

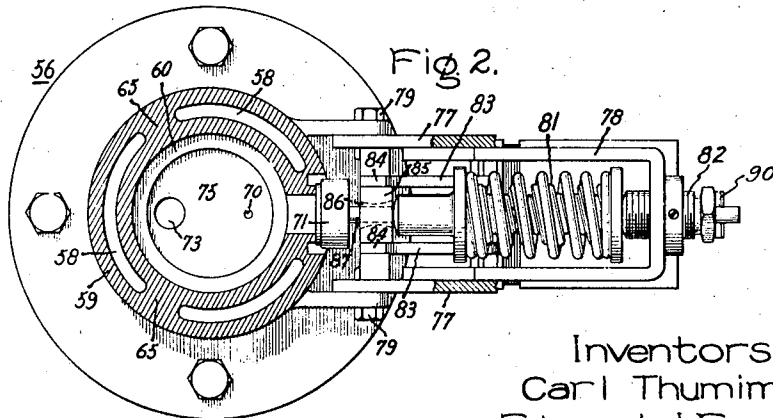
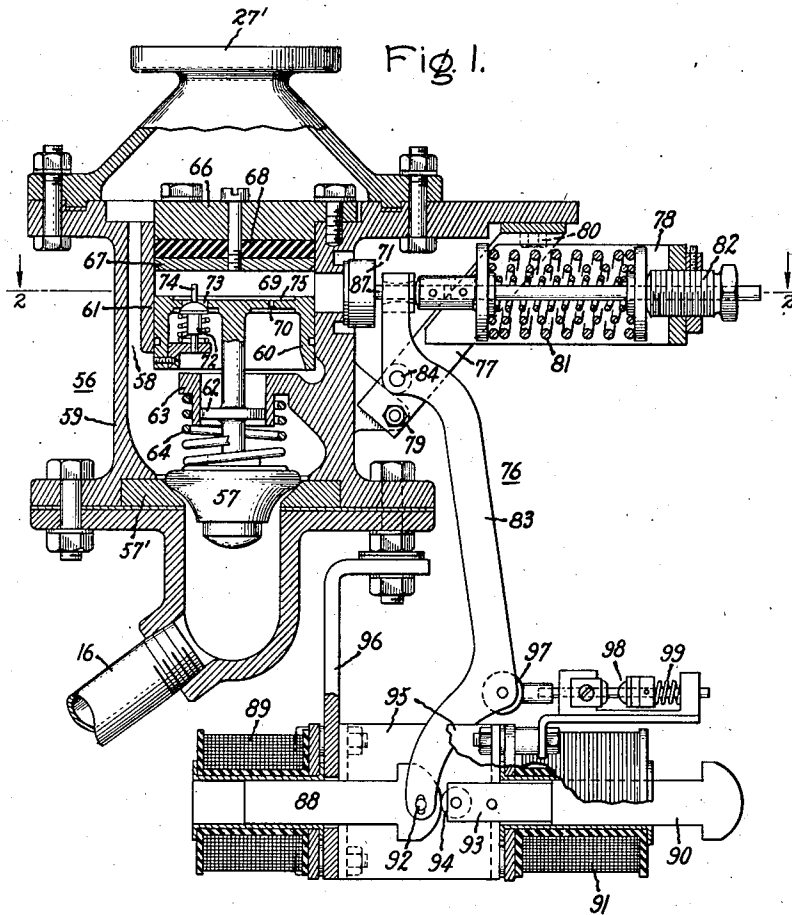
Feb. 2, 1943.

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2,310,130

VALVE SYSTEM

Original Filed Feb. 6, 1940



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UNITED STATES PATENT OFFICE

2,310,130

VALVE SYSTEM

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Original application February 6, 1940, Serial No.
317,564. Divided and this application July 16,
1940, Serial No. 345,810

1 Claim. (Cl. 137—139)

Our invention relates to valve systems and more particularly to valve systems for the control of the flow of gas under pressure such as is used in connection with gas-blast circuit breakers.

This application is a division of our application Serial No. 317,564, filed February 6, 1940, entitled "Circuit breaker operating system" and assigned to the same assignee as the present invention.

In order to eliminate the fire hazard, circuit breakers have been designed which do not utilize oil or other inflammable liquid for arc-extinguishing purposes but instead employ a blast of air or other gas to extinguish the arc formed both when the circuit is broken between the relatively movable contacts of the circuit breaker and also during the closing operation of the circuit breaker to prevent the formation of any arc at this time. Apart from numerous operating and structural advantages of gas-blast circuit breakers for many applications, the problem of providing a suitable control or operating system furnishes considerable difficulty.

The value of any circuit breaker lies in its ability to interrupt the circuit at the proper time and in the proper manner and without a proper operating system for such circuit breaker, its value is largely lost since the value of the operating system lies in its ability to effect control of the circuit breaker in the manner intended. If such control is not obtained in the manner desired, many undesirable conditions may result.

It is necessary to obtain opening of the circuit breaker in as short a time as possible after the condition which initiates the opening movement occurs and this is no less true of gas-blast circuit breakers than of any other type. In order to produce the gas-blast, a valve must be operated releasing the fluid under pressure at the proper instant. To operate such a valve directly against the fluid pressure would require considerable force and, in addition, would tend to slow down the operating cycle of the circuit breaker. Balanced pressure valves have been proposed for this purpose, wherein a pilot valve requiring relatively little force to operate, unbalances the pressure on a piston-operated valve so that the fluid pressure forces the blast valve open. The balanced pressure valves of the prior art did not operate with the speed desired for high-speed circuit breaker operation and gas-blast circuit breaker operating systems employing balanced pressure valves were not as satisfactory as might

be desired. We have provided a new and improved operating system for gas-blast circuit breakers including a balanced pressure type of blast valve which operates at a much higher speed than the balanced pressure valves of the prior art.

Accordingly, it is an object of our invention to provide a new and improved blast valve for controlling the flow of fluid.

It is another object of our invention to provide a new and improved valve system in which a small operating force may control a relatively large valve operating it at high speed.

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 claim annexed to and forming a part of this specification.

For a better understanding of our invention, reference may be had to the accompanying drawing in which Fig. 1 is a cross-sectional view of the blast valve of our invention, and Fig. 2 is a sectional view taken on line 2—2 of Fig. 1.

Referring now to the drawing, we have illustrated blast valve 56 as controlling the flow of fluid between conduits 27' and 16. Conduit 27' is connected to a source of fluid under pressure, not shown, while conduit 16 may be connected to the arc chute of a suitable circuit breaker, also not shown. Blast valve 56 of the balanced pressure type is illustrated as comprising a streamlined valve member 57 which controls the flow of fluid between conduit 27' and conduit 16 through annular passageway 58. Valve member 57 cooperates with a replaceable valve seat 57' which is mounted in a casing 59 enclosing a cylinder 61 within which piston 60 operatively connected to valve member 57 reciprocates. Piston 60 is preferably flexibly connected with valve member 57 for the purpose of self-alignment and is provided with a valve guide 62 reciprocating in a sleeve-like member 63. A spring member 64 is placed between sleeve member 63 and valve member 57 normally to tend to hold said valve member in the closed position. Cylinder 61, sleeve-like member 63, and spring member 64 are supported centrally by radial ribs 65 bridging across annular air passage 58.

The upper end of cylinder 61 is closed by a plate 66 to which is fastened a metallic striking plate 67. Between the metallic striking plate 67 and plate 66 is a flexible buffer disk 68 to cushion the opening of blast valve 56. The space 69 in cylinder 61 between piston 60 and striking plate

67 is maintained at the absolute minimum determined only by the space required for opening valve 57 as will be set forth in greater detail hereinafter. A small passage 70 is provided in piston 60 to interconnect the cylinder 61 on either side of piston 60 and, hence, to balance the pressures operating on the upper and lower surfaces under steady-state conditions. The area of piston 60 is relatively large compared to the area of valve member 57 so that a considerably lower pressure operating on piston 60 may overcome a higher pressure operating on valve member 57.

In order to open blast valve 56, a pilot valve 71 of relatively large diameter is opened, rapidly releasing the pressure on the upper side of piston 60, whereby an unbalance of the pressure on piston 60 is obtained and the fluid pressure operating against the under side of piston 60 is sufficient to overcome the forces holding valve member 57 closed, which comprise the fluid pressure acting on the back of valve member 57 and spring means 64. Thereupon valve member 57 is forced open rapidly and piston 60 contacts with striking plate 67 whereupon check valve 72 closing port 73 in piston 60 is opened by virtue of the extension 74 thereon which engages with striking plate 67. The upper surface of piston 60 is recessed at 75 so that fluid pressure either through small passage 70 or port 73 within which check valve 72 operates is distributed over the entire upper surface of piston 60.

The time of opening of valve 57 is dependent upon the rate of pressure drop in space 69 which, in turn is a function of the volume of space 69 and the area of pilot valve 71. In the balanced pressure valves of the prior art, the volume of space 69 was necessarily large to accommodate the biasing spring which was contained in this space. By eliminating spring 64 from space 69, it has been possible to decrease greatly the volume of space 69 determined only by the clearance necessary for valve member 57. Furthermore, the area of pilot valve 71 has been made as large as practicable and this combination has enabled us to obtain an operating speed much higher than was possible heretofore.

Check valve 72 is provided so that pressure in space 69 may be built up rapidly when pilot valve 71 is closed so that valve member 57 is snapped shut in a minimum period of time. The extension 74 on check valve 72 is sufficiently long so that check valve 72 is maintained in the open position for a reasonable length of time to prevent fluttering of the valve member 57.

It will be understood by those skilled in the art that operation of pilot valve 71 requires considerably less operating force than would be required to open blast valve 57 directly. The pilot valve 71 and operating mechanism 76 therefor are mounted as a complete constructional unit in U-shaped frame members 77 and 78 which are bolted at 79 and 80, respectively, to casing 59. Pilot valve 71 is held in the closed position by means of spring mechanism 81 supported by U-shaped member 78 and including adjustable means 82 by which the closing force on pilot valve 71 may be adjusted to just overcome the normal fluid pressure in space 69 tending to open pilot valve 71. Movement of pilot valve 71 against the force of spring mechanism 81 is effected through a pair of levers 83 pivotally mounted at 84 to U-shaped member 77 and interconnected by block 85 provided with an opening 86 through which rod 87 for operating pilot valve 71 is con-

nected. This opening 86 in block 85 is enlarged at either end thereof so as to prevent any binding action between rod 87 and block 85 during the pivotal movement of levers 83. Pivotal movement of levers 83 is obtained either by the leftward pull of armature 88 of solenoid 89 or by the leftward thrust of armature 90 of solenoid 91. Pivotally mounted levers 83 are connected in clevislike fashion to armature 88 at 92 while an extension 93 provided with a roller 94 is connected to armature 90 of solenoid 91 so that movement of armature 90 may be transmitted through roller 94 and armature 88 to pivotally mounted members 83 for operating pilot valve 71. Solenoids 89 and 91 are coaxially mounted and connected to one another by means of U-shaped plates 95. The entire apparatus including solenoids 89 and 91 is supported from casing 59 as a unitary structure by member 96.

Pivotally mounted levers 83 may be provided with a roller 97 for operating a suitable switch 98, biased to the closed position by spring means 99, whenever pilot valve 71 is opened.

The operation of balanced pressure valve 56 will be obvious to those skilled in the art in view of the detailed description included above. If either solenoid 89 or 91 is energized, levers 83 are rotated so as to open pilot valve 71 against the bias of spring means 81. Such opening of pilot valve 71 will allow the pressure in space 69 to decrease rapidly so that the pressure balance on piston 60 is disturbed and the force acting upwardly on piston 60 being very large with respect to the downwardly acting forces causes opening of valve member 57 so that a blast of fluid may flow from conduit 27' through annular passageway 59 to conduit 16. As long as pilot valve 71 is open, the relatively large diameter thereof allows any fluid passing through small opening 70 to escape, thereby maintaining an unbalanced pressure on piston 60 so that valve member 57 remains in its open position.

Because of the sudden unbalance of pressures on piston 60 when pilot valve 71 is open, valve member 57 opens at very high speed and piston 60 engages with resiliently supported striking plate 67. Extension 74 of check valve 72 engages with striking plate 67 and causes opening of this valve but, as long as pilot valve 71 is open, insufficient fluid pressure is allowed to pass to the upper end of cylinder 61 so that valve member 57 is held in the open position by the unbalanced fluid pressures. Upon deenergization of either of the solenoids 89 or 91, pilot valve 71 will snap shut under the force of spring means 81 and the very small volume 69 above piston 60 is rapidly filled with fluid through opening 70 and check valve 72. As soon as sufficient pressure is built up therein, valve member 57 is snapped shut, thereby cutting off communication between conduits 27' and 16. From the above description, it will be observed that a relatively small force is required to open pilot valve 71, which causes operation of balanced pressure valve 56 against the high fluid pressures which are controlled by valve 56.

Although we have described our invention as usable in connection with a gas-blast circuit breaker, it will be understood by those skilled in the art that it is applicable to any arrangement where it is desired to control the flow of fluid under pressure to a lower pressure region.

It will be apparent to those skilled in the art that our invention is not limited to the particular construction shown but that changes and modi-

fications may be made without departing from the spirit and scope of our invention and we aim in the appended claim to cover all such changes and modifications.

What we claim as new and desire to secure 5
by Letters Patent of the United States is:

A valve system comprising a main valve member for controlling the flow of fluid between a source of fluid under pressure and a fluid passage, a piston operatively connected to said main 10
valve member, a cylinder for said piston, means for closing one end of said cylinder to define a chamber in said cylinder having a minimum volume determined solely by the opening movement of said main valve member, said piston and cylinder being so constructed and arranged that the 15
forces acting on said piston due to fluid under

pressure are substantially neutralized during the closed position of said valve, a solenoid-operated pilot valve for substantially instantaneously releasing the fluid under pressure in said chamber to unbalance the forces acting on said piston and cause high-speed opening of said valve, means for limiting and cushioning the opening movement of said valve, and a check valve in said piston arranged to engage with said last-mentioned means to cause opening thereof when said main valve is in the open position, whereby high-speed closing of said main valve is obtained upon closing of said pilot valve.

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