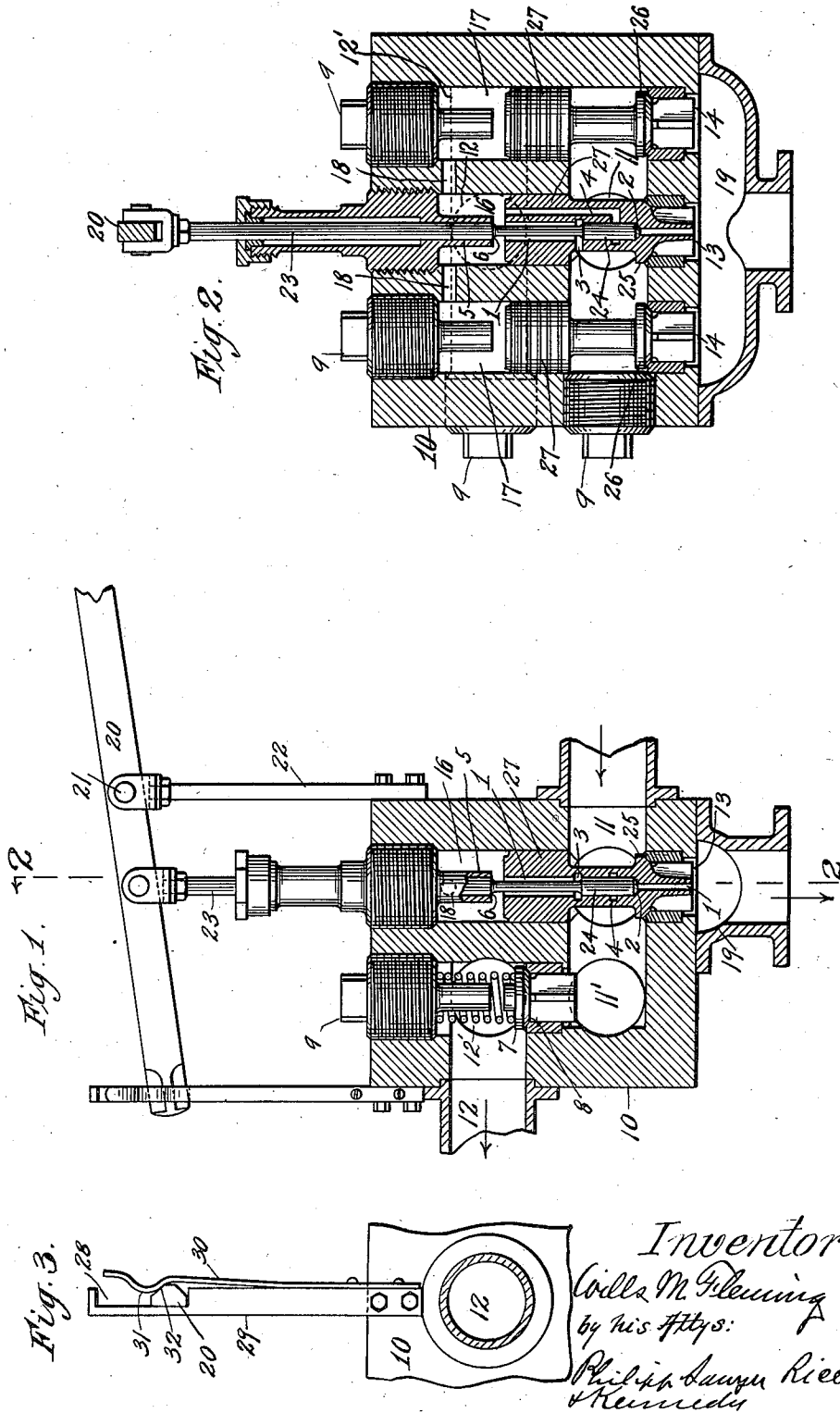


W. M. FLEMING.
HYDRAULIC BY-PASS VALVE.
APPLICATION FILED NOV. 9, 1915.

1,202,173.

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UNITED STATES PATENT OFFICE.

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HYDRAULIC BY-PASS VALVE.

1,202,173.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WILLS M. FLEMING, a citizen of the United States, residing at Holyoke, county of Hampden, and State of Massachusetts, have invented certain new and useful Improvements in Hydraulic By-Pass Valves, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to improvements in high pressure hydraulic by-pass valves whereby the discharge from power operated high pressure pumps delivering to an accumulator or directly to hydraulically operated machinery may be diverted during periods in which the discharge of the pump is not being utilized or otherwise when it is desired that the pump shall discharge against no load.

The especial object of the invention is to produce a by-pass valve construction of this class that shall be simple and rugged in construction, with the pilot valve balanced so as to be suitable for very heavy pressures and by which all fluttering of the by-pass valve or pilot valve shall be eliminated, and dancing of the accumulator piston avoided.

A further object of the invention is the production of a hydraulic by-pass construction in which the by-passing of the fluid shall be accomplished by a multiplicity of by-pass valves controlled and operated by a single pilot valve and large flows and high pressures thus controlled with a pilot valve of moderate size.

For a full understanding of the invention a detailed description of a construction embodying the invention in its preferred form will now be given in connection with the accompanying drawings forming a part of this specification and the features forming the invention will then be specifically pointed out in the claims.

In the drawings; Figure 1 is a central vertical section of a by-pass valve construction embodying the invention. Fig. 2 is a section on the line 2—2 of Fig. 1. Fig. 3 is a detail view of the device for securing a full throw of the pilot valve.

Referring to the drawings, a suitable casing 10, preferably formed of a single forged billet with all the water passages worked

out of the solid block, as shown, is provided with inlet 11 from the pump, connecting with inlet chamber 11' formed by a cross passage in the block, discharge 12 connecting with a passage forming discharge chamber 12', with spring pressed discharge valves 7 seated on discharge ports 8 between chambers 11', 12', of which valves and ports one is shown, main by-pass port 13 and auxiliary by-pass ports 14, these by-pass ports 13, 14 connecting chamber 11' with waste or by-pass discharge casing 19 connected to the pump suction or other low pressure discharge, and being controlled by main and auxiliary by-pass valves 25, 26, the stems of which carry pistons 27, which pistons work in pressure chambers 16, 17 above the chamber 11' and connected by passages 18. The passages and chambers are all bored in the block or casing 10, the ends of the bores at the sides of the block being stopped by screw plugs 9. Lever 20, operated by hand, or automatically by the position of the accumulator piston or otherwise, is fulcrumed in any suitable manner as at 21 on standard 22 and is connected to stem 23 of the pilot valve 24, seating and operating in main by-pass valve 25. By-pass valve 25 is provided with a central passage 1, running the full length of the valve body and contracted at its lower end to provide a seat 2 for the end of the pilot valve 24. A passage 3 in the piston 27 connecting with central passage 1 above the pilot valve establishes communication between the pressure chambers 16, 17, and the inlet chamber 11 and another passage 4 in the piston 27 connects the chambers 16, 17 with the lower portion of the passage 1, a short distance above seat 2. Pilot valve 24 is formed above seat 2 as a plunger valve of such length as to control ports 3, 4, and these ports are so positioned that the pilot valve closes port 3 before it opens port 4 in its opening movement and closes port 4 before it opens port 3 in its closing movement. The pilot valve also fully opens the port through seat 2 into discharge 1, before opening port 4, and closes port 4 before closing this discharge port, so that there is no pressure flow over seat 2 with the pilot valve partially open. The pilot valve stem works in a sleeve 5 within pressure chamber 16, and is formed with a

shoulder or piston 6 subject to the pressure in chamber 16, the area of this shoulder or piston being such as to balance the downward pressure on the top of the pilot valve when closed. The lever 20 preferably extends beyond the pilot valve spindle 23 and works in a groove 28 in guide 29, and is held in either its uppermost or lowermost position by the spring 30 formed with a bend 31 acting upon a cam portion 32 provided at the end of lever 20, so as to throw the pilot valve to the end of its movement after passing the center and thus assure a full quick throw of the pilot valve, and to hold it in either position.

The operation of the construction is as follows: The pressure fluid passes from chamber 11' by discharge valves 7 into discharge chamber 12' and through pipe 12 to an accumulator or to the hydraulically operated machinery, and through passages 3 and 1, in the main by-pass valve piston 27 to the pressure chamber 16, and through passages 18 to the auxiliary pressure chamber 17, thus holding the by-pass valves 25, 26 closed by the pressure on the top of pistons 27. When the pressure fluid is to be by-passed, the lever 20 is operated by hand or automatically, as arranged, to raise pilot valve 24 which, in its upward movement, first shuts off connection between passages 3 and 1 so as to close the pressure chambers 16, 17 to the inlet and opens the port through seat 2, and then opens passage 4 from pressure chamber 16 to discharge, thus relieving the pressure in chambers 16, 17. The main by-pass valve 25 and the auxiliary by-pass valves 26 then open and the valves 7 close and the pressure fluid will be by-passed through by-pass ports 13, 14 to the waste discharge 19. On the movement of lever 20 to close pilot valve 24 to stop by-passing, the pilot valve first closes passage 4 so as to stop the flow of liquid from pressure chambers 16, 17, and then opens passage 3 to admit pressure fluid to these chambers and closes the port through seat 2. There is no period, therefore, either in opening or closing the pilot valve during which pressure fluid is circulating through passages 3, 4, and over the pilot valve seat.

The avoidance of flow of pressure fluid from the inlet through the pilot valve port avoids the rapid cutting and quick destruction of the pilot valve and its seat, which would be caused by such high pressure flow, and the fluttering of the pilot valve which would be thus caused and would result in pounding and breakage. The spring 30 and cam 32 assure the pilot valve, and consequently the by-pass valves being full open or full shut, and secure a quick throw of the pilot valve to full open or full shut position, and thus prevent the wire drawing and cutting of the valves and seats that would

result from partial opening. The pilot valve is perfectly balanced when closed so that it may readily be operated by hand or a solenoid, notwithstanding very high pressures are used. Moreover, with an accumulator and the demand upon the accumulator equal to the capacity of the pump delivering to it, the dancing of the accumulator piston, which results with the usual by-pass valve constructions, on account of the repeated quick opening and closing of the by-pass valve, is prevented by my construction with the "lap" on the pilot valve requiring an appreciable time for the pilot valve to move from open to closed position, and vice versa. The use of a casing formed in a single forged billet with the passages worked therein, and metal to metal pressure joints, avoids the use of packing, stuffing boxes, gaskets, and such small parts, and the use of very high pressures is thus made more practicable. The use of a plurality of by-pass valves is much preferable for hydraulic systems of large flow at high pressure, a single large valve being more liable to wear and breakage.

It will be understood that the invention, broadly considered, is not to be limited to the use of a plurality of by-pass valves nor to a casing formed in a single block with the passages worked therein, although these form specific features of my invention, but that a single by-pass valve and casings of other form may be used. It will be understood, also, that the invention is not to be limited to the exact form or arrangement of by-pass and pilot valve arrangement illustrated, but that many modifications may be made within the invention as defined by the claims.

What I claim is:

1. In a hydraulic by-pass system, the combination with the by-pass valve and its pressure chamber for closing the valve, and inlet and outlet ports for said pressure chamber, of a pilot valve controlling said ports and arranged to close the inlet port before opening the outlet port on the opening movement of the pilot valve and to close the outlet port before opening the inlet port on the closing movement of the pilot valve.

2. In a hydraulic by-pass system, the combination with the by-pass valve and its pressure chamber for closing the valve, and inlet and outlet ports for said pressure chamber, of a pilot valve having its end seated to close the outlet port and controlling said ports and carrying a plunger valve controlling the outlet passage between the pilot valve seat and pressure chamber, whereby the flow of pressure fluid over the pilot valve seat is prevented until the pilot valve is moved away from the seat and the outlet passage opened by the plunger portion of the valve.

3. In a hydraulic by-pass system, the com-

5 bination with the by-pass valve and its pressure chamber for closing the valve, and inlet and outlet ports for said pressure chamber, of a pilot valve seated at its end to close the outlet port and carrying a plunger valve controlling the inlet port and the outlet passage between the pilot valve seat and pressure chamber, said pilot valve and ports being arranged to close the inlet port before opening the outlet port on the opening movement of the pilot valve and to close the outlet port before opening the inlet port on the closing movement of the pilot valve, whereby the pressure fluid does not flow over the pilot valve seat until the pilot valve has closed the inlet port and the further movement of the plunger valve has opened the outlet passage.

4. In a hydraulic by-pass system, the combination with the by-pass valve and its pressure chamber for closing the valve, of separate passages connecting with said chamber for admitting and discharging pressure fluid from the chamber, and a single pilot valve controlling said passages.

5. In a hydraulic by-pass system, the combination with the by-pass valve and its pressure chamber for closing the valve, of a balanced pilot valve controlling the admission and discharge of pressure fluid for said chamber.

6. In a hydraulic by-pass system, the combination with a plurality of by-pass valves and their pressure chambers for closing said valves, of a single pilot valve controlling the admission and discharge of pressure fluid for the pressure chambers of all the by-pass valves.

7. In a hydraulic by-pass system, the combination with the by-pass valve and its pressure chamber for closing the valve, of a pilot valve controlling the admission and discharge of pressure fluid for said chamber, a member for moving said valve, and means brought into action by the movement of said member for throwing the pilot valve into

and holding it in full open or full shut position.

8. In a hydraulic by-pass valve construction, the block 10 having inlet and discharge chambers formed therein on different planes and connected by a passage adapted to receive a valve seat, and passages formed in the block at an angle to the inlet chamber and forming by-pass discharge ports and pressure chambers for the by-pass valves.

9. In a hydraulic by-pass valve construction, the block 10 having inlet chambers 11, 11' formed therein at right angles to each other, discharge chamber 12' parallel with chamber 11' and connected therewith by passages adapted to receive valve seats, and passages formed in the block at right angles to the inlet chamber 11 and forming by-pass discharge ports 13, 14, and pressure chambers 16, 17 for the by-pass valves.

10. The combination with by-pass valve and its stem and piston 27 thereon, having inlet passages 3, 1, connecting the pressure chamber with the inlet chamber and outlet passage 4 connecting with the by-pass discharge, and seat 2 for the end of the pilot valve, of pilot valve 24 seated at its end to close the discharge and having a plunger valve portion controlling passages 3, 4.

11. In a hydraulic by-pass system, the combination with the by-pass valve and its pressure chamber for closing the valve, of a pilot valve controlling the admission and discharge of pressure fluid for said chamber, lever 20 for moving the pilot valve having cam 32, and spring 30 having cam portion 31 co-acting with cam 32 to throw the pilot valve into and hold it in full open or full shut position.

In testimony whereof, I have hereunto set my hand, in the presence of two subscribing witnesses.

WILLS M. FLEMING.

Witnesses:

THOS. H. WESTPHAL,
MAURICE A. FEENEY.