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THERMOSTATIC SWITCH

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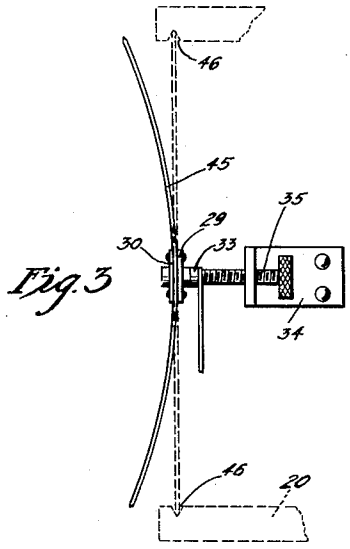


Fig. 3

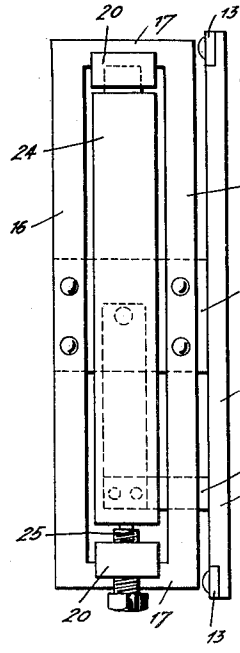


Fig. 2

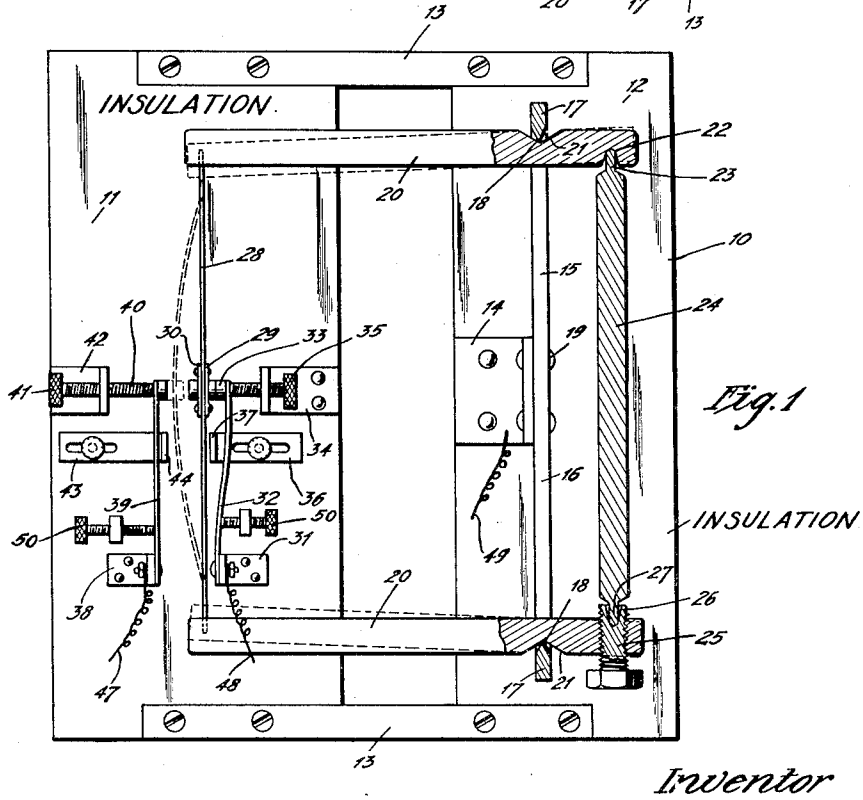


Fig. 1

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THERMOSTATIC SWITCH

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8 Claims. (Cl. 200—137)

This invention relates to improvements in thermostatically controlled switches, and particularly of the type in which the action of the switch element is controlled by unequal expansion of two or more pieces of different kinds of material.

Numerous switches have been placed on the market in which a thermostatic strip is employed, composed of metals having different co-efficient of expansion, said metals being placed side by side and permanently secured together by rivets or welding. The action of the switch element depends upon the force imparted by the bending action of the strip due to temperature change. This movement is slow and varies with the temperature change. For that reason auxiliary devices or mechanism are usually employed whereby strains or stresses may be placed on the strip in such a manner as to cause it to act suddenly, wherein the movement of the strip may be utilized for opening or closing the contact members of electric switches. The auxiliary mechanism provided for accomplishing this quick movement of the switch contacts is usually more or less complicated and unreliable in its operation, having movable elements which are subject to wear and breakage.

It is, therefore, the object of my invention to provide a simple, durable and inexpensive thermostatic switch positive and reliable in its action and at the same time capable of imparting to one or more switch contact members quick movement for opening and closing an electric circuit in which the contacts are included, and whereby a sufficient pressure may be maintained between the contact members to properly establish the electrical circuit.

A further object is to provide in a thermostatic switch, of that type employing a flexible strip adapted to receive longitudinal pressure due to temperature change, and to be arched or bulged laterally when the pressure becomes excessive, in which the initial bending of the element takes place slowly and finally completes its movement suddenly, improved means whereby contact members controlled by the movement of said flexible member may be maintained in a closed position during the initial movement of the strip and allowed to separate at the time the sudden movement of the strip takes place.

More specifically it is the object of my invention to construct a thermostatic switch in which the controlling elements are composed of materials having different co-efficient of expansion wherein the said materials are separated rather than united, and connected by suitable leverage devices wherein one of the elements may be formed of a flexible strip of material and another formed of a rigid piece of material in such manner that pressure developed by the expansion of one of the materials may be imparted to the other in such manner that the resiliency of the strip may be overcome by the expansion of the rigid member, said pressure being applied longitudinally of the flexible member to cause sudden buckling action, and in connection therewith suitable contact members for an electric circuit actuated by movement of said flexible member.

My invention consists in the construction, arrangement and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawing, in which:

Figure 1 is a side elevation of my improved switch.

Figure 2 is an end elevation of same.

Figure 3 illustrates a modified form of the flexible element used in my switch.

My improved switch comprises a base 10 constructed preferably of two strips of insulating material 11 and 12, spaced apart a slight distance, their ends being connected by metallic bars 13. Secured to the member 10 is a bracket 14 to which a yoke 15 is secured. Said yoke is preferably of rectangular formation having side members 16 and end members 17. The end members 17 have their inner edges provided with beveled portions 18, as clearly indicated in Figure 1. The member 15 is secured to the bracket 14 by suitable rivets 19 and is constructed preferably of a metal or material in which the co-efficient of expansion is nearly zero, such as is commonly known as "Invar". The said yoke 15 is supported in a plane perpendicular to the base.

Extended transversely through the yoke is a pair of lever devices 20 formed of rigid material and mounted substantially parallel and having their outer edges provided with notches 21 for receiving the members 18. Said notches 21 are near the back of the levers 20. The back end of the inner edge of the top lever 20 is provided with a notch 22 for receiving a contracted and flat portion 23 of a vertically arranged bar 24.

The rear end of the lower lever 20 is provided with a set screw 25 having its inner end provided with a socket 26 for receiving a contracted portion 27 formed on the lower end of the bar 24. The member 27 is rotatively mounted within the socket 26 while the member 24 is held against rotation by means of the member 23. Said bar 24

is formed of a material having a high co-efficient of expansion.

Fixed in the forward ends of the levers 20 is a flexible strip 28 also formed of a material having a high co-efficient of expansion. The ends of the strip 28 are fixed in the ends of the levers 20 so that the strip 28 may be considered mechanically as a column having both of its ends fixed.

Secured to the central portion of the strip 28 I have provided oppositely arranged contact members 29 and 30. Supported on the member 11 I have provided a bracket 31 to which a spring 32 has one end fixed. The opposite end of the spring has a contact member 33 designed to engage the contact member 29 when the strip 28 is in its normal condition, preferably under slight pressure.

Secured to the member 11 is also a bracket 34 in which is mounted a set screw 35, the outer end of which is designed to engage the inner face of the free end of the member 32, and provides means for varying the initial pressure between the contact members 29 and 33. The member 11 is also provided with an adjustable stop device 36 having a laterally extending portion 37 designed to be engaged by the spring 32 for limiting the outward movement of the contact member 33.

A bracket 38 is secured to the member 11 and has one end of a spring 39 fixed thereto. The free end of the spring carries a contact member 40 adapted to move toward and from the contact member 30. A set screw 41 is mounted in a bracket 42 for limiting the outward movement of the contact member 40, while a stop device 43 is adjustably connected to the member 11 for limiting the inward movement of the said contact member. Said contact member has a laterally extending portion 44 for engaging the inner face of the spring 39.

The description thus far relates to the preferred form of my device, the operation of which is as follows:

Assuming that the members 20, 24 and 28 have been mounted in the manner illustrated in Figure 1 and as before described, and that the contact member 33 is adjusted to engage the contact member 29 under slight pressure, and that the set screw 25 has been adjusted to apply slight pressure to the ends of the member 24, and the lever devices 20, which in turn will cause longitudinal pressure to be applied to the strip 28, this pressure, however, being such as to permit the strip 28 to be supported in a substantially straight line, then it will be seen that an increase in the temperature will cause both of the members 24 and 28 to expand, tending to cause the levers 20 to move outwardly. This outward movement of the levers 20 is prevented by the yoke 15, inasmuch as said yoke lengthens slightly due to an increase in temperature.

A further increase in temperature will increase the longitudinal pressure on both of the members 24 and 28 until the resiliency of the member 28 has been overcome, at which time the central portion of the member 28 will have a tendency to either bulge inwardly or outwardly. Inasmuch as the said strip is held against inward movement by the set screw 35, it will be caused to bulge suddenly outwardly to the dotted line position shown in Figure 1, forming a compound curve.

Inasmuch as the expansion of the members 24 and 28 is substantially equal, it will readily be seen that as soon as the member 28 bulges outwardly, the free ends of said member will be permitted to move inwardly with the levers in the dotted line position shown in Figure 1. The outward movement of the rear ends of the levers caused by the expansion of the member 24 is converted into an inward multiplied movement as applied to the ends of the members 28, so that the contact member 29 is forced apart from the contact member 33 a considerable distance. The contact member 33 is permitted to follow the initial outward movement of the central portion of the strip 28 until the said strip reaches the position in which a rapid outward movement takes place, at which time the outward movement of the contact 33 is limited by the member 37. Set screws 50 are also provided for varying the working tension of the springs 32 and 39, whereby pressure between their respective contact members may be varied.

Thus it will be seen that I have provided means whereby the contact members 29 and 33 will be rapidly and positively separated.

The operation of the device thus far relates to the opening of a closed electrical circuit upon an increase in temperature. If it is desired to close the circuit upon an increased temperature change, then the contact member 40 is adjusted by means of the set screw 41 to make contact with the member 30 at the time the outward bending movement of the member 28 takes place. The member 41 is adjusted inwardly to permit the contact 40 to follow the contact member 30 as the temperature drops, at which time the member 28 will gradually assume a straight line until a predetermined point has been reached, at which time the spring 39 engages the member 44 and the member 28 suddenly returns to its normal position, causing the contacts 30 and 40 to be opened.

In Figure 3 I have illustrated a slightly modified form of the flexible element designated by the numeral 45, and is constructed of a flexible piece of sheet metal having a co-efficient of expansion similar to that of the member 24. In this modified form the outer ends of the levers 20 are provided with notches 46 for receiving the ends of the member 45. The member 45 is initially bent or set as illustrated in solid lines in Figure 3. The central portions of the strips have contact members 29 and 30. The contact 29 is held against inward movement by the set screw 35 in the manner before described. The strip is placed in position with the contact 29 against the contact 33, after which the outer ends are bent inwardly and placed in the notches 46, thus placing a bending strain on the strip, having a tendency toward bowing inwardly as longitudinal pressure is applied to the ends of the strip.

This inward movement, however, is not permitted by the set screw 35. The device will then operate substantially in the manner before described.

In this connection it will be seen that as the members 24 and 28 expand, compression strains are set up in the member 28 tending to buckle the said member laterally.

The members 13 are preferably constructed of the same material as the levers 20, so that any lengthening of the levers 20 will be compensated for by lengthening of the strip 28 so that the initial tension between the contacts 29 and 33 will not be effected by temperature changes, as would otherwise be the case, as it will readily be seen that lengthening or shortening of the levers 20 would move the entire strip 28 outwardly or inwardly and decrease or increase the pressure between said contact members.

The brackets 31 and 38 are provided with electrical conductors 47 and 48, either of which may be included in a circuit in which a conductor 49 is included, said conductor being connected to a bracket 14.

Although my thermostatic switch device is adapted primarily for the opening and closing of electrical contacts, it will readily be seen that the movement of the strip 28 may be utilized to operate other mechanism without departing from the spirit of my invention.

Although in most cases the levers 20 are preferably formed of rigid material, yet it will be seen that at times it might be desirable to form them of somewhat flexible material, so that the end of said lever would be bent outwardly as pressure is applied thereto, so that the inward movement of the end of the flexible member might be further multiplied as its central portion is bulged outwardly.

The member 24 is formed of any material having a high co-efficient of expansion such as zinc, and of a comparatively large cross sectional area to provide the necessary strength against buckling action, while the member 28 may be formed of more resilient material even if it has a somewhat lower co-efficient of expansion.

Thus it will be seen that a switch device may be constructed of comparatively cheap materials, and at the same time is very effective and reliable in its operation.

I claim as my invention:

1. A thermostatic switch comprising a base, a pair of spaced and substantially parallel lever devices, fulcrums for said lever devices near one set of corresponding ends, a frame supporting said fulcrums formed of material having a low co-efficient of expansion, a rigid bar formed of material having a high co-efficient of expansion pivotally supported transversely between the shorter ends of said levers, a flexible strip of material also having a high co-efficient of expansion arranged transversely between the longer ends of said levers, the ends of said strip being fixed in said levers, an electrical contact member carried by the central portion of said strip, a second contact member carried by said base and adjacent to the first contact member under slight pressure at a predetermined temperature, whereby increased temperature as applied to said bar and strip will cause excess longitudinal pressure to be applied to said strip and its central portion to be suddenly bent outwardly and said contact members caused to disengage each other.

2. A thermostatic switch comprising a base, a bar of rigid material and a rectilinear strip of flexible material as normally supported, said members having a high co-efficient of expansion, means for retaining said members against longitudinal expansion and for imparting longitudinal pressure of either member longitudinally to the other whereby the pressure of the rigid member will overcome the longitudinal pressure and resiliency of the flexible member and to multiply the movement of the rigid member as applied longitudinally to said flexible member, whereby the center of the flexible member will be caused to suddenly buckle laterally, electrical contact members carried by said flexible member, a co-acting and yieldably mounted contact member, and adjustable means for limiting the movement of the last contact member.

3. A thermostatic switch including a movable contact member for electric circuits, thermostatic means for actuating said contact member for moving the contact member slowly through its initial movement and finally terminating in a rapid movement, a yieldably mounted contact member adapted to make initial contact with the first contact member and follow said contact member during said initial movement, means for limiting the movement of the second contact member during the rapid movement of the first contact member to cause said contact members to separate, and adjustable means for varyinng the working pressure between said contact members.

4. A thermostatic switch including a movable contact member for electric circuits, thermostatic means for actuating said contact member for moving the contact member slowly through its initial movement and finally terminating in a rapid movement, a yieldably mounted contact member adapted to make initial contact with the first contact member and follow said contact member during said initial movement, and means for limiting the movement of the second contact member during the rapid movement of the first contact member to cause said contact members to separate.

5. A thermostatic switch comprising a base, a bar of rigid material and a straight strip of flexible material as normally supported, said members having a high co-efficient of expansion, means for retaining said members against longitudinal expansion and for imparting longitudinal pressure of either member longitudinally to the other whereby the pressure of the rigid member will overcome the longitudinal pressure and resiliency of the flexible member and to multiply the movement of the rigid member as applied longitudinally to said flexible member, whereby the center of the flexible member will be caused to suddenly buckle laterally, and means actuated by said flexible member for closing an electric circuit.

6. In a thermostatic switch, the combination of a base, a bar of rigid material and a strip of flexible material, said members having a high co-efficient of expansion, means having a low co-efficient of expansion for retaining said members against longitudinal expansion and for imparting longitudinal pressure of either member longitudinally relative to the other, whereby the pressure of the rigid member will overcome the longitudinal pressure and resiliency of the flexible member and to multiply the movement of the rigid member as applied longitudinally to the flexible member, whereby the center of the flexible member will be caused to suddenly buckle laterally.

7. A thermostatic switch including a movable contact member for electric circuits, a thermostatic means for actuating said contact member for moving the contact member slowly through its initial movement and finally terminating in a rapid movement, a yieldably mounted contact member adapted to make initial contact with the first contact member and follow said contact member during its initial movement, adjustable means for limiting the movement of the second contact member during the rapid movement of the first contact member to cause said contact members to separate, and adjustable means for varying the working pressure between said contact members.

8. In a thermostatic switch, the combination of a base, a bar of rigid material and a curved strip of flexible material, said members having a high co-efficient of expansion, means for supporting the ends of said flexible strip against lateral movement, adjustable means for applying pres-

sure laterally to the central portion of said flexible strip to support it normally in a rectilinear position, means having a low co-efficient of expansion for retaining said flexible strip and said rigid bar against longitudinal expansion and for imparting the longitudinal pressure of either member longitudinally to the other, whereby the pressure of the longitudinal member will overcome the longitudinal pressure and resiliency of the flexible member and multiply the movement of the rigid member as applied longitudinally to the flexible member, whereby the center of the flexible member will be caused to suddenly move laterally from the adjustable means for securing the same in a rectilinear position.

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