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VALVE SYSTEM FOR HYDRAULIC PRESS CIRCUITS

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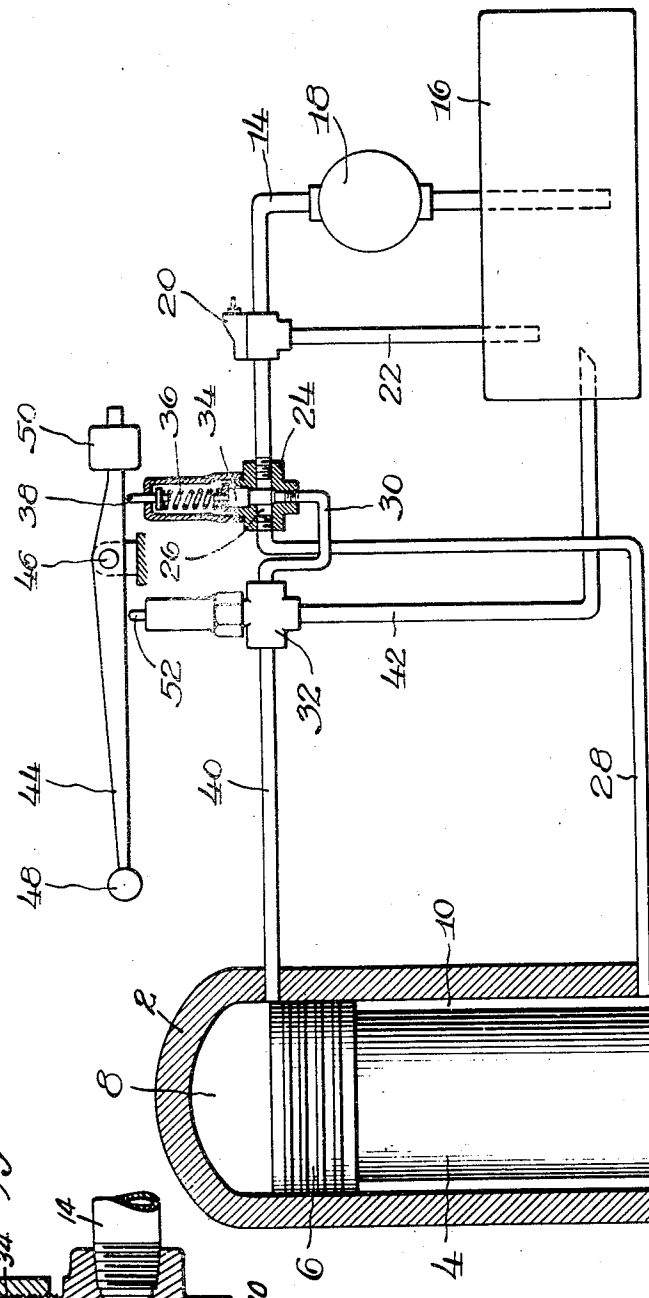


Fig. 1

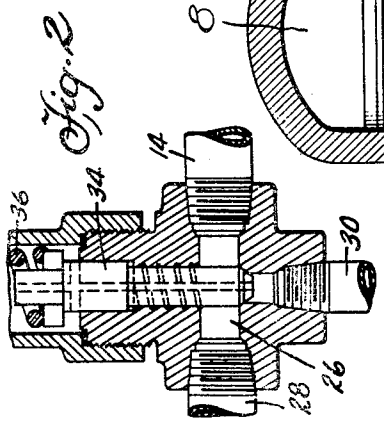


Fig. 2

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VALVE SYSTEM FOR HYDRAULIC PRESS CIRCUITS

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10 Claims. (Cl. 60—52)

1

My invention relates to hydraulic machinery and more particularly to novel hydraulic actuating means therefor.

The general object of my invention is to design a sensitive hydraulic circuit by means of which the associated mechanism is capable of applying pressure to a work piece in an amount proportionate to the pressure exerted by the operator, thus enabling the operator to "feel" the pressure directly without constant reference to a gauge.

Another object of my invention is to eliminate the necessity for a servo or follow-up control in a circuit of the above type, thereby preventing backlash or looseness in the control mechanism which, as will be readily understood by those skilled in the art, frequently causes a condition wherein the ram fails closely to follow the handle.

Still another object of my invention is to simplify a circuit of the above type, thereby reducing the manufacturing costs thereof while, at the same time, maintaining the sensitivity thereof.

In the drawings, Figure 1 is a somewhat diagrammatic view of a hydraulic press with my novel sensitive circuit connected thereto, and Figure 2 is a sectional view taken through one of the valves in my novel system.

Describing my invention in detail, the press which is fragmentarily illustrated includes a cylinder 2 with a ram 4 reciprocal therewithin, said ram having a head 6 slidably fitted within the cylinder in the usual manner and defining therewith a main pressure chamber 8 above the head and an annular pull-back chamber 10 below the head. A platen indicated at 12 is mounted on the lower end of the ram. It will be understood by those skilled in the art that if desired, the pull-back chamber 10 may be eliminated and one or more relatively small pull-back rams and associated cylinders may be utilized for pulling the platen 12 upwardly to its retracted position.

My novel hydraulic circuit comprises a supply line 14 connected to a reservoir tank 16 containing a quantity of any suitable hydraulic actuating fluid, such as oil, and a pump 18 of conventional form is mounted in the line 14. A relief valve 20 is provided, said valve being of conventional form and being adapted to discharge into the tank 16 through the relief line 22 at a predetermined maximum pressure, thus preventing the building up of dangerous pressures in the circuit by the pump 18.

The line 14 is connected to a pull-back operating valve 24, the chamber 26 of which is connected to the pull-back chamber 10 by means of the pull-back supply line 28. The chamber 26 is also connected by a port in the valve 24 to a pipe 30 which is connected to the internal chamber of the operating valve 32 which is substantially identical in construction with the valve 24. The valve 24 comprises a stem 34 which is urged to its closed position by means of a spring 36 actuated by a plunger 38 in the manner hereinafter described.

2

The internal chamber of the valve 32 is connected to the main cylinder chamber 8 by a pipe 40 forming a part of the supply line 14, and the chamber of the valve 32 is also connected by means of a discharge pipe 42 to the tank 16.

The control lever 44 is afforded a fixed pivot at 46 intermediate its ends and is provided on one end thereof with a ball-like handle 48 and on the opposite end thereof with a counterweight 50 serving a purpose hereinafter described in connection with the operation of the system. When the control lever 44 is in its neutral position, as shown in the drawing, the lever is approximately horizontal so that pressure is applied to neither of the operating valves 24 or 32. The pump is operable to circulate hydraulic fluid in the system through the supply line 14 into the valve 24 through the pipe 30 into the valve 32 and through the discharge pipe 42 into the tank 16. This is possible inasmuch as pressure is not applied at this point to either of the valves, thus permitting them to open the ports communicating with the pipes 30 and 42 respectively.

When the operator desires to bring the press ram down upon the work he grasps the ball handle 48 and pulls it down, thereby applying pressure to the spring stem 52 of the valve 32, said stem being operable to apply pressure to the associated spring, thus moving its actuated stem into closed position restricting discharge of hydraulic fluid through the discharge pipe 42. This causes the hydraulic fluid to flow through the pipe 40 into the main cylinder chamber 8 to build up pressure therewithin sufficient to move the ram 4 downwardly to engage the platen 12 with the work. It will be understood that the ram is moved downwardly against the pressure within the pull-back chamber 10 which is of substantially less cross-sectional area than that of the chamber 8 so that the differential between the two chambers permits actuation of the ram to its advanced position.

When the platen 12 comes into contact with the work piece it may stop because of insufficient pressure in the chamber 8 to accomplish

the work desired. In this event, the operator exerts additional pressure downwardly on the handle 48, thereby increasing the pressure on the spring within the valve 32 and consequently increasing the pressure within the chamber 8, as will be clearly understood by those skilled in the art. It may be noted that by means of this arrangement, the operator can "feel" the resistance of the work in the same manner as if he were accomplishing it directly by means of a crowbar or a lever.

When the working stroke has been completed, the ram 4 is returned to its retracted position by raising the handle 48, thus pivoting the lever 44 clockwise about the pivot point 46 and exerting pressure against the plunger 38. This compresses the spring 36, thereby urging the spindle 34 to its closed position to prevent passage of fluid within the system through the pipe 30. Thus, the fluid is urged through the pull-back supply pipe 28 into the pull-back chamber 10, and the ram is moved upwardly urging the fluid within the chamber 8 back through the pipe 40 and the valve 32 through the discharge pipe 42 into the tank 16. At this point, the operator may release the handle 48 and the counterweight 50 is still operable to exert a slight pressure on the plunger 38, thereby maintaining a slight pressure in the pull-back line 28 and the pull-back chamber 10 in order to prevent the ram 4 from creeping downwardly by force of gravity.

It will be readily apparent to those skilled in the art that if desired, the counterweight 50 may be eliminated and a conventional holding valve may be mouned in the line 28 to prevent the above-mentioned downward creeping of the ram 4 from its retracted position, and in this event, the valve 24 need not necessarily be of the spring actuated type illustrated, but may be of any conventional design adapted to close immediately and positively upon application thereto of pressure by the lever 44.

It is to be understood that I do not wish to be limited by the exact embodiment of the device shown which is merely by way of illustration and not limitation as various and other forms of the device will, of course, be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

I claim:

1. In an hydraulic press, a cylinder, a ram reciprocal herewithin and having a head slidably fitted therein, a main pressure chamber in said cylinder at one side of said head, an annular pull-back pressure chamber defined by said cylinder and said ram at the opposite side of said head, and a hydraulic circuit comprising a reservoir tank, a pair of operating valves each having an inlet chamber and a discharge port, a pump drawing liquid from said tank and delivering it to the chamber of one valve and through said chamber to the pull-back chamber, a connection from the discharge port of said one valve to the inlet chamber of the other valve, said other valve having its chamber connected to said main chamber and also connected through its discharge port to said tank, a valve stem in each valve for closing the port therein, spring means for moving said stems to their closed positions, and operating means for alternately stressing the spring means of respective valves, said operating means comprising a control lever operatively associated with said spring means, and a counterweight on said lever for normally exerting a slight stress on the spring means associated with the

said one valve, each of said valves having fluid passages therein enabling fluid under pressure from the associated pressure chamber to move the stem of the associated valve to open position against the action of said spring means upon partial or complete release of stresses on said spring means.

2. In an hydraulic machine comprising hydraulic motor means including main and pull-back cylinder chambers and ram means reciprocal therewithin, said pull-back chamber having less cross-sectional area than said main chamber, the combination of a reservoir tank, a pump having its suction side connected thereto, valve means connected to said main chamber and to said tank, said valve means being adapted in its closed position to prevent flow of fluid therethrough to said tank while permitting flow of fluid to said main chamber, pull-back valve means connected to said pull-back chamber and to said first-mentioned valve means, said pull-back valve means being adapted in its closed position to prevent flow of fluid therethrough to said first-mentioned valve means while permitting flow of fluid to said pull-back chamber, a connection between said pull-back valve means and said pump, and means for alternately actuating said first and second-mentioned valve means, said actuating means including compression spring means for urging each valve means to its closed position, and a manually operable lever adapted to exert direct compressive forces on said spring means, each of said valve means having fluid passages therein enabling fluid under pressure from the associated chamber to open the associated valve means against the action of said spring means.

3. In an hydraulic machine of the class described comprising hydraulic motor means including main and pull-back cylinder chambers and ram means reciprocal therewithin, said pull-back chamber being of less cross-sectional area than said main chamber, the combination of a hydraulic circuit comprising a reservoir tank, a pump having its suction side connected thereto, a pull-back valve connected to the discharge side of said pump and connected to said pull-back chamber, an operating valve connected to a port in said first-mentioned valve and comprising a port connected to said tank, said operating valve being connected to said main chamber, a stem in each valve for closing the port therein, resilient actuating means associated with said stems, and means for alternately operating the actuating means of respective valves, said operating means comprising a lever pivoted intermediate its extremities, and means operatively connecting said lever to said resilient means, each of said valves having fluid passages therein enabling fluid under pressure from the associated pressure chamber to move the stem of the associated valve to open position against the action of said resilient means.

4. In an hydraulic press, a cylinder, a ram reciprocal therewithin and having a head slidably fitted therein, a main pressure chamber in said cylinder at one side of said head, an annular pull-back pressure chamber defined by said cylinder and said ram at the opposite side of said head, and a hydraulic circuit comprising a reservoir tank, a pair of operating valves each having an inlet chamber and a discharge port, a pump drawing liquid from said tank and delivering it to the chamber of one valve and through said chamber to the pull-back chamber, a connection

from the discharge port of said one valve to the inlet chamber of the other valve, said other valve having its chamber connected to said main chamber and also connected through its discharge port to said tank, a valve stem in each valve for closing the port therein, spring means for moving said stems to their closed positions, and operating means for alternately stressing the spring means of respective valves, each of said valves having fluid passages therein enabling fluid under pressure from the associated pressure chamber to move the stem of the associated valve to open position against the action of said spring means upon partial or complete release of stresses on said spring means.

5. In an hydraulic machine, hydraulic motor means including main and pull-back cylinder chambers and ram means reciprocal therewithin, said pull-back chamber being of less cross-sectional area than said main chamber, and a hydraulic circuit comprising a reservoir tank, a pump having its suction side connected thereto, a pull-back valve connected to the discharge side of said pump and connected to said pull-back chamber, an operating valve connected to said first-mentioned valve and also connected to said tank and to said main chamber, said operating valve being operable in its closed position to cut off its connection to said tank, and said pull-back valve being operable in its closed position to cut off its connection to said operating valve, and operating means for alternately closing said valves, said operating means including resilient means for urging said operating valve to its closed position, and a manually operable lever for stressing said resilient means, each of said valves having fluid passages therein enabling fluid under pressure from the associated chamber to open the associated valve.

6. In an hydraulic machine, hydraulic motor means including main and pull-back cylinder chambers and ram means reciprocal therewithin, said pull-back chamber being of less cross-sectional area than said main chamber, and a hydraulic circuit comprising a reservoir tank, a pump having its suction side connected thereto, a pull-back valve connected to the discharge side of said pump and connected to said pull-back chamber, an operating valve connected to said first-mentioned valve and also connected to said tank and to said main chamber, said operating valve being operable in its closed position to cut off its connection to said tank, and said pull-back valve being operable in its closed position to cut off its connection to said operating valve, means for closing said valves, and means including a manually operable lever for alternately actuating said last-mentioned means, each of said valves having fluid passages therein enabling fluid under pressure from the associated chamber to open the associated valve.

7. In an hydraulic machine of the class described comprising hydraulic motor means including main and pull-back cylinder chambers and ram means reciprocal therewithin, said pull-back chamber being of less cross-sectional area than said main chamber, the combination of a hydraulic circuit comprising a reservoir tank, a pump having its suction side connected thereto, a pull-back valve connected to the discharge side of said pump and connected to said pull-back chamber, an operating valve connected to a port in said first-mentioned valve and comprising a port connected to said tank, said operating valve being connected to said main chamber, a stem

in each valve for closing the port therein, resilient actuating means associated with said stems, and means for alternately operating the actuating means of respective valves, each of said valves having fluid passages therein enabling fluid under pressure from the associated chamber to move the stem of the associated valve to open position.

8. In an hydraulic machine, hydraulic motor means including main and pull-back cylinder chambers and ram means reciprocal therewithin, said pull-back chamber being of less cross-sectional area than said main chamber, and a hydraulic circuit comprising a reservoir tank, a pump having its suction side connected thereto, a pull-back valve connected to the discharge side of said pump and connected to said pull-back chamber, an operating valve connected to said first-mentioned valve and also connected to said tank and to said main chamber, said operating valve being operable in its closed position to cut off its connection to said tank, and said pull-back valve being operable in its closed position to cut off its connection to said operating valve, means for closing said valves, and operating means for alternately actuating said last-mentioned means, each of said valves having fluid passages therein enabling fluid under pressure from the associated chamber to open the associated valve.

9. In combination, a hydraulic motor comprising advance and return chambers of relatively large and small cross-sectional areas respectively, and ram means reciprocal within said chambers, advance and pull-back lines connected respectively to said advance and pull-back chambers, pull-back valve means connected to said pull-back line, means for actuating said valve means, operating valve means connected to said advance line, to said pull-back valve means, and to a discharge line, said operating valve means being adapted in the open position thereof to deliver hydraulic fluid to said discharge line, and said operating valve means being adapted in the closed position thereof to deliver hydraulic fluid to said advance line and to restrict flow of said fluid to said discharge line, and means for actuating said operating valve means, said pull-back valve means being adapted in the open position thereof to deliver hydraulic fluid to said pull-back line and to said operating valve means, and said pull-back valve means being adapted in the closed position thereof to deliver hydraulic fluid to said pull-back line and to restrict flow of said fluid to said operating valve means, and a source of hydraulic pressure fluid connected to said pull-back valve means, said last-mentioned actuating means including resilient means for urging said operating valve means to the closed position thereof against the pressure of the hydraulic fluid therein, and manually operable means for stressing said resilient means against the resistance of said pressure in said operating valve means.

10. In a hydraulic machine, hydraulic motor means including advance and pull-back chambers of relatively large and small cross-sectional areas respectively, and ram means reciprocal within said chambers, and a hydraulic circuit including a source of hydraulic pressure fluid, pull-back and operating valves connected to said pull-back and advance chambers respectively, said pull-back valve being connected to said source, and said operating valve being connected to said pull-back valve, a discharge line connected to said operating valve, said operating valve being adapted in its closed position to restrict flow of

fluid to said discharge line, said pull-back valve being adapted in its closed position to restrict flow of said fluid to said operating valve, and operating means for alternately opening and closing respective valves in such manner that one of said valves is open when the other thereof is closed.

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