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G. J. DE ANGELO ET AL

3,492,614

CIRCUIT BREAKER WITH THRUST TRANSMITTING OPERATING MECHANISM

Filed Jan. 18, 1968

3 Sheets-Sheet 1

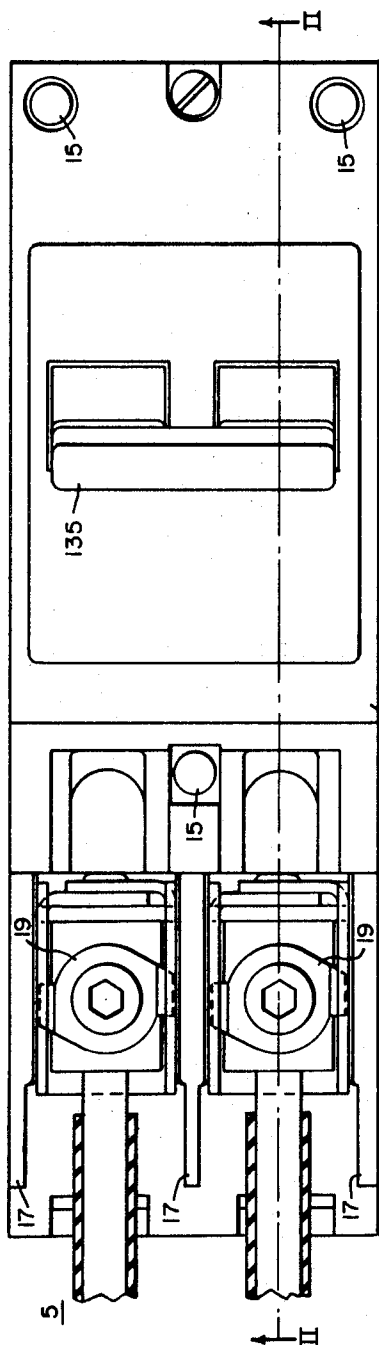


FIG. 1.

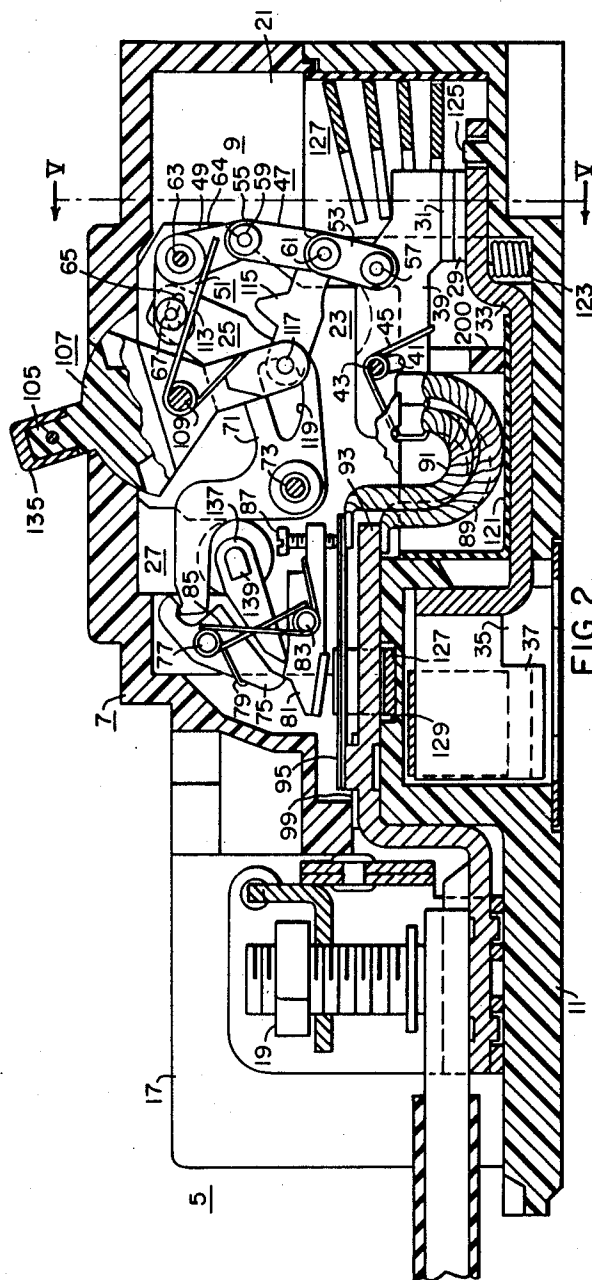


FIG. 2.

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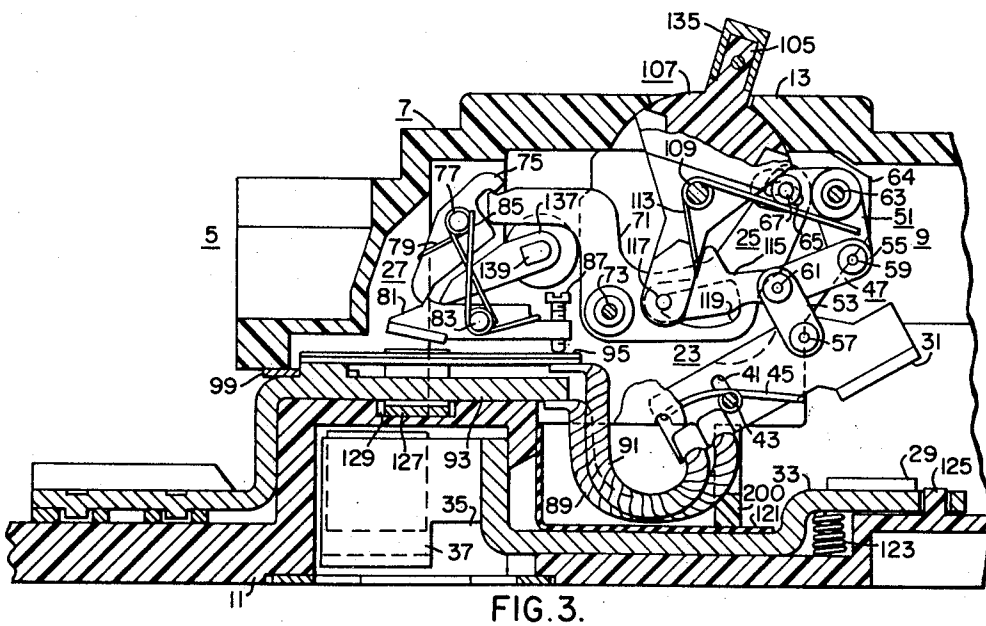
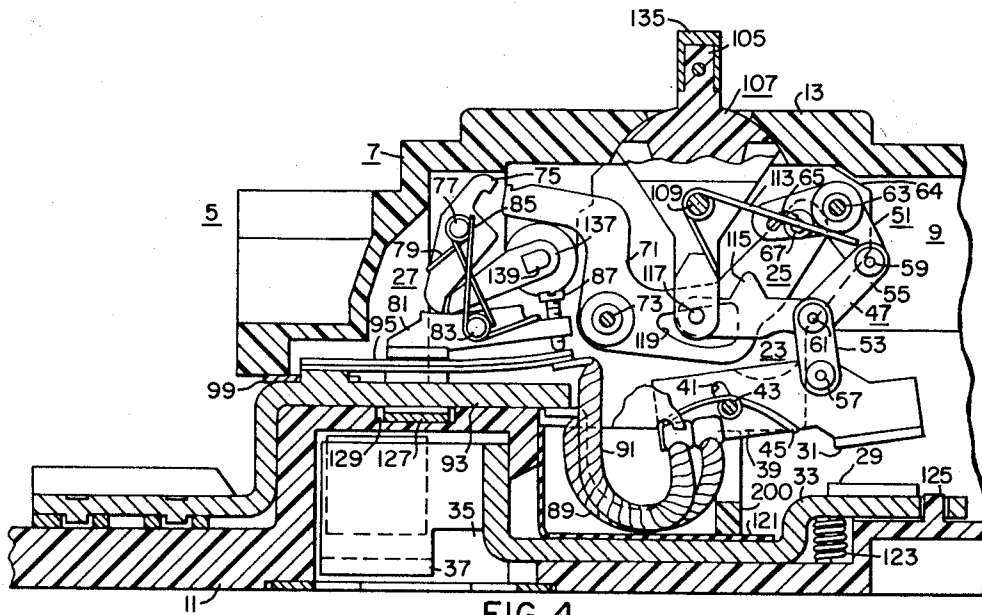
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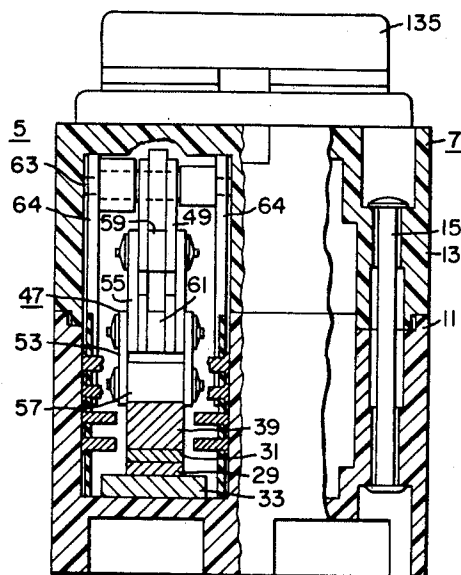


FIG. 5.

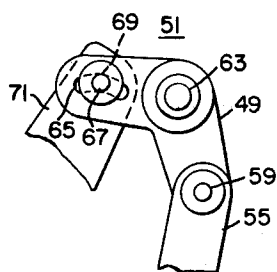


FIG. 6.

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CIRCUIT BREAKER WITH THRUST TRANSMITTING OPERATING MECHANISM

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Int. Cl. H01h 3/00, 73/00

U.S. Cl. 335—191

10 Claims

ABSTRACT OF THE DISCLOSURE

A circuit breaker comprises an improved compact thrust-transmitting operating mechanism. The mechanism is constructed to move the handle intermediate the "on" and "off" positions when the breaker trips to provide a visual indication that the breaker has tripped.

CROSS-REFERENCES TO RELATED APPLICATIONS

Certain features of the herein disclosed circuit breaker are disclosed in the co-pending patent applications Ser. No. 698,848, filed Jan. 18, 1968 and Ser. No. 698,809, filed Jan. 18, 1968.

BACKGROUND AND OBJECTS OF THE INVENTION

For certain circuit breaker applications, it is desirable to provide increased contact pressure without a high-strength overcenter spring mechanism that would make manual operation difficult. Thus, an object of this invention is to provide an improved thrust-transmitting operating mechanism for increased contact pressure.

Another object is to provide an improved thrust-transmitting operating mechanism with means for moving the handle of the circuit breaker to an intermediate position during tripping operations to provide a visual indication that the circuit breaker has tripped.

A further object of this invention is to provide a circuit breaker with an improved thrust-transmitting operating mechanism that is compact in construction.

SUMMARY OF THE INVENTION

An improved circuit breaker comprises a first link pivotally connected to a contact arm and a second link pivotally connected to a latched trip structure. The first and second links are connected by means of a knee pivot, and a third link, which is pivotally connected to the knee pivot, is pivotally connected to a manually operable operating member. The operating member operates through the third link to thrust the toggle to an erected position moving the contact arm to a closed position. A spring is provided below the stationary contact structure to provide contact pressure in the closed position of the contacts. The operating member operates the third link to collapse the toggle to effect an opening operation of the contact arm. The trip structure comprises an elongated releasable cradle or trip member pivotally supported intermediate the ends thereof. The releasable trip member is latched at one end by means of a trip device. The other end of the releasable trip member is connected to the second toggle link by means of a pivotally supported angle link. One leg of the angle link is pivoted to the second toggle link and the other leg is connected to the releasable trip member by means of a lost-motion connection. During tripping operations, the cradle is released to permit the upper pivotal connection of the second toggle link and the angle link to move to thereby permit an opening movement of the contact arm. As the

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contact arm moves to the open position, the toggle collapses and the operating member is moved to an intermediate position to provide a visual indication that the circuit breaker has tripped. During the tripping operation, the parts of the trip structure and operating mechanism do not move to a substantially higher position within the housing so that the height-wise dimension of the circuit breaker can be kept relatively small. The circuit breaker is reset by moving the operating member to the full off position to move the releasable trip member and link members to the reset position in which position the releasable trip member is automatically latched by the trip device to permit manual operation of the circuit breaker. During closing operations, the movable contact engages the stationary contact with a toe-and-heel engagement, and during opening operations the movable contact leaves the stationary contact with a heel-and-toe disengagement whereby the wear from contact engagement and arcs occurs mostly on the toe portion of the contact.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a top plan view of a two-pole circuit breaker constructed in accordance with principles of this invention;

FIG. 2 is a sectional view taken generally along the line II—II of FIG. 1 showing the breaker in a closed position;

FIG. 3 is a view similar to FIG. 2, with parts broken away and with the breaker in the "off" position;

FIG. 4 is a view similar to FIG. 3 with the breaker in the tripped position;

FIG. 5 is a sectional view, with parts shown in elevation and with parts broken away, taken generally along the line V—V of FIG. 2; and

FIG. 6 is a view illustrating the connection between the releasable trip member, angle-link and upper toggle link.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, there is shown therein a circuit breaker 5 comprising an insulating housing 7 and a circuit-breaker structure 9 supported on the housing 7.

The insulating housing 7 is a two-part housing comprising a base 11, having a generally planar bottom, and a cover 13 secured to the base 11 by means of three rivets 15. The base 11, at one end thereof, comprises insulating barriers 17 forming two adjacent cavities. The cavities are open at the top and open at the one end of the housing for receiving two clamp-type terminals 19 that are used to connect conducting lines to the two-pole units. The terminals 19 are more specifically described in the co-pending patent application of Kenneth R. Coley, Ser. No. 698,809, filed Jan. 18, 1968. The base 11 and cover 13 cooperate to form two adjacent compartments 21 for housing the circuit breaker parts of the two pole units.

Each of the circuit-breaker structures 9 comprises an operating mechanism 23, trip structure 25 and trip device 27. A separate circuit-breaker structure 9 is supported in each of the compartments 21.

Since the parts of the two pole units of the circuit breaker are identical, only the pole unit seen in FIGS. 2-4 will be specifically described.

Referring to FIG. 2, the operating mechanism 23 comprises a stationary contact 29 and a movable contact 31. The stationary contact 29 is fixedly secured to a rigid conductor 33 that extends toward the one end into a cavity 35, formed in the base 11, where the conductor 33 is connected to or is part of a clip-on type terminal 37 that is supported in the cavity 35. The cavity 35 is open at the bottom of the base 11 for receiving a stab conductor that would protrude into the cavity 35 to be engaged by the clip-on type connector 37. The movable

contact 31 is fixedly secured to an elongated contact arm 39. The contact arm 39 is provided with a slot 41 therein for receiving a supporting pin 43. A torsion spring 45 biases the one end of the contact arm 39 to the position seen in FIG. 3 wherein the pin 43 is at the lower part of the slot 41. A toggle 47 connects the contact arm 39 with an angle-link 49 of a trip structure 51. The toggle 47 comprises a lower toggle link 53 and an upper toggle link 55. The lower toggle link 53 is pivotally connected to the contact arm 39 by means of a pin 57 and the upper toggle link 55 is pivotally connected to one leg of the angle-link 49 by means of a pin 59. The toggle links 53 and 55 are pivotally connected by means of a knee pivot pin 61. The angle-link 49 comprises two legs that are angularly spaced and movable as a unit. The angle-link 49 is mounted on a fixed pivot 63 that is supported between a pair of rigid side plates 64 that are supported in the associated compartment. Only one of the side plates 64 is seen in FIG. 2, and both of the side plates are seen in FIG. 5. As can be seen in FIG. 5, the links 53, 47 and 49 are twin links in that each of these links comprises a pair of spaced link members. As is best seen in FIG. 6, the other leg of the angle-link 49 is provided with a slot 65 therein for receiving a pin 67 that also extends through an opening 69 in a releasable cradle member or trip member 71. The pin 67 moves in the slot 65 and opening 69 permitting relative movement between the angle-link 49 and the trip member 71 during tripping and resetting operations. The trip member 71 is pivotally supported, intermediate the ends thereof, on and between the side plates 64, by means of a pin 73. The trip member 71 is maintained in the latched position seen in FIG. 2 by means of the trip device 27.

The trip device 27 comprises a latch member 75 that is pivotally supported, intermediate the ends thereof, between the side plates 64 on a pin 77. The latch member 75 is biased in an unlatching (counterclockwise FIG. 2) direction by means of a torsion spring 79. The upper end of the latch 75 engages the trip member 71 to latch the trip member 71 in the position seen in FIG. 2. The lower end of the latch member 75 is latched by means of a latch member 81 that is pivotally supported intermediate the ends thereof on a pin 83 that is supported between the side plates 64. The latch member 81 is biased in a latching (clockwise FIG. 2) direction about the pin 83 by means of a torsion spring 85. A calibrating screw 87 is threadably supported on one end of the latch member 81.

In the closed position of the circuit breaker 5, a circuit extends from the plug-in line terminal 37 through the conductor 33, stationary contact 29, movable contact 31, contact arm 39, parallel flexible conductors 89 and 91, parallel conducting paths 93 and 95, through the left-hand (FIG. 2) part of the conductor 93 to a conducting line that may be connected to the conductor 93 by means of the clamp-type terminal connector 19. The conductor 93 is a rigid conductor that is fixedly secured in the housing 7. As can be seen in FIG. 2, the rigid conductor 93 rests on a generally flat part of the base above the cavity 35. A flexible pad 99 is placed over the conductor 93, and when the housing cover 13 is tightly riveted down against the base 11 the pad 99 and rigid conductor 93 are sandwiched between the cover 13 and base 11 so that the clamping force of the rivets 15 (FIG. 5) operates to fixedly secure the rigid conductor 93 within the housing. The main conducting path between the contact arm 39 and clamp-type terminal 19 is through the rigid conductor 93. A parallel conducting path is provided through the flexible conductor 91 and bimetal 95 to heat the bimetal 95 to thermally trip the circuit breaker in a manner to be hereinafter specifically described. As can be seen in FIG. 2, the bimetal 95 is supported at the left end thereof on the rigid conductor 93, and the free end of the bimetal 95 is free to flex in an upward (FIG. 2) direction to trip the circuit breaker.

Referring to FIG. 2, it will be noted that the housing is provided with an opening in the front thereof. A handle port 105 of an insulating operating member 107 protrudes through the opening to permit manual operation of the circuit breaker. The insulating operating member 107 is pivotally supported on the side plates 64 by means of a pin 109. A torsion spring 113 biases the operating member 107 in a clockwise (FIG. 2) direction. A link member 115 is pivotally connected, at one end thereof, to the knee 61 of the toggle 47. The link 115 is pivotally connected at the other end thereof to the lower end of the operating member 107 by means of a pin 117. The pin 117 moves in an opening 119 in the trip member 71.

The circuit breaker is shown in FIG. 2 in the closed position with a generally L-shaped insulating member 121 insulating the rigid conductor 33 from the conductors that are positioned above the insulating member 121. A coil compression spring 123 is positioned under the rigid conductor 33 to bias the conductor 33 upward to provide contact pressure between the contacts 29, 31 in the closed position of the contacts. The housing base is provided with an insulating projection 125 that extends into an opening in the conductor 33 to prevent substantial lateral movement of the conductor 33. Upward movement of the conductor 33 is limited by an insulating member 200 that is held down by the plates 64 that are in turn held down by the cover 13. An arc-extinguishing structure 127 is provided for extinguishing arcs drawn between the contacts during opening operations.

The circuit breaker is shown in the closed position in FIG. 2. When it is desired to manually operate the circuit breaker to the open position, the operating member 107 is pivoted from the "on" position seen in FIG. 2 to the "off" position seen in FIG. 3. During this movement, the operating member 107 operates through the link 115 to move the knee 61 of the toggle 47 to the left whereupon the erected toggle 47 collapses moving the contact arm 39, toggle 47, link 115 and operating member 107 to the open position seen in FIG. 3. The opening operation is effected by the force of the worker manually moving the operating member 107 which force is aided by the forces of the springs 123, 45 and 113. During the opening operation, as the toggle 47 starts to collapse the spring 45 first moves the contact arm 39 to the position where the pin 43 is at the lower point of the slot 41 during which movement the heel part of the movable contact 31 first separates from the stationary contact 29, and when the pin 43 engages the contact arm at the bottom of the slot 41 the final movement of the contact arm 39 is counterclockwise about the pin 43 during which movement the toe portion of the movable contact 31 separates from the stationary contact 29 and during which movement the contact arm 39 pivots about the pin 43 to the fully open position seen in FIG. 3.

When it is desired to manually operate the circuit breaker to the closed position, the operating member 107 is manually operated from the "off" position (FIG. 3) to the "on" position (FIG. 2). During this movement, the link 115 is driven by the operating member 107 to operate the toggle 47 from the collapsed to the erected position. The link 115, which is pivotally connected at one end thereof to the operating member 107 by means of the pin 117 and at the other end thereof to the knee pivot 61 of the toggle 47, serves as a thrust-transmitting connection between the operating member 107 and the knee pivot 61 of the toggle 47. During the initial part of this movement, the contact arm 39 pivots about the pin 43 until the toe of the contact 31 engages the stationary contact 29 whereupon further closing movement of the toggle 47 operates to move the contact arm 39 to the fully closed position, wherein both the toe and heel of the contact 31 engage the stationary contact 29, during which movement the left (FIG. 2) end of the contact arm 39 is moved downward, as the slot 41 moves relative

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to the stationary pivot pin 43, to the fully closed position.

During the manual opening and closing operations of the circuit breaker, the angle-link 51 is stationary to maintain the pivot 59 of the upper toggle link 55 fixed.

The circuit breaker is tripped open by operation of the trip device 27. In addition to the bimetal 95, the trip device 27 comprises a U-shaped magnetic member 127 supported with the bight portion thereof in a cavity 129 in the base 11 and with the opposite legs thereof extending upward on opposite sides of the rigid conductor 93 and on opposite sides of the bimetal 95. The latch member 81 is magnetic and the left-hand (FIG. 2) end of this member is positioned above the opposite legs of the member 127 whereby the member 81 functions as an armature of an electromagnetic trip structure. An alternative construction would be to make the latch member 81 non-magnetic and to secure a magnetic member to the member 81 above the member 127.

Upon the occurrence of an overload above a first predetermined value and below a second predetermined value, the bimetal 95, which is heated by the heat generated by the current flow therein and which is also heated by the heat generated in the rigid conductor 93, flexes with the free end (on the right) moving upward to engage the calibrating screw 87 to move the latch member 81 in a counterclockwise direction to release the latch member 75. Upon release of the latch member 75, the trip member 71 is released and the contact arm 39 is free to move to the open position under the bias of the spring 45. Although the main tripping force is exerted by the spring 45, the contact pressure spring 123 provides additional force during the initial movement, and the relatively weak spring 113 also aids in providing an opening force. The blow-off forces generated by the arc also aid the tripping movement. The contact arm 39 moves from the position shown in FIG. 2 to the tripped position shown in FIG. 4 with the trip member 71 moving clockwise and with the angle-link 51 moving counterclockwise to permit the upper pivot 59 of the toggle 47 to move to release the toggle 47 which collapses to the tripped position seen in FIG. 4. During the tripping operation, the spring 113 operates to move the operating member 107 to a tripped position (FIG. 4) intermediate the "on" and "off" positions. The operating member 107 is stopped in the tripped position by engagement of the pin 117 with an edge of the trip member 71 in the slot 119. When it is desired to reset the circuit breaker for manual operation, the operating member 107 is moved from the tripped position seen in FIG. 4 to a position slightly past the full "off" position seen in FIG. 3. During this movement, the pin 117 engages the trip member 71 in the slot 119 to rotate the trip member 71 in a counterclockwise direction. Near the end of this movement of the operating member 107, the end of the trip member 71 engages the latch member 75 moving the latch member clockwise to the latching position, and when the latch member 75 reaches the latching position the spring 85 biases the latch member 81 to the latching position to latch the latch member 75 whereby upon release of the operating member 107 the circuit breaker will be latched in the position seen in FIG. 3. When the trip member 71 is in the latched position the angle-link 51 is held stationary so that the upper pivot 59 of the toggle 47 is fixed whereby the circuit breaker may be manually operated between the "on" and "off" positions in the same manner hereinbefore described. The slot-and-pin connection between the angle-link 51 and trip member 71 prevents movement of the angle-link 51 when the trip member is latched in a stationary position and permits the relative movement between these parts during the tripping and resetting operations. The angle-link 51 enables a tripping operation of the trip member 71 with the trip member 71 not moving to a position substantially higher within the circuit breaker housing than the original position of the trip

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member 71 so that the height-wise dimension of the circuit breaker housing can be kept compact.

Upon the occurrence of an overload above the second predetermined value, magnetic flux generated in the members 127, 81 by means of the current flowing through the members 93, 95 causes attraction of the armature 81 to the yoke 127 whereupon the armature 81 moves to the tripped position instantaneously without the time delay of the thermal tripping operation. Upon movement of the latch member 81 to the tripped position the circuit breaker is tripped in the same manner as was hereinbefore described with regard to the thermal tripping operation. The circuit breaker is thereafter reset in the same manner as was hereinbefore described with regard to the resetting operation following the thermal tripping operation.

As was previously set forth, the circuit breaker 5 is a two pole circuit breaker with each of the poles constructed as shown in FIGS. 2-6. A handle tie member 135 (FIGS. 1 and 5) connects the handles of the two pole units together for simultaneous manual operation. In order to provide that both of the pole units will trip upon the tripping of either of the pole units, a separate member 137 (FIG. 2) is pivotally mounted between the side plates 64 of each of the poles. Each of the members 137 is pivotally supported on a pin 139. The members 137 in the two pole units are operatively connected for simultaneous pivotal movement about the same axis. Upon the occurrence of a tripping operation in either pole unit, the associated latch 75 will engage the associated member 137 to cam the member 137 in a counterclockwise (FIG. 2) direction whereupon both of the members 137 will simultaneously move counterclockwise so that the member 137 in the adjacent pole unit will engage that armature 81 to move the armature 81 in the adjacent pole unit to the tripped position. When the circuit breaker is reset, the armatures 81 engage the members 137 to move the members 137 to the position shown in FIG. 2.

In the preferred embodiment, the operating member 107 is moved to an intermediate position during tripping operations to provide a visual indication that the circuit breaker is tripped. In this embodiment, it is necessary to reset the circuit breaker in the manner hereinbefore described in order to manually operate the breaker after each tripping operation. If it is desired to provide an automatic-reset circuit breaker, the spring 113 is merely strengthened to provide enough drive during a tripping operation to force the operating member 107 to the reset position. With the strengthened spring mounted in the breaker, the operating member 107 will be automatically moved to the reset position during tripping operations. Thus, after tripping operations, the breaker will be automatically reset and a worker will be able to manually operate the breaker without manually resetting the breaker.

We claim as our invention:

1. A circuit breaker comprising a stationary contact, a movable contact, a contact arm carrying said movable contact, a latched trip structure, a toggle comprising a first link pivotally connected to said contact arm and a second link pivotally connected to said latched trip structure, a knee pivot pivotally connecting said first and second links, a manually operable operating member, a thrust-transmitting connection between said operating member and said knee pivot, said operating member being manually movable to a closed position to operate through said thrust-transmitting connection to erect said toggle to thrust said contact arm to the closed position, said operating member being operable to an open position to move said contact arm to the open position, trip means latching said latched trip structure and operating automatically upon the occurrence of certain overload current conditions to release said latched trip structure, upon release of said latched trip structure said latched

trip structure and said toggle moving to a tripped position to effect automatic opening of said contacts, and means operating automatically upon release of said latched trip structure to move said operating member to a tripped position intermediate said closed and opened positions to provide a visual indication that said circuit breaker has tripped.

2. A circuit breaker according to claim 1, said operating member being manually movable from said intermediate position to a reset position to reset said trip structure in a position wherein said trip means latches said trip structure to enable manual operation of said operating member following a tripping operation.

3. A circuit breaker according to claim 2, said operating member being pivotally mounted on a fixed pivot, and said thrust transmitting connection comprising a link member pivotally connected at one end thereof to said operating member and at the other end thereof to said knee pivot.

4. A circuit breaker according to claim 3, said latched trip structure comprising an elongated trip member pivotally supported intermediate the ends thereof and an angle-link, said angle-link comprising a pivot part and a pair of legs extending from said pivot part at an angle, means pivotally supporting said angle-link at said pivot part, said trip means latching one end of said releasable member, means operatively connecting the other end of said releasable member with a first leg of said angle-link, means pivotally connecting the second leg of said angle-link to said second link, in the latched position of said trip structure said trip member and said angle-link remaining stationary during manual operations of said circuit breaker, and upon release of said trip structure said trip member and said angle-link moving to permit movement of said toggle to thereby permit automatic opening of said contacts.

5. A circuit breaker according to claim 4, and said connection between said trip member and said angle-link comprising a slot-and-pin connection permitting lost motion between said trip member and said angle-link.

6. A circuit breaker comprising a stationary contact, a movable contact, a contact arm carrying said movable contact, a latched trip structure comprising an elongated trip member and an angle-link, means pivotally supporting said elongated trip member intermediate the ends thereof, said angle-link comprising a pivot part and a pair of legs extending from said pivot part at an angle, means pivotally supporting said angle-link at said pivot part, trip means latching one end of said trip member, means operatively connecting the other end of said trip member to a first leg of said angle-link, a toggle comprising a first link pivotally connected to said contact arm

and a second link pivotally connected to the second leg of said angle-link, a knee pivot pivotally connecting said first and second links, a manually operable operating member, a thrust transmitting connection between said operating member and said knee pivot, said operating member being movable to a closed position to operate through said thrust transmitting connection to erect said toggle to thrust said contact arm to the closed position, said operating member being movable to an open position to move said contact arm to the open position, said trip means operating upon the occurrence of certain overload current conditions to release said trip member, and upon release of said trip member said trip member and said angle-link moving to permit movement of said toggle to permit movement of said contact arm to an open position.

7. A circuit breaker according to claim 6, said connection between said trip member and said first leg of said angle-link comprising a lost motion connection connecting said trip member and angle-link with lost motion.

8. A circuit breaker according to claim 6, spring means comprising a torsion spring member engaging said contact arm and biasing said contact arm to move said contact arm to the open position upon release of said trip member.

9. A circuit breaker according to claim 6, means operating automatically to move said operating member to a tripped position intermediate said open and closed positions upon release of said trip member, said operating member being movable from said intermediate position to said open position to reset said trip structure in a position wherein said trip member is latched by said trip means, and said trip member and said angle-link in the reset position remaining stationary during manual opening and closing operations of said circuit breaker.

10. A circuit breaker according to claim 9, and said connection between said trip member and said first leg of said angle-link comprising a lost motion connection.

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