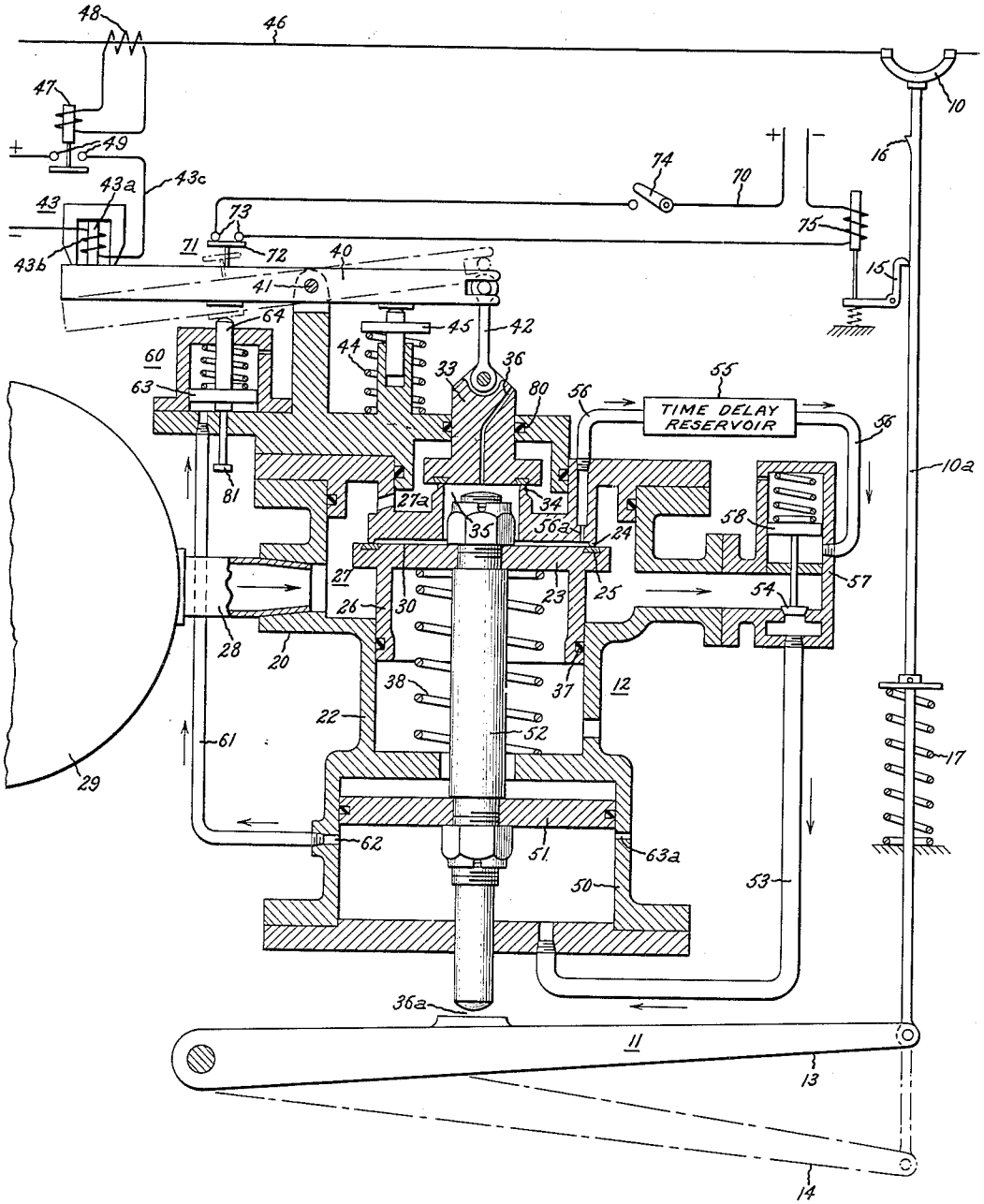
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FLUID ACTUATED CIRCUIT BREAKER OPERATING MECHANISM

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Inventors:
John W. Beatty,
Reed M. Anderson,
by J. Wesley Saulsbury
Their Attorney.

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FLUID ACTUATED CIRCUIT BREAKER OPERATING MECHANISM

John W. Beatty, Lansdowne, and Reed M. Anderson, Glenolden, Pa., assignors to General Electric Company, a corporation of New York

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This invention relates to a fluid actuated operating mechanism for an electric circuit breaker, and more particularly, to an improved arrangement for effecting extreme high speed response of such an operating mechanism.

The conventional fluid actuated operating mechanism comprises a source of high pressure fluid, a fluid motor, and a conduit which interconnects these parts and contains a control valve operative to permit high pressure actuating fluid to flow to the motor. Where such a control valve and conduit is utilized, there is invariably an undesirable time delay between the time the control valve is opened and the time that sufficient pressure is built up within the motor to effect high speed operation of the motor. This time delay results from the distance through which the fluid must flow to actuate the motor and also from the pressure reduction produced by the valve and the intervening conduit.

One approach which has been made toward reducing this undesirable time delay is illustrated in Bartlett Patent No. 2,290,726, wherein the fluid reservoir and the cylinder of the fluid motor have been integrally constructed. Although this integral construction appreciably reduces the distance between the reservoir and the fluid motor, there still exists between the reservoir and the motor, a control valve and orifice structure through which all of the actuating fluid must flow in order to operate the fluid motor. Inherently, such flow through these parts will result in pressure reduction which tends to lessen the speed of response of the fluid motor.

It is, therefore, an object of this invention to provide for a circuit breaker an improved fluid actuated operating mechanism which is capable of extreme high speed.

It is a further object of this invention to arrange the control valve for a fluid motor in such a manner that the valve is required to pass only a very small portion of the actuating fluid, whereas the great bulk of the actuating fluid may flow to the fluid motor piston through a substantially unrestricted path which is independent of the control valve.

It is a further object of this invention to subject the working surface of a piston of a fluid motor to high pressure actuating fluid within a minimum period of time after the control valve is opened.

It is a further object of this invention to provide a fluid actuated operating mechanism which requires no separate pressure switches to effect automatic circuit breaker opening in response to loss of pressure.

In accordance with one form of the present invention, there is provided, for operating a circuit breaker, a fluid motor comprising casing structure and a reciprocable piston mounted within said casing structure and having a first wall portion which cooperates with said casing structure to define a substantially closed reservoir. This reservoir is normally filled with high pressure actuating fluid, and said first portion of the piston wall serves as a pressure confining wall of the reservoir. When the piston is in its initial position, it is urged into abutment with a seat which is arranged to seal off a second portion of the piston surface from the high pressure gas. This second portion of the piston surface communicates with a small pilot chamber in which the fluid pressure is controlled by a pilot valve. Operation of the pilot valve permits an instantaneous build-up of pressure within the pilot chamber which is effective to initiate movement of the piston away from its seat so as to permit high pressure fluid from said reservoir to flow rapidly past the piston seat and into effective driving relationship with said second portion of the piston.

An additional feature of one form of the present invention is that the pilot valve for the fluid motor is proportioned so that the pressure of the adjacent fluid upon the valve creates a force which cooperates with the coercive forces produced by a magnetic trip latch of the circuit breaker to normally hold the pilot valve closed against the bias of a spring. If the system pressure should fall below a safe level, the spring overcomes these opposing forces thereby opening the pilot valve to initiate circuit breaker opening operation of the fluid motor.

Further objects and advantages of our invention will become apparent as the following description proceeds, and the features of novelty which characterize our invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of our invention reference may be had to the accompanying drawing, the single figure of which is a partially schematic view of a circuit breaker comprising a fluid actuated operating mechanism constructed in accordance with this invention, the fluid actuated mechanism being shown in cross section.

Referring now to the drawing, we have illustrated our invention in connection with a circuit breaker comprising a movable contact member **10** connected, through an insulated operating rod **10***a* to a pivotally mounted actuating lever **11**. This lever **11** is movable by the fluid motor **12** from the solid-line closed position **13** to the dotted-line open position **14** thereby to effect opening operation of the circuit breaker. The circuit breaker is shown as of the latched-open, biased-closed type, to which our invention is especially applicable; i. e. upon opening of the breaker, a latch **15** engages behind a catch **16** to hold the breaker in open position against the bias of a closing spring **17** until such time as the breaker is unlatched, as will be described in greater detail hereinafter.

The fluid motor **12** comprises casing structure **20** having a reduced tubular portion defining a cylinder **22** in which a main actuating piston **23** is reciprocably mounted. When the circuit breaker is in the closed position shown, the piston is positioned in its uppermost position wherein its upper working surface **30** abuts in sealing relationship against the downwardly directed annular rib or seat **24**. For assuring an effective seal, the piston **23** preferably carries an insert ring **25** of yieldable material which abuts in registering relationship against the seat **24**. When the piston is in the position shown, its wall portion **26** which is disposed external to the seat **24** cooperates with adjacent portions of casing structure **20** to form a relatively large reservoir **27** which surrounds the piston **23**. This reservoir **27** communicates, through a conduit **28**, with a source, such as the tank **29**, of high pressure fluid (preferably air) so that the reservoir **27** is normally filled with air at the same high pressure as the source. It will be observed that the actuating piston itself actually constitutes a pressure confining wall of the reservoir **27**, so that at the instant the piston **23** leaves its seat **24**, high pressure air from the reservoir **27** instantaneously flows radially inwardly past the seat **24**, flooding the piston top wall or working surface **30**, independently of any control valve, thereby to provide

full unrestricted air pressure behind piston 23 throughout substantially its entire opening stroke.

For initiating an opening operation of the actuating piston 23, there is provided control means comprising a pilot valve 33, which in its closed position, abuts in sealing relationship against an upwardly directed annular seat 34, which, like the piston seat 24, is formed on a part of the casing structure 20. The inner surface of the portion of casing structure 20 extending between the two seats, together with the lower surface of the seated valve 33 and the upper surface 30 of piston 23, define a small minimum-space pilot chamber 35. This pilot chamber 35 is normally at atmospheric pressure due to the presence of a restricted bleed passage 36 extending from the chamber to atmosphere. The reservoir 27, containing air at full supply pressure communicates freely with a subchamber 27*a* which surrounds the valve seat 34, so that when the pilot valve 33 is lifted, high pressure air instantly flows past the seat 34 and into the chamber 35. The pilot valve 33, being of the semi-balanced type, is aided in its movement toward fully-open position by the high pressure air acting with piston effect upon its lower surface as the pressure builds up in the pilot chamber 35. Since the pilot chamber 35 has a very small volume, on the order of, say less than two cubic inches, and since all of the exits from chamber 35 are quite restricted, air pressure within the pilot chamber 35 builds up to a high value substantially instantaneously. This instantaneous pressure buildup immediately unseats piston 23, so that air then flows unrestrictedly from reservoir 27 rapidly past the large seat 24 thereby to subject the piston 23 to full supply pressure, as previously described.

From the foregoing description it will be apparent that the air flow past pilot valve 33 primarily serves to trigger or initiate movement of the main actuating piston 23, and as a result, only a minor portion of the actuating air flows from the reservoir past the pilot valve, whereas the major portion of the actuating air, which feeds directly from the large surrounding reservoir 27, flows to the working portion of piston surface 30 through a substantially unrestricted path which is independent of pilot valve 33. As a result, the working surface 30 of the actuating piston is exposed to full supply pressure almost instantaneously after the pilot valve is opened, whereby extreme high speed response of the fluid motor is produced.

To further increase the speed of response of the fluid motor, lost motion has been provided between the actuating piston 23 and the contact operating linkage. This lost motion has been obtained in the illustrated embodiment of the invention by spacing the lower end of the piston rod 52 a slight distance from the actuating lever 11, as shown at 36*a*. It will be apparent that this lost motion spacing at 36*a* permits initial movement of the piston 23 away from its seat 24 without restraint from the operating linkage and the closing spring 17. As a result, only a comparatively small pressure buildup within the pilot chamber 35 is needed in order to initiate piston movement. Once piston movement is initiated, the piston is immediately exposed to full supply pressure, as pointed out hereinabove.

For normally holding the piston 23 in its uppermost or seated position against its seat 24, the seat 24 and the piston 23 are proportioned so that an upwardly-acting differential air pressure is exerted on the piston when it is seated. Specifically, the effective piston surface area disposed radially inwardly of annular seat 24 is slightly greater than the effective piston surface area bounded by annular piston sealing ring 37, and as a result, a greater area is exposed to air pressure forces acting upwardly than to those acting downwardly. In view of this pressure relationship, the compression spring 38 which is disposed beneath the piston 23 may be of a relatively light construction since it serves mainly to

insure that the piston 23 will be properly seated when the system is being filled with compressed air, either initially or after subsequent exhaustings of the system, as may be required for maintenance.

For initiating an opening operation of the pilot valve 33 in response to predetermined electrical conditions, there is provided a pilot armature in the form of a lever 40 which is centrally pivoted at 41 and which is operatively interconnected at one end through link 42 to the pilot valve 33. This armature lever 40, at its other end, is normally held in a horizontal position by the attraction of a magnetic latching device 43. Since the details of this magnetic latch form no part of the present invention and correspond to a latch 21 described in Coggeshall Patent 2,479,315, the latch 43 of the present application is shown only diagrammatically. For the purposes of this description, it is believed sufficient merely to point out that the armature lever 40 is normally held in its horizontal position by coercive forces produced by a permanent magnet 43*a* forming a part of the latch. The latch additionally comprises a trip coil 43*b* connected in a control circuit 43*c*. The trip coil is arranged in such a manner that when control power is applied thereto the coercive forces of the permanent magnet 43*a* are instantly neutralized so that the armature lever 40 is free to rapidly separate from the latch 43 under the bias of trip latch spring 44 acting through a slidably mounted guide element 45. For suitably applying the control source of power to the trip coil 43*b* of latch 43 in response to predetermined electrical conditions, e. g. overcurrent in line 46, there is provided an overcurrent relay 47 connected to be energized from a current transformer 48. When relay 47 is actuated, its normally-open contacts 49 are closed to complete a control power circuit through the trip coil 43*b* of latch 43, thereby effecting high-speed release of armature lever 40 in the desired manner described.

After the main actuating piston 23 has moved downwardly through its contact opening stroke, it is desirable to rapidly reset, or return, the operative parts of the fluid motor to the normal position shown in the drawing, so that the fluid motor thereby is placed in readiness to respond properly to a subsequent contact reclosing operation of the breaker. To effect this desired rapid resetting, there is provided at the lower side of the fluid motor a cylinder 50 reciprocably receiving a reset piston 51, which is interconnected with main actuating piston 23 by a piston rod 52. The effective working surface of the reset piston 51 is greater than the effective working surface of piston 23, so that the reset piston 51 may predominate when both working surfaces are subjected to the high pressure air. For supplying high pressure air to the lower side of the return piston 51 at a predetermined instant after full opening of the circuit breaker contacts 10 is assured, there is provided a duct 53 interconnecting the reservoir 27 and the bore of cylinder 50. Air flow through the duct is controlled by a biased-closed control valve 54. This control valve 54 is opened with a predetermined short time delay after opening movement of piston 23 is initiated. Such time delay is achieved in one form of the present invention by a time delay reservoir shown schematically at 55. This reservoir 55 is connected by external piping 56 with the pilot chamber 35 and with a control cylinder 57 for a valve operating piston 58 disposed at the delivery end of the piping. The flow of air into piping 56 from pilot chamber 35 is restricted by a bleed passage 56*a* through which air enters piping 56.

The resetting of the piston may be described as follows: When opening operation of piston 23 is initiated by the opening of valve 33, high pressure air also will flow restrictedly through the bleed passage 56*a* into the piping 56, and after a predetermined short time delay resulting from reservoir 55 will open control valve 54,

thereby permitting high pressure air flow from the main reservoir 27 to cylinder 50 whereby to return the then lowered reset piston to its upper and reset position.

Resetting of the latch 43 and valve 33 are effected by latch-resetting motor 60. This motor 60 communicates with the resetting cylinder 50 through a motor control duct 61 which conducts high pressure air from the cylinder 50 to the motor 60 when the upwardly moving reset piston has moved above and uncovered the cylinder side port 62. At this instant the high pressure gas supplied to the motor 60 will lift piston 63 until its rod 64 pivots the pilot armature lever 40 from its dotted line position to the solid line reset position wherein it is held by magnetic latch 43. This pivoting of armature lever 40 returns the pilot valve 33 to its normally-closed, circuit-condition-responsive position. The pressure beneath the main reset piston 51 is maintained for a sufficient length of time to permit the pressure in pilot chamber 35 to be relieved to atmosphere through the bleed passage 36, whereby the main actuating piston 23 will be held in closed position so long as valve 33 is maintained closed. Concurrently with this movement of main piston 23 into its reset position, the bleed port 63*a* in cylinder 50 is uncovered so that pressure beneath piston 51 soon falls to the atmospheric level. When this condition occurs, the fluid motor 12 is completely reset and is in readiness to properly respond to a reclosing operation of the contacts 10. That is, in the event that the contacts are reclosed, say, upon a sustained fault, the fluid motor is in readiness to immediately open the contacts.

In order to prevent initiation of a circuit breaker rapid reclosing operation before the latch 43 and the motor 12 are safely reset, there is provided in the closing or reclosing control circuit 70 an interlock means 71. This interlock means comprises a switch member 72 which is operated from the pilot armature lever 40 to bridge contacts 73 when the latch and motor are reset and which opens the contacts 73 whenever these parts are tripped or not reset. Contacts 73, circuit breaker closing switch 74, and the operating coil 75 for the hold-open latch 15 are arranged in series relationship in the closing control circuit 70, so that closing of the switch 74 will be effective to close the circuit breaker only if the contacts 73 are closed. If the contacts 73 are closed, closing of the switch 74 will energize coil 75 to unlatch the breaker and permit contact 10 to close under the influence of spring 17. If the latch and motor have not been reset, the contacts 73 will remain open thereby preventing energization of latch coil 75 by closing switch 74.

Another feature of the present invention, is that the mechanism, without the necessity of any additional pressure switches, is capable of automatically opening the circuit breaker in case the supply pressure should fall below a predetermined operating value, thereby insuring that the breaker will not remain closed if the prevailing conditions are not available for effecting a fully rated interrupting capacity opening operation. This automatic feature is obtained by the balanced design of the valve 33 and the magnetic trip latch 43. More particularly, when valve 33 is closed, the trip latch spring 44 is opposed by the holding force of the permanent magnet 43*a* of magnetic latch 43 and by the differential air pressure on valve 33, namely, the preponderating air force over the larger area bounded by the pilot valve seat 34 minus the lesser air force over the smaller area bounded by the seal 80 which surrounds the valve stem. Thus, if the system pressure falls, this pneumatic differential closing force on the valve will decline accordingly. The spring 44 is designed to provide a force which is just sufficient to overcome the holding force of permanent magnet 43*a* and the declining hold-close force from the pilot valve 33 when the air supply pressure has fallen to some predetermined fraction of its original value. When the pressure does drop to this predetermined fractional value, which corresponds to a diminished, but adequate, operating air pressure, the spring 44 will overcome the combined pilot valve force and magnetic latch force whereby to open valve 33 thereby initiating an automatic opening operation of the circuit breaker while there is still adequate operating pressure.

For initially filling the system with high pressure air, it is desirable to hold the pilot valve 33 closed so that the system will not lose air, say, through the bleed passage 36 at a rate which materially interferes with the effective build-up of pressure in the system. To this end, the lift piston 63 of the latch reset motor 60 is provided with a manually operable lift rod 81 which, when raised, resets the latch 43 to its magnetically attracted position and lowers the pilot valve 33 to a closed position, whereby to seal off the top of pilot chamber. The bottom of the pilot chamber will be sealed off by the piston 23 which, under these no-pressure conditions, is held in its uppermost position by the light compression spring 38 which, as already explained is provided for this purpose.

Another feature of this invention which contributes to high speed movement of the main actuating piston 23 is that no significant amount of high pressure air is permitted to leave the chamber surrounding the piston until a substantial portion of the opening stroke has been completed. Thus, substantially full supply pressure is available during this portion of the opening stroke. This essentially closed condition of the surrounding chamber results from the fact that the only exit from the chamber which is of significant size is blocked by the then closed control valve 54 for a predetermined period of time after the initiation of the piston opening stroke. This time delayed operation of valve 54 is obtained by the use of time delay reservoir 55, as described hereinabove.

While we have shown and described a particular embodiment of our invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from our invention in its broader aspects and we, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In a circuit breaker operating mechanism, a fluid motor comprising casing structure, a piston movable within said casing structure, said piston having a wall portion cooperating with said casing structure to define a reservoir filled with high pressure fluid, said wall portion forming a pressure confining wall of said reservoir, sealing means engageable with said piston to seal off a working portion of the piston wall from said high pressure fluid in said reservoir, means defining a pilot chamber communicating with said sealed-off working portion, and pilot valve means movable to effect an increase in the fluid pressure within said pilot chamber whereby to move said piston out of sealed relationship with said sealing structure.

2. A fluid motor comprising casing structure, a piston movable within said casing structure, said piston having a first pressure-confining wall portion cooperating with said casing structure to define a fluid reservoir, sealing means engageable with said piston to seal off a second portion of the piston wall from fluid in said reservoir, means defining a pilot chamber communicating with said second portion, and pilot valve means disposed between said reservoir and said pilot chamber and movable to permit fluid to flow from said reservoir into said pilot chamber whereby to move said piston out of sealed relationship with said sealing structure.

3. A fluid motor comprising casing structure, a piston movable within said casing structure, said piston having a first wall portion cooperating with said casing structure to define a reservoir filled with high pressure fluid, said first wall portion serving as a pressure-confining wall of said reservoir, sealing means cooperable with said piston to seal off a second portion of the piston wall from said

high pressure fluid, control means including a pilot valve openable to apply high pressure fluid to said second portion so as to move said piston out of sealed relationship with said sealing means whereby fluid from said reservoir flows past said sealing means and into drive transmitting relationship with said second portion of the piston.

4. The fluid motor of claim 3 in combination with means for returning said piston to its position of sealed relationship with said sealing means, and reset means movable to close said pilot valve substantially coincidentally with said return movement of said piston.

5. In a circuit breaker operating mechanism, a fluid motor comprising casing structure containing an opening having a predetermined cross-sectional area, a movable piston slidably received in sealed relationship within said opening, said casing structure and said piston defining therebetween a fluid reservoir, sealing means cooperable with said piston to seal off a working portion of the piston surface from fluid within said reservoir, the effective area of said sealed-off working portion being larger than said predetermined cross-sectional area, means defining a pilot chamber communicating with said sealed-off working portion, and pilot valve means movable to control the fluid pressure within said pilot chamber.

6. A fluid motor comprising a casing, a piston movably mounted within said casing and having a working surface and a pressure confining wall portion, said pressure confining wall portion being disposed to cooperate with said casing to define a reservoir containing fluid under pressure, means biasing said piston for movement in one direction, stop means on said casing engaging said working surface in sealing relation to limit biasing movement of said piston and to seal at least a portion of said working surface from said fluid in said reservoir, and means including a valve movable to admit fluid under pressure to said portion of the working surface thereby to move said piston against its bias and to expose said working surface portion to the pressure of fluid in said reservoir.

7. A fluid motor for operating a circuit breaker comprising casing structure, a piston movable within said casing structure, said piston having a first wall portion cooperating with said casing structure to define a reservoir filled with high pressure fluid, said first wall portion forming a pressure-confining wall of said reservoir, a seat against which said piston abuts so as to seal off a second portion of its surface from the high pressure fluid in said reservoir, structure defining a pilot chamber communicating with said sealed-off second portion, and pilot valve means movable to control the fluid pressure within said pilot chamber.

8. A fluid motor comprising casing structure, a piston movable within said casing structure, said piston having a first wall portion cooperating with said casing structure to define a reservoir filled with high pressure fluid, said first wall portion forming a pressure-confining wall of said reservoir, a seat against which said piston abuts so as to seal off a second portion of its surface from said high pressure fluid, structure defining a pilot chamber communicating with said second portion, pilot valve means disposed between said reservoir and said pilot chamber and movable to permit high pressure gas to flow from said reservoir into said pilot chamber whereby to initiate withdrawal of said piston from its seat.

9. A fluid motor comprising casing structure defining a chamber filled with high pressure fluid, a walled piston movable in said chamber, sealing means on the casing structure and engageable with said piston to seal off a portion of the piston wall from the high pressure fluid in said chamber, control means including a pilot valve movable to apply high pressure fluid to said piston wall portion whereby to initiate movement of said piston out of engagement with said sealing means so that high pressure fluid from said reservoir flows past the sealing means and into driving relation with said piston wall portion, and means for maintaining said chamber substantially closed against the exit of high pressure fluid for a predetermined period of time after movement of said piston is initiated.

10. A fluid motor comprising enclosing structure defining a reservoir filled with high pressure fluid, said enclosing structure comprising a movable piston having a working surface, means urging said piston to a position where at least a portion of its working surface is effectively sealed off from the high pressure fluid in said reservoir, control means for initiating movement of said piston comprising structure defining a pilot chamber communicating with said sealed-off portion of said working surface, and pilot valve means for controlling the fluid pressure within said pilot chamber.

11. A fluid motor comprising enclosing structure defining a reservoir filled with high pressure fluid, said enclosing structure comprising a movable piston having a working surface, means urging said piston to a position where at least a portion of its working surface is effectively sealed off from the high pressure fluid in said reservoir, control means for initiating movement of said piston comprising structure defining a pilot chamber communicating with said sealed-off portion of said working surface, and pilot valve means disposed between said reservoir and said pilot chamber and operable to control the fluid pressure within said pilot chamber.

12. A fluid motor comprising casing structure, a piston movably mounted within said casing structure, said piston having a wall cooperating with said casing structure to define a reservoir extending about said piston and filled with fluid under high pressure, said piston wall forming a pressure confining wall of said reservoir, a seat for said piston, means urging said piston against said seat so as to seal off a portion of said piston wall from said high pressure fluid, control means for initiating movement of said piston away from said seat, said control means comprising a pilot chamber communicating with said sealed-off portion, and pilot valve means arranged to control fluid flow into said pilot chamber.

13. In a circuit breaker having a movable contact member, a fluid motor having a contact-actuating piston, operating mechanism coupling said piston to said movable contact member, said fluid motor comprising casing structure, a piston movable within said casing structure, said piston having a first wall portion cooperating with said casing structure to define a reservoir filled with high pressure fluid, said first wall portion forming a pressure-confining wall of said reservoir, sealing means engageable with said piston in its initial position to seal off a second portion of the piston wall from said high pressure fluid, control means for initiating movement of said piston out of sealing engagement with said sealing means, said operating mechanism being provided with lost motion therein which permits said control means to effect said initial piston movement independently of movement of said contact member.

14. A circuit breaker comprising relatively movable contacts, a fluid motor for effecting relative movement of said contacts, a normally-closed pilot valve openable to initiate operation of said fluid motor, said pilot valve being disposed in a reservoir containing high pressure fluid, said valve when closed having a greater area exposed to fluid pressure acting in a closing direction than is exposed to fluid pressure acting in an opening direction whereby said high pressure fluid normally urges the valve toward closed position with a force varying with its pressure, biasing means urging said valve toward open position, a magnetic latching device comprising a magnet acting to restrain said biasing means and to hold said valve in closed position, said latching device being responsive to predetermined electrical conditions to free said biasing means to open said valve, said spring having sufficient strength to overcome the combined force of said magnet and the fluid pressure force on said

valve when pressure in said reservoir falls below a predetermined level.

15. In combination, a fluid motor comprising an actuating piston and a normally-closed pilot valve openable to initiate movement of said actuating piston, said fluid motor comprising structure defining a reservoir filled with high pressure fluid, said valve being disposed in said reservoir and, when closed, having a greater area exposed to fluid pressure acting in a closing direction than is exposed to fluid pressure acting in an opening direction whereby said high pressure fluid normally urges said valve toward closed position with a force which is a function of said pressure, biasing means opposing said force and urging said valve toward open position, said biasing means being arranged to open said pilot valve when pressure in said reservoir falls below a predetermined level.

16. A circuit breaker comprising separable contacts, means biasing said contacts toward closed position, fluid motor means operative to separate said contacts, a valve openable to initiate operation of said motor means, means

for resetting said valve to its closed position after operation of said motor means has been initiated, restraining means for holding said contacts in open position against said biasing means, actuating means for disabling said restraining means whereby to permit said biasing means to close said contacts, interlock means operatively interconnecting said valve and said actuating means, said interlock means normally being responsive to movement of said valve to render said actuating means inoperative to disable said restraining means whenever said valve is open, whereby the biasing means can move the contacts to closed position only when said valve has been reset to its closed position.

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