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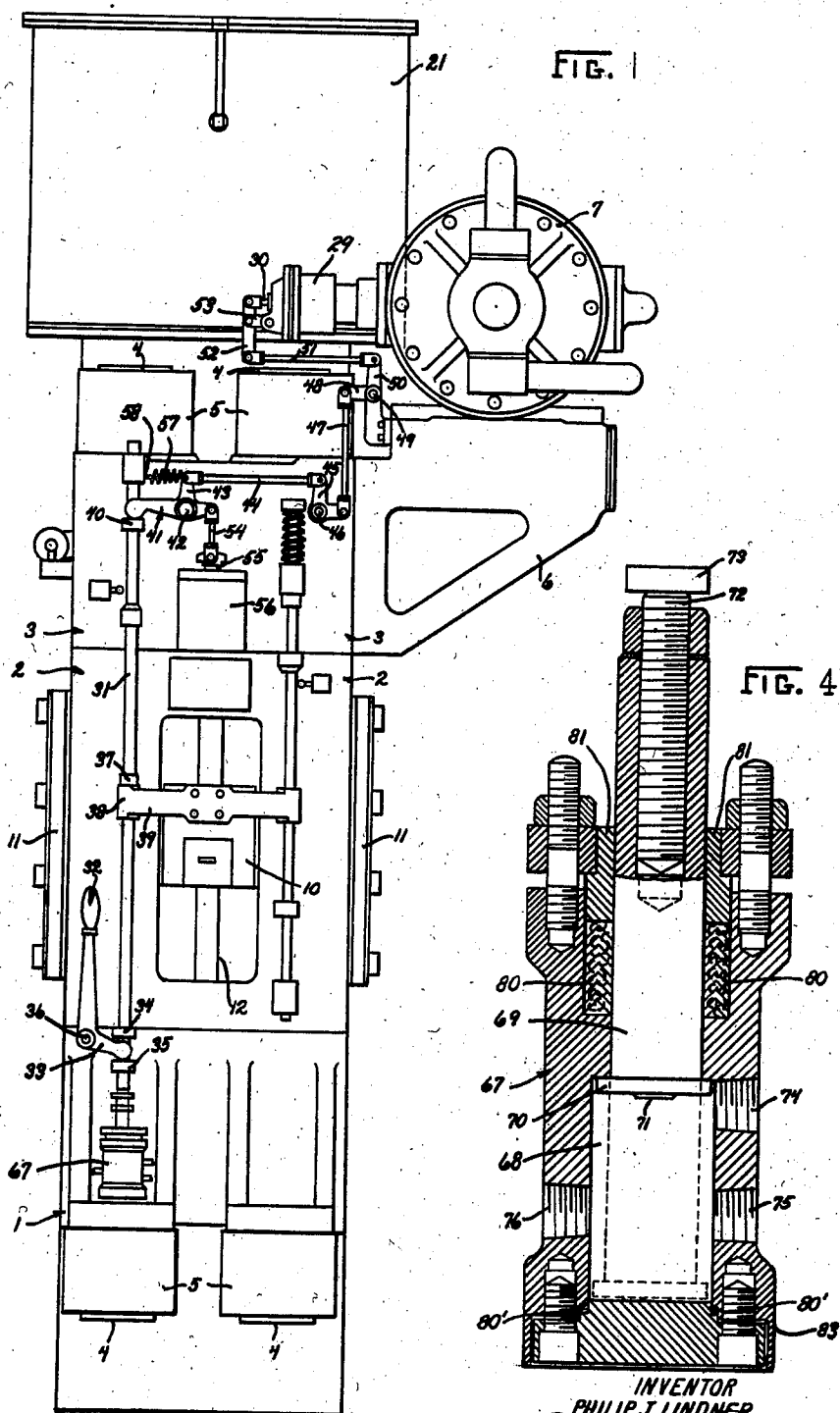
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FLUID OPERATED SLOW-DOWN MECHANISM FOR PRESSES

Filed Jan. 11, 1940

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FIG. 2

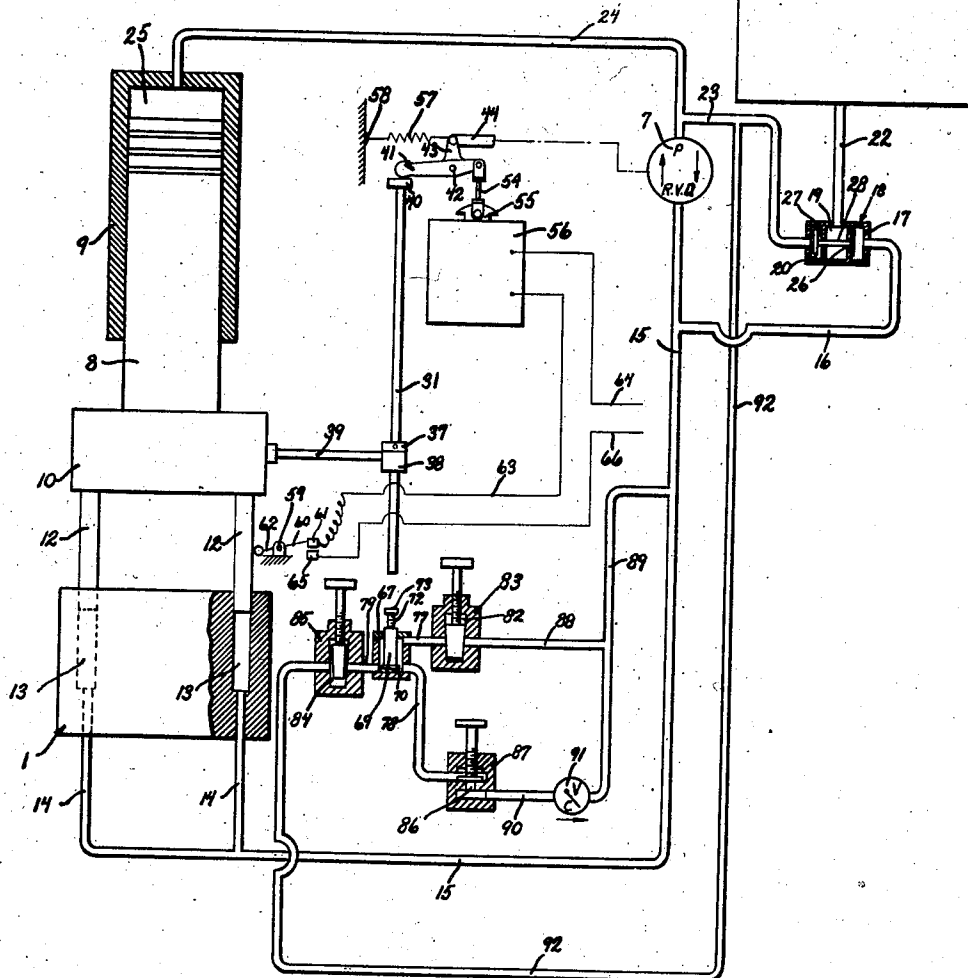
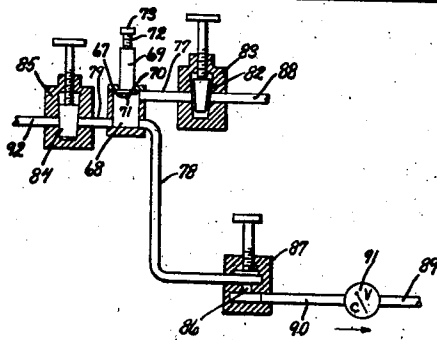


FIG. 3



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2,298,393

FLUID OPERATED SLOW-DOWN MECHANISM FOR PRESSES

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Application January 11, 1940, Serial No. 313,320

9 Claims. (Cl. 60—52)

The present invention relates to presses, and in particular to fluid operated presses, in which at the end of the press operation means are actuated for reversing the movement of the pressing platen.

It is an object of the invention to provide a press of the above type, in which the return movement of the press platen may be slowed down when desired.

Another object of the invention is to provide a press having its press platen returned by fluid operated means, in which the fluid means may be controlled so as to slow down the movement of the press platen during a predetermined portion of its return stroke.

A further object of the invention consists in providing a press having a fluid operated press platen, in which the return movement of the press platen is automatically slowed down at a predetermined position of the press platen.

Still another object of the invention consists in providing a fluid operated press of the character set forth in the preceding paragraphs with controlling means for varying the time of the slow-down operation.

These and other objects and advantages will appear more clearly from the following description in connection with the accompanying drawings in which:

Figure 1 shows a fluid operated press with automatically reversible movement of the press platen as may be used in connection with a slow-down mechanism of the present invention;

Figure 2 diagrammatically illustrates a fluid operated press with the slow-down mechanism of the invention in one position;

Figure 3 shows the slow-down mechanism in another position, and

Figure 4 is, in a somewhat larger scale, a detail of the slow-down mechanism according to the invention.

Referring to the drawings, Figure 1 illustrates a fluid operated press such as is set forth in detail in U. S. Patent No. 2,113,110 and which is therefore described in the present invention only so far as is necessary for a clear understanding of the present invention.

The press as illustrated in the drawings comprises a base 1 joined by side members 2 to the top member 3. These members are connected by the strain rods 4 on which the nuts 5 have been threaded. Secured to the top member 3 is a bracket 6 on which is mounted the main hydraulic pump 7, which operates the main hydraulic plunger 8, (see Figure 2) reciprocating

in the cylinder 9. The plunger 8 is connected to the press platen 10 which reciprocates in guide-ways (not shown) provided in the side members 2, and is retained in position by the retaining members 11 bolted to the side members 2 of the press. Secured to the platen 10 and extending downwardly therefrom are two additional pistons 12 (Figure 2) which are adapted to reciprocate in the cylinder bores 13 of the base 1. The cylinder bores 13 communicate through conduits 14 and 15 with the pump 7 and through a conduit 16 branching off from conduit 15 with a chamber 17 of a valve casing 18. The valve casing 18 comprises two further chambers 19 and 20 of which the chamber 19 communicates with a fluid-filled tank 21 by means of a conduit 22, while chamber 20 communicates through a conduit 23 and a conduit 24 with the cylinder bore 25 of cylinder 9. The valve chamber 19 is adapted alternately to communicate with the valve chamber 17 through an opening 26, and with the valve chamber 20 through an opening 27. The openings 26 and 27 are controlled by a floating double valve 28.

The main pressing plunger 8, reciprocating in the cylinder 9, is caused to act by means of pressure fluid supplied by the main hydraulic pump 7 from the fluid tank 21 at the top of the press. The main hydraulic pump 7 is preferably of the variable delivery type and its discharge may be controlled either by the provision of a reversing valve or by shifting the flow-control element of the pump directly. In the form shown in the drawings, the main pump 7 is provided with a servomotor 29 having a piston-and-cylinder assembly for moving the flow-control element to and fro. The servomotor 29 is supplied with pressure fluid from an auxiliary pump (not shown), and its operation is controlled by means of the servomotor valve rod 30. Thus by moving the servomotor valve rod 30 in or out, the servomotor 29 may be caused to shift the flow-control ring of the main pump 7 in opposite directions and thus change the quantity and direction of the pressure fluid supplied by the main pump 7. The details of this servomotor control system form no part of the present invention and will be found disclosed in the U. S. Patent No. 1,861,116. When the platen 10 is to perform a pressing stroke, the pressure fluid from the main pump 7 is supplied to the main cylinder bore 25. However, when the platen 10 is to perform a return stroke, the pressure fluid from the pump 7 is supplied to the push-back cylinders 13 causing the pistons 12 thereof to raise the platen 10.

The shifting movement of the servomotor valve rod 30 for causing fluid supply either to the main cylinder 9 or push-back cylinders 13 may be controlled in various manners. According to the embodiment shown in Figures 1 and 2, a push rod 31 is reciprocally mounted on the frame of the press. Also mounted upon the press is a hand lever 32 having a crank member 33 adapted to engage the collars 34 and 35 on the push rod 31, and move it upward or downward, as the hand lever 32 is shifted. The hand lever 32 is pivotally mounted on the stub shaft 36. An adjustable collar 37 is attached to the push rod 31 and is adapted to be engaged by a movable sleeve 38 on an arm 39 carried by and connected with the platen 10. The push rod 31 carries a second adjustable collar 40 abutting one end of a lever 41 which is shiftable about the stub shaft 42 and is also provided with a crank 43. The crank 43 is connected by a link 44 to an arm or a bell crank 45 shiftable about the stub shaft 46. The opposite arm of the bell crank 45 is connected by a link 47 to a crank 48 shiftable about the stub shaft 49. Rigidly connected with the crank 48 is the crank arm 50 connected by a link 51 to the servomotor valve rocker arm 52 which is pivotally supported upon the floating link 53 mounted upon the housing of the servomotor 29. The lever 41 is furthermore connected by means of a link 54 with the armature 55 of a solenoid 56. The push rod 31 is constantly urged in a downward direction by means of a tension spring 57, one end of which engages the crank arm 43 while the other end of the spring 57 is attached to a fixed point 58.

The motion of the armature 55 is transmitted to the servomotor by means of the lever 54, crank 43, link 44, bell crank 45, link 47, crank 48, crank arm 50, link 51, rocker arm 52, and rod 30. Thus, when the solenoid 56 is energized in the manner described later, the armature 55 moves downward, causing the crank 43 to move in clockwise direction. This motion is transmitted through the bell crank 45 and the subsequent mechanism to the servomotor rocker arm 52, causing the servomotor control valve rod 30 to move inward to the right. When the solenoid 56 is de-energized, its armature 55 moves upward, causing the servomotor control valve rod 30 to move outward to the left, by means of the previously mentioned links and levers.

It is obvious that instead of the servomotor control valve rod 30 being thus operated by the solenoid 56, a reverse valve for the pump 7 may be similarly operated to reverse the direction and vary the quantity of the pressure fluid being delivered by the main pump 7 to the main piston 8.

The energization of the solenoid 56 may, for instance, be effected as illustrated in Figure 2, wherein a switch 59 is provided with an arm 60 having a contact 61, and with a second arm 62 adapted to be engaged and shifted downward by the platen 10 when the latter has reached a predetermined position. The contact 61 is connected by the conductor 63 with one terminal of the solenoid 56 while the other terminal of the solenoid is connected with the main line 64. When the switch 59 is in closed position, the contact 61 engages a fixed contact 65 which is connected with the main line 66, so that current flows from the line 66 through contacts 65 and 61 and line 63 through the solenoid 56 and from there to the main line 64. When the platen 10 shifts arm 62 of the switch 59 downward, the

contacts 61 and 65 disengage and remain disengaged until the operator closes the switch.

If a full automatic operation of the press is desired, the switch 59 may be closed at the end of the return stroke in any desired manner, for instance by a lever system which is operated by the platen or the push rod 31 when the main piston 8 has reached its uppermost position. When the contacts 61 and 65 are disengaged, the solenoid 56 is de-energized so that the spring 57 moves the lever 41 in anticlockwise direction, thereby pushing the push rod 31 downward and shifting the servomotor valve rod 30 toward the left thereby putting the pump on stroke in the opposite direction and reversing the press movement.

It will readily be seen that this action of reversal takes place in the time that is necessary for the spring 57 to move the push rod 31 downward. This movement of the push rod 31 may be so rapid that the sudden reversal may cause damage to the workpiece, particularly when drawing shells of very thin section. The sudden reversal of the platen may cause a tearing of the shell wall in its thin section around the mouth of the shell. To overcome this difficulty, a slow-down cylinder 67 is attached to the press frame just below the lower end of the push rod 31. The slow-down cylinder 67, which is shown in detail and in a somewhat larger scale in Figure 4, comprises a bore 68 in which a plunger 69 is movably mounted. The plunger 69 comprises a flange 70 at the lower end thereof and a hub 71 at the bottom of the flange 70, for spacing the flange 70 from the bottom of the bore 68 when the plunger 69 has reached its lowermost position. The upper end of the plunger 69 is provided with a thread engaged by an adjustable screw 72. The screw 72 has a head 73 adapted to engage the lower end of the push rod 31. The head 73 is adjustable so that the distance between the head and the lower end of the push rod 31 may be adjusted in accordance with the desired operating conditions.

The cylinder 67 is provided with three tapped bores 74, 75 and 76 to which are connected conduits 77, 78 and 79 respectively for introducing liquid into the bore 68 and withdrawing the same therefrom. A packing 80 associated with a gland 81 is provided at the upper end of the cylinder 67 to prevent leakage of fluid therefrom. Similarly, gasket 80' is provided for preventing leakage from the bore 68 at the bottom thereof. The conduit 77 leads to a tapered bore 82 of a choke valve 83. Similarly, conduit 79 leads to a tapered bore 84 of a choke valve 85. The conduit 78 is adapted to effect communication between the bore 68 of the slow-down cylinder 67 and a chamber 86 of a shut-off valve 87. Conduits 88 and 89 are provided for effecting communication between the tapered bore 82 of the choke valve 83 and the conduit 15, while a conduit 90 is adapted to effect communication between the chamber 86 of the shut-off valve 87 and the conduit 15. A check valve 91 is provided in the conduit 90 which allows a flow of liquid only in the direction indicated by the arrow A and opens as soon as there is a suction effect in the lines 89 and 15 while pressure prevails in the bore 68 of the slow-down cylinder. In this instance, pressure fluid may quickly escape from the bore 68 of the slow-down cylinder 67 into the line 89. A conduit 92 leads from the bore 84 of the choke valve 85 to the conduit 23.

Operation

If it is desired to slow down the press at the beginning of the return stroke, the choke valve 83 and the shut-off valve 87 are closed while the choke valve 85 is open as indicated in Figure 2. The plunger 69 of the slow-down cylinder is assumed to be in its lowermost position. The operator now closes the electric switch 59 so that current flows from the main line 66 through contacts 65, 61, line 63, through solenoid 56 to the main line 64. This causes energization of the solenoid 56 which attracts its armature 55 and thereby shifts the lever 41 against the thrust of the spring 57 in clockwise direction so as to move the pump 7 from its neutral stroke into working stroke position. As a result, liquid is delivered by the pump 7 through conduit 24 into the cylinder bore 25 above the piston 8 which moves downward by gravity. This liquid is supplemented by liquid from the tank 21 through the conduit 22, the chamber 19, the opening 27 and the conduits 23 and 24. At this time the fluid pressure in the conduit 23, the conduit 92, the chamber 84 of the choke valve 85, the conduit 79 and the bore 86 of the slow-down cylinder 87 will generally not be sufficient to move the plunger 69 upward. However, when the platen 10 contacts the workpiece, pressure starts to build up in the conduits 24, 23 and 92 and eventually causes valve 28 to move toward the right so as to close the opening 27 and to release the opening 26. A portion of the pressure fluid supplied by the pump 7 is now pressed through conduits 23 and 92 into the choke valve 85 and from there into the bore 86 of the slow-down valve and now lifts the slow-down piston 69.

When the platen 10 approaches the end of its working stroke it shifts the lever 62 in anticlockwise direction thereby disengaging contacts 60 and 61, and breaking the circuit through the solenoid 56. This causes the spring 57 to move the lever 41 in anticlockwise direction which normally would move through such an angle that the lever system connected therewith would put the pump on full stroke in the opposite direction. Actually however, at the time the contacts 60 and 61 are disengaged, the plunger 69 has reached its desired upper position in which it engages the lower end of the push rod 31 and has lifted the push rod previously dropped down by its own weight, to such an extent that the collar 40 on the push rod stops the anticlockwise movement of the lever 41 in a position in which the link 44, operatively connected with lever 41, has shifted the pump only slightly beyond its neutral position. Consequently, only a relatively small quantity of liquid is delivered by the pump through conduits 15 and 14 into the push back cylinders 13 with the result that the platen 10 moves very slowly upward. At this time the pressure in conduit 15 acts through the conduit 16 on valve 28, so as to cause the latter to close the opening 18, and to release the opening 27. The liquid past piston 8 may then return from the bore 25 through conduits 24 and 23 into the tank 21. Since the solenoid 56 is de-energized and the pressure past piston 8 is relieved, the spring 57 and the weight of the push rod 31 are sufficient to overcome the liquid pressure acting upon the plunger 69 in the slow-down cylinder 67 so that the slow-down plunger 69 is gradually moved downward while the pump 7 is gradually moved into its desired full delivery position. The liquid past the plunger 69 may escape

through conduits 92, 23 and 22 into the tank 21. It will be clear from the foregoing description that the rate at which the pump is moved to its full delivery position during the return stroke of the platen 10 is dependent on the adjustment of the choke valve 85.

When the platen 10 approaches the end of its return stroke, the sleeve 38 engages the collar 37 on the push rod 31 and lifts the latter so that the lever 41 moves the pump into its initial position. The press is now ready for its next working stroke.

While the above operation refers to cases where the workpiece is stripped from the platen at the beginning of the return stroke, it is sometimes desired to leave the workpiece on the platen and to strip it therefrom only when the platen has cleared the die. In such a case the return stroke of the platen may start at full speed but should be slowed down before the workpiece engages the stripper. To this end the same slow-down device may be used. However, in this instance the choke valve 83 and the shut-off valve 87 are opened while the choke valve 85 is closed. This position is shown in Figure 3.

At the beginning of the working stroke the plunger 69 of the slow-down cylinder is in its upper position as shown in Figure 3, since, during the last return stroke of the plunger 8, it has been forced to that position by pressure acting from the push back cylinders 13 through the conduits 14, 15, 89, 88, choke valve 83 and conduit 77. Pressure cannot escape through the conduit 78, the shut-off valve 87, conduit 90 and check valve 91, since the pressure on check valve 91 is balanced. Similarly, the valve 28 has been moved by the pressure in the conduits 14, 15 and 16 into its left-hand position as indicated in Figure 2. In a manner similar to that described above, the switch 59 is closed so that the solenoid 56 is energized and causes lever 41 to move the pump into position for delivering fluid into the bore 25 of the main cylinder 9. Again liquid from the tank 21 flows through conduit 22, opening 27 and conduits 23 and 24 past the press plunger 8 which now moves downward. Liquid from the push cylinders 13 escapes through the conduits 14 and 15 to the suction side of the pump 7. The suction effect in conduits 14, 15 and 89 causes the check valve 91 to open, so that the liquid in the bore 86 of the slow-down cylinder may quickly escape to the suction side of the pump 7, and the slow-down plunger 69 is moved downward. The downward movement of the slow-down plunger 69 is supported by the push rod 31 which due to its weight follows the downward movement of the sleeve 38, connected with the platen 10, and pushes the plunger 69 downward by acting upon the head 73.

As soon as the platen 10 engages the workpiece, pressure in the conduits 24 and 23 is built up which causes valve 28 to move toward the right so as to close the opening 27 and to release the opening 26. No pressure fluid can pass from conduits 23 and 92 into the chamber 86 of the slow-down cylinder 67 since the choke valve 85 is closed. When the platen 10 during its downward movement approaches its lowermost position, it shifts the lever 62 in anticlockwise direction, thereby disengaging contacts 61 and 65 and de-energizing solenoid 56. When this occurs, the slow-down plunger 69 has reached its lower position, so that the spring 57 can shift the lever 41 in anticlockwise direction and

thereby puts the pump on full or substantially full stroke in the opposite direction to quickly reverse the press movement. Liquid is now delivered by the pump through the conduits 15 and 14 into the push back cylinders 13 while the pressure in the conduit 15 shifts the valve 28 toward the left, thereby closing the opening 26 and releasing the opening 27 so that liquid may escape from the bore 25 of the main cylinder 9 through the conduits 24 and 23 and return through the opening 27 and the conduit 22 into the tank 21.

During this return stroke liquid also passes through the conduit 15 and the conduits 89 and 88 into the chamber 82 of the choke valve 83 (Figure 3) and from there into the bore 68 of the slow-down cylinder 67. The plunger 69 will now be slowly lifted and as it moves upward, will push the control rod 31 gradually upward to reduce the pump stroke and thereby slow down the return stroke of the press. It will be noticed that the check valve 91 remains closed during the upward movement of the slow-down plunger 69 because the check valve 91 can open in the direction of the arrow A only, and the pressure in conduits 89 and 15 is higher than the pressure between the shut-off valve 87 and the check valve 91. It will also be clear from the foregoing description that the rate of the slow-down during the return stroke of the platen will be dependent on the adjustment of the choke valve 83. In other words, the faster the liquid can fill the bore 68 and move up the plunger 69, the quicker will the stroke of the pump 7 be reduced.

When the platen 10 approaches its desired uppermost position, the sleeve 38 engages the collar 37 on the push rod 31, and in the manner previously described causes the push rod 31 to shift the lever 41 so as to return the pump to its initial position. The press is now ready for the next working stroke.

It will be understood that I desire to comprehend within my invention such modifications as may be necessary to adapt it to varying conditions and uses. For instance, the push-back cylinder 13 and pistons 12, may be dispensed with by substituting a double acting plunger for the plunger 8 and connecting the conduit 15 accordingly with the lower portion of the cylinder 9.

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. In combination, a plunger having associated therewith fluid operable advancing and retracting means for reciprocating said plunger, a fluid source for supplying pressure fluid selectively to said advancing and retracting means, slow-down means operable by fluid from said fluid source for slowing down the return stroke of said plunger, controlling means operable to admit fluid from said fluid source to said slow-down means selectively during the working or the return stroke of said plunger, to move said slow-down means into position for slow-down operation, and means responsive to the admission of pressure fluid to said retracting means for bringing about said slow-down operation at the beginning or any other desired point of travel of said plunger during its retraction stroke depending on the admission of pressure fluid to said slow-down means during the advancing or during the return stroke of said plunger.

2. In combination in a press, a movable platen, a cylinder-and-piston assembly operatively con-

nected with said platen, a pressure fluid source for supplying fluid to said cylinder-and-piston assembly, controlling means adapted to control the direction of flow from said fluid source to said cylinder-and-piston assembly, means operable independently of the direction of movement of said platen and adapted responsive to the direction of the flow of fluid from said fluid source to said cylinder-and-piston assembly to automatically slow down the movement of said platen during a predetermined portion of its return stroke, and means for varying the last mentioned predetermined portion.

3. In combination in a press, a reciprocable press plunger having associated therewith fluid operable advancing and retracting means, a fluid pump for supplying fluid selectively to said advancing or retracting means to alternately effect a working stroke and a return stroke of said press plunger, controlling means including a lever system for varying the delivery stroke of said pump, electrically operable means adapted to shift said lever system in one direction, spring means urging said lever system in another direction, a push rod adapted to engage and disengage said lever system to control the same, a reciprocable member operable by fluid from said pump independently of the position of said plunger to cause movement of said rod in a direction for reducing the delivery of said pump, and means for admitting fluid from said pump to said reciprocable member selectively during the advancing or return stroke of said plunger, thereby enabling a slow down movement of said plunger during a predetermined variable portion of its return stroke.

4. In combination in a press, a press plunger having associated therewith fluid operable advancing and retracting means, a reversible variable delivery pump for supplying fluid selectively to said advancing or retracting means to alternately effect a working stroke and a return stroke of said press plunger, yielding means constantly urging said pump to full delivery retraction stroke position for the return stroke of said press plunger, a reciprocable member adapted to counteract said yielding means, slow-down means comprising a fluid operable slow-down plunger adapted to receive fluid from said pump for moving said reciprocable member against the influence of said yielding means, means for admitting fluid from said pump to said slow-down plunger selectively during the advancing or return stroke of said press plunger for restricting the delivery stroke of said pump by moving said slow-down plunger into its operative position selectively during the working stroke or the return stroke of said press plunger, and means for varying the rate of operation of said slow-down plunger.

5. In combination in a press, a press plunger having associated therewith fluid operable advancing and retracting means, a fluid pump for supplying pressure fluid selectively to said advancing or retracting means to alternately effect a working and a return stroke of said press plunger, spring means constantly urging said pump into full delivery position for the return stroke of said press plunger, a reciprocable member adapted to counteract said spring means, a slow-down cylinder with a fluid operable piston for actuating said reciprocable member, controlling means operable to admit fluid from said pump to said slow-down cylinder selectively during the working or return stroke of said press

plunger for moving said piston into its effective position, and an abutment member adjustably connected to said piston and responsive to movement of said piston into effective position to engage and move said reciprocable member against the thrust of said spring during the return stroke of said press plunger, thereby restricting the delivery stroke of the fluid pump and causing a slowed down movement of said press plunger during a predetermined variable portion of its return stroke.

6. In combination in a press, a movable platen, a cylinder-and-piston assembly operatively connected with said platen, a variable delivery pump adapted to pump fluid into said cylinder-and-piston assembly to alternately effect a working stroke and a return stroke of the platen, controlling means for varying the delivery stroke of said pump, a slow-down cylinder-and-piston assembly adapted to actuate said controlling means for varying the delivery stroke of said pump during a predetermined portion of the return stroke of said platen, means independent of the movement of said platen for conveying pressure fluid from said pump to said slow-down cylinder and piston assembly to actuate the same, and conduit means including valve means adapted both to control the rate of flow of pressure fluid to and from said slow-down cylinder-and-piston assembly to vary the rate of the slow down operation, and to predetermine the operation of said slow-down cylinder and piston assembly during the first or last portion of the return stroke of said platen.

7. In combination in a press, a reciprocable press plunger, fluid operable advancing and retracting means operatively connected with said plunger for reciprocating the same, a fluid source adapted to supply pressure fluid selectively to said advancing or retracting means to alternately effect a working and a return stroke of said plunger, controlling means comprising a lever system for varying the delivery of said fluid source, a slow-down cylinder and piston assembly adapted to be actuated by fluid from said fluid source independently of the direction of movement of said plunger, and in response to the supply of pressure fluid to said retracting means to cause a shifting movement of said lever system to restrict the delivery of said fluid source during a predetermined portion of the return stroke of said plunger, means for varying said predetermined portion to effect restriction of the delivery of said fluid source during any desired portion of the return stroke of said plunger, said last named means including a choke valve adapted to communicate with said fluid source and said slow-down cylinder and piston assembly

and having an adjustable choke member associated therewith for varying the rate of flow of fluid from said fluid source to said slow-down cylinder and piston assembly, thereby controlling the rate of the slow-down operation.

8. In combination in a press, a movable platen, a cylinder-and-piston assembly operatively connected with said platen, a reversible variable delivery pump adapted to pump fluid into said cylinder-and-piston assembly to alternately effect a working stroke and a return stroke of the platen, controlling means comprising a lever system for varying the delivery stroke of the pump, a slow-down cylinder-and-piston assembly adapted to be actuated by fluid from said pump so as to cause a shifting movement of said lever system to restrict the delivery stroke of said pump during a predetermined portion of the return stroke of said platen, a first conduit comprising a first control valve and adapted to effect communication between one side of said pump and said slow-down cylinder-and-piston assembly, a second conduit comprising a second control valve and adapted to communicate with said slow-down cylinder-and-piston arrangement and the other side of said pump, and a third conduit communicating with the same side of said pump as said first conduit and comprising a shut-off valve and a check valve adapted to allow fluid to flow from said slow-down cylinder-and-piston assembly to said pump but not vice versa, each of said control valves being adapted to vary the flow of fluid therethrough, thereby controlling the rate of the slow down operation.

9. In combination in a press, a press plunger having associated therewith fluid operable advancing and retracting means for reciprocating said plunger, a fluid pressure source for selectively supplying fluid to said advancing or retracting means to effect a working stroke or a return stroke of said plunger, fluid operable slow down means adapted in its operative position to restrict the delivery of said fluid source, yielding means at times urging said slow down means into inoperative position, adjustable controlling means operable to admit a variable quantity of pressure fluid to said slow down means during the working stroke of said plunger for varying the maximum slow down action of said slow down means at the initiation of the return stroke of said plunger, and means responsive to the admission of pressure fluid to said retracting means for initiating the slow down action of said slow down means, while simultaneously causing said yielding means gradually to return said slow down means to inoperative position.

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