July 29, 1941. H. W. LANDENBERGER 2,250,539

HYDRAULIC CONTROL DEVICE

Filed March 15, 1938 2 Sheets-Sheet 1

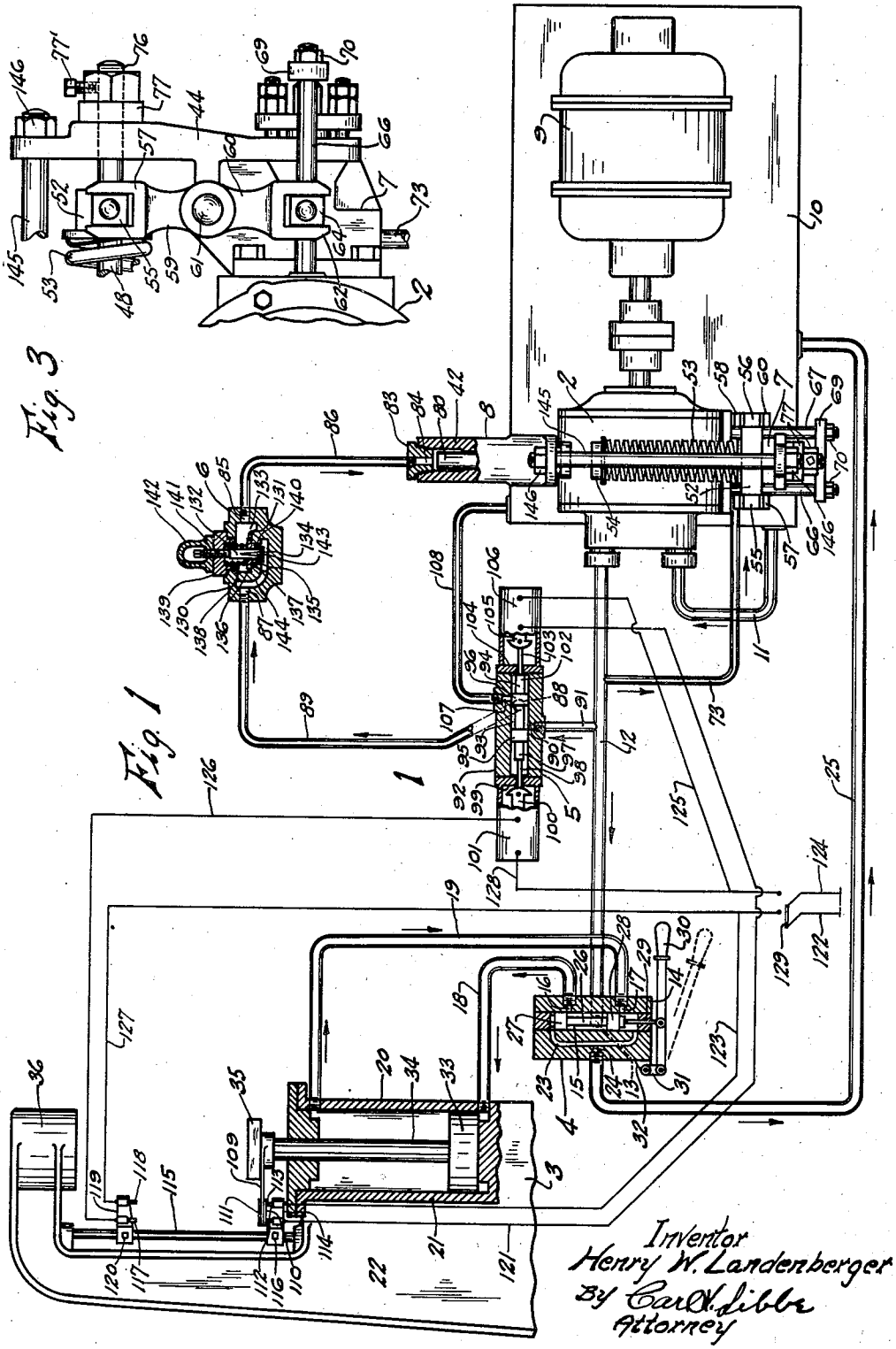


Fig. 3

Fig. 1

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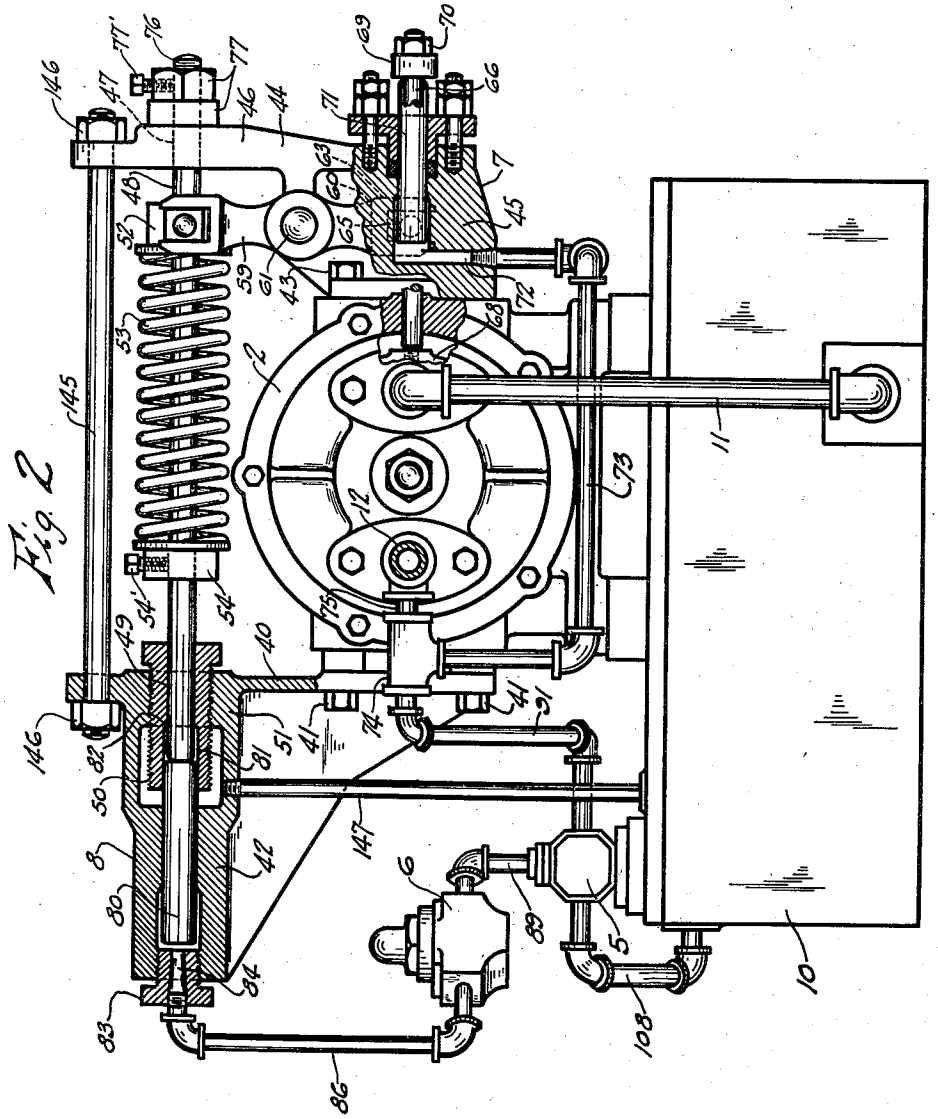


Fig. 2

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HYDRAULIC CONTROL DEVICE

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10 Claims. (Cl. 103—38)

This invention relates to hydraulic control devices, and more particularly to devices for controlling the pressures developed by pumps.

One object of the present invention is to provide in a fluid system including a variable stroke pump, adjustable control means adapted to condition the pump for operation at any one of a wide range of initial predetermined pressures, to then condition the pump for operation at any one of a wide range of different predetermined pressures, and thereafter to cause a gradual change in pressures developed by said pump until the initial predetermined pressure has been attained.

Another object is to provide control means for pumps of the stated character, including adjustable resilient means adapted to condition the pump for operation at any one of a wide range of predetermined pressures, and adjustable fluid pressure means operable upon said resilient means for conditioning the pump for operation at any one of a wide range of different predetermined pressures.

A further object is to provide a control mechanism for pumps of the stated character including a novel arrangement of valves, one of which permits free flow of fluid in one direction, but restricted flow in the reverse direction.

A further object is to provide in a fluid system including a pump and a motor, control means adapted to condition the pump for operation at any one of a wide range of initial pressures during a portion of the travel of said motor in one direction, to then condition said pump for operation at any one of a wide range of different predetermined pressures, and when said motor reaches its limit of travel to gradually reduce the pressures developed by said pump until the initial predetermined pressure has been attained.

A further object is to provide in a fluid system including a pump and a motor, a control device including a novel arrangement of the automatically operable valves which enables operation of the pump at a wide range of predetermined pressures.

Other and further objects will become apparent as the description of the invention progresses.

Of the drawings:

Fig. 1 is a general assembly view, diagrammatic in part, of the fluid control device comprising the present invention, several of the elements thereof being shown in section.

Fig. 2 is a side elevational view partly in section of the pump and the control means therefor, certain of the parts being broken away to show certain of the elements thereof, and

Fig. 3 is a fragmentary view of one end of the pump and certain of the control elements associated therewith.

Referring to the drawings, the numeral 1 designates generally the fluid system which in the present instance comprises a pump 2, a hydraulic press 3, press control valve 4, pump control valves 5 and 6, and fluid motors 7 and 8.

Pump 2 may be of the radial piston type shown and described in Patent No. 1,077,979, and may be operated by an electric motor 9 or by any other suitable power means. Pump 2 and motor 9 are suitably mounted upon a supply tank 10 from which fluid is drawn into the pump 2 through a pipe 11. The fluid so drawn into pump 2 is discharged therefrom through a pipe 12. Pipe 12 is connected at one end thereof to the inlet port 13 of press control valve 4. Valve 4 comprises a casing 14 having a cylindrical chamber 15 provided therein which at all times is in communication with inlet port 13. Chamber 15 also communicates with a pair of spaced ports 16 and 17 to which are respectively connected one end of a pair of pipes 18 and 19. The other ends of pipes 18 and 19 are connected to the lower and upper ends respectively, of the cylinder 20 of a fluid motor 21 secured in any suitable manner to the frame 22 of hydraulic press 3. The opposite ends of chamber 15 are connected by a passage 23 provided in casing 14 which in turn communicates with a discharge port 24. Discharge port 24 is connected to supply tank 10 by means of a pipe 25. Operating in chamber 15 of valve 4 is a valve element 26 comprising a pair of spaced interconnected valve heads 27 and 28. A valve stem 29 is connected to valve head 28 and extends through the lower end of casing 14. The free end of valve stem 29 is pivotally connected to a lever 30 intermediate the ends of the latter. Lever 30 is pivoted at one end thereof to the lower end of a link 31, the other end of said link being pivotally mounted on an ear 32 secured to and extending laterally from the lower end of casing 14. When lever 30 is in the full line position shown in Fig. 1, the fluid from pump 2 flows to the lower end of cylinder 20 through pipe 12, port 13 of valve 4, chamber 15, port 16 and pipe 18. The piston 33 operating in cylinder 20 is therefore moved upwardly. The fluid at the upper end of cylinder 20 now discharges to exhaust through pipe 19, port 17, the lower end of chamber 15, passage 23, and pipe 25. When lever 30 is moved to the dotted

line position shown in Fig. 1, the fluid entering chamber 15 of valve 4 flows through port 17 and is conducted to the upper end of cylinder 20 by pipe 19, thereby causing the piston 33 to descend. The fluid at the lower end of cylinder 20 now flows to supply tank 10 through pipe 18, port 16, the upper end of chamber 15, passage 23 and pipe 25. Piston 33 has secured thereto a piston rod 34, to the upper end of which is secured a platen 35. Consequently when piston 33 is moved upwardly platen 35 is actuated toward the work which may be attached to the head 36 of press 3. The head 36, as shown in Fig. 1, is secured to the upper end of the frame 22 and extends laterally therefrom.

The present invention contemplates a control device which enables operation of the pump at a relatively low predetermined pressure at which pressure the press platen begins its initial movement toward the work. When the platen engages the work the pressure in the system builds up to a higher value. The present invention further contemplates means for maintaining a predetermined higher pressure in the system and to thereafter gradually reduce the pressure until the initial, relatively low, predetermined pressure has been reached. The control mechanisms for accomplishing these results will now be described in detail.

Referring more particularly to Fig. 2, it will be observed that a bracket 40 is secured to the left hand side of pump 2 by any suitable means, such as by bolts 41. The upper end of bracket 40 has provided therein the cylinder 42 of fluid motor 8. Secured to the opposite side of pump 2 by bolts 43 is a second bracket 44. The lower end of this bracket has formed therein the cylinder 45 of the fluid motor 7. The vertical extension 46 of bracket 44 has provided therein a horizontally disposed aperture 47 through which extends a rod 48. The left hand end of rod 48 extends through the central bore 49 of a nut 50 which makes threaded engagement with the enlarged portion 51 of cylinder 42. Rod 48 has slidably mounted thereon a crosshead 52 against which one end of a coil spring 53 abuts. Spaced from crosshead 52 and secured to rod 48 by any suitable means, such as a screw 54', is an adjustable spring seat 54 against which the other end of spring 53 abuts. Crosshead 52 has provided at the opposite ends thereof a pair of rectangular guide blocks 55 and 56, which respectively receive the upper bifurcated ends 57 and 58 of a pair of levers 59 and 60. Levers 59 and 60 are pivoted intermediate their ends on a rod 61, mounted in any suitable manner in bracket 44. The lower bifurcated ends 62 and 63 of levers 59 and 60 engage a pair of substantially rectangular bearing blocks 64 and 65 pivotally mounted on guide rods 66 and 67, respectively. The left hand ends of guide rods 66 and 67 are secured to the sliding blocks 68 of pump 2, while the right hand ends thereof are secured in any suitable manner to a crosshead 69, such as by nuts 70, engaging the outer threaded ends of said guide rods. Cylinder 45 of fluid motor 7 has operating therein a piston 71, the right hand end (Fig. 2) of which engages the inner side of crosshead 69 at a point substantially midway between guide rods 66 and 67. The left hand end of cylinder 45 communicates with a substantially vertical port 72 provided in the lower end of bracket 44, and to which one end of a pipe 73 is connected. The other end of pipe 73 is connected to pipe 12 by means of a T coupling 74, and a short pipe 75.

The portion of rod 48 extending beyond the right hand side of bracket 44 is provided with screw threads 76 for receiving a pair of correspondingly threaded nuts 77. It therefore is apparent that to adjust the tension of spring 53 it is only necessary to adjust the nuts 77 which causes an axial movement of rod 48. After proper adjustment of spring 53 the nuts 77 may be held against accidental movement by a set screw 77', or by any other suitable means. If the nuts 77 are so adjusted as to cause rod 48 to move to the right, spring seat 54 will tend to compress spring 53. The pressure thus created in spring 53 tends to slide crosshead 52 to the right which in turn swings levers 59 and 60 in a clockwise direction about their pivot 61. This action of levers 59 and 60 causes the sliding blocks 68 of pump 2 to move to the left by virtue of the connection thereof with guide rods 66 and 67. The sliding blocks 68 of pump 2 will remain in adjusted position until the pressure imposed upon the left hand end of piston 71 exceeds the pressure of spring 53. When this occurs piston 71 will move to the right, thereby actuating crosshead 69, guide rods 66 and 67, and consequently the sliding blocks 68 to leakage stroke position.

The cylinder 42 of fluid motor 8 also has operating therein a piston 80. The right hand end of piston 80 extends into the enlarged bore 81 at the left hand end (Fig. 2) of nut 50, and is adapted to engage the left hand end of rod 48. It will be noted that the diameter of piston 80 is greater than that of rod 48, and that the movement of piston 80 to the right is limited by the annular shoulder 82 at the right hand end of bore 81. It therefore is seen that when piston 80 is subjected to pressure it tends to move to the right and thereby compresses spring 53. By adjusting nut 50 the extent of movement of piston 80, and consequently the degree of compression of spring 53, may be varied. Motor 8 is also connected to the pressure side of pump 2 by means of a series of connections which will now be described in detail.

Cylinder 42 of motor 8 has secured to the left hand end thereof a plug 83 having a central port 84 provided therein. The outer end of port 84 is connected to the port 85 of valve 6 by means of a pipe 86. The port 87, at the opposite side of valve 6, is connected to the intermediate port 88 of valve 5 by means of a pipe 89. The inlet port 90 of valve 5 is connected to the T coupling 74 by means of a pipe 91. Thus when the valves 5 and 6 are in the proper position of adjustment, fluid under pressure from pump 2 is conducted to the end of motor 8, through pipes 12, 91, valve 5, pipe 89, valve 6, pipe 86 and port 84.

Referring more particularly to Fig. 1, it will be observed that valve 5 comprises a casing 92 having a substantially cylindrical chamber 93 provided centrally thereof. Mounted in chamber 93 is a valve element 94 comprising a pair of spaced interconnected valve heads 95 and 96. Valve head 95 has secured thereto a reduced extension 97 to the outer end of which is secured a further reduced valve stem 98. Valve stem 98 extends through and is guided in an aperture provided in the left hand end wall 99 of casing 92, and the outer end thereof is secured to the core 100 of a solenoid 101. Valve head 96 has also secured thereto a reduced extension 102 to the outer end of which is secured one end of a further reduced valve stem 103. Valve stem 103 extends through and is guided in an aperture pro-

vided in the right hand end wall 104 of casing 92 and the right hand end thereof is secured to the core 105 of a solenoid 106. Valve 5 also has provided therein a port 107 which is connected to supply tank 10 by means of a pipe 108.

As shown in Fig. 1, piston rod 34 has secured thereto an arm 109 constructed of any suitable insulating material. The left hand end of arm 109 has provided at the lower side thereof a contact plate 110, and at its upper side a second contact plate 111. Lower contact plate 110 is adapted to engage a pair of contact elements 112 and 113 secured to a bracket 114 mounted on a vertically disposed rod 115 secured in any suitable manner to the press frame 22. Bracket 114 may be adjusted vertically and held in any position of adjustment by a set screw 116. The upper contact plate 111 is adapted to engage a second pair of contact elements 117 and 118 secured to a second bracket 119 also mounted on rod 115. Bracket 119 may also be adjusted vertically and held in any position of adjustment by means of a set screw 120. Contact 112 is connected to one end of solenoid 106 by a conductor 121. Contact 113 on the other hand is connected to a bus bar 122, leading from any suitable source of electric power, by a second conductor 123. The other end of solenoid 106 is connected to the other of the bus bars 124 by a third conductor 125.

Contact 117 is connected to one end of solenoid 101 by conductor 126, while contact 118 is connected to bus bar 122 by a second conductor 127. The other end of solenoid 101 is connected to bus bar 124 by a third conductor 128. The circuit just described may be closed or interrupted by means of a switch 129. It therefore is seen that when switch 129 is closed and the parts are in the position shown in Fig. 1, the circuit to solenoid 106 is closed, thereby causing actuation of the valve 94 to the right. The movement of the valve 94 to the right is limited by the end of the extension 102 abutting the end wall 104 of the valve casing. When the parts are in this position fluid from pipe 12 enters the central chamber 93 of valve 5 between valve heads 95 and 96 through pipes 91 and port 90. From chamber 93 the fluid then flows through port 88 and into pipe 89, which conducts it to the port 87 of valve 6.

If valve 4 is adjusted to the position shown in Fig. 1, fluid also enters the lower end of cylinder 20 causing the piston 33 to move upwardly. As soon as piston 33 begins its upward movement contact plate 110 moves out of engagement with contact elements 112 and 113, thereby interrupting the circuit to solenoid 106 of valve 5. Valve element 94, however, being of the balanced type, remains in adjusted position. When the platen 35 reaches its upper limit of travel contact plate 111 engages contacts 117 and 118, thereby closing the circuit to solenoid 101. When this occurs valve element 94 is actuated to its left hand position of adjustment whereby the fluid entering chamber 93 is trapped between valve heads 95 and 96. Fluid from motor 8, as will more fully appear hereinafter, may then flow to exhaust through pipe 86, valve 6, pipe 89, port 88, the left hand end of chamber 93, port 107 and pipe 108.

The valve 6 is of the type which permits substantially free flow of fluid in the direction of the arrows in Fig. 1, but restricted flow in the reverse direction and comprises a casing 130 having a pair of relatively movable valve elements 131 and 132 provided therein. Casing 130 has provided therein an enlarged central chamber 133 and a lower chamber 134, the two chambers being connected by a circular central passage 135. Valve element 131 is provided with an annular flange 136 at the upper end thereof, which, when in its lower position, rests upon a valve seat 137. Valve 131 is normally held upon its seat 137 by a coil spring 138, which extends between the upper surface of said valve and an adjustable plug 139, making threaded engagement with an aperture provided in the upper end of casing 130. Valve 131 is also provided with a central bore 140 through which the lower end of valve element 132 extends. The portion of valve 131 which extends through passage 135, it will be noted, is tapered, thus when said valve is moved upwardly fluid from chamber 134 may pass around the outer surface thereof and into chamber 133.

The upper end of valve element 132 has secured thereto a threaded shank 141 which engages the correspondingly threaded central bore of plug 139. Thus, valve element 132 may be raised or lowered by simply turning the shank 141 thereof. To prevent accidental movement of valve element 132, a protective cap 142 is provided over the end thereof and secured to the shank 141 by making threaded contact therewith. Valve element 132 has provided therein a wedge-shaped slot 143 through which fluid from chamber 133 may pass to chamber 134. The rate at which fluid may pass through slot 143 depends upon the position of valve 132. When the valve is in its lowermost position substantially no fluid can pass through the valve. However, as the valve element 132 is elevated, progressively greater quantities of fluid may pass therethrough. The lower chamber 134 of valve 6 is connected to port 87 by a passage 144. Consequently the fluid entering valve 6 through port 87 will now flow to chamber 134 through passage 144. The fluid pressure so entering valve 6 now operates against the lower end of valve element 131, thereby lifting the same from its seat and permitting a substantially free flow of fluid through passage 135 to chamber 133. From chamber 133 the fluid flows through port 85 to pipe 86, which conducts it to cylinder 42 of motor 8. If the fluid pressure so directed against the end of piston 80 is sufficient to overcome the pressure exerted by spring 53 the said piston moves to the right (Fig. 2), thereby further compressing spring 53. Piston 80 moves to the right until the end thereof engages the annular shoulder 82 provided in the adjustable nut 50. When valve element 94 is shifted to the left by the action of solenoid 101, cylinder 42 of motor 8 is disconnected from pump 2 and connected to exhaust as previously described. Valve element 131 is now closed by the action of spring 138, as well as the pressure in chamber 133. The fluid entering chamber 133 from cylinder 42 now leaks into chamber 134 through the slot 143 provided in valve element 132, and then flows to exhaust through passage 144, port 87, pipe 89, port 88, the right hand end of chamber 93, port 107 and pipe 108.

When the pressure operating on piston 80 of fluid motor 8 is relieved, spring 53 moves rod 48, and consequently piston 80 to the left until the parts assume their initial position of adjustment. This action of the spring 53 upon the parts forces the fluid through valve 6 in the manner just described. Due to the restricted flow of fluid through valve element 132, a re-

tarded action results, and consequently the pressure developed by pump 2 gradually decreases until the predetermined pressure resulting from the initial setting of the parts is obtained. To prevent movement of brackets 40 and 44 away from each other under the higher pressure conditions in the system, a tie rod 145 is provided. This tie rod extends through apertures provided in the upper ends of brackets 40 and 44, and is secured thereto by nuts 146, as shown in Figs. 1 and 2. As shown more particularly in Fig. 2, any leakage of fluid past piston 80 drains to supply tank 10 through a pipe 147.

From the foregoing description it is thought that the operation of my improved hydraulic control device is apparent. However, in order to correlate the various elements thereof a brief résumé of the operation of the apparatus as a whole will now be given.

Fig. 1 shows the parts in normal position wherein the piston 33 and platen 35 are in their lower position of adjustment. Brackets 114 and 119 are now adjusted vertically to suit the size of the materials to be placed in the press 3. When piston 33 is in its lower position of adjustment, the contact plate 110 is in engagement with contact elements 112 and 113, thereby completing the circuit to solenoid 106. Nuts 77 are now adjusted to compress spring 53 to condition the pump for operation at the desired predetermined initial pressure. This causes actuation of levers 59 in a clockwise direction, which in turn through their connection with rods 66 and 67 actuate sliding blocks 68 of the pump to on-stroke position. Nut 59 is then adjusted the proper amount to enable further compression of spring 53 by piston 80. Valve element 132 of valve 6 is also adjusted to regulate the rate of discharge therethrough. Lever 30 is then moved to the full line position shown in Fig. 1.

The preliminary adjustments to the apparatus having been completed, switch 129 is now closed, thereby completing the circuit to solenoid 106 and causing operation of valve element 94 to its right hand position of adjustment, as shown in Fig. 1. Fluid now is drawn into pump 2 upon operation thereof by motor 9 from supply tank 10 through pipe 11, and is discharged therefrom through pipe 12. Fluid then enters the central chamber 15 of valve 4 through port 13 and then flows through port 16, and pipe 18, to the lower end of cylinder 20, causing piston 33, and consequently platen 35 to move upwardly toward the work. The fluid in cylinder 20, above piston 33, now passes to supply tank 10 through pipe 19, port 17, of valve 4, the lower end of chamber 15, passage 23, port 24, and pipe 25. Upon movement of piston 33 upwardly contact plate 110 moves out of engagement with contact elements 112 and 113 thereby interrupting the circuit to solenoid 106. Valve 5 being of the balanced type, however, remains in adjusted position. Fluid from pipe 12 also passes through pipe 91, port 90 of valve 5, to the central chamber 93 thereof, and then discharges from chamber 93 to port 88, and enters port 87 of valve 6 through pipe 89. The fluid entering port 87 of valve 6 passes through passage 144 to chamber 134 and operates against the lower surface of valve element 131, causing the latter to move upwardly away from its seat against the tension of spring 138. The fluid now passes to the central chamber 133 through the communicating passage 135 and then flows through port 85 and into pipe 86 which conducts it to the end of cylinder 42 of fluid motor 8.

As the platen 35 engages the work, the pressure in the system increases, and when this pressure operating on the end of piston 80 exceeds the compression of spring 53 piston 80 moves to the right, causing further compression of spring 53. Piston 80 continues its movement to the right until the right hand end thereof (Fig. 2) engages the annular shoulder 82 of nut 50. Pump 2 is now conditioned to operate at a higher predetermined pressure. The pressure in the system is also delivered to the left hand end (Fig. 2) of fluid motor 7 through pipe 73, and when this pressure exceeds the pressure of spring 53 piston 71 actuates crosshead 69, and consequently the sliding blocks 68 of pump 2 to leakage stroke position. The relatively high predetermined pressure is thus maintained at a constant value.

As platen 35 reaches its upper limit of travel, contact plate 111 engages contact elements 117 and 118, thereby completing the circuit to solenoid 101, which actuates valve element 94 to its left hand position of adjustment.

Fluid from pump 2 entering the central chamber 93 of valve 5 through pipes 12 and 91 is now trapped between valve heads 95 and 96. When valve element 94 is adjusted to this position, valve head 96 uncovers port 88 of valve 5 whereby the said port now communicates with the right hand end of chamber 93, which in turn is connected to supply tank 10 by pipe 108. Cylinder 42 of motor 8 is now connected to exhaust, the fluid therein discharging through port 84, pipe 86, port 85, to the central chamber 133 of valve 6. The fluid then flows through the slot 143 of valve element 132 and into lower chamber 134.

The rate at which fluid discharges through slot 143 depends upon the initial setting of valve element 132. The fluid entering chamber 134 then flows through passage 144, port 87, pipe 89, port 88, to the right hand end of chamber 93 of valve 5 from which it discharges to supply tank 10 through port 107 and pipe 108. Valve element 132 acts as a check valve to prevent a rapid discharge of the fluid from motor 8, and consequently producing a rapid reduction in the pressure delivered by pump 2. By providing this check on the fluid the pressure developed by pump 2 is gradually reduced until the spring 53 has urged piston 80 to its left hand position of adjustment (Fig. 2) at which time the pump delivers fluid pressure in accordance with the initial setting of spring 53 by the adjustment of nut 77. This initial pressure is maintained by motor 7 which, it will be remembered, is connected to the pressure side of pump 2 by pipe 73. Should the pressure tend to exceed this predetermined value piston 71 moves to the right to adjust the element 68 toward leakage stroke position, as hereinbefore described. When platen 35 has completed its work upon the materials, the operator actuates lever 30 of valve 4 to the dotted line position shown in Fig. 1, whereupon fluid discharging from pump 2 through pipe 12 now flows from central chamber 15 of valve 4 through port 17, and is conducted to the upper end of piston 33 by pipe 19, whereupon the said piston 33, as well as platen 35, descend. The materials may now be removed from the press.

Upon movement of piston 33 downwardly contact plate 111 moves out of engagement with contact elements 117 and 118, thereby interrupting the circuit to solenoid 101. Valve ele-

ment 94, however, remains in the last position of adjustment. The fluid at the lower end of cylinder 20 now passes to supply tank 10 through pipe 18, port 16, the upper end of chamber 15 of valve 4, passage 23, port 24 and pipe 25. When the piston 33 reaches its lowermost position, contact plate 110 again engages contact elements 112 and 113, whereupon valve element 94 of valve 5 is urged to the position shown in Fig. 1 by the action of solenoid 106. The operator then swings lever 30 of valve 4 to the full line position shown in Fig. 1, whereupon fluid from pump 2 is now delivered to the lower end of piston 33, and the cycle of operation just described is repeated.

From the foregoing description it is apparent that a simplified, as well as highly efficient control device has been provided. The various adjustable features associated with the device enable operation thereof through a wide range of pressures. The device therefore may be employed for various uses wherein such variable pressures are desired.

While the embodiment herein shown and described is admirably adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to limit the invention thereto, since it may be embodied in other forms, all coming within the scope of the claims which follow.

What is claimed is:

1. In a device of the class described, the combination of a variable stroke pump, control means including manually adjustable pressure means for placing said pump on stroke, means connected to the pressure side of said pump and operating in opposition to said pressure means for returning said pump to leakage stroke position when the pressure acting thereon exceeds that of said pressure means, and power means operable upon said pressure means for changing the initial adjustment of the latter whereby said pump is maintained on stroke at a different predetermined pressure.

2. In a device of the class described, the combination of a variable stroke pump, control means including manually adjustable pressure means for placing said pump on stroke, means connected to the pressure side of said pump and operating in opposition to said pressure means for returning said pump to leakage stroke position when the pressure acting thereon exceeds that of said pressure means, power means operable upon said pressure means for changing the initial adjustment of the latter whereby said pump is maintained on stroke at a different predetermined pressure, and adjustable means for limiting the movement of said power means.

3. In a device of the class described, the combination of a variable stroke pump, control means including an adjustable spring for placing said pump on stroke, a fluid motor connected to the pressure side of said pump and operating in opposition to said spring for returning said pump to leakage stroke position when the pressure acting on said motor exceeds the pressure of said spring, manual means for adjusting said spring whereby said pump may be maintained on stroke at different predetermined pressures, and a second fluid motor connected to the pressure side of said pump and operable upon said spring to change the pressure to which it was originally adjusted by said manual means, whereby said pump is maintained on stroke at a different predetermined pressure.

4. In a device of the class described, the combination of a variable stroke pump, control means including an adjustable spring for placing said pump on stroke, a fluid motor connected to the pressure side of said pump and operating in opposition to said spring for returning said pump to leakage stroke position when the pressure acting on said motor exceeds the pressure of said spring, manual means for adjusting said spring whereby said pump may be maintained on stroke at different predetermined pressures, a second fluid motor connected to the pressure side of said pump and operable upon said spring to change the pressure to which it was originally adjusted by said manual means, whereby said pump is maintained on stroke at a different predetermined pressure, and means for predetermining the extent of movement of said last mentioned motor means.

5. In a device of the class described, the combination of a variable stroke pump, control means including an adjustable spring for placing said pump on stroke, a fluid motor connected to the pressure side of said pump and operating in opposition to said spring for returning said pump to leakage stroke position when the pressure acting thereon exceeds the pressure of said spring, manual means for adjusting said spring whereby said pump may be maintained on stroke at different predetermined pressures, a second fluid motor connected to the pressure side of said pump, said second fluid motor being operable upon said spring to change the pressure to which it was originally adjusted by said manual means, whereby said pump is maintained on stroke at a different predetermined pressure, said second motor comprising a cylinder having a piston operable therein, and means for predetermining the extent of movement of said piston, said last mentioned means comprising an adjustable nut secured to one end of said cylinder and having an opening provided therein for receiving said piston, and stop means provided in said opening for limiting the movement of said piston.

6. In a device of the class described, the combination of a pump, control means for said pump including a spring for placing said pump on stroke, means operating in opposition to said spring for returning said pump to leakage stroke position when the pressure developed by said pump exceeds the pressure of said spring, manual means for adjusting said spring to predetermine the pressures to be developed by said pump, fluid pressure means including a plunger operable upon said spring for changing the initial adjustment thereof whereby operation of said pump is effected at a higher pressure, valve means for controlling the operation of said plunger, said valve means comprising a three-way valve and a flow control valve, said flow control valve comprising elements which permit free flow of fluid to said fluid pressure means when said three-way valve is actuated to one position of adjustment, and restricted flow from said fluid pressure means when said three-way valve is actuated to a second position of adjustment.

7. In a device of the class described, the combination of a pump, control means for said pump including a spring for placing said pump on stroke, means operating in opposition to said spring for returning said pump to leakage stroke position when the pressure developed by said pump exceeds the pressure of said spring, manual means for adjusting said spring to predetermine the pressures to be developed by said pump, fluid

pressure means including a plunger operable upon said spring for changing the initial adjustment thereof whereby operation of said pump is effected at a higher pressure, valve means for controlling the operation of said plunger, said valve means comprising a three-way valve and a flow control valve, said flow control valve comprising elements which permit free flow of fluid to said fluid pressure means when said three-way valve is actuated to one position of adjustment, restricted flow from said fluid pressure means when said three-way valve is actuated to a second position of adjustment, and automatically operable means for actuating said three-way valve to different positions of adjustment.

8. In a device of the class described, the combination of a pump, control means for said pump including a spring for placing said pump on stroke, means operating in opposition to said spring for returning said pump to leakage stroke position when the pressure developed by said pump exceeds the pressure of said spring, manual means for adjusting said spring to predetermine the pressures to be developed by said pump, fluid pressure means including a plunger operable upon said spring for changing the initial adjustment thereof whereby operation of said pump is effected at a higher pressure, valve means for controlling the operation of said plunger, said valve means comprising a three-way valve and a flow control valve, said flow control valve comprising elements which permit free flow of fluid to said fluid pressure means when said three-way valve is actuated to one position of adjustment, restricted flow from said fluid pressure means when said three-way valve is actuated to a second position of adjustment, and electrically operable means for actuating said three-way valve to different positions of adjustment.

9. In a device of the class described, the combination of a pump, control means for said pump including resilient means for placing said pump on stroke, means connected to the pressure side of said pump and operating in opposition to said resilient means for returning said pump to leakage stroke position, means for adjusting said resilient means to predetermine the pressures to be developed by said pump, fluid pressure means connected to the pressure side of said pump and operable upon said resilient means for changing the initial adjustment thereof, means for interrupting the circuit between said pump and fluid pressure means, and a valve for restricting the flow of fluid from said fluid pressure means to exhaust when the circuit is so interrupted whereby said resilient means gradually returns to its initial position of adjustment.

10. In a device of the class described, the combination of a pump, control means for said pump including a spring for placing said pump on stroke, means operating in opposition to said spring for returning said pump to leakage stroke position when the pressure developed by said pump exceeds the pressure of said spring, means for adjusting said spring to predetermine the pressures to be developed by said pump, fluid pressure means operable upon said spring to change the initial adjustment thereof whereby operation of said pump is effected at higher pressure, a fluid circuit connecting said fluid pressure means to the pressure side of said pump, valve means provided in said circuit including a three-way valve and a flow control valve, said three-way valve when adjusted to one position permitting fluid from said pump to pass to said control valve, a pressure actuated valve element provided in said control valve which permits substantially free flow of fluid to said fluid pressure means, means for actuating said three-way valve to disconnect the flow of fluid from said pump to said fluid pressure means, while connecting the latter to exhaust, an adjustable check valve element provided in said flow control valve to restrict the flow of fluid from said fluid pressure means to exhaust, whereby said spring gradually moves to its first position of adjustment causing the pressures developed by said pump to gradually decrease until the first mentioned pressure developed thereby is reached.

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