Nov. 27, 1962 H. D. EPSTEIN 3,066,205

THERMOSTATIC SWITCH

Filed March 16, 1959

FIG. 1.

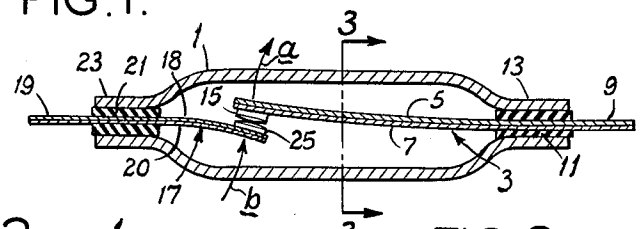


FIG. 2.

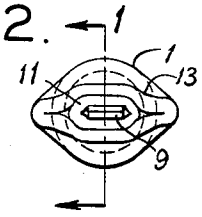


FIG. 3.

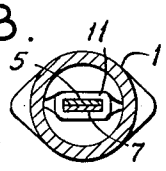


FIG. 4.

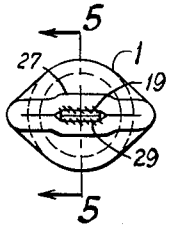


FIG. 5.

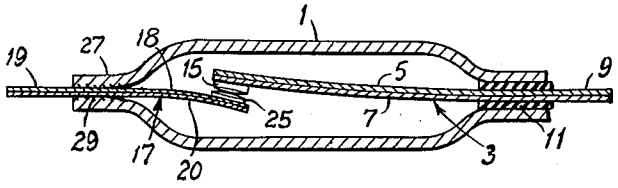
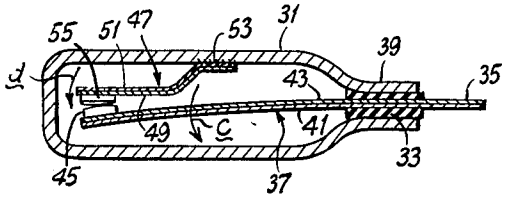


FIG. 6.



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3,066,205

THERMOSTATIC SWITCH

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3 Claims. (Cl. 200—113)

This invention relates to thermostatic switches, and more particularly to switches for motor protection circuits and the like.

Among the several objects of the invention may be noted the provision of a thermostatic switch for motor protection circuits adapted to minimize overswing of temperature caused by high currents such as flow under locked rotor conditions, while at the same time providing for more positive make and break contact action; and the provision of a switch of this class which is simple and compact in form, adapted readily to be located in or on circuits such as motor windings to be protected. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of which will be indicated in the following claims.

In the accompanying drawings, in which several of various possible embodiments of the invention are illustrated,

FIG. 1 is an axial section showing one form of the invention;

FIG. 2 is a right-hand end view of the switch shown in FIG. 1;

FIG. 3 is a cross section taken on line 3—3 of FIG. 1;

FIG. 4 is an end view showing another form of the invention;

FIG. 5 is an axial section taken on line 5—5 of FIG. 4; and,

FIG. 6 is an axial section showing a third form of the invention.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to FIG. 1, there is shown at numeral 1 an elongate tubular switch casing or support composed, for example of metal, although it may be formed of other materials such as an insulating material, if desired. At numeral 3 is shown a first relatively long bimetallic thermostatic strip or blade having bonded components 5 and 7. Component 5 has a lower coefficient of thermal expansion than does component 7. One end of the strip 3 extends from the casing 1 through an encirclement of insulating material 11 to form a terminal 9. The casing 1 is crimped around the material 11, as shown at 13. This anchors strip 3. A contact 15 is carried at the inner free end of the strip 3.

Numeral 17 indicates a second bimetallic strip or blade which is shorter than the strip 3 and extends outward to form a terminal 19. This extension is through an encirclement of anchoring insulating material 21 about which the casing is crimped as shown at 23. Strip 17 has a component 18 having a coefficient of thermal expansion which is lower than the coefficient of thermal expansion of its other component 20. At the end of the strip 17 is carried a contact 25.

The strip 17 has a greater electrical resistance and a lower thermal mass than strip 3, as for example, by making this strip 17 of higher resistance material and shorter or narrower or thinner than strip 3, or any suitable combination of these. The lower thermal mass of strip 17 results in its relatively rapid heating and cooling, as compared with the cooling of strip 3, in response to overload current. It is preferred that strip 17 be shorter than strip 3, whereby its reaction is increased against downward bending in response to pressure between contacts 15 and 25. This accelerates the time at which the switch reaches an opening state under given heating conditions. Nevertheless, this does not interfere with desired delayed switch-closing action, as will appear.

Assume that the device is wired into a circuit supplying a motor winding to be protected under conditions including high overload current, for example locked rotor current. The strip 17, due to its greater resistance, will heat and rise in temperature more rapidly than will the strip 3. Therefore, although strip 3 will warp in the direction shown by dart *a*, strip 17 will warp more rapidly in the same direction, as shown by dart *b*. Strip 17, being short and comparatively stiff, does not have its deflecting movement unduly restricted by reaction from strip 3. This causes contact 25 to tend to overtake contact 15 and temporarily increases the contact pressure between them. This continues until strip 3 rises in temperature sufficiently to increase its rate of recessive movement in the direction of dart *a*. Finally, contact 15 will rapidly separate from contact 25, thus opening the circuit. This final rapid opening action is due to the large free movement of contact 15 (when it moves) offered by the relatively long length of strip 3 and the relatively confined final movement of contact 25 caused by the relatively short length of strip 17. The circuit-opening action or trip is quite rapid and positive.

After the circuit has opened, the strip 17 in the absence of current will cool much more rapidly than will strip 3, due to its considerably lower thermal mass occasioned by the relatively small volume of material contained in it, as compared to the relatively large volume of material contained in the strip 3. Thus, upon cooling, contact 25 is rapidly withdrawn a large distance from contact 15, leaving a comparatively large gap to be traversed by the return movement of contact 15 before the circuit can reclose. Strip 3, having the higher thermal mass, will cool off more slowly, and this fact, coupled with the existence of this greater gap, will provide a relatively long period before reclosure of the circuit will occur. In other words, the retractive movement of contact 25 is more rapid than that of contact 15. Such a condition is advantageous, in that the motor winding thus has increased time within which to cool between cycling events, thereby minimizing temperature rise in the motor winding under cycling conditions.

In FIGS. 4 and 5 is shown another form of the invention, in which all parts that bear the same numbers as in FIG. 1 are the same. The difference in this case exists in the manner in which the casing 1 is crimped at its left-hand end, the insulation at this point being omitted. The metal casing 1 in this construction is crimped directly to the strip 17, as shown at numeral 27, and may be welded thereto as shown at 29. This provides for a heat-conductive connection between them, whereby ambiently applied heat will flow more rapidly to and from strip 17 than strip 3. This also has the effect of making the casing 1 available as a line terminal, if desired. Thus this form of the invention responds effectively to temperature changes caused by ambient heating, as well as such changes caused by flow of current through the strips.

In FIG. 6 is shown another form of the invention, of reduced length. In this example, the metal casing which is cup shaped is shown at numeral 31. Insulation is shown at 33, surrounding the terminal end 35 of the strip 37. The crimping of the casing around the insulation 33 and terminal 35 is shown at 39. The strip 37 has its component of high coefficient of thermal expansion indicated at 43, and the component of relatively low coefficient of thermal expansion at 41. It will be understood

that the strip **37** is comparatively long and has a comparatively large heat mass. It carries at its free end a contact **45**.

At numeral **47** is shown a shorter bimetallic strip, again having a low thermal mass and a relatively greater resistance, designed for comparatively rapid heating upon application of current and comparatively rapid cooling in the absence of current. This strip **47** has a component of relatively high coefficient of thermal expansion shown at **51**, and a component of relatively low coefficient of thermal expansion shown at **49**. One end of the strip **47** is anchored to the casing **31**, as by means of welding **53**. Its other and free end carries a contact **55**. The operation of this form of the invention is simliar to that above described. Upon application of high overload current, strip **47** heats comparatively rapidly and strip **37** comparatively slowly. The resulting motion of the end of strip **37** in the direction *c* is therefore overtaken by the resulting motion of the end of strip **47**, shown at *d*. This temporarily increases the contact pressure. Then as strip **37** heats and its temperature rises, the contact **45** withdraws from contact **55** to open the circuit. The result is immediate and rapid cooling of strip **47**, which sends contact **55** into a position providing a large gap between contacts, which is only slowly closed upon slow recooling of the relatively high heat mass strip **37**. The result is that this form of the invention has the advantages above referred to in connection with the forms shown in FIGS. 1–4. It also has the advantage of the FIG. 5 form in that it responds effectively to temperature changes induced by ambient heating, this being due to the heat-conductive connection between the metal casing **31** and the strip **47**.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A thermostatic switch comprising first and second electrically insulated thermostatic strips, a heat-conductive metal casing surrounding said strips, each strip being anchored at one end thereof to said casing and being free at its other end, said free ends carrying engageable and disengageable first and second contacts, the first strip in respect to the second strip being comparatively shorter, of comparatively higher resistance and of comparatively lower heat mass, said casing being in direct heat-conducting contact with the shorter strip at the point at which it is anchored and including electrical and heat insulation between the casing and the longer strip at the point at which it is anchored, each strip having components of relatively high and low coefficients of thermal expansion arranged for contact movements in the same general direction in response to temperature changes, whereby in response to heating of the strips, contact pressure is initially increased by overtaking movement of the first contact relative to the second contact, the contacts being thereafter rapidly separated, and in response to cooling, the rate of retractive movement of the first contact relative to the second contact is greater, thereby delaying switch closure.

2. A thermostatic switch according to claim 1, wherein said heat-conductive contact between the shorter strip and the casing is located adjacent an intermediate portion of said second strip and the strips extend generally in the same direction from their respective points at which they are anchored.

3. A thermostatic switch according to claim 1, wherein the strips extend in opposite directions from the points at which they are anchored to the casing to form terminals.

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