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AUTOMATIC VALVE CONTROLLING MECHANISM FOR ELECTRIC CIRCUIT BREAKERS

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Fig. 1.

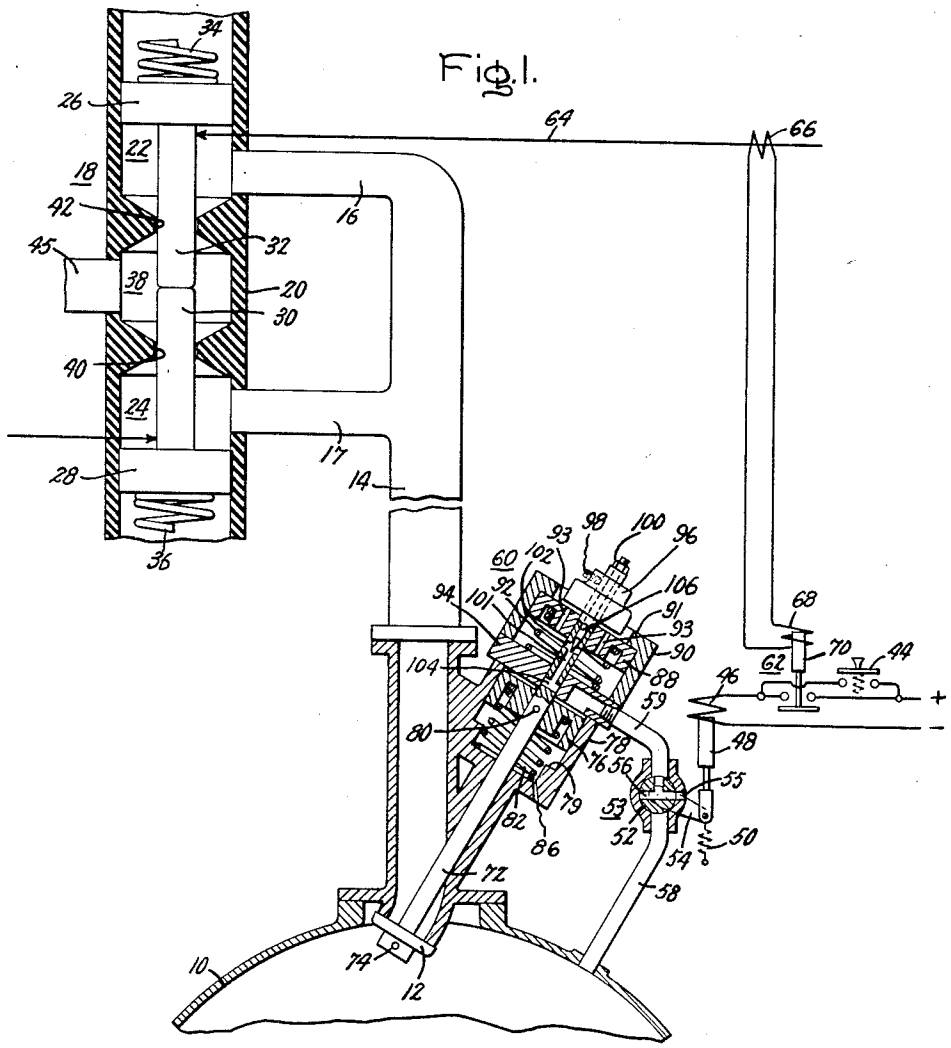
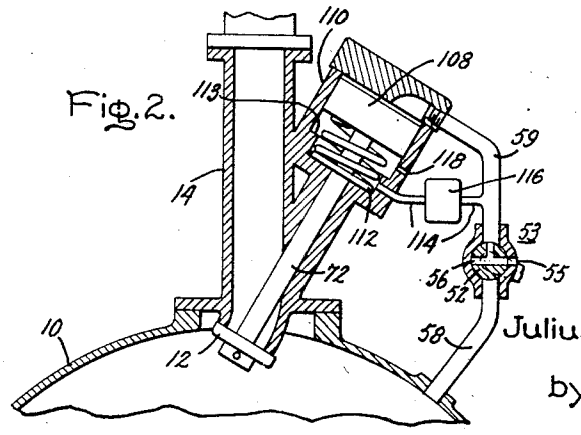


Fig. 2.



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AUTOMATIC VALVE CONTROLLING MECHANISM FOR ELECTRIC CIRCUIT BREAKERS

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8 Claims. (Cl. 137—139)

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My invention relates to fluid control means for electric circuit breakers and, more particularly, to an automatically operable mechanism for controlling the degree of opening of a blast valve used to supply fluid to a circuit breaker of the fluid actuated type.

Circuit breakers utilizing a blast of fluid to extinguish the arc drawn between retractable contacts may also utilize the fluid blast to perform the retracting action of the contacts and, therefore, the amount of fluid required may be quite large. This is particularly true if the circuit breaker is of the reclosing type where several operations may be performed within a relatively short period of time, thus necessitating the use of a relatively large storage tank or reservoir for the fluid.

In circuit breakers employing biased-closed interrupting contacts, an isolating switch is placed in the main circuit in series with the circuit breaker interrupting contacts. In such cases, after a circuit interrupting operation is performed by the circuit breaker, the circuit breaker interrupting contacts must be maintained in the open position sufficiently long to permit the isolating switch to form a sufficient isolating gap. The rate of flow and pressure of the fluid necessary to maintain the circuit breaker interrupting contacts in the open position after interruption has been accomplished may be considerably less than that required for the dual purpose of both holding these contacts open and blasting the arc drawn therebetween to extinction.

A principal object of my invention, therefore, is the provision of means whereby the overall consumption of fluid may be substantially reduced thereby making possible a smaller fluid storage capacity than ordinarily would be required for a particular circuit breaker application.

Another object of my invention is the provision of means for supplying a relatively large quantity of fluid for the purpose of causing the circuit breaker contacts to separate and at the same time to blast the arc to extinction followed by a substantial reduction in the quantity and pressure of fluid supplied for the purpose of maintaining the contacts separated and insulated from each other until such time as the isolating switch blade will have formed a suitable series isolating gap.

Still another object of my invention is the provision of means for initially causing the main blast valve to assume its fully opened position for a predetermined time and thereafter to revert to an intermediate or partially opened position whereby the amount and pressure of fluid supplied to the circuit breaker may be reduced after the interruption of the circuit.

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A further object of my invention is the provision of piston means automatically operable in response to pressure supplied from the fluid tank or reservoir for controlling the main blast valve and thereby to conserve the amount of fluid required to perform a circuit interrupting operation.

Other objects and advantages of my invention will become apparent from the following description taken in conjunction with the accompanying drawing, in which: Fig. 1 represents a circuit interrupting arrangement incorporating a blast valve operable by two piston members to opened, closed, and intermediate positions constituting a preferred embodiment of my invention and in which Fig. 2 represents a modification thereof having only one piston member. The scope of my invention will be pointed out in the appended claims.

With reference to the preferred form of my invention as illustrated in Fig. 1, the numeral 10 represents a fluid tank or reservoir from which fluid is supplied through main blast valve 12, conduit 14, branch conduits 16 and 17 to the circuit breaker schematically represented and generally indicated by the numeral 18. Fluid from auxiliary conduits 16 and 17 enters the circuit breaker housing 20 to occupy chambers 22 and 24. Thus fluid pressure in the chambers 22 and 24 bears against the surfaces of pistons 26 and 28 to which main contacts 32 and 30 are secured. The pressure of the fluid forces pistons 26 and 28 apart against the action of biasing springs 34 and 36 to draw an arc between contacts 30 and 32 in the enclosure 38. As the contacts 30 and 32 pass through the throats 40 and 42 respectively, a blast of pressure fluid is caused to flow from the chambers 22 and 24 into the enclosure 38 where a blasting action takes place which is sufficient to extinguish the arc and to expel the products of the interrupting operation such as gas and other materials to atmosphere through the exhaust vent 45.

The circuit interrupting operation may be initiated by manually closing the switch schematically indicated at 44 which operation supplies a current from a source of potential, not shown, to the coil 46 which in turn picks up the armature 48 against the bias of spring 50 to cause the plug member 52 of pilot valve 53 to rotate counterclockwise due to the upward movement of the arm 54 thereby causing the passage 56 in plug

member 52 to become aligned with auxiliary conduit 58 and thereby to permit the flow of fluid from reservoir 10 to the automatically operable blast valve controlling mechanism generally indicated at 60 which mechanism constitutes the preferred embodiment of my invention.

It will be obvious to those skilled in the art, that instead of the manually operable switch 44, a relay generally indicated at 62, could be utilized to initiate a circuit interrupting operation. Current changes occurring in line 64 could be reflected through a current transformer schematically represented at 66 to energize the winding 68 of relay 62 causing armature 70 to move upwardly thereby completing the circuit to the relay coil 46.

The valve mechanism 60 of Fig. 1 will now be described. Rod 72 is rigidly secured as by a pin 74 to blast valve disc 12. Piston 76 is slidable within cylinder 78 and is secured to rod 72 by any suitable means such as by pin 80. Spring 82 may be used for the purpose of biasing piston 76, rod 72 and valve disk 12 to the closed position. A port such as 86 may be provided in cylinder 78 to insure communication between atmosphere and the underside of piston 76. Port 86 will prevent the entrapment of fluid under piston 76 as for instance when the piston is moving downwardly. If it is desired to utilize the cushioning effect of fluid under piston 76, the port 86 may be omitted. Piston 88 is slidably mounted on shaft 72 within cylinder 90. Spring 92 biases piston 88 away from the common end wall or partition 94 which separates the two cylinders 78 and 90. Suitable ports or vents 93 may be drilled through the piston 88 in the direction of its axis. The capping member 96 is secured to the rod 72 in any suitable manner such as by a set screw 98. Radially extending ports 102 and 104 are provided in the hollow portion 101 of the rod 72. Needle valve 106 is slidably adjustable within the hollow portion 101 of the rod 72 for the purpose of controlling the flow of fluid from the hollow portion 101 of the shaft 72 through the vents 102 into the cylinder 90. Thus, it will be seen that the ports 102 and 104, the hollow portion 101 of rod 72 together with the central opening in partition 94 form an auxiliary valve interposed between cylinders 78 and 90. The adjusting mechanism for needle valve 106 may comprise internal threads on the inner surface of hollow portion 101 of rod 72 at the upper end of rod 72 and external threads on the needle valve 106. The needle valve may be secured in a particular position by a nut 100 which would bear against the upper end of rod 72 and which would engage the external threads on needle valve 106.

As shown in Fig. 1 the valve 12 is in the closed position. In this position there is no pressure in the portion 59 of conduit 58. Piston 76 is biased upwardly by the spring 82 and a small clearance exists between the upper surface of piston 76 and the lower surface of the common end wall 94. In the position shown in Fig. 1 the ports 93 are uncovered so that atmospheric pressure may exist inside the cylinder 90. When the valve 12 is in its intermediate and opened positions the capping member 96 abuts against the upper surface of piston 88 to seal the ports 93. The clearance distance between the upper surface of piston 88 and the lower surface of capping member 96 is also the distance of travel of valve 12 and its associated parts from the intermediate position to the closed position of valve 12 as will be more fully understood as the description proceeds. In the valve closed position shown in Fig. 1, the piston 88 is biased upwardly by its spring 92 into abutting relationship with the apertured outer end wall 91 of cylinder 90.

For the purpose of supplying a relatively large blast of pressure fluid to the circuit breaker 18 to perform a retracting operation of the contacts 30 and 32 and also to blast the arc drawn therebetween, it is necessary to cause the valve 12 to assume its fully opened position. To accomplish full opening of the valve 12, plug member 52 of the pilot valve 53 is rotated counterclockwise by energizing coil 46 either manually or through a current transformer as explained above. Pressure fluid from reservoir 10 passes through conduit 58, pilot valve 53, portion 59 of conduit 58 and through an opening in the common end wall or partition 94 to the inside of cylinder 78. It will be observed that ports 104 in rod 72 are covered. Fluid pressure against the upper surface of piston 76 will force that piston, the rod 72, and the valve 12 to move downwardly against the bias of spring 82 until the valve 12 has reached its fully opened position. As the rod 72 moves downwardly, the capping member 96 engages the upper surface of piston 88 and forces that piston downwardly against the bias of spring 92. After the rod 72 has moved a slight distance toward the fully opened position of valve 12, the ports 104 in rod 72 are uncovered as they clear the common end wall 94. Pressure fluid then passes from cylinder 78 through ports 104, the hollow portion 101 of rod 72 and the ports 102 in rod 72 and thence into the cylinder 90. The rate at which pressure builds up in cylinder 90 is controlled by the particular setting to which needle valve 106 has been adjusted. Preferably the setting of needle valve 106, the size and position of openings 102 and 104 will be chosen to permit valve 12 to reach its fully opened position and to remain in that position long enough to insure the extinguishment of the arm drawn between contacts 30 and 32 of circuit breaker 18. It will be observed that the maximum travel of piston 76 and rod 72 toward the opened position of valve 12 is limited by the shoulder 79 in the cylinder 78. Preferably the quantity of fluid allowed to pass into cylinder 90 during the opening operation of valve 12 will be sufficient to afford a pneumatic cushioning action which will serve yieldably to arrest downward motion of piston 88 and, in turn, the downward motion of valve 12, rod 72 and piston 76. As discussed above, the needle valve 106 will have been so adjusted that valve 12 will be forced to remain open for a long enough time to permit extinguishment of the arc drawn between retractable contacts 30 and 32.

As explained above, in order to conserve the amount of fluid required to perform an interrupting operation, it is desirable to reduce the fluid flow after the arc has been extinguished and pending the formation of a sufficient isolating gap by the series connected isolating switch. To accomplish this purpose in accordance with my invention, the valve 12 is caused to move toward its closed position to occupy an intermediate or partially opened position which will reduce the quantity of fluid flow to an amount just sufficient to maintain the circuit breaker contacts in their isolating position.

Assuming that the main valve 12 is fully opened, the operation of my invention whereby the valve 12 is moved to its intermediate position will now be explained. When the valve 12 is fully opened fluid pressure from portion 59 of

conduit 58 passes through openings 104, hollow portion 101 of rod 72, openings 102 and into the inside of cylinder 90. Because piston 88 is of larger diameter than piston 76, the force exerted by piston 88 to cause rod 72 and valve 12 to move toward the closed position will be greater than the force on the upper surface of piston 76 tending to hold valve 12 in the open position. This net force together with the action of springs 92 and 82 will cause the valve to move towards the closed position. Such movement will be arrested when piston 88 engages the shoulder 91 of cylinder 90. The pressure from portion 59 of auxiliary conduit 58, bearing against the upper surface of piston 76, will be sufficient to maintain valve 12 in its partially opened or intermediate position at a clearance distance equal to the normal clearance between the upper surface of piston 88 and the lower surface of capping member 96. The valve 12 will remain in this position so long as normal fluid pressure exists on the upper side of piston 76.

The pressure fluid allowed to pass through conduit 14 to circuit breaker 18, after the arc has been interrupted need be maintained only so long as may be necessary for the series connected isolating switch to assume a safe isolating position. When the isolating switch has assumed such a position, it is desirable to permit the circuit breaker 18 to close in again under the action of biasing springs 34 and 36 in order that needless waste of pressure fluid from reservoir 10 may be avoided. To this end valve 12 is, of course, allowed to assume its fully closed position. To cause valve 12 to move from its intermediate position to its closed position it is only necessary, in accordance with my invention, to close the pilot valve 53 and thereby to shut off the supply of fluid from reservoir 10. When plug member 52 of valve 53 is moved clockwise under the action of biasing spring 50, fluid pressure within the cylinder 78 and above piston 76, is allowed to escape to atmosphere through portion 59 of conduit 58, and exhaust vent 55 of pilot valve 53. Biasing spring 82 will then force piston 76 and rod 72 upwardly so as to cause capping member 96 to become disengaged from piston 88 by a suitable normal clearance distance such as is indicated in the drawing. This upward motion of rod 72 will be sufficient to cause valve 12 to reach its fully closed position thereby shutting off further supply of fluid from reservoir 10 through conduit 14 to circuit breaker 18.

It will be observed that when the main valve 12 is closed, any fluid pressure which may exist within the cylinder 90, and below the piston 88, will be allowed to escape to atmosphere through the ports 93 in piston 88 because of the clearance distance between piston 88 and capping member 96. It will also be observed that atmospheric pressure only may exist within cylinder 78 and below piston 76 because of the communication through port 86 to atmosphere. The mechanism 60 is, therefore, automatically readied for a new cycle of performance.

Fig. 2 represents a modification of my invention wherein like parts are represented by the same numerals as those used in connection with the device of Fig. 1. The device of Fig. 2 performs in a manner similar to the performance of the device of Fig. 1 in that the device of Fig. 2 provides for an initial inrush of pressure fluid to the breaker followed by a reduction in the quantity and pressure of fluid for the purpose of conserving fluid from tank 10.

In the device of Fig. 2 the numeral 108 designates a piston slidably mounted in a cylinder 110. The numeral 112 represents a biasing spring for the piston 108, rod 72 and valve 12 which spring serves to bias valve 12 to the closed position. The number 114 represents a conduit for supplying fluid pressure to the underside of piston 108 while the numeral 116 represents a small fluid reservoir. A port 118 is provided in the wall of cylinder 110 and is located at a point intermediate the limits of travel of piston 108 for the purpose of determining the intermediate position of valve 12 as will be better understood as the description proceeds.

In order for the device of Fig. 2 to cause the valve 12 to assume its fully opened position, the valve 53 is opened in any suitable manner such as described in connection with the device in Fig. 1. Fluid pressure then flows from reservoir 10, conduit 58, portion 59 of conduit 58, and into the cylinder 110 above piston 108. This fluid pressure within cylinder 110 will operate to force piston 108, rod 72 and valve 12 downwardly to the fully opened position of valve 12 and the maximum flow of fluid will be allowed to enter circuit breaker 18 through conduit 14. The shoulder 113 within cylinder 110 serves as a limiting stop and determines the lower-most position of piston 108. After pilot valve 53 is opened, fluid pressure enters conduit 114 which may be of smaller cross sectional area than conduit 58. Because of the smaller cross sectional area of conduit 114, the rate of flow of fluid therethrough will be less than the rate of flow of fluid through portion 59 of conduit 58 and hence the build-up of pressure within cylinder 110, below piston 108, will be less rapid than the build-up of pressure above piston 108. In this way initial downward movement of piston 108, and opening of valve 12, is accomplished. The relative sizes of conduit 114 and portion 59 of conduit 58 as well as the size of spring 112 are preferably chosen to permit valve 12 to remain in its fully opened position until after the arc drawn between retractable contacts 30 and 32 has been extinguished. After extinguishment of the arc drawn between contacts 30 and 32, sufficient pressure builds up within cylinder 110 below piston 108 which together with the force of spring 112 will cause piston 108, rod 72 and valve 12 to move upwardly until piston 108 uncovers bleed port 118, at which time some of the pressure below piston 108 will be allowed to escape to atmosphere and a condition of equilibrium for piston 108 will result when pressure above that piston balances the total valve closing force comprising the fluid pressure below the piston and the force exerted by the spring 112. This condition of equilibrium will correspond to an intermediate position for valve 12 and will, therefore, result in a substantial reduction in the amount of fluid supplied through conduit 14 to circuit breaker 18 from reservoir 10. The cross sectional areas of conduit 58 and the portion 59 thereof as well as the cross sectional area of conduit 114 and the size of spring 112 together with the location of bleed port 118 will be chosen to cause piston 108 and valve 12 to assume the proper intermediate position. It may be desirable further to delay the build-up of pressure within cylinder 110 and below piston 108 by the insertion in conduit 114 of a relatively small reservoir such as that indicated by the numeral 116.

In order to cause the valve 12 to move from its partially opened or intermediate position to

its closed position in accordance with my invention, it is simply necessary to close the valve 53. When valve 53 is closed, pressure from within cylinder 110 on the upper side of piston 108 may escape through portion 59 of conduit 58 and through the exhaust vent 55 of valve 53. Pressure from below piston 108 may escape through conduit 114, reservoir 116, portion 59 of conduit 58, and through exhaust vent 55 of pilot valve 53 to atmosphere. An alternate path of escape of pressure from below piston 110 is afforded by the bleed port 118 which is uncovered as soon as the piston 108 moves a short distance toward the valve closed position. The piston 108 moves to its uppermost position under the bias of spring 112. Thus the device is quickly and automatically prepared for a succeeding cycle of operation.

It will be apparent to those skilled in the art that my invention is not limited to the particular construction shown but that changes and modifications may be made without departing from the spirit and scope of my invention and I intend in the appended claims to cover all such changes and modifications.

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

1. A mechanism for controlling the flow of fluid from a source of fluid under pressure to an electric circuit breaker comprising a main valve operative to opened, closed and intermediate positions, a rod operatively connected to said main valve at one end and having a projection at the other end, a cylinder through which said rod is movable axially, a first piston secured to said rod and slidable in said cylinder in response to fluid pressure from said source to move said main valve to its fully opened position, spring means for biasing said first piston and main valve to the closed position, a second piston which is spring biased toward the projection on said rod and slidably mounted thereon and disposed within said cylinder, a partition in said cylinder interposed between said pistons and dividing said cylinder into two chambers, an opening in said partition through which said rod is slidable, and means including ports on said rod for establishing communication between said chambers at a predetermined position of said main valve after the initiation of the opening movement thereof, whereby said main valve is moved to its intermediate position by pressure fluid acting on said second piston and by the action of the biasing springs.

2. A mechanism for controlling the flow of fluid from a source of fluid under pressure to an electric circuit breaker comprising a main valve which is spring biased to closed position and operative to opened, closed and intermediate positions, a piston operatively connected to said main valve, a cylinder for said piston, a conduit interposed between said source and said cylinder for supplying fluid to one side of said piston to cause said main valve to assume its fully opened position, a second piston and cylinder associated with said first piston and operative to move said main valve toward its closed position, an auxiliary valve interposed between said source and said second cylinder and operative at a predetermined time after initiation of the opening movement of said main valve for supplying fluid under pressure to one side of said second piston to cause said main valve to move to its intermediate position, and an adjustable member disposed in the path of fluid flowing through said auxiliary valve for regulating the time required for the main valve to move from its fully opened position to its intermediate position.

3. A mechanism for controlling the flow of fluid from a source of fluid under pressure to an electric circuit breaker, comprising a main valve which is spring biased to closed position and operative to opened, closed and intermediate positions, a piston operatively connected to said main valve, a cylinder for said piston, a conduit interposed between said source and said cylinder for supplying fluid to one side of said piston to cause said main valve to assume its fully opened position, an opening in said cylinder for preventing the build-up of pressure on the other side of said piston, a second piston and cylinder operative to move said main valve toward its closed position, and an auxiliary valve interposed between said source and said second cylinder and operative at a predetermined time after initiation of the opening movement of said main valve for supplying fluid under pressure to one side of said second piston initially to provide a cushioned stop for said second piston and thereafter to cause said main valve to move to its intermediate position.

4. A mechanism for controlling the flow of fluid from a source of fluid under pressure to an electric circuit breaker comprising a main valve which is spring biased to closed position and operative to opened, closed and intermediate positions, a rod operatively connected to said main valve at one end and having a projection at the other end, a cylinder through which said rod is movable axially, a first piston secured to said rod and slidable in said cylinder in response to fluid pressure from said source to move said main valve to its fully opened position, spring means for biasing said first piston and main valve to the closed position, a second piston which is spring biased toward the projection on said rod and slidably mounted thereon and disposed within said cylinder, a partition in said cylinder interposed between said pistons and dividing said cylinder into two chambers, an opening in said partition through which said rod is slidable, and means including ports on said rod for establishing communication between said chambers after the initiation of the opening movement of said main valve for admitting fluid pressure to one side of said second piston to aid such piston and the biasing springs of both pistons in moving said rod and said main valve to the intermediate position.

5. A mechanism for controlling the flow of fluid from a source of fluid under pressure to an electric circuit breaker comprising a main valve which is operative to opened, closed and intermediate positions, a rod operatively connected to said main valve at one end and having a projection at the other end, a cylinder through which said rod is movable axially, a first piston secured to said rod and slidable in said cylinder in response to fluid pressure from said source to move said main valve to its fully opened position, a second piston of larger diameter than said first piston and slidably mounted on said rod within said cylinder, a partition in said cylinder interposed between said pistons and dividing said cylinder into two chambers, an opening in said partition through which said rod is slidable, and means including ports on said rod for establishing communication between said chambers after the initiation of the opening movement of said main valve whereby fluid pressure is admitted to one side of said second piston to

cause such piston to exert a force against said projection sufficient to move said main valve to the intermediate position.

6. A mechanism for controlling the flow of fluid from a source of fluid under pressure to an electric circuit breaker comprising a main valve which is spring biased to closed position and operative to opened, closed, and intermediate positions, a piston operatively associated with said main valve, a cylinder for said piston, a first conduit interposed between said source and said cylinder for supplying fluid to one side of said piston to cause said main valve to assume its fully opened position, means including a second conduit of smaller cross-sectional area than said first conduit for supplying fluid to the other side of said piston to cause said piston to move toward its intermediate position at a predetermined time after said valve has occupied its fully opened position, and a port in said cylinder for venting the fluid from said second conduit to atmosphere upon being uncovered by said piston, said port being positioned to determine the intermediate position of said piston and said main valve.

7. A mechanism for controlling the flow of fluid from a source of fluid under pressure to an electric circuit breaker comprising a main valve which is spring biased to closed position and operative to opened, closed, and intermediate positions, a piston operatively associated with said main valve, a cylinder for said piston, a first conduit interposed between said source and said cylinder for supplying fluid to one side of said piston to cause said main valve to assume its fully opened position, a second conduit for supplying fluid to the other side of said piston to cause said main valve to move toward its closed position, a reservoir in said second conduit for delaying the build-up of fluid pressure on said other side of said piston until a predetermined time after said valve has moved to its opened position, and a port in said cylinder for venting the fluid from said second conduit to atmosphere, said port being positioned to determine the intermediate position of said piston and said main valve.

8. A fluid-actuated operating mechanism comprising a cylinder, piston means in said cylinder, biasing means normally restraining said piston means in one position, means including valve means for supplying fluid pressure to one surface of said piston means to cause movement thereof to an operated position against the action of said biasing means, fluid pressure control means for admitting fluid pressure from said valve means to another surface of said piston means during movement of said piston means toward its operated position, the build-up of pressure at said another surface being effective together with said biasing means to move said piston means toward its normal position, means for arresting said last-mentioned movement of said piston means in an intermediate position, said biasing means being effective to return said piston means to its normal position when the supply of fluid pressure to said piston is cut off.

JULIUS W. TIMMERMAN, JR.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,238,567	Prince	Apr. 15, 1941
2,290,726	Bartlett	July 21, 1942
2,403,328	Banning	July 2, 1946

FOREIGN PATENTS

Number	Country	Date
651,477	Germany	Oct. 14, 1937