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[54] CIRCUIT BREAKER WITH AMBIENT COMPENSATION

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[56]

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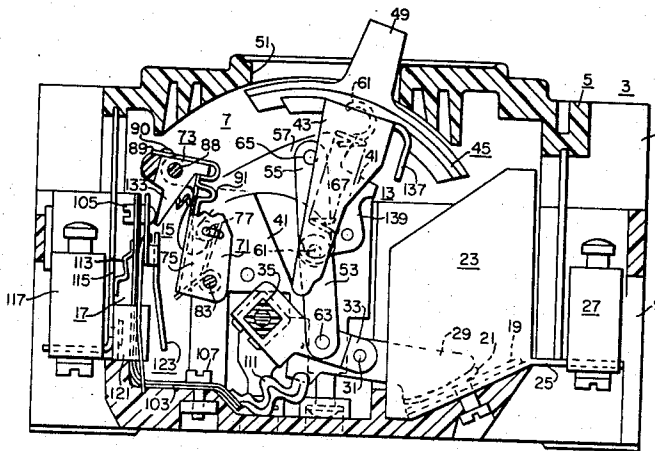
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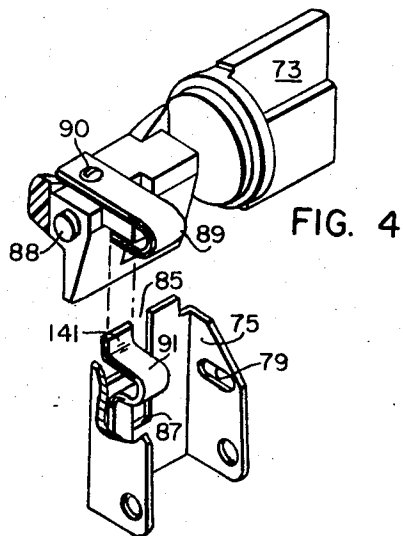
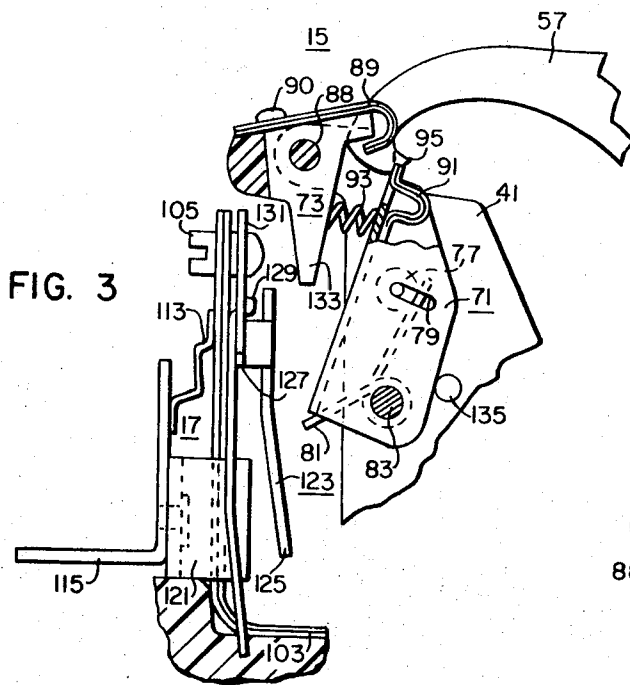
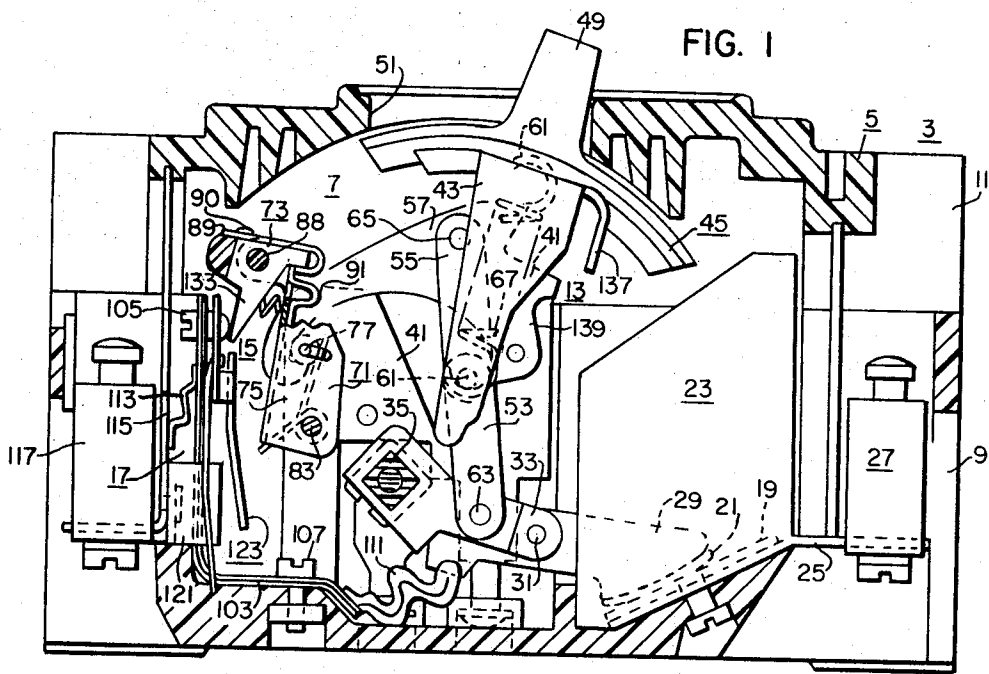
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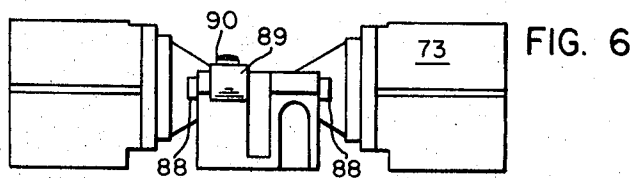
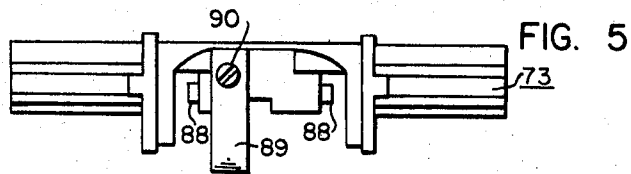
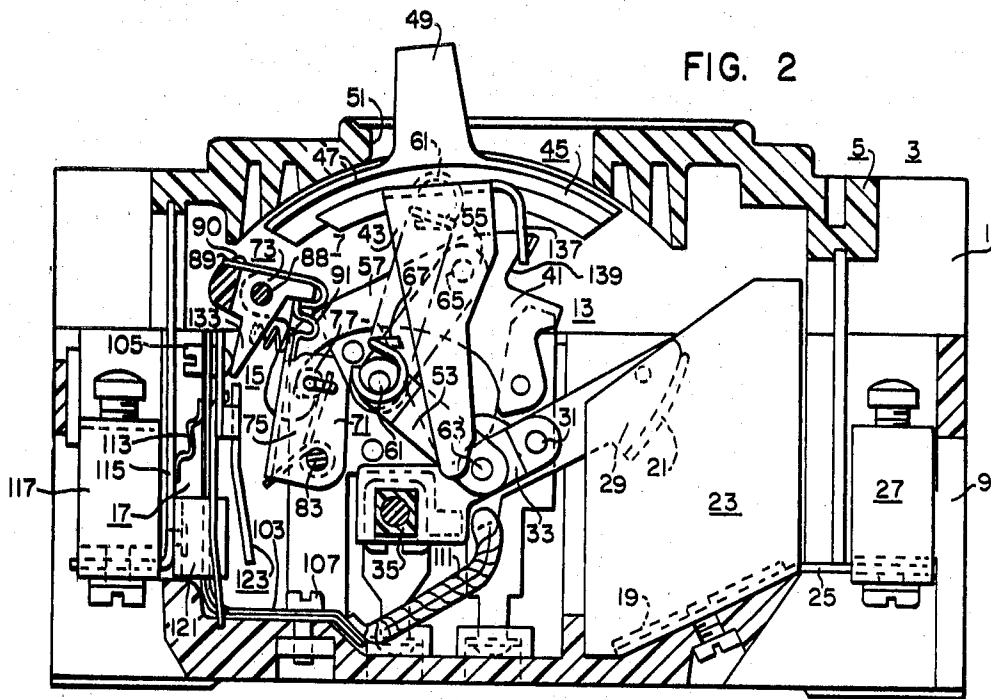
ABSTRACT

A circuit breaker comprises a current responsive tripping bimetal and a pair of compensating bimetals in latching engagement with each other to compensate for movement of the current responsive tripping bimetal in response to changes in ambient temperature. The circuit breaker is a multi-pole circuit breaker with a current responsive tripping bimetal in each pole and one pair of compensating bimetals in only one of the poles.

10 Claims, 6 Drawing Figures







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CIRCUIT BREAKER WITH AMBIENT COMPENSATION

BACKGROUND OF THE INVENTION

1. Field of the Invention:

Circuit breakers of the type comprising ambient temperature compensating means for compensating for movement of a tripping bimetal in response to changes in the ambient temperature.

2. Description of the Prior Art:

In each of the patents to Hulbert U.S. Pat. No. 2,703,351 and Cellerini et al. U.S. Pat. No. 2,795,670 there is disclosed a circuit breaker with a tripping bimetal responsive to current flow for tripping the breaker upon the occurrence of overloads and a compensating bimetal for compensating for movement of the tripping bimetal in response to changes in ambient temperature. This invention is an improvement over prior art of the type disclosed in the above-mentioned patents in that a pair of compensating bimetals separate from the tripping bimetal are provided in a latching engagement to compensate for movement of the tripping bimetal in response to changes in the ambient temperature. With both of the compensating bimetals, which are looped bimetals, flexing during compensation, desirable compensating characteristics are achieved in a compact construction. An additional advantage of this invention over structure of the type disclosed in the Cellerini et al patent is that the latching compensating bimetals, which are utilized in only one pole of the multi-pole circuit breaker, are spaced from the tripping bimetal to be less affected by current-generated heat in the tripping bimetal.

SUMMARY OF THE INVENTION

An improved circuit breaker comprises a pair of contacts and a latched trip member movable when released to a trip position to effect automatic opening of the contacts. Latch means, comprising a pair of looped compensating bimetals in latching engagement with each other, latches the trip member in the latched position. The compensating bimetals are operable to a releasing position out of latching engagement with each other to release the trip member. A tripping bimetal, separate from the compensating bimetals, is responsive to current flow and flexes upon the occurrence of an overload current above a predetermined value to effect operation of the latched compensating bimetals to the releasing position. The compensating bimetals, which are spaced from the tripping bimetal, compensate for movement of the tripping bimetal in response to changes in the ambient temperature. The circuit breaker is a multi-pole circuit breaker with a tripping bimetal in each pole unit and one pair of compensating bimetals in only one of the pole units.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side sectional view through the center pole unit of a three-pole circuit breaker with the parts shown in the closed position;

FIG. 2 is a view similar to FIG. 1 with the parts shown in the open position;

FIG. 3 is a partial view of the trip and latch means seen in FIGS. 1 and 2 with the parts shown in the tripped-open position;

FIG. 4 is a perspective view, with parts broken away, illustrating the pair of compensating bimetals seen in FIGS. 1-3;

FIG. 5 is a top plan view of the trip bar seen in FIGS. 1-4; and

FIG. 6 is an end view of the trip bar seen in FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The operating mechanism and trip device of the circuit breaker herein disclosed are similar to that disclosed in the copending application of Nick Yorgin et al. Ser. No. 621,321, filed Mar. 7, 1967.

Referring to the drawings, there is shown, in FIGS. 1 and 2, a three-pole circuit breaker 3 comprising an insulating hous-

ing 5 and a circuit-breaker mechanism 7 supported in the housing 5. The housing 5 comprises an insulating base 9 and an insulating cover 11 cooperating with the base 9 to enclose the circuit-breaker mechanism 7 that is mounted on the base 9.

The circuit-breaker mechanism 7 comprises an operating mechanism 13, a latch mechanism 15 and a thermal-and-magnetic trip device 17.

A stationary contact 19, a movable contact 21 and an arc-extinguishing unit 23 are provided for each pole unit of the breaker. The stationary contact 19 for each pole is rigidly mounted on the inner end of a conducting strip 25 that is secured to the base 9 and that extends outward to an external cavity where a well-known type of solderless terminal connector 27 is secured to the outer end of the conductor 25. The movable contact 21 for each of the pole units is mounted on a contact arm 29 that is pivotally mounted by means of a pin 31 on a switch arm 33 that is fixedly secured to an insulating tie bar 35. The switch arms 33 for all three pole units are secured to the tie bar 35 for common movement with the tie bar that is mounted for pivotal movement about an axis normal to the plane of the paper in FIGS. 1 and 2. A suitable spring in each pole unit biases the associated contact arm 29 in a clockwise (FIGS. 1 and 2) direction about the switch arm 33 to provide contact pressure in closed position of the contacts.

The operating mechanism 13 is a single operating mechanism disposed in the center pole unit of the three-pole breaker. The operating mechanism 13 is supported on two metallic rigid supporting plates 41 that are fixedly secured to the base 9 in the center pole unit of the circuit breaker. Only one of the plates 41 is seen in FIG. 2. An inverted U-shaped operating lever 43 is pivotally supported on the supporting plates 41 with the inner ends of the legs of the lever 43 positioned in U-shaped notches in the plates 41. An insulating operating member 45 is fixedly supported on the front portion of the operating lever 43. The operating member 45 comprises an insulating shield 47 and a handle 49. The handle 49 protrudes out through an opening 51 in the cover 11, and the shield 47 closes the opening 51 in all positions of the handle.

The switch arm 33 for the center pole unit is operatively connected, by means of a toggle comprising toggle links 53 and 55, to a releasable trip member or cradle 57 that is pivotally supported on the supporting plates 41 by means of a pin member 59. The toggle links 53, 55 are pivotally connected together by means of a knee pivot pin 61. The toggle link 53 is pivotally connected to the center pole switch arm 33 by means of a pin 63, and the toggle link 55 is pivotally connected to the releasable member 57 by means of a pin 65. Overcenter springs 67 are connected under tension between the knee pivot 61 and the bight portion of the operating lever 43.

The contacts are manually opened by movement of the handle 41 in a counterclockwise direction from the "on" or closed position seen in FIG. 1 to the "off" or open position seen in FIG. 2. This movement carries the line of action of the overcenter springs 67 to the left causing collapse of the toggle 53, 55 to thereby rotate the tie bar 35 in a counterclockwise direction to simultaneously move the three switch arms 33 of the three pole units to the open position. The contacts are manually closed by reverse movement of the handle 49, which movement moves the line of action of the overcenter springs 67 to the right to erect the toggle 53, 55 to thereby rotate the tie bar 35 in a clockwise direction to move the switch arms 33 of the three pole units to the closed position seen in FIG. 1.

The releasable trip member 57 is latched in the position seen in FIGS. 1 and 2 by means of the latch mechanism 15. The latch mechanism 15 comprises a roller latch member 71 and a trip bar latch member 73. The roller latch member 71 comprises a generally U-shaped main body part 75 and a roller member 77 movably supported for limited travel on the main body part 75. As can be seen in FIG. 3, the roller member 77 is provided with pin portions at the opposite ends thereof that fit within elongated slots 79 in the side walls of the main body

part 75. A torsion spring member 81 (FIG. 3) biases the roller member 77 to one end of the slots 79. The roller-latch member 71 is pivotally supported on the supporting plates 41 by means of a pin member 83. A slot 85, (FIG. 4) having a lower end 87, is provided in the bight portion of the U-shaped member 75 to permit movement of the releasable member 57 between the latched and tripped positions in a manner to be hereinafter described.

The trip bar latch member 73 is an insulating trip bar that extends across all three of the pole units. The trip bar latch member 73 is a molded insulating member formed to provide a pair of insulating pin portions 88 (FIG. 4) that are disposed in suitable openings in the supporting plates 41 to pivotally support the trip bar latch member 73 on the supporting plates 41. The trip bar latch member 73, which extends through the three pole units, is formed to be supported on only the two supporting plates 41 that are positioned in the center pole unit. A looped compensating bimetal 89 is secured to the trip bar latch member 73 by means of a screw 90. The compensating bimetal 89 latches a looped compensating bimetal 91, that is welded to the main body part 75 of the roller-latch member 71, to latch the roller latch member 71 in the latched position seen in FIGS. 1 and 2. The compensating bimetal latch 89, 91 will be hereinafter more specifically described. A compression spring 93 (FIG. 3) is positioned between the roller latch member 71 and the trip bar latch member 73 to bias the trip bar latch member 73 in a latching direction. As can be understood with reference to FIG. 3, the trip member 57 is provided with a lower hook-shaped end 95 that engages under the roller 77 to latch the trip member 57 in the latched position seen in FIGS. 1 and 2.

There is a separate thermal-and-magnetic trip means 17 in each pole unit. Each of the trip means 17 comprises a generally L-shaped bimetal member 103 having an adjusting actuating screw 105 supported at the upper free end thereof. Each of the bimetals 103 is secured to the base 9 by means of a screw member 107, and electrically connected to the associated switch arm 33 by means of a flexible conductor 111. Another flexible conductor 113 (FIG. 2) is connected at one end to the upper end of the associated bimetal 103 and at the other end to the vertical leg of a generally L-shaped conductor 115 that extends through an opening at the one end of the housing. A separate solderless terminal connector 117 is secured to the horizontal leg of each of the conductors 115. Each trip means 17 also comprises a generally U-shaped magnetic member 121 that is welded or otherwise fixedly secured, at the bight portion thereof, to the vertical leg of the associated L-shaped conductor 115. The opposite legs of each U-shaped magnetic member 121 extend on opposite sides of the vertical leg of the associated bimetal 103 to terminate opposite a magnetic armature 123. Each of the armatures 123 comprises a lower part 125 (FIG. 3) that is positioned opposite the legs of the associated magnetic member 121 and a pair of arm portions 127 (only one of which is seen in FIG. 3) on opposite sides of the armature 123. The arm portions 127 rest on ledge parts of the insulating base 9 to pivotally support the armature 123 in the manner more specifically described in the above-mentioned patent of Nick Yorgin et al. Ser. No. 621,321. A separate spring member 129 is provided in each pole unit to bias the associated armature 123 in a counterclockwise direction about the pivot 127. Each of the armatures 123 comprises an upper actuating part 131 (FIG. 3) disposed above the pivot 127 for cooperating with a depending projecting part 133 on the trip bar latch member 73. There is a depending projecting part 133 on the common trip bar latch member 73 in each pole unit for cooperating with the armature 123 and actuating screw 105 of each pole unit.

The circuit for each pole unit extends from the terminal connector 117 (FIG. 1) to the conductor 115, the flexible conductor 113, the bimetal 103, the flexible conductor 111, the contact arm 29, the contact 21, the contact 19, the conductor 25 to the other terminal connector 27.

When the circuit breaker is in the latched position seen in FIGS. 1 and 2, the tension springs 67 operate through the toggle link 55 and pivot 65 to force the trip member 57 in a clockwise direction about the pivot 59. Clockwise movement of the trip member 57 is restrained by the engagement of the free end 95 of the trip member 57 under the roller member 77 of the roller latch 71 with the trip member 57 pulling the roller latch 71 in a clockwise direction about the pivot 83. Clockwise movement of the roller latch 71 about the pivot 83 is restrained by the engagement of the compensating bimetal latch 91, that is secured to the part 75 of the roller latch 71, with the compensating bimetal latch 89 that is secured to the trip bar latch member 73 by means of the screw 90. The force of the compensating bimetal latch 91 against the compensating bimetal latch 89 operates through the axis of the pivot 88 of the trip bar latch member 73 so that clockwise movement of the roller latch 71 is restrained by the trip bar latch member 73 without tending to move the trip bar latch member 73 about the axis of the pivotal support 88 of the trip bar 73. Thus, the trip bar latch member 73 is in a neutral position latching the roller latch 71 and trip member 57 in the latched position seen in FIGS. 1 and 2.

The circuit breaker is shown in the closed position in FIG. 1. Upon the occurrence of an overload current above a first predetermined value and below a second predetermined value in any of the pole units, the bimetal 103 in the overloaded pole unit becomes heated by the current therein and flexes to the right with a time delay whereupon the actuating screw 105 engages the associated part 133 of the trip bar latch member 73 to rotate the trip bar latch member 73 in a counterclockwise unlatching direction. During this movement, the compensating bimetal latch 89 on the trip bar latch member 73 clears the compensating bimetal latch 91 on the roller latch 71 whereupon the roller latch 71 is free to move in a clockwise direction about the pivot 83 thereof. Upon release of the roller latch 71, the springs 67 operate to rotate the trip member 57 in a clockwise direction moving the roller latch 71 and trip member 57 to the tripped position seen in FIG. 3. Upon movement of the trip member 57 to the tripped position seen in FIG. 3, the line of action of the springs 67 is to the left and the springs 67 collapse the toggle 53, 55 rotating the switch arm 33 that is attached to the toggle link 53 to move the tie bar 35 and the three switch arms for the three pole units in a counterclockwise direction opening the contacts of all three pole units in a well known manner.

The roller notch 71 is stopped in the position shown in FIG. 3 by the stop projection 135 on one of the supporting plates 41. When the circuit is interrupted the bimetal 103 cools and straightens to the initial position.

Upon the occurrence of a tripping operation the springs 67 maintain the operating lever 43 and handle 49 in a position intermediate the "off" and "on" positions in a well known manner to provide a visual indication that the circuit breaker has been tripped.

Before the circuit breaker can be manually operated after an automatic tripping operation, the circuit breaker mechanism must be reset or relatched. Resetting is effected by movement of the handle 49 to a position slightly past the full "off" position. During this movement, a part 137 on the operating lever 43 engages a shoulder portion 139 on the releasable trip member 57 to rotate the releasable trip member 57 in a counterclockwise direction about the pivot 59. During this movement, the releasable trip member 57 moves down in the slot 85 (FIG. 4) in the roller latch 71, and the end part 95 of the releasable trip member 57 engages the roller 77 moving the roller 77 in the slot 79 against the bias of the spring 81 to a position which permits movement of the end part 95 of the releasable trip member 57 past the roller 77. When the end part 95 of the releasable trip member 57 passes the roller 77 the torsion spring 81 biases the roller 77 back to the position seen in FIGS. 1-3. During this resetting movement of the releasable trip member 57, the end part 95 of the releasable trip member 57 engages the surface 87 (FIG. 4) on

the roller latch 71 at the bottom of the slot 85 moving the roller latch 71 in a counterclockwise direction from the tripped position seen in FIG. 3 to the reset or latched position seen in FIG. 2. As the roller latch 71 moves the the position seen in FIG. 2, the spring 93 (FIG. 3), which has been additionally charged by the counterclockwise movement of the roller latch 71, biases the trip bar latch member 73 in a clockwise (FIG. 3) direction moving the trip bar latch member 73 clockwise to the latching position seen in FIG. 2 wherein the compensating bimetal latch 89 engages the compensating bimetal latch 91 to again latch the parts in the position seen in FIG. 2. Thereafter, upon release of the handle 49 by the operator, the springs 67 again bias the toggle link 55 to bias the trip member 57 in a clockwise (FIG. 2) direction to move the trip member up to engage the roller 77 in the latched position seen in FIG. 2. Thereafter, the handle 49 can be manually moved between the "off" and "on" positions to operate the contacts in the manner hereinbefore described.

Upon the occurrence of an overload above the second predetermined value in any of the pole units, the current flowing through the bimetal 103 energizes the associated magnetic members 121, 123 sufficiently to attract the armature 123 toward the stationary magnetic member 121. During this movement the armature 123 moves in a clockwise direction about the pivot 127, against the bias of the associated spring 129, and the upper part of the armature 123 engages the depending projection 133 on the trip bar latch member 73 to rotate the trip bar latch member 73 in a counterclockwise direction to release the roller latch member 71 whereupon the trip member 57 is released to move to the tripped position seen in FIG. 3 to effect an instantaneous magnetic tripping operation in the same manner as was hereinbefore described with regard to the time-delay thermal tripping operation. Upon interruption of the circuit and deenergization of the magnetic members 121, 123 the associated spring 129 moves the armature 123 back to the initial position seen in FIGS. 1-3. The circuit breaker is relatched following a magnetic tripping operation in the same manner as was hereinbefore described.

Each of the looped compensating bimetals 89 and 91 comprises a pair of opposite flat smooth bimetal faces.

As can be understood with reference to FIG. 4, the compensating bimetal 89 engages the compensating bimetal 91 at a smooth flat-face surface 141 of the compensating bimetal 91. The compensating bimetal 91 is provided with a looped portion below the surface 141, and a flat portion below the looped portion which flat portion is welded to the main body part 75 of the roller latch member 71. The high expansion side of the tripping bimetal 103 is on the left as seen in FIG. 3, and the high expansion side of each of the compensating bimetals 89 and 91 is on the inside of the associated loop. Upon the occurrence of a rise in ambient temperature, the tripping bimetal 103 will flex in response to the rise in ambient temperature to move the upper or free end thereof to the right. In order to compensate for this movement of the tripping bimetal 103 so that the movement of the tripping bimetal 103 in response to the rise in ambient temperature will not alter the thermal trip characteristics of the circuit breaker, the two compensating bimetals 89 will flex to increase the latch engagement between the compensating bimetals 89, 91. With the high expansion sides of the looped bimetals 89, 91 being on the inside of the loops, the loops of these compensating bimetals 89, 91 will expand to increase the latch engagement between the compensating bimetals 89, 91. Upon a decrease in ambient temperature, the tripping bimetal 103 will move to the left and the compensating bimetals 89, 91 will both move to reduce the amount of latch engagement between the compensating bimetals 89, 91. The selection of the bimetals 103, 89, 91, along with the construction and arrangement of parts, is such that the movement of the compensating bimetals 89, 91 will neutralize the effect of movement of the tripping bimetal 103 in response to changes in the ambient temperature so that the thermal tripping characteristics of the circuit breaker will not

be affected by changes in ambient temperature. Although there are three thermal tripping bimetals 103 in the three pole units of the circuit breaker, there is only one pair of compensating bimetals 89, 91 in only the center pole unit where the bimetals 89, 91 provide the latch between the trip bar latch member 73 and the roller latch member 71. The one pair of compensating bimetals 89, 91 compensates for flexing of the three tripping bimetals 103 in the three pole units of the circuit breaker.

I claim:

1. A circuit breaker comprising a pair of contacts, a trip member in a latched position and movable when released to a tripped position to effect opening of said contacts, latch means comprising a pair of compensating bimetals in latching engagement with each other to effect latching of said trip member in said latched position and operable to a releasing position out of latching engagement with each other to effect release said trip member, a tripping bimetal separate from said compensating bimetals, said tripping bimetal being responsive to current flow and flexing upon the occurrence of an overload current above a predetermined value to effect operation of said latch means to said releasing position, and said compensating bimetals compensating for movement of said tripping bimetal in response to changes in ambient temperature.

2. A circuit breaker according to claim 1, said pair of bimetals comprising a first looped bimetal and a second loop bimetal in latching engagement with said first looped bimetal, and said looped bimetals being constructed and arranged such that both of said looped bimetals expand in the direction to increase said latching engagement upon a rise in ambient temperature.

3. A circuit breaker according to claim 1, said latch means comprising a first latch member for latching said trip member and a second latch member for latching said first latch member, a first of said compensating bimetals being secured to said first latch member and the second of said compensating bimetals being secured to said second latch member such that said latching engagement between said first and second compensating bimetals latches said first latch member to thereby latch said trip member.

4. A circuit breaker according to claim 3, said tripping bimetal being separate from said second latch member and moving to engage and actuate said second latch member to move said second latch member to thereby move said second bimetal out of latching engagement with said first bimetal upon the occurrence of said overload current above a predetermined value.

5. A circuit breaker according to claim 4, said first compensating bimetal being a first looped bimetal and said second compensating bimetal being a second looped bimetal in latching engagement with said first looped bimetal, said looped bimetals being constructed and arranged such that both loops expand in the direction to increase said latching engagement upon a rise in ambient temperature.

6. A circuit breaker according to claim 1, said circuit breaker being a multi-pole circuit breaker, a separate of said tripping bimetals in each pole responsive to the current flow in the associated pole and flexing upon the occurrence of an overload current above a predetermined value in the associated pole to effect operation of said latch means to said releasing position, and said latch means being a single latch means in only one of said poles.

7. A circuit breaker according to claim 6, and said pair of compensating bimetals comprising a first looped bimetal and a second looped bimetal in latching engagement with said first looped bimetal, said looped bimetals being constructed and arranged such that both looped bimetals expand in the direction to increase said latching engagement upon a rise in ambient temperature.

8. A circuit breaker according to claim 7, said latch means comprising a first latch member latching said trip member and a second latch member latching said first latch member, a first

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of said looped bimetals being secured to said first latch member, the second of said looped bimetals being secured to said second latch member and being in latch engagement with said first looped bimetal, a common trip bar common to all of the poles of said circuit breaker, said first latch member being a part of said common trip bar, said common trip bar comprising a part in each pole unit for cooperating with the tripping bimetal in the associated pole unit, each of said tripping bimetals upon tripping movement thereof cooperating with the associated part of said common trip bar to move said common trip bar to thereby move said second looped bimetal to the releasing position out of latching engagement with said first looped bimetal.

9. A circuit breaker according to claim 8, said first looped

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bimetal comprising a pair of opposite flat bimetal faces, and said second looped bimetal engaging said first looped bimetal at one of said flat bimetal faces in latching engagement with said first looped bimetal.

10. A circuit breaker according to claim 9, said common trip bar being an insulating trip bar, an actuation screw carried on each of said tripping bimetals adjacent the associated part of said common trip bar, each of said actuating screws upon tripping movement of the associated tripping bimetal engaging the associated part of said common trip bar and moving said common trip bar to move said second looped bimetal to the releasing position out of latching engagement with said first looped bimetal.

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