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VALVE ARRANGEMENT FOR HALTING REVERSIBLE RAMS TO PREVENT OVERSTROKING THEREOF

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Fig. 1

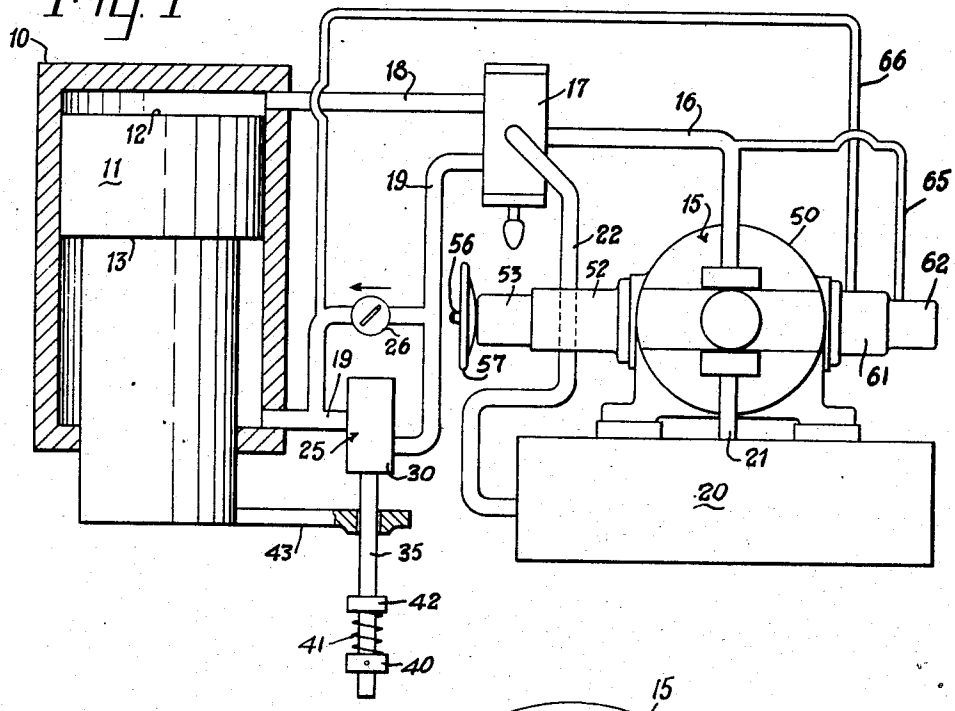


Fig. 2

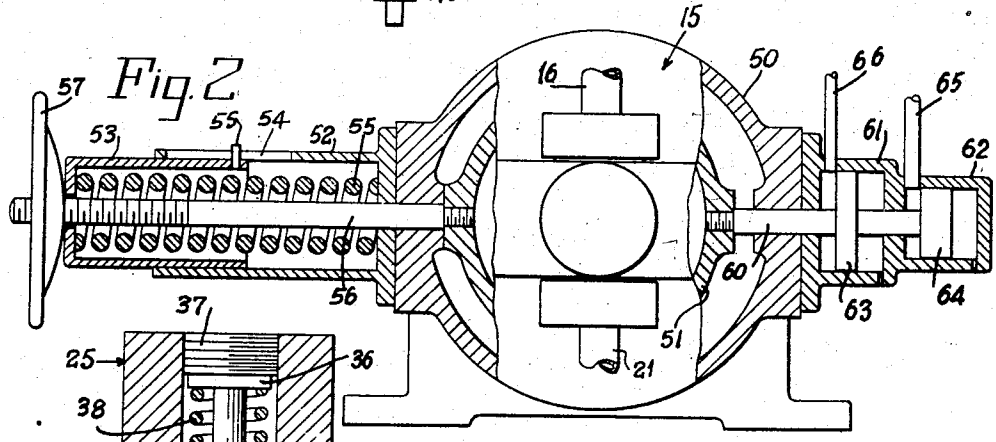
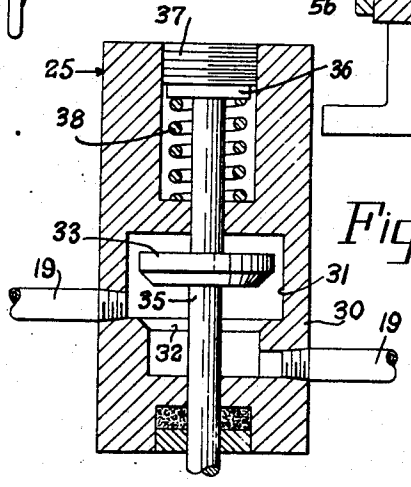


Fig. 3



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VALVE ARRANGEMENT FOR HALTING REVERSIBLE RAMS TO PREVENT OVER-STROKING THEREOF

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3 Claims. (Cl. 60—52)

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This invention relates to fluid operable systems and, particularly, to fluid operable control systems for use in connection with the control of a hydraulic motor.

In hydraulic presses which include a reciprocating ram, it is desirable that means be provided for preventing the over-stroking of the said ram. This is desirable in order to prevent the ram from bottoming against the packing or other parts of the press or cylinder which are not designed to support the thrust of the said ram. Also, in many instances it is necessary to provide a means to stop the ram at a predetermined point during or immediately subsequent to the working stroke thereof so as to prevent the damaging of expensive blanking or forming dies.

Hitherto it has been customary to provide positive stop means such as blocks which the ram or platen engages at the aforementioned predetermined point of travel. Such an arrangement has the disadvantage of unduly stressing the mechanical parts of the press as well as overloading the hydraulic circuit. Also considerable shock may be created by the sudden halting of the press ram or platen against a positive and unyielding stop means such as a block.

Accordingly, it is an object of this invention to provide a means for stopping a hydraulic motor in any predetermined position of movement without the use of blocks or similar positive stop means.

It is another object of this invention to accomplish the above result without creating unduly high pressures within the hydraulic system associated with the hydraulic motor.

These and other objects will become more apparent upon reference to the following description taken in connection with the attached drawings in which:

Figure 1 is a diagrammatic view of a hydraulic motor and circuit therefor provided with the ram halting means of this invention, and

Figure 2 is a view of the pressure generator employed in this circuit and fitted with various controls according to this invention, and

Figure 3 is a section through a spring loaded valve constructed according to this invention.

General arrangement

According to this invention, a fluid operable motor such as a vertically acting reciprocating type motor is supplied with pressure fluid from a fluid source of variable delivery. The fluid source may be directly connected to the opposite areas of the reciprocating ram thereby to reciprocate the same or may be connected through a reversing valve with the said ram.

The fluid source is preferably urged toward full stroke position by a yielding means and includes control cylinder and piston assemblies responsive to predetermined pressures for moving the pump toward and into neutral or no delivery position.

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According to the present invention a valve is provided which, in response to a predetermined travel of the reciprocating ram, closes off the exhaust passage from the ram and thereby causes a pressure to be built up therein. The pressure is conducted to one of the aforementioned control cylinder piston assemblies and is effective to move the pump to neutral.

Detailed description

Referring to the drawings in detail and, particularly, Figure 1, there is shown a fluid operable motor means comprising a cylinder 10 having reciprocably mounted therein a differential plunger 11 having an advancing area 12 and a retracting area 13.

A source of pressure such as the pump 15 is provided for supplying fluid through the conduit 16 and 4-way valve 17 to the conduits 18 and 19 and thence to the areas 12 and 13 thereby to reciprocate the plunger 11. The pump 15 draws fluid from the reservoir 20 through a conduit 21, while the 4-way valve 17 exhausts fluid through the conduit 22 back to the reservoir 20.

The valve 17 is a standard distributing valve and is adapted, in one position, to interconnect the conduits 16 and 18 while simultaneously interconnecting the conduits 19 and 22 whereby pressure fluid is delivered to the main area 12 of the plunger 11 while the retraction area 13 is exhausted. The valve 17 is also adapted to effect fluid communication between the conduits 16 and 19 while simultaneously interconnecting the conduits 18 and 22 thereby to deliver pressure fluid to the retraction area 13 while exhausting the main or advancing area 12.

The conduit 18 includes a valve 25 which normally permits free flow in either direction therethrough but which is by-passed by a check valve 26 for permitting fluid flow from the valve 17 to the retraction area 13 but not vice-versa, this valve being provided for a reason which will become apparent hereinafter.

The valve 25, more particularly shown in Figure 3, comprises a casing 30 having a shouldered axial bore therein as at 31, the shoulder forming a valve seat as at 32. Reciprocably mounted in the bore 31 is a valve member 33 which is adapted to be moved downwardly into engagement with the seat 32 thereby to interrupt the fluid connection between the portions of the conduit 18 entering on opposite sides of the valve casing. The valve member 33 is rigidly attached to or is integral with a rod 35 which terminates, at its upper end in an enlarged portion 36 which is stopped, in its upward movement by the threaded

plug 37. A yielding means such as the spring 38 bears between the underside of the enlarged portion 36 and a portion of the casing 30 and serves to urge the portion 36, the rod 35 and the valve member 33 into their extreme upward position thereby normally to maintain a free fluid flow through the valve.

Referring again to Figure 1, it will be seen that the rod 35 extends downwardly from the valve 25 and has affixed thereto, near its lower end, a collar 40. Resting on the collar 40 is a spring 41 which supports a second collar 42 which latter is slidable on the rod 35. An arm 43 is attached to the platen and encircles the rod 35 and is slidable thereover. This arrangement is such that, at a predetermined point of forward travel of the plunger 11, the arm 43 will engage the collar 42 and, through the spring 41, the collar 40 and the rod 35 move the valve member 33 downwardly against the seat 32 and thereby effect interruption of the fluid flow through the conduit 19.

The construction of the pump 15 is more particularly shown in Figure 2 where it will be seen to comprise a casing 50 within which is mounted a movable flow control member 51. Attached to the left side of the casing 50 is an adjustable yielding means for continuously urging the flow control member 51 toward maximum delivery position. The yielding means comprises a pair of telescoping cylinders 52 and 53, the former being provided with a slot 54 and the latter with a pin 55, these last mentioned means preventing relative rotation between the cylinders 52 and 53. A spring 55 is mounted within the cylinders and bears against one end of the cylinder 52 and the opposite end of the cylinder 53. A rod 56 is threadedly attached to the flow control member 51 and extends through the center of the spring 55 and through the end wall of the cylinder 53. The end of the rod 56 which extends through the end wall of the cylinder 53 is threaded and has associated therewith a hand wheel 57 which abuts the outer portion of the cylinder 53. The hand wheel 57 is effective, when moved, to adjust the thrust with which the spring 55 urges the cylinder 53, rod 56 and flow control member 51 toward the left or maximum delivery position.

Attached to the opposite side of the flow control member 51 from the rod 56 is a rod 60 which extends through the casing 50 into a pair of cylinders 61, 62. Attached to the rod 60 within the cylinder 61 is a piston 63 and within the cylinder 62 a piston 64. A conduit 65 leads from the left end of the cylinder 62 to the discharge conduit 16 of the pump 15 while a conduit 66 leads from the left end of the cylinder 61 to the conduit 19 at a point between the cylinder 10 and the valve 30. It will be noted that the effective area of the piston 63 is larger than the effective area of the piston 64 and that, therefore, a greater pressure is required to be introduced into the cylinder 62 through the conduit 65 in order to shift the flow control member toward neutral against the thrust of the spring 55 than is required to be introduced into the cylinder 61 to accomplish the same result.

Operation

In operation, a working or downward stroke of the plunger 11 is instituted by shifting the valve 17 to interconnect the conduits 16 and 18 and the conduits 19 and 22. With the valve so shifted pressure fluid is delivered from the pump 15 to the main area 12 while the retraction area 13 is exhausted through the conduit 19 and valves 25 and 17 and conduit 22 to the reservoir 20.

The plunger 11, under these conditions, moves downwardly into work engaging position and thereafter performs such work as it is desired to do. At the completion of the working stroke the valve 17 is shifted so as to interconnect the conduits 16 and 19 and the conduits 18 and 22. The pump now delivers pressure fluid through the conduit 19 to the retraction area 13 while the advancing area 12 is exhausted through the conduit 18, valve 17 and conduit 22 to the reservoir. The upward movement of the press platen may be stopped in any desirable manner, say, by automatic linkage or by manually shifting the valve 17 to a neutral position.

If, at the completion of the working stroke, it is desired to maintain the press ram in engagement with the work under a predetermined pressure, the piston-cylinder 64, 62 is effective to accomplish this by moving the pump substantially to neutral in response to the pressure conducted thereto by conduit 65. Subsequent to this pressure dwell the valve 17 may be shifted to institute the retraction stroke.

If, however, on the downward stroke of the plunger 11, the same advances beyond the maximum desirable point of travel, the plunger will be brought to a halt in the following manner: the collar 40 on the rod 35 is adjusted so that the platen arm 43 engages the collar 42 and moves the same downwardly to compress the spring 41 and thereby to close the valve 25 when the aforementioned maximum point of travel has been attained. When the valve 25 is closed, that is, when the rod 35 has moved the valve member 33 downwardly into engagement with the seat 32 against the thrust of the spring 38, the passage of fluid through the conduit 19 is interrupted and the fluid remaining in the lower side of the cylinder 10 is trapped. With the fluid beneath the plunger 11 trapped, further movement downwardly of the said plunger is effective to create a pressure in the said trapped fluid which is conducted, by means of the conduit 66, to the cylinder 61 where it acts on the piston 63 to urge the flow control member of the pump toward neutral. It will be apparent that the pressure required to move the pump to neutral or no delivery position under these circumstances is less than the pressure required to move the pump to neutral when the ram is dwelling on the work as explained hereinbefore. It will also be evident that, since the retraction area 13 is considerably smaller than the advancing area 12, the pressure on the advancing area and, therefore, in the pump discharge conduit will be even smaller than the pressure developed in the lower end of the cylinder 10. For example, if the advancing area is four times the area of the retraction area, and the piston 63 is twice the area of the piston 64, the pressure developed by the pump in order to shift the same to neutral in the event the ram over strokes will be on the order of one-eighth of the maximum pressure developed by the pump when the ram is performing work. Subsequent to the shifting of the pump to neutral when the ram has over-stroked and closed the valve 25, a retraction stroke of the ram may be instituted by shifting the valve 17 so as to direct the pump discharge into conduit 19 while simultaneously exhausting the advancing area through the conduit 18, valve 17 and conduit 22 to the reservoir. At this time, the discharge of the pump flows through conduit 16, valve 17 and conduit 19 to the check valve 26 and passes therethrough to the retraction area 13. The valve 25 is thus by-

passed and the fact that the same is closed has no effect whatsoever on the normal retraction stroke of the ram.

It will be apparent that various modifications are possible in the structure and arrangement thereof without in any way departing from the spirit of the invention. For example, the pump 15 could be of the reversible variable delivery type and be connected directly to the advancing and retracting areas thereby eliminating the reversing valve 17.

Accordingly, it will be understood that I do not wish to be limited to the specific structure and arrangement shown in the drawings but desire to comprehend such modifications thereof 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 downwardly acting fluid operable plunger having associated therewith a larger advancing area and a smaller retraction area, a variable delivery pump connected to supply actuating fluid to said areas for reciprocating said plunger, a first valve selectively operable for directing the flow of fluid from said pump to said advancing area or to said retraction area while simultaneously exhausting the other of said areas, a second valve arranged between said retraction area and said first valve and including a valve member movable to interrupt fluid communication between said retraction area and said first valve, yielding means associated with said valve member for continuously urging the same into position to permit fluid communication between said retraction area and said first valve, a rod attached to said valve member, a collar adjustably attached to said rod, a spring on said rod and supported by said collar, an arm associated with said plunger and adapted in response to a predetermined advancing movement thereof to engage said spring and therethrough to urge said collar, said rod and said valve member against the thrust of said yielding means into position for said valve member to interrupt fluid communication between said retraction area and said first valve, a fluid operable servomotor associated with said pump and hydraulically connected with said retraction area and operable in response to the pressure created thereby by the advancing movement of said plunger immediately subsequent to the closing of said second valve to move said pump into substantially no delivery position thereby to halt said plunger, and means associated with said second valve and operable to permit the flow of fluid from said first valve to said retraction area so as to permit the initiation of a retraction stroke when said second valve is closed.

2. In a hydraulic system, a reciprocable ram means having a larger advancing area and a smaller retraction area, a variable delivery pump for supplying actuating fluid to said areas for reciprocating the ram, a reversing means, said reversing means being selectively operable to direct the discharge of the pump to the advancing area or to the retraction area while simultaneously connecting the other of said areas to exhaust, a first fluid operable servomotor associated with said pump and having an effective area hydraulically connected with the outlet of said pump and operable in response to a predetermined pressure therein to move said pump into substantially no delivery position, a second fluid operable servomotor associated with said pump and having an effective area substantially larger than that of said first servomotor hydraulically connected with said retraction area and operable in response to a predetermined pressure therein substantially smaller than the first mentioned predetermined pressure to move said pump into substantially no delivery position, a valve hydraulically connected with said retraction area and said reversing means and operable by said ram in response to a predetermined advancing movement thereof to interrupt the flow of fluid from said retraction area to said reversing means to create pressure in said retraction area, and means by-passing said hydraulically connected valve for permitting the flow of fluid from said reversing means to said retraction area only.

3. In a hydraulic system, a reciprocable ram means having a larger advancing area and a smaller retraction area, a variable delivery pump for supplying actuating fluid to said areas for reciprocating the ram, a reversing means, said reversing means being selectively operable to direct the discharge of the pump to the advancing area or to the retraction area while simultaneously connecting the other of said areas to exhaust, a first fluid operable servomotor associated with said pump and having an effective area hydraulically connected with the outlet of said pump and operable in response to a predetermined pressure therein to move said pump into substantially no delivery position, a second fluid operable servomotor associated with said pump and having an effective area substantially larger than that of said first servomotor hydraulically connected with said retraction area and operable in response to a predetermined pressure therein substantially smaller than the first mentioned predetermined pressure to move said pump into substantially no delivery position, a valve hydraulically connected with said retraction area and said reversing means and operable by said ram in response to a predetermined advancing movement thereof to interrupt the flow of fluid from said retraction area to said reversing means to create pressure in said retraction area, and means by-passing said hydraulically connected valve for permitting the flow of fluid from said reversing means to said retraction area only, said by-passing means including a conduit which by-passes said hydraulically connected valve, and a check valve in said conduit.

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