Nov. 28, 1967 R. J. RUCKRIEGEL 3,355,563

LOST MOTION THERMOSTATIC ELECTRICAL SWITCH

Original Filed Jan. 9, 1964 3 Sheets-Sheet 1

Fig. 1.

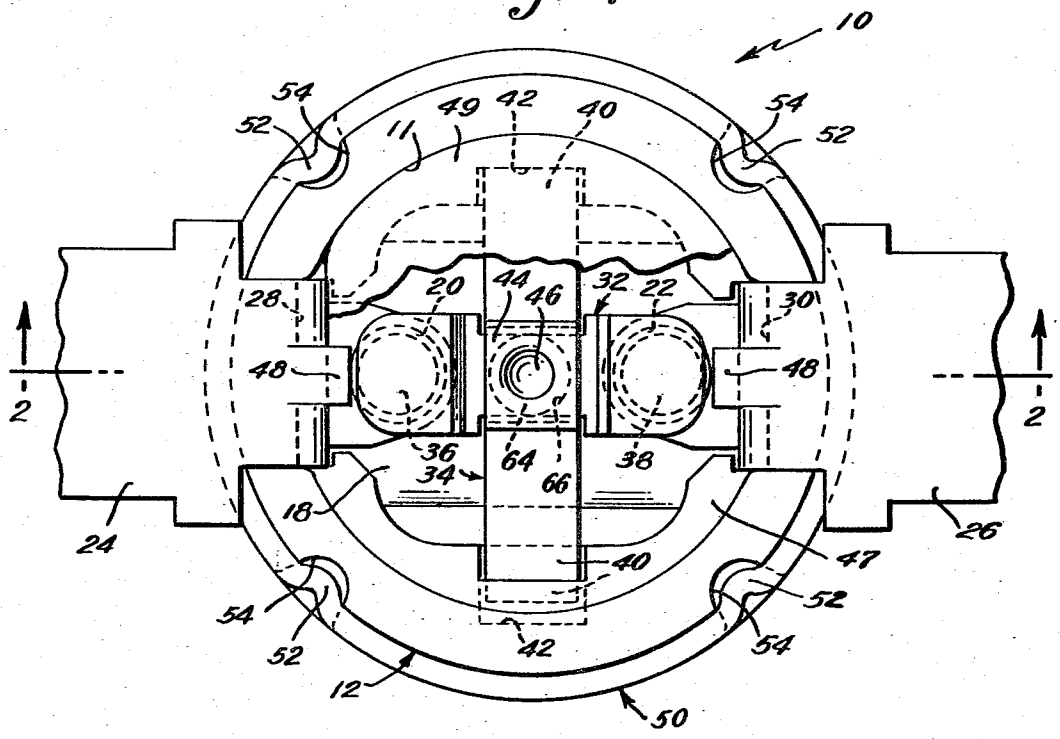


Fig. 2.

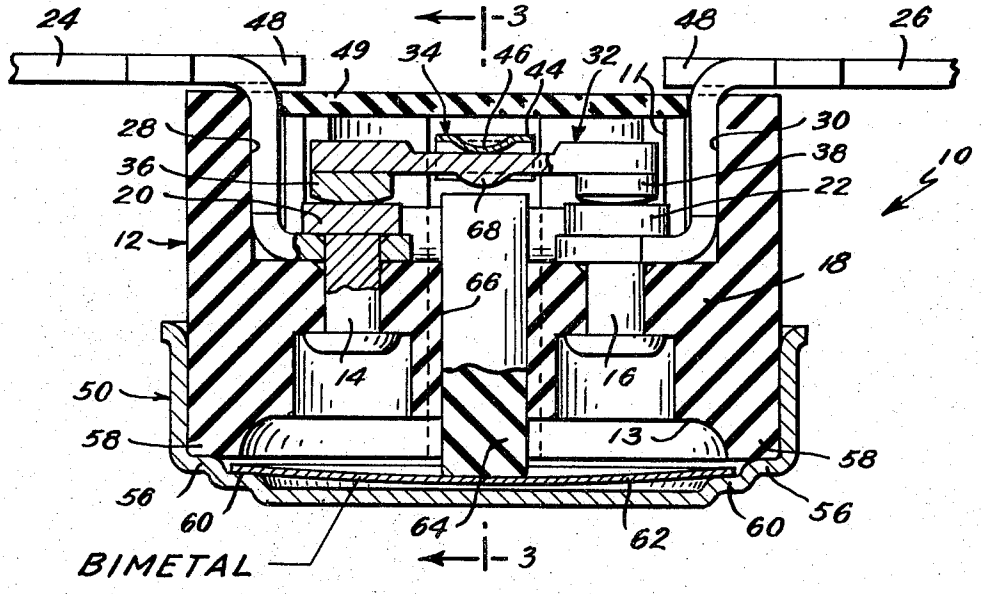


Fig. 3.

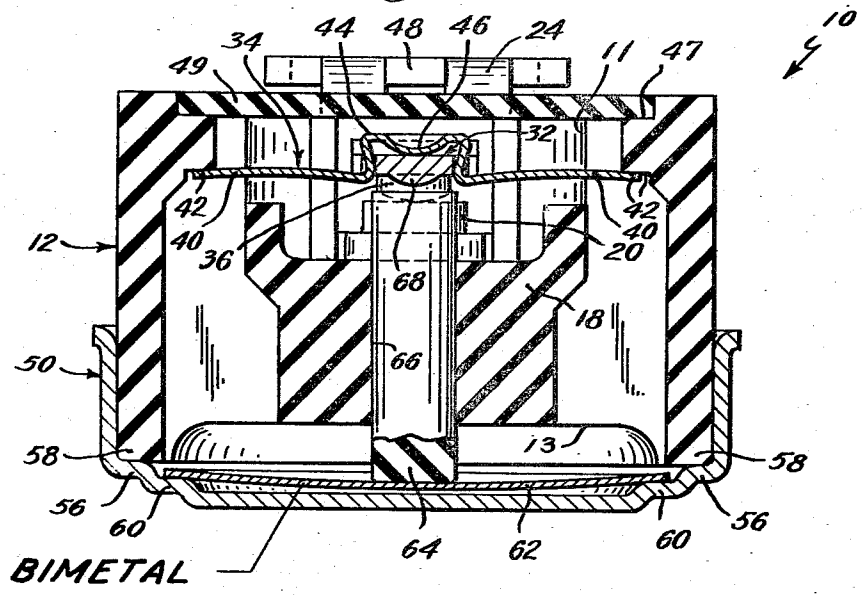
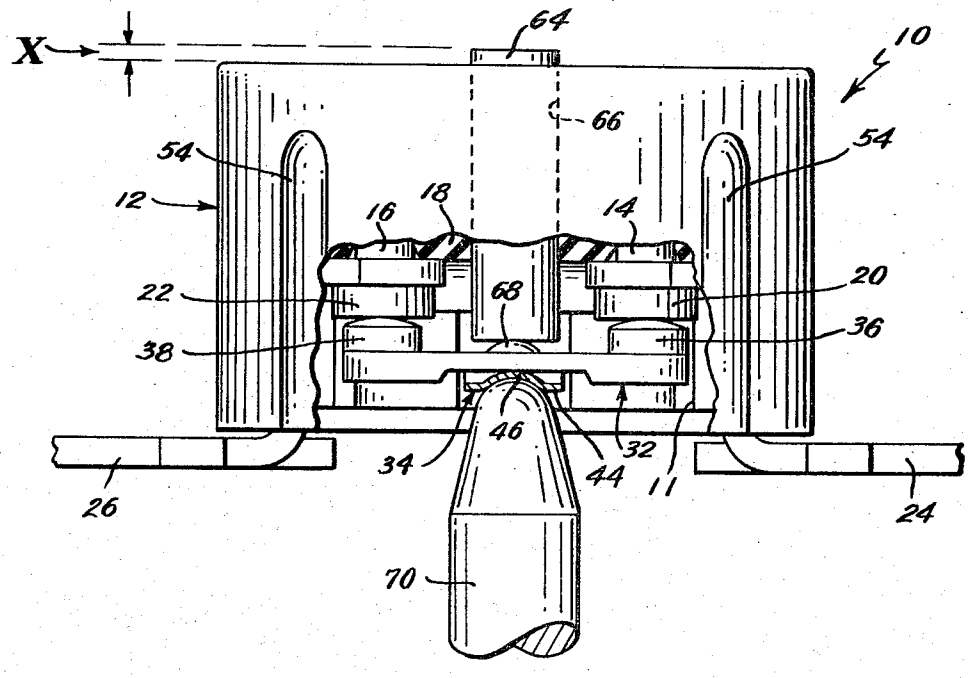

10
44
48
46
24
34
49
11
47
32
42
42
40
40
36
20
12
68
18
50
66
58
13
58
56
56
60
60
64
62
BIMETAL

Fig. 6.


X
64
10
66
54
54
12
16
18
14
22
68
20
38
36
46
32
34
44
11
26
24
70

LOST MOTION THERMOSTATIC ELECTRICAL SWITCH

Original Filed Jan. 9, 1964 3 Sheets-Sheet 3

Fig. 4.

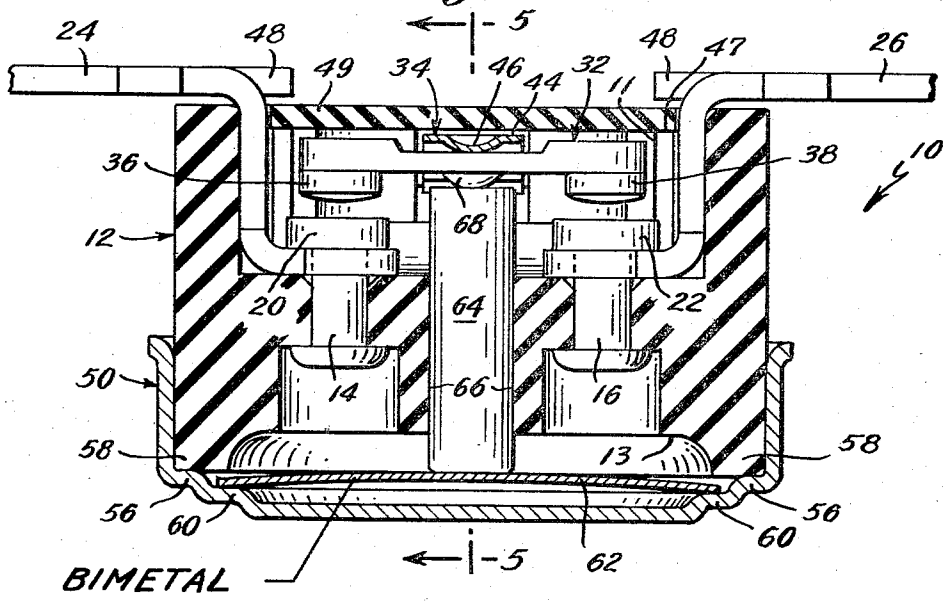
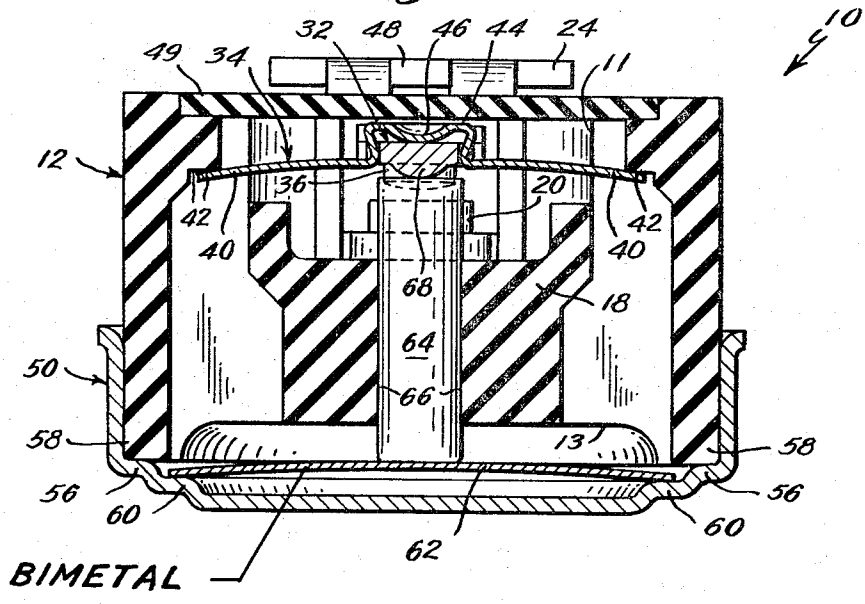


Fig. 5.



United States Patent Office 3,355,563 Patented Nov. 28, 1967

3,355,563

LOST MOTION THERMOSTATIC ELECTRICAL SWITCH

Raymond J. Ruckriegel, Versailles, Ky., assignor to Texas Instruments Incorporated, Dallas, Tex., a corporation of Delaware

Continuation of application Ser. No. 336,750, Jan. 9, 1964. This application Aug. 11, 1966, Ser. No. 571,946
3 Claims. (Cl. 200—138)

This application is a continuation of Ser. No. 336,750, filed Jan. 9, 1964, and now abandoned.

This invention relates to thermostatic electrical switches and, with regard to certain more specific features, to switch structures adaptable for 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 and adjustment 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 a further object of the instant invention to provide a switch of the class described whose design permits a switch package of minimum physical size having maximum ratings 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 sequences 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 one of various possible embodiments of the invention is illustrated:

FIG. 1 is a partly fragmentary, top plan view of a switch according to the instant invention with the cover removed for clarity of illustration;

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

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

FIG. 4 is a view correspondingly generally to FIG. 2 showing the device in the "off" or "contacts-open" position;

FIG. 5 is a view similar to FIG. 3 showing the device in the "off" or "contacts-open" position; and

FIG. 6 is an inverted plan view, partly sectional and partly fragmentary, similar to FIG. 2 illustrating a step in the manufacture of the instant device.

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

Referring now to the drawings, particularly FIGS. 1–3, an exemplary construction is shown which takes the form of an automatically resetting, thermally responsive, snap-acting switch generally indicated by reference numeral 10. Electrical switch 10 includes a casing or housing generally indicated by reference numeral 12, formed of a molded, insulating material. The interior of housing 12 is divided into a switch cavity 11 (the upper portion as viewed in FIG. 2) and a disc cavity (the lower portion as viewed in FIG. 2), by a web of material 18 molded into housing 12.

Mounted within the housing 12 are a pair of contact-carrying electrically conductive rivets 14 and 16 located in suitable apertures passing through web 18. Mounted on the upper ends of rivets 14 and 16 in electrically conductive relationship are stationary contacts 20 and 22, respectively, formed of a suitable electrically conductive material such as, for example, fine silver. Alternatively, contacts 20 and 22 may be formed integrally on rivets 14 and 16 by plating the ends of the rivets with suitable contact material.

Rivets 14 and 16 also form mounting posts to which are secured in electrically conductive relationship the inner ends of electrically conductive terminals 24 and 26. Terminals 24 and 26 are further retained against movement relative to the housing 12 by means of recesses 28, 30, formed in the interior of housing 12 and in which a portion of the terminals are nested.

Also mounted within the housing 12 are a contact-carrying bridging member, generally indicated by reference numeral 32, and a spring retaining member generally indicated by reference numeral 34. Bridging member 32 is formed of a suitable electrically conductive material such as, for example, copper or brass, and carries on the lower portion of each of its ends contacts 36 and 38 formed of electrically conductive material such as fine silver and located for movement into engagement with contacts 20 and 22, respectively, in response to movement of bridge member 32. It will be noted that since the rivets, terminals, contacts and bridge member are formed of electrically conductive material and since, in the contacts-closed position shown in FIGS. 2 and 3 are located in electrically conductive relationship, an electrical circuit is formed from terminal 24 to rivet 14 through contacts 20 and 36, through bridging member 32 to the other contact 38, through contact 22, rivet 18, and thence to terminal 26.

As best seen in FIG. 3, bridge 32 is held in an interlocking relationship with spring retaining member 34 which extends in a direction generally perpendicular to the longitudinal direction of bridge 32. Spring member 34 is formed of a suitably flexible and resilient material such as, for example, brass or copper. The ends 40 of spring 34 are located in recessed shelves 42 formed in the walls of housing 12. The center section of spring 32 has formed therein a recess or receptacle 44 which receives the center portion of bridging member 32. As best seen in FIG. 3, receptacle 44 generally conforms in configuration to the cross section of bridge 32. The upper portion of receptacle 44 has a dome-like projection 46 bent into it which abuts a flat portion of the bridge 32 to provide for pivotal movement of bridge 32 with respect to the spring 34.

Since retaining member 34 is formed of resilient material and since its ends are anchored in recesses 42, retaining member 34 resiliently urges bridge 32 in a downward direction as viewed in FIG. 2 and hence urges contacts 36 and 38 into engagement with contacts 20 and 22. It will be noted that the resilient interlocking relationship between spring retainer 34 and bridge 32 provides a complete locating means for bridge 32. When bridge 32 is located in receptacle 44 and when spring ends 40 are located in recesses 42, bridge 32 and hence contacts 36 and 38 are properly aligned for engagement with contacts 20 and 22, respectively. The switch cavity 11 is enclosed by a cover 49, the peripheral portions of which rest on a flange 47 formed on the upper portion of housing 12. Cover 49 is retained in position by a pair of lugs 48 bent out of terminals 24 and 26.

The disc cavtiy 13 is covered by a telescoped metal cup 50. As best seen in FIG. 1, cup 50 is held in position on housing 12 by means of dimples 52 formed in the cover 50 which dimples project into grooves 54 molded into the exterior wall of housing 12. Cup 50 also has formed therein a shoulder 56 which abuts shoulder 58 on housing 12 so as to accurately position the shelf 60. Resting upon shelf portion 60 is a thermostatic bimetallic element which, in the normal contacts-closed position is downwardly convex as shown in FIGS. 2 and 3, and

which, in the snapped, contacts-open position, is upwardly convex as shown in FIGS. 4 and 5.

When disc **62** is in the normal position shown in FIGS. 2 and 3, a predetermined rise in temperature causes disc **62** to snap to the position shown in FIGS. 4 and 5. A subsequent predetermined decrease in temperature causes a reverse snap movement to the normal position. Snap movement of the disc **62** is transmitted to the bridge **32** and hence contacts **36** and **38** by means of a transfer pin **64** formed of a suitable electrical insulating material such as, for example, ceramic. Transfer pin **64** is slidably received in a suitable aperture **66** passing through web **18**. The lower end of transfer pin **64** abuts disc **62** while the upper end is spaced from and movable into engagement with a downwardly convex dome portion **68** formed on bridge **32**. Dome portion **68** permits pivotal movement of the bridging arm **32** with respect to the transfer pin **64**.

It will be noted that there is a predetermined clearance distance established between the upper end of the transfer pin and the dome portion **68** of the bridge **32** when transfer pin **64** rests on disc **62** in the normal disc position shown in FIGS. 2 and 3. This clearance permits some free movement of the pin **64** from the FIG. 2 position before engagement with dome **68** on the bridge **32** 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 **64** has moved into engagement with dome projection **68** of bridge **32** so that when the disc **62** snaps upward to its other extreme contacts-open configuration as shown in FIGS. 4 and 5, the bridge **32** is urged upwardly to disengage contacts **36** and **38** from contacts **20** and **22**. 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 **62** decreases by a predetermined amount, the disc **62** snaps back to the normal position shown in FIGS. 2 and 3, thus releasing transfer pin **64**. Spring member **34** urges bridge **32** and hence contacts **36** and **38** into engagement with stationary contacts **20** and **22**.

It will be seen that web **18** advantageously provides an integral arc shield between the switch cavity **11** and the disc cavity **13**. This permits maximum rating of the switch **10**. It will be seen that the dome projections **46** and **68** permit pivotal movement of bridge **32** relative to the spring retainer **34** and transfer pin **64** as noted. This pivoting joint permits re-orientation of the bridge **32** and hence contacts **36** and **38** with respect to stationary contacts **20** and **22**, whereby neither set of contacts experiences repeated engagement and disengagement ahead of the other set of contacts. This advantageously insures even distribution of contact wear on both sets of contacts as well as an even distribution of contact pressure.

The manufacture of thermostatic switches employing transfer pins or the like has heretofore been beset with certain difficulties due to the criticality of the dimensions of the transfer pin. If the 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 disc to the contacts. Since in many thermostatic switches 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 transfer pin becomes time-consuming and expensive. In the past, this criticality has required stocking an assortment of various lengths of transfer pins which, of course, necessitates the maintenance of an expensive inventory of pins in incremental lengths.

In FIG. 6 is illustrated a method of manufacture in which the size of the transfer pin is not within easily attained critical limits, which method overcomes the above stated problem. Prior to assembling the cover member **49** and the cup **50** and disc **62** into switch assembly **10**, a transfer pin **62**, which is normally too short by a variable (within limits), easily attained amount, is selected. The pin is inserted in aperture **66** and the switch structure **10** is inverted to the position shown in FIG. 6. A fixture **70** is then located on the concave side of dome **46** on spring **34** and is moved into engagement with dome **46** which engages bridge **32** at its center until bridge **32** is in the contacts-closed position shown in FIG. 6. Previously, it has been determined that if transfer pin **64** protrudes from the plane formed by the bottom portion of housing **12** by a distance X, creep movement of the disc **62** preliminary to its snap action is not transmitted to the bridge **32** and hence contacts **36** and **38**. Since pin **64** is normally short, it protrudes from the plane of the bottom of housing **12**, if at all, by an amount less than the required distance X. The further application of force through fixture **70** bends bridge **32** slightly and moves transfer pin **64** until it protrudes the required distance X from the plane of the bottom of housing **12**. It will be noted that the central portion of bridge **32** is of reduced cross sectional shape to insure bending at the central portion thereof.

In this manner, the problem of critical distances and dimensions is solved and the criticality involved in the selection of a transfer pin is obviated. The selection of parts of exactly correct, difficult to attain, 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.

In view of the above it will be seen that the mechanical actuation of the switch contacts occurs only within the so-called pure snap range of the bimetallic disc. To state it otherwise, movement of the disc in its creep range prior to pure snap movement is not permitted to be transmitted to the bridging member and hence to the contacts during any action. Ordinarily these features would be difficult to accomplish because of the former requirements for stocking many sizes of presorted, carefully gauged parts and the need for selective assembly of the same. As a result of the instant invention, switches of an improved, controlled quality and lower cost can be made.

It should be understood that although the invention has been described to open the contacts upon a temperature rise, it is equally applicable on an automatic reset type of switch in which the contacts close upon temperature rise. In addition, it will be seen that a thermostatic switch is provided in which high quality at low cost is obtained and which permits miniaturized construction. It is also seen that the integrally formed arc shield permits higher ratings of the switch while the automatic location of the bridge member and contacts through the interlocking relation with the spring retaining member provides advantageous manufacturing facility and efficient switch operation.

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 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.

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.

I claim:

1. A thermostatic electric switch comprising a housing; a web of electrically insulating material formed in said housing to provide first and second cavities separated by said web; a pair of electrically conductive rivets mounted on said web to provide a pair of stationary electrical contacts in said first cavity; a pair of electrically conductive terminals mounted on one of their ends on said rivets and retained in fixed position by a pair of recesses found in said housing; a bridge support carrying a pair of movable electrical contacts mounted adjacent the ends of said bridge support for engagement with said stationary contacts; said bridge support being bendable intermediate its ends to locate said member and stationary contacts relative to each other; a resilient spring member each of whose ends is retained in a recess formed in said housing, the central portion of said spring member forming a receptacle for the central portion of the bridge member to resiliently urge said movable contacts into engagement with said stationary contacts; a transfer pin located in an aperture formed in said web for slidable movement therewithin, one end of said transfer pin being spaced by a predetermined amount from said bridge support; a thermostatic snap-acting element mounted on said housing adjacent the other end of said transfer pin for movement in response to a temperature change to move said transfer member into engagement with said bridge support to move said movable contacts out of engagement with said fixed contacts; said predetermined space between said transfer pin end and said bridge support providing a lost-motion connection therebetween such that

creep movement of said thermostatic element is absorbed in said lost-motion connection without transfer of movement to said bridge support sufficient to move said movable contacts out of engagement with said fixed contacts.

2. A switch as set forth in claim 1 including a projection formed on a portion of said spring member receptacle and located in abutting engagement with a portion of said bridge support to provide for pivotable movement therebetween; said pivotable connection between said spring member and said bridge support permitting simultaneous engagement and disengagement of each of said pairs of fixed and movable contacts.

3. A switch as set forth in claim 2 wherein said spring member receptacle is interlockingly engaged with said bridge member to inhibit lateral movement of said bridge support relative to said fixed contacts to provide accurate alignment of said movable and said fixed contacts.

References Cited

UNITED STATES PATENTS

2,230,770	2/1941	Van Almelo	200—138
2,238,881	4/1941	Evans	200—138
3,014,105	12/1961	Schmitt	200—138
3,091,121	5/1963	Moorhead	200—138 X
3,164,701	1/1965	Kirchhubel	200—113 X
3,164,702	1/1965	Ruckriegel et al.	200—113 X

BERNARD A. GILHEANY, *Primary Examiner.*

T. MACBLAIN, H. A. LEWITTER,

Assistant Examiners.