

March 13, 1951

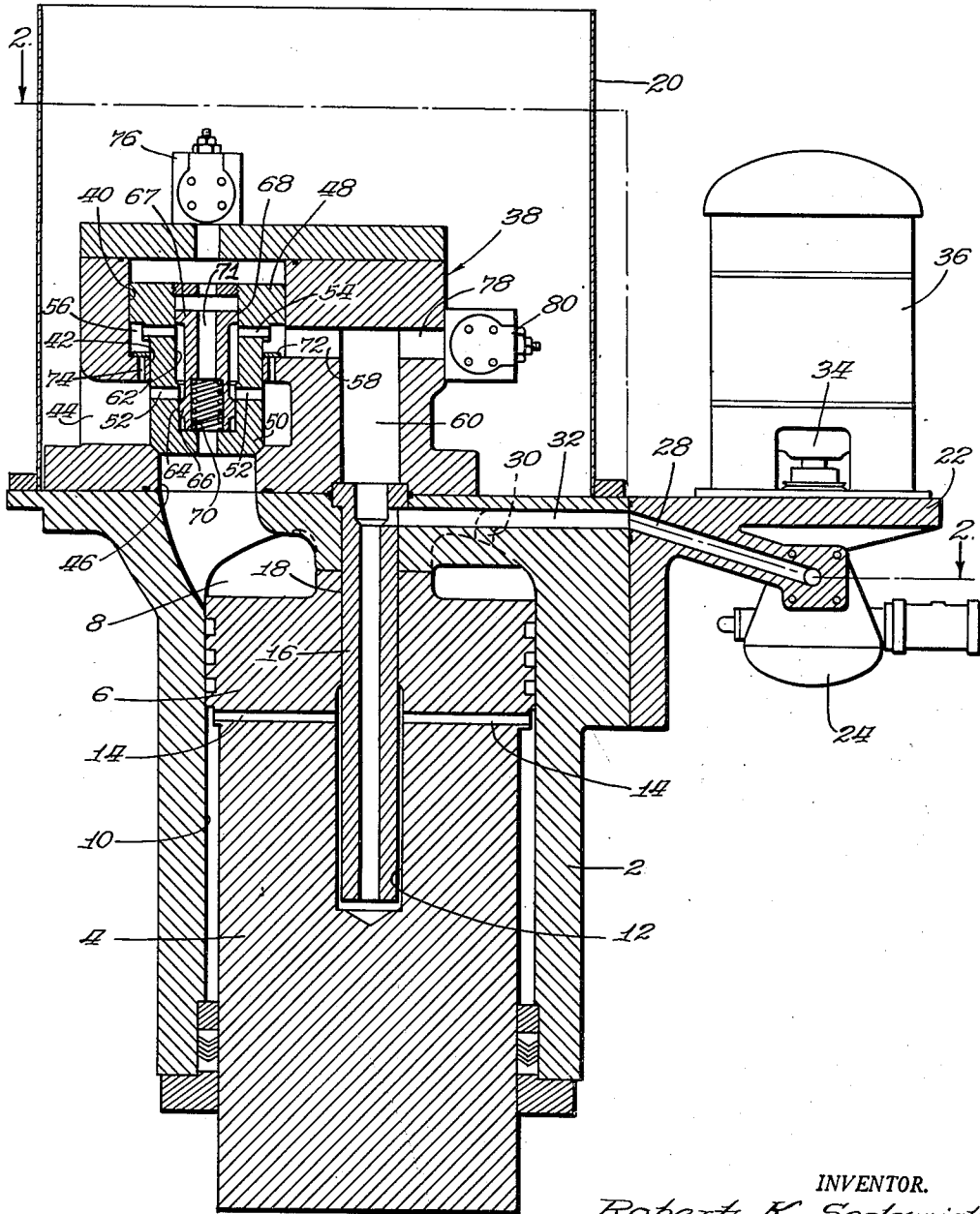
R. K. SEDGWICK
PREFILL VALVE

2,544,731

Filed March 18, 1948

2 Sheets-Sheet 1

Fig. 1.



INVENTOR.

Robert K. Sedgwick

BY

Wm O. B. Garner
Att'y.

March 13, 1951

R. K. SEDGWICK

2,544,731

PREFILL VALVE

Filed March 18, 1948

2 Sheets-Sheet 2

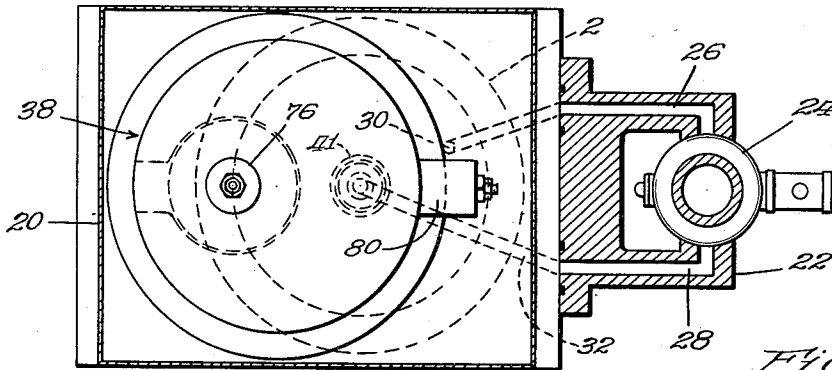


Fig. 2

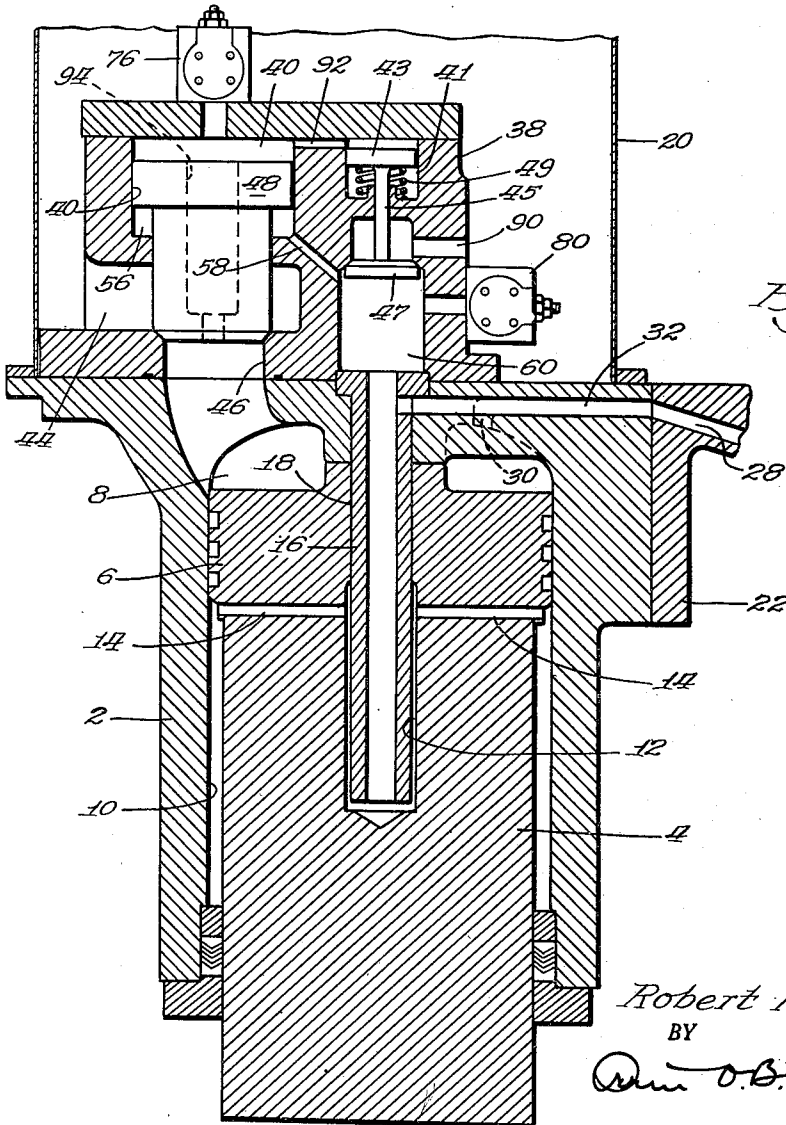


Fig. 3

INVENTOR.

Robert K. Sedgwick

BY

Wm O. B. Garner

Atty.

UNITED STATES PATENT OFFICE

2,544,731

PREFILL VALVE

Robert K. Sedgwick, Oak Park, Ill., assignor to
American Steel Foundries, Chicago, Ill., a cor-
poration of New Jersey

Application March 18, 1948, Serial No. 15,531

13 Claims. (Cl. 121—38)

1

This invention relates to hydraulic presses and more particularly to a novel prefill valve arrangement particularly adapted to a pipeless press circuit of the type disclosed in my copending application, Serial No. 545,058, filed July 15, 1944, in the United States Patent Office, and now abandoned.

A general object of the invention is to devise novel prefill valve means for opening the main or full pressure chamber of an hydraulic motor to communication with a reservoir of low pressure hydraulic fluid during the rapid advance and pullback phases of the motor's cycle and for cutting off said communication during the full pressure phase of the cycle.

A more specific object of the invention is to provide prefill valve means of vertical design wherein the parts move vertically to open and closed position with the positive action heretofore possible only with valve means of horizontal design wherein the parts move horizontally to open and closed position.

Still another object of the invention is to afford, in combination with the above-mentioned features, prefill valve means which close immediately upon restriction of fluid flow from the pullback chamber and other valve means responsive to pressure in the main chamber for connecting the pullback chamber to the hydraulic reservoir until the operating pressure within the main chamber has been drawn off through the fluid supply system thereby preventing noise and shock to the reservoir resulting from opening of the prefill valve means while high pressures exist in the main chamber.

The foregoing and other objects and advantages of the invention will become apparent from a consideration of the following specification and the accompanying drawings, wherein:

Figure 1 is a side view of the hydraulic press embodying the invention, portions of the press being shown in elevation and other portions being shown in vertical section;

Figure 2 is a sectional view on the line 2—2 of Figure 1; and

Figure 3 is a view comparable to Figure 1 but illustrating a modification of the invention.

Describing the invention in detail and referring first to the embodiment shown in Figures 1 and 2, the press comprises a main cylinder casting, generally designated 2, containing a ram 4 with a head 6 defining a main or full pressure advance chamber 8 and a return or pullback chamber 10 within the cylinder casting 2. The ram 4 is provided with a central bore or passage 12 connected

2

to the pullback chamber 10 as by radial ports 14 and containing a pullback tube 16 slidably fitted in a restricted portion 18 of the passage 12 in substantially fluid-tight engagement with said portion at the upper end of the passage.

The cylinder casting 2 supports a tank or reservoir 20 adapted to contain a suitable supply of low pressure hydraulic fluid such as, for example, oil. The cylinder also supports a bracket 22 carrying a conventional pump 24 preferably of the well-known variable discharge, reversible delivery type. The bracket is connected in any suitable manner, as by cap screws (not shown), to the cylinder casting and is provided with advance and return ports 26 and 28 respectively, connected with advance and return lines 30 and 32 extending through the cylinder casting, the line 30 being connected to the main chamber 8 and the line 32 being connected to the pullback tube 16. The bracket 22 supports a motor 34 operably connected to the pump 24. The bracket also supports a housing 36 for the motor.

It will be understood that in operation of the device, as hereinafter discussed in detail, the pump 24 alternately delivers pressure fluid to and exhausts pressure fluid from the respective lines 30 and 32 in such manner that the line 30 delivers pressure fluid when the line 32 is exhausted and vice versa. If desired, this may be accomplished by means of suitable valving rather than a reversible delivery pump such as that disclosed in the present case. However an object of the present invention is to eliminate such valving and the necessary piping therefor.

The cylinder casting 2 also supports a prefill valve body 38 containing a cylindrical prefill valve chamber 40 having a smaller diameter portion 42 adapted to communicate through a passage 44 with a port or passage 46 connected to the chamber 8. A hollow prefill valve stem 48 reciprocates within the chamber 40 and comprises a smaller diameter portion 50 adapted to close the port 46 in the closed position of the stem. The stem portion 50 comprises ports 52 connected to the passage 44 and other ports 54 connected to the larger diameter portion of the chamber 40 beneath the larger diameter portion of the stem 48 which defines an annular chamber 56 connected to a passage 58 which is in turn connected by a passage 60 to the upper end of the pullback tube 16.

The prefill valve stem 48 comprises a cylindrical chamber or bore 62 having a smaller diameter portion 64 receiving a smaller diameter portion 66 of a hollow valve stem 67 having a larger

3

diameter portion 68 fitted into the larger diameter portion of the bore 62. The valve stem 68 is spring-pressed by a spring 70 to its closed position whereat the ports 52 are closed from communication with the ports 54 and the annular chamber 56.

Sleeved over the portion 50 of the prefill valve stem 48 is an annular valve plate 72 adapted to close ports 74 connecting the chamber 56 with the passage 44.

It may be noted that each stem 48 and 67 is formed with a larger diameter portion and a smaller diameter portion whereby, as hereinafter described in connection with the operation of the press, the development of pressing tonnage in the chamber 8 acting against the relatively great pressure area of the stem 48 thrusts the latter downwardly to closed position and also thrusts the valve stem 67 downwardly to open position against the resistance of spring 70, inasmuch as the stem 67 comprises a longitudinal passage 71 accommodating flow of fluid from the passage 46 to the top of the chamber 40, whereby pressure in passage 46 acts on the top surfaces of the stems 48 and 67.

The top of valve chamber 40 is connected to a conventional relief valve 76 adapted to discharge into the reservoir 20 to maintain a predetermined maximum pressure value within the chamber 8, and the passage 60 is connected by a passage 78 to a similar relief valve 80 adapted to prevent excessive pressure in the pullback chamber and associated conduits in the pullback phase of the operating cycle.

In the operation of the press, the operator initiates the rapid advance phase of the cycle by actuating the pump 24 to the advance position thereof whereat fluid is drawn to the suction side of the pump from the pullback passage 32 and is delivered from the discharge side of the pump to the advance passage 30. Under these conditions the ram descends toward the work, forcing fluid from the pullback chamber 10 through the pullback tube 16 into the passage 32 and into the annular passage 56 holding the prefill valve stem 48 in the open position thereof accommodating flow of fluid from the hydraulic reservoir 20 into the chamber 8 as the ram 4 moves on its rapid advance stroke toward the work.

As the ram encounters resistance of the work, the advance movement of the ram is checked, diminishing the flow of fluid from the pullback chamber 10 to the passage 60 and the pullback passage 32. This causes a rapid drop in the pressure within the annular chamber 56 causing the prefill valve stem 48 to be urged to the closed position shown in Figure 1 and sucking the annular valve plate 72 to its open position to accommodate supply of hydraulic fluid to the pullback passage 32 which is, under these conditions, delivering fluid to the suction side of the pump. With the valve stem 48 closed, pressure rapidly builds up in the chamber 8 acting on the larger diameter portion of the stem 48 to maintain it in tightly closed position and acting on the larger diameter portion 68 of the valve stem 67 to force the latter downwardly to the open position shown in Figure 1 whereat fluid is supplied from the reservoir 20 through the passage 44, the ports 52 and 54 to the annular chamber 56 which is in communication with the pullback line 32 thus insuring an adequate supply of fluid for the pump 24 while the latter is on the full pressure advance stroke thereof.

4

The pullback phase of the cycle is initiated by reversing the pump 24. Under these conditions the pump directs pressure fluid to the pullback passage 32 and draws fluid from the advance passage 30. The fluid in the pullback passage 32 is exhausted through the passages 60 and 58 and the annular chamber 56 into the ports 54 and thence through ports 52 into the reservoir 20. When pressure within the advance chamber 8 is relieved sufficiently to accommodate closing of the stem 67, the pressure of the fluid trapped within the annular chamber 56 urges the stem 48 to its open position whereat fluid from the advance chamber 8 is expelled through the passages 46 and 44 into the reservoir 20 as the ram moves on its pullback stroke preparatory to initiation of another cycle.

Figure 3 shows a modified valve mechanism in a press otherwise identical with that shown in Figures 1 and 2. Parts of the press in Figure 3 corresponding to those of Figure 1 and 2 are identified by corresponding numerals.

In the embodiment of Figure 3, the valve body 38 comprises a cylindrical chamber 41 receiving a cylindrical pistonlike portion 43 of a valve stem 45 slidably fitted within a complementary opening of the body 38 and connected to a valve member 47 which is biased to closed position by a spring 49. The body 38 is provided with a port 90 adapted to be closed against communication with the pullback line 32 and opened to communication therewith by means of the valve member 47, which is held in open position on the full pressure stroke by pressure fluid admitted to chamber 41 by means of a port 92 communicating with the top of the prefill valve chamber 40.

Thus on the rapid advance phase of the cycle, the ram 4 moves downwardly as fluid is pumped into the advance line 30 and is sucked from the pullback line 32. Under these conditions, the prefill valve stem 48 is held in its open position by pressure conveyed through the passage 58 to the annular chamber 56. This pressure is maintained by the fluid forced from the pullback tube 16 as the ram moves downwardly and this pressure is also effective to hold the valve member 47 in its upper or closed position.

The pressing or full pressure advance stroke of the ram 4 is initiated, as in the previously described embodiment, by resistance of the work to the rapid advance stroke of the ram 4, whereupon pressure in the passage 60 of the body 38 drops, accommodating movement of the prefill valve stem 48 to its closed position and at the same time sucking the valve member 47 to its open position whereupon the reservoir 20 is opened to communication through the port 90 and the passage 60 with the pullback line 32. As pressure builds up in the advance chamber 8, it is transmitted upwardly through the hollow prefill valve stem 48 which is provided with a central passage, indicated at 94. Under these conditions the pressure in the top of the prefill valve chamber 40 is effective to hold the valve stem 48 in its closed position inasmuch as the top pressure area thereof is substantially greater than the bottom pressure area. The pressure in the top of the chamber 40 is conveyed through the port 92 to the chamber 41 thereby acting against the top of the valve member 43 holding the valve member 47 in its open position to insure steady flow of fluid through the port 90.

The pullback phase of the cycle is initiated by reversing the fluid supply, so that the pressure

5

fluid is admitted to the pullback line 32 and the advance line 30 is exhausted, the valve member 47 being maintained in its open position by the pressure against the valve member 43 accommodating flow of fluid from the pullback line 32 and the port 90 into the reservoir 20 until the pressure within the chamber 8 has been bled off sufficiently to accommodate raising of the prefill valve stem 48 by the pressure in the passage 58 and to accommodate closing of the valve stem 47 whereupon the ram 4 moves on its pullback stroke urging fluid from the advance chamber 8 through the port 46 and passage 44 into the reservoir 20.

It will be understood that I do not wish to be limited by the exact embodiments of the device shown which are 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. A prefill valve for an hydraulic circuit having a motor with advance and return chambers and ram means reciprocal therein, and a reservoir of low pressure fluid; said valve comprising a body member having a vertical cylindrical chamber including an upper larger diameter portion and a lower smaller diameter portion, a passage in said body member beneath the smaller diameter portion of said chamber adapted to accommodate flow of fluid between the reservoir and the advance chamber, a valve stem member having a larger diameter portion and a smaller diameter portion slidably fitted within respective portions of the valve chamber in substantially fluid-tight engagement therewith, said valve stem member being adapted in closed position to cut off communication between said reservoir and the advance chamber, a passage through said valve stem member affording flow of fluid at all times from the advance chamber to the top of the larger diameter portion of the valve chamber, the top area of said stem member being greater than the bottom area thereof, another high pressure passage in said body member connected to the return chamber and connected to a section of the larger diameter portion of the valve chamber containing a downwardly facing area of the stem member, a low pressure passage in one of the members adapted to connect the reservoir to said other high pressure passage, and valve means within said one member comprising a vertically movable valve element having a top pressure area connected to the top of the valve chamber and having a downwardly facing pressure area connected to said other high pressure passage, said element being adapted in its upper closed position to cut off communication between said low pressure passage and said other high pressure passage and being adapted in a lower open position to accommodate flow of fluid between said low pressure passage and said other high pressure passage, and spring means in said one member for yieldingly biasing the valve element to the closed position thereof.

2. A prefill valve comprising a body member with an inlet passage and an outlet passage, a cylindrical chamber in said body member having a larger diameter portion and a smaller diameter portion, a valve stem member having a larger diameter portion slidably fitted in the larger diameter portion of said chamber in substantially fluid-tight engagement therewith and having a smaller diameter portion slidably fitted in the

6

smaller diameter portion of said chamber in substantially fluid-tight engagement therewith, said stem member being adapted in a closed position thereof to cut off communication between the inlet and outlet passages and being adapted in an open position to accommodate flow of fluid between said passages, said body member having another inlet passage spaced from the first-mentioned passages and connected to the larger diameter portion of the chamber at a point therein containing an opening pressure area of said stem member, said stem member having a longitudinal passage therethrough connected to the outlet passage, the larger diameter portion of said stem member having a greater closing pressure area than the opening pressure area of the smaller diameter portion of said stem member, and valve means in one of said members having an opening pressure area and a closing pressure area adapted to be acted upon respectively by the fluid pressure in said longitudinal passage and the pressure in said other inlet passage, and a low pressure inlet port in said one member, said valve means being adapted to connect said other inlet passage to said low pressure inlet port when the pressure in said outlet and longitudinal passages exceeds that within said other inlet passage by a predetermined value and being adapted at other times to cut off communication between said other inlet passage and said low pressure inlet port, whereby the pressure in said other inlet passage acting upon the first-mentioned area is effective to actuate said stem member to open position.

3. A prefill valve for an hydraulic circuit having a motor with advance and return chambers and ram means reciprocal therein, and a reservoir of low pressure fluid; said valve comprising a body member with a passage adapted to be connected to the reservoir, a high pressure passage adapted to be connected to the advance chamber, another high pressure passage adapted to be connected to the return chamber, a valve chamber in said body member having larger and smaller diameter portions, a valve stem member having portions complementary to said chamber portions, the smaller diameter portion of the stem being adapted to close said high pressure passage against communication with the first-mentioned passage, said stem having a longitudinal passage therethrough affording flow of pressure fluid from the first-mentioned high pressure passage to a section of the larger diameter portion of the valve chamber containing a closing area of the stem member substantially greater than the opening area of the smaller diameter portion of the stem member, said stem member having an opening area in another section of the larger diameter portion of said valve chamber, passage means connecting the last-mentioned section to said other high pressure passage, a low pressure port in one of said members, and valve means in said one member having opposed pressure areas acted upon respectively by the pressure in the first-mentioned section of the valve chamber and the pressure in said other high pressure passage, said valve means being adapted to accommodate flow of fluid between the port and said other high pressure passage when the pressure in the first-mentioned section of the valve chamber exceeds that within said other high pressure passage by a predetermined value and being adapted at other times to cut off communication between said other high pressure passage and said port.

4. In a system for actuation of an hydraulic motor having advance and return chambers, and ram means reciprocal therein; the combination of fluid supply means adapted in the advance position thereof to direct pressure fluid to the advance chamber and exhaust fluid from the return chamber and adapted in the return position thereof to deliver pressure fluid to the return chamber and exhaust fluid from the advance chamber, a reservoir of low pressure fluid, prefill valve means connecting said reservoir to said advance chamber, said valve means comprising a casing having a passage connecting said reservoir to said advance chamber, a vertically movable valve stem slidably fitted in said chamber and having a passage extending longitudinally therethrough from top to bottom thereof, the pressure area at the top of said stem being greater than that at the bottom of said stem, whereby fluid pressure within the advance chamber tends to hold said stem in the closed position thereof, said casing having a passage connected to the return chamber and to a portion of the casing containing a downwardly facing area of said stem, whereby fluid pressure delivered to the last-mentioned passage from the return chamber is effective under certain conditions to hold said stem in the open position thereof, valve means having opposed pressure areas acted upon by the fluid in the respective chambers, said last-mentioned valve means being adapted to open accommodating flow of fluid between the return chamber and the reservoir whenever the pressure in the advance chamber exceeds that within the return chamber by a predetermined value and adapted at other times to restrict flow of fluid between the reservoir and the return chamber.

5. In a system of the class described for actuation of an hydraulic motor having a cylinder carrying a pullback tube, and a ram having a head slidably fitted in said cylinder to define advance and pullback chambers therein, the ram being hollow and having the tube slidably fitted therein, and passage means connecting the interior of the ram with the pullback chamber; the combination of fluid supply means for delivering pressure fluid to the advance chamber while exhausting the tube and for delivering pressure fluid to the tube while exhausting the advance chamber, a reservoir of low pressure fluid, prefill valve means comprising a casing with a passage connecting the advance chamber to the reservoir, a valve chamber in the casing, and a prefill valve stem in the valve chamber adapted to open and close the passage with respect to said advance chamber, said stem having a passage extending from end to end thereof and having a greater pressure area adapted to close the stem than that adapted to open the stem, a passage in said casing connecting the tube to a portion of said valve chamber containing an area of said stem adapted to open the same, and valve means adapted to connect said last-mentioned passage to the reservoir when the pressure in the advance chamber exceeds that within the pullback chamber by a predetermined value and adapted at other times to cut off communication between the reservoir and the last-mentioned passage.

6. A system, according to claim 5, wherein independent relief valve means are provided for connecting the prefill valve chamber and the second-mentioned valve passage, respectively, to said reservoir, for maintaining the pressure in

the advance and pullback chambers at predetermined values.

7. In a system for actuation of an hydraulic motor having advance and return chambers, and ram means reciprocal therein; the combination of means for alternately directing pressure fluid to and exhausting pressure fluid from respective chambers, a reservoir of low pressure fluid having a connection to the advance chamber, prefill valve means for opening and closing said connection, said valve means comprising a vertically movable hollow stem having a vertical opening therethrough and having a greater top pressure area acted upon by pressure in the advance chamber tending to close the stem than the bottom area of the stem, said stem having another downwardly facing pressure area acted upon by the pressure in the return chamber during the rapid advance stroke and the return stroke of said ram means to hold said stem open, valve means adapted to automatically accommodate unrestricted flow of fluid between the return chamber and the reservoir when the pressure in the advance chamber exceeds that in the return chamber by a predetermined value, said last-mentioned valve means being adapted at other times to automatically restrict flow of fluid between the reservoir and the return chamber whereby the pressure in the latter chamber acts upon the second-mentioned area to hold said stem open.

8. A system for actuation of an hydraulic motor having a cylinder, a pullback tube carried thereby, a hollow ram having a head reciprocal in the cylinder and defining advance and pullback chambers therein, said tube being afforded a fluid-tight fit within said ram and being reciprocal within a passage in said ram; and passage means connecting said passage at all times to the pullback chamber; the combination of a reversible delivery pump having opposite sides thereof connected to the advance chamber and the tube respectively, a reservoir of low pressure fluid, prefill valve means adapted to open and close communication between the advance chamber and the reservoir, a passage connecting the tube to the prefill valve means for delivering pressure fluid thereto to open the latter on the pullback and the rapid advance strokes of the ram, and valve means having opposed areas acted upon respectively by the pressure in the advance chamber and the tube, the last-mentioned valve means being adapted to open communication between the reservoir and the tube when the pressure in the advance chamber exceeds that within the tube by a predetermined value and adapted at other times to close communication between the tube and the reservoir.

9. A system, according to claim 8, wherein the prefill valve means comprises a stem with a passage extending longitudinally therethrough, the stem having a greater closing area acted upon by the pressure in the advance chamber than the opening area of said stem acted upon by the fluid in the advance chamber, the stem having another opening area connected to the tube, and the other valve means comprises a valve member slidably fitted within the stem passage and having opposed opening and closing areas connected to the advance chamber, the opening area of said member being greater than the closing area thereof.

10. In an hydraulic circuit for actuation of an hydraulic device comprising advance and pull-

back chambers, and ram means reciprocal therein; the combination of means for alternately delivering fluid to and exhausting fluid from respective chambers, a reservoir of low pressure fluid connected to the advance chamber, valve means having opposed pressure areas acted upon by the fluid in respective chambers and adapted when the pressure in the advance chamber exceeds that in the pullback chamber by a predetermined value to open accommodating flow of fluid between said reservoir and the pullback chamber and adapted at other times to close restricting flow of fluid between said reservoir and the pullback chamber, prefill valve means in the connection between said reservoir and said advance chamber comprising a relatively great closing pressure area and a relatively small opening pressure area acted upon by the fluid in said advance chamber in the closed position of the prefill valve, said prefill valve means having another opening pressure area connected to the pullback chamber.

11. In an hydraulic circuit for actuation of an hydraulic device comprising advance and return chambers and ram means reciprocal therein; the combination of prefill valve means adapted to open and close said advance chamber with respect to an associated source of low pressure fluid, said prefill valve means having small and large opening and closing areas respectively communicating with the advance chamber, and having another opening area communicating with the return chamber, valve means for opening and closing communication between the source and the return chamber, said last-mentioned valve means having an opening area communicating at all times with the advance chamber and having a closing area communicating at all times with the return chamber, one-way valve means between the source and said other opening area of the prefill valve means for accommodating flow of fluid from the source, and means for alternately delivering high pressure fluid to and exhausting high pressure fluid from said chambers.

12. An hydraulic circuit as described in claim 11, wherein the second mentioned valve means are housed within the prefill valve means.

13. In an hydraulic circuit for actuation of an hydraulic device comprising advance and return chambers and ram means reciprocal therein; the combination of a reservoir of low pressure fluid, prefill valve means comprising a casing member connected to the reservoir and to the advance chamber, said casing member having a bore with an upper larger diameter portion and a lower smaller diameter portion, a valve stem member with upper and lower parts complementary to and slidably fitted in respective bore portions in substantially fluid tight engagement therewith, a passage through said stem member from top to bottom thereof, the lower part of said stem member being adapted to close said advance chamber from communication with said reservoir, a downwardly facing surface on said upper part acted on by the pressure in the return chamber, and valve means in one of said members having an opening area acted upon by fluid pressure in the advance chamber and having a closing area acted upon by fluid pressure in the return chamber, said valve means being adapted when open to connect the return chamber to the reservoir and being adapted when closed to cut off communication between the return chamber and the reservoir.

ROBERT K. SEDGWICK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,892,568	Ernst	Dec. 27, 1932
1,940,668	Ernst	Dec. 26, 1933
2,077,894	Patrick	Apr. 20, 1937
2,161,804	Dinzl	June 13, 1939
2,204,270	Dinzl	June 11, 1940
2,343,177	Flowers	Feb. 29, 1944