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W. H. MOKSU

2,767,284

THERMOSTATIC SWITCH

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Fig. 1

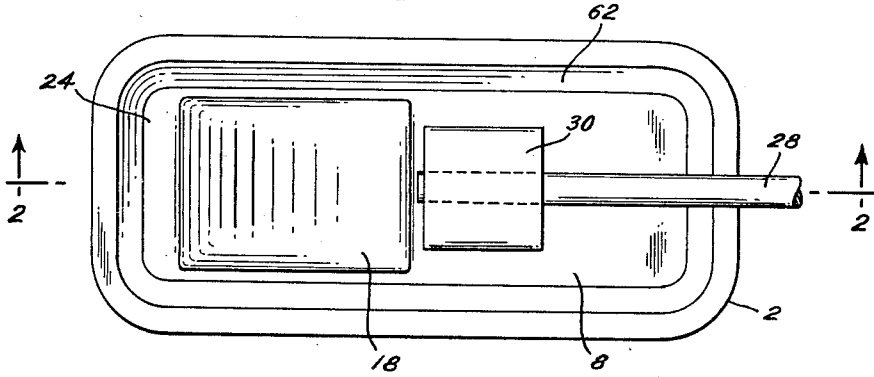


Fig. 3.

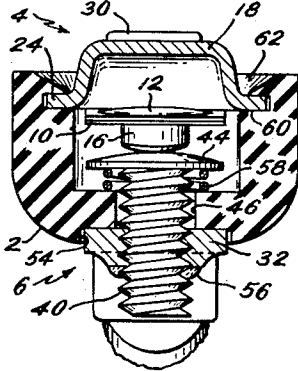


Fig. 2

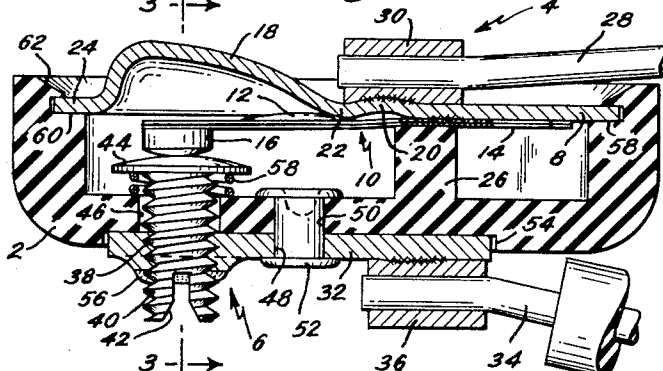
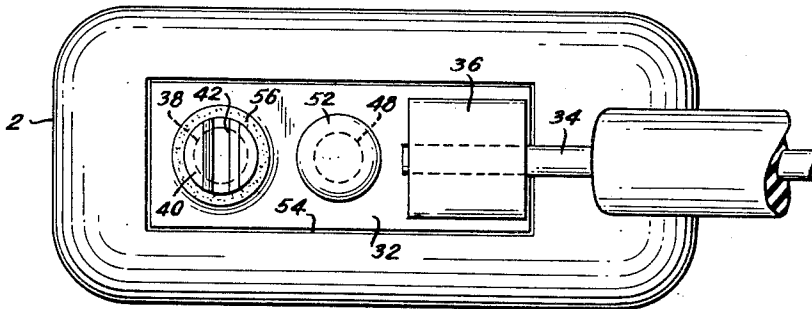


Fig. 4.



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2,767,284

THERMOSTATIC SWITCH

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6 Claims. (Cl. 200—138)

This invention relates to snap-acting thermostatic switches, and in particular to thermostatic switches of the snap-acting type which are so simply constructed as to enable them to be made very economically and in very small sizes. The invention is an improvement over the invention set forth in United States patent application Serial No. 412,251, filed in the United States Patent Office on February 24, 1954, by the same inventor.

As indicated above, the invention lies in the field of small, simple and economically-made thermostatic switches. Particularly is it adaptable to be made by a mass production method, due to the few number of parts involved, and the particular way these parts are assembled and the assembled device calibrated. As so made, the thermostats are small enough to be embedded directly (for example) in the windings of small fractional horsepower motors, and small transformers, the thermostat serving to prevent such devices from overheating. Among the desired characteristics of such thermostats are: low heat mass, adequate electrical insulation, quickness of heat transfer to the thermal element of the device, ease and permanence of calibration, low cost, and clean electrical make and break of its contacts.

Among the several objects, therefore, of the invention may be noted the provision of a snap-acting thermostatic switch of improved simplicity such as to make it feasible for low cost mass production; the provision of a switch of the class described which has low heat mass and therefore has fast response to the device whose temperature it is controlling; the provision of a switch of the class described which may be readily and permanently calibrated; the provision of a switch of the class described which provides a unique and improved low cost mounting for a snap-acting thermostat element; and the provision of a novel and simple means for fastening elements to molded synthetic resins.

Other objects and advantages of the invention will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combination of elements, features of construction, and arrangement of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which one embodiment of the invention is illustrated:

Fig. 1 is a top view of one embodiment of this invention, showing details of the cover plate thereof and an electrical connection made thereto;

Fig. 2 is a cross sectional elevation taken in the direction of sight lines 2—2 on Fig. 1;

Fig. 3 is a cross sectional end view taken in the direction of sight lines 3—3 on Fig. 2; and

Fig. 4 is a bottom view showing details of an adjustable contact-carrying plate and an electrical connection made thereto.

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

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Referring to the drawings, and in particular to Figs. 2 and 3, there is shown a thermostat comprising a rectangular cup-shaped base 2, having mounted therein the various parts of the thermostat. These parts are in two assemblies, as follows: The cover plate and snap-acting thermal element assembly indicated generally by numeral 4; and the adjustable contact and its carrying plate assembly indicated generally by numeral 6. Referring to the first of these, a combination cover and carrying plate 8 is provided and is made of sheet metal such as copper, or brass, or preferably steel. Attached to plate 8 by autogenous welding is the elongated thermostat element indicated generally by numeral 10, having a dished area 12 provided therein to make the thermostat element snap-acting (as is provided in the United States Patent No. 1,448,240), and having a tail portion 14 which is welded as aforesaid to the plate 8. An electrical contact 16 is welded to the element at one end as shown. It will be observed that the plate 8 is formed to provide two recessed portions 18 and 20, the purpose of which will now be described.

Recessed portion 18 is provided to give the snap-acting, contact-carrying portion (the lefthand end as drawn) of the element 10 space to snap upwards and downwards. Recessed portion 20 is provided to permit portion 22 of the plate to act as a restraining point which, as will be noted, bears against the dished portion 12 somewhere between the center thereof and that place where the dished portion merges into the tail end 14. By this construction, the snap-acting portion of the element 10 is not bound in any way that would inhibit the freedom of its motion, and yet the dished portion 12 is constrained to permit its operating temperature to be adjusted. Plate 8 is provided with a surrounding flat periphery 24.

As an integral part of the base 2, there is provided the upstanding wall 26, and it will be observed that wall 26 bears against the thermal element 10 between the place where the thermal element is welded to the cover plate 8 and the place on the thermal element where the portion 22 of the cover plate bears against the thermal element. The purpose of wall 26 in its bearing against the thermal element 10 is to prevent the thermal element from creeping closed after it has once opened. If the wall 26 were to be removed in the construction shown, then it would be found that the element, instead of snapping to a contact-closed position, would have a tendency to creep downwardly (as drawn) to a position in which the contacts would be closed before the snap-acting portion 12 would snap.

Also attached to the top surface of plate 8 is the electrical conducting wire 28, this attachment being done by inserting the end of the conducting wire in a sleeve 30, this sleeve being preferably made of steel, and then the sleeve and the contained end of the wire are jointly welded to the plate 8 as indicated by the cross hatched lines.

Thus it will be observed that the thermal element assembly can be made as a unit together with its attached electrical conducting wire. The order of the assembly of this unit 4 is first to assemble the conducting wire to the plate 8 by welding as indicated above, and then the preformed snap-acting element 10 is welded to the other side of plate 8 as indicated.

The other assembly 6 comprises a contact screw-plate 32 to which is attached the electrical conducting wire 34, this attachment being made by welding, using the sleeve 36 in the manner indicated above for conducting wire 28. At the other end of contact plate 32 is provided a threaded hole 38 into which is threaded the contact-carrying adjusting screw 40, this being slotted as shown at 42 to permit the entry of an adjusting tool. The inner end of screw

40 carries the electrical contact 44 which mates with the electrical contact 16 carried by the snap-acting element 10. A hole 46 is provided in the base 2 to receive the contact screw 40, and also to help support the screw. (This permits the use of a thinner plate 32 than would otherwise be the case.) The plate 32 is provided with a mounting hole 48, and a matching hole 50 is provided in the base, these being adapted to receive the single rivet 52 which serves to hold the mounting plate and its contact-carrying screw firmly against the base 2. A shallow recess 54 is molded into the base 2 as a guide and positioning means for the plate 32, thus making possible the attachment of the plate in a firmly secured predetermined position by means of the single rivet 52.

In view of the fact that the plate 32 is generally of thin material (for example, it may be about 0.030 inch thick) only a few threads in plate 32 will engage the contact screw 40, these being formed in an extruded portion of the plate in conventional manner. Thus the contact screw may not be a tight fit in these threads, and any looseness at this point during the calibrating operation may give trouble due to a movement of the screw from the time the screw is adjusted to calibrated position and the time that the screw is permanently fastened in position as by soldering (this solder being indicated by numeral 56). Therefore, in order to prevent this looseness and to secure the screw so that no change will inadvertently take place up to and including the soldering operation, a spring 58 is provided between the head 44 of the screw 40 and the base 2. As shown, the spring used may be a simple one-or-two-turn coiled helical spring. However, other spring means can be used, such as a spring-type washer, or a piece of resilient material such as soft rubber or silicone through which the screw 40 extends so that the resilient material is compressed between the head 44 and the base 2. Thus, it will be seen that the contact plate assembly consisting of the plate 32 and its electrical connection can be assembled first and then fitted to the base 2 in recess 54 by means of the single rivet 52.

After the assembly 6 has been mounted to the base 2 and the adjusting screw 40 is in position, the plate 8 is set in place on the shoulder 60 which forms a rabbet with the adjacent upstanding portion of the base as shown in Figs. 2 and 3 and which is molded as an integral part of the base 2. Thereafter, the material of the base 2 (either a thermosetting resin or a thermoplastic resin) is hot formed as indicated by numeral 62 down over the flat periphery 24 as shown in Figs. 2 and 3; the portion 62 thus permanently fastening the thermostat assembly 4 in the rabbet and in its proper position to the base 2. It is realized, of course, that hitherto it has been thought impossible to hot mold a thermosetting resin after the article has once been molded. However, it has been discovered that if the heat of molding is applied correctly and for the proper length of time, a limited further flowing of the thermosetting resin can and will take place, and that this limited flowing can be utilized very advantageously as shown here for the purpose of tightly fastening a plate to a base as indicated. Below will be further described the exact technique used for a particular thermostat as an illustration of how this can be done.

At this point it is appropriate to indicate the manner in which the completed assembly is put together. It has already been told above how the thermostat assembly 4 is first made, and then how the contact plate with its conducting wire is assembled and fastened to the base. Thereafter, the order of construction is as follows:

(1) With the contact plate 32 fastened to the base, the spring 58 is placed over the screw 40 and the latter is screwed into its properly threaded hole 38.

(2) The thermostat assembly 4 is then placed on top of the base on shoulder 60 and the assembly of these parts is placed in a hot molding machine where the seal 62 is made as indicated above.

(3) Adjusting screw 40 is then turned either upwardly or downwardly as the case may be until the proper snapping temperature of the snap-acting dished portion 12 is arrived at.

(4) The adjusting screw is thereafter held permanently in this position by the application thereto of the solder 56.

The thermostat shown in the drawings has an over-all length of approximately 0.844 inch and an approximately over-all width of 0.375 inch. Its height (from the bottom of the adjusting screw to the top of the hollow provided by recessed portion 18) is approximately 0.360 inch. A material from which base 2 may be advantageously made is that sold under the trademark Resinox No. 3479. The cover plate is approximately 0.020 inch thick and the thermal element is approximately 0.003 to 0.004 inch thick.

The hot molding or hot staking which makes the seal 62 is done as follows: The heat staking is done with a molding iron having a temperature of about 475° F. which is applied for 5 seconds with a pressure of 35 pounds per square inch. Under these conditions, the material mentioned flows readily to provide the turned-over shoulder indicated by numeral 62.

It is to be noted that with this construction, the device lends itself admirably to simple and economical mass production. The parts used are either stamped parts (such as the plates 8 and 32) or parts made on automatic machinery (such as the rivet 52 and the adjusting screw 40). The thermal element 10 may also be made on automatic machinery. A minimum number of parts is involved, and all fastening operations are done by either welding or riveting as described. The device itself is very small, and as indicated in the first part of this specification, may be embodied in the windings of the devices such as motors or transformers which it is designed to protect. Because of the sealing effected at 62, the device is in effect sealed against the inclusion of any dirt or other materials such as potting compounds which would spoil its operation, etc. Because of the attachment of the snap-acting element directly to the cover plate 8, heat is led rapidly into and out of the thermal element 10 and therefore the device is fast in its response to temperature changes.

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

As many changes could be made in the above constructions 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.

I claim:

1. A snap-acting thermostatic switch comprising a cup-shaped base of molded plastic having an upstanding outer wall, the top of said wall having a rabbet on its inner edge; a metal closure plate having its periphery resting in said rabbet; means holding said closure plate in said rabbet; a thermostat element having one portion thereof fastened to, and in electrical contact with, the inner side of said closure plate, another portion of said element being inherently snap-acting and free to snap toward and away from the bottom of said base; a supporting member within said base and bearing against the underside of said thermostat element at a point intermediate the fastened and snap-acting portions thereof; a first electrical contact carried by the snap-acting portion of said element and in electrical engagement therewith; a second electrical contact adjustably mounted on said base and positioned to be engaged and disengaged by said first contact to make and break an electrical circuit; and means for adjusting from outside said base the position of said second contact relative to said bottom of the base.

2. A snap-acting thermostatic switch comprising a cup-shaped base having an upstanding outer wall of heat-deformable material, the top of said wall having a rabbet

on its inner edge; a metal closure plate having its periphery resting in said rabbet, said periphery being held in said rabbet by means of deformed portions of said material which overlie said periphery; a thermostat element having one portion thereof fastened to, and in electrical contact with, the inner side of said closure plate, another portion of said element being inherently snap-acting and free to snap toward and away from the bottom of said base; a supporting member within said base and bearing against the under side of said thermostat element at a point intermediate the fastened and snap-acting portions thereof; a first electrical contact carried by the snap-acting portion of said element and in electrical engagement therewith; a second electrical contact adjustably mounted on said base and positioned to be engaged and disengaged by said first contact to make and break an electrical circuit; and means for adjusting from outside said base the position of said second contact relative to said bottom of the base.

3. The thermostatic switch of claim 2 in which said supporting member comprises a wall upstanding from the bottom of said base on the interior thereof and having its top at approximately the level of the bottom of said rabbet.

4. The snap-acting thermostatic switch of claim 2 in which said snap-acting element comprises an elongated strip of thermostat metal having one end thereof dished in order to provide thereby said snap-acting portion.

5. A snap-acting thermostatic switch comprising a cup-shaped base having an upstanding outer wall of heat-deformable material, the top of said wall having a rabbet on its inner edge; a metal closure plate having its periphery resting in said rabbet, said periphery being held in said rabbet by means of deformed portions of said material which overlie said periphery; a thermostat element having one portion thereof fastened to, and in electrical contact with, the inner side of said closure plate, another portion of said element being inherently snap-acting and free to snap toward and away from the bottom of said base; a supporting member within said base and bearing against the underside of said thermostat element at a point intermediate the fastened and snap-acting portions thereof; a first electrical contact carried by the snap-acting portion of said element and in electrical engagement therewith; a second electrical contact adjustably mounted on said base and positioned to be engaged and disengaged by said first contact to make and break an

electrical circuit; means for adjusting from outside said base the position of said second contact relative to said bottom of the base, said thermostat element comprising an elongated strip of thermostat metal having one portion thereof dished to provide said snap-acting portion, said fastened portion of said thermostat element being substantially flat and welded to said closure plate, and said supporting member comprising an upstanding wall mounted on the base within said cup and having its top bearing against said thermostat element at a place between said snap-acting portion and said welded portion.

6. A snap-acting thermostatic switch comprising a cup-shaped base of molded plastic having an upstanding outer wall, the top of said wall having a rabbet on its inner edge; a metal closure plate having its periphery resting in said rabbet and held therein by means of wall material heat deformed and pressed inwardly to overlie said periphery; a thermostat element comprising an elongated strip of thermostat metal having one portion thereof dished to provide a snap-acting portion and another portion thereof substantially flat, said element being welded to the inside of said closure plate by said flat portion, said dished portion being free to snap toward and away from the bottom of said base; an upstanding wall mounted on said base and bearing against said element at a point between said snap-acting portion and said welded portion thereby to prevent part if not all of the creep motion of said element in one direction; a first electrical contact carried by said snap-acting portion of said element in electrical engagement therewith and therefore in electrical engagement with said closure plate; a metal adjusting plate fastened to the bottom of said base on the outside thereof and having therein a threaded screw hole; an adjusting screw threaded into said screw hole and extending into the interior of said base; an electrical contact fastened to said adjusting screw in the interior of said base and positioned to be engaged by said first contact to make and break an electrical circuit; and means for making electrical connections to said closure plate and to said adjusting plate.

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