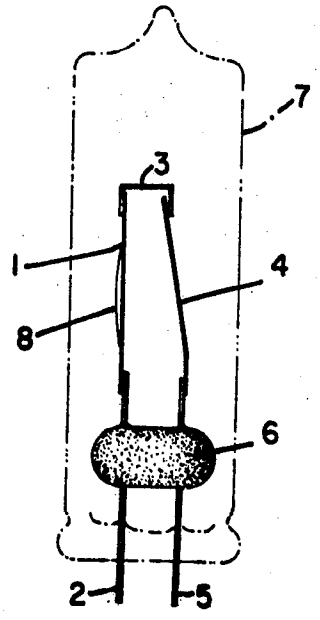
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3,278,705	10/1966	Dennis	337/362
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ABSTRACT: A thermostatic switch comprising a thermal snap-action element which is constraining, and in electrical contact with a spring element. On overheating, the thermal element snaps away from, and releases, the spring element, thereby breaking the electrical circuit. The released or unstrained position of the spring element is spaced from the thermal element in order to prevent electrical contact when the latter returns to its normal position.



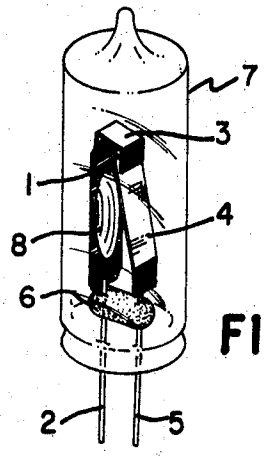


FIG. 1

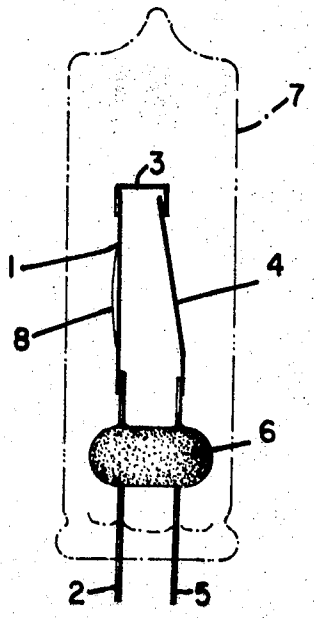


FIG. 2

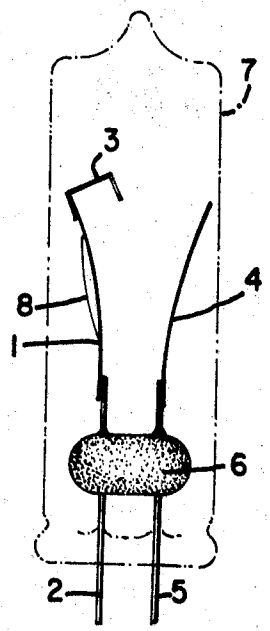


FIG. 3

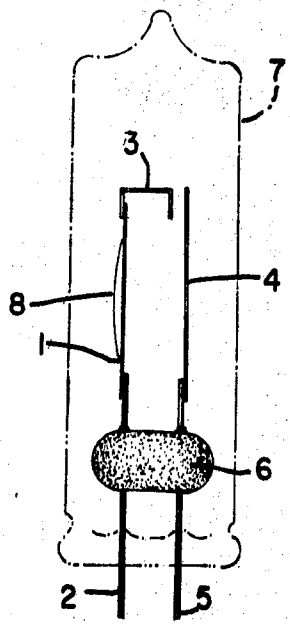


FIG. 4

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THERMOSTATIC SWITCH

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to protective devices for permanent or nonpermanent interruption of an electrical circuit when the control element of the device attains a predetermined temperature, resulting either from current overload or thermal rise. More particularly, it relates to such devices which are used with electrical equipment in which overheating can be destructive to such equipment. An example of such equipment is a fluorescent lamp ballast.

2. Description of the Prior Art

Current-sensitive fuses or circuit breakers are generally unsuitable for the protection of the above-mentioned type of equipment since they interrupt the electrical circuit only when an excessive amount of current flows. It is possible for an electrical apparatus such as a lamp ballast to overheat without a significant increase in current because of a redistribution of the heat generated by internal wattage losses.

Thermal protective devices which are based on eutectic alloys designed to melt at a predetermined control temperature are not sufficiently reliable, since the melting temperature of such an alloy can increase when the alloy is held at temperature approaching its melting point for long periods of time. This condition exists in an economically designed ballast where the operating temperature is but a few degrees Centigrade below the overheated temperature at which it is desired to interrupt the electrical circuit. Normally, when the ballast overheats, it has reached the end of its useful life and should be replaced before the potting material, such as tar, can melt and drip out of the overheated ballast.

Automatic recycling, thermostatic, bimetal-activated devices, such as shown in U.S. Pat. No. 3,278,705, issued on Oct. 11, 1966 to P. J. Dennis, are quite reliable for the applications mentioned above. However, they are too expensive for the use contemplated herein where, when an electrical apparatus has overheated and activated the control device, signifying an approaching end of useful life, the apparatus, with the control device usually contained therein, is replaced. Thus, the control device need function only once to serve its useful purposes.

SUMMARY OF THE INVENTION

My invention relates to a thermostatic control device which is simple to manufacture and is inexpensive enough to be used in a one-time application, that is, where the device and the electrical apparatus which it controls will normally be replaced when the device has been actuated but once.

The device comprises a thermal snap-action bimetallic element to one end of which a U-shaped latch is joined. Constrained by the latch away from its unstrained position and making electrical contact therewith is one end of a spring arm. When the thermal element is heated above a predetermined temperature it snaps away from and releases the spring arm which returns to its natural unstrained position and the electrical circuit is opened. On cooling, the thermal element may return to its original position but the electrical circuit remains open since the spring arm is spaced from it in its unstrained position and there is then no electrical contact between the thermal element and the unstrained spring arm.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a thermostatic switch in accordance with this invention showing the spring arm in electrical contact with the latch.

FIGS. 2, 3 and 4 are side views of the same device with the envelope in phantom, showing the electrical elements in, respectively, the normal latched position, the overheated tripped position and the cooled returned position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1, lead-in wires 2 and 5 are spaced apart from each other and are supported by, and protrude through, insulator 6 which is, typically, a glass bead. One end of thermal element 1 is fastened, such as by welding, to one end of lead-in wire 2. Element 1 is a snap-acting, laminated, thermostatic metal, such as shown in U.S. Pat. No. 3,278,705, supra, which is comprised of metal laminae having different coefficients of thermal expansion. Element 1 has a dish shaped portion 8 thereon which causes the snap action of the element when it is heated above a predetermined temperature. Latch 3 is roughly U-shaped and is made, typically, of stainless steel. The first leg of latch 3 is joined, such as be welding, to the other end of element 1 and the second leg of latch 3 faces spring arm 4. Spring arm 4 is made, typically, of spring-tempered high-carbon steel and is joined at one end, such as by welding, to that end of lead-in wire 5 which protrudes from insulator 6, in approximately the same direction as does the end of lead-in wire 2 to which element 1 is joined. Spring arm 4 is welded to lead-in wire 5 in such a position that the free end of arm 4 is adjacent to, but spaced from, the facing leg of latch 3. In a specific example of the invention the offset space therebetween at room temperature was 1/16 inch when arm 4 was in an unstrained position. To render the device functional, the free end of arm 4 is biased toward, and inserted behind the adjacent leg of, latch 3. Thus the end of arm 4 is constrained by latch 3 and there is electrical contact therebetween. In the specific example mentioned above, arm 4 underlay the leg of latch 3 for a distance of 0.030 inch at room temperature.

The device, as shown in FIG. 1 and 2, is in normal operating position, with arcuate arm 4 in electrical contact with latch 3. When protectively installed in an electrical apparatus, the calibration or snap temperature of element 1 is generally several degrees Centigrade above the normal operating temperature of the electrical apparatus. The device must also be installed in thermal register with the apparatus, that is, in a position where heat developed in the apparatus will be communicated to the device. In addition, the device must be electrically connected with the apparatus so that a severance of the electrical connection between arm 4 and latch 3 will interrupt the electrical power to the apparatus. Thus, although the device is usually connected in series with the electrical apparatus, it can be separately connected to an electrical relay or circuit breaker which, when tripped, will interrupt power to the apparatus.

In one specific example the device was installed inside, and in series with, a fluorescent lamp ballast, abutting the ballast metal cover. The normal operating temperature of the ballast cover was about 90° C. and the device had a calibration temperature, within one or two degrees, of 105° C. Although a ballast of this type is normally expected to operate satisfactorily for years, it can tend to overheat as it nears the end of its useful life. When overheating occurs to the extent that element 1 is heated to about 105° C., the device will trip, as shown in FIG. 3, and terminate the current therethrough thereby shutting off the power to the electrical apparatus. At the instant of tripping, element 1 snaps and laterally displaces latch 3 away from arm 4 for a sufficient distance to release arm 4. At the instant of release, arm 4 springs away from latch 3 beyond its unstrained position, as shown in FIG. 3, but rapidly returns to its offset unstrained position as shown in FIG. 4.

The distance by which arm 4 underlays the leg of latch 3, at room temperature, must be sufficient to maintain the constraint and electrical contact therebetween when the device is heated from room temperature to the normal ballast operating temperature of 90° C., since thermostatic element 1 increasingly deflects away from arm 4 as the device is heated. However, the underlaying distance must not exceed that which will permit release of arm 4 when element 1 snaps open. Thus, in the example, although arm 4 underlay latch 3 for a distance of about 0.030 inches at room temperature, at the operating tem-

perature of 90° C., this distance was reduced to about 0.020 inch, due to the deflection of element 1 away from arm 4. And the snap deflection of about 0.030 inch for latch 3 was sufficient to release arm 4.

When the device has cooled back to room temperature, as a result of the cessation of electrical power to the apparatus, arm 1 and latch 3 return to their normal room temperature positions, but the circuit remains open because of the separation between arm 4 and latch 3, as shown in FIG. 4.

Latch 3 and spring arm 4 may have a metallic coating thereon, such as silver, which would effectively lower the contact resistance between their mating surfaces. Lowering the contact resistance essentially allows a higher contact rating for the device and better reliability.

Another advantage of this invention is that the contact pressure increases during heating of the device thereby lowering the contact resistance, until overheating snaps element 1 and breaks the contact. If desired, the device can be manually reset by physically relatching spring arm 4 and latch 3.

Envelope 7 may be made of any suitable material, such as glass or plastic which supports and encloses the device but which does not interfere with its mechanical and electrical action. When the envelope is made of glass, hermetic sealing may be conventionally accomplished.

It is apparent that modifications and changes can be made within the spirit and scope of the instant invention, but it is my intention to be limited only by the appended claims.

I claim:

1. A thermostatic switch for one-time operation comprising: a thermostatic snap-acting substantially flat bimetallic element having a snap-action-causing dish-shaped portion thereon; means supporting said element a latch affixed to the free end of said element; and an electrically conductive resilient spring arm spaced in its unstrained position from said latch, one end of said latch constraining, and making electrical contact, one end of said spring arm.

2. The switch of claim 1 wherein said spring arm is released by said latch when said element snaps open.

3. The switch of claim 2 wherein said latch is substantially U-shaped and one leg of said latch is affixed to said element and the other leg constrains, and makes electrical contact with, one end of said spring arm.

4. The switch of claim 6 wherein said element is designed to open at a predetermined temperature, thereby breaking the electrical contact between said latch and said spring arm, and said electrical contact remains broken when said element snaps back to its previous position.

5. The switch of claim 1 in combination with an electrical apparatus wherein the snap temperature of said element is several degrees Centigrade above the normal operating temperature of said apparatus.

6. A thermostatic switch comprising: a thermostatic snap-acting substantially flat bimetallic element having a snap-action-causing dish-shaped portion thereon; means supporting said bimetallic element; latch means on the free end of said bimetallic element; an electrically conductive resilient spring arm; support means spacing said spring arm from said bimetallic element such that the free end of said spring arm is offset from said latch when said spring arm is in its unconstrained position; said latch means in the circuit-closed position constraining and making electrical contact with, the free end of said spring arm at one end of said latch means.

7. The switch of claim 6 wherein said latch means is substantially U-shaped.

8. The switch of claim 7 wherein one leg of said latch means constrains and is in electrical contact with, one end of said spring arm.

9. A thermostatic switch for one time operation comprising: two substantially parallel spaced-apart lead-in wires; insulative support means for said wires; a thermostatic snap-acting substantially flat metallic element one end of which is mounted on one of said lead-in wires, said metallic element having a snap-action causing, dish-shaped portion thereon; a latch mounted on the opposite end of said metallic element; and an electrically conductive resilient spring arm mounted on the other of said lead-in wires and offset from said latch when in its unconstrained position, said offset distance therebetween being less than about three times the snap deflection of said metallic element, said spring arm being normally held in constrained position by said latch.