

Sept. 19, 1944.

T. F. STACY

2,358,353

HYDRAULIC PRESS

Filed July 20, 1937

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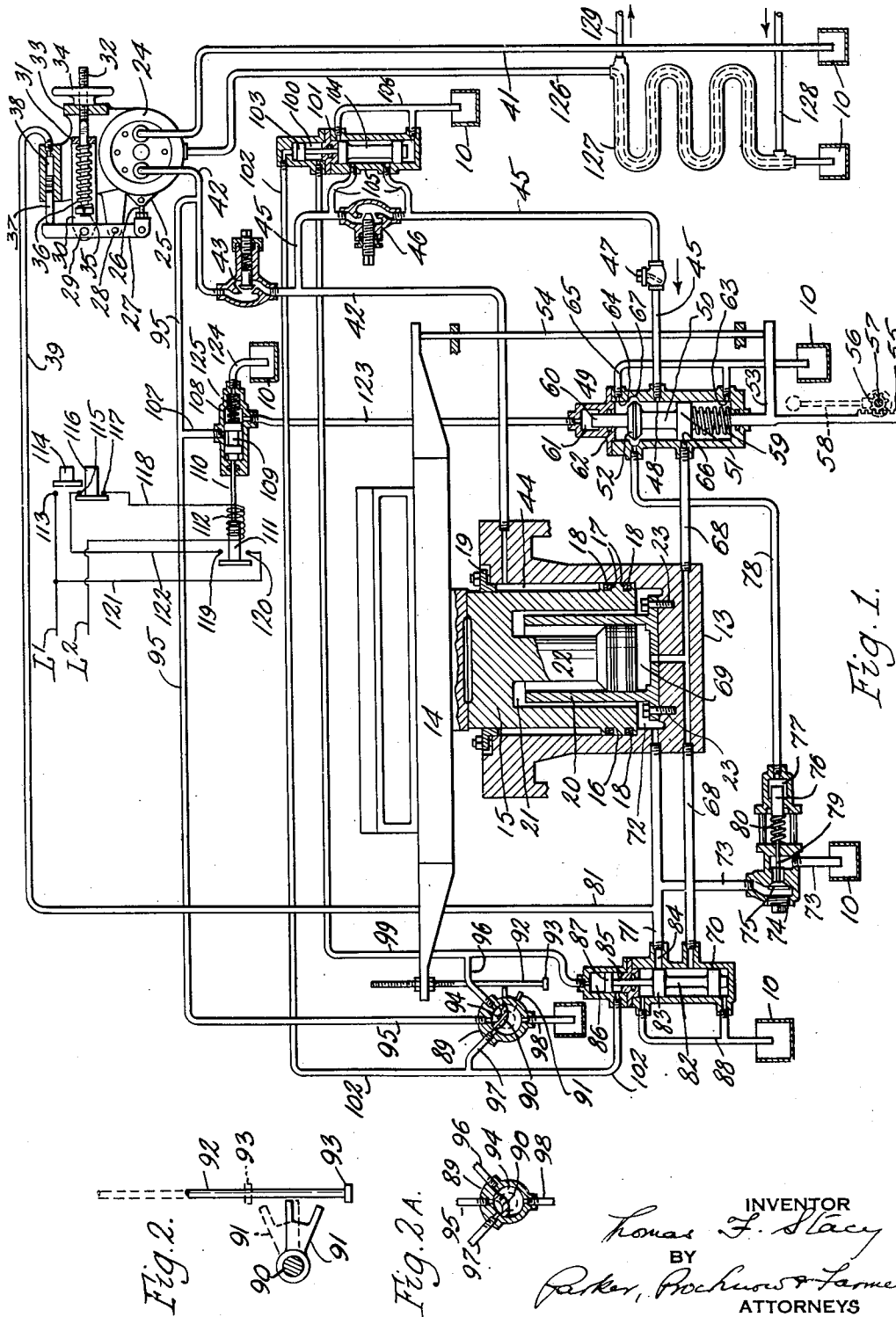


Fig. 1.

Fig. 2.

Fig. 2A.

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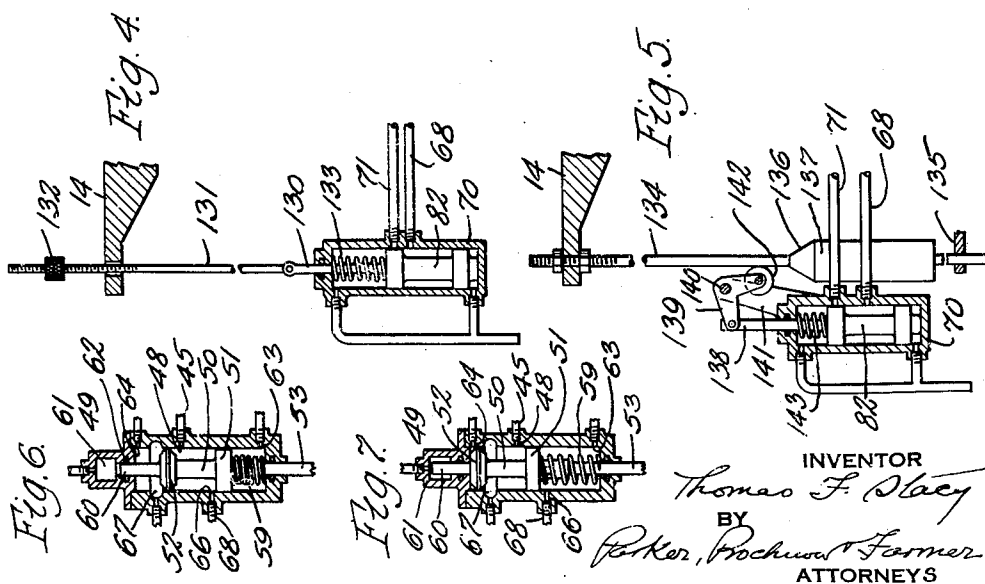
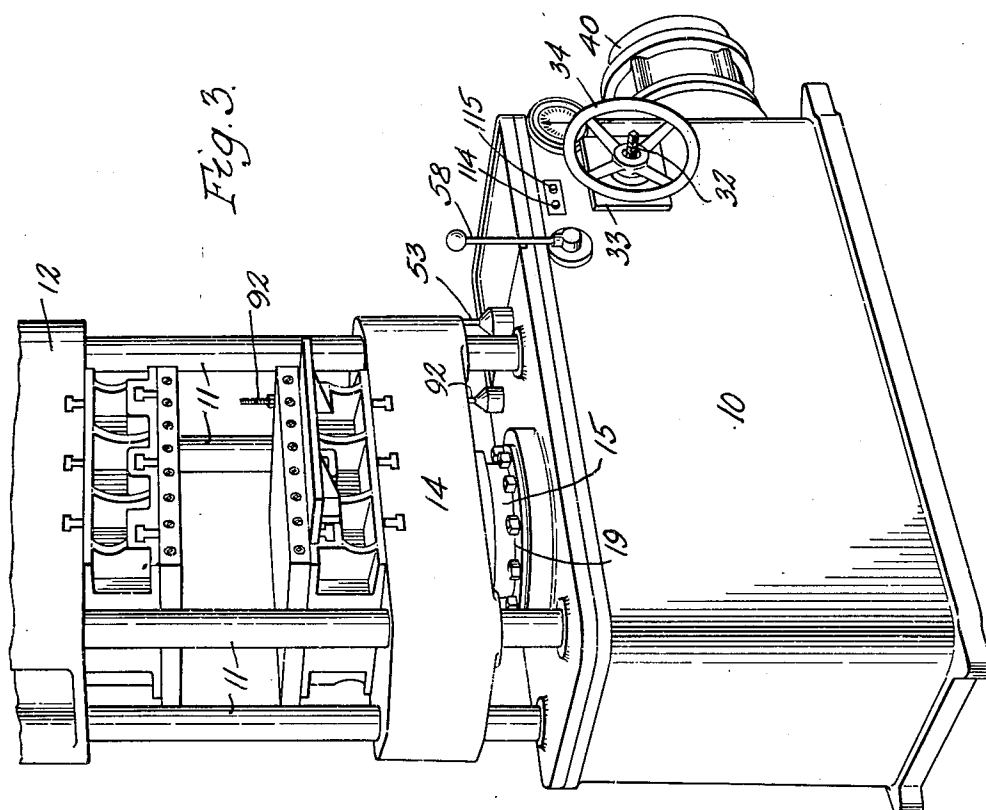
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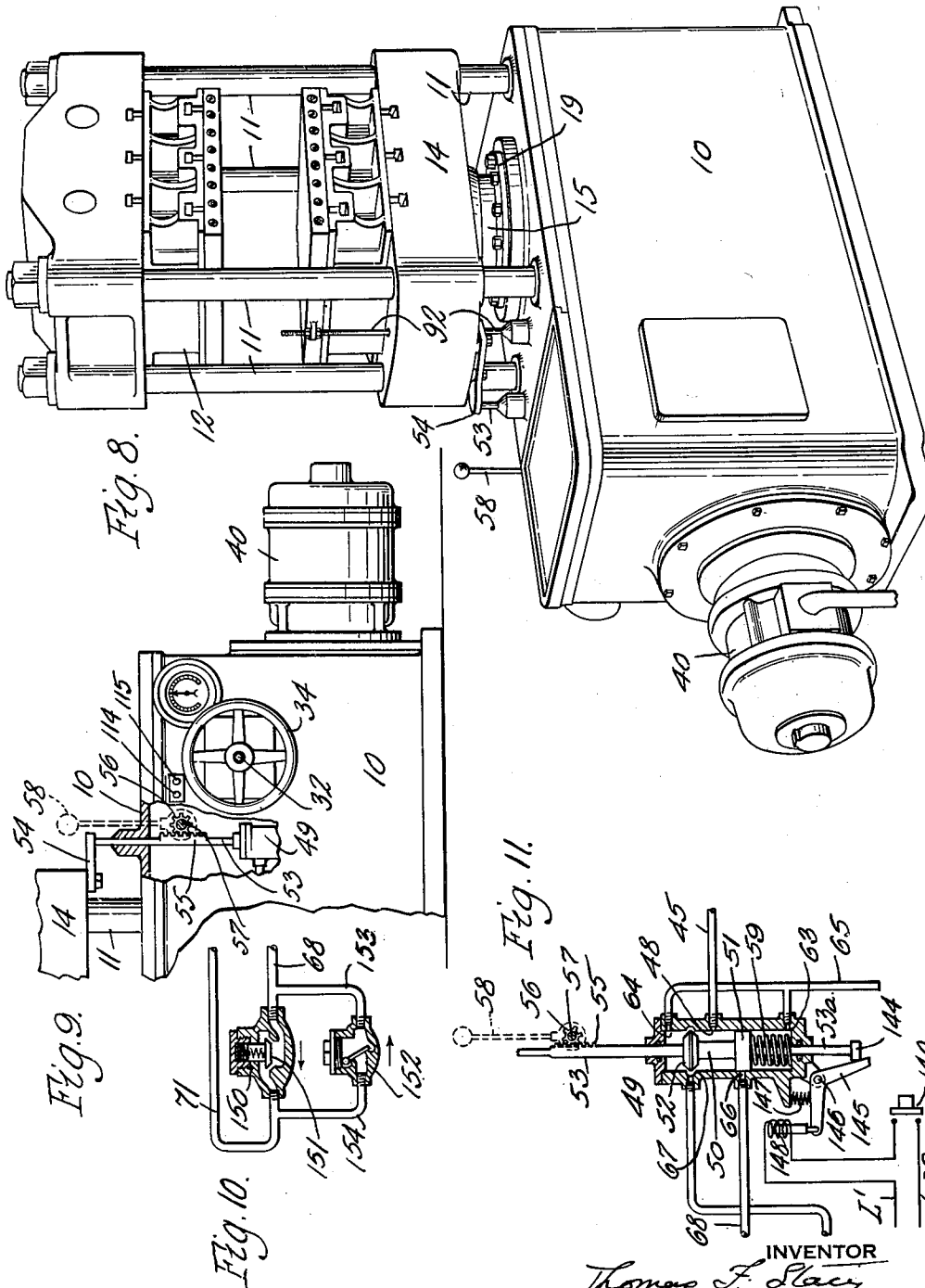
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3 Sheets-Sheet 3



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HYDRAULIC PRESS

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16 Claims. (Cl. 18—16)

This invention relates to hydraulic presses and particularly to the control of the same.

An object of the invention is to generally improve hydraulic presses and their control.

Another object of the invention is to provide an improved hydraulic press and control means therefor, with which piston rings may be employed in the hydraulic ram for advancing the working member, and with which scoring of the cylinder wall by leakage of operating liquid past the piston rings under a high pressure differential will be effectively prevented or rendered negligible.

Another object of the invention is to provide an improved hydraulic press and operating system therefor, with which the working member may be given a rapid, preliminary advance movement and then at a desired position or point in such advancement, or as soon as predetermined pressure conditions on said working member have been reached, the travel slowed down and increased pressure made available automatically.

Another object of the invention is to provide an improved hydraulic press and operating system therefor with which the advancement and retraction of the working member may be accomplished under the control of a single master valve in a simple and practical manner, with which the working member may be stopped and held in any position in its advancement or retraction in a simple, practical and inexpensive manner, with which the working member will automatically stop its retraction, and hold it in retracted position, at any predetermined position in its retraction, and with which rapid retraction of the working member may be obtained.

Another object of the invention is to provide an improved hydraulic press and operating system therefor, with which the rate of travel of the working member may be effectively and automatically controlled beginning at any selected, intermediate point in its advancing movement.

Various other objects and advantages will appear from the following description of several embodiments of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

Fig. 1 is a diagram of a hydraulic press and an improved operating system for the same, constructed in accordance with this invention and illustrating one embodiment thereof;

Fig. 2 is a sectional elevation through a portion of a valve operating mechanism which forms a part of the system according to this embodiment of the invention, and illustrating different operating positions for this part;

Fig. 2A is a sectional elevation of that valve in a different operative position from that shown in Fig. 1;

Fig. 3 is a perspective of a hydraulic press and operating system therefor constructed in accordance with this invention and illustrating the self-contained and compact arrangement of the same, the embodiment of the invention being the same as that shown diagrammatically in Fig. 1;

Fig. 4 is a sectional elevation of a modification of one of the valve mechanisms and operating means therefor illustrated in Fig. 1;

Fig. 5 is a sectional elevation of still another modification of the same valve mechanism;

Fig. 6 is a sectional elevation through the main or three-position valve illustrated in Fig. 1 which controls the direction of travel of the working member or platen, the valve element thereof being shown in the operative position it is given when advancement of the working member is desired;

Fig. 7 is a similar, sectional elevation of the same valve, but with the valve element thereof in another operative position which it is given when retraction of the working member is desired;

Fig. 8 is another perspective similar to Fig. 3 but from the opposite face thereof;

Fig. 9 is a front elevation of a portion of the press and system shown in Figs. 3 and 8 but with a portion of the tank housing broken away to show the manner of operating the main control or three-position valve thereof;

Fig. 10 is an elevation, partly in section, of a composite valve arrangement that may be substituted for the valve of Fig. 1 which connects the primary and secondary hydraulic advancing means for said working member, and thus illustrates still another embodiment thereof; and

Fig. 11 is an elevation, partly in section, of a modification of the three-position or main control valve illustrated in Fig. 1, and which may be substituted therefor.

Referring first particularly to Figs. 1 to 3, 6, 7, 8 and 9, the improved hydraulic press includes a tank or reservoir 10 of any suitable shape and size, and which is much larger than is necessary for storing the surplus operating liquid for the press. In the diagram of Fig. 1, instead of show-

ing a large tank 10, a plurality of small tanks 10 are illustrated for different connections, but it will be understood that all of the small tanks 10 in Fig. 1 correspond to the single large tank 10 in the other figures of the drawings. Extending from the tank or reservoir 10 are strain posts 11, Figs. 3 and 8, which connect a fixed head 12 to the main cylinder 13, Fig. 1, which cylinder is located within the tank 10. This is a typical prior hydraulic press, but heretofore the cylinder 13 has not been disposed within the tank which contains the surplus or reserve operating liquid.

A platen or working member 14 is slidably mounted on the strain rods 12 for reciprocation therealong toward and from the fixed head 12, and this member 14 has a post or piston 15 depending or projecting therefrom through a wall of the tank 10 and into the cylinder 13, where it forms with the cylinder 13 a hydraulic device by which the working member 14 is advanced toward the head 12 or retracted. The hydraulic device may be single acting or double acting, or separate means may be employed for retracting the platen or working member. The hydraulic device is illustrated as of the double acting type, although it will be understood that this is merely a preferred arrangement and that instead of it, separate and supplementary hydraulic devices may be connected to the working member for advancing the latter first through a rapid, press closing movement, and then with a slower movement but at a much higher possible pressure on the working member when resistance is encountered.

The cylinder 13, Fig. 1, as illustrated, has an open end through which the piston or post 15 extends, the other end of the cylinder 13 being closed except for connections thereto. The end of the piston 15 which extends within the cylinder 13 is provided with an enlarged head 16 which cooperates with the cylinder wall to form a fairly close slidable fit between them. The periphery of this head 16 is provided with one or more annular grooves 17, and in each groove one or more piston rings 18 may be disposed so as to effectively close the clearance between the piston head and the cylinder wall in the same manner that the piston rings of an internal combustion engine or a steam engine provide a reasonably tight, sliding connection with the cylinder wall.

The open end of the cylinder 13 through which the piston 15 extends is closed by a packing gland 19 of any suitable construction, such glands being commonly employed in hydraulic presses and need no particular explanation. The gland 19 is merely illustrated conventionally in Fig. 1. A cup shaped shell 20, Fig. 1, is secured at its bottom or closed end to the closed end of the cylinder 13 within the chamber of the cylinder, and it extends into an annular recess 21 provided in that end face of the piston 15 which is received in the cylinder 13.

The central portion 22 of the piston 15 which is encompassed by the annular groove 21 acts as an auxiliary or primary piston for the rapid advancement of the working member in a manner which will be explained hereinafter, and this auxiliary piston or post 22 is slidably received within the cup shaped shell 20 which in fact functions as an auxiliary or primary cylinder. The post 22 may also have an enlarged head at its free end which in its periphery is provided with one or more annular grooves for mounting piston rings in the same manner that such rings are mounted in the grooves 17 in the outer pe-

riphery of the piston 15. The shell or auxiliary cylinder 20 may be secured to the main cylinder 13 in any suitable manner such as by cap screws 23.

In the broader aspects of the invention, any source of operating liquid under pressure may be employed, but in order that the pressing system may be self contained as far as possible, I preferably utilize a variable delivery, pressure holding type of rotary pump 24, Fig. 1. This type of pump is well known and extensively used in the industry for the operation of hydraulic presses, and is shown merely conventionally in Fig. 1. Pumps of this type are disclosed, for example, in U. S. Patents 1,077,979, 1,656,034, 1,638,653 and 1,250,170. Such a pump utilizes a shiftable yoke 25, which by its lateral shifting movement (in Fig. 1) varies the rate of delivery of the pump.

The yoke 25 is connected by a link 26 to one end of a lever 27, this lever being pivoted at 28 on a suitable bracket of the pump frame. The lever 27 extends beyond the pivot 28 and is pivotally connected at 29 to a link 30 which extends approximately parallel to the link 26. Link 30 has a flange 31 through which slides a rod 32. The rod 32 passes freely through a boss 33 of the pump frame, and a hand wheel 34 is threaded on the outer end of the rod 32. The portion of rod 32 passing through the flange 31 is non-circular in cross section, and the aperture in flange 31 is similarly shaped so as to prevent rotation of the rod 32 without restricting its sliding movement. Thus when the hand wheel 34 is rotated in one direction, it will tend to pull the rod 32 through the bracket 33.

The opposite end of the rod 32 is provided with a head or shoulder 35, and a helical compression spring 36 is disposed on the rod 32 under compression between the shoulder 35 and the flange 31, so as to urge the rod 32 in a direction to force the hand wheel 34 against the bracket 33 and rock lever 27 clockwise in Fig. 1. The spring 36 thus acts through the link 26 to urge the yoke 25 in a direction to cause maximum rate of delivery of the pump, and the pressure which holds the yoke in that position yieldingly, may be varied by varying the stress on the spring 36, merely through rotation of the hand wheel 34 in one direction or the other, depending upon whether an increase or decrease in the holding pressure is desired. The pump is also provided with a small piston 37, disposed in a position to be engaged by the lever 27, and reciprocating in a small cylinder 38 mounted on the frame of the pump.

Operating liquid is supplied to the cylinder 38 through a pipe 39, and the pressure in the cylinder 38 on the piston 37 urges the lever 27 in a direction to shift the yoke 25 in a manner to decrease the rate of delivery of the pump in opposition to the spring 36. This explanation of the pump and of the parts 25 to 39 is merely typical of pumps of this type now on the market and extensively used in connection with hydraulic presses, and the pump details illustrated in Fig. 1 are to be understood as being merely typical and no part of the invention except in connection with the remainder of the system.

The pump 24 is continuously operated from any suitable source, such as a motor 40, Figs. 3, 8 and 9, and the intake side of the pump is connected by a pipe 41 to the reservoir or tank 10. Thus the pump 24 withdraws operating liquid from the tank 10 through pipe 41, and delivers it under pressure through outlet pipe 42. The pipe

42 preferably contains therein a suitable choke valve 43 which creates a slight back pressure on the pump, so as to make available for other purposes a small portion of the operating liquid, as will be explained shortly. The choke valve 43 may be of any suitable type, which remains closed until a desired pressure has been built up and then opens and passes all liquid in excess of that necessary to create the desired initial back pressure. Such a choke valve may be spring closed and pressure opened, as shown in Fig. 1.

The pipe 42 beyond the choke 43 extends directly to the pull-back chamber 44 which, in the illustrated example, is the chamber between the end of the cylinder 13 that is closed by the gland 19 and the piston head 16, and which, with the piston 15, functions as a pull-back hydraulic device. The pump 24 thus delivers operating liquid under pressure to the chamber 44 of the pull-back device, and by its action on the annular, exposed or pressure face of the piston head 16 urges the working member in a retracting direction. A branch pipe 45 leads from the pipe 42, at a point between the choke 43 and the cylinder 13, to a meter valve 46 which is preferably adjustable to regulate the quantity of liquid passing therethrough, that is, the valve 46 has a valve opening which may be regulated to increase or decrease the space through which the liquid may flow in passing through this valve. Beyond the valve 46 the pipe 45 contains a one-way free check valve 47, and then is connected to a port 48 of a three-position or main control valve 49. The check valve 47 opens freely to pass liquid through the pipe 45 to the valve 49, and closes automatically to prevent return flow. The arrow below valve 47 indicates the direction in which the free flow may occur.

The three-position valve 49 includes an elongated chamber in which is disposed a valve element 50 mounted for reciprocation endwise of the chamber of the valve. This valve element 50 is provided with a pair of heads 51 and 52 spaced apart a suitable distance on opposite sides of the port 48 and which engage with the wall or housing of the valve. The valve element 50 has a reduced extension or rod 53, Fig. 9, passing through one end of the valve casing and through a wall of the tank 10 into a position to be engaged and depressed by an arm 54, provided on the working member or platen, as the platen approximately completes its retraction movement. Within the tank 10 the rod or extension 53 is provided with a rack 55 which meshes with a pinion 56 mounted on a shaft 57. The shaft 57 extends outwardly through a wall of the tank 10 and there carries an operating handle 58, Figs. 3 and 8.

Referring again to Figs. 1, 6 and 7, a helical compression spring 59 is interposed between the end of the casing of the valve 49 and the head 51, so as to urge the valve element 50 in a direction to draw the rod 53 further into the valve casing. The end 60 of the valve element 50, at the end opposite the rod or extension 53, extends into a cylinder 61 through a suitable packing gland 62. When fluid under pressure is admitted to the cylinder 61 it will force the piston 60 and valve element 50 in opposition to the spring 59, and carry the rod 53 outwardly away from the arm 54 on the platen, if the platen is in retracted position. The valve 49 is provided with end exhaust ports 63 and 64 which are connected by a pipe 65 to the tank 10, also with a port 66 which is between the port 48 and the

end port 63 and closed by the head 51 of the valve element 50 when the latter is in an intermediate position, such as shown in Fig. 1, and also on its chamber wall with an annular groove 67 at a point between and spaced from the end port 64 and the inlet port 48.

The periphery of the head 52 of the valve element 50 is bevelled on opposite faces, so that when the valve element is positioned in an intermediate position, as shown in Fig. 1, in which the head 52 is aligned with the groove 67, liquid may pass from the inlet port 48 around the bevelled periphery of the head 52 and reach the outlet port 64. The port 66 in valve 49 is connected by a pipe 68 to the chamber 69 at the bottom or closed end of the auxiliary cylinder formed by the shell 20. The pipe 68 is also connected through a valve 70 to a pipe 71 which communicates with the secondary or main pressure cylinder or chamber 72 surrounding the shell 20 at the closed end of the cylinder 13. When the valve element 50 of the valve 49 is in the intermediate position shown in Fig. 1, any pressure of the operating liquid delivered by the pump 24 is exerted on the pull-back chamber 44 through pipe 42, and all the liquid delivered passes through meter valve 46, pipe 45 and check valve 47 to the valve 49, where it is free to pass around the bevelled head 52 of the valve element and reach the exhaust port 64 through which it may pass back to the tank 10.

The port 66 is at this time closed by the head 51, so that no liquid may escape from either of the chambers 69 or 72 and thus the liquid delivered by pipe 45 will pass back to the tank 10 idly. This prevents any movement of the working member or platen 14 under any pressure exerted on the piston 15 through the pull-back chamber 44. The working member thus is held in the same position notwithstanding the continuous operation of the pump.

The exposed annular face of piston head 16 in chamber 44 of the platen retracting device is smaller in area than the exposed end area of post 22 in the closed end of the shell or cup 20, and also smaller in area than the remaining area of the inner end of piston 15, so that whenever the same pressure per unit area is applied to both chambers 44 and 69, or to chambers 44, 69 and 72, the platen will always be advanced by the resulting pressure differential.

The pipe 71 has a branch pipe 73 leading to the tank 10, and in this pipe 73 is disposed a pilot operated check valve 74. The valve element 75 of this valve is free to open and pass liquid from the tank 10 through the pipes 73 and 71 to the chamber 72 to fill the increasing space created therein by the advancing piston 15. The valve element 75 closes automatically in order to prevent reverse flow from the secondary cylinder or chamber 72 back to the tank 10. A pilot piston 76 reciprocates in a pilot cylinder 77 which is connected by a pipe 78 to the groove 67 of the valve element 49. The piston 76 of this pilot operated check valve has a stem 79 which extends into a position beneath the valve element 75 so that when sufficient pressure is created in the pilot cylinder 77, the piston 76 will be forced in an outward direction and through its stem 79 will urge the valve element 75 into open position. A spring 80 tends to return the pilot piston 76 into retracted position where it releases the valve element 75 and allows the latter to close. A pipe 81 extends from the pipe 71 to the cylinder 38 of the pump con-

trol, and therefore the pressure per unit area in the cylinder 38 of the pump control will be substantially the same as and directly responsive to the pressure per unit area in the pipe 71 and chamber 72 which is acting at any time on the main advancing ram in the cylinder 13.

The valve 70 has a spool shaped valve element 82 which reciprocates endwise in the valve housing, and a head 83 on the element 82 closes the port 84 into which the pipe 71 opens. The pipe 68 opens into the chamber of the valve 70 opposite the intermediate part of the spool, so that communication will be established between the pipes 68 and 71 whenever the valve element 82 of valve 70 is operated endwise to carry head 83 from over the port 84, that is to operate it upwardly in Fig. 1. The valve element 82 has a reduced stem 85 which extends outwardly of the valve 70, through a suitable gland and into a pilot cylinder 86, where it terminates in a pilot piston head 87. Thus by applying fluid under pressure to opposite ends of the pilot cylinder 86, the valve element 82 may be shifted to and from the position shown in Fig. 1 so as to close the port 84, as shown in Fig. 1, or to uncover it and establish communication between pipes 68 and 71. The ends of the housing of the valve 70 are connected by a pipe 88 to the tank 10 so that any leakage of operating liquid along the valve element 82 may return freely to the tank 10 and there will be no opposition of trapped liquid opposing the reciprocation of the valve element 82.

A pilot control valve 89 is disposed in a position for operation by the working member or platen 14 when the latter reaches a desired position in its advancing movement. For this purpose the valve 89 is shown as having a rotary valve element 90 which is provided externally of the valve housing with a forked operating arm 91, Figs. 1 and 2. A rod 92 is adjustably mounted on the platen to extend in the direction of travel of the platen and is provided at one end with a head or flange 93 which is engageable with the fingers of the fork of the arm 91 to rock the arm 91 between the full and dotted line positions shown in Fig. 2 as the platen moves back and forth. This valve element 90 is of course frictionally held in adjusted positions, and as the head or flange 93 moves the arm 91, it clears the fork thereof and is able to continue its movement forwardly and backwardly in either direction, yet as it moves it picks up the arm 91 and rocks it into its other position and then continues on, free of the arm 91.

When the valve element 90 is in full line position, shown in Fig. 1, its passage 94 connects pipes 95 and 96, and when the arm 91 is rocked from the full line to the dotted line position of Fig. 2, the passage 94 of the valve element 90 connects the pipe 95 to a pipe 97 and breaks the connection between the pipes 95 and 96, as shown in Fig. 2A. The valve 89 is provided with an outlet pipe 98 which connects with either the pipe 97 or the pipe 96, depending upon the position of the valve element 90. When the valve element 90 is in the position shown by full lines in Fig. 1, pipe 97 is connected to the pipe 98, and when the arm 91 is rocked to turn the valve element 90 counter-clockwise in Fig. 1 into the position shown in Fig. 2A, the pipe 96 will be connected to the exhaust or drain pipe 98. The pipe 95 is connected to the pipe 42 between the pump 24 and the choke valve 43, and thus liquid under pressure will always be supplied through the pipe 95

to the valve 89. The pipe 96 is connected to a pipe 99 which runs between one end of the pilot cylinder 86 and one end of a pilot cylinder 100 of a bypass valve 101.

The other end of the pilot cylinder 100 is connected by a pipe 102 to the pipe 97 and also to the other end of the pilot cylinder 86. Thus when the valve element 90 of the platen pick-up valve 89 is in the position shown by full lines in Fig. 1, an operating liquid delivered by the pump will be conducted through pipe 95 to the valve 89 and thence to the pipe 96 where it divides, a portion being delivered to the outer end of the pilot cylinder 86 to set the valve element 82 in a position to close communication between the pipes 68 and 71, that is, between the primary and secondary cylinders acting on the piston 15. Another portion of the operating liquid delivered through the pipe 96 passes through the pipe 99 to the inner end of the pilot cylinder 100 of by-pass valve 101, and operates a piston 103 in that cylinder.

A valve element 104 of valve 101 is connected to the piston 103, and when the latter is moved by liquid from pipe 99, the valve element 104 will be moved into the position shown in full lines in Fig. 1, where the central part of the spool-like valve connects by-pass pipes 105 to one another, and thus establishes a direct by-pass around the meter valve 46. When the valve element 90 of the platen pick-up valve 89 is rotated counter-clockwise in Fig. 1 so that its passage 94 will connect the pipes 95 and 97, as shown in Fig. 2A, the pipe 96 will be connected to drain or exhaust pipe 98, and the operating liquid from the pump delivered through pipe 95 will now be conducted by the pipes 97 and 102 to the inner end of pilot cylinder 86 and to the outer end of the pilot cylinder 100. This will cause movement of the valve element 82 upwardly in Fig. 1 so that the head 83 thereof will uncover the port 84 and thus establish a direct communication between the pipes 68 and 71.

At the same time, the liquid delivered through pipe 102 to the pilot cylinder 100 will force the valve element 104 downwardly in Fig. 1 until a flange of the spool covers and closes the opening into one of the pipes 105, and thus interrupts the liquid flow through the pipes 105, thus making it necessary for all of the liquid passing through pipe 45 to pass through the meter valve 46. The ends of the valve chamber of valve 101 in which the valve element 104 reciprocates are connected by a pipe 106 to the tank 10 so that there will be no trapped liquid in the ends of the valve chamber which will interfere with the movements of the valve element 104.

A branch 107 of the pipe 95 is connected to an electrically operated valve 108. This valve is provided with a reciprocating, spool shaped valve element 109 having an operating stem 110 passing outwardly through one end of the housing of the valve 108, and there connected to the core 111 of a solenoid 112. The solenoid 112 receives an energizing current through line wires L' and L² from any suitable source of current. The line L' is connected to a contact 113 of a normally open switch 114, that is, one spring urged into open position, the other contact 115 of that switch being also in contact with a normally closed switch 116, that is, one spring urged into closed position. The other contact 117 of the switch 116 is connected by a wire 118 to one side of the solenoid 112. The other side of the solenoid is connected to the line wire L².

The core 111 of the solenoid 112 is arranged to engage and electrically connect a pair of contacts 119 and 120 when the valve element 109 has been moved to the right in Fig. 1, a distance corresponding to that desired for the valve element 109. The contacts 119 and 120 are connected by wires 121 and 122 respectively to the line wire L' and the contact 115. When the valve element 109 is moved to the right from the position shown in Fig. 1 by the solenoid 112 until the core 111 engages contacts 119 and 120, the central portion of reduced diameter of the valve element 109 will then be in position to connect the pipe 107 with a pipe 123 leading to the outer end of the pilot cylinder 61.

When the valve element 109 is in the position shown in Fig. 1, the valve element 109 will prevent fluid flow from pipe 107 to pipe 123, and entirely uncover the opening to pipe 123, and connect the latter through the adjacent end of the casing of the valve 108 with an exhaust pipe 124 leading to the tank 10. A spring 125 in the casing of valve 108 acts on the valve element 109 and tends to urge it into the position shown in Fig. 1, and thus automatically urges the core 111 of solenoid 112 into the position shown in Fig. 1.

In pumps of the variable delivery type, such as pump 24, there may be leakage of operating liquid past the pistons and this slippage oil or liquid is usually relatively hot. Heretofore such slippage oil or liquid has been drained directly into the reservoir or tank, and all the liquid in the tank cooled by cooling coils. According to my invention the slippage oil, or operating liquid is drained from the bottom of the pump and conducted by a pipe 126 through a heat exchanger 127 back to the tank 10. A cooling liquid, such as cold water, is circulated by the pipes 128 and 129 through a jacket surrounding the pipe 126 in the heat exchanger, so as to cool the slippage oil before it is discharged into the tank 10. The cooling water is preferably circulated through the heat exchanger in a direction counter to the flow of the slippage oil through that exchanger in order to obtain maximum cooling efficiency.

The operation of the pressing system just described will now be explained. With the various parts in the positions shown in Figs. 1, 2, 3, 8 and 9, the platen or working member 14 is in its retracted position, where it is urged downwardly by liquid delivered from the pump 24 through the pipe 42 to the retracting cylinder 44, but the piston 15 cannot further be retracted or descend because escape of liquid from the chamber 69 is prevented by the valve head 51 of the three-position valve 49, and from chamber 72 is prevented by the valve head 83 and by the now closed, pilot operated check valve 74. The liquid delivered by the pump 24 will thus pass through the pipe 42, choke 43, pipe 45, meter valve 46 and also its by-pass formed by pipes 105 and the valve 101, and check valve 47 into the chamber of the valve 49.

The liquid then passes around the bevelled head 52 and out through the port 64 and pipe 65 back to the tank 10. There is thus no substantial back pressure or resistance offered by the valve 49, and consequently the liquid will circulate idly through the valve 49 back to the tank 10 and thence through pipe 41 to the intake side of the pump 24. Consequently there will be no substantial pressure on the liquid in the valve 49 such as may tend to force open the pilot operated check valve 74. Even if the valve 74 was forced open, the piston 15 could not

descend because the escape of liquid from chamber 69 is still prevented by the valve head 51 of the three-position valve 49. At the same time, the liquid from the pump is delivered through pipe 95 to the valve 89 and thence through the pipes 96 and 99 to the inner end of the pilot cylinder 100 and the outer end of the pilot cylinder 86, so as to hold the valve elements 104 and 82 in the positions shown in full lines in Fig. 1. The valve element 50 is held in the intermediate position shown in Fig. 1 because of the engagement of its valve rod 53 by the arm 54 on the platen or working member 14 as the latter descended.

In order to initiate an advancing movement of the working member or platen 14, the operator turns the handle 58 in a direction to push the valve element 50 of the three-position or main control valve 49 further than that produced by the working member 14 which would be downwardly in Fig. 1, and into the position shown in Fig. 6. When this happens, the valve head 51 will uncover the port 66, and at the same time the bevelled head 52 will pass out of alignment with the groove 67 and will prevent the flow of liquid from pipe 45 to the port 66 and thence through the port 64 to the tank 10. Since the area of the exposed or free end face of the auxiliary piston or stem 22 of the main piston 15 is greater than that of the exposed annular end area of the piston in the chamber 44, the pressure in chamber 69 will cause an advancing movement of the piston 15 and platen 14. The liquid displaced from the chamber 44 by this advancing movement will pass through the pipe 42 into the pipe 45 and thence to the chamber 69 with the other liquid delivered by the pump 24. The space in chamber 72, which is enlarged by the upward travel of the piston 15, will be filled by liquid sucked into the chamber 72 from the tank 10 by means of the pipe 73, the freely opening check valve 74 and the pipe 71.

This advancing movement can be stopped at any time by merely returning the handle 58 to the position shown in Figs. 3, 8 and 9, and spring 59 urges return of valve element 50 to the intermediate position. The handle 58 must be held in this intermediate position at this time, however, because the valve rod 53 has been released by the advancing movement of the platen 14, and the spring 59 would otherwise shift the valve element 50 into the other extreme position shown in Fig. 7. The starting and stopping of this advancing movement of the platen 14 through manipulation of the handle 58 is mainly utilized while dies are being set up on the platen or moving member 14 and the fixed head, and usually not in the normal operation of the press, although it will be understood that the operation could be fully controlled by the handle 58 in this manner. Instead of using the handle 58 in the normal operation of the press, switch buttons 114 and 116 serve to start and reverse the travel of the press.

Assuming that the parts are in the position shown in Fig. 1, one may start the advancing movement of the platen 14 by momentarily closing the normally open switch 114. This completes a circuit from line wire L', contact 113, switch 114, contact 115, switch 116, contact 117, wire 118 and solenoid 112 to line wire L2. The solenoid being now energized will shift its core 111 to the right (Fig. 1) and will connect the contacts 119 and 120. Thereupon a circuit is established as follows: line wire L', wire 121,

contact 120, core 111, contact 119, wire 122, contact 115, switch 116, contact 117, wire 118, solenoid 112, and line wire L². The core 111 thus closes a stick or holding circuit for the solenoid 118 and this holding circuit includes in series therein the normally closed switch 116. The switch 114, being spring urged into open position, opens automatically as soon as it is released.

When the solenoid 112 is energized, it shifts the valve element 109 to the right in Fig. 1 and connects the pipe 107 to the pipe 123. Liquid from the pump 24 then passes through the pipe 95, pipe 107, valve 108 and pipe 123 to pilot cylinder 61 and forces the valve element 50 endwise into the position shown in Fig. 6. This is the same position into which the valve element 50 was moved by the handle 58 as above described, and the platen 14 will now start or continue its advancing movement.

When the platen 14 reaches a desired position in its advancing movement, such as when the dies interposed between the platen 14 and fixed head 12 are about to engage, the rod 92 which has been previously set by adjustment on the platen 14 will by means of the head 93 engage with the forked arm 91 and rock it from the position shown in full lines in Fig. 2 to the dotted line position in that figure, which shifts the valve element 90 from the position shown in full lines in Fig. 1 to that shown in Fig. 2A. When this happens, liquid from the pump 24 is delivered through pipes 42 and 95, and valve 89 to pipes 97 and 102 which conduct the liquid from valve 89 to the inner end of the pilot cylinder 86 and to the outer end of the pilot cylinder 100. Since the opposite ends of those pilot cylinders are then exhausted through valve 89, the valve elements 82 and 104 will be shifted to their other positions in which the pipe 68 is connected to pipe 71 and the by-pass around the meter valve 46 is closed.

All of the liquid delivered by the pump to the chambers 69 and 72 will then be obliged to pass through the meter valve 46, and by suitable regulation of the latter the rate of travel of the platen can be regulated. After the valve element 82 has been moved, as just explained, to connect the pipes 68 and 71, the liquid delivered by the pump through pipe 45 will then pass to both of the cylinder chambers 69 and 72 and force the platen 14 further in an advancing direction but at a slower speed. When this happens the pressure in pipe 73 will cause the valve element 75 to seat, so that the liquid delivered to the chamber 72 cannot escape through the valve 74 back to the tank 10. This advancing movement of the platen 14 will continue, and as the material between the dies is compressed, the pressure in the chambers 69 and 72 will build up through continued operation of the pump 24.

The increasing pressure in the chamber 72 will be communicated through the pipes 71 and 81 to the small cylinder 38 of the pump 24 and act through the piston 37 on the lever 27 in a direction tending to set the yoke 25 for zero delivery of the pump. This movement of the lever 27 by the piston 37 is opposed by the spring 36, and consequently no such resetting of the yoke 25 will occur until the desired pressure for which the hand wheel 34 has been set has been approximately reached, and then when that pressure is reached the piston 37 of the pump will automatically set the yoke 25 to zero delivery position, but the pump 24 will continue to op-

erate, yet deliver only sufficient liquid to the chambers 69 and 72 to maintain the desired pressure.

After this pressure has been maintained for the desired duration, the attendant pushes the button 116 which opens the holding circuit for the solenoid 112, whereupon the valve element 109 will be shifted back into the position shown in Fig. 1 by the spring 125, with the result that liquid no longer can pass through from pipe 107 into pipe 123, and the latter will then be vented through pipe 124. The pressure in pilot cylinder 61 of the valve 49 is then relieved, and the spring 59 shifts the valve element 50 to the other extreme position shown in Fig. 7. When this happens the valve head 51 will move between the ports 48 and 66 and stop the delivery of liquid through pipe 45 to pipe 68, and the latter pipe will then be connected through the lower end (Fig. 1) of the valve 49 to the port 63 which allows escape of liquid from the chamber 69 through pipes 68 and 65 back to the tank 10. At the same time, the bevelled valve head 52 is disposed beyond the groove 67 and prevents the flow of liquid from the inlet port 48 to the port 64 and consequently the liquid entering the valve through the port 48 will pass through the groove 67 and pipe 78 to the pilot cylinder 77 and there, by its action on the piston 76, will force open the check valve 75. This allows liquid to pass from the cylinder chamber 72 back to the tank 10 directly.

The valve element 82 has remained in the same position and consequently as soon as the pipe 68 was connected to the port 63, the pressure was relieved in not only the chamber 69 but also in the chamber 72, since the liquid would escape from the chamber 72 through the pipe 71 and valve 70 back to the pipe 68. As soon as the pressure in pipe 71 falls sufficiently, however, the check valve 74 will be forced open, and then the liquid may pass from the chamber 72 directly through the pipe 73 and valve 74 back to the tank 10. At the same time, the pump 24 is delivering liquid through the pipe 42 to the pull back chamber 44 and since there is now no opposing or back pressure in the chambers 69 and 72, the pressure in the chamber 44 will force the piston 15 downwardly or inwardly in the cylinder 13 and retract the working member 14.

As the platen or working member 14 approaches the desired limit of its retraction, the arm 54 thereon, Figs. 8 and 9, will engage the valve rod 53 and force it inwardly into the tank 10 and thus shift the valve element 50 into the intermediate position shown in full lines in Fig. 1, where further escape of liquid from the pipe 68 is prevented so as to stop the further retraction of the piston 15, and liquid delivered by the pump circulates idly through the port 64 and pipe 65 back to the tank 10. This position of the valve element 50 also releases the pressure in the pipe 78 and pilot cylinder 77, and the valve 74 is then free to close.

It will be noted, however, that as soon as the platen 14 started its retraction, the head 93 moved backwardly and soon engaged the forked arm 91 and rocked the valve element 90 back into the position shown in Fig. 1, whereupon the valve elements 104 and 82 were returned to the position shown in Fig. 1. The platen 14 will thus come to rest at the end of its return travel and remain there until the operator either closes the switch 114 to start a regular normal advance-

ment of the member 14, or operates the handle 58 to initiate an advance movement of the member 14. Any slippage of the operating liquid in the pump will drain through pipe 126 and heat exchanger 127 into the tank 10, and be cooled thereby before it is mixed with the liquid in the tank 10.

Instead of employing the valve 89 for controlling the valve 82, the platen or working member 14 may directly control the valve element 82 of valve 70, as shown in Fig. 4. In this embodiment of the invention the valve element 82 is provided with an operating stem 130, Fig. 4, which extends outside of the casing of the valve 70 and is connected to a rod 131 which passes loosely through an aperture in the platen 14. An adjustable abutment 132 is provided on the upper or outer end of the rod 131, so that when platen 14 reaches the desired position, such as where the dies are engaging or are about to engage the work, the platen 14 will engage the abutment 132 and shift it and rod 131 endwise, thereby moving the valve element 82 sufficiently to uncover the opening into pipe 71 and establish communication between pipes 68 and 71. This communication will continue, even though the valve element 82 may continue its movement for a further distance sufficiently to complete the pressing operation. A spring 133 tends to return the valve element 82 to its position shown in Fig. 4, as soon as the rod 131 is released during the retraction of the platen 14.

Still another means for operating the valve element 82 is shown in Fig. 5 in which the platen 14 is directly coupled to a rod 134 which is suitably guided at its free end in a bearing 135. This rod 134 has a bevelled cam surface 136 at one end of an enlargement 137. The valve element 82 has an operating rod 138 extending outwardly on the casing of the valve 70, where it is connected by a pin and slot connection to one arm of a bell crank lever 139, which is pivoted at 140 on a bearing arm 141 extending from the casing of the valve 70. The other arm of the bell crank 139 mounts a roller or cam follower 142 which is normally disposed in the path of travel of the enlargement 137. Hence, as the platen 14 advances, the cam 136 will engage the roller 142 and cam it in a direction to move the valve element 82 endwise and uncover the pipe 71. This required movement of the valve element 82 is obtained by the time the roller 142 reaches the cylindrical part of the enlargement 137, after which the travel of platen 14 and rod 134 in the advancing direction may continue without further operation of the valve 82. During retraction of the platen 14, as soon as the roller 142 is again opposite the cam 136, it will ride down the same under the action of a spring 143, and the valve element 82 will be returned by spring 143 to the normal position shown in Figs. 1 and 5.

In Fig. 11 a slight modification in the three-position valve 49 of Fig. 1 is shown. Instead of utilizing the pilot cylinder 61 to secure the valve element 50 in the Fig. 6 position, the valve 50 is provided with a valve rod 53a which extends beyond the casing of the valve and carries a head 144. A latch lever 145, pivoted at 146, is engageable behind the head 144 when the valve element 50 is shifted endwise against the action of the spring 59 into the Fig. 6 position. A spring 147 acting on the latch lever 145 urges it into latching position behind the head 144. Thus,

when the valve element 50 is shifted from the neutral or intermediate position, shown in Figs. 1 and 11, into the position shown in Fig. 6, it will be latched by the lever 145 in that position.

While a manual release may be provided for the lever 145, the release may be accomplished in a simple manner by the use of a solenoid 148 which acts on the lever 145 in a direction to unlatch it from behind the head 144. The solenoid 148 is supplied with current from a circuit which includes line wires L¹ and L² and a normally open switch 149, the latter being in series with the solenoid. Thus, when one desires to release the latch 145 and start a retraction of the platen 15 or working member 14, one merely closes the switch 149 momentarily so as to energize the solenoid 148 and unlatch the head 144. The spring 59 then returns the valve element 50 to the Fig. 7 position, and starts a retraction of the platen, as explained above in connection with Fig. 1.

The valve 70 of Figs. 1, 4, and 5 may also be replaced by a spring closed and pressure opened valve and a check valve, connected in parallel to one another, as shown in Fig. 10. Referring now particularly to Fig. 10, the valve 70 may be replaced by a valve 150 which is of the spring closed and pressure opened type, with the direction of flow indicated by the arrow beneath the same, and with the connections to the pipes 68 and 71 as indicated in Fig. 10. The valve element 151 of the valve 150 will remain closed until the pressure builds up in the pipe 68 sufficiently to unseat it, and then it will automatically pass a liquid to the main pressure chamber 72 of the cylinder 13. With such an arrangement, the platen 14 will be given its rapid movement, with only the chamber 69 furnishing the advancing pressure, until a desired resistance is encountered by the platen, such as after the dies have engaged the work. Then the valve element 151 will be forced open by the increasing pressure in pipe 68, and the pressure will be built up in chamber 72 as well as 69.

As soon as the pressure in pipe 68 falls, however, which occurs when the three-position or main controlling valve element 50 is set in the Fig. 7 position to initiate the retraction of the platen, the valve element 151 will close and further escape of liquid from the chamber 72 would then be prevented. The escape of liquid from chamber 72 is essential at this time, however, and therefore I connect a free check valve 152 by pipes 153 and 154 to the pipes 68 and 71, in parallel to the valve 151, but the check valve 152 operates to open automatically in the direction of the arrow shown below it, and pass liquid only in the opposite direction from that passed by valve 150, so that the liquid from the chamber 72 can then pass through pipe 71, pipe 154, free check valve 152, and pipe 153 back to pipe 68. From pipe 68 it continues to tank 10 with the liquid from chamber 69. In this manner, the pressure in chamber 72 is reduced sufficiently to allow the pilot operated check valve 74 to open.

In the foregoing description, it will be understood that the meter valve 146 is illustrated merely conventionally, and that any suitable type of meter valve, many of which are available in the open market, may be used for that purpose. It will be noted that one may stop the travel of the platen 14 at any intermediate position in its advancement or retraction, and hold it in that position, and cause any increments of movement in either direction therefrom, merely

by manipulation of valve 49. It will also be noted that the speed of travel of the platen is relatively rapid until a desired position is reached, or until desired resistance is encountered, and then the rate of travel of the platen will be slowed down materially or to any desired extent. The advancement of the platen will continue until a desired pressure has been built up, whereupon the pump 24 will set itself to short stroke and maintain that pressure as long as desired. When a retraction of the platen is initiated, it will continue unless stopped by a manual operation of the valve 49, until the platen reaches the desired retracted position in which it automatically sets valve 49 to intermediate position.

By using the pressure controlled, variable delivery type of pump, the travel of the platen is slowed down as the final or maximum desired pressure is approached, which is advantageous when molding certain products under pressure, such as phenylaldehyde condensation resins, commonly known as "Bakelite." This slowing down in the pressing operation, just before the maximum pressure is reached, is important with such materials as "Bakelite" because the material in the molds which is becoming plastic at this time, is allowed more time to flow out into the various parts of the die. This slowing down in the pressing operation is by this invention automatically controlled. This slowing down as the dies are closing, such as by having the platen automatically slow down the rate of its advancement at a desired position, is important when the press is used to close and hold closed the dies or molds utilized in die casting, because if the dies are moving too rapidly as they close, they may hit with too much impact or force with resulting breakage, battering or other injury thereto. High clamping or holding pressures on the dies are, however, available for die casting purposes.

During a retraction of the working member or platen 14, and after the pilot operated check valve 74 has been opened, the operating liquid may escape from the secondary or high pressure chamber 72 directly back to the tank 10, and the liquid in the primary chamber 69 is free to escape directly back to the tank 10 through the three-position valve. The resistance to retraction of the platen is therefore rather small, and if the piston 15 is upright so that gravity aids in the retraction of the platen, the platen may tend to descend more rapidly than liquid is supplied by the pump 24 to the chamber 44, with the result that the piston 15 would tend to create a suction in the pipe 42 and also in the pipe 45 which is connected thereto.

If such a suction is created, the pressure in the pipe 78 would fall and the valve element 75 controlling the escape of liquid from the secondary or high pressure chamber would close, and thereupon the descent of the platen would be stopped. This would be only momentary however, because the pressure in pipes 42 and 45 would soon build up again and force open the valve element 75. Hence the platen would tend to settle or be retracted by jerky or intermittent increments of movement, but the insertion of valve 47 in the pipe 45 will effectively prevent this and allow for a smooth, continuous and rapid retraction of the platen. The valve 47 opens to pass operating liquid through the pipe 45 to the pipe 48 and pilot cylinder 77, and force open the valve element 75 early in the downward travel

or retraction of the platen, and if a suction or fall of pressure should be momentarily created in the pipes 42 and 45, the check valve 47 would immediately close, and prevent any back travel in the pipe 78 which would allow premature closure of the valve element 75.

While I have illustrated the pump 24 as being of the pressure holding, variable delivery type as the preferred embodiment of the invention, it will be understood that other means for supplying the liquid under pressure may be employed. For example, an ordinary pump with a by-pass through a spring loaded, release valve could be utilized for this purpose and is to be considered as the mechanical equivalent of the pump 24 in the broader interpretation of the invention.

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

I claim as my invention:

1. In a hydraulic press, a main cylinder, a ram extending into said cylinder and having within the cylinder a piston head cooperating with the wall of the cylinder, said cylinder at its open end through which said ram extends having a packing gland slidably engaging said piston, the exposed area of one face of said piston head being substantially greater than on its opposite face, said piston head mounting piston rings in its periphery which engage said cylinder wall, a source of fluid under pressure connected separately to said cylinder at opposite sides of said piston head, and always exerting the same pressure per unit area upon both sides of said head when applied to both sides of the head, means for controlling the passage of said fluid under pressure to said cylinder through said separate connection to the cylinder at the side of the piston head of greater exposed area, and for exhausting said fluid from that side of the piston head, whereby the ram will travel in one direction or the other selectively in accordance with whether said means is causing admission of said fluid to or exhaust from said cylinder, and scoring of said cylinder wall by liquid passing said rings under high pressure will be prevented.

2. In a hydraulic press, a main cylinder, a ram in said cylinder and having within the cylinder a piston head cooperating with the interior wall of said cylinder, the exposed face pressure area of said head at one side of said head being materially less than on the other side, said head having an annular groove in its periphery, a piston ring in said groove and engaging the cylinder wall for closing the space between said head and cylinder, means for applying a fluid under high pressure to that face of said head having the greater exposed face pressure area for forcing said ram in one direction, and means for supplying to the cylinder at the face of said head having the lesser exposed face pressure area, a fluid under a pressure per unit area approximately equal to that on the opposite face of said head whereby the pressure differential per unit area on opposite faces of said piston will be sufficiently small so that leakage along the cylinder wall past said piston under a high pressure differential and tending to score said cylinder walls will be substantially avoided.

3. In a hydraulic press, a cylinder, a ram operating in said cylinder and having a piston head cooperating with the cylinder wall and with dif-

ferent pressure face areas on opposite faces thereof, said head having an annular groove in its periphery, a piston ring loose in said groove and engaging the cylinder wall to close the space between said head and the cylinder wall, means for supplying a high pressure fluid to said cylinder at that side of said head having the greater pressure face area for forcing the ram in one direction in said cylinder, and means for concomitantly supplying to said cylinder at the opposite side of said head, a fluid pressure per unit area approximately equal to that on the other side of said head, whereby the pressure differential per unit area on opposite faces of said piston will be so small that leakage of actuating fluid under a high pressure differential past said ring and tending to score the cylinder wall will be substantially avoided.

4. In a hydraulic press, a main cylinder closed at one end and open at the other, a ram extending into the open end of said cylinder and having within the cylinder an external peripheral flange forming a piston head cooperating with the wall of the cylinder, said cylinder at its open end through which said ram extends having a packing gland slidably engaging said ram, a tube-like wall projecting from the closed end of said cylinder within the cylinder and spaced from the wall thereof, said ram having in its inner end a deep, annular recess to loosely telescope with said tube-like wall, the portion of the inner end of said ram encircled by said recess having an outside peripheral flange forming an auxiliary and smaller piston head cooperating with the inner surface of said tube-like wall, the outside peripheral surfaces of said piston heads having annular grooves, piston rings confined in said grooves and making tight sliding seals between the piston heads and their said cooperating walls, a source of fluid under pressure connected to said cylinder between the first mentioned piston head and said gland, means connecting said source to the closed end of said cylinder within the space encircled by said tube-like wall, means for connecting together the closed end of said cylinder at opposite sides of said tube-like wall, a valve in said last connecting means and operable to open position when pressure on the entire inner end of the ram is desired, whereby the pressure on both sides of both piston heads may be approximately balanced for use with relatively high pressures per unit area, to restrict the tendency of the actuating fluid to leak past said piston rings under high pressure differentials.

5. In a hydraulic press or the like, a reservoir, a variable delivery pump, a connection between said pump and said reservoir by which the pump withdraws an operating fluid from the reservoir and delivering it under pressure, said pump having an outlet for slippage operating fluid, a conduit connecting said outlet to said reservoir for conducting the slippage fluid back to said reservoir, and means associated with said conduit for cooling said slippage fluid before its discharge into said reservoir.

6. In a hydraulic press, a platen, hydraulic pull-back means acting on said platen for retracting it, primary hydraulic means acting on said platen to advance it into pressing position, secondary hydraulic means for supplementing the pressing action of said primary means, a source of operating liquid under pressure, a valve, a pipe connecting said source to said valve, and said valve to said primary hydraulic means and said valve having a movable valve element op-

erable selectively into three different positions to connect said source to said primary means, to close the pipe to said primary means, or to conduct liquid away from said primary means depending upon the position of said valve element, a connection between said primary and secondary hydraulic means, a valve in said connection for closing and opening communication between said primary and secondary hydraulic means, a reservoir, and a check valve connected between said reservoir and said secondary hydraulic means and opening freely to conduct liquid from said reservoir to said secondary hydraulic means and automatically closing to prevent reverse flow, and means controlled by said valve element and operable when pressure on said primary hydraulic means has been released for forcibly opening said check valve to pass liquid from said secondary means directly to said reservoir during retraction of said platen.

7. In a hydraulic press, a vertically moving platen, hydraulic pull-back means acting on said platen for retracting it downwardly, primary hydraulic means acting on said platen to advance it upwardly into pressing position, secondary hydraulic means for supplementing the pressing action of said primary means, a source of operating liquid under pressure, a valve, a pipe connecting said source to said valve, and said valve to said primary hydraulic means and operable selectively to connect said source to said primary means, to close the pipe to said primary means, or to conduct liquid away from said primary means depending upon the position of said valve, a check valve in the connection from said source to said first valve and opening to pass fluid solely towards said valve from said source, a connection between said primary and secondary hydraulic means, a valve in said connection for closing and opening communication between said primary and secondary hydraulic means, a reservoir, and another check valve connected between said reservoir and said secondary hydraulic means and opening freely to conduct liquid from said reservoir to said secondary hydraulic means and automatically closing to prevent reverse flow, means operable when pressure on said primary hydraulic means has been released for forcibly opening said check valve to pass liquid from said secondary means directly to said reservoir during retraction of said platen, and a separate connection from said source to said pull-back means for supplying liquid under pressure to said pull-back means continuously.

8. In a hydraulic press, a working member, hydraulic pull-back means acting on said member for retracting it, primary hydraulic means for advancing said working member, secondary hydraulic means also acting on said working member to advance it and supplement the pressure of said primary means on said member, a conduit including a valve connected between said primary and secondary means, a continuously operating pump forming a source of operating liquid under pressure connected to said pull-back means, a three-position valve, a pipe connecting said three-position valve to said source, a pipe connecting said three-position valve to said primary means, an exhaust pipe also connected to said three-position valve, said three-position valve having therein a valve element movable into one position in which it connects said source directly to said primary means and closes said exhaust connection, into an intermediate position in which it closes the pipe to said primary

means and connects the pipe from said source to said exhaust pipe, and into a third position in which it connects the pipe to said primary means with said exhaust pipe and closes communication between said pipe leading from said source and said exhaust pipe, means yieldingly urging said valve element into said third position, means operated by said working member while travelling in a retraction direction for operating said valve element against the action of said urging means into said intermediate position, means for operating said valve element also against the action of said urging means from said third position selectively into the intermediate or first positions, and means for also operating said valve element into said first position against the action of said urging means and holding it in that position.

9. In a hydraulic press, a working member, hydraulic pull-back means acting on said member for retracting it, primary hydraulic means for advancing said working member, secondary hydraulic means also acting on said working member to advance it and supplement the pressure of said primary means on said member, a conduit including a valve connected between said primary and secondary means, a continuously operating pump forming a source of operating liquid under pressure connected to said pull-back means, a three-position valve, a pipe connecting said three-position valve to said source, a pipe connecting said three-position valve to said primary means, an exhaust pipe also connected to said three-position valve, said three-position valve having therein a valve element movable into one position in which it connects said source directly to said primary means and closes said exhaust connection, into an intermediate position in which it closes the pipe to said primary means and connects the pipe from said source to said exhaust pipe, and into a third position in which it connects the pipe to said primary means with said exhaust pipe and closes communication between said pipe leading from said source and said exhaust pipe, means yieldingly urging said valve element into said third position, means operated by said working member while travelling in a retraction direction for operating said valve element against the action of said urging means into said intermediate position, means for operating said valve element also against the action of said urging means from said third position selectively into the intermediate or first positions, means for also operating said valve element into said first position against the action of said urging means and holding it in that position, means including a check valve for connecting said secondary means to said reservoir, and opening freely to pass liquid from said reservoir to said secondary means when said working member is advancing and when said first valve is closed, a pilot device for forcibly opening said check valve, and a connection from said pilot device to said three-position valve at a point therein to receive actuating liquid from said source whenever said valve element is in said third position.

10. In a hydraulic press, a working member, primary hydraulic means for advancing said working member, secondary hydraulic means also operable on said working member to advance it in the same direction and supplement the pressure of said primary means, a source of liquid under pressure, means connecting said source to said primary and secondary means for controlling the activity thereof, a meter valve in said connection from said source for controlling the

rate of delivery of liquid from said source to said hydraulic means, a bypass around said meter valve, and means operable for closing said bypass around said meter valve while liquid from said source is being delivered directly to said secondary means, whereby the rate of advancing travel of said working member under pressure from both primary and secondary means may be controlled by said meter valve, and said advancing travel under pressure only from said primary means may be free of control by said meter valve.

11. In a hydraulic press, a platen, ram means connected to said platen for operating it upwardly in a working stroke and downwardly in a retraction movement and having a pull-back chamber and two separate advancing chambers, a continuously operating pump, a pipe connecting said pump directly to said pull-back chamber, pipe means for delivering fluid from said pump to one of said advancing chambers and having valve means for controlling the delivery of fluid under pressure to said one advancing chamber and for connecting said chamber to exhaust selectively, a pipe also connecting said valve means to the other of said advancing chambers and having a valve therein, an exhaust pipe connected to said second advancing chamber and having a pilot operated check valve therein, said pilot operated valve normally closing to prevent escape of fluid from said second advancing chamber, a connection from the operating chamber of said pilot valve to said valve means, and said valve means being operable to deliver fluid under pressure to said pilot cylinder whenever said first advancing chamber is connected to exhaust, and a free check valve in said pipe means between said valve means and said pump, opening to permit flow from said pump to said valve means and automatically closing to prevent reverse flow.

12. In a hydraulic press of the type in which a ram is elevated vertically in a working stroke, hydraulic pull-back means acting on said ram for retracting it, primary hydraulic means acting on said ram to elevate it, secondary hydraulic means for supplementing the pressing action of the primary means, a continuously operating pump connected to said pull-back means, a valve having therein a valve element movable selectively into an intermediate and two end positions, a pipe connecting said pump to said valve and having therein a free check valve opening towards said valve and automatically closing to prevent reverse flow, means connecting said primary and secondary means and having therein a valve controlled by the travel of the ram and opened at a selected point in the travel of the ram and continuing open during the remainder of the elevation of the ram, a pilot operated, prefill valve connected to said secondary means, the pilot chamber of said prefill valve being connected to said first valve, said valve element operable when in intermediate position to close the connection therefrom to said primary advancing means, connect said pipe from the pump to exhaust, and said pilot operated chamber to exhaust, also operable when in one end position to connect the pipe from said pump to said primary means and the pilot chamber of the prefill valve to exhaust, and operable when in the other end position to connect said primary advancing means to exhaust and said pipe from said pump to said pilot operated chamber, means for yieldingly urging said valve element into said last named end position, and ram controlled means for operating said valve element against said urging

means into said intermediate position at a selected point in the retraction of said ram.

13. In a hydraulic press, a platen, a ram connected to said platen for operating the same, a continuously operating pump, a valve having therein a valve element movable between three positions, one of which is an intermediate position and the other two of which are end positions on opposite sides of said intermediate position, a connection from said pump to said valve, a connection from said valve to said ram and closed by said valve element when the latter is in said intermediate position, an exhaust pipe leading from said valve and connected to said pump connection through said valve when said valve is in said intermediate position, a pilot operated, prefill valve connected to said ram and having its pilot operating chamber connected to said valve for connection to said pipe from the pump when said valve element is in one end position, for connection to said exhaust and disconnection from said pipe from the pump when in said other end position and for connection to exhaust and said pipe from said pump when in said intermediate position, means yieldingly urging said valve element into said end position in which the pilot valve chamber is connected to said pipe from the pump, platen controlled means for forcing said valve element against the action of said urging means into said intermediate position as said platen approaches retracted position, and additional means for selectively forcing said valve element further against said urging means into the end position in which it connects the pipe from said pump to said ram and connects said pilot chamber to exhaust.

14. In a hydraulic press, a platen, a ram connected to said platen for operating the same, a continuously operating pump, a valve having therein a valve element movable between three positions, one of which is an intermediate position and the other two of which are end positions on opposite sides of said intermediate position, a connection from said pump to said valve, and having a choke therein to create a selected minimum back pressure on said pump, a connection from said valve to said ram and closed by said valve element when the latter is in said intermediate position, an exhaust pipe leading from said valve and connected to said pump connection through said valve when said valve is in said intermediate position, a pilot operated, prefill valve connected to said ram and having its pilot operating chamber connected to said valve for connection to said pipe from the pump when said valve element is in one end position, for connection to said exhaust and disconnection from said pipe from the pump when in said other end position, and for connection to exhaust and said pipe from said pump when in said intermediate position, means yieldingly urging said valve element into said end position in which the pilot valve chamber is connected to said pipe from the pump, platen controlled means for forcing said valve element against the action of said urging

means into said intermediate position as said platen approaches retracted position, and additional means operated by the back pressure on said pump for selectively forcing said valve element further against said urging means into the end position in which it connects the pipe from said pump to said ram and connects said pilot chamber to exhaust.

15. In a hydraulic motor, a working member, fluid actuated means for operating said member toward and from work, a control element for said means operable into one position in which it causes a working operation of said member, means for yieldingly urging said element in a direction out of said one position and fully into another position in which it causes a return of said member, a continuously running pump, a connection from said pump to said fluid actuated means and having a choke therein to create a minimum predetermined back pressure on the pump, hydraulic means for forcing said element into said one position and holding it in that position, another connection between said pump, before its connection to said choke and said hydraulic means to furnish continuously available fluid under pressure for operating said hydraulic means, a valve in said another connection, and means by which said valve may be operated to connect said pump to said hydraulic means or disconnect it therefrom.

16. In a hydraulic press, a platen mounted for movement upwardly and downwardly, hydraulic means for operating said platen upwardly in a working stroke, and downwardly in a retraction movement, said means including two separate platen elevating chambers and a platen retraction chamber, a continuously operating pump, a reservoir connected to the intake side of said pump, a pipe connecting the output side of said pump to said retraction chamber, a valve device connected to said pump and to one of said elevating chambers and operable to cause the delivery of fluid under pressure to said one elevating chamber and to connect that chamber to said reservoir selectively, a conduit connecting said elevating chambers to one another and having a valve therein, an exhaust pipe connecting the other of said elevating chambers to said reservoir and having therein a pilot operated check valve that normally closes to prevent escape of fluid from said other elevating chamber but opens freely to pass fluid from said reservoir to said other elevating chamber, a connection from the operating chamber of said pilot valve to said valve device and connected by the latter to said pump when said one elevating chamber is connected by said valve device to said reservoir, but disconnected from said pump when said one elevating chamber is connected by said valve device to said pump, and a free check valve in the connection from said valve device to said pump and opening to pass fluid from said pump to said valve device and closing automatically to prevent fluid flow in the opposite direction.

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