Oct. 22, 1963 J. W. BULLOCK ETAL 3,108,164

CIRCUIT BREAKER WITH TEMPERATURE COMPENSATING BI-METAL ELEMENT

Filed April 2, 1962 2 Sheets-Sheet 1

FIG. 1.

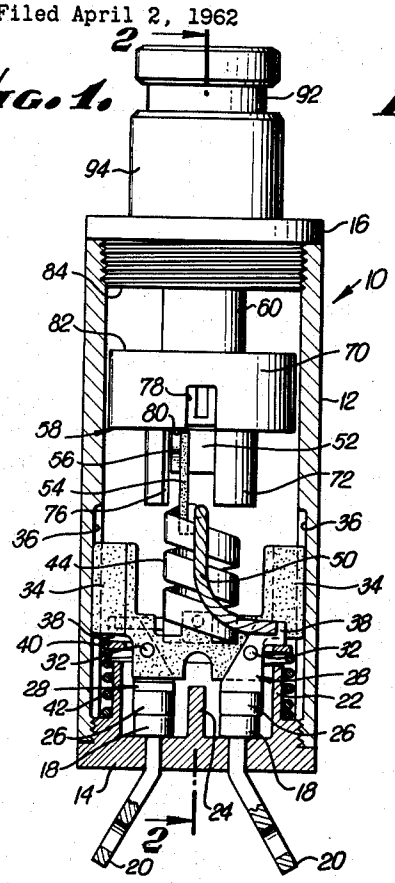


FIG. 2.

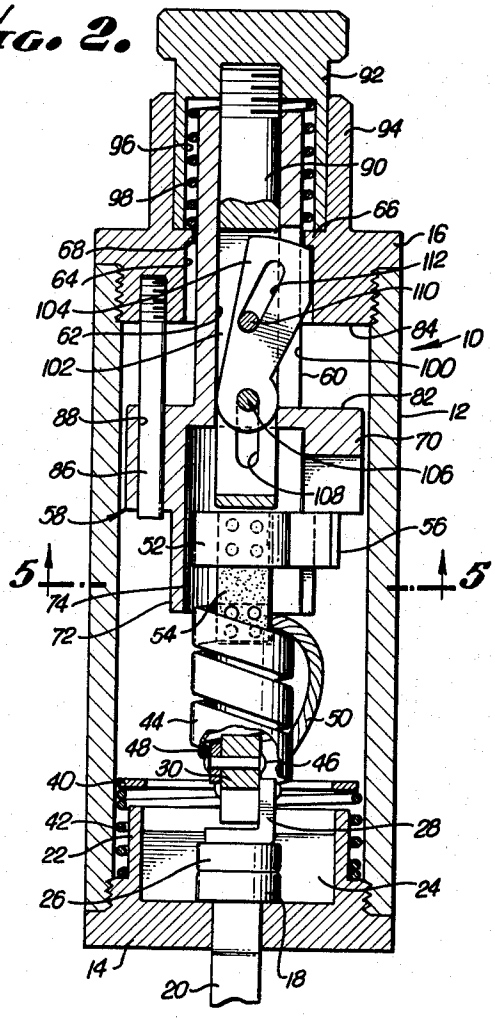


FIG. 6.

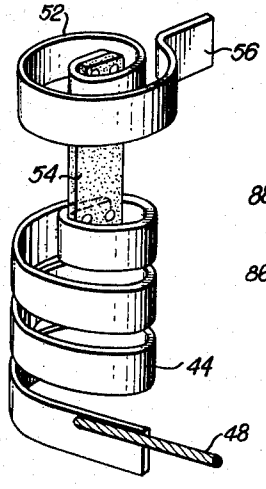
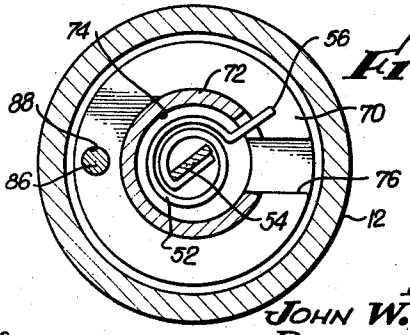


FIG. 5.



INVENTORS
JOHN W. BULLOCK
PRESTON D. ROWAN
BY
Huebner & Worrel
ATTORNEYS.

Oct. 22, 1963 J. W. BULLOCK ETAL 3,108,164

CIRCUIT BREAKER WITH TEMPERATURE COMPENSATING BI-METAL ELEMENT

Filed April 2, 1962

2 Sheets-Sheet 2

FIG. 3.

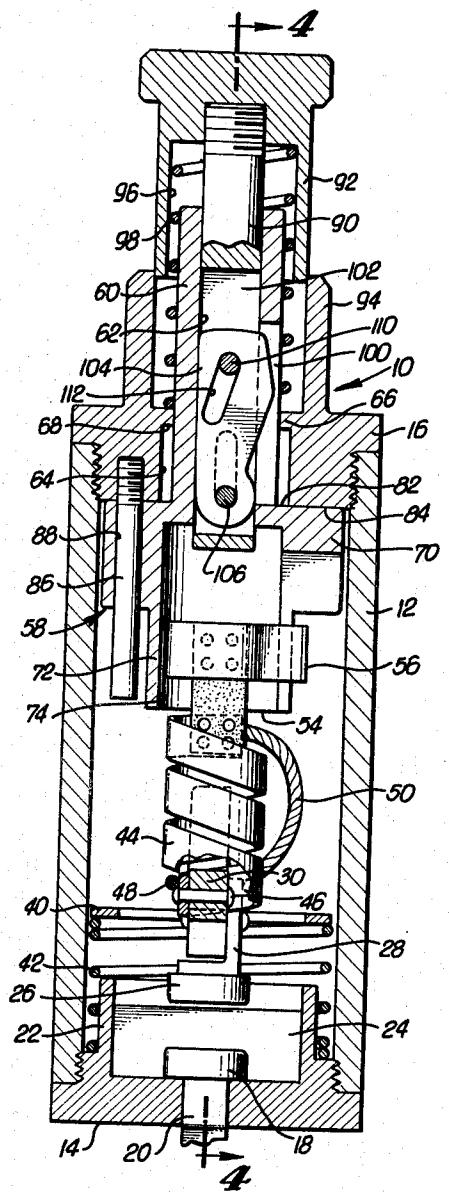
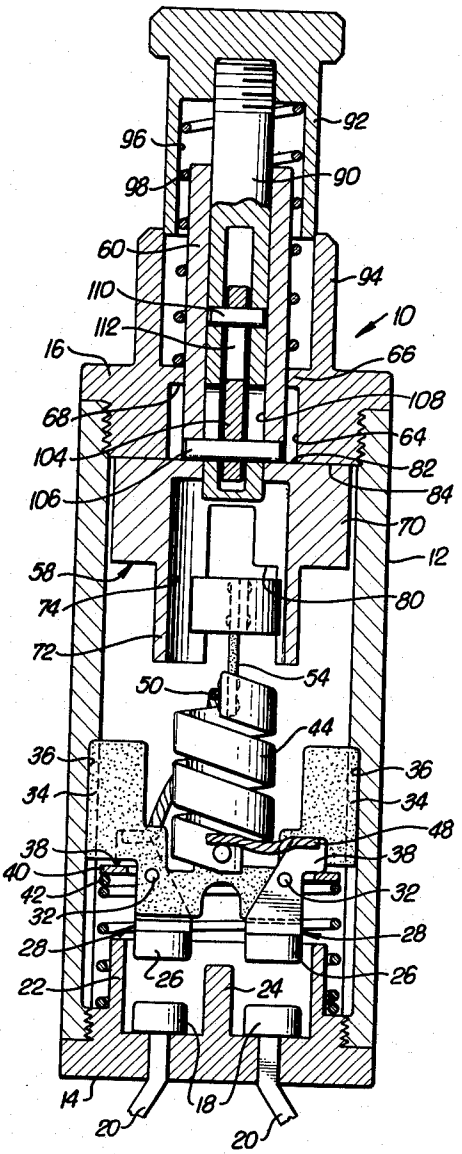


FIG. 4.



JOHN W. BULLOCK
PRESTON D. ROWAN
INVENTOR.

BY Huebner & Worrel

ATTORNEYS.

United States Patent Office 3,108,164 Patented Oct. 22, 1963

3,108,164

CIRCUIT BREAKER WITH TEMPERATURE COMPENSATING BI-METAL ELEMENT

John W. Bullock, Sherman Oaks, and Preston D. Rowan, Fullerton, Calif., assignors to Briles Products, Inc., El Segundo, Calif., a corporation of California

Filed Apr. 2, 1962, Ser. No. 184,241
10 Claims. (Cl. 200—116)

The present invention relates to circuit breakers for electrical systems, and it relates particularly to a novel circuit breaker which includes a thermoelement that is sensitive to heat induced by electrical currents passing therethrough and which employs ambient temperature sensing means that compensates for environmental temperatures and enables the thermoelement to function properly under the influence of environmental temperatures and overload conditions determined by the passing of current therethrough.

It is an object of this invention to provide a circuit breaker with an ambient temperature compensating means sensitive to environmental temperatures, that enables a thermoelement, sensitive to heat induced by electrical current passing therethrough, to function properly at prescribed overload conditions, despite the influence of the environmental temperature imposed on the thermoelement.

A further object of this invention is to provide a circuit breaker having the foregoing characteristics wherein the thermoelement and the ambient temperature compensating means are compressed between two units of the circuit breaker, which are the switch assembly including contacts and the latching assembly for moving the contacts to the "make" or closed position, so as to hold the contacts in the engaged position against the force of a contact separating spring, and so as to apply sufficient force to the latching mechanism to hold it in its latch position against spring latch release means, thermal shift of the thermoelement resulting from current overload causing the thermoelement to transmit the thermal shift to the ambient temperature-sensing means to move the latter off a shoulder and relieve the holding pressure between the latching assembly, the thermoelement, the ambient temperature-sensing element and the contacts, whereby the latch will be released, permitting the contact separating spring to open the contacts.

A more specific object of this invention is to provide a circuit breaker of the character described wherein the thermoelement, of bi-metal construction, is connected to but heat insulated from the ambient temperature-sensing means, also of bi-metal construction.

A still more specific object of this invention is to provide a circuit breaker of the character described wherein the thermoelement is in the form of a helical coil that is connected by a heat insulation medium to an ambient temperature-sensing means, also in the form of a coil.

A yet further object of this invention is to provide a circuit breaker of the character described wherein the latching assembly, switch assembly, thermoelement, ambient temperature-sensing means and all structure associated therewith are located within a relatively small and compact housing.

Further objects and advantages of this invention will appear during the course of the following part of this specification wherein the details of construction and mode of operation of a preferred embodiment are described with reference to the accompanying drawings, in which:

FIG. 1 is a vertical, axial section, partly in elevation, illustrating the circuit breaker with temperature compensating bi-metal element in the make position;

FIG. 2 is an enlarged vertical, axial section taken on line 2—2 of FIG. 1;

FIG. 3 is a vertical, axial section, partly in elevation, similar to FIG. 2, but illustrating the breaker in the "break" position;

FIG. 4 is a vertical, axial section taken on line 4—4 of FIG. 3;

FIG. 5 is a cross-sectional view taken on line 5—5 of FIG. 2; and

FIG. 6 is a perspective view illustrating the ambient temperature-sensing device connected to the current sensing thermoelement.

Referring to the drawings, the circuit breaker 10 includes a cylindrical shell or casing 12 which may be composed of plastic or a suitable metal such as aluminum. An end plug 14 composed of insulating material is threadedly engaged in the bottom of shell 12. The bottom end plug 14 is suitable for supporting fixed contact members and their respective external conductors. A top end plug 16 is threadedly engaged in the upper end of shell 12, and is adapted to support the latching assembly as hereinafter described.

A pair of fixed contact members 18 are mounted on bottom end plug 14 adjacent to the inner wall of the end plug, and a pair of conductors 20 are connected to the respective contact members 18 and extend through end plug 14 so as to provide means for connecting the circuit breaker into an electrical circuit.

It is preferred to provide the bottom end plug 14 with an axially-directed, annular wall 22 spaced a short distance inside of the inner wall of the outer shell 12, with a transverse web 24 dividing the region enclosed in wall 22 into two recesses in which the contacts 18 are respectively positioned.

A pair of movable contact members 26 are disposed in spaced relationship to the respective fixed contact members 18, being integrally attached to respective contact support arms 28 which are pivotally mounted on a breaker bar 30 by means of spaced pivot pins 32. Breaker bar 30 is provided at its sides with a pair of axially extending ears 34 which are slidably mounted in respective axial grooves 36 in the inner wall of the cylindrical casing 12, whereby to permit axial sliding movement of the breaker bar 30 within casing 12.

Radially outwardly-projecting fingers 38 are provided on the respective contact support arms 28, the fingers 38 being engaged by a shunt ring 40 which is forced against fingers 38 by means of contact separating coil spring 42. Spring 42 engages shunt ring 40 at one of its ends, the other end of spring 42 being disposed around the annular wall 22 and seating against end plug 14. Coil spring 42 is a relatively strong compression spring, and in the "break" or unactuated position of the circuit breaker as shown in FIGS. 3 and 4, spring 42 holds the movable contact members 26 in spaced relation to the fixed contact members 18. It is to be noted that the coil spring 42 of relatively large diameter for driving the contacts apart is much more positive in action and less likely to break than the conventional coiled tension springs having fragile end loops which are usually employed in circuit breakers.

A bi-metal thermoelement 44 of helical form is axially disposed in casing 12, and has its lower end attached to breaker bar 30 as by means of a transverse pin 46. The thermoelement 44 is electrically connected proximate its lower end to one of the contact support arms 28 by means of a flexible conductor or "pigtail" 48, while the thermoelement 44 is electrically connected proximate its upper end to the other contact support arm 28 by means of a second flexible conductor or "pigtail" 50.

Bi-metal ambient temperature compensating means 52, having a "clockspring"-type coil configuration, is provided in the present invention and is mechanically coupled

at the inner end thereof to the upper end of thermoelement 44 by a strip or bar 54 of heat insulating material. By way of example only, and not by way of limitation, a presently preferred material for the strip or bar 54 is compressed mica and glass that includes a small amount of resin binder and is known as Micalex.

If desired, the thermoelement 44 and ambient temperature compensating means 52 may be connected directly together without the intervening member 54, or a single strip of bi-metal material may be employed which includes a portion coiled in one direction corresponding to thermoelement 44 and a portion coiled oppositely corresponding to the temperature compensating means 52. However, the intervening strip or bar 54 is desirable as a barrier against direct heat conduction from thermoelement 44 to compensating means 52.

The bi-metal ambient temperature compensating means 52 is coiled from strip or bar 54 in a direction opposite to thermoelement 44, and is provided at its outer end with an integral, radially outwardly-directed thrust finger 56 adapted to be engaged by the latching assembly in the manner hereinafter described.

The breaker bar 30 is composed of an electrical insulating material, while the contact support arms 28 are metallic, conducting members. Thus, when the breaker is in its "make" or actuated position, current is conducted through the breaker from one of the external conductors 20 through its respective fixed contact member 18 and movable contact member 26, thence through the respective contact support arm 28, through one of the flexible conductors 48 and 50, thence through the coiled thermoelement 44 and through the other flexible conductor 48 or 50 to the other contact support arm 28, and thence through its respective movable contact member 26 and fixed contact member 18 to the other external conductor 20. This current which passes through the thermoelement in the actuated position of the device will, by heating the thermoelement, cause the thermoelement to mechanically shift through an arc, the extent of which depends upon the amount of current passing through the thermoelement.

The arc of travel described by the shift of the thermoelement will be transmitted through insulation strip 54 to the ambient temperature compensating means 52 to cause the thrust finger 56 to mechanically shift through an arc that corresponds to the arc of travel defined by the thermoelement. This shifting is clockwise in FIG. 5. When a current overload condition is present, this transmitted arc of travel will be sufficient to release the latching assembly in the manner hereinafter described.

A portion of the current which passes through the circuit breaker will be by-passed from the thermoelement, this portion of the current passing directly from one of the contact supporting arms 28 to the other through shunt ring 40. It will thus be apparent that the sensitivity of the unit may be varied by providing shunt rings 40 of different electrical resistance values, thus to permit more or less current to flow through the thermoelement 44. This permits the circuit breaker to be provided in one standard form for uses requiring various sensitivities, by merely varying the resistance value of the shunt ring 40 in accordance with the sensitivity desired.

It is to be noted that the positioning of the contacts in the bottom end of the casing causes the suddenly-expanding gases which result from arcing upon breaking of the contacts to be directed axially away from the contacts, to provide a strong gas blow-out action so as to shorten the time duration of arcing. Arcing is further reduced by employing the coiled thermoelement 44 with its lower end proximate the contacts, surge currents through the thermoelement upon breaking of the contacts resulting in a strong magnetic field adjacent the lower end of the thermoelement, this field attracting the arc axially away from the contacts.

Slidably mounted in the upper portion of the cylindrical casing 12 is a release member 58, the release member

58 including a tubular upper portion 60 having an internal bore 62. This tubular upper portion 60 of the release member 58 is slidable within an axial bore 64 in the upper end plug 16, end plug 16 having a flange 66 thereon which extends radially inwardly of the bore 64 so as to provide a latching shoulder 68 against which the latch member is frictionally engaged as hereinafter set forth.

The release member 58 also includes an annular enlargement 70 integral with the tubular upper portion 60 and disposed within the casing 12, the enlargement 70 including a depending skirt portion 72 of somewhat reduced diameter, and a counter bore 74 which is substantially larger in diameter than the bore 62 through the tubular upper portion 60. The skirt 72 is provided with a relatively wide axial opening 76, and the enlargement 70 is provided with a narrower axial slot 78, thus to provide a shoulder 80 on the enlargement 70, the shoulder 80 being positioned adjacent to axial slot 78. The release member 58 is preferably composed of electrical insulation material.

In the unactuated or "break" position of the breaker, the ambient temperature compensating means 52 is axially disposed within the skirt 72, with the thrust finger 56 extending outwardly through the opening 76 in the skirt, this position of the parts being best illustrated in FIGS. 3 and 4. It will be seen that in this unactuated position of the circuit breaker, the annular enlargement 70 of the release member 58 does not exert any downward pressure on the thrust finger 56 of the ambient temperature compensating means 52, so that the contact separating spring 42 is permitted to hold the contacts in the open position. However, in the actuated or "make" position of the circuit breaker, the release member 58 will be spaced downwardly a substantial distance from the upper plug 16 as best shown in FIGS. 1 and 2, with thrust finger 56 engaged against shoulder 80 on the annular enlargement 70 so that the thermoelement 44 holds the contacts together against the force of contact separating spring 42.

It will be noted that the upper limit of travel of release member 58 in casing 12 is determined by engagement by the outwardly-directed face 82 on annular enlargement 70 against the downwardly-directed face 84 of the upper end plug 16.

An increase in the ambient temperature within the cavity of the circuit breaker will raise the temperature of the thermoelement 44 further than the temperature resulting from passage of the load current through the thermoelement, thus causing thermal shift of the upper end of thermoelement 44 through a greater arc than would occur solely as the result of the load current. This, in turn, would tend to cause premature release of the circuit breaker before a true overload condition is reached. However, since the ambient temperature compensating means 52 is coiled from its connection with thermoelement 44 in a direction opposite to the thermoelement coil, increase in the ambient temperature will cause the thrust finger 56 to shift relative to the upper end of the thermoelement through an arc in the opposite direction from the ambient temperature shift in the thermoelement, thus cancelling out the ambient temperature shift of the thermoelement. The net result is that the combination of thermoelement 44 and ambient temperature compensating means 52 is responsive substantially only to current passing through the thermoelement 44, and not to ambient temperature changes.

An axially-disposed aligning pin 86 is mounted in upper end plug 16, as by threaded engagement therein, and extends downwardly through an axial opening 88 in the enlargement 70 of release member 58, thus to prevent any rotation of release member 58 in the casing, while permitting release member 58 to slide axially within the casing.

A manual control cam bar 90 is slidable axially within the bore 62 of release member 58, and threadedly supports a plunger 92 at its upper end. The plunger 92 is

reciprocable in an upwardly-extending sleeve 94 formed externally on the upper end plug 16. Plunger 92 is provided with an internal recess 96 within which the upper end of latch release spring 98 seats. Spring 98 comprises a coil compression spring, with its lower end seating against an upwardly-directed annular shoulder of the upper end plug 16 so as to bias the plunger 92 and its connected cam bar 90 upwardly toward the unactuated position as best illustrated in FIG. 3 and FIG. 4.

An axial slot 100 is provided through the wall of the tubular upper portion 60 of release member 58, and aligned with the slot 100 is an axial slot 102 extending through the cam bar 90.

Latch member 104 is positioned within the axial slots 100 and 102, and is pivotally connected adjacent its lower end to the tubular portion 60 of release member 58 by means of a pivot pin 106 so that the latch member 104 moves up and down reciprocably with the release member 58. Relative axial movement between cam bar 90 and the tube 60 is permitted, despite the presence of pivot pin 106, by means of an axial pin slot 108 in cam bar 90.

A cam pin 110 is mounted in cam bar 90 so as to extend across the axial slot 102, cam pin 110 being engaged through a cam slot 112 in the latch member 104. Cam slot 112 is offset at an acute angle relative to the axis of cam bar 90 so that downward movement of cam bar 90 relative to the tube 60 will swing latch member 104 outwardly through axial slot 100 to a position in which the latch member 104 is engageable against the shoulder provided by flange 66 in the upper end plug 16 as shown in FIG. 2, whereas upward movement of the bar 90 within tube 60 will swing latch member 104 inwardly in position as shown in FIG. 3. It will thus be seen that the latch member 104 functions as a cam follower that is controlled by the cam pin 110.

In order to actuate the circuit breaker from the unactuated position as shown in FIGS. 3 and 4 to the actuated position as shown in FIGS. 1 and 2, all that is necessary is to manually push the plunger 92 downwardly or inwardly relative to the casing, moving cam bar 90 and release member 58 downwardly, downward force being applied to the tubular upper portion 60 of release meber 58 through cam pin 110 and latch member 104. The plunger 92 thus moves downwardly until latch member 104 is forced radially outwardly under the end plug flange 66 so as to be frictionally engaged against the latching shoulder 68. In this actuated position of the device, the shoulder 80 on release member 58 engages thrust finger 56 of the ambient temperature compensating means 52 which results in forcing the ambient temperature compensating means and the thermoelement 44, as well as the movable contacts, downwardly against the force of contact separating spring 42 so as to cause engagement of the contacts. The force of contact separating spring 42 is transmitted through the thermoelement 44, ambient temperature compensating means 52 and through release member 58 and pivot pin 106 to latch member 104 and provides the frictional engaging force of latch member 104 against the latching shoulder 68 so as to retain the device in the latched position.

If it is desired to manually disengage the circuit breaker, all that is necessary is to pull upwardly on the plunger 92, thus causing cam pin 110 to move upwardly relative to latch member 104 so as to cam the latch member off the latching shoulder 68, thus to release the circuit breaker.

The circuit breaker will be automatically disengaged when an overload current passes through thermoelement 44 so as to mechanically shift the thermoelement. The shifting of the thermoelement is transmitted to the ambient temperature device and the thrust finger thereon which is caused to slide off of the shoulder 80 on the release member 58. When the thrust finger 56 moves off of shoulder 80, the compressive force of contact separating spring 42 is instantaneously removed from the thermoelement 44 as well as ambient temperature compensating means 52, and hence from the release member 58, whereby the upwardly-directed force of latch release spring 98 on plunger 92 and on the cam bar 90 will cause cam pin 110 to swing the latch member 104 off of the latching shoulder 68, whereby the latch release spring 98 is permitted to move the cam bar 90 upwardly, the bottom of axial pin slot 108 in cam bar 90 engaging the pin 106 to move release member 58 to its uppermost position.

It will be apparent that if an attempt is made to actuate the circuit breaker while the condition of overloading persists, when the contacts are made, the thrust finger 56 on temperature compensating device 52 will immediately shift to a position off of shoulder 80, whereby engagement is prevented, thus making the unit "trip free." However, if the current is within the allowable range when an attempt is made to reclose the circuit breaker, the thrust finger 56 will again engage shoulder 80 to permit the latching mechanism to be engaged.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein, but is to be accorded the full scope of the appended claims.

We claim:

1. A circuit breaker which comprises: a housing; a pair of spaced fixed contacts mounted in the housing; a breaker bar composed of insulating material movably mounted in the housing; a pair of spaced, movable contacts mounted on said breaker bar, said breaker bar being movable between an open circuit position in which said movable contacts are spaced from said fixed contacts and a closed circuit position in which said movable contacts engage the respective fixed contacts; first spring means biasing said breaker bar and movable contacts toward said open circuit position; a thermal-sensitive structure including a first bi-metal thermoelement which is sensitive and responsive to electrical current passing therethrough and including a second bi-metal thermoelement which is sensitive and responsive to the ambient temperature in said housing; said structure embodying shoulder means and means engageable with said breaker bar; an electrical connection between each of said movable contacts and a first and a second point on said first thermoelement, respectively; release means having a shoulder thereon movably mounted in said housing, said release means being movable between an open circuit position in which said shoulder is spaced from said shoulder means on said structure so as to permit said breaker bar and movable contacts to be held in their said open circuit positions by said first spring means, and a closed circuit position in which said shoulder is compressed against said shoulder means on said structure so as to hold said breaker bar and movable contacts in their said closed circuit positions; a latching surface in said housing; a latch member movably mounted on said release means so as to move between a release position in which it clears said latching surface to permit said breaker bar and movable contacts to be moved by said first spring means to their open circuit position, and a latched position in which the latch member is held in latching engagement with said latching surface by the compressive force of said first spring means; second spring means biasing said latch toward its said release position; and means on said release means for moving said release means to its said closed circuit position and for moving said latch members to its said latched position; thermomechanical shifting of first thermoelement upon the passage of an overload current therethrough causing said shoulder means on said structure to move off of said shoulder so as to release the compressive force holding the latch in its said latched position, whereby said

second spring means will move said latch member out of engagement with said latching surface, permitting said first spring means to drive said movable contacts to their said open circuit position; thermomechanical shifting of said second thermoelement upon a variation of ambient temperature in said housing substantially compensating for thermomechanical shifting of said first thermoelement resulting from said variation of ambient temperature.

2. A circuit breaker as defined in claim 1, wherein said thermoelements are aligned in said housing between said breaker bar and said release means.

3. A circuit breaker as defined in claim 1, wherein said thermoelements are interconnected, but thermally insulated from each other by a heat insulating member adapted to transmit the thermomechanical shifting from one thermoelement to another.

4. A circuit breaker according to claim 1, wherein said thermoelements are composd of bi-metal strips.

5. A circuit breaker according to claim 1, wherein one of said thermoelements has a helical coil configuration and the thermomechanical shifting thereof constitutes an arc of travel.

6. A circuit breaker according to claim 1, wherein one of said thermoelements has a coil configuration and the thermomechanical shifting thereof constitutes an arc of travel.

7. A circuit breaker which comprises: a housing; a pair of spaced, fixed contacts mounted in the housing; a breaker bar composed of insulating material movably mounted in the housing; a pair of spaced, movable contacts mounted on said breaker bar, said breaker bar being movable between an open circuit position in which said movable contacts are spaced from said fixed contacts and a closed circuit position in which said movable contacts engage the respective fixed contacts; first spring means biasing said breaker bar and movable contacts toward said open circuit position; a pair of axially aligned, interconnected bi-metal thermoelements one of which is a helically coiled bi-metal strip sensitive and responsive to electrical current passing therethrough and the other being a coiled bi-metal strip sensitive and responsive to the ambient temperature in said housing; one of said thermoelements embodying shoulder means and the other thermoelement embodying means engageable with said breaker bar; an electrical connection between each of said movable contacts and a first and a second point on said current responsive thermoelement respectively; release means having a shoulder thereon movably mounted in said housing, said release means being movable between

an open circuit position in which said shoulder is spaced from said shoulder means on one of said thermoelements so as to permit said breaker bar and movable contacts to be held in their said open circuit positions by said first spring means, and a closed circuit position in which said shoulder is compressed against said shoulder means on one of said thermoelements so as to hold said breaker bar and movable contacts in their closed circuit positions; a latching surface in said housing; a latch member movably mounted on said release means so as to move between a release position in which it clears said latching surface to permit said breaker bar and movable contacts to be moved by said first spring means to their open circuit position; and a latched position in which the latch member is held in latching engagement with said latching surface by the compressive force of said first spring means; second spring means biasing said latch toward its said release position; and means on said release means for moving said release means to its said closed circuit position and for moving said latch member to its said latched position; thermo-mechanical shifting through an arc of travel of said current responsive thermoelement upon the passage of an overload current therethrough causing said shoulder means on one of said thermoelements to move off of said shoulder so as to release the compression force holding the latch in its said latched position, whereby said second spring means will move said latch member out of engagement with said latching surface, permitting said first spring means to drive said movable contacts to their said open circuit positions; thermomechanical shifting through an arc of travel of said ambient temperature responsive thermoelement upon a variation of ambinet temperature in said housing substantially compensating for thermomechanical shifting of said current responsive thermoelement through an arc of travel resulting from said variation of ambient temperature.

8. A circuit breaker according to claim 7, wherein said current responsive thermoelement is engageable with said breaker bar and supports said ambient temperature responsive thermoelement in proximity to said release means.

9. A circuit breaker according to claim 8, wherein said shoulder means is on said ambient temperature responsive thermoelement.

10. A circuit breaker according to claim 7, wherein said ambient temperature compensating thermoelement has a clockspring configuration.

No references cited.