Feb. 28, 1950 J. S. ZIMMER 2,499,208

THERMALLY ACTUATED SWITCH

Filed April 21, 1948

Fig. 2.

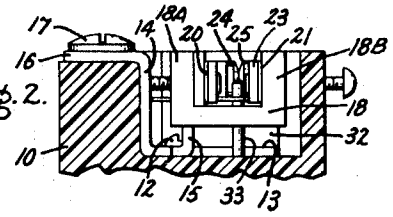



Fig. 1.

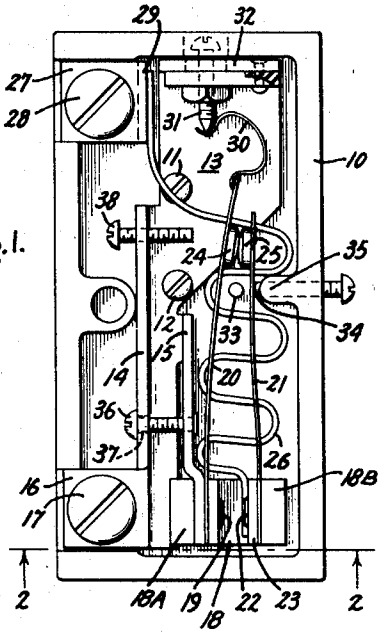



Fig. 3.

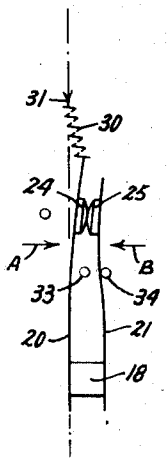



Fig. 4.

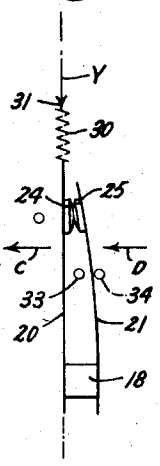



Fig. 5.

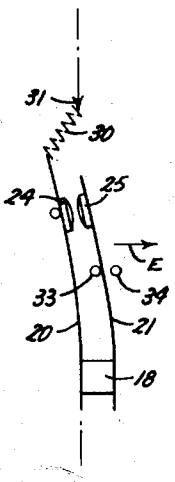
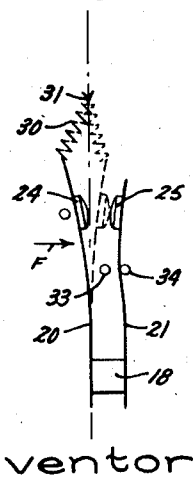



Fig. 6.




Inventor:
John S. Zimmer,
by Claude A. Mott
His Attorney.

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# UNITED STATES PATENT OFFICE

2,499,208

## THERMALLY ACTUATED SWITCH

John S. Zimmer, Scotia, N. Y., assignor to General Electric Company, a corporation of New York

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5 Claims. (Cl. 200—122)

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My invention relates to circuit-interrupting devices, and more particularly to thermally actuated switches.

The main object of my invention is to provide a thermally actuated switch of relatively simple construction and adapted to handle a wide range of temperature changes.

Another object is the provision of a switch of the type above referred to in which the initial and final contact pressure is constant up to the instant the contacts open, thereby to eliminate arcing between said contacts.

In practicing my invention, I provide a pair of substantially similar bimetal strips electrically insulated from each other and mounted, at adjacent ends, in substantially parallel spaced relation upon a supporting base. Complementary contacts are secured to the free ends of the strips, and they are so secured that a predetermined pressure exists between the contacts. The two strips, thus disposed in parallel spaced relation, are so arranged that an increase in temperature thereof will cause both to flex in the same direction while maintaining constant pressure between the contacts. A resilient member, such as a hair-pin spring, connected between the base and the free end of one of the strips provides a snap action upon separation of the contacts.

Other objects and advantages of my invention will become apparent by reference to the following description and accompanying drawing in which Fig. 1 is an illustrative embodiment of a switch mechanism embodying my invention; Fig. 2 is a fragmentary view in section taken along line 2—2 of Fig. 1; and Figs. 3, 4, 5 and 6 are diagrammatic representation of the switch showing sequentially the various significant positions of the parts during a complete operation.

Referring to the drawing, I provide a base 10 of electric insulating material, shown here as a case for the support of the components of the switch mechanism. Attached to the base 10 by screws 11—12 is an electrically conductive member 13. The member 13 is provided with a portion defining a U having arms 14—15 and a portion 16 extending outwardly from the arm 14. The extended portion 16 serves to engage a screw 17 and this combination provides a terminal for connection to an electric circuit (not shown).

The arm 15 has secured to it a U-shaped insulating member 18 comprising a pair of arms 18A—18B and is attached to the arm 18A by means of a rivet 19, the rivet serving also to secure to the member 18A a bimetal member 20. The right-hand arm 18B has secured to it

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a cooperating bimetal member 21 which is fastened in place by a rivet 22 through a metal plate 23. The bimetal members 20—21 have attached to them a pair of complementary contacts 24—25.

The last-named arrangement provided a series connected circuit from the terminal arrangement 16—17 through the arms 14—15, bimetal members 20—21, contacts 24—25, the circuit being completed through a resistance or heater wire 26 attached to the plate member 23 by one end and to a second terminal arrangement comprising a metal member 27 and a screw 28. The metal member 27 is in the form of an angle, one leg 29 of which extends downwardly. It is to this leg that the other end of the wire 26 is secured as by brazing, welding or other suitable means.

In the embodiment of the invention shown, it is contemplated that the switch be utilized as an overload device, the wire 26 being disposed adjacent the bimetal members to provide additional heat under overload conditions so as to actuate said members. However, this arrangement can be utilized for the control of temperature by means of the bimetal members alone by substituting more sensitive bimetal members without departing in any way from the principle of my invention.

The bimetal members are so secured as to provide a predetermied pressure between the contacts 24—25. In this particular arrangement of the strips 20—21, an increase in temperature will cause both strips to deflect in the same direction, that is to the left with respect to the observer. The advantage of the above arrangement will be explained in more detail further along.

Means for imparting a positive make or break, or so-called snap action between the contacts 24—25, is provided by a resilient member, for example, a hair-pin type spring 30 pivotally mounted between a pivotal member 31 and the free end of the bimetal member 20. In the normally closed position of the switch as shown in Fig. 1, the pressure of the spring 30 is slight. However, since the free end of the bimetal member moves through an arc, the distance between the pivot 31 and the free end of the bimetal member 20 decreases as the bimetal member starts its movement to the left, thus increasing the pressure exerted by the spring 30. When the member 20 starts to cross the center line Y or critical position (see Fig. 4) which lies in the plane of a line extending longitudinally from the point of the pivot 31, the aforementioned snap action takes place, as will be presently explained in great-

er detail. In the present embodiment the pivot 31 is supported by an upwardly extending portion 32 of the member 13.

Figs. 3 to 6 illustrate generally the movement of the bimetal members during the occurrence of an increase or change in temperature.

In Fig. 3, the contacts 24—25 are shown in closed circuit position with the bimetal members 20—21 under normal temperature conditions, both bimetal members exerting pressure in the direction shown by the arrows A—B. Assuming a change in temperature occurs, both members 20—21 commence to flex in the direction indicated by the arrows C—D in Fig. 4. This movement is resisted by the spring member 30 but at a decreasing rate as the temperature in the bimetal members 20—21 begins to induce a stronger deflection in said members and they begin to approach a position of unstable equilibrium represented by the center line Y.

As the movement of the bimetal members 20—21 continues to the left, with respect to the observer, they pass the position of unstable equilibrium Y and the pressure of the spring 30 is now added to the pressure produced by the change of temperature in the members 20—21 and a toggle or snap action takes place, the rate of movement of both members 20—21 being increased. However, the member 21 continues to exert a positive pressure on the member 20 until it reaches a stop 33. Thereafter the member 20 abruptly leaves the member 21 under the added pressure of the spring 30 to quickly and cleanly break contact, with a snap, between the contacts 24—25. This arrangement avoids so-called zero pressure between the contacts 24—25.

Zero contact pressure is a condition that exists when utilizing a single bimetal member carrying a contact and arranged to engage a fixed complementary contact. The aforementioned condition occurs when the thermal unit is gradually heated so that motion of same is slow as it draws its attached contact away from the fixed contact and brings about the condition of so-called zero contact when no current flows between the contacts. Thereafter the bimetal starts to cool off and starts its return movement to the fixed contact. This causes the movable contact to oscillate back and forth toward the fixed contact with attendant arcing and destruction of the contact surfaces. The aforementioned condition is not quite as prevalent where the increase in temperature is sudden and high so that fast heating occurs, but it is equally true that overload conditions do occur where the temperature increase is gradual. It is this particular condition which the features of my invention serve to overcome.

Once the contacts 24—25 have separated, the bimetal members 20—21 start to cool off. Since the member 20 is under pressure of the spring member 30, the member 21 starts moving to the right, as indicated by the arrow E, at a greater rate than the member 20 and will reach a second stop member 34. A predetermined time later the member 20 starts its right-hand movement as represented by the arrow F and as the temperature begins to drop the rate of movement increases. When the position of unstable equilibrium Y is reached and the member 20 starts to pass to the right of the position Y, added impetus is given to the member 20 and the same snap action between the contacts 24 and 25 takes place.

While the stop 34 is shown to be an adjustable screw member, a projection 35 could serve equally as well.



Means for adjusting the pressure between the contacts 24—25 is provided by a screw member 36 in engagement with the arm 15. The screw member passes through an aperture 37 in the arm 14 and thus serves to anchor the screw 36. Turning the screw 36 inwardly causes the bimetal member to be pressed against the stop 34 with increasing pressure. Thus a higher temperature or larger current is necessary to overcome this increase in pressure to start the bimetal members 20—21 moving. Rotation away from the observer provides a converse arrangement.

Means for adjusting the reset time of the switch is provided by a screw member 38 threadably engaged with the arm 14 at its upper portion. Turning the screw 38 inwardly shortens the reset time since the pressure to be overcome by the bimetal member 20 is reduced. The pressure between the contacts 24—25 is set at a predetermined value by properly forming the bimetal members before assembling.

The embodiment of my invention as illustrated and described has been selected for the purpose of setting forth the principles involved. It will be obvious that the invention may be modified to meet various conditions for different specific uses and it is, therefore, intended to cover by the appended claims all such modifications which fall within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A thermal responsive switch comprising a pair of thermally deformable cantilever switch members mounted in substantially parallel spaced relation and having at their free ends a pair of complementary switch contacts, said switch members being biased to maintain said contacts in engagement and disposed for like deformation in following relation upon like changes in temperature while maintaining said contacts in engagement under pressure, overcenter spring means connected to one of said switch members, thereby to move said one switch member overcenter with a snap action, and stop means limiting movement of the other said switch member in both directions.

2. A thermally responsive switch comprising a pair of thermally deformable cantilever switch members mounted in substantially parallel spaced relation and having at their free ends a pair of complementary switch contacts in normally closed relation, one of said switch members arranged to lead and the other to follow when both are heated, overcenter spring means connected to said leading switch member, thereby to move same with a snap action, and stop means limiting movement of following switch member in both directions.

3. A thermal responsive switch having a pair of terminals adapted for connection to a source of current, a pair of thermally deformable cantilever strips mounted in substantially parallel spaced relation and carrying at their free ends a pair of cooperating contacts, said strips having proximate ends fixed and electrically insulated one from the other, and being biased to maintain said contacts in engagement and arranged to move in leading and following relation in response to changes in temperature, means for connecting one of said terminals to the fixed end of a first of said strips, a heating element connected between a second of said terminals and the fixed end of said other strip, said element

being disposed in heat conducting relation with said strips, an overcenter spring toggle connected to the free end of the first-named strip and disposed normally to hold both strips on one side of a dead center position but decreasingly to resist the movement of said strips toward said center position in response to a change in temperature of said heating element and then to accelerate the movement of said first-named strip beyond said center position, and a stop member disposed intermediate said strips and arranged to stop following movement of the other strip when the first strip moves overcenter.

4. A thermal responsive switch comprising a pair of elongated thermally deformable cantilever members mounted in substantially parallel spaced relation and carrying at their free ends a pair of cooperating switch contacts, said cantilever members being biased to maintain said contacts in engagement at a predetermined normal temperature and being disposed to deform in leading and following relation when heated while maintaining said contacts in engagement under pressure, and an overcenter toggle member connected to the free end of the leading cantilever member thereby decreasingly to resist movement of said cantilever member as it approaches the dead center position.

5. A thermal responsive switch comprising a pair of thermally deformable cantilever strips mounted in substantially parallel spaced relation



and having at their proximate free ends a pair of cooperating switch contacts, said strips being disposed to deform in response to changes in temperature so that said free ends move in leading and following relation while maintaining said contacts in engagement under pressure, an overcenter spring member having a single stationary point of support, a pivotal connection between said spring member and the movable end of one of said strips, said spring member being arranged to apply a force tending to hold both strips on one side of a dead center position and decreasingly to oppose thermal movement of said strips toward dead center position and thereafter to accelerate said one strip in overcenter movement, and stop means limiting overcenter following movement of the other said strip.

JOHN S. ZIMMER.


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