Dec. 10, 1968 J. O. MOORHEAD ET AL 3,416,115

THERMOSTATIC SWITCH WITH IMPROVED CAPACITY AND AUTOMATIC CALIBRATION

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2 Sheets-Sheet 1

Fig. 1.

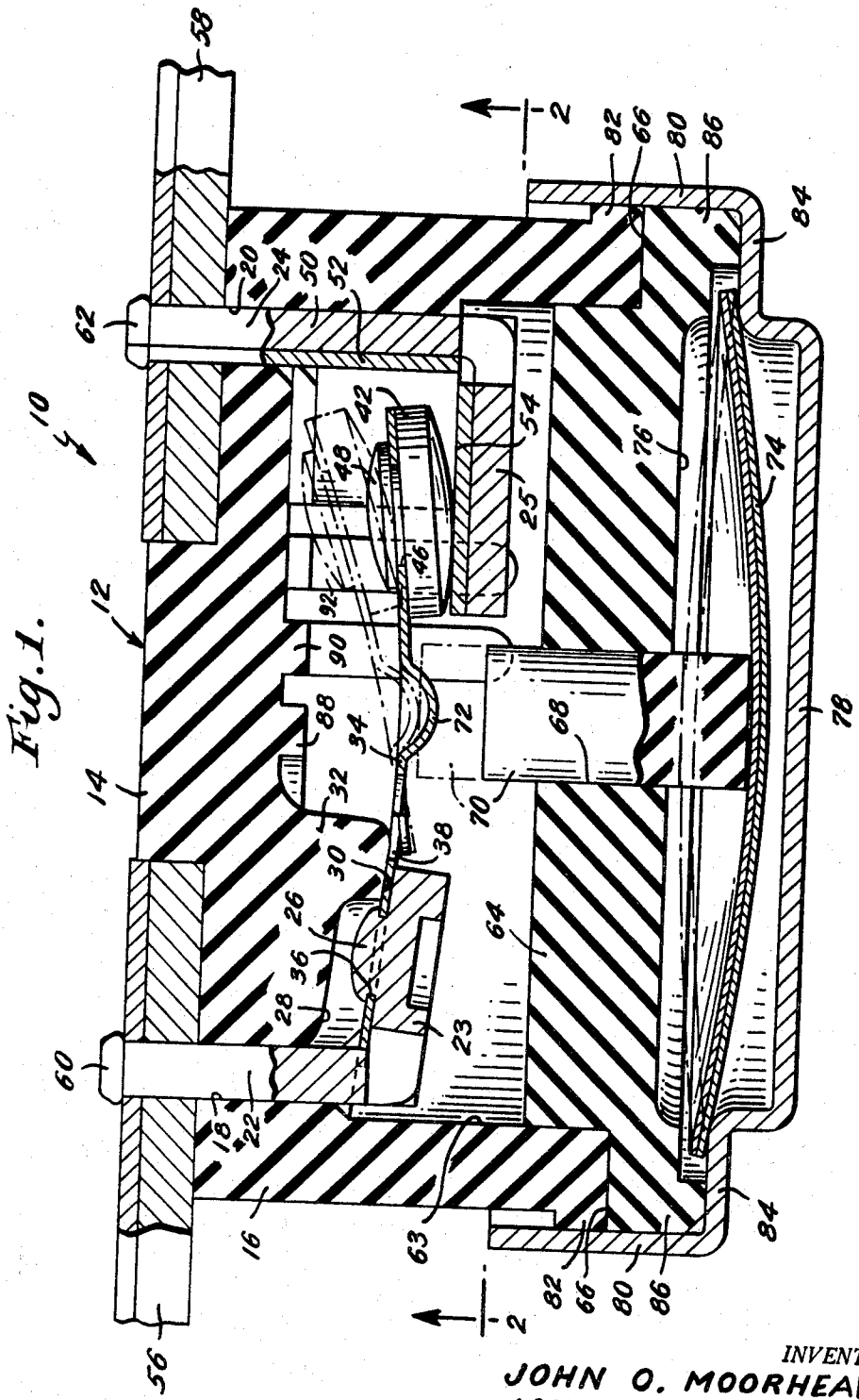

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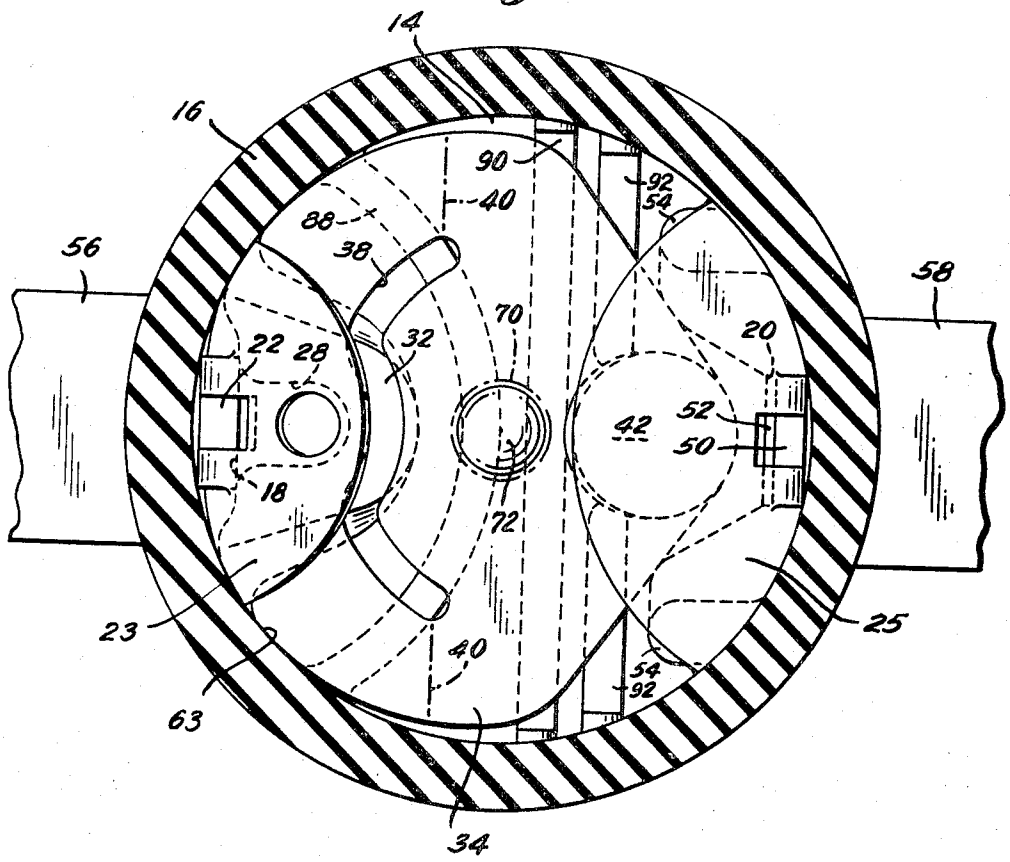
Fig. 2.



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THERMOSTATIC SWITCH WITH IMPROVED CAPACITY AND AUTOMATIC CALIBRATION

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ABSTRACT OF THE DISCLOSURE

An automatic reset switch having especially high electrical rating for a given minimal size is disclosed, in which improved contact supports (movable and stationary) are provided which cooperate with reference surfaces of the housing to determine a given contact pressure without further calibration of the device. The supports and contacts are relatively massive to also serve as heat sinks to conduct the electrically generated heat away from the switching area. The stationary contact is elliptical in shape and conforms closely to the inside cylindrical side wall of the switch to maximize arc absorption and quenching. The contacts are also relatively massive to facilitate arc absorption and dissipation. A thermal element is mounted in an electrically separated section of the switch and is operatively connected to a flat, spring arm mounting the movable contact by means of a transfer pin which is adapted to contact a dimple portion of the spring arm resulting in pivotal movement of the arm with respect to the pin. The spring arm is of a particular configuration to give minimal electrical resistance and spring rate with concomitant maximal flexing life and volume. Arc shadow means is provided in the switch chamber to prevent conductive tracking of the vaporized contact material.

This invention relates to thermostatic electrical switches and more specifically to switch structures adaptable for use in the assembly of automatic reset switches.

Among the several objects of the invention may be noted the provision of thermostatically controlled electrical switches, particularly those of the snap-acting type incorporating improved features of form adapted to save manufacturing costs while preserving the accurate dimensional relations required for a high quality product and the provision of switches of the class described which can conveniently be made up in the so-called automatic reset type.

It is yet another object of the invention to provide an automatic reset thermostatic switch which delivers high reliability and long life yet is economical to produce.

Another object of the invention is the provision of a switch which has an especially high electrical rating for a given minimal size particularly useful in tabletop appliances and the like.

It is a further object of the instant invention to provide a switch of the class described which design permits a switch package of minimal physical size having maximum rating and capabilities and which permits low cost manufacturing.

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 construction and methods hereinafter described and the scope of which will be indicated in the following claims.

In the accompanying drawings in which one of the various possible embodiments of the invention is illustrated:

FIGURE 1 is a vertical cross section through the switch.

FIGURE 2 is a bottom plan section taken on line 2—2 of FIGURE 1.

Similar reference characters indicate corresponding parts throughout the views of the drawings. Dimensions of certain of the parts as shown in the accompanying drawings have been modified for the purposes of clarity of illustration.

Referring now to the drawings, switch **10** comprises a base assembly **12** which includes a support member **14** of an electrically insulating material such as a phenolic resin and is generally cup-shaped having a depending wall portion **16**. Apertures **18** and **20** are provided in the closed end of support member **14** to permit passage therethrough of movable contact arm support **22** and contact arm member **24** respectively. Contact arm support **22** comprises a relatively massive member generally L-shaped and provided with a rivet head **26** preferably formed integrally therewith. A recess **28** is formed in support **14** to provide clearance for rivet head **26**. Surface **30** of boss **32** formed in support **14** is used as a reference surface as will be more fully explained infra. A movable flat spring arm or support **34** is provided with an aperture **36** through which rivet head **26** is inserted and headed over. Slot **38** may be provided in member **34** to permit a controlled bending motion of member **34** as indicated at **40**. (See FIGURE 2.) Contact button **42** which is as massive as space permits, is attached by conventional means to member **34** as by inserting head **44** through aperture **46** in member **34** and heading over as at **48**. Button **42** is formed of a good electrically conductive material, such as silver. Spring member **34** is comprised of two portions; the first, a bending portion which is generally semi-circular in shape conforming closely to the side walls of the cylindrical switch housing and cantilever mounted on contact support **22**; the second portion may be described as a contact mounting portion and is formed with a dimpled motion transfer area **72**. The extremities of the second portion converge from the first portion toward a distal end which encompasses the movable contact **42**. At the boundary between the first and second portions slot **38** is preferably located to control the bending motion at a desired location.

As further explained below, the flatness of the spring results in a more uniform spring constant which facilitates the contact pressure setting by means of the reference surfaces. The particular shape maximizes the volume for a minimum spring constant.

Contact arm **24** is composed of a good electrically and thermally conducting material which may take the form of a layer **50** of brass with an overlay **52** of silver to further enhance conductivity. Contact arm **24** is generally L-shaped and its position is referenced by shoulders or bosses **54** of support **14**, see especially FIGURE 2. Elements **22**, **24** are connected to terminals **56**, **58** respectively in a conventional manner as by heading over at **60**, **62**. Terminals **56**, **58** are shown as composed of two layers of material to obtain maximum conductivity at minimal cost; however, it is obvious they could be monolayered.

The precise location of surface **30** of support **14** is carefully chosen since it determines, together with the location of contact **25** and of contact arm **24**, the contact pressure between contacts **42**, **25** and hence the calibration of the device. Contact arm support **22** is bent approximately 90° and then biased against surface **30**

so that the precise angle of portion 23 of support 22 will coincide with that of surface 30.

A guide member 64, formed of electrically insulating material, is formed with an annular shoulder 66 which seats the free end of wall 16 enclosing the switching area or cavity 63. Guide member 64 is formed with coaxial aperture 68 in which is slidably received a motion transfer pin 70 also formed of electrically insulating material. One end of pin 70 is adapted to engage movable member 34 at a dimpled portion 72. The other end is engageable with a thermostatic bimetallic element 74 which in its normal contacts closed position is downwardly convexed as shown in solid lines in FIGURE 1, and which in a snapped, contacts open position, is upwardly convexed as shown in phantom lines in FIGURE 1.

A disc cavity 76, formed in guide 64, is enclosed by metal cap 78. Cap 78 has upstanding wall portion 80 which closely fits around the periphery of guide 64 and shoulder 82 formed in wall 16 and is frictionally held thereto. Cap 78 has formed therein a shelf 84 which abuts shoulder 86 of guide 64 to accurately position the shelf 84. Resting upon shelf portion 84 is bimetallic element 74.

The lower end of transfer pin 70 abuts disc 74 while the upper end is spaced from and movable into engagement with dimpled portion 72 formed in movable arm 34. Dimpled portion 72 permits pivotable movement of arm 34 with respect to transfer pin 70.

It will be noted that there is a predetermined clearance established between the upper end of the transfer pin and the dimpled portion 72 of movable arm 34 when transfer pin 70 rests on disc 74 in the normal disc position shown in FIGURE 1, this clearance permits some free movement of the pin 70 from the solid line FIGURE 1 position before engagement with dimple 72 while the initial inherent slow creep of the disc from its extreme contacts closed configuration to an intermediate critical snap-acting configuration occurs. When the critical snap-acting configuration of the disc is achieved, the transfer pin 70 has moved into engagement with dimple 72 so that when disc 74 snaps upward to its other extreme contacts open configuration as shown in phantom lines in FIGURE 1 movable arm 34 is urged upwardly to disengage contacts 42 and 25. Thus, this clearance assures that the preliminary creep action of the disc is not transferred into a preliminary creep opening of the contacts.

When the temperature sensed by disc 74 decreases by a predetermined amount, the disc 74 snaps back to the normal position shown in solid lines in FIGURE 1 thus releasing transfer pin 70. Resilient arm 34 urges contacts 42 and 25 into engagement.

Guide 64 advantageously provides an integral arc shield between the disc cavity 76 and the switching mechanism. Further, guide 64 isolates the switching area 63 and prevents electrical tracking to cup 78 which may be grounded. This enhances the electrical rating of switch 10. Further, rib members 88, 90 and 92 also provide arc shadows which prevent a shorting conductive layer being deposited on the side walls of support member 14.

Additionally, we are able to achieve particularly high electrical ratings as follows: the mass on contacts 42 and 25 is as large as possible for the space 63 available to absorb and dissipate the arc created when an electric current is interrupted. For fixed contact 25, see FIGURE 2, we use a generally elliptically shaped contact closely conforming to the inside periphery of wall 16 and of maximum size. This also helps to absorb and quench such arcs. The vertical leg of contact arm 24 is formed closely adjacent to contact 25 to aid in quencing of arcs and also in minimizing the length of arcing time. It is important to quench the arcs created and to minimize the arcing time because by so doing the evaporation of the contact material, e.g. silver, is diminished thereby increasing the service life of the device and permitting a higher electrical rating.

As a further aid in decreasing the contract material evaporation and fatigue of the elements the temperature in the switching area should be kept as low as possible. We accomplish this by forming contact arm support 22 and contact arm 24 integrally with the mounting of arm 34 and contact 25 respectively and by making them as massive as possible. These serve as heat sinks and conduct electrically generated heat (arcing and I^2R heat, especially the I^2R heat generated in the relatively thin arm 34) away from the switching area.

The contact material which does manage to evaporate is caused to dissipate and diffuse over a larger area due to the shape of contact 25 and arm 34 which help to prevent the formation of a low resistance conductive path to ground or a short circuit between the contacts. The shape of flexible arms 34, see FIGURE 2, which is generally fan-shaped and described supra, covers most of the available space within wall 16, is also dictated by the need to have a minimal electric resistance, a minimal spring rate, a maximal flexing life with a maximal thickness and a minimal spring back when the contacts are closed (that distance portion 72 must move before the contacts separate). In order to enhance conductivity arm 34 is preferably plated with silver and to increase fatigue life of arm 34 it is preferably constructed of beryllium copper.

Savings in production are effected, inter alia, by forming rivet 26 integrally with portion 23 of contact arm support 22, which also results in a more precise structure; avoiding adjustment of contact pressure by employing the reference surfaces 30, 54 of base 14; and by using a flat (except for dimple 72) flexible arm 34 which can be prehardened thereby avoiding further heat treating and resulting in a flatter piece which permits closer limits in contact pressure.

It should be understood that the invention is applicable to opening or closing the contacts upon a temperature rise. In addition, it will be seen that a thermostatic switch is provided in which high quality and high rating at low cost is obtained and in a minimally sized package.

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 arrangements 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 therein is for the purpose of description and not of limitation.

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, 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. An electric switch comprising:
   (a) a generally cup-shaped base formed of electrically insulating material;
   (b) a first mounting and referencing boss formed in the base;
   (c) a relatively massive L-shaped movable arm support and heat sink of electrically and thermally conductive material having two legs, one leg received on and biased against the boss;
   (d) an electrically conductive movable arm supported at one end thereof by the said one leg of the movable arm support;
   (e) a movable contact mounted on another end of the movable arm;
   (f) a second mounting and referencing boss formed in the base;

(g) an L-shaped stationary contact having two legs, one leg mounted on and biased against the second boss;

(h) said movable contact adapted to move into and out of engagement with the stationary contact;

(i) a guide member mounted in and closing the open end of the base;

(j) a motion transfer pin slidably mounted in an aperture in the guide;

(k) a snap-acting disc; and

(l) a cap and disc retaining member enclosing the guide and the base; the transfer pin slidably located intermittent the movable arm and the disc.

2. An electrical switch assembly having high electrical rating in a minimum size package and at low cost comprising:

(a) a molded electrically insulating base member shaped generally as a hollow cylinder with one closed end having two apertures;

(b) a first reference boss formed in the base member;

(c) a generally L-shaped movable arm support, a first leg of which is inserted through one aperture in the closed end, a second leg of which is biased against the first reference boss;

(d) a second reference boss formed in the base member;

(e) a generally L-shaped stationary contact arm, a first leg of which is inserted through a second aperture in the closed end, a second leg of which is biased against the second reference boss, the second leg of the stationary contact arm serving as a contact surface;

(f) a movable arm mounted on the second leg of the movable arm support; and

(g) a contact button mounted on the movable arm at a location spaced from the movable arm support, the contact button movable into and out of engagement with the stationary contact surface.

3. An electrical switch assembly according to claim 2 further comprising:

(h) an electrical insulating guide member closing the open end of base member, the guide member formed with an aperture therein;

(i) a thermostatic element located adjacent the guide member on the side thereof removed from the contact elements;

(j) thermostatic element retaining means retaining said element in said adjacent location; and

(k) an electrically insulating motion transfer pin slidably received in the aperture provided in the guide member, one end of the pin engageable with the thermostatic element, the other end engageable with the movable arm.

4. An electrical switch assembly according to claim 3 in which a dimple portion is formed in the movable arm which is engageable with the transfer pin.

5. An electrical switch assembly according to claim 2 in which the L-shaped movable arm support and the L-shaped stationary contact arm are relatively massive formed of electrically and thermally conductive material and serve to keep the temperature in the contact area low by conducting the electrically generated heat away from the contact area and by acting as a heat sink.

6. An electrical switch assembly according to claim 2 in which the stationary contact surface is generally elliptical in shape providing maximum arc quenching surface; the movable arm is a prehardened, flat, flexible member having two portions; the first, a bending portion generally semi-circular in shape conforming closely to the cylindrical wall of the base and cantilever mounted on the second leg of the movable arm support; the second, a contact mounting portion having extremities converging from the first portion to a distal end which encompasses the contact button.

7. An electrical switch assembly according to claim 6 in which the L-shaped stationary contact arm and the movable arm have a layer of highly electrically conductive material thereon.

8. An electrical switch assembly according to claim 2 in which the rivet is formed integrally with the second leg of the movable arm support, and the rivet is used to mount the movable arm.

9. An electrical switch assembly according to claim 3 in which a plurality of ribs are formed on the internal surface of the base member, the ribs providing arc shadows to prevent tracking by contact material which is dissipated by electrical arcs and the guide member cooperates with the base member to electrically isolate the switching members and prevent tracking to ground.

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