

Feb. 5, 1957

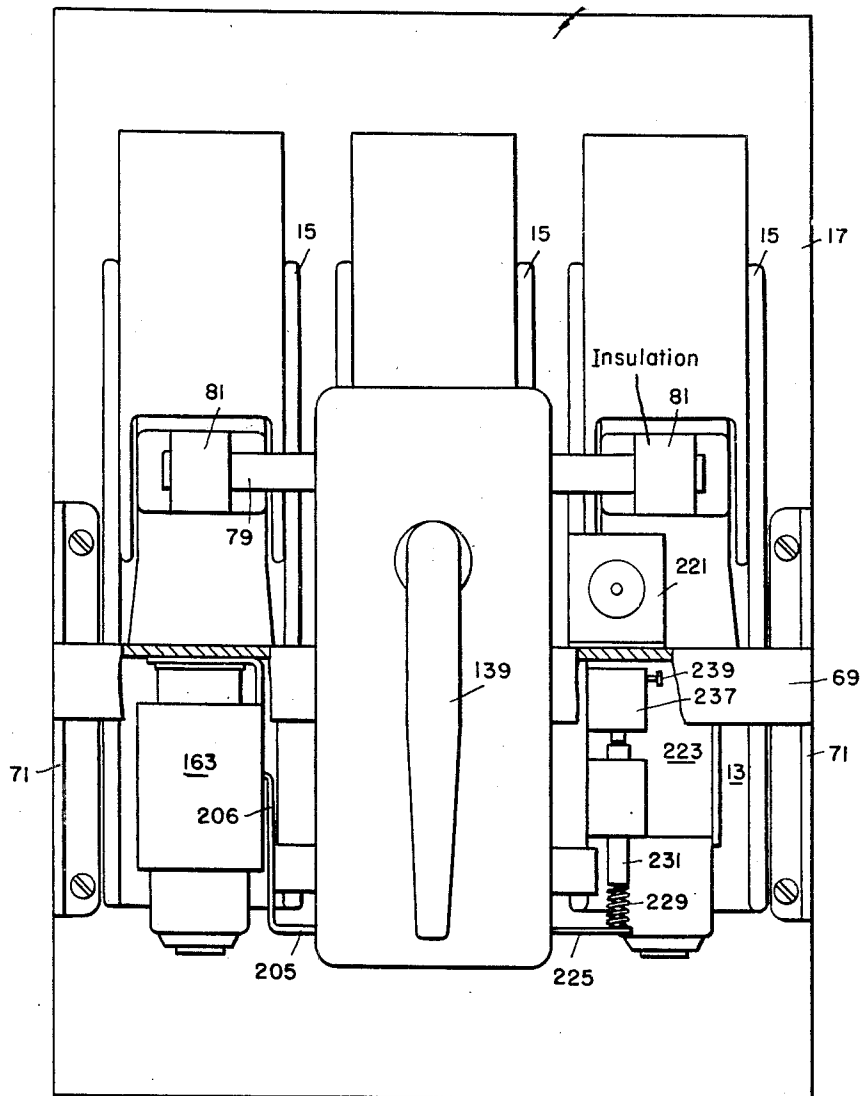
J. H. TAYLOR
CIRCUIT BREAKER

2,780,694

Filed Oct. 30, 1953

3 Sheets-Sheet 1

Fig.1.



WITNESSES:

E. A. M'Cluskey.
Paul Garlin

INVENTOR

John H. Taylor.

BY

BY Ralph W. Swingle
ATTORNEY

Feb. 5, 1957

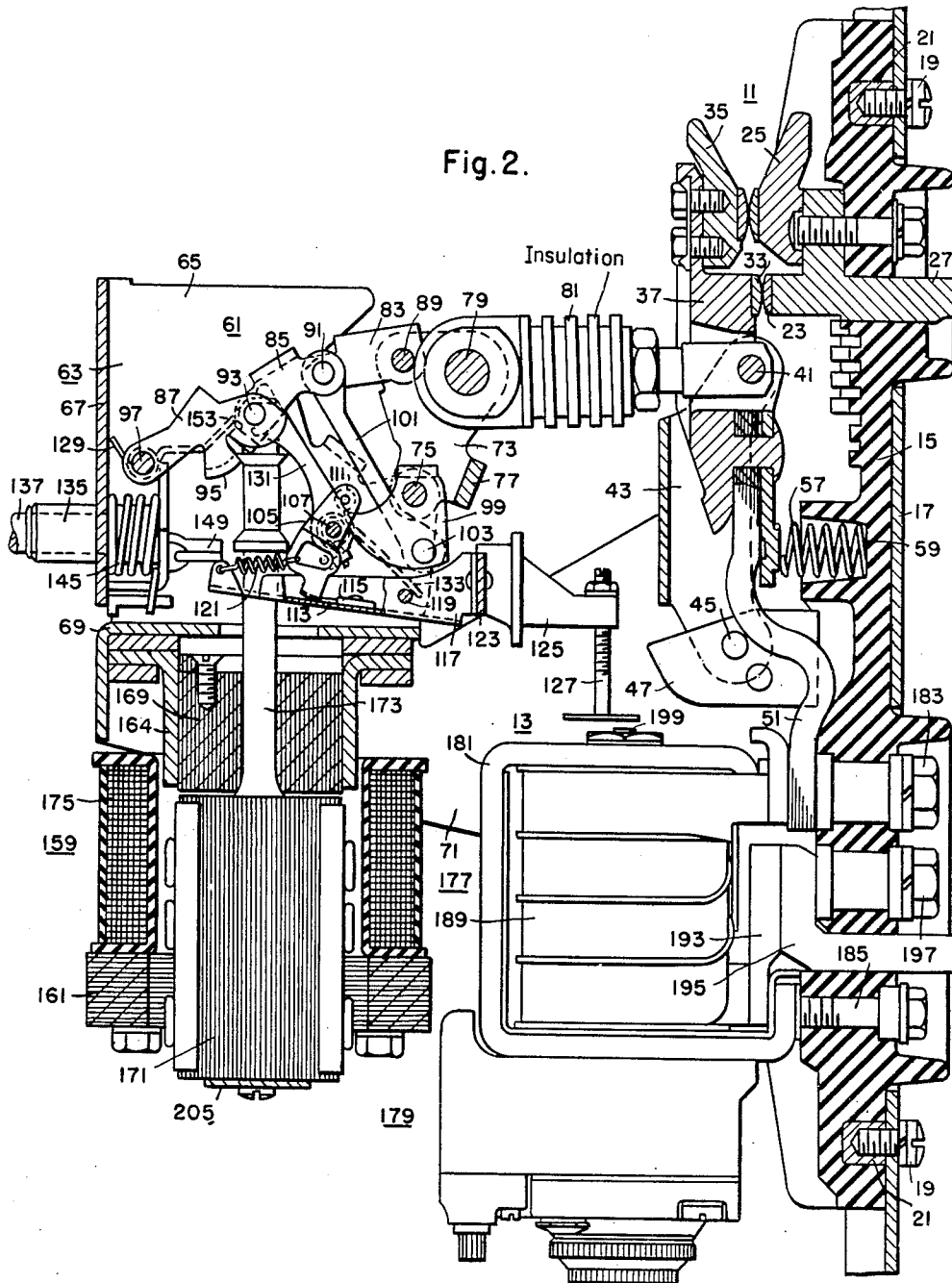
J. H. TAYLOR
CIRCUIT BREAKER

2,780,694

Filed Oct. 30, 1953

3 Sheets-Sheet 2

Fig.2.



WITNESSES:

E. A. M. C. Key.
Paul Taylor.

INVENTOR

John H. Taylor.

BY

BY
Ralph W. Sumigla
ATTORNEY

Feb. 5, 1957

J. H. TAYLOR
CIRCUIT BREAKER

2,780,694

Filed Oct. 30, 1953

3 Sheets-Sheet 3

Fig. 3.

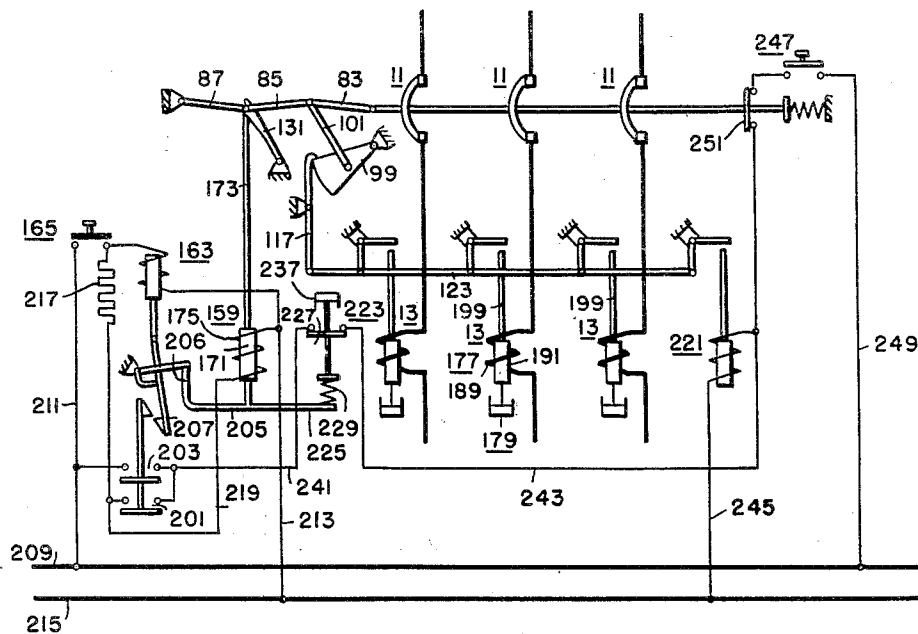
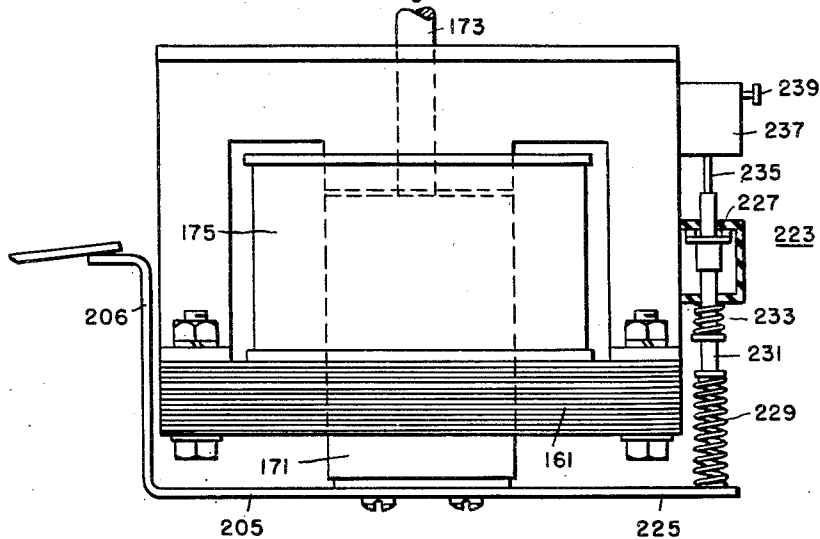


Fig. 4.



WITNESSES:

E. A. M. C. C. C.
R. H. C. C. C.

INVENTOR

John H. Taylor.

BY

Ralph W. Summigh
ATTORNEY

1

2,780,694

CIRCUIT BREAKER

John H. Taylor, Pittsburgh, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application October 30, 1953, Serial No. 389,315

8 Claims. (Cl. 200—98)

This invention relates to circuit breakers and more particularly to circuit breakers of the type used for controlling light to moderate power distribution circuits.

In certain circuit breaker applications, for instance, where a circuit breaker is to be applied in a selective tripping system as a source breaker or as a bus tie or group feeder breaker, the breaker is equipped with an overcurrent trip device which trips the breaker with a time delay on all values of overload currents up to the interrupting capacity of the breaker. With the breaker latched in the closed position, the breaker will carry such excessive overload currents for some time without damage to the breaker and will then interrupt the circuit.

If an attempt is made to close the breaker against a fault current on the line the breaker would likely be severely damaged. The reason for this is that the large magnetic forces which tend to blow the contacts apart are greater than the force applied by the closing mechanism to close the contacts. Merely providing greater closing force does not solve the problem because the greater closing force would, when closing the breaker with a normal current on the line, cause damage to the breaker.

An object of the invention is to provide a circuit breaker having a trip device embodying time delay tripping means and means for tripping the breaker instantaneously only when the breaker is closed with a fault on the line.

Another object of the invention is to provide a circuit breaker embodying time delay and instantaneous tripping means with means for rendering the instantaneous tripping means effective only during a closing operation.

Another object of the invention is to provide a circuit breaker having a normally ineffective instantaneous trip means with means for rendering the instantaneous trip means effective only during a closing operation of the breaker.

The invention, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description thereof when read in conjunction with the accompanying drawings.

In said drawings:

Fig. 1 is a front elevational view of the circuit breaker.

Fig. 2 is an elevational view partly in section of a circuit breaker embodying the principles of the invention, the circuit breaker being shown in the closed contact position.

Fig. 3 is a schematic view of the circuit breaker and the control circuit therefor.

Fig. 4 is an enlarged front elevational view of the closing solenoid.

The invention is illustrated as applied to a circuit breaker of the type fully disclosed in copending application Serial No. 141,136, filed January 28, 1950, by John B. MacNeill, Fritz E. Florschütz, Ture Lindstrom and

2

Bernard G. Tremblay now Patent No. 2,669,623, issued February 16, 1954, and assigned to the assignee of this application.

Referring to Fig. 2 of the drawings, the circuit breaker includes a plurality of pole units each comprising a contact structure indicated generally at 11, and an overcurrent trip device indicated generally at 13. The contact structure and the trip device for each pole unit are mounted on a separate insulating base 15 which is rigidly secured to a metal panel 17. Since the pole units are alike, only the center pole unit is illustrated and described.

The insulating base 15 for the center pole unit is secured to the panel 17 by means of screws 19 threadedly engaging metal inserts 21 molded integral with the insulating base 15.

The contact structure 11 comprises a stationary main contact 23 and a stationary arcing contact 25, both of which are secured on the inner end of a terminal conductor 27 which extends through suitable openings in the insulating base 15 and in the metal panel 17.

Cooperating with the stationary main and arcing contacts 23 and 25, respectively, is a movable main contact 33 and a movable arcing contact 35. The movable main contact 33 is mounted on a pivoted contact carrying member 37 and the movable arcing contact 35 is suitably mounted on the contact carrying member 37.

The contact carrying member 37 is pivotally mounted by means of a pivot pin 41 on the upper or free end of a generally channel-shaped switch arm 43 having its two sides pivoted by means of separate pivot pins 45 on spaced brackets 47 mounted on the base 15.

The contact carrying member 37 is electrically connected by means of a flexible conductor 51 to the energizing coil of the trip device 13 to be later described. A spring 57 compressed between the lower end of the contact carrying member 37 and a spring seat 59 in the insulating base 15 provides contact pressure in the closed position of the breaker and also biases the contact structure in opening direction.

The movable contact structure is normally maintained in the closed position by an operating mechanism indicated generally at 61 (Fig. 2) mounted in a U-shaped frame 63. The frame 63 comprises spaced side members 65 (only one being shown) and a connecting cross member 67. The frame 65 is supported on a platform 69 which forms the cross member of a main bracket comprising a pair of spaced side members 71 (Figs. 1 and 2) joined at their outer ends by the cross member or platform 69. The platform extends across the width of the breaker and the side members 71 are rigidly secured to the metal panel 17 on the outsides of the two outer pole units.

The operating mechanism includes a lever 73 pivotally mounted on a pivot pin 75 supported in the side member 65 of the frame 63. The lever 73 comprises a pair of spaced levers joined by a cross member 77 and between them support a rod 79 which extends across all three poles of the breaker. The rod 79 is operatively connected by means of an insulating connecting member 81 to the pivot pin 41 in the free end of the switch member 43 on which the movable contact member 37 is mounted. There is a connecting member 81 for each pole of the breaker connecting the rod 79 to the moving contact structure for each pole unit so that upon operation of the rod 79 the movable contact structure for all three poles move in unison.

An operating linkage comprising toggle links 83, 85 and 87 is provided to hold the lever 73 and consequently the movable contacts in the closed position and to oper-

3

ate the movable contacts to open and closed positions. The toggle link 83 is pivotally connected to the lever 73 by a pivot pin 89 and the toggle link 85 is connected by a knee pivot pin 91 to the toggle link 83 and by a knee pivot pin 93 to the toggle link 87. The toggle link 87 is pivotally mounted on a fixed pivot 97 in the frame 63 and has a cam member 95 thereon.

The linkage 83, 85, 87 comprises two toggles one of which 83, 85 functions as a tripping toggle and the other 85, 87 as a closing toggle. The tripping toggle 83, 85 is normally slightly underset above a line drawn through the pivot pins 89, 93 and the closing toggle 85, 87 is normally underset below a line drawn through the pivots 91, 97, the closing toggle 85, 87 being shown in Fig. 1 in the position it assumes during a closing operation just as the arcing contacts 35, 25 touch.

The tripping toggle 83, 85 is normally biased in a direction to cause its collapse by a component of the spring 57 which bias the movable contact structures for the several poles of the breaker in opening direction and bias the connecting members 81 toward the left (Fig. 2). The tripping toggle 83, 85 is normally prevented from collapsing by means of a main latch member 99 pivoted on the pivot pin 75 and connected by a link 101 to the knee pin 91 of the tripping toggle, the link 101 being connected to the latch member 99 by a pivot pin 103.

The main latch 99 is held in latching position by an intermediate latch lever 105 pivoted on a pin 107 supported in the frame 63. The latch lever 105 carries a latch roller 111 which normally engages the main latch 99 to releasably restrain the latter in holding position. The latch lever 105 at its lower end carries a latch member 113 engaging a light-load latch 115 mounted on a channel-shaped member 117 pivotally mounted on a pin 119 supported in the frame 63. The latch lever 105 and the member 117 are biased to their latching positions by a spring 121 tensioned between the parts as shown in Fig. 2. Rigidly mounted on the right hand end of the channel-shaped member 117 is a trip bar 123 which extends across all of the poles of the breaker and has secured thereto an insulating bracket 125 for each pole of the breaker. Each of the brackets 125 has a headed screw 127 adjustably mounted therein for cooperating with the trip device 13 for the corresponding pole unit in a manner to be later described.

As long as the main latch 99 is held in latching position by the latching mechanism just described, the tripping toggle 83, 85 will, through the link 101, be held in the position shown in which the breaker contacts are held in the closed position. The closing toggle 85—87 is normally biased in a direction to cause its collapse by a spring 129 but is normally prevented from collapsing by a shouldered support member 131 pivoted on the pin 107 and biased by a spring 133 into supporting engagement with the knee pin 93 of the closing toggle.

Rigidly secured to the front plate or cross member 67 of the frame 63 is a bearing member 135 in which is rotatably mounted a handle shaft 137 to the outer end of which is secured an operating handle 139 (Fig. 1). Secured to the inner end of the shaft 137 is a cam member 149 which has the dual function of engaging the free end of the channel-shaped member 117 to manually trip the breaker upon movement of the handle 139 (Fig. 1) in one direction and of engaging the cam 95 on the closing toggle 85, 87 to manually close the breaker upon movement of the handle 139 in the opposite direction. The cam member 149 and the handle are biased in both directions to a central position in a well known manner by means of a spring 145.

Assuming the circuit breaker to be in the closed and latch position with the support member 131 supporting the closing toggle 85, 87 in its extended thrust transmitting position, the breaker is tripped open by manually rotating the handle shaft in the proper direction. During this

4

movement the cam member 149 engages and actuates the channel-shaped member 117 to disengage the latch member 115 from the latch 113 whereupon the force exerted by the springs 57 biasing the switch arms 43 in opening direction and transmitted through the connecting members 81, the rod 79 and the lever 73, causes the tripping toggle 83, 85 to collapse upwardly and effects opening movement of the movable contacts for all of the poles of the breaker.

The closing toggle 85, 87 does not immediately collapse following release of the latch mechanism since it is held by the support 131. During the collapsing movement of the tripping toggle 83, 85 the toggle link 85 rotates counterclockwise about the pivot pin 93 causing an ear 153 formed on the link 85 to engage and move the support member 131 to disengage the shoulder thereon from beneath the pin 93 whereupon the toggle 85, 87 collapses downwardly under the bias of the spring 129 and the weight of the moving armature of a closing solenoid, which will be described later. Collapse of the closing toggle 85, 87 causes resetting of the tripping toggle 83, 85 to thrust transmitting positions and resetting of the latching mechanism to latching positions. The mechanism is now in condition for a closing operation.

The contacts are closed either manually by operation of the shaft 137 by the handle or from a remote point by operation of a closing solenoid indicated generally at 159. In order to close the contacts manually, the shaft 137 is rotated in the direction opposite to the direction it is rotated to manually trip the breaker. This operation of the shaft 137 engages the cam member 149 with the cam 95 on the closing toggle link 87 and straightens the closing toggle 85, 87. Since, at this time, the knee of the tripping toggle 83, 85 is restrained by the latching mechanism, the thrust of straightening the closing toggle 85, 87 is transmitted through the tripping toggle to rotate the lever 73 in a clockwise direction to close the contacts. As the knee pin 93 of the closing toggle 85, 87 arrives at the fully closed position the support 131 is moved by the spring 133 into supporting engagement with the knee pin 93 to maintain the contacts closed.

The circuit breaker is closed automatically by energization of the closing solenoid 159 which is effected either manually or automatically by means of a closing relay 163 (Fig. 3) which is energized by closing a suitable switch 165. The solenoid 159 comprises a fixed magnet yoke 161 and a fixed core member 169 supported on brackets 164 secured to the underside of the platform 69. A movable armature 171 is attached to the lower end of an operating rod 173 which extends upwardly and has its upper end pivotally connected to the knee pivot pin 93 of the closing toggle 85, 87. An energizing coil 175 wound on an insulating spool is supported on the fixed magnet yoke 161.

In the closed position of the breaker the armature 171 is held in its raised position in which it is shown in Fig. 2. When the breaker is tripped open the closing toggle 85, 87 collapses permitting the armature 171 to assume its lower or unattracted position. Thereafter, upon energization of the coil 175, the armature 171 is attracted upward straightening the closing toggle 85—87 and closing the breaker contacts.

Referring to Fig. 3 of the drawing which schematically illustrates the circuit breaker and the control circuit in the closed condition of the breaker, the relay 163 controls contacts 201 and 203, however, when the breaker closing solenoid 159 functions to close the breaker a member 205 (Figs. 1, 3 and 4) mounted on the moving armature 171 of the closing solenoid 159 unlatches the contacts 201 and 203 from the relay 163 thus permitting the contacts to open and deenergize the closing solenoid even if the manual switch 165 is held closed.

When the closing toggle 85—87 collapses during an opening operation the moving armature 171 of the closing solenoid drops down to its unattracted position the mem-

5

ber 205 is moved downward permitting engagement of a latch device 207 (Fig. 3) which releasably connects the relay contacts 201 and 203 to the relay 163. With the breaker in the open position closure of the switch 165 effects energization of the relay 163 over a circuit extending from one side 209 of a control circuit over a wire 211, the switch 165, coil of the relay 163 and a wire 213 to the other side 215 of the control circuit.

When it is energized the relay 163 closes the contacts 201 and 203 sealing itself in over the wire 211, contacts 203 and 201, a resistance 217, coil of relay 163 and wire 213. Closing the contacts 201 and 203 also energizes the coil 175 of the closing solenoid 159 over wire 211, contacts 203 and 201, wire 219, coil 175 of the closing solenoid and wire 213. As set forth previously, the closing solenoid 159, when energized, thrusts upwardly on the closing toggle 85—87 straightening this toggle and closing the breaker contacts.

Near the end of the closing stroke of the solenoid 159 a portion 206 of the member 205 engages and actuates the latching device 207 and unlatches the contacts 201 and 203 from the relay 163. The contacts 201 and 203 are immediately moved to their open position by spring means (not shown) effecting deenergization of the closing solenoid 159 and opening the holding circuit for the relay 163.

The circuit breaker is automatically tripped open after a time delay by operation of the trip device 13 for any pole of the breaker. The trip device may be of any suitable type preferably of the type fully disclosed and claimed in the aforementioned Patent No. 2,669,623 which is arranged to trip the breaker with a relatively long time delay and a relatively short time delay in response to overload currents of different values below a predetermined value.

The trip device 13 comprises generally a tripping electromagnet 177 (Figs. 2 and 3) and a time delay device 179. The tripping electromagnet 177 comprises a magnet yoke 181 secured to the base by means of bolts 183 and 185 (Fig. 2). The bolt 183 which secures the upper end of the magnet yoke 181 to the base also serves to secure the lower end of the flexible conductor 51 to the upper turn of the winding 189. The lower turn of the winding 189 has a conducting lug 193 secured thereto and the lug 193 is secured to a conducting terminal 195 by means of a bolt 197 which also secures these elements to the base 15. The energizing winding 189 is thus electrically connected in series relation in the circuit through the breaker. Upon energization of the tripping electromagnet the movable armature 191 (Fig. 3) thereof is attracted upwardly and actuates a trip rod 199 which engages the headed screw 127 and operates the trip bar 123 to trip the breaker.

The time delay device 179 is of the fluid dashpot type and is provided with means for admitting fluid to the dashpot at different rates to provide long and short time delays in the operation of the trip device in response to overload currents of different magnitude below a predetermined value of, for instance, ten times normal rated current.

Means is provided for tripping the breaker open instantaneously only during a closing operation when the breaker closes in against an excessive overload current of ten times normal rated current or, a short circuit current. This means comprises a shunt trip device 221 (Figs. 1 and 3) which is normally used to manually trip the breaker from a remote point, and a time delay switch indicated generally at 223 (Figs. 1, 3 and 4). The switch 223 (Fig. 4) is mounted on the frame of the closing solenoid and is actuated to the closed position by an expansion 225 of the member 205 on the moving armature 171 of the closing solenoid 159. The contacts 227 of the switch 223 are operated to the closed position by means of a spring 229 disposed between the extensions 225 and a switch operating rod 231. In the closed position of the

6

breaker the armature 171 of the closing solenoid is held in the upper position with the spring 229, which at this time is compressed, holding the contacts 227 closed against the bias of a light spring 233 biasing the contacts 227 open.

The upper end of the switch operating rod 231 engages a rod 235 for operating a time delay device 237 that is also mounted on the frame of the closing solenoid. Adjusting means 239 (Fig. 4) is provided for adjusting the amount of time delay provided in the closing of the switch 223.

The time delay switch 223 controls a circuit for energizing the shunt trip device 221 during a closing operation of the breaker, the circuit extending from the one side 209 of the control circuit over wire 211, contacts 203 of relay 163, a wire 241, contacts 227 of the time delay switch, a wire 243, coil of the shunt trip device 221 and a wire 245 to the other side 215 of the control circuit. While the contacts 227 of the time delay switch 223 are closed in the closed position of the breaker, the circuit just described for energizing the shunt trip device 221 is open at the contacts 203 of the closing relay 163. When the breaker is tripped open and the closing toggle 85—87 collapses the armature 171 of the closing solenoid drops to its lower or unattracted position. In addition to effecting relatching of the contacts 201 and 203 to the closing relay 163, this movement of the armature 171 reduces the compression of the spring 229 to the point where it permits the contacts 227 of the time delay switch 223 to open and also permits resetting of the time delay device 237.

With the breaker in the open position, closing the manual switch 163 effects energization of the closing relay 163 which closes the contacts 201 and 203 energizing the closing solenoid 159 over the circuit previously described. During approximately the first half of the closing stroke of the armature 171 the spring 229 is compressed to the point where it starts the contacts 227 in closing operation, the closing movement of the contacts then being retarded by the time delay device 237. The time delay device 237 is adjusted by means of the adjustment 239 to permit the contacts 227 of the switch 223 to close approximately two alternating current cycles after the breaker is fully closed and latched and also after the contacts 201 and 203 have opened. If the breaker closes in with normal current on the line it will close in and latch up and the contacts 201 and 203 will open before the contacts 227 close. However, if the breaker closes in against a fault or short circuit current on the line the magnetic effect which tends to blow the main breaker contacts open will stall or at least slow down the closing movement of the armature 171 of the closing solenoid sufficiently to permit the spring 229 to close the contacts 227 before the contacts 201 and 203 are tripped free of the closing relay and opened. In this situation the shunt trip magnet 221 will be energized over the contact 203 and 227 and the previously described circuit and instantaneously trip the breaker free of the closing solenoid.

The shunt trip device 221 is utilized to trip the breaker open from a remote point. In order to energize the shunt trip and trip the breaker there is provided a manual switch 247 (Fig. 3) which, when closed, effects energization of the shunt trip over a circuit extending from the side 209 of the control circuit, a wire 249, auxiliary contacts 251 closed when the breaker is closed, the coil of the shunt trip and wire 245 to the other side of the control circuit.

The invention provides a circuit breaker embodying a trip device which trips the breaker with a time delay at all times except during a closing operation and which trips the breaker instantaneously during a closing operation and then only if the breaker is closed with a fault current or short circuit current on the line.

Having disclosed the invention in accordance with the provisions of the patent statutes, it is to be understood that various changes and modifications may be made in

the structural details thereof without departing from some of the essential features of the invention.

I claim as my invention:

1. In a circuit breaker having relatively movable contacts and operating means therefor, a movable member movable to effect automatic opening of said contacts, a first tripping magnet responsive to overload currents for moving said movable member, a time delay device operatively related to said tripping magnet for effecting a time delay in the operation of said movable member, a second tripping magnet operative when energized to instantaneously move said movable member, a closing magnet, a switch operated by said closing magnet for effecting energization of said second tripping magnet, a relay for effecting energization of said closing magnet, contacts operated by said relay only during a closing operation for effecting energization of said second tripping magnet, and time delay means arranged to delay energization of said second tripping magnet for a predetermined time following energization of said closing magnet.

2. In a circuit breaker having relatively movable contacts, power operated means for closing said contacts, a first trip device comprising tripping magnet responsive to overload currents for effecting automatic opening of said contacts, a time delay device operatively related to said first trip device for effecting a time delay in the operation of said first trip device, a second trip device comprising a tripping magnet operative when energized to effect instantaneous opening of said contacts, switch means operable only during a closing operation for effecting energization of said second tripping magnet, stored energy means for actuating said switch means, means operated by said power operated means for storing energy in said stored energy means, and time delay means operatively related to said switch means for delaying operation of said switch means and energization of said second tripping magnet until a predetermined time in the closing operation of said power operated means.

3. In a circuit breaker having relatively movable contacts, power operated means for closing said contacts, trip means comprising a first trip device comprising tripping magnet responsive to overload currents for effecting automatic opening of said contacts, a time delay device operatively related to said trip device to effect a time delay in the operation of said first trip device, a second trip device comprising a tripping magnet operative when energized to effect instantaneous opening of said contacts, a relay for effecting energization of said power operated means and for preparing a circuit for energizing said second tripping magnet, switch means for effecting energization of said second tripping magnet, stored energy means for actuating said switch means, means operated by said power operated means for storing energy in said stored energy means, and time delay means arranged to delay operation of said switch means and energization of said second tripping magnet until a predetermined time in the closing operation of said power operated means.

4. In a circuit breaker having relatively movable contacts, power operated means for closing said contacts, a trip member movable to effect automatic opening of said contacts, a first trip device comprising tripping magnet responsive to overload currents for actuating said trip member, a time delay device operatively related to said trip device for effecting a time delay in the operation of said first trip device, means controlling said time delay device to provide long and short time delays in the operation of said first trip device, a second trip device comprising a tripping magnet operative when energized to effect instantaneous opening of said contacts, switch means for effecting energization of said second tripping magnet, stored energy means for actuating said switch means, means operated by said power operated means for storing energy in said stored energy means, and time delay means arranged to delay opera-

tion of said switch means and energization of said second tripping magnet until a predetermined time in the closing operation of said power operated means.

5. In a circuit breaker having relatively movable contacts and operating means therefor, a movable member movable to effect automatic opening of said contacts, trip means comprising a first tripping electromagnet operative in response to overload currents to move said movable member, time delay means operatively related to said trip means causing a time delay in the operation of said movable member by said tripping electromagnet, a second tripping electromagnet operative when energized to instantaneously move said movable member, a closing magnet, a closing relay for effecting energization of said closing magnet, contact means operated by said closing relay for effecting energization of said second tripping magnet, a switch operable to closed position by said closing magnet during a closing operation thereof for controlling the energization of said second tripping magnet, and time delay means arranged to delay closing of said switch and energization of said second tripping magnet for a predetermined time following energization of said closing magnet.

6. In a circuit breaker having relatively movable contacts, power operated means for closing said contacts, trip means comprising first trip device responsive to overload currents for effecting automatic opening of said contacts, a time delay device connected to effect a time delay in the operation of said first trip device, a second trip device comprising an electromagnet operative when energized to effect instantaneous opening of said contacts, switch means operated by said power closing means for effecting energization of said electromagnet, time delay means operatively related to said switch means for delaying closing of said switch means until after said breaker is closed when said breaker is closed under certain circuit conditions, and the electromagnetic forces produced when the breaker is closed under certain other conditions retarding the closing operation of said power operated means sufficiently to permit said switch means to close and effect energization of said second trip device.

7. In a circuit breaker having relatively movable contacts, power operated means for closing said contacts, trip means comprising a trip device responsive to overload currents for effecting automatic opening of said contacts, time delay means for providing a time delay in the operation of said trip device, a tripping electromagnet operative when energized to effect instantaneous opening of said contacts, switch means operated by said power operated means during a closing operation for effecting energization of said tripping electromagnet, time delay means arranged to delay operation of said switch means until a predetermined time in the closing operation, and means responsive to excessive overload currents for retarding the closing movement of said power operated means sufficiently to permit said switch means to operate and effect energization of said tripping electromagnet.

8. In a circuit breaker having relatively movable contacts, electromagnetic closing means for closing said contacts, trip means comprising a trip device responsive to overload currents for effecting automatic opening of said contacts, time delay means disposed and arranged to effect a time delay in the operation of said trip device, a tripping electromagnet operative when energized to effect instantaneous opening of said contacts, a closing relay for effecting energization of said closing electromagnet, a circuit connection controlled by said closing relay for energizing said tripping electromagnet, switch means controlling the circuit connection for said tripping electromagnet, resilient means operated by said closing electromagnet operating said switch means, time delay means arranged to delay operation of said switch means until a predetermined time near the end of the

closing operation of said closing electromagnet, and the electromagnetic force produced when said contacts are closed against an excessive fault current retarding the closing operation of said closing electromagnet sufficiently to permit said resilient means to operate said switch means and effect energization of said tripping electromagnet.

5

References Cited in the file of this patent

UNITED STATES PATENTS

1,292,651	Rippl	Jan. 28, 1919
2,274,350	Thumim	Feb. 24, 1942
2,669,623	MacNeill et al.	Feb. 16, 1954