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TEMPERATURE RESPONSIVE SWITCH WITH IMPROVED STRUT ARRANGEMENT

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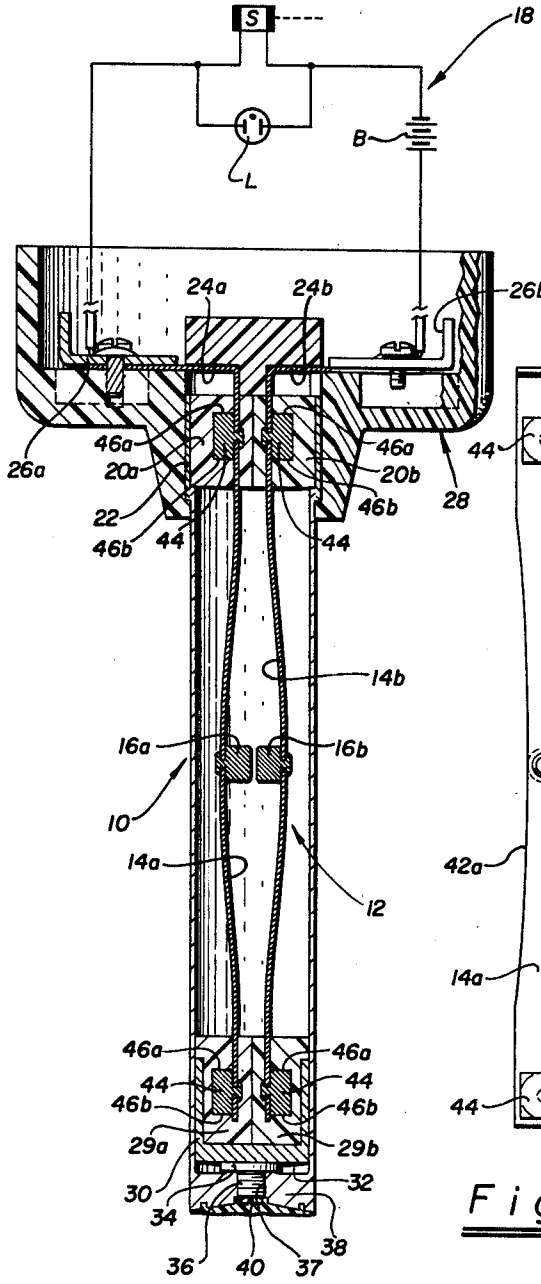


Fig. 1

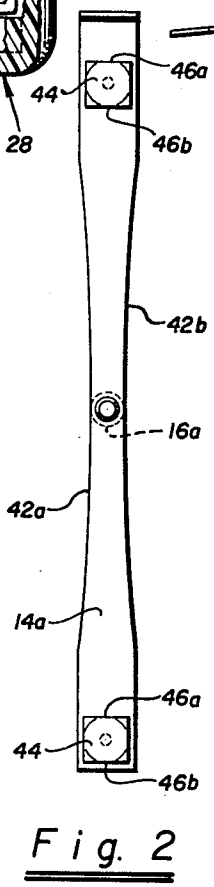
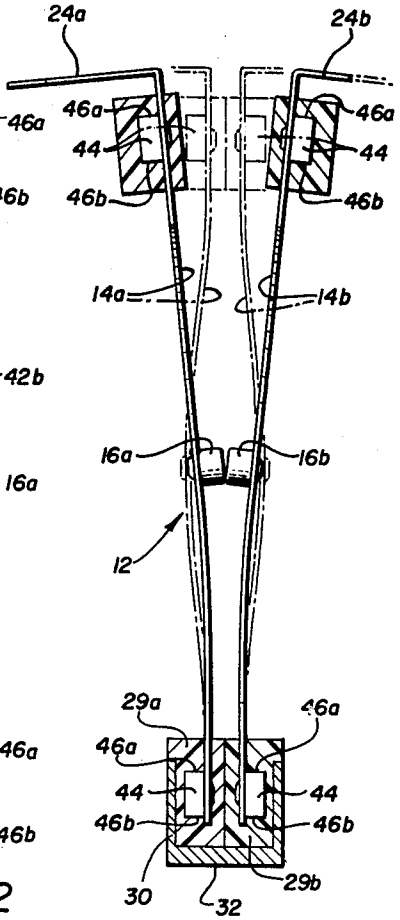


Fig. 2

Fig. 3



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TEMPERATURE RESPONSIVE SWITCH WITH IMPROVED STRUT ARRANGEMENT

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The present invention relates to temperature responsive switches which are known as thermostatic switches and which are employed to close or open electrical control circuits in accordance with predetermined temperature changes. More particularly, the invention relates to thermostatic switches of the kind employed in fire detection circuits.

Switches of this type may comprise a pair of oppositely arched, juxtaposed spring struts that face each other with their concave sides and which carry midways on their confronting inner surfaces contact beads. By mounting the spring struts in such a manner that they are held under compression, the struts are bowed outwardly away from each other and the contact beads are thus held apart. Hence the circuits into which the struts may be connected, are interrupted. This is usually accomplished by molding the opposite ends of the struts into plastic plugs, placing the resultant assembly into a thin walled metal shell, securing one of said plugs firmly to said shell, exerting sufficient pressure upon the opposite plug in a direction axially of the assembly to establish the required degree of separation of the contact beads, and anchoring said opposite plug within the shell in its adjusted position as described in U.S. Patent No. 2,755,359 of Howard A. Rike. By making the shell of a material of the proper thermal expansion coefficient, i.e. of a material of a substantially higher thermal expansion coefficient than the material from which the arched spring struts are made, the shell increases in axial length in response to predetermined rises in temperature and this is effective to relax the pressure exerted upon the spring struts allowing them to straighten out and bring the beads in contact with each other. As a result, the circuit onto which the described mechanism is connected, is closed and whatever fire alarm or fire fighting devices are controlled by said circuit enter into operation.

To predetermine the performance of the described switch mechanisms so that they may be depended upon to operate in precisely the required manner, i.e. close the contact beads at predetermined rates of increases in the ambient temperature, or at predetermined temperature levels, it is of course necessary that they all respond to the described setting operations in a like manner, i.e. that the struts arch symmetrically away from each other when pressure is applied to the adjustable plug during the assembly of the units, and that the struts once adjusted, do not "creep" within the plugs but remain safely anchored in said plugs in their initial position relative to said plugs. This has been difficult to achieve in mass production. It was found that the known switch units even though assembled from practically identical components and carefully preset, performed differently under identical circumstances.

It is an object of my invention to provide a thermostatic switch mechanism of the type referred to, that may readily be adjusted to perform in a predetermined manner.

Another object is to provide a switch mechanism, of the type referred to, that may be depended upon to respond in an identical manner to setting operations during its assembly.

These and other objects of my invention will be apparent from the following description of the accompanying drawings which illustrate a preferred embodiment thereof and wherein—

FIGURE 1 is a vertical central section through a thermostatic switch mechanism embodying my invention.

FIGURE 2 is an elevation of a spring strut forming part of the switch mechanism shown in FIGURE 1, and constructed in accordance with the invention; and

FIGURE 3 is a front elevation of two spring struts in partially assembled condition.

In endeavoring to construct the spring struts of the described switch assembly so that they would deform readily and symmetrically when placed under compression in a direction longitudinally thereof, I found that it was not enough to make them thin and/or highly flexible. In fact if made too thin, they deform in a random manner and thus are incapable of precise presetting and uniform performance. Moreover, the assembly becomes too sensitive to shocks, and once adjusted may readily become misadjusted when handled during the installation operations. I have found that the spring struts of a thermostatic switch mechanism of the type here under consideration may be depended upon to deform symmetrically under compression without significant sacrifice in their sturdiness if constructed to taper uniformly from both ends towards their operational center point, i.e. the point at which the contact beads are located.

Furthermore, I have found that corrugations or barbs provided in the strut portions that are to be embedded in the plastic plugs, are not sufficient to prevent "creep" of the struts relatively to the plugs when held under compression for extended periods of time. I have found, however, that square anchoring blocks provided at or near the ends of the struts in a position where a pair of their parallel edges extend at right angles to the longitudinal axis of the strut assembly, i.e. to the direction in which the setting pressure is applied, will effectively prevent creep of the struts relative to the mounting plugs for practically unlimited periods of time and thus effectively preserve the temperature settings of the described type of thermostatic switches.

Having first reference to FIGURE 1, the thermostatic switch assembly of the invention comprises an outer housing 10 in the form of a thin-walled cylindrical shell of a metal or metal alloy of a high thermal conductivity and a high thermal expansion coefficient, such as brass, stainless steel, or certain aluminum alloys. Within the housing is received the contact-establishing switch mechanism 12 which is formed by two oppositely arched, juxtaposed spring struts 14*a* and 14*b* that face each other with their concave surfaces and which carry at the mid points of said concave surfaces opposed contact beads 16*a* and 16*b*, respectively, that may be made of silver. The struts form part of an electrical circuit 18 represented by the solenoid S and the battery B in FIGURE 1. During normal temperature conditions the circuit 18 is interrupted by subjecting the struts to sufficient pressure in a direction longitudinally thereof, to flex them outwardly away from each other to an extent where the beads lose contact with each other. For this purpose the upper ends of the struts are embedded in a pair of complementary semi-cylindrical plugs 20*a* and 20*b* which are fitted into, and firmly held in, the radially expanded upper portion 22 of the shell 10. To form connector lugs, the outwardly projecting ends of the struts may be turned radially away from each other as shown at 24*a* and 24*b*, respectively. The lugs 24*a*, 24*b* may be secured to terminals 26*a* and 26*b* that are located in a suitable socket of a plastic dielectric which may be molded around the upper end of the shell 10, as indicated at 28 in FIGURE 1.

The lower end portions of the struts 14*a* and 14*b* may likewise be embedded in complementary semi-cylindrical plugs 29*a* and 29*b* of a dielectric plastic, which are firmly held in a cup-shaped sheath 30 of brass or like metal; and the sheath in turn is slidably arranged within the lower

end of shell 10 and bears with its flat bottom 32 against the flat head 34 of a setting screw 36 which is engaged in a threaded aperture 37 in the closed bottom 38 of the shell 10. The outer end of the setting screw 36 is provided with a slot indicated at 40 in FIGURE 1, which may be engaged by a screw driver to adjust its vertical position within the aperture 37 and in this manner preset the compression exerted upon the switch mechanism 12 to predetermine the distance between the contact beads 16 thereof under ordinary temperature conditions. In first molding the struts into the upper or lower plugs 29*a*, 29*b*, or 29*a*, 29*b*, as the case may be, they are disposed in such a manner that they diverge from each other to a small degree, when the complementary plugs are placed into their proper position with their mating surfaces in contact with each other, such as illustrated in FIGURE 3. Hence, upon proper assembly of the opposite plug portions, the struts may form shallow outwardly turned arches, as indicated in phantom lines in FIGURE 3.

When the strut assembly has been inserted into the shell 10 and its upper plugs have been firmly secured to the expanded upper end 22 of the shell in the manner illustrated in FIGURE 1, the whole assembly is heated uniformly to the temperature at which the beads should make contact in practice and close whatever circuit they control. Thereupon, the setting screw 36 is adjusted to exert the proper amount of pressure upon the bottom of sheath 30 to hold the arched struts at said temperature level in a position wherein the beads are just about to contact each other. This may be accomplished by connecting a visible or audible indicator into a suitable test circuit, such as represented by the lamp L which is shown as shunted across the solenoid S in FIGURE 1. Whenever the slightest adjustment of the setting screw to exert greater pressure upon the sheath causes the lamp to go out, the proper setting has been established.

For the described switch units to perform in an identical manner, i.e. to effect contact of the beads in response to a predetermined rate of increase in the ambient temperature or to a predetermined temperature level, it is essential that the opposed struts 14*a*, 14*b* flex in a symmetrically identical manner when placed into and secured to the shell, and especially when subjected to the above described re-setting operation. This I accomplish, without unduly weakening the structure of the struts, by constructing the struts in such a manner that they diminish in width from their opposite ends in the direction toward the area where they carry the contact beads, as illustrated in FIGURE 2 where the side edges of the strut form shallow smoothly rounded arcs indicated at 42*a* and 42*b*. By tapering the struts in the decribed manner toward their operational center point, I enable them to flex readily and uniformly in response to the slightest pressure applied to them by the setting screw 36 and to the slightest differences in contraction between the shell 10 and the struts themselves as the device is allowed to cool to room temperature after the above described pre-setting operations have been performed. As a result thereof, they will straighten out uniformly and perform in a dependable manner whenever the device is subjected to predetermined rates of increase in the ambient temperature and/or to predetermined temperature levels.

I have also found that small square blocks of a suitable metal, such as steel, riveted to the struts in the regions which are to be embedded in the plastic dielectric plugs, positively prevent any "creep" of the struts relatively to the plugs for practically unlimited periods of time, even when they are subjected to substantial bending pressures. Hence, a setting once accomplished, may be depended upon to retain its intended effect upon the performance

of the device for many years. It is important, however, that one pair of parallel edges of the blocks be disposed at approximately right angles to the longitudinal axis of the strut assembly, i.e. to the direction in which the setting pressures are applied, as best illustrated in FIGURE 2, where the reference number 44 identifies the anchoring blocks and the reference numbers 46*a* and 46*b* designate the edges of said blocks that are disposed at right angles to the direction in which the strut-flexing pre-setting pressure is applied to the strut assembly.

While I have described my invention with the aid of an exemplary embodiment thereof, it will be understood that the invention is not limited to the specific constructional details shown and described which may be departed from without departing from the scope and spirit of the invention.

I claim:

1. A strut for a thermostatic switch mechanism of the type described comprising a strip of spring metal having longitudinal edges constructed to taper from the opposite ends of said strip toward a mid point thereof, a contact bead provided at said mid point, angular anchoring blocks secured to said strip at end portions thereof with an edge of said blocks disposed substantially at right angles to the longitudinal axis of said strip, and mounting plugs of a dielectric plastic molded around said end portions and said anchoring blocks.

2. A switch mechanism for switches of the type described comprising two juxtaposed spring struts having longitudinal edges constructed to taper from their opposite ends in shallow arcs toward a mid point thereof, opposed contact beads provided on said struts at said mid points thereof, rectangular anchoring blocks secured to said struts at opposite end portions thereof with an edge of said blocks disposed substantially at right angles to the longitudinal axis of said struts, and mounting plugs of a dielectric plastic molded around said end portions and said anchoring blocks.

3. A thermostatic switch comprising a thin-walled outer metal housing, disposed within said housing a pair of oppositely arched juxtaposed spring struts having longitudinal edges constructed to taper from the opposite ends of said struts in shallow arcs toward a mid point thereof, opposed contact beads provided on said struts at said mid points, square-shaped anchoring blocks riveted to opposite end portions of said struts with an edge of said blocks disposed substantially at right angles to the longitudinal axis of said struts, mounting plugs of a dielectric plastic molded around said end portions and said anchoring blocks, the mounting plug at one end of said struts being secured firmly to one end of said housing and the mounting plug at the opposite end of said struts being slidably received in the opposite end of said housing, and means at said opposite end of the housing for applying pressure to said slidable plug.

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