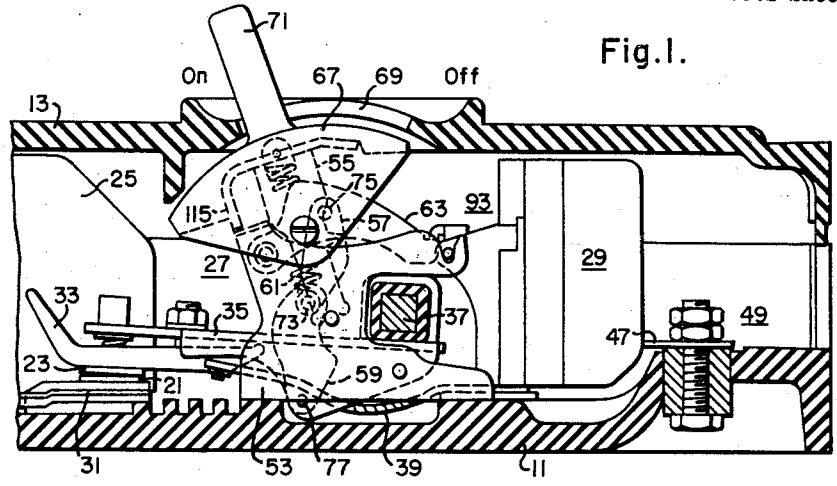
Jan. 19, 1960 A. R. CELLERINI ET AL 2,922,008

CIRCUIT BREAKER

Filed July 31, 1957 2 Sheets-Sheet 1

Fig.1.



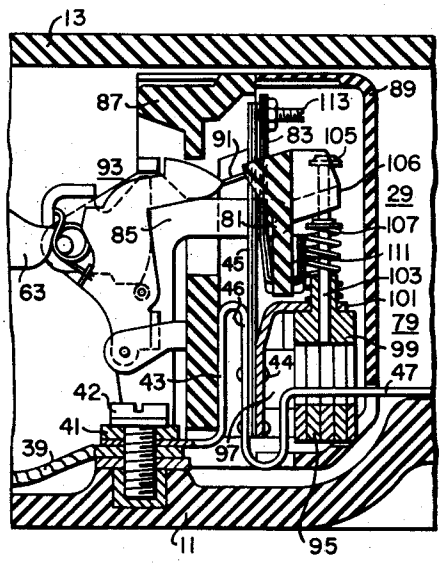


Fig.2.

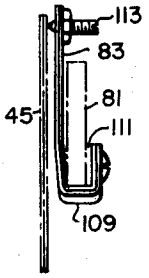
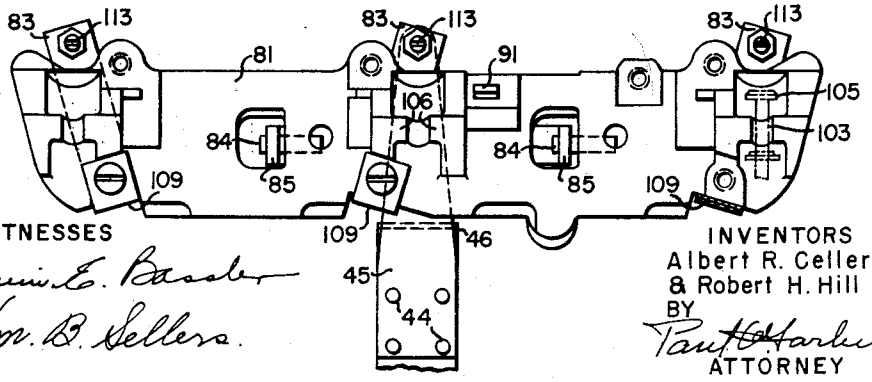


Fig.3.

Fig.4.



WITNESSES

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Jan. 19, 1960 A. R. CELLERINI ET AL 2,922,008

CIRCUIT BREAKER

Filed July 31, 1957 2 Sheets-Sheet 2

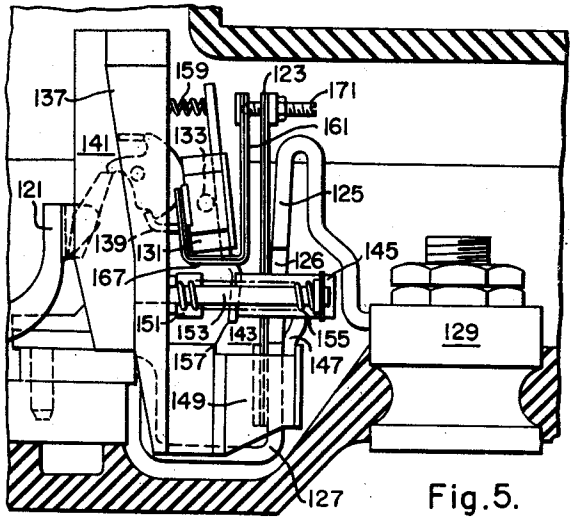


Fig.5.

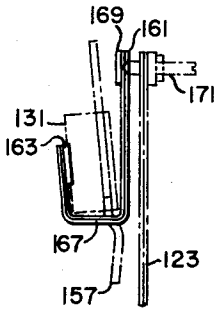


Fig.6.

Fig.7.

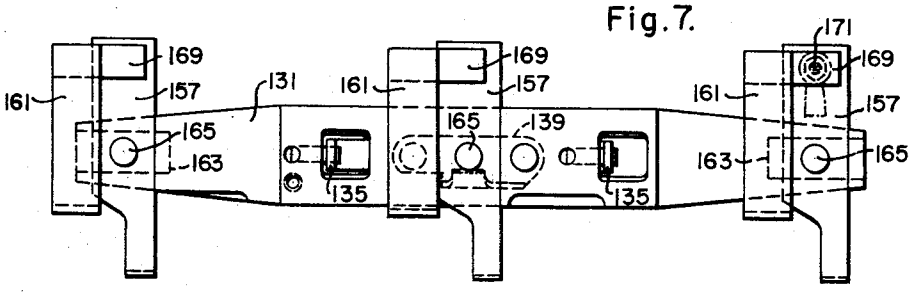


Fig.8.

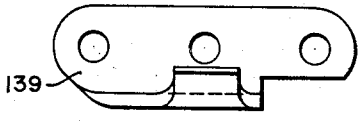


Fig.9



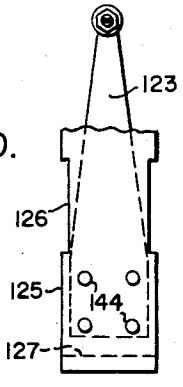


Fig.10.

United States Patent Office 2,922,008 Patented Jan. 19, 1960

2,922,008

CIRCUIT BREAKER

Albert R. Cellerini, Beaver, and Robert H. Hill, South Beaver Township, Beaver County, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application July 31, 1957, Serial No. 675,477
8 Claims. (Cl. 200—116)

This invention relates to circuit breakers for controlling lighting and moderate power circuits, and more particularly to ambient temperature compensation of thermal trip devices for such circuit breakers.

An object of this invention is to provide a circuit breaker embodying a thermally responsive trip means and a trip member movable by said trip means to effect opening of the breaker, with means mounted on and movable with said trip member for compensating the thermally responsive trip means for changes in ambient temperature in a very compact manner requiring no increase in the size of the circuit breaker or trip unit therefor.

Another object of the invention is to provide a circuit breaker embodying thermally responsive trip means and a trip member movable by the trip means to effect opening of the breaker with a temperature compensating element mounted on said trip member and engageable by said thermally responsive trip means to move the trip member in which the compensating element is mounted on the trip member in a position wholly or partially laterally offset from the thermally responsive trip means.

Another object of the invention is to provide a circuit breaker embodying a current responsive heater for the tripping bimetal element and an improved ambient temperature compensating bimetal having its end nearest the hottest part of the heater spaced away from the heater and having the end of the compensating bimetal remote from the heater acuated by the end of the tripping bimetal remote from the heater.

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

In said drawings:

Figure 1 is an elevational view, partly in section, of a circuit breaker embodying the principles of the invention;

Fig. 2 is an enlarged vertical sectional view showing the trip device of the circuit breaker illustrated in Fig. 1;

Fig. 3 is a detailed view showing the ambient temperature compensating bimetal element and its relation to the current responsive bimetal element;

Fig. 4 is an elevational view of the common trip bar with the ambient temperature compensating bimetal elements mounted thereon;

Fig. 5 is an elevational view, partly in section, showing a modification of the ambient temperature compensating means applied to a somewhat different type of trip device;

Fig. 6 is a detail view showing the ambient temperature compensating bimetal element shown in Fig. 5 and its relation to the current responsive bimetal element;

Fig. 7 is an elevational view of the common trip bar of Fig. 5 with the ambient temperature compensating bimetal elements mounted thereon;

Figs. 8 and 9 are views showing the latch member on the trip bar of the modification shown in Fig. 5; and

Fig. 10 is a detail view showing the heater element.

Referring to Fig. 1 of the drawings, the circuit breaker comprises a base **11** of molded insulating material on which the several elements of the circuit breaker are mounted, and a cover **13** of molded insulating material which may be fastened or sealed to the base and cooperates with the base to form an enclosing housing for the circuit breaker.

The circuit breaker is of the multipole type and the mechanism may be of the general type disclosed in Patent No. 2,508,178, issued May 16, 1950 to T. Lindstrom et al., and assigned to the assignee of the present invention. The circuit breaker includes a stationary contact **21**, a movable contact **23** and an arc extinguisher **25** for each pole of the breaker. A common operating mechanism indicated generally at **27** is provided for simultaneously actuating the three movable contacts **23** to open and closed positions, and a sealed trip device indicated generally at **29** serves to effect automatic opening of the breaker contacts in response to predetermined overload conditions in the current through any pole of the breaker.

The stationary contact **21** is rigidly mounted on the inner end of a conducting strip **31** which extends out of the end of the housing and is connected to a line terminal (not shown). The movable contact **23** for each pole is rigidly mounted on a contact arm **33** supported on a switch arm **35** secured on a tie bar **37** which extends across all of the poles of the breaker and supports the switch arms for the several poles of the breaker for movement together to open and closed positions. The contact arm **33** is connected by a flexible conductor **39** to a terminal **41** (Fig. 2) secured to the base **11** by a screw **42** which also serves to secure one leg of a heater element **43** to the base.

The heater element **43** is relatively short and may be of uniform cross section for its whole length between the terminal **41** and a load terminal **49** (Fig. 1), except there might be a reduction in cross section caused by rivet holes (Fig. 4) by which a thermally responsive bimetal element **45** is secured thereto so that the portion **46** adjacent the rivet holes is heated by the current flow therethrough. The thermally responsive bimetal element **45** forming a part of the trip device **29** is mounted by rivets **44** on the heated leg of the heater element **43** adjacent its heated section **46** which is at the highest temperature when an overload occurs. The heater element **43** is electrically integral with a conducting strip **47**. The conducting strip extends out of the trip device and is connected to the load terminal **49** (Fig. 1). The current through the circuit breaker thus flows through the heater element **43** and its hottest part is at **46** close to its connection to the lower end of the tripping bimetal **45**. Thus, the lower end of the tripping bimetal is heated by conduction from the hottest part of the heater and not merely by radiation, and being heated near its lower end gives the maximum deflection at its upper end due to the lever action of the length of the bimetal.

The operating mechanism **27** (Fig. 1) for the breaker is disposed in the center compartment of the housing and is supported by a pair of frames **53** (only one being shown) secured to the base **11**. The operating mechanism comprises a forked operating lever **55**, a toggle comprising links **57** and **59**, overcenter springs **61** and a pivoted releasable cradle **63** controlled by the trip device **29**. An arcuate insulating shield **67** for substantially closing an opening **69** in the cover **13** is mounted on the outer end of the operating lever **55** and has an integral handle **71** extending out through the opening **69** to permit manual operation of the breaker mechanism.

The toggle links **57** and **59** are pivotally connected together by a knee pivot pin **73**. The toggle link **57** is pivotally connected by a pivot pin **75** to the cradle **63** and the toggle link **59** is pivotally connected to the switch arm **35** for the center pole by a pivot pin **77**. The overcenter springs **61** are connected under tension between the knee pivot pin **73** of the toggle **57—59** and the outer end of the operating lever **55**.

The circuit breaker is operated to open position by manipulation of the handle 71 (Fig. 1) in a clockwise direction to the "off" position actuating the overcenter springs 61 to cause collapse of the toggle 57—59 and opening movement of the switch arms 35 for all of the poles of the breaker in a well known manner.

The circuit breaker is manually closed by reverse movement of the handle 71 from the "off" to the "on" position which causes the springs 61 to move overcenter and straighten the toggle 57—59 thereby moving the switch arms for all of the poles to the closed position.

In addition to the thermally responsive tripping bimetal element 45 for each of the poles, the trip device also includes a series overload tripping magnet 79 (Fig. 2) for each pole, a trip bar 81 common to all of the poles and an ambient temperature compensating bimetal element 83 for each pole. The trip bar 81 is made of insulating material and is pivotally supported by means of pins 84 (Fig. 4) in a generally U-shaped bracket 85 (Fig. 2) secured to the base 11 by the screws 42. The bracket 85 also supports an insulating base 87 for the trip device. A sealed cover 89 of insulating material is provided to enclose the trip device. A latch 91 (Fig. 2) on the trip bar 81 normally engages a latch mechanism 93, which, in turn, engages the cradle 63 to releasably restrain the operating mechanism in the closed position.

The tripping electromagnet 79 comprises a U-shaped magnet yoke 95 (Fig. 2) supported on a bracket 97 which is rigidly mounted on the trip device base 87. A movable armature 99 is slidably supported in an extension 101 of the bracket 97 and has secured thereto a rod 103 which, at its outer end, has a head 105 for engaging projections 106 on the trip bar and operating the trip bar 81 upon energization of the magnet. A spring 107 coiled about the rod 103 biases the rod and the armature 99 to the unattracted position. The tripping electromagnet 79 is energized by the conducting strip 47 which extends between the legs of the U-shaped magnet yoke.

The ambient temperature responsive bimetal elements 83 are mounted on the trip bar 81 on the side thereof opposite the tripping bimetal elements 45. Each of the bimetal elements 83 forms a loop as at 109 (Figs. 3 and 4) around and under the lower edge of the trip bar 81 and extends upwardly along the side of the trip bar adjacent the tripping bimetal element 45 to avoid the tripping projections 106. In this manner a longer length of bimetal is provided for more accurate compensation. While the ambient temperature responsive bimetal 83 is fairly close to the tripping bimetal 45 adjacent its upper end, it should be noted that the upper end of the tripping bimetal is not heated by any current flow through this bimetal and that its upper end is quite remote from the heater section 46 so that there is little heat transfer to the compensating bimetal from the heater for the thermally responsive tripping bimetal element 45.

The lower ends of the ambient temperature responsive bimetal elements 83 are rigidly secured to a projection 111 (Figs. 2, 3 and 4) on the trip bar 81. It will be seen that the supported ends of the compensating bimetal elements 83 are offset to one side of the lower end of the tripping bimetal elements 45 for purposes of clearance when the trip bar 81 is operated, and to reduce the effect on the ambient temperature responsive bimetal element 83 of heat transfer by radiation from the thermally responsive bimetal elements 45 and its heater section 46. From these points of support on the projections 111 at one side of the tripping bimetal element each of the compensating bimetal elements extend upwardly at an angle to the tripping bimetal element 45 so that an adjusting screw 113 in the free end of the compensating bimetal element 83 is in line with the free end of the tripping bimetal element 45 so as to be engaged thereby upon thermal bending of the latter to actuate the trip bar 81. This makes the compensating bimetal about as long as if it extended down along the heater section 46 but keeps it away from the hottest part of the bimetal and heater.

When a low overload current occurs the tripping bimetal element 45 is heated by the heater element 43 and when heated a predetermined amount bends toward the right (Fig. 2) and engages the adjusting screw 113 on the compensating bimetal element 83 to actuate the trip bar 81 and effect release of the cradle 63 and opening of all of the breaker contacts after a time delay provided by the time required to heat the bimetal element 45.

The high-expansion side of the tripping bimetal element is on the left-hand side thereof and the high-expansion side of the compensating bimetal element 83 is also on the left-hand side thereof as viewed in Figs. 2 and 3; consequently, the bimetal elements will bend in the same direction in response to changes in ambient temperature, thus maintaining substantially the same relation between the free end of the tripping bimetal 45 and the adjusting screw 113 in the free end of the compensating bimetal element during changes in ambient temperatures.

The circuit breaker is tripped open instantaneously by operation of the tripping electromagnet 79. When the magnet is energized by overload currents of, for instance, 1000% or more of normal rated current, or by short-circuit currents, the armature 99 is attracted causing the head 105 on the rod 103 to engage and actuate the trip bar 81 thereby effecting instantaneous release of the cradle 63 and automatic opening of the breaker contacts.

Following an automatic opening operation, it is necessary to reset and relatch the mechanism before the contacts can be closed. This is effected by moving the handle 71 clockwise as far as it will go. During this movement a projection 115 on the operating lever 55 engages a shoulder on the cradle 63 and moves the latter in a clockwise direction near the end of which movement the latch end of the cradle is reengaged with the latch mechanism 93 in a well-known manner. The breaker contacts are then closed in the previously described manner by movement of the handle to the "on" position.

Figs. 5, 6 and 7 illustrate the invention applied to a trip device for a somewhat different type of circuit breaker. The circuit breaker is of the multipole type and may be of the general type disclosed in Patent No. 2,486,300, issued October 25, 1949 to Ture Lindstrom et al., and assigned to the assignee of the instant invention. The operating mechanism of the circuit breaker is not shown herein but reference may be had to Patent No. 2,486,300 for a fuller understanding thereof. The operating mechanism includes a releasable cradle 121 (Fig. 5) which is releasably restrained by the trip device, and when released effects automatic opening of the breaker.

The trip device comprises a thermally responsive tripping bimetal element 123 having its lower end rigidly mounted by rivets 144 on a heater portion 125 which is at the highest temperature when an overload occurs. The heater element is a part of a conductor 127 which at its outer end is connected to a terminal 129.

The heater element 125 is similar in construction to that shown in H. J. Lingal Patent No. 2,047,739, issued July 14, 1936, and has a section 126 (Fig. 10) of reduced width and increased resistance to be heated by the current flow therethrough. The inner end of the conductor 127 is connected by suitable means in the circuit which extends through the breaker contacts. The current through the circuit of the breaker thus flows through the heater 125 and its hottest part is at 126 near its connection to the lower end of the tripping bimetal 123. The lower end of the tripping bimetal is thus heated by conduction from the hottest part of the heater and not merely by radiation, and being heated near its lower end gives the maximum deflection at its upper end due to the lever action of the length of the bimetal. A trip bar 131 (Figs. 5 and 7) common to all

of the poles of the breaker is pivotally mounted on spaced brackets **135** by means of pins **133** (Fig. 7). The spaced brackets **135** are mounted on a base **137** of insulating material. A latch **139** mounted on the trip bar cooperates with latch mechanism **141** to normally releasably restrain the releasable member **121** and the operating mechanism in operative position. A tripping electromagnet **143** is also provided for each pole of the breaker. The electromagnet comprises a U-shaped fixed magnet yoke **145** rigidly supported on an extension **147** of a bracket **149** mounted on the base **137** of the trip device. A movable armature **151** is slidably mounted on spaced studs **153** (only one being shown) on the base **137** and is biased to unattracted position by springs **155** surrounding the studs **153**. A member **157** is secured to the trip bar **131** in each pole and extends downwardly to be engaged by the armature **151** upon energization of the electromagnet to actuate the trip bar and effect release of the releasable member **121**. The member **157** for at least one of the poles extends above the trip bar **131** and is biased by a spring **159** to bias the trip bar to latching position.

An ambient temperature responsive bimetal element **161** (Figs. 5, 6 and 7) for each pole of the breaker is mounted on the trip bar **131** on the side thereof opposite the tripping bimetal element **123** but offset laterally from the latter as seen in Fig. 7. The bimetal elements **161** are mounted on brackets **163** which are rigidly attached to the trip bar **131**. The brackets **163** for the outer poles are mounted on the trip bar by rivets **165** which secure the members **157** to the trip bar and extend laterally to one side of the tripping bimetal elements where the bimetal elements **161** are suitably secured thereto. The rivet **165** for the center pole in addition to securing the member **157** and the bracket **163** to the trip bar also assists in securing the latch **139** to the trip bar. The ambient temperature responsive bimetal elements **161** are secured to the brackets **163** preferably by welding and form loops as at **167** (Figs. 5 and 6) extending around under the trip bar **131** so that the main portion of the bimetals **161** extend upwardly along the side of the trip bar adjacent the tripping bimetal element **123**. This makes the compensating bimetal about as long as if it were extended down along the heater section **124** but keeps it away from the hottest part of the tripping bimetal and heater. At their upper ends, each of the compensating bimetal elements **161** has rigidly secured thereto a bar **169** which extends laterally thereof to be engaged by a calibrating screw **171** in the upper end of the associated tripping bimetal element **123**. Thus, a longer length of ambient temperature bimetal is provided which results in more accurate calibration. While the ambient temperature responsive bimetal **161** is fairly close to the tripping bimetal **123** adjacent its upper end, it will be understood that the upper end of the tripping bimetal is not heated by any current flow through this bimetal and its upper end is remote from the heater portion **125** so that there is little heat transfer to the compensating bimetal **161** from the heater for the tripping bimetal element **123**.

The high-expansion sides of the tripping bimetal element **123** and the compensating bimetal element **161** are on the right-hand sides thereof as viewed in Figs. 5 and 6; consequently, the bimetal elements will bend in the same direction in response to changes in ambient temperature, thus maintaining substantially the same relation between the end of the calibrating screw **171** and the bar **169** during changes in ambient temperature. By spacing the ambient temperature responsive bimetal elements laterally from the current responsive bimetal elements the ambient temperature responsive bimetal elements are substantially shielded from the heat transfer by radiation from the current responsive bimetal elements and their heater sections **126**.

When a low overload current occurs the tripping bimetal element **123** is heated by the heater element **125** and when heated a predetermined amount bends toward the left (Fig. 5) causing the calibrating screw **171** to engage the bar **169** and, through the compensating bimetal **161**, moves the trip bar **131** counterclockwise and effects release of the cradle **121** and opening of all of the breaker contacts.

The circuit breaker is tripped open instantaneously by operation of the tripping electromagnet **143**. When the magnet is energized by an overload current of, for instance, 1000% or more of normal rated current, or by a short-circuit current, the armature **151** is attracted toward the magnet yoke **145**, engaging the member **157** and actuating the trip bar **131** to effect instantaneous release of the cradle **121** and automatic opening of the breaker contacts.

The invention provides a circuit breaker embodying a trip device including a thermally responsive tripping bimetal and having an improved ambient temperature compensating bimetal means that is mounted in a plane substantially parallel to but spaced from the tripping bimetal and also spaced laterally from the tripping bimetal. By this construction the facing surfaces of the bimetal elements are disposed a substantial distance apart so that the compensating bimetal is relatively unaffected by the heat of the tripping bimetal.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from the spirit of the invention.

We claim as our invention:

1. A circuit breaker having relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a trip member movable to cause release of said releasable means, a heater element, a thermally responsive non-current carrying tripping bimetal element having one end supported on said heater element and the other end free, said tripping bimetal element being heated by said heater element in response to the current of the circuit, an ambient temperature responsive bimetal element having one end supported on said trip member and the other end free, said ambient temperature responsive bimetal element having a portion extending in a plane substantially parallel to but spaced from said tripping bimetal element, support means on said trip member on the side thereof opposite said tripping bimetal element supporting said one end of said ambient temperature responsive bimetal element at a point spaced laterally from the heated end of said tripping bimetal element, the free end of said tripping bimetal element upon thermal bending thereof actuating said ambient temperature responsive bimetal element to move said trip member and effect release of said releasable means.

2. A circuit breaker having relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a trip member movable to effect release of said releasable means, a thermally responsive tripping bimetal element having one end supported and the other end free, said tripping bimetal extending along one side of said trip member and heated by the current of the circuit, an ambient temperature responsive bimetal element having one end supported on said trip member and the other end free, said ambient temperature responsive bimetal element extending in a plane substantially parallel to said tripping bimetal, a separate support member having one end secured to said trip member on the side thereof opposite said tripping bimetal element mounting the supported end of said ambient temperature responsive bimetal element at a point spaced laterally from said tripping bimetal element, the free end of said tripping bimetal element upon thermal bending thereof actuating said ambient tem-

perature responsive bimetal element to move said trip member and effect release of said releasable means.

3. A circuit breaker having relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a pivoted trip member movable to cause release of said releasable means, a thermally responsive tripping bimetal element having one end supported and the other end free and extending adjacent one side of said trip member, said tripping bimetal being heated in response to the current of the circuit, an ambient temperature responsive bimetal element having one end supported on said pivoted trip member and the other end free, a separate support member having one end secured to said trip member and the other end mounting the supported end of said ambient temperature responsive bimetal element on the side of said trip member opposite said tripping bimetal but spaced laterally therefrom, said ambient temperature responsive bimetal element extending around said trip member and along the side of said trip member adjacent said tripping bimetal element, the free ends of said bimetal elements being disposed adjacent to each other, and means on the free end of said ambient temperature responsive bimetal element engageable by the free end of said tripping bimetal element upon thermal bending thereof to move said trip member and cause release of said releasable means.

4. A multipole circuit breaker having relatively movable contacts for each pole and means releasable to effect automatic opening of said contacts, a trip member common to all of said poles operable to effect release of said releasable means, a thermally responsive tripping bimetal element for each pole disposed to be heated in response to the current of the circuit of the associated pole and extending adjacent one side of said trip member, a heater element in each pole supporting said tripping bimetal elements, an ambient temperature responsive bimetal element for each pole having one end supported on said trip member, said ambient temperature responsive bimetal elements extending in a plane substantially parallel to but spaced from said tripping bimetal elements, support members having one end secured to said common trip member on the side thereof opposite said tripping bimetal element and their other ends supporting said ambient temperature responsive bimetal elements at a point spaced laterally from the corresponding tripping bimetal elements, the end of each of said tripping bimetal elements actuating the ambient temperature responsive bimetal element for the associated pole upon thermal bending of said tripping bimetal element to operate said common trip member and effect release of said releasable means.

5. A multipole circuit breaker having relatively movable contacts for each pole and means releasable to effect automatic opening of said contacts, a trip member common to all of said poles operable to effect release of said releasable means, a heater element for each pole a thermally responsive tripping bimetal element for each pole mounted on the heater for its pole disposed to be heated by said heater element in response to the current of the circuit of the associated pole and extending adjacent one side of said trip member, an ambient temperature responsive bimetal element for each pole having one end supported on said trip member, said ambient temperature responsive bimetal elements extending in a plane substantially parallel to but spaced from said tripping bimetal elements, support members having one end secured to said common trip member on the side thereof opposite said tripping bimetal element and their other ends supporting said ambient temperature responsive bimetal elements at a point spaced laterally from the corresponding tripping bimetal elements, said support members for at least one of the outer poles supporting the ambient temperature responsive bimetal elements for said outer pole at a point beyond the end of said common trip member, the end of each of said tripping bimetal elements actuating the ambient temperature responsive bimetal element for the associated pole upon thermal bending of said tripping bimetal element to operate said common trip member and effect release of said releasable means.

6. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device comprising a trip member movable to cause release of said releasable means, a heater element heated by the current of the circuit, a tripping bimetal element having one end mounted on said heater element to be heated by conduction from said heater element, an ambient temperature responsive bimetal element having one end supported on said trip member and the other end free, said free end of said ambient temperature responsive bimetal being disposed to be engaged by said tripping bimetal to move said trip member, and the end of said ambient temperature responsive bimetal element nearest the heated end of said tripping bimetal element being offset laterally from said tripping bimetal.

7. A circuit breaker having relatively movable contacts and operating means releasable to effect opening of said contacts, a trip device comprising a trip member movable to cause release of said operating means, a heater element heated by the current of the circuit, a tripping bimetal element having one end supported on said heater element to be heated by conduction from said heater element and the other end free, an ambient temperature bimetal element having one end supported on said trip member and the other end disposed to be engaged by the free end of said tripping bimetal element to move said trip member, said supported end of said ambient temperature responsive bimetal element being bent around said trip member and mounted on said trip member on the side thereof opposite said tripping bimetal and offset laterally from said heater element.

8. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device comprising a trip member movable to cause release of said releasable means, a heater element heated by the current of the circuit, a tripping bimetal element having one end mounted on said heater element to be heated by conduction from said heater element, an ambient temperature responsive bimetal element having one end supported on said trip member and the other end free, said free end of said ambient temperature responsive bimetal being disposed to be engaged by said tripping bimetal to move said trip member, and the end of said ambient temperature responsive bimetal element nearest the heated end of said tripping bimetal element being offset laterally from said tripping bimetal, the end of said ambient temperature responsive bimetal element nearest the heated end of said tripping bimetal element being bent around said trip member and mounted on the side of said trip member opposite the heated end of said tripping bimetal.

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