

March 29, 1949.

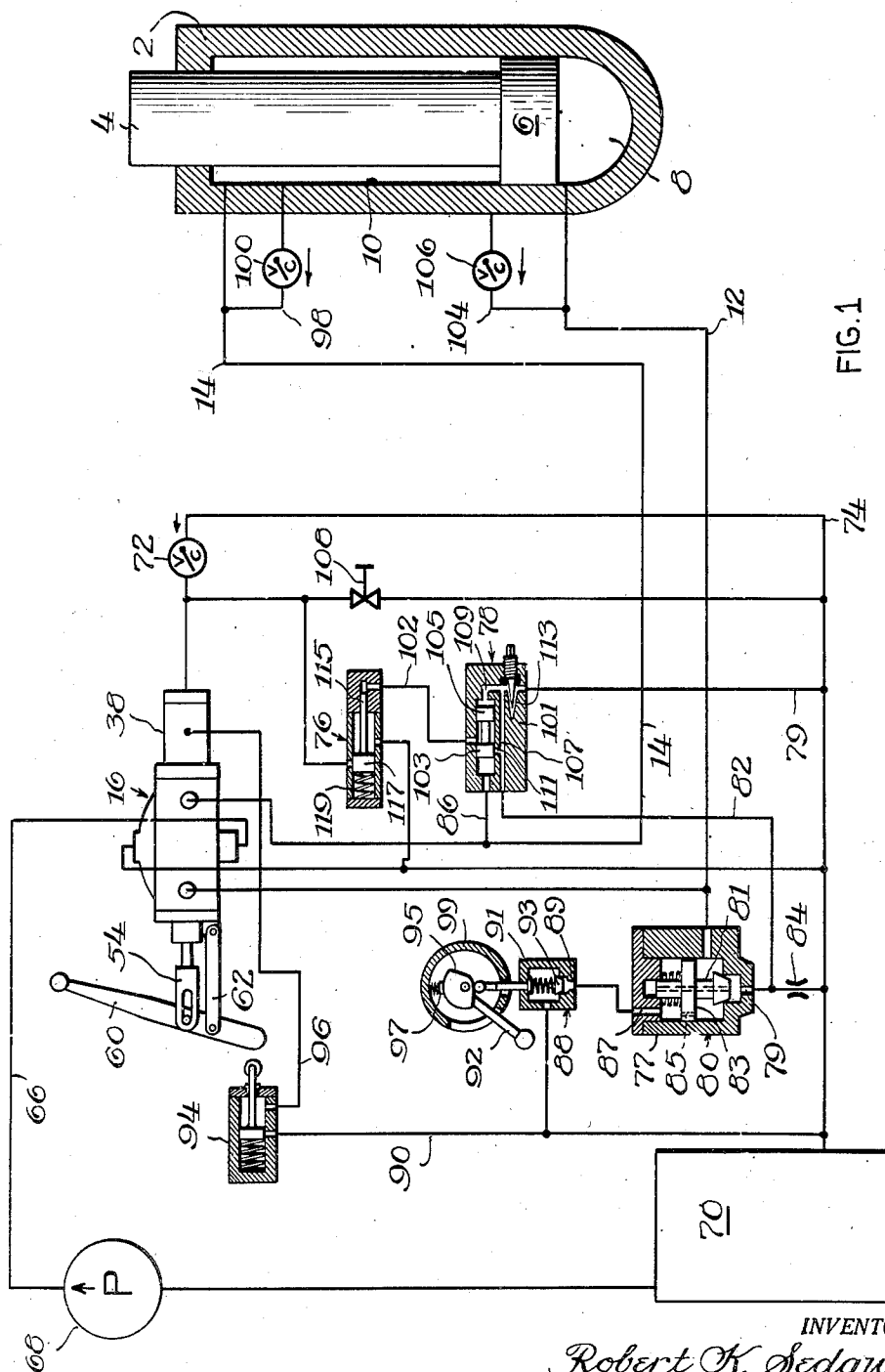
R. K. SEDGWICK ET AL

2,465,758

CONTROL CIRCUIT FOR FLUID ACTUATED MOTORS

Filed Sept. 29, 1944

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

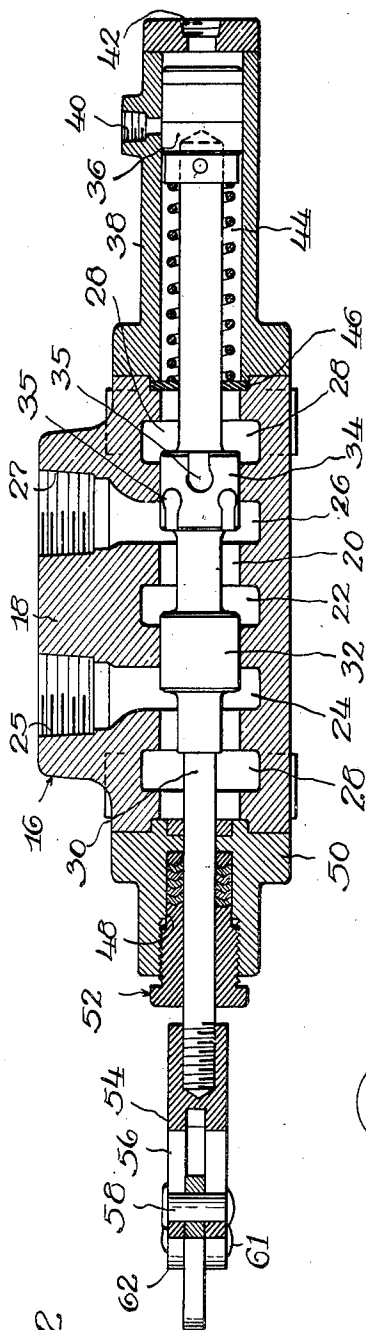


Fig. 2

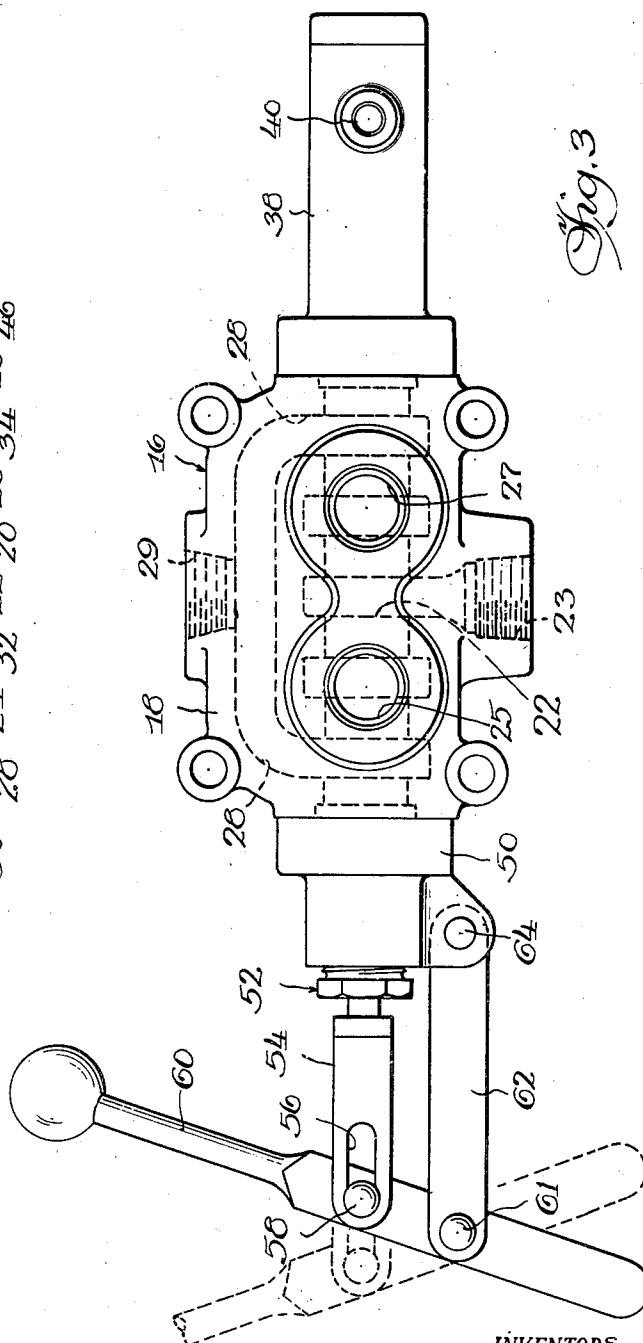


Fig. 3

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UNITED STATES PATENT OFFICE

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CONTROL CIRCUIT FOR FLUID ACTUATED MOTORS

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Our invention relates to hydraulic machinery such as presses and more particularly to novel control means therefor.

The general object of our invention is to provide control means for effecting what is commonly known in the art as semi-automatic operation of a hydraulic machine such as a press or, in other words, an operation wherein the hydraulic ram advances toward the work and at the end of the working or advance stroke automatically reverses and stops in its original retracted position preparatory to the initiation of a new cycle by the operator.

Our invention is particularly adapted for utilization in a device such as an ordnance shell press which is normally operated in explosive atmosphere and for this reason the system is of novel design to eliminate electrical equipment, mechanical latching devices and pilot pumps, all of which might tend to cause an explosion under these conditions.

The preferred cycle of operation for the press consists of an upward advance and pressing stroke, an adjustable dwell under pressure, and a downward accelerated retraction stroke, and it is desirable that the operator shall be relieved of all responsibility for the pressure attained and the duration of the dwell.

In our novel hydraulic system, reversal of the press ram is by pressure rather than distance. That is to say, the control means for initiating the reverse or retraction stroke of the ram is actuated by means responsive to a predetermined pressure built up within the main chamber of the press cylinder as the advance stroke of the ram is stopped by the work.

The above-mentioned objects of our invention are achieved by incorporating in our novel system a four-way operating valve, the stem of which is spring-pressed to its reverse position wherein the press ram is reversed or retracted from the work. Associated with the valve is a pilot cylinder receiving a piston-like extremity of the valve stem and connected to the system by a one-way check valve permitting flow of hydraulic fluid into the pilot cylinder and preventing flow of fluid therefrom. Thus when the stem is actuated to its advance position by the operator, hydraulic fluid flows into the pilot cylinder and becomes entrapped therein, thereby preventing the stem from assuming its reverse position. The pilot cylinder is exhausted by novel means operatively connected to the relief valve of the system which opens in the usual manner whenever the pressure in the system reaches a predetermined maximum on the advance stroke of the ram.

A different object of our invention is to provide a control system such as above described wherein the ram is afforded on its advance stroke an adjustable dwell under pressure prior to the reverse

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or retraction stroke, and we accomplish this object by incorporating a time delay valve in the connection between the relief valve and the pilot cylinder of the operating valve.

Still another object of our invention is to design a system wherein the operator may instantly stop the ram on its advance stroke under emergency conditions, and this object is achieved by a quick stop valve connected to a port in the pilot cylinder for partially exhausting the latter so that the operating valve stem is permitted to move to its neutral position upon actuation of the quick stop valve.

In the drawings, Figure 1 is a diagram of our hydraulic control system.

Figures 2 and 3 illustrate the operating valve in detail, Figure 2 being a bottom view partially in section, and Figure 3 being a side elevational view.

Describing our invention in detail, the press comprises a cylinder 2 and a ram 4 reciprocal therewithin, said ram having a head 6 slidably fitted within the cylinder to define therewithin a main chamber 8 and an annular pull-back or return chamber 10. The chambers 8 and 10 are connected respectively by main and pull-back supply lines 12 and 14 to a four-way operating valve generally designated 16 and shown in detail in Figures 2 and 3.

The valve 16 comprises a body or casing 18 with an internal cylindrical bore 20 communicating with an inlet chamber 22 having a port 23 (Figure 3) and also communicating with spaced outlet or distribution chambers 24 and 26 having respectively ports 25 and 27, all of said ports being formed and arranged for connection in any conventional manner to the associated pipe lines forming a part of the system, as hereinafter described in detail. The casing 18 also comprises a discharge chamber 28 communicating at each end thereof with the bore 20 and having intermediate its ends a port 29 for connection to the return or relief line communicating with the fluid reservoir or tank, as hereinafter described.

The valve stem or spindle 30 comprises a pair of cylindrical piston-like portions 32 and 34 slidably fitted within the bore, and the portion 34 comprises a plurality of flutes or notches 35, 35 in the cylindrical perimeter thereof for a purpose hereinafter discussed.

One end of the stem is provided with a piston 36 slidably reciprocal within a pilot cylinder 38 secured in any convenient manner to the casing 18, and the cylinder 38 is provided with two ports 40 and 42 serving a purpose hereinafter discussed. A spring 44 is sleeved over the stem 30 and bears against the piston 36 and against an abutment ring 46 mounted between the casing 18 and the cylinder 38, said spring being operable to move the stem to its reverse or pull-back position, as

shown in the drawings, wherein hydraulic pressure fluid is directed to the pull-back line 14 which is connected to the port 27. At the same time, hydraulic pressure is exhausted from the main line 12 which is connected to the port 25. The other end of the stem 30 extends through an opening 43 in the cap 50 secured in any desired manner to the casing 18, said opening being afforded a fluid-tight seal by a conventional packing gland assembly generally designated 52.

A yoke 54 is connected to the exterior extremity of the stem 30 and is slotted at 56 to afford a pivotal lost-motion connection for the pin 58 carried by the operating lever or handle 60, said lever being pivotally connected adjacent its lower extremity at 61 to a link 62 pivoted at 64 to the cap 50.

Referring again to Figure 1, it will be seen that the port 23 of the inlet chamber 22 is connected to the supply line 66 which is connected to the discharge side of a conventional unidirectional pump 68, the suction side of which is connected to the reservoir or tank 70 which contains a supply of any suitable hydraulic fluid medium, such as oil. The port 42 (Figure 2) of the pilot cylinder 38 is connected through a one-way check valve 72 (Figure 1) to the relief or return line 74 communicating with the tank 70, said valve 72 being operable to permit flow of hydraulic fluid into the pilot cylinder 38.

A pilot valve 76 of conventional design hereinafter described is connected to the port 42 and to the relief line 74 for opening the pilot cylinder 38 to communication therewith, said pilot valve having an operative hydraulic connection to a time delay valve 78 hereinafter described operable to open the pilot valve 76 after a predetermined period of time subsequent to the actuation of the time delay valve in the manner hereinafter described.

The time delay valve is directly connected to the return line 74 by a branch line 79 and is connected to the conventional relief valve 80 by a branch line 82 at a point upstream of a nipple or throttle 84 affording a restricted passage therein, said line 82 communicating with the return line 74. The time delay valve 78 is also connected by a branch line 86 to the pull-back line 14, thus permitting the pressure therein to reset the valve 78, when the stem 30 is in its reverse position, above described.

The relief valve 80 is connected to a pressure setting valve 88 which is connected by a branch line 90 to the return line 74, said valve 88 having a handle 92 associated with conventional mechanism hereinafter described for setting the pressure at which the relief valve 80 opens. The branch line 90 is also connected to a quick stop valve 94 which is in turn connected by a sub-branch line 96 to the port 40 in the pilot cylinder 38.

In the operation of our novel hydraulic system, the operator initiates the advance stroke of the ram 4 by pushing the handle 60 to the left (Figure 1), thus moving the stem 30 in that direction against the resistance of the spring 44, thereby establishing communication between the supply line 66 and the main chamber supply line 12 through the valve chamber 24 and its port 25. At the same time, the pull-back line 14 is relieved or opened to discharge into the return line 74 through the port 27 of the operating valve chamber 26 and through the chamber 28. This causes the ram to be advanced until its associated platen (not shown) engages the work. The valve stem

30 is maintained in its advance position due to the fact that the piston 36 in its initial movement to the left draws hydraulic fluid through the check valve 72 into the pilot cylinder 38.

Overtravel of the ram on its advance stroke is prevented by the branch line 98 of the pull-back line 14, said branch line normally communicating with the pull-back chamber 10 through a one-way check valve 100 which permits flow of fluid from the main chamber 8 into the pull-back line 14 in the event that the head 6 of the ram advances to a point whereat the branch line 98 is open to communication with the main chamber 8 of the cylinder.

When the ram is stopped as its associated platen engages the work, pressure builds up within the main chamber 8 to a predetermined value at which the relief valve 80 opens. The relief valve comprises a casing 77 with a port 79 normally closed by a spring-pressed stem 81 comprising an enlarged piston 83 reciprocal within a complementary bore in the casing, a port 85 being provided through the piston to accommodate flow of fluid to the upper side thereof as pressure builds up in the line 12. The upper end of the bore is connected by a passage 87 to a port 89 in the casing 91 of the valve 88. The port 89 is normally closed by a spring-pressed seat member 93, the spring pressure being adjusted by a cam 95 attached to the handle 92 for actuation of the cam which is maintained in any desired adjusted position by a friction device 97 within the casing 99 containing the cam. When pressure in the line 12 builds up to a sufficient value to open the seat member 93, the stem 81 of the relief valve 80 is moved to its open position, whereupon the line 12 is opened to communication with the line 74 through the nipple 84. The nipple causes a substantial back pressure in the branch line 82, thereby actuating the time delay valve 78 which comprises a casing 101 with an internal bore receiving a complementary stem including spaced spools or spindles 103 and 105. The casing 101 comprises a passage 107 connected to the associated bore by an end port 109 and an intermediate port 111 which is blocked by the spool 103 in the closed position of the valve 78. The end port 109 communicates with the branch line 79 of the return line 74 through an adjustable needle valve 113. Thus, by adjusting the needle valve 113, the rate at which pressure in the passage 107 builds up against the spindle 105 is regulated. When this pressure reaches a value sufficient to shift the stem to its open position, fluid from the passage 107 passes through port 111 into the line 102, thereby developing pressure against the piston end 115 of a stem 117 in the pilot valve 76, thereby shifting said stem to its open position against the resistance of a spring 119. When the stem 117 moves to its open position the cylinder 38 is exhausted into the line 74.

Exhaustion of the pilot cylinder 38 permits the spring 44 to move the stem 30 to its reverse position as seen in Figure 2. At this point, the main chamber 8 and its supply line 12 are opened to discharge through the valve chamber 28 into the return line 74. At the same time pressure fluid from the supply line 66 is directed through the valve chambers 22 and 26 into the pull-back line 14, thus causing the ram 4 to move downwardly on its return or retraction stroke.

Overtravel of the ram 4 on its retraction stroke is prevented by the branch line 104 communicating with the interior of the cylinder 2 by a one-way check valve 106 permitting flow of fluid from

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the cylinder into the main line 12. Thus when the ram reaches its lowermost retracted position as seen in the drawings, the high pressure fluid within the return or pull-back chamber 10 is conveyed through valve 106 into the line 12 and thence through valve 16 into the exhaust line 74.

In the event that the operator desires to stop the cycle under emergency conditions when the ram 4 is on its advance stroke, the lever 60 may be moved sharply to the right (Figure 1), whereupon the lost-motion connection between the pin and slot 58 and 56 permits the lever to rotate in a clockwise direction about its pivot point 61 so that the lower end of the lever 60 actuates the quick stop valve 94, thereby opening the same and permitting discharge of the pilot cylinder 38 through the port 40, the sub-branch line 96, and the valve 94 into the return line 74. It will be understood by a consideration of Figure 2 that the portion 36 of the stem 30 will move, under these conditions, toward the right until it covers the port 40 which is so arranged that it is covered when the stem 30 is in its neutral position. Thus the ram is stopped and remains stationary.

It may be noted that when the stem 30 is in its neutral position the port 25 is blocked by the portion 32 of the stem 30, thus holding the ram up in the event of an emergency stop such as above described. The flutes 35, 35, under these conditions, permit flow of fluid from the inlet chamber 22 of the operating valve into the relief or discharge chamber 28 thereof and thence to the return line 74 and back to the tank or reservoir 70.

After an emergency stop, the operator can again initiate the advance stroke of the ram by pulling the lever 60 to the left (Figure 1) whereupon the ram is advanced from its stopped position toward the work. If, however, the operator wishes to reverse the ram before proceeding with the cycle, it is necessary to open the reset valve 108 which exhausts the pilot cylinder 38 through the port 42 into the return line 74 and permits the operating valve stem 30 to move to its reverse position shown in the drawings.

All of the valves utilized in our novel arrangement, with the exception of the operating valve 16, are of conventional design and may be purchased as standard equipment from any manufacturer; and for this reason, the construction of these valves is not herein described in detail.

It is to be understood that we 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.

We claim:

1. In a semiautomatic hydraulic circuit for a hydraulic device comprising main and pull-back cylinder chambers and ram means reciprocal therewithin, the combination of a reservoir tank, a pump having its suction side connected thereto, an operating valve comprising a body having an internal bore with an inlet port connected to the discharge side of said pump, independent connections between said valve bore and said chambers respectively, and a connection between said valve bore and a return line connected to said tank, a valve stem reciprocal within said bore and having a piston slidably reciprocal within a pilot cylinder associated with said valve, a connection between the end of said cylinder and said return line including a one-way valve pre-

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venting flow of fluid from said cylinder to said return line, said stem being spring-pressed to its reverse position wherein fluid from said pump is directed to said pull-back chamber and is directed from said main chamber into said return line, said valve being adapted in its advance position to accommodate flow of fluid from said pump into said main chamber and to accommodate flow of fluid from said pull-back chamber to said return line, a pressure relief valve in the connection between said operating valve and said main chamber, said relief valve being connected to said return line through a branch line having a throttle, a time delay valve in said branch line upstream of said throttle, a pilot valve connected to said cylinder and said return line, said pilot valve being normally closed, and an operative connection between said time delay valve and said pilot valve whereby the latter is opened to exhaust said cylinder at a predetermined time subsequent to the opening of said relief valve, operating means for moving said stem to its advance position in which it is maintained by the fluid within said cylinder until the latter is exhausted, said operating means comprising a lever having intermediate the ends thereof a fixed pivotal fulcrum and a lost-motion connection with said stem, and a normally closed quick stop valve connected to said return line and connected to said cylinder, one end of said lever being operatively associated with said quick stop valve.

2. In a hydraulic circuit for a hydraulic device comprising main and pull-back cylinder chambers and ram means reciprocal therewithin, the combination of a reservoir tank, a pump having its suction side connected thereto, valve means connected to the discharge side of said pump, said valve means also being connected to said chambers and to a return line connected to said tank, said valve means being adapted in the advance position thereof to accommodate flow of fluid to said main chamber from said pump and to said return line from said pull-back chamber, said valve means being adapted in the reverse position thereof to accommodate flow of fluid from said pump to said pull-back chamber and from said main chamber to said return line, a cylinder associated with said valve means and connected to said return line through a one-way check valve accommodating flow of fluid there-through into said cylinder, said cylinder having a piston therein operatively associated with said valve means for maintaining the latter in the advance position thereof until said cylinder is opened to exhaust, spring means for urging said valve means to the reverse position thereof, and operating means for moving said valve means to the advance position thereof against the resistance of said spring means, a pressure relief valve in the connection between said valve means and said main chamber, said relief valve being connected to said return line through a branch line having a restricted orifice, a normally closed pilot valve adapted in its open position to exhaust fluid within said cylinder to said return line, hydraulically operated means operatively connected to said pilot valve and to said branch line upstream of said orifice for opening said pilot valve, said last-mentioned means comprising a time delay valve, and quick stop valve means for opening said pilot cylinder to discharge into said return line.

3. In a hydraulic circuit for operation of a hydraulic device comprising main and pull-back

chambers and ram means reciprocal therewithin, the combination of a supply line connected to a source of hydraulic fluid under pressure, a relief line, operating valve means connected to said lines, said valve means being adapted in the advance position thereof to accommodate flow of pressure fluid from said source to said main chamber and to accommodate flow of fluid from said pull-back chamber to said relief line, and said valve means being adapted in the reverse position thereof to accommodate flow of fluid from said source to said pull-back chamber and to accommodate flow of fluid from said main chamber to said relief line, spring means for urging said valve means to the reverse position thereof, manually operated means comprising a lever for moving said valve means to the advance position thereof against the resistance of said spring means, a fluid pressure device operatively connected to said valve means for maintaining the same in the advance position thereof, a pressure relief valve in the connection between said valve means and said main chamber, said relief valve being adapted in its open position to relieve pressure in said main chamber, means for rendering said device ineffective, and an operative connection between said relief valve and said last-mentioned means for actuation of the latter when said relief valve is in its open position, a quick stop valve having a hydraulic connection with said device, said stop valve being adapted in its open position to bleed the fluid pressure in said device, and a lost-motion connection between said lever and said operating valve means, whereby actuation of said lever while said operating valve means is held in its advance position by said device is operable to engage said lever with said quick stop valve for opening the latter.

4. In a hydraulic circuit for a hydraulic device comprising main and pull-back cylinder chambers and ram means reciprocal therewithin, the combination of a reservoir tank, a pump having its suction side connected thereto, valve means connected to the discharge side of said pump, said valve means being connected to said chambers and to a return line connected to said tank, said valve means being adapted in the advance position thereof to accommodate flow of fluid to said main chamber from said pump and to said return line from said pull-back chamber, said valve means being adapted in the reverse position thereof to accommodate flow of fluid from said pump to said pull-back chamber and from said main chamber to said return line, a cylinder associated with said valve means and connected to said return line through a one-way check valve accommodating flow of fluid therethrough into said cylinder, said cylinder having a piston therein operatively associated with said valve means for maintaining the latter in the advance position thereof until said cylinder is opened to exhaust, spring means for urging said valve means to the reverse position thereof, and operating means for moving said valve means to the advance position thereof against the resistance of said spring means, a pressure relief valve in the connection between said valve means and said main chamber, said relief valve being connected to said return line through a branch line having a restricted orifice, a normally closed pilot valve adapted in its open position to exhaust fluid within said cylinder to said return line, and hydraulically operated means operatively connected to said pilot valve and to said

branch line upstream of said orifice for opening said pilot valve, said last-mentioned means comprising a time delay valve.

5. In a semiautomatic hydraulic circuit for a hydraulic device comprising main and pull-back cylinder chambers and ram means reciprocal therewithin, the combination of a reservoir tank, a pump having its suction side connected thereto, valve means connected to the discharge side of said pump, said valve means also being connected to said chambers and to a return line connected to said tank, said valve means being adapted in the advance position thereof to accommodate flow of fluid to said main chamber from said pump and to said return line from said pull-back chamber, said valve means being adapted in the reverse position thereof to accommodate flow of fluid from said pump to said pull-back chamber and from said main chamber to said return line, a cylinder associated with said valve means and connected to said return line through a one-way check valve accommodating flow of fluid therethrough into said cylinder, said cylinder having a piston therein operatively associated with said valve means for maintaining the latter in the advance position thereof until said cylinder is opened to exhaust, spring means for urging said valve means to the reverse position thereof, and operating means for moving said valve means to the advance position thereof against the resistance of said spring means, a pressure relief valve in the connection between said valve means and said main chamber, said relief valve being connected to said return line through a branch line having a restricted orifice, a normally closed pilot valve adapted in its open position to exhaust fluid within said cylinder to said return line, and hydraulically operated means operatively connected to said pilot valve and to said branch line upstream of said orifice for opening said pilot valve in response to the opening of said relief valve.

6. In an hydraulic circuit for an hydraulic motor comprising main and pull back cylinder means, and ram means reciprocal therein; the combination of main and pull back supply lines connected to respective cylinder means, a discharge line, operating valve means for connecting each supply line to an associated source of pressure fluid while exhausting the other supply line to said discharge line, a piston and cylinder device operatively connected to said valve means for maintaining the same in a first position thereof whereat said source is connected to said main supply line, a one-way check valve connecting said device to the discharge line to accommodate flow of fluid to said device as said operating valve means is actuated to said first position thereof, a relief valve connected to the main supply line for exhausting the latter to the discharge line whenever the pressure in said main cylinder means exceeds a predetermined value, means automatically responsive to opening of said relief valve for bleeding said device, and means for actuating said operating valve means to a second position thereof whereat said source is connected to the pull back supply line upon bleeding of said device.

7. In an hydraulic circuit for an hydraulic device comprising advance and return chamber means, and ram means reciprocal therein; the combination of advance and return lines connected to respective chamber means, a discharge line, operating valve means adapted to connect each line to an associated source of pressure fluid

while exhausting the other line to said discharge line, a fluid pressure device operatively connected to said valve means for maintaining the same in the advance position thereof whereat said source is connected to said advance line, means for actuating said valve means to the return position thereof upon bleeding of said device, a pilot valve connected to said device and to said discharge line for bleeding said device thereto when said pilot valve is open, a relief valve in the advance line adapted to exhaust the same to said discharge line when the pressure in said advance chamber means exceeds a predetermined maximum value, and means for automatically opening said pilot valve in response to opening of said relief valve, said pilot valve being at all times disconnected from said advance line.

8. In a semiautomatic hydraulic circuit for a hydraulic device comprising main and pull-back cylinder chambers and ram means reciprocal therewithin, the combination of a reservoir tank, a pump having its suction side connected thereto, an operating valve comprising a body having an internal bore with an inlet port connected to the discharge side of said pump, independent connections between said valve bore and said chambers respectively, and a connection between said valve bore and a return line connected to said tank, a valve stem having spaced portions slidably reciprocal within said bore and having a piston slidably reciprocal within a pilot cylinder associated with said valve, a connection between the end of said cylinder and said return line including a one-way valve preventing flow of fluid from said cylinder into said return line, said stem being spring-pressed to its reverse position wherein pressure fluid from said pump is directed to said pull-back chamber and is directed from said main chamber into said return line, said stem being adapted in its advance position to accommodate flow of fluid from said pump into said main chamber and to accommodate flow of fluid from said pull-back chamber to said return line, operating means for moving said stem to its advance position in which it is maintained by the fluid within said cylinder until the latter is exhausted, and means responsive to a predetermined maximum pressure within said main chamber for opening said cylinder to exhaust, said last-mentioned means comprising a pilot valve connected to said return line and to said cylinder.

9. In a circuit of the class described, a pair of supply lines, operating valve means connected to said lines and adapted to connect either supply line to an associated source of pressure fluid while exhausting the other supply line, means for actuating said valve means to a first position whereat fluid from said source is directed to one of said supply lines, a fluid pressure device operatively connected to said valve means and adapted to hold the same in said first position thereof until said device is bled, a pilot valve connected to said device for bleeding the same, a relief valve in said one line for exhausting fluid therefrom at a predetermined pressure value, means responsive to opening of said relief valve for automatically opening said pilot valve to bleed said device, said pilot valve being at all times disconnected from said lines, and means automatically effective upon bleeding of said device for actuating said operating valve means to a second position thereof whereat fluid from said source is delivered to the other supply line.

10. In a circuit of the class described com-

prising a pair of supply lines, and operating valve means connected to said lines and adapted to connect each line to an associated source of pressure fluid while exhausting the other line; the combination of a fluid pressure device operatively coupled with said valve means for actuation therewith, one-way check valve means accommodating flow of fluid into said device upon actuation of said operating valve means to a first position thereof whereat said source is connected to one of said lines, said device being adapted to hold said operating valve means in said first position until said device is bled, pilot valve means at all times independent of pressure fluid flowing through said lines from said source, said pilot valve means being connected to said device for bleeding the same upon opening of said pilot valve means, relief valve means in said one line adapted upon development of a predetermined pressure valve therein to open thereby exhausting said one line, means responsive to opening of said relief valve means for automatically opening said pilot valve means, and means for automatically actuating said operating valve means to a second position thereof whereat said source is connected to the other supply line upon bleeding of said device.

11. In a hydraulic circuit for a hydraulic device comprising main and pull-back cylinder chambers and ram means reciprocal therewithin, the combination of a reservoir tank, a pump having its suction side connected thereto, an operating valve comprising a body having an internal bore with an inlet port connected to the discharge side of said pump, independent connections between said valve bore and said chambers respectively, and a connection between said valve bore and a return line connected to said tank, a valve stem reciprocal within said bore and having a piston slidably reciprocal within a pilot cylinder associated with said valve, a connection between the end of said cylinder and said return line including a one-way valve preventing flow of fluid from said cylinder into said return line, said stem being spring-pressed to its reverse position wherein pressure fluid from said pump is directed to said pull-back chamber and is directed from said main chamber into said return line, said valve being adapted in its advance position to accommodate flow of fluid from said pump into said main chamber and to accommodate flow of fluid from said pull-back chamber to said return line, operating means for moving said stem to its advance position in which it is maintained by the fluid within said cylinder until the latter is exhausted, means responsive to a predetermined maximum pressure within said main chamber for opening said cylinder to exhaust, and valve means independent of said last-mentioned means for opening said cylinder to exhaust under emergency conditions.

12. In a system of the class described, main and pull back cylinder means, ram means reciprocal therein, a supply line connected to a source of hydraulic pressure fluid, a relief line, operating valve means connected to said lines and to said main and pull back cylinder means for alternately opening respective cylinder means to communication with respective lines, said valve means being adapted in the neutral position thereof to trap the fluid in said main cylinder means and to direct flow of fluid from said supply line to said relief line, a fluid pressure device connected to said relief line, a one-way check valve in said last-mentioned connection accommodating flow

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of fluid to said device, means for actuating said operating valve means to an advance position thereof whereat said supply line is open to communication with said main cylinder means, said actuating means being operable to actuate said device to a position at which it retains said operating valve means in the advance position thereof, means independent of said check valve for exhausting said device when the pressure in said main cylinder means reaches a predetermined maximum value whereby the device accommodates movement of said valve means to the reverse position thereof, quick stop means for partially exhausting said device whereby the latter accommodates movement of said valve means to the neutral position thereof, reset valve means independent of said quick stop means and the first-mentioned exhausting means for completely exhausting said device, and means operable upon exhaustion of said device by any of said exhausting means for actuating said operating valve means to the position accommodated by said device.

13. In a system of the class described, main and pull-back cylinder means, ram means reciprocal therein, a supply line connected to a source of hydraulic pressure fluid, a relief line, operating valve means connected to said lines and to said main and pull-back cylinder means for alternately opening respective cylinder means to communication with respective lines, said valve means being adapted in the neutral position thereof to trap the fluid in said main cylinder means and to direct flow of fluid from said supply line to said relief line, a pilot cylinder connected to said relief line, a one-way check valve in said last-mentioned connection accommodating flow of fluid into said pilot cylinder, a piston in said pilot cylinder, means for moving said operating valve means to the advance position thereof whereat said supply line is open to communication with said main cylinder means, said moving means being operable to move said piston into a position at which it retains said valve means in the advance position thereof, means independent of said check valve for exhausting said pilot cylinder when the pressure in said main cylinder

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means reaches a predetermined maximum value whereby the piston accommodates movement of said valve means to the reverse position thereof, quick stop means for partially exhausting said pilot cylinder whereby the piston accommodates movement of said valve means to the neutral position thereof, and means operable upon exhaustion of said pilot cylinder by either of said exhausting means for moving said valve means to the position accommodated by said piston.

14. In a system of the class described, a source of pressure fluid, main and pull-back cylinder means, ram means reciprocal therein, operating valve means for alternately opening said main cylinder means and pull-back cylinder means to communication with said source and to discharge respectively, said valve means being adapted in the neutral position thereof to trap the fluid in said main cylinder means and to direct flow of fluid from said source to discharge, means for moving said valve means to the advance position thereof whereat the main cylinder means is connected to said source and the pull-back cylinder means is opened to discharge, means for automatically moving said valve means to the reverse position thereof when the pressure in said main cylinder means reaches a predetermined maximum value, and quick stop means for moving said valve means to the neutral position thereof under emergency conditions.

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