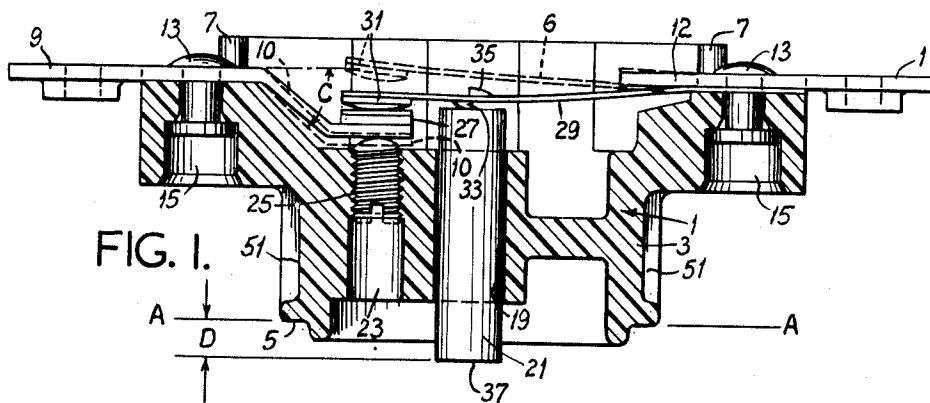
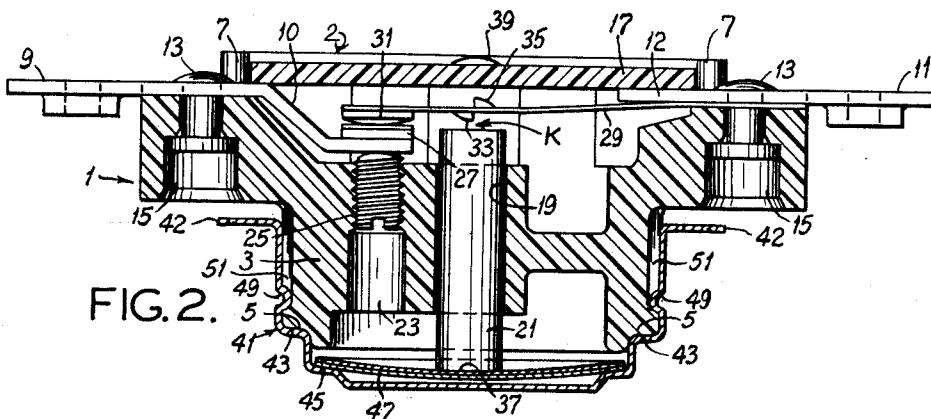
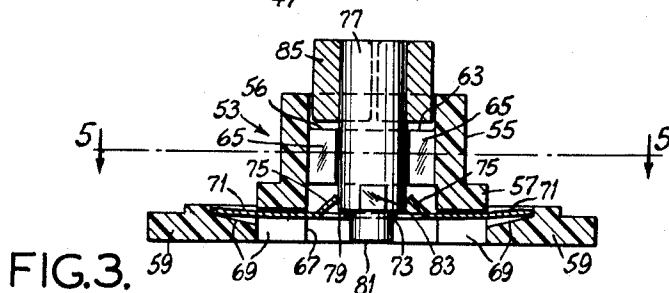


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THERMOSTATIC SWITCH AND METHOD OF ASSEMBLY

Filed May 29, 1961

4 Sheets-Sheet 1



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Jan. 5, 1965

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3,164,702

THERMOSTATIC SWITCH AND METHOD OF ASSEMBLY

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4 Sheets-Sheet 2

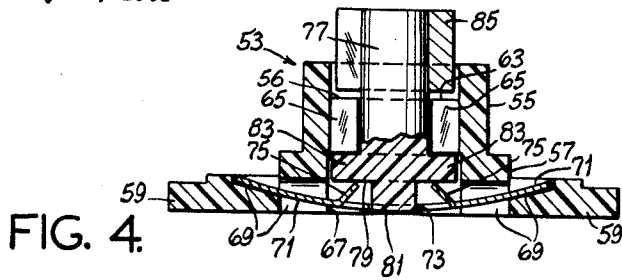


FIG. 4.

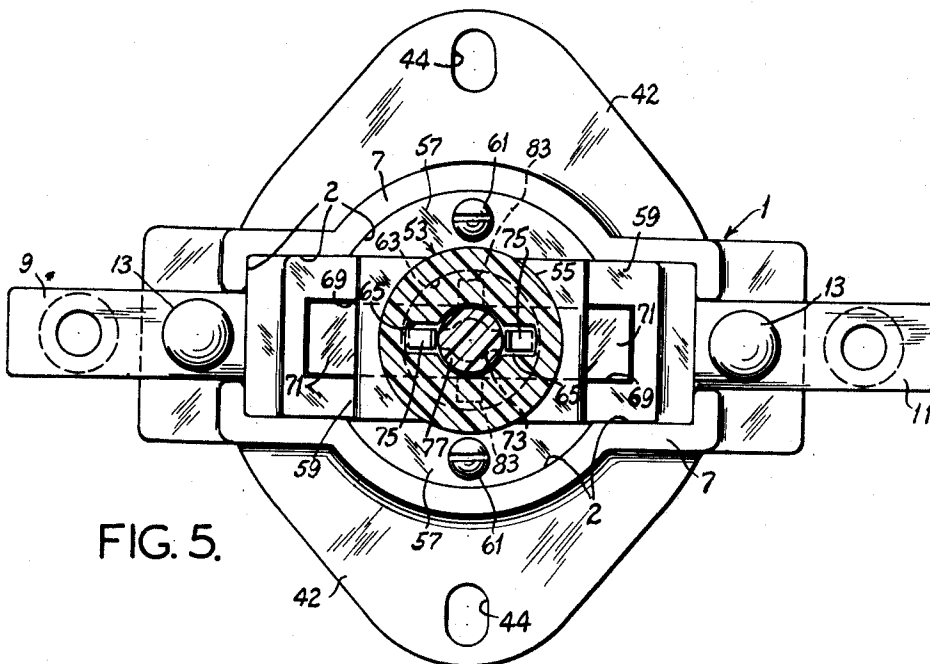


FIG. 5.

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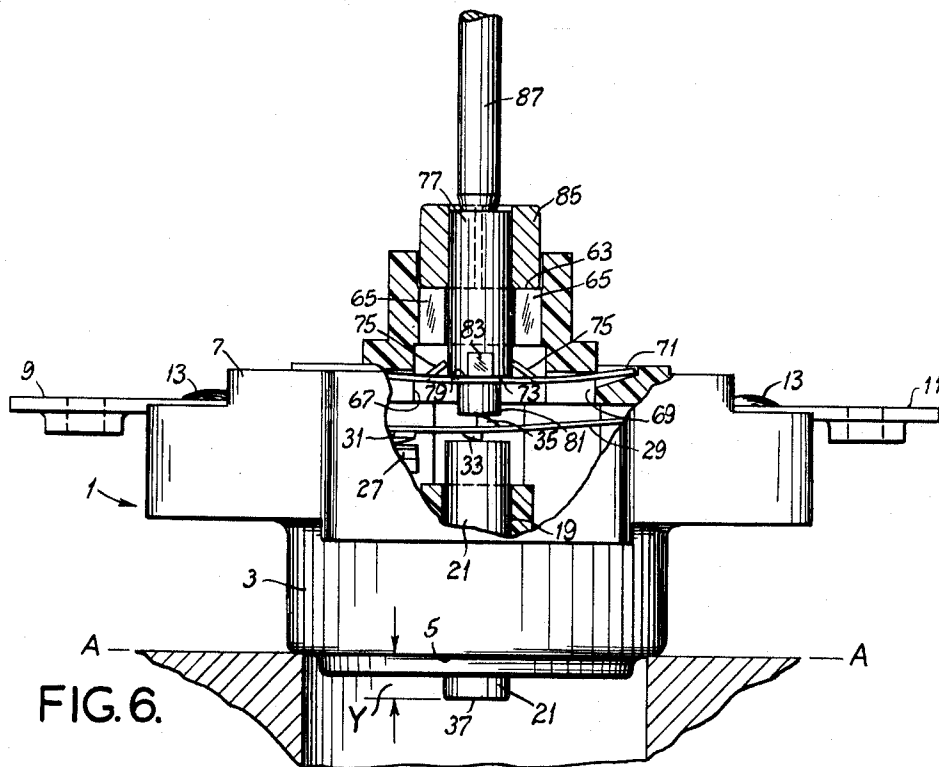
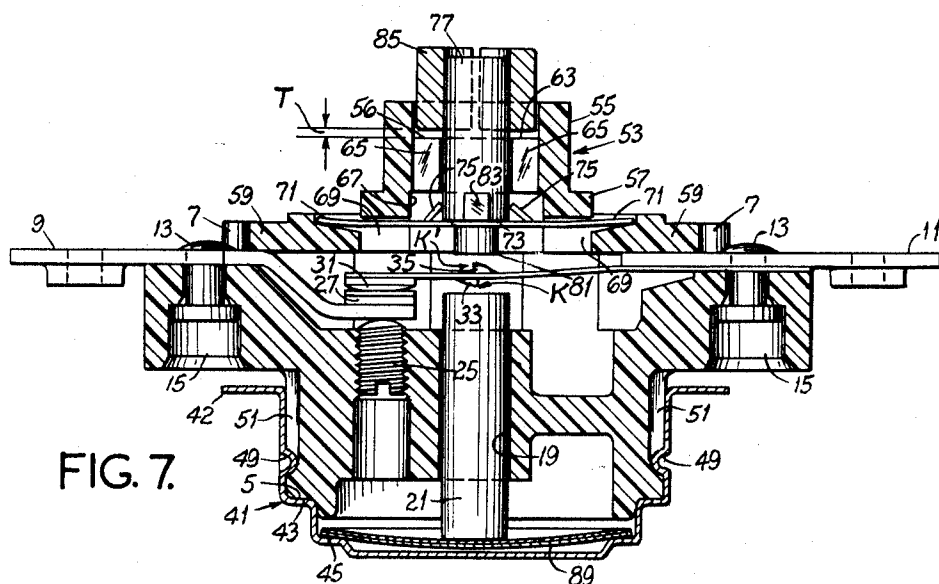
R. J. RUCKRIEGEL ETAL

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THERMOSTATIC SWITCH AND METHOD OF ASSEMBLY

Filed May 29, 1961

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Jan. 5, 1965

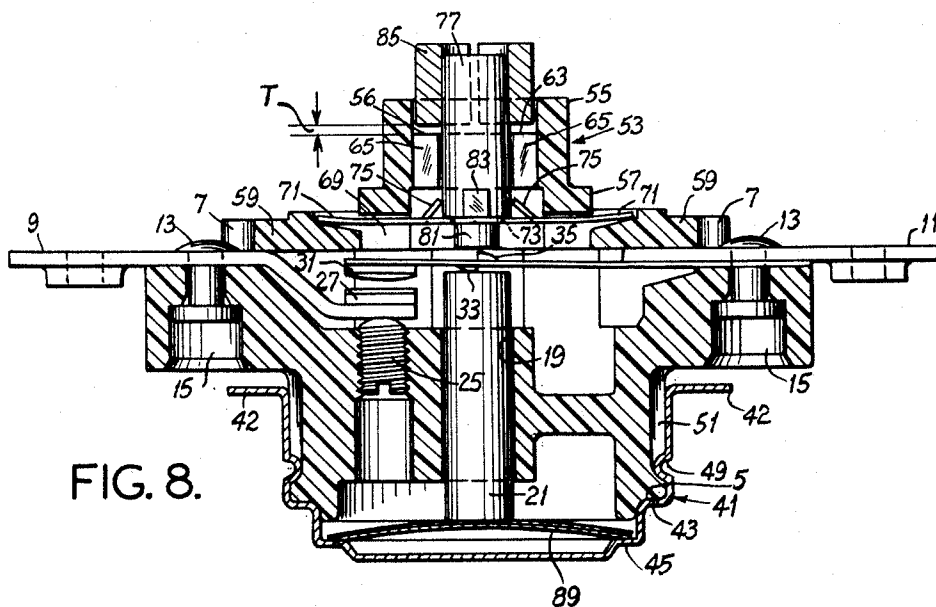
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3,164,702

THERMOSTATIC SWITCH AND METHOD OF ASSEMBLY

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3,164,702

THERMOSTATIC SWITCH AND METHOD OF ASSEMBLY

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2 Claims. (Cl. 200-138)

This invention relates to thermostatic electrical switches, and with regard to certain more specific features, to switch structure adaptable for assembly of both the automatic and manual reset type switches of this class.

Among the several objects of the invention may be noted the provision of thermostatically controlled electrical switches and particularly the snap-acting type, incorporating improved features of form and adjustment adapted to save manufacturing costs while preserving the accurate dimensional relationships required for a high-quality product; and the provision of switches of the class described which may conveniently be made up in both so-called automatic reset and manual reset types. 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, steps and sequence of steps, features of construction and manipulation, and arrangements of parts which will be exemplified in the constructions and methods 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 of a primary subassembly of parts useful for constructing either an automatic or manual reset type of thermostatic switch;

FIG. 2 is a view similar to FIG. 1, showing the addition of certain parts to produce an automatic reset type of switch from the parts shown in FIG. 1;

FIG. 3 is an axial section of a manual reset button assembly adapted for the construction of a manual reset form of the switch;

FIG. 4 is a view similar to FIG. 3, showing a preliminary assembly step employed for producing the assembly of FIG. 3;

FIG. 5 is a cross section taken on line 5-5 of FIG. 3 and showing the manual reset button assembly applied to produce a manual reset type of switch;

FIG. 6 is a subassembly of switch parts, and of the manual reset button subassembly illustrated in FIGS. 3-5, showing a preliminary adjustment step employed for producing a manual reset form of the switch;

FIG. 7 is a cross section of a completed manual reset switch after adjustment, the switch being shown in closed position; and

FIG. 8 is a view similar to FIG. 7, showing the manual reset type of switch in open-circuit position.

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

The manufacture of thermostatic switches employing transfer pins or the like has heretofore been beset with certain difficulties with regard to both the automatic and manual reset types. If a pin is too short it will not transfer sufficient motion to open the contacts properly upon tripping. If it is too long, it may transmit undesirable creep action of the thermostat to the contacts. In the manual reset type an excessively long pin will permit the operator to hold the contacts closed while the temperature rises to an unsafe condition. In most applications this is undesirable, and in many it is mandatory that it shall

not be possible. Since in many thermostats the usable working travel of the thermostatic disc used as a sensing element is small, a total travel of .010" being not uncommon, the selection of the proper reset pin length becomes bothersome and expensive.

Briefly, the switch made according to the present invention comprises a primary subassembly, with contacts therein operated by a snap-acting thermostatic disc which delivers its motion to one of the contacts through a transfer pin or the like. In one form of the switch, the snap-acting disc may be of the automatic reset type, so that no manual reset mechanism is required. In another form of the switch, the snap-acting disc may be of the manual reset type, requiring a manual reset mechanism. By means of the invention, certain adjustments are provided during assembly which will permit the use of fairly widely variable lengths of transfer pins without encountering the stated difficulties. This is accomplished by providing adjustments that can be made during assembly to accommodate dimensional variations in parts of the assembly. Selection of parts of exactly correct sizes is no longer required, and the individual parts do not require individual measurements, sorting or stocking, preparatory to assembly. They need to be only of approximately correct sizes. Of advantage is the fact that a subassembly such as shown in FIG. 1 may be used either for production of automatic reset or manual reset switches. In addition, a low-cost, four-part reset preassembly such as shown in FIGS. 3 and 4 is employed for making manual reset switches, which may be assembled and stocked for use as required. The four parts constituting this reset assembly require no gaging during their initial assembly with one another as a unit and may therefore be brought together in a minimum of time as a subassembly to be stocked for final assembly, provision being made for final adjustment at that time. This reset assembly of FIGS. 3 and 4 is disclosed and claimed in our United States patent application Serial No. 389,990 filed August 17, 1964.

Referring now more particularly to FIG. 1, which shows a primary subassembly, there is illustrated a body structure 1 in the form of a housing or frame composed of molded insulating material. The body 1 is made up with a cup-shaped cylindrical portion 3, having an outside flat shoulder 5 which establishes a reference plane A-A. Extending from the top of the body 1 is a flange formation 7. The top of the body 1 is slotted through the formation 7 to an appropriate depth for the reception of conductive terminal strips 9 and 11. The strips 9 and 11 are held by rivets 13 in openings 15 of the body 1. A nest 2 is formed by the flange formation 7. The shape of the nest 2 appears best in FIG. 5, wherein an alternative part to be described is nested. In FIG. 2 the nest 2 is shown as being for the reception of a flat cover 17 formed of electrically insulated material. This is the case when the subassembly of FIG. 1 is to be employed for the production of an automatically resettable device such as shown in FIG. 2.

At numeral 19 is shown a central axial opening (preferably cylindrical in cross section) for the reception of a ceramic or like insulating transfer pin 21 of like cross section. Such pins are not readily obtainable to close tolerances in length. At numeral 23 is shown an outside-access opening, the inner end of which is threaded for the final reception of a set screw 25.

The terminal strip 9 is riveted in place either before the set screw is inserted or, if the set screw is inserted, before it has been advanced. Terminal strip 9 is originally so formed that when it is initially riveted in place its inner end 10 assumes the dotted-line position shown at the upper left in FIG. 1, with the screw 25 either missing or backed off if inserted. This inner end 10 carries a fixed contact 27. Attached to the inner end 12 of

terminal 11 is a cantilever spring contact arm which carries a movable contact 31. This spring arm extends transversely across the end of pin 21. The inner ends 10 and 12 of terminals 9 and 11, respectively, are bendable and thus constitute adjustable hinge means. In its initially riveted position (either before the set screw is inserted or, if it is inserted, backed off) the terminal 9 is formed at angle C, as shown by the dotted lines in FIG. 1.

Next, a transfer pin 21, which may be a master or one from a lot to be used, is inserted into the opening 19 and located with its lower end at the distance D from plane A—A (for example, at .070 inch). This distance has been predetermined as the one to be downwardly terminated by end 37 of pin 21 within the pure snap-acting range of a bimetallic thermostatic disc 47 such as shown in FIG. 2. The pin is held in this position by means of a suitable fixture which is capable of holding the pin 21 at distance D against downward force on the pin up to a certain critical value, say three ounces. The fixture is provided with means indicating when such critical force has been reached. These are various jigs and fixtures available for the purpose. The critical force is that which determines the contact pressure of several ounces between contacts, to be described.

Next, with the pin 21 positioned as above described, the inner end of the terminal 11 is bent from its original dotted-line position 6 to cause the spring arm 29 to engage the top of the pin. Bending is continued until said pressure, for example, three ounces, is indicated by the fixture at distance D. It will be appreciated that, after bending has been completed, with the pin in the location stated, which is its solid-line position in FIG. 1, the inner end 10 of the terminal strip 9 is still in its dotted-line position at angle C with the contacts open. Then set screw 25 may be inserted (or if already inserted in its back-off position) may be screwed in until the fixed contact at the inner end of strip 9 just touches the movable contact 31 in the solid-line position shown in FIG. 1. At this time, pin 21 is held in place as indicated in FIG. 1. This bends the inner end 10 of terminal 9 upward, so as to reduce the angle C. This finally bent position is maintained by the set screw 25 in its final position. It will be understood that while the screw 25 is a convenient means for effecting this bending operation, it might be omitted and the bending of the inner end 10 of strip 9 accomplished otherwise. The subassembly of FIG. 1 is now in a condition that when the fixture is removed, whether or not the pin is left in place, the assembly will have the proper contact pressure for subsequent operation of the switch.

As will be noted from FIGS. 1 and 2, the spring arm 29 carries on its underside a lug 33 and on its upper side a lug 35. Use of these will be described below.

The completed structure for constructing an automatic reset switch is shown in FIG. 2. The cover 17 is held by fasteners, one of which is shown at 39. The other end of the body 1 is covered by a telescoped metal cup 41 which is held in position by dimples 49 formed in grooves 51. The cup 41 is flanged to form ears 42 in which are opening 44 for supporting or mounting purposes. The cup 41 is also formed with a shoulder 43, which is forced up against shoulder 5 so as accurately to position a shelf portion 45 thereof. Resting upon the shelf portion 45 is a bimetallic snap-acting thermostatic disc 47, the normal contacts-closed position of which is downwardly convex as shown, and the snapped contacts-open or tripped position of which is upwardly convex. It will be understood that the established distance D (FIG. 1) takes into account the curvature of the disc 47, so that after assembly as shown in FIG. 2, a clearance K is established between the upper end of the transfer pin and the lower lug 33 when the pin 21 rests on the disc 47. This clearance, by allowing some free movement of the pin 21 between lug 33 and disc 47, permits initial inherent

slow creep of the disc from its extreme contacts-closed configuration to an intermediate critical snap-acting configuration at which it snaps upward to its other extreme contacts-open configuration. Thus this clearance K assures that the preliminary creep action of the disc is not translated into preliminary creep opening of the contacts 27 and 31. As a result, these contacts are opened only in response to snap movement of the disc. This minimizes arcing at the contacts. The gaged adjusting means above described assures an accurate economical correlation of controlling factors, where these are of a low order of magnitude and were heretofore difficult and costly to control. This was particularly true in view of the fact that small ceramic pins such as 21 are not obtainable in closely matched lengths. In practice, such pins may be very small, such as on the order of $\frac{1}{8}$ inch in diameter and $\frac{3}{8}$ inch long, and their forming methods do not result in close tolerances. But, despite this, according to the present invention, close operating tolerances are obtained at low cost.

The subassembly of FIG. 1 is intended not only for the automatic reset switch of FIG. 2 but also for use in manufacturing manual reset switches, such as illustrated in FIGS. 5, 7 and 8. For such manual reset switches, manual reset buttons are required. For that purpose a manual reset button subassembly such as shown in FIGS. 3 and 4 is employed. This will be described before describing the manual reset switch as a whole and its complete method of manufacture, part of which involves what was described in connection with FIG. 1.

Referring to FIGS. 3 and 4, there is shown at numeral 53 a four-piece capping assembly which has an upwardly extending sleeve 55. Sleeve 55 which forms a guide is provided with an inner stop-forming flange 56 and a lower outer flange 57. From flange 57 extend transverse ears 59. The assembly 53 is designed to replace the cover 17 shown in FIG. 2. The replacement 53 is illustrated in FIG. 5 and, as will be seen from that figure, the cap is nested in the flange 7, instead of the flat cover 17 as in FIG. 2. Hold-down screws are shown at 61.

The sleeve 55 is provided with an internal upper shoulder-forming counterbore 63. The inner flange 56 is provided with two opposite axial slots 65. Beneath the slots 65 is a second counterbore 67. Openings 69 connect the counterbore 67 with the tops of the ears 59. At numeral 71 is shown a leaf spring in which is a central opening 73, provided by striking up opposite fingers 75. Spring 71 is easily slipped into position by pushing it through one opening 69 and resting its ends in these openings 69. It and its fingers 75 are flexible enough for this purpose.

At 77 is shown a reset pin, the lower end of which is shouldered as shown at 79 for resting on the spring 71 and for providing a boss 81 extending into the opening 73 in the spring 71. Extending oppositely from the shoulder portions 79 are bayonet-type lugs 83 adapted to pass through the slots 65. Attached to the upper end of the pin 77 by means of a medium force fit is a button-forming split sleeve 85.

The reset pin 77, with the split ring 85 attached thereto, is dropped down into the sleeve 55 in a position wherein the lugs 83 slide down the grooves 65. The lugs 83 can then be pushed down on the fingers 75, thereby bowing the spring 71 downward, allowing the lugs to emerge downwardly from the slots 65 (FIG. 4). They may then be turned at right angles from the position shown in FIG. 4 to that shown in FIG. 3. This positions the lugs 83 between the fingers 75, which then spring into the FIG. 3 position. Since the lugs 83 are now disaligned from the grooves 65, the reset pin 77 cannot escape upward. Then, because of fingers 75 interfering with return rotation of the lugs 83, the reset pin 77 cannot be turned sufficiently to bring the lugs 83 into alignment with the groove 65. The only substantial reset pin movement then possible is its limited axial movement, the amount of

which is limited by engagement of the ring 85 with the shoulder 63. Reset button subassemblies such as illustrated in FIG. 3 may be carried in stock, ready for application to primary subassemblies such as shown in FIG. 1, for the production as desired of manual reset switches such as illustrated in FIGS. 5-8.

Although the button-forming ring 85 is shown as being slit, it may be a solid ring, providing an appropriate force fit of a nature permitting the desired adjustment described. In addition, it may have an internally splined or like connection with the reset pin 77. The primary requirement is that the interference fit shall be capable of holding the adjusted effective length of the reset pin throughout the useful life of the switch under normal environmental conditions of temperature, humidity, vibration and reset cycling, while at the same time allowing for the original press-fit adjustment by tool 87 (FIG. 6). If axial adjustment is desired to be accomplished without a tool such as 87, the ring 85 may be threaded on the reset pin with suitable lock means for use after adjustment. Use of the press fit and tool is preferable however.

In FIG. 6 is illustrated how each stocked manual reset button subassembly (FIGS. 3 and 4) is applied and adjusted upon assembly for making a manual reset type of switch, which employs a manual reset type disc. After adjustment as above described in connection with FIG. 1 to obtain dimension D, further adjustments are made as follows: Downward pressure is exerted by the adjusting tool 87 upon the reset pin 77. This at first also moves down the ring 85 until it engages the shoulder 63. Upon continued application of force (say 70 lbs. or so) from the adjusting tool 87, the force of the fit between the ring 85 and the reset pin 77 is overcome. Movement is continued to drive down the pin 77 which, through lugs 35 and 33, drives down the pin 21 which by suitable means may be held against lug 33 holding contact 31 a definite distance away from contact 27. Adjustment is continued until dimension Y is obtained between plane A-A and the lower end of the pin 21. This dimension has been predetermined to bring about the functions which are discussed below. Upon removal of the tool 87, reset pin 77 will move upward, as shown in FIG. 7, by a distance T under the raising action of spring 71. This introduces a clearance K' between the underside of boss 81 and upper lug 35. This is in addition to the clearance K which occurs between lower lug 33 and the upper end of pin 21. The distance Y is that which has been predetermined to give this proper clearance K'. It will be recalled that the clearance K has already been obtained through the adjustments accomplished as described in connection with FIGS. 1 and 2.

The disc 89 is located in a cup 41. The cup is the same as that already described in connection with the automatic reset switch shown in FIG. 2. The assembled manual reset switch, ready for operation, is shown in the contacts-closed position of its manual reset disc 89 in FIG. 7. It will be seen that in FIG. 7 there are two clearances, namely, the lower clearance K like the clearance K in FIG. 2, and the clearance K'. The clearance K is between the lower lug 33 and the upper end of the transfer pin 21 which, as before, prevents the initial operating creep movement of the thermostat 89 from its contacts-closed position toward its critical configuration from transmitting slow actuating movement to the contact 31. The only opening movement transmitted to contact 31 is that which occurs upon snap action provided by the disc 89 after it has passed through its creep movement. The clearance K' at this time permits the upward rapid movement of contact 31 (compare FIGS. 7 and 8).

Upon pushing down the button-forming ring 85, in order manually to reclose the switch, its motion is limited by engagement of its lower margin with the shoulder 63. This motion is sufficient to push the transfer pin 21 (via lugs 35 and 33) to bow down the disc 89 sufficiently to reach its critical configuration beyond which it will snap

back to the position shown in FIG. 7, if cool enough. However, the available travel T of the reset pin is insufficient to drive the disc all the way to its extreme cold downwardly convex position. Thus the pin 21 cannot be manually driven down far enough to close the contacts 27 and 31, should the disc 89 not be cool enough to cause it spontaneously to assume its downwardly dished position. In other words, the movement of the reset pin is only sufficient to bow a hot disc to but not through its critical condition for snap action, which latter will not occur unless the disc is cooled sufficiently. Under hot conditions, the contacts 27 and 31 remain open. It will therefore be evident that, by means of the adjustments above described the manual reset type form of the switch shown in FIGS. 7 and 8 is trip-free.

In view of the above, it will be seen that the mechanical actuation of the switch contacts 27 and 31 occurs only within the so-called pure snap range of the bimetallic disc, whether the switch incorporates an automatic reset type or a manual reset type of thermostatic disc. Stated otherwise, movement of the disc in its creep range prior to pure snap movement is not permitted to be transmitted to the contacts during any action. And in addition the switch is trip free. Ordinarily these features would be difficult to accomplish because of the former requirements for stocking many sizes of presorted carefully gaged parts and the need for selective assembly of the same. As a result of the invention, switches of improved controlled quality and lower cost may be made.

It should be understood that although the invention has been described to open the contacts upon temperature rise, it is equally applicable on an automatic reset type of switch as shown in FIG. 2 wherein the contacts close upon temperature rise.

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 and methods 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.

We claim:

1. A thermostatic electric switch comprising a support, a transfer pin supported for axial movement longitudinally along an axis in the support, a cantilever spring extending transversely across a first end of said pin and mounted on one side of the pin axis on a first bendable means carried on the support, a snap-acting thermostatic member on the support opposite the second end of the pin and movable by gradual action from either of two opposite extreme configurations through at least one intermediate critical configuration for snap action, a movable contact mounted on said spring on the other side of said axis, a fixed contact also mounted on the other side of said axis adjacent the movable contact, a second bendable means mounting said fixed contact, a set screw in the support for bending said second bendable means, said first bendable means being adjusted to produce a desired contact pressure between said contacts by movement of the spring, the second bendable means being adjusted by said set screw to position the contacts when closed to space the cantilever spring from the first end of the transfer pin sufficient to allow movement from one of its extreme configurations to a critical snap-acting configuration without transfer of movement to said spring sufficient to open the contacts, and thereafter under snap action to transfer sufficient movement to the spring for rapid contact disengagement, a reset pin carried on said support for axial movement on said axis to and from the transfer pin, a second spring biasing the reset pin away from the transfer pin, head means on one end of the reset pin adapted for axial adjustment thereon, stop means on said structure for said head means, said head means being

adjustably positioned relative to said reset pin to produce a clearance between the other end of the reset pin and the spring sufficient only when the thermostatic member is in its other extreme configuration and the contacts open to transmit movement from the reset pin through the transfer pin to the thermostatic member for moving the latter from said second extreme configuration to a critical configuration for snap action without closing the contacts.

2. The method of locating transfer and reset pins in a thermostatic switch housing for proper transmission of movement by the transfer pin from a snap-acting thermostat with lost motion to an adjustable spring support for a movable contact, said movable contact being engageable with an adjustable fixed contact, the reset pin being adjustable on a spring-retained manual reset member which has a limiting manually set position relative to the housing; comprising predeterminately locating the transfer pin in a first operative position relative to the housing, adjusting the position of said adjustable spring support in a direction to engage the transfer pin with sufficient spring deflection to obtain a desired contact force while holding the transfer pin in said location with an equal and opposite force, adjusting the fixed contact to engage the movable contact while the transfer pin is so

held, adjusting the reset pin against spring-return action to a location relative to the reset member when the reset member is in its limiting position so as to place the transfer pin in a predetermined position for resetting of the thermostat without engaging the contacts, attaching the thermostatic element to the housing, said first position of the transfer pin being such that after attachment of the thermostatic element the transfer pin has sufficient lost motion between the spring support and the thermostatic element to take up creep movement of the thermostatic element without transfer of said movement to open said contacts, but thereafter upon snap movement to transfer snap action to the spring support to open the contacts.

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