May 23, 1967 G. J. MEIJER 3,321,597

CIRCUIT BREAKER HAVING A THERMORESPONSIVE ELEMENT WITH TWO LEG PORTIONS AND RESET BUTTON FOR CAMMING SAID LEG PORTIONS

Filed July 19, 1965

3 Sheets-Sheet 1

Fig. 1.

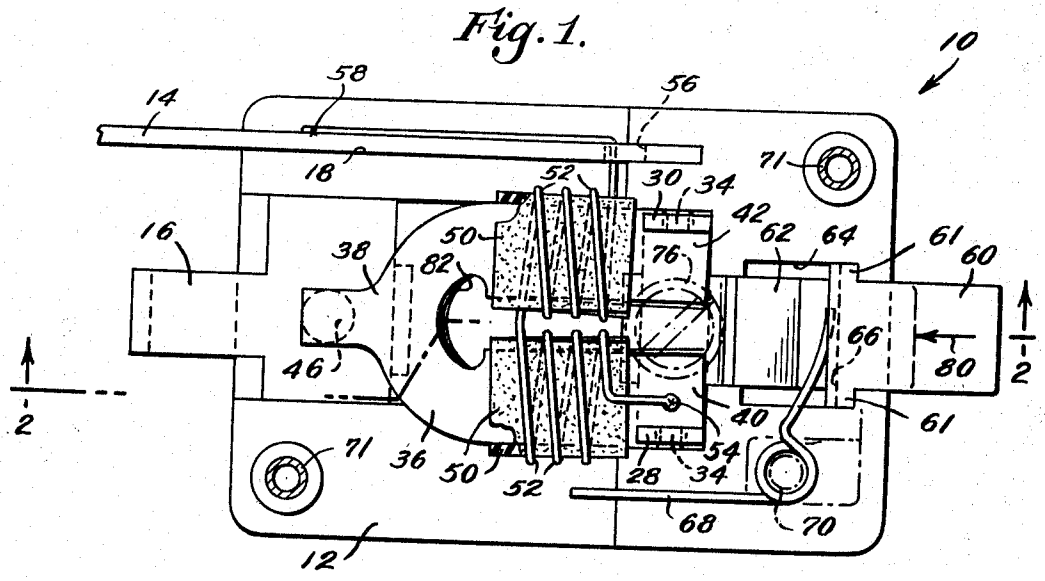


Fig. 2.

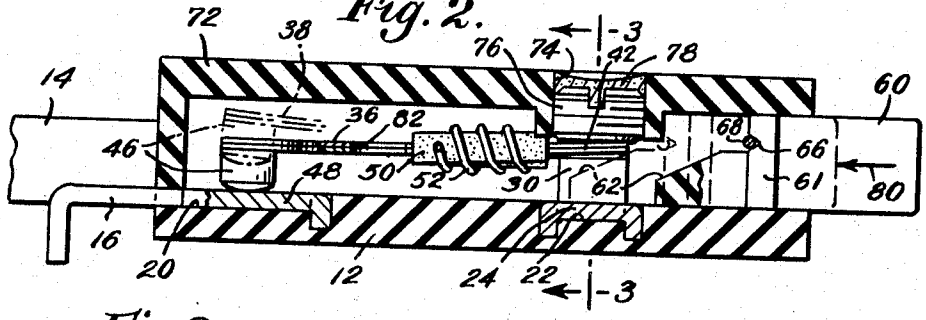


Fig. 3.

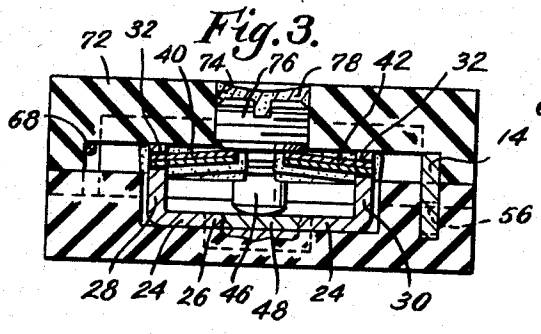
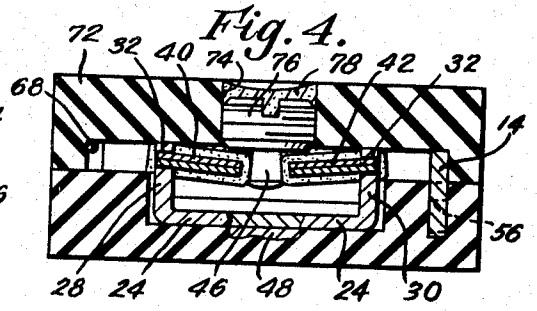


Fig. 4.



Inventor,
Gerhardus Jan Meijer,
by John C. Hoag
Agent.

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Fig. 5.

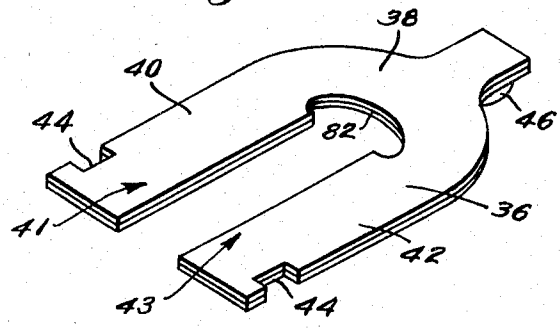


Fig. 8.

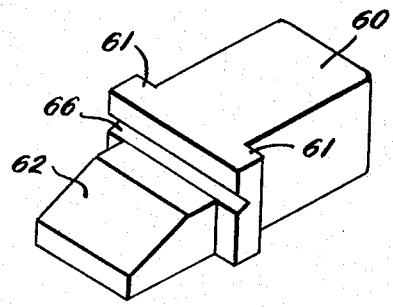


Fig. 6.

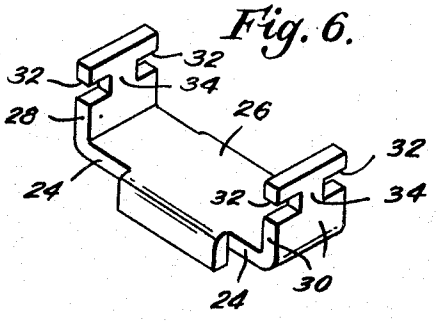


Fig. 7.

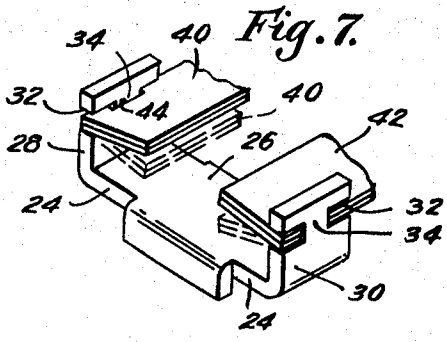
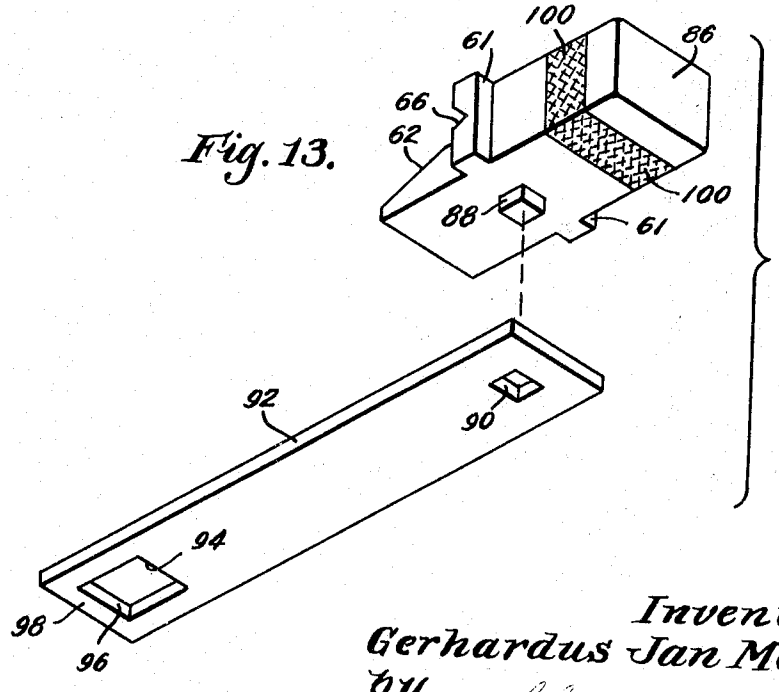


Fig. 13.



Inventor,
Gerhardus Jan Meijer,
by
Agent.

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Fig. 10.

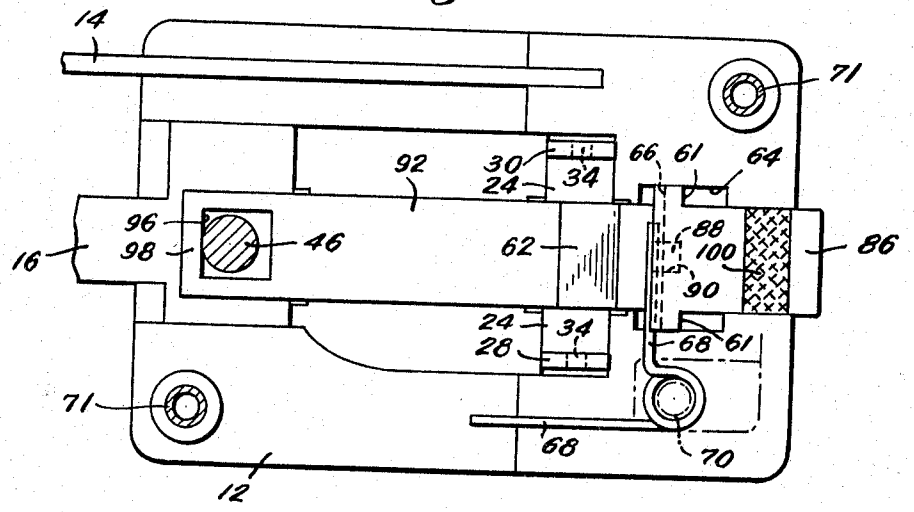


Fig. 9.

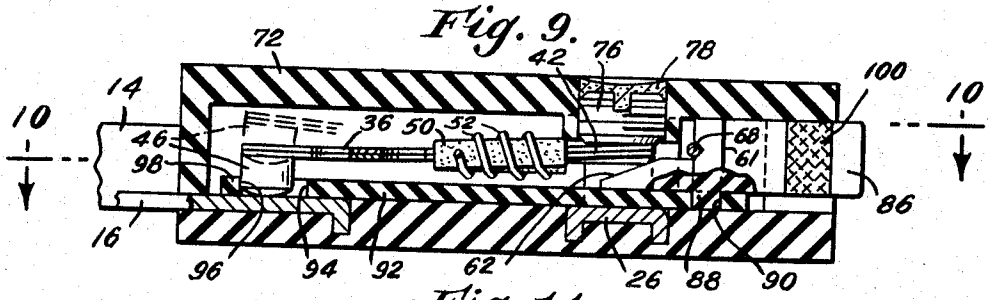


Fig. 11.

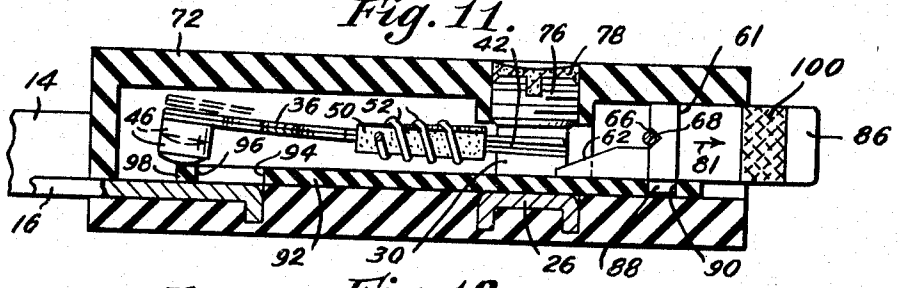
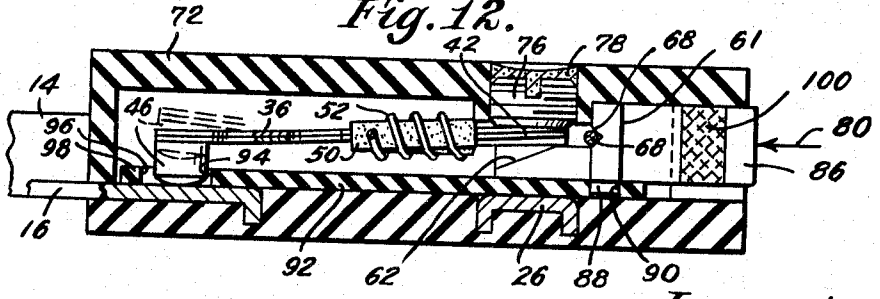


Fig. 12.



Inventor,
Gerhardus Jan Meijer,
by John C. Haug
Agent.

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CIRCUIT BREAKER HAVING A THERMORESPONSIVE ELEMENT WITH TWO LEG PORTIONS AND RESET BUTTON FOR CAMMING SAID LEG PORTIONS

Gerhardus Jan Meijer, Almelo, Netherlands, assignor to Texas Instruments Incorporated, Dallas, Tex., a corporation of Delaware

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11 Claims. (Cl. 200—122)

This invention relates to electric switching devices and particularly to miniaturized switching devices.

It is one object of the instant invention to provide a new and improved miniaturized switch particularly useful as a safety device for appliances and the like the size of which in furtherance of the present trend in industry, are constantly being decreased.

It is another object to provide a switch with manual resetting means either with or without means to indicate whether the switch is on or off.

Another object is the provision of a switch which is automatically resettable.

Yet another object of the invention is the provision of a switch which may be easily adapted for use as a circuit breaker, a thermostat or a motor protector.

Among the further objects of the instant invention are included the provision of a miniaturized electric switch which is precise, vibration and shock resistant, simple in construction, economical to manufacture, simple to calibrate and the parts of which can be mass produced and easily assembled.

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

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

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

FIGURE 1 is a top plan view of the first illustrated embodiment of the instant invention shown with the cover removed and showing part of the cover in phantom lines;

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

FIGURE 3 is a sectional view taken on line 3—3 of FIG. 2 showing the contacts in closed position;

FIGURE 4 is a sectional view similar to FIG. 3 but showing the contacts in open position;

FIGURE 5 is a perspective view of the snap-acting member;

FIGURE 6 is a perspective view of a bracket which mounts the FIG. 5 snap-acting element as shown in FIG. 7;

FIGURE 7 is a perspective view of details of the mounting of a snap-acting element in the mounting bracket;

FIGURE 8 is a perspective view of the reset button used in the first embodiment of the invention;

FIGURE 9 is a sectional view similar to FIG. 1 but showing a second embodiment of the invention;

FIGURE 10 is a plan view taken on line 10—10 of FIG. 9;

FIGURE 11 is a sectional view similar to FIG. 9 but showing the contacts in open position;

FIGURE 12 is a sectional view similar to FIG. 9 but showing the switch with the reset button depressed;

FIGURE 13 is an exploded perspective view of the reset button and slide assembly used in the second illustrated 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 have been modified for the purpose of clarity of illustration.

In the embodiment of the invention illustrated in FIGS. 1–8, switch **10** comprises a base portion **12** made of electrical insulating material such as a phenolic resin and may be formed in any convenient manner such as by molding. First and second terminals, **14** and **16**, are mounted in base **12** in groove **18** and recessed seat **20** respectively. Terminals **14** and **16** are made of a good electrical conductive material such as Monel. Another recessed seat **22** is provided in base **12** which mounts bracket **24** made of material such as Monel which has spring characteristics but which is thick and stiff enough to retain its shape when it is deformed. Bracket **24** is attached to base **12** at its bight portion **26** by any convenient means such as stycasting and has upstanding leg portions **28** and **30**. The distal end portions of legs **28** and **30** are I-shaped to form part of a hinge structure which will be explained below. The I-shape is formed by providing slots **32** in each distal end portion of legs **28** and **30** leaving center portions **34** intact. Bracket **24** mounts a thermostatic element **36** which may be formed of bimetal having good spring characteristics and which is therefore flexible. Thermostatic element **36** is shown as generally U-shaped although it will be understood that other similar configurations may be employed (e.g. V-shape). U-shaped element **36** is formed of bight portion **38** joining legs **40** and **42**. Near the distal end of legs **40** and **42** is provided on the outside edge slots **44** which interdigitate with center portions **34** and slots **32** of bracket **24** conveniently forming hinges for the legs to pivot about their outer edge portion as seen in FIG. 7. Slots **32** are wider than the thickness of the thermostatic element thereby freely permitting legs **40** and **42** to twistably pivot in a way to be explained infra. A contact **46** made of silver or other good electrical conductive material is fixedly attached in any convenient manner to bight portion **38** of thermostatic element **36** and is movable into and out of engagement with the fixed contact **48** which is located on terminal **16**. Sleeves **50** of any good electrical insulation material such as rubber are placed about legs **40** and **42** and a heater wire **52** of a suitable cross sectional configuration such as round, square, etc. is wound or coiled around the two sleeves or insulation layers **50**. One end of the wire **52** is attached to the thermostatic element in any convenient location such as the distal portion of leg **40** as by welding at **54** while the other end of wire **52** is inserted through aperture **56** in terminal **14** and is attached to terminal **14** as by welding at **58**. It may be preferable to have electric current pass through both legs **40**, **42** in which case a shunt can be attached between the distal portions of the legs. Or it may be preferable not to have electric current pass through either of legs **40**, **42** in which case instead of attaching

the first end of wire 52 to element 36 at 54 it could be attached near bight 38.

Switch 10 may be provided, if desired, with a reset button 60 which includes a cam surface 62. Button 60 is slidably received in groove 64 and is movable, as best seen in FIG. 2, between an inactive-out position shown in solid lines limited by stop 61, and a reset-in position shown in dotted lines. A groove 66 is provided in reset button 60 which seats spring 68, which spring biases button 60 toward the inactive-out position. Spring 68 is mounted on a projection 70 of cover 72 made of an electrical insulating material such as a phenolic resin, which fits over base 12 and encloses switch 10 as shown in FIG. 2. Any convenient fastening means may be used to secure cover 72 to cover base 12, such as screws 71. Cover 72 is provided with a threaded aperture 74 in which is located calibration screw 76 which may be sealed after calibration with a standard potting compound 78.

An electric current may be traced from terminal 14 to wire 52 through leg 40 of bimetallic element 36, contact 46, contact 48 and finally terminal 16.

Thermostatic element 36 acts as a snap-acting element moving from the solid line position shown in FIG. 2 to the dotted line position in the same figure. Since thermostatic element 36 is a flexible material it will be seen that as the distal portion of legs 28 and 30 of bracket 24 are squeezed together the distal portions of legs 40 and 42 will also be squeezed together creating a force which is transmitted to the bight portion of the element thereby causing the element to buckle into a dished configuration. This then causes the legs 40 and 42 to pivot about the hinge area.

An inspection of FIGURES 2–4 will illustrate that when the inside portions of 41 and 43 of legs 40, 42 respectively have moved above the horizontal in relation to the hinge portion of the legs that the contact is in a closed position, that is, contact 46 is in engagement with fixed contact 48 and bight portion 38 has moved downwardly. When the inside portions 41, 43 are below the horizontal in relation to the hinge, contacts 46, 48 are out of engagement and bight portion 38 has moved upwardly. FIGURE 3 indicates the normal position of the bimetallic element 36—the contacts closed position. A predetermined quantity of electric current passing through the resistance heater wire 52 will cause the bimetallic element 36 to warm up, the bight portion 38 to bend, finally causing the element to snap through to the FIG. 4, contacts open configuration. Upon sufficient cooling element 36 can be returned to its normal FIG. 3 contacts closed position. It will be readily understood that the amount of squeezing of legs 28, 30 of bracket 24 will directly affect the temperature range at which the element will snap from one stable position to the other. When legs 40, 42 are squeezed the temperature at which snap in either direction occurs, the free snap range, contact force, contact gap, and all other snap acting characteristics incident thereto will be affected, thereby serving as a calibration means for the device. A further calibration may be achieved through use of screw 76. As seen in FIG. 3 screw 76 can be made to engage inside portion 41, 43 of legs 40, 42 respectively thereby directly controlling the temperature at which the element will snap from contacts closed position to contacts open position. Screw 76 will not affect the temperature at which snapping from contacts open position to contacts closed position occurs. After this calibration is accomplished potting material 78 may be placed around screw 76 to prevent tampering with the calibration of the device.

It should be noted that the cover may be conveniently spaced from the bimetallic element to prevent over travel of the element when snapping to the contact open position thereby preventing deleterious effects on calibration of the device.

As thus far described the thermostatic element 36 can be selected and shaped so that it will go from a contacts open to a contacts closed position and vice versa merely on a predetermined change in temperature of the element. That is, the switch will cycle through the contacts open and closed positions based on the current value passing through the device; which current causes the heating. However in many instances it is desirable to provide a manual reset means. In so doing the element 36 can be made to assume two stable positions by providing a larger cut out between legs 40, 42 adjacent the bight portion 38 as shown at 82 in FIG. 1. It has also been found helpful to minimize the width of the apex portion whereat the contact is attached. This results in the legs 40, 42 assuming a greater angle with the horizontal in the contacts open position thereby requiring a greater force to cause the element to snap back to the contacts closed position. Further, a prestressed element could be used to facilitate the realization of desired snap acting characteristics. A bimetallic element as described supra has two relatively stable positions. One position is the contacts closed position shown in FIG. 3 but upon sufficient heating the element will snap to the contacts open position shown in FIG. 4 which also is a stable position. That is, the element will not snap back to contacts closed position even upon normal cooling unless an additional force is exerted on it. This force is supplied by means of a reset button. One such reset button 60 is shown in FIGS. 1–8.

A force indicated by arrow 80 will cause button 60 to move inwardly in groove 64 against the bias of spring 68 until cam surface 62 contacts wire inner portions 41, 43 of legs 40, 42 respectively, forcing legs 40, 42 to assume the FIG. 3 contacts closed position. However, if the element 36 is too warm it can still maintain the contacts open position. Thus this may be referred to a trip free device.

Another embodiment is illustrated in FIGS. 9–13 which shows a manually resettable switch with means indicating whether the contacts are in the open or closed position. Since all the parts of the FIGS. 9–13 embodiment are identical to the FIGS. 1–8 embodiment except for the resetting and indicator means a description of these same parts will not be repeated. Reset button 86 corresponds to reset button 60 of the first embodiment but is provided with a lug 88 on its bottom surface which is received in a mating aperture 90 in slide 92 which slide is formed of a good electrical insulating material. Button 86 is slidable in groove 64, and slide 92 is slidable therewith, between an inactive-out position as seen in FIG. 9 and a resetting-in position as seen in FIG. 11. An aperture 94 is provided in slide 92 through which contact 46 is received when the button is depressed toward the reset-in position. As seen in FIG. 12, a force indicated by arrow 80, depressing button 86 will cause the slide to move to the left aligning aperture 94 of slide 92 with contact 46. At the same time cam surface 62 forces inner leg portions 41, 43 upwardly causing the element to snap to the contacts closed position. When force 80 is removed from the button, spring 68 will bias the button out-wardly until edge 96 of slide 92, defining aperture 94 engages contact 46 (as seen in FIGS. 9 and 10) which will then prevent further travel of the button and slide assembly. Upon overheating of element 36 said element will snap to the position shown in dotted lines in FIG. 9 thereby permitting button 86 and slide 92 under the influence of spring 68 (see arrow 81) to move outwardly until stop 61 engages the housing and stops the movement of the button assembly. In this position it will be noted that the end 98 of the slide 92 prevents contact 46 from engaging fixed contact 48. This serves to make the device particularly insensitive to vibration and permits the use of an automatically resettable element which would therefore not require the use of a cam surface. Also it is conducive to providing positive identification means. Portion 100 of button 86 is colored with a color contrasting to that of the remainder of the button so

that when the button is in the inactive-out position and with slide end **98** preventing contact engagement the color can readily be seen indicating that the switch is in the off (contacts open) position. When the button is in the reset-in position the colored portion **100** is not visible (see FIGS. 9 and 12) so that it can readily be observed that the switch is in the on (contacts closed) position.

It should be noted that the heater **52** need not be mounted directly on legs **40, 42** but could be placed in close proximity thereto. Further, the thermostatic element **36** need not be composed entirely out of bimetal. That is, it may be desirable to employ a monometal of particularly good spring characteristics for legs **40, 42** and form only the bight position **38** out of bimetal.

Another obvious modification would comprise the provision of conventional manual switching means which would directly open or close contacts **46, 48** as desired.

The switch can be used in several ways with minor modifications. The heater **52** can be deleted entirely and apertures in the housing can be provided so that the switch can be utilized as a thermostat, circuit breaker or motor protector. Additionally the switch could employ a heater as well as having apertures in the housing so that it would be sensitive both to current overloads and ambient heat.

In view of the above, it can be seen that the instant invention provides a miniaturized switch which can be easily and quickly produced at low cost. The instant invention provides a miniaturized switch which has excellent low current ratings, is precise, can be easily, quickly and uniquely calibrated and assembled. Further the switch is shock resistant and capable of providing indication means, and has manual or automatic resetting means.

A typical example illustrating the degree of miniaturization attained by the instant invention is as follows: a switch weighing 1.83 grams and measuring .74" x .48" x .23 inch.

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, 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.

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.

I claim:

1. An electric switch comprising:

(a) an electrical insulating support;

(b) an electrically conductive thermoresponsive element having two leg portions;

(c) a bracket mounting said element on said support and adapted to squeeze said leg portions toward one another forming a snap acting element snapable from one position to a second position;

(d) a fixed contact mounted on said support;

(e) a contact mounted on said element remote from said bracket and movable into engagement with said fixed contact when said element is in said first position and out of engagement with said fixed contact when said second element is in said second position whereby an electrical circuit can be closed or opened;

(f) a reset button extending through a portion of said support and having a cam surface, said button slidable on said support between an inactive position and a reset position where said cam surface contacts and cams said leg portions when said element is in said second position; and

(g) biasing means urging said button toward said inactive position.

2. A switch according to claim **1** in which the said leg portions are pivotably mounted on said bracket.

3. A switch according to claim **2** in which the pivotable mounting comprises I-shaped portions on the bracket and a U-shaped portion on each leg portion which interdigitate with said I-shaped portions.

4. A switch according to claim **2** in which a calibrating screw is mounted so that it is engageable with said leg portions.

5. A switch according to claim **1** further including:

(h) a slide of electrical insulating material slidable with said button; and

(i) an aperture in said slide through which said movable contact is received when said button is in the reset position but not when in the inactive position.

6. A switch according to claim **5** in which a coded color is applied to that portion of said button which is movable into and out of the switch thereby providing indicating means showing whether the said circuit is closed or open.

7. An electric switch comprising:

(a) a housing comprising a base and a cover;

(b) said base compound of electrical insulating material provided with a first terminal groove, a second terminal recessed seat and a bracket recessed seat;

(c) said cover composed of electrical insulating material provided with a threaded aperture, and forming an enclosure with said base;

(d) a first terminal received in said first terminal groove in said base;

(e) a second terminal received in said second terminal seat in said base and providing a fixed contact surface;

(f) a U-shaped bimetallic element having a bight portion and two leg portions, each distal outside leg portion provided with a slot;

(g) a U-shaped mounting bracket having a bight portion received in said bracket seat in said base, and having two upstanding legs, the distal portion of each leg being I-shaped and which interdigitate with the sloted leg portions of said element providing a pivotal hinge mounting whereby the inside portions of said element legs can move upwardly or downwardly about said hinge mounting;

(h) an insulating layer wrapped about each element leg intermediate said slot and said element bight portion;

(i) a heater wire coiled about each said insulating layers, one end attached to said first terminal, the other end attached to said element; and

(j) a movable contact mounted on the bight portion of said element and movable into and out of engagement with said fixed contact.

8. A switch according to claim **7** including:

(k) a reset button with a cam surface movable in a groove provided in said base and extending through said housing, said button movable between an inactive position and a reset position, the cam surface of said button when moved to said reset position cams up the inside portions of the said element; and

(l) biasing means mounted in said housing urging said button toward said inactive position.

9. A switch according to claim **7** including:

(k) a calibration screw adapted to engage the inner distal portions of said element legs.

10. A switch according to claim **8** further including:

(m) a slide of electrical insulating material connected to and movable with said button and provided with

an aperture through which is received said movable contact when said button is in the reset position but not when in the inactive position, said slide precluding contact engagement when the button is in the inactive position.

11. A switch according to claim 10 including a coded color applied to that portion of the button which moves into and out of the housing thereby providing means indicating whether the switch is in the contacts open or contacts closed position.

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BERNARD A. GILHEANY, *Primary Examiner.*

H. A. LEWITTER, *Assistant Examiner.*