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3,361,883

CALIBRATED THERMOSTATIC SWITCH AND METHOD FOR CALIBRATING
THE SAME INCLUDING WELDED LUG AND RECESS MEANS

Original Filed Feb. 3, 1964

2 Sheets-Sheet 1

Fig. 1.

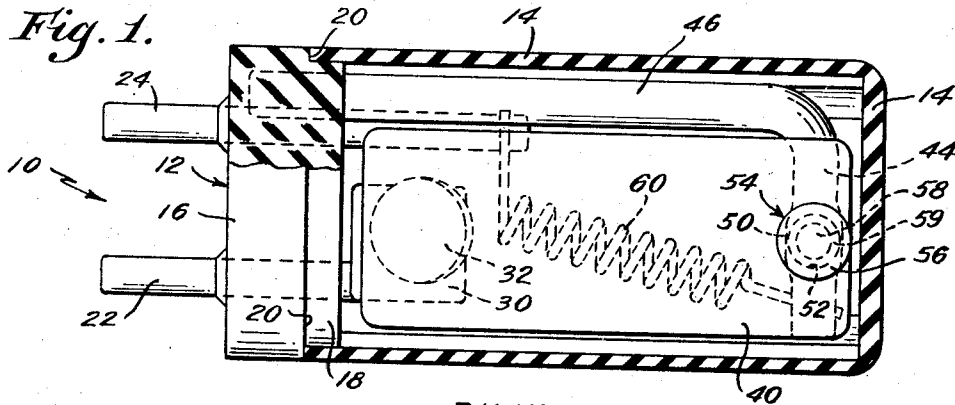


Fig. 2.

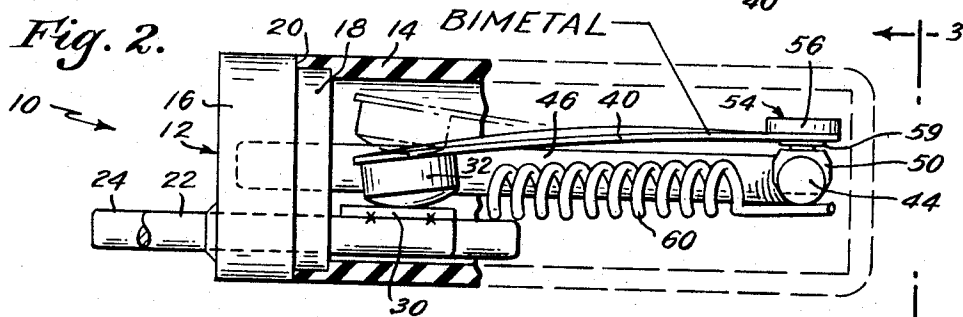


Fig. 4.

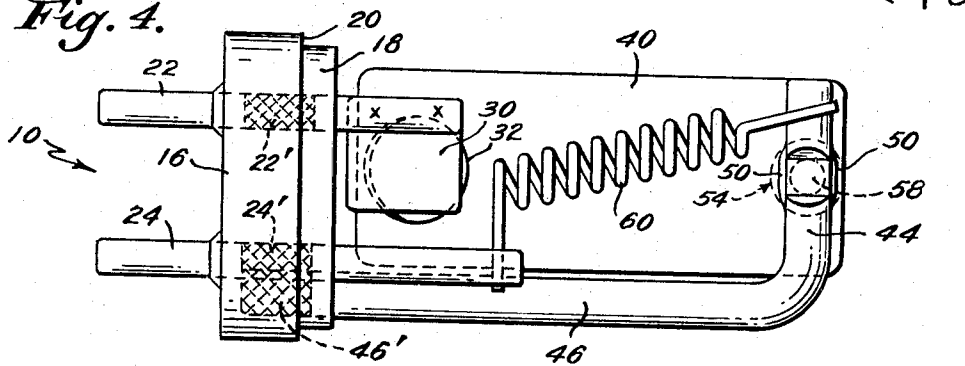


Fig. 5.

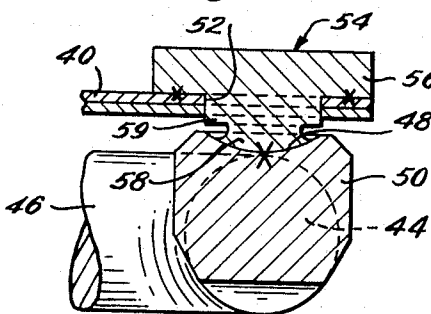
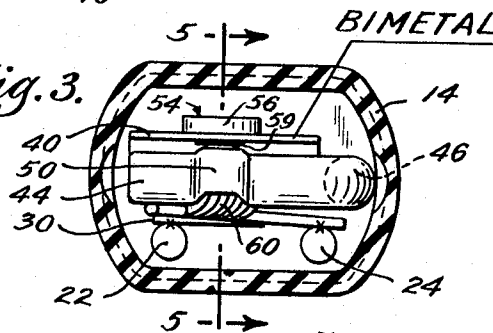


Fig. 3.



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Fig. 6.

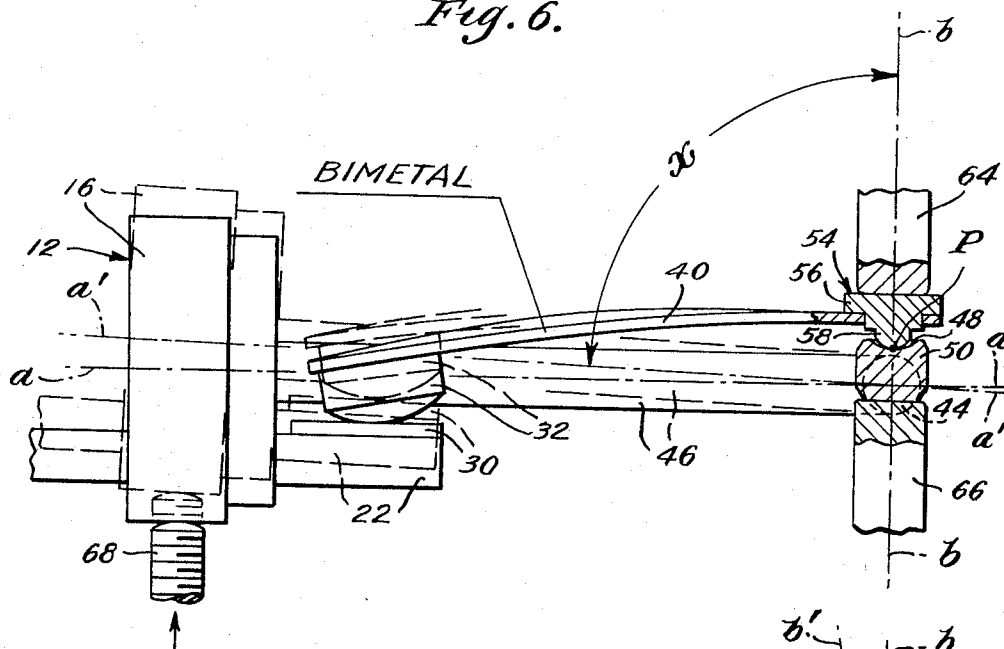
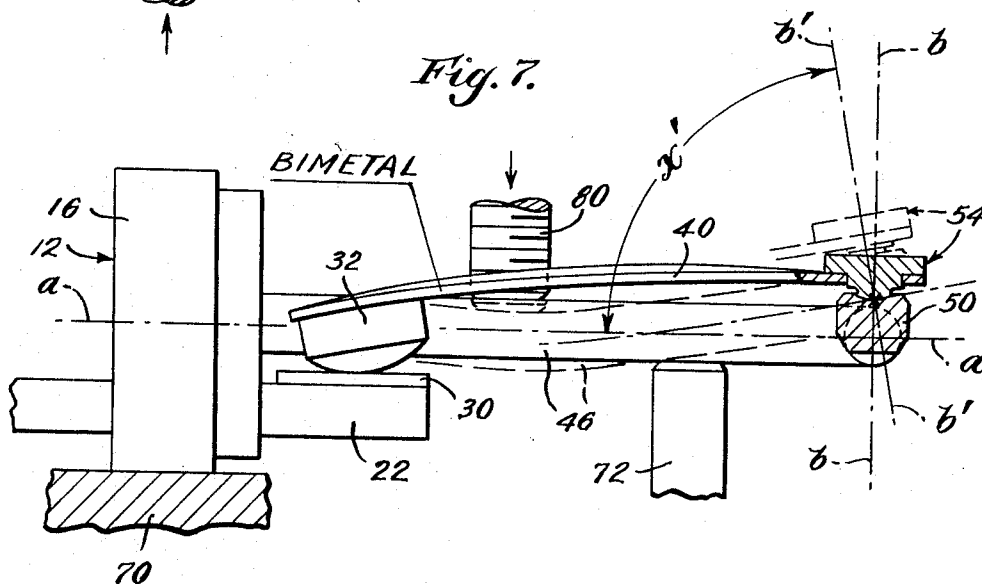


Fig. 7.



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CALIBRATED THERMOSTATIC SWITCH AND METHOD FOR CALIBRATING THE SAME INCLUDING WELDED LUG AND RECESS MEANS

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Continuation of application Ser. No. 341,881, Feb. 3, 1964. This application Nov. 1, 1966, Ser. No. 591,336
6 Claims. (Cl. 200—122)

ABSTRACT OF THE DISCLOSURE

A thermostatic switch adapted for miniaturization is shown to comprise a base, first and second electrically-conductive terminals mounted on said base in electrically-insulated relation to each other, a stationary contact provided by a portion of said first terminal, a mounting arm having first and second intersecting portions and having said first arm portion secured to said base in electrically-insulating relation to said terminals to dispose said second arm portion in spaced relation to said base, a snap-acting thermostatic member electrically connected to the second terminal and having a deformed portion responsible for its snap-action, an electrical contact supported on one end of the thermostatic element for movement into and out of engagement with the stationary contact in response to snap movement of the thermostatic member, and a welding lug secured to the opposite end of the thermostatic member so that an end of the lug extends from the thermostatic member. The second portion of the mounting arm has a dish-shaped recess therein forming a locating surface and the extending end of the welding lug fits into the mounting arm recess to engage the locating surface, the lug being disposed in selected angular relation to the mounting arm and being welded to the arm within the recess for supporting the thermostatic member in spaced, cantilever relation to the mounting arm in selected orientation relative to the stationary contact to calibrate the switch.

This application is a continuation of the copending application Ser. No. 341,881, which was filed Feb. 3, 1964, and which is now abandoned.

This invention relates to thermostatic switches, and in particular, to thermostatic switches of the snap-acting type which are small enough to be inserted or embedded directly in the windings of small, fractional horsepower motors or into cavities of small motors and small transformers, the thermostatic switch serving to prevent such devices from overheating. It is to be understood, however, that the invention is not limited to such protective use mentioned above but may be used wherever found applicable.

It is one object of the instant invention to provide thermostatic switch means of the above type which is simple in construction, adapted for miniaturization, inexpensive to manufacture, and reliable in operation.

It is another object of the instant invention to provide a thermostatic switch which is adapted for miniaturization so as to be conveniently insertable into the small spaces directly adjacent the heated parts of motors, transformers, fluorescent ballasts and the like, to which heating parts a temperature response is to be made by the switch.

It is yet another object of the instant invention to provide a thermostatic switch means which is safe and reliable in operation and is easily and simply calibrated.

It is also an object of the instant invention to provide simple, effective methods of accurately calibrating small thermostatic switches.

Among the several further objects of the instant invention may be noted the provision of a thermostatic switch

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of such simplicity as to make it feasible for mass production; which may be easily calibrated; which is both heat and current sensitive, durable, accurate, compact, which is versatile and susceptible to varying electrical ratings, particularly low current ratings; which embodies a minimum number of parts; and which is simple and economical to manufacture.

Other objects will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, steps and sequences of steps, features of construction and manipulation, and arrangements of parts 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, partly in section of one embodiment of the instant invention;

FIG. 2 is an elevational view of the switch shown in FIG. 1, with parts of the cover broken away;

FIG. 3 is a view taken on line 3—3 of FIG. 2;

FIG. 4 is a bottom plan view of a switch according to the instant invention;

FIG. 5 is an enlarged detail sectional view taken on line 5—5 of FIG. 3;

FIGS. 6 and 7 are enlarged fragmentary views similar to FIG. 2 showing methods of calibrating according to the instant 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 have been modified for the purposes of clarity of illustration.

Referring now to the drawings, and particularly to FIGS. 1—5, there is shown a thermostatic switch indicated generally by numeral 10. Thermostatic switch 10 comprises a thermostatic subassembly indicated generally by numeral 12 and a tubular cover or container therefor indicated by numeral 14. Thermostatic subassembly 12 comprises a base 16 including a projecting hub 18 and a peripherally extending flange 20, each of which are adapted to mate with the open end portion of container or cover member 14, as best seen in FIGS. 1 and 2. Cover member 14 has an inside peripheral configuration at its open end so as to provide a snug fit over the hub 18 and flush engagement with base 16, as shown in FIGS. 1 and 2. Cover or container member 14 and base 16 are formed of an electrically insulating moldable resin such as the phenolic resins or other thermosetting types.

As will be clear from the following description, thermally responsive switch 10 is both heat and current sensitive and is adapted to provide so-called inherent over-heat protection. Thermostatic switch 10 includes two electrically conducting terminals 22 and 24 extending through and projecting on opposite sides of base member 16. As best seen in FIGS. 1 and 2, terminal 22, at its inner end, mounts an electrically conducting stationary contact 30, which is adapted to engage a movable contact 32 carried by a thermostatic snap-acting disc 40. Disc 40 comprises a relatively thin, elongated thermostat metal strip which is dished or deformed along substantially its entire length to provide for its snap action. Deforming the disc along substantially its entire length provides a snap-acting disc which is substantially free of creep movement prior to snap movement of the disc. The use of such a disc in the instant switch eliminates the need for additional special creep-inhibiting or preventing means.

Thermostatic switch 10 also includes an L-shaped mounting member or arm having legs 44 and 46 arranged

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substantially at right angles to each other. The free end of leg 46 is embedded in base member 16 and does not extend through to the opposite side, as best seen in FIGS. 1 and 6. Base member 16 cantilever mounts the L-shaped mounting member and maintains the same in electrically insulated relation to both terminals 22 and 24. Leg 44 serves to cantilever mount thermostatic snap-acting disc 40, as best seen in FIGS. 1, 2 and 4.

Leg 44 includes, along a portion of its length opposite the fixed contact 30, a locating or centering recess 48 located in raised section 50 on arm 44. One end of disc 40 is secured, as by welding to a welding slug 54 of the type shown and described more fully in copending application Ser. No. 291,202, filed on June 27, 1963, in the name of Montague R. Duval and entitled, Means and Method for Making Electrical Connections, and assigned to the assignee of the instant invention.

As is described more fully in the above-noted application, welding slug 54 includes a head portion 56 and a depending shank portion 58. Disc 40, having a contact 32 welded thereto, is welded to head portion 56 with shank portion 58 extending through aperture 52 in disc 40. In this manner a disc assembly is formed which includes contact 32, disc 40 and slug 54. Thereafter slug 54 (and hence disc 40) is secured to arm 44 by a weld connection at recess 48 between arm 44 and the free end of shank portion 58. It will be noted that shoulders 59 on shank portion 58 protects disc 40 from the effects of the welding at recess 48 as is described in the Duval application. In this manner disc 40 is cantilever mounted on arm 44 and located such that contact 32 is movable into and out of engagement with stationary contact 30 in response to snap movement of disc 40.

Electrically secured to a portion of leg 44 as by welding is one end of an electrical heater 60 which may take the form of conventional resistance heater wire or the like. Heater wire 60 may be provided with an electrically insulating coating. Although a round wire is illustrated as an example of a heating element, a planar heating element may also be used, and it is to be understood that this may be a strip, ribbon, or the like, arranged in a plane. The term "wire" is used herein as characterizing each of these heater parts. Heater 60 is electrically connected as by welding at its other end to terminal 24. As best seen in FIG. 1, heater 60 is disposed below the snap-acting thermal element 40 in close thermal juxtaposition therewith and is connected between terminal 24 and leg 44. It will be understood that heater 60 may take various forms and can be mounted in various ways between leg 44 and terminal 24 so as to be in close thermal juxtaposition to disc 40.

When contacts 30 and 32 are closed, as shown in FIG. 2, an electrically conductive path is established leading from terminal 22, to contact 30, contact 32, through thermally responsive snap-acting disc 40, to leg 44, serially through heater 60, to electrically conducting terminal 24.

It will be understood that switch 10 may be employed without heater 60 if desired.

In FIGS. 6 and 7 are shown methods of calibrating the switch 10. Referring to FIG. 6, during the assembly of thermostatic subassembly 12 a disc assembly including a disc 40, contact 32 and slug 54 is selected and located with the shank portion 58 in locating recess 48. Thereafter electrodes 64 and 66 are located respectively on the upper surface of head portion 56 and on the under side of raised section 50. The compressive force between electrodes 64 and 66 retains the disc assembly in fixed position on arm 44. It has been found that the temperature at which disc 40 will snap is a function of its location with respect to the contact 30 and, more particularly, is a function of the angle x between the axial centerline $b-b$ through slug 54 and the centerline $a-a$ through arm 46. By adjusting angle x the desired temperature setting or calibration of the switch 10 can be achieved. A screw 68 or other means for applying a force to base 16 is located on the under side of base 16. Screw 68 is

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turned to apply a force tending to raise the base end of the subassembly 12. Electrodes 64 and 66 retain the slug and arm in a relatively fixed position. However, as base 16 is raised from the solid-line to the dotted-line position in FIG. 6, arm 44 is permitted to pivot about the end P of shank 58, while slug 54 is retained in a fixed position, centerline $a-a$ moves to $a'-a'$, thereby achieving the desired angular relationship x and hence calibration. After the desired angle x is achieved, the assembly is welded at point P to preserve the calibration. An alternate method of calibration is shown in FIG. 7. After the disc assembly has been welded to arm 44 to form subassembly 12, the subassembly is located with a fixed support 70 located at the under side of base 16 and a second support 72 located under a point along the length of arm 46. Thereafter a screw 80 or other force applying means is located along the length of arm 46 intermediate the base 16 and the support 72 on the lower surface of arm 46. When screw 80 is turned a force is brought to bear on the arm 46 tending to bend arm 46 from the solid-line position to the dotted-line position shown in FIG. 7. Axial centerline $b-b$ through welding slug 54 moves to $b'-b'$ to form the axle x which is predetermined as the angle at which the desired calibration is achieved when screw 80 is released, arm 46 remains bent in the dotted-line position thereby preserving calibration.

It will be noted that the above calibration methods may be performed with the subassembly and supports in various arrangements and in varying orientations. It will also be understood that the bending of arm 46 and the pivoting about point P may be in either direction as required.

It will also be understood that in ascertaining what the predetermined calibration should be, subassembly 12 may be located in an ambient temperature equal to the desired snap open temperature and, thereafter, either of the above calibration methods may be followed until disc 40 snaps open.

Terminals 22 and 24, and L-shaped mounting arm 46 may be cylindrical in form and may be formed of, for example, stainless steel. These elements may also be provided with knurled portions 22', 24' and 46' for connection to base member 16. Thermostatic switch 10 may be quickly and easily assembled. After the thermostatic subassembly 12 is prepared and the disc 40 has been calibrated in the manner described above, the subassembly 12 is slidably inserted into cover member 14, and secured thereto thereby sealing the device.

The complete calibrated and sealed device, in applications as a motor protective device, may be inserted into a cavity in a small motor such as a miniature motor currently in use in military aircraft, or the device can be buried in the windings of a motor that it is to protect. In such a place, it is responsive immediately and faithfully to the actual temperature of the motor winding. The terminals 22 and 24 are, for example, connected in series with one lead to the motor winding. Thus, if the motor should approach a temperature which is deleterious to the winding insulation, or dangerous as a fire hazard, etc., thermostatic element 40 will snap upwardly (as shown in the dashed lines in FIG. 2) to separate movable contact 32 from stationary contact 30, thus interrupting the current to the motor. When the motor has cooled to a predetermined temperature which is a preselected amount below the "hot" snapping temperature, thermostatic element 40 will snap back to close the circuit of the motor for re-energization thereof. Heater 60, which is in electrical series connection with thermostatic disc 40, may be designed so as to pass normal load currents but with abnormal currents, will generate sufficient heat to quickly actuate the snap-acting disc 40 to snap to a contacts-open position and interrupt the circuit.

From the above, it can be seen that the instant invention provides a thermostatic switch which comprises a

relatively small number of parts, which can be simply, quickly and inexpensively produced, and yet can be simply calibrated. The thermostatic switch comprises individual subassemblies which can be mass produced and quickly and inexpensively assembled into operative position. The thermostatic switch of the instant invention affords a miniaturized construction with a relatively small number of parts.

The unique construction of the thermostatic switch of the instant invention renders its operation substantially free from influence of vibration and renders the thermostatic switch particularly suited to applications where severe vibration is a factor.

The switch of the present invention has minimum heat mass and minimum size, leading to quick heat response. Such quick heat responses are very valuable and are critical in certain motor protection applications.

Further, simplified accurate methods of calibration of the switch have been provided.

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

It is to be understood that the invention is not limited 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 practised 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.

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.

We claim:

1. A thermostatic switch adapted for miniaturization comprising a base;

first and second electrically-conductive terminals mounted on said base in electrically-insulated relation to each other;

a stationary contact provided by a portion of said first terminal;

a mounting arm having first and second intersecting portions, said first arm portion being secured to said base in electrically-insulated relation to said first and second terminals, said second arm portion being disposed in spaced relation to said base and having a recess therein forming a dish-shaped locating surface;

a snap-acting thermostatic member electrically-connected to said second terminal and having a deformed portion responsible for its snap-action;

an electrical contact supported on one end of said thermostatic member for movement into and out of engagement with said stationary contact in response to snap movement of said thermostatic member; and

a welding lug secured to the opposite end of said thermostatic member, said lug having an end fitted within said mounting arm recess in selected angular

relation to said mounting arm to engage said locating surface, said lug being welded to said mounting arm within said recess for supporting said thermostatic member in spaced, cantilever relation to said mounting arm in selected orientation relative to said stationary contact for calibrating said switch.

2. A thermostatic switch as set forth in claim 1 wherein said welding lug end has a rounded surface engageable with said locating surface in a plurality of angular orientations of said lug relative to said mounting arm.

3. A thermostatic switch as set forth in claim 2 wherein said deformed portion of said thermostatic member extends along substantially the entire length of said thermostatic member to substantially limit movement of said thermostatic member to snap movement thereof.

4. A thermostatic switch as set forth in claim 2 wherein said thermostatic member is electrically connected to said second terminal by means of electrical heater means disposed in thermal juxtaposition to said thermostatic member.

5. The method of calibrating a thermostatic electrical switch comprising the steps of mounting a stationary contact on a base, mounting an arm on said base so that an arm recess forming a dish-shaped locating surface is disposed in spaced relation to said stationary contact, attaching a welding lug to one end of snap-acting thermostatic member so that one end of said lug extends from said member, holding said lug end in engagement with said locating surface on said arm, orientating said lug in selected angular relation to said arm while in engagement with said locating surface to position said thermostatic member in selected orientation relative to said stationary contact, and welding said lug to said arm in said selected angular relation to said arm for calibrating said switch.

6. A method of calibrating a thermostatic electrical switch as set forth in claim 4 wherein said lug end is held in engagement with said locating surface by gripping said lug end arm between electrodes and wherein said lug is welded to said arm by passing electrical current between said electrodes through said lug end arm.

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