

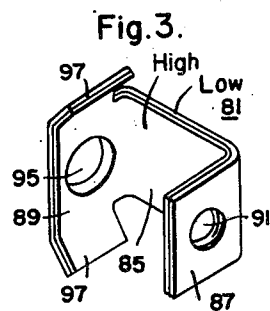
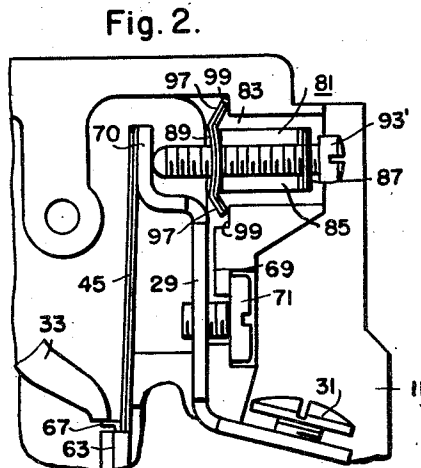
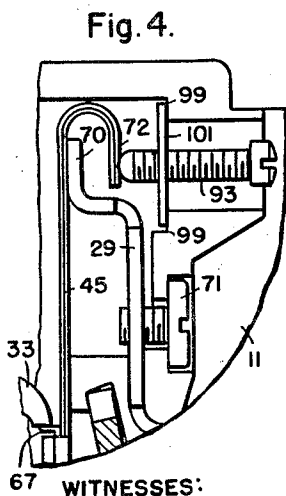
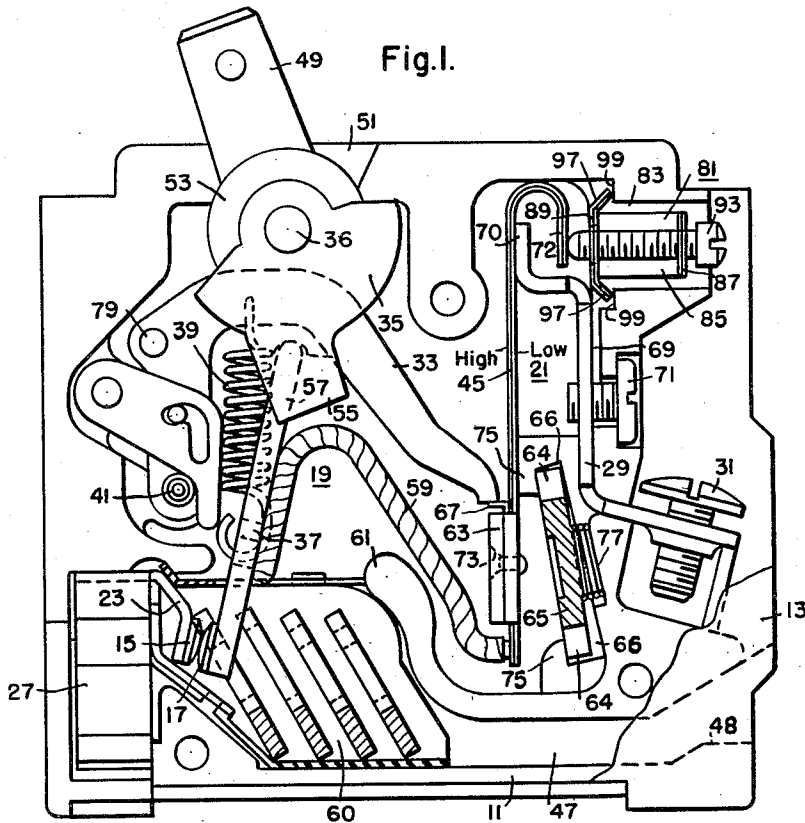
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2,798,918

CIRCUIT BREAKER

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2,798,918

CIRCUIT BREAKER

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12 Claims. (Cl. 200—116)

This invention relates to circuit breakers of the thermally responsive type for controlling lighting and moderate power circuits, and particularly to ambient temperature compensation of thermal trip devices.

In many applications of small automatic circuit breakers it is desirable to compensate the thermally responsive trip element for changes in ambient temperature in order to maintain substantially constant time-current tripping characteristic. Due to the limited space in such small circuit breakers it is often difficult or impossible to provide a compensating element having sufficient deflection in response to changes in ambient temperature to adequately compensate the thermally responsive tripping element for changes in ambient temperature. One object of the invention, therefore, is to provide a plurality of relatively small temperature compensating elements, the cumulative deflection of which is sufficient to compensate the thermally responsive trip element of a circuit breaker for changes in ambient temperature.

Another object of the invention is to provide a circuit breaker embodying a thermally responsive tripping element in which a portion of the tripping element is utilized to compensate the tripping element for changes in ambient temperature.

Another object of the invention is to provide a circuit breaker according to the preceding paragraph with additional compensating means which cooperates with the portion of the thermally responsive tripping element to increase the amount of ambient temperature compensation.

Another object of the invention is to provide a circuit breaker embodying a thermally responsive trip device with novel means for compensating the trip device for changes in ambient temperature.

Another object of the invention is to provide a circuit breaker embodying a thermally and magnetically responsive trip device with a combined ambient temperature compensating means and adjusting means.

Another object of the invention is to provide a circuit breaker embodying a thermally responsive trip device having adjusting means for said trip device with novel means cooperating with the adjusting means to compensate the trip device for changes in ambient temperature.

Another object of the invention is to provide a circuit breaker embodying a thermally responsive tripping element and adjusting means therefor with a temperature compensating element which acts through the adjusting means to compensate the tripping element for changes in ambient temperature.

A further object of the invention is to provide a circuit breaker according to the preceding paragraph in which a portion of the thermally responsive tripping element cooperates with the adjusting means to increase the amount of compensation provided.

Another object of the invention is to provide a circuit breaker embodying a thermally responsive tripping element with one or more elements for compensating the

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thermally responsive trip element for changes in ambient temperature wherein one or the other or all of the compensating elements can be assembled in the breaker to provide different amounts of temperature compensation.

The invention, both as to construction and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description thereof when read in conjunction with the accompanying drawing.

In said drawing:

Figure 1 is a vertical elevational view of a circuit breaker with the cover largely broken away and partly in section embodying the principles of the invention;

Fig. 2 is an elevational view of a portion of the circuit breaker shown in Fig. 1 embodying one of the compensating elements which is shown deformed in response to a rise in ambient temperature;

Fig. 3 is a perspective view of the temperature compensating element shown in Fig. 2; and

Fig. 4 is an elevational view of a portion of the circuit breaker showing the looped end of the tripping bimetal element used alone to compensate for changes in ambient temperature.

The invention is illustrated as applied to a circuit breaker of the type disclosed in application Serial No. 285,598, filed May 2, 1952, by L. W. Dyer, now Patent No. 2,677,025 issued April 27, 1954, and assigned to the assignee of the instant application.

Referring to Fig. 1 of the drawing, the circuit breaker comprises an open sided casing 11 of molded insulating material and a cover plate 13 also of molded insulating material shown broken away to more clearly illustrate the mechanism, stationary contact means 15, movable contact means 17, an operating mechanism 19, and a trip device 21.

The stationary contact 15 is rigidly secured to the inner end of a conducting strip 23, the outer end of which is provided with a terminal connecting means, such as a plug-in member 27 for connecting the breaker in an electric circuit. At the opposite end of the housing 11 is a conducting strip 29 which at its inner end is connected to the trip device 21 (to be later described) and which is provided with a terminal connecting means, such as a screw 31 at its outer end for connecting the breaker in an electric circuit.

The movable contact 17 is rigidly secured on the free end of a U-shaped switch arm 37 having its legs 57 supported in recesses in the legs 55 of a U-shaped operating lever 35 of molded insulating material. The operating lever 35 is pivotally mounted by means of trunnions 36 molded integral therewith supported in suitable companion openings (not shown) in the housing 11 and in the cover 13. An operating spring 39 is connected under tension between the bight of the switch arm 37 and a releasable carrier 33 pivoted on a pin 41 supported in openings in the housing 11 and in the cover plate 13.

The operating lever 35 is provided with an operating handle 49 molded integral therewith and extending out through an opening 51 in the housing 11. The operating lever 35 is also provided with an arcuate member 53 molded integral therewith and cooperating with the housing 11 to substantially close the opening 51 in all positions of the handle 49. The switch arm 37 is electrically connected by means of a flexible conductor 59 to one end of a bimetal element 45 forming part of the trip device 21. The bimetal element 45 is suitably rigidly secured, preferably by welding, to the inner end of the conducting strip 29.

The switch arm 37 is operated to manually open and close the contacts 15—17 by manipulation of the handle 49. Movement of the handle 49 in a clockwise direction from the position shown carries the upper pivoted ends

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of the legs 57 of the switch arm across to the left of the line of action of the operating spring 39 which then biases the switch arm to the open position and causes movement of the switch arm to the open position with a snap action.

The contacts are manually closed by reverse movement of the handle. Counterclockwise movement of the handle 49 from the open position to the closed position shown moves the pivoted upper ends of the legs 57 of the switch arm 37 across to the right of the line of action of the spring 39 which thereupon acts to close the contacts with a snap action.

An arc extinguisher 60 is provided to quickly extinguish the arc drawn when the circuit is interrupted. The arc extinguisher may be of any suitable type but preferably comprises a stack of spaced slotted plates of magnetic material. The hot gas is vented through a passage 47 extending along the base of the housing 11 and out through an opening 48 in the end of the housing opposite the contacts.

The circuit breaker is adapted to be tripped open instantaneously in response to overload currents above a predetermined value, or in response to short circuit currents, and after a time delay on lesser overload currents, by means of the trip device 21. Operation of the trip device 21 releases the carrier 33 whereupon the operating spring 39 moves the carrier clockwise carrying the line of action of the spring 39 across to the right of the pivot of the switch arm 37. Thereafter the spring 39 acts to move the switch arm to open position with a snap action. The clockwise movement of the carrier 33 is arrested by engagement with a projection 61 on the housing 11.

The trip device 21 comprises the bimetal element 45 and an electromagnet including an armature 63 mounted on the thermal bimetal element and an H-shaped magnetic member or magnet yoke 65 having long ends 64 mounted in recesses 66 in the side wall of the housing 11 and in companion recesses (not shown) in the cover 13 for limited movement relative to the magnetic member 63. The conducting strip 29 is secured to the adjacent end wall of the housing 11 by means of a screw 71 with a clearance space 69 between the conducting strip and the end wall above the screw 71. The bimetal element 45 is rigidly secured by suitable means preferably by welding to an offset portion of the upper inner end 70 of the conducting strip 29. The upper end of the bimetal element 45 has a reverse bend and the shorter leg 72 extends downward to the right of the offset 70, the purpose of which will be described later.

The magnetic member 63 surrounds three sides of the bimetal element 45 and is rigidly secured thereto by means of a rivet 73 which also serves to secure a latch element 67 to the bimetal element. The latch element normally engages and releasably restrains the carrier lever 33 in operative position. It will be noted that the holding force is applied to the bimetal in tension and does not stress the bimetal with a bending force. The magnet yoke 65 is biased by means of a light compression spring 77 toward the armature 63 and against shoulders 75 of the recesses 66 in the housing 11 and the corresponding shoulders (not shown) in the cover plate 13.

Upon the occurrence of an overload current above rated current but below a predetermined value of, for instance, 1000% of rated current, the bimetal element 45 is heated by the current flow therein and deflects toward the right causing the latch 67 to release the carrier 33 whereupon the operating mechanism functions in the manner previously described to automatically open the breaker contacts.

When a heavy overload current, such for example as 1000% or more of rated current, or a short circuit current occurs, the current flowing through the bimetal element 45 energizes the electromagnetic means a sufficient amount to cause the magnetic member 65 to instantaneously attract the armature 63 thus bending the bimetal element

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45 and causing release of the carrier 33 and effecting instantaneous opening of the breaker contacts.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and re-latch the operating mechanism. This is accomplished by moving the handle 49 clockwise to the full open position during which movement the legs 55 of the operating lever 35 engage a pin 79 in the carrier 33 and move the carrier counterclockwise about its pivot 41. Near the end of its counterclockwise movement, the free end of the carrier 33 wipes by the latch 67 slightly bending the bimetal element which then resumes its normal latching position. The switch arm is then moved to close the contacts in the previously described manner by movement of the handle 49 counterclockwise to the closed position.

Means is provided to compensate the current responsive bimetal element 45 for changes in ambient temperature. This means comprises a generally U-shaped, compensating bimetal element 81 disposed in a recess 83 in the base 11 of the housing. The bimetal element 81 has a yoke portion 85 and legs or end portions 87 and 89. The leg 87 is provided with a tapped opening 91 (Fig. 3) which threadably receives an adjusting screw 93. The screw 93 passes through a clearance opening 95 in the leg 89 of the compensating bimetal and the rounded inner end of the screw 93 abuts against the short leg 72 of the bimetal element 45. The leg 89 of the compensating bimetal 81 is provided with ears 97 formed at outwardly extending angles, the ends of the ears 97 being pressed against shoulders 99 on the base 11 by the inherent resiliency of the conducting strip 29 acting through the screw 93.

By turning the screw 93 a greater or lesser pressure is brought to bear on the offset portion 70 depending on the direction the screw 93 is turned. This causes movement of the offset 70 and of the end of the bimetal 45 affixed thereto and also causes movement of the latch member 67 relative to the end of the carrier 33 thereby varying the tripping time of the device.

The high expansion side of the compensating bimetal 81 is on the inside of the U, consequently upon a rise in ambient temperature, the leg 89 and the ears 97 will bend toward the left while the leg 87 will bend toward the right substantially as shown in Fig. 2. The bending of the leg 89 and the ears 97 toward the left permits the inherent resiliency of the offset 70 acting through leg 72 of the bimetal element 45 and the screw 93 to move the yoke 85 and the leg 87 toward the right maintaining the ears 97 in contact with the shoulders 99. At the same time the bending of the leg 87 toward the right moves the screw 93 an additional distance toward the right permitting further movement of the short leg 72 of the bimetal element 45 and, consequently, further movement of the offset 70 toward the right. Since the high expansion side of the tripping bimetal element 45 is on the outside of the loop at the upper end thereof and on the right of the short leg 72, the increase in ambient temperature will cause the loop to close up, moving the leg 72 toward the offset 70. This permits the inherent resiliency of the conductor strip 29 to move the offset 70 an additional distance toward the right, the cumulative deflection of the legs 87 and 89 of the compensating bimetal element 81 and the compensating leg 72 of the tripping bimetal element 45 permitting sufficient movement of the offset 70 and the tripping bimetal 45 to compensate the latter for changes in ambient temperature. The movement of the offset 70 of the conductor strip 29 is a pivotal movement about a pivot point located at a point adjacent the screw 71. As a result of this movement of the offset 70 the tripping bimetal element 45, which is rigidly mounted thereon, will be moved in a direction to move the latch element 67 toward the left thereby maintaining a substantially constant latch overlap between the latch 67 and

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the end of the carrier 33, thus compensating the tripping bimetal element 45 for a rise in ambient temperature.

A decrease in the ambient temperature will cause the legs 87 and 89 to bend in the opposite direction, that is, toward each other and the ears 97 on the leg 89 will bend inwardly thus moving the screw 93 toward the left. At the same time the decrease in ambient temperature will cause the leg 72 of the bimetal 45 to move toward the right, the cumulative deflection of the parts of the compensating bimetal element 81 and of the compensating portion 72 of the bimetal element 45 causing the offset 70 to move toward the left. As a result of this movement of the offset 70 the tripping bimetal element 45 will be moved toward the right moving the latch 67 toward the right relative to the end of the carrier 33 thus compensating the tripping bimetal element 45 for a decrease in ambient temperature.

As shown in Fig. 2, the compensating bimetal element 81 may be used alone to provide a lesser degree of temperature compensation. In the Fig. 2 modification the compensating leg 72 of the tripping bimetal element 45 is omitted and the screw 93' is long enough to directly engage the offset 70. The compensating bimetal 81 (Fig. 2) functions exactly as in the previously described manner, the only difference being that the cumulative deflection of the several portions thereof is transmitted through the screw 93' directly to the offset 70. By using the compensating bimetal element 81 alone the amount of compensation provided is reduced by the amount provided by the leg 72 (Fig. 1) of the bimetal element 45.

If still less temperature compensation is desired the compensating bimetal element 81 may be omitted and the tripping bimetal element 45 may be compensated for changes in ambient temperature by the leg 72 thereof acting alone as shown in Fig. 4. The screw 93 (Fig. 4) threadedly engages a nut or plate 101 which is held in place against the shoulders 99 on the casing 11 by the inherent resiliency of the conducting strip 29. A change in the ambient temperature will cause the leg 72 of the bimetal element 45 to bend toward or away from the offset 70. Since the high expansion side of the bimetal element 45 is on the outside of the loop an increase in ambient temperature will cause the leg 72 to bend toward the offset 70 and a decrease in ambient temperature will cause the leg 72 to bend away from the offset 70 thus compensating the tripping bimetal element 45 for the change in temperature.

It will be seen that there is provided a single compensating element comprising a portion of the tripping bimetal element which cooperates with the adjusting means to provide a predetermined degree of compensation for the tripping bimetal for changes in ambient temperature. There is also provided a compensating bimetal element in which the adjusting screw is mounted and which has a plurality of deflecting portions providing a compound deflection in response to changes in ambient temperature. This element provides a greater amount of compensation than a single compensating element. Either one of the compensating elements alone can be assembled in the breaker to provide different amounts of compensation, or they can be assembled together in the breaker so that their cumulative deflection provides a maximum amount of temperature compensation.

Having described the invention specifically in accordance with the statutes, it is to be understood that various changes and modifications can be made without departing from the spirit of the invention.

I claim as my invention:

1. A circuit breaker comprising relatively movable contact means, operating means releasable to effect automatic opening of said contact means, a trip device comprising a current carrying bimetal element formed from a single strip of bimetallic material and having one end heated in response to current, resilient means supporting said bimetal element at a point between the ends thereof,

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means on said one end of said bimetal element at one side of said support means for initiating release of said releasable operating means, the other end of said bimetal element at the other side of said support means having a reverse bend about a transverse axis parallel to its faces to form a loop, the high and low expansion sides of said bimetal element being so arranged that said one end of said bimetal element bends in response to abnormal circuit conditions to release said releasable means and said other end of said bimetal element bends in response to changes in ambient temperature to effect movement of said resilient support means to compensate the trip device.

2. A circuit breaker comprising relatively movable contact means, operating means releasable to effect automatic opening of said contact means, a trip device comprising a current carrying bimetal element formed from a single strip of bimetallic material, means supporting said bimetal element at a point between its ends, one end of said bimetal element at one side of said support means being heated in response to current flowing therein, means on said one end of said bimetal element for initiating release of said releasable operating means, the other end of said bimetal element at the other side of said support means having a reverse bend about a transverse axis parallel to its faces to form a loop, the high and low expansion sides of said bimetal element being so arranged that said loop deflects in response to changes in ambient temperature to effect movement of said support means to compensate said one end of said bimetal element.

3. A circuit breaker comprising relatively movable contact means and operating means releasable to effect automatic opening of said contact means, a trip device comprising a current carrying bimetal element formed from a single strip of bimetallic material, support means supporting said bimetal element at a point between its ends, said bimetal element on one side of said support means having means for initiating release of said releasable operating means, said bimetal element on the other side of said support means having a reverse bend about a transverse axis parallel to its faces to form a loop, adjusting means engaging said loop applying pressure to said support means to thereby vary the position of said bimetal element, and the high and low expansion sides of said bimetal element being so arranged that the end of said loop moves relative to said support means in response to changes in ambient temperature to compensate said trip device.

4. A circuit breaker comprising relatively movable contact means and operating means releasable to effect automatic opening of said contact means, a trip device comprising a bimetal element heated in response to current and having means for initiating release of said releasable operating means, means supporting said bimetal element at one end, a separate U-shaped bimetal element having spaced legs, an adjusting screw on one leg of said U-shaped bimetal applying a pressure to said support means, the other leg of said U-shaped bimetal element being biased against a fixed stop by said support means, the high and low expansion sides of said separate U-shaped bimetal element being so arranged that the legs thereof move relative to each other in response to changes in ambient temperature whereby the cumulative movement of said legs bodily moves said adjusting screw to compensate said trip device.

5. A circuit breaker comprising separable contact means and means releasable to effect separation of said contact means, a trip device comprising a bimetal element heated in response to current and having means for initiating release of said releasable means, means mounting said bimetal element at one end, a U-shaped bimetal element having spaced legs, an adjusting screw mounted in one leg of said U-shaped bimetal element and extending through an opening in the other leg, said screw

engaging said mounting means to apply a pressure there-to, said other leg having ears thereon engaging fixed support means, the high and low expansion sides of said U-shaped bimetal being so arranged that said legs deflect relative to each other in response to changes in ambient temperature, the deflection of said one leg bodily moving said screw relative to said other leg and said mounting means, and deflection of said other leg bodily moving said U-shaped bimetal element to thereby increase the movement of said screw relative to said mounting means to compensate said trip device for changes in ambient temperature.

6. A circuit breaker comprising a casing, relatively movable contact means, means releasable to effect opening of said contact means, a terminal member mounted on said casing and a portion extending into said casing, a trip device comprising a bimetal element having one end rigidly mounted on said terminal member, said bimetal element being operable to effect release of said releasable member, a U-shaped bimetal element having spaced legs, means mounting said U-shaped bimetal element in said casing, an adjusting screw mounted in one of said legs for applying a pressure to said portion of said terminal, the high and low expansion sides of said U-shaped bimetal being so arranged that said legs deflect in opposite directions relative to each other in response to changes in ambient temperature, the deflection of said one leg bodily moving said adjusting screw to vary the pressure applied to said portion of said terminal, and the deflection of said other leg bodily moving said U-shaped bimetal to increase the movement of said screw.

7. In a circuit breaker comprising relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a current carrying tripping bimetal element heated in response to current for effecting release of said releasable means, means supporting said current carrying bimetal element adjacent one end thereof, a U-shaped bimetal element having spaced legs both of which are movable, means on one of said legs engaging and applying a pressure to said support means, the other leg of said U-shaped bimetal element being biased against a fixed member by said support means, the high and low expansion sides of said U-shaped bimetal element being so arranged that the legs thereof move relative to each other in response to changes in ambient temperature whereby the combined movement of both of said legs moves said force-applying means to move said support means for said current carrying bimetal to thereby compensate said trip device.

8. In a circuit breaker comprising relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a tripping bimetal element for initiating release of said releasable means, means supporting said tripping bimetal element at one end thereof, a first compensating bimetal element on said support means for said tripping bimetal element, a U-shaped compensating bimetal element having spaced legs thereon both of which are movable, means on one of said legs applying a pressure to said first compensating bimetal element, the high and low expansion sides of said U-shaped compensating bimetal element being so arranged that the legs move relative to each other in response to changes in ambient temperature to bodily move said pressure applying means, and said first compensating bimetal element and said U-shaped compensating bimetal element bending in response to changes in ambient temperature to effect movement of said support means for said tripping bimetal element relative to said pressure applying means to compensate said trip device.

9. In a circuit breaker comprising relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a tripping bimetal element operable to effect release of said releasable means, support means supporting one end

of said tripping bimetal element, a first compensating bimetal element mounted on said support means, a U-shaped bimetal compensating element having spaced legs, an adjusting screw in one of said legs engaging and applying a pressure to said first compensating bimetal element, the high and low expansion sides of said U-shaped compensating bimetal element being so disposed that said legs move in opposite directions relative to each other in response to changes in ambient temperature, the cumulative bending of said legs bodily moving said adjusting screw relative to said first compensating bimetal element, and said first compensating bimetal element moving relative to said support means in response to changes in ambient temperature to compensate said trip device.

10. In a circuit breaker comprising relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a tripping bimetal element heated in response to current and operable to effect release of said releasable means, support means supporting one end of said tripping bimetal element, a first compensating bimetal element mounted on said support means for said tripping bimetal element, a second compensating bimetal element having spaced legs thereon both of which are movable, a member mounted on one of said legs of said second compensating bimetal element and engaging said first compensating bimetal element, the cumulative bending of said first and second compensating bimetal elements in response to changes in ambient temperature effecting movement of said support means for said tripping bimetal element to compensate said tripping bimetal element for changes in ambient temperature.

11. In a circuit breaker comprising relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a bimetal element formed from a single strip of bimetallic material having one end heated in response to current, resilient means supporting said bimetal element between its ends, means at said one end of said bimetal for initiating release of said releasable means, the other end of said bimetal element having a reverse bend about a transverse axis parallel to its faces to form a loop having a free end, a U-shaped bimetal element having spaced legs, an adjusting screw mounted in one of said legs and engaging the free end of said loop to apply a pressure to said support means, said resilient support means biasing the other leg of said U-shaped bimetal element against a fixed support, the high and low expansion sides of said U-shaped bimetal element being so arranged that the legs thereof move relative to each other in response to ambient temperature, the high and low expansion sides of said loop being so disposed that the free end of said loop moves relative to said support means in response to changes in ambient temperature, and the cumulative bending of said U-shaped bimetal element and said loop compensating said trip device for changes in ambient temperatures.

12. In a circuit breaker comprising a casing, relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a tripping bimetal element heated in response to current and operable when heated a predetermined amount to effect release of said releasable means, support means for supporting said tripping bimetal element, a first temperature compensating bimetal element on said support means, adjusting means for applying a pressure to said first compensating bimetal element, a second temperature compensating bimetal element, said casing having surfaces and recesses thereon for receiving and supporting said adjusting means and for receiving and supporting said second temperature compensating bimetal element when said adjusting means is removed, and an adjusting screw on said second temperature compensating bimetal element for applying a pressure to said first temperature compensating bimetal element, the cumulative deflection of both of said temperature compensating bimetal elements in re-

sponse to changes in ambient temperatures varying the pressure on said support means to compensate said trip device.

References Cited in the file of this patent

UNITED STATES PATENTS

2,340,050	Gano	Jan. 25, 1944
2,459,629	Dorfman et al.	Jan. 18, 1949
2,508,591	Allen	May 23, 1950

5

10

Walker et al.	Sept. 18, 1951
Walton	Sept. 23, 1952
Ingwersen	Jan. 13, 1953
Senn	Mar. 24, 1953
Toth et al.	Sept. 29, 1953
Allen	Oct. 20, 1953
Dorfman	Oct. 20, 1953
Jackson	Jan. 12, 1954
Jackson et al.	Dec. 14, 1954