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CIRCUIT BREAKER WITH AMBIENT COMPENSATION MEANS

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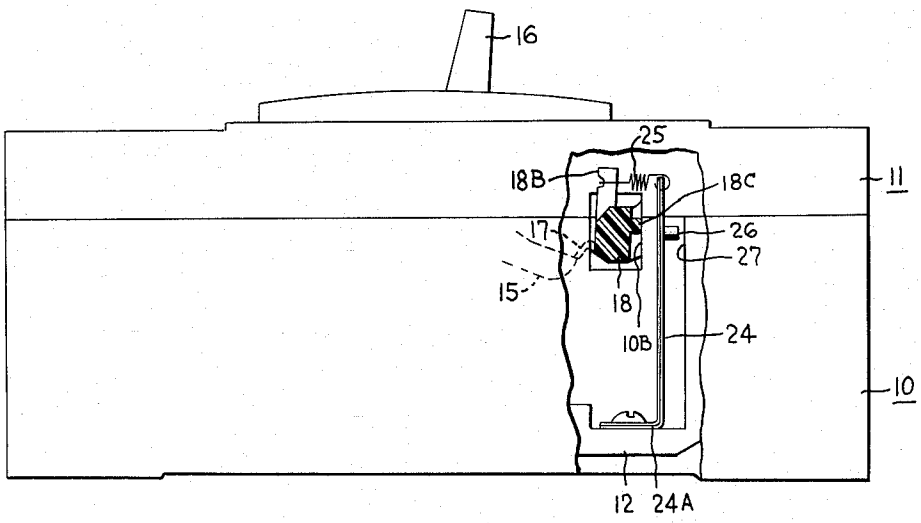


FIG. 1

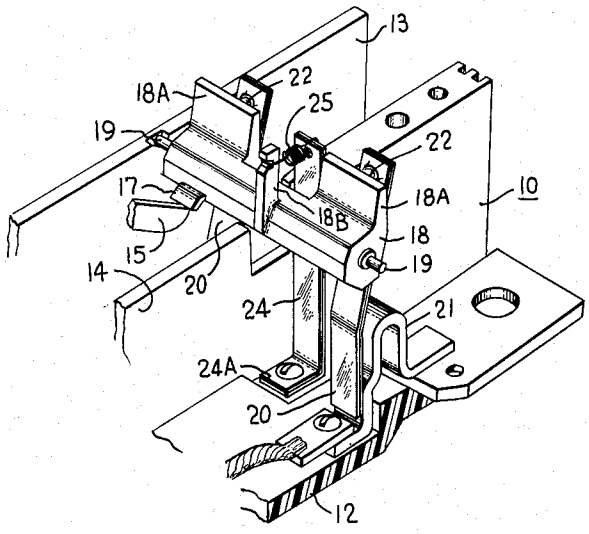


FIG. 2

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CIRCUIT BREAKER WITH AMBIENT COMPENSATION MEANS

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My invention relates to electric circuit breakers, and more particularly to electric circuit breakers of the type including thermal current responsive means and means for correcting such thermal current responsive means to compensate for changes in circumambient temperature.

Automatic circuit breakers including thermal current responsive means are subject to variation in their operating characteristics depending upon the temperature of the ambient air in which they are located. Thus a circuit breaker located in air of 90° temperature will not carry as much current without tripping as the same breaker will carry when located in air having a temperature of 40°.

It is a general object of the present invention to provide means for compensating automatic circuit breakers including thermal current responsive means for ambient temperature changes which means is simple, inexpensive and easy to install.

It is another object of the invention to provide such ambient compensating means which requires only a single compensating bimetal for a circuit breaker having two or more poles.

It is another object of the invention to provide compensating means for an electric circuit breaker of the type including a releasable latch system, which compensating means operates on the latch system but does not alter the amount of latch-overlap.

Other objects of the invention will in part become obvious and in part be pointed out in the following detailed description, and the scope of the invention will be pointed out in the appended claims.

In accordance with the invention in one form, an electric circuit breaker is provided of the type including a plurality of pole chambers, with at least one movable contact in each pole chamber. Operating means is provided for operating all such contact members in unison between open and closed circuit position. The operating mechanism includes a common tripping member extending across all poles of the circuit breaker and movable to initiate automatic opening. Thermal current responsive means is provided in each of the poles which is responsive to current passing through such pole, and which operates on the common trip bar to cause opening upon the occurrence of predetermined current conditions. Means is provided for compensating for changes in ambient temperature, comprising a biasing spring having one end connected to the common trip bar and having its other end connected to the movable end of a compensating bimetallic strip. The compensating bimetallic strip is disposed and arranged so that upon increase in temperature, the movable end moves in a direction to increase the tension of the bias spring acting on the common trip member. Thus at relatively higher temperatures, the thermal current responsive means of each pole must produce relatively greater force in order to cause tripping movement of the common trip bar. Such relatively greater force in turn, requires the generation of more heat by the thermal current responsive means, thereby permitting more current to flow before tripping occurs than would otherwise be the case. This action compensates for the effect of ambient temperature on the thermal current responsive means.

The invention will be more fully understood from the following detailed description, and its scope will be pointed out in the appended claims.

Referring to the drawings,

FIGURE 1 is a side elevation view of an electric circuit breaker incorporating the invention, and

FIGURE 2 is a fragmentary perspective view of the trip device portion of the circuit breaker of FIGURE 1.

Referring to FIGURE 1, the invention is shown as incorporated in an electric circuit breaker of the molded case type including an insulating base portion **10** and an insulating cover **11**. The base **10** includes a bottom wall **12** and opposed side wall portions **13**, with intermediate partitions **14** dividing the enclosure into a pair of "pole chambers." A two-pole breaker is shown for convenience. It will be understood, however, that the invention is equally usable with single, two or three or more pole breakers.

Each of the pole chambers includes a pair of relatively movable contacts, not shown, the movable contacts of all poles being ganged together for movement in unison between open and closed circuit positions. Operating mechanism, not shown, is provided, including a releasable member **15** (FIG. 1) which, when released, causes automatic opening of all of the contacts. The operating mechanism is manually operable by means of a handle member **16**.

The releasable member **15** is normally restrained in latched position by means of a latch projection **17** carried by a common trip bar **18** extending across all poles of the circuit breaker. The common trip bar **18** is supported for pivotal movement by suitable bearing supports at opposite ends **19**, such as by notches in the side walls **13**. Rotation of the common trip bar **18** in counterclockwise direction withdraws the latch project **17** from the releasable member **18**, initiating automatic opening.

Thermal current responsive means is provided for each of the poles of the circuit breaker, each of such means comprising an elongated bimetallic strip **20** rigidly attached at one end to a generally U-shaped heater conductor **21** having the opposite ends thereof rigidly attached to the bottom wall **12** of the base **10**. The upper end of each of the bimetallic strips **20** carries an actuating or calibrating screw **22**. Each calibrating screw **22** is adapted to engage a corresponding projecting portion **18A** of the common trip bar **18**, to rotate the common trip bar in counterclockwise direction to cause tripping.

In order to provide ambient temperature compensation, there is provided, in accordance with the invention, a single ambient compensating bimetallic strip **24**, having one end **24A** bent over and fixedly attached to the bottom wall **12** of the circuit breaker base **10**. The upper end of the compensating strip **24** has attached thereto one end of a coil type tension biasing spring **25**, the other end of which is hooked around an upstanding boss or projection **18B** carried by the common trip bar **18**. The compensating bimetallic strip **24** also carries a stop member **26** (FIG. 1) which is engageable with an abutment **27** of the base **10** upon predetermined deflection of the compensating bimetallic strip **24**, to limit the possible deflection of the upper end of the strip, and hence the possible degree of ambient compensation.

Rotation of the common trip bar **18** in clockwise direction by the biasing spring **25** is limited by engagement of a portion **18C** with an abutment portion **10B** of the base **10**. This engagement fixes the normal position of the trip bar **18**, and in turn, determines the amount of overlap between the latch member **17** and the latched or releasable member **15**.

In operation, at normal or reference ambient temperatures, the upper end of the bimetallic strip **24** is positioned in a predetermined position so as to exert a given amount of bias on the common trip bar **18**. On the occurrence of predetermined overload conditions in the circuit, one or both of the bimetals **20** is heated and deflects so as to move its calibrating screw **22** into

engagement with the projection portion 18A of the common trip bar, rotating the common trip bar to cause tripping.

As is well known, the temperature of a bimetallic strip must be increased to a predetermined point in order to provide a predetermined amount of deflection against a predetermined bias or load. Also, increase of the temperature of a bimetallic strip follows a well-known inverse-time curve relationship, which means generally that a given temperature can be reached by the existence of a high current for a relatively short time or by the existence of a relatively low current for a relatively long time.

It will be understood that this general relationship must be modified in accordance with the rate of heat loss by the bimetallic strip to surrounding elements and so forth. In general, however, it may be stated that when the circuit breaker is calibrated with reference to a particular ambient temperature, there is a particular maximum amount of current which can be carried by the circuit breaker indefinitely without causing tripping. Since an increase in ambient-temperature can be expected to cause an increase in temperature of all parts of the circuit breaker including the bimetallic strips **20**, any substantial increase in such ambient temperature would normally cause tripping at a current less than the aforesaid maximum current. Stated conversely, since such elevated ambient temperature supplies a portion of heat to the bimetallic strip, some lesser value of current is required to cause the bimetallic strip to move to tripping position.

In accordance with the invention, however, the ambient compensating bimetal **24** is also heated by an increase in ambient temperature, and it is so disposed and arranged that upon increase in temperature its free end moves to the right as viewed to increase the tension of the bias spring **25**. An increase in the strength of the bias spring **25**, in turn, means that the current responsive bimetallic strips **20** must attain a higher temperature in order to cause tripping. Thus the net effect is to enable each pole of the circuit breaker to carry current of the same or substantially the same magnitude as the aforementioned maximum current value even though the ambient temperature has increased.

For reasons of safety, it is desirable that the action of the compensating bimetallic strip **24** be limited. Thus it is usually desirable that if the ambient temperature increases beyond a predetermined amount, the circuit breaker should be opened even though little or no heat is being contributed by current. For this reason, the ambient compensating bimetal **24** is provided with a stop projection **26** which engages a corresponding abutment **27** of the base **10** and limits movement of the upper end of the compensating bimetallic strip **24** to the right as viewed. It will be noted that this limiting action takes place without further restricting the warping of the compensating bimetal, since the compensating bimetal is free to warp further even though the upper end does not change its position following engagement of the stop **26** with the abutment **27**. When such excess deflection occurs, the upper end of the compensating bimetal strip changes it angle slightly, but this has no substantial effect on the length of the biasing spring **25**.

It will be observed that the ambient compensating system disclosed is relatively inexpensive and requires only a single compensating bimetal for a plurality of poles. The system does not interfere with the latching arrangement used at each of the poles. If desired, it may be readily omitted by substituting a stationary anchor for the end of the biasing spring **25**. In addition, the system makes possible the use of a relatively sensitive ambient compensating bimetal since a relatively long length may be used, the length generally being substantially equal to that of the current responsive bimetals **20**.

An important feature of the invention is that deflection of the compensating bimetal **24** does not affect the amount of latch overlap of the member **17** on the releasable member **15**.

While the invention has been described in connection with one particular embodiment, it will be readily appreciated that many modifications thereof may readily be made and it is therefore intended by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electric circuit breaker comprising:

(a) an insulating casing;

(b) a movable trip member movable to cause automatic opening of said circuit breaker;

(c) thermal current responsive means disposed and arranged to operate on said movable member to cause opening of said circuit breaker upon the occurrence of predetermined current conditions;

(d) an elongated non-current-carrying compensating bimetal strip having one end thereof rigidly mounted in said circuit breaker casing, and the other end movable;

(e) biasing means acting between the movable end of said compensating bimetallic strip and said movable trip member, said biasing means acting on said trip member to oppose movement of said trip member in releasing direction;

(f) said movable end of said compensating bimetallic strip being moved in a predetermined direction and acting on said biasing means to increase the force exerted by said biasing means on said trip member upon deflection of said compensating bimetallic strip due to increase in ambient temperature;

(g) a stop projection on said movable end of said bimetallic strip extending in said predetermined direction, and a stop abutment rigidly supported by said casing adjacent said projection, said projection engaging said abutment upon a predetermined amount of deflection of said bimetallic strip due to increase in ambient temperature, said movable end of said bimetallic strip thereafter having no substantial further movement in said predetermined direction upon continued deflection of said bimetallic strip due to increase in ambient temperature.

2. An electric circuit breaker comprising:

(a) an insulating casing;

(b) operating means for said circuit breaker comprising a releasable member releasable to cause automatic opening of said circuit breaker;

(c) latch means normally restraining said releasable member;

(d) a movable trip member movable to cause releasing movement of said latch member;

(e) at least one elongated current responsive bimetallic strip disposed and arranged to be heated by the action of current through said circuit breaker;

(f) means carried by said current responsive bimetallic strip for engaging said trip member to move said trip member in tripping direction upon an increase in temperature of said current responsive bimetallic strip;

(g) ambient compensating means comprising an elongated bimetallic strip supported adjacent one end in said casing, the other end of said compensating bimetallic strip being movable in response to increase in ambient temperature;

(h) spring means between the movable end of said ambient compensating bimetallic strip and said movable trip member, said spring means being disposed and arranged to exert a bias force on said trip member in a direction to oppose tripping movement thereof;

(i) said movable end of said compensating bimetallic strip being moved in a predetermined direction and acting on said spring means to increase the force exerted by said biasing means on said trip member upon deflection of said compensating bimetallic strip due to increase in ambient temperature;

(j) a stop projection on said movable end of said bimetallic strip extending in said predetermined direction, and a stop abutment rigidly supported by said casing adjacent said projection, said projection engaging said abutment upon a predetermined amount of deflection of said bimetallic strip due to increase in ambient temperature, said movable end of said bimetallic strip thereafter having no substantial further movement in said predetermined direction upon continued deflection of said bimetallic strip due to increase in ambient temperature.

3. A multi-pole electric circuit breaker comprising:

(a) a generally rectangular insulating casing having a bottom wall, opposed side walls and at least one partition wall defining at least two pole chambers;

(b) operating mechanism for operating said multi-pole circuit breaker comprising a manually operable handle member and a member releasable to cause automatic opening of all poles of said circuit breaker;

(c) latch means normally restraining said releasable member;

(d) a movable trip member movable to cause releasing movement of said latch member;

(e) at least one elongated current responsive bimetallic strip in each of said chambers disposed and arranged to be heated by the action of current through said circuit breaker;

(f) means carried by each of said current responsive bimetallic strips for engaging said trip member to move said trip member in tripping direction upon an increase in temperature of said current responsive bimetallic strip;

(g) ambient compensating means comprising an elongated bimetallic strip supported adjacent one end in said casing between said current responsive bimetallic strips, the other end of said compensating bimetallic strip being movable in response to increase in ambient temperature;

(h) spring means between the movable end of said ambient compensating bimetallic strip and said movable trip member, said spring means being disposed and arranged to exert a bias force on said trip member in a direction to oppose tripping movement thereof;

(i) said movable end of said compensating bimetallic strip being moved in a predetermined direction and acting on said spring means to increase the force exerted by said biasing means on said trip member upon deflection of said compensating bimetallic strip due to increase in ambient temperature;

(j) a stop projection on said movable end of said bimetallic strip extending in said predetermined direction, and a stop abutment rigidly supported by said casing adjacent said projection, said projection engaging said abutment upon a predetermined amount of deflection of said bimetallic strip due to increase in ambient temperature, said movable end of said bimetallic strip thereafter having no substantial further movement in said predetermined direction upon continued deflection of said bimetallic strip due to increase in ambient temperature.

4. An electric circuit breaker comprising:

(a) a generally rectangular insulating casing having a bottom wall, opposed side walls, and at least one partition wall defining at least two pole chambers;

(b) operating mechanism for operating said multi-pole circuit breaker comprising a manually operable handle member and a member releasable to cause automatic opening of all poles of said circuit breaker;

(c) an insulating trip bar extending across all of said pole chambers and having a projection thereon in each of said pole chambers;

(d) a latch member carried by said trip bar and normally engaging and restraining said releasable member;

(e) an elongated current responsive bimetallic strip in each of said pole chambers, said bimetallic strips being in aligned laterally spaced relation, means in each of said pole chambers for heating said current responsive bimetallic strips by the action of current through the corresponding pole of said circuit breaker;

(f) each of said current responsive bimetallic strips being fixedly mounted on said bottom wall of said insulating casing at one end;

(g) means carried by the other end of each of said current responsive bimetallic strips for engaging said projections on said common trip bar respectively to rotate said common trip bar so as to move said latch member away from said releasable member to cause automatic opening of said circuit breaker;

(h) a non-current-carrying ambient compensating bimetallic strip having one end thereof fixedly mounted on said insulating casing between said current responsive bimetallic strips and having its other end movable;

(i) tension spring means acting between said common trip bar and said movable end of said compensating bimetallic strip;

(j) said compensating bimetallic strip being disposed and arranged to move said movable end thereof in a direction away from said common trip bar and to increase the force of said tension spring opposing release of said latch member upon deflection of said compensating bimetallic strip due to increased temperature;

(k) whereby the biasing force opposing movement of said trip bar in tripping direction by said current responsive bimetallic strips is increased upon an increase in ambient temperature.

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