Oct. 6, 1964 J. F. MARQUIS 3,152,235

BI-METALLIC OVERLOAD RELAY HAVING SNAP SWITCH TOGGLE ACTION

Filed June 9, 1961 2 Sheets-Sheet 1

Fig. 1

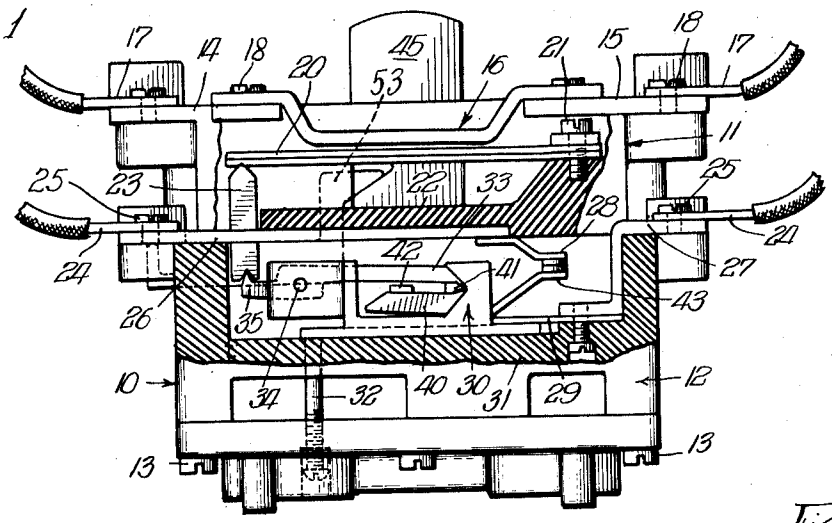


Fig. 5

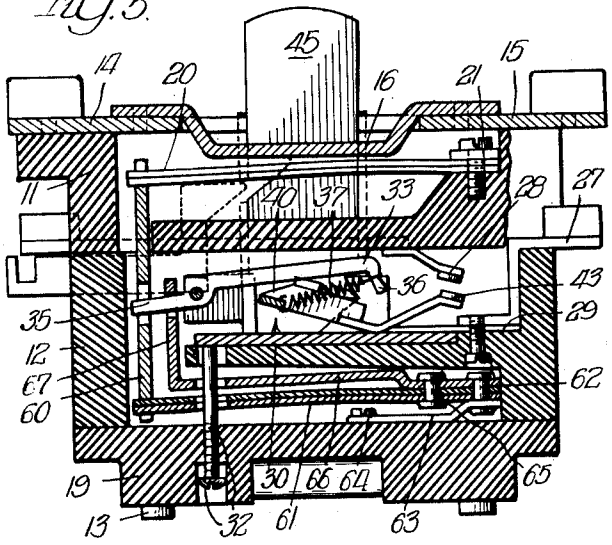


Fig. 7

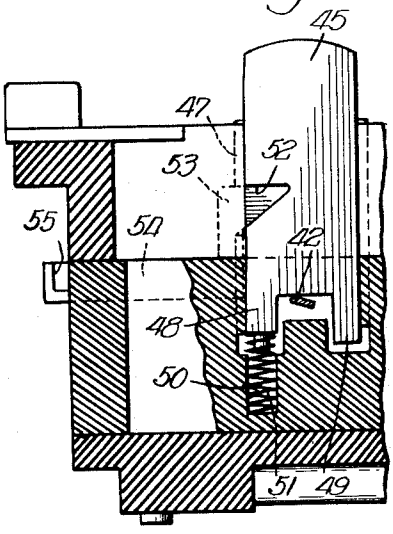
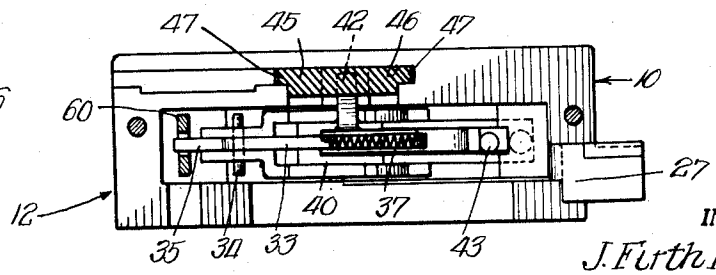


Fig. 6



INVENTOR.
J. Firth Marquis.
BY
Byron Hume Green & Clement
ATTYS.

Oct. 6, 1964 J. F. MARQUIS 3,152,235

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Filed June 9, 1961 2 Sheets-Sheet 2

Fig. 2

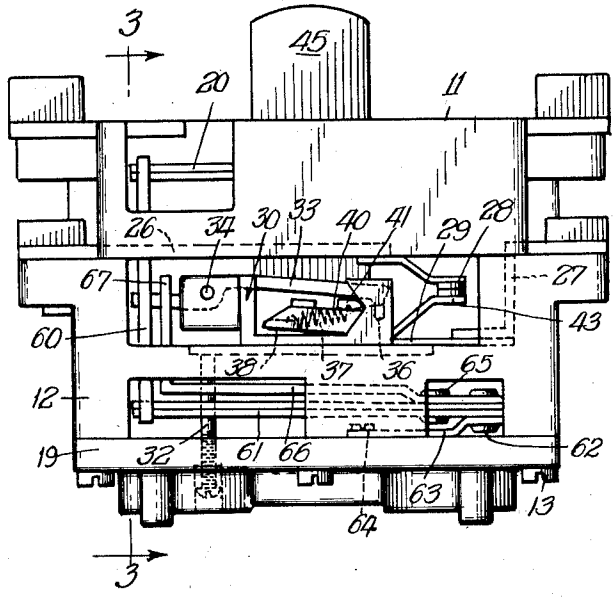
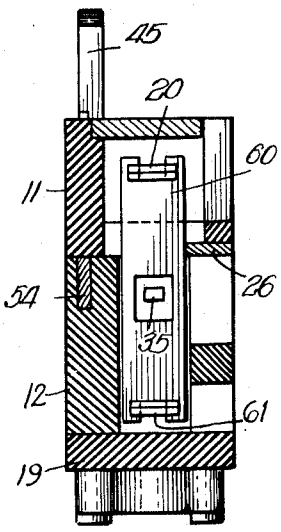


Fig. 3



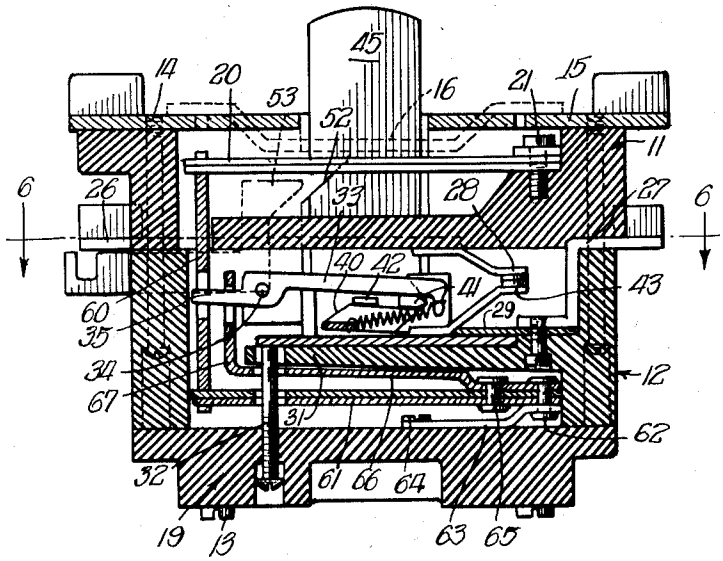


Fig. 4

INVENTOR.
J. Firth Marquis,
BY
Byron Hume Groen & Clement
Attys.

United States Patent Office

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BI-METALLIC OVERLOAD RELAY HAVING SNAP SWITCH TOGGLE ACTION

John Firth Marquis, St. Charles, Ill., assignor to Furnas Electric Company, Batavia, Ill., a corporation of Delaware

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7 Claims. (Cl. 200—122)

The invention relates to switch mechanism and has reference in particular to an overload relay of the bimetallic type incorporating a snap switch having toggle action for opening and closing an electric circuit.

The overload relay of the invention is operable to automatically open and close an electric switch when the circuit thereof is subjected to overload current conditions, and in combination therewith a resetting plunger is provided adapted to be manually actuated for closing the switch or which can be locked in position whereby the switch will automatically close following each opening action as caused by an overload condition.

In connection with the foregoing an object resides in the provision of an overload relay switch having a resetting plunger and wherein irrespective of whether the plunger is free for manual resetting or locked for automatic resetting, the overload relay switch is trip free in either condition of operation.

Another object of the invention resides in the provision of a snap acting switch of the toggle type for controlling an electric circuit in response to overload conditions, and which will incorporate adjustable means having operative relation with the snap acting switch whereby the trip setting of the switch can be varied.

Another object is to provide a switch as described and wherein the adjustable means is constructed and arranged to effect bodily movement of the switch structure as a unit with respect to the bimetallic strip, whereby the trip setting of the switch can be varied to cause the relay to operate at a higher or lower current value.

Still another object is to provide a snap acting, toggle type of overload switch mechanism which will be fully compensated so that tripping of the switch will take place substantially independently of changes in ambient temperature over a wide range.

Another object is to provide an overload relay as described which can be readily converted from the non-compensated type to the compensated type, and wherein the conversion will not materially alter the basic combination constituting the invention.

Still another object is to provide an overload relay embodying the structural features and having the mode of operation as described and wherein the bimetallic strips are mounted for cantilever action so as to eliminate lost motion and improve reliability.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation, as will be more fully described and particularly pointed out in the specification, drawings and claims appended thereto.

In the drawings which illustrate an embodiment of the device and wherein like reference characters are used to designate like parts—

FIGURE 1 is an elevational view showing the non-compensated type of bimetallic overload relay of the invention, certain parts being broken away to better illustrate the improved structural features of the same;

FIGURE 2 is an elevational view of a temperature compensated form of overload relay coming within the invention and which incorporates an additional bimetallic strip for compensating purposes;

FIGURE 3 is a sectional view taken vertically and transversely of the compensated overload relay as shown in FIGURE 2, substantially along line 3—3 of said figure;

FIGURE 4 is a sectional view taken vertically and longitudinally of the relay as shown in FIGURE 2, the switch contacts and associated parts thereof being illustrated as in a closed circuit position;

FIGURE 5 is a sectional view similar to FIGURE 4 but showing the compensated type of overload relay with switch contacts and associated parts in circuit open position;

FIGURE 6 is a horizontal sectional view taken substantially along line 6—6 of FIGURE 4; and,

FIGURE 7 is a detail sectional view illustrating the locking means for locking the resetting plunger for automatic reset operations.

The non-compensated type of overload relay as shown in FIGURE 1 incorporates the basic features of the invention and wherein the structure identified by numeral 10 comprises a housing of relatively hard and durable material having insulating qualities and which may be in two or more parts such as the top housing part 11 and the bottom housing part 12. The said parts are joined together by the securing screws 13. The upper housing part 11 has terminal members 14 and 15 secured thereto and which support the heater 16. The conductors 17 of the electric circuit, to be protected against overload current conditions, are suitably secured by the screws 18 to the terminal members 14 and 15, and current is conducted by the heater when the circuit is closed. The top housing part 11 also contains the bimetallic element 20 in the form of a strip fixedly secured at its right hand end by the screw 21 to a wall of the housing part so as to have cantilever action. As a result, the free left hand end of the bimetallic strip is able to flex downwardly in response to the heat produced by the heater 16. Another wall of the top housing part 11, namely wall 22, extends horizontally below the bimetallic strip and said wall aids in insulating the switch elements of the device from the heater and from the bimetallic strip.

The heater 16 is formed of any suitable metal having such resistance to the flow of an electric current as to produce considerable heat which influences the bimetallic strip causing flexing of the same as well understood in the art. The flexing movement of the bimetallic strip is transmitted by the coupler 23 to the movable lever of a switch unit and which has toggle action for controlling the opening and closing of the electric circuit, all in a manner which will now be described.

The other conductors of the electric circuit namely 24, are respectively secured by the screws 25 to the terminal members 26 and 27, the former being located in a recess formed on the underside of wall 22, and the latter being located in contact with an outside wall of the bottom housing part 12. The terminal member 26 has the stationary contact 28 fixed thereto and said contact is flexibly supported by its connecting strip. The terminal member 27 is electrically connected by the metal strip 29 to the switch unit designated in its entirety by the numeral 30. The metal strip 29 is soldered or riveted to the base of the switch unit at the right hand end of the unit, and thus the unit may have limited movement by cantilever action in an upward direction. Normally, however, the base of the switch unit may rest on the top of wall 31 of the bottom housing part 12. Adjusting screw 32 is provided for the purpose of lifting the left end of the switch unit and thus causing the same to pivot in a counterclockwise direction as permitted by the strip 29 whereby the position of the switch unit may be varied. Accordingly it will be observed that the screw 32 has threaded engagement in the housing part 12 and that the screw extends through the wall 31 so as to contact the base of the switch unit 30 at the left hand end thereof.

The switch unit 30 as employed in the non-compensated unit of FIGURE 1 is similar in construction and mode of operation to the switch unit employed in the temperature compensated modification as best shown in FIGURES 2, 4 and 5. Thus the movable lever 33 of the switch unit is pivoted at 34 and the left hand end of the same extends outwardly beyond the rear of the unit for a knife contact at 35 with the coupler 23. The opposite end of the movable lever 33 is formed at 36, FIGURE 2, to provide a depending part for connection with the toggle spring 37. The opposite end of the toggle spring is anchored at 38 to the toggle lever 40. Said toggle lever carries at its upper right hand end a pair of knife elements 41 which have contact with the apex of the triangular openings provided, respectively, by the side walls of the switch unit. The rear end of the toggle lever 40 above the anchoring for the toggle spring is formed to provide a laterally extending flange 42, FIGURES 6 and 7, and which functions as a resetting element for the switch. Also, the right hand end of the toggle lever 40 is integral with the movable contact 43 and which is adapted to coact with the stationary contact 28 for making and breaking the electric circuit.

With the contacts 28 and 43 of the switch unit in closed position as shown in FIGURE 1, it will be understood that the electric circuit is operative, since conductors 17 are connected by the heater 16, whereas conductors 24 are connected by the terminal members 26 and 27, by the metal strip 29 and by the closed contacts 28 and 43 of the switch unit. It follows that current flow will take place in heater 16. Should overload conditions develop to a predetermined degree, the heat produced will flex the bimetallic strip 20 in a downward direction sufficient to open the switch contacts 28 and 43. This is accomplished by downward movement of the coupler 23 effecting pivotal movement of the lever 33 in a counterclockwise direction. When the lever has rotated to an extent such that the toggle spring 37 is above a dead center position, as determined by the pivot point of the knife elements 41, the toggle lever 40 will be rotated in a clockwise direction. This will effect a separation between the stationary contact 28 and the movable contact 43 and thus the circuit is opened and current flow in the circuit will be terminated. Due to the snap action of the toggle lever 40, the breaking of the electric circuit is rapid and excessive arcing between the contacts is eliminated.

It is possible to set the present overload relay so that opening of the switch will take place when a current of a predetermined value is caused to flow through the heater 16. This setting of the present relay is accomplished by the threaded adjusting screw 32 which can be rotated to lift the switch unit 30 from its supported position on wall 31. A lifting of the switch unit at its left hand end will in effect pivot the same in a clockwise direction as permitted by the flexible strip 29, and accordingly the switch unit will be located closed to the bimetallic element 20. Thus said element may flex to a less extent and still actuate the movable lever 33 to open the switch contacts. It will be understood from the foregoing that when the adjusting screw 32 is rotated to elevate the left hand end of the switch unit that the contacts will open on a lower value of current and conversely when the adjusting screw is rotated to lower the left hand end of the switch unit, the said contacts will require a greater value of current before opening.

The toggle action of the switch unit is such that the contacts will remain open after the toggle lever 40 has been rotated to separate the movable contact 43 from the stationary contact 28. Accordingly it is necessary to provide some form of resetting mechanism for moving the toggle lever 40 downward or in a counterclockwise direction for returning the same to initial position. Of course, when the toggle spring 37 moves below a dead center position, as determined by the pivot point of the knife elements 41, the toggle spring 37 will become operative to move the toggle lever into its fully returned position. In this position of the toggle lever the movable contact 43 will again engage the stationary contact 28 so that the circuit is re-established.

The overload relay of the invention incorporates a resetting plunger 45, FIGURES 6 and 7, disposed in a groove 46 extending vertically of the housing 10. The groove is so formed as to accommodate the lateral flanges 47 extending laterally from the side edges of the plunger and for the greater length of the plunger. The lower end of the plunger is bifurcated to form the two depending legs 48 and 49 and the space thus provided between the legs accommodates the flange or resetting element 42. This element has been described as extending laterally from the top rear end of the toggle lever 40 and as shown in FIGURE 7, the legs 48 and 49 of the plunger straddle the element. In order to maintain the plunger in its elevated inoperative position the recess 50 formed in the housing part 12 accommodates the coil spring 51 which is caused to engage the leg 48 of the plunger. The action of the spring, therefore, is to force the plunger in an upward direction so that the plunger is normally maintained out of contact with the resetting element 42.

However, it is possible to lock the resetting plunger 45 in a depressed or resetting position, and for this purpose the right hand edge of the plunger has the triangular shaped notch 52 formed therein. Said opening is adapted to received a locking pawl such as 53 carried by the slide 54 which is mounted for reciprocating movement adjacent the rear wall of the housing 10 and in substantial alignment with the flange 47 on the notched side of the plunger. The slide 54 extends outwardly beyond the side wall of the housing 10 and the said extending end is formed with the finger opening 55.

With the slide 54 withdrawn from the notch 52 as shown in FIGURE 5, the resetting plunger 45 is free for manual actuation. Thus following an opening action of the switch contacts, the same can be closed by merely depressing the plunger, since the resetting element 42 will be engaged and the toggle lever 40 will be moved downwardly to relocate the elements of the toggle switch in their initial and operative position. However, when the slide 54 is pushed in to cause the locking pawl 53 to be inserted within the notched opening 52 as in FIGURE 7, the resetting plunger 45 is locked in a depressed position. In this position of the resetting plunger, the same will have contact with the element 42, but due to the resiliency of this element, the toggle switch is permitted to open, and the switch is also caused to automatically close. Of course, this action requires that the notch 52 have a precise location lengthwise of the plunger so that when locked by the pawl 53 the plunger will engage the element 42 with the proper tension whereby to permit opening action of the toggle switch and also cause its automatic closing.

The modified structure shown in FIGURES 2, 4 and 5 is characterized by the provision of temperature compensating means, and accordingly the switch will trip upon predetermined current loads independently of ambient temperature conditions. The housing 10 of relatively hard insulating material is preferably formed in three parts including an upper housing part 11, an intermediate housing part 12, and a base housing part 19, all three parts being secured together by the screws 13. The top housing part 11 retains the terminal members 14 and 15 which in turn support the heater 16. Said part also supports the bimetallic strip 20 fixed by the screw 21 to a wall of said part so as to have cantilever action, and below the bimetallic element 20 the said top housing part provides the dividing and insulating wall 22. The terminal members 26 and 27 are associated with the switch elements as previously described, with member 26 having location in a groove formed in the undersurface of the wall 22 and which in turn electrically connects with and supports the stationary contact 28. The terminal member 27 is dis-

posed in contact with the side wall of the housing part 12, and the relatively thin and flexible strip 29 electrically and mechanically joins the same to the switch unit 30. The adjusting screw 32 is threaded into and through wall 31 so as to engage the base of the switch unit for varying the setting for the tripping of the switch.

As regards the switch unit, it has been previously stated that the construction of the same and its mode of operation is similar to that shown in FIGURE 1. However, in this modification the rear end 35 of the pivoted switch lever 33 may be somewhat elongated with the knife edge being eliminated and said rear end 35 may project through an opening provided in the coupler 60. The coupler mechanically connects the bimetallic strip 20 with the bimetallic compensating strip 61. The said compensating strip is hingedly mounted to permit limited movement, being fixedly secured by the rivet 62 to the flexible metal strip 63 which provides the hinge for the compensating strip. The hinge 63 is in turn anchored by the screw 64 to the bottom housing part 19. The rivet 62 and also rivet 65 securely join the compensating strip 61 to the actuating arm 66, the said arm having a bent upwardly directed end 67 in operative relation with the projecting end 35 of the movable switch lever 33. It will be observed that the adjusting screw 32 extends through openings, respectively, in the compensating strip 61 and actuating arm 66 so that the adjusting screw does not interfere with the movement of these elements.

With the contacts 28 and 43 of the switch unit in closed relation, it will be understood that current will flow through the heater 16 and if excessive current should flow beyond a predetermined setting, the heat generated will produce such downward deflection of the strip 20 as to cause opening of the switch contacts. In this modification the bimetallic strip 20 is operatively connected by the coupler 60 to the bimetallic strip 61. Downward deflection of 20 will move 61 in a downward direction and to the same extent. This will result in downward movement of the actuating arm 66 since the arm is fixed to the compensating strip. The end 67 of the actuating arm will accordingly contact end 35 and produce counter-clockwise rotation of the movable switch lever 33 with the result that the switch contacts are caused to open.

Unless the overload relay of the invention is compensated in some manner, it will be understood that ambient temperature changes will cause the bimetallic strip 20 to deflect independently of the heater 16 and thus trip time will be reduced at high ambient temperatures and the same will be increased at low ambient temperatures. It follows that such operation is undesirable, and accordingly the invention contemplates the provision of the second bimetallic strip 61 for compensating purposes and which is hingedly mounted and has the switch actuating arm secured thereto. Should an increase in the ambient temperature take place, it will cause 20 to flex downwardly and simultaneously therewith the bimetallic strip 61 will also flex downwardly an equal amount. However, this relatively minor flexing movement of the bimetallic strip does not cause any movement of the actuating arm 66. In a similar manner a drop in the ambient temperature will cause both of the bimetallic strips to deflect upwardly, but only to a limited extent and here again, no movement is imparted to actuating arm 66. The arm 66 will move only when 20 and 61 are deflected downwardly to a substantial extent by the heat produced by the heater 16. This heat which is sensed by the bimetallic strip 20 does not influence the compensating strip 61 due to the remote location of the compensating strip 21 on the bottom of the relay housing. As a result tripping of the switch contacts will take place independently of ambient temperature conditions, and at the exact setting as determined by the adjusting screw. The resilient mounting of the contact 28 constitutes an important feature of the present switch since the resiliency and flexibility of the contact gives good wiping action and also prevents contact chatter at the breaking point for the electric circuit.

The invention is not to be limited to or by details of construction of the particular embodiment thereof illustrated by the drawings, as various other forms of the device will, of course, be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

What is claimed is:

1. In an electric switch, the combination including a heat responsive element comprising a bimetallic strip anchored at one end so as to have flexing movement at its opposite free end, a stationary switch contact, a switch unit of the toggle type, said unit including a pivotally mounted movable lever and a pivotally mounted toggle lever, resilient means connecting an end of the movable lever with an end of the toggle lever, a movable contact fixed to and movable with the toggle lever and adapted to coact with the stationary contact, a second bimetallic strip providing temperature compensating means, a hinge element for anchoring one end of the second strip so that the opposite end may have flexing movement and so that the strip may also have limited pivot-like movement towards and from the switch unit and about the hinge element as an axis, said heat responsive element and said compensating means being located on opposite sides of the switch unit and being disposed so that flexing takes place towards and from the switch unit, coupler means connecting the flexing ends of the two bimetallic strips, and an actuating arm fixed to the second bimetallic strip at the connection of the same to the hinge element, said arm extending approximately parallel with the second bimetallic strip for approximately its length and having connected relation with the movable lever of the switch unit.

2. An electric switch as defined by claim 1, additionally including a heater disposed adjacent the first mentioned bimetallic strip for subjecting the same to variable heat conditions, and wherein adjusting means are provided for adjusting the position of the switch unit bodily towards and from the first mentioned bimetallic strip and substantially parallel to the longitudinal axis of the coupler means, whereby the relation of the parts can be varied for varying the particular heat condition which will effect movement of the movable lever for separating the movable contact from the stationary switch contact.

3. In an overload relay of the compensated type, in combination with a housing, of a heater element supported by the housing, a bimetallic strip providing heat responsive means located below the heater element and anchored at one end to the housing so that its free end may flex towards and from the heater element, a switch unit anchored to the housing by a hinge element, a movable lever pivotally mounted by the switch unit, a toggle lever also pivotally mounted by the switch unit, resilient means operatively connecting the levers to effect toggle action of the toggle lever upon pivotal movement of the movable lever, a stationary contact in fixed relation on the housing, a movable contact fixed to the toggle lever and having snap action for engaging and separating from the stationary contact as the toggle lever has toggle action, a second bimetallic strip providing compensating means and which is also anchored by a hinge member to the housing, said second bimetallic strip being located below the switch unit on the side opposite the heat responsive means and capable of flexing at its free end in the same directions and to an extent equal to that of the heat responsive means when subjected to the same ambient temperature conditions, coupler means connecting the flexing ends of the two bimetallic strips, and an actuating arm fixed to the second bimetallic strip at the connection of the same with its hinge member, said actuating arm having operative connected relation with the movable lever of the switch unit.

4. An overload relay as defined by claim 3, additionally including an adjusting member carried by the housing and having contact with the switch unit at the end thereof opposite the hinge element, said adjusting member being adjustable to vary the position of the switch unit and thus the position of the movable lever with respect to the actuating arm which has an operative connected relation with said lever.

5. In an electric switch, the combination with a housing and a stationary switch contact associated with the housing, of a switch unit providing a movable contact for co-action with the stationary switch contact, said switch unit being located within the housing and which provides a supporting surface for the same, means mounting the switch unit for pivot-like movement away from and towards its supporting surface and with pivot axis of the switch unit being located at the end of the unit adjacent the movable contact, a movable lever pivotally mounted by the switch unit and being operatively connected to the movable contact for effecting opening and closing movements thereof with the stationary contact upon movement of the movable lever, a heat responsive element comprising a bimetallic strip anchored at one end thereof to the housing so as to have flexing movement at its opposite free end, coupler means providing an operative connection of the flexing end of the bimetallic strip with the movable lever of the switch unit, and adjusting means having an adjustable relation with the housing and being operative for moving the switch unit bodily with respect to its supporting surface and towards and away from the bimetallic strip in a direction substantially parallel to the longitudinal axis of the coupler means, whereby the relation of the parts and the particular heat condition which will effect movement of the movable lever for separating the movable contact from the stationary switch contact can be varied.

6. In an electric switch, the combination with a housing and a stationary switch contact associated with the housing, of a switch unit providing a movable contact for co-action with the stationary switch contact, said switch unit being located within the housing and which provides a supporting surface for the same, means mounting the switch unit for pivot-like movement away from and towards its supporting surface and with the pivot axis of the switch unit being located at the end of the unit adjacent the movable contact, a movable lever pivotally mounted by the switch unit, toggle means joining the movable lever with the movable contact whereby the contact is caused to engage and separate from the stationary contact with the snap action upon pivotal movement of the movable lever, a heat responsive element comprising a bimetallic strip anchored at one end thereof to the housing so as to have flexing movement at its opposite free end, coupler means providing an operative connection between the said flexing end of the

bimetallic strip and the movable lever of the switch unit, and adjusting means adjustably mounted by the housing and operative for moving the switch unit bodily with respect to its supporting surface and towards and away from the bimetallic strip in a direction substantially parallel to the longitudinal axis of the coupler means, whereby the relation of the parts and the particular heat condition which will effect movement of the movable lever for separating the movable contact from the stationary switch contact can be varied.

7. In an electric switch, the combination with a housing and a stationary switch contact associated with the housing, of a switch unit providing a movable contact for coaction with the stationary switch contact, said unit being located within the housing and which provides a supporting surface for the same, means mounting the switch unit for pivot-like movement away from and towards its supporting surface and with the pivot axis of the switch unit being located at the end of the unit adjacent the movable contact, a movable lever pivotally mounted by the switch unit and being operatively connected to the movable contact for effecting opening and closing movements thereof with the stationary contact upon movement of the movable lever, a heat responsive element comprising a bimetallic strip anchored at one end to the housing so as to have flexing movement at its opposite free end, a second bimetallic strip providing temperature compensating means and which is also anchored at one end to the housing so as to have flexing movement at its opposite free end, said heat responsive element and said temperature compensating means being located on opposite sides of the switch unit and being disposed so that flexing takes place toward and from the switch unit, coupler means connecting the flexing ends of the two bimetallic strips, and actuating arm fixed to the second bimetallic strip and having connected relation with the movable lever of the switch unit, and adjusting means having an adjustable relation with the housing and being operative for moving the switch unit bodily with respect to its supporting surface and towards and away from the first mentioned bimetallic strip in a direction substantially parallel to the longitudinal axis of the coupler means, whereby the relation of the parts and the particular heat condition which will effect movement of the lever for separating the movable contact from the stationary switch contact can be varied.

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