

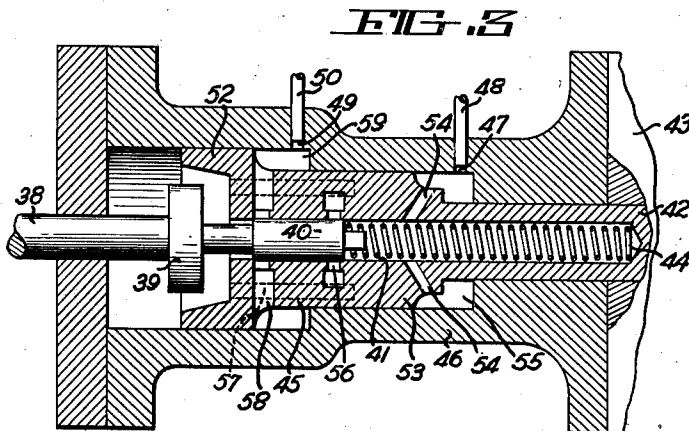
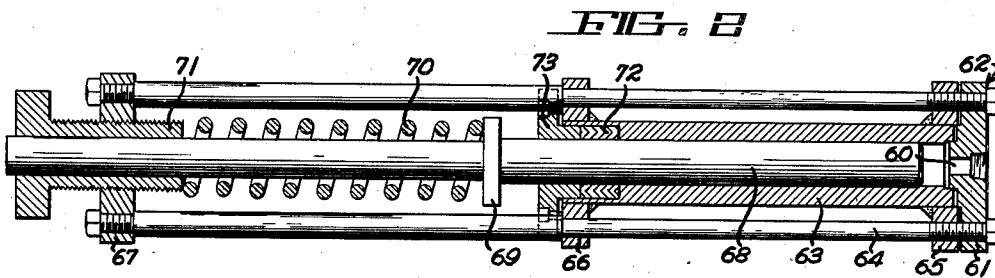
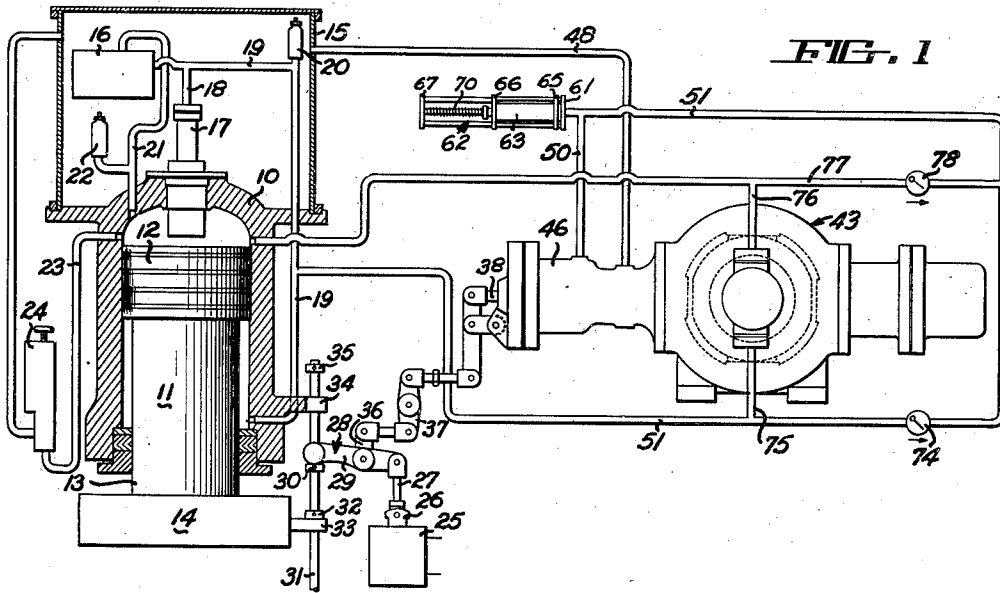
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W. R. TUCKER

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HYDRAULIC SYSTEM

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INVENTOR
WARREN R. TUCKER
By *Toulmin & Toulmin*
ATTORNEYS

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HYDRAULIC SYSTEM

Warren R. Tucker, Dayton, Ohio, assignor to The Hydraulic Development Corporation, Inc., Wilmington, Del., a corporation of Delaware

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This invention relates to hydraulic systems and, in particular, to hydraulic systems comprising fluid operable means, controlling a pump, and pilot means for actuating said controlling means.

In hydraulic systems of the above mentioned type, it has been customary heretofore to provide a pilot pump for actuating fluid operable means controlling the movement of the flow control member of a variable delivery pump. Such pilot pumps, which are used only during the brief period of changing the direction of delivery of the main pump, are relatively expensive to manufacture, and, in case of a constant delivery pilot pump, are also expensive in operation because the delivery of such a pilot pump is by-passed to an exhaust during most of the time of its operation. Furthermore, if a variation of the delivery of the pilot pump is desired, the pilot pump has to be constructed as a variable delivery pump, or additional means is necessary in connection with the pilot pump to allow such variation.

Accordingly, it is an object of the invention to provide simplified means which is adapted to replace the pilot pumps heretofore used in systems of the above mentioned type, while being less expensive than such pilot pumps.

It is another object of the invention to provide a hydraulic system comprising a variable delivery pump and fluid operable means for varying the delivery thereof, in which accumulator means is provided adapted to supply pressure fluid to said fluid operable means and to be loaded by said pump.

A further object of the invention consists in the provision of a system of the type mentioned above, in which the accumulator means is provided with simple adjusting means for varying the quantity of fluid delivered by said accumulator means.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing, in which:

Figure 1 diagrammatically illustrates a hydraulic system comprising accumulator means according to the invention.

Figure 2 is a section through an embodiment of accumulator means according to the invention.

Figure 3 is a simplified section through servomotor means of the pump shown in Figure 1.

General arrangement

The hydraulic system according to the invention substantially comprises a variable delivery pump with fluid operable servomotor means for

causing movement of the flow control member of the pump and, thereby, variation of the pump delivery, while a cylinder piston assembly is hydraulically connected with said servomotor means and also with the delivery side of the pump.

In this way, the said cylinder piston assembly is loaded by the delivery of the pump and, in case a variation of the delivery or direction of delivery of the pump is desired, delivers fluid to the servomotor means for actuating the same.

Structural arrangement

Referring now to the drawing in detail, the hydraulic circuit shown in Figure 1 comprises a press cylinder 10 having reciprocally mounted therein a ram, generally designated 11, and comprising a piston 12 and piston rod 13, which latter supports the press platen 14.

Mounted on top of the press cylinder 10 is a fluid reservoir or surge tank 15 housing a main cylinder release and pump by-pass valve 16 and a surge valve 17. The valve 16 serves the purpose of facilitating the initiation of the retraction stroke of the press ram 11 by releasing the pressure from the advancing side of said ram, while the surge valve 17 is intended to allow pre-filling of the press cylinder 10 during the first portion of the advancing stroke of the press ram, during which the latter moves downwardly by gravity. The valves 16 and 17 do not form a part of the present invention and for a more detailed description thereof, reference may respectively be had to U. S. Patents Nos. 2,268,205 and 2,193,248 both to Ernst.

The surge valve 17 and main cylinder release and pump by-pass valve 16 are interconnected by conduit means 18 and 19, which latter comprises a safety valve 20 and leads to the lower portion of the press cylinder 10. The upper portion of the press cylinder 10 communicates with a conduit 21 comprising a safety valve 22 and leading to the main cylinder release and pump by-pass valve 16.

Also communicating with the upper portion of the press cylinder 10 is a conduit 23 comprising a tonnage control valve 24 and leading to the tank 15. The tonnage control valve 24 may be of any desired type, for instance, of the type disclosed in U. S. Patent 2,224,957 to Ernst. The tonnage control valve 24 is adapted, in response to a predetermined pressure acting upon the advancing side of the piston 12, to break the energizing circuit for the solenoid 25 which, when energized, attracts an armature 26. The armature 26 is connected by a link 27 with a three

arm lever, generally designated 28, one arm 29 of which is adapted to be engaged by a collar 30 adjustably mounted on a push rod 31. The push rod 31 has adjustably mounted thereon a second collar 32 adapted to be engaged by the arm 33 connected to the press platen 14.

The push rod 31 is guided in the press portion 34 and is prevented from leaving the press portion 34 by the collar 35, likewise adjustably mounted on the push rod 31.

The lever 28 has its arm 36 connected with a link system 37, which is pivotally connected with a valve member 38 (see Figure 3). The valve member 38 comprises a collar 39 for limiting its leftward movement and a control piston 40. The control piston 40 is reciprocable in a bore 41 provided in a reciprocable control rod 42 which, in its turn, is connected with the flow control member of the pump 43 in any conventional manner. The pump 43 is a reversible variable delivery pump and for a more detailed description thereof reference may be had to U. S. Patent No. 2,184,665 to Ernst.

Arranged between the control piston 40 and the bottom of the bore 41 is a spring 44 continuously urging the piston 40 toward the left. The reciprocable control rod 42 comprises a differential piston 45 reciprocable in the servomotor casing 46, which latter has a port 47 communicating with an exhaust line 48, which latter leads to the tank 15.

The servomotor casing 46 is also provided with a port 49 communicating with a conduit 50 leading to the conduit 51. The differential piston 45 comprises a larger piston portion 52 and a smaller piston portion 53. The smaller piston portion 53 is provided with channels 54 connecting the bore 55 with the bore 41. The piston portion 53 furthermore comprises passageways 56 communicating through passageways 57 with the left side of the piston portion 52. Passageways 58 are provided in the smaller piston portion 53 adjacent the larger piston portion 52, which passageways are adapted to effect communication between the bore 59, in which the piston portion 52 is reciprocable, with the bore 41, in which the control piston 40 is slidable.

The conduit 51, which communicates with the port 49 in the servomotor casing 46 through the conduit 50, has one end connected to the port 60 in the closure member 61 of the accumulator, generally designated 62. The closure member 61 is connected to the cylinder 63 in any convenient manner, for instance, by strain rods 64 which interconnect the flanges 65, 66 and 67, of which the flanges 65 and 66 are connected to the cylinder 63, for instance, by welding.

Reciprocably mounted in the cylinder 63 is a plunger 68 having a collar 69 engaging one end of a spring 70, the other end of which is engaged by an adjustable screw or abutment member 71. The abutment member 71 is threaded in the flange 67 and may be adjusted from the outside of the accumulator 62; simultaneously, the abutment member 71 also serves for guiding the left end of the plunger 68.

Packing material 72, compressed by a gland 73, is provided for preventing leakage around the plunger 68.

The conduit 51 comprises a check valve 74 and leads to the conduit means 19 while being connected through conduit 75 with one side of the pump 43. The other side of the pump 43 is connected through a conduit 76 with a conduit

77 comprising a check valve 78 and having one end connected to the conduit 51, while the other end leads to the upper portion of the press cylinder 10.

Operation

It may be assumed that all parts of the hydraulic system occupy the position shown in Figure 1, while the accumulator plunger 68 is in its left hand position so that the accumulator cylinder 63 is loaded with the required quantity of fluid for operation of the servo-motor piston 45.

To perform a working cycle, the operator starts the pump 43 and, in any convenient manner, closes the energizing circuit for the solenoid 25. Energization of the solenoid 25 causes movement of the armature 26 so that the latter causes shifting movement of the three arm lever 28 in clockwise direction whereby the link system 37 moves the valve member 38 toward the right. This causes the piston 40 to compress the spring 44 and to establish fluid connection between the right hand portion of the bore 59 and the left hand portion thereof through the passageways 58 and bore 41.

As a result thereof, the spring 70 presses the plunger 68 toward the right so that the fluid in the accumulator 62 passes through conduit 50, passageways 58 and bore 41 toward the left hand end of the bore 59 where it acts upon the piston portion 52 so as to move the same and, thereby, the flow control rod 42 toward the right. This results in a shifting movement of the pump 43 to full delivery forward stroke position. Consequently, pressure fluid from the pump 43 is now conveyed through conduits 76 and 77 into the upper portion of the press cylinder 10, while fluid is withdrawn from the lower portion of the press cylinder 10 through conduits 51 and 75.

The ram 11 now moves downwardly by gravity as fast as fluid is withdrawn from the lower portion of the press cylinder 10. During this movement, fluid passes from the tank 15 through the surge valve 17. As soon as the ram 11 encounters resistance exerted by a work piece, pressure begins to build up in the upper portion of the press cylinder and closes the surge valve 17. The ram 11 now starts its actual pressing stroke.

A portion of the fluid delivered by the pump 43 through the conduit 76 passes through check valve 78 and conduit 51 into the cylinder 63 of the accumulator 62 so as to move the plunger 68 toward the left until the compressed spring 70 balances the pressure acting on the plunger 68, at which time the accumulator 62 is again loaded.

When, at the end of the pressing stroke, a predetermined pressure has built up in the upper portion of the press cylinder 10, this pressure is conveyed through conduit 23 to the tonnage control valve 24 so as to cause the latter to interrupt the energizing circuit for the solenoid 25. The thus caused deenergization of the solenoid 25 allows the spring 44 in the servomotor casing 46 to shift the control piston 40 toward the left, thereby establishing fluid connection between the passageways 56 and the exhaust line 48 through the bore 41 and channels 54. Consequently, the fluid in the left portion of the bore 59 escapes to the tank 15 through the exhaust line 48, while the spring 70 again shifts the plunger 68 toward the right, thereby causing the fluid from the accumulator 62 to flow through conduit 50 to the right hand end of the bore 59 where it acts upon the piston portion 52 so as

to move the latter and, therefore, also the flow control member 42 toward the left.

As a result thereof, the pump 43 is shifted to full delivery retraction stroke position. The pump 43 now delivers pressure fluid through conduits 75, 51 and 19 to the lower portion of the press cylinder 10, while fluid is withdrawn from the upper portion of the press cylinder 10 through conduits 77 and 76 as soon as the pressure in the upper portion of the press cylinder 10 has been released by the main cylinder release and pump by-pass valve 16. The pressure in the conduit 19 also causes the surge valve 17 to open so that a part of the fluid expelled by the ram 11 is passed into the tank 15. The ram 11 now moves upwardly.

A portion of the pressure fluid delivered by the pump 43 into the conduit 51 is conveyed through check valve 74 into the cylinder 63 of the accumulator 62 where it moves the plunger 68 toward the left and compresses the spring 70 in the manner previously mentioned.

When the ram 11 approaches the end of its retraction stroke, the platen 33 engages the collar 32 and lifts the push rod 31 so as to cause the collar 30 on the push rod 31 to shift the three arm lever 28 in clockwise direction to such an extent that the latter, by means of the link system 37, forces the valve member 38 and, thereby, the piston 40 toward the right through a partial stroke. This causes a portion of the fluid in the accumulator 62 to pass through the conduit 56 and passageways 58 into the left portion of the bore 59 where it shifts the piston portion 52 and, thereby, the control rod 42 toward the right until the passageways are again closed by the control piston 40. The pump 43 is now in substantially neutral or no delivery position, so that the ram 11 is halted. The press is now ready for a new cycle.

If, for some reason, the pump 43 with servomotor 46 is to be replaced by a pump and servomotor of different capacity, the accumulator 62 can be adapted to the new requirement without any changes in structure and operation. All that is necessary to meet the new situation is merely to adjust the abutment screw 71 to vary the thrust of the spring 70. This constitutes a further material simplification over the heretofore known practice of using pilot pumps which, in order to allow a similar exchange of the main pump, would have to be unnecessarily large, with a corresponding waste in cost and operation.

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

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

1. In a hydraulic system, a variable delivery pump, fluid operable servomotor means including a differential plunger associated with said pump for controlling the delivery thereof, spring-loaded fluid pressure storage means in continuous fluid communication with one side of said differential plunger and operable to convey fluid pressure to said servomotor means to actuate the latter,

means responsive to a predetermined pressure at the pressure side of said pump to convey fluid pressure from said pressure side to said storage means for loading the same, and conduit means connecting the interior of said storage means to the discharge side of said variable delivery pump.

2. In a hydraulic system, a pressure fluid source, fluid operable servomotor including a differential plunger operatively connected with said fluid source for controlling the delivery thereof, fluid pressure storage means in continuous fluid communication with the smaller area of said plunger means and operable to convey fluid pressure to the larger area of said plunger to actuate the same, said fluid pressure storage means comprising a cylinder with a plunger reciprocally mounted therein, spring means continuously urging said plunger in one direction, means for adjusting the thrust of said spring means, means responsive to a predetermined pressure of said fluid source to convey fluid pressure from said fluid source to said cylinder for loading the same, and conduit means connecting the interior of the cylinder of said storage means to the discharge side of said variable delivery pump.

3. In a hydraulic system, a pressure fluid source, fluid operable servomotor means including a differential plunger operatively connected with said fluid source for controlling the delivery thereof, fluid pressure storage means continuously hydraulically connected with one side of said plunger and operable to convey fluid pressure to one or both sides of said plunger to actuate said plunger, said fluid pressure storage means comprising a cylinder with a plunger reciprocally mounted therein, spring means continuously urging said plunger in one direction, adjusting means for varying the thrust of said spring means, means responsive to a predetermined pressure of said fluid source to convey fluid pressure from said fluid source to said cylinder for loading the same against the thrust of said spring means, and conduit means connecting the interior of the cylinder of said storage means to the discharge side of said variable delivery pump.

4. In a control system, a reversible variable delivery pump, a control cylinder, a fluid operable differential plunger reciprocable in said cylinder and operatively connected with said pump for controlling the delivery and direction of delivery of said pump, hydraulic pressure storage means including a cylinder, a spring-loaded plunger therein for selectively supplying pressure fluid to one or both sides of said plunger, said storage means being continuously hydraulically connected with the smaller area of said differential plunger, valve means associated with said differential plunger and operable to control the fluid connection between the differential areas of said differential plunger, means responsive to a predetermined pressure at the pressure side of said pump to connect said pressure side with the plunger of said storage means to load the same, and conduit means connecting the interior of the cylinder of said storage means to the discharge side of said variable delivery pump.

WARREN R. TUCKER.