May 17, 1949. G. J. EASLEY ET AL 2,470,608

CIRCUIT BREAKER

Filed July 18, 1944 2 Sheets-Sheet 1

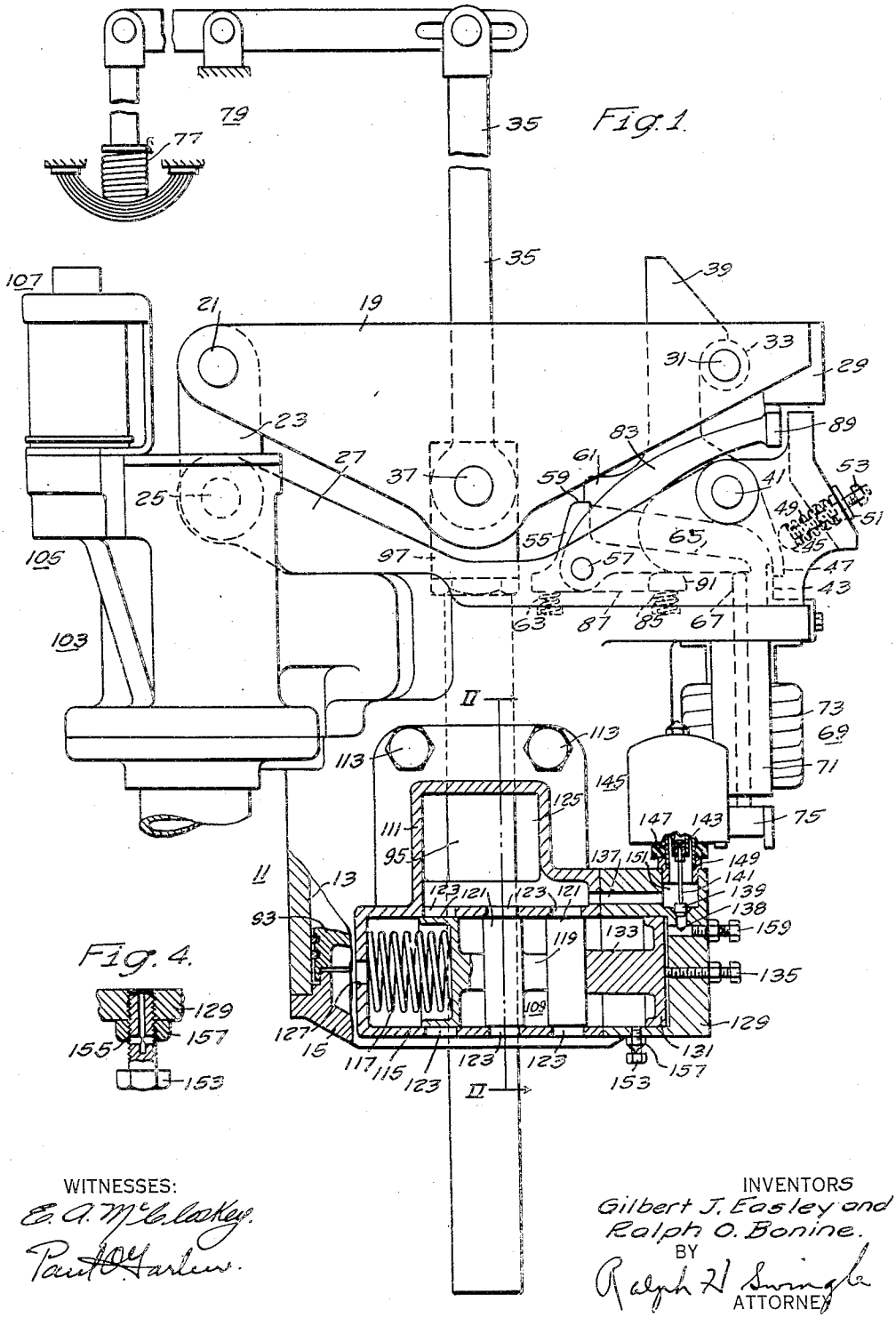


Fig. 1.

Fig. 4.

WITNESSES:
E. A. McCloskey.
Paul O. Harlow.

INVENTORS
Gilbert J. Easley and
Ralph O. Bonine.
BY
Ralph L. Swingle
ATTORNEY

May 17, 1949. G. J. EASLEY ET AL 2,470,608

CIRCUIT BREAKER

Filed July 18, 1944 2 Sheets-Sheet 2

Fig. 2.

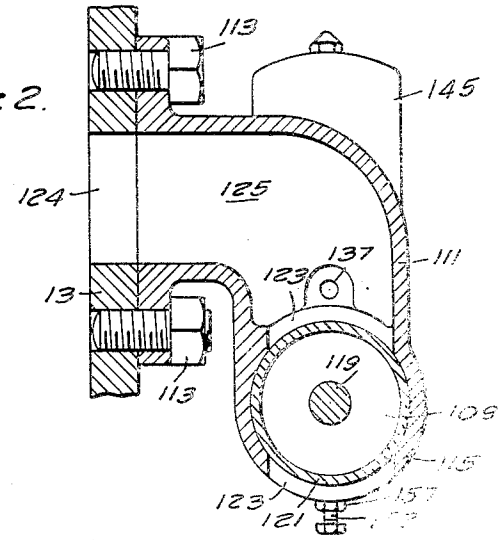
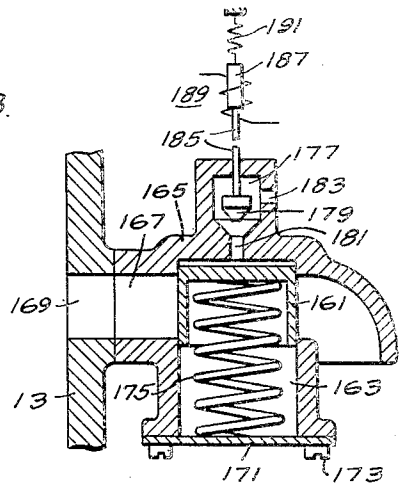


Fig. 3.



WITNESSES:
E. A. McCloskey.
Paul H. Harlow.

INVENTORS
Gilbert J. Easley and
Ralph O. Fonine.
BY
Ralph W. Swingle
ATTORNEY

Patented May 17, 1949 2,470,608

UNITED STATES PATENT OFFICE

2,470,608

CIRCUIT BREAKER

Gilbert J. Easley, Forest Hills, and Ralph O. Bonine, Edgewood, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application July 18, 1944, Serial No. 545,438

15 Claims. (Cl. 200—82)

1

This invention relates to circuit breakers, and more particularly to circuit-breaker operating mechanisms of the fluid-pressure type.

An object of the invention is to provide a circuit-breaker operating mechanism of the fluid-pressure operated type having an improved exhaust valve for quickly exhausting the fluid pressure from the working side of the piston.

Another object of the invention is to provide a circuit-breaker operating mechanism of the type operated by fluid pressure with an improved high-speed valve for quickly exhausting the working-fluid pressure.

Another object of the invention is to provide a fluid motor with an improved high-speed valve for quickly exhausting the working pressure from the motor wherein the valve is operated by the working pressure and remains open longer to more completely exhaust the working fluid pressure.

Another object of the invention is to provide a circuit-breaker operating mechanism of the type operated by fluid pressure with an improved exhaust valve for quickly exhausting the working pressure wherein the valve is operated by the working pressure admitted to a separate chamber for maintaining said valve open to more completely reduce the working pressure.

Another object of the invention is to provide a circuit-breaker operating mechanism of the type operated by fluid pressure with an improved exhaust valve for quickly reducing the operating pressure in the mechanism in which opening movement of the exhaust valve is initiated by a piston, the valve being moved to full open position by fluid pressure, the piston being effective to hold the valve open after the pressure has been reduced below the value at which the valve would ordinarily close.

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 best be understood from the following detailed description of several embodiments thereof when read in connection with the accompanying drawings, in which:

Figure 1 is an elevational view partly in section of a circuit-breaker operating mechanism embodying the principles of the invention;

Fig. 2 is a vertical sectional view taken on line II—II of Fig. 1;

Fig. 3 is a vertical sectional view of a modification of the invention; and

Fig. 4 is a detail sectional view of one of the adjustable bleeder valves.

Referring to the drawing, the operating mechanism includes a main casting 11 which is formed to provide a cylinder 13 closed at the upper end by an integral part of the casting. The lower end of the cylinder 13 is closed by means of a

2

member 15. An operating lever 19 is pivotally mounted at one end on the casting 11 and consists of a pair of spaced parallel levers (only one being shown) pivotally connected at one end by means of a pivot pin 21 to the upper ends of a pair of parallel links 23 (only one being shown). The lower ends of the links 23 are pivoted by means of a pivot pin 25 on ears 27 (only one being shown) projecting from the main casting 11. The free ends of the operating levers 19 are rigidly connected by means of a cross member 29 and carry a short shaft 31 therebetween, on which is mounted a latch roller 33 disposed between the levers 19.

The circuit breaker shown schematically at 79 is biased to open circuit position by means of an accelerating spring 77 and is connected to the operating mechanism by means of an operating rod 35. The breaker operating rod 35 is pivotally connected by a pivot pin 37 to the operating lever 19.

In order to hold the breaker closed, the operating lever 19 is held in the closed position by means of a high speed latching mechanism including a main latch 39 pivotally supported on the main casting 11 by means of a pivot pin 41. The latch 39 is disposed between the levers 19 and is adapted to engage the roller 33 carried by the free ends of the breaker operating levers 19 to restrain the operating mechanism and the breaker in closed circuit position. The latch 39 is biased to latching position against a stop 43 by means of a spring pressed plunger 45 which engages a projection 47 of the latch. The plunger 45 is slidably mounted in an opening in a portion of the main casting 11 and is biased inwardly against the projection 47 of the latch 39 by means of a compression spring 49 surrounding the plunger 45 and disposed between a sleeve 51 threaded into the casting 11, and the head of the plunger. An adjustable nut 53 is provided on the outer end of the plunger 45 to limit the inward movement of the plunger.

The construction of the latch face of the main latch 39 is such that this latch, by itself, will not serve to hold the breaker operating lever 19 in latching position. An auxiliary latch 55 is provided for engaging and holding the main latch 39 in latching position. The auxiliary latch 55 is pivotally mounted on the casting 11 by means of a pivot pin 57 and has a latch projection 59 which engages under a tail portion 61 of the main latch 39 in the latching position of the latching mechanism. The auxiliary latch 55 is biased to latching position by means of a compression spring 63 seated in a recess in the casting and engaging a projection of the latch 55. The auxiliary latch 55 is also provided with a projection 65 which extends directly over the upper end of a trip plunger 67 of an electromagnetic trip device 69. In addition to the trip plunger 67, the trip device com-

prises an E-shaped core 71 of magnetic material, an energizing coil 73 mounted on the center leg of the core 71, and a movable armature 75. The trip plunger 67 is secured to the center portion of the armature 75 and extends upwardly through a guide opening in the center portion of the core 71 and through an opening in the horizontal portion of the main casting 11.

When the trip device 69 is energized, the armature 75 is moved upwardly against the core 71 causing upward movement of the trip plunger 67. The upward movement of the trip plunger rotates the auxiliary latch 55 counterclockwise and disengages the projection 61 of the main latch 39, whereupon the accelerating spring 77 of the circuit breaker, shown schematically at 79, moves the breaker to the open circuit position, the operating lever 19 being rotated counterclockwise about its pivot 21 by the opening movement of the breaker. During the early part of the opening movement of the operating lever 19, the roller 33 forces the main latch 39 in a counterclockwise direction as it clears the latch. As soon as the roller 33 clears the main latch 19, the spring 49 acts to return the latch 39 to latching position.

Means is provided to prevent the restoration of the auxiliary latch 55 to its latching position until the operating lever 19 is returned to closed position. This means comprising a U-shaped holding lever 83, the legs of which are pivotally mounted on the pivot pin 57 on opposite sides of the auxiliary latch 55. The holding lever 83 is biased in a counterclockwise direction by a spring 85 compressed between a spring seat in the casting 11 and a projection 87 of the holding lever. The cross member 89 of the holding lever 83 is disposed directly beneath the free end of the operating lever 19 and thus is held in inoperative position when the operating lever is in closed position. When the operating lever is released and moves toward open position, the holding lever 83 is rotated counterclockwise at which time a lateral extension 91 of the holding lever 83 engages and holds the auxiliary latch 55 in unlatched position until the breaker operating arm 19 is returned to closed position and the roller 33 is reengaged by the latch face of the main latch 39. For this purpose, the biasing spring 85 of the holding lever 83 is of greater strength than the auxiliary latch biasing spring 63.

The breaker is adapted to be closed by compressed gas admitted to the cylinder 13 above an operating piston 93. The piston 93 is secured to a piston rod 95 slidable through an air-tight opening in the top wall of the cylinder 11. A connector 97 is threadedly connected to the piston rod 95 and pivotally connected to the pivot pin 37 carried by the operating lever 19, thus directly connecting the piston 93 to the breaker operating rod 35.

Compressed air is admitted from an auxiliary air reservoir or tank (not shown) to the upper end of the cylinder 13 through an inlet passage controlled by a main inlet valve indicated generally at 103 secured to the side of the casting 11. The opening operation of the main inlet valve 103 is, in turn, controlled by an electromagnetically operated pilot valve 105. The main inlet valve 103 and the pilot valve 105 are fully disclosed in copending application Serial No. 410,686, filed September 13, 1941, of J. M. Cumming and R. C. Cunningham now Patent No. 2,408,199, issued September 24, 1946, and assigned to the assignee of the present invention. For this reason, a detailed disclosure of these elements is not included herein since, for a complete understanding thereof, reference may be had to the above-noted application.

The pilot valve 105 is operated by an electromagnet 107 which, when energized, causes opening of the pilot valve 105 to admit compressed air from the tank to operate the main inlet valve 103. Actuation of the inlet valve admits compressed air to the upper end of the operating cylinder 13 which drives the piston quickly downwardly to close the breaker.

When the mechanism is operated to closed position, the operating lever 19 rotates in a clockwise direction, and near the end of this clockwise travel, the roller 33 engages the inclined surface of the main latch 39. As the roller passes along this inclined surface, the latch 39 is rotated counterclockwise until the roller passes the nose of the latch whereupon the retrieving spring 49 restores the main latch 39 to latching position. As the roller 33 passes the nose of the main latch 39, the cross member 29 on the free end of the operating lever 19 engages the free end of the holding lever 83 and rotates the holding lever clockwise to its normal position permitting the spring 63 to restore the auxiliary latch 55 clockwise to latching position.

When the breaker is opened on a normal opening operation, the gas in the cylinder above the piston 93 is at atmospheric pressure, and offers little resistance to the opening movement of the piston by the spring 77. This gas is compressed slightly by the opening movement of the piston and serves to absorb the kinetic energy of the moving parts at the end of the opening stroke. When the breaker is being, or has just been, closed by the application of gas pressure above the piston 93, and there is a fault existing on the line, the trip device is actuated and the breaker mechanism reverses its direction of movement and moves toward the open position. At this time the gas in the cylinder is at or near full closing pressure and it is necessary to quickly exhaust the closing gas pressure in order to permit quick reversal of the parts and opening of the contacts to thereby prevent damage to the breaker parts and to prevent damage to translating devices operated by the current of the circuit controlled by the breaker.

An important feature of the invention is the provision of an exhaust valve mechanism in which the opening movement of the valve is initiated by fluid pressure admitted thereto by means of an electromagnetically operated pilot valve, the exhaust valve being moved to full open position by the blast of exhausting fluid pressure from the operating cylinder, and in which the exhaust valve is maintained in its open position by the initiating opening pressure after the pressure of the exhausting fluid has fallen below the point at which the valve would ordinarily close.

The exhaust valve 109 is supported for operation in a housing 111 (Figs. 1 and 2) secured by means of bolts 113 to the side of the main casting 11. The exhaust valve is disposed for sliding movement in the cylindrical lower portion 115 of the housing 111 and is biased to closed position by means of a compression spring 117. The exhaust valve 109 comprises a multiple valve member 119 slidable in the valve cylinder 115. A plurality of piston-type valves 121, formed integral with the valve member 119, cooperate with a plurality of exhaust ports 123 extending through the walls of the cylinder 115 and communicate the main operating cylinder 13 through an opening 124 (Fig.

2) in the cylinder wall and a chamber 125 in the upper part of the housing 111 to the atmosphere. The exhaust ports, however, are normally closed by the piston valves 121. The spring 117, which biases the valve member 119 and the piston valves thereon to closed position, is disposed in the left-hand end of the valve cylinder 115, one end bearing against the left-hand end of the valve member 119. The end wall of the cylinder 115 is provided with an opening 127 to prevent trapping of air between the left-hand piston valve 121 and the end wall of the cylinder.

Disposed in a cylinder 129, which forms an extension of the main exhaust valve cylinder 115 and is rigidly secured thereto, is a pilot piston 131 which has an integral stem 133 against which the separate exhaust valve member 119 bears in the closed position. The spring 117 normally biases the exhaust valve and the pilot piston 131 against an adjustable stop screw 135 disposed in the right-hand end of the extension cylinder 129. The purpose of the adjustable screw 135 is to adjust the position of the main exhaust valve. The chamber 125 communicates directly with the main operating cylinder 13 and, by means of passages 137 and 138 in the extension cylinder 129, communicates the cylinder 13 to the extension cylinder 129 at the working side of the pilot piston 131. An electromagnetically operated pilot valve 139 disposed in the passage 137 controls the admission of compressed fluid from the main operating cylinder 13 to the extension cylinder 129 to effect operation of the pilot piston 131 and opening of the exhaust valve. The valve 139 is mounted on the lower end of a rod 141, the upper end of which has a lost-motion connection with the movable armature 143 of an electromagnet 145. The electromagnet 145 is rigidly mounted on insulating member 147 which is, in turn, mounted on a sleeve 149, threadedly engaging in an opening 151 in the cylinder extension 129. In order to prevent compressed gas, which might leak past the right-hand piston valve 121 into the space between said piston valve and the pilot piston 131, from falsely opening the exhaust valve, there is provided a bleeder valve 153 (Figs. 1, 2 and 4) comprising a screw having a T-shaped opening 155 therein communicating with the space between the exhaust valve and the pilot piston 131 to the atmosphere. The bleeder valve 153 is screwed into an opening in the cylinder extension 129 and is provided with a lock nut 157 for locking the bleeder valve in the adjusted position. A second bleeder valve 159 of similar construction is disposed in the end of the cylinder extension 129 and serves to connect the passage 138 and the space to the right of the pilot piston 131 to the atmosphere. Both of the bleeder valves 153 and 159 are adjustable to vary the rate at which the fluid pressure escapes therethrough.

Assuming that the breaker is in the open position with the piston 93 (Fig. 1) in the upper end of the operating cylinder 13 and that the inlet valve 103 has functioned to admit fluid pressure to the cylinder above the piston 93, the operation of the exhaust valve mechanism is described as follows:

As the piston 93 in its downward or closing movement passes the exhaust port or opening 124, the closing fluid pressure expands into the chamber 125, but since the exhaust valve 109 and the pilot valve 139 are closed at this time, the closing pressure in the operating cylinder is maintained. Just before the piston 93 and the breaker operating mechanism reach the end of the closing movement, the breaker contacts touch, and, if at this time, an overload exists on the circuit controlled by the breaker, the trip device 69 will function to release the latch mechanism and permit the accelerating spring 77 to quickly reverse the direction of movement of the mechanism and operate the breaker contacts to open position. At this time, however, the full closing fluid pressure is in the cylinder and, in order to obtain high speed reversal of the mechanism, it is necessary to dump the closing fluid pressure to atmosphere with the highest possible speed. Simultaneously with the energization of the trip device 69, the electromagnet 145 is energized and opens the pilot valve 139 whereupon the closing fluid pressure in the cylinder 13 is admitted through the passages 137—138 to the cylinder 129 to the right of the pilot piston 131 which is immediately moved toward the left, moving the exhaust valve 109 therewith and opening the exhaust ports 123. As soon as the piston type valves 121 are cracked open, the rush of compressed fluid through the ports 123 blasts the exhaust valve 109 to full open position independently of pilot piston 131. At the same time, the fluid pressure built up in the working end of the cylinder 129 back of the pilot piston 131 moves this piston to the left. When the pressure in the main operating cylinder is reduced to a given value, the spring 117 acts to close the exhaust valve, but since the fluid pressure trapped back of the piston 131 exhausts slowly to the atmosphere through the bleeder valve 159, the pilot piston is held far enough to the left to maintain the exhaust valve open for a predetermined time after the closing pressure in the cylinder 13 has fallen below a given value, thus more completely venting the operating cylinder. As soon as the trapped fluid pressure is exhausted from the cylinder 129, the spring 117 closes the exhaust valve 109 and restores the pilot piston to its normal position in the end of the cylinder 129.

According to the modification of the invention illustrated in Fig. 3, advantage is taken of the leakage of fluid pressure around the exhaust valve to initiate opening movement of the exhaust valve. Referring to Fig. 3, the single piston type exhaust valve 161 is mounted for vertical movement in cylinder 163 formed in a housing 165. The housing 165 is suitably secured to the wall of the operating cylinder 13 (shown completely in Fig. 1) and is provided with an exhaust passage 167 in alignment with an exhaust port 169 in the wall of the operating cylinder. The lower end of the exhaust valve cylinder 163 is closed by means of a plate 171 attached thereto by means of screws 173. The plate serves to support a spring 175 which biases the exhaust valve 161 to closed position. Disposed in a chamber 177 is a normally open valve 179 which is adapted to close a vent or bleeder opening 181. The vent 181 is for the purpose of venting leakage pressure from the operating cylinder, the leakage passing through the vent 181, the chamber 177 and through an opening 183 through the wall of the chamber 177. The valve 179 is mounted on the lower end of a valve rod 185 which has its upper end secured to the armature 187 of an electromagnet 189. A spring 191 normally biases the armature 187 to unattracted position and the valve 179 to open position.

On the normal closing operation, as the operating piston 93 (Fig. 1) passes below the exhaust port 169 (Fig. 3), the closing fluid pressure is retained in the operating cylinder 13 by the closed

exhaust valve 161, a small amount of compressed fluid leaking past the exhaust valve and to atmosphere through the vent 181. Should the breaker be closed in against a fault existing on the main circuit, the trip device 69 (Fig. 1) would be energized to effect high speed reversal of the mechanism and opening of the breaker. At the same time the trip device is energized, the electromagnet 189 is also energized and moves the valve 179 to closed position thereby closing the vent 181. The closing pressure in the operating cylinder is trapped above the exhaust valve 161 and immediately moves this valve in opening direction. As soon as the exhaust valve is cracked, the rush of compressed gas past the valve blasts it to its fully opened position, thus quickly dumping the closing gas pressure from the operating cylinder to permit high speed opening movement of the circuit breaker mechanism. The exhaust valve 161 is closed by the spring 175 when the pressure in the cylinder is reduced to a predetermined value or when the operating piston 95 passes above the exhaust port 169.

Having described several embodiments of the invention in accordance with 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. It is, therefore, desired that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

We claim as our invention:

1. An operating mechanism for a circuit breaker comprising a fluid motor, means for admitting fluid pressure to said motor to operate said breaker to closed position, a valve operable to an open position during a closing operation of said motor to cause quick collapse of the fluid pressure on the working side of said motor, actuating means comprising a valve actuating piston operable by fluid pressure to initiate an opening operation of said valve, said valve being operable by fluid pressure to full open position independently of said valve actuating piston following said initial opening operation thereof.

2. In an operating mechanism for a circuit breaker, fluid pressure operated means for closing the breaker, an inlet valve operable to admit fluid pressure to effect closing of said breaker, a valve operable to quickly reduce the pressure in said pressure operated means, actuating means comprising a valve actuating piston operated by fluid pressure for moving said valve a predetermined distance in opening direction to admit fluid pressure to one end of said valve, said valve being operable by fluid pressure independently of said valve actuating piston to full open position following said initial opening movement thereof, and means for holding said actuating piston in a position for restraining said valve in open position for a predetermined time after the pressure in said pressure operated means is reduced below a predetermined value.

3. In an operating mechanism for a circuit breaker, means comprising a fluid motor operable to close said breaker, means operable to admit fluid pressure to said motor to effect closing of said breaker, means comprising a cylinder and a valve operable therein to cause collapse of the fluid pressure in said motor, actuating means comprising a valve actuating piston disposed in one end of said cylinder and operable by fluid pressure to initiate opening movement of said valve, and means for admitting fluid pressure to said one end of said cylinder for operating said valve actuating piston, said valve being operable to full open position by fluid pressure independently of said piston following said initial opening movement thereof.

4. In an operating mechanism for a circuit breaker, means comprising a fluid motor operable to close said breaker, means operable to admit fluid pressure to said motor to effect closing of said breaker, means comprising a cylinder and a valve operable therein to cause collapse of the fluid pressure in said motor, actuating means for said valve comprising a piston disposed in one end of said cylinder and operable by fluid pressure to initiate opening movement of said valve, and means for admitting fluid pressure to said one end of said cylinder for operating said valve actuating piston, said valve being operable to full open position by fluid pressure independently of said piston following said initial opening movement thereof, and means for trapping fluid pressure in said one end of said cylinder to hold said piston in a position to hold said valve open for a predetermined time.

5. In an operating mechanism for a circuit breaker comprising a fluid motor, means for admitting fluid pressure to said motor to operate said breaker to closed position, means comprising a cylinder and a valve operable therein to cause quick collapse of the fluid pressure in said motor, means biasing said valve to closed position, actuating means for said valve comprising a piston disposed in one end of said cylinder and operable by fluid pressure to initiate opening movement of said valve, means operable during a closing operation of said motor to admit fluid pressure to said one end of said cylinder, said valve being operable to full open position by fluid pressure independently of said piston following said initial opening movement thereof, and means for holding said piston in a position wherein it maintains said valve open against the force of said spring after the fluid pressure in said motor has collapsed below a predetermined value.

6. In an operating mechanism for a circuit breaker comprising a fluid motor, means comprising an inlet valve operable to admit fluid pressure to said motor to operate said breaker to closed position, an exhaust valve operable to cause collapse of the fluid pressure in said motor, actuating means comprising valve actuating piston operable by compressed fluid for actuating said exhaust valve a predetermined distance in opening direction, said exhaust valve following said predetermined actuation thereof being operated to full open position by fluid pressure independently of said actuating piston, an electromagnetically operable valve for admitting fluid pressure to said actuating means.

7. In a circuit breaker comprising relatively movable contacts, operating mechanism for said contacts comprising a fluid motor, means for admitting fluid pressure to said motor to operate said contacts to closed position, a trip device operable in response to abnormal circuit conditions to effect opening of said contacts, a first valve operable to open a passage to cause quick collapse of the fluid pressure on the working side of said motor, means comprising a valve actuating piston for initiating operation of said valve, a second valve operable mechanically independently of said trip device to cause the fluid pressure from the working side of said motor to operate said valve actuating piston, said first valve following the initial operation thereof being

operable independently of said valve actuating piston to full open position by direct force of the working fluid pressure, and means for causing said valve actuating piston to hold said first valve open after the working fluid pressure in said motor has decreased to a predetermined value.

8. In an operating mechanism for a circuit breaker comprising a fluid motor, means for admitting fluid pressure to said motor to operate said breaker to closed position, means comprising a cylinder and a plurality of piston type valves operable in said cylinder to open a plurality of passages to thereby cause quick collapse of the fluid pressure on the working side of said motor, spring means disposed in one end of said cylinder for biasing said valves to closed position and for moving said valves to closed position following an opening operation thereof, a valve actuating piston disposed in the other end of said cylinder and operable by fluid pressure to effect opening of said valves, means operable to admit fluid pressure to said other end of said cylinder to operate said piston, and means for trapping the fluid pressure back of said piston to maintain said valves open for a predetermined time.

9. In an operating mechanism for a circuit breaker comprising a fluid motor, means for admitting fluid pressure to said motor to operate said breaker to closed position, means comprising a valve biased to closed position and operable to open position by fluid pressure to cause quick collapse of the fluid pressure in said motor, means comprising a passage disposed to vent fluid pressure leaking past said valve, and a second valve operable to close said passage to thereby cause the leaking fluid pressure to initiate opening movement of the first named valve.

10. In an operating mechanism for a circuit breaker comprising a fluid motor, means for admitting fluid pressure to said motor to operate said breaker to closed position, means comprising a valve biased to closed position and operable to open position by fluid pressure to cause quick collapse of the fluid pressure in said motor, means comprising a passage disposed to vent fluid pressure leaking past said valve, and a second valve operable to close said passage to thereby cause the leaking fluid pressure to initiate opening movement of the first named valve, said first named valve being moved to full open position by fluid pressure.

11. In an operating mechanism for a circuit breaker comprising a fluid motor, means for admitting fluid pressure to said motor to operate said breaker to closed position, an exhaust valve operable to quickly reduce the fluid pressure in said motor, means comprising a passage disposed to normally vent fluid pressure leaking to the top of said exhaust valve, and means comprising an electromagnetically operable valve for closing said passage to thereby cause the fluid pressure to initiate operation of said exhaust valve.

12. In a circuit breaker comprising relatively movable contacts, operating mechanism for said contacts comprising a fluid motor, means for admitting fluid pressure to said motor to operate said contacts to closed position, a trip device operable in response to predetermined circuit conditions to effect opening of said contacts, an exhaust valve movable to an open position to cause quick collapse of the working pressure in said motor, valve means operable mechanically independently of said trip device to cause the working pressure in said motor to initiate opening movement of said exhaust valve, and said exhaust valve being constructed and arranged to be moved to full open position directly by the exhaust blast of the working pressure following said initial opening movement thereof.

13. A circuit breaker operating mechanism comprising a fluid motor, means for admitting fluid pressure to said motor to operate said breaker to closed position, a valve operable to an open position during a closing operation of said mechanism to cause quick collapse of fluid pressure on the working side of said motor, a valve actuating piston operable by fluid pressure to initiate opening movement of said valve, said valve being constructed and arranged to be moved to full open position independently of said valve actuating piston following said initial operation movement thereof, and adjusting means for adjusting the position of said valve actuating piston in the closed position of said valve.

14. An operating mechanism for a circuit breaker comprising a fluid motor, means for admitting fluid pressure to said motor to effect closing of said breaker, means comprising a cylinder and a valve operable therein to cause collapse of the fluid pressure in said motor, an actuating piston disposed in one end of said cylinder and operable by fluid pressure to initiate opening movement of said valve, means for admitting fluid pressure to said one end of said cylinder for operating said piston, said valve being constructed and arranged to be moved to full open position by fluid pressure independently of said actuating piston following said initial operation movement thereof, means for trapping fluid pressure in said one end of said cylinder to hold said piston in a position to hold said valve open for a predetermined time, and adjustable valve means for exhausting the trapped fluid pressure from said one end of said cylinder.

15. An operating mechanism for a circuit breaker comprising a fluid motor, means comprising an inlet valve operable to admit fluid pressure to said motor to operate said breaker to closed position, tripping means operable to effect opening of said breaker, exhaust valve means movable to an open position by the working pressure in said motor to cause collapse of the working pressure in said motor, electromagnetically operated valve means separate from said tripping means to cause the working pressure in said motor to initiate opening movement of said exhaust valve means, and said exhaust valve being constructed and arranged to be moved to full open position by the direct force of the exhausting working pressure following said initial opening movement thereof.

GILBERT J. EASLEY.
RALPH O. BONINE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,836,813	Rankin	Dec. 15, 1931
1,873,787	Rankin	Aug. 23, 1932
2,286,023	Strang	June 9, 1942
2,349,650	Cumming et al.	May 23, 1944
2,379,178	Peek	June 26, 1945
2,408,199	Cumming et al.	Sept. 24, 1946