Dec. 8, 1942. V. S. SHAW 2,304,620

FLUID OPERATED SLOW DOWN MECHANISM FOR PRESSES

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FIG. 1

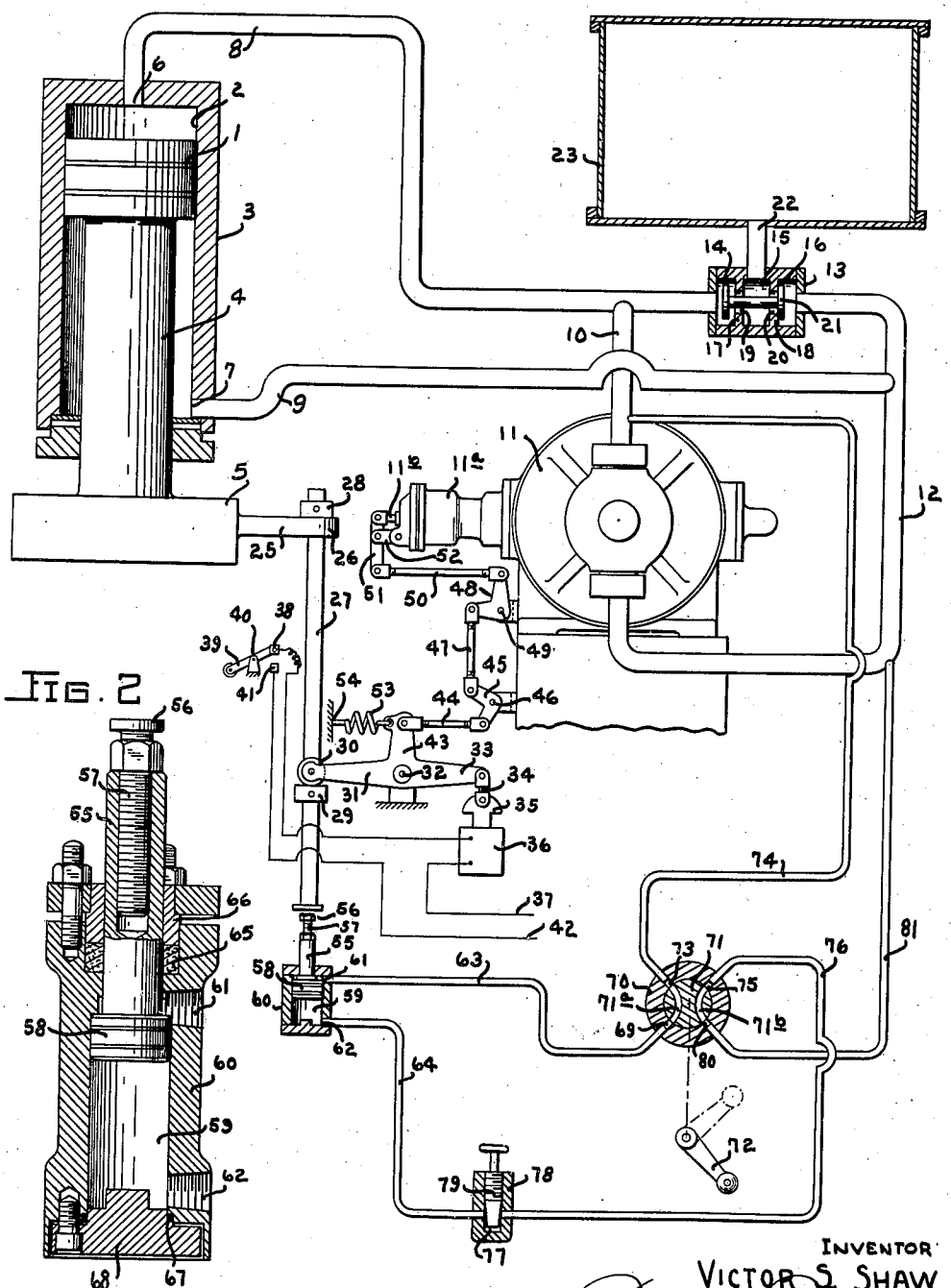


FIG. 2

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FLUID OPERATED SLOWDOWN MECHANISM FOR PRESSES

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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.

Still another object of the invention consists in providing a fluid operated press of the type set forth above with a single control means which when moved into one position will cause the platen to start its return stroke slowly and then gradually to speed up, and, when moved into another position, will cause the platen to move rapidly during the first portion of its return stroke and then gradually to slow down.

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

Figure 1 illustrates diagrammatically a fluid operated press in connection with a slow-down device according to the present invention;

Figure 2 shows, on a somewhat larger scale, a detail of the slow-down device.

In the drawing, 1 is a double acting press piston which is reciprocably mounted in the bore 2 of the main cylinder 3 and carries by means of the piston rod 4 a press platen 5. The main cylinder 3 has two ports 6 and 7 which communicate with a conduit 8 and 9 respectively. The conduit 8 communicates with a conduit 10 leading to one side of the fluid pump 11, while the conduit 9 communicates with a conduit 12 leading to the other side of the fluid pump 11. Arranged between the conduits 8 and 9 is a valve casing 13 subdivided into three chambers 14, 15 and 16 by means of partitions 17 and 18. The partitions 17 and 18 have apertures 19 and 20 through which a double valve 21 extends and through which, according to the position of said valve, the chamber 15 may alternatively communicate with the chamber 14 or the chamber 16. The chamber 14 further communicates through a conduit 22 with a fluid filled tank 23.

The main fluid pump 11 is preferably of the variable delivery type, and its discharge may be controlled either by the provision of the reversing valve or by shifting the flow-control element of the pump directly. In the form shown in the drawing, the main pump 11 is provided with a servomotor 11a having a piston-and-cylinder assembly for moving the flow-control element to and fro. The servomotor 11*a* is supplied with pressure fluid from an auxiliary pump (not shown), and its operation is controlled by means of the servomotor valve rod 11*b*. Thus by moving the servomotor valve rod 11*b* in or out, the servomotor 11*a* may be caused to shift the flow control ring of the main pump 11 in opposite directions and thus change the direction and vary the quantity of the pressure fluid supplied by the main pump 11. 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 5 is to perform a pressing stroke, the pressure fluid is supplied from the main pump 11 through conduits 10 and 8 into that portion of the bore 2 which is above the press piston 1. The press platen 5 has connected therewith an arm 25 with a collar 26 through which extends a push rod 27. The collar 26 is adapted to engage a collar 28 adjustably mounted on the push rod 27. The push rod 27 has a second collar 29, likewise adjustably mounted thereon which is adapted to engage a roller 30 carried by a lever 31. The lever 31 is shiftable about a pivot 32 and has an arm 33 pivotally connected with a rod 34 which, in its turn, is connected with the armature 35 of a solenoid 36. One terminal of the solenoid 36 is connected with the main line 37, whereas the other terminal of the solenoid 36 is connected with a contact 38 of a switch arm 39 shiftable about a pivot 40.

The lever 31 is provided with a crank 43 which is connected by the link 44 to one arm of a bell crank lever 45 shiftable about the stub shaft 46. The other arm of the bell crank 45 is connected by a link 47 with one arm of a bell crank lever 48 shiftably mourted upon the stub shaft

49. The other arm of the bell crank lever 48 is connected by a link 50 with the servomotor valve rocker arm 51 which is pivotally supported upon the floating link 52 mounted upon the housing of the servomotor. The servomotor valve rocker arm 51 is pivotally connected with the control valve rod 11b. The crank arm 43 of the lever 31 is also connected with a tension spring 53, the other end of which is connected with a fixed point 54.

Below and in axial alignment with the push rod 27 is a piston rod 55 carrying at its upper end an abutment 56, for instance a screw head, which is adjustable relative to the piston rod 55 by means of the threaded shaft 57 connected with the abutment 56 and engaging a corresponding thread in the piston rod. The lower end of the piston rod 55 carries a piston 58 reciprocably mounted in the bore 59 of the slow-down cylinder 60. The bore 59 of the slow-down cylinder 60 communicates through openings 61 and 62 with conduits 63 and 64 respectively. Leakage from the bore 59 is prevented by a packing 65 and gland 66 and by a gasket 67 in cooperation with the closure 68.

The conduit 63 leads to a port 69 of a four-way valve comprising a casing 70 and a cock 71 having two channels 71a and 71b. The cock 71 is adapted to be rotated by 90° by means of a lever 72. The valve casing 70 comprises a port 73 communicating through a conduit 74 with the conduit 10. A further port 75 in the valve casing 70 communicates with a conduit 76 which leads to a chamber 77 of a choke valve 78 having a tapered bolt adjustably mounted therein. The chamber 77 also communicates with the lower port 62 of the bore 59 by means of the conduit 64. A further port 80 in the four-way valve casing 70 communicates through a conduit 81 with the conduit 12.

The operation of the device is as follows:

Assuming that the pump 11 is in neutral position and the remaining parts are in the position shown in Figure 1, the operator shifts the switch arm 39 so that the contacts 38 and 41 engage each other. Current then flows from the main line 42 through contacts 41 and 38 and through the solenoid 36 to the main line 37, thereby energizing the solenoid 36. The solenoid 36 attracts its armature 35 and shifts the lever 31 in clockwise direction which in its turn, by means of the lever system 44, 45, 47, 48, 50, 51 and 11b, moves the pump 11 into position for delivery of fluid into the conduits 10 and 8 through which the fluid enters the bore 2 of the main cylinder 3. The liquid below the piston 1 escapes through the conduits 9 and 12 and flows to the suction side of the pump 11.

During the first portion of the downward stroke of the piston 1, the latter moves downward by gravity and liquid from the tank 23 flowing through conduit 22, aperture 19 and conduit 8 supplements the liquid delivered by the pump 11 to fill that portion of the bore 2 which is above the piston 1. At the same time a portion of the fluid delivered by the pump flows from the conduit 10 through the conduit 74, the channel 71a and conduit 63 into that portion of the bore 59 which is above the piston 58 of the slow-down cylinder 60. The liquid above the piston 58 moves the latter downward to its lower position so that the push rod 27, due to its gravity, can follow the downward movement of the platen arm 25 without interference by the abutment 56. The fluid below the piston 58 escapes through the conduit 64, the chamber 77, the conduit 76, the channel 71b and the conduit 81 to the suction side of the pump 11.

As soon as the platen 5 contacts the workpiece, fluid pressure is built up in the conduit 8, which pressure causes the valve 21 to move toward the right thereby closing the aperture 19 and releasing the aperture 20. The fluid in the conduit 64, choke valve chamber 77 and conduits 76, 81 and 12, which now communicates through the aperture 20 with the fluid tank 23 cannot lift the piston 58 of the slow-down cylinder 60 against the fluid pressure built up by the pump 11 since the fluid pressure of the latter is higher. Consequently, the piston 58 remains in the position into which it was moved by the fluid above the piston 58.

When the platen 5 approaches the end of its working stroke, it shifts the switch arm 39 in anti-clockwise direction, thereby disengaging the contacts 38 and 41 and de-energizing the solenoid 36. The armature 35 is then released and spring 53 shifts the lever arm 31 in anti-clockwise direction. This shifting movement of the lever 31 causes by means of the lever system 44 to 51 and 11b, a rapid movement of the pump into position for full delivery of fluid through conduits 12 and 9 into that portion of the bore 2 which is below the press piston 1, thereby starting a rapid return stroke of the platen 5. At this time the pressure in the conduits 12 and 9 causes the valve 21 to move toward the left thereby closing the aperture 20 and releasing the aperture 19 in the valve casing 13. Furthermore, at this time, a portion of the liquid delivered by the pump into the conduit 12 flows through the conduit 81, the channel 71b, the conduit 76, into the choke valve chamber 77. From there the liquid flows through the conduit 64 into the bore 59 of the slow-down cylinder 60 where it lifts the piston 58.

When the platen 5 during its return stroke has reached a predetermined position, the piston 59 has been lifted to such an extent that it engages the lower end of the push rod 27 and gradually lifts the same so that the collar 29 on the push rod 27 engages the roller 30 and shifts the lever 31 in clockwise direction. The lever 31 then in its turn moves the servomotor valve rod 11b toward the right by means of the lever system 44 to 51, thereby decreasing the pump stroke. In this way the press speed will be gradually slowed down and reaches its slowest speed when the piston 58 is in its uppermost position. When the platen 5 has reached its uppermost position, the collar 26 engages the collar 28 and lifts push rod 27 which, in its turn, by means of the collar 29, engages the roller 30 of the lever 31 and moves the latter in clockwise direction. This movement of the lever 31 shifts, by means of the lever system 44 to 51, the pump 11 into its initial position. The press is now ready for the next working stroke.

If it is desired to have the return stroke start slowly and gradually speed up, the four-way valve cock 71 is turned by 90° by shifting the lever 72 into the position indicated in dot-dash lines in Figure 1. The ports 73 and 75 then communicate through the channel 71b while the ports 69 and 80 communicate with each other through the channel 71a. When switch arm 39 is now shifted in clockwise direction so that contacts 38 and 41 engage each other, the solenoid 36 is energized, and as previously described, the pump 11 and the tank 23 deliver liquid into the cylinder bore 2 above the press piston 1. At the same time, fluid

is delivered by the pump through the conduits 10 and 74, through the channel 71b and the conduit 76 into the choke chamber 77 from where the fluid flows through the conduit 64 into the bore 59 of the slow-down cylinder 60, thereby gradually moving the piston 58 and the abutment 56 upward.

The liquid above the piston 58 may escape through the conduit 63, the channel 71a, the conduit 81 to the suction side of the pump 11. When the platen 5 contacts the workpiece, a high pressure is built up in the conduits 8 and 10 which causes valve 21 to move toward the right, thereby closing the aperture 19 and releasing the aperture 20. However, the pressure of the liquid in the tank and in the conduits 12, 81 and 63 is lower than the pump pressure, so that the piston 58 continues its upward movement if it has not yet reached its upper position.

When the platen 5 approaches the end of its downward stroke, it shifts the switch arm 39 in anti-clockwise direction, thereby disengaging the contacts 38 and 41 and de-energizing the solenoid 36. The spring 53 now shifts the lever 31 in clockwise direction, but due to the fact that at this time the abutment 56 of the slow-down piston 58 engages the lower end of the push rod 27 the lever 31 can move in anti-clockwise direction only until it engages the collar 29 on the push rod 27. This movement of the lever 31 causes the lever system 44 to 51 and 11b connected thereto, to shift the pump only slightly beyond neutral position for delivery of fluid into the conduits 12 and 9 so that the return stroke starts very slowly. The pressure in conduits 12 and 9 causes the valve 21 to move toward the left thereby closing the aperture 20 and releasing the aperture 19. Since now the conduit 8 communicates with the suction side of the pump and with the tank 23, in other words, since the pressure in conduit 74, the channel 71b, the conduit 76, the choke valve chamber 77 and the conduit 64 is released, the pressure of the spring 53 and the weight of the push rod 27 together with pressure from the push back line, acting through conduit 81, channel 71a and conduit 63, move the piston 58 downward and push the liquid below the piston 58 through conduits 64, 76, 74 and 10 into the suction side of the pump. At the rate at which the piston 58 is moving downward, the pump stroke is increased, thereby increasing the return movement of the platen. When the platen approaches its uppermost position, the collar 26 of the platen arm 25 engages, as previously described, the collar 28 on push rod 27 thereby lifting the latter which, in its turn, shifts the lever 31 in clockwise direction so that the lever system 44 to 51 connected therewith, returns the pump to its initial position. The press is now ready for the next working stroke.

As will be clear from the above, the setting of the choke valve 78 will determine the rate at which the fluid will flow into and be pushed out of the slow-down cylinder bore 59; in other words, the setting of the choke valve will determine the rate of the slow-down operation. The setting of the abutment 56 relative to the piston 58 will determine the shortest delivery stroke of the pump during the slow-down operation.

It will also be understood that, if desired, the platen 5 may be connected with a lever or switch mechanism which, at the uppermost position of the platen 5, automatically shifts the switch arm 39 in clockwise direction, thereby engaging the contacts 38 and 41 and energizing solenoid 36 so as automatically to start 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.

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

1. In combination in a hydraulic system, a main plunger having associated therewith fluid operable advancing and retracting means for reciprocating said plunger, a slow-down plunger associated with fluid operable advancing and retracting means for respectively moving said slow-down plunger into a first or second position, conduit means for effecting hydraulic connection between said main plunger advancing and retracting means and said slow-down plunger advancing and retracting means, a fluid source for supplying pressure fluid to said press plunger and said slow-down plunger advancing and retracting means, means operable by movement of said slow-down plunger into said first position for decreasing the delivery of said fluid source to said main plunger retracting means, and valve means arranged to control the hydraulic connection between said main plunger advancing and retracting means and said slow-down plunger advancing and retracting means, said valve means being movable selectively into one position to cause said main plunger to start its retraction stroke slowly and then gradually to speed up, and into another position to cause said main plunger to move rapidly during the first portion of its retraction stroke and then gradually to slow down.

2. In combination in a press, a movable platen, a double-acting cylinder-piston assembly operatively connected with said platen for reciprocating the same, a fluid source adapted to supply fluid to said cylinder-piston-assembly to alternately effect a working stroke and a return stroke of said platen, means associated with said fluid source and adapted to restrict the flow of fluid from said fluid source to said cylinder-piston-assembly during a predetermined portion of the return stroke of said platen, slow-down means associated with advancing and retracting means and adapted to be supplied with fluid from said fluid source for actuating said flow restricting means, a valve arranged to control the supply of fluid from said fluid source to said advancing and retracting means and movable selectively into one position to move said slow-down means into operative position during the advancing stroke of said platen, and into another position to move said slow-down means into operative position during the return stroke of said platen, and means responsive to the delivery of pressure fluid from said fluid source to said cylinder-piston-assembly for retracting said platen to make said slow-down means effective during the first or second portion of said platen return stroke depending on the movement of said slow-down means into operative position during the advancing or retracting stroke of said platen.

3. In combination in a press, a main press plunger having associated therewith fluid operable advancing and retracting means for reciprocating said press plunger, a fluid pump adapted to supply fluid to said advancing and retracting means and being associated with means to alternately effect a working stroke and a return stroke of said press plunger, a slow-

down plunger provided with fluid operable advancing and retracting means adapted to receive fluid from said pump to reciprocate said slow-down plunger, means operable by said slow-down plunger for restricting the flow of fluid from said pump to said press plunger during a predetermined portion of the return stroke of said press plunger, means for selectively varying the period of said flow restriction independently of the travel of said press plunger, and a four-way valve with four ports having two ports thereof respectively connected with said press plunger advancing and retracting means and the other two ports respectively connected with said slow-down plunger advancing and retracting means, said four-way valve being adapted selectively to establish communication of each port with one of its two adjacent ports thereby controlling the fluid from said pump to said slow-down plunger advancing and retracting means so as to cause said press plunger either to start its return stroke slowly and then gradually to speed up or to move rapidly during the first portion of its return stroke and then gradually to slow down.

4. In combination in a hydraulic system, a main cylinder with a double-acting main plunger therein, an auxiliary cylinder, a double-acting auxiliary plunger reciprocable in said auxiliary cylinder, a fluid source for supplying pressure fluid to said cylinders for actuating said plungers, control means operable by said auxiliary plunger for reducing the delivery of said fluid source to slow down the speed of travel of said main plunger, conduit means connected to said fluid source and to each end of said main cylinder, a four-way valve controlling communication between opposite ends of said main cylinder and the opposite ends of pressure fluid from said fluid source to one or the other side of said auxiliary cylinder independently of the travel of said main plunger, and an adjustable throttle interposed between said four-way valve and one end of said auxiliary cylinder for varying the speed of movement of said auxiliary plunger in both directions.

5. In combination in a hydraulic press, a press plunger having associated therewith fluid operable advancing and retracting means for reciprocating said press plunger, an auxiliary plunger associated with fluid operable advancing and retracting means for reciprocating said auxiliary plunger, a fluid source adapted to supply pressure fluid to said press plunger advancing and retracting means and to said auxiliary plunger advancing and retracting means, a first conduit means connecting said fluid source with said press plunger advancing means, a second conduit means connecting said fluid source with said press plunger retracting means, means associated with said fluid source for directing pressure fluid alternately to said press plunger advancing and to said press plunger retracting means, a third conduit means and a fourth conduit means respectively connected to said auxiliary advancing means and to said auxiliary retracting means, a four-way valve for controlling communication of said first and second conduit means with said third and fourth conduit means, and an adjustable throttle valve for varying the flow of fluid between said auxiliary plunger retracting means and said four-way valve to vary the travelling speed of said auxiliary plunger in one direction.

6. In combination in a press, double-acting press plunger reciprocably mounted in a main cylinder, a fluid pump adapted to supply fluid to said main cylinder and being associated with means to alternately effect a working stroke and a return stroke of said press plunger, slow-down means comprising an auxiliary cylinder and a double-acting slow-down piston reciprocable in said auxiliary cylinder and adapted to restrict the flow of fluid from said pump to said main cylinder during a predetermined portion of the return stroke of said press plunger, a four-way valve communicating with four conduits, two of which are connected to the respective ends of the main cylinder while the other two conduits are connected to the respective ends of said auxiliary, and a throttle provided in one of said last mentioned two conduits operable selectively to vary the slow-down period of said slow-down piston, said four-way valve being adapted, when moved into one position, to cause said press plunger to start its return stroke slowly and then gradually to speed up, and when moved into another position to cause said press plunger to move rapidly during the first portion of its return stroke and then gradually to slow down.

7. In combination in a press, a movable platen, a double-acting main cylinder-and-piston assembly operatively connected with said platen for reciprocating the same, a reversible variable delivery pump for supplying fluid to said assembly to alternately effect a working stroke and a return stroke of said platen, controlling means including a lever system for varying the delivery stroke of said pump, a fluid operable double-acting slow-down cylinder piston assembly adapted to be actuated by fluid from said pump and to operate said lever system during a predetermined portion of the return stroke of said platen, adjusting means associated with said slow-down cylinder-piston-assembly and said lever system for varying the operative connection therebetween, and a valve controlling the supply of fluid from said pump to said slow-down cylinder and movable selectively into one position, to cause the platen to start its return stroke slowly and then gradually to speed up, or into another position to cause said platen to move rapidly during the first portion of its return stroke and then gradually to slow down, and a throttle hydraulically connected with and interposed between said valve and said slow-down cylinder-and-piston assembly and adapted to vary the time period of the slow-down or speed up operation of said slow-down cylinder-and-piston assembly.

8. In combination in a press, a movable platen, a double-acting cylinder-and-piston assembly operatively connected with said platen for reciprocating the same, a reversible variable delivery pump for supplying fluid to said assembly to alternately effect a working stroke and a return stroke of said platen, spring means constantly urging said pump into full delivery position for the return stroke of the platen, a reciprocable member adapted to counteract said spring means, slow-down means comprising a slow-down plunger having associated therewith advancing and retracting means operable by fluid from said pump, said plunger being adapted to move said reciprocable member against the influence of said spring means during a predetermined variable portion of the return stroke of said platen to restrict the delivery stroke of said pump, adjusting means associated with said slow-down plunger for changing the length thereof to determine the minimum delivery stroke of the pump during the return stroke of the platen, and a

valve adapted to control the supply of fluid to said slow-down plunger so as selectively to cause the platen to start its return stroke slowly and then gradually to speed up, or to cause said platen to move rapidly during the first portion of its return stroke and then gradually to slow down.

9. In combination in a press, a press plunger having associated therewith fluid operable advancing and retracting means, a variable delivery pump for supplying fluid to said advancing and retracting means for actuating said plunger, means associated with said pump to alternately effect a working stroke and a return stroke of said platen, controlling means including a lever system for varying the delivery stroke of said pump, means operable 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, slow-down means including a double-acting fluid operable cylinder-piston system adapted to be hydraulically connected with said pump and to operate said push rod independently of the travel of said press plunger for causing a slow-down movement of said press plunger during a desired variable portion of its return stroke, and valve means controlling the hydraulic connection between said pump and said slow-down cylinder-piston system and operable selectively to cause the press plunger to start its return stroke slowly and then gradually to speed up, or to cause said press plunger to move rapidly during the first portion of its return stroke and then gradually to slow down.

VICTOR S. SHAW.