MULTI-POLE CIRCUIT BREAKER WITH COMMON TRIP BAR

Filed Feb. 16, 1966 Sheet 1 of 2

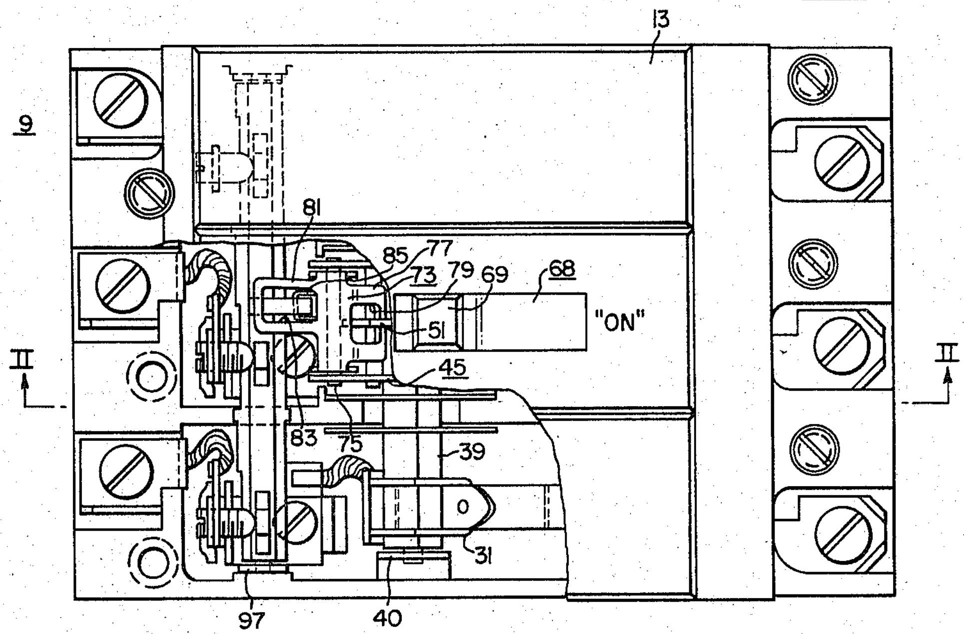

FIG. 1.

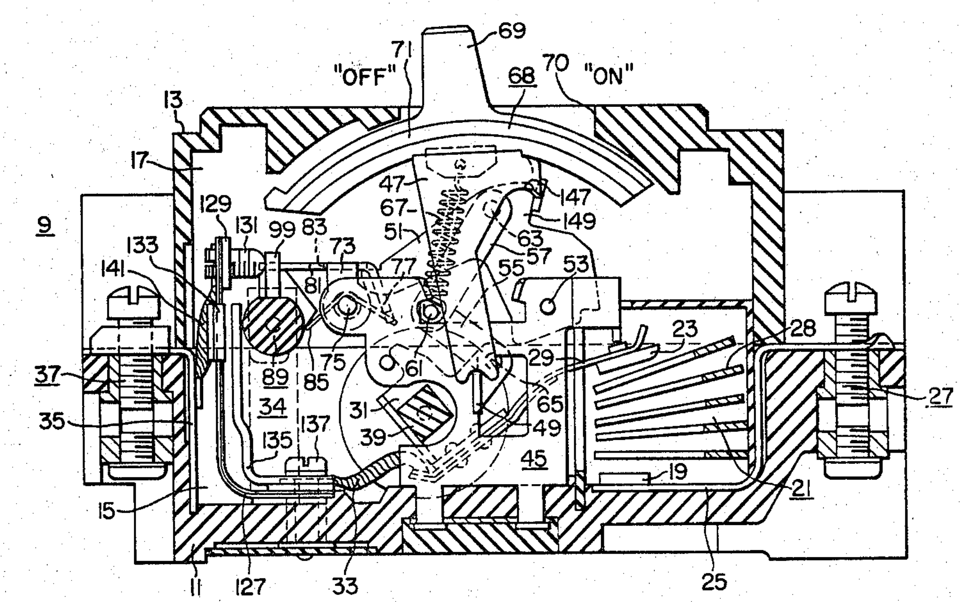

FIG. 2.

WITNESSES

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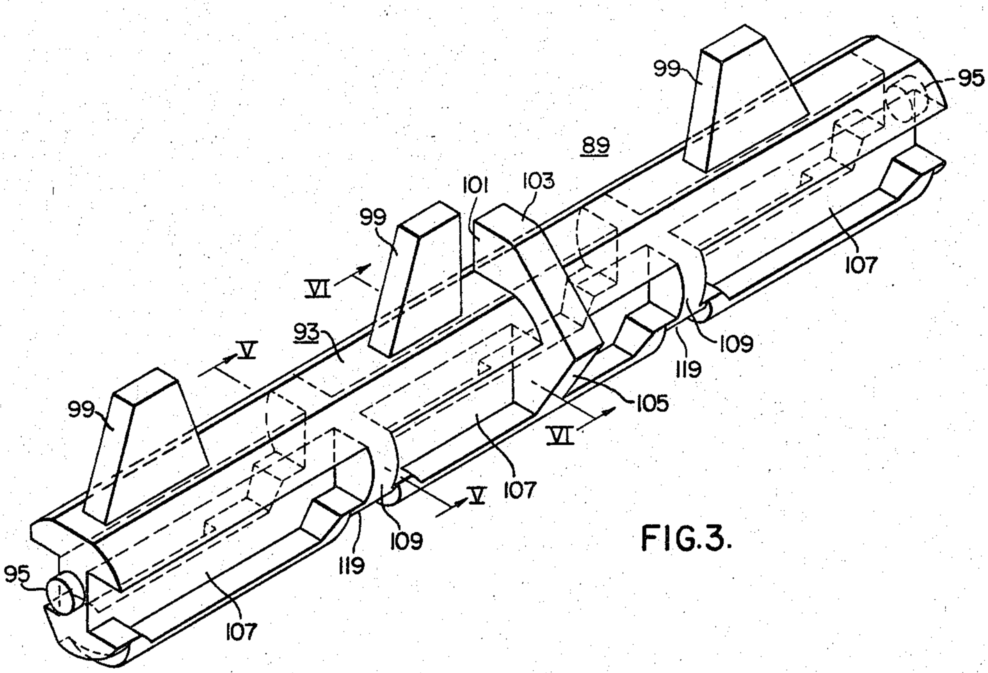


FIG.3.

FIG.4.

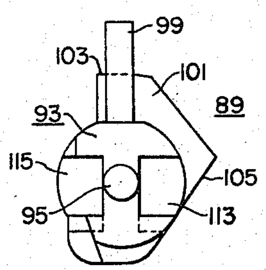


FIG.5.

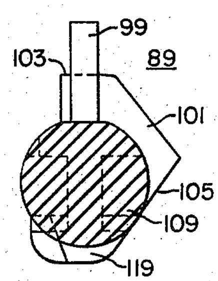
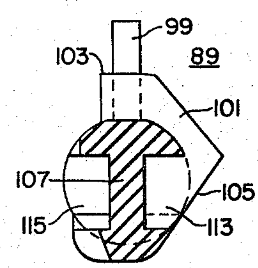


FIG.6.



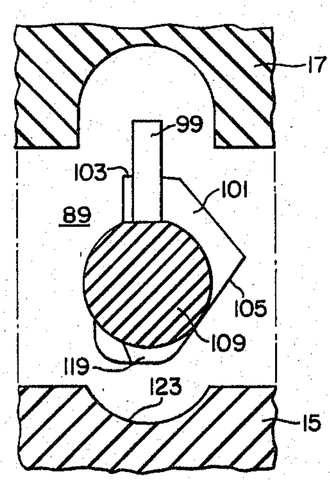


FIG.7.

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3,422,381

MULTI-POLE CIRCUIT BREAKER WITH COMMON TRIP BAR

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U.S. Cl. 335—9 12 Claims
Int. Cl. H01h 75/00; 77/00; 83/00

ABSTRACT OF THE DISCLOSURE

A multi-pole circuit breaker having a trip bar that is common to all of the poles and that is operable to trip the circuit breaker upon the occurrence of an overload in any of the poles. The trip bar has a latch part with a latch surface thereon which latch part and latch surface are of molded insulating material molded integral with said trip bar.

In the patent to Dyer et al., Pat. No. 2,416,163, there is disclosed a common trip bar comprising a main body part of molded insulating material and a separate latch part that comprises a metallic metal piece that is embedded in the molded main body part to serve as a latch for the circuit breaker. The Dyer et al. trip bar also comprises a shaft that is embedded in the main body part to support the trip bar for rotation about its longitudinal axis. An object of this invention is to advance the art by providing an improved multi-pole circuit breaker comprising a molded insulating trip bar that is common to all of the poles and that comprises an integral molded latch surface.

Another object of this invention is to provide an improved multi-pole circuit breaker comprising a molded insulating trip bar that is common to all of the poles and that comprises a latch part and pivot pins that are molded integral with the main body portion of the trip bar.

Another object of this invention is to provide an improved circuit breaker comprising a molded insulating trip bar that comprises integral pole unit body parts that are generally I-beam shaped in cross section to provide adequate structural strength with less material, and integral barrier body parts that are disk shaped in cross section to cooperate with the circuit breaker housing barriers in order to prevent the passage of gases between adjacent pole units.

A general object of this invention is to provide a multi-pole circuit breaker with an improved insulating trip bar common to all of the poles of the circuit breaker.

These and other objects and advantages of the invention, together with the detailed structure and mode of operation of the invention, will be best understood from the following detailed description when read in conjunction with the accompanying drawings.

In said drawings:

FIGURE 1 is a top plan view, with parts broken away, or a circuit breaker embodying principles of this invention;

FIG. 2 is a sectional view taken generally along the line II—II of FIG. 1;

FIG. 3 is a perspective view of the trip bar seen in FIGS. 1 and 2;

FIG. 4 is an end elevational view of the trip bar seen in FIG. 3;

FIG. 5 is a sectional view taken generally along the line V—V of FIG. 3;

FIG. 6 is a sectional view taken generally along the line VI—VI of FIG. 3; and

FIG. 7 is a sectional view of the trip bar with parts of the insulating barriers of the circuit breaker shown in section and exploded for the purpose of clarity.

Referring to FIGS. 1 and 2 of the drawings, there is

shown therein a 3-pole circuit breaker **9** comprising a molded insulating housing that comprises a base **11** and cover **13** both of molded insulating material. Between each pair of adjacent pole units, a barrier **15**, that is molded integral with the insulating base **11**, cooperates with a barrier **17**, that is molded integral with the insulating cover **13**, to isolate the pole units. The barriers **15** and **17** divide the housing **11, 13** longitudinally into three adjacent pole-unit compartments.

Each pole of the circuit breaker (only one pole being shown in FIG. 2) includes a stationary contact **19**, an arc extinguisher **21**, and a movable contact **23**. The stationary contact **19** is mounted on the inner end of a conducting strip **25**. A well known type of terminal connector, indicated generally at **27**, is provided at the outer end of the conducting strip **25** to enagle connection of the circuit breaker in an electric circuit. The arc extinguisher **21** comprises a plurality of slotted plates **28** of magnetic material, which plates are disposed such that the movable contact **23** moves through the slots of the plates. The arc drawn between the separating contacts is extinguished in the arc extinguisher **21** in a well known manner. The movable contact **23** is carried at the free end of a spring conducting contact arm **29** that is connected to a U-shaped switch member **31**. A flexible conductor **33** is connected at one end to the contact arm **29** and at the other end to a trip device indicated generally at **34**. The trip device will be hereinafter more specifically described. The trip device **34**, at the other end thereof, is connected to a terminal strip **35** that is connected at the external end thereof to a terminal connector indicated generally at **37**. The arc-extinguishers, current-carrying parts and trip devices of the three poles of the circuit breaker are of substantially identical construction. Thus, only one pole is herein specifically shown and described.

The three movable switch members **31** are fixedly mounted on an insulating tie-bar **39** that extends across the pole units of the circuit breaker. The tie-bar **39** is supported for rotation about its longitudinal axis on two brackets **40** (only one of which is seen in FIG. 1) that are disposed at the opposite sides of the housing **11, 13**. The three switch members **31** and contact arms **29** are simultaneously moved to the open and closed positions upon rotation of the tie-bar **39**.

A single operating mechanism is provided for simultaneously actuating the contact means of the three poles of the circuit breaker to the open and closed positions. The operating mechanism is mounted on a supporting frame structure indicated generally at **45** that is disposed in the center pole unit compartment. An inverted generally U-shaped operating member **47** is provided for manually operating the circuit breaker. The operating member **47** is pivotally supported, at the inner ends of the legs thereof, on support means **49** fixedly supported on the bracket structure **45**. A releasable trip member **51** is supported on a pin **53** that is pivotally supported on the support bracket structure **45**. A pair of toggle links **55** and **57** are pivotally connected together by a knee pivot **61**. The upper toggle link **57** is pivotally connected to the trip member **51** by means of a pin **63**. The lower toggle link **55** is pivotally connected to the switch member **31** of the center pole unit by means of a pin **65**. Two tension springs **67** (only one being shown in FIG. 2) are connected at the inner ends thereof to the knee pivot **61** and at the outer ends thereof to the bight portion of the U-shaped operating member **47**. A molded insulating operating handle **68** is connected to the operating member **47**. The handle **68** comprises an external handle part **69** that protrudes out through an opening **70** in the front of the housing cover **13**. An annular shield part **71** is formed integral with the handle **68** to substantially close the opening **70** in all positions of the handle.

Upon clockwise (FIG. 2) movement of the handle 68 from the "off" position to the "on" position the operating member 47 and springs 67 are operated to move the toggle 55, 57 to a more straightened position with a snap action to simultaneously move the three contact arms 29 to the closed position. Upon counterclockwise (FIG. 2) movement of the handle 68 from the "on" position to the "off" position the operating member 47 and springs 67 are operated to effect collapse of the toggle 55, 57 to simultaneously move the three contact arms 29 to the open position seen in FIG. 2. The operation of this type of operating mechanism is more specifically described in the above-mentioned patent to Dyer et al., Pat. No. 2,416,163.

A latch 73 is supported on a pivot pin 75 that is pivotally supported at the opposite ends thereof in suitable openings in the supporting frame 45. One arm 77 of the latch 73 extends downwardly (FIG. 2) on one side of the pivot 75 and an opening 79 (FIG. 1) is provided in this end 77. The other arm 81 of the latch 73 is disposed on the other side of the pivot 75. An opening 83 (FIG. 1) is provided in the arm 81. A torsion spring 85, that is supported on the pin 75, engages the arm 77 of the latch 73 and also the trip bar structure 89 to bias the latch 73 in a counterclockwise (FIG. 2) direction and to bias the trip bar structure 89 in a counterclockwise (FIG. 2) direction.

The trip bar structure 89 comprises a main body part, indicated generally at 93 (FIG. 3), of molded insulating material. Two pivot-pin parts 95, which are molded integral with the main body part 93 at opposite ends of the main body part, are supported in openings in suitable brackets (only one of which brackets is seen at 97 in FIG. 1) to support the trip bar for rotation about its longitudinal axis. Three projections 99 (FIG. 3), which are molded integral with the main body part 93, extend upwardly to be engaged during tripping operations in a manner to be hereinafter described. There is a separate projection 99 positioned in each of the three pole-unit compartments of the circuit breaker. A latch part 101, that is molded integral with the main body part 93, is provided with a flat latch surface 103 at the upper side thereof. The latch surface 103 is part of the molded material of the trip bar 89. The torsion spring 85 (FIGS. 1 and 2) engages a lower surface 105 (FIG. 3) of the latch part 103 to bias the trip bar 89 in a counterclockwise (FIG. 2) direction. As can be seen in FIG. 3, the main body part 93 of the trip bar 89 comprises three pole-unit body parts 107 and two barrier body parts 109. Each of the three pole-unit body parts is I-beam shaped in cross section, and each of the two barrier body parts 109 is disk shaped (FIG. 5) in cross section. As is illustrated in FIGS. 3–7, each of the projections 99 extends upward from the associated I-beam pole-unit body parts 107 and the latch part 101 in the center pole unit projects from the I-beam pole-unit body part to provide the latch surface 103 and to receive, in supporting engagement, one part of the torsion spring 85. As is illustrated in FIG. 6, there are two cavities 113 and 115 on opposite sides of the center leg of the generally I-beam construction of each of the pole-unit body parts 107. As can be seen in FIGS. 3, 5 and 7, the lower part or base part of the I-beam construction of the pole-unit body parts on each of the two opposite sides of each of the barrier body parts 109 are disposed lower than the bottom of parts 109 to form slots 119 in the trip bar below the barrier body parts 109. The barriers 15 (FIGS. 2 and 7) of the base 11 of the housing 11, 13 fit into the slots 119, and each of the barriers 15 is provided with a curved surface 123 that cooperates with the lower curved surface of the associated barrier body part 109. The lower parts of the I-beam pole-unit body parts 107 of the trip bar 89 depend below the barrier 15 on opposite sides of each of the barrier body parts 109 to close off the opening in the barrier part 15 to prevent the passage of gases between pole-units. An advantage of the I-beam construction of the pole-unit body parts of the trip bar 89 is that adequate strength is provided with a reduced amount of material. The advantage of having the barrier body parts of the trip bar 89 formed with a disk-shaped solid cross section (FIG. 5) is that the barrier body parts serve to close off the opening in the barriers 15, 17 (FIGS. 2 and 7) to prevent the passage of gases between pole-units of the circuit breaker.

The trip bars of this invention may be made from either thermoplastic or thermosetting molding materials. Molded trip bars made from a thermoplastic material having the tradename Polysulfone were assembled into circuit breakers which were then subjected to a series of test requirements specified normally for the standard underwriters' approved circuit breakers. These circuit breakers successfully met all of the prescribed test requirements.

There is a trip device 34 (FIG. 2) in each of the three pole-units of the circuit breaker. Each of the trip devices 34 comprises an elongated generally L-shaped bimetal member 127 that is supported at the lower leg thereof. A tab part 129 is attached to the upper end of the bimetal 127, and an adjusting screw 131 is threaded into a tapped opening in the tab part 129. A generally U-shaped magnet yoke 133 is supported on the bimetal 127 with the opposite legs thereof facing in the direction of an L-shaped magnetic member 135. A screw 137 secures the magnetic member 135 and the bimetal 127 to the base of the circuit breaker. The screw member 137 also connects the flexible conductor 33 to the bimetal member 127. A flexible conductor 141 is connected at one end thereof to the upper end of the bimetal 127, and at the other end thereof to the terminal conductor 35.

The circuit through each pole of the circuit breaker extends from the terminal 27 (FIG. 2) through the terminal conductor 25, the stationary contact 19, the movable contact 23, the contact arm 29, the flexible conductor 33, the bimetal member 127, the flexible conductor 141, the terminal conductor 35 to the other terminal connector 37.

The circuit breaker can be manually operated between the "on" and "off" positions when the releasable trip member 51 is latched in the position shown in FIGS. 1 and 2. As seen in FIGS. 1 and 2, the trip member 51 extends into the opening 79 (FIG. 1) to engage the latch 73. The springs 67 act through the toggle link 57 to tend to rotate the releasable trip member 51 in a clockwise (FIG. 2) direction about the pivot 53. The trip member at the free end thereof engages the latch 73 tending to rotate the latch 73 in a counterclockwise (FIG. 2) direction. Counterclockwise movement of the latch 73 is prevented by engagement of the end part 81 thereof with the generally flat latch surface 103 (FIGS. 3–7) of the latch part 101 of the trip bar 89. The force tending to rotate the trip member 73 in a counterclockwise direction operates through the latch part 101 (FIG. 3) of the trip bar 89 in a downward (FIG. 2) direction through the axis of rotation of the trip bar 89. Thus, the trip bar 89 serves to maintain the trip 51 in the latched position. It is noted that the I-beam construction of the trip bar 89 provides strength to resist flexing from the force tending to rotate the latch 73 toward an unlatching position.

When a low overload above a predetermined value, for example 125% of the normal current, occurs in the circuit of any pole of the circuit breaker, the low overload current heats the associated bimetal 127. When the bimetal 127 has been heated a predetermined amount by the overload current the bimetal will deflect to the right (FIG. 2) whereupon the adjusting screw 131 will move against the associated projection 99 of the trip bar 89 to rotate the trip bar 89 in a clockwise (FIG. 2) direction. During this tripping movement of the trip bar 89 the latch part 101 and latch surface 103 thereof will be moved into alignment with the opening 83 in the latch member 73, to release the latch member 73. An overload will occur only when the circuit breaker is in the closed position in which position the toggle **55**, **57** is in a more straightened position. When the trip bar **89** has been rotated to the tripping position the springs **67** will operate through the link **57** and the trip member **51** to thereby rotate the latch **73** in a counterclockwise direction whereupon the trip member **51** will be released through the opening **79** (FIG. 1) in the latch **73**. Upon release of the trip member **51**, the springs **67** will operate to collapse the toggle **55**, **57** to simultaneously open the three contact arms **29** in a manner well known in the art. The handle **68** will be moved to an intermediate position between the "on" and "off" positions to provide a visual indication that the circuit breaker has been tripped. The mechanism is reset by moving the handle **68** slightly beyond the full "off" position. During this movement a part **147** on the operating member **47** will engage a part **149** on the trip member **51** to rotate the trip member **51** in a counterclockwise (FIG. 2) direction. Near the end of this movement, the trip member **51** will move into the opening **79** (FIG. 1) of the latch **73** and engage the latch **73** at the lower end of the opening to rotate the latch **73** in a clockwise (FIG. 2) direction back to the latching position seen in FIG. 2 whereupon the torsion spring **85** will move the trip bar **89** back to the latching position seen in FIG. 2 with an extension **99** engaging an adjusting screw **131** to stop the trip bar **89** in the position seen in FIG. 2. Upon release of the handle **68** the springs **67** will operate to bias the trip member **51** in a clockwise (FIG. 2) direction which movement will be prevented by engagement of the trip member **51** with the latch **73** which latch **73** is latched by engagement of the part **81** thereof with the latch surface **103** (FIG. 3) of the latch part **101** of the trip bar **89**. The circuit breaker can be then manually operated in the same manner hereinbefore described. When the handle **68** is released, during the time that the trip member moves in the opening **79** (FIG. 1) from the position where the trip member engages the latch **73** at the lower edge of the opening to the position where the trip member engages the latch at the upper edge of the opening (FIG. 2) the torsion spring **85** operates to bias the latch member **73** into latching engagement with the latch surface **103**.

Upon the occurrence of a severe overload or short circuit such, for example, as 10 times or more of the normal rated current, the current through the bimetal **127** will energize the electromagnet **133**, **135** sufficiently that the magnetic member **133** will be attracted instantaneously toward the magnetic member **135** flexing the bimetal **127** whereupon the screw **131** will move against the associated projection **99** to move the trip bar **89** to a tripping position to effect a tripping operation in the same manner hereinbefore described. The circuit breaker may then be reset in the same manner hereinbefore described. The circuit breaker is trip free in that the contacts will be tripped open even if the handle **68** is held in the "on" position.

From the foregoing, it can be understood that there is provided by this invention an improved multi-pole circuit breaker comprising a common molded insulating trip bar that latches the circuit breaker in operating position and that is operated upon the occurrence of an overload in any of the pole-units to release the operating mechanism to effect automatic opening of the circuit breaker. The latch part of the trip bar is molded integral with the main body portion of the trip bar. The insulating pivot pins at opposite ends of the trip bar are also molded integral with the main body portion of the trip bar. The molded insulating trip bar comprises integral pole-unit body parts that are generally I-beam shaped in cross section to provide adequate structural strength with less material, and integral barrier body parts, between the pole-unit body parts, that are disk shaped in cross section to cooperate with the circuit breaker housing barriers in order to prevent the passage of gases between adjacent pole units.

While a specific embodiment of the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the construction and arrangement of parts may be used without departing from some of the essential features of the invention.

I claim as my invention:

1. A multi-pole circuit breaker comprising a plurality of pole units, a pair of cooperable contacts in each pole unit, a releasable member in a latched position and releasable to effect automatic opening of all of said pairs of said contacts, a trip bar of molded insulating material, said bar being common to all of said pole units, said trip bar comprising a latch part having a latch surface thereon which latch part and latch surface are of molded insulating material molded integral with said trip bar, said latch surface engaging said releaseable member to latch said releaseable member in said latched position, trip means in each of said pole units, each of said trip means being constructed to operate automatically in response to an overload current above a predetermined value to move said trip bar to a tripping position during which movement said latch surface is moved to release said releaseable member.

2. A multi-pole circuit breaker according to claim **1**, said trip bar comprising an elongated member extending across all of said pole units, said trip bar comprising a pair of molded pivot pins of insulating material molded integral therewith at opposite ends thereof, said circuit breaker comprising supporting means engaging said molded pivot pins to support said trip bar for pivotal movement about the elongated axis thereof.

3. A multi-pole circuit breaker according to claim **1**, said trip bar comprising a main body portion of molded insulating material, said latch part projecting from said main body portion, and said circuit breaker comprising spring means engaging said latch part to bias said trip bar to said latching position.

4. A multi-pole circuit breaker according to claim **1**, said trip bar comprising an elongated molded main body portion of insulating material extending across all of said pole units, said trip bar comprising a pair of molded pivot pins of insulating material at opposite ends of said elongated main body portion molded integral with said elongated main body portion, said circuit breaker comprising support means engaging said molded pivot pins to support said trip bar for pivotal movement about the elongated axis thereof, said latch part comprising a projecting latch part of insulating material extending from said main body portion and molded integral with said main body portion, said latch surface being an integral insulating surface of said projecting latch part, said trip bar comprising a separate trip projection of insulating material in each pole unit which trip projections are molded integral with said main body portion, and in each pole unit the associated trip means comprising a bimetal structure that flexes in response to an overload current within a predetermined range in the associated pole unit to operate against the associated trip projection to pivot said trip bar to said tripping position.

5. A multi-pole circuit breaker according to claim **4**, and said circuit breaker comprising biasing means engaging said projecting latch part to bias said trip bar to the latching position.

6. A multi-pole circuit breaker comprising an insulating housing, said housing comprising a pair of adjacent compartments and insulating barrier means separating said adjacent compartments, a different pole unit in each of said compartments, said barrier means having opening means therein, an elongated molded insulating trip bar common to said pole units extending through said opening means into each of said adjacent compartments, a separate pair of cooperable contacts in each of said compartments, a latched releasable member in one of said compartments releasable to effect opening of said pairs of contacts, a latch part on said trip bar engaging said latched releasable member to latch said latched releasable member, pivot means supporting said trip bar for movement about the elongated axis thereof, said circuit breaker comprising spring means effecting a bias of said latched releasable member against said latch part, separate trip means in each of said compartments, each of said trip means operating automatically in response to an overload current above a predetermined value to move said trip bar about said axis to a tripping position during which movement said latch part moves to release said latched releasable member, said molded insulating trip bar comprising a separate pole unit body part in each of said compartments and a barrier body part between said pole unit body parts which pole unit body parts and barrier body part are molded as integral parts of said molded insulating trip bar, each of said pole unit body parts comprising a center leg part elongated for structural strength in the direction of the thrust force of said latch member through the axis of said trip bar, and said barrier body part being positioned in said opening means in said barrier means and being disk shaped in cross section to cooperate with said barrier means to prevent the passage of gases between said compartments.

7. A multi-pole circuit breaker according to claim **6**, and each of said pole unit body parts being generally I-shaped in cross section.

8. A multi-pole circuit breaker according to claim **7**, and said latch part comprising a projecting part of insulating material molded integral with said trip bar at one of said pole unit body parts.

9. A multi-pole circuit breaker according to claim **8**, and said elongated molded insulating trip bar comprising a pair of molded insulating pin members molded integral with said trip bar at opposite ends of said trip bar to support said trip bar for rotation about the elongated axis thereof.

10. A multi-pole circuit breaker according to claim **1**, a trip member in a latched position latched by said releasable member, operating spring means biasing said trip member toward an unlatched position and operating through said trip member to bias said releasable member toward an unlatched position which movement is restrained by the engagement of said releasable member with said latch surface of said trip bar, a handle member movable between operating positions when said releasable member and trip member are in said latched positions to operate said contacts between closed and open positions, and upon movement of said trip bar to said tripping position said operating spring means operating to move said releasable member to an unlatched position and to move said trip member to an unlatched position to effect automatic opening of said contacts.

11. A multi-pole circuit breaker according to claim **10**, and in each pole unit the associated trip means comprising a bimetal structure that flexes in response to an overload current within a predetermined range to operate against said trip bar to move said trip bar to the tripping position.

12. A multi-pole circuit breaker according to claim **10**, said trip bar being supported for pivotal movement and moving to said tripping position in a first direction about the pivot thereof, said releasable member being supported for pivotal movement and moving toward the unlatched position in a second direction about the pivot thereof which second direction is opposite said first direction, and said trip member being supported for pivotal movement and moving to the unlatched position in said first direction about the pivot thereof.

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U.S. Cl. X.R.

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