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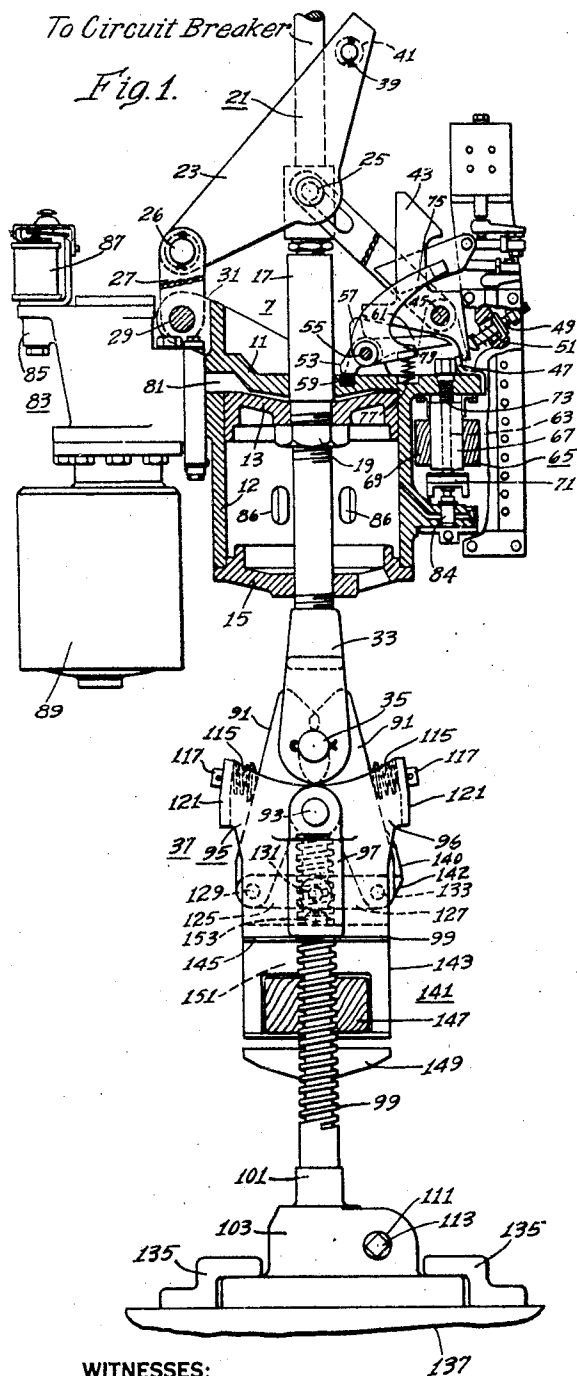
J. M. CUMMING ET AL

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CIRCUIT BREAKER MECHANISMS

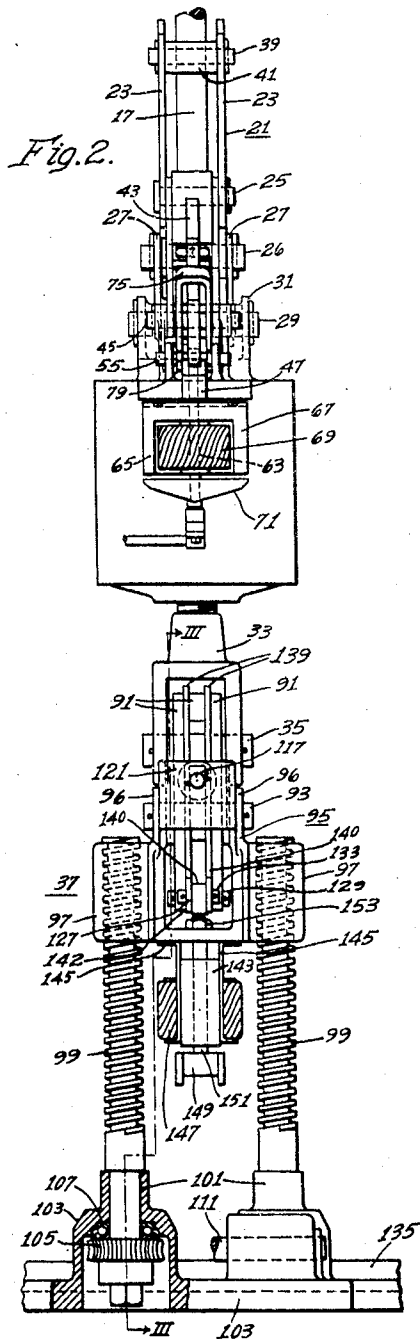
Filed April 4, 1942

3 Sheets-Sheet 1



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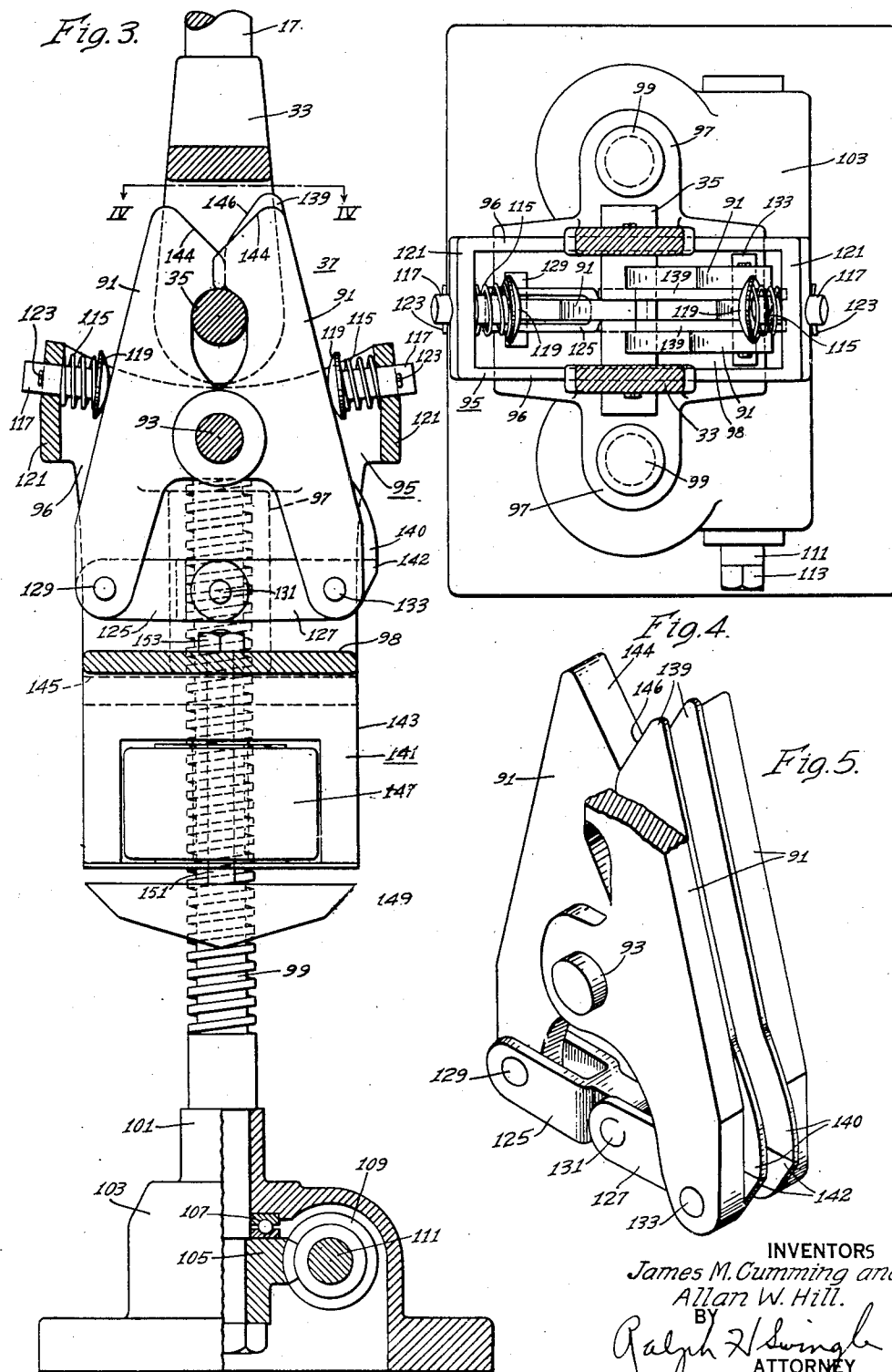
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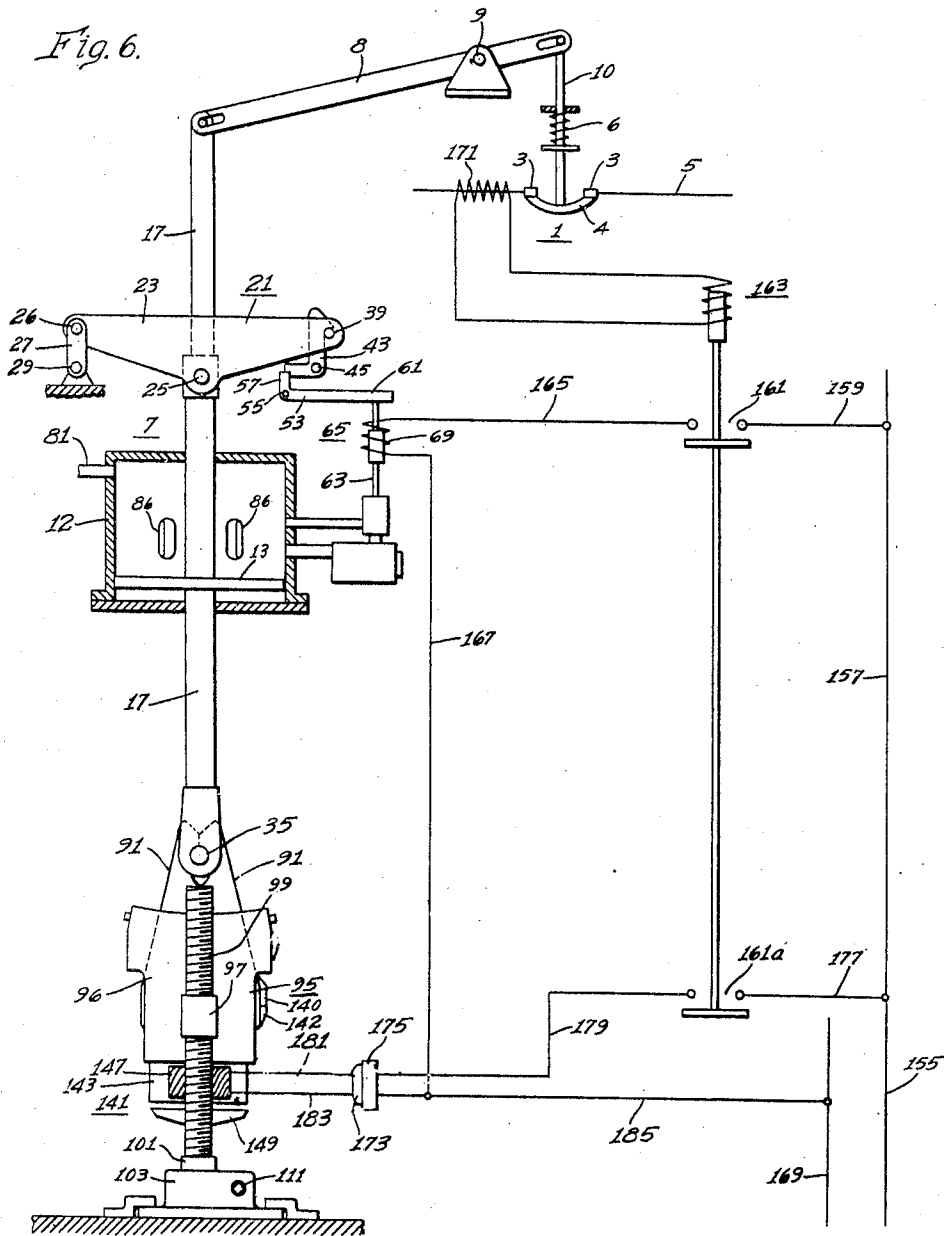
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Fig. 6.



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2,349,650

CIRCUIT BREAKER MECHANISM

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Application April 4, 1942, Serial No. 437,668

14 Claims. (Cl. 200—82)

This invention relates to circuit breakers and more particularly to operating means for operating a circuit breaker.

An object of the invention is the provision of a circuit breaker with a manual closing device which is operable to automatically release the breaker and permit opening thereof in response to predetermined conditions.

Another object of the invention is to provide an improved manual closing device for a high power circuit breaker which is detachably associated with the breaker operating mechanism.

Another object of the invention is to provide a detachable manual closing device for a high power circuit breaker comprising a traveling latch releasably engageable with a part movable with the breaker operating mechanism and manually operable to close the breaker.

Another object of the invention is to provide an improved closing device for a circuit breaker comprising a latching mechanism for releasably connecting the closing device to a part movable with the breaker, the latching mechanism being provided with an automatically operable locking device for releasably locking the latching mechanism in latching position.

Another object of the invention is to provide an improved manual closing device for a circuit breaker comprising a traveling latch mechanism for releasably connecting the closing device to a part movable with the breaker, in which the breaker is trip free of the manual closing device.

Another object of the invention is to provide a manual closing device for a circuit breaker comprising means for releasably coupling the closing device to the breaker and a trip device mounted on the closing device and operable in response to predetermined circuit conditions to automatically disconnect the breaker from the closing device.

Another object of the invention is to provide a manual closing device for a circuit breaker comprising latch means for releasably coupling the closing device to the breaker and a trip device mounted on and movable with the closing device, the trip device being automatically operable to release the latch means and thereby uncouple the breaker from the closing device, the trip device also being manually operable to uncouple the closing device from the breaker.

Another object of the invention is the provision of a circuit breaker with an improved manually operable closing device which is simple, reliable in operation and inexpensive to manufacture.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation together with additional objects and advantages thereof will be best understood from the following detailed description of a single embodiment thereof when read in conjunction with the accompanying drawings, in which:

Figure 1 is an elevational view, partly in section, of a compressed air operated mechanism for a circuit breaker, and a manually operated closing device embodying the principles of the invention.

Fig. 2 is a side elevational view of the mechanism shown in Fig. 1.

Fig. 3 is an enlarged sectional view of the manual closing device, taken substantially on line III—III of Fig. 2.

Fig. 4 is a plan view taken on line IV—IV of Fig. 3 showing the manual closing device.

Fig. 5 is a perspective view, partly in section, of the mechanism for latching the manual closing device to the breaker operating mechanism; and,

Fig. 6 is a wiring diagram of the electrical control circuits for the circuit breaker operating mechanism and the manual closing device, the breaker and the operating mechanism being shown schematically.

Referring to Fig. 6 of the drawings, the circuit breaker 1 shown schematically, may be of any conventional construction and comprises stationary contacts 2 and a movable bridging contact member 4 for cooperating with the contacts 2 to open and close a main circuit indicated by the single line 5. The circuit breaker may be of the multi-pole type in which case a set of contacts 2 and 4 is provided for each pole with the bridging contact members 4 connected together for simultaneous movement in the well known manner. The circuit breaker is biased to open position by means of an accelerating spring 6 and is mechanically connected to the operating mechanism indicated generally at 7 by means of a lever 8 pivoted at 3 on a fixed support. One end of the lever 8 is pivotally connected to the breaker lift rod 10 and the other end is pivotally connected to a breaker operating rod 17 which is connected to the operating mechanism 7.

Referring to Fig. 1, the circuit breaker operating mechanism 7 comprises a main casting 11 forming a cylinder 12 in which a piston 13 is adapted to be operated by compressed air to close the circuit breaker. The cylinder is closed

at its lower end by a closure member 15 secured thereto. The breaker operating rod 17 extends axially through openings in the casting 11, the piston 13 and the closure member 15, and is secured to the piston 13 by means of a shoulder on the rod 17 and a nut 19 threaded on to the rod. The operating rod 17 is pivotally connected to an operating lever 21 comprising a pair of parallel levers 23 (Fig. 2), by means of a pivot pin 25. The operating levers 23 are pivotally connected by a pivot pin 26 to the upper ends of a pair of parallel links 27 which are pivotally mounted by means of a pivot pin 29 on projection 31 of the main casting 11. A yoke member 33 secured on the lower end of the operating rod 17 carries a pin 35 with which a manual closing device, indicated generally at 37, is adapted to cooperate to manually close the breaker.

The free ends of the levers 23 carry a short shaft 39 which rotatably supports a roller 41 disposed between the levers. A high speed latching mechanism including a main latch 43 is adapted to engage the roller 41 to releasably hold the operating lever 23 in closed position thus holding the circuit breaker in closed circuit position. The latch 43 is pivotally supported on a pivot 45 mounted in the main casting 11 and is biased to latching position against a stop 47 by means of a spring pressed plunger 49. The plunger 49 is slidably mounted in an opening in a portion of the main casting 11 and is biased inwardly by means of a compression spring 51.

The construction of the latch face of the main latch 43 is such that this latch, by itself, will not serve to hold the breaker operating lever 21 in closed position. For this reason a trigger latch 53 is provided for engaging and holding the main latch in latching position. The trigger latch 53 is pivotally supported on the main casting by means of a pivot pin 55 and has a latching projection 57 which engages under a tail of the main latch in the latching position of the main latch. The trigger latch is biased to latching position by a compression spring 59. A tail 61 of the trigger latch 53 extends directly over the upper end of a trip rod 63 which forms a part of an electromagnetic trip device 65. In addition to the trip rod 63 the trip device includes an E-shaped magnet core 67 suitably mounted on the main casting 11 and having an energizing winding 69 around its center leg. The trip rod 63 is slidable vertically through the center of the core member and has an armature 71 secured thereto below the core 67. The trip rod 63 and the armature 71 are biased downwardly by means of a spring 73 disposed between the main casting 11 and a collar on the trip rod.

Referring to Fig. 6, the winding 69 of the trip device 65 is connected in an energizing circuit extending from an auxiliary source conductor 155, conductor 159, contacts 161 of a conventional fault responsive relay 163, through a conductor 165, winding 69 and through conductors 167 and 185 to the other source conductor 169. The fault relay is adapted to be operated to close the contacts 161 upon the occurrence of a predetermined overload condition in the main circuit 5. The energizing winding of the fault relay 163 is energized by a current transformer 171 which is adapted to be energized by the main circuit conductor 5 in the usual manner. When a predetermined overload or a short circuit occurs in the main circuit 5 controlled by the breaker 1, the fault relay 163 is energized sufficiently to

close the contacts 161 and effect energization of the trip device 65.

When the trip device 65 is energized the armature 71 is attracted upwardly against the core 67 moving the trip rod 63 upwardly therewith. This movement of the trip rod rotates the trigger latch 53 counterclockwise and disengages the tail 57 thereof from the main latch 43, whereupon the accelerating spring 6 (Fig. 6) of the circuit breaker moves the breaker to open circuit position rotating the operating lever 21 counterclockwise to the position shown in Fig. 1. During the initial movement of the operating lever to open position the roller 41 (Fig. 1) cams the main latch 43 counterclockwise, the spring 51 acting to restore the main latch to latching position as soon as the roller clears it. In order to prevent the trigger latch 53 from resuming its latching position before the operating lever 21 has returned to closed position, a U-shaped holding lever 75 is provided, the legs of which are pivoted on the pivot pin 55. The holding lever 75 is biased in a counterclockwise direction by a spring 77 seated in a recess in the main casting 11 and which engages a projection 79 of the holding lever. The free end of the holding lever 75 is disposed directly beneath the end of the operating lever 21 so that the holding lever is held in inoperative position when the operating lever 21 is in closed position. When the operating lever 21 is released and moves toward open position, the spring 77 rocks the holding lever counterclockwise and the projection 79 thereof engages and holds the trigger latch 53 in unlatched position until the operating lever 21 is returned to closed position.

The circuit breaker is normally closed or automatically reclosed by downward movement of the piston 13 which is effected by compressed air admitted to the upper end of the cylinder through an inlet passage 81. The inlet passage 81 is controlled by a main inlet valve indicated generally at 83, and the opening operation of the inlet valve is controlled by a pilot valve 85 which is operated by an electromagnet 87. The main inlet valve and the pilot valve are not shown herein in detail since they form no part of the present invention.

It is thought sufficient to state here that the electromagnet 87 may be energized from any suitable source either manually or automatically to cause opening of the pilot valve 85 and admit air under pressure from a reservoir 89 (Fig. 1) to operate the main inlet valve 83. Operation of the main valve 83 admits compressed air through the inlet passage 81 to the upper end of the cylinder 12 forcing the piston 13 downwardly and moving the breaker to closed position. As the operating lever 21 arrives at closed position, the roller 41 slips by the main latch 43 which is immediately restored to latching position by the spring 51. Also as the lever 21 arrives at the closed position, the end thereof engages and rocks the holding lever 75 to its inoperative position which permits the trigger latch 53 to resume its latching position.

The trip device 65, in addition to operating the latching means 43-53, also controls a pilot valve 84 which in turn controls the operation of a dump valve (not shown) for dumping pressure air from the upper portion of the cylinder through a large port 86 to atmosphere, upon operation of the trip device 65. This permits the breaker to open quickly without being opposed by pressure air above the piston 13 thus producing the effect of trip free operation.

The operating mechanism as thus far described, with the exception of the manual closing device 37, is of the same construction as disclosed and claimed in the copending application of J. M. Cumming and R. C. Cunningham, Serial No. 410,686, filed September 13, 1941, and assigned to the assignee of the present invention.

As previously set forth, the manual closing device 37 is adapted to be engaged with the pin 35 carried by the yoke member 33 secured to the lower end of the operating rod 17, and manually moved downwardly to close the breaker. The closing device 37 includes a traveling latch comprising a plurality of latch levers 91 pivotally supported on a pivot pin 93 and adapted to be disposed two on one side of the pin 35 and one on the opposite side of said pin when the closing device is set in position to close the breaker. The pivot pin 93 is mounted in a substantially rectangular carriage or frame 95 comprising parallel side members 96 (Fig. 4) joined at the bottom by a plate 98 (Fig. 3) formed integral with the side members 96. The side members 96 are also joined at each end (Figs. 3 and 4) by cross members 121 also formed integral with the side members. Bosses 97 formed integral with the side members 96 are provided with threaded openings to receive a pair of vertically disposed operating screws 99 rotatably mounted in bearings 101 extending upwardly from a base casting 103. On the lower end of each of the screws 99 is secured a gear 105 (only one being shown) disposed in housings formed by the casting 103. A ball thrust bearing 107 is provided between each of the gears 105 and the inside of the casting 103. Each of the gears 105 meshes with a worm 109 secured on a horizontally disposed shaft 111 rotatably mounted in bearings in the casting 103. The shaft 111 is provided with a squared end 113 (Figs. 1 and 4) projecting beyond the base housing and which is adapted to receive a hand crank (not shown) so that the shaft 111, gears 109 and 105 and the screws 99 may be manually rotated to effect vertical movement of the frame 95 and the latches 91.

The latch levers 91 are spring pressed to their latching positions by means of springs 115 (Figs. 1, 3 and 4) coiled around plungers 117 and disposed between rounded heads 119 of the plungers and the cross members 121 integral with the frame 95. The plungers 117 are slidable in the cross members 121 and their inward movement is limited by cotter pins 123 therein bearing against the outside face of the cross members. The lower ends of the latch levers 91 are connected by a toggle comprising a bifurcated toggle link 125 (Figs. 3 and 5) and a toggle link 127 comprising a pair of links. The bifurcated end of the toggle link 125 straddles the lower end of the single latch lever 91 disposed on one side of the pin 35, and is pivotally connected thereto by means of a pin 129. The toggle links 127 are disposed on each side of the toggle link 125 and are connected thereto by a knee pivot pin 131. The other ends of the links 127 are pivotally connected to the lower ends of the other two latch levers 91 by means of a single pin 133 extending through openings in the latch levers 91 and in the toggle links 127. The toggle 125-127 is normally overcenter below a line through the centers of the pins 129 and 133 and thus maintains the latch levers 91 in their latching positions as shown.

The manual closing device 37 is not permanently attached to a single breaker mechanism

but may be removably attached to anyone of a number of breakers for the purpose of manually closing them. In order to attach the device 37, the screws 99 are rotated in a direction to lower the traveling frame 95 and the latch levers 91 carried thereby. The base 103 of the device is then inserted beneath angle brackets 135 (Fig. 1) secured to a fixed part 137 of the breaker mechanism structure and so located that the latches 91 will be positioned directly below the pin 35. The screws 99 are now rotated in a direction to raise the traveling latch mechanism in order to engage the latch levers 91 with the pin 35. Since the toggle 125-127 at this time is overcenter in a position to lock the latches 91 in their latching positions, it is necessary to provide means to collapse the toggle over center above the line 129-133 before the latches 91 may be engaged with the pin 35.

Referring to Figs. 3, 4 and 5, it may be observed that a pair of toggle operating levers 139 is pivotally supported on the pin 93 and each of the levers 139 has its lower end 140 disposed in cooperative relation with a projection 142 on the outer end of each of the toggle links 127. The upper ends of the latches 91 are beveled at 144. The upper ends of the toggle operating lever 139 are also beveled as at 146 and extend upwardly a greater distance from the center 93 than do the latches.

As the screws 99 are rotated to raise the traveling latch mechanism the beveled faces 146 of the operating levers 139 will first engage the pin 35 and continued upward travel of the carriage causes the levers 139 to wipe by the pin 35 which results in rocking the levers clockwise (Fig. 3) about the pivot 93. At this movement the lower ends 140 thereof engage the projections 142 of the toggle links 127 and rock these links clockwise about the pin 123 causing collapse of the toggle 125-127. With the toggle in collapsed condition, further upward movement of the traveling latch mechanism 37 brings the beveled faces 144 of the latch levers 91 into engagement with the pin 35 which causes further separation of the latches. As the upward movement of the mechanism continues the latching ends of the latch levers 91 pass above the pin 35 whereupon the springs 115 act to move the latch levers into latching engagement with the pin. The head 119 of the plunger 117 which is disposed in cooperative relation with right hand latch levers 91 (Figs. 3 and 4) also engages the toggle operating levers 139 and rocks these levers counterclockwise to the position in which they appear in Fig. 3. At this time, the lower ends 140 of the levers 139 free the projections 142 on the toggle links 127 whereupon the toggle 125-127 resumes its overcenter holding position under the combined influence of the springs 115 and of gravity.

The latches 91 are now fully engaged with the pin 35 and locked in this position by means of the toggle 125-127. The screws 99 are now rotated in a direction to lower the traveling latch mechanism 37, which draws the breaker operating rod 17 downwardly to close the breaker and at the same time rotates the operating lever 21 clockwise to its closed position where it is latched in the previously described manner.

One of the important features of the invention is the provision of a detachable manual closing means for a circuit breaker wherein the breaker is trip free of the manual closing means during the entire length of closing travel.

The trip-free device includes an electromagnet 141 (Figs. 1, 2, 3, and 6) comprising an E-shaped core member 143, mounted on the under side of the bottom plate 98 of the frame 95 by means of brackets 145 (Fig. 2), and having an energizing coil 147 surrounding the center leg of the core. A movable armature 149 is secured to the lower end of a vertically disposed trip rod 151 extending through an opening in the core member and an opening in the bottom plate 98. The upper end of the trip rod 151 is disposed directly beneath the knee of the toggle 125—127 and has a nut 153 threaded thereon which engages the upper face of the bottom plate 98 to limit the downward movement of the armature.

The energizing winding 147 for the traveling trip device 141 is adapted to be energized over a control circuit connected in parallel with the circuit for energizing the trip device 65 for the operating mechanism 7. Since the closing device 37 may be moved and utilized to close a number of breakers, the winding 147 is provided with a plug-in device 173 (Fig. 6) which may be plugged into a receptacle 175 connected to the control circuit for the particular breaker to be closed. The circuit for energizing the winding 147 extends from the control source conductor 155, the conductor 157, a conductor 177, contacts 161a of the fault relay 163, a conductor 179 to one terminal (not shown) of the receptacle 175, one side of the plug 173, a conductor 181, the winding 147 of the trip device 141, a conductor 183 to the other side of the plug 173, from the other terminal of the receptacle 175 over a conductor 185 to the other side 169 of the control source.

When it is desired to manually close a circuit breaker the closing device 37 is coupled thereto in the previously described manner and the plug 173 is inserted into the receptacle 175 of that particular breaker thus connecting the winding 147 in the control circuit for the breaker being closed. Should an overload of predetermined value or a short circuit occur during the closing movement of the breaker when it is being closed by means of the manual closing device 37, the magnet 141 will be immediately energized. Energization of the magnet attracts the armature 149 and thrusts the rod 151 upwardly forcing the toggle 125—127 overcenter in a direction to cause its collapse. When this occurs the upward force of the breaker operating rod 17, occasioned by the breaker accelerating spring 6 which biases the rod 17 upwardly in opening direction, causes the pin 35 to separate the latching ends of the latches 91, freeing the pin 35 therefrom and permitting the accelerating spring 6 to move the breaker 1 to open position.

As soon as the magnet 141 is deenergized the latch levers 91 are restored to their latching positions by the springs 115, and the weight of the toggle links 125—127 causes the toggle to resume its overcenter holding position. The closing device 37 may be reconnected with the pin 35 in order to again close the breaker. In order to manually disconnect the latches 91 from the pin 35, the armature 149 may be manually raised to cause collapse of the toggle 125—127 and while holding the toggle in collapsed condition, the shaft 111 may be rotated in a direction to cause the screws 99 to lower the frame 95 thereby disengaging the latch levers 91 from the pin 35.

While the invention has been disclosed in accordance with the provisions of patents statutes, it is to be understood that various changes in the structural details and arrangements of parts

thereof may be made without departing from some of the essential features of the invention. It is desired, therefore, that the language of the appended claims be given the broadest reasonable construction permissible in the light of the prior art.

We claim as our invention:

1. The combination of a circuit breaker, a member movable to close the breaker, power operated means for moving said member to close the breaker, a tripping means effective to trip the breaker in response to predetermined abnormal conditions while mechanically connected to the power operated means, manually operable means engageable with said member for moving the member to close the breaker, and a trip-free tripping means effective to cause disconnection of the movable member from the manually operable means in response to predetermined abnormal conditions occurring during a closing movement of the manually operable means.

2. The combination of a circuit breaker, a member movable to close the breaker, power operated means for moving said member to close the breaker, manually operable means releasably engageable with the member and operable to move said member to close the breaker, and a trip device movable with the manually operable means and responsive to predetermined abnormal conditions to cause disengagement of the movable member from the manually operable means.

3. The combination of a circuit breaker, an operating member movable to close the breaker, means comprising a fluid motor for moving said operating member to close the breaker, a trip device operable in response to predetermined overload conditions to cause opening of the breaker, a manually operable closing device operable to move said operating member to close the breaker, and a trip device movable with said manually operable closing device and operable in response to predetermined circuit conditions to cause opening of the breaker irrespective of the closing movement of the manually operable closing device.

4. The combination of a circuit breaker, an operating member movable to close the breaker, means comprising a fluid motor operable to move said operating member to close the breaker, a trip device operable in response to predetermined circuit conditions to cause opening of the breaker, a manually operable closing device including a traveling latch mechanism for releasably connecting said closing device to the operating member, manually operable means for operating the latch mechanism and the operating member to close the breaker, and a trip device movable with the latch mechanism and operable in response to predetermined circuit conditions for causing said latch mechanism to release the operating member.

5. In a circuit breaker having a latch mounted on a fixed part for holding said circuit breaker in closed position, closing mechanism for said circuit breaker comprising a movable carriage, manually operable means for moving said carriage in a direction to close the breaker, means for coupling the carriage to a part movable with the breaker, and a trip device movable with the carriage and operable to cause opening movement of the breaker irrespective of the closing movement of the carriage.

6. A closing mechanism for a circuit breaker comprising power operated closing means oper-

atively connected at all times with said breaker, a reciprocably movable carriage, manually operable means for moving said carriage, latching mechanism for releasably coupling the carriage to a part movable with the breaker, said carriage being movable in one direction to effect said coupling and movable in another direction to move the breaker to closed position, and a trip device operable in response to predetermined conditions to cause automatic uncoupling of the breaker from said carriage.

7. A closing device for a circuit breaker comprising power operated closing means operatively connected at all times to said breaker, a reciprocably movable carriage, manually operable means for moving said carriage, a plurality of latches pivotally mounted on said carriage for detachably connecting the carriage to a part movable with the breaker, said carriage being movable in one direction to effect said connection and movable in another direction to move the breaker to closed circuit position, and means for restraining the latches in latching position.

8. A closing device for a circuit breaker comprising a movable carriage, manual operating mechanism for moving said carriage in a direction to close the breaker, a plurality of opposing latches on the carriage for releasably connecting said carriage to the breaker, common locking means for locking all of said latches in latching position, and electroresponsive means movable with the carriage and operable in response to predetermined conditions to cause opening movement of the breaker irrespective of the closing movement of the carriage.

9. In an operating mechanism for a circuit breaker, the combination of a part movable to an open position and to a closed position for opening and closing the breaker, power operated closing means operatively connected at all times to said part, a movable carriage, means for coupling said carriage to said part, means for restraining the coupling means in coupling position, manual operating mechanism for moving the carriage in a direction to close the breaker, and a trip device automatically operable during a closing movement of said carriage in response to predetermined conditions for operating the restraining means to cause opening of the breaker.

10. The combination with a circuit breaker, of a main operating device comprising a fluid motor for operating the breaker to closed circuit position, an auxiliary operating device removably attachable to a fixed part and to a part movable with the breaker for manually operating the breaker to closed circuit position, said auxiliary operating device comprising a movable carriage, a plurality of latch members mounted on said carriage and operable to releasably connect the carriage to the part movable with the

breaker, and manually operable mechanism for moving the carriage in a direction to move the breaker to closed position to cause closing of the breaker.

11. The combination of a circuit breaker, an operating member movable to close the breaker, power operated means for moving said member to close the breaker, a manually operable closing device including a traveling carriage, a plurality of latch members pivotally mounted on said carriage for releasably connecting said carriage to the operating member, means comprising a toggle connecting said latch members for restraining said latch members in latching position, and a trip device operable in response to predetermined circuit conditions for operating said toggle to cause opening of the breaker.

12. The combination of a circuit breaker, an operating member movable to close the breaker, a manually operable device including a traveling carriage for moving the operating member to close the breaker, a plurality of latch members biased to latching position for connecting the carriage to the operating member, a toggle for restraining the latch members in latching position, means engageable by the operating member for operating the toggle to effect said connection, manually operable means for moving the carriage in a direction to close the breaker, and a trip device carried on the carriage and operable in response to predetermined circuit conditions for operating the toggle to effect disconnection of the operating member from the carriage.

13. In combination, a circuit breaker, power operated closing means for closing said breaker, means automatically operative to effect opening of said breaker, said circuit breaker remaining operatively related and under the control of said power operated closing means at all times, and manually operable closing means for closing said circuit breaker, said automatic means when operated causing opening of said circuit breaker irrespective of the position of said manually operable closing means.

14. In combination, a circuit breaker, compressed gas closing means for closing the breaker, means automatically operative to effect opening of said circuit breaker, means operated simultaneously with said automatic means for deenergizing the closing means, said circuit breaker remaining operatively associated with and under the control of said closing means at all times, and manually operable closing means for closing said circuit breaker, said automatic means when operated causing opening of said circuit breaker irrespective of the position of said manually operable closing means.

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