Nov. 12, 1957 M. BINGENHEIMER ET AL 2,813,167

CIRCUIT BREAKER

Filed July 21, 1953

Fig.1.

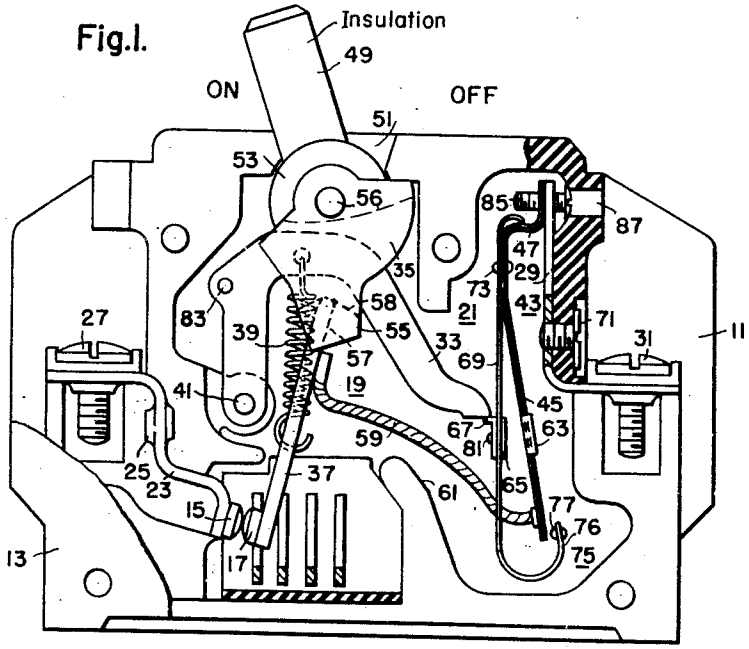
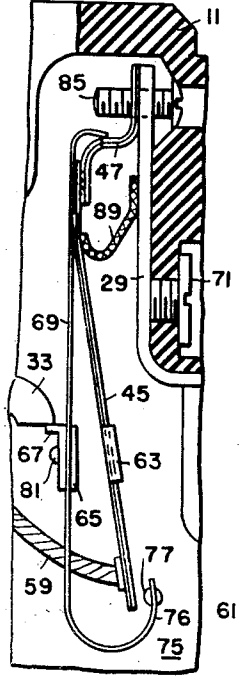


Fig.3.



WITNESSES:

E. A. McCloskey.

Paul H. Harlow.

Fig.2.

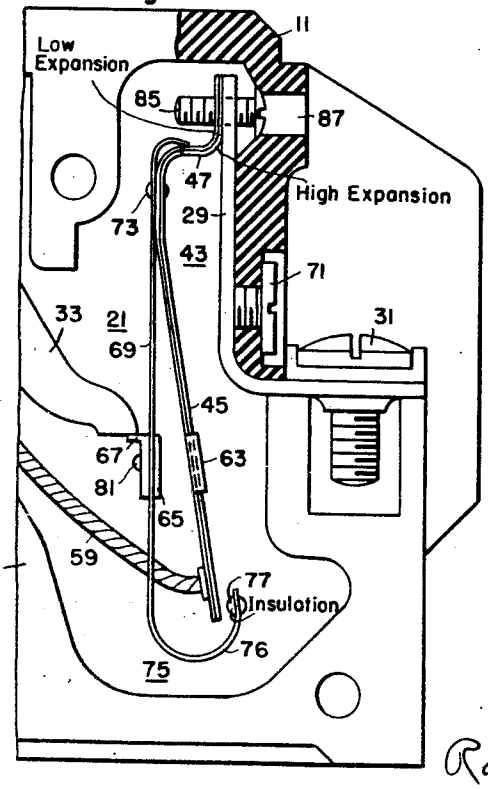
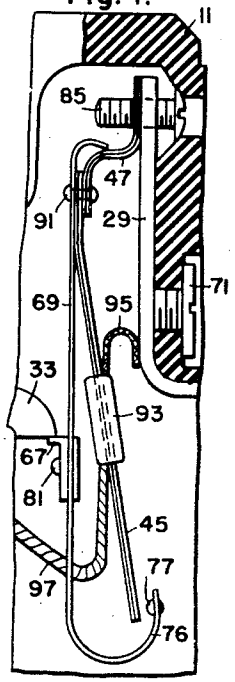


Fig.4.



INVENTORS

Melvin Bingenheimer

and Eugene J. Walker.

BY

Ralph H. Swingle

ATTORNEY

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CIRCUIT BREAKER

Melvin Bingenheimer and Eugene J. Walker, Beaver, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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11 Claims. (Cl. 200—88)

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

An object of the invention is to provide a circuit breaker embodying an improved thermally and magnetically responsive trip device including a temperature compensating element wherein the thermally responsive trip element and the magnetically responsive means are supported entirely on the temperature compensating element.

Another object of the invention is to provide a circuit breaker embodying an improved thermally and magnetically responsive trip device having the trip member, the thermally responsive element and the magnetically responsive means supported entirely on an ambient temperature compensating element.

Another object of the invention is to provide a circuit breaker according to the preceding paragraphs wherein functioning of the temperature compensating element does not alter the magnetic trip characteristics of the device.

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 a preferred embodiment thereof, when read in conjunction with the accompanying drawing.

In said drawing:

Fig. 1 is a side elevational view, with the cover plate broken away and partly in section, of a circuit breaker embodying the principles of the invention;

Fig. 2 is an enlarged side elevational view partly in section of a portion of the circuit breaker showing the trip device.

Fig. 3 is an enlarged fragmentary view showing a modification of the bimetal structure.

Fig. 4 is a view similar to Fig. 3 showing a further modification of the bimetal structure.

Referring to Fig. 1 of the drawing, the circuit breaker comprises generally, a housing **11** and a cover plate **13** therefor of molded insulating material, the cover plate being largely broken away to more clearly show the mechanism, stationary contact means **15** and cooperating 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 multi-angular terminal member **23** which is seated in an angular slot **25** molded in one end wall of the housing **11**. The outer end of the terminal **23** is provided with a connecting means **27** for connecting the terminal **23** in an electric circuit. At the opposite end of the housing **11** is disposed a terminal member **29** which, at its inner end, supports the trip device **21** to be described later. The terminal **29** at its outer end is provided with a connecting means **31** for connecting the terminal in an electric circuit.

The movable contact **17** is rigidly secured on the free end of a U-shaped switch member **37** having its legs **57** supported in recesses **58** in legs **55** of a U-shaped operating lever of molded insulating material. The operating lever

35 is pivotally supported by means of trunnions **56** molded integral therewith and mounted in an opening in the housing **11** and in a companion opening in the cover plate **13**. An overcenter operating spring **39** is connected under tension between the bight of the switch member **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 integral operating handle **49** extending out through an opening **51** in the housing **11**. The operating lever is also provided with an integral arcuate portion **53** which cooperates with the housing **11** to substantially close the opening **51** in all positions of the handle. The switch member **37** is electrically connected by means of a flexible conductor **59** to one end of a thermally responsive bimetal element **45** forming a part of the trip device **21**.

The switch member **37** is operated to manually open and close the contact means by manipulation of the handle **49**. Movement of the handle in a clockwise direction from the Fig. 1 position carries the legs **57** of the switch member **37** across to the left of the line of action of the operating spring **39** which then biases the switch member to the open position and causes movement thereof to open position and opening of the contacts with a snap action.

The contacts are manually closed by reverse movement of the operating handle **49**. Counterclockwise movement of the handle from the "off" position to the "on" position moves the legs **57** of the switch member **37** across to the right of the line of action of the operating spring **39** which thereupon acts to close the contacts with a snap action.

The circuit breaker is tripped open instantaneously in response to overload currents above a predetermined value, or short circuit currents, and after a time delay in response to overload currents below the predetermined value by operation of the trip device **21**. Operation of the trip device **21** releases the carrier **33** whereupon the operating spring **39** moves the carrier clockwise about the pivot pin **41**, moving the line of action of the overcenter operating spring **39** across to the right of the center line of the switch arm **37**. The spring **39** then acts to move the switch arm **37** to the open position with a snap action. The movement of the carrier **33** is arrested by its engagement with a projection **61** on the housing **11**.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and relatch the mechanism. This is accomplished by moving the handle **49** clockwise to the full "off" position during which movement the legs **55** of the operating lever **35** engage a pin **83** in the carrier **33** and move the carrier counterclockwise about its pivot **41**. Near the end of the counterclockwise movement, the free end of the carrier **33** wipes by a latch member **67**, slightly flexing a resilient member **69** which then moves the latch member **67** back into latching engagement with the end of the carrier **33**. Thereafter, the switch member is moved to close the contacts **15—17** in the previously described manner, by movement of the operating handle counterclockwise to the "on" position.

The trip device **21** comprises a compound bimetal element indicated generally at **43** comprising a tripping portion **45** and an ambient temperature compensating portion **47**. The free end of the tripping bimetal element **45** is connected by means of the flexible conductor **59** to the switch member **37**. The tripping bimetal **45** and the compensating bimetal **47** may be formed from either a single piece of compound bimetal or from separate pieces of bimetal having similar or different characteristics according to the tripping and compensating characteristics desired. The two bimetal portions **45** and **47** if made from separate pieces may be rigidly joined in any suitable

manner such as by welding, riveting or brazing as shown in Figs. 3 and 4. Preferably the bimetals are rigidly joined by means of a butt weld (Fig. 2) with their high expansion sides on opposite sides, the high expansion side of the tripping bimetal 45 being on the left adjacent the resilient member 69 and the high expansion side of the compensating bimetal being on the right thereof adjacent the terminal 29. The terminal 29 extends along the inner surface of the adjacent end wall of the housing 11 and is secured thereto by means of a screw 71 and the compensating bimetal 47 is rigidly secured to the inner end of the terminal 29 in any suitable manner preferably by welding. Just below the point of attachment of the compensating bimetal 47 to the terminal 29 the bimetal element 47 is formed inwardly and the tripping bimetal 45 is secured thereto at this point. The tripping bimetal 45 is then formed downwardly and extends for a short distance substantially parallel to the terminal 29 to form a flat surface to which the resilient member 69 is secured. The resilient member 69 is rigidly attached to the bimetal 45 by a rivet 73 (Fig. 2) as illustrated or by welding. Below the point of attachment of the resilient member 69 to the tripping bimetal element 45, the latter extends downwardly at an angle to the terminal 29. The lower end of the resilient member 69 is looped as shown at 75 and the upwardly extending free end 76 of the loop which is disposed adjacent the low expansion side of the tripping bimetal carries an insulating button 77 for insulating the free end of the tripping bimetal 45 from the resilient member 69.

A magnetic member or magnet yoke 63 is rigidly mounted on the tripping bimetal element 45 preferably by welding and a magnetic member or armature 65 is rigidly secured to the resilient member 69 by means of a rivet 81 which also serves to secure the latch member 67 to the resilient member 69. As shown, the latch member 67 normally engages and releasably restrains the carrier 33 in operative position and is the actuating member or portion which when moved initiates movement of the movable member or carrier 33 to effect separation of the contact means.

With normal rated current flowing through the bimetal 43 the magnetic member 63 is not sufficiently energized to attract the armature 65. Upon the occurrence of an overload current above the rated current but below a predetermined value of, for instance 1000% of normal rated current, the tripping bimetal 45 is heated by the current flow therein and deflects moving the free end thereof toward the right. As the tripping bimetal element deflects, it engages the insulating button 77 and moves the lower end of the trip member 69 in the same direction against its bias causing the latch or actuating portion 67 to release the carrier 33 whereupon the operating mechanism functions in the previously described manner to automatically open the contacts.

When a heavy overload current or a short circuit current of, for example 1000% or more of rated current, occurs the current flowing through the bimetal element 43 energizes the magnetic member 63 sufficiently to cause it to attract the armature 65 which bends the resilient member 69 toward the right releasing the carrier 33 and effecting substantially instantaneous opening of the breaker contacts.

As previously stated, the high expansion side of the tripping bimetal 45 is on the left adjacent the resilient member 69. Consequently, an increase in the temperature of the surrounding medium would cause the tripping bimetal to bend toward the right or in tripping direction. However, the increase in ambient temperature will cause the compensating bimetal 47, which has its high expansion side on the right and lower side thereof, to bend upwardly which will move the trip device including the tripping bimetal 45, the resilient member 69 and the electroresponsive means 63—65 toward the left without changing the air gap of the electroresponsive means. This action maintains the same latch overlap so that the thermal tripping time of the circuit breaker for a given value of overload current will be substantially the same regardless of changes in ambient temperature.

Adjusting means is provided whereby the tripping point of the thermal trip may be varied without changing the magnetic air gap of the magnetic members 63—65. The adjusting means comprises an adjusting screw 85 threadedly engaging the upper end of the terminal 29 and having its rounded head seated in a concave seat in the housing 11. One access opening 87 in the housing permits the insertion of a tool for turning the screw 85 to thereby adjust the trip device. The opening 87 may be sealed following calibration to prevent tampering by unauthorized persions.

Fig. 3 illustrates a somewhat different bimetal structure. In the form shown in Fig. 3, the ends of the bimetal elements 45 and 47 overlap and are rigidly secured together by welding or brazing substantially as illustrated. The spring or biased trip member 69 is welded or brazed to the bimetal 45 instead of being secured thereto by a rivet as shown in Fig. 2. The upper end of the tripping bimetal element 45 is connected at a point just below compensating bimetal element 47 to the terminal conductor 29 by means of a flexible shunt conductor 89. The flexible conductor 89 shunts the current around the compensating bimetal element 47 so that this bimetal is not heated by the current.

According to the modification shown in Fig. 4 the upper end of the tripping bimetal element 45 overlaps the lower end of the compensating bimetal element 47 and the bimetal elements and the spring members 69 are rigidly secured together by means of a rivet 91.

A heater element 93 (Fig. 4) is provided to heat the tripping bimetal 45 in response to overload currents. The heater element 93 has one end connected by means of a flexible conductor 95 to the terminal conductor 29 and the other end of the heater is connected by means of a flexible conductor 97 to the switch arm 37 (Fig. 1).

The invention provides a circuit breaker having few parts and of simple and inexpensive construction embodying an improved trip device in which all of the elements are mounted at a single point on one of the terminals of the breaker. The tripping bimetal element, the electromagnetic trip device and the latch member are all mounted on the compensating bimetal which, in turn, is supported on the breaker terminal. The compensating bimetal element moves the entire trip device in response to a change in ambient temperature to compensate the device for changes in ambient temperature. This results in approximately the same thermal tripping for an overload current of given value regardless of the temperature of the surrounding atmosphere.

While the form of mechanism shown and described herein is admirably adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to confine the invention to the form of embodiment disclosed herein, for it is susceptible of embodiment in various forms without departing from the spirit of the invention.

We claim as our invention:

1. In a circuit breaker, separable contact means, a movable member for effecting separation of said contact means upon the occurrence of an overload, a trip device comprising a single piece of compound bimetal having a temperature compensating portion, and a tripping portion which bends when heated, said portions of said bimetal being butt joined at one end thereof, means rigidly supporting the compensation portion of said bimetal, an actuating member mounted on the tripping portion of said bimetal and movable thereby, said member when moved to a predetermined position initiating movement of said movable member to effect separation of said contact means, and said compensating portion of said bimetal deflecting in response to changes in ambient

temperature to bodily move said tripping portion and said actuating member while said tripping portion of said bimetal and said actuating member maintain substantially the same positions relative to each other.

2. In a circuit breaker, separable contact means, a movable member for effecting separation of said contact means upon the occurrence of an overload, a trip device comprising a single piece of compound bimetal having a temperature compensating portion, and a tripping portion which bends when heated, said portions of said bimetal being butt joined at one end thereof and having their high-expansion sides in reverse positions whereby deflection of said temperature compensating portion bodily moves said trip device and compensates said trip device for changes in the ambient temperature, means rigidly supporting the temperature compensating portion of said bimetal, a trip member supported adjacent the supported end of said tripping portion of said bimetal and actuated by said bimetal upon thermal bending thereof, said temperature compensating portion of said bimetal deflecting in response to changes in ambient temperature to bodily move said tripping portion of said bimetal and said trip member while said tripping portion of said bimetal and said trip member maintain substantially the same positions relative to each other, and said trip member when actuated to a predetermined position initiating movement of said movable member to effect separation of said contact means.

3. In a circuit breaker, separable contact means, a movable member for effecting separation of said contact means upon the occurrence of an overload, a trip device comprising a bimetal having a temperature compensating portion, and a tripping portion which bends when heated, said portions of said bimetal being butt joined at one end and having their high-expansion sides in reverse positions whereby deflection of said temperature compensating portion compensates said trip device for changes in the ambient temperature, means rigidly supporting the temperature compensating portion of said bimetal, a trip member supported adjacent the supported end of said bimetal and actuated by said bimetal upon thermal bending thereof, said trip member when actuated to a predetermined position initiating movement of said movable member to effect separation of said contact means, and electromagnetic means comprising a member of magnetic material on said bimetal, and an armature on said trip member, said magnetic member and said armature having an air gap between them, said tripping portion of said bimetal, said trip member and said electromagnetic means being supported on said compensating portion of said bimetal, and said armature being attracted to said member of magnetic material upon a sudden excessive overload to actuate said trip member, and said compensating portion of said bimetal element deflecting in response to changes in ambient temperature to bodily move said trip device to thereby compensate said trip device for changes in ambient temperature while said air gap remains substantially constant.

4. In a circuit breaker having a spring actuated trip arm, a temperature compensating bimetal mounted at one end and having its other end movable, a trip device supported on said temperature compensating bimetal adjacent the movable end thereof and operable to effect release of said trip arm, said trip device comprising a tripping bimetal and a magnetic member carried thereon, said tripping bimetal being joined adjacent one end thereof to the movable end of said temperature compensating bimetal, said bimetals having their high and low expansion sides in reverse position whereby deflection of said compensating bimetal moves the tripping bimetal of said trip device to compensate for changes in ambient temperature, and means movable by said tripping bimetal upon thermal bending of said tripping bimetal to cause release of said trip arm, an armature portion on said movable means opposite the magnetic

member on said tripping bimetal, and deflection of said temperature compensating bimetal moving said end of the tripping bimetal mounted thereon while said magnetic member on the tripping bimetal and said armature portion on the movable means maintain substantially the same positions relative to each other.

5. In a circuit breaker comprising a casing, contact means and means releasable to effect opening of said contact means, a conducting member extending into said casing, a temperature compensating bimetal having one end mounted on said conducting member and the other end free, a trip device supported on said compensating bimetal comprising a tripping bimetal supported on said temperature compensating bimetal and operable to release said releasable means, said bimetals being butt joined and having their high and low expansion sides in reverse positions whereby deflection of said temperature compensating bimetal compensates said tripping bimetal for changes in the ambient temperature, a biased member mounted on said tripping bimetal and operative upon thermal bending of said tripping bimetal to cause release of said releasable means, and electromagnetic means comprising a magnetic member on said tripping bimetal and an armature on said biased member having an air gap therebetween, said armature being operable upon a sudden excessive overload to operate said biased member and effect release of said releasable means, said tripping bimetal, said biased member and said electromagnetic means all being supported on said temperature compensating bimetal so that deflection of said compensating bimetal bodily moves said trip device to compensate said trip device for changes in ambient temperature while said air gap remains substantially constant.

6. In a circuit breaker comprising a casing, separable contact means and means releasable to effect separation of said contact means, a conducting member extending into said casing and rigidly secured thereto, a trip device operable to effect release of said releasable means comprising a first bimetal having one end mounted on the inner end of said conducting member and the other end free, a second bimetal butt joined to the free end of said first bimetal, said bimetals having their high and low expansion sides in reverse positions whereby the deflection of one of said bimetals compensates the other bimetal for changes in ambient temperature, a biased member mounted adjacent the second of said bimetals and extending along one side thereof, said biased member having a portion disposed adjacent the other side of said second bimetal, deflection of said first bimetal moving said second bimetal and said biased member while said second bimetal and said biased member maintain substantially the same positions relative to each other, said biased member when moved to a predetermined position causing release of said releasable means, and said second bimetal deflecting when heated a predetermined amount in response to overload currents to move said biased member.

7. In a circuit breaker comprising a casing, separable contact means and means releasable to effect separation of said contact means, a conducting member extending into said casing and rigidly secured thereto, a trip device operable to effect release of said releasable means comprising a temperature compensating bimetal having one end supported on the inner end of said conducting member and the other end free, a current responsive tripping bimetal having one end butt joined to and supported on the free end of said compensating bimetal, said bimetals having their high and low expansion sides in reverse positions whereby the deflection of said compensating bimetal compensates said current responsive bimetal for changes in ambient temperature, a resilient member having one end supported on one of said bimetals, said resilient member extending along one side of said current responsive bimetal and having a portion disposed adjacent the opposite side of said current responsive bimetal, said resilient

member when moved to a predetermined position effecting release of said releasable means and separation of said contact means, thermal bending of said current responsive bimetal moving said resilient member to cause release of said releasable means, and said temperature compensating bimetal deflecting in response to changes in ambient temperature to bodily move said current responsive bimetal and said resilient member to compensate said trip device while said current responsive bimetal and said resilient member maintain substantially the same positions relative to each other.

8. In a circuit breaker having a spring actuated trip arm, a trip device operable to effect release of said trip arm comprising a current responsive bimetal, an actuating mmeber mounted on said bimetal on one side thereof and having a portion disposed adjacent the other side of said bimetal, said actuating member when moved to a predetermined position causing release of said trip arm, electroresponsive means comprising a magnetic member mounted on said bimetal and an armature mounted on said actuating member, said magnetic member and said armature having an air gap therebetween, thermal bending of said current responsive bimetal moving said actuating member to effect release of said trip arm, said armature being drawn to said magnetic member upon a sudden excessive overload to effect release of said trip arm, an ambient temperature responsive bimetal having one end supported and the other end free, said current responsive bimetal being butt joined to the free end of said ambient temperature responsive bimetal so that the latter supports said trip device including said current responsive bimetal, said actuating member and said electroresponsive means, and said bimetals having their high and low expansion sides in reverse positions whereby deflection of said compensating bimetal moves said current responsive bimetal and said actuating member to compensate said trip device for changes in the ambient temperature while said air gap remains substantially the same.

9. In a circuit breaker having separable contact means and means releasable to effect separation of said contact means, a temperature compensating bimetal having one end rigidly supported and the other end free, a trip device for effecting release of said releasable means comprising a tripping bimetal mounted on said temperature compensating bimetal, a biased member mounted on said tripping bimetal and operative upon thermal bending of said tripping bimetal to effect release of said releasable means, electromagnetic means comprising a magnetic member and an armature having an air gap therebetween, said magnetic member being mounted on said tripping bimetal, said armature being mounted on said biased member and operable upon the occurrence of sudden excessive overload currents to operate said biased member and effect release of said releasable means, all of the parts of said trip device including the tripping bimetal, the biased member and the electromagnetic means being supported on said temperature compensating bimetal whereby deflection of said temperature compensating bimetal bodily moves said trip device to compensate said trip device for changes in ambient temperatures while permitting said air gap to remain substantially constant.

10. In a circuit breaker having separable contact means and means releasable to effect separation of said contact means, a temperature compensating bimetal having one end rigidly supported and the other end free, a trip device for effecting release of said releasable means comprising a tripping bimetal mounted on the free end of said temperature compensating bimetal, a biased member mounted on said tripping bimetal and operable by thermal bending of said tripping bimetal to effect release of said releasable means, and deflection of said temperature compensating bimetal bodily moving said trip device including said tripping bimetal and said biased member to compensate said trip device for changes in ambient temperature while said tripping bimetal and said biased member maintain substantially the same positions relative to each other.

11. In a circuit breaker comprising a casing, separable contact means and means releasable to effect separation of said contact means, a conducting member extending into said casing and rigidly secured thereto, a trip device operable to effect release of said releasable means comprising a first bimetal having one end mounted on the inner end of said conducting member and the other end free to move, a second bimetal joined to the free end of said first bimetal, said bimetals having their high and low expansion sides in reverse positions whereby the deflection of one of said bimetals compensates the other bimetal for changes in ambient temperature, a member of magnetic material mounted on said second bimetal, a biased member mounted adjacent the second of said bimetals and extending along one side thereof, said biased member having a portion disposed adjacent the other side of said second bimetal, an armature portion on said biased member opposite the member of magnetic material on the second bimetal for attraction thereto, deflection of said first bimetal moving the end of said second bimetal joined thereto while the member of magnetic material mounted on said second bimetal and the armature portion on said biased member maintain substantially the same positions relative to each other, said biased member when moved to a predetermined position causing release of said releasable means, and said second bimetal deflecting when heated a predetermined amount in response to overload currents to move said biased member.

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