

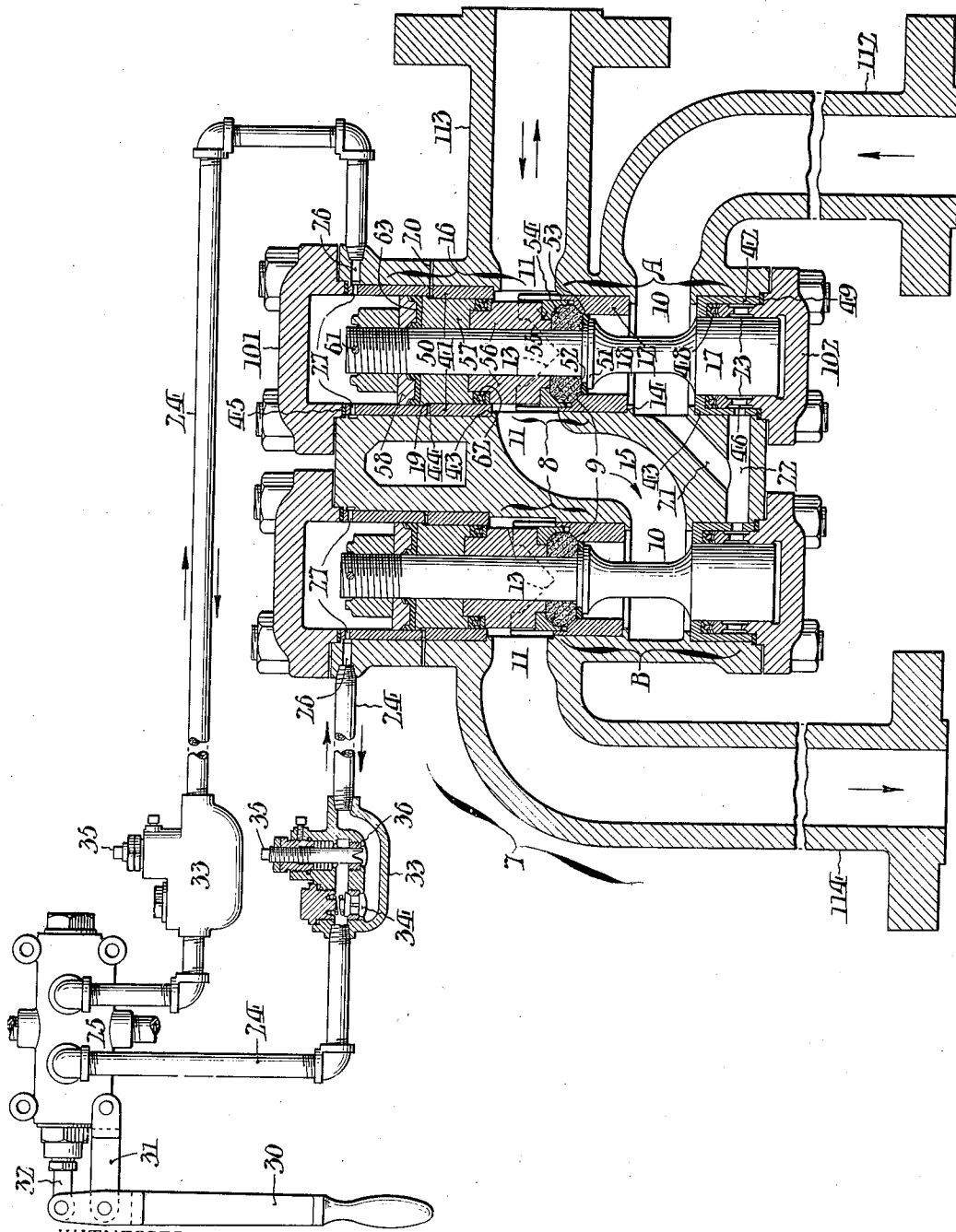
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VALVE DEVICE

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VALVE DEVICE

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This invention relates to valve devices, and particularly fluid actuated valves. The invention is especially adaptable and advantageous for control or manipulator valves that admit high pressure fluid to the operating cylinders of hydraulic presses or the like, and also vent or exhaust the spent fluid. The invention permits of controlling the rates of movement of the valve(s) both ways, closing them slowly and opening them quickly, or vice versa, as desired. It also affords the advantage that valves can be closed against the flow through them, rather than with the flow, as usual, thus avoiding hammering of the valve against its seat. However, the valves can also be closed with the flow with a minimization of hammer against the seat, if this is desired for any reason.

Various other features and advantages of the invention will appear from the following description of a species or form of embodiment, and from the drawing.

The drawing shows a longitudinal section through a valve device conveniently embodying the invention, and also shows, mainly in elevation, arrangements for supplying actuating fluid to the valve device and venting the fluid from it.

The valve mechanism here illustrated includes two valve members A and B movable to and fro in adjacent parallel bores in a casing 7, and each including a valve head 8 cooperating with an annular seat 9 immediately located in the length of the valve bore. As shown, the upper and lower ends of the valve bores are closed by removable covers 101, 102, detachably bolted to the casing 7. Preferably, the valve head 8 seats against the seat 9 as a poppet valve; accordingly, the annular valve seat 9 is shown beveled, and the annular surface of the valve head 8 that seats against it is correspondingly beveled, —both, as shown, to an angle of 45°. Each valve bore has ports and passages 10, 11 at opposite sides of its seat 9 (above and below said seat) for the fluid controlled by the valve. Preferably, each valve head 8 also coacts peripherally (as a piston valve) with a corresponding portion of its valve bore, which may be formed in a sleeve 12 upstanding from and integral with the seat 9. The sleeve 12 is apertured or notched (in a tapering or V-shape) at 13, substantially above the seat 9, for communication between its interior and the port 11. The sleeve 12 (which includes the seat 9 as an internal shoulder therein) is shown as a removable liner fitted in the casing 7 and abutting against a shoulder 14. As here shown, the valve casing 7 has fluid connections 112, 113, and 114

which lead to the ports 10, 11 of the valve A and to the port 11 of the valve B, and which may be connected, respectively, to a source of fluid under pressure, to a hydraulic cylinder of a press or the like, and to an exhaust or discharge for spent fluid. There is also in the casing 7 a passage or duct 15 that connects the outlet port 11 of the valve A to the inlet port 10 of the valve B. With these connections, the valve A serves as an admission valve for admitting fluid under pressure from the supply connection 112 to the hydraulic cylinder connection 113, and the valve B serves as an exhaust valve for venting spent fluid from the cylinder connection 113 to the exhaust connection 114. Accordingly, the ports 10 of both valves serve as inlet ports and the ports 11 as outflow ports; and the valves A, B open with the flow through the valve seats 9, and close against this flow,—though these relations might readily be reversed, if desired.

As the valves A and B and the associated features of the casing 7 are substantially just alike, only the valve A and its bore are described in detail.

Besides the valve head 8, the valve member A comprises upper and lower piston heads 16 and 17 operating in opposite ends of the valve bore, beyond the inlet and outlet ports 10 and 11, to move the valve to and fro to seat and unseat the valve head 8. Between the valve head 8 and the piston head 17, the valve A is reduced at 18 to permit passage of fluid through the seat 9 when the valve is open. As shown, the piston head 16 and the upper portion of the valve bore, above the seat 9, are larger than the piston head 17 and the lower portion of said bore, below said seat 9; and at 19, substantially above the port 11, the piston head 16 and the upper portion of the valve bore are enlarged to a still larger size than just above said seat 9. The annular space or shoulder at 19 is suitably vented,—as by one or more ports or passages 20 leading out through the wall of the casing 7 to the atmosphere, at a point where its outlet is plainly visible on the outside of the casing,—so as to expose to atmospheric pressure the differential annular shoulder 19 by whose area the upper portion of the piston head 16 exceeds in cross section the lower portion of said piston head. Even when the valve A is open, therefore, the upper piston head 16 presents at its outer side a greater area to be acted on by pressure tending to close the valve than the annular (beveled) seating surface of the valve head 8 and the outer side of the lower piston 17 present to be acted on by pressure tending

to open the valve. When the valve is seated, on the other hand, the valve head 8 and the piston head 17 present equal opposing areas to the pressure fluid to be controlled, and the only areas exposed to be acted on by the opposing pressures tending to open the valve and to hold it closed are those of the outer faces of the pistons 17 and 16, respectively.

The valve A is preferably opened by fluid pressure constantly supplied to the outer side of the lower piston head 17, and is preferably closed by fluid pressure supplied to the outer side of the upper piston 16 when it is desired to close the valve. For constantly supplying valve-opening pressure fluid to the outer side of the piston head 17, there is shown a by-pass connection comprising a passage 21 communicating with the fluid supply connection 112 of the casing 7 through the inlet port 10, and opening into a cross passage 22 in the casing 7. One end of this cross passage 22 opens through the surface of the valve bore into a shallow annular groove 23 around the piston head 17, and from this groove 23 fluid may leak down around piston head 17 into the lower end of the valve bore. In a similar manner, fluid under pressure may be supplied from the other end of the cross passage 22 to the lower side of the lower piston 17 of the valve B. For supplying and venting valve closing pressure fluid to and from the outer side of the upper pistons 16 of the two valves A, B, there are shown pipe connections 24 to an auxiliary admission and exhaust valve device 25 of any suitable type and construction. As here shown, the pipes 24 connect into annular ducts 26 formed in the thickness of the casing wall 7, and themselves connected into the upper ends of the valve bores through ports 27. The valve proper (not shown) may be manually manipulated by means such as a hand lever 30 (shown as fulcrumed on one end of a link 31, whose other end is pivoted to the valve casing 25) that is pivotally connected at its upper end to the stem 32 of the valve 25. As here shown, there is interposed in each of the pipe lines 24 a check and regulating valve device 33, comprising a spring-actuated check valve 34 opening upward to permit free return flow toward the valve 25, and a screw threaded "needle" valve member 35 which may be screwed up and down through its seat opening 36 to control the freedom of outflow from the valve 25 to the valve casing 7. The lower end of the valve member 35 may have a transverse V-groove across it, to give delicate regulation.

As here shown, the internal surface of each valve bore that coacts with the piston heads 16 and 17 is formed by suitable removable liners 41 and 42 fitted in the casing and abutting endwise against suitable shoulders 43. The shoulder of the valve bore at 19 is formed in the upper liner 41, as well as the inner portions of the vent passage(s) 20, and the ports 27. The liner 41 may be annularly and externally grooved at 44, to assure connection between the inner and outer portions of the passage(s) 20 when the liner is put in place. This liner 41 is held against its shoulder 43 in the casing 7 by the upper valve-bore cap 101, a fluid-tight joint being made by an annular packing ring 45 interposed between the end of the liner 41 and an annular ridge on the cap 101. As here shown, the cap 101 is recessed to afford an upward extension of the valve bore. The piston head 16 may be provided with means for making it fluid tight in both the smaller and

larger upper portions of the valve bore in the liner 41, as explained hereinafter.

As already indicated, the lower portion of the piston head 17 preferably works rather loosely in the line 42, so as to permit leakage of fluid from the internal groove 23 in said liner to the outer, lower side of said piston head. In the present instance, the liner 42 includes an inner part 45 telescoping into the other part of the liner and integral with the lower valve-bore cap 102. The part 45 may have an external annular groove 46, as well as the internal annular groove 23 and the ports interconnecting said grooves. Annular packing 48 for making the upper part of the piston head 17 fluid-tight in the valve bore is interposed between the upper end of the part 45 and a superjacent internal shoulder on the liner 42. A fluid-tight joint between the cap 102 and the casing may be made by means of a packing ring 49 interposed between the lower end of liner 42 and a shoulder on the cap 102, around its portion 45.

As here shown, the valve piston A is a built-up member, comprising a main part 50 including the lower head 17 and the adjacent reduced portion of the valve, and provided with a couple of shoulders 51, 52 above said neck; a series of annular or cylindrical members 53, 54, 55, 56, 57, 58 mounted on the cylindrical shank of said part 50 above the shoulder 51; and a (castellated) nut 60, for clamping the parts together, screwed on the upper end of said shank and suitably locked, as by a pin 61. The member 53 is shown as a hard rubber or similar ring resting on the shoulder 51 around the shoulder 52. The member 54 is shown as a doubly beveled reversible disc of elastic packing material, one bevel of which forms the active surface of the valve head 8. The member 55 is shown as a metal ring whose outer periphery fits in the upper portion of the sleeve 12, and is of the same diameter as the smaller lower bore of the upper liner 41, while its lower side is recessed to accommodate the upper portion of the member 54. This member 55 fits around the reduced lower end of the metal member 56, which is shown as slightly smaller than the member 55. An annular packing 62 is mounted around the reduced upper end of the member 56, between its shoulder and the end of the superjacent metal member 57,—which fits easily in the lower and upper bores of the liner 41,—making the lower portion of the piston 16 fluid-tight in the lower bore of the liner 41. The metal member 58 serves as follower for the cup packing 63 that makes the upper end of the piston head 16 fluid tight in the larger upper bore of the liner 41.

The vent port or passage 20 from the annular space at 19 intermediate the lower and upper packings 62, 63 of the upper piston head 16 of the valve member A affords a means of determining the condition of these packings. So long as they are both properly fluid-tight, there is no escape of fluid from the port 20; but if either packing 62, 63 begins to leak, the escaping liquid will be visible at this port. If such escape is observed when the valve A is closed and pressure is applied on the upper end of the piston head 16, it means that the upper packing 63 is leaking; if it is observed when the valve A is open and the upper end of the piston head 16 is vented, it means that the lower packing 62 is leaking. Escape of fluid at 20 all the time would, of course, indicate leakage at both the packings 62, 63.

A mode of operation of the valve device is as follows:

As shown, both the valves A, B are seated, cutting off the cylinder connection 13 from both pressure and exhaust, and thus locking the controlled press piston (not shown); and the manipulator valve 25 is accordingly in mid-position. If this valve 25 is now shifted to admit actuating fluid under pressure (which may be water or oil from the main supply controlled by the valve A, and at the same pressure as this main supply) above the piston 16 of the valve A, this valve A will remain closed. By this same movement of valve 25, however, the upper or outer side of piston 16 of valve B will be vented; and the pressure on the lower or outer side of its piston 17 will therefore open the valve B, venting the piston of the press or the like to exhaust. If and when the valve 25 is shifted the other way, to admit actuating fluid under pressure to the upper outer side of the piston 16 of valve B and to vent the upper outer side of the piston 16 of valve A, valve B will be closed to shut off the press cylinder from exhaust, and valve A will be opened to admit pressure fluid to the press piston. At any desired point of the press piston stroke, valve 25 can be thrown to mid-position, closing both valves A, B as shown, and locking the press piston in position.

It will be seen that the pressure active in closing the valves A, B is merely that on the differential areas at 19, and that their closing movements take place against the flow through the valve seats 9, and hence without hammering. By proper adjustment of the regulator valve members 35, these closing movements can be made as slow and gradual as desired. On the other hand, the opening movements of the valves A, B are produced by pressure on the full areas of the piston heads 16, 16, without any resistance but what is imposed by the size of the pipes 24, and can therefore be as quick as desired. It will also be apparent that by reversing the devices 33 in the pipe lines 24, they can be used to control and vary the rapidity of opening of the valve A, B, if that should be desirable.

Having thus described my invention, I claim:

1. In a valve, the combination of a casing having a valve bore with inlet and outlet ports for the fluid to be controlled, and a valve seat between said inlet and outlet ports, said valve bore being larger at the side of said valve seat where the outlet port is than at the side where the inlet port is; a valve member in said casing movable to and fro through said seat, and having a valve head portion for seating against said seat to close passage therethrough between said inlet and outlet ports, and also having piston heads in said valve bore at opposite sides of said valve seat beyond said inlet and outlet ports, said valve head and the piston head beyond said inlet port presenting equal areas to the fluid to be controlled when the valve is seated against its said seat, but the piston head beyond said outlet port presenting a greater area at its outer side than the piston head beyond said inlet port presents at its outer side; means for constantly supplying valve-opening pressure fluid to said casing at the outer side of the piston head beyond said inlet port; and means for supplying and venting valve-closing pressure fluid to and from said casing at the outer side of the piston head beyond said outlet port; so that the valve head is opened by the constant pressure on the outer side of the one piston head when the other side of the other

piston head is vented, and is closed against the flow through said valve seat by pressure on the outer side of said other piston head overcoming the constant pressure on the outer side of the first-mentioned piston head.

2. In a valve, the combination of a casing having a valve bore with inlet and outlet ports for the fluid to be controlled and a valve seat between said inlet and outlet ports, said valve bore being larger at the side of said valve seat where the outlet port is than at the side where the inlet port is; a valve member in said casing movable to and fro through said seat, and having a valve head portion for seating against said seat to close passage therethrough between said inlet and outlet ports, and also having piston heads in said valve bore at opposite sides of said valve seat beyond said inlet and outlet ports, said valve head and the piston head beyond said inlet port presenting equal areas to the fluid to be controlled when the valve is seated against its said seat, but the piston head beyond said outlet port presenting a greater area at its outer side than said valve head and the outer side of the piston head beyond said inlet port present to valve-opening pressure when the valve is unseated, and the differential area being constantly vented; means for constantly supplying valve opening pressure fluid to said casing at the outer side of the piston head beyond said inlet port; and means for supplying and venting valve-closing pressure fluid to and from said casing at the outer side of the piston head beyond said outlet port; so that the valve head is opened by the constant pressure on the outer side of the one piston head when the other side of the other piston head is vented, and is closed against the flow through said valve seat by pressure on the outer side of said other piston head overcoming the constant pressure on the outer side of the first-mentioned piston head.

3. In a valve, the combination of a casing having a valve bore with inlet and outlet ports for the fluid to be controlled, and a valve seat between said inlet and outlet ports; a valve member in said casing movable to and fro through said seat, and having a valve head portion for coacting with said seat to close and open the passage therethrough between said inlet and outlet ports, and also having piston heads in said valve bore at opposite sides of said valve seat beyond said inlet and outlet ports, the piston head beyond said inlet port being more pressure tight in the valve bore adjacent said inlet port than at its end remote therefrom; means for constantly supplying valve opening pressure fluid to said casing at the outer side of the piston head beyond said inlet port, comprising a by-pass from said inlet port to the portion of said piston head that is less pressure tight, where fluid may leak along the piston head to its outer side; and means for supplying and venting valve-closing pressure fluid to and from said casing at the outer side of the piston head beyond said outlet port; so that the valve head is opened by the constant pressure on the outer side of the one piston head when the other side of the other piston head is vented, and is closed against the flow through said valve seat by pressure on the outer side of said other piston head overcoming the constant pressure on the outer side of the first-mentioned piston head.

4. In a valve, the combination of a casing having a valve bore with inlet and outlet ports for the fluid to be controlled and a valve seat be-

tween said inlet and outlet ports, said valve bore being larger at the side of said valve seat where the outlet port is than at the side where the inlet port is; a valve member in said casing movable to and fro through said seat, and having a valve head portion for seating against said seat to close passage therethrough between said inlet and outlet ports, and also having piston heads in said valve bore at opposite sides of said valve seat beyond said inlet and outlet ports, the piston head beyond said outlet port presenting a greater area at its outer side than said valve head and the outer side of the piston head beyond said inlet port present to valve-opening pressure when the valve is unseated, and the differential area being constantly vented through a passage whose outlet is visible; means for constantly supplying valve-opening pressure fluid to said casing at the outer side of the piston head beyond said inlet port; and means for supplying and venting valve-closing pressure fluid to and from said casing at the outer side of the piston head beyond said outlet port; so that the valve head is opened by the constant pressure on the outer side of the one piston head when the other side of the other piston head is vented, and is closed against the flow through said valve seat by pressure on the outer side of said other piston head overcoming the constant pressure on the outer side of the first-mentioned piston head.

5. In a valve, the combination of a casing having adjacent valve bores for fluid admission and exhaust valves, each of said valve bores being provided with inlet and outlet ports for the fluid to be controlled, and a valve seat between said inlet and outlet ports, the outlet port of the admission valve bore being connected to the inlet port of the exhaust valve bore; a valve member in each of said valve bores movable to and fro through its said seat, and having a valve head portion for coacting with said seat to close and open the passage therethrough between its said inlet and outlet ports, and also having piston heads in the valve bore at opposite sides of its valve seat, beyond its inlet and outlet ports; means for constantly supplying valve-opening pressure fluid to said casing at the outer sides of the piston heads beyond the inlet ports; and means for supplying valve-closing pressure fluid to said casing at the outer side of the piston head beyond one outlet port, and for concurrently venting the outer side of the piston head beyond the other outlet port, and vice versa; so that each valve head is opened by the constant pressure on

the outer side of one corresponding piston head when the outer side of the other corresponding piston head is vented, and is closed against the flow through said valve seat by pressure on the outer side of said other piston head overcoming the constant pressure on the outer side of the first-mentioned piston head, whereby one valve head is opened when the other is closed, and vice versa.

6. In a valve, the combination with a casing having adjacent valve bores for fluid admission and exhaust valves, each of said valve bores being provided with inlet and outlet ports for the fluid to be controlled, and a valve seat between said inlet and outlet ports, said valve bore being larger at the side of said valve seat where the outlet port is than at the side where the inlet port is, and the outlet port of the admission valve bore being connected to the inlet port of the exhaust valve bore; a valve member in each of said valve bores movable to and fro through its said seat, and having a valve head portion for seating against said seat to close passage therethrough between its said inlet and outlet ports, and also having piston heads in the valve bore at opposite sides of its valve seat, beyond its inlet and outlet ports, the piston head beyond each outlet port presenting a greater area at its outer side than the corresponding valve head and the outer side of the piston head beyond the corresponding inlet port present to valve-opening pressure when the valve is unseated, and the differential areas being constantly vented; means for constantly supplying valve-opening pressure fluid to said casing at the outer sides of the piston heads beyond the inlet ports, comprising a by-pass from the inlet port of the admission valve-bore; and means for supplying valve-closing pressure fluid to said casing at the outer side of the piston head beyond one outlet port, and for concurrently venting the outer side of the piston head beyond the other outlet port, and vice versa; so that each valve head is opened by the constant pressure on the outer side of one corresponding piston head when the outer side of the other corresponding piston head is vented, and is closed against the flow through said valve seat by pressure on the outer side of said other piston head overcoming the constant pressure on the outer side of the first-mentioned piston head, whereby one valve head is opened when the other is closed, and vice-versa.

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