

[54] **CIRCUIT BREAKER**

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[22] Filed: **May 27, 1971**

[21] Appl. No.: **147,449**

[52] U.S. Cl. **337/66, 337/70, 337/72, 337/75**

[51] Int. Cl. **H01h 21/16**

[58] Field of Search **337/62, 64, 65, 66, 70, 72, 337/74, 75**

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[57] **ABSTRACT**

A novel latch and release mechanism for an electrical circuit breaker is disclosed herein wherein the switch assembly is held closed while contact loading pressure by-passes a thermal release mechanism so that this latter mechanism is unloaded. Trip cams are provided which are responsive to movement of the thermal release mechanism for releasing the load on the latch mechanism wherein spring pressure urges the latch open and the contact closures of the switch assembly open. A temperature compensation means is operatively coupled to the trip cams of the release mechanism for pre-setting the precise release point of the contact loading pressure.

38 Claims, 20 Drawing Figures

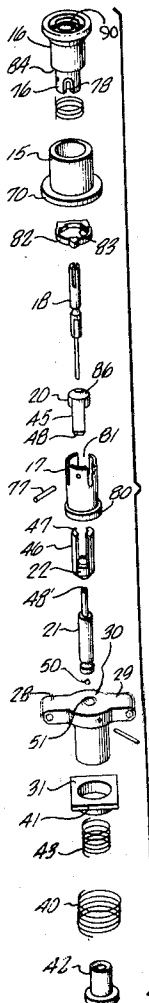


FIG. 1.

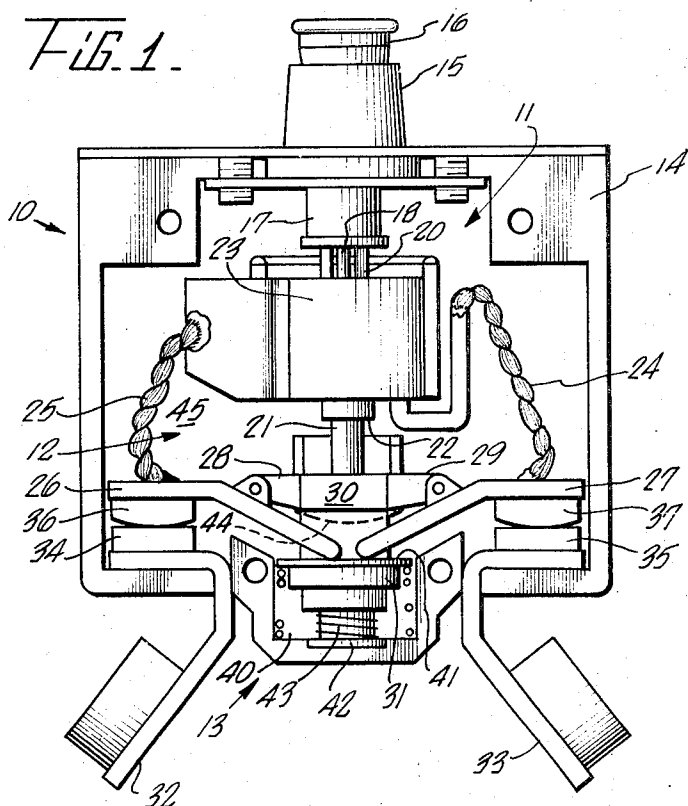


FIG. 2.

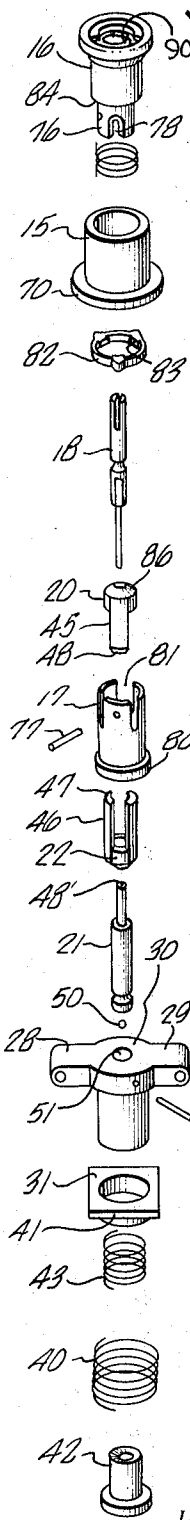
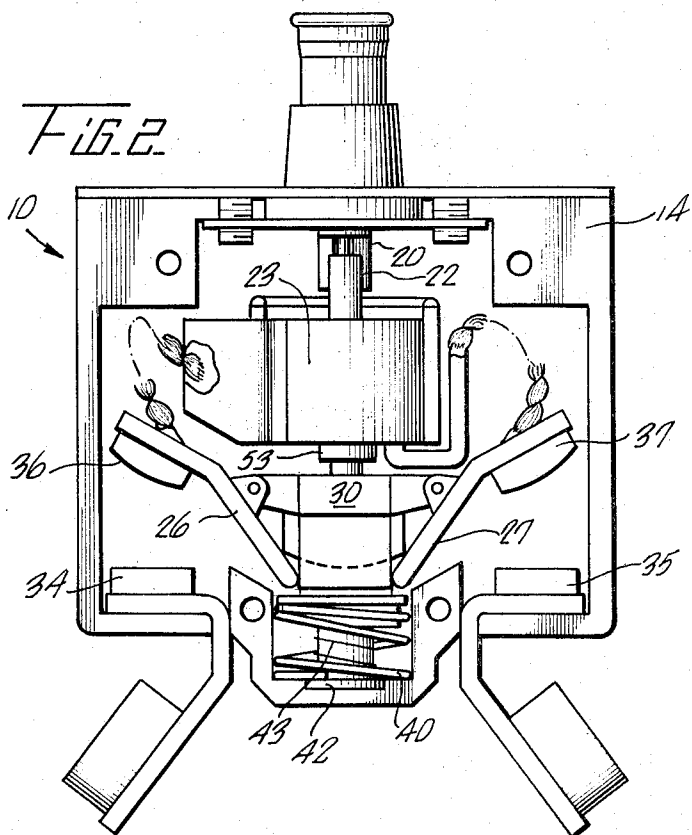
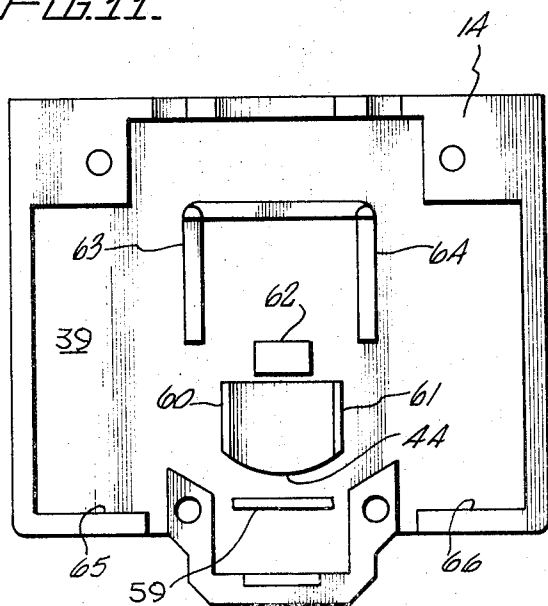
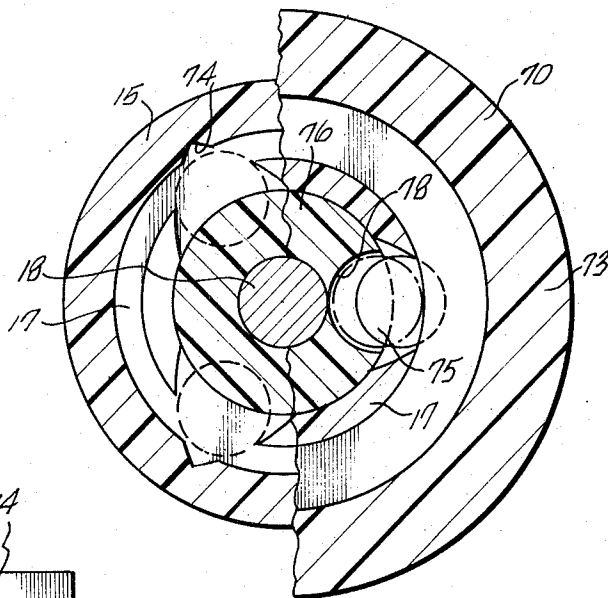
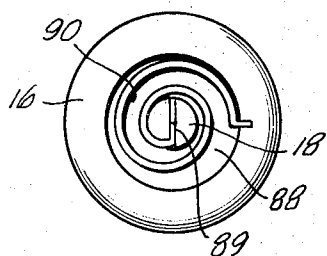
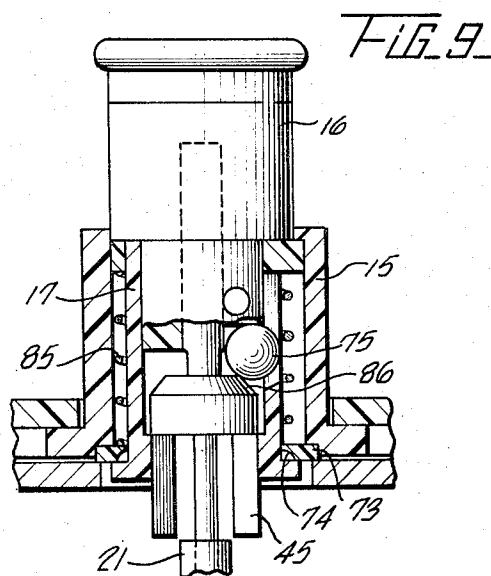
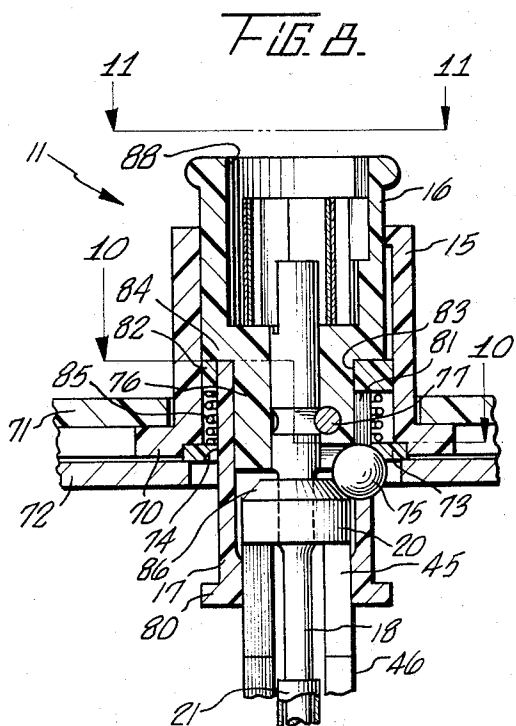


FIG. 3.

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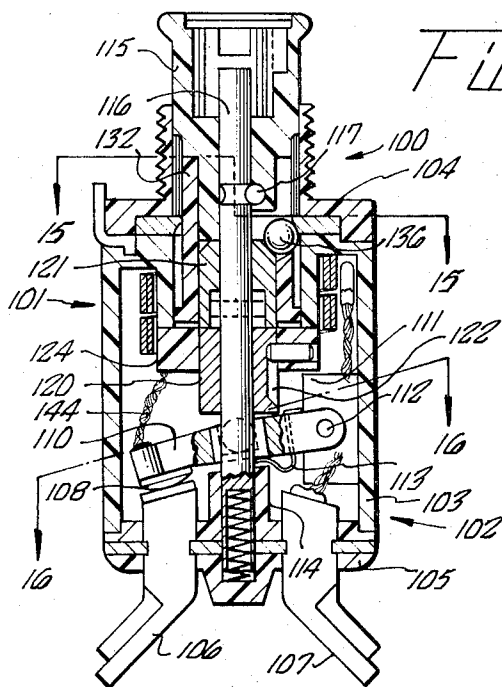


FIG. 12

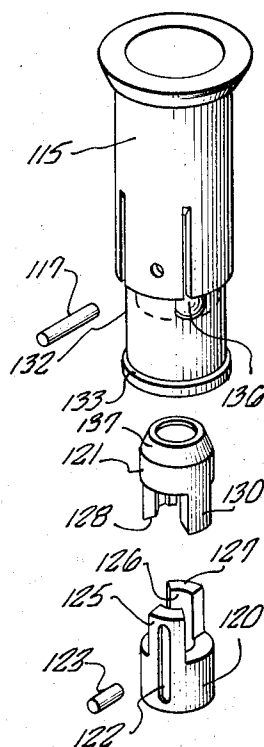


FIG. 14

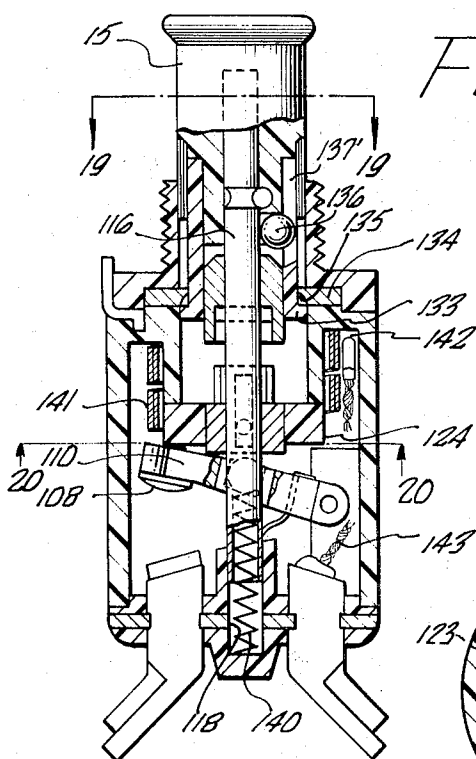


FIG. 13

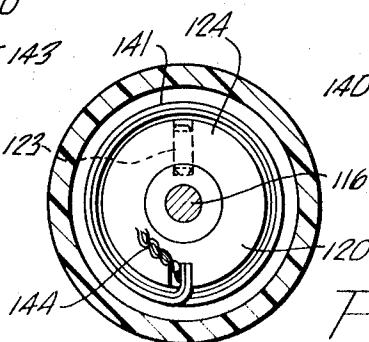
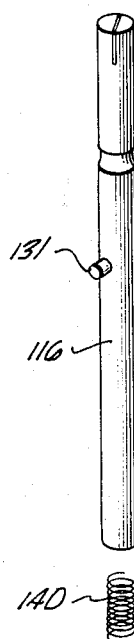


FIG. 20

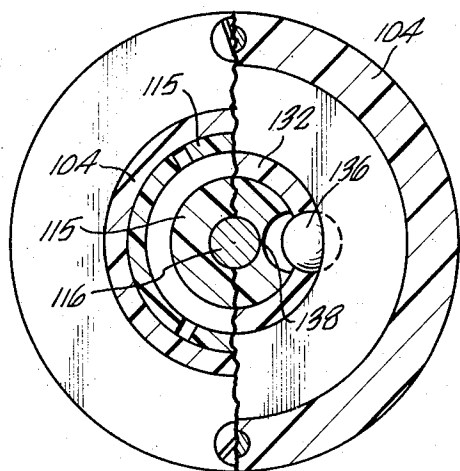


FIG. 15.

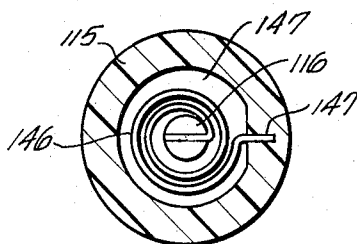


FIG. 19.

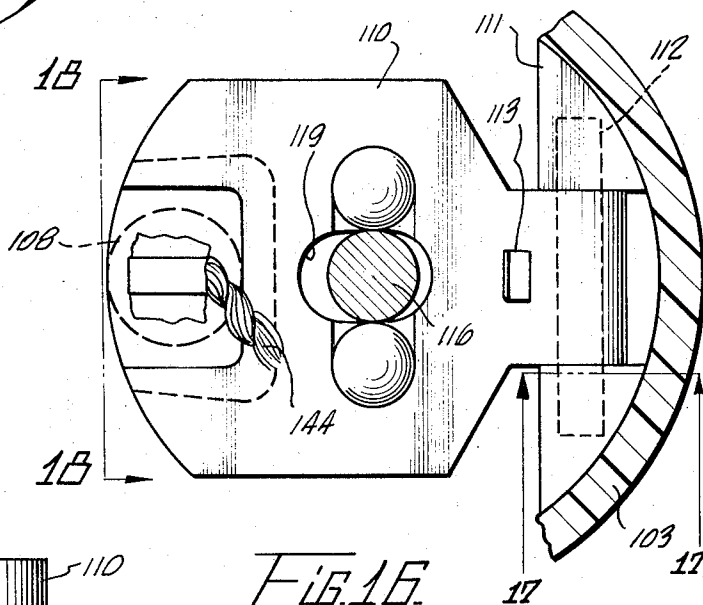


FIG. 16.

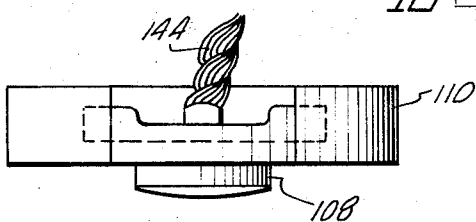


FIG. 18.

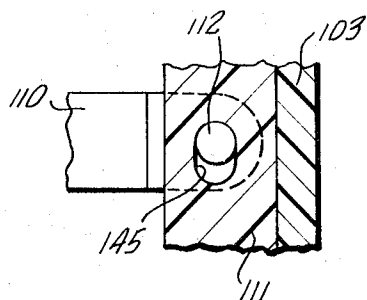


FIG. 17.

CIRCUIT BREAKER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electrical circuit breakers and, more particularly, to a novel circuit breaker incorporating a latch mechanism for holding switch contacts closed and a thermal release mechanism wherein the applied pressure load of the latch mechanism is isolated from the thermal release mechanism and which further includes a temperature compensation means for adjusting the thermal release point of the release mechanism.

2. Description of the Prior Art

In the past, it has been the conventional practice to provide a circuit breaker of the type that is "trip free," that is, one that cannot be manually held on while a condition of current overload persists, which is simple in construction, having a minimum number of operative parts, and which may be made relatively small in size and light in weight. It is desirable to have a long operative life and to be capable of handling heavy current loads, and which includes strong, positive spring means for separating the contacts upon release of the breaker by a current overload, while at the same time being safe against accidental release, even under extreme conditions of shock and vibration. In general, a circuit breaker of this character includes three principal units, namely, (1) a switch assembly, (2) a latching assembly for moving the switch assembly to the "make" or closed position and for holding the switch assembly in this position, and (3) a thermal element release assembly for releasing the latch assembly and permitting the switch assembly to return to the "break" or open position. Usually, all three of these principal portions of the circuit breaker are compressed together in the "make" position, with the contacts of the switch assembly being held tightly in the engaged position against strong spring force which urges the contact apart. This compression of the parts in the "make" position hold all movable parts of the circuit breaker tight against shock and vibration and provides an excellent electrical as well as mechanical connection through the contacts.

The switch assembly includes a pair of stationary terminal contacts secured to the circuit breaker housing and a pair of movable contacts usually secured to a movable block operably connected to the thermal element so as to be responsive to physical displacement of the thermal element to move the movable contacts out of engagement with the stationary contacts. One of the major problems encountered with conventional latch assemblies resides in undesired loading of the release mechanism to maintain the switch mechanism closed. Since opening of the movable contacts of the switch mechanism relies upon movement of the thermal element under load, it is found that contact pressure will be different in similar circuit breaker constructions in a given production run, resulting in inconsistent calibration from one breaker to another.

Applying the latch load through the release mechanism in order to provide contact closure pressure undesirably loads or encumbers the release mechanism so that consistent release among a large number of mass produced breakers cannot be relied upon. Furthermore, consistency in the repeatability of release after reset is adversely affected.

The bi-metal element is the heart of the circuit breaker and every attempt must be made to allow this element to operate freely and without restriction. If this can be done, a high degree of accuracy and of consistency of response in repeated operations can be achieved to an extent heretofore not attainable in a circuit breaker. Also, since there are many variables in the latch assembly, contact pressure is also adversely affected so that sufficient contact opening clearance cannot be assured repeatedly from one production unit to the next.

Generally, circuit breakers employ a bi-metal thermal response element which expands in the presence of thermal differentials to release the latch assembly. However, changes in ambient temperature as well as other environmental conditions sometimes cause the bi-metal element to react in the absence of circuit current overload so that false circuit breaking occurs. Obviously, this is an undesirable event.

SUMMARY OF THE INVENTION

The difficulties and problems encountered with conventional latch and release assemblies for circuit breakers are obviated by the present invention which provides a latch mechanism having a slidable sleeve adapted to be releasably locked to the housing by a ball whereby the latch load is transferred through the ball and a central shaft assembly to the switch assembly for providing contact pressure. A bi-metal element is coiled about a pair of trip latches in the mechanism that transfers the contact pressure between the latch ball and the switch assembly and which forcibly bear against each other. A selected one of the trip latches is connected to the bi-metal element and is responsive to rotary movement thereof to enable it slide into mating and interleaved relationship with the other trip latch to effect removal of the contact pressure load from the ball. An opening spring forcibly urges the closure contacts of the switch assembly to separate. The selected trip latch is operably coupled to a temperature compensation means carried by the latch mechanism so as to rotate the selected trip latch in response to ambient temperature conditions so that the release of the latch mechanism in response to a circuit overload condition may be more properly determined.

Therefore, it is among the primary objects of the present invention to provide a novel latch mechanism for a circuit breaker having a release mechanism non-loaded and by-passed by the contact pressure load.

Another object of the invention is to provide a temperature compensating means for a circuit breaker adapted to compensate for environmental thermal conditions.

Another object of the present invention resides in a novel latch mechanism and release mechanism therefor adapted to open the switch contact in response to a current overload wherein the release mechanism is free from contact pressure loading.

Still another object of the present invention is to provide a novel circuit breaker wherein the contact load pressure by-passes the thermal element release mechanism.

Another object of the present invention is to provide a novel thermal release assembly for circuit breakers whereby the contact pressure will be the same in all circuit breakers of similar design of a given production run.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings, in which:

FIG. 1 is an elevation view with one half of the housing removed of a novel circuit breaker incorporating the latch and temperature compensation mechanism of the present invention showing the contact closures thereof in their closed position;

FIG. 2 is a view similar to FIG. 1 illustrating the latch mechanism released and the contacts in their fully open position;

FIG. 3 is an exploded perspective view of major component parts comprising the latch assembly and contact closure mounting assembly;

FIG. 4 is an enlarged fragmentary view partly in cross-section of a portion of the latch assembly illustrating the trip cams of latch mechanism in their latched position in;

FIG. 5 is a cross-sectional view of the latch members as taken in the direction of arrows 5—5 of FIG. 4;

FIG. 6 is an enlarged elevational view, partly in section, of the contact closure mechanism employed in the circuit breaker of FIGS. 1 and 2;

FIG. 7 is an elevational view of inside side of one portion or side of the circuit breaker housing;

FIG. 8 is an enlarged longitudinal section view of the upper part of the latch assembly illustrated in cocked or loaded condition when the contacts are closed as shown in FIG. 1;

FIG. 9 is a view similar to FIG. 8 showing the latch assembly released such as when the contacts are open as shown in FIG. 2;

FIG. 10 is a stepped cross-sectional view of the latch assembly as taken along line 10—10 of FIG. 8;

FIG. 11 is a top plan view of the temperature compensation means employed in the circuit breaker of FIG. 8 as taken in the direction of arrows 11—11 thereof;

FIG. 12 is a longitudinal section view of an electrical circuit breaker incorporating another embodiment of the present invention;

FIG. 13 is a view similar to FIG. 12 showing the latch mechanism released and the contacts in their open position;

FIG. 14 is an exploded perspective view of the major component parts comprising the latch assembly of FIGS. 12 and 13;

FIG. 15 is a transverse section view of the latch assembly of FIGS. 12 and 13 as taken along line 15—15 of FIG. 12;

FIG. 16 is an enlarged transverse section view of the contacts mounting assembly shown in FIG. 12 as taken in the direction of arrows 16—16 thereof;

FIG. 17 is a fragmentary view, in section, of the contact mounting assembly as taken in the direction of arrows 17—17 of FIG. 16;

FIG. 18 is an end elevational view of the contact assembly shown in FIG. 16 as taken in the direction of arrows 18—18 thereof;

FIG. 19 is a transverse sectional view of the temperature compensation means as taken in the direction of arrows along line 19—19 of FIG. 13.

FIG. 20 is a transverse section view taken along line 20—20 of FIG. 13.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a circuit breaker 10 employing the latch assembly and temperature compensation means of the present invention is illustrated. In general, the circuit breaker includes a latch assembly designated generally by numeral 11 and a thermal element release assembly for releasing the latching assembly designated generally by numeral 12. Immediately beneath the thermal element release assembly, there is a switch assembly designated generally by numeral 13. The latch assembly, thermal element release assembly and the switch assembly are enclosed within a housing 14. The housing comprises a pair of identical sections which are held together by suitable fasteners to define an interior cavity in which the components of the circuit breaker are located. As illustrated, only one-half of the housing is shown. The latch assembly 11 is capable of moving the switch assembly to a "make" or closed position and for holding the switch assembly in this position until released. The latch assembly includes a guide 15 for movably supporting a button 16 which includes an extended portion or sleeve 17 disposed within the interior cavity of the housing. The latch assembly 11 includes a central mounting shaft 18 on which an upper latch member 20 is mounted in non-rotative but axially slidable condition. Shaft 18 is coaxially and coextensively disposed with respect to a lower shaft 21 which carries a lower latch member 22. The latch members are provided with slots defined by spaced apart parallel legs or body portions so that when a mating occurs between alternate slots and legs of the respective latches, the legs will interleave so that loading tension is released from the latch assembly to permit release of the switch assembly.

The trip cams 20 and 22 are rotated relative to one another by the thermal element release assembly 12 which includes a coiled bimetal strip 23 having braided wires 24 and 25 welded to the opposite ends thereof and, in turn, having their opposite ends welded to a pair of movable contact arms 26 and 27. The movable contact arms 26 and 27 form a part of the switch assembly and are pivotally mounted at their respective mid-sections to the ends of opposed lateral projections 28 and 29 carried on a vertical slide member 30. The slide member 30 carries shaft 21 and includes a guided body portion which extends downwardly through an insulating washer 31 which is held in a recess in the housing 14.

Fixedly secured on opposite sides of the housing 14, there is provided a pair of stationary terminals 32 and 33 which include fixed contacts 34 and 35 residing in the housing interior cavity. The fixed contacts are adapted to be selectively engaged by contact buttons 36 and 37 mounted on movable contact arms 26 and 27. As illustrated in FIG. 1, contact pressure is maintained by means of a main contact spring 40 which is coaxially disposed about the body portion of slide member 30 and is expandably disposed between the bottom of the housing 14 and a flange 41 carried on insulating washer 31. The contact pressure is established

by means of the forcible urging of spring 40 against flange 41 which bears against the extreme end of the contact arms 26 and 27 so as to pivot the arms in a direction causing the contacts 36 and 37 to press against the fixed contacts 34 and 35 respectively.

As shown in FIG. 1, when the latch assembly is depressed with the button 16 substantially enclosed by member 15, and the opposing ends of trip latches or cams 20 and 22 are bearing against one another. This arrangement loads the latch assembly and the switch assembly but does not load the thermal element release assembly. The pressure loading extends through the abutting ends of the trip latches or cams 20, 22 and extends down to the lower shaft 21 and into a lower guide 42 and operating spring 43 compressed between. The spring 43 is compressed between a flange on lower guide 42 and the upper end of an inner bore in slide member 30. The spring 43 is held substantially compressed due to the fact that the opposing ends of the trip cams are engaged which places a load through the lower shaft 21 opposing the force of spring 43. The flange 41 of the insulating washer 31 bears against the opposing ends of the contact arms 26 and 27 in response to the expansion of spring 40 to provide substantial contact pressure between the movable and fixed contacts.

However, upon release, when the cams are rotated with respect to each other in response to expansion of the bimetal thermal element 23, the body portions of the cams will meet with the corresponding slots so that the expansion of spring 43 will urge the cams together and permit the slide member 30 to move upwardly.

As the slide member 30 moves upwardly, the contact arms pivot about their pivot connection with projections 28 and 29 on the slide member 30. Flange 41 is moved upward by spring 40 to maintain contact pressure until flange 41 engages stop 59 in the housing as shown in FIG. 7. The inner spring 43 continues the upward motion of the slide member until the movable contact arms 26 and 27 bear against semi-circular cams 44 in the housing wall forcing the contact arms 26 and 27 to accelerate opening at an exponential rate. When the acceleration stage is reached, there is no spring pressure exerted by insulating washer 31 and its flange 41 against the moving contact arms 26 and 27 so that the fixed and movable contacts freely separate to maximum opening. The upper surface of the opposing ends of the contact arms bear against a pair of semi-circular cams or aligned rounded members 44 carried on the inside surface walls of the housing halves in response to upward movement of the slide member so as to effect fixed and movable contact separation at an exponential rate. The inside surface wall is indicated by numeral 39 in FIG. 7 and semi-circular cam 44 is shown in dotted lines in FIGS. 1 and 2 since it lies behind the mass of slide portion 30. Further more, the opposing ends of the contact arms are bifurcated so that the opposite legs loosely embrace the opposite sides of the slide member 30 so as to accommodate its mass therebetween.

Upon reclosing or resetting the breaker, the push button assembly moves the contact slide assembly 30 down until the movable contact arms 26 and 27 hit the flange 41 on insulating washer 31 whereby the flange exerts pressure against the contact arms as the contacts move downward. When the movable contacts make connection with the stationary contacts, the spring 40

then is allowed to transfer its energy into contact pressure.

Referring now to FIG. 3, an exploded view of the central components of the circuit breaker 10 are illustrated so as to show the relative position and location thereof when assembled. Of particular note are the trip cams 20 and 22 which include body portions or legs 45 and 46 respectively. The opposing end of the legs 45 and 46 include opposing surfaces 47 and 48 which abut with one another. However, as previously described, upon rotation of trip cam 22 with respect to trip cam 20 in response to movement of the bi-metal element 23, the body section 46 will be forcibly urged into the slots of trip cam 20 between body portions 45. This causes the slide member 30 to move upwardly by the forcible urging of spring 43. It is also to be noted that the lower shaft 21 seats on a ball or sphere 50 which is supported in a recess 51.

As shown in the enlarged views of FIGS. 4 and 5, the thermal element release assembly includes the bimetal 23 having its inner end, indicated by numeral 52, secured to an insulating mounting piece 53 via pigtail connector 54. Mounting piece 53 is fixedly secured to the lower trip cam 22 of the latch assembly so that the rotary movement of the bimetal coil is translated into rotational movement of the lower trip latch. In one form, the bimetal element 23 is of a type that can absorb 600° in temperature without yielding and shall be of low enough resistance so as not to allow power dissipation to exceed 5 watts. With a 175° rise in bimetal element temperature, an 18° deflection of the coiled element will occur. This high deflection permits consistent calibration. The bimetal element may be helically or coil wound and fixed at one end to the case as indicated by numeral 49. The other end 53 is free to move in a circular motion and is not subjected to latch loading. No load from pushbutton actuation to contact closing passes through the bimetal element. In this manner, the present invention has eliminated the most important factor in inconsistent calibration which is latch loading of the bimetal element.

FIG. 4 further shows the trip latches 20 and 22 arranged in end-to-end relationship with the opposing ends of their legs 45 and 46 in forced abutment. Upon rotation of bimetal end 52 in the direction shown in FIG. 5, the body portions of the trip cam latches will ride into respective slots associated with the other trip cam latch. The trip cam latches 20 and 22 are carried on the shafts segment 18 and 21 respectively. Shaft segment 18 has its end slidably carried within bore 48 formed in the adjacent end of shaft 21.

Referring now in detail to the enlarged view of the switch assembly shown in FIG. 6, it is to be further noted that the slide assembly 30 is secured to the lower shaft portion 21 via a connection pin 55. As shown in broken lines, the slide member 30 is in its fully raised or upward position as forcibly urged by spring 43 when the cam latches are interleaved. As shown in solid lines, the contact arms are in their closed or engaged positions with respect to the fixed contacts 34 and 35; however, as shown in broken lines, the contact arms and slide member are elevated so as to provide a substantial clearance between the movable contacts and the fixed contacts. While the contact arms are in the solid line position, it can be seen that spring 40 urges the upper surface of flange 41 carried on the insulating washer 31 against the yoke end of the contact arm so as to forcibly

urge the movable contact into engagement with the fixed contacts. Also, it can be seen that an annular bore or opening 56 is provided in the body portion of the slide member 30 to accommodate the spring 43. The spring 43 operates against the base flange of member 41 on one of its ends and against a portion of the slide member terminating the annular space or groove 56 on the slide member. The slide member 30 is further provided with an elongated shank 57 which is slidably inserted into the lower guide 41.

Referring now to FIG. 7, one of the pair of housing halves is illustrated in which the inside wall surface is indicated by numeral 45 for the internal cavity in which rocker or semi-circular surface 44 is disposed. The semi-circular surface 44 is bordered by vertical sections 60 and 61 between which slide member 30 vertically moves. The upward limit of the slide member is restricted by means of engagement with the lower surface of a block 62 disposed between the walls 60 and 61. The bimetal coil is substantially disposed between rounded beads 63 and 64. Housing walls further provide surfaces 65 and 66 on which fixed contacts 34 and 35 may be supported via the terminals 32 and 33. It is to be fully understood that although one-half portion of housing 14 is illustrated in FIG. 7, another identical half portion is employed which cooperates with the internally projecting surfaces and walls such as semicircular portion 44, sections 60 and 61, block 62, and beads 63 and 64, so that the internal cavity may readily house the components previously described and illustrated.

Referring to FIGS. 8 and 9, a longitudinal-sectional view of the latch mechanism 11 is shown wherein the latch is set in FIG. 8 and is released in FIG. 9. It is to be noted that guide 15 for button 16 includes a lower annular flange 70 which is held in stationary position between spaced-apart members 71 and 72 of the case. Annular flange 70 is provided with a counterbored shoulder adjacent its central bore entrance which is occupied by a ball race 73 having a central opening therein coaxial with the bore of guide 15. The lower surface of the race 73 adjacent the opening includes a plurality of depressions, such as depression 74, adapted to bear against the periphery of a ball latch 75 when the mechanism is in its latched condition. Pushbutton 16 includes a body portion 76 which is provided with a central bore adapted to receive the end of upper shaft 18. The shaft is connected to the button 16 via a pin 77. Also, it is to be noted that button 16 includes a plurality of elongated slots, such as slot 78, as shown more clearly in FIGS. 3 and 10, each of which is adapted to slidably receive a respective ball latch 75 in a vertical direction. Secured to the pushbutton 16 about its body portion 76 is sleeve 17 which is secured by means of pin 77. Thereby, button 16, shaft 18, and sleeve 17 form a three part unitary structure adapted to move up and down within the guide 15.

An annular flange located on one end of sleeve 17 which is adapted to engage with the underside of ball race 73 when the ball latch 75 is in its unlatched condition, as shown in FIG. 9. Also, it is to be noted that the cylindrical body of sleeve 17 is formed with a plurality of longitudinally extending slots, such as open-ended slot 81, which is in corresponding alignment with the slots 78 in the body portion of button 16 and in alignment with the respective indentations 74.

Disposed in an annular channel between the outer surface of the cylindrical portion of sleeve 17 and the inner surface of the cylindrical stationary guide 15, there is provided a washer 82 having inwardly projected elements 83 that are slidably engaged within the aligned slots 81 and 78 formed in the sleeve and button respectively. Slidable washer 82 is urged against an annular shoulder 84 of the button 16 by means of an expansion latch spring 85 compressed between the washer 82 and the upper surface of ball race 73. The spring 85 is disposed within the channel separating the inside surface of guide 15 with the outside surface of sleeve 17.

Therefore, it can be seen that the normal bias of spring 85 is to forcibly urge the button upwardly into the position shown in FIG. 9 whereby the spring 85 will be fully expanded within its annular channel. Under this condition ball latch 75 will reside within the aligned slots 78 and 81. When the latch mechanism is in its latched condition, ball 75 rides on a tapered surface 86 formed on the upper end of trip cam latch 20. This applies a radially outward component of force to the ball 75 forcing the ball into an indentation 74 in the ball race 73. As previously noted, spring 43 forcibly urges or biases the lower shaft 21 upwardly and since the lower trip cam latch 22 is carried thereon, the ends 47 of the latch will be forcibly urged against the ends 48 on the upper trip cam latch 20. The loaded upper trip cam latch 20 is then forcibly urged against one side of the ball latch 75 and the load is transferred through the ball race 73 into the guide 15 and eventually to the housing 14. In this description, it is to be particularly noted that at no time does the latch load transfer into any portion of the thermal release mechanism.

When the lower trip cam 22 rotates relative to the upper trip cam 20, the lower shaft 21 and its trip cam 22 will move upwardly in response to the urging of springs 40 and 43 after the body portions 46 of the lower trip cam come into alignment with the slots formed in the upper trip cam 20, which occurs and simultaneously with the legs 45 of the upper trip cam coming into alignment with the slots formed in the lower trip cam. Such action then takes the load away from upper trip cam 20 and hence, the radially outward component of force of tapered surface 86 of the cam 80 against the ball 75 is removed. This allows the ball to move radially inward into the position of FIG. 9 as the bias of spring 85 moves the button 16 into the position of FIG. 9. To reset the latch mechanism, pushbutton 16 is pressed downwardly against the expansion of spring 85 whereupon the ball latch 75 will again be moved over the tapered surface 86 and into the indentation 74 when the button is depressed as far as the FIG. 8 position. It should be borne in mind that three ball latches are illustrated in the present embodiment but that the operational description has been directed to a single ball latch with the understanding that the other two ball latches operate in an identical manner. Also, when the pushbutton 16 is being pressed downwardly, the ends 48 of the upper trip cam 20 will bear against ends 47 of the lower trip cam so that the downward urging of the pushbutton will cause the trip latch 22 and its lower shaft 21 to be forced downwardly against the tension of spring 40 for reset.

Since rotary motion is provided in the bimetal release mechanism, it follows that the latch mechanism must be effective to trip the breaker upon such rotation.

Shafts 18 and 21 extend from the pushbutton actuator to the movable contact assembly. Their opposing ends are telescopically related, as shown in FIGS. 4, 8 and 9 so that they are always mated and will always line up coaxially with each other so that the inner shaft 18 will be a guide for the outer shaft 21. Once in position, the shafts will remain assembled and will never be out of position. By employing a release motion which is rotary, a variety of vibration problems are avoided.

Referring now in detail to FIG. 11, it can be seen that the outer end of pushbutton 16 is formed with a cavity 88 into which the outer end portion of upper shaft 18 extends. This end is provided with a slot 89 occupied by one end of a temperature compensating bimetal coil 90. The opposite end of the coil is secured to the inside wall surface of pushbutton 16 within cavity 88. By this means, temperature compensation can be accomplished with much greater ease as the calibration will be quite consistent and the ambient environment is compensated sooner as the compensating bimetal is on the portion of the housing that is exposed to external environment of the panel when the breaker is mounted on a panel.

For temperature adjustment, the temperature compensating bimetal element 90 may be coiled in a loose condition or a tight condition which will cause a slight rotation of the upper shaft 18 which in turn positions the slot and body portions of the respective trip cams 20 and 22 either nearer or farther apart angularly so that when the main bimetal element 23 moves in a circular direction, the trip cams will trip sooner or later as set by the temperature compensation means. Normally, ambient environmental conditions will pre-set or adjust the temperature compensating bimetal element 90 and manual adjustment is not required; however, such adjustment is available.

Referring now to FIG. 12, another embodiment of the present invention is shown in which a single pair of contacts in the switch assembly are provided as well as a simplified latch mechanism. The breaker shown in FIG. 12 is in its closed condition and includes a latch assembly designated generally by numeral 100, a thermal release mechanism designated generally by numeral 101 and a switch assembly designated generally by numeral 102. As described earlier, the present embodiment includes a case or housing 103 having a stationary guide portion 104 closing one end thereof and a base cap 105 closing the opposite end of the housing. A stationary contact or terminal 106 is fixedly carried on the base cap 105 while an independent second terminal 107 is similarly carried on the base cap. Terminal 106 has a fixed contact surface engageable by a movable contact 108 carried on one end of an arm 110. The opposite end of arm 110 is pivotally mounted on a portion 111 of the housing by means of a pivot 112. Therefore, it can be seen that contact closure is maintained by the pivoting action of arm 110 so that the contact closure is either made or broken. The movable contact is normally biased open by a resilient means such as a specially contoured leaf spring 113, or other spring which acts against a base cap portion 114 at one end and against the top surface of the pivotal arm 110 which is at a location normally above the pivot 112.

The latch assembly or mechanism 100 which provides the contact pressure includes a pushbutton 115 which is slidably mounted for reciprocal movement within the central bore of the cylindrical portion of

guide 104. The pushbutton 115 further includes a central bore in which one end of a central shaft 116 is secured by means of a tangential pin 117 located in a peripheral groove 116g in the center shaft. The center shaft downwardly depends from pushbutton 115 and terminates in sliding relationship within a bore 118 formed in the cap portion 114. A central elongated or elliptical opening 119, as shown in FIG. 16, accommodates passage of the shaft 116 through the pivotal arm 110 so that no binding or interference exists when either the shaft 116 moves relative to the arm or the arm moves relative to the shaft. A pair of rotating ball bearings 98 and 99 are carried on the arm so as to reduce friction therebetween as the shaft moves in relation to the arm.

The latch mechanism further includes a lower trip latch 120 and an upper trip latch 121 which are carried on the central shaft 116 midway between its opposite ends. Lower trip latch 120 is formed with an elongated, longitudinal groove or channel 122 into which pin 123 is disposed. The axial movement of trip latch 120 with respect to its mounting on the shaft is limited by engagement of pin 123 with the opposite ends of groove or channel 122. The pin 123 is fixedly carried on a circular insulator member 124 which is adapted to rotate approximately 90° during the thermal release action. The lower trip latch 120 includes upwardly projecting parallel legs or body portions 125 and 126 which are in fixed spaced apart relationship and further includes terminating ends 127 which are adapted to press against or abut against ends 128 associated with parallel finger portions 130 downwardly depending from the upper trip latch 121. As previously described in connection with the embodiment shown in FIG. 1, the respective legs or body portions of the trip latches will interleave in their associated slots when the lower trip latch 120 is rotated with respect to the upper trip latch. Since the lower trip latch is keyed to the member 124 via pin 123, rotation of member 124 will effect rotation of the lower trip latch 120 with respect to the upper trip latch 121 so that the respective legs or body portions will be aligned with associated slots in the opposite trip latch. When the latch mechanism is in its latched condition, the opposing end surfaces 127 and 128 are in abutment as shown in FIG. 12 and the end of pin 123 is at the top of channel 122. The upper trip latch 121 is prevented from rotation by means of a stop pin 131 which is fixedly carried on the central shaft 116.

Similar to the embodiment shown in FIG. 1, a sleeve 132 is provided which is fixedly carried by the pushbutton 115 and shaft 116. The sleeve is secured to the pushbutton and shaft via pin 117, so that a three part unitary structure is provided which will move up and down with respect to the housing within guide 104. The upward movement of the unitary structure is restricted by engagement of a flange 133 carried on the end of the sleeve, as shown in FIG. 13, with the underside of a ball race 134. The downward movement of the latch assembly as a structural unit is restricted by engagement of the opposing surfaces 127 and 128 of the trip latches. The ball race 134 includes an indentation 135 which is adapted to receive a part of a ball latch 136 as shown in FIG. 12. When in its latched condition, the ball will not only reside within the indentation 135 but will bear against a tapered surface 137 formed on the upper end of the trip latch 121. When the ball latch 136 is in its unlatched condition as shown in FIG. 13, the ball re-

sides within an elongated channel 139 formed in sleeve 132 and partially within a gap 138 formed in the extreme inner end of pushbutton 115. When in its unlatched condition, a compressed spring 140 bears against the base cap 105 and against the shaft 116 to forcibly urge the latch assembly upward within guide 104. The expansive bias of spring 140 is additive to the upward bias of spring 113.

As illustrated in FIG. 12, the latch assembly 100 is in its locked or latched condition and the applied spring bias of spring 140 is transferred through central shaft 116 and through sleeve 132 and ball latch 136 into race 134 and into the housing. Since the bias of spring 113 normally urges the arm 110 to pivot upwardly, the upper surface of the arm will bear against the lower end of trip latch 120. However, when released, such as by rotating member 124, as will be described later, the lower trip latch 120 will also rotate and align its legs 125 and 126 with the slots or openings defined by the finger portions 130 carried on the upper trip latch 121. During the interleaving of the lower and upper latches, the lower latch moves upwardly on the central shaft until the bottom end of the groove 122 abuts the pin 123. The upward movement of the lower latch allows the contact arm 110 to rise to the "open" position of FIG. 13. The lower trip latch slides through member 124 at this time. Since the upper latch 121 is now unloaded, the trip latch ball 136 will be released and the upward expanding bias of spring 140 will urge sleeve 132 upward to carry the ball into gap 138 and into the condition shown in FIG. 13.

The thermal release mechanism 101 includes a helical bimetal element 141 having a plurality of turns disposed coaxially about the shaft 116 within the central cavity of the housing 103. The bimetal element is secured at one end to insulator element 124, as shown in FIG. 20, and is secured at its opposite end to a terminal 142 carried on the housing. Terminal 142 is mechanically and electrically connected to switch terminal 107 via a flexible, braided wire 143. The end of the bimetal element attached to insulator member 124 is in communication with contact 108 via a flexible, braided wire 144. Therefore, the bimetal element 141 is permitted to operate freely and without restriction even when the latch mechanism is loaded. Also no load from pushbutton actuation to contact closing passes through the bimetal element. Non-loading of the bimetal element results in improved accuracy and in a high degree of consistency of calibration which is a high degree in the present invention and not attainable in conventional thermal circuit breakers.

With respect to the switch assembly 102, it is to be noted that by using spring 113, the movable contact assembly is forced to open approximately three times the normal. This is due to the fact that spring 140 affects initial separation of the contacts while spring 113 provides for increased separation at an exponential rate.

In FIG. 15, it can be seen that the ball latch 136 moves in and out of gap 138 depending upon whether the ball is in its latched or unlatched condition. As shown in this FIGURE, the ball latch is in its latched condition and gap 135 is not occupied by the ball.

In FIG. 16, it can be seen that anti-friction balls 98 and 99 are rotatably carried on arm 110 and are disposed on opposite sides of the central shaft 116. FIGS. 16 and 18 show the contact 108 carried on the arm 110

and illustrate the welded connection of one end of braid wire 144 secured thereto.

In FIG. 17, pivot 112 for arm 110 is shown as being connected to the arm via an elongated or elliptical opening 145 which provides a loose connection therebetween so that the exponential separation of the contact closures may be effected by the respective springs as previously described.

Referring now in detail to FIG. 19, it can be seen that a temperature compensation means is provided in a fashion similar to that previously described with respect to the embodiment of FIG. 1. The extreme end of central shaft 116 is formed with a slot in order to receive and hold one end of a coiled bimetal element 146. The other end of the element as indicated by numeral 147 is secured to the pushbutton 115. The bimetal element 146 resides within an open cavity 148 formed in the pushbutton. The temperature compensation means operates substantially the same as described with respect to the embodiment shown in FIG. 1. The movement of the bimetal coil 146 will cause shaft 116 to rotate accordingly and to align the respective slots and body portions of trip latches 120 and 121 closer or farther apart.

Therefore, it can be seen that the circuit breaker embodiments of the present invention provide a novel trip-free latch mechanism and thermal release mechanism that results in advantageous and desirable features not found in the prior art. The release mechanism is not loaded by the latch assembly and is free to operate its release function in a non-restricted condition. The latch mechanism is extremely simple and reliable so that fail-safe techniques and features are embodied therein. The component parts of the circuit breakers may be readily assembled on a mass production basis so that a high yield is obtainable in circuit breaker calibration and repeatability of operation.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all equivalents and modifications as fall within the true spirit and scope of this invention.

What is claimed is:

1. In a circuit breaker, a housing enclosing a latch assembly; a thermal release assembly including a thermally responsive element for actuating said latch assembly; and a switch assembly including relatively movable contacts operable between closed and open positions, and means to operate said contacts between said positions, said switch assembly being held in its closed position by said latch assembly, and said switch operating means acting independently of said thermally-responsive element, said latch assembly comprising central shaft means carried within said housing, a pair of latch members coaxially mounted on said shaft means and having leg portions engaged in end-to-end relationship in closed circuit position, one of said latch members being mounted on and rotatable about the axis of said shaft means and connected to and operative in response to an electric current overload in said thermal release assembly for rotation relative to said other latch member; the end-to-end engagement of said latch members becoming disengaged after said rotating latch

member has rotated through a predetermined angle, thereby permitting separation of said contacts.

2. The invention as defined in claim 1 including a resilient means operably supporting one of said latch members and biasing it into engagement with the other latch member.

3. A circuit breaker as claimed in claim 2 having manually operable means operating through said latch assembly to cause contact engagement, said manually operable means being rendered ineffective upon actuation of said thermal release assembly.

4. The invention as defined in claim 2 wherein said thermally responsive means includes a coiled bimetal element positioned coaxially with respect to the afore-said axis.

5. The invention as defined in claim 1 wherein said switch assembly comprises a slide member coaxially disposed with respect to said latch assembly and said thermal release assembly; a guide member supported by said housing and slidably mounting said slide member for axial movement; a pair of contact arms pivotally mounted on said slide member, each arm having a contact carried on one of its ends; fixed contacts supported by said housing and engageable by said movable contacts; said switch operating means including first resilient means urging said arms in a direction to apply pressure of said movable contacts against said fixed contacts; second resilient means coaxially disposed with respect to said first resilient means and operably coupled between said housing and said slide member urging said slide member in a direction to relieve the contact pressure, to cause pivoting of said arms and contact separation in response to release of said latch assembly.

6. The invention as defined in claim 5 wherein said first resilient means comprises a coiled compression spring engaging the housing and a supporting member slidable relative to said slide member and engaged by said spring and engaging said contact arms.

7. The invention as defined in claim 6 wherein said second resilient means comprises a compressed helical spring coaxial with said first spring.

8. The invention as defined in claim 7 wherein the opposing inside wall surfaces of said housing include aligned rounded members engageable by said contact arms in response to said movement of said slidable member to effect contact separation at an exponential rate.

9. The invention as defined in claim 8 including stop means on said housing engageable with said slidable member to limit movement thereof.

10. A circuit breaker as claimed in claim 1 having manually operable means operating through said latch assembly to cause contact engagement, said manually operable means being rendered ineffective upon actuation of said thermal release assembly.

11. A circuit breaker as claimed in claim 1 in which said central shaft means is a unitary shaft.

12. The invention as defined in claim 11 including resilient means operably supporting one of said latch members and biasing it into engagement with the other latch member.

13. The invention as defined in claim 12 wherein said thermal release assembly includes a helical bimetal element having one end fixedly secured in relation to said housing.

14. The invention as defined in claim 11 wherein said switch assembly comprises a contact arm pivotally mounted on said housing member, said arm having a movable contact carried on its end, a fixed contact supported by said housing and engageable by said movable contact, said arm having means engageable by said latch assembly to pivot said movable contact into engagement with said fixed contact, resilient means moving said arm and movable contact into contact disengaged position in response to release of said latch assembly.

15. The invention as claimed in claim 14 including a lost motion pivot connection between said pivotally mounted contact arm and said housing.

16. In a circuit breaker, a housing enclosing a latch assembly, an overload current responsive thermal release assembly for actuating said latch assembly, and a switch assembly including separable contact means held in closed position by said latch assembly, said latch assembly comprising first and second elements coaxially disposed in end-to-end abutting relationship, resilient means forcibly urging said elements together, means operably disposed between said first element and said housing to transfer the load of said resilient means to said housing by-passing said thermal release assembly when said elements are in abutment, means operably connecting said second element to said thermal release assembly to disable said abutting relationship on occurrence of an overload permitting said switch assembly to move to open position, and actuating means operating through said transfer means to restore said elements to abutting relationship and said switch assembly to closed position after overload release.

17. The invention as defined in claim 16 wherein said elements comprise a pair of slotted members having body portions in abutment under pressure from said resilient means, and said second element is adapted to align its slots with said body portions of said first element in response to movement of said thermal release assembly enabling the first and second elements to move together.

18. The invention as defined in claim 16 including a temperature compensation means connected to said first element, and means interconnecting said temperature compensating means and said housing.

19. The invention as defined in claim 18 wherein said temperature compensation means comprises a bimetal coil.

20. The invention as defined in claim 16, including central shaft means slidably carrying said first and said second elements, and wherein said thermal release assembly includes a bimetal coil having one end fixedly connected to said switch assembly and the other end connected to said second abutting element, whereby an overload current said coil moves said second elements with respect to said first element.

21. The invention as defined in claim 20 having temperature compensation means including a bimetal coil having one end secured to said shaft, and means interconnecting the other end of said coil and said housing.

22. The invention as defined in claim 16 wherein said transfer means includes means slidably carried on said housing and coaxially disposed with respect to said elements, resilient means yieldably urging said slidable means away from said elements, and ball means engaging with said slidable means and operable to set in a

first position between said first element and said housing to transfer loading from said switch assembly to said housing and operable to move out of said set position when said abutting relationship is disabled.

23. In a circuit breaker, a housing, a latch assembly enclosed in said housing, a thermal release assembly connected with said latch assembly for releasing it, a switch assembly held in closed position by said latch assembly, said switch assembly comprising a member slidable along an axis, movable contact means operated by movement of said slidable member, fixed contact means supported from said housing and engageable by said movable contact means, said latch assembly comprising relatively movable latch members having endwise abutting portions, means guiding at least one of said latch members for slidable movement coaxially with respect to the other and with respect to said switch-member axis, one of said latch members being turnable about said switch-member axis, a thermally responsive means connected with said turnable latch member and electrically connected with said movable contact means and operated by overload current to cause turning of said turnable latch member permitting relative axial movement of said latch members to cause circuit breaking, said thermally responsive means being independent of the stresses of switch opening and closing forces and also of the forces holding said switch assembly in closed position.

24. A circuit breaker as claimed in claim 23 in which said thermally responsive means is a coiled bimetal positioned coaxially with respect to the aforesaid axis.

25. A circuit breaker as claimed in claim 23 having means operating through said latch assembly to cause contact engagement, said operating means being rendered ineffective upon actuation of said thermal release assembly.

26. A circuit breaker as claimed in claim 23 having manually operable means operating through said latch members said manually operable means being rendered ineffective on actuation of said thermally responsive means.

27. In a circuit breaker as claimed in claim 23 in which the latch members have axially extending portions abutting at their ends, and recessed portions adjacent said axially extending portions for reception of the axially extending portions after predetermined rotation of said turnable latch member.

28. In a circuit breaker as claimed in claim 23 in which the latch members have axially extending parallel legs with recesses therebetween, the ends of said legs abutting in one switch position, said legs entering said recesses after predetermined rotation of said turnable latch member.

29. In a circuit breaker, a housing, a latch assembly enclosed in said housing, a thermal release assembly connected with said latch assembly for releasing it, a switch assembly held in closed position by said latch assembly, said switch assembly comprising a member slidable along an axis, fixed and movable contact means engageable and disengageable by movement of said slidable member, manually operable means movable along said axis to cause engagement of said fixed and movable contact means, and means biasing said movable contact means toward disengagement; said latch assembly comprising latch members which are movable relatively to one another both axially and rotatively with respect to said axis, said latch members

when in one axial position being operable by said manual means to move said contact means into engagement, said latch members being relatively rotatable in said one axial position into a position in which one is axially movable relatively to the other to cause disengagement of said contact means; said thermal release assembly comprising means responsive to overload current connected to one of said latch members for moving it rotatively to cause said disengagement, said thermally responsive means being independent of the stresses of switch opening and closing forces and also of the forces holding said switch assembly in closed position.

30. A circuit breaker as claimed in claim 29 in which said thermally responsive means is a coiled bimetal positioned coaxially with respect to the aforesaid axis.

31. A circuit breaker as claimed in claim 29 in which said overload responsive means is fixedly mounted at one end and movably connected at its other end to one of said latch members and is independent of forces applied by said manual means to close said contact means and of forces tending to separate said contact means.

32. A circuit breaker as claimed in claim 30 in which said overload responsive means is fixedly mounted at one end and movably connected at its other end to one of said latch members and is independent of forces applied by said manual means to close said contact means and of forces tending to separate said contact means.

33. In a circuit breaker, a housing enclosing a latch assembly, an overload current responsive thermal release assembly for actuating said latch assembly, and a switch assembly held in its closed position by said latch assembly, said latch assembly comprising first and second elements coaxially disposed in end-to-end abutting relationship, resilient means forceably urging said elements together, transfer means including said elements operably disposed between said resilient means and said housing to transfer the load of said resilient means to said housing by-passing said thermal release assembly when said elements are in abutment, means operably connecting said second element to said thermal release assembly to disable said abutting relationship on occurrence of an overload; said switch assembly comprising a fixed contact mounted on said housing, a contact arm having an end pivotally supported from said housing and a contact on its other end, said switch assembly being engageable with said latch assembly for moving said movable contact into engagement with said fixed contact, said resilient means urging said movable contact away from said fixed contact, and actuating means operating through said transfer means to restore said elements to abutting relationship after overload release.

34. The invention as defined in claim 33 wherein said elements comprise a pair of slotted members having body portions in abutment under pressure from said resilient means, and said second element is adapted to align its slots with said body portions of said first element in response to movement of said thermal release assembly enabling the first and second elements to move together.

35. The invention as defined in claim 33 including a temperature compensation means connected to said first element, and means interconnecting said temperature compensating means and said housing.

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36. The invention as defined in claim 35 wherein said temperature compensation means comprises a bimetal coil.

37. The invention as defined in claim 33 wherein said transfer means includes means slidably carried on said housing and coaxially disposed with respect to said elements, resilient means yieldably urging said slidable means away from said elements, and ball means engaging with said slidable means and operable to set in a

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first position between said first element and said housing to transfer loading from said switch assembly to said housing and operable to move out of said set position when said abutting relationship is disabled.

38. The invention as claimed in claim 33 including a lost motion pivot connection between said pivotally mounted contact arm and said housing.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PAGE 1

Patent No. 3,792,403 Dated February 12, 1974

Inventor(s) John W. Bullock

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On first page of the patent, after the drawings, insert the middle initial "W." in the name of Inventor. Column 1, penultimate line, insert --repetitive-- before "of"; change "release" to --releases--; Column 2, actual line 56, change "contact" to --contacts--; Column 3, actual line 24, the word "in" should be deleted; Column 4, actual line 30, after "shaft" insert --means having an upper section; Column 6, line 16, "If" should be --It--; Column 6, line 22, "pigtail" should be --a J-shaped--; Column 6, line 23, --to which is connected a pigtail connection 24-- should be inserted after "54"; Column 11, line 3, --(See Fig. 15).-- should be inserted after "115."; Column 11, line 6, --upper-- should be inserted before "latch"; "assembly" should be --member--; Column 11, line 7, --via the pin 131 abutting the upper latch member 121-- should be inserted after "104"; Column 11, line 8, "bias" should be --urge--; --contact biasing-- should be inserted after "of"; --during contact opening movement-- should be inserted before the period; Column 11, line 11, --coil-- should be inserted before "spring"; Column 11, line 26, --insulator-- should be inserted before "member"; Claim 1 should read:

--1. In a circuit breaker, a housing enclosing a latch assembly; a thermal release assembly including a thermally responsive element for actuating said latch assembly, and a switch assembly including relatively movable contacts operable between closed and open positions, and means to operate said contacts manually into closed position, said switch assembly being held in its closed position by said latch assembly, and said switch operating means acting independently of said thermally-responsive element, said latch assembly comprising axially movable central shaft means mounted within said housing,

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Patent No. 3,792,403 Dated February 12, 1974

Inventor(s) John W. Bullock

a pair of latch members coaxially mounted on said shaft means and having leg portions engaged in end-to-end relationship in closed circuit position, one of said latch members being mounted on and rotatable about the axis of said shaft means and connected to and operative in response to an electric current overload in said thermal release assembly for rotation relative to said other latch member; the end-to-end engagement of said latch members becoming disengaged after said rotating latch member has rotated through a predetermined angle, thereby permitting separation of said contacts.--; Claim 3, should read as follows:

--3. A circuit breaker as claimed in claim 2 in which said manually operable closing means operates through said latch assembly to cause contact engagement, said manually operable means being rendered ineffective upon actuation of said thermal release assembly.--; Claim 10 should read as follows:

--10. A circuit breaker as claimed in claim 1 in which said manually operable closing means operates through said latch assembly to cause contact engagement, said manually operable means being rendered ineffective upon actuation of said thermal release assembly.--;

Claim 16 should read as follows:

--16. In a circuit breaker, a housing enclosing a latch assembly, an overload current responsive thermal release assembly including a thermally responsive element for actuating said latch assembly, and a switch assembly including separable contact means held in closed position by said latch assembly, said latch assembly comprising first and second elements coaxially disposed in end-to-end abutting relationship, resilient

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Patent No. 3,792,403 Dated February 12, 1974

Inventor(s) John W. Bullock

means forcibly urging said elements together, means operably disposed between said first element and said housing to transfer the load of said resilient means to said housing by-passing said thermal release assembly when said elements are in abutment, means operably connecting said second element to said thermally responsive element and to rotate it independently of said contacts and to disable said abutting relationship on occurrence of an overload permitting said switch assembly to move to open position, and actuating means operating through said latch assembly and by-passing said thermal release assembly to restore said elements to abutting relationship and said switch assembly to closed position after overload release.--;

Claim 17 should read:

--17. The invention as defined in claim 16 wherein said elements comprise a pair of slotted members each having body portions positioned on opposite sides of their said co-axis and adapted to abut in axially balanced condition, said second element being adapted to align its slots with said body portions of said first element in response to movement of said thermal release assembly enabling the first and second elements to move together.--;

Claim 20, line 7 (Column 14, line 56) change "elements" to --element--; Claim 21, line 3 (Column 14, line 61) insert --means-- after "shaft"; Claim 23, line 7 (Column 15, line 11) insert --to closed position-- before "by"; Claim 23, line 14 (Column 15, line 18) insert --said-- before "one"; Claim 25 should read:

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Patent No. 3,792,403 Dated February 12, 1974

Inventor(s) John W. Bullock

--25. A circuit breaker as claimed in claim 23 wherein said slidable member operates through said latch assembly to cause contact engagement, said operation being rendered ineffective upon actuation of said thermal release assembly.---

Claim 26 should read:

--26. A circuit breaker as claimed in claim 16 wherein said manually operable means operates through said latch members to cause contact engagement, said manually operable means being rendered ineffective on actuation of said thermally responsive means.--;

Delete Claim 27; Claim 28 should read:

--28. In a circuit breaker as claimed in claim 23 in which the latch members each have axially extending parallel legs positioned on opposite sides of said axis with recesses therebetween, the ends of said legs abutting in axially balanced condition in one switch position, said legs entering said recesses after predetermined rotation of said turnable latch member.--;

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,792,403 Dated February 12, 1974

Inventor(s) John W. Bullock

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 33, line 13 (Column 16, line 41), insert --one of-- before "said"; delete "second" before "element"; "element" should be --elements--; Claim 34 should read:

--34. The invention as defined in claim 33 wherein said elements comprise a pair of slotted members each having body portions positioned on opposite sides of their said co-axis and adapted to abut in axially balanced condition, said second element being adapted to align its slots with said body portions of said first element in response to movement of said thermal release assembly enabling the first and second elements to move together.--

This certificate supersedes Certificate of Correction issued March 18, 1975 and May 20, 1975.

Signed and Sealed this

fourteenth Day of October 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,792,403

Dated February 12, 1974

Inventor(s) John Bullock

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 26 should read:

-- 26. A circuit breaker as claimed in claim 23 wherein said manually operable means operates through said latch members to cause contact engagement, said manually operable means being rendered ineffective on actuation of said thermally responsive means. --

This certificate supersedes Certificate of Correction issued March 18, 1975.

Signed and sealed this 20th day of May 1975.

(SEAL)

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,792,403 Dated February 12, 1974

Inventor(s) John W. Bullock

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On first page of the patent, after the drawings, insert the middle initial "W." in the name of Inventor. Column 1, penultimate line, insert -- repetitive-- before "of"; change "release" to --releases--; Column 2, actual line 56, change "contact" to --contacts--; Column 3, actual line 24, the word "in" should be deleted; Column 4, actual line 30, after "shaft" insert --means having an upper section; Column 6, line 16, "If" should be --It--; Column 6, line 22, "pigtail" should be --a J-shaped--; Column 6, line 23, --to which is connected a pigtail connection 24-- should be inserted after "54"; Column 11, line 3, --(See Fig. 15).-- should be inserted after "115."; Column 11, line 6, --upper-- should be inserted before "latch"; "assembly" should be --member--; Column 11, line 7, --via the pin 131 abutting the upper latch member 121-- should be inserted after "104"; Column 11, line 8, "bias" should be --urge--; --contact biasing-- should be inserted after "of"; --during contact opening movement-- should be inserted before the period; Column 11, line 11, --coil-- should be inserted before "spring"; Column 11, line 26, --insulator-- should be inserted before "member"; Claim 1 should read:

--1. In a circuit breaker, a housing enclosing a latch assembly; a thermal release assembly including a thermally responsive element for actuating said latch assembly, and a switch assembly including relatively movable contacts operable between closed and open positions, and means to operate said contacts manually into closed position, said switch assembly being held in its closed position by said latch assembly, and said switch operating means acting independently of said thermally-responsive element, said latch assembly comprising axially movable central shaft means mounted within said housing,

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Inventor(s) John W. Bullock

a pair of latch members coaxially mounted on said shaft means and having leg portions engaged in end-to-end relationship in closed circuit position, one of said latch members being mounted on and rotatable about the axis of said shaft means and connected to and operative in response to an electric current overload in said thermal release assembly for rotation relative to said other latch member; the end-to-end engagement of said latch members becoming disengaged after said rotating latch member has rotated through a predetermined angle, thereby permitting separation of said contacts.--; Claim 3, should read as follows:

--3. A circuit breaker as claimed in claim 2 in which said manually operable closing means operates through said latch assembly to cause contact engagement, said manually operable means being rendered ineffective upon actuation of said thermal release assembly.--; Claim 10 should read as follows:

--10. A circuit breaker as claimed in claim 1 in which said manually operable closing means operates through said latch assembly to cause contact engagement, said manually operable means being rendered ineffective upon actuation of said thermal release assembly.--;

Claim 16 should read as follows:

--16. In a circuit breaker, a housing enclosing a latch assembly, an overload current responsive thermal release assembly including a thermally responsive element for actuating said latch assembly, and a switch assembly including separable contact means held in closed position by said latch assembly, said latch assembly comprising first and second elements coaxially disposed in end-to-end abutting relationship, resilient

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Patent No. 3,792,403 Dated February 12, 1974

Inventor(s) John W. Bullock

means forcibly urging said elements together, means operably disposed between said first element and said housing to transfer the load of said resilient means to said housing by-passing said thermal release assembly when said elements are in abutment, means operably connecting said second element to said thermally responsive element and to rotate it independently of said contacts and to disable said abutting relationship on occurrence of an overload permitting said switch assembly to move to open position, and actuating means operating through said latch assembly and by-passing said thermal release assembly to restore said elements to abutting relationship and said switch assembly to closed position after overload release.--;

Claim 17 should read:

--17. The invention as defined in claim 16 wherein said elements comprise a pair of slotted members each having body portions positioned on opposite sides of their said co-axis and adapted to abut in axially balanced condition, said second element being adapted to align its slots with said body portions of said first element in response to movement of said thermal release assembly enabling the first and second elements to move together.--;

Claim 20, line 7 (Column 14, line 56) change "elements" to --element--; Claim 21, line 3 (Column 14, line 61) insert --means-- after "shaft"; Claim 23, line 7 (Column 15, line 11) insert --to closed position-- before "by"; Claim 23, line 14 (Column 15, line 18) insert --said-- before "one"; Claim 25 should read:

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--25. A circuit breaker as claimed in claim 23 wherein said slidable member operates through said latch assembly to cause contact engagement, said operation being rendered ineffective upon actuation of said thermal release assembly.--;

Claim 26 should read:

--26. A circuit breaker as claimed in claim 16 wherein said manually operable means operates through said latch members to cause contact engagement, said manually operable means being rendered ineffective on actuation of said thermally responsive means.--;

Delete Claim 27; Claim 28 should read:

--28. In a circuit breaker as claimed in claim 23 in which the latch members each have axially extending parallel legs positioned on opposite sides of said axis with recesses therebetween, the ends of said legs abutting in axially balanced condition in one switch position, said legs entering said recesses after predetermined rotation of said turnable latch member.--;

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It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 33, line 13 (Column 16, line 41), insert --one of-- before "said"; delete "second" before "element"; "element" should be --elements--; Claim 34 should read:

--34. The invention as defined in claim 33 wherein said elements comprise a pair of slotted members each having body portions positioned on opposite sides of their said co-axis and adapted to abut in axially balanced condition, said second element being adapted to align its slots with said body portions of said first element in response to movement of said thermal release assembly enabling the first and second elements to move together.--

Signed and sealed this 13th day of March 1975.

(SEAL)

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks