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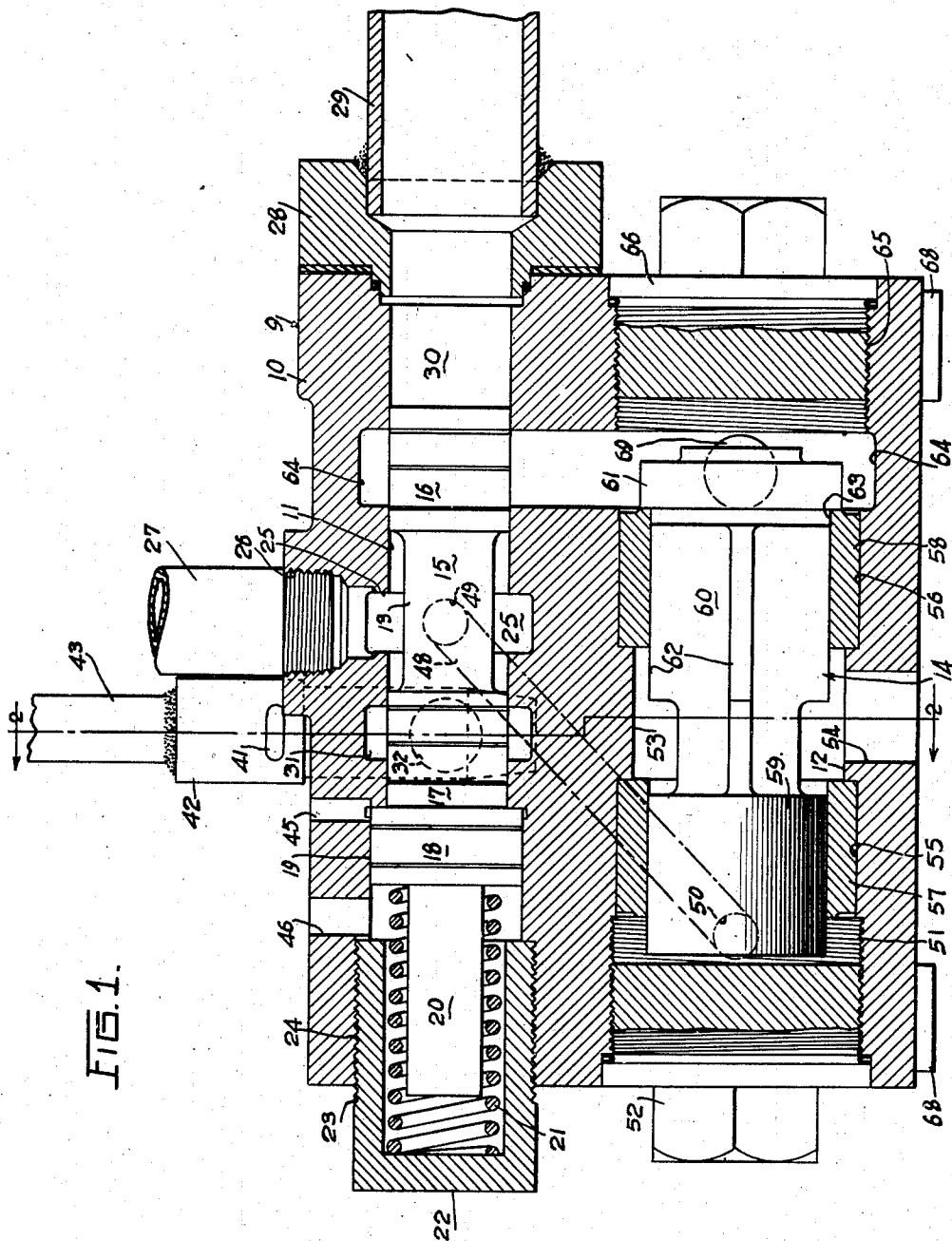
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2,268,205

MAIN CYLINDER RELEASE AND PUMP BY-PASS VALVE

Filed July 24, 1939

2 Sheets-Sheet 1



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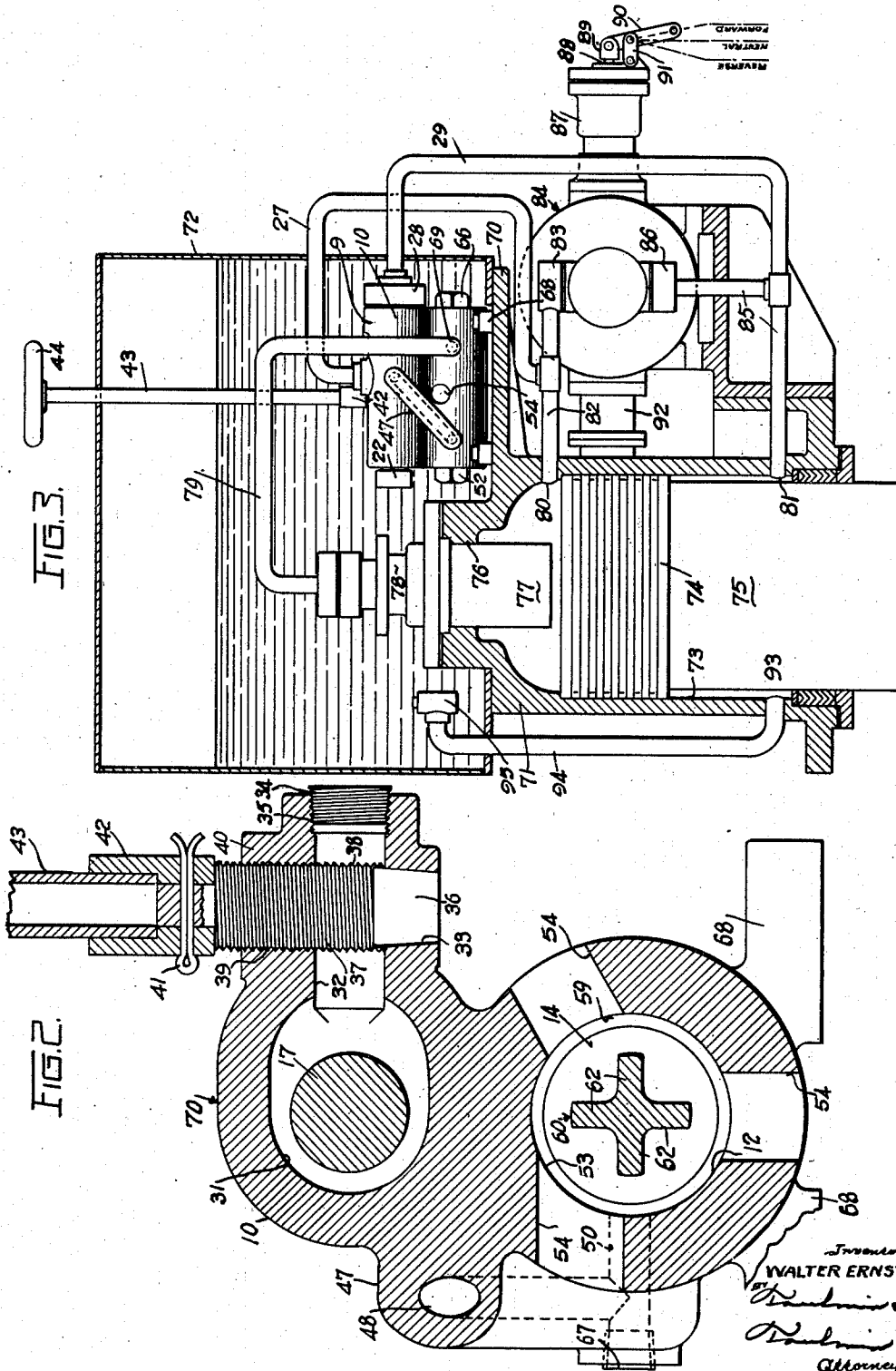
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UNITED STATES PATENT OFFICE

2,268,205

MAIN CYLINDER RELEASE AND PUMP BY-PASS VALVE

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2 Claims. (Cl. 137—153)

This invention relates to hydraulic machinery, and in particular, to valves.

One object of the invention is to provide a valve which permits a controlled release of hydraulic pressure from the main cylinder of a hydraulic press upon the reversal of the main plunger after the completion of the pressing stroke.

Another object is to provide a main cylinder release and by-pass valve operative to gradually release hydraulic pressure from the main cylinder of a hydraulic press immediately after the reversal of the main plunger upon the completion of the pressing stroke, and at the same time to momentarily by-pass the discharge of the pump which supplies the circuit with pressure fluid until the pressure is completely released from the main cylinder, after which the valve shifts to permit the pressure to build up in the pull-back circuit and return the main plunger to its retracted position.

Another object is to provide a main cylinder release and pump by-pass valve having a pair of valve plungers in a casing arranged in such a manner so that one plunger automatically shifts to release pressure from the main cylinder of the press upon the reversal of the pump supplying the press, this release taking place gradually so as to avoid shock, while at the same time the pump discharge is temporarily by-passed until the pressure is completely released from the main cylinder, after which the other valve plunger automatically closes to permit the building up of pressure in the pull-back circuit and the consequent return of the main plunger to its retracted position.

In the drawings:

Figure 1 is a central vertical longitudinal section through the main cylinder release and pump by-pass valve of this invention, taken in a plane passing through the axes of the two valve plungers.

Figure 2 is a cross section taken along the line 2—2 in Figure 1.

Figure 3 is a diagrammatic view, partly in section, showing the connections of the valve of this invention in a typical hydraulic press circuit.

In general, the main cylinder release and pump by-pass valve of this invention consists of a casing having a pair of valve plungers, with the valve chamber of one plunger connected to an operating chamber adjacent the end of the other valve plunger. When the pump is reversed to admit pressure fluid to the pull-back line, this automatically shifts the first valve plunger into

a position where it discharges pressure from the main cylinder through a needle valve. This gives a controlled release of hydraulic pressure from the main cylinder upon the reversal of the main plunger after the pressing stroke. At the same time the other valve plunger is held open as long as pressure still stands in the main cylinder circuit, thereby temporarily by-passing the discharge of the pump. When pressure has been completely released from the main cylinder circuit the second valve plunger closes, cutting off the temporary by-pass and permitting pressure to build up in the pull-back line, thereby reversing the main plunger.

Valve construction

Referring to the drawings in detail, Figure 1 shows the main cylinder release and by-pass valve, generally designated 9, as consisting of a casing 10 having a pair of bores 11 and 12, in which reciprocate a pair of plungers 13 and 14, respectively. The plunger 13 consists of a stem 15 having two heads 16 and 17 reciprocable in the bore 11, and a third head 18 reciprocable in a counterbore 19. Beyond the head 18 the stem 15 terminates in an extension 20 surrounded by a coil spring 21. The latter engages the head 18 at one end, and the inner wall of a hollow cap 22 at its other end. The cap 22 is provided with a threaded portion 23 engaging the threaded bore 24 coaxial with the bores 19 and 11. By rotating the cap 22 the force of the compression spring 21 upon the valve plunger 13 may be varied.

The valve bore 11 opens into a central chamber 25, to which fluid is admitted through a threaded port 26 from the main cylinder branch line 27. The right-hand end of the bore 11 is provided with a connection 28 for securing thereto the end of the pull-back branch line 29 (Figures 1 and 3). Thus the right-hand end of the valve bore 11 serves as an operating chamber 30 for shifting the valve plunger 13 by pressure fluid acting against the right-hand end of the head 16 on the valve plunger 13. The valve bore 11 also opens into a discharge chamber 31 (Figures 1 and 2), from which the passageway 32 runs to a tapered discharge port 33, the passageway 32 being closed at its outer end by a plug 34 threaded into the threaded bore 35.

The tapered discharge port 33 is configured to receive the correspondingly tapered end 36 of a needle valve member, generally designated 37, and having a threaded portion 38 threaded into the threaded bore 39 in the extension 40 of

the casing 10. Secured to the needle valve member 37, as by the cotter pin 41 (Figure 2), is the base 42 of the operating rod 43. The latter is provided at its upper end with a hand wheel 44 (Figure 3), by which the needle valve member 37 may be rotated and the annular space between the tapered bore 33 and the tapered end 36 of the needle valve member 37 may be varied so as to control the rate of release of the fluid. The counterbore 19 is provided with a pair of ports 45 and 46 for the discharge of fluid leaking past the heads 17 and 18, respectively.

The casing 10 is provided with a diagonal ridge 47 containing a passageway 48 (Figures 2 and 3) running from a port 49 opening out of the chamber 25 to a port 50 opening into the threaded counterbore 51, forming an end chamber and extension of the valve bore 12. The end of the threaded counterbore 51 is closed by a threaded plug 52 inserted therein. The valve bore 12 is provided with a central exhaust chamber 53, from which exhaust ports 54 extend outward through the casing 10 (Figure 3). The valve bore 12 on either side of the chamber 53 is provided with counterbores 55 and 56, having sleeves 57 and 58 mounted therein and constituting seats for the valve plunger 14. The sleeve 57 is slidably engaged by a piston head 59 on the valve plunger 14, whereas the sleeve 58 is slidably engaged by a fluted portion 60 thereon, and terminating in a head 61. The fluted portion 60 is provided with four flutes 62, through which fluid can pass. The end of the sleeve 58 serves as a port 63, which is closed by the head 61 (Figure 1). The port 63 opens into a chamber 64, which extends down to the port 63 from the valve bore 11 and contains the head 61 on the valve plunger 14. Beyond the counterbores 55 and the chamber 64 the casing 10 is provided with a threaded port 65, closed by a threaded plug 66. The threaded plugs 52 and 66 permit access to the valve plunger 14. The port 50 (Figure 2) is closed at its outer end by a threaded plug 67. The casing 10 is provided with integral feet 68 for supporting the valve upon the floor of the tank in which it is placed. A port 69 opens out of the chamber 64 and serves for the connection of a conduit running to the operating chamber of the surge valve, as hereinafter described.

Valve circuit

A typical circuit in which the main cylinder release and pump by-pass valve of this invention may be employed is shown in Figure 3. This circuit includes the main cylinder release and by-pass valve 9 of the invention, supported by its feet 68 upon the shelf 70 forming a part of the main cylinder 71 (Figure 3), and likewise forming a support for the bottom of the surge tank 72 in which the valve 9 is placed. The main cylinder 71 is provided with a cylinder bore 73 having the piston head 74 of the main plunger 75 reciprocable therein. The head of the main cylinder 71 is provided with a port 76 opening into the surge tank 72, and containing the surge valve 77 of the type described in the Ernst Patent No. 1,892,568, issued December 27, 1932. The details of the surge valve 77, therefore, form no part of the present invention. The surge valve 77 is provided with an operating chamber 78 connected by the conduit 79 to the port 69 of the valve casing 10.

The main cylinder bore 73 is provided with upper and lower ports 80 and 81, on opposite sides of the main plunger head 74. The conduit 82

runs from the port 80 to the connection 83 of the variable delivery pump 84. The conduit 82 is likewise connected to the conduit 27 running to the upper port 26 in the valve casing 10, previously referred to. Running from the lower port 81 in the main cylinder 71 is a conduit 85 leading to the connection 86 of the variable delivery pump 84, opposite the connection 83. The conduit 85 is likewise connected to the conduit 29 running to the end of the valve bore 11 (Figure 1). The variable delivery pump 84 is of any suitable type, the type illustrated being described and claimed in the copending application of Walter Ernst, Ser. No. 186,859, filed January 25, 1938, and is controlled by a servomotor 87 as regards the quantity and direction of its delivery.

The variable delivery pump 84 consists of a cylinder barrel having radial cylinder bores with pistons engaging a secondary rotor, rotatable upon an axis decentered from the axis of rotation of the cylinder barrel so that the pistons are thereby reciprocated in the cylinders. The distance of decentration of the axes of rotation of the cylinder barrel and secondary rotor, respectively, may be varied by moving the shift ring surrounding the secondary rotor. This shift ring is connected to the servomotor 87 and shifted thereby. The servomotor 87, in turn, is under the control of a servomotor control valve 88, which is connected as at 89 (Figure 3) to a rocking lever 90 supported upon a floating link 91.

The lever 90 may be shifted into the different positions indicated in Figure 3 so as to provide a forward or reverse delivery of fluid, or the cylinder barrel and secondary rotor may be caused to rotate upon a common axis of rotation when the lever 90 is in the position marked "Neutral" (Figure 3). When the lever 90 is shifted to the position marked "Forward" the pump connection 83 delivers pressure fluid into the conduit 82 and the connection 86 becomes a suction connection, withdrawing fluid from the conduit 85. When the lever 90 is shifted into the position marked "Reverse," the connection 83 and conduit 82 are placed in suction and the connection 86 and conduit 85 are placed under pressure.

The opposite side of the pump 84 is provided with a safety centering device 92, described in Ernst application, Ser. No. 170,250, filed October 21, 1937, and forming no part of the present invention. The lower end of the cylinder bore 73 is provided with a port 93, from which the conduit 94 runs to a check valve 95 within the surge tank 72.

Operation

In the operation of the main cylinder release and pump by-pass valve of this invention, the pump 84 is placed in position for forward delivery by shifting the lever 90 to the position marked "Forward." Pressure fluid is then discharged through the port 80, into the space above the main plunger head 74, and is withdrawn from the space beneath the latter through the port 81. The main plunger 75 then descends to perform its pressing stroke, and the surge valve 77 automatically opens to prefill the space above the head 74 until resistance is encountered, whereupon the surge valve 77 automatically closes and pressure is built up above the head 74 to perform the pressing stroke. While the plunger 75 is performing the pressing stroke a portion of the pressure fluid enters the central chamber 25 of the valve 9, through the conduit 27. This pressure fluid, however, acts against

the equal annular areas of the valve heads 16 and 17, hence, one pressure balances the other and the valve plunger 15 remains immovable. A portion of this pressure fluid passes through the port 49, the passageway 48 and the port 50, into the end chamber 51 of the valve bore 12, acting against the end of the head 59 and shifting the valve plunger 14 to the right so that the head 61 uncovers the port 63 and opens communication between the chamber 64 and the exhaust chamber 53.

When the pressing stroke has been completed, the reversible variable delivery pump 84 is reversed by shifting the lever 90 to the position marked "Reverse," whereupon pressure fluid is now delivered into the conduits 85 and 29 and withdrawn from the conduits 80 and 27. The shock of reversal which would otherwise occur from the presence of the high pressure in the space above the main plunger head 74 is prevented by the action of the main cylinder release and by-pass valve 9. As soon as the pump 84 is reversed, the pressure fluid supplied to the pull-back conduit 85 likewise passes into the branch conduit 29 and into the right-hand end of the upper valve bore 11, where it acts against the end 30 of the head 16, and shifts the valve plunger 15 to the left by compressing the spring 21. The consequent shifting of the head 17 to the left opens communication between the chambers 25 and 31. Pressure fluid then escapes from the space above the main plunger head 74, through the port 80, the conduits 82 and 27, the chambers 25 and 31, the passageway 32 (Figure 2) and the needle valve port 33. This needle valve port 33 provides a gradual release of the pressure fluid from the main cylinder, and prevents the shock which would otherwise occur.

Meanwhile, since there is pressure still standing in the valve chamber 25, the valve plunger 14 is held in its position shifted to the right and opening communication between the chambers 64 and 53. Under these circumstances the pump discharge is temporarily by-passed through the conduit 29, the end chamber 30, the chamber 64, the port 63 and the exhaust chamber 53, through the exhaust ports 54, into the surge tank 72. Thus the pump discharge is temporarily by-passed while the release of pressure in the main cylinder 71 takes place. When this release has been entirely completed so that the pressure in the main cylinder and end chamber 51 has dropped to zero, the valve plunger 14 will shift to the left, under the influence of the pressure fluid in the chamber 64, causing the head 61 to close the port 63. With the outlet of the chamber 64 thus closed, the pump 84 is enabled to build up pressure in the pull-back conduit 85 and return the main plunger 75 to its upper or retracted position.

The rate at which the pressure fluid is discharged from the main cylinder 71 is adjusted by rotating the hand wheel 44. This rotates the needle valve member 37 and changes the separation

between its tapered end 36 and the tapered port 33. This opening is adjusted until no shock occurs in the system. Without the needle valve 37 the direct discharge of the pressure fluid would permit the release of pressure too quickly from the main cylinder, thereby causing shock to the pressure system unless the outlet port were made of a very small diameter. The provision of the needle valve enables the size of this port to be adjusted according to the most favorable circumstances.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims and the invention.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A release and by-pass valve comprising casing means having a release valve bore and a by-pass valve bore, each bore having inlet and outlet chambers, a release valve member and a by-pass valve member in said release valve bore and by-pass valve bore respectively, an operating chamber associated with each valve member, each valve member having means thereon for selectively interconnecting and disconnecting said inlet and outlet chambers, means for yieldingly urging said release valve member in one direction, means responsive to the admission of pressure fluid to said release-valve-operating-chamber for urging said release valve member in the opposite direction, means responsive to the admission of pressure fluid to said release valve inlet chamber for shifting said by-pass valve member to its by-passing position, and means subjecting the by-pass valve directly to the hydraulic pressure of the release valve operating chamber when the release valve is shifted to open position, for closing the by-pass valve when pressure subsides in the release valve inlet chamber.

2. A release and by-pass valve comprising a casing having a release valve bore and a by-pass valve bore therein, each bore having inlet and outlet ports, a release valve member movable in one direction in said release valve bore by yielding means and in the opposite direction by hydraulic means for controlling said release valve inlet and outlet ports, a by-pass valve member arranged in said by-pass valve bore and movable therein in opposite directions respectively by a valve head and a hydraulically operable piston, operating chambers associated with each valve member, said by-pass piston being operable by fluid admitted through said release valve inlet port, and means subjecting the by-pass valve directly to the hydraulic pressure of the release valve operating chamber when the release valve is shifted to open position, for closing the by-pass valve when pressure subsides in the release valve inlet chamber, said by-pass valve being closed solely by the hydraulic pressure in said chamber.

WALTER ERNST.