

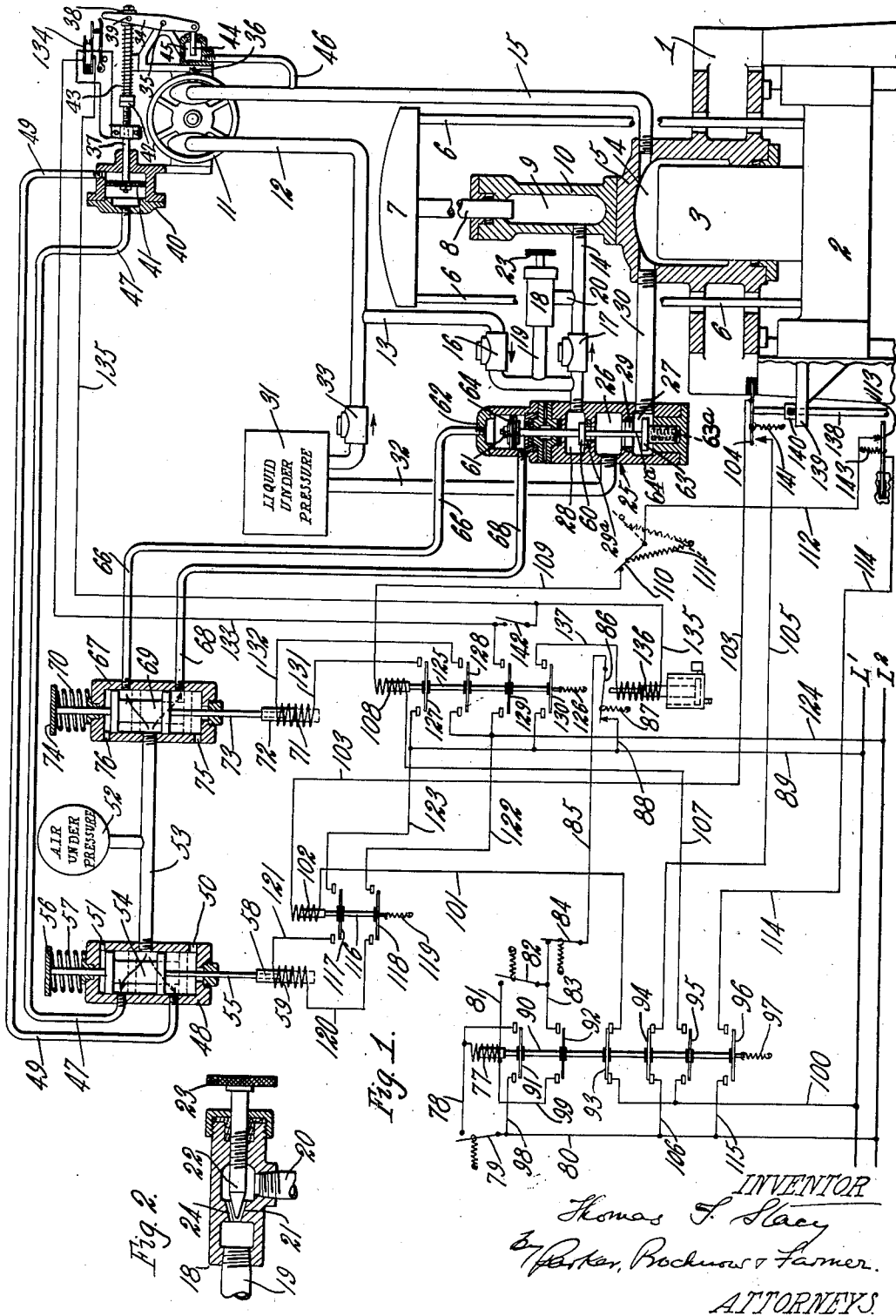
Nov. 24, 1936.

T. F. STACY
HYDRAULIC SYSTEM

2,062,196

Filed Feb. 10, 1934

2 Sheets-Sheet 1



INVENTOR
Thomas F. Stacy
By Parker, Rocknow & Farmer.
ATTORNEYS

Nov. 24, 1936.

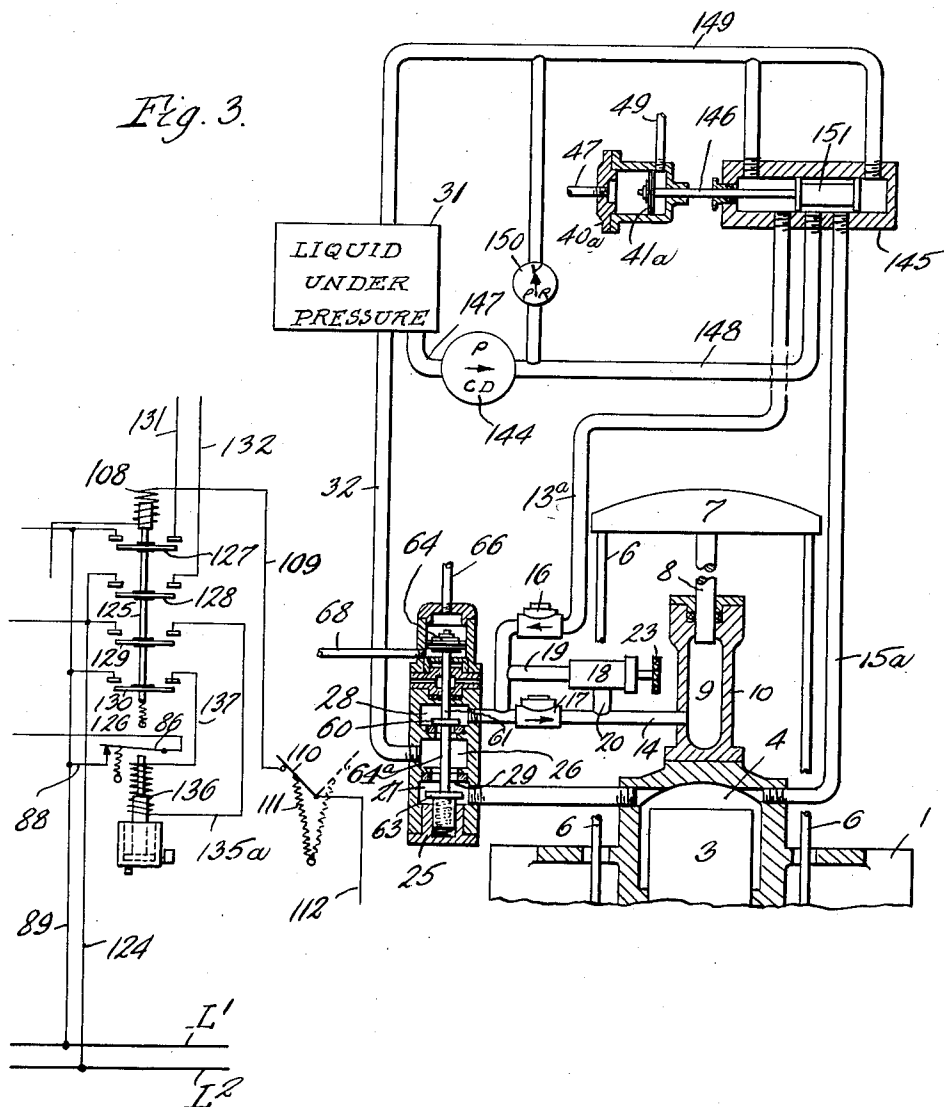
T. F. STACY

2,062,196

HYDRAULIC SYSTEM

Filed Feb. 10, 1934

2 Sheets-Sheet 2



INVENTOR.
Thomas F. Stacy
Parker, Richards & Farmer.
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,062,196

HYDRAULIC SYSTEM

Thomas F. Stacy, Piqua, Ohio, assignor to The
French Oil Mill Machinery Company, Piqua,
Ohio

Application February 10, 1934, Serial No. 710,693

49 Claims. (Cl. 60—52)

This invention relates to hydraulic systems, and particularly to the mechanism for controlling the reciprocations of a working member, such as the platen of a hydraulic press.

5 An object of the invention is to provide improved means for controlling the hydraulic system which operates the platen or working member in both directions, with which the platen or working member may be stopped and held in any intermediate position, with which the travel of the platen may be reversed at any point in its travel in either direction, with which the rate of descent or pressing movement of the platen may be controlled and regulated, and which will be relatively simple, compact, dependable and inexpensive.

Another object of the invention is to provide an improved controlling mechanism for a hydraulic circuit utilizing a reversible, variable delivery pump which will automatically move itself to neutral delivery condition, when the pressure of the fluid delivered by the pump reaches a selected pressure, and with which the pump may be reversed automatically at a selected, predetermined and adjustable period of time after the pump is automatically set to neutral delivery following a power stroke of the platen.

A further object of the invention is to provide an improved press system in which the delivery of the continuously operating pump to the main ram is by-passed at practically no material pressure while the platen is in open or other selected positions, and with which the use of a separate by-pass valve is unnecessary.

35 A further object of the invention is to provide improved electrical means for controlling the hydraulic circuit by which a platen or working member of a press is operated in both directions and stopped and held in any desired intermediate positions, with which the press may be opened automatically a selected interval of time after a predetermined pressure on said platen has been reached, and with which the platen is automatically stopped in a selected open position.

45 Another object of the invention is to provide improved means for controlling the operations of the platen of a hydraulic press, with which the speed of closing of the press may be regulated, and with which the speed of closing cannot be less than that caused by the delivery capacity of the pump.

50 Various other objects and advantages will be apparent from the following description of an embodiment of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

Fig. 1 is a diagrammatic view of a portion of a 60 hydraulic press, and of the operating and con-

trolling means therefor, all constructed in accordance with this invention;

Fig. 2 is a sectional elevation through the valve for regulating the rate of descent or power movement of the platen; and

Fig. 3 is a diagrammatic view of a portion of the system shown in Fig. 1 in which a uni-directional pump with a reversing valve has been substituted for the reversible pump of Fig. 1.

In the illustrated embodiments of the invention, the press includes a frame 1 having a platen or working member 2 mounted and guided in the frame for vertical movement. The platen 2 is attached to the main piston or ram 3 that extends into the working chamber 4 of a cylinder 5 which is carried by the head of the frame. When liquid under pressure is supplied to the chamber 4 it will force the piston or ram 3 downwardly or outwardly and cause a descent or power movement of the platen 2. Pullback rods 6 are connected to the platen 2 and extend upwardly therefrom to a common crosshead 7 which in turn carries a smaller and pullback piston or ram 8. This piston 8 extends into the working chamber 9 of pullback cylinder 10, and when liquid under pressure is supplied to the chamber 9, the piston 8 will be forced outwardly and, through the crosshead 7 and rods 6, will retract the platen 2.

A reversible flow variable delivery pump 11 (Figs. 1 and 2) is driven continuously from any 30 suitable source of power. One side or conduit terminal of the pump is connected by pipes 12, 13 and 14 to the pullback chamber 9, and the other side or conduit terminal of the pump is connected by pipe 15 to the working chamber 4 of the main 35 ram cylinder 5. The pump 11 is therefore connected to the working chambers 4 and 9 and will transfer the operating liquid from one ram to the other, alternately, depending upon the direction in which the pump is delivering the operating 40 liquid. The pipe 13 contains therein a free check valve 16 which opens freely to pass fluid from the pump toward the chamber 9 and closes automatically to prevent reverse flow. The pipe 14 is also provided with a free check valve 17 which opens 45 freely to pass fluid from the pipe toward the chamber 9 and closes automatically to prevent reverse flow.

An adjustable valve 18 is connected in parallel or shunt across the check valve 17 by means of 50 pipes 19 and 20. This valve 18 is provided with a seat 21, and with a stem 22 which is adjusted toward and from the seat by an operating button 23 provided on the outer end of the valve stem. By adjusting the stem toward the seat the liquid 55 flow through the valve in each direction will be adjustably regulated, and since the valve 17 closes automatically to prevent liquid flow through the pipe 14 in a direction away from the chamber 9, all liquid leaving the chamber 9 must pass through 60

the valve 18 where its rate of escape is controlled by a suitable manipulation of the button 23. In order that the valve 18 may not be fully closed and prevent all escape of liquid from the chamber 9 while pressure is being applied to main ram cylinder 4, I provide a groove 24 across the seat 21 of the valve 18 so that a minimum restricted flow through the valve 18 is always possible, regardless of the position of the valve stem 22.

A differential valve device 25 is provided with a central or intermediate chamber 26 and end chambers 27 and 28, and the intermediate chamber 26 communicates with the end chambers 27 and 28 through passages having valve seats or rings 29 and 29a, respectively. The pipe 14 is connected to the end chamber 28 of the valve device, and a pipe 30 connects the chamber 4 of the main ram cylinder to the end chamber 27 of the valve device. A source of operating liquid under pressure may be contained in a closed tank or reservoir 31 and is connected by a pipe 32 to the intermediate chamber 26 of the differential valve device 25. Source 31 is also connected to the pipe 12 through a free check valve 33 which opens automatically to pass fluid from the tank 31 or pipe 32 towards the pump and closes automatically to prevent reverse flow. The chambers 4 and 9, the pump 11, the tank 31, the differential valve device 25, and the pipes connecting these parts together form a hydraulic circuit by which the reciprocations of the platen in both directions are controlled.

The pump is controlled by a yoke 34 which is pivoted at 35 and connected at one end to control pump rods 36. A general control rod 37 passes slidably through a bearing block 38, which is pivoted at 39 in an arm of the yoke 34, and at its other end passes into a pilot cylinder 40 where it carries a piston head 41.

An abutment 42 is adjustably mounted on the rod 37, intermediate of its ends, and a helical, compression spring 43 is compressed between the abutment 42 and the bearing block 38 carried by the yoke. The end of the rod 37 which passes through the block 38 terminates in a head which prevents the rod 37 from being pulled out of the block 38 under the action of the spring 43. When the rod 37 is moved endwise in one direction, such as to the left in Fig. 1, the head of the rod will engage the bearing block 38 and forcibly rock the yoke 34 to the left in Fig. 1, which is in a direction to pull outwardly on the control rods 36 and set the pump first to neutral delivery condition and then, if the movement is continued, to set the pump for delivery of fluid into the pipe 12 and create suction in the pipe 15. When the rod 37 is moved in the opposite direction, such as to the right in Fig. 1, the abutment 42 moves the spring 43 and through it will exert a yielding, resilient pressure on the block 38 which is carried by the yoke, and this will rock the yoke 34 into the full line position shown in the drawings, where it sets the pump for delivery of liquid into the pipe 15 and creates a suction in the pipe 12. The spring 43, yoke 34, and rod 37 move together as a unit except that the yoke may be operated, by sufficient pressure, against spring 43 without movement of rod 37.

A piston 44 extends into a closed cylinder 45 that is connected by a pipe 46 to the pipe 15, so that a hydraulic pressure will be exerted on the yoke 34 which is proportional to the pressure of the liquid in the pipe 15 leading to the main ram chamber 4.

When the pressure in the chamber 4 increases

to a predetermined extent, the pressure on the yoke by the piston 44 will overcome the pressure of the spring 43 thereon, and the yoke will move the block 38 against the action of the spring 43, until the reaction of the spring 43 balances the pressure on the yoke which is proportional to the pressure in the chamber 4. As the yoke 34 is rocked in this manner, it will shift the control rods 36 of the pump and set the pump to neutral delivery position and the continuing pressure in pipe 15 holds the yoke 34 in this position.

The control rod 37 is shifted endwise by fluid pressure supplied to the pilot cylinder 40 alternately at opposite faces of the piston 41. A pipe 47 connects one end of the pilot cylinder 40 to the chamber of a valve device 48, adjacent, but spaced from, one end thereof, and a pipe 49 connects the other end of the cylinder 40 to the valve device 48 at a point adjacent, but spaced from, the end opposite the opening into pipe 47. The valve device 48 is a four-way valve and is provided with vents 50 and 51 at the extreme end thereof. Air or other fluid under pressure from any suitable source 52, is connected by a pipe 53 to the chamber of the valve device 48 at a point between the openings into the pipes 47 and 49. A valve element 54, which is somewhat spool shaped, is fixed on a stem 55 that extends from opposite ends thereof through opposite ends of the casing of the valve device 48.

At one end, the stem 55 carries a head 56, and a helical compression spring 57 is compressed between the head 56 and the casing of the valve device 48, so as to urge the valve element 54 towards one end of the chamber of the valve device, as shown in full lines in Fig. 1. The valve element 54 is of such length that the peripheral groove thereof will always connect the opening into pipe 53 with the opening into the pipe 47 and 49, one at a time and alternately as the valve element 54 is shifted endwise in the casing of the valve device. The other end of the stem 55 terminates in a magnetic body or armature 58 which functions as the core of a solenoid or electromagnet 59.

When the solenoid 59 is energized, it will pull the core or armature 58 in a direction to shift the valve element 54 against the action of the spring 57, from the full to the dotted line position, and when the magnet 59 is de-energized the spring 57 will return the valve element 54 to the full line position shown in the drawings. When the valve element 54 is in the full line position shown in the drawings, air under pressure will pass from the source or tank 52 through the pipe 53 into the casing of the valve device 48, thence along the peripheral groove of the valve element 54 and into the pipe 47, thence into the pilot cylinder 40 where it forces the piston 41 to the right. Through the rod 37, spring 43 and block 38, the yoke 34 will be yieldingly forced in a direction to set the pump into a position to deliver operating fluid into the pipe 15 as shown in the drawings.

If the magnet or solenoid 59 is energized, and the valve element 54 is shifted into the dotted line position shown in the drawings the air under pressure will pass from the pipe 53 along the peripheral groove of the valve element 54 into the pipe 49, instead of the pipe 47, and hence will pass to the opposite end of the pilot cylinder 40. The air pressure in the right hand end of the cylinder 40 will cause a movement of the piston 41 and the rod 37 to the left in the drawings, and cause a reversal of the pump and delivery of the 75

operating liquid into the pipe 12 instead of the pipe 15.

Within the differential valve 25 is a valve element 60 which is guided in reciprocations toward and from its valve seat or ring 29a by a stem 61 which extends outwardly through the end of the valve casing into the working chamber of a pilot cylinder 62. A free check valve element 63 is disposed in the end chamber 27 for movement toward and from the valve seat or ring 29. The element 63 has a guiding stem which slides in a recess in the adjacent end of the casing of the valve device 25, and a spring 63a disposed in this stem and acting between it and the closed end 15 of the recess, yieldingly urges the valve element 63 in a direction to close against the seat or ring 29.

It is desirable that only one of the valve elements 60 and 63 be closed at any one time, although both may be open at the same time and, therefore, I provide a projection or stem 64a on the valve element 60 which reciprocates through the passage of the seat ring 29 and forcibly opens the valve element 63 when the valve element 60 moves into closed position on its related seat 29a. When the valve element 60 moves away from its seat, so as to open the passage from the end chamber 28 into the intermediate chamber 26, the stem 64a will release the valve element 63, whereupon the element 63 will be urged toward its seat 29 by its spring 63a. The end of the stem 61 which terminates in the pilot cylinder 62 carries a piston 64. A pipe 66 connects one end of the pilot cylinder 62 to a valve device 67, which is identical with the valve device 48, and a pipe 68 connects the opposite end of the pilot cylinder 62 also to the valve device 67.

The spool shaped valve element 69 in this valve device 67 is shifted endwise by a spring 70 into the position shown in full lines in the drawings, and in the opposite direction into the dotted line position, by the pull of a solenoid 71 on a magnetic core or armature 72 attached to the outer end of the valve stem 73 on which the spool of valve element 69 is mounted. The stem 73 also extends through the opposite end of the casing of the valve device 67 and terminates in a head 74. The spring 70 is compressed between the head 74 and the casing of the valve device 67. Vents 75 and 76 are provided for the chamber of the valve device 67 in the ends thereof.

The pipe 53 is also connected to the chamber of the valve device 67, at a point between the opening of the chamber into the pipes 66 and 68, and, therefore, air under pressure will always pass into one of the pipes 66 and 68 as determined by the position of the spool shaped valve element 69. That pipe 66 or 68 which is not receiving air under pressure will be automatically vented by one of the vents 75 and 76 which are alternately connected with the pipes 66 and 68. Thus, as the valve element 69 is shifted back and forth in the valve device 67, compressed air or other fluid under pressure will be supplied alternately to the opposite ends of the cylinder 62, and will reciprocate the valve element 60 toward and from its seat.

The control of the solenoids 59 and 71 will next be described. Power for the actuation of these solenoids is obtained from line wires L1 and L2 which may be from any available source of electricity. A holding or stick relay 77 is connected through a wire 78, a normally open switch 79 and a wire 80 to one of the line wires such as L2. The other end of this relay is connected through a wire 81, normally open switch

82, a wire 83, a normally closed switch 84, and a wire 85 to one side of a timer switch 86. The timer switch, which is normally urged into closed position by a spring 87, is connected at one side by wires 88 and 89 to the other line wire L1. The switches 79 and 82 are spring actuated into open positions, and must both be closed at one time in order to energize the relay 77.

The relay armature rod 90 carries bridge contacts 91, 92, 93, 94, 95, and 96, and a spring 97 acting on the rod 90 urges it in one direction against the pull of the relay winding 77, so that when the circuit of the relay is open, the spring 97 will shift the rod 90 and its contacts into the position shown in the drawings. The wire 98 leading from the wire 80, and the wire 78 are connected to terminals that are bridged by contact 91 when the relay winding is energized, and a wire 99 and the wire 83 are connected to terminals which are bridged by bridge contact 92 when the relay winding is energized.

The wires 78 and 98, contact 91, wire 99, contact 92, and wire 83 form a shunt across the two controlling switches 79 and 82, and this shunt is closed by the relay when the relay is energized, and hence completes a stick circuit which will remain closed until broken either by the switch 84 or the timer switch 86. The bridge contact 93 of the relay, when the relay is deenergized, connects a wire 100 leading from the line wire L1 with a wire 101 leading to one side of a relay 102, and the relay 102 is connected at its other side by a wire 103 to a normally closed switch 104, provided on the press frame. The bridge contact 94 is effective, when the relay 77 is deenergized, to connect a wire 105 leading from the other side of the switch 104 to a wire 106 which extends from the wire 80 that is always connected to the line wire L2. Thus, when the relay 77 is de-energized the contacts 93 and 94 thereof complete a circuit from the line wires L1 and L2 through the relay 102 and the normally closed switch 104.

This circuit through the relay 102 is broken by the opening of switch 104, and also by the energizing of the relay 77, for a purpose which will appear hereinafter. The contact 95 of the relay 77 connects the wire 100 to a wire 107, when the relay 77 is energized, and the wire 107 is connected to one side of a relay 108, the other side of that relay being connected by a wire 109 to one side of a switch 110. The switch 110 is yieldingly held in open and closed position by a toggle spring 111. The other side of the switch 110 is connected by a wire 112 to one side of a normally closed switch 113 also mounted on the frame of the press. The contact 96 of the relay 77 connects a wire 114 leading from the other side of the switch 113 to a wire 115 that leads from the wire 80 and the line wire L2. The contacts 95 and 96 are in circuit interrupting, or open positions when the relay 77 is de-energized, and when the relay 77 is energized, the contacts 95 and 96 thereof will close a circuit through the relay 108, and the switches 110 and 113, and that circuit may be broken at three different points which are at the relay 77 upon de-energization thereof, and at the switches 110 and 113.

The relay 102 operates a stem or element 116 which carries bridge contacts 117 and 118, the stem being retracted upon de-energization of the relay 102 by a spring 119. The contacts 117 and 118 connect wires 120 and 121, leading from opposite sides of the solenoid 59, to circuit wires 122 and 123 respectively. The wire 123 is con-

connected to the wire 89 leading from the line wire L1, and the wire 122 is connected to a wire 124 which leads to the other line wire L2. Thus the solenoid 59, which controls the valve element 54 of the valve device 48, is controlled entirely by the relay 102.

The relay 108 operates a stem or element 125 which is retracted by a spring 126 upon de-energization of the relay. This stem or element 125 carries bridge contact arms 127, 128, 129 and 130. The contact 127, upon energization of the relay 108, connects the branch line wire 89 to a wire 131 leading to one side of the solenoid 71, and the contact 128, upon energization of the relay 108, will connect the wire 132 leading from the other side of the solenoid 71 to the branch line wire 124. Thus, the contacts 127 and 128, upon energization of the relay 108, will close a circuit from the line wires L1 and L2 through the solenoid 71 that controls the position of the valve element 69 in the valve device 67.

The contact 129 is effective, upon energization of the relay 108, to connect the wire 124 with a wire 133 leading to one side of a normally open switch 134 located at the pump 11, and the other side of that switch is connected by a wire 135 to one side of the winding 136 of a timing device that is adapted to open the timer switch 86. A wire 137 leading from the other side of the winding 136 is connected, upon energization of the relay 108, to the wire 89 by means of the bridge contact 130. Thus, when the relay 108 is energized, its contacts 129 and 130 will form a circuit from the line wires through the timer winding 136 and the normally open switch 134 located at the pump 11. This switch 134 is disposed in a position to be closed by the yoke 34 when the yoke moves into a position in which it sets the delivery of the pump at approximately neutral, and when the yoke 34 is in a position that causes delivery of the pump into the pipe 15, it will clear the switch 134 and allow that switch to open. The switch 134 may advantageously be mounted on the rod 37, preferably on the head end which abuts block 38, so as to move as a unit therewith and be closed only when the yoke 34 moves against spring 43 and relatively to rod 37, and to remain open when the pump is reversed by pilot cylinder 40.

A rod 138 is mounted on the frame of the press in a position for endwise movement in the direction of travel of the platen 2, and when the platen 2 approaches its upper limit of movement during the operation of the pull-back ram, an arm 139 on the platen will engage and lift an adjustable abutment or collar 140 provided on the rod 138, and thus will lift the rod 138. The rod 138, when lifted, engages and opens the switch 104 that is normally held closed by a spring 141. The switch 113 is normally held closed by a spring 143, and is disposed in a position to be opened by the arm 139 of the platen, if the platen overruns its expected travel in a pressing direction.

The timer 136 may be any time relay or equivalent timer which opens switch 86, a selected and adjustable interval of time after the relay or timer is energized or its circuit opened or closed. One such relay is disclosed in my co-pending application Serial No. 671,197 filed May 15, 1933. A manually operated switch 142 may be disposed in shunt across the switch 134 so that one may remove the timer from the control of the pump by closing switch 142 when one desires

the timing operation to start as soon as relay 108 is energized.

Operation

In the operation of the platen 2 under the control of the mechanism which has been hereinabove described, let it be assumed that the press is in open position, as shown in the drawings. When the platen 2 is in this retracted or open position, the relay 77 will be de-energized, and its contacts 93 and 94 will be in closed position. The relay 102, whose circuit is normally closed at this time by the contacts 93 and 94 of the relay 77, will be de-energized because its circuit is opened at the switch 104 through the retraction of the platen. The relay 108 will also be de-energized because its circuit will be broken by the bottom pair of contacts 95 and 96 of the relay 77. The timer winding 136 is also de-energized because its circuit is opened at the bottom pair of contacts 129 and 130 of the now de-energized relay 108. Since the relays 102 and 108 are de-energized the circuits through the solenoids 59 and 71 are open, and the valve elements 54 and 69 of the valve devices 48 and 67 will be held in the full line positions through the action of the springs 57 and 70.

With the valve element 54 in this full line position, air under pressure passes from the source 52 through the pipe 53 and the valve element 54 to the pipe 47, which leads to one end of the pilot cylinder 40. The pressure of the air in the cylinder 40 forces the pump control rod 37 to the right and shifts yoke 34 into a position to set the pump for delivery of operating liquid into the pipe 15 leading to the working chamber 4 of the main ram. When the valve element 69 is in the full line position shown in the drawings, air will also pass from the source 52 through the pipe 53, the valve element 69, and pipe 66 to the top end of the pilot cylinder 62, and the compressed air thus transmitted to the pilot cylinder 62 will force the piston 64 in a direction to force the valve element 60 into closed position, during which movement of element 60 the stem 64a will engage and force open the check valve 63. Thus, the valve element 60 will be held closed, and the valve element 63 will be held open.

With the various parts in these positions, the operating liquid discharged by the pipe 15 into working chamber 4 of the main ram, instead of forcing a downward movement of platen 2 will pass through the pipe 30 into the end chamber 27, thence past the open check valve 63 into the intermediate chamber 26, thence through the pipe 32, source 31, free check valve 33 and pipe 12 to the other side of the pump to complete a hydraulic circuit. The liquid circulated by the pump will pass, without material pressure, through the main working cylinder 4 and the differential valve. At this time the operating liquid in the working chamber 9 of the pullback ram will be locked against escape because it can only escape through the pipe 14 and this escape is prevented by the automatically closing check valves 16 and 17 and the closed valve element 60.

Any pressure created in the working chamber 4 on the main ram or piston 3 will not cause a downward movement of the platen because the platen 2 can only descend if the liquid trapped in the pullback working chamber 9 is allowed to escape. While the liquid trapped in the chamber 9 can, of course, pass through the regulating valve 18 its further escape is prevented by the check valve 16 and the valve element 60. The 75

platen will thus be held positively in its retracted position, and the pump will continue to operate without producing any change in the position of the platen.

5 To start an operation of the platen the operator closes both switches 79 and 82, which completes a circuit through the stick relay 77, from line wire L2, wire 80, switch 79, wire 78, relay 77, wire 81, switch 82, wire 83, switch 84, wire 85, 10 switch 86, wires 88 and 89 to line wire L1. Immediately upon the energizing of this relay 77, the contacts 91 and 92 thereof will complete the shunt or stick circuit, and the subsequent opening of the switches 79 and 82 will not cause a deenergization 15 of the relay 77. When the relay 77 is energized in this manner, the middle pair of contacts 93 and 94 will be moved into open circuit positions but no change in relay 102 occurs at this time because the circuit of that relay is now also open at the 20 switch 104. Upon the same energization of the relay 77, the bottom pair of contacts 95 and 96 will close a circuit through the relay 108 and the switches 110 and 113, and this circuit will remain closed until the relay 77 is deenergized unless 25 sooner broken by an operation of either switch 110 or 113.

When the relay 108 is energized by the closing of its circuit, its upper pair of contacts 127 and 128 will close a circuit through the solenoid 71 30 and cause a movement of the valve element 69 from the full to the dotted line position in the drawings. When this occurs, compressed air will pass from the source 52 through the pipe 68 to the inner end of the pilot cylinder 62, and force 35 the piston 64 outwardly and forcibly open the valve element 60. This releases the other check valve element 63. When the valve element 69 moved into the dotted line position it cut off the supply of compressed air to the pipe 66 and vented 40 pipe 66 through the port 76 so that the air trapped in the outer end of the pilot cylinder 62 can escape as it is displaced by the upward movement of the piston 64.

When the relay 108 is energized, as above explained, its lower pair of contacts 129 and 130 complete a circuit through the timing device 136 and the pump operated switch 134, but since the yoke 34 at this time releases the switch 134, the latter will be open, and this will hold open the circuit through the timing device 136 and delay 45 the start of the timing operation, unless switch 142 is closed. With the valve element 60 now open, the operating liquid can escape from the pull-back chamber 9 through the pipes 14 and 20, regulating valve 18, pipe 19, remainder of pipe 14 to end chamber 28, thence through the intermediate chamber 26, pipe 32, source 31, check valve 33, and pipe 12 to the pump. The platen is now free to drop, and the speed at which it drops is regulated by a suitable adjustment of the button 23 which varies the rate at which the operating liquid escapes. The leak groove 24 is of a size to permit descent of the platen at the rate 50 caused by the delivery of the pump alone, which prevents the building up of abnormal and dangerous pressures in both cylinders 4 and 9.

The released check valve element 63 is urged toward closed position by its spring, but is prevented from closing at this time by flow of fluid from source 31 to cylinder 4, until the pressure in cylinder 4 and source 31 becomes equalized, as will be explained presently. The liquid delivered by the pipe 15 and source 31 will then force the platen 2 downwardly at a rate which is regulated by the valve 18, and is never less and usually

higher than that caused by the delivery of the pump. Since the relay 102 is still de-energized, the pump continues to discharge into the pipe 15. The operating liquid from source 31, under pressure, flows through pipe 32 to the intermediate chamber 26, and then through end chamber 27 5 and pipe 30 into chamber 4 to fill the space in the chamber 4 vacated by the descending piston 3, because the liquid required to fill the space in cylinder 4 which is vacated by the descending piston 10 3 is greater than the liquid escaping from the pull-back chamber 9. The combined pressure of the liquid delivered through the pipe 15 and from the source 31 will force the platen 2 downwardly at a rapid rate which may be regulated by valve 15 18.

As soon as the platen 2 encounters substantial resistance, such as when it meets the work, the liquid will not flow from source 31 into the chamber 4, because the pressure in the chamber 4 will 20 then soon build up and equalize or exceed the pressure of that in source 31. The liquid delivered by the pump through pipe 15, will then tend to flow through pipe 30 toward the source 31 and the intake side of the pump, but since the valve 25 element 63 is now a free check valve it will immediately seat, and prevent any escape of liquid from chamber 4 through pipe 30. The pump will now discharge directly into the main working chamber 4, and will build up the pressure therein 30 to the desired point. This will continue until the pressure in the chamber 4, which will correspond to the pressure in the pipe 15, builds up to a predetermined pressure, at which time the pressure on the piston 44 caused by the pressure in pipe 15 35 and transmitted through the pipe 46 to the cylinder 45 will be sufficient to move the yoke 34 and overcome the spring 43, whereupon the yoke 34 will move against the spring 43 into a position in which it sets the pump for approximately neutral or no delivery condition which is a position 40 intermediate the limits of movement of the yoke 34. By adjusting the abutment 42, the pressure at which the pump moves itself to neutral delivery may be regulated. 45

When the yoke 34 moves to this intermediate position it closes the switch 134 and, therefore, completes the circuit through the timing device 136 to start the latter in operation. The pump will thus remain in neutral delivery condition and 50 will maintain this selected pressure on this platen 2. The timing device 136 will then, at a selected interval of time after it was started in operation through the closing of the switch 134, operate the switch 86 into open position. When the switch 86 55 opens, the stick circuit through the relay 77 is opened, and this de-energizes the main control relay 77.

When the platen 2 started to descend it released the rod 138 which dropped and released the self- 60 closing switch 104 that is in series with the relay 102. That closing of switch 104 did not cause an energization of the relay 102, because at that time the circuit of the relay 102 was opened at the contacts 93 and 94 of the energized main control relay 77. Thus, no change in the relay 102 occurred immediately upon the release and closing 65 of the switch 104 at the start of the downward movement of the platen.

Upon the de-energization of the relay 77, which 70 is caused through the opening of switch 86 by the timing device 136, the circuit of relay 102 is closed by the contacts 93 and 94 of the now de-energized relay 77, and the circuit of the relay 108 is opened by the opening of the contacts 95 75

and 96 of relay 77. The closing of the circuit through relay 102 causes a closing of the circuit to the solenoid 59, by reason of the movement of contacts 117 and 118, and thereupon the solenoid 59 pulls the valve element 54 from the full to the dotted line position against the action of spring 57. The valve element 54 thus vents the pipe 47 through the vent port 51, and cuts off the flow of air under pressure through pipe 53 to pipe 47. It also interrupts communication between the pipe 49 and vent 50, and connects the pipe 49 to the pipe 53. Thereupon air under pressure flows through pipe 49 to the other end of the pilot cylinder 40, and forces the piston 41 in a direction to move the control rod 37 and through it the yoke 34 into a position causing reversal of delivery of the pump.

The pump now delivers its operating liquid under pressure into pipe 12 and creates a suction in pipe 15. At the same time the opening of the circuit of the relay 108, through the de-energization of the relay 77, results in the opening of the circuit through the solenoid 71. The spring 70 then shifts the valve element 69 from the dotted to the full line position shown in the drawings, which causes a venting of the pipe 68 to atmosphere through the vent port 75, and the passage of compressed air through pipe 53 into pipe 66, thereby forcing the piston 64 in a direction tending to close the valve element 60 and open the free check valve 63. The high pressure in the main chamber 4 will prevent the immediate opening of the valve 63, and thus the piston 64 will not move downwardly, yet the air pressure thereon tending to force it into the position shown in full lines will continue.

During this short interval the operating liquid is being withdrawn from chamber 4 through the pipe 15 by the pump, and this quickly lowers the pressure in chamber 4 and permits opening of the valve element 63 and the operation of the piston 64. The liquid delivered by the pump into pipe 12 cannot pass the check valve 33 to the source 31 but can pass freely through the pipe 13, check valve 16, check valve 17, and pipe 14 into the pull back chamber 9, which causes a pressure on the pull back piston 8 tending to retract the platen 2 into the position shown. While the pressure in the main chamber 4 is being lowered sufficiently to allow opening of the valve element 63, the valve element 60 remains open and the liquid delivered by the pump through the pipe 12 will pass through the end chamber 28 into the intermediate chamber 26 of the differential check valve and will pass through the pipe 32 into the source 31. As soon as the pressure in the chamber 4 lowers sufficiently, and piston 64 operates to close valve element 60, all of the liquid delivered by the pump will pass into the pullback chamber 9 and cause a retraction of the platen.

Upon the opening of the valve element 63, some of the liquid displaced from the chamber 4 by the main piston 3 will pass through pipe 30, the differential valve device, and pipe 32 into the tank 31 having an air chamber where it is stored under pressure ready for a new downward movement of the platen. Since the fluid displaced by the piston 3 from the chamber 4 is greater than that delivered by the pump to the pull back chamber 9, part of the liquid displaced from the chamber 4 cannot pass through the pump and is conveyed directly to the source 31 and stored under pressure. With this condition of the apparatus, the platen will be returned to its retracted position and when it closely approaches

its retracted position, as shown in the drawings, it will engage the collar 140 and elevate rod 138 to forcibly open the switch 104.

The opening of the switch 104 opens the circuit through the relay 102, and this causes an opening of the circuit through the solenoid 59. Thereupon the spring 57 returns the valve element 54 from the dotted to the full line position shown in the drawings. This causes a venting of the pipe 49 and passes compressed air from the pipe 53 through pipe 47 to the pilot cylinder 40, which forces the piston 41 and the rod 37 to the right or in a direction in which it rocks the yoke 34 into a position in which it causes a reversal of the delivery of the pump. Thereupon the pump will receive its liquid through the pipe 12, and deliver it under pressure into the pipe 15.

This opening of switch 104 causes no change in the circuit of the relay 108, and therefore, no change in the valve element 69. Since the valve element 63 is held open by the pressure on piston 64, the liquid delivered into pipe 15, instead of forcing the piston 3 downwardly, will pass idly through chamber 4, pipe 30, valve device 25, pipe 32, check valve 33 and pipe 12 back to the pump, thus re-establishing the idle hydraulic circuit which was functioning in this manner at the start of the first operation. Further upward movement of the platen 2 is thus prevented, and the downward movement of the platen is prevented by the trapping of the operating liquid in the pull back chamber 9.

The movement of the yoke 34 into this position shown on the drawings releases the switch 134 which opens, this deenergizes the timing device and allows it to reset for a new timing operation, and this releases the switch 86 which automatically closes and re-establishes the stick circuit except for its interruptions at the upper pair of contacts of the relay 77. The platen is, therefore, retracted into the position shown and held in that position.

If the platen should overstroke in a pressing direction, such as when no dies or work are in the press it is important that the travel of the press be limited, and for this purpose the switch 113 is disposed in a position to be operated by the arm 139 before it engages the usual stress pins, not shown, of the press. The arm 139, thus in its downward stroke opens the switch 113 and causes a de-energizing of the relay 108, and this causes a de-energizing of the solenoid 71, whereupon the valve element 69 returns to the full line position shown in the drawings, and causes a movement of the piston 64 and an opening of the check valve element 63, so that the downward travel of the platen is stopped and retained idly in this overstroke position until returned by the attendant.

The attachment or press operator can, of course, reverse the press and cause a return of the platen from any point in its travel in a pressing direction, merely by opening the normally closed switch 84 which breaks the stick circuit of relay 77, the same as it is broken by the timing device. If one desires to stop the platen at any point in its downward travel and hold it in that position, the switch 110 is merely shifted into the open or dotted line position shown in the drawings, when the desired point in the downward travel of the platen has been reached, which produces the same effect as the opening of the switch 113.

Referring now to Fig. 3, a slight modification of the invention is illustrated in which the re-

versible, variable delivery pump 11 is replaced by a pump 144, which is a uni-directional pump or one that operates only in one direction when driven in one direction. In addition to the uni-directional pump, I also include a 4-way reversing valve 145 whose operating stem 146 is operated, in order to change the direction of delivery of the operating liquid from one ram to the other, by the piston 41a operating in the cylinder 40a which may be the same as the cylinder 40 of Figs. 1 and 2. The pipes 47 and 49 which supply operating fluid to the cylinder 40a are the pipes identified by the same characters in Figs. 1 and 2. In Fig. 3, sufficient of the unmodified parts of Fig. 1, and given the same reference characters, are illustrated so as to illustrate only the changes required in the replacement of the reversible pump by the uni-directional pump 144 and the reversing valve 145.

The pump 144 is connected at its intake side by a pipe 147 to the tank or source of liquid under pressure 31, and at its delivery side it is connected by a pipe 148 to the central part of the reversing valve 145. The ends of the chamber of the valve 145, which are connected alternately to the ram cylinders, are connected by a branched pipe 149 to the tank 31, and a pressure relief valve 150 is connected between the pipes 148 and 149 so that if the pressure at the outlet side of the pump should exceed a predetermined safe pressure, the relief valve 150 will open and by-pass the delivered liquid through the tank 31 until a safe pressure is again restored in the pipe 148. One of the delivery ports of the valve 145 is connected by the pipe 15a to the cylinder 4, and the other delivery port of the valve 145 is connected by the pipe 13a to the pull back chamber 9. With this arrangement, the valve 33 of Fig. 1 may be omitted. Since a reversing valve, such as the valve 145, does not ordinarily have a neutral delivery position, the switch 134 of Fig. 1 may be omitted in the arrangement of Fig. 3, and wire 135a, corresponding to wire 135 of Fig. 1, connects device 136 directly to switch arm 129, so that the timing operation will begin immediately upon the energization of the relay 108, and if no material time interval for the maintenance of the pressure is desired, the timing device 136 may be set to operate immediately upon its energization. The valve element 151 of the reversing valve 145 is operated by the stem 146, and thus as fluid under pressure is admitted alternately to the opposite ends of the cylinder 40a, the valve element 151 will be reciprocated to change the delivery of the pump from the pipe 13a to the pipe 15a and vice versa, depending upon the direction of movement of the valve element 151.

In the operation of the system, as modified in Fig. 3, the reversing valve element 151 will be operated in the same manner that the stem 37 of Fig. 1 is operated, and the pump will deliver the operating liquid under pressure to the main and pull back cylinders of the press alternately. When the pump is delivering to one of the cylinders, fluid from the other cylinder will be discharged through the valve device 25 into the tank 31, except that when the pump is delivering fluid through the pipe 15a to the main cylinder 4, with the parts in the positions shown in Fig. 3, the liquid delivered by the pump to the cylinder 4 will by-pass idly through the cylinder 4 and back to the tank 31 in the same manner, and for the same reason, that it circulates through cylinder 4 and the valve device 25 under

the conditions shown in Fig. 1. At such a time the liquid will be trapped in the pull back cylinder 9 and the platen will be held idly in its elevated or retracted position. The downward movement of the platen, or its pressing stroke, 5 will be initiated the same as described for Fig. 1, and the operation is otherwise the same as described in connection with Fig. 1.

It will be observed that automatic reversal and retraction of the platen is obtained, that the 10 platen is automatically stopped and held in a desired retracted position, and that it may be stopped and held in any selected position in its pressing movement, and then its travel continued in the same direction or reversed, as may 15 be selected by the press operator.

It will be understood that various changes in the details, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in 20 the art within the principle and scope of the invention, as expressed in the appended claims.

I claim:

1. A hydraulic motor system comprising a working member, means guiding said member for 25 movement in alternate directions, hydraulic means connected to said member to operate it in a power direction, hydraulic means also connected to said member for operating it in the opposite direction to retract it, pumping means connected 30 to both of said hydraulic means for transferring an operating fluid to said hydraulic means alternately, a valve in the connection from said pumping means to the retracting means for preventing direct flow from the retracting means to the 35 pumping means, a source of operating fluid, a connection from said source to each of said hydraulic means and to said pumping means, valve means in each connection for controlling fluid flow between said source and each of said hydraulic 40 means and preventing flow from said pumping means directly to said source, and means selectively operable to reverse said valve means in each connection while the pumping means continues to deliver operating fluid to said first hydraulic 45 means for by-passing fluid from the pumping means through the valve means in the connection from said source to the first mentioned said hydraulic means, whereby the movement of said member in said power direction may be stopped at any position in its travel and held in that position. 50

2. A hydraulic motor system, comprising a working member, means guiding said member for 55 movement in alternate directions, hydraulic means connected to said member to impart thereto a power stroke, hydraulic means also connected to said member for retracting it, pumping means connected to both of said hydraulic means for transferring an operating fluid to them alternately, a source of operating fluid, a connection from 60 said source to said first hydraulic means, a valve in said connection through which flow in both directions may occur, a connection from said source to that side of the pumping means which 65 delivers fluid to the retracting means and having a valve therein restricting flow therein to a direction from said source toward said pumping means, a one way valve disposed in the connection from said pumping means to said retracting 70 means, restricting fluid flow to a direction from said pumping means toward said retracting means and disposed between said retracting means and the connection from said pumping means to said source, means having a valve there- 75

in and operable for connecting the second of said hydraulic means to said source during said power strokes and means for operating said first valve into open position so as to by-pass fluid delivered by said pumping means to said first mentioned means, and close the valve in the connection from said second hydraulic means to said source, whenever one desires to stop the platen in any position in a power stroke.

3. A hydraulic motor system, comprising a working member, hydraulic means connected to said member to impart a power stroke thereto, hydraulic means also connected to said member for retracting it, a reversible flow pump connected between said hydraulic means for transferring alternately therebetween an operating fluid, a source of operating fluid, a connection from said source to each of said hydraulic means, valve means in each connection for controlling fluid flow between said source and each of said hydraulic means, an interconnection between said valve means by which the closing of either valve automatically opens the other valve, a one-way check valve in the connection from said pump to said retracting means, and restricting fluid flow therethrough to a direction away from said pump, a connection from said source to that side of the pump which is connected to the retracting means, said connection from said source to said pump having therein a one-way valve restricting fluid flow therethrough to a direction from said source toward said pump, and means for closing said valve means in the connection from said source to said retracting means and for opening the other of said valve means, whereby fluid delivered by said pump to said first mentioned hydraulic means may be by-passed through said source without pressure, and said working member will be held stationary at any point in a power stroke.

4. A hydraulic motor system, comprising a working member, hydraulic means connected to said member for imparting thereto a power stroke, hydraulic means also connected to said member for retracting it, a source of fluid, a connection from said source to said retracting means, a connection from said source to said first mentioned means, a valve in the connection from said source to said retracting means, a valve in the connection from said source to the other of said means, means for opening the said valve in the connection from said source to said first hydraulic means and concurrently closing the other of said valves, a reversible flow, pump device connected at one side to the connection between said source and said retracting means at a point between the valve in that connection and the retracting means, and having in said connection from the pump device to said first connection a one-way check valve limiting fluid flow therethrough to a direction away from said pump device, a connection from said source to said one side of the pump device between the pump device and the valve encountered therein, and having therein a one-way valve limiting fluid flow therein to a direction from said source toward said pump device, and means selectively operable on said valve opening means to open said valve in the connection from said source to said first mentioned hydraulic means and close said other of said valves while said pump device is delivering fluid to said first mentioned hydraulic means, whereby the fluid delivered by said pump device may be by-passed idly through said source, and enable said member to be held against further movement in a power

stroke, by the fluid confined in said retracting means.

5. A hydraulic motor system comprising a working member, main hydraulic means connected to said member to impart thereto a power stroke, hydraulic means also connected to said member for retracting it, a source of operating fluid, a conduit connecting said source to said retracting means and having at spaced intervals therein two valves, the valve nearest the retracting means being a one-way check valve limiting fluid flow therethrough to a direction toward said retracting means, a by-pass around said one-way valve and having a restricting passage of selected size through which fluid may pass from said retracting means toward said source, a conduit connecting said source to said main hydraulic means and having therein a self-closing valve that in closing prevents fluid flow from said main hydraulic means towards said source, pump means connected to the first mentioned conduit between the two valves therein, and to said main hydraulic means so as to form therewith a hydraulic circuit, and operable to transfer operating fluid alternately between said hydraulic means, so as to cause operation of said member in either direction, the connection from said pump means to said first mentioned conduit having therein a one-way check valve limiting fluid flow therethrough to a direction towards said retracting means, and a connection from said source to said pump means and having therein a one-way check valve opening to pass fluid solely towards said pump means, the other of said two valves being selectively operable from outside the hydraulic circuit and operable in closing to open said self-closing valve.

6. A hydraulic motor system comprising a working member, main hydraulic means connected to said member to impart thereto a power stroke, hydraulic means also connected to said member for retracting it, pumping means, pipes connecting said pumping means to each of said hydraulic means for transferring fluid between said hydraulic means in alternate directions so as to cause operation of said member in either direction, a check valve in the pipe between said pumping means and retracting means and limiting fluid flow therethrough to a direction toward said retracting means, a source of operating fluid, a conduit connecting said source to said retracting means at a point between said check valve and said retracting means and having a valve therein, a conduit connecting said source to said main hydraulic means, and having a valve therein, means interacting between said last mentioned valves, and upon the closing of either valve automatically opening the other valve, a pipe connecting said source to that side of said pumping means which is connected to said retracting means, said pipe from said source also having therein a one-way check valve limiting fluid flow from said source toward said pump, and means for forcibly closing said valve in the first mentioned conduit and through said interacting means opening said valve in the conduit from said source to said main hydraulic means, whereby when said pumping means is delivering fluid to said main hydraulic means, the delivered fluid may be by-passed through said source idly and said member held in any position by the fluid locked in said retracting means.

7. A hydraulic motor system comprising a working member, hydraulic means connected to said member to operate it in a power direction, 75

hydraulic means also connected to said member for retracting it, reversible pumping means connected to each of said means and forming therewith a reversible hydraulic circuit for transferring operating fluid between both of said means alternately upon reversal of said pumping means to cause operations of said member in opposite directions, a source of operating fluid connected to said circuit to absorb excess fluid due to inequalities in the fluid capacities of said means, and means associated with said circuit and source, and selectively operable, while said pumping means continues to deliver fluid in the same direction, for circulating, idly through said source, operating fluid being delivered to said first hydraulic means by said pumping means, when a cessation in the movement of said member is desired.

8. A hydraulic motor system comprising a working member, hydraulic means connected to said member to impart thereto a power stroke, hydraulic means also connected to said member for retracting it, pumping means connected to each of said hydraulic means and forming therewith a hydraulic circuit for transferring operating fluid between said hydraulic means alternately to cause operation of said member in opposite directions, and means operable while said pumping means is delivering fluid to said first hydraulic means for by-passing said pumping means while said pumping means continues to deliver fluid to said first hydraulic means and for concomitantly preventing escape of fluid from said retracting means, so as to stop said working member in any desired position in a power stroke.

9. A hydraulic motor system comprising a working member, hydraulic means connected to said member to impart thereto a power stroke, hydraulic means also connected to said member for retracting it, a reversible flow pump connected to both of said means and forming therewith a hydraulic circuit by the operation of which said pump will transfer fluid between said means alternately, so as to cause operation of said member in either direction, said reversible pump having a controlling member movable into three controlling positions, in one of which it causes delivery of said pump in one direction, in another of which it causes delivery in the opposite direction, and in the third position of which the delivery is neutral, means responsive to pressure in said circuit during a power stroke for automatically setting said controlling member to approximately neutral position and timing means set in operation automatically by said pump control member when said member reaches said neutral position, for causing an operation of said pump to deliver operating fluid to said retracting means, a predetermined interval of time after said pump control member reaches approximately neutral position.

10. A hydraulic motor system comprising a working member, a reversible pump having three operating conditions, in one of which it delivers fluid in one direction, in another of which it delivers fluid in the opposite direction, and in the third condition of which it is neutral, with no delivery in either direction, hydraulic means connected to said member and operating it in opposite directions and also connected to and forming with said pump a hydraulic circuit by which said member is operated in one direction when the pump is in condition to deliver fluid in one direction, and operated in the opposite direction when the pump is in condition to deliver fluid in the opposite direction, and having no movement

when the pump is in neutral condition, means responsive to the pressure of the fluid delivered by said pump in one direction for placing said pump in neutral delivery condition at once when the pressure of the fluid delivered by the pump in one direction exceeds a predetermined pressure, and means set into operation by said pump automatically when the pump is placed in neutral delivery condition, for reversing the delivery of the pump a predetermined interval of time after the pump is placed in neutral delivery condition, following operation of said member in one of said directions.

11. A hydraulic motor system comprising a working member, a main ram and a pullback ram connected to said member to reciprocate it, a reversible flow pump connected between said rams for transferring fluid between said rams alternately in order to cause movement of said member in opposite directions, a source of operating liquid, a conduit connecting said source to said pullback ram, a conduit also connecting said source to said main ram, a check valve in each of said conduits opening to permit liquid flow from said source toward said rams, and means acting between said valves for forcibly opening either of said valves when the other valve closes, pilot means connected to the valve in the conduit to the pullback ram for operating it in both directions, a valve device, a source of fluid under pressure connected to operate said pilot means and controlled by said valve device, pilot means for reversing said pump, a second valve device connected to said reversing means and to said source of fluid under pressure, whereby the reversing pilot means will be actuated by said fluid under pressure under the control of said second valve device, means including an electrical circuit for operating one of said valve devices, means including an electrical circuit for operating the other of said valve devices, a controlling device for selectively operating said circuits to cause operation of said valve devices and through them selected operation of said working member in both directions, and a switch in the circuit controlling the second valve device for modifying that circuit to cause a reversal of the pump independently of the operation of the other valve device.

12. A hydraulic motor system comprising a working member, a main ram and a pullback ram connected to said member to reciprocate it, a reversible flow pump device connected between said rams for transferring fluid between said rams alternately in order to cause movement of said member in opposite directions, a source of operating liquid, a conduit connecting said source to said pull-back ram, a conduit also connecting said source to said main ram, a check valve in each of said conduits opening to permit liquid flow from said source toward said rams, pilot means connected to the valve in the conduit to the pullback ram for controlling its operations, a valve device, a source of fluid under pressure connected to operate said pilot means and controlled by said valve device, pilot means for reversing said pump device, a second valve device connected to said reversing means and to said source of fluid under pressure, whereby the reversing pilot means will be actuated by said fluid under pressure under the control of said second valve device, means including an electrical circuit for operating one of said valve devices, means including an electrical circuit for operating the other of said valve devices, a controlling device for selectively operat-

ing said circuits to cause operation of said valve devices and through them selected operation of said working member in both directions, and a switch included in the circuit of said second valve device and disposed in a position to be opened by said member when said member reaches a selected position in its return movement, whereby the delivery of said pump device may be changed from the pull-back ram to the main ram by said working member automatically without a corresponding operation of said first pilot means.

13. A hydraulic motor system comprising a working member, a main ram and a pull-back ram connected to said member to reciprocate it, a reversible flow pump device connected between said rams for transferring fluid between said rams alternately in order to cause movement of said member in opposite directions, a source of operating liquid, a conduit connecting said source to said pull-back ram, a conduit also connecting said source to said main ram, a check valve in each of said conduits opening to permit liquid flow from said source toward said rams, pilot means connected to the valve in the conduit to the pull-back ram for controlling its operations, a valve device, a source of fluid under pressure connected to operate said pilot means and controlled by said valve device, pilot means for reversing said pump device, a second valve device connected to said reversing means and to said source of fluid under pressure, whereby the reversing pilot means will be actuated by said fluid under pressure under the control of said second valve device, an electrical operating circuit for each of said valve devices, a stick circuit relay for controlling said circuits to close one while the other is open and vice versa, and a switch in the circuit controlling the pump device reversal and disposed in a position to be opened by said member when said member reaches a desired position in an opening direction.

14. A hydraulic motor system comprising a working member, a main ram and a pull-back ram connected to said member to reciprocate it, a reversible flow pump device connected between said rams for transferring fluid between said rams alternately in order to cause movement of said member in opposite directions, a source of operating liquid, a conduit connecting said source to said pull-back ram, a conduit also connecting said source to said main ram, a check valve in each of said conduits opening to permit liquid flow from said source toward said rams, pilot means connected to the valve in the conduit to the pull-back ram for controlling its operations, a valve device, a source of fluid under pressure connected to operate said pilot means and controlled by said valve device, pilot means for reversing said pump device, a second valve device connected to said reversing means and to said source of fluid under pressure, whereby the reversing pilot means will be actuated by said fluid under pressure under the control of said second valve device, an electrical circuit controlling each valve device independently of the other, a stick circuit relay controlling both of said circuits and closing one while the other is opened and vice versa, a switch in the circuit controlling the pump device reversing valve device, disposed in a position to be opened by said working member when said member reaches a selected position in an opening movement, and a normally closed switch in the circuit controlling the other valve device disposed in a position to be opened by said member if said member moves in an opening

direction beyond said selected position to a selected extent.

15. A hydraulic motor system comprising a working member, a main ram and pull-back ram connected to said member to reciprocate it, reversible pumping means connected between said rams for transferring fluid between said rams alternately in order to cause movement of said member in opposite directions, a source of operating liquid, conduits connecting said source to said rams and having controlling valves therein, means for reversing said pumping means, additional means for operating said valves in said conduits, electrical circuits controlling the activity of said last two mentioned means, a relay controlling said circuits, and a switch in the circuit controlling the pump reversing means disposed in a position for operation by said member when said member reaches a desired position in an opening direction, so as to cause a reversal of said pumping means without an operation of said conduit valves by said additional means.

16. A hydraulic motor system comprising a working member, a main ram and pullback ram connected to said member to reciprocate it, reversible pumping means connected between said rams for transferring fluid between said rams alternately in order to cause movement of said member in opposite directions, a source of operating liquid, conduits connecting said source to said rams and having controlling valves therein, means for reversing said pumping means, additional means for operating said valves in said conduits, electrical circuits controlling the activity of said last two mentioned means, a relay controlling both said circuits, a switch in the circuit controlling the pump reversing means disposed in a position for operation by said member when said member reaches a desired position in an opening direction, so as to cause a reversal of said pumping means without an operation of said conduit valves by said additional means, and a switch in the other of said circuits also disposed in a position for operation by said member to cause an operation of said additional means and through it of the valves of said conduits, if said member continues its movement by the main ram materially beyond a desired position.

17. A hydraulic motor system comprising a working member, a main ram and pullback ram connected to said member to reciprocate it, reversible pumping means connected between said rams for transferring fluid between said rams alternately in order to cause movement of said member in opposite directions, a source of operating liquid, conduits connecting said source to said rams and having controlling valves therein, means for reversing said pumping means, additional means for operating said valves in said conduits, electrical circuits controlling the activity of said last two mentioned means, a relay controlling said circuits and operable to cause actuation of said pump reversing means and valve operating means in a desired relation to one another, and timing means controlled by one of said circuits and in turn controlling said relay circuit for causing an operation of said relay in a manner to reverse the direction of travel of said member, a predetermined and selected interval of time after a selected operation of said relay.

18. A hydraulic motor system comprising a working member, a source of operating fluid, hydraulic means for reciprocating said member including a main ram and a retracting ram, a reversible flow variable delivery pump, means in-

cluding a valve device for connecting said source to said rams alternately, connections between said source, rams, pump and valve device for forming a hydraulic circuit, in which said fluid may be transferred between said rams alternately or by-passed through said source and valve device, controlling means for reversing said pump, and also for setting it for neutral delivery when the pressure of the fluid delivered by the pump in one direction exceeds a predetermined and selected pressure, means for operating said valve device, an electrical circuit for controlling said pump reversing means, an electrical circuit for controlling said valve operating means, a switch mechanism for controlling said circuits in a selected relation to one another so as to cause reciprocation of said member, and timing means controlled jointly by said switch mechanism and said pump controlling means and operable automatically to change said switch mechanism in a manner to cause a reversal in the direction of travel of said member, a predetermined and selected interval of time after said pump is set to neutral delivery following delivery by said pump in said one direction.

19. A hydraulic motor system comprising a working member, a source of operating fluid, hydraulic means for reciprocating said member, including a main ram and a retracting ram, a reversible flow variable delivery pump and a valve device for connecting said source to said rams alternately, connections between said source, rams, pump and valve device for forming a hydraulic circuit, in which said fluid may be transferred between said rams alternately or by-passed through said source and valve device, controlling means for reversing said pump, and also for setting it for neutral delivery when the pressure of the fluid delivered by the pump in one direction exceeds a predetermined and selected pressure, means for operating said valve device, an electrical circuit for controlling said pump reversing means, an electrical circuit for controlling said valve operating means, a switch mechanism for controlling said circuits in a selected relation to one another so as to cause reciprocation of said member, timing means controlled jointly by said switch mechanism and said pump controlling means and operable automatically to change said switch mechanism in a manner to cause a reversal in the direction of travel of said member, a predetermined and selected interval of time after said pump is set to neutral delivery following delivery by said pump in said one direction, and means associated with said timing means for removing it from the control of said pump controlling means and causing the starting of the timing operation immediately upon the operation of said switch mechanism to start a movement of said member in one direction.

20. A hydraulic motor system comprising a working member, a source of operating fluid, hydraulic means for reciprocating said member including a main ram and a retracting ram, a reversible flow variable delivery pump and a valve device for connecting said source to said rams alternately, connections between said source, rams, pump and valve device for forming a hydraulic circuit, in which said fluid may be transferred between said rams alternately or by-passed through said source and valve device, controlling means for reversing said pump, and also for setting it for neutral delivery when the pressure of the fluid delivered by the pump in one direction reaches a predetermined and selected pressure,

means for operating said valve device, an electrical circuit for controlling said pump reversing means, an electrical circuit for controlling said valve operating means, a switch mechanism for controlling said circuits in a selected relation to one another so as to cause reciprocation of said member, and timing means controlled jointly by said switch mechanism and said pump controlling means and operable automatically to change said switch mechanism in a manner to cause a reversal in the direction of travel of said member, a predetermined and selected interval of time after said pump is set to neutral delivery following delivery by said pump in said one direction, said switch mechanism including a stick circuit relay having in series with its holding circuit a switch opened by said timing means.

21. In a hydraulic press system, a platen, a hydraulic circuit for operating said platen in opposite directions and including a reversible flow, variable delivery pump which automatically places itself into neutral delivery condition when the pressure of fluid delivered by it in one direction exceeds a predetermined pressure, time controlled means operative for reversing said pump to retract the platen a selected and predetermined interval of time after an operation of said means is initiated, and means controlled by said pump and rendered effective automatically, when said pump places itself in neutral delivery condition, to initiate an operation of said time controlled means.

22. In a hydraulic motor system, a working member, means including a hydraulic circuit for operating said member in opposite directions and including means for causing a reversal in the direction of travel of said member, means responsive to pressure in the hydraulic circuit, while said member is being operated in one direction, for causing a reversal in the direction of travel of said member automatically after said pressure reaches a predetermined pressure, and means including an element operated by said member whenever said member reaches a predetermined position in its travel in said one direction, for altering said hydraulic circuit to stop further travel of said member and automatically holding it in that position.

23. In a hydraulic motor system, a working member, means including a hydraulic circuit for operating said member in opposite directions and including means for causing a reversal in the direction of travel of said member, means responsive to pressure in the hydraulic circuit, while said member is being operated in one direction, for causing a reversal in the direction of travel of said member automatically after said pressure reaches a predetermined pressure, means effective concurrently with said pressure responsive means and including an element operated by said member whenever said member reaches a predetermined position in its travel in said one direction, for altering said hydraulic circuit to stop further travel of said member and hold it in that position, and manually controlled means for also altering said hydraulic circuit and causing a return travel of said member at any position in its forward travel.

24. In a hydraulic motor system, a working member, a main ram and a pullback ram connected to said member to reciprocate it, means including a pump and a hydraulic circuit connected between said rams for transferring fluid between the rams alternately to cause operation of said member in opposite directions, controlling

means for the transferring means for determining the direction of travel of said working member, means responsive to the pressure in said main ram during a forward stroke of said member for causing a retraction of said member automatically after the pressure reaches a desired maximum, additional means effective concurrently with said pressure responsive means for also controlling said controlling means and operable by said member when said member passes a predetermined position in a forward direction of travel for altering said hydraulic circuit to automatically stop and hold the working member in that position, and means also operative on said controlling means for selectively altering said circuit to cause a retraction of said working member from any point in the forward travel of said member.

25. In a hydraulic motor system, a working member, a main ram and a pullback ram connected to said member to reciprocate it, means including a pump and a hydraulic circuit connected between said rams for transferring fluid between the rams alternately to cause operation of said member in opposite directions, controlling means for the transferring means for determining the direction of travel of said working member, means responsive to the pressure in said main ram during a forward stroke of said member for causing a retraction of said member automatically after the pressure reaches a desired maximum, additional means also controlling said controlling means and operable by said member when said member passes a predetermined position in a forward direction of travel for altering said hydraulic circuit to automatically stop and hold the working member in that position, means also operative on said controlling means for selectively altering said circuit to cause a retraction of said working member from any point in the forward travel of said member, and a retraction limiting device operable by said member at any selected point during its return travel for setting said hydraulic circuit to cause a forward travel of said member, but idly shunting the operating fluid around said main ram to hold said member automatically in a starting position.

26. In a hydraulic motor system, a working member, a main ram and a pullback ram connected to said member to reciprocate it, means including a pump and a hydraulic circuit connected between said rams for continuously circulating an operating fluid and transferring it between the rams alternately to cause operation of said member in opposite directions, controlling means for said transfer means for altering the direction of transfer of the fluid between the rams to determine the direction of travel of said member, electrically controlled means responsive to pressure in said main ram during a forward stroke actuation thereof for causing a retraction of said member automatically after the pressure in the main ram reaches a desired maximum, electrical means also controlling said controlling means and having a switch operable by said member when said member passes a predetermined position in said forward stroke for altering said circuit to automatically stop and hold the working member in that position, and also having another switch in series with the first switch and selectively operable for manually stopping and holding said member in any position in its forward travel, and electrical means associated with said electrically controlled means and selectively and manually operable to cause an al-

teration of said hydraulic circuit and a retraction of said member from any position during the forward travel of said member.

27. In a hydraulic motor system, a working member, a main ram and a pullback ram connected to said member to reciprocate it, means including a pump and a hydraulic circuit connected between said rams for transferring fluid between the rams alternately to cause operation of said member in opposite directions, means associated with said pump and circuit for changing the direction of fluid delivery between said rams, a stick relay having a stick circuit, an electric circuit controlled by said relay and in turn controlling said direction changing means, valve mechanism associated with said hydraulic circuit and selectively operable to shunt the fluid delivered to said main ram past said main ram and trap said fluid in said pullback ram, electrical means for controlling the operation of said valve mechanism and having a controlling, auxiliary electric circuit also controlled by said relay, each of said relay controlled electric circuits being closed when the other is opened, and this relation being reversed through energization and deenergization of said relay, a switch in said first relay-controlled electric circuit for operation individually in that circuit during a return movement of said member to cause said first means to deliver fluid to said main ram without operation of said relay, and switch means for opening said stick circuit to cause a deenergization of said relay and a setting of said valve mechanism to shunt operating fluid around said main ram and trap fluid in said pullback ram.

28. In a hydraulic motor system, a working member, a main ram and a pullback ram connected to said member to reciprocate it, means including a pump and a hydraulic circuit connected between said rams for transferring fluid between the rams alternately and thereby causing operation of said member in opposite directions, valve mechanism included in said hydraulic circuit and having a portion operable under one setting to shunt fluid delivered to the main ram past said ram back to the pump, and also limit fluid travel in the connection to the pullback ram solely to a direction toward said pullback ram, and operable when in another setting for connecting said pullback ram to the intake side of said pump and effecting an interruption of the shunting of said fluid past said main ram, means including a controlling electric circuit for operating said portion of valve mechanism from one setting to the other, means including an electric circuit for changing the delivery of the pump from one ram to the other, and a relay for alternately closing one of said electric circuits and opening the other upon energization and deenergization thereof, a stick circuit for said relay, a switch in said stick circuit for causing a deenergization of said relay so as to effect a reversal in the direction of travel of said member, and a switch included in said circuit that controls the direction of delivery of fluid between the rams, by which when that circuit is closed by the stick relay, a change in the direction of delivery of fluid between the rams may be effected without an operation of said relay and without an operation of the circuit controlling the valve mechanism.

29. In a hydraulic motor system, a working member, a main ram and a pullback ram connected to said member to reciprocate it, means including a pump and a hydraulic circuit con-

5 nected between said rams for transferring fluid
between the rams alternately and thereby causing
operation of said member in opposite directions,
valve mechanism included in said hydraulic cir-
circuit and having a portion operable under one set-
ting to shunt fluid delivered to the main ram past
said ram back to the pump, and also limit fluid
travel in the connection to the pullback ram
solely to a direction toward said pullback ram,
and operable when in another setting for con-
necting said pullback ram to the intake side of
said pump and effecting an interruption of the
shunting of said fluid past said main ram, means
including a controlling electric circuit for operat-
ing said portion of valve mechanism from one set-
ting to the other, means including an electric
circuit for changing the delivery of the pump from
one ram to the other, and a relay for alternately
closing one of said electric circuits and opening
the other upon energization and deenergization
thereof, a stick circuit for said relay, a switch in
said stick circuit for causing a deenergization of
said relay so as to effect a reversal in the direc-
tion of travel of said member, and a switch in-
cluded in said circuit that controls the direction
of delivery of fluid between the rams, by which
when that circuit is closed by the stick relay, a
change in the direction of delivery of fluid be-
tween the rams may be effected without an oper-
ation of said relay and without an operation of
the circuit controlling the valve mechanism, said
last named switch being a limit switch operable
automatically by said member when said member
reaches a desired position during its return move-
ment, whereby when said member reaches said
desired position the direction of delivery of fluid
between the rams will be altered without an oper-
ation of said valve mechanism, and said mem-
ber will be locked in that position.

30. In a hydraulic motor system, a working
member, a main ram and a pullback ram con-
nected to said member to reciprocate it, means
including a pump and a hydraulic circuit con-
nected between said rams for transferring fluid
between the rams alternately and thereby causing
operation of said member in opposite directions,
valve mechanism included in said hydraulic cir-
cuit and having a portion operable under one set-
ting to shunt fluid delivered to the main ram past
said ram back to the pump, and also limit fluid
travel in the connection to the pullback ram solely
to a direction toward said pullback ram, and op-
erable when in another setting for connecting
said pullback ram to the intake side of said pump
and effecting an interruption of the shunting of
said fluid past said main ram, means including a
controlling electric circuit for operating said por-
tion of valve mechanism from one setting to the
other, means including an electric circuit for
changing the delivery of the pump from one ram
to the other, and a relay for alternately closing
one of said electric circuits and opening the other
upon energization and deenergization thereof, a
stick circuit for said relay, a switch in said stick
circuit for causing a deenergization of said relay
so as to effect a reversal in the direction of travel
of said member, a switch included in said circuit
that controls the direction of delivery of fluid be-
tween the rams, by which when that circuit is
closed by the stick relay, a change in the direc-
tion of delivery of fluid between the rams may be
effected without an operation of said relay and
without an operation of the circuit controlling the
valve mechanism, and a switch also included in
series in the circuit controlling said valve mecha-

nism, whereby said valve mechanism may be oper-
ated into a position to shunt fluid delivered to said
main ram back to the pump without altering the
direction of delivery of fluid between said rams,
and thereby to stop and hold said member in any
desired position during the forward stroke thereof.

31. In a hydraulic motor system, a working
member, a main ram and a pullback ram con-
nected to said member to reciprocate it, means in-
cluding a pump and a hydraulic circuit connected
between said rams for transferring fluid between
the rams alternately and thereby causing opera-
tion of said member in opposite directions, valve
mechanism included in said hydraulic circuit and
having a portion operable under one setting to
shunt fluid delivered to the main ram past said
ram back to the pump, and also limit fluid travel
in the connection to the pullback ram solely to a
direction toward said pullback ram, and operable
when in another setting for connecting said pull-
back ram to the intake side of said pump and
effecting an interruption of the shunting of said
fluid past said main ram, means including a con-
trolling electric circuit for operating said portion
of valve mechanism from one setting to the other,
means including an electric circuit for changing
the delivery of the pump from one ram to the
other, and a relay for alternately closing one of
said electric circuits and opening the other upon
energization and deenergization thereof, a stick
circuit for said relay, a switch in said stick cir-
cuit for causing a deenergization of said relay so
as to effect a reversal in the direction of travel
of said member, a switch included in said circuit
that controls the direction of delivery of fluid be-
tween the rams, by which when that circuit is
closed by the stick relay, a change in the direc-
tion of delivery of fluid between the rams may be
effected without an operation of said relay and
without an operation of the circuit controlling
the valve mechanism, and a switch also included
in series in the circuit controlling said valve
mechanism, whereby said valve mechanism may
be operated into a position to shunt fluid delivered
to said main ram back to the pump without alter-
ing the direction of delivery of fluid between said
rams, and thereby to stop and hold said mem-
ber in any desired position during the forward
stroke thereof, said last named switch being dis-
posed in a position for operation by said member
during a forward movement thereof.

32. In a hydraulic motor system, a working
member, a main ram and a pullback ram con-
nected to said member to reciprocate it, means
including a pump and a hydraulic circuit con-
nected between said rams for transferring fluid
between the rams alternately and thereby caus-
ing operation of said member in opposite direc-
tions, valve mechanism included in said hydraulic
circuit and having a portion operable under one
setting to shunt fluid delivered to the main ram
past said ram back to the pump, and also limit
fluid travel in the connection to the pullback ram
solely to a direction toward said pullback ram,
and operable when in another setting for con-
necting said pullback ram to the intake side of
said pump and effecting an interruption of the
shunting of said fluid past said main ram, means
including a controlling electric circuit for operat-
ing said portion of valve mechanism from one
setting to the other, means including an electric
circuit for changing the delivery of the pump
from one ram to the other, and a relay for alter-
nately closing one of said electric circuits and
opening the other upon energization and deen-

energization thereof, a stick circuit for said relay, a switch in said stick circuit for causing a de-energization of said relay so as to effect a reversal in the direction of travel of said member, a switch included in said circuit that controls the direction of delivery of fluid between the rams, by which when that circuit is closed by the stick relay, a change in the direction of delivery of fluid between the rams may be effected without an operation of said relay and without an operation of the circuit controlling the valve mechanism, a switch also included in series in the circuit controlling said valve mechanism, whereby said valve mechanism may be operated into a position to shunt fluid delivered to said main ram back to the pump without altering the direction of delivery of fluid between said rams, and thereby to stop and hold said member in any desired position during the forward stroke thereof, and another switch in series with said last named switch and manually operable to stop and hold said member selectively in any position in its forward travel, said second switch being disposed in a position for operation by said member during a forward movement thereof.

33. A hydraulic motor system comprising a working member, main hydraulic means connected to the member for imparting a power stroke thereto, hydraulic retracting means also connected to said member for retracting it, a source of operating fluid, pumping means, pipes connecting said pumping means to each of said hydraulic means and to said source and forming therewith a hydraulic circuit for transferring fluid between said hydraulic means in alternate directions so as to cause operation of said member in either direction, a double valve included in said circuit and controlling flow between said source and said hydraulic means, electrically controlled means for regulating the direction of transfer of an operating fluid between said hydraulic means, separate electrically controlled means for operating said double valve in both directions, and means including a relay for controlling both of said electrically controlled means and causing travel of said member in accordance with a predetermined plan, as said relay is energized and deenergized.

34. A hydraulic motor system, a working member, a main ram for operating said member in one direction, a retracting ram for returning said member, a source of operating fluid pumping means, a hydraulic circuit connecting said rams, said source, and said pumping means and by which operating fluid delivered by said means is delivered to said rams alternately to cause actuation of said rams alternately, a double valve included in said circuit for controlling flow between said source and said rams and connecting said source with said rams alternately and operative with the circuit to transfer fluid between said rams in alternate directions and cause travel of said member in either direction, electrically controlled means for operating said double valve to connect one ram or the other to said source, electrically controlled means for controlling said pumping means, and common controlling means for both of said electrically controlled means, so as to cause their operation in a desired relation to one another and thereby cause movements of said member in opposite directions, whereby said member may be caused to travel in alternate directions under the control of said common means.

35. A hydraulic motor system, a working mem-

ber, a main ram for operating said member in one direction, a retracting ram for returning said member, a source of operating fluid, pumping means, a hydraulic circuit connecting said rams, said source, and said pumping means, and by which operating fluid delivered by said means is delivered to said rams alternately to cause actuation of said rams alternately, a double valve included in said circuit for controlling flow between said source and said rams and connecting said source with said rams alternately and operative with the circuit to transfer fluid between said rams in alternate directions and cause travel of said member in either direction, electrically controlled means for operating said double valve to connect one ram or the other to said source, electrically controlled means for controlling said pumping means, common controlling means for both of said electrically controlled means, so as to cause their operation in a desired relation to one another and thereby cause movements of said member in opposite directions, whereby said member may be caused to travel in alternate directions under the control of said common means, and means of causing operation of said double valve controlling means separately from the control of the pumping means, but under the general control of said common controlling means.

36. A hydraulic motor system, a working member, a main ram for operating said member in one direction, a retracting ram for returning said member, a source of operating fluid, pumping means, a hydraulic circuit connecting said rams, said source, and said pumping means, and by which operating fluid delivered by said means is delivered to said rams alternately to cause actuation of said rams alternately, a double valve included in said circuit for controlling flow between said source and said rams and connecting said source with said rams alternately and operative with the circuit to transfer fluid between said rams in alternate directions and cause travel of said member in either direction, electrically controlled means for operating said double valve, electrically controlled means for controlling said pumping means, common controlling means for both of said electrically controlled means, so as to cause their operation in a desired relation to one another and thereby cause movements of said member in opposite directions, whereby said member may be caused to travel in alternate directions under the control of said common means, and means acting jointly with said common means for also controlling the pump controlling means separately from said double valve controlling means.

37. A hydraulic motor system, a working member, a main ram for operating said member in one direction, a retracting ram for returning said member, a source of operating fluid, pumping means, a hydraulic circuit connecting said rams, said source, and said pumping means and by which operating fluid delivered by said means is delivered to said rams alternately to cause actuation of said rams alternately, a double valve included in said circuit for controlling flow between said source and said rams and connecting said source with said rams alternately and operative with the circuit to transfer fluid between said rams in alternate directions and cause travel of said member in either direction, electrically controlled means for operating said double valve, electrically controlled means for controlling said pumping means, common controlling means for

both of said electrically controlled means, so as to cause their operation in a desired relation to one another and thereby cause movements of said member in opposite directions, whereby said member may be caused to travel in alternate directions under the control of said common means, and means acting jointly with said common means for also controlling the pump controlling means separately from said double valve controlling means, and rendered effective by said member at a selected point in its travel in one direction to cause a change in the action of said pumping means while the double valve remains unchanged.

38. In a hydraulic system, a working member, a main ram and a pullback ram connected to said member for reciprocating it, a continuously operating, reversible pump, a source of operating fluid, means including said source, pump and rams and forming a hydraulic circuit by which said member may be reciprocated by transferring operating fluid from one ram to the other, said means including a connection from said source to each ram and to said pump at the side connected to said pullback ram, said connection having a valve therein for passing fluid towards said pump and preventing reverse flow, valve means for preventing direct reverse fluid flow from said pullback ram to said pump, but passing fluid from said pump to said pullback ram, means for reversing said pump to transfer fluid in either direction between said rams, and means operable by said member, when said member reaches a desired position in a retraction movement, for operating said pump reversing means to reverse its direction of delivery and concomitantly by-passing fluid from said pump around said main ram to hold said member in retracted position.

39. In a hydraulic system, a working member, a main ram and a pullback ram connected to said member for reciprocating it, a continuously operating, reversible pump, a double valve, a source of operating fluid, means including said source, valve, pump and rams and forming a hydraulic circuit by which said member may be reciprocated by transferring operating fluid from one ram to the other and connecting said source to said rams alternately through said double valve, said means including a connection from said source to each ram and to said pump at the side connected to said pullback ram, said connection having a valve therein for passing fluid towards said pump and preventing reverse flow, valve means for preventing direct reverse fluid flow from said pullback ram to said pump, but passing fluid from said pump to said pullback ram, means for reversing said pump to transfer fluid in either direction between said rams, and means operable by said member, when said member reaches a desired position in a retraction movement, for operating said pump reversing means and concomitantly operating said double valve into a position for bypassing fluid from said pump around said main ram to hold said member in retracted position.

40. In a hydraulic system, a working member, a main ram and a pullback ram connected to said member for reciprocating it, a continuously operating, reversible pump, a double valve, a source of operating fluid, means including said source, valve, pump and rams and forming a hydraulic circuit by which said member may be reciprocated by transferring operating fluid from one ram to the other and connecting said source to said rams alternately through said double

valve, means for reversing said pump to transfer fluid in either direction between said rams, a relay, a stick circuit for said relay, means including a circuit closed by energization of said relay for operating said valve in a direction to conduct fluid from said pullback ram to said pump and source and operating said valve in the opposite direction when said relay is deenergized, means including another circuit opened by the energization of said relay for reversing said pump and operable to set said pump to deliver fluid to said main ram when said relay is energized, and means operated by said member, at any selected position in a retraction movement, for opening said another circuit and causing a reversal of the pump without a concomitant operation of said valve.

41. In a hydraulic system, a working member, a main ram and a pullback ram connected to said member for reciprocating it, a continuously operating, reversible pump, a double valve, a source of operating fluid, means including said source, valve, pump and rams and forming a hydraulic circuit by which said member may be reciprocated by transferring operating fluid from one ram to the other and connecting said source to said rams alternately through said double valve, means for reversing said pump to transfer fluid in either direction between said rams, a relay, a stick circuit for said relay, means including a circuit closed by energization of said relay for operating said valve in a direction to conduct fluid from said pullback ram to said pump and source and operating said valve in the opposite direction when said relay is deenergized, means including another circuit opened by the energization of said relay for reversing said pump and operable to set said pump to deliver fluid to said main ram when said relay is energized, means operated by said member, at any selected position in a retraction movement, for opening said another circuit and causing a reversal of the pump without a concomitant operation of said valve, and means responsive to pressure in said main ram for initiating an opening of said stick circuit whenever the pressure in said main ram reaches a selected pressure.

42. In a hydraulic system, a working member, a main ram and a pullback ram connected to said member for reciprocating it, a continuously operating, reversible pump, a double valve, a source of operating fluid, means including said source, valve, pump and rams and forming a hydraulic circuit by which said member may be reciprocated by transferring operating fluid from one ram to the other and connecting said source to said rams alternately through said double valve, means for reversing said pump to transfer fluid in either direction between said rams, a relay, a stick circuit for said relay, means including a circuit closed by energization of said relay for operating said valve in a direction to conduct fluid from said pullback ram to said pump and source, and operating said valve in the opposite direction when said relay is deenergized, means including another circuit opened by the energization of said relay for reversing said pump and operable to set said pump to deliver fluid to said main ram when said relay is energized, means operated by said member, at any selected position in a retraction movement, for opening said another circuit and causing a reversal of the pump without a concomitant operation of said valve, and means operable by said member, when said member reaches a selected position in a forward movement, for

opening said valve operating circuit while said relay is energized and continues energized.

43. In a hydraulic system, a working member, a main ram and a pullback ram connected to said member for reciprocating it, a continuously operating, reversible delivery pump, a source of operating fluid, means including said source, pump and rams and forming a hydraulic circuit by which said member may be reciprocated by transferring operating fluid from one ram to the other, said means including a connection from said source to each ram and to said pump at the side connected to said pullback ram, said connection having a valve therein for passing fluid towards said pump and preventing reverse flow, valve means for preventing direct reverse fluid flow from said pull-back ram to said pump, but passing fluid from said pump to said pullback ram, means for reversing said pump to transfer fluid in either direction between said rams, means operable by said member, when said member reaches a desired position in a retraction movement, for operating said pump reversing means and concomitantly by-passing fluid from said pump around said main ram to hold said member in retracted position, and means selectively operable to discontinue the by-passing of fluid when a forward movement of said member is desired.

44. In a hydraulic motor system, a working member, means including continuously operating, reversible pumping means and a hydraulic circuit for operating said member in forward and retraction strokes, depending upon the direction of delivery of said means and the condition of said circuit, and means responsive to the travel of said member in a retraction stroke for automatically reversing said pumping means in a manner to set it for causing a forward movement of said member and for automatically and concurrently stopping said working stroke.

45. In a hydraulic motor system, a working member, a source of operating fluid hydraulic rams connected to and operating said member in both directions, a hydraulic circuit, having connections between said rams and said source, a reversible pump forming part of said circuit for transferring operating fluid in alternate directions between said rams and thereby causing movements of said member alternately in a working stroke and a retraction stroke, depending upon the direction of delivery of said pump, valve means in said connections for altering said circuit to connect said rams alternately with said source and thus also control the travel of said member, means for forcibly operating said valve means to connect the other ram to said source and operable normally at each reversal of delivery of said pump to aid in the control of the direction of travel of said member, and means responsive to the travel of said member during a retraction stroke for automatically reversing said pump to cause a working stroke of said member while said valve means remains concurrently in unchanged condition in which said valve means connects said source to the ram causing the working stroke, thereby stopping and holding said member in retracted position, with the pump delivering idly in the direction it operates when causing a working stroke of said member.

46. In a hydraulic motor system, a working member, a source of operating fluid, a main ram for causing a working stroke of said member, a retraction ram for returning said member, a hydraulic circuit including said rams and having connections between said rams and said source,

means including a pump forming part of said circuit for transferring operating fluid between said rams in alternate directions and operable at will to reverse the direction of transfer and thereby normally cause movement of said member in alternate directions, valve means in said connections and operable to connect said rams to said source alternately, means outside of said circuit for forcibly operating said valve means to change the ram which is connected to said source and thus release operating fluid supplied to one ram or the other depending upon the condition of operation of said valve means, means normally operating said outside means and reversing the direction of delivery of said pump means concurrently to reverse the direction of travel of said member, and means responsive to the travel of said member during a retraction movement thereof, for automatically reversing the direction of delivery of said pump means while said valve means remains concurrently unchanged in which it connects said source to the main ram, thereby by-passing the fluid delivered to the main ram back towards said source, whereby said member remains unmoved by said operating fluid.

47. In a hydraulic motor system, a working member, means including a hydraulic circuit for operating said member in opposite directions and including means for causing a reversal in the direction of travel of said member, means responsive to pressure in the hydraulic circuit, while said member is being operated in one direction, for causing a reversal in the direction of travel of said member automatically after said pressure reaches a predetermined pressure, and means effective concurrently with said pressure responsive means and including an element operated by said member whenever said member reaches a predetermined position in its travel in said one direction, for altering said hydraulic circuit to stop further travel of said member and automatically holding it in that position.

48. In a hydraulic press, a working member, means including a hydraulic circuit for operating said member in opposite directions, in one of which directions it presses an object, means responsive to the pressure of said member on said object while operating on said object, for stopping movement of said member in a pressing direction, when said pressure reaches a predetermined pressure, and holding it at that pressure on said object, and normally inactive timing means set in operation automatically by said pressure responsive means solely after said predetermined pressure has been reached, and operable to cause a movement of said member in the opposite direction away from said object, a predetermined interval of time after said predetermined pressure on said object has been reached.

49. In a hydraulic press, a working member, means including a variable delivery pump for actuating said member to press an object and also operable to retract said member, means for setting said pump automatically to approximately neutral delivery position when the pressure on said object reaches a predetermined pressure, so as to hold that pressure on said object, and timing means set in operation automatically by said pump setting means as the pump is set for approximately neutral delivery, and operable to cause a retraction of said member a predetermined interval of time after said timing means is set in operation.

THOMAS F. STACY.