Sept. 1, 1970 E. J. WALKER 3,526,861

CIRCUIT BREAKER WITH IMPROVED TRIP DEVICE

Filed May 3, 1968 3 Sheets-Sheet 1

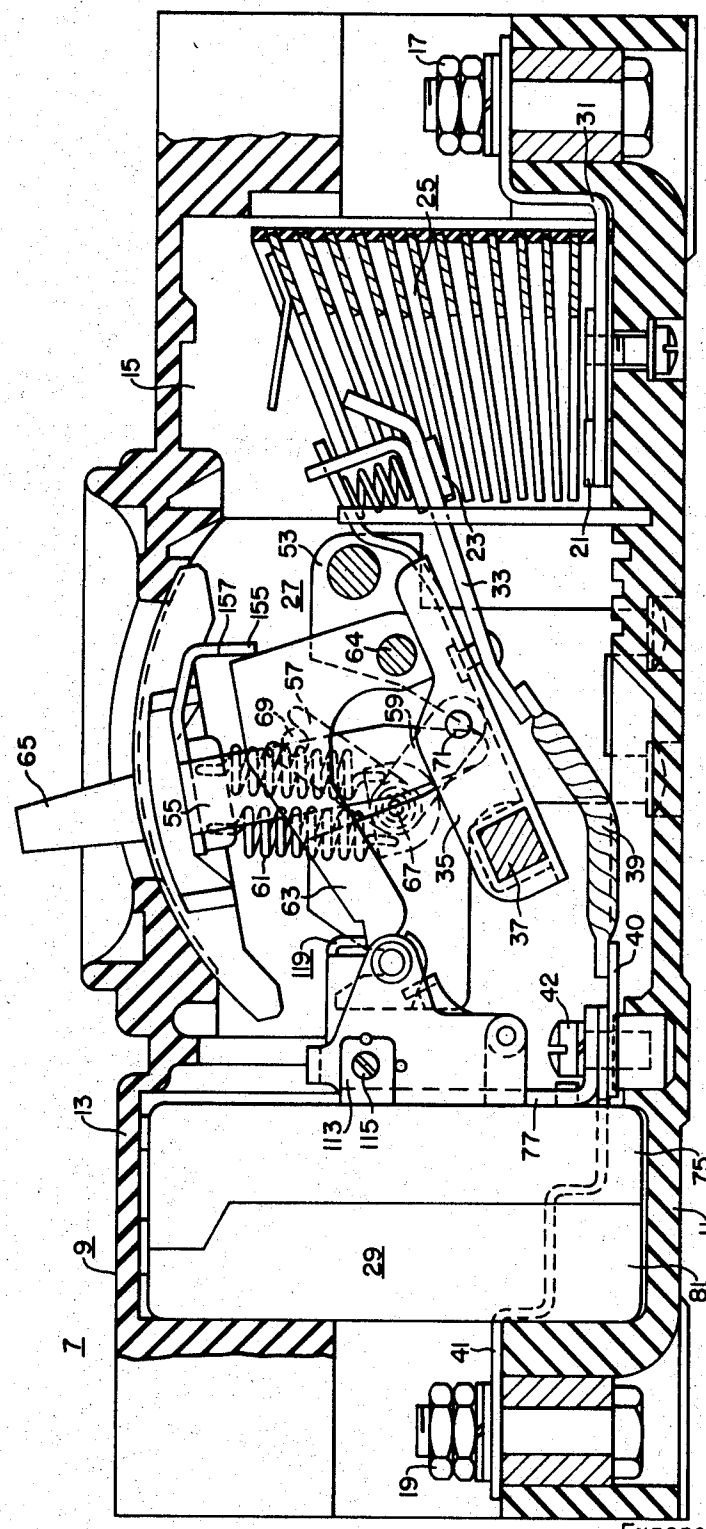


FIG. 1.

WITNESSES

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CIRCUIT BREAKER WITH IMPROVED TRIP DEVICE

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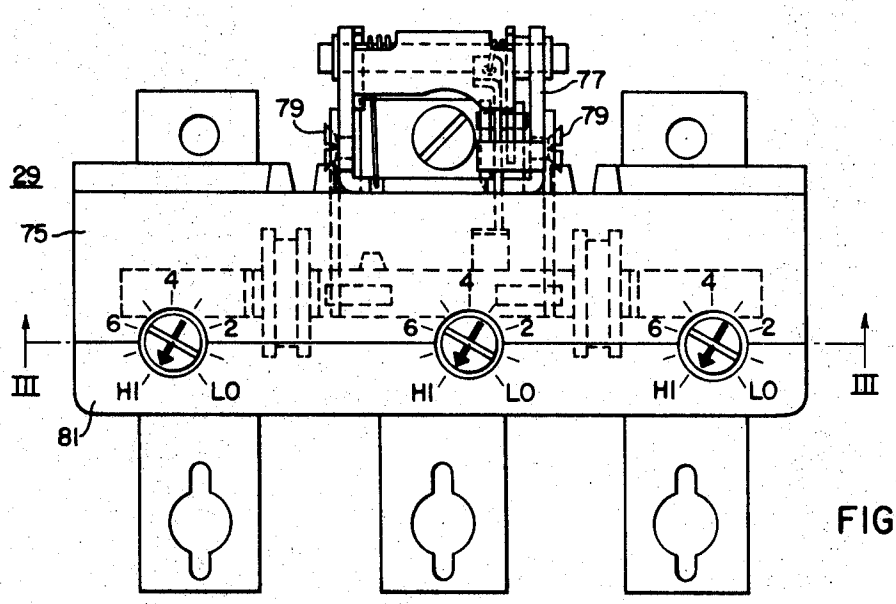


FIG. 2.

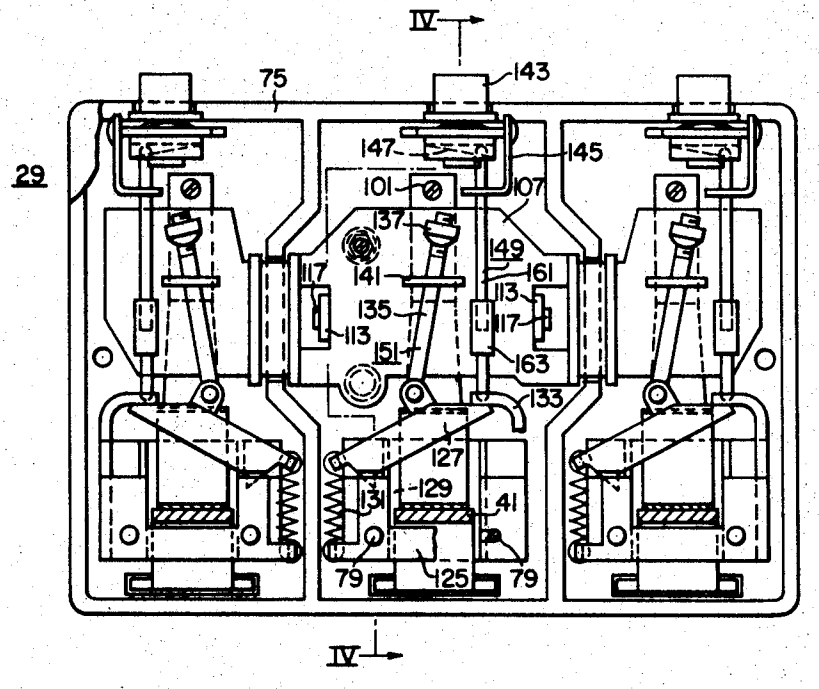


FIG. 3.

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CIRCUIT BREAKER WITH IMPROVED TRIP DEVICE

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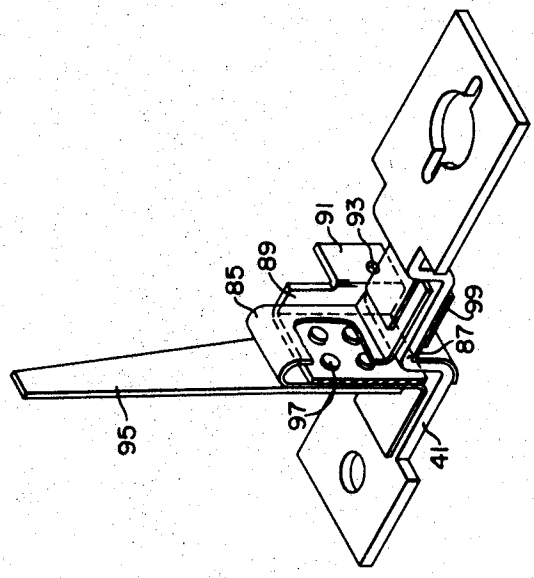


FIG. 5.

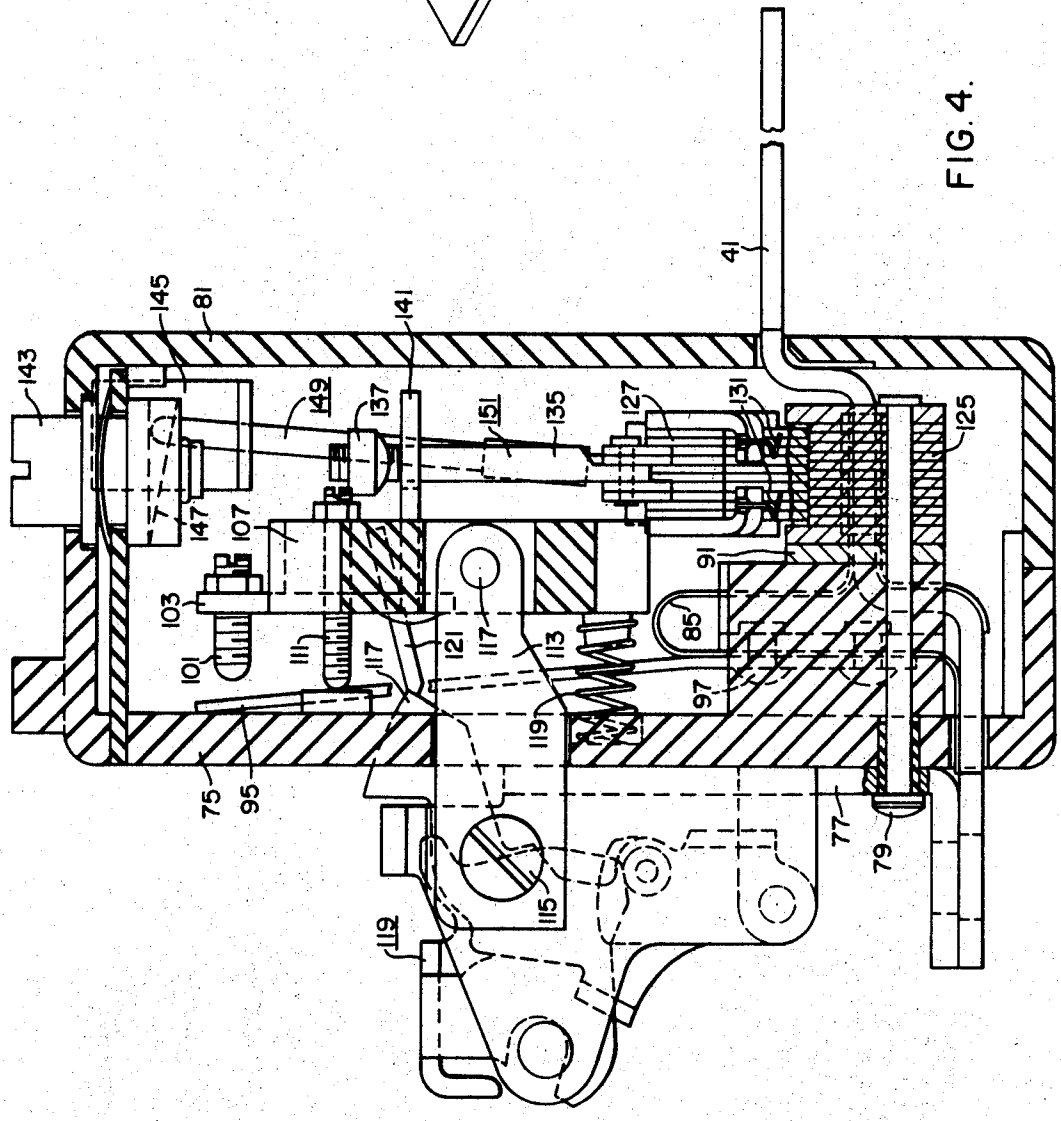


FIG. 4.

United States Patent Office 3,526,861 Patented Sept. 1, 1970

3,526,861

CIRCUIT BREAKER WITH IMPROVED TRIP DEVICE

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Filed May 3, 1968, Ser. No. 726,474
Int. Cl. H01h 75/12
U.S. Cl. 335—35 6 Claims

ABSTRACT OF THE DISCLOSURE

A circuit breaker comprises an improved thermal and magnetic trip device. The breaker comprises a pair of contacts for opening and closing a circuit. The trip device comprises a main conductor in electrical series with the contacts and a shunt conductor for shunting current around a portion of the main conductor. A bimetal is connected to the shunt conductor to be heated in response to the current in the shunt conductor to thereby thermally trip the breaker. A magnetic core and armature are supported to be energized by the full current in the circuit to thereby magnetically trip the breaker. The parts are supported so that limited movement of the main conductor does not interfere with calibration or adjustment of the trip device.

BACKGROUND OF THE INVENTION

In the design of certain types of circuit breakers it is desirable to provide certain thermal and electromagnetic tripping characteristics in an overall construction that will not lose calibration or adjustment either during assembly of the breaker or thereafter when terminals are tightened and loosened. For example, in some applications the main conductor that carries current through the trip device is provided with terminal portions that are moved when pressure is applied thereto connecting or disconnecting operations. The parts should be so supported that this limited movement of the main conductor does not interfere with the calibration or adjustment of the thermal and/or electromagnetic trips. Thus, an object of this invention is to provide a circuit breaker with an improved thermal and magnetic trip device that permits liimted relative movement of the main conductor without disturbing the calibration or adjustment of either the thermal trip or the magnetic trip.

Another object of this invention is to provide a circuit breaker with an improved trip device, comprising a main conductor for energizing the trip device with an electromagnetic trip energized by the full current through the trip device to operate a trip member and with a thermal trip comprising a bimetal connected to a shunt conductor that shunts a portion of the full current past a portion of the main conductor for heating the bimetal to operate the trip member, with the trip device being constructed and arranged such that the main conductor can move under stresses without affecting the calibration or adjustment of either the thermal trip or the electromagnetic trip.

PRIOR ART

The patent to Stevenson et al., No. 3,211,860 discloses a circuit breaker comprising a thermal and electromagnetic trip device wherein a bimetal is connected directly to the main conductor to be heated by the full current in the main conductor.

The patent to Strobel Pat. No. 3,244,837 discloses a circuit breaker comprising a thermal and electromagnetic trip device with the electromagnetic trip being energized by the current in a looped conductor that provides a shunt path parallel to a portion of the main conductor.

SUMMARY OF THE INVENTION

A circuit breaker comprises the pair of contacts for opening and closing a circuit and a main conductor in electrical series with the contacts. A trip device, comprising a trip member pivotally supported on a fixed pivot and operable to effect automatic opening of the contacts, comprises a shunt conductor connected at opposite ends thereof to the main conductor to provide a parallel shunt path parallel to a portion of the main conductor. A thermal trip comprises a bimetal that is fixedly connected at one end to the shunt conductor with the other end being free to move, when the bimetal flexes, to operate the trip member. An electromagnetic trip comprises a generally U-shaped magnetic core, that is energized by the full current in the circuit, and an armature structure that is pivotally supported on one leg of the core and that is movable to operate the trip member. The supported end of the bimetal and the U-shaped magnetic core are both fixedly supported with relation to the fixed pivot of the trip member so that movement of the trip device or movement of the main conductor will not disturb the calibration or adjustment of either the thermal trip or the electromagnetic trip. The trip device is a removable trip device with the main conductor comprising a terminal at each of the opposite ends thereof so that under certain conditions the main conductor is subjected to stresses that will tend to move the main conductor. The circuit breaker is an insulating-housing or molded-case type three-pole circuit breaker with the removable trip device comprising a separate thermal and electromagnetic trip for each pole unit and a single trip member or trip bar common to all of the pole units.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view in section through the center-pole of a three-pole circuit breaker with the trip device being shown in side elevation;

FIG. 2 is a plan view of the removable trip device see in FIG. 1;

FIG. 3 is a sectional view taken along the line III—III of FIG. 2;

FIG. 4 is a sectional view, enlarged relative to FIG. 3, taken generally along the line IV—IV of FIG. 3;

FIG. 5 is a perspective view of parts of the trip device seen in FIGS. 2–4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawings, a circuit breaker **7** shown therein comprises an insulating housing **9**. The insulating housing **9** comprises a base **11** and a removable cover **13** suitably secured to the base **11**. The circuit breaker is a three-pole circuit breaker with insulating barrier means **15**, formed with the base **11** and cover **13**, forming three adjacent compartments for housing the three-pole units. A pair of terminals **17** and **19**, are provided in cavities at opposite ends of each pole unit for enabling connection of each pole unit in an electric circuit.

The circuit breaker is of the type more specifically described in the patent to Stevenson et al. Pat. No. 3,260,822. The circuit breaker comprises a stationary contact **21**, a movable contact **23** and an arc-extinguisher **25** for each pole unit. A common operating mechanism **27** is provided for simultaneously actuating the three movable contacts to open and closed positions. A trip device indicated generally at **29** serves to effect automatic opening of the breaker contacts in response to overload conditions in a manner to be hereinafter described.

The terminal **17** is disposed at the outer end of a conducting strip **31** which extends into the housing and

rigidly supports the stationary contact **21**. The movable contact **23** is mounted on a rigid contact arm **33** that is supported on a switch arm **35** that is connected to an insulating tie bar **37**. The tie bar **37** extends across all three pole units of the breaker and supports the switch arms for the several pole units for unitary movement. The tie bar **37** is suitably supported in the housing for movement about an axis to open and closed positions. The contact arm **33** is connected, by means of a flexible conductor **39**, to a conductor **40** that engages a main conductor **41** that is secured at one end thereof to the base **11** by means of a screw **42**. The screw **42** connects the conductor **40** with the main conductor **41**. The main conductor **41** extends through the trip unit **29** and is connected at its outer end to the terminal **19**. As can be seen in FIG. 5, the main conductor **41** is widened at the opposite ends thereof to provide the terminal portions for receiving the screw **42** and terminal **19** in a well known manner.

The operating mechanism **27** is disposed in the center compartment of the housing and is supported on a pair of spaced frame members **53**, (only one being shown), which are secured to the base **11**. The operating mechanism comprises an inverted generally U-shaped operating lever **55**, a toggle compressing toggle links **57, 59**, a pair of overcenter springs **61** and a releasable cradle or trip member **63** that is controlled by the trip device **29**. The operating lever **55** is pivotally supported at the inner ends of the legs thereof in U-shapes slots in the spaced supporting plates **53**. The cradle or trip member **63** is pivotally supported on a pin **64** that is supported between the spaced plate members **53**. An insulating handle **65**, that is supported on the outer end of the lever **55**, extends through a suitable opening in the front of the cover **9** to permit manual operation of the breaker.

The toggle links **57** and **59** are pivotally connected together by means of a knee pivot **67**. The front end of the link **57** is pivotally connected to the trip member **63** by means of a pin **69**. The back end of the toggle link **59** is pivotally connected to the switch arm **35**, for the center pole unit, by means of a pin **71**. The overcenter springs **61** are connected under tension between the outer end of the operating lever **55** and the knee pivot **67** of the toggle **57, 59** in a well known manner.

The circuit breaker is manually operated to the open position seen in FIG. 1 by counterclockwise movement of the handle **65** to the "off" position, which movement moves the overcenter springs **61** to cause collapse of the toggle **57, 59** and opening movement of the switch arms **35** for all of the pole units in a well known manner. The breaker is manually closed by reverse or clockwise movement of the handle **65** to the "on" position which movement moves the overcenter springs **61** to erect a toggle **57, 59** to thereby move the switch arms **35** for all of the pole units to the closed position in a manner well known in the art.

Referring to FIGS. 2–5, the trip device **29** comprises an insulating base or support member **75** that is fixedly secured to a rigid metallic supporting bracket **77** by means of a pair of rivets **79**. An insulating cover **81** is removably connected to the base **75** by a pair of screws (not shown) to provide an insulating housing **75, 81** for housing parts of the removable trip device. The housing **75, 81** is separated into three compartments for housing the three thermal and electromagnetic trips of the three pole units. Only the thermal and electromagnetic trip of the center-pole unit will be specifically described, it being understood that the description applies to each of the pole units. As is best seen in FIGS. 4 and 5, a looped conductor **85** is connected at the opposite ends thereof to the main conductor **41** to provide a parallel current path for shunting a portion of current around an intermediate portion **87** of the main conductor **41**. A rigid metallic generally U-shaped bracket **89**, having a pair of flanges **91** (only one of which is seen in FIG. 5) at the opposite sides thereof, is fixedly secured to the base **75** by means of the two rivets **79** which extend through openings **93** (FIG. 5) in the flanges **91**. A bimetal **95** is fixedly secured at the lower end thereof to one leg of the looped conductor **85** and to the bight portion of the bracket **89** by means of four rivets **97**. As can be seen in FIG. 5, an insulating wrapper **99** is provided around portions of the conductor **41** and loop conductor **85** to insulate these conductors from adjacent parts. As can be seen in FIG. 4, the free end of the bimetal **95** is disposed opposite a calibrating or adjusting screw **101** that is supported on an extension **103** that is attached to an insulating trip bar **107**. A screw **111** is supported on the trip bar to limit counterclockwise (FIG. 4) movement of the trip bar **107**. The trip bar **107** is pivotally supported in the housing **75, 81** by means of a pair of supporting arms **113** that are supported on the bracket **77** by means of screws **115**. As can be seen in FIG. 3, the trip bar **107** is formed with a pair of insulating pin portions **117** that extend through openings in the arms **113** to support the trip bar **107** for pivotal movement about the pins **117**. A spring **119** (FIG. 4) biases the trip bar **107** in a counterclockwise direction. In the normal position of the trip bar **107**, a latch member **121**, that is rigidly imbedded in the trip bar **107**, engages a latch portion **117** of a latching mechanism that is indicated generally at **119** and that restrains the cradle or trip member **63** (FIG. 1) in the latched position shown in FIG. 1.

As can be understood with reference to FIGS. 3–5, the rivets **79** also extend through openings in a laminated U-shaped magnetic core **125**. Thus, the rivets **79** of the center-pole unit, fixedly mount the U-shaped magnetic core **125**, the rigid bracket **89** and the insulating base **75** to the bracket **77**. There is a bracket **77** in only the center-pole unit. It can be understood that in each of the two outer pole units the pair of rivets **79** fixedly mount the associated U-shaped magnetic core **25** and the associated bracket **89** to the base **75**. Continuing on with a description of the trip means of the center-pole unit, a laminated magnetic armature **127** is provided with a knife-edge type pivot **129** at one end thereof that is suitably supported in a V-shaped slot in one leg of the associated U-shaped core **125**. A pair of springs **131** bias the armature **127** into the open or unattracted position seen in FIG. 3. An elongated arm **135** is pivotally connected to the armature **127** at the lower end thereof, and is provided with a calibrating or adjusting nut **137** at the upper end thereof. The rod or arm **135** extends through an opening in a plate member **141** that is fixed to the insulating trip bar **107**. An insulating adjusting knob **143** protrudes through an opening in the front of the trip-device housing **75, 81**, and is supported for rotation on a supporting bracket **145** that is fixedly secured to the base **75**. The adjusting knob **143** is provided with a cam surface **147** at the lower end thereof that engages the front end of a rod **149**. The lower end of the rod **149** extends through an opening in the bracket **133** and engages the front surface of the armature **127**. The air gap of the electromagnet can be adjusted by rotating the knob **143** to move the rod **149** longitudinally to thereby pivot the armature **127** to adjust the air gap between the armature **127** and the one leg of the associated magnetic core **125**. The armature **125**, rod **135** and nut **137** form an armature structure indicated generally at **151** which armature structure is actuated to operate the trip bar in a manner to be hereinafter more specifically described.

As can be seen in FIG. 1, the screw **42** fixedly mounts the bracket **77** to the base **11** in the center-pole unit of the circuit breaker to thereby fixedly mount the trip device **29** in position.

Referring to FIG. 1, it will be understood that when the circuit breaker is closed, the circuit through each pole unit extends from the terminal **19** through the main conductor **41**, with the loop conductor **85** (FIGS. 4 and 5) shunting a portion of the current around the intermediate

portion 87 of the main conductor 41, through the conductor 40, the flexible conductor 39, the contact arm 33, the movable contact 23, the stationary contact 21, the conducting strip 31 to the other terminal 17.

When the circuit breaker is closed, and a persistent overload, such for example as from 125% of normal current to 10 times normal current, occurs in any of the pole units, the heat generated by the current in the looped shunt conductor 85 is conducted to the bimetal 95 and the bimetal 95 flexes such that the upper end thereof moves to the right (FIG. 4) to engage the screw 101 to rotate the trip bar 107 clockwise (FIG. 4) whereupon the latch 121 releases the latch portion 117 of the latch structure 119 to free the cradle or trip member 63 (FIG. 1). When the circuit breaker is closed, the toggle 57, 59 is erected, and upon release of the cradle 63 the springs 61 operate to rotate the cradle 63 clockwise (FIG. 1) about the pivot 64 to cause collapse of the toggle 57, 59 to open the circuit breaker in a manner well known in the art. During this operation, the handle 65 is moved to an intermediate position intermediate the "on" and "off" positions to provide a visual indication that the circuit breaker has been tripped. The breaker cannot be closed following a tripping operation until the mechanism is reset and relatched. The mechanism is reset and relatched by moving the handle 65 to a position slightly past the full "off" position during which movement an extension 155 on the operating lever 55 engages a shoulder 157 on the cradle 63 pivoting the cradle counterclockwise (FIG. 1). Near the end of this movement, the free end of the cradle 63 wipes past the latch structure 119, and upon release of the handle 65, the latch structure 119, which is again latched by the latch 121 of the trip bar 107, latches the free end of the cradle 63 in a manner well known in the art. After the cradle 63 has been relatched, the operating handle 65 can be moved to the "on" position to close the contacts in the same manner as was hereinbefore described.

During the above-described thermal tripping operation the bimetal 95 flexes with a time delay so that if the overload is a momentary overload the circuit breaker will not trip out. Upon the occurrence of a severe overload of 10 times or more of the normal current through any of the pole units, the electromagnet 125, 127, which is energized by the full current in the conductors 41, 85, is operated to effect instantaneous attraction of the armature 127 toward the core 125 and the armature 127 pivots on the one leg of the core 125 moving toward the other leg of the core 125. During this movement, the armature structure 151 is moved downward and the nut 137 engages the associated projection or plate 141 to pivot the trip bar 107 clockwise (FIG. 4) whereupon the cradle 63 is released to effect a tripping operation in the same manner as was hereinbefore described. The circuit breaker is reset and relatched following an electromagnet tripping operation in the same manner as was hereinbefore described.

During assembly of the circuit breaker, the thermal trip is calibrated by adjusting the position of the screw 101 (FIG. 4) on the extension 103 of the trip bar 107 to thereby adjuts the initial position of the air gap between the bimetal 95 and the adjusting screw 101. The electromagnetic trip is also adjusted during the assembly of the circuit breaker. Referring to FIG. 3, the elongated rod 149 comprises a top portion 161 that is threaded into a bottom portion 163. Rotation of either of these portions 161 or 163 with relation to the other portion will thereby vary the length of the rod 149 to thereby adjust the amount of air gap when the adjusting knob 143 is at a particular position. The electromagnetic trip is also adjusted by rotating the nut 137 to provide that the nut 137 will engage the associated plate 141 near the end of the armature tripping movement and to provide that the nut 137 will in fact operate to rotate the trip bar 107 to a tripping position near the end of the armature movement.

As was previously described, the trip device 29 is a removable trip device mounted in the circuit breaker by means of the screw 42 (FIG. 1), and the main conductors 41 are subjected to stresses that can move the main conductors 41 when the screws 42 are tightened and loosened and when the terminals 19 (FIG. 1) are tightened or loosened. With the construction of the trip device as disclosed, the movement of the main conductors 41 under stresses will not move the magnetic cores 125, the armature structures 151, the elongated rods 149, the bimetals 95, or the trip bar 107. As can be seen in FIG. 4, the rivets 79 fixedly secure the magnetic coil 125 and bracket 89 to the base 75 which is fixedly secured to the supporting bracket 77 so that these parts are all fixed with relation to each other. The trip bar 107 is mounted on the supporting arms 113 which are in turn mounted on the bracket 77 so that the pivots 117 of the trip bar are fixed with relation to the supporting bracket 77. The rod 149 engages the armature 127 and the cam surface of the adjusting knob 143 that is mounted on the bracket 145 that is fixed to the housing base 75 so that the adjusted position of the adjusting rod 149 is fixed with relation to the supported bracket 77. Thus, although there can be movement of the rod 149 during adjustment, and although there is movement of the armature 127 during a tripping operation, and although there is movement of the bimetal 95 during a thermal tripping operation, these movements are not movements that will adversely affect the calibration or adjustment of the trip device, and movement of the trip device as a unit or movement of the main conductors 41 under the above-mentioned stresses will not adversely affect the calibration or adjustment of either the thermal trip or the electromagnetic trip. With the bimetal 95 mounted on a portion of the looped conductor 85, and with the looped conductor 85 shunting current around a portion of the main conductor 41, the desirable thermal tripping characteristics are achieved. With the full pole-unit current energizing the electromagnet 125, 127, the desirable electromagnet tripping characteristics are achieved.

We claim:

1. A circuit breaker comprising a pair of contacts for opening and closing a circuit, a trip device comprising a main conductor in electrical series with said contacts, said trip device comprising a trip member operatively movable to effect automatic openings of said contacts, said trip device comprising a shunt conductor connected to provide a parallel current path parallel to a portion of said main conductor for shunting current around said portion of said main conductor, said trip device comprising a thermal trip and an electromagnetic trip, said thermal trip comprising a bimetal connected to said shunt conductor in a heat-conducting relationship with said shunt conductor and being in an unactuated position, said thermal trip being calibrated such that upon the occurrence of an overload current above a first predetermined value in said circuit said bimetal is heated by the heat generated in said shunt conductor and flexes to operatively move said trip member, said electromagnetic trip comprising a magnetic core and a magnetic armature structure supported to be energized by the full current in said circuit, said core and armature structure being in an unactuated position, said electromagnetic trip being calibrated such that upon the occurrence of an overload current in said circuit above a second predetermined value said armature structure moves toward said core to operatively move said trip member, said trip device comprising support means, said support means supporting said trip member and said bimetal such that said trip member and said bimetal cannot move relative to each other in such a way as to destroy the calibration of said thermal trip, said support means supporting said trip member and said core and armature structure such that said trip member and said core and armature structure cannot move relative

to each other in such a way as to destroy the calibration of said electromagnetic trip.

2. A circuit breaker according to claim 1, said circuit breaker comprising an insulating housing with said contacts being supported within said housing, said trip device comprising a removable trip device removably supported within said housing, and said main conductor comprising terminal means at opposite ends thereof to permit connection and disconnection of said trip device in electrical series with said contacts in said circuit to be controlled by said contacts.

3. A circuit breaker according to claim 2; said circuit breaker comprising a multi-pole circuit breaker with a pair of said contacts for each pole; said trip device comprising a multi-pole trip device with a separate main conductor, shunt conductor, bimetal, magnetic core and magnetic armature structure for each pole; and said trip member comprising a common trip member common to all of said poles and being supported for pivotal movement about a fixed pivot on said support means.

4. A circuit breaker comprising a pair of contacts for opening and closing a circuit, a trip device comprising a main conductor in electrical series with said contacts, said trip device comprising a trip member pivotally supported on a fixed pivot and operable to effect automatic opening of said contacts, said trip device comprising a shunt conductor connected at opposite ends thereof to said main conductor and comprising an intermediate portion spaced from said main conductor to provide a parallel shunt path parallel to a portion of said main conductor for shunting current around said portion of said main conductor, said trip device comprising a bimetal fixedly connected at one end thereof to said intermediate portion of said shunt conductor and having the other end free to move when the bimetal flexes, upon the occurrence of an overload current above a first predetermined value said bimetal being heated by the current in said shunt conductor and flexing to operatively move said trip member, said trip device comprising a generally U-shaped magnetic

core supported to be energized by the full current in said main conductor and shunt conductor, said trip device comprising an armature structure pivotally supported on one leg of said core and pivotally movable about the pivot thereof toward and away from the other leg of said core, upon the occurrence of an overload above a second predetermined value said armature structure moving toward the other leg of said core to operatively move said trip member, and said trip device comprising support means supporting said flexed pivot of said trip member said one end of said bimetal and said core in positions fixed with relation to each other on said support means.

5. A circuit breaker according to claim 4, said circuit breaker comprising an insulating housing with said contacts being supported within said housing, said trip device being a removable trip device removable as a unit from said housing, said main conductor extending between the legs of said magnetic core and comprising terminal means at the opposite ends thereof to enable connection and disconnection of said contacts and said main conductor in said circuit to be controlled by said contacts.

6. A circuit breaker according to claim 5; said circuit breaker comprising a multi-pole circuit breaker with a pair of said contacts for each pole; said trip device comprising a multi-pole trip device with a separate main conductor, shunt conductor, bimetal, magnetic core and armature structure for each pole; and said trip member comprising a common trip member common to all of said poles and being supported for pivotal movement about a fixed pivot on said support means.

References Cited

UNITED STATES PATENTS

3,211,860	10/1965	Stephenson	337—50
3,244,837	4/1966	Strobel	337—50

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H. BROOME, Assistant Examiner