CIRCUIT BREAKER TRIP AND LATCH MECHANISM

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References Cited
UNITED STATES PATENTS
2,051,224 8/1936 Cole et al. 335/168
2,794,881 6/1957 Frank 335/191
3,460,075 8/1969 Yorgin et al. 335/173

ABSTRACT

A circuit breaker with a thermal and magnetic tripping mechanism for releasing the separable contacts of the circuit breaker in response to overload currents. The tripping mechanism comprising a trip bar responsive indirectly to the overload current for releasing a trip lever which in turn releases a latch lever. The latch lever and trip lever being pivoted on spaced pivot points and the trip lever having a roller mounted thereon for retaining the latch lever in the latched position and for rolling out of engagement with the latch lever when the trip lever is released, whereby shorter levers and less force are required to actuate the mechanism.

7 Claims, 7 Drawing Figures
CIRCUIT BREAKER TRIP AND LATCH MECHANISM

CROSS REFERENCE TO RELATED APPLICATIONS

This invention is related to the invention disclosed in the application of Alfred Maier et al., Ser. No. 345,394, filed Mar. 27, 1973.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a circuit breaker having a trip and latch mechanism responsive to thermal and magnetic forces.

2. Description of the Prior Art

Circuit breakers of the type disclosed in U.S. Pat. No. 3,530,414 comprise overcurrent protective devices that function satisfactorily for responding to such abnormal currents as overcurrents, ground fault currents, and short currents that occur in an electrical distribution system. Certain disadvantages have developed, however, with that type of construction including augmented size for operating parts with the development of additional overcurrent protective means.

SUMMARY OF THE INVENTION

Generally, it has been found in accordance with this invention that the foregoing disadvantage may be overcome by providing a protective device for a circuit breaker which comprises relatively movable contact means and means releasable to effect opening of said contact means, the releasable means including a releasable arm movable between latch and unlatched position, a trip device operable to effect unlatching of the releasable arm, the trip device comprising magnetic trip means, a trip bar, a latch lever, and a trip lever, the latch lever being movable between latched and unlatched positions of the releasable arm and being biased in the latched position and being urged to the unlatched position by the releasable arm, the trip lever being movable between latch and unlatched positions of the latch lever and being in the latched position, the latch lever being retained in the latched position by the trip bar, a pin rotatably mounted on the trip lever and located in the path of movement of the latch lever to retain the latch lever in the latched position when the trip bar is in the latched position, and the pin being in rotatable contact with the latch lever as the latch lever moves to the unlatched position when the trip lever is unlatched by the trip bar, whereby the rotatable pin minimizes the frictional forces between the trip lever and the latch lever upon movement of the latch lever from the latched to the unlatched position.

The advantage of the device of this invention is that it reduces the load on the trip bar and enables the use of shorter levers and less force, which in turn provides for a more compact operative device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view of a circuit breaker;

FIG. 2 is a right elevational view of the trip device;

FIG. 3 is a left elevational view of the trip device;

FIG. 4 is a vertical sectional view taken on the line IV—IV of FIG. 3;

FIG. 5 is a vertical sectional view taken on the line V—V of FIG. 3;

FIG. 6 is a plan view of the trip device shown in FIGS. 2—5; and

FIG. 7 is a vertical sectional view taken on the line VII—VII of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, a circuit breaker is generally indicated at 3 and it comprises an insulating housing 5 and a circuit breaker mechanism 7 supported within the housing.

The housing 5 comprises an insulating base 9 and an insulating cover 11.

The circuit breaker mechanism 7 comprises an operating mechanism, and a latch and trip device 15. Except for the latch and trip device, the circuit breaker 3 is of the type that is generally described in the patent to Albert R. Cellarini et al., U.S. Pat. No. 3,287,534 issued Nov. 22, 1966. The circuit breaker 3 is a three-pole circuit breaker comprising three compartments disposed in side-by-side relationship, the center pole compartment (FIG. 1) is separated from the two outer pole compartments by insulating barrier walls formed with the housing base 9 and cover 11. The operating mechanism 13 is disposed in the center pole compartment and is a single operating mechanism for operating the contacts of all three pole units.

Each pole unit comprises a stationary contact 21 that is fixedly secured to a rigid main conductor 23 that in turn is secured to the base 9 by bolt 25. In each pole unit, a movable contact 27 is welded or brazed to a contact arm that is mounted on a switch arm 31 by a pivot pin 33. The arms 29 and 31 for all three of the pole units are supported at one end thereof and rigidly connected on a common insulating tie bar 35 by which the arms of all three pole units move in unison. Each of the contact arms 29 is biased about the associated pivot pin 33 by means of a spring 37 to provide contact pressure in the closed position.

The operating mechanism 13 actuates the switch arms 31 between open and closed positions. The mechanism comprises a pivoted formed operating lever 39, a toggle comprising two toggle links 41 and 43, overcenter springs 45 and 47, and a pivoted releasable cradle or arm 49 controlled by the trip device 15. An insulating shield 51 for substantially closing an opening 53 in the cover 11, is mounted on the outer end of the operating lever 39 and has an integral handle portion 55 extending out through the opening to enable manual operation of the breaker. The toggle links 41 and 43 are pivotally connected together by a knee pivot pin 57. The toggle link 41 is pivotally connected to the releasable arm 49 by a pin 59, and the toggle link 43 is pivotally connected to the switch arm 31 of the center pole unit by a pin 61. The overcenter springs 45 and 47 are connected under tension between the knee pivot pin 57 and the outer end of the operating lever 39. The circuit breaker is manually operated to the open position by movement of the handle portion 55 in a counterclockwise direction to the "off" position, which movement actuates the overcenter springs 45, 47 to collapse the toggle links 41 and 43 to the position shown in FIG. 1, and opening movement of the contact
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The circuit breaker is manually closed by reverse movement of the handle portion 55 from the "off" position to the "on" position, which movement causes the springs 45, 47 to move over center and straighten the toggle links 41, 43 thereby moving the contact arm 29, for all of the pole units, to the closed position as shown in broken line position.

The trip device 15 serves to effect automatic release of the releasable cradle or arm 49 and opening of the breaker contacts for all of the pole units, in response to predetermined overload conditions in the circuit breaker through any or all pole units of the circuit breaker, in a manner described hereinbelow.

The circuit through each pole unit extends from a right-hand terminal 63 through the conductor 23, the contacts 21, 27, the contact arm 29, a flexible conductor 65, that is secured to the contact arm 29, a conductor 67, a trip conductor 69, to a left-hand terminal connector 71. Bolt means 73 secure one end of the trip conductor 69 to the conductor 67 and the other end of the trip conductor 69 is disposed between a backup plate 75 and the terminal 71 where it is secured in place by mounting bolt 77 of the terminal 71.

As shown in FIGS. 2–6 the latch and trip device 15 comprises a molded insulating housing base 81 and a molded insulating housing cover 79 secured to the base to enclose a molded insulating trip bar 83 that is common to all three of the pole units. As shown in FIG. 3, the base 81 includes a pair of spaced partitions 85 and 87 which are vertically disposed and integral with the base for separating the interior of the housing into three compartments, each compartment containing one of the three poles. In a similar manner, the cover 79 is provided with partitions corresponding to partitions 85 and 87 and have mating surfaces therewith in a manner similar to the mating surfaces of the peripheral surfaces of the base 81 and cover 79 as indicated by a parting line 99 (FIG. 6).

As shown in FIG. 3, the partitions 85 and 87 have notches 91 and 93, respectively, which together with flat surfaces of the cover 79 serve as journals for round shaft portions 95 and 97 of the trip bar 83. Accordingly, when the housing base 79 and cover 79 are assembled they retain the trip bar 83 in place, whereby the trip bar is free to rotate on an axis extending through the shaft portions 95 and 97. As shown more particularly, in FIG. 5, each section of the trip bar 83 located within the space compartments of the housing comprise upper and lower portions 83a and 83b, which are above and below the axis of rotation of the trip bar. Each upper portion 83a is provided with an adjusting screw and nut assembly 99 which cooperates with a bimetal member 101 for adjusting the spacing between the upper ends of the bimetal member and the trip bar portion 83a in response to the degree of deflection of the upper end of the member 101 toward the member 83a, whereby the trip bar 83 is rotated clockwise by the bimetal member and thereby trips the circuit breaker to the open position. The lower end portion 83b of the trip bar 83 is preferably provided with a drive screw 103 by which contact is made with an adjoining member for similar rotation of the trip bar in the manner to be described hereinbelow.

As shown more particularly in FIG. 5, the trip conductor 69 includes an inverted U-shaped intermediate portion 69a which constitutes a single loop of a stationary magnetic structure. Stationary magnetic structure also comprises a magnetic core 105, a U-shaped frame 107 having a pair of spaced flanges 109 one of which is shown in FIG. 5, and an armature 111. The assembly of the intermediate U-shaped portion 69a, the core 105, and the intermediate portion of the frame 107 together with the lower portion of the bimetal member 101 are secured in place by suitable means such as rivets 113 on the housing base 79. The lower end portion of the bimetal member 101 is in surface to surface contact with the conductor 69, whereby upon the occurrence of a low persistent overload current below a predetermined value of, for example, 10 times normal rated current, the bimetal member 101 is heated and deflects to the right through an air gap dependent upon the setting of the adjustment screw 99. Thus, when a low persistent overload current occurs, the trip bar 83 is actuated to trip the circuit breaker.

The armature 111 is disposed between the space flanges 109 of the U-shaped frame 107 and is pivotedly mounted therein to rotate about an axis 115 near the lower end of the armature. For that purpose, the armature 111 is preferably mounted by suitable means such as rivets 117 on a support lever 119 having oppositely extending out-turned lugs 121 which are seated in corresponding openings 123 in the flanges 109. Each flange 109 is also provided with a V-shaped notch 125 into which edge portions of the lever 119 and armature 111 extend. The notches 125 thereby limit movement of the assembly of the lever 119 and armature 111 when the armature is attracted toward the core 105. Accordingly, the assembly of the lever 119 and armature 111 which is biased in the clockwise direction by coil springs 127 (FIG. 3) is movable counterclockwise against the spring to engage the drive screw 103 and thereby rotates the trip bar 83 clockwise. When an overload current above a value such, for example, as ten times normal rated current or a short circuit current occurs, the stationary magnetic structure is energized and the armature 111 is attracted toward the core 105 causing instantaneous release of the releasable arm 49 and opening of the contacts 21 and 27.

In addition to the foregoing, means are provided for adjusting the spacing between the armature 111 and the core 105, whereby upon maximum spacing of the armature from the core, a greater current overload is required to attract the armature toward the core. Conversely, when the spacing is reduced, a smaller overload current is required to actuate the trip bar 83. For that purpose a lever 129 having a lower end disposed over the upper end of the lever 119 is mounted within the housing and is provided with calibration means including a calibration screw 131 at the upper end of the lever 129. As shown in FIG. 3, each lever 129 includes a notch 133 on each opposite side thereof which notch is seated in corresponding projections 135 of the housing base 79 where the levers 129 are retained in place by the cover 81. An adjusting knob 137 is seated within the top end of the housing base and is provided with a lower end portion having a cam surface. Inasmuch as the lever 129 is biased counterclockwise about its pivot point by the spring 127 of the lower lever 119 the calibration 131 rides on the cam surface of the lower portion 139 of the adjusting knob 137.

As shown in FIG. 3 and 5, each adjusting knob 137 includes a flange 141, the lower surface of which in-
includes spaced notches 143. An index member 145 is disposed below the flange 143 and is provided with a projection 147 for engaging one of the spaced notches 143 as the calibrating screw 136 is rotated to the desired position. Accordingly, the desired spacing between the armature 111 and the core 105 is established by rotation of the adjusting knob 137.

Since the housing cover 79 is used to hold the levers 129 in place, it is necessary to assemble the trip unit completely before calibrating the position of the lever 129. For that reason, a removable flexible shield 149 is disposed in an access opening 151 of the cover 79 in order to turn the calibrating screw 131 and 99. When the calibration is made, the shield 149 is replaced in the opening. The mechanism by which the releasable arm 49 is released is shown in FIG. 2, 4 and 6. The mechanism includes the trip bar 83, a trip lever 153 and a latch lever 155. A U-shaped mounting frame 157 is mounted on the base 79 with spaced upright sides 157a and 157b providing mounting support for the levers. The trip lever 153 includes a U-shaped portion 159 at the lower end which portion is mounted on a pivot pin 161 which extends from the side 157a of the frame. The U-shaped lower portion of the lever maintains the lever upright adjacent the frame side 157a. The upper end of the trip lever 153 includes a flange 163 which engages a notch 165 on the trip bar 83. As shown in FIG. 4 a portion of the trip bars extends through an opening 167 in the insulating base 79.

The latch lever 155 includes down-turned portions 155a and 155b which are mounted on a pivot pin 169 the opposite ends of which are secured in the sides 157a and 157b of the frame 157. A spring 171 is mounted on the pin 169 and has end portions engaging the levers 153 and 155 for biasing the levers in the latched positions.

When the releasable arm 49 is in the latched position as shown in FIG. 1, the arm which is pivoted on a pivot pin 173 is secured in the latched position below the lever 155 and applies a rotatable force thereon. As shown in FIGS. 4 and 7, the latch lever 155 is prevented from turning due to engagement of the lower end of the lever on a roller or rotating pin 175 which is mounted in the U-shaped portion 159 of the trip lever 153. As a result of the rotating force on the latch lever 155, the trip lever 153 is biased clockwise and is prevented from movement by engaging of the flange 163 in the notch 165 of the trip bar 83. When the trip bar is rotated clockwise, the flange 163 is dislodged from the latch position within the notch 165 and the trip lever 153 rotates clockwise to move the roller 175 from engagement with the lower end of the latch lever 155. As a result, the latch lever 155 is free to rotate about the pin 169 and thereby unlashes the releasable arm 49 from the latch position.

As the roller 175 moves from engagement with latch lever 155, the roller rotates and thereby minimizes friction between these parts. Thus, the length of the levers can be shortened as compared with levers used with a nonrotating pin; and a more compact structure is obtained.

In FIG. 3, a projection 177 extends from the upper corner of the trip bar portion 83a, which projection is aligned with an aperture 179 in the housing base 79. By extending a pin through the opening 179 (FIG. 2), and pressing against the projection 177, the trip bar may be tripped manually.

Accordingly, the device of the present invention provides a new and novel trip device for a circuit breaker which is of a more compact size than the previous trip devices of the same rating. The advantage of the smaller dimensions is due primarily to the use of lever means having smaller space requirements than magnetic tripping devices of prior construction. As a result of the more compact arrangement of parts, the outer dimensions of the circuit breaker housing may also be reduced for circuit breakers of the same rating.

What is claimed is:

1. A circuit breaker comprising relatively movable contact means and means releasable to effect automatic opening of said contact means, the releasable means including a releasable arm movable between latched and unlatched positions, a trip device operable to effect unlatching of the releasable arm, the trip device comprising magnetic trip means, a trip bar, a latch lever, and a trip lever, the latch lever being movable between latched and unlatched positions of the releasable arm and being biased in the latched position and being urged to the unlatched position by the releasable arm, the trip lever being movable between latched and unlatched positions of the latch lever and being biased in the latch position, the trip lever being retained in the latch position by the trip bar, a pin rotatably mounted on the trip lever and located in the path of movement of the latch lever to retain the latch lever in the latch position when the trip bar is in the latch position, and the pin being in rotatable contact with the latch lever as the latch lever moves to the unlatched position when the trip lever is unlatched by the trip bar, whereby the rotatable pin minimizes the frictional forces between the trip lever and latch lever upon movement of the latch lever from the latch to the unlatched positions.

2. The circuit breaker of claim 1 in which the distance between the pivot point and the trip bar contact of the trip lever is greater than the distance between the pivot point and the releasable arm contact of the latch lever.

3. The circuit breaker of claim 2 in which the rotatable pin is nearer the pivot point of the trip lever than is the trip bar.

4. The circuit breaker of claim 3 in which the distance between the pivot point of the latch lever to the releasable pin is greater than the distance between said pivot point and the contact of the latch lever and the releasable arm.

5. The circuit breaker of claim 1 in which the latch lever comprises a flange that is substantially parallel to the axis of rotation of the latch lever, and the releasable arm being held in the latch position by the flange.

6. The circuit breaker of claim 1 in which the latch lever and trip lever are rotatable on parallel axis.

7. The circuit breaker of claim 1 in which the trip device comprises a bimetal strip having one end mounted on the conductor and another end disposed in a position adjacent to the trip bar to effect movement of the trip bar to the unlatched position.

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