

[54] **CIRCUIT BREAKER WITH EXTERNALLY OPERABLE MEANS FOR MANUAL ADJUSTMENT AND MANUAL TRIPPING**

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[51] Int. Cl. **H01h 71/74**

[58] Field of Search..... **335/176, 42, 45,**
335/23; 337/50

[56] **References Cited**

UNITED STATES PATENTS

3,073,925 1/1963 Thomas et al. 335/42

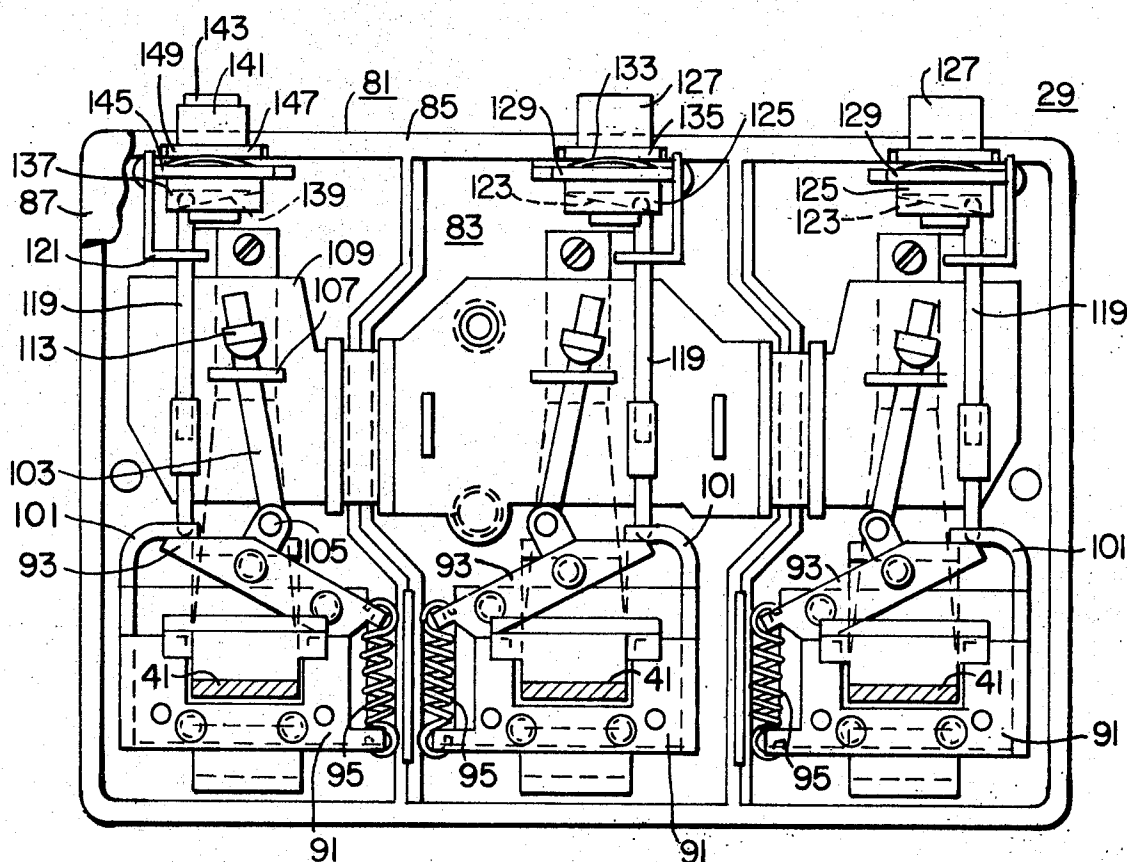
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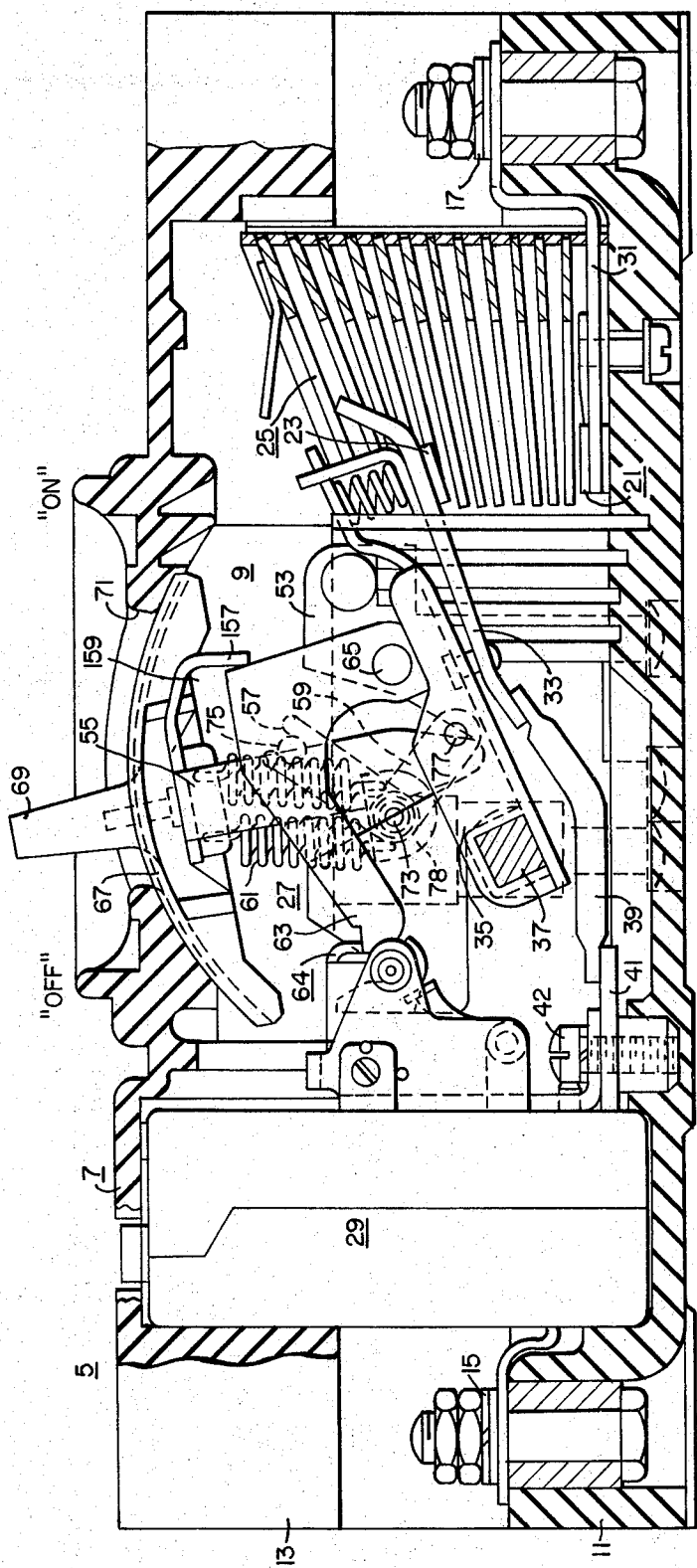
Primary Examiner—Harold Broome
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[57] **ABSTRACT**

A circuit breaker is provided with externally accessible adjusting means manually operable to adjust the trip means of the breaker and manually operable to trip the breaker.

10 Claims, 7 Drawing Figures





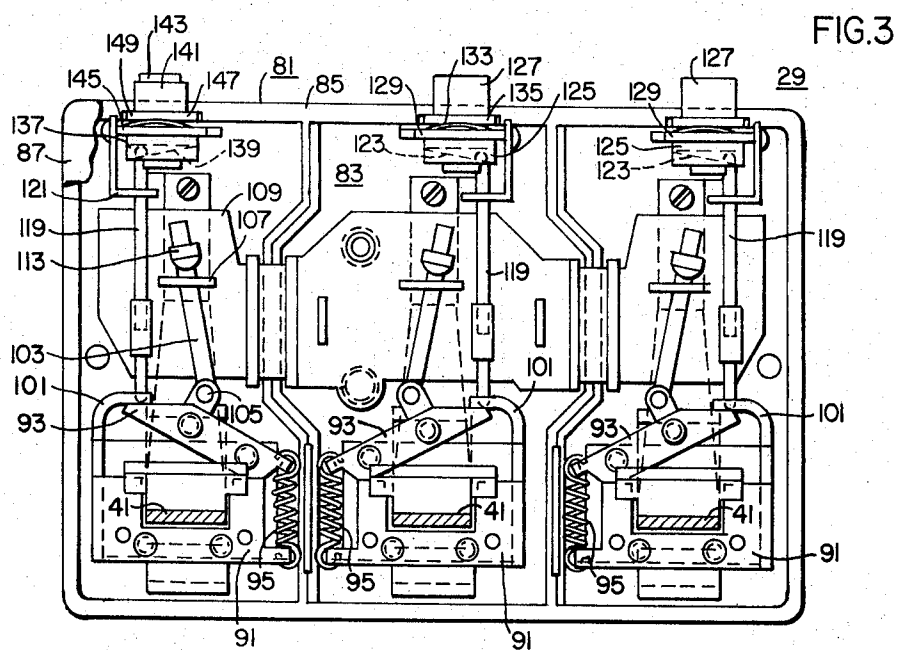
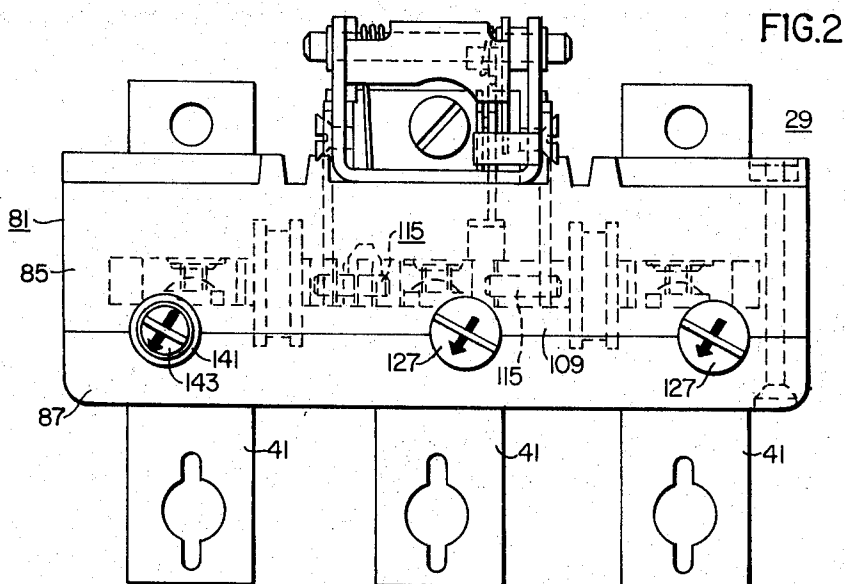


FIG.4

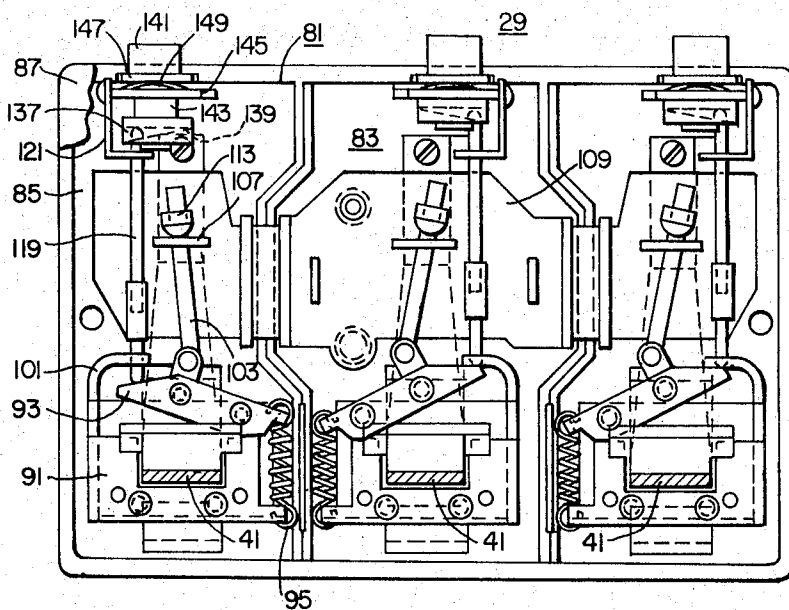


FIG.5

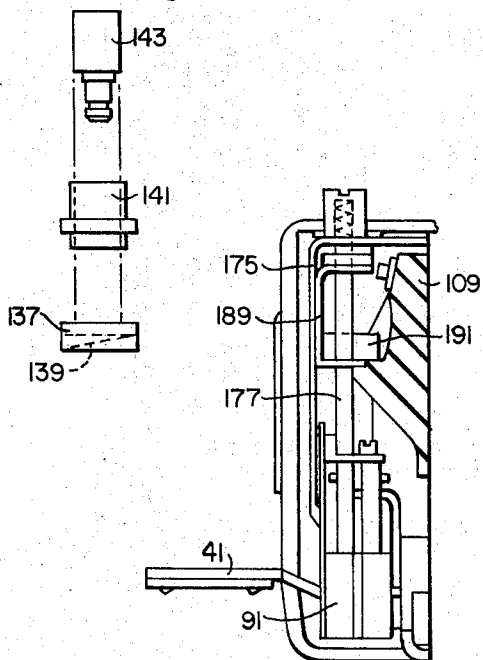
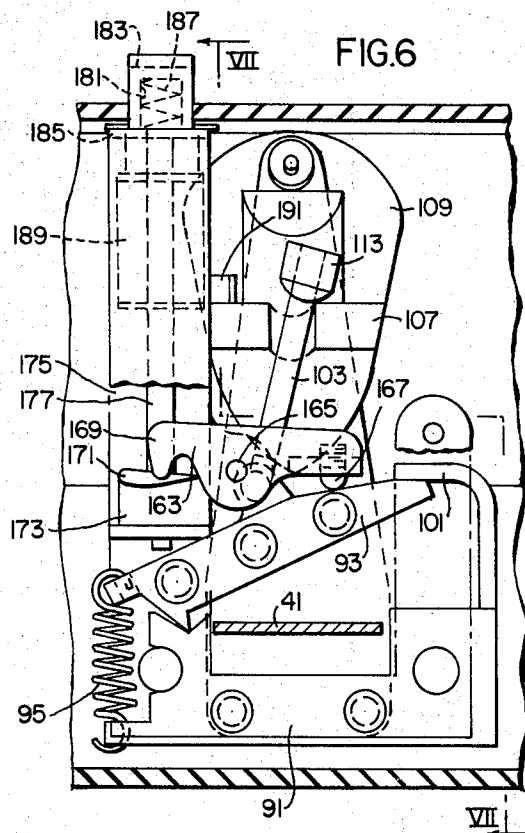


FIG.7

FIG.6



CIRCUIT BREAKER WITH EXTERNALLY OPERABLE MEANS FOR MANUAL ADJUSTMENT AND MANUAL TRIPPING

BACKGROUND OF THE INVENTION

1. Field of the Invention

Circuit breakers of the type comprising an insulating housing, trip means disposed within the housing for automatically tripping the circuit breaker under overload current conditions and externally accessible means for adjusting the trip characteristics of the trip means.

2. Description of the Prior Art

Circuit breakers of the general type herein disclosed are disclosed in the U.S. Pat. to Thomas et al. No. 3,073,925 and in the U.S. Pat. to Stevenson Jr. et al. No. 3,211,860. The U.S. Pats. to Layton et al. No. 3,480,890 and to Erickson No. 3,585,541 disclose insulating housing type circuit breakers with externally accessible means manually operable to trip the breakers.

SUMMARY OF THE INVENTION

A circuit breaker is provided comprising an insulating housing and a circuit breaker structure supported in the housing. The circuit breaker structure comprises a pair of cooperable contacts, a trip member movable from an initial position to a tripped position to effect automatic opening of the contacts and trip means automatically operable upon the occurrence of overload current conditions above a predetermined value to effect movement of the trip member to the tripped position. The insulating housing has an opening in the front thereof. Adjusting means, supported at the opening, comprises an externally accessible adjusting member that is rotatable to adjust the tripping characteristics of the trip means and that can be manually depressed to move the trip member to the tripped position. In one embodiment the adjusting member can be depressed to depress an adjusting rod to move the armature of an electromagnetic trip means in order to effect manual movement of the trip member to the tripped position, and in the other embodiment the adjusting member can be depressed to depress a bracket that directly engages the trip member to move the trip member to the tripped position.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 2 is a top plan view of the trip device seen in FIG. 1;

FIG. 3 is a front view of the trip device seen in FIG. 2 with almost all of the cover broken away and with the trip device conductors shown in section;

FIG. 4 is a view similar to FIG. 3 with the push-to-trip pole being shown in the manually depressed position;

FIG. 5 is a perspective view of part of the adjusting and trip means of the pole unit that is seen on the left in FIG. 4;

FIG. 6 is a view similar to FIG. 3 of one pole unit of a trip device illustrating another embodiment of the invention; and,

FIG. 7 is a sectional view taken generally along the jogged section line VII—VII of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is shown therein a circuit breaker 5 comprising an insulating housing 7 and a circuit breaker structure 9 supported within the housing 7. The housing 7 comprises an insulating base 11 and an insulating cover 13 removably secured to the insulating base 11. The breaker is a three-pole breaker with each pole comprising a pair of terminals 15 and 17 supported at the opposite ends of the base 11.

The circuit breaker is of the type described in the patent to Stevenson Jr. et al. U.S. Pat. No. 3,211,860. Thus, only a brief description of the circuit breaker is provided herein. The circuit breaker structure 9 includes a stationary contact 21, a movable contact 23 and an arc extinguishing structure 25 for each pole unit. A common spring operating mechanism indicated generally at 27 is provided for simultaneously actuating the three movable contacts between open and closed positions. A trip device indicated generally at 29 is provided to effect automatic opening of the breaker contacts in response to predetermined overload conditions in any pole unit of the three-pole circuit breaker.

In each pole unit, the terminal 17 is supported at the outer end of a conducting strap 31 that extends into the housing and that rigidly supports the associated stationary contact 21. The movable contact 23 for each pole unit is mounted on a contact arm 43 but is supported on a switch arm 35 that is secured to a common insulating tie bar 37. The tie bar 37 extends across all three of the pole units and supports the switch arms 35 of the three-pole units for simultaneous movement between open and closed positions. The tie bar pivots about an axis normal to the plane of the paper as seen in FIG. 1. In each pole unit, the conducting contact arm 33 is connected by means of a flexible conductor 39 to an intermediate trip device conductor 41 that is secured at one end thereof to the base 7 by means of a bolt 42. Each of the trip device conductors 41 extends through the trip device 29 and is connected at the outer end thereof to a terminal 15.

The operating mechanism 27, which is disposed in the center pole unit of the housing, is supported by 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 comprising toggle links 57 and 59, overcenter spring means 51 and a releasable trip member 63. The trip member 63 is latched out one end thereof by a latch structure 64 and pivotally supported at the other end thereof on a pivot pin 65 that is supported on the frame member 53. An arcuate insulating shield 67, that is secured to the upper end of the operating lever 55, comprises a handle part 69 that extends out through an opening 71 in the front of the housing.

The toggle links 57 and 59 are pivotally connected together by a knee pivot pin 73. The upper toggle link 57 is pivotally connected to the trip member 63 by means of a pin 75 and the lower toggle link 59 is pivotally connected to the switch arm 35 of the center pole unit by means of a pin 77. The overcenter springs 61 are connected under tension between the upper end of the operating lever 55 and a plate member 78 that is connected to the knee pivot 73 of the toggle 57, 59.

When the circuit breaker is in the closed position, the circuit through each pole unit extends from the terminal 15 through the trip device conductor device 41, flexible conductor 39, contact arm 33, contact 23, contact 21, conductor 31 to the other terminal 17. The circuit breaker is manually closed by clockwise movement of the handle 69 from the "off" to the "on" position. This movement moves the lever 55 to move the springs 61 overcenter to erect the collapsed toggle 57, 59 to thereby pivot the tie bar 37 and the three switch arms 35 clockwise to thereby move the three contact arms 33 into the closed position. The circuit breaker is manually operated to the open position by reverse movement by the handle 69 from the "on" to the "off" position. This movement moves the lever 55 to move the springs 61 overcenter to cause collapse of the toggle 57, 59 to move the tie bar 37 and switch arms 35 in a counterclockwise direction to thereby move the three contact arms 33 to the open position seen in FIG. 1.

The trip device 29 (FIGS. 2-4) comprises an insulating trip device housing 81 and a trip-device structure 83 supported within the trip device housing 81. The trip device housing 81 comprises an insulating back 85 and an insulating cover 87 removably secured to the insulating back 85. The trip device housing 81 encloses the three pole units of the trip device.

Referring to FIG. 3, each pole unit comprises a U-shaped magnetic yoke 91 and a magnetic armature 93 pivotally supported on one leg of the magnetic yoke 91. A separate spring means 95 is provided to bias each of the armatures 93 to the unattracted position seen in FIG. 3. Referring to the orientation of the pole units as seen in FIG. 3, the two armatures 93 on the right will move clockwise to the tripped position and the one armature 93 on the left will move counterclockwise to the tripped position. As can be understood with reference to FIG. 3, each of the trip device conductors 41 passes between the legs of the associated U-shaped stationary magnetic yoke 91. In each pole unit, a member 101 limits movement of the associated armature 93 in the maximum air gap unattracted position. In each pole unit, a rod 103 is pivotally connected to the associated armature 93 by means of a pivot pin 105. Each of the rods 103 extends through an opening in a part 107 that is secured to a common insulating trip bar 109. In each pole unit an actuating screw 113 is threaded on the upper end of the associated rod 103. The trip bar 109 is an insulating trip bar that extends across all three of the pole units of the trip device. A pair of pivot support pins 115 (FIG. 2) pivotally supports the insulating trip bar 109 for movement about an axis normal to the plane of the paper as seen in FIG. 1. In each pole unit, an elongated rod 119 extends through an opening in the part 101 and rests on the top of the associated armature 93. The upper part of each of the rods 119 extends through an opening in a bracket 121. Regarding the two pole units on the right (FIGS. 3 and 4) the top of each rod 119 engages a cam surface 123 of a cam 125. The pole unit on the left will be hereinafter described. Each of the cam members 125 is fixedly connected to a lower portion of an adjusting knob 127. Each of the adjusting knobs 127 has a reduced inner end portion that extends through an opening in a plate 129 that is secured to the associated bracket 121. The inner end portion of each of the adjusting knobs 127 is fixedly secured to the associated cam 125 so that the cam 125 will be rotated in unison with the adjusting

knob 127. In each of the two pole units on the right, a spring washer 133 is supported between the associated plate 129 and the associated adjusting knob 127 to bias the adjusting knob frontward. A shoulder portion 135 of each adjusting knob 127 engages a portion of the housing of the trip unit. As can be understood with reference to FIG. 2, each of the adjusting knobs 127 is provided with a slot therein for receiving a screw driver that may be used to rotate the knob 127. Upon rotation of each of the knobs 127 the associated cam 125 will be rotated to move the cam surface 123 against the top of the associated rod 119 to thereby move the associated rod 119 in a vertical direction to thereby pivot the associated armature 93 and vary the air gap between the associated armature 93 and the one leg of the associated magnetic yoke 91. As can be understood with reference to FIG. 3, each of the knobs 127 can be depressed slightly against the spring 133 only to the extent of engaging the top of the associated plate 129 which limited movement merely enables indexing of the adjusting knob 127. The pole unit on the left as seen in FIGS. 3 and 4, however, is different from the two pole units on the right in that there is included a push-to-trip feature in the adjusting means of the pole unit on the left.

Referring to FIGS. 3, 4 and 5, the pole unit on the left comprises a cam 137 having a lower cam surface 139 at the bottom thereof, an intermediate tubular member 141 and an adjusting member 143. During assembly of the pole unit on the left, the adjusting member 143 is moved into the opening in the tubular member 141 and through an opening in a support plate 145 that is secured to the associated support bracket 121. The inner end of the member 143 is then fixedly secured to the cam 137. The tubular member 141 comprises an annular shoulder part 147 that engages a surface of the housing 81 (FIGS. 3 and 4) under the bias of a spring washer 149 to limit frontward movement of the tubular part 141. The cam 137 engages the bottom surface of the plate 145 to limit frontward movement of the cam 137 and adjusting knob 143. The cam surface 139 of the cam 137 engages the top of the associated adjusting rod 119. In the pole unit on the left in FIG. 3, the bias of the spring 95 biases the armature 93 in a clockwise direction forcing the rod 119 up into engagement with the cam surface 139 to force the cam 137 against the plate 145 to the position shown in FIG. 3. When it is desired to adjust the electromagnetic trip of the pole unit on the left, the adjusting knob 143, which has a screw driver slot therein (FIG. 2) is rotated to rotate the cam surface 139 against the rod 119 to effect vertical movement of the rod 119 to thereby vary the air gap between the associated armature 93 and the one leg of the associated magnetic yoke 91. When it is desired to manually trip the breaker a tool having an end portion smaller than the dimension of the opening of the tubular member 141 is forced inward to move the adjusting member 143 and cam 137 inward (FIG. 4) to manually trip the breaker in a manner to be hereinafter described.

When the circuit breaker is in the closed position and an overload above a predetermined value occurs in any of the pole units, the magnetic flux generated by the current in the associated conductor 41 operates in the associated yoke 91 and armature 93 to attract the associated armature 93 which then pivots about the one leg of the yoke 91 in the direction of the other leg of the

yoke 91 pulling the rod 103 downward (FIG. 3) whereupon the nut 113 engages the part 107 of the trip bar 109 to rotate the trip bar about the pivot pins 115 (FIG. 2) to thereby release the latch structure 64 (FIG. 1) to in turn release the free end of the trip member 63. Upon release of the trip member 63, the trip member 63 is moved in a clockwise (FIG. 1) direction about the pivot 65 under the bias of the springs 61 to effect collapse of the toggle 57, 59 and opening movement of all of the switch arms 35 in a manner well known in the art. Upon the occurrence of a tripping operation, the handle 69 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 after a tripping operation until the handle 69 is moved to the fully open or "off" position during which movement a projection 157 connected to the handle 69 engages a shoulder 59 of the trip member 63 rotating the trip member 63 in a counterclockwise direction about the pivot 65 until the trip member 63 re-engages the latching mechanism 64. After the trip member 63 has been relatched, the operating handle 69 can be moved to the "on" position to close the circuit breaker in the same manner as was hereinbefore described.

When it is desired to manually trip the circuit breaker the adjusting knob 143 of the pole unit on the left (FIGS. 2-4) is depressed inwardly to move the associated cam 137 inwardly to thereby depress the associated rod 119 (FIG. 4) and armature 93 whereupon the associated nut 113 engages the associated part 107 of the trip bar 109 to thereby rotate the trip bar 109 about the pivot pins 115 (FIG. 2) to thereby release the trip member 63 whereupon the circuit breaker is tripped in the same manner as was hereinbefore described. A tool, having an end portion smaller than the diameter of the opening in the tubular member 141, may be used to depress the adjusting knob 143. The circuit breaker is reset following a manual tripping operation in the same manner as was hereinbefore described.

As can be understood with reference to FIG. 1, the adjusting knobs 127, 143 extend from the trip device 129 into openings in the front of the circuit breaker cover 11 such that they do not extend up past the plane of the generally planar front portion of the cover 13. Thus, it is less likely that the member 143 will be accidentally depressed to manually trip the breaker. In the embodiment disclosed in FIGS. 1-5, the manual push-to-trip feature operates such that upon depression of the knob 143 the rod 119 is depressed to move the associated armature inwardly to move the associated rod 103 and nut 113 to move the trip bar 109 to the tripped position. In the embodiment disclosed in FIGS. 6 and 7, the adjusting knob can be depressed to directly operate the trip bar to the tripped position without moving the armature.

Referring to FIGS. 6 and 7, one pole unit of a three-pole trip device is disclosed in order to illustrate another embodiment of the invention. The pole unit shown in FIGS. 6 and 7 is push-to-trip pole unit. The trip device of FIGS. 6 and 7 is incorporated in a circuit breaker in the same manner that the trip device 29 is incorporated in the circuit breaker disclosed in FIG. 1. The trip device of FIGS. 6 and 7 includes a trip device conductor 41, a magnetic yoke 91, an armature 93 pivoted on one leg of a U-shaped yoke 91, spring means 95 biasing the armature in a counterclockwise direc-

tion to the unattracted position seen in FIG. 6, a member 101, a rod 103, a trip bar part 107 that is part of a trip bar 109 and a nut 113 all of which function and operate in the same manner as the related parts disclosed and described with regard to the first embodiment of the invention. The means for adjusting the armature to adjust the air gap and the push-to-trip feature are modified in the embodiment illustrated in FIGS. 6 and 7.

Referring to FIG. 6, a cam follower 163 is supported for pivotal movement on a pivot pin 165. An adjusting screw 167, which is threadably mounted on one end of the cam follower 163, engages the front of the armature 93. The other end 169 of the cam follower 163 engages a cam surface 171 at the top or front of a cam 173. The cam 173 is supported on the lower end of a generally U-shaped support bracket 175. An elongated rod 177 is connected at the lower end thereof to the cam 173. The rod 177, at the upper end thereof, extends into an opening 181 in an adjusting knob 183 that is provided with a shoulder portion 185 that engages the undersurface of the top of the U-shaped supporting bracket 175. A spring 187, disposed in the opening 181 of the adjusting knob 183, biases the adjusting knob 183 upward (FIG. 6) which movement is limited by the engagement of the part 185 of the knob 183 with the top of the U-shaped bracket 175. A U-shaped bracket 189 at the top thereof engages the bottom of the adjusting knob 183. The top and bottom legs of the bracket 189 have openings therein for receiving the rod 177 which passes therethrough. The bracket 189 comprises an actuating part 191 that rests on the top of the part 107 of the trip bar 109 so that upon inward movement of the bracket 189 the part 191 engaging the part 107 of the trip bar 109 will rotate the trip bar to the tripped position. A projection 190 on the rod 177 fits in a slot 191 in the knob 183 to key the rod 177 and knob 183 together such that rotation of the knob 183 will rotate the rod 177 and cam 173. The projection 190 and slot 191 permit vertical movement of the knob 183 relative to the rod 177. Except for the push-to-trip feature the trip device of FIGS. 6 and 7 is constructed to operate in a circuit breaker in the same manner as is disclosed in the patent to Thomas et al., U.S. Pat. No. 3,073,925. This invention involves a modification of one pole unit of the trip device of the Thomas et al. patent such as to provide the push-to-trip feature to enable manual tripping of the circuit breaker. The openings in the legs of the U-shaped bracket 189 are large enough, relative to the rod 177 which passes therethrough, that the bracket 189 can move vertically relative to the rod 177. The flat bight portion of the U-shaped bracket 189 engages the support bracket 175 to prevent rotation of the bracket 189 on the rod 177. Thus, the bracket 189, which will move inward upon depression of the knob 183, will not rotate when the knob 183 is rotated to adjust the trip characteristics of the breaker.

Referring to FIGS. 6 and 7, when an overload above a predetermined value in any of the three pole units occurs the magnetic flux generated by the current in the conductor 41 draws the armature 93 counterclockwise toward the one leg of the U-shaped yoke 91 during which movement the rod 103 is pulled down and the nut 113 engages the part 107 of the trip bar 109 to rotate the trip bar 109 to the tripped position to effect an electromagnetic tripping operation of the circuit breaker in the same manner as was hereinbefore de-

scribed with regard to the first embodiment of this invention and in the same manner as is disclosed in the above-mentioned patent to Thomas et al. U.S. Pat. No. 3,073,925. The air gap between the armature 93 and magnetic yoke 91 is adjusted by rotation of the adjusting knob 183. When it is desired to adjust the magnetic trip, a screw driver is inserted into the top slot of the adjusting knob 183 and the knob 183 is rotated to rotate the cam 173 whereupon the cam surface 171, operating on the end 169 of the pivoted cam follower 163, pivots the cam follower 163 about the pivot 165 to thereby pivot the armature 93 to adjust the air gap between the right side of the armature 93 (FIG. 6) and the one leg of the U-shaped magnetic yoke 91. When it is desired to manually trip the circuit breaker the knob 183 is forced inward with a screw driver or other tool whereupon the bracket 189 is moved inward, relative to the rod 177, whereupon the projection or actuating part 191 of the bracket 189 moves the part 107 of the trip bar 109 to rotate the trip bar 109 to the tripped position to trip the circuit breaker. Upon release of adjusting knob 183 the spring 187 will return the knob 183 to the unactuated position, and spring means, not shown, will return the trip bar 109 and bracket 189 to the unactuated position seen in FIGS. 6 and 7. The knob 183 fits into an opening in the front of the circuit breaker housing in the same manner as is described in the above-mentioned U.S. Pat. No. 3,073,925 with the top of the knob 183 being no higher than the front of the front cover to prevent accidental manual tripping operations.

From the foregoing, it can be understood that there is provided by this invention an improved circuit breaker with externally accessible adjusting means that can be manually operable to adjust the magnetic trip means of the circuit breaker and manually operable to trip the breaker.

We claim:

1. A circuit breaker comprising an insulating housing, a circuit breaker structure supported in said housing, said circuit breaker structure comprising a pair of cooperable contacts, a trip member movable from an initial position to a tripped position to effect automatic opening of said contacts, trip means automatically operable upon the occurrence of overload current conditions above a predetermined value to effect movement of said trip member to said tripped position, said housing having an opening therein, adjusting means accessible at said opening and being manually operable to adjust the trip characteristics of said trip means, and said adjusting means also being manually operable to effect movement of said trip bar to said tripped position.

2. A circuit breaker according to claim 1, said adjusting means comprising an adjusting member manually movable in one mode to adjust the trip characteristics of said trip means, and said adjusting member being manually movable in another mode to effect movement of said trip bar to said tripped position.

3. A circuit breaker according to claim 1, said adjusting means comprising an adjusting member supported for rotatable movement and also for rectilinear movement, said adjusting member being rotatable to adjust the trip characteristics of said trip means, and said adjusting member being rectilinearly movable inwardly to effect movement of said trip bar to said tripped position.

4. A circuit breaker according to claim 3, spring means biasing said adjusting member outwardly to an unactuated position, said adjusting member being rectilinearly movable inwardly against the bias of said spring means to an actuating position to effect movement of said trip member to said tripped position, and said adjusting member when in the actuating position being below the front surface of said housing.

5. A circuit breaker according to claim 4, said trip means comprising a yoke and an armature supported for movement relative to said yoke with an air gap between said armature and said yoke, upon the occurrence of overload current conditions above said predetermined value said armature being attracted toward said yoke to effect movement of said trip member to said tripped position, said adjusting means comprising cam means operable upon rotation of said adjusting member to vary said air gap to thereby vary the tripping characteristics to said trip device, and upon inward rectilinear movement of said adjusting member said adjusting member operating to effect movement of said trip member to said tripped position.

6. A circuit breaker according to claim 5, a cam follower disposed between said cam member and said armature, actuating means connected between said armature and said trip member, upon the occurrence of said overload current condition above said predetermined value said armature being attracted to said yoke to move said actuating means to thereby move said trip member to the tripped position, upon rotation of said adjusting member said cam follower being moved to move said armature to vary said air gap, and upon inward rectilinear movement of said adjusting member said cam follower being moved inwardly to move said armature to move said actuating means to thereby move said trip member to said tripped position.

7. A circuit breaker according to claim 6, said circuit breaker comprising a generally planar front surface, and said adjusting member being rotatable about an axis generally normal to the plane of said front surface, and said adjusting member being movable rectilinearly in a direction generally normal to the plane of said front surface.

8. A circuit breaker according to claim 5, a cam follower disposed between said cam member and said armature, actuating means connected between said armature and said trip member, upon the occurrence of said overload current condition above said predetermined value said armature being attracted to said yoke to move said actuating means to thereby move said trip member to the tripped position, upon rotation of said adjusting member said cam follower being moved to move said armature to vary said air gap, and means movable inwardly with said adjusting member to directly move said trip bar to the tripped position independent of any movement of said cam and armature.

9. A circuit breaker according to claim 8, said circuit breaker comprising a generally planar front surface, and said adjusting member being rotatable about an axis generally normal to the plane of said front surface.

10. A circuit breaker according to claim 9, and said adjusting member being rectilinearly movable in a direction generally normal to the plane of said front surface.

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