

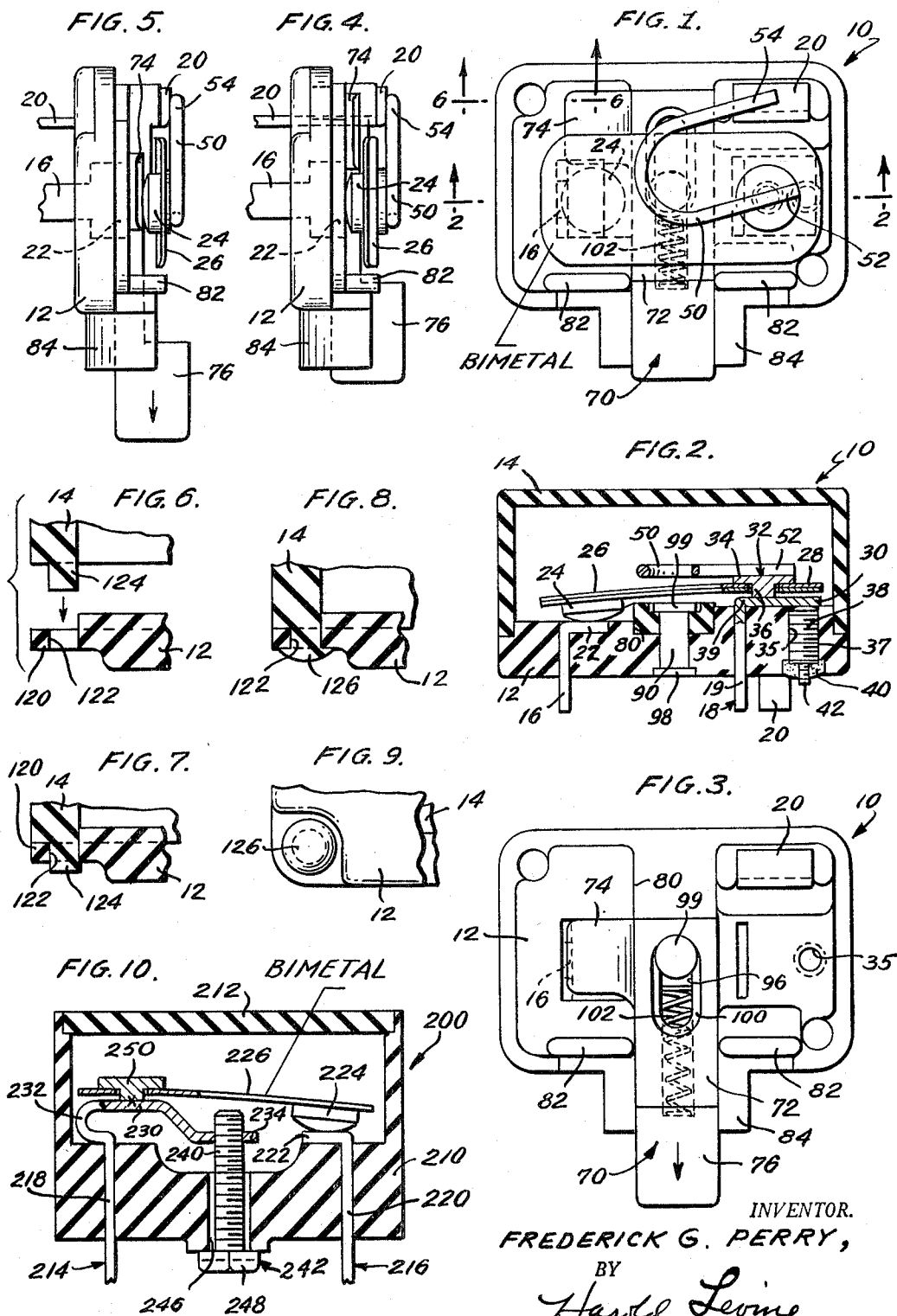
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ELECTRIC SWITCH HAVING IMPROVED CALIBRATION AND ADJUSTING MEANS

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ELECTRIC SWITCH HAVING IMPROVED CALIBRATION AND ADJUSTING MEANS**Frederick G. Perry, Barrington, R.I., assignor to Texas Instruments Incorporated, Dallas, Tex., a corporation of Delaware**

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4 Claims. (Cl. 200—122)

This invention relates to electrical switches, and in particular to a snap-acting thermally responsive electrical switch construction and an improved switch housing construction.

Among the several objects of the invention may be noted the provision of means and method for providing an inexpensive and simple interconnection between parts formed of electrically insulating material, which parts are particularly useful for an electrical switch housing; the provision of a thermally responsive electrical switch which incorporates means for conveniently and inexpensively effecting calibration and adjustment of the snap acting thermally responsive member of the switch; and the provision of a thermally responsive electrical switch which is simple in construction, embodies a minimum number of parts, is adapted for miniaturization, and which is simple and economical to manufacture and reliable in operation.

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, all of which will be exemplified in the structures and methods hereinafter described, and the scope of the application of which will be indicated in the following claims.

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

FIG. 1 is a top plan view, with cover removed, of an electrical switch according to one embodiment of the present invention;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a view similar to FIG. 1 and omits the thermally responsive element and certain other parts for clarity of illustration;

FIG. 4 is a left hand elevational view of the switch shown in FIG. 1 and showing the parts in a contacts closed position;

FIG. 5 is a view similar to FIG. 4 but showing the parts in a contacts open position;

FIG. 6 is a fragmentary exploded sectional view taken on line 6—6 of FIG. 1 of one corner of the base and cover member showing the parts prior to assembly according to another feature of this invention;

FIG. 7 is a view similar to FIG. 6 showing the parts in interfitting engagement but prior to the heat deformation step for final connection;

FIG. 8 is a view similar to FIG. 7 showing the parts after the heat deformation step;

FIG. 9 is a bottom view of the parts shown in FIG. 8; and

FIG. 10 is a sectional view similar to FIG. 2 of a switch according to a second embodiment of the invention.

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

Dimensions of certain of the parts as shown in the drawings may have been modified and/or exaggerated for purposes of clarity of illustration.

It is to be understood that the invention is not limited

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in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring now to the drawings and particularly FIGS. 1—5, there is shown a thermally responsive electrical switch indicated generally by numeral 10. Switch 10 includes a base 12 and a cover member 14 both of which are formed of an electrically insulating material such as a thermo-setting phenolic moldable resinous material. Cover member 14 is advantageously fastened and firmly secured to base 12 without the use of adhesives, pins, rivets, eyelets, or other fasteners, according to a feature of the present invention which will be described in greater detail below.

Base member 12 is provided with a plurality of open ended slots which co-operatively interfit with and respectively mount three electrically conductive terminals 16, 18 and 20, each of which terminals include a portion projecting exteriorly of base 12 for connection into an electrical circuit. Terminal 16 provides an electrical contact 22 at its upper surface which is nested in and received in a suitable recess formed in base 12 as shown. Contact 22 is positioned for engagement with a movable electrical contact 24 mounted on and electrically connected as by riveting, welding or the like to one end of a snap acting thermally responsive, bimetallic, strip type member 26. Member 26 generally comprises a relatively thin elongated bimetallic strip having a dish or non-developable portion which is responsible for its snap action. Snap acting element or disc 26 is of the type for example as shown and described in the John A. Spencer U.S. Patent 1,448,240 of March 23, 1923. Contacts 22 and 24 may be formed of conventional electrically conductive material such as for example silver or a silver alloy.

The other end 28 of snap acting element 26 is cantilever mounted on and electrically connected to a portion 30 of terminal 18 by means of a welding slug generally indicated at 32. Welding slug 32 and its co-operation with member 26 for mounting and electrically connecting the member 26 to terminal portion 30 is the subject of and is more fully described in a co-pending application serial No. 291,202, filed June 27, 1963 in the name of Montague R. Duval and entitled "Means and Method for Making Electrical Connections" assigned to the assignee of this application and to which reference may be had for details of this feature.

Briefly, welding slug 32 includes an annularly extending head or flange portion 34 and a shank portion 36. Shank 36 is received within a suitably formed aperture in member 26 and projects therebeyond. Flange portion 34 is initially welded to member 26 to form a subassembly therewith. Thereafter shank portion 36 is welded to terminal portion 30 to cantilever mount member 26. It will be noted that shank portion 36 of welding slug 32 spaces end 28 of element 26 from the terminal portion 30 as best seen in FIG. 2.

Terminal 18 includes a leg portion 19 which extends through a slot in base 12 to the exterior side of the base. Portion 30 overlies base 12 and extends at an angle (for example a right angle) to portion 19 and may be formed integrally therewith. Portion 30 also extends in a direction away from contact 22 and is joined to portion 19 at a junction 39.

An adjusting screw 37 is threadably received within a suitably formed aperture 35 in base 12 as best seen in FIG. 2. The free end 38 of screw 37 is disposed adjacent

and for engagement with the free end of terminal portion 30. Calibration of the thermally responsive element 26 may be effected by rotating screw 36 to cause portion 30 to move or bend relative to terminal portion 19 about junction 39. Such movement of portion 30 (and of the cantilevered mounted end 28 of snap acting member 26 carried thereby) relative to base 12 (in a direction transverse to base 12) causes the free contact carrying end of member 26 to move relative to stationary contact 22 to thereby adjust the operating temperature of member 26. It will be seen that movement of screw 36 upwardly (as seen in FIG. 2) against portion 30 will cause portion 30 (and cantilever mounted end 28) to bend or rotate in a counterclockwise direction about junction 39 and away from base 12 to urge contact 24 downwardly against stationary contact 22 to increase the contact pressure between contacts 22 and 24, and stress element 26. It will be understood that portions 19 and 30 along with junction 39 are relatively stiff so that when portion 30 is deformed to an adjusted position by bending about junction 39, the parts will remain in the adjusted position.

End 42 of screw 37 is accessible exteriorly of base 12 for manipulation to effect calibration after the switch has been assembled. After the thermal element 26 has been calibrated for desired operation, a sealing compound 40, for example a sty-cast sealing compound, may be applied about the exteriorly projecting free end 42 of screw 37 to maintain the parts in fixed calibrated assembled relation.

Switch 10 also includes an electrical heater element 50, one end 52 of which is electrically connected, as by welding, to flange portion 34 of slug 32. The other end 54 of heater 50 is electrically connected to an upper portion of terminal 20 as best seen in FIG. 1. Heater 50 may be wire like in form and formed of metal or a material having substantial electrical resistance. Heater 50 is disposed in intimate thermal juxtaposition with element 26 and also advantageously affords a direct heat conductive connection with element 22 through the welding slug 32 to provide for rapid and efficient heat transfer.

Switch 10 also provides for manual reset operation in the form of a manually operable movably mounted member generally indicated at numeral 70. Member 70 is generally L-shaped and includes a long leg 72 and a short leg 74. A portion of leg 74 is of reduced thickness to provide a relatively thin tongue which is interposable between contacts 22 and 24 when the latter move to a contacts open position as best seen in FIG. 5. Member 70 is formed of an electrically insulating material and preferably one which provides a smooth, hard surface finish so as to prevent surface breakdown and scratching to avoid formation of deposits between contacts 22 and 24 and the creation of an undesirable electrically insulating barrier between the contacts. Leg 72 includes a handle portion 76 extending into manually actuable position externally of base 12 and cover 14. As best seen in FIG. 3, base 12 provides a guideway 80 in which leg 72 is received for reciprocal sliding movement between contacts open and contacts closed positions. Base 12 also provides a pair of spaced upstanding lugs or projections 82 between which leg 72 is positioned. Base 12 further provides a semitubular projecting portion 84 within which leg 72 is received and guided for reciprocal sliding movement. Cover member 14 provides a correspondingly shaped semitubular projecting portion (not shown) which abuts and mates with portion 84 to completely surround and enclose leg portion 72.

Switch 10 includes a rivet like stud 90 (see FIG. 2) the shank of which is received within an oval shaped recess 96 in leg 72 of member 70. Stud 90 is fixedly secured to base 12 as by riveting or heading over end portion 98 as best seen in FIG. 2. The other end of retaining stud 90 includes an enlarged flanged portion 99 which is received in a recessed shoulder 100 provided in member 72 adjacent oval shaped aperture or slot 96.

A spring member 102 is received within suitable recesses provided in base 12 and in the underside of leg 72 facing base 12. One end of spring 102 bears against the base 12 and the other end of the spring member bears against leg 72 to urge member 70 for movement in a contacts opening direction in the direction of the arrow shown in FIGS. 3 and 4 to move manually actuable handle portion 76 toward the extended position shown in FIG. 5.

Spring means 102 thus resiliently urges or biases interposable tongue 74 for movement from the FIG. 1 contacts closed position to a resetting contacts open position as shown in FIG. 5. As best seen in FIGS. 1 and 4, when the parts are in a contacts closed position, tongue 74 abuts the side of movable contact 24. When thermally responsive snap acting element 26 is heated to a predetermined amount by the current flowing therethrough in combination with the heat derived from heater 50, it will snap from the contacts closed position shown in FIGS. 1, 2, and 4 to the contacts open position shown in FIG. 5. This permits tongue 74 to move from the FIGS. 1 and 4 position to a resetting position as shown in FIG. 5 under the biasing force of spring 102 (in the direction of the arrows in FIGS. 3 and 5) to interpose tongue 74 between contacts 22 and 24 and prevent mating interengagement thereof when element 26 cools to its reverse snapping temperature. To reset the switch 10, that is to reclose the electrical circuit, manually actuable portion 76 is manually pushed inwardly from the position shown in FIG. 5 to the position shown in FIG. 4 against the action of spring 102 to force tongue 74 from underneath contact 24. The spring force of the snap acting element 26 then brings contact 24 to bear against contact 22. Spring 102 preferably exerts relatively little spring force and thus advantageously reduces the force required for manual resetting of the switch. This feature is particularly advantageous in those installations where the reset button 76 is relatively inaccessible and it is difficult to bring much finger pressure to bear.

Referring now to FIGS. 6-9 another feature of the present invention provides a relatively simple and inexpensive means and method for quickly and easily securing parts together and particularly parts which are formed of a heat deformable electrically insulating material such as that described above for base 12 and cover member 14 of switch 10. Referring now to FIG. 6, there is shown a fragmentary portion of one corner of base 12 and cover member 14. Base 12 is provided with a shoulder portion 120 which provides an open ended aperture 122. Cover member 14 provides an integrally formed projecting lug or post 124 which interfits with and is received within aperture 122. Cover member 14 also includes a shoulder portion or surface adjacent lug 124 which mates and abuttingly interfits with shoulder 120 as seen in FIGS. 7 and 8. When the parts are assembled, as shown in FIG. 7, post 124 projects beyond a part or side of base 12 adjacent shoulder 120. After the parts have been assembled, as shown in FIG. 7, the free projecting end of post 124 is heat deformed about base 12 adjacent aperture 122 with a heating element for example such as a soldering iron or a suitably heated tool, to post 124 to provide a headed over boss portion 126 (as shown in FIG. 8) to tightly secure the parts together in fixed assembled relationship. To facilitate heat deforming, it is preferred to use a general purpose type moldable phenolic resinous material which loses its dimensional stability when subjected to temperatures on the order of 350° F. or less. It should, however, be understood that any phenolic or electrically insulating resinous material which is heat deformable can be employed in carrying out the invention.

From the foregoing, it can be seen that the heat staking method and construction described and illustrated in FIGS. 6-9 provides a relatively simple and economical means and method for securely fastening phenolic molded

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parts together without the use or necessity of adhesives, rivets, pins, eyelets, or other types of fasteners.

Referring now to FIG. 10, there is shown a second embodiment of a switch according to the present invention and generally indicated at numeral 200. Switch 200 includes a cup shaped base 210, the open end of which may be closed by a cover member 212. Base 210 and cover 212 may be formed of a suitable electrically insulating material such as a moldable phenolic resinous material. Base member 210 mounts a pair of electrically conductive terminal members generally indicated at numerals 214 and 216. Terminals 214 and 216 respectively include legs 218 and 220 which are received in suitable apertures or open ended slots formed in base member 210, and include portions extending exteriorly of the base member 210 to facilitate electrical connection of the switch in an electrical circuit.

Terminal 216 includes a stationary electrical contact providing portion 222 which is connected and may be formed integrally with leg 220 as shown. Stationary contact 222 is adapted to mate with a movable contact 224 mounted on and electrically connected to one end of a snap acting thermally responsive bimetal disc or strip member 226 which is or may be substantially identical to snap acting bimetal member 26 of switch 10.

Terminal 214 includes a disc mounting portion 230 which overlies base 210 and is interconnected with leg 218 by a loop junction portion 232, which spaces support portion 230 from base 210 as shown. Terminal 214 also includes an offset portion 234 which is offset and extends from the support portion 230 beneath member 226 in a direction toward the base and away from the thermal element 226. The free end of portion 234 overlies a central portion of base 210. Portions 230 and 234 are rigidly interconnected together. Portions 234, 230, 232, and 218 of terminal 214 may be formed integrally if desired. The free end of portion 234 is provided with an aperture in which a threaded portion 240 of an adjusting screw 242 is threadedly received. Adjusting screw 242 is preferably of the self-tapping type and is received in and extends through a suitable unthreaded clearance aperture 246 provided by base 210. The diameter of aperture 246 is sufficiently greater than the diameter of the threaded shank portion 240 of screw 242 to provide for adequate clearance. Adjusting screw 242 also includes a hexagonal head portion 248 which is accessible exteriorly of base 210 for effecting adjustment and calibration of the switch.

Snap acting member 226 is cantilever mounted on and electrically connected to support portion 230 by means of a welding slug or projection 250 which may be identical with welding slug 32 described above for switch 10. Welding slug 250 also spaces the bimetallic snap acting element 226 from the support portion 230. It will be seen that rotation of adjusting screw 242 will cause member 234 to move upwardly or downwardly as seen in FIG. 10 (depending upon direction of rotation) to cause support member 230 (and the cantilever mounted end of snap acting member 226) to pivot or rotate relative leg 218 and base 210 about junction loop portion 232 which in turn will move the contact carrying end of member 226 relative to the stationary contact 222 to effect calibration and adjustment of the operating temperature of snap acting element 226.

It will be seen from the foregoing that the present invention provides for simple and inexpensive calibration of a snap acting thermally responsive switch; provides a switch (FIGS. 1-5) which affords rapid and efficient heat transfer from an electrical heater member to the thermally responsive actuating member of the switch; and also provides a simple and inexpensive means and method for quickly and easily securing phenolic parts together. The calibration means of this invention also advantageously renders the switches particularly suitable for miniaturized constructions.

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

As many 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, and it is also intended that the appended claims shall cover all such equivalent variations as come within the true spirit and scope of the invention.

I claim:

1. An electrical switch comprising a base formed of electrically insulating material, a first electrically conductive terminal mounted on said base; a first electrical contact carried by said first terminal; a second electrically conductive terminal mounted on said base; said second terminal having a first portion connected to said base and a second portion overlying said base and extending at an angle to said first portion; an elongated snap acting thermally responsive element having a deformed portion therein responsible for its snap action, a welding slug mounted on said element adjacent one end thereof; said slug having portions projecting from opposite sides of said element, one of said portions thicker than said thermally responsive element and welded to said second portion of said second terminal thereby cantilever mounting said thermally responsive element on said second portion in spaced relation thereto preventing deleterious effects on the calibration of said thermally responsive element, said element electrically connected to said second portion of said second terminal; a second electrical contact electrically mounted on the other end of said element for movement into and out of engagement with said first electrical contact; and manually operable resetting means mounted on said base intermediate said base and snap acting element; said base providing a guideway for receiving said resetting means for reciprocal sliding movement therein between a contacts-closed position and a contacts-open resetting position, said resetting means having a portion formed of electrically insulating material; said resetting means portion in the contacts-open resetting position being disposed intermediate said stationary and movable contacts preventing interengagement of said contacts; means urging said portion of said resetting means for movement from the contacts closed to the resetting position; said resetting means portion abutting a side of said movable contact when the latter is in the contacts closed position and being inoperative to move to the resetting position until after said movable contact moves out of engagement with said stationary contact.

2. An electrical switch comprising a base formed of electrically insulating material, a first electrically conductive terminal mounted on said base, a first electrical contact carried by said first terminal; a second electrically conductive terminal mounted on said base; said second terminal having a first portion connected to said base and a second portion overlying said base and extending at an angle to said first portion and in a direction away from said first contact; an elongated snap acting thermally responsive element having a deformed portion therein responsible for its snap action; a welding slug mounted on said element adjacent one end thereof; said slug having portions projecting from opposite sides of said element, one of said portions thicker than said element and welded to said second portion of said second terminal thereby cantilever mounting said element on said second portion in spaced relation thereto, said element electrically connected to said second portion of said second terminal, a second electrical contact electrically mounted on the other end of said element for movement into and out of engagement with said first electrical contact; and an adjusting screw carried by said base and engageable with said second portion of said second terminal for moving the latter and the cantilever mounted end of said snap acting element

relative to said base in a direction transverse to said base to effect calibration of said switch, said adjusting screw including a portion extending exteriorly of said base.

3. A thermally responsive electrical switch comprising a base formed of electrically insulating material, a first electrically conductive terminal mounted on said base; a first electrical contact carried by said first terminal; a second electrically conductive terminal mounted on said base; said second terminal having a first portion connected to said base and a second portion overlying said base and extending at an angle to said first portion; and an elongated snap acting thermally responsive strip type member; a second electrical contact carried by said member adjacent one end thereof for engagement with said first contact; a welding slug secured to said member adjacent the other end thereof; said slug having portions projecting from opposite sides of said member, one of said portions thicker than said member and welded to said second portion of said second terminal thereby cantilever mounting said thermally responsive member on said second portion in spaced relation thereto; a third electrically conductive terminal mounted on said base; an electrical heater member overlying said snap acting element and electrically connected to said third terminal and to the other said welding slug portions and manually operable resetting means mounted on said base intermediate said base and snap acting member; said base providing a guideway for receiving said resetting means for reciprocal sliding movement therein between a contacts-closed position and a contacts-open resetting position, said resetting means having a portion formed of electrically insulating material; said resetting means portion in the contacts-open resetting position being disposed intermediate said stationary and movable contacts preventing interengagement of said contacts; means urging said portion of said resetting means for movement from the contacts closed to the resetting position; said resetting means portion abutting a side of said movable contact when the latter is in the contacts closed position and being inoperative to move to the resetting position until after said movable contact moves out of engagement with said stationary contact.

4. A manual reset thermally responsive electrical switch comprising a base formed of electrically insulating material, a stationary electrical contact mounted on said base, an elongated snap acting thermally responsive bimetal strip member having a deformed portion therein responsible for its snap action, a movable electrical contact car-

ried by said member adjacent one end thereof for movement into and out of engagement with said stationary contact, an electrical terminal mounted on said base and including a portion overlying said base; the other end of said snap acting member cantilever mounted on and electrically connected to said terminal portion, adjustable means for moving said terminal portion and cantilever mounted end of said snap acting member relative to said base to effect calibration of said switch, manually operable resetting means mounted on said base intermediate said base and snap acting member; said base providing a guideway for receiving said resetting means for reciprocal sliding movement therein between a contacts-closed position and a contacts-open resetting position, said resetting means having a portion formed of electrically insulating material; said resetting means portion in the contacts-open resetting position being disposed intermediate said stationary and movable contacts preventing interengagement of said contacts; spring means urging said portion of said resetting means for movement from the contacts closed to the resetting position; said resetting means portion abutting a side of said movable contact when the latter is in the contacts closed position and being inoperative to move to the resetting position until after said movable contact moves out of engagement with said stationary contact.

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