Feb. 4, 1936. J. K. DOUGLAS ET AL 2,029,708

HYDRAULIC PRESS

Filed March 14, 1930. 3 Sheets-Sheet 1

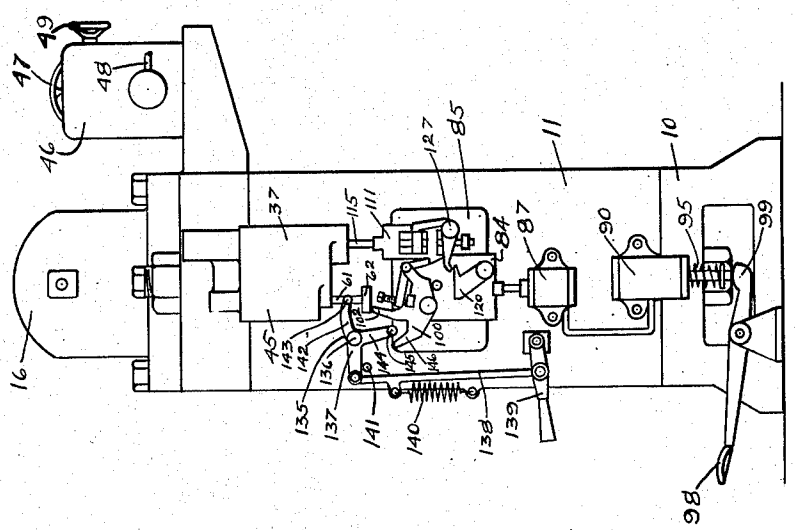


Fig. 2.

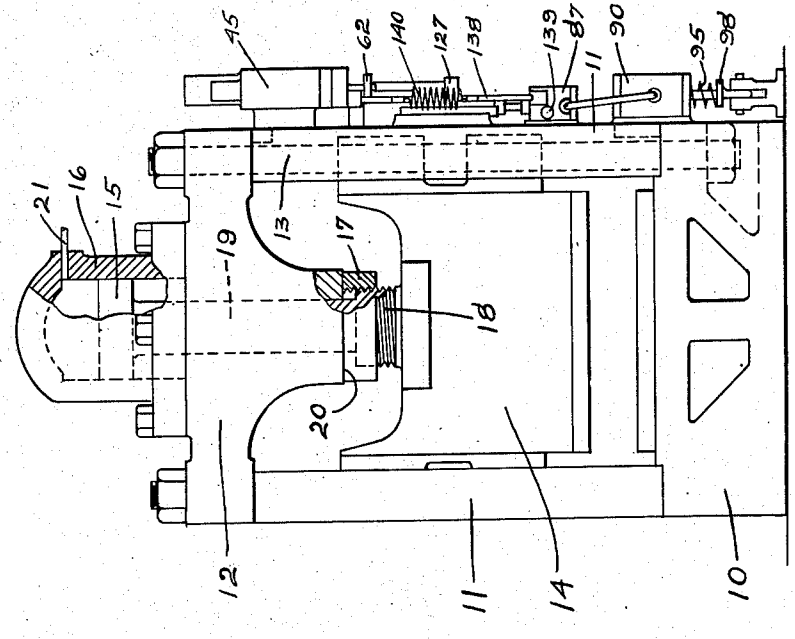


Fig. 1.

Inventors

GEORGE L. HEIDEN.

JAMES K. DOUGLAS.

By Ralph Brown.

Attorney

Feb. 4, 1936. J. K. DOUGLAS ET AL 2,029,708

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Filed March 14, 1930 3 Sheets-Sheet 2

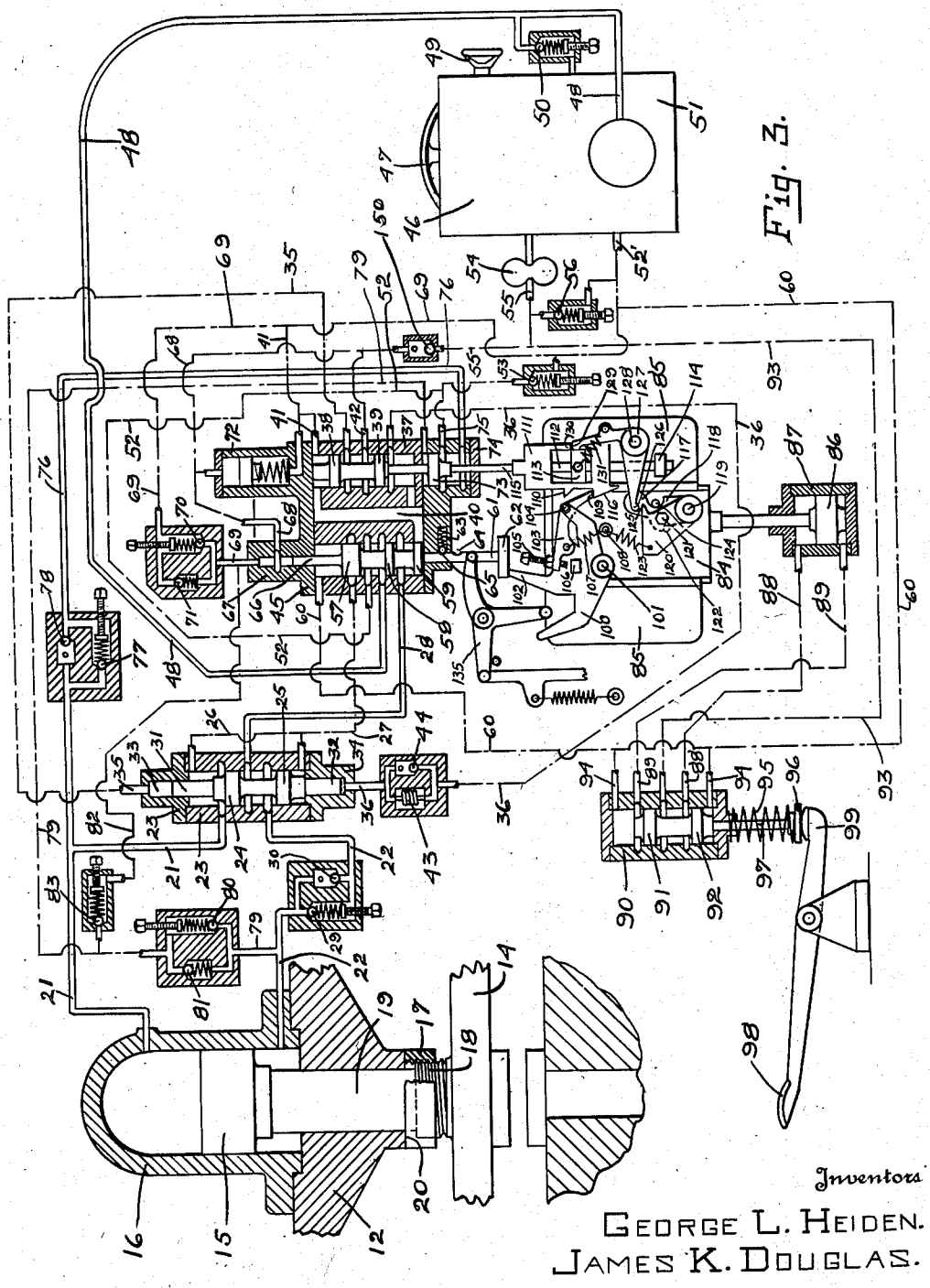


Fig. 2.

Inventors

GEORGE L. HEIDEN.

JAMES K. DOUGLAS.

By Ralph Brown

Attorney

Feb. 4, 1936. J. K. DOUGLAS ET AL 2,029,708

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Filed March 14, 1930 3 Sheets-Sheet 3

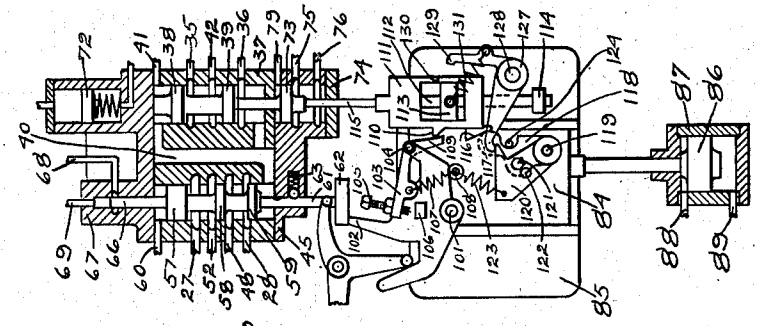


Fig. 4.

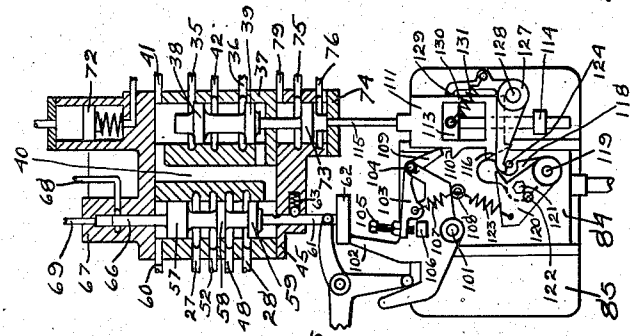


Fig. 5.

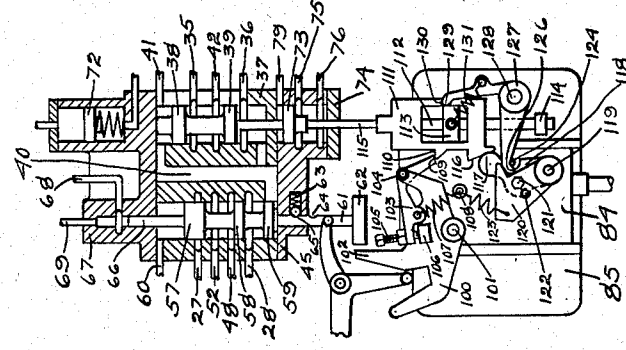


Fig. 6.

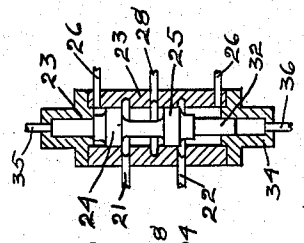


Fig. 7.

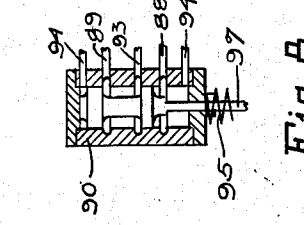


Fig. 8.

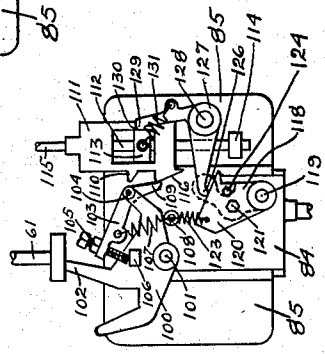


Fig. 9.

Inventors

GEORGE L. HEIDEN.

JAMES K. DOUGLAS.

By Ralph Lewis Brown

Attorney

Patented Feb. 4, 1936 2,029,708

UNITED STATES PATENT OFFICE

2,029,708

HYDRAULIC PRESS

James K. Douglas and George L. Heiden, Milwaukee, Wis., assignors to The Oilgear Company, Milwaukee, Wis., a corporation of Wisconsin

Application March 14, 1930, Serial No. 435,750

18 Claims. (Cl. 60—52)

This invention relates to hydraulic presses.

One object of the present invention is the provision of an improved hydraulic drive for presses capable of effecting extremely rapid reciprocation thereof through a short stroke. This we have accomplished by the use of a pump fed hydraulic circuit under the control of a reversing valve which responds to pressure at both ends of the stroke to automatically reverse the circuit.

Other more specific objects and advantages will appear from the following description of an illustrative embodiment of the present invention.

In the accompanying drawings:—

Figure 1 is a front elevation of hydraulic press embodying the present invention.

Fig. 2 is a side elevation thereof.

Fig. 3 is a diagrammatic illustration of the hydraulic system employed for driving the press.

Figs. 4, 5 and 6 are views partly in section and partly in elevation of certain of the valves shown in Fig. 3 together with their associated control mechanism, illustrating different characteristic positions thereof.

Fig. 7 is a sectional view of the reversing valve shown in Fig. 3, illustrating a second position thereof.

Fig. 8 is a sectional view of the starting valve illustrating a second position thereof.

Fig. 9 is an elevational view of the control mechanism of Figs. 4, 5 and 6 showing an adjusted condition thereof.

The press shown in Figs. 1 and 2 comprises an appropriate base 10, standards 11, and head 12, tied together by heavy tension rods 13 which also serve as guides for a vertically reciprocable platen 14. The platen 14 is supported and actuated by a piston 15 working in a cylinder 16 on the head 12. A collar 17 threaded on a boss 18 formed on the piston rod 19 coacts with the face 20 on the head 12 to limit the upward or return stroke of the platen 14. The piston 15 is actuated by liquid supplied to the upper or lower ends of the cylinder 16 through pipes 21 and 22 under the control of a reversing valve 23 of a type preferably such as will now be described.

The valve 23 comprises a housing longitudinally bored to receive a plunger having two heads 24 and 25 closely fitted for lengthwise movement therein. The opposite ends of the bore communicate with each other through a pipe 26 which connects with an exhaust pipe 27. A supply pipe 28 communicates at all times with the annular space between the heads 24 and 25. Head 24 controls the pipe 21 and head 25 controls the pipe 22. The arrangement is such that when the plunger of valve 23 is in the lower position of Fig. 3 pipe 22 is connected with the supply pipe 28, and pipe 21 is connected with the exhaust pipe 27 through pipe 26; and when the plunger of this valve assumes the upper position of Fig. 7 pipe 21 is connected with the supply pipe 28, and pipe 22 is connected with the exhaust pipe 27 through pipe 26.

A low pressure relief valve 29 interposed within the pipe 22 offers some resistance to the flow of liquid through the pipe 22 from the lower end of the cylinder 16 and thus serves to support the piston when the press is at rest and the pipe 22 open to exhaust. A check valve 30 connected across the relief valve 29 permits a free flow of liquid through the pipe 22 into the base of the cylinder.

The plunger of valve 23 is hydraulically actuated by auxiliary plungers 31 and 32 formed at the opposite ends thereof and working in cylinders 33 and 34 respectively applied to the opposite ends of the valve housing. Pipes 35 and 36 connected with the cylinders 33 and 34, respectively, are controlled by an appropriate pilot valve 37 of a type preferably such as will now be described.

The pilot valve 37 shown in Figs. 3, 4, 5 and 6 comprises a block bored to receive a plunger having two heads 38 and 39 fitted for axial movement therein. The opposite ends of the bore communicate with each other through a passage 40 formed in the valve block, and an exhaust pipe 41 communicates with the passage 40 through one end of the bore. A pressure pipe 42 communicates at all times with the annular space between the heads 38 and 39. Head 38 controls the pipe 35, and head 39 controls the pipe 36, so that when the plunger of valve 37 is in the elevated position of Fig. 3 pipe 35 communicates with the pressure pipe 42, and pipe 36 communicates with the exhaust pipe 41 through the passage 40, and when this plunger is in the lower position of Fig. 5 pipe 36 communicates with the pressure pipe 42, and pipe 35 communicates with the exhaust pipe 41. It will thus be noted that when the plunger of valve 37 is elevated, pressure is transmitted from pipe 42 through pipe 35 to the auxiliary plunger 31 to lower the plunger of valve 23, and when the plunger of valve 37 is lowered pressure is transmitted from pipe 42 through pipe 36 to the auxiliary plunger 32 to elevate the plunger of valve 23.

A choke coil 43 in the form of a coil of small diameter tubing is preferably interposed within the pipe 36 so as to restrict the flow therethrough

from the cylinder 34 and thus retard the downward movement of the plunger of valve 23. A check valve 44 connected across the choke coil 43 permits a free flow of liquid through pipe 36 to the cylinder 34 to thereby permit a rapid upward movement of the valve plunger.

The pipe 28 is supplied with driving liquid through a cut-off valve 45 from an appropriate pressure source, such as a variable displacement pump 46 of a well known type. The pump shown is fully described in the prior patent to Walter Ferris, No. 1,558,002, issued October 20, 1925. It is driven at constant speed from an appropriate power source through a pulley 47 and delivers liquid through a pipe 48 at a rate dependent upon the setting of a control element herein shown as a hand wheel 49. A high pressure relief valve 50 connected with pipe 48 protects the pump and system against excessive pressures. The pump receives its supply of liquid from a sump 51 in the base of the pump housing, which is replenished by liquid returned thereto through a pipe 52'. A low pressure relief valve 53 connects the pipe 52' to a pipe 52 and maintains a low pressure therein. A gear pump 54 of a well known type, ordinarily contained in the pump housing, receives liquid from the sump 51 and discharges into a pipe 55 which connects with pipe 42. A low pressure relief valve 56 connected with pipe 55 determines the degree of pressure therein.

In the system shown the housing of valve 45 is formed integral with that of valve 37 and is longitudinally bored to receive a plunger having three heads 57, 58, and 59. The upper end of the bore is connected to a drain pipe 60 connected with pipe 52, and the lower end of the bore communicates with the drain passage 40. Head 57 controls the exhaust pipe 27 from the valve 23; pipe 52 communicates with the annular chamber between the heads 57 and 58; pipe 28 communicates with the annular chamber between the heads 58 and 59; and the head 58 controls the pipe 48. The arrangement is such that when the plunger of valve 45 is in the lower position of Figs. 3 and 6 pipes 27 and 28 are blocked, and the supply pipe 48 from the pump is connected with the return pipe 52 leading to the sump through the relief valve 53 and pipe 52'; and when the plunger of valve 45 is in the elevated position of Figs. 4 and 5 the exhaust pipe 27 is connected with the return pipe 52, and the supply pipe 48 is connected with pipe 28 so that liquid delivered from the pump 46 is directed to the upper or lower end of cylinder 16 dependent upon whether the plunger of valve 23 is elevated or depressed.

The plunger of valve 45 is elevated by a stem 61 depending therefrom and carrying a head 62. A spring loaded detent 63 cooperates with notches 64 and 65 formed in the stem 61 to yieldably retain the same in elevated or depressed position. The plunger of valve 45 is lowered by a fluid actuated auxiliary plunger 66 projecting from the upper end thereof and working in a cylinder 67. A pressure pipe 68, connected intermediate the ends of cylinder 67 and controlled by the plunger 66, is supplied with liquid under pressure from the gear pump through pipe 55, the outer end of cylinder 67 being connected with a pipe 69 leading to the drain pipe 52'. Pipe 69 contains a low pressure relief valve 70 which offers a definite resistance to the escape of liquid therethrough from cylinder 67 to the drain pipe 52', and a check valve 71 connected across the relief valve 70 permits free passage of liquid through pipe 69 to the cylinder 67. A small pressure accumulator 72 of a well known type is preferably connected with the pipe 69 for a purpose which will later appear.

The plunger of the pilot valve 37 is hydraulically operated in both directions by a double acting piston 73 connected to the lower end thereof and working in a cylinder 74. A pipe 75, leading from the cylinder 74 intermediate the ends thereof and controlled by the piston 73, communicates with the return pipe 52. A pipe 76 communicating with the lower end of cylinder 74 connects with pipe 21 through a high pressure relief valve 77 which offers high resistance to the flow of liquid from pipe 21 to cylinder 74. A check valve 78 connected across the valve 77 permits a free flow of liquid through pipe 76 in the opposite direction. Similarly a pipe 79 communicating with the upper end of cylinder 74 connects with pipe 22 through a high pressure relief valve 80 which offers high resistance to the flow of liquid from pipe 22 to cylinder 74, and a check valve 81 connected across valve 80 permits a free flow in the opposite direction. A pipe 82, connected with pipe 79 beyond the valve 80, communicates with the end of cylinder 67 through pipe 69 and contains a relief valve 83 which offers considerable resistance to the flow of liquid from pipe 79 to the cylinder 67.

Referring to Fig. 3 it will be noted that the main piston 15 of the press is elevated so that the stop collar 17 abuts the lower face of the he 12; that the plunger of the reversing valve 23 is depressed so that pipe 28 is connected with the lower end of cylinder 16, and pipe 27 is connected with the upper end of cylinder 16; that the plunger of the cut-off valve 45 is depressed so that both pipes 27 and 28 are blocked and the piston 15 is thus locked in elevated position, and so that pipe 48 is connected with pipe 52 and the entire discharge from the pump escapes through the low pressure relief valve 53 to the sump in the pump casing; and that the plunger of the pilot valve 37 is elevated.

To start the press the plunger of the cut-off valve 45 is elevated into the position of Fig. 4 by forcing the stem 61 thereof upwardly to thereby connect pipe 27 with the return pipe 52 and pipe 28 with pipe 48. Pipe 48 from the pump is thus connected to the lower end of cylinder 16 through pipes 28 and 22, and since the piston 15 cannot move upwardly the pressure in the lower end of the cylinder 16 rises, the relief valve 80 opens and pressure is transmitted through pipe 79 to the upper end of cylinder 74 to lower the plunger of pilot valve 37 into the position of Fig. 5. Pressure from the gear pump 54 is then directed from pipe 55 through pipes 42 and 36 to the cylinder 34 to thereby elevate the plunger of the reversing valve 23 into the position of Fig. 7. The lower end of cylinder 16 is thus connected through pipes 22, 26, and 27 to the return pipe 52, and the pipe 48 from the pump is connected through pipes 28 and 21 to the upper end of cylinder 16 and the piston 15 starts down.

The piston 15 continues downwardly until the pressure in the upper end of cylinder 16 is increased by the resistance of the work to such a degree as to open the relief valve 77, whereupon pressure is transmitted through pipe 76 to the lower end of cylinder 74 to thereby again elevate the plunger of the pilot valve 37 into the position of Figs. 3 and 4. Gear pump pressure is then transmitted through pipes 42 and 35 to the cylinder 33 to thereby return the plunger of the reversing valve 23 into the lower position of Fig. 3, so that the lower end of the cylinder 16 receives

the discharge from the pump through pipes 48, 28, and 22 and the piston 15 starts up. This upward movement continues until arrested by the engagement of stop collar 17 against the face 20 of the head 12, whereupon the pressure in the lower end of the cylinder 16 again rises causing the relief valve 80 to reopen and to again transmit pressure to upper end of cylinder 74 to again lower the plunger of the pilot valve 37 so as to again elevate the plunger of the reversing valve 23 and thus cause the piston 15 to again move down. The piston 15 thus continues to reciprocate, automatically reversing at both ends of the stroke in response to a rise in pressure in the system, as long as the plunger of the cut-off valve 45 remains in the elevated position of Figs. 4 and 5.

In the press shown provision is made for controlling both valves 45 and 37 so that the press may be made to operate continuously in the manner described or to come to rest after completion of a single cycle including a down stroke and return stroke of the piston. Mechanism for this purpose comprises a slide plate 84 guided for vertical reciprocation in a bracket 85 fixed to the side of the press below the valves 37 and 45. The plate is connected to and actuated by a piston 86 working in a cylinder 87. Pipes 88 and 89 connected to the opposite ends of the cylinder 87 are controlled by an appropriate valve 90 in the form of a housing longitudinally bored to receive a plunger having two heads 91 and 92. A pressure pipe 93, connected with the gear pump through pipe 55, communicates with the annular space between the heads 91 and 92. Pipe 88 is controlled by the head 92, and pipe 89 is controlled by the head 91. Both ends of the valve bore communicate through pipes 94 with the drain pipe 60. A spring 95 bearing against the head 96 of a stem 97 yieldably retains the plunger of valve 90 in the lower position of Fig. 3 in which position pipe 93 is connected with pipe 88 so that the piston 86 and plate 84 assume the lower position of Fig. 3. The plunger of valve 90 may be elevated into the position of Fig. 8 by depression of pedal 98 on one end of a lever whose other end 99 is engaged beneath the head 96. When elevated the valve 90 connects the pressure pipe 93 with the pipe 89 to thereby elevate the piston 86 and the plate 84 into the position shown in Figs. 4, 5 and 6.

A rocker element 100, pivotally mounted at 101 on the slide plate 84, carries a finger 102 normally engaged beneath the head 62 on the stem 61 of valve 45. The element 100 also carries a trip element 103 rockably supported at 104 thereon. A stop screw 105 in the tail of the trip 103 coacts with a lug 106 on the rocker element 100 to limit the rocking action of the trip thereon. A spring 107 connecting the tail of the trip and a stud 108 on the slide plate serves to yieldably retain the trip and rocker element in the positions shown in Fig. 3 with the finger 102 beneath the head 62. The stud 108 also limits the rocking action of the element 100 toward the right. A nose 109 on the trip 103 normally projects into the path of travel of a lug 110 projecting from one side of a frame 111 which is also mounted for vertical reciprocation on the bracket 85. In this instance the frame is connected with a bar 112 guided in brackets 113 and 114 on the bracket 85, and is actuated by and with the plunger of valve 37 through a tail rod 115.

The frame 111 also carries a cam 116 for coaction with the head 117 of a lever 118 rockably supported upon a stud 119 projecting from the slide plate 84. A trip lever 120 also mounted on the stud 119 is connected to the lever 118 through a bolt 121 so as to move therewith, a second perforation 122 being provided in the lever 120 to receive the bolt 121 and to thereby permit adjustment of lever 120 relative to lever 118. A spring 123 connected to the lever 120 and to the stud 108 urges both levers toward the right. A stop pin 124 projecting from the plate 84 coacts with lever 118 to limit the movement thereof toward the right. The lever 120 is provided with a nose 125 for cooperation with the tail 126 of a pawl 127 supported as at 128 on the bracket 85. The pawl is provided with a nose 129 for engagement beneath a shoulder 130 formed on the frame 111 to releasably retain the frame 111 in elevated position. A spring 131 connected to the pawl 127 and to the guide bracket 113 urges the nose of the pawl toward the frame.

Before starting the press the several parts of the control mechanism assume the positions shown in Fig. 3 with the nose 129 of the pawl 127 beneath the shoulder 130 of the frame 111 so as to retain the plunger of the pilot valve 37 elevated, and with the finger 102 of the rocker element 100 beneath the head 62. Then to start the press the operator depresses the pedal 98 to thereby elevate the plunger of valve 90 and cause the piston 86 and slide plate 84 to rise into the position of Fig. 4. As the plate moves up the finger 102 forces the plunger of valve 45 into the elevated position of Fig. 4, and the nose 125 of lever 120 strikes the tail 126 of the pawl 127 to effect withdrawal of the nose 129 thereof from the shoulder 130, so that the plunger of valve 37 is then free to lower as soon as pressure is transmitted to the upper end of cylinder 74 through pipe 79 from the lower end of cylinder 16. When this occurs the plunger of valve 23 is elevated in the manner previously described and the piston 15 moves down. As the plunger of valve 37 and the frame 111 move down, the cam 116 on the frame acts upon the head 117 of lever 118 so as to force both levers 118 and 120 toward the left so that the nose 125 is withdrawn from the tail 126 of pawl 127 permitting the same to assume the position shown in Fig. 5.

Then when the piston 15 reaches the end of its down stroke and the plunger of valve 37 is again elevated, by pressure transmitted through pipe 76 from the upper end of cylinder 16, the frame 111 also moves upwardly and the lug 110 thereon strikes the nose 109 of the trip element 103 and tilts the rocker element 100 toward the left, to thereby withdraw the finger 102 from beneath the head 62, as indicated in Fig. 6. And when the plunger of valve 37 and the frame 111 reach their elevated positions the nose 129 of the pawl 127 automatically engages beneath the shoulder 130 on the frame 111 to thereby lock the valve and frame in elevated position. This elevation of valve 37 effects depression of the valve 23 in the manner previously described and the piston 15 starts up. Then when the piston 15 reaches the end of its up stroke the pressure in the lower end of cylinder 16 increases and breaks through the valves 80 and 83 and pipe 82 to cylinder 67, and acting on the auxiliary plunger 66 forces the plunger of valve 45 downwardly into the position of Fig. 6. Pipe 48 is thus connected to the return pipe 52 and the piston 15 comes to rest. It will be noted that the pressure transmitted through valve 80 and pipe 79 to the upper end of cylinder 74 is ineffective to lower the plunger of

valve 37 because of the detent 127. The pedal 98 is then released permitting the plunger of valve 90 to reassume the depressed position of Fig. 3, whereupon the piston 86 and slide plate 84 lower and the several parts carried thereby reassume the positions shown in Fig. 3. The press is then in condition to repeat the cycle hereinabove described by again depressing the pedal 98.

If an automatic and continuous repetition of the cycle is desired the trip element 103 is so adjusted, by manipulation of the screw 105, that the nose 109 thereon is retracted from the path of travel of the lug 110, (see Fig. 9); and the lever 120 is advanced with respect to lever 118 by transferring the bolt 121 into the second perforation 122, so that the nose 125 is never withdrawn from beneath the tail 126 of the pawl 127. With the parts so adjusted the pawl 127 is held in inactive position, so as not to interfere with the lowering of the valve 37, so long as the slide plate 84 is elevated; and also the rocker element 100 remains unaffected by the lug 110, so that the finger 102 remains beneath the head 62 and thus retains the valve 45 in elevated position so long as the slide plate 84 is elevated. With the parts thus arranged the press is started by depressing the pedal 98 to thereby elevate the plate 84 and the plunger of valve 45 in the manner previously described. With the plunger of valve 45 retained in elevated position by the engagement of the finger 102 beneath the head 62, and with the plunger of the pilot valve 37 free to reciprocate in response to pressures transmitted through the valves 77 and 80, the piston 15 will continue to reciprocate until the pedal 98 is released to thereby lower the plate 84 into the position of Fig. 3. Thereafter, as the piston 15 reaches the upper end of its return stroke, the pressure in the lower end of the cylinder 16 is transmitted through valves 80 and 83 to the cylinder 67 to return the plunger of valve 45 into the lower position of Fig. 3 to thereby stop the press.

Provision is also made for stopping the press at any point in the cycle. Mechanism for this purpose comprises a lever 135 rockably supported as at 136 on the side of the press. One arm 137 of this lever is connected through appropriate linkage 138 with a hand lever 139 rockably supported within convenient reach of the operator. A spring 140 connected with the link 138 and the frame of the press yieldably retains both levers in the positions shown in Fig. 2, with the arm 137 resting upon a stop pin 141 projecting from the side of this press. Another arm 142 of lever 135 carries a roller 143 normally disposed above the head 62 and operable thereon to depress the plunger of valve 45. A third arm 144, depending from the lever 135, carries a roller 145 for coaction with the tail 146 of the rocker element 100 to swing the same and the finger 102 from beneath the head 62. The arrangement is such that when the hand lever 139 is raised lever 135 is rocked clockwise so that the roller 145 strikes the tail 146 of the rocker element 100 to displace the finger 102 from beneath the head 62, and the roller 143 strikes the head 62 to thereby lower the plunger of valve 45 into the position of Fig. 3. When this occurs the pipe 48 from the pump is connected to the return pipe 52, so that the pressure flow in pipe 28 is destroyed and the press stops.

It will be noted that the piston 86 is actuated by liquid supplied from the gear pump 54 through the valve 90, and that the auxiliary plungers 31 and 32 are also actuated by liquid supplied from the same pump through the valve 37. The accumulator 72 functions as an auxiliary pressure source to insure prompt and complete actuation of the valve 23, regardless of the demands made upon the gear pump 54 by the cylinder 87. The accumulator 72 is normally maintained in a charged condition by liquid supplied from the gear pump through pipes 55 and 68, and whenever the plunger of valve 37 is shifted into a new position, liquid discharged from the accumulator may pass through pipe 68 to pipe 42 to thus augment the flow from the gear pump and thus insure a prompt flow of liquid to one of the actuating cylinders 33 or 34 of the valve 23. A check valve 150 is preferably provided in the pipe 55 to prevent escape of liquid from the accumulator to the valve 90 and cylinder 87 so that the accumulator may be reserved as a source of supply for the valve 37 and the auxiliary cylinders 33 and 34 of the valve 23.

From the foregoing it will be noted that a hydraulic drive has been provided which responds automatically to stalling pressures in the press cylinder to effect prompt reversal of movement at both ends of the stroke. In the press shown reversal at the end of the working or down stroke occurs as the result of the increased pressure produced in the upper end of the cylinder 16 by the reaction between the dies, and reversal at the end of the return or upward stroke occurs as a result of the increased pressure produced in the lower end of the cylinder by the reaction between the stop collar 17 and the face 20 of head 12. Since reversal thus occurs as the result of pressure rather than piston movement, an extremely short stroke is possible with a consequent increase in number of strokes per minute. In fact, a blanking press of one hundred and twenty tons capacity, equipped with a hydraulic drive embodying the present invention, has operated successfully at speeds as high as one hundred and twenty cycles per minute, executing a one-eighth inch stroke, and providing sufficient clearance between the dies for feeding purposes.

Various changes may be made in the embodiment of the invention hereinabove described without departing from or sacrificing the advantages of the invention as defined in the appended claims.

We claim:—

1. In a press the combination of a reciprocable member, means including a pump fed hydraulic circuit for operating said member, valve mechanism in said circuit for reversing the flow therein to thereby reverse the movement of said member, fluid actuated means for operating said valve mechanism, a hydraulically operated pilot valve for controlling said fluid actuated means, and a pressure relief valve connected with each side of said circuit and responsive to a predetermined pressure therein for directing liquid from either side of said circuit to said pilot valve for operating the same.

2. In a press the combination of a reciprocable member, means including a hydraulic circuit for operating said member, valve mechanism in said circuit for reversing the flow therein to thereby reverse the movement of said member, fluid actuated means for operating said valve mechanism, a pressure relief valve connected with said circuit, a pilot valve actuated by liquid discharged through said relief valve for controlling said fluid actuated means, and means responsive to the pressure in said circuit exceeding a predetermined value for terminating the flow and re-

ducing the pressure in said circuit to thereby render said member inactive.

3. In a press the combination of a reciprocable member, a hydraulic circuit supplied with motive liquid from a suitable source and having a hydraulic motor connected therein for operating said member, a valve mechanism operable to reverse the flow in said circuit to thereby reverse the movement of said member, means responsive to the pressure in said circuit exceeding a predetermined value for operating said valve mechanism, and a valve mechanism operable in response to the pressure in said circuit exceeding a predetermined value and operable independently of said pressure responsive means for disconnecting said motor from said source to thereby render said member inactive.

4. The combination of a reciprocable member, means including a hydraulic circuit for reciprocating the same, a valve mechanism automatically operable in response to the pressure in said circuit exceeding a predetermined value to reverse the flow in said circuit to thereby reverse the movement of said member, a second valve mechanism operable to start and stop the flow in said circuit to thereby start and stop said member, means under the control of the operator for shifting said second named valve mechanism into starting position, means responsive to the pressure in said circuit exceeding a predetermined value at the end of a stroke of said member for automatically returning said second named valve mechanism into stop position to thereby cause said member to stop at the end of a reciprocation, and means adjustable to render said pressure responsive means ineffective to thereby cause said member to continue to reciprocate until stopped manually.

5. The combination of a reciprocable member, means including a hydraulic circuit for reciprocating the same, a valve automatically operable in response to the pressure in said circuit exceeding a predetermined value to reverse the flow in said circuit to thereby reverse the movement of said member, a second valve operable to start and stop the flow in said circuit to thereby start and stop said member, means under the control of the operator for shifting said second valve into starting position, said means including a detent adjustable to either hold said second valve in starting position or to be automatically operable to permit return of said second valve into stop position, and means responsive to the pressure in said circuit exceeding a predetermined value at the end of a stroke of said member for automatically returning said second valve into stop position.

6. The combination of a reciprocable member, means including a hydraulic circuit for operating the same, valve mechanism automatically operable to reverse the flow in said circuit to thereby reverse the movement of said member at the end of each stroke, a second valve mechanism operable to render said circuit active or inactive to thereby start and stop said member, a detent normally engageable with said second valve mechanism and movable to shift said valve mechanism into starting position, means controlled by said first named valve mechanism for shifting said detent out of engagement with said second valve mechanism to permit return thereof into stop position, and means automatically operable to return said second valve into stop position at the end of a stroke of said member.

7. The combination of a reciprocable member, means including a hydraulic circuit for operating the same, valve mechanism automatically operable to reverse the flow in said circuit to thereby reverse the movement of said member at the end of each stroke, a second valve mechanism operable to render said circuit active or inactive to thereby start or stop said member, a detent normally engageable with said second valve mechanism and movable to shift the same into starting position, and means normally controlled by said first valve mechanism for shifting said detent out of engagement with said second valve mechanism to permit return thereof into stop position, said detent shifting means being adjustable to render the same unaffected by said first named valve mechanism.

8. The combination of a reciprocable member, hydraulically actuated means for operating the same, a pressure responsive valve for reversing the movement of said member at the end of each stroke, means for releasably retaining said valve in one position, a second valve for starting and stopping said member, means operable to shift said second valve into starting position, said last named means being operable to release said retaining means to permit said second valve to assume a second position, means normally operable to releasably retain said second valve in starting position, means responsive to movement of said first named valve into said first mentioned position for releasing said last named retaining means, and pressure responsive means for returning said second valve into stop position.

9. The combination of a reciprocable member, hydraulically actuated means for operating said member, a pump, hydraulic driving connections between said pump and said operating means, an auxiliary pump, a reversing valve in said connections actuated by pressure generated by said auxiliary pump for reversing the movement of said member, and a pilot valve responsive to the pressure in said connections for effecting automatic operation of said reversing valve to cause reciprocation of said member.

10. The combination of a reciprocable member, a pump fed hydraulic circuit for operating the same, an auxiliary pump, a reversing valve in said circuit actuated by pressure generated by said auxiliary pump, and a pilot valve automatically operable in response to predetermined pressures in said circuit for controlling said reversing valve to cause the same to effect reciprocation of said member.

11. The combination of a reciprocable member, a pump fed hydraulic circuit for operating the same, a reversing valve in said circuit operable to reverse the movement of said member, an auxiliary pump, a pressure accumulator energized by said auxiliary pump for operating said reversing valve, and a pilot valve responsive to pressure in said circuit for controlling said reversing valve.

12. The combination with a hydraulic press including a reciprocatory platen; of a pump dischargeable in one direction only; means forming with the press and with the pump a high pressure hydraulic press-operating circuit; a reversing valve operatively connected in said circuit; a low pressure hydraulic pilot circuit; a pilot valve operatively connected in said low pressure circuit; pressure responsive actuating means associated with said reversing valve; hydraulic connections between the pilot valve and said pressure responsive actuating means for admitting

fluid from said low pressure circuit to said actuating means to shift the reversing valve when the pilot valve is shifted; means for shifting the pilot valve when the platen approaches the limit of one of its reciprocatory movements and means responsive to the pressure in said high pressure circuit for shifting said pilot valve upon said platen stalling at the other end of its reciprocating movement.

13. The combination with a hydraulic press including a reciprocatory platen; of a pump dischargeable in one direction only; means forming with the press and with the pump a high pressure hydraulic press operating circuit; a reversing valve operatively connected in said circuit; a low pressure hydraulic pilot circuit; a pilot valve operatively connected in said low pressure circuit; pressure responsive actuating means associated with said reversing valve; hydraulic connections between the pilot valve and said pressure responsive actuating means for admitting fluid from said low pressure circuit to said actuating means to shift the reversing valve when the pilot valve is shifted; and means responsive to the pressure in said press operating circuit exceeding a predetermined value for automatically shifting the pilot valve when the platen reaches the limit of one of its reciprocatory movements.

14. The combination with a hydraulic press including a reciprocatory platen; of a pump dischargeable in one direction only; means forming with the press and with the pump a high pressure hydraulic press-operating circuit; a reversing valve operatively connected in said circuit; a low pressure hydraulic pilot circuit; a pilot valve operatively connected in said low pressure circuit; pressure responsive actuating means associated with said reversing valve; hydraulic connections between the pilot valve and said pressure responsive actuating means for admitting fluid from said low pressure circuit to said actuating means to shift the reversing valve when the pilot valve is shifted; means responsive to the pressure in said press operating circuit exceeding a predetermined value for automatically shifting the pilot valve when the platen reaches the limit of its pressing stroke; and other means for automatically shifting the pilot valve in the opposite direction when the platen approaches the end of its return stroke.

15. The combination with a hydraulic press including a reciprocatory platen; of a pump dischargeable in one direction only; means forming with the press and with the pump a high pressure hydraulic press-operating circuit; a reversing valve operatively connected in said circuit; a low pressure hydraulic pilot circuit; a pilot valve operatively connected in said low pressure circuit; pressure responsive actuating means associated with said reversing valve; hydraulic connections between the pilot valve and said pressure responsive actuating means for admitting fluid from said low pressure circuit to said actuating means to shift the reversing valve when the pilot valve is shifted; and pressure responsive means associated with said pilot valve and having hydraulic communication with said high pressure circuit; said pressure responsive means being operable for shifting the pilot valve in one direction upon the attainment of a predetermined pressure in said circuit when the platen approaches the end of its pressing stroke.

16. The combination with a hydraulic press including a reciprocatory platen, a main cylinder, and a platen returning cylinder; of a pump dischargeable in one direction only; means forming with the pump and with said cylinders a high pressure hydraulic press-operating circuit; a reversing valve connected in said circuit for reversing the direction of fluid travel therein to reciprocate the platen, said valve including a valve casing formed with a valve chamber, a port communicating with said pump and with said valve chamber, a port communicating with said main cylinder and with said valve chamber, a port communicating with said platen returning cylinder and with said valve chamber, and means mounted for movement in said valve chamber for placing said pump in communication with said main cylinder when said means are moved in one direction, and for placing said pump in communication with said platen returning cylinder when said means are moved in the opposite direction; pressure responsive actuating means associated with said movable means for moving the latter in opposite directions; a low pressure pilot circuit; a pilot valve operatively connected in said circuit; hydraulic connections between the pilot valve and said pressure responsive actuating means for admitting fluid under pressure from said low pressure circuit to said actuating means to move said movable means when the pilot valve is shifted; means for shifting the pilot valve when the platen approaches the end of one of its reciprocatory movements and means responsive to the pressure in said high pressure circuit for shifting said pilot valve upon said platen stalling at the other end of its reciprocating movement.

17. The combination, with a reciprocable member, of a hydraulic circuit having a hydraulic motor connected therein for driving said member, a power pump for supplying liquid to said circuit to operate said motor, a hydraulically operated reversing valve connected into said circuit for reversing the flow therein to thereby effect reciprocation of said member, an auxiliary pump for supplying liquid to said reversing valve to operate the same, a resistance valve connected to each side of said circuit, and a pilot valve controlling the delivery of liquid from said auxiliary pump to said reversing valve and operated by liquid discharged through said resistance valves to thereby effect reversal of said reversing valve each time the pressure in either side of said circuit exceeds a predetermined value.

18. The combination, with a reciprocable member, of a hydraulic circuit having a hydraulic motor connected therein for driving said member, a power pump for supplying liquid to said circuit to operate said motor, a hydraulically operated reversing valve connected into said circuit for reversing the flow therein to thereby effect reciprocation of said member, an auxiliary pump for supplying liquid to said reversing valve to operate the same, a resistance valve connected to each side of said circuit, a pilot valve controlling the delivery of liquid from said auxiliary pump to said reversing valve and operated by liquid discharged through said resistance valves to thereby effect reversal of said reversing valve each time the pressure in either side of said circuit exceeds a predetermined value, and a start and stop valve connected between said power pump and said motor and operable to disconnect said motor from said power pump.

JAMES K. DOUGLAS.
GEORGE L. HEIDEN.