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THERMOSTATIC SWITCH

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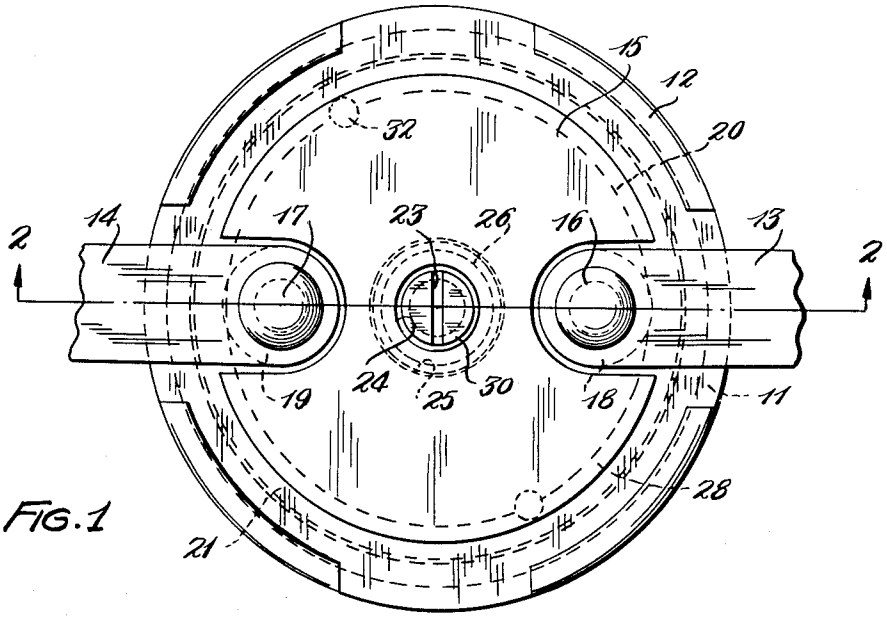


FIG. 1

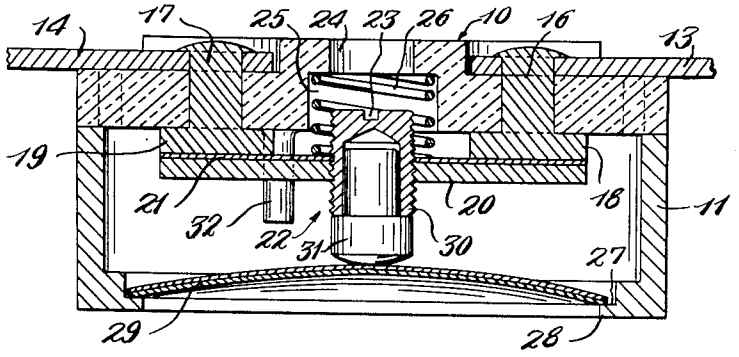


FIG. 2

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THERMOSTATIC SWITCH

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This invention relates to thermostatic switches and, more particularly, to such switches in which contact operation is effected in response to the reversal of curvature of a curved bimetallic disc.

One type of thermostatic switch employs a curved bimetallic member in the form of a substantially dish-shaped or convexo-concave disc as the operating element. Such a disc "snaps through center," i. e., rapidly reverses its curvature, upon attaining a predetermined temperature and this reversal of curvature is utilized to control the movement of a contact or contacts of the switch so that such movement is effected with a snap action. However, in prior switches of this type, it is customary to firmly clamp the periphery or the central portion of the bimetallic disc. Also, it is common in such switches to connect the movable contact means or a motion transmitting member to the bimetallic disc. Such clamping of the disc or connection of members thereto destroys or greatly reduces the ability of the disc to flex in the region of the clamping or connections, and hence the response of the disc to temperature changes is altered by the restraints thus imparted so that the switch operation tends to be erratic and/or requires a comparatively large temperature differential. Moreover, the adjustment or calibration of such switches has frequently been effected by means which so alters the forces exerted upon the disc that the temperature differential of the switch or other operating characteristics are altered.

An object of this invention is to provide an improved snap acting thermostatic switch employing a curved bimetallic disc to control contact operation in which the disc has no portion thereof rigidly held from movement and has no parts of the switch mechanism connected to the disc so that the flexure of the latter is substantially unaltered by its utilization in the switch mechanism thereby facilitating quantity production of switches having substantially uniform characteristics.

Another object of the invention is to provide an improved snap acting thermostatic switch employing a curved bimetallic disc to control contact operation wherein the disc is loosely supported adjacent its periphery and the motion resulting from reversal of its curvature in response to a predetermined temperature is transmitted to a movable contact member of the switch by a motion transmitting means which is resiliently maintained in abutting contact with the central portion of the disc but is not connected thereto whereby all areas of the disc are free to respond to a predetermined change in temperature.

A further object of the invention is to provide an improved thermostatic switch as defined in the preceding paragraphs and in which the motion transmitting means between the bimetallic disc and movable conductive member of the switch is carried by the latter and is adjustable relative thereto for conditioning the switch to operate at different predetermined temperatures.

An additional object of the invention is to provide an improved snap acting thermostatic switch as defined above wherein "creepage" or like lost motion of the bimetallic

operating disc may be eliminated, thereby preventing frying of the contacts, without affecting the uniformity of response of the switch upon attainment of a predetermined temperature.

A more specific object of the invention is to provide an improved thermostatic switch as defined above wherein a movable contact member is continuously urged from engagement with stationary contact means of the switch and carries a member adjustable relative to the movable contact member and maintained in abutment with the central portion of a convexo-concave bimetallic disc which has the peripheral portion thereof freely resting upon a planar surface, whereby the flexure of the disc is substantially unrestrained and hence switch operations in response to attainment of a predetermined temperature are substantially uniform.

The invention further resides in certain novel features of the construction and in combination of parts of the mechanism in which the invention is embodied, and further objects and advantages of the invention will be apparent to those skilled in the art to which it pertains from the following description of the presently preferred embodiment thereof which is described with reference to the accompanying drawing, forming a part of this application, and in which:

Fig. 1 is an enlarged top plan view of a thermostatic switch constructed in accordance with the invention, portions of the switch terminals being broken away; and

Fig. 2 is a vertical sectional view through the switch shown in Fig. 1, the view being taken substantially on the sectional indicating line 2—2 of Fig. 1.

The embodiment of the invention in a snap acting thermostatic switch is here illustrated as comprising a support including a base portion 10 and a side wall portion 11. As here shown, the base 10 is circular and formed of insulating material, while the side wall 11 is formed of metal, shaped to a substantially cylindrical configuration, and attached to the base 10 by having spaced portions adjacent one edge removed thereby providing integral projecting parts or lips 12 which are received in complementary recess of the base 10 and held in engagement therewith by an upsetting or spinning action performed upon the portions 12 as will be readily understood by those skilled in the art. Alternatively, the side wall 11 may be formed integrally with the base 10.

The outer face of the base 10 is provided with terminal members 13 and 14, only a portion of which are here illustrated, but which may be of any suitable form, the inner ends of which are received in recesses of a boss 15 on the base thereby preventing the terminals from contacting a surface which the base may engage. The terminals 13 and 14 are here shown as secured to the base 12 by studs or rivets 16 and 17, respectively, the inner ends of which are enlarged and disposed upon the inner face of the base 10 to thereby provide spaced stationary contacts 18 and 19. The reduced diameter portions of the studs or rivets extend through aligned openings in the base and terminal members 13 and 14 with the outer ends of these studs or rivets peened or upset on the outer surface of the terminal members thereby securing the latter to the base as well as firmly holding the contacts 18 and 19 in place.

The movable conductive member of the switch is formed by a substantially disc-shaped member 20 of metal which is adapted to move to and from bridging engagement with the stationary contacts 18 and 19. As here shown, the surface of the member 20, which engages the stationary contacts 18 and 19, is provided with a layer 21 of silver or other suitable contact material but it will be understood that the member may be formed of but a single material, if desired.

The member 20 has a central opening therethrough

which is tapped and threadably receives an externally threaded motion transmitting means 22, portions of which extend on either side of the member 20. This motion transmitting means has the end thereof adjacent the base 10 provided with a tool receiving surface as, for example, a screw driver slot 23, which is aligned with and accessible through a central opening 24 in the base 10. The opening 24 is preferably countersunk or otherwise enlarged from the side of the base internally of the side wall 11, as is indicated at 25, thereby providing a seat for one end of a helical compression spring 26. The other end portion of the spring is disposed around the adjacent end of the motion transmitting means 22 and engages the surface of the conductive member 20.

The side wall 11 of the switch is provided with a planar surface 27 facing towards the base 10, which surface is here shown as provided upon an annular flange 28 extending radially inwardly of the side wall 11 adjacent the outer edge thereof. The planar surface 27 provides the support for the peripheral portion of a dished bimetallic disc 29, which is preferably imperforate and of convexo-concave shape, the central portion of the disc being engaged by the adjacent end of the motion transmitting means 22. Preferably, the motion transmission means 22 has the threaded portion 30 formed of metal and provided with an axial bore in which is received a headed stud or button 31 formed of insulating material, such as a ceramic substance or the like. The outer surface of the stud 31, which is maintained in engagement with the bimetallic disc 29, is preferably of convex configuration, as will be apparent from Fig. 2, to lessen the area of contact.

A switch constructed as illustrated and described is of the normally closed type since the movable conductive member 20 is normally held in engagement with the stationary contacts 18 and 19. However, when the switch has been subjected to a predetermined temperature change, the bimetallic disc 29 will reverse its direction of curvature with a snap action. Since the motion transmitting means 22, carried by the conductive member or disc 20, is maintained in engagement with the bimetallic disc 29 under the force of the spring 26, the member 20 is moved from engagement with the contacts 18 and 19 by the spring 26 so that the circuit through the switch is broken. The breaking of the circuit is, therefore, positive in nature and rapidly effected under control of the bimetallic disc 29. When the temperature to which the switch is subjected returns to its initial value, the bimetallic disc 29 will again reverse its curvature returning to the position illustrated in Fig. 2. This returns to movable conductive member 20 into bridging engagement with the contacts 18 and 19 thereby reclosing the circuit through the switch.

The temperature at which switch operation is effected may be adjusted, for calibration or like purposes, by altering the position of the motion transmitting means 22 relative to the conductive disc or member 20. This may be effected after the switch is assembled by means of a screw driver or other suitable tool inserted through the opening 24 and engaged in the slot 23 of the conductive member 20. Rotation of the member 20 with the member 22 during such adjustment is prevented by one or more guide members or studs 32 supported by the base 10 and received in suitable recesses or openings in the periphery of the member 20. These guide members or studs 32, which also serve to prevent radial displacement of the member 20, may be formed as integral portions on the inner face of the base 10 or may be separate members secured thereto, if desired. Alternatively, the member 20 may have a diameter closely approximating the interior diameter of the side wall 11 and rotation preventing cooperating surfaces provided upon the member 20 and the adjacent portion of the side wall 11. Furthermore, it is not necessary that the member 20 be a circular disc and hence this member and the cooperating rotation preventing means may be provided in other shapes and forms than those here specifically mentioned.

The adjusted position of the motion transmitting means 22 relative to the conductive member 20 may be maintained in any desired manner as, for example, by providing a small drop of solder between the means 22 and the member 20 or by providing a locking action between the threads of the member 20 and the threaded portion 30 of the motion transmitting means. Such locking action may be achieved by forming one of the threads with a slightly different pitch from that of the other thread or by other expedients well known in the art.

It will now be apparent that, in accordance with this invention, the bimetallic disc 29 is free to flex in all portions thereof since it is neither clamped in place nor does it have any rigid members connected thereto. Thus, it will be observed that the peripheral portion of the disc freely rests upon the planar surface 27 and may slide slightly thereon to the extent necessary during flexing of the disc when it reverses its direction of curvature. It will also be observed that the motion of the central portion of the disc is transmitted to the movable conductive member 20 without the need of a connection to the disc so that there are no holes in the disc or rigid members connected thereto which would alter the mode of flexing of the disc. Consequently, switches of the type here disclosed can be produced in quantity with highly uniform characteristics thereby reducing the amount of calibration or adjustment necessary to enable the switches to operate upon attaining a desired temperature. Furthermore, the temperature differential within which the switches are operative is smaller and more nearly constant than in the case of switches wherein the bimetallic disc is either clamped in place or has rigid connections thereto. In addition, it will be observed that calibration of the improved switch may be readily effected after the switch is assembled and that this calibration does not alter the characteristics of the switch other than the temperature to which it responds.

The adjustability provided by the threaded connection between the members 20 and 22 also permits elimination of contact frying by removing creepage of the bimetallic disc. That is to say, when an unrestrained convexo-concave bimetallic disc is subjected to a temperature change the first response is a relatively slow increase in the radius of curvature of the disc and the "snap action" does not occur until a critical point is reached whereupon the disc snaps through center. This relatively slow change of temperature, which is known as "creepage," frequently results in contact frying since the contact pressure is reduced by the creepage to the place where slight vibrations, jolts or the like will cause momentary separation of the movable contact from the stationary contacts. This difficulty may be eliminated with switches of the construction here disclosed by effecting adjustment of member 22 relative to the member 20 until the former engages the bimetallic disc 24 with sufficient force so that the latter is deflected an amount substantially corresponding to the aforementioned "creepage" change in curvature. Consequently, the first movement of a bimetallic disc thus conditioned is a reversal of curvature, which occurs with a snap action, and there is no unstable position wherein the contacts can intermittently open and close due to vibrations or similar disturbances.

Although the presently preferred embodiment of a switch constructed in accordance with this invention has been illustrated and described in considerable detail, it is to be noted that these details of the construction may be altered by those skilled in the art without departing from the principles of the invention. For example, as mentioned above, the side wall and base may be formed in one piece. In the event such one piece construction employs metal as the material, insulating means for the terminals 13 and 14 and stationary contacts 18 and 19 would, of course, be provided. Also, in the event the side wall and base are formed in one piece, the planar

surface for supporting the bimetallic disc **29** could then be formed either as a separable member or by spinning or otherwise turning inwardly a portion of the side wall **11** after the bimetallic disc **29** is introduced therein. It will also be evident that although a layer of contact material **21** has been shown upon the surface of the member **20**, this layer may be omitted in certain cases and/or a similar layer of material could be provided upon the stationary contacts **18** and **19**. Furthermore, the shape of the conductive member **20** may be other than a disc.

The aforementioned suggested changes in the construction are not exhaustive and are offered only as representative of alterations which may be made by those skilled in the art without departing from the principles of the invention. Consequently, it will be apparent that the invention should not be construed as limited to the precise details of structure here illustrated and described except as may be required by the subjoined claims.

Having thus described the invention, I claim:

1. A thermostatic switch unit comprising a base, a plurality of stationary contacts on said base, a rigid conductive member movable to and from bridging engagement with said contacts, spring means between said base and conductive member continuously urging the latter from engagement with said contacts, a dished bimetallic disc adapted to reverse its direction of curvature upon attaining a predetermined temperature and having an imperforate central portion, means connected to said base and forming therewith a switch housing enclosing said conductive member and loosely supporting said disc adjacnt its periphery, and motion transmitting means adjustably secured to said conductive member and having a portion abutting the central of said disc with a free bearing engagement, whereby operation of said switch may be varied by adjusting the position of said motion transmitting means relative to said conductive member.

2. A thermostatic switch unit comprising a switch housing including a substantially planar base portion and a side wall extending outwardly from said base portion adjacent the periphery thereof, a plurality of stationary electrical contacts mounted on said base portion within the confines of said side wall, a rigid electrical conductive member within said housing and movable to and from bridging engagement with said contacts, spring means between said base portion and said conductive member continuously urging the latter from engagement with said stationary contacts, means extending inwardly of said side wall and spaced axially from said base portion providing a supporting surface on the opposite side of said conductive member from said spring means, a dished bimetallic disc having its peripheral portion freely resting upon said surface and its central portion imperforate and unsupported, and motion transmitting means adjustably secured to said conductive member and continuously abutting the central portion of said disc under the influence of said spring means with a free bearing engagement, whereby said conductive means is moved from engagement with said contacts by said spring means when said disc reverses its curvature and the operation of the switch may be varied by adjusting the position of said motion transmitting means relative to said conductive member.

3. A thermostatic switch unit comprising a switch housing including a base having an opening therethrough and a side wall extending outwardly from said base adjacent the periphery thereof, stationary electrical contact means mounted on said base within the confines of said side wall, a rigid conductive member within said housing and movable to and from engagement with said contact means, the said housing also including a planar surface facing said base and spaced axially therefrom on the opposite side of said conductive member from said contact means, a convexo-concave bimetallic disc having its

peripheral portion freely resting upon said planar surface and its central portion unsupported, motion transmitting means adjustably secured to said conductive member in alignment with the said opening in the base thereby permitting access to said means through said opening, the said motion transmitting means abutting the central portion of said disc, and spring means between said base and conductive member continuously urging the conductive member from engagement with the stationary contact means, whereby the said conductive member is moved from engagement with said contact means by said spring means when the bimetallic disc reverses its curvature and the operation of the switch is adjusted by altering the position of said motion transmitting means relative to said conductive member.

4. A thermostatic switch unit comprising a base having a substantially planar central opening, a side wall extending outwardly from said base adjacent the periphery thereof and forming a switch housing therewith, a plurality of stationary contacts mounted on said base within the confines of said side wall, a rigid conductive member within said housing and movable to and from bridging engagement with said contacts, means on said side wall providing a planar surface facing said base and spaced axially therefrom on the opposite side of said conductive member from said contacts, a convexo-concave bimetallic disc having its peripheral portion freely resting upon said planar surface and its central portion unsupported, motion transmitting means adjustably secured to said conductive member in alignment with the said opening in the base thereby permitting access to said means through said opening, the said motion transmitting means abutting the central portion of said disc, and spring means between said base and conductive member continuously urging the conductive member from engagement with the stationary contacts, whereby the said conductive member is moved from engagement with said contacts by said spring means when the bimetallic disc reverses its curvature, and the operation of the switch is adjusted by altering the position of said motion transmitting means relative to said conductive member.

5. A thermostatic switch comprising a base having a two-diameter central opening, a side wall extending outwardly from said base adjacent the periphery thereof on the side thereof having the portion of the opening with the greater diameter, a plurality of stationary contacts mounted on said base within the confines of said side wall, a rigid conductive member movable to and from bridging engagement with said contacts, an annular flange extending around the interior of said side wall providing a planar surface facing said base and spaced axially therefrom, a convexo-concavo bimetallic disc having its peripheral portion freely resting upon said planar surface and its central portion unsupported, motion transmitting means adjustably secured to said conductive member in alignment with the said opening in the base thereby permitting access to said means through said opening, the said motion transmitting means abutting the central portion of said disc with a part of said motion transmitting means extending beyond the conductive member on the side thereof adjacent said base, and a helical spring having one end received about the said extending portion of the motion transmitting means and the other end received in the greater diameter portion of the opening in said base thereby continuously urging the conductive member from engagement with the stationary contacts, whereby the said conductive member is moved from engagement with said contacts by said spring when the bimetallic disc reverses its curvature and the operation of the switch is adjusted by altering the position of said motion transmitting means relative to said conductive member.

6. A switch as defined in claim 5 and wherein the adjustable connection between said motion transmitting

means and said conductive member comprise interengaging screw threads, and the said motion transmitting means has a tool receiving surface on the portion thereof accessible through said opening.

7. A switch as defined in claim 6 wherein the said motion transmitting means is an externally threaded member threaded through a tapped opening in said conductive member with portions extending on either side of said conductive member, the end of said threaded member abutting said disc having a convex surface and the other end thereof being provided with a tool receiving surface.

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