June 26, 1945. H. L. PEEK 2,379,178

CIRCUIT BREAKER

Filed June 4, 1942

Fig. 1.

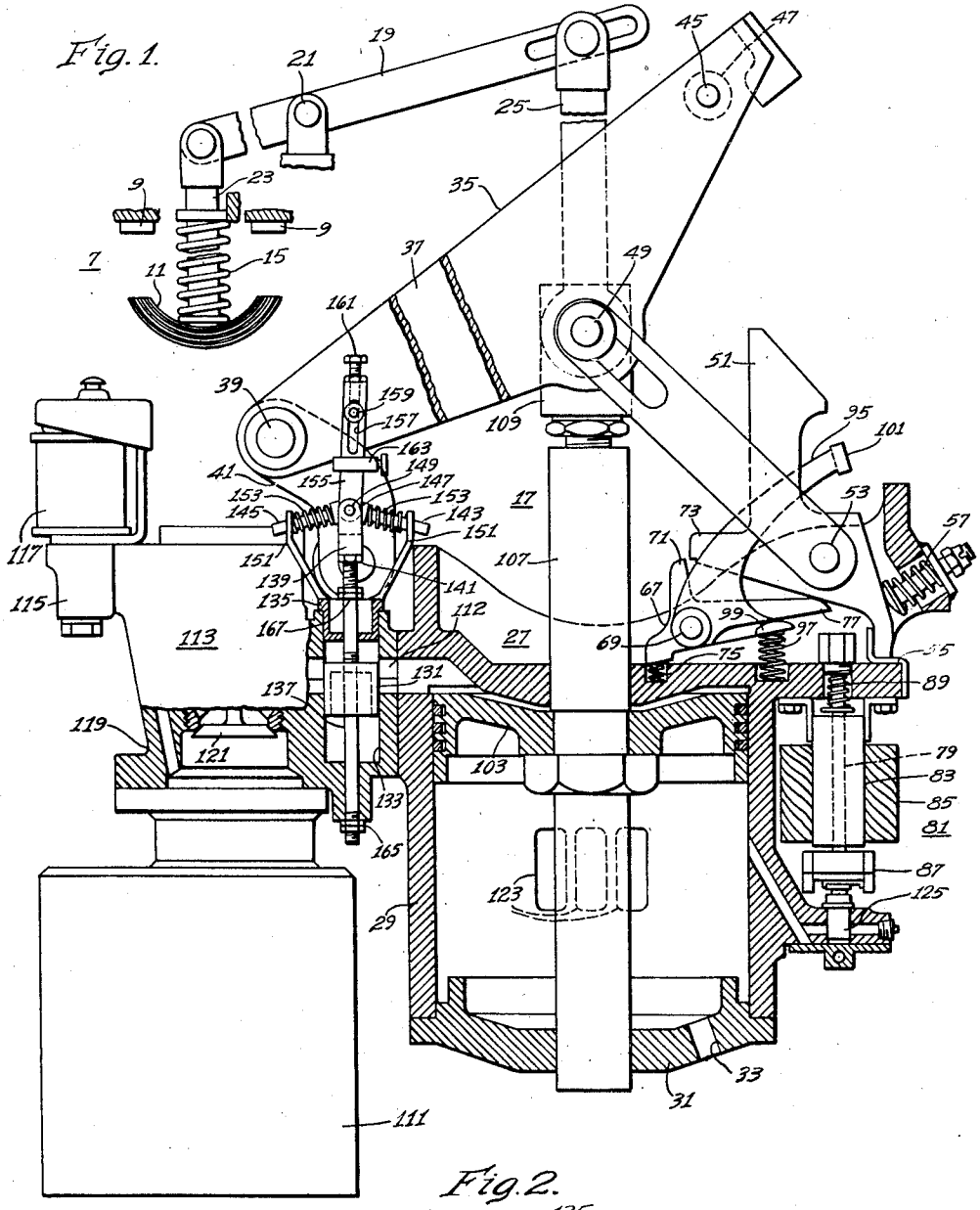
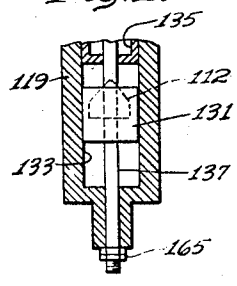


Fig. 2.



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CIRCUIT BREAKER

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17 Claims. (Cl. 200—82)

The invention relates to circuit interrupters and more particularly to circuit breaker operating means of the fluid or gas pressure type.

In the design of compressed air or gas operating means for circuit breakers which have relatively heavy contact loads, a combination of operating gas pressure and operating piston area must be selected which will develop sufficient driving power to overcome the heavy contact load which is picked up during the latter part of the closing stroke after the contacts touch. If the breaker is to be used for quick reclosing service, sufficient power must also be developed to quickly reverse the movement of the breaker on quick reclosing operations which are preferably initiated at an intermediate point in the opening stroke. If the large driving force required for these conditions is applied during the first part of the closing stroke on normal closing operations from the full open position, the circuit breaker will be operated at such a high speed and the kinetic energy developed will be so large that it may result in destructive slamming of the breaker and mechanism.

An object of the invention is the provision of a circuit breaker having fluid pressure operating means which automatically applies a greater closing force during the latter portion of the closing stroke than during the first part of the closing operation.

Another object of the invention is the provision of a circuit breaker having a fluid pressure or compressed gas operating means which applies a predetermined closing force during the first part of a closing operation starting from the full open position and automatically exerts an increased closing force during the final portion of the closing stroke and also on quick automatic reclosing operations.

Another object of the invention is the provision of a circuit breaker with a compressed gas operating means having an automatic throttle means which throttles the flow of operating gas a predetermined amount during the first part of the closing stroke starting from the full open position of the breaker, and which automatically opens near the end of the closing stroke to thereby increase the closing power when the heavy contact load of the breaker is picked up.

Another object of the invention is the provision of a circuit breaker as described in the preceding paragraph, wherein the automatic throttle means remains in the open or non-throttling position during a quick reclosing operation thus admitting a large quantity of operating gas to quickly reverse the motion of the breaker and reclose the breaker at high speed.

Another object of the invention is the provision of a circuit breaker having a compressed gas operating means and automatic throttle means as described in the preceding paragraphs wherein the throttle means comprises a throttle valve automatically operated by mechanical means in accordance with the position and movement of the breaker or the operating piston.

Another object of the invention is the provision of a compressed air operated circuit breaker with an automatic mechanically operated throttle valve, operation of which is initiated by a part movable with the breaker operating piston.

Another object of the invention is the provision of a compressed gas circuit breaker operating mechanism with an automatic throttle valve which is adjustable so that the operating mechanism can be used on various sizes of circuit breakers having closing loads varying from a low value up to the highest capacity of the mechanism.

Further objects and advantages of the present invention will become apparent from the following detailed description of one embodiment thereof, reference being had to the accompanying drawing in which:

Figure 1 is an elevational view, partly in section, of a compressed air circuit breaker operating mechanism embodying the invention, the circuit breaker being shown schematically, and

Fig. 2 is a fragmentary detail sectional view showing the throttle valve element as viewed at right angles to the showing thereof in Fig. 1.

The present invention is illustrated as applied to a circuit breaker operating means similar to that disclosed in the copending application of James M. Cumming and R. C. Cunningham, Serial No. 410,686, filed September 13, 1941, and assigned to the assignee of this invention. In certain aspects the present invention is an improvement over the circuit breaker operating means disclosed and claimed in the copending application of Richard C. Cunningham, Serial No. 410,870, filed September 15, 1941, which is also assigned to the same assignee as the present invention. In the last mentioned application Serial No. 410,870, a throttle valve is provided which is pneumatically operated to open position on quick reclosing operations to quickly reverse the movement of the breaker. In the present invention, as distinguished from application Serial No. 410,870, the automatic throttle valve is operated mechanically during the latter portion of the closing stroke of the piston to provide an increased flow of com-

pressed air during the final portion of the closing stroke, and the throttle valve is also maintained in open position during quick reclosing operations.

Referring to the drawing, the circuit breaker represented schematically at 7 may be of any conventional construction either of the oil break or air break type. The circuit breaker, as schematically shown, comprises stationary contact means 9 and movable contact means 11. Most conventional circuit breakers usually embody a contact pressure spring construction for maintaining the desired pressure engagement of the contacts in the closed position. The main bridging contact is usually backed by springs to secure contact pressure. The contact pressure securing means is represented very schematically in the drawing by the resilient laminated leaf spring construction of the movable contact member.

Although illustrated as a single pole circuit breaker, it will, of course, be understood that the breaker may be a multipole circuit breaker having a set of contacts 9 and 11 for each pole thereof with the movable contacts mechanically connected for simultaneous operation in the usual manner. The circuit breaker is biased to open circuit position by means of an accelerating spring shown schematically at 15, and the breaker is mechanically connected to the operating mechanism indicated generally at 17 by a suitable connecting means. The connecting means is represented schematically as comprising a lever 19, pivoted at 21, on a fixed support, one end of the lever being pivotally connected to the breaker lift rod 23 and the other end being pivotally connected to an operating rod 25 which is, in turn, mechanically connected to the operating mechanism 17.

The operating mechanism comprises a main casting 27 which is formed to provide a cylinder 29 closed at the upper end by an integral part of the casting. A closure member 31 is secured to the lower end of the cylinder 29, this closure member having a relatively large port 33 therein open to the atmosphere. An operating or latching lever 35 is pivotally mounted at one end on the casting 27. The operating lever consists of two spaced parallel levers 37 which are pivotally connected at one end by means of a pivot pin 39 to the upper end of a pair of links 41 (only one being shown) pivotally mounted on the main casting 27. The free end of the levers 37 comprising the operating lever are connected by a cross member and carry a short shaft 45 therebetween on which is rotatably mounted a latching roller 47 disposed between the levers 37. The breaker operating rod 25 is pivotally connected by a pivot pin 49 to the midpoint of the operating lever 35, the pivot pin extending transversely through the levers 37 and engaging an opening in the lower end of the rod 25. The breaker operating lever is adapted to be held in closed position to hold the breaker closed by means of the high speed latching mechanism comprising a main latch 51 which is pivoted on the main casting 27 by a pivot pin 53. The latch 51 is adapted to extend between the parallel levers 37 and its latch end is adapted to engage and restrain the latching roller 47 carried by the free end of the operating lever 35. The latch 51 is biased to latching position against a stop 55 by means of a spring pressed plunger 57. An auxiliary latch 67 is provided for normally engaging and holding the main latch 51 in latching position. The auxiliary latch 67 is pivoted on the casting 27 by a pivot pin 69 and has a latch projection 71 adapted to engage under a projection 73 of the latch 51. A spring 75 biases the auxiliary latch 67 to latching position. The auxiliary latch is provided with a projection 77 which extends directly over the upper end of the trip plunger 79 of an electromagnetic trip device 81.

The trip device 81 comprises, in addition to the trip plunger 79, an E-shaped core 83 of magnetic material, an energizing winding 85 mounted on the center leg of the core and the movable armature 87 cooperating with the core 83. The trip plunger 79 is secured to the center portion of the armature 87 and slidably extends upwardly through a guide opening in the center leg of the core 83 and through an opening in the horizontal portion of the main casting 27. A spring 89 biases the armature 87 downwardly to unattracted position.

When the trip device 81 is energized, the armature 87 thereof is moved upwardly against the core 83 causing upward movement of the trip plunger 79. This upward movement of the trip plunger moves the auxiliary latch 67 counterclockwise and disengages the projection 73 of the main latch 51 whereupon the accelerating spring 15 of the circuit breaker moves the breaker to open position, the operating lever 35 being rotated counterclockwise about its pivoted end by the opening movement of the breaker. During the initial opening movement of the operating lever 35 the roller 47 pushes the main latch 51 in a counterclockwise direction as it clears the latch. In order to prevent the auxiliary latch 67 from returning to latching position until the breaker lever 35 is returned to closed position, there is provided a U-shaped balance lever 95, the legs of which are pivotally mounted on the extending ends of the pivot pin 69 on opposite sides of the auxiliary latch 67. The balance lever 95 is biased counterclockwise by a compression spring 97 which is seated in a recess in the casting 27 and engages the under side of a projection 99 of the balance lever. A cross member 101 on the free end of the balance lever 95 is disposed directly beneath the free end of the operating lever 35 so that the balance lever will be held down in an inoperative position when the operating lever 35 is in closed and latched position. However, when the operating lever 35 is released the balance lever 95 is rocked counterclockwise and the portion 99 thereof engages and holds the auxiliary latch 67 in unlatching position until the breaker operating lever 35 is returned to its closed position and its roller has become reengaged under the latch face of the main latch 51. For this purpose, the biasing spring 97 is stronger than the auxiliary latch spring 75.

An operating piston 103 is reciprocably movable within the operating cylinder 29, and this piston has a piston rod 107 which slidably extends in a fluid-tight manner through an opening provided therefor in the top wall of the cylinder 29. The upper end of the piston rod 107 has a connecting element 109 threadedly connected thereto which is pivotally connected to the pivot pin 49 carried by the operating or latching lever 35. Thus the operating piston 103 is mechanically connected directly to the circuit breaker operating rod 25.

The operating piston 103 is adapted to be moved downwardly in the cylinder 29, to close or automatically reclose the circuit breaker, by compressed air from an auxiliary air reservoir or tank 111, the compressed air being admitted

to the upper end of the cylinder 29 through an inlet passage 112 controlled by a main inlet valve indicated generally at 113. The opening operation of the main inlet valve is controlled by a pilot valve 115 operated by an electromagnet or solenoid 117.

The inlet valve mechanism is of the same construction as that disclosed in the aforementioned copending application of J. M. Cumming and R. C. Cunningham, Serial No. 410,686. The inlet valve 113 comprises a valve housing 119 and a main valve element 121 mounted in the valve housing. The main valve element 121 is adapted to be operated to open position by a valve piston (not shown) upon energization of the valve controlling electromagnet 117, and the valve is returned to closed position by spring means (not shown) upon deenergization of the electromagnet 117.

In order to provide for quick reversal of movement of the operating piston 103 and circuit breaker 7 to provide the effect of trip-free operation of the circuit breaker, the mechanism is provided with an air pressure exhaust means similar to that disclosed in the aforementioned copending application Serial No. 410,686. The air pressure exhaust means causes quick collapse of air presure in the operating cylinder above the piston 103 whenever the trip device 81 is operated so as to dump the pressure air to atmosphere and thereby permit quick opening of the circuit breaker. The air pressure exhaust means is fully disclosed in the aforementioned copending application Serial No. 410,686 and comprises air pressure exhaust ports 123 formed in the side of the operating cylinder which are adapted to be connected to atmosphere by a main exhaust valve (not shown). The main exhaust valve is automatically opened by the air pressure above the operating piston 103 when a pilot valve 125 is opened in response to operation of the trip device 81. The exhaust ports 123 are of larger size than the compressed air inlet passage 112 so that the breaker will be opened quickly upon operation of the trip device 81 even though the main inlet valve may be open and admitting compressed air to the cylinder at the time the trip device is operated. Thus the breaker is trip free of the closing means. The ports 123 are so located that they are closed by the operating piston early in the opening movement of the breaker before the piston reaches the intermediate position at which compressed air is admitted for accomplishing quick reclosing operation of the circuit breaker.

The compressed air operating means is operable to produce normal closing operations of the circuit breaker starting from the full open position of the breaker, and is also operable to effect quick automatic reclosing operations of the breaker wherein the reclosing movement is initiated at an intermediate point in the opening stroke of the breaker after the circuit is interrupted but before the breaker reaches full open position. The control circuits for controlling the operation of the electromagnet inlet valve 117 and the trip device 81 are preferably the same as the control circuits disclosed in the aforementioned copending application Serial No. 410,686. These control circuits have not been shown in this application as they are unnecessary for a complete understanding of the present invention. It is believed sufficient to state that the tripping electromagnet 81 is energized in response to an overload or short circuit in the main circuit, and also by a manual trip control switch. For quick automatic reclosing operations, the inlet valve controlling electromagnet 117 is automatically energized by an auxiliary switch at an intermediate point in the opening stroke of the breaker to cause the inlet valve to admit compressed air to the operating cylinder at this time. The electromagnet 117 may also be energized by a manual closing control switch to effect closing operation of the circuit breaker from the full open position of the breaker. Reference may be had to the aforementioned copending application for the details of the control circuits for accomplishing the above operations.

The circuit breaker operating mechanism as thus far described, is the same as that disclosed in the aforementioned copending application Serial No. 410,686.

In accordance with the present invention, the circuit breaker operating means is provided with an automatic throttle means which is effective to throttle the flow of compressed air to the operating cylinder a predetermined amount during the first part of the closing stroke of the operating piston on normal closing operation of the circuit breaker, and which is automatically operated to an open or non-throttling position during the latter portion of the closing stroke to permit compressed air to flow to the operating cylinder at an increased rate during the final portion of the closing stroke. Compressed air is admitted relatively slowly by the throttle during the first part of the normal closing operation thus decreasing the tendency of the operating mechanism to slam. A larger quantity of compressed air is admitted to the operating cylinder by the throttle during the final portion of the closing stroke thereby providing sufficient driving power to overcome the relatively heavy contact load imposed by the contact pressure spring means during the final portion of the closing stroke. The throttle means is also constructed so that it will remain in open position during the major portion of the opening stroke of the operating piston and during quick reclosing operations, thereby admitting the larger quantity of compressed air necessary to quickly reverse the movement of the circuit breaker and quickly reclose the same.

The automatic throttle means comprises a cylindrical piston shaped valve element 131 slidably mounted in a vertically disposed cylindrical recess 133 which crosses the inlet air passage 112 in the inlet valve housing 119. A closure cap 135 is secured in the upper end of the cylindrical recess 133 for closing the upper end of this recess. The valve element 131 is threadedly mounted on the central portion of a rod 137 which slidably extends in a fluid-tight manner through openings provided therefor in the closure member 135 and in the bottom of the valve housing 119. The valve element 131 is secured in mounted position on the rod 137 by a retaining pin (not shown). The upper end of the rod 137 is threadedly connected to a U-shaped connecting element 139, a lock nut 141 being provided to secure the connection. The valve element 131 is adapted to be actuated to its throttling position, and to its open or non-throttling position by a snap acting spring toggle comprising a pair of rods or links 143 and 145 having U-shaped rod ends 147 which are pivotally connected together and to the connecting element 139, by a pivot pin 149 which forms the knee of the actuating toggle. The free ends of the toggle rods 143 and 145 slidably extend through enlarged openings provided therefor in

a pair of supporting arms 151 which are secured to the closure member 135. A compression spring 153 is mounted on each toggle rod and disposed in compression between the head 147 and supporting arm 151 of the rod.

The valve element 131 is adapted to be actuated to its throttling position shown in Fig. 1 during the latter part of the opening stroke of the breaker and operating piston, and actuated to its open or non-throttling position during the latter portion of the closing stroke of the breaker operating piston. A link 155 is provided for the purpose of initiating the actuation of the valve element 131 at the proper time. The connecting link 155 is pivotally connected at its lower end to the knee of the actuating toggle by means of the pivot pin 149, and the upper portion of the link is provided with an elongated slot 157 which engages a pin or stud 159 projecting laterally from the breaker operating lever 35. An adjusting screw 161 is threaded into the upper end of the link 155 and the lower end of this screw is adapted to extend into the upper portion of the slot 157. The adjustment of the screw 161 determines the point in the opening stroke of the breaker operating piston at which actuation of the valve element 131 to its throttling postion will be initiated. An adjustable collar 163 may be mounted on the link 155 adjacent the lower end of the slot 157 to determine the point at which actuation of the valve element 131 to its open position will be initiated.

Adjustment of the throttling position, that is, the degree of throttling of the valve 131 is accomplished by means of a pair of lock nuts 165 which are threaded on the extending lower end of the valve rod 137. These lock nuts act as an adjustable stop to determine the upper or throttling position of the valve element 131. Adjustment of the open or non-throttling position of the valve element 131 is accomplished by means of a pair of lock nuts 167 which are threaded on the upper portion of the valve rod 137. These lock nuts 167 limit the amount of downward movement of the valve element 131 and thus determine the size of the air opening provided in the open position of the valve element 131. The inlet air passage 112 is of general triangular shape, as shown by the dotted lines in Fig. 2, so as to provide for a maximum range of adjustment of the throttle opening provided by the valve element 131 in the throttle position thereof. In the position of the parts shown in Figs. 1 and 2, the valve element 131 provides a relatively high degree of throttling since only the apex of the triangular shaped inlet passage 112 is uncovered by the valve element in the throttling position thereof. If the lock nuts 165 are backed off, the size of the throttle opening will be decreased and if the lock nuts are screwed upwardly on the rod the size of the throttle opening will be increased.

The operation of the mechanism is briefly as follows: When the circuit breaker is in the full open position, as shown in Fig. 1, the throttle valve element 131 is maintained in the throttling position as shown, in which it will act to throttle the flow of compressed air to the upper end of the cylinder a predetermined amount. To close the circuit breaker, the inlet valve controlling electromagnet 117 is energized by closing a manual control switch. Energization of the electromagnet 117 opens the pilot valve 115 and thereby causes opening of the main inlet valve 121. Upon opening of the main inlet valve 121 compressed air flows through the inlet passage 112 into the upper end of the operating cylinder 29 and moves the operating piston 103 downwardly to closed position to effect closing of the circuit breaker. During the first part of the closing stroke, the throttle valve 131 is maintained in throttling position in which it throttles the flow of compressed air to the cylinder a predetermined amount admitting air to the operating cylinder relatively slowly. Shortly before the contacts of the circuit breaker touch, the projecting pin 159 will engage the bottom of the slot 157 in the link 155 and thereby initiate actuation of the throttle valve 131 to its open position. As soon as the knee pin 149 of the actuating toggle is moved downwardly through the deadcenter position, the spring toggle actuates the valve element 131 downwardly to its open position with a snap action, thus the valve element 131 is actuated to open throttle position during the latter portion of the closing stroke of the breaker operating piston and allows the compressed air to flow at an increased rate into the operating cylinder and thereby provide a relatively large driving force during the final portion of the closing stroke of the operating piston. When the circuit breaker reaches the fully closed position, the latching roller 47 is engaged under the main latch 51 and the breaker is held latch closed by the latching mechanism. As soon as the breaker reaches the fully closed position, the valve controlling electromagnet 117 is deenergized and the main inlet valve 121 returns to closed position shutting off the flow of compressed air to the operating cylinder 29.

If an overload or short circuit occurs in the circuit controlled by the circuit breaker, the trip device 81 will be immediately energized and the trip plunger 79 thereof quickly moved upwardly to effect release of the latching mechanism and at the same time opening of the exhaust pilot valve 125. The release of the latching mechanism comprising the auxiliary latch 67 and main latch 51 permits the circuit breaker to be moved quickly to open position by its accelerating spring 15. The opening of the exhaust pilot valve 125 will cause the main exhaust valve to open if there is any substantial air pressure in the operating cylinder above the piston 103, to thereby dump the air to atmosphere through the exhaust ports 123.

If the circuit breaker is set for quick automatic reclosing operation, the inlet valve controlling electromagnet 117 will be automatically energized early in the opening stroke of the circuit breaker thereby causing the inlet valve 121 to open and admit compressed air to the operating cylinder during the opening movement. The throttle valve 131 remains in the open or non-throttling position during the major portion of the opening stroke and hence will be in open position at the time compressed air is admitted for quick reclosing and will remain open during the quick reclosing operation. This is due to the length of the slot 157 in the connecting link 155. Since the throttle valve 131 is in the open throttle position a large quantity of compressed air will be admitted to the operating cylinder and the compressed air will quickly reverse the movement of the operating piston and initiate the reclosing movement of the operating piston at an intermediate point in the opening stroke before the circuit breaker reaches full open position. The reclosing movement proceeds and if the fault or overload condition which caused the initial opening has been cleared, the circuit breaker will be

driven to the fully closed position and relatched. The inlet valve controlling electromagnet 117 will be deenergized and the inlet valve 121 returned to closed position when the breaker reaches the fully closed and latched position. However, if the overload or fault condition is still present at the time the circuit breaker contacts reach the touch position during the reclosing movement, the trip device 81 will be immediately energized in response to the overload condition and will retrip the breaker by releasing the latching mechanism and simultaneously opening the exhaust pilot valve 125. The opening of the exhaust pilot valve 125 will cause the main exhaust valve to open and dump the closing air from the operating cylinder to atmosphere so that it will not retard the opening movement of the circuit breaker.

The circuit breaker may be manually tripped by means of the manual trip control switch which effects energization of the trip device 81. The circuit breaker will be moved quickly to the full open circuit position and during the latter part of the opening movement shortly before the breaker reaches its full open position, the projecting pin 159 on the breaker operating lever 35 will engage the adjusting screw 161 adjacent the end of the slot 157 and initiate actuation of the throttle valve element 131 to its throttling position shown in Fig. 1. The snap action toggle will thereby be caused to snap to its upper overcenter position shown, moving the valve with a snap action to its throttling position. The mechanism is now ready for a normal closing operation.

From the foregoing, it will be seen that the automatic throttle valve 131 causes the flow of compressed air to the operating cylinder to be throttled a predetermined amount during the first part of each closing operation started from full open position, and the throttle valve is automatically opened during the latter part of the closing stroke of the operating piston thereby admitting a large quantity of air to the upper side of the operating piston during the final portion of the closing stroke. The throttle valve remains in the open throttle position during the major portion of the opening stroke of the operating piston and during quick reclosing operations, due to the elongated slot 157 in the connecting link 155, so that an increased quantity of air will be admitted to the operating cylinder on quick reclosing operations.

The lock nuts 165 and 167 provide a means for adjusting both the throttling and the open throttle position of the throttle element 131. This enables a single mechanism to be used for operating a number of different sized breakers. The adjusting screw 161 is set so that the throttle valve 131 will not be actuated to its throttling position until late in the opening stroke of the circuit breaker in order to insure that the valve element will remain in its open position during quick reclosing operations.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts may be made without departing from some of the essential features of the invention. Although the throttle valve has been shown as applied to a certain specific type of compressed air operating means, it will be understood that the invention is also applicable to other types of compressed air or compressed gas operating means for circuit breakers. It is desired, therefore, that the language of the appended claims be given the broadest reasonable interpretation permissible in the light of the prior art.

I claim as my invention:

1. Compressed gas operating means for a circuit breaker comprising a cylinder, an operating piston in said cylinder operable to close the breaker, a source of compressed gas for operating said piston, means for automatically controlling the rate of flow of gas to said cylinder including a valve having one position in which the flow of gas to said cylinder is limited to a predetermined rate by said means, said valve having an open position in which it permits gas to flow to said cylinder at an increased rate, actuating means for said valve including an actuating member connected to said valve, and means movable with said piston and engageable with said actuating member to initiate actuation of said valve from said one position to said open position during the latter portion of the closing movement of said piston on normal closing operations of the breaker, said valve remaining stationary in said open position during the major portion of the opening stroke of the breaker and being actuated to said one position only during the latter portion of the opening movement of said breaker.

2. Compressed gas operating means for a circuit breaker comprising a cylinder, an operating piston in said cylinder operable to close the breaker, a source of compressed gas for operating said piston, means for automatically controlling the rate of flow of gas to said cylinder comprising a valve having one position in which the flow of gas to said cylinder is throttled a predetermined amount by said means and having an open position in which it permits gas to flow to said cylinder at an increased rate, actuating means for said valve including spring means for quickly moving said valve from said one position to said open position, actuation of said valve from said one position to said open position being initiated in response to the movement of said piston during the latter portion of the closing movement of the piston, and said valve being actuated to said one position in response to the movement of said piston during the latter portion of the opening movement of said piston.

3. Compressed gas operating means for a circuit breaker comprising a cylinder, an operating piston in said cylinder operable to close the breaker, a source of compressed gas for operating said piston, means for automatically controlling the rate of flow of gas to said cylinder comprising a valve having one position in which the flow of gas to said cylinder is throttled a predetermined amount by said means and having an open position in which it permits gas to flow to said cylinder at an increased rate, actuating means for said valve including spring means for quickly moving said valve from said one position to said open position, and means movable with said piston for initiating actuation of said valve to said open position during the latter portion of the closing movement of said piston, said valve being actuated to said one position in response to the movement of said piston during the latter portion of the opening movement of said piston.

4. Compressed gas operating means for a circuit breaker comprising a cylinder, a piston in said cylinder operable to close the breaker, a lever connected to said piston, a source of compressed gas for operating said piston, a valve for controlling the flow of gas to said cylinder for

closing the breaker, actuating means for said valve including a spring actuated toggle and an actuating member connected to said valve, said actuating member having a lost motion connection with said lever for causing said valve to be actuated from one position to an open position during the latter part of the closing movement of said piston and for causing said valve to be actuated to said one position during the latter part of the opening movement of the piston.

5. Compressed gas operating means for a circuit breaker comprising a cylinder, a piston in said cylinder operable to close the breaker, a source of compressed gas for operating said piston, means for automatically controlling the rate of flow of gas to said cylinder for closing the breaker comprising a valve having one position in which the flow of gas to said cylinder is throttled a predetermined amount by said means and having an open position in which it permits gas to flow to said cylinder at an increased rate, means for adjusting the degree of throttling provided by said means, actuating means for said valve, means movable with said piston and engageable with said valve actuating means for initiating the actuation of said valve from said one position to said open position during the latter part of the closing stroke of said operating piston, and adjusting means for adjusting the amount of opening provided by said valve in the open position thereof.

6. In combination, a circuit breaker movable to open and to closed circuit position, compressed gas operating means therefor comprising a cylinder, a piston in said cylinder operable to close the breaker, a source of compressed gas for operating said piston, means comprising a valve and actuating mechanism therefor mechanically actuated in response to predetermined movements of the breaker for limiting the flow of gas to said cylinder to a predetermined rate during the first part of the closing stroke of the piston started from the full open position and for automatically causing gas to be supplied to said cylinder at a substantially increased rate during the latter part of such closing stroke and also during the entire stroke traversed by said piston on instantaneous reclosing operations of the breaker.

7. In an electric circuit breaker comprising relatively movable contacts, a fluid motor for operating the circuit breaker, a supply system for supplying fluid under pressure to said motor, orifice means through which fluid under pressure is supplied to said motor and means for controlling said orifice means in response to predetermined movements of said fluid motor for causing a predetermined driving force to be applied to the motor by fluid under pressure during the first part of the closing stroke of said fluid motor on normal closing operations of the breaker and for automatically causing a substantially increased driving force to be applied to said fluid motor by fluid under pressure during the latter portion of the closing stroke of the motor on normal closing operations and also during substantially the entire reclosing stroke traversed by the motor on instantaneous reclosing operations of the breaker.

8. In an electric circuit breaker comprising relatively movable contacts, a fluid motor for closing the circuit breaker, means for supplying fluid under pressure to said motor, means including variable orifice means for controlling the rate of flow of fluid to said motor and actuating means for said variable orifice means controlled by predetermined movements of said motor for causing fluid under pressure to be supplied to the motor at a predetermined limited rate during the first part of the closing stroke of the motor on normal closing operations and for causing fluid under pressure to be supplied to the motor at a substantially increased rate during the latter part of such normal closing stroke of the motor and also at said increased rate during substantially the entire stroke traversed by the motor on instantaneous reclosing operations of the breaker.

9. In an electric circuit breaker comprising a pair of relatively movable contacts, a fluid motor for closing said circuit breaker, a source of fluid under pressure, means for controlling the rate of flow of fluid under pressure to said motor comprising a valve, actuating means for said valve controlled by predetermined movements of said motor operable to automatically actuate said valve from one position to open position during the latter part of the closing stroke of said motor on normal closing operations of said circuit breaker and for causing said valve to remain stationary in open position during the entire stroke traversed by said fluid motor on instantaneous reclosing operations of said circuit breaker.

10. In an electric circuit breaker comprising a pair of relatively movable contacts, a fluid motor for closing said circuit breaker, means for supplying fluid under pressure to said motor, means for controlling the rate of flow of fluid under pressure to said motor comprising a valve, actuating means for said valve having a lost motion operative relation with said fluid motor for actuating said valve from one position to an open position during the latter part of the closing movement of the motor on normal closing operations of the breaker and for causing said valve to remain in said open position during the entire stroke traversed by said motor on instantaneous reclosing operations of the circuit breaker.

11. In an electric circuit breaker comprising a pair of relatively movable contacts, a fluid motor for closing said circuit breaker, means for supplying fluid under pressure to said motor to operate said circuit breaker, means including a valve for controlling the rate of flow of fluid to said motor, actuating means for said valve comprising a spring and an actuating member having a lost motion operative relation with said fluid motor for causing said valve to be actuated from one position to an open position during the latter part of the circuit breaker closing stroke of said motor on normal closing operations of the breaker and to remain in said open position during the major part of opening stroke of said motor and for causing said valve to be actuated to said one position during the latter part of the opening stroke of the motor.

12. In an electric circuit breaker comprising relatively movable contacts, a fluid motor for operating said circuit breaker, means for supplying fluid under pressure to actuate said breaker to closed circuit position, connecting means through which fluid under pressure is supplied to said motor, a valve associated with said connecting means having one position in which it closes at least part of said connecting means whereby the flow of fluid to said motor is limited to predetermined rate and having an open position in which it allows fluid to be supplied to the motor at a substantially increased rate, actuating means for said valve operable to actuate said valve from said one position to open position during the latter part of the closing stroke of said motor on normal closing operations of the breaker and for

causing said valve to remain stationary in said open position during the major portion of the opening stroke of said motor and during the entire stroke traversed by said motor on instantaneous reclosing operations of the breaker.

13. In an electric circuit breaker comprising relatively movable contacts, a fluid motor for operating said circuit breaker, means for supplying fluid under pressure to said motor to actuate the breaker to closed position, connecting means through which fluid under pressure is supplied to said motor, a valve associated with said connecting means having one position in which it closes at least a part of said connecting means to thereby limit the rate of flow of fluid to said motor and having an open position in which it allows fluid to be supplied to said motor at a substantially increased rate, actuating means for said valve controlled in response to predetermined movements of said motor for causing said valve to remain in said one position during the first part of the closing stroke of said motor on normal closing operations of the breaker and to be actuated to open position during the latter part of the closing stroke of said motor on normal closing operations of the breaker and to remain in open posiiton during the entire reclosing stroke traversed by the motor on instantaneous reclosing operations of the breaker.

14. In an electric circuit breaker having relatively movable contacts, operating means therefor comprising an operating cylinder having a piston therein operatively related with said breaker, means for supplying fluid under pressure to said cylinder to close the breaker, connecting means through which fluid under pressure is supplied to said cylinder, a valve associated with said connecting means having one position in which flow of fluid to the motor is limited to a predetermined rate and having an open position in which it allows fluid to be supplied to said cylinder at a substantially increased rate, actuating means for said valve controlled in response to predetermined movements of said piston, said valve remaining in said one position during the first part of the closing stroke of said piston on normal closing operations of the breaker and being actuated to open position during the latter part of such closing stroke of the piston and remaining stationary in said open position during the major part of the opening stroke of the breaker and during the entire reclosing stroke traversed by the piston on instantaneous reclosing operations of the breaker, said valve being actuated to said one position during the latter part of the opening stroke of the breaker.

15. In an electric circuit breaker comprising relatively movable contacts, operating means therefor comprising a fluid motor, means for supplying fluid under pressure to said motor to actuate the breaker to closed position, connecting means through which fluid under pressure is supplied to said motor, a valve associated with said connecting means having one position in which the flow of fluid to said motor is limited to a predetermined rate, said valve having an open position in which it allows fluid under pressure to be supplied to said motor at a substantially increased rate, actuating means for said valve for causing said valve to remain in said one position during the first part of the closing stroke of said motor on normal closing operations of the circuit breaker and for actuating said valve to open position during the latter part of such closing stroke of the motor, said actuating means causing said valve to remain stationary in open position during the major portion of the opening stroke of the breaker and during the entire stroke traversed by the motor on instantaneous reclosing operations of the breaker.

16. Compressed gas operating means for a circuit breaker comprising a cylinder, an operating piston in said cylinder operable to close the breaker, a source of compressed gas for operating said piston, means for automatically controlling the rate of flow of gas through said cylinder including a valve having one position in which the flow of gas to said cylinder is limited to a predetermined rate by said means, said valve having an open position in which it permits gas to flow to said cylinder at an increased rate, actuating means for said valve including an actuating member connected to said valve, and means rendering said actuating member responsive to movement of the breaker to initiate actuation of said valve from said one position to said open position during the latter portion of the closing movement of said piston on normal closing operations of the breaker, said valve remaining stationary in said open position during the major portion of the opening stroke of the breaker and being actuated to said one position only during the latter portion of the opening movement of said breaker.

17. In combination, a circuit breaker having relatively movable contact means movable to an open circuit position and to a closed circuit position, operating mechanism for closing said breaker comprising a cylinder having mounted therein a piston operatively connected to the movable contact means, supply means for supplying fluid under pressure to said cylinder for effecting operation of said piston, valve means for automatically controlling the rate of flow of fluid under pressure from said supply means to said cylinder, means actuated by said operating mechanism as said piston approaches the limit of its contact opening stroke for rendering said valve means operative to limit the flow of fluid to said cylinder to a predetermined rate during the first part of a subsequent contact closing stroke, means actuated by said operating mechanism as said piston approaches the limit of its contact closing stroke for causing said valve means to increase the rate flow of fluid to said cylinder during the final part of such closing stroke, and means controlled by said operating mechanism for maintaining said valve in the position for effecting supply of fluid at an increased rate during substantially the entire reclosing stroke traversed by said piston on instantaneous reclosing operations of the circuit breaker.

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