

Aug. 25, 1959

D. E. CLARKE
ELECTRICAL SWITCH

2,901,575

Filed Aug. 16, 1957

2 Sheets-Sheet 1

Fig. 1.

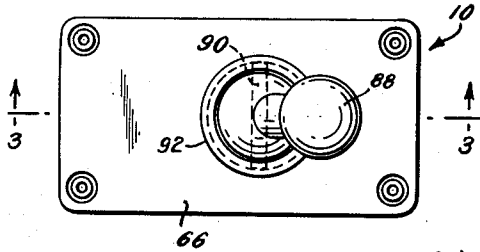


Fig. 2.

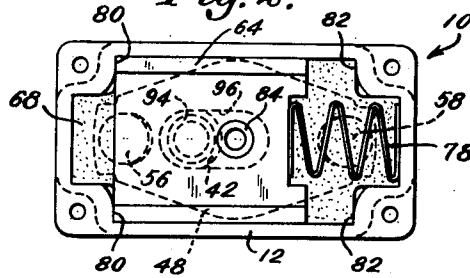


Fig. 3.

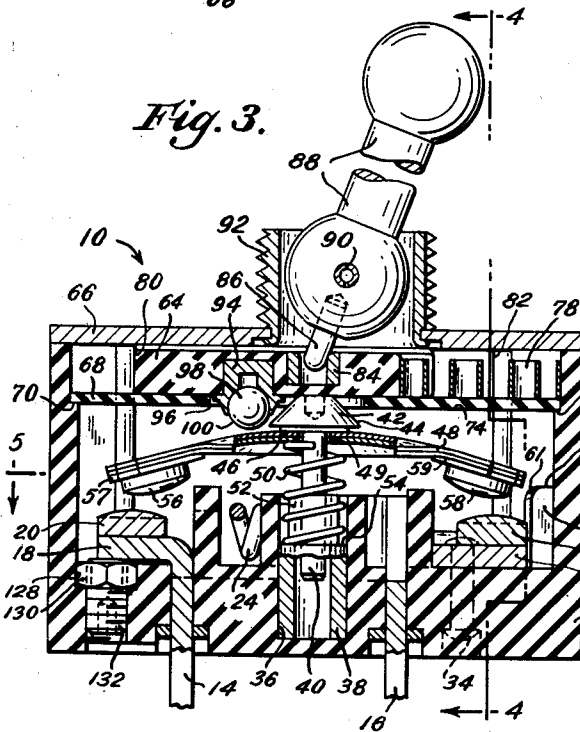


Fig. 4.

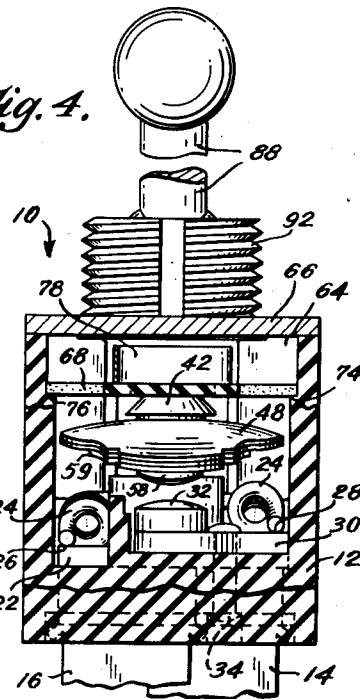


Fig. 5.

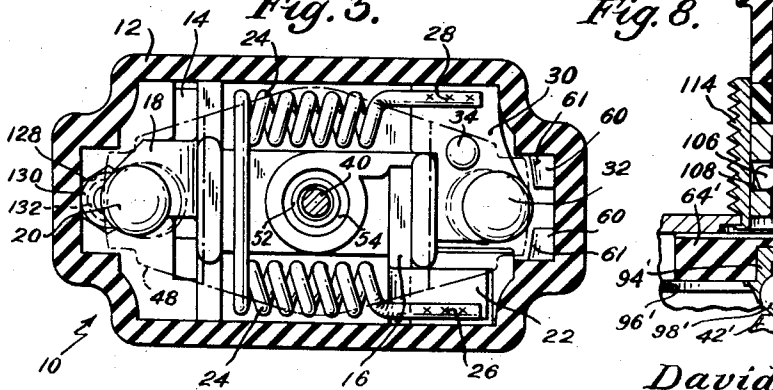
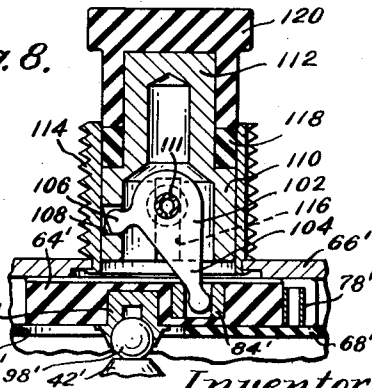


Fig. 8.



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ELECTRICAL SWITCH

2 Sheets-Sheet 2



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2,901,575

ELECTRICAL SWITCH

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Application August 16, 1957, Serial No. 678,512

15 Claims. (Cl. 200—122)

This invention relates to electrical switches, and more particularly, to such switches which incorporate a pair of cooperating contacts relatively movable between open and closed positions.

This invention represents an improvement over the inventions respectively disclosed and claimed in U.S. Patent No. 2,345,451, granted March 28, 1944, to J. D. Bolesky, and in copending U.S. application, Serial No. 586,547 of W. W. Cardin et al., filed May 22, 1956 now Patent No. 2,863,965.

An object of this invention is to provide an electrical switch having improved operating characteristics.

A further object of this invention is to provide an improved electrical switch incorporating a unique arrangement for effecting rapid closing of at least one pair of contacts thereof. A further object of this invention is to provide such a switch by which the contacts thereof wipe against each other during movement to closed position. A further object of this invention is to provide such a switch which is simple, inexpensive to manufacture and dependable in operation.

A further object of this invention is to provide a resettable circuit breaker incorporating a unique arrangement for effecting snap closure of at least one pair of contacts thereof.

Other objects will be in part obvious and in part 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 following claims.

In the accompanying drawings, in which the invention is illustrated:

Fig. 1 is a plan view of an electrical switch embodying the present invention;

Fig. 2 is a view similar to Fig. 1 but with the cover plate and operating handle removed;

Fig. 3 is a sectional view on an enlarged scale taken along line 3, 3 of Fig. 1;

Fig. 4 is a sectional view taken along line 4, 4 of Fig. 3;

Fig. 5 is a sectional view taken along line 5, 5 of Fig. 3;

Figs. 6 and 7 are similar to Fig. 3 but respectively show the movable parts of the device in an intermediate stage of operation and in the position at which the contacts thereof are retained in closed relationship; and

Fig. 8 is a fragmentary sectional view showing an alternative form of actuating means for the switch.

Referring to the drawings, the numeral 10 generally indicates an electrical switch incorporating the present invention. This switch takes the form of a circuit breaker which includes a base or casing member 12. Base member 12 provides a hollow interior and is formed of a suitable insulating material such as one of the common molded plastics. A pair of electrical terminals 14 and 16, respectively, are carried by base member 12. Ter-

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terminal 14 includes an overturned portion 18 upon which an electrical contact 20 is mounted. Terminal 16 is provided with an overturned portion 22, the latter being electrically connected to one end of a heater 24 by any suitable means such as a weld at 26. The opposite end of heater 24 is electrically connected, as by welding at 28, to a support 30 for an electrical contact 32. It will be apparent that when contacts 20 and 32 are electrically connected, an electrically conductive path is established leading from terminal 14 through, in succession, contact 20, contact 32, heater 24 and terminal 16. Support 30 is secured to base member 12 by any suitable means such as a rivet 34.

The use of a heater in association with a thermally responsive element (later to be described) is well known and its function need not be described in detail. It will suffice to note that such a heater adds heat to the thermally responsive element in addition to that developed in the latter due to the passage of current therethrough, and is generally utilized in installations having a relatively low current rating. It will be noted that in those installations where such a heater is not required or desired it may be eliminated, in which case contact 32 could be electrically connected to terminal 16 in a manner similar to that by which contact 20 is electrically connected to terminal 14.

Base member 12 is provided with a socket 36 within which a sleeve 38 is disposed. Disposed with a loose fit within sleeve 38 and guided for movement thereby is a headed shank 40. Head 42 carried by shank 40 provides a cam surface 44 and a surface 46 engageable with the adjacent surface of an inherently thermally responsive, snap-acting element 48. Element 48 provides an aperture 49 through which shank 40 extends. The mutually adjacent surfaces of head 42 and element 48 are ordinarily maintained in engagement by means of a compression spring 50. As best shown in Figs. 3, 6 and 7, one end of the spring is biased against element 48. The opposite end of spring 50 is biased against shoulder 54 provided by sleeve 38, and part of this spring is disposed between a reduced diameter portion 52 of sleeve 38 and a portion of the internal wall defining socket 36 in base member 12. Headed shank 40 is symmetrical on both sides of all planes within which the axis thereof lies whereby head 42 and the shank provide their intended functions in all positions of rotation thereof.

Inherently thermally responsive, flexible, snap-acting element 48 is formed of composite material and is of the type disclosed in U.S. Patent No. 1,448,240, granted on March 13, 1923 to J. A. Spencer. By way of example, element 48 may take the form disclosed in copending U.S. application, Serial No. 497,109, filed on March 28, 1955, now Patent No. 2,860,208. In response to a change in temperature thereof, element 48 is snappable from the downwardly bowed condition shown in full lines in Figs. 3, 4, 6 and 7 to the upwardly bowed condition shown in broken lines in Fig. 7. In response to a sufficient temperature change in the opposite direction, element 48 is snappable from the upwardly bowed condition to the downwardly bowed condition. A pair of mutually spaced contacts 56 and 58 are carried in electrically conductive connection with element 48 through the intermediary of electrically conductive strips or bars 57 and 59, respectively. Element 48 is movable, by means later to be described, from the upper, contacts-open position shown in Fig. 3 to the lower, contacts-closable position shown in Fig. 7. In the upper position of element 48, contacts 56 and 58 are separated respectively from contacts 20 and 32, and in the lower position thereof, contacts 56 and 58 are engageable with contacts 20 and 32, respectively.

A ledge 60 is provided for a purpose later to become

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apparent. Ledge 60 may be provided by the upper surfaces of a pair of mutually spaced, upstanding sections 62, 62 integral with base member 12. It will be clear that, although ledge 60 is shown in the drawing as being formed by two spaced surfaces, this ledge could be provided in the form of a single continuous surface as well as in other forms. Ledge 60 is relieved or sloped adjacent element 48 at 61. It will be noted that the inclination of portion 61 of ledge 60 is in a general direction toward contact 32.

Mounted for rectilinear movement to the right from the position shown in Fig. 3 is a slide 64. Slide 64 is confined laterally by the adjacent internal surfaces provided by casing member 12, at its upper surface by cover member 66, and at its lower surface by a slide-supporting member 68. Cover plate 66 can be secured to casing member 12 in any suitable manner such as by screws (not shown). Slide-supporting member 68 is, in turn, supported at its ends by shoulders 70 and 72, and at its sides by shoulders 74 and 76, all provided by casing member 12. Slide 64 is biased to the left as viewed in Figs. 2 and 3 by means of a compression spring 78. Casing member 12 provides a pair of stops 80, 80 limiting the extent of movement of the slide toward the left as viewed in Fig. 2 and a pair of stops 82, 82 limiting the extent of movement of the slide to the right.

Slide 64 carries a wear-resistant bushing 84 for the reception of one end of a pin 86 carried by a toggle lever 88. Lever 88 is mounted for pivotal movement about a pin 90, the latter having its ends disposed in the wall of an externally threaded, hollow cylindrical neck 92. Neck 92 is carried by cover member 66 in position about an adjacent aperture provided by the latter.

Slide 64 carries a cam-mounting member 94 which projects through an aperture 96 provided by supporting member 68. Member 94 mounts a ball 98 for free rotation of the latter, the exterior surface of the ball providing a cam surface 100 for cooperation with the cam surface 44 provided by head 42.

An alternative form of means for actuating slide 64 is shown in Fig. 8. Except as specifically pointed out in this paragraph, the structure of the embodiment illustrated in Fig. 8 is identical with that of Fig. 3. The reference numerals of the parts shown in Fig. 8 which are or may be identical with their counterparts in the remaining figures of the drawing are the same as the reference numerals of the latter but primed. The embodiment of Fig. 8 includes a bell crank 102, the end of one leg 104 of which is disposed within bushing 84' and the end of the other leg 106 of which is disposed in an aperture 108 provided by the wall 110 of a counterbored member 112. Bell crank 102 is mounted for pivotal movement about pin 111, the latter having its ends secured in the wall provided by externally threaded, cylindrical, hollow neck 114. The walls of the lower end of member 110 provide a pair of slots 116 which accommodate pin 111 and cooperate therewith to guide member 110 and the structure fixed thereto for vertical movement as viewed in Fig. 8. Fixedly carried by member 110 is a band 118 and a push button 120. The parts are shown in Fig. 8 in the position corresponding to that shown in Fig. 7. It will be apparent that depression of push button 120 from its fully retracted position toward that shown in Fig. 8 effects counterclockwise movement of bell crank 102 about the axis of pin 111 whereby slide 64' is moved to the right. It is also noted that compression spring 78' resiliently biases slide 64' to the left as viewed in Fig. 8, whereby push button 120 is also resiliently biased to its fully retracted position. Band 118 may be formed of a color or appearance contrasting with that of the adjacent portion of push button 120, thereby clearly to indicate whether the respective pairs of cooperating contacts of the device are closed or open. In this regard, when push button 120 is disposed but not forcibly held in the position shown in Fig. 8, band 118 is hidden be-

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hind member 114 and contacts 56 and 58 are engaged with contacts 20 and 32, respectively; and when the push button is in its fully retracted position, band 118 is exposed to view and contacts 56 and 58 are respectively disengaged from contacts 20 and 32.

Operation of the device as illustrated in Figs. 1-7 will now be described. With the parts in the respective positions shown in Fig. 3, element 48 is in its uppermost, contacts-open position whereat spring 50 resiliently biases the upper surface of head 42 against the adjacent portion of slide 64, element 48 is in the downwardly-bowed, contacts-closable condition, and slide 64 is in fully retracted position against stops 80, 80 under the influence of compression spring 78. When lever 88 is pivoted in a counterclockwise direction from the position shown in Fig. 3, slide 64 along with ball 98 is moved to the right against the bias of spring 78 to bring cam surface 100 into engagement with cam surface 44. Sufficient clearance is provided between the internal wall of sleeve 38 and shank 40 that upon continued pivotal movement of the lever, shank 40 tilts in a clockwise direction to bring the right-hand end of element 48 into over-hanging relationship with sloped surface portion 61 of ledge 60. Headed shank 40 is depressed in this tilted relationship as ball 98 continues to move to the right, with the result that the right-hand end of element 48 moves into overlapping engagement with sloping surface 61 and contact 56 is moved into engagement with contact 20; this being the position of the parts as shown in Fig. 6. Upon further continued movement of ball 98 to the right, the latter moves against head 42 and continues to depress the headed shank while in its tilted relationship until the cam surface provided by the ball reaches the uppermost tip of cam surface 44 provided by head 42. From the time that cam surface 100 first engages cam surface 44 until the former reaches the uppermost tip of cam surface 44, it is apparent that the relationship between cam surfaces 100 and 44 is such that the resultant force acting against element 48 is directed along a line intermediate the directions in which element 48 is movable from contacts-closable to contacts-open position and in which the element is movable laterally of this first mentioned direction under the tilting movement of headed shank 40. Also, during this time head 44 is depressed against the bias of spring 50 and against the bias built up in element 48 due to deflection of the central portion thereof relative to its respective end portions.

Head 42 provides an annular surface 124, into engagement with which cam surface 100 of ball 98 moves after leaving cam surface 44. Upon movement of cam surface 100 into engagement with surface 124, the lateral component of force exerted to the right against element 48 as viewed in Fig. 6 is released, and under the vertical force exerted by head 42 against element 48 the latter shifts to the left as the end of element 48 slides off relieved portion 61, contact 56 wipes against contact 20, and contact 58 snaps into engagement with contact 32.

The advantages of the contacts snapping to closed position as opposed to creeping to closed position are well known to those skilled in the art. For example, if contacts 56 and 58 were permitted to creep to closed position it would be possible to burn out the switch or at least upset its calibration due to over-heating by closing on a fault. That is, the temperature at which element 48 snaps from contacts-closable to contacts-open condition is substantially higher when the contacts first move into engagement than it is when element 48 is in the "pulled-in" calibrated position shown in Fig. 7. By snapping contact 58 into engagement with contact 32, the time during which contact 58 is in engagement with contact 32 and the element 48 is not in fully pulled-in condition is so very short that the calibrated temperature at which element 48 snaps to the contacts-open condition is reached before deleterious overheating occurs.

Upon continued movement of slide 64 along with ball

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98 toward the position shown in Fig. 7, ball 98 rides over the innermost edge of annular surface 124 and into engagement with a catch provided by the open end of a socket 126 in head 42. During the short interval after ball 98 moves off surface 124 and before it seats in catch 126, the ball exerts a lateral component of force through head 42 to the left against element 48 as viewed in Fig. 7 with the result that element 48 shifts further to the left whereby each of contacts 56 and 58 wipes against its cooperating contact 20 and 32, respectively. The wiping action between contacts 56 and 20 and between contacts 58 and 32 results in an abrading action tending to maintain the mating surfaces of the respective contacts in a clean condition free of dust, sulfides, oxides and other foreign matter.

With ball 98 seated in catch 126, slide 64 is engaged with stops 82, 82 provided by casing member 12 and the parts are in the positions shown in Fig. 7. In a manner corresponding to that described above with respect to the push button shown in Fig. 8, when toggle lever 88 is in the position shown in Fig. 7 but not forcibly held there, the respective pairs of cooperating contacts of the circuit breaker are closed; and when lever 88 is in the position shown in Fig. 3, the respective pairs of cooperating contacts are open.

With the parts in the positions shown in Fig. 7, the relationship between the forces exerted by springs 50 and 78 and the element 48 itself is such that catch 126 will retain ball 98 therein, and element 48 will be retained in the contacts-closed position. In this regard, the forces exerted by element 48 and spring 50 produce a greater effect tending to maintain ball 98 within catch 126 than the effect of spring 78 against slide 64 tending to release the ball from the catch and result in movement of slide 64 to the right toward the position shown in Fig. 3. However, the effect of spring 50 tending to maintain the ball within the catch is less than the effect of spring 78 tending to move the slide to the position shown in Fig. 3, with the result that, if lever 88 is released in the position shown in Fig. 7 while the element 48 is in its upwardly bowed, contacts-open condition, ball 98 will be released from the catch and slide 64 will move to its retracted position. Furthermore, the force exerted by element 48 alone due to deflection thereof has a greater effect tending to retain ball 98 within socket 126 than the effect of spring 78 tending to move the slide to retracted position, and the result is that the parts will be retained in the positions shown in Fig. 7 under shock and vibration conditions.

When inherently thermally responsive element 48 responds to a temperature change by snapping to the upwardly bowed condition shown in broken lines in Fig. 7, the force exerted by element 48 itself tending to retain ball 98 within catch 126 is released, spring 78 overcomes the force exerted by spring 50, and slide 64 moves to retracted position carrying ball 98 with it. With movement of slide 64 to the position shown in Fig. 3, element 48 moves upwardly under the bias of spring 50 until head 42 engages the adjacent surface of the slide, and lever 88 pivots in the clockwise direction to the position shown in Fig. 3.

A unique feature of this invention lies in the fact that although ledge 60 is disposed in interfering relationship with the adjacent end of element 48 to provide the snap-closing feature of contacts 58 and 32 upon closing of these contacts, this interfering relationship does not exist during opening of the contacts for the reason that ledge 60 is disposed in spaced relationship to the path of the adjacent end of element 48 during movement of the latter to contacts-open position and contacts-open condition.

Calibration of the device can be effected as follows. Base member 12 provides a recess 128 which interfits with a nut 130 whereby the latter is retained against rotation relative to base member 12. Accessible from the exterior of base member 12 is a screw 132 threadedly en-

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gaged with nut 130. By rotation of screw 130 into engagement with and against overturned portion 18 of terminal 14, the latter can be elevated to change the height of contact 20 relative to the base whereby the amount of "pull-in" of the element 48 can be adjusted. This, in turn, correspondingly adjust the temperature at which element 48 snaps from the contacts-closable condition to the contacts-open condition.

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

The dimensions and size of certain of the parts as shown in the drawings have been modified for the purposes of clarity of illustration.

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. In combination; a casing, an inwardly extending ledge carried by said casing, a first electrical contact carried by said casing, an inherently snap-acting thermostatic element carrying a second contact, means mounting said element for movement of the latter in first opposite directions between a contacts-open position and a contacts-closed position, said means permitting movement of said element in second opposite directions laterally relative to said first opposite directions when said element is in said contacts-open position, and means for exerting a force against said element for first moving the latter in one of said second opposite directions and toward said contacts-closed position to bring a portion of said element into overlapping engagement with said ledge and for then moving said element in the other of said second opposite directions and to contacts-closed position whereby said portion of the element snaps off said ledge and said first contact snaps into engagement with said second contact.

2. In combination: a base; a first contact mounted on said base; a second contact; an inherently snap-acting thermostatic element carrying said second contact; means mounting said element for movement in a first direction from a position at which said contacts are open to a position at which said contacts are closed, said mounting means permitting movement of said element in a second direction transversely of said first direction; said element being movable in the direction opposite to said first direction from contacts-closed position to contacts-open position; a ledge adjacent a portion of said element and spaced from the path of said portion when the element moves from contacts-closed to contacts-open position, and means for exerting a force against said element for moving the latter in said second direction and then in said first direction thereby first to bring said portion of the element into overlapping engagement with said ledge, said means thereafter moving said element in a direction opposite to said second direction to snap said portion off said ledge whereby said second contact snaps into engagement with said first contact.

3. The combination as set forth in claim 2 wherein said first-named means includes a shank; said shank being tiltably disposed in guiding means therefor.

4. The combination as set forth in claim 3 wherein said shank has a head fixed thereto; said head bearing against said element and providing a cam surface for cooperation with said last-named means to exert said force against the element.

5. The combination as set forth in claim 4 wherein said last-named means includes a slide carrying a second cam surface for coaction with said first cam surface.

6. The combination as set forth in claim 2 wherein the surface of said ledge engaged by said portion of the element is inclined in a direction substantially toward said first contact.

7. In combination: a base; a first contact mounted on

said base; a second contact; an inherently snap-acting thermostatic element carrying said second contact; means mounting said element for movement in a first direction from a position at which said contacts are open to a position at which said contacts are closed, said mounting means permitting movement of said element in a second direction transversely of said first direction; said element being movable in the direction opposite to said first direction from contacts-closed position to contacts-open position; a ledge adjacent a portion of said element and spaced from the path of said portion when the element moves from contacts-closed to contacts-open position, and means for exerting a force against said element first in a direction intermediate said first and second directions, then in said first direction and then with a lateral component in a direction substantially opposite to said second direction thereby first to bring said portion of the element into overlapping engagement with said ledge, then to snap said portion off said ledge whereby said second contact snaps into engagement with said first contact and then to wipe said second contact against said first contact.

8. The combination as set forth in claim 7 wherein said guided means comprises a headed shank; the head of said shank engaging said element and the shank lying within an aperture provided by said element.

9. The combination as set forth in claim 8 wherein said head provides a first cam surface; and said last-mentioned means includes a member providing a second cam surface for coaction with said first cam surface.

10. The combination as set forth in claim 9 wherein said head provides a catch for reception of said member to retain said element in said second position until released.

11. The combination as set forth in claim 7 wherein the surface of said ledge engaged by said portion of the element is inclined in a direction substantially toward said first contact.

12. In combination: a first electrical contact and a second electrical contact; a snap-acting thermostatic element responsive to temperature change; said element carrying said first contact and being biased for movement along a path from a first position to a second position with respect to said second contact whereby in said first position said element, when it responds to temperature change, biases said first contact in a direction from engaging to disengaging position with respect to said second contact; said first contact, with said element in said second position, being disengaged from said second contact; means guided for movement along said path and engageable with said element; said last-mentioned means permitting movement of said element laterally of said path; a ledge adjacent said element and spaced from the path thereof during movement of the element from said first position to said second position; and means movable against said guided means for first laterally moving said element into overlap-

ping engagement with said ledge, for then moving a portion of said element to said first position, and then moving said element in a direction opposite to the first lateral motion whereby said element snaps off said ledge and said first contact snaps into engagement with said second contact.

13. The combination as set forth in claim 12 wherein the surface of said ledge engaged by said element is inclined in a direction substantially toward said first contact.

14. In combination: a snap-acting member carrying a first electrical contact and snappable from a first condition to a second condition; means mounting said member for movement from a first position to a second position; a second electrical contact engaged with said first electrical contact when said member is in said first condition and said first position; said contacts being disengaged from each other when said member is in said second condition or said second position; a ledge adjacent a portion of said member; said ledge being spaced from the path of movement of said portion when said member snaps from said first condition to said second condition and moves from said first position to said second position; said means permitting lateral displacement of said portion of the member into overlying relation to said ledge; means resiliently biasing said member in the direction from said first position to said second position; and means for applying force against said member, when the latter is in said first condition and said second position, for moving said member first laterally and in the direction opposite to the first-named direction to bring said portion into overlapping engagement with said ledge and for then moving said member farther in said opposite direction to snap said portion off the ledge whereby said second contact snaps into engagement with said first contact.

15. The combination as set forth in claim 14 wherein said member comprises a thermostatic element snappable in response to temperature change from said first condition to said second condition.

References Cited in the file of this patent

UNITED STATES PATENTS

1,677,710	Daniker	July 17, 1928
2,467,745	Harrison	Apr. 19, 1949
2,548,678	Obenour	Apr. 10, 1951
2,566,720	Dissinger	Sept. 4, 1951
2,622,169	Cataldo et al.	Dec. 16, 1952
2,681,962	Sundt	June 22, 1954
2,743,333	Epstein	Apr. 24, 1956
2,810,041	Wills	Oct. 15, 1957
2,811,604	Cole	Oct. 29, 1957
2,811,605	Christensen et al.	Oct. 29, 1957

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,901,575

August 25, 1959

David E. Clarke

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 2 and 3, for "assignor to Texas Instruments Incorporated, of Attleboro, Massachusetts, a corporation of Massachusetts," read -- assignor to Texas Instruments Incorporated, a corporation of Delaware, --; in the heading to the printed specification, lines 3, 4 and 5, for "assignor to Texas Instruments Incorporated, Attleboro, Mass., a corporation of Massachusetts" read -- assignor to Texas Instruments Incorporated, a corporation of Delaware --; column 4, line 69, for "engagetment" read -- engagement --; column 6, line 6, for "adjust" read -- adjusts --.

Signed and sealed this 26th day of April 1960.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON

Commissioner of Patents

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

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