

Oct. 28, 1952

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2,615,302

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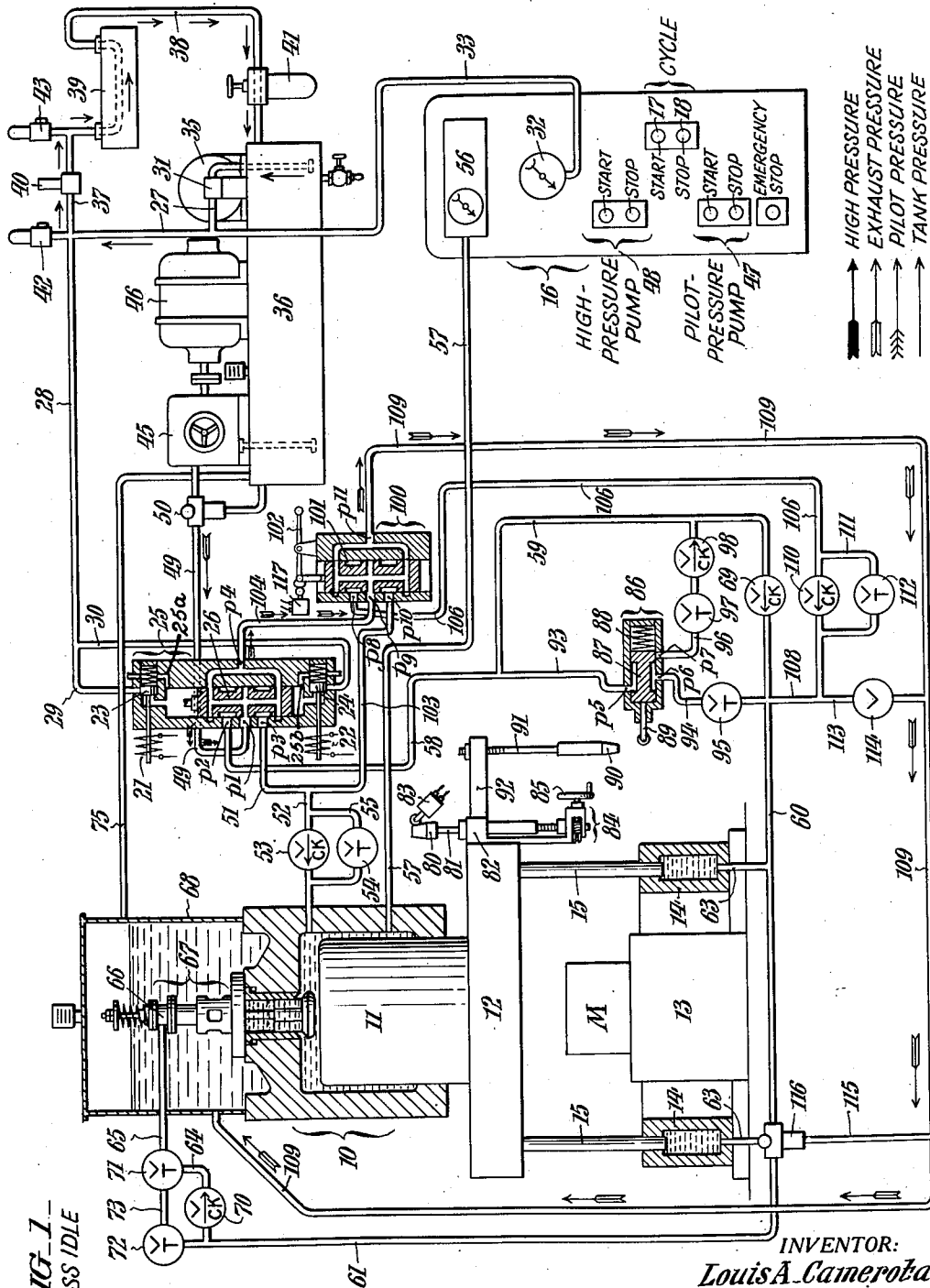


FIG. 1-
PRESS IDLE

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Oct. 28, 1952

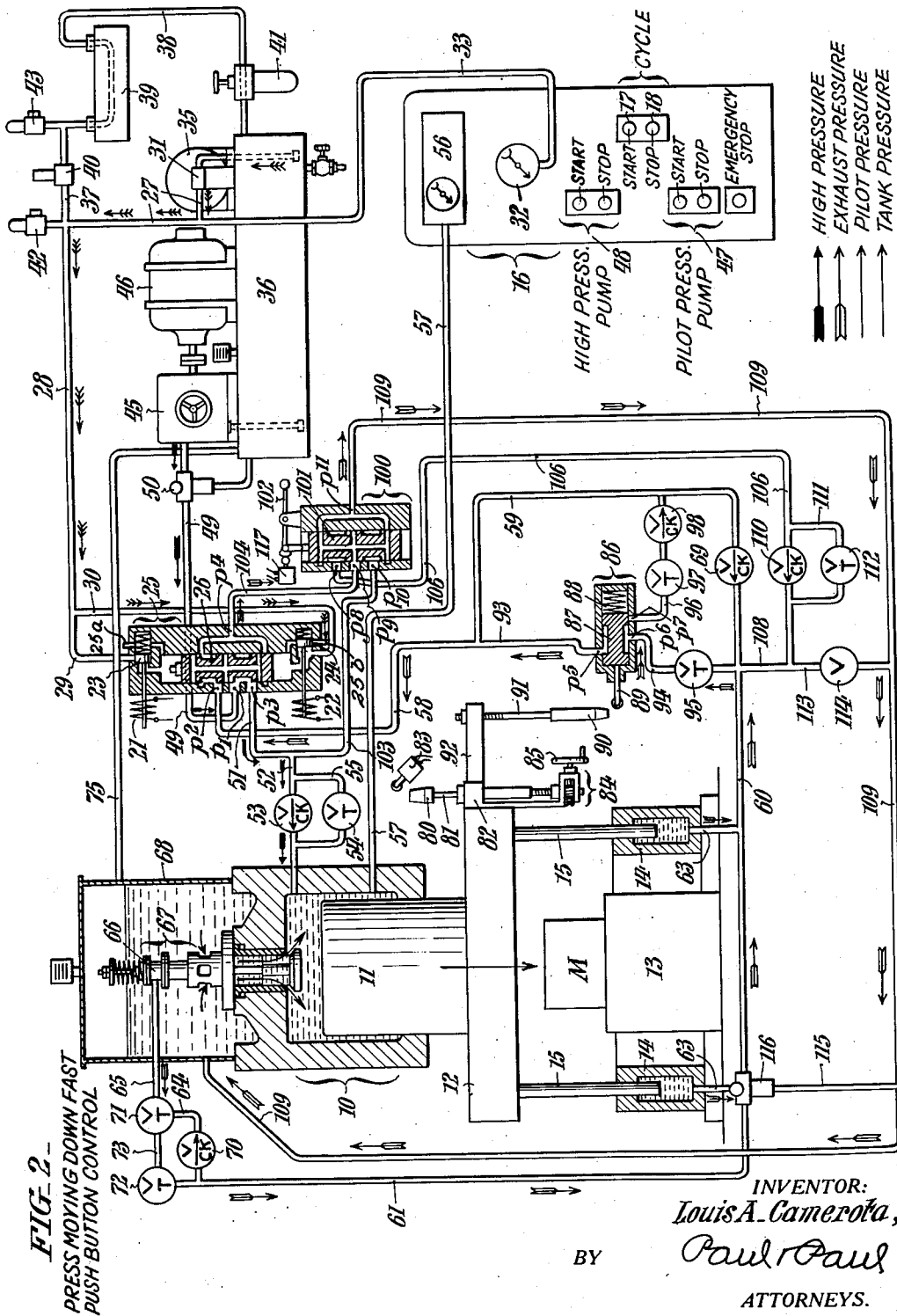
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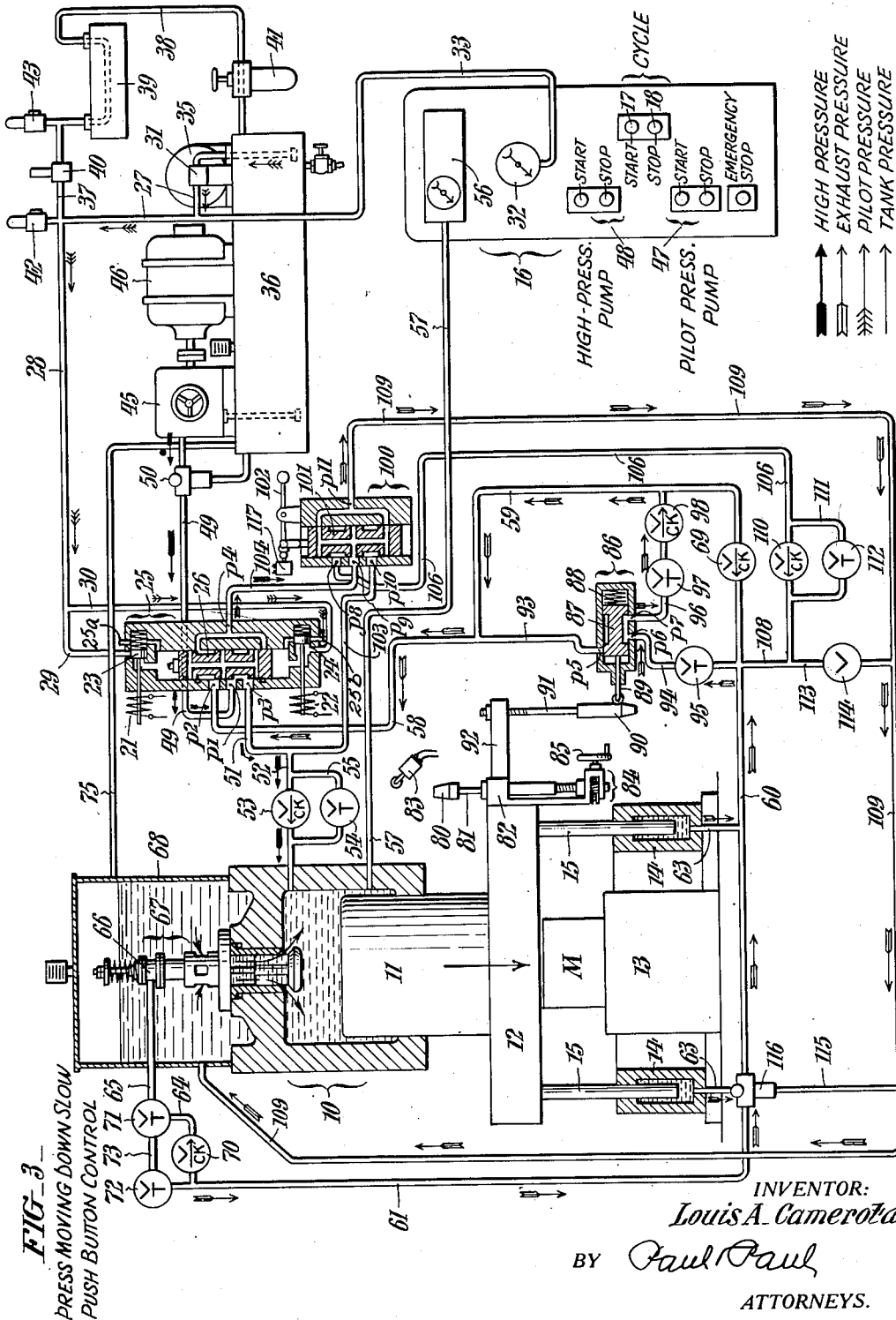
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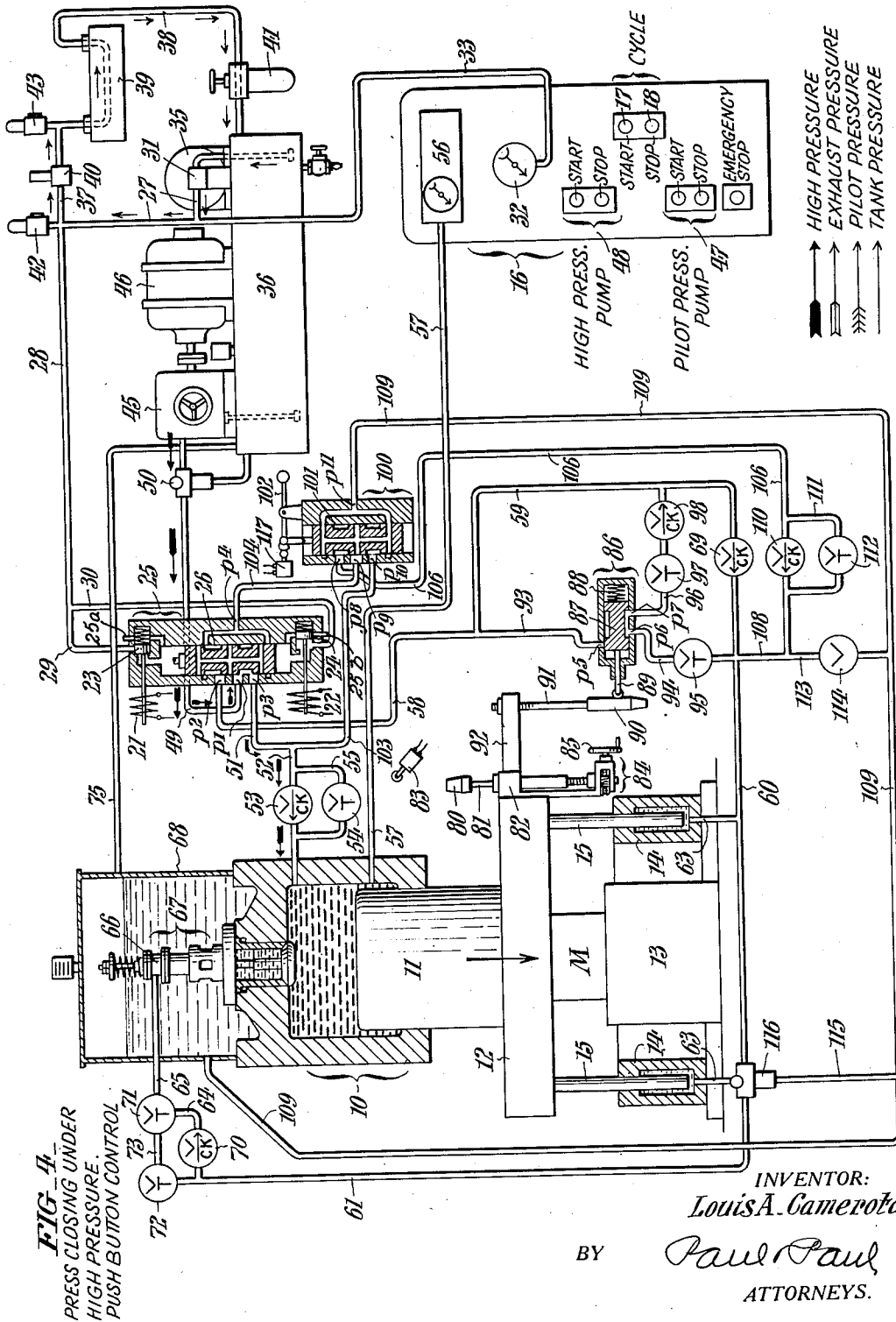
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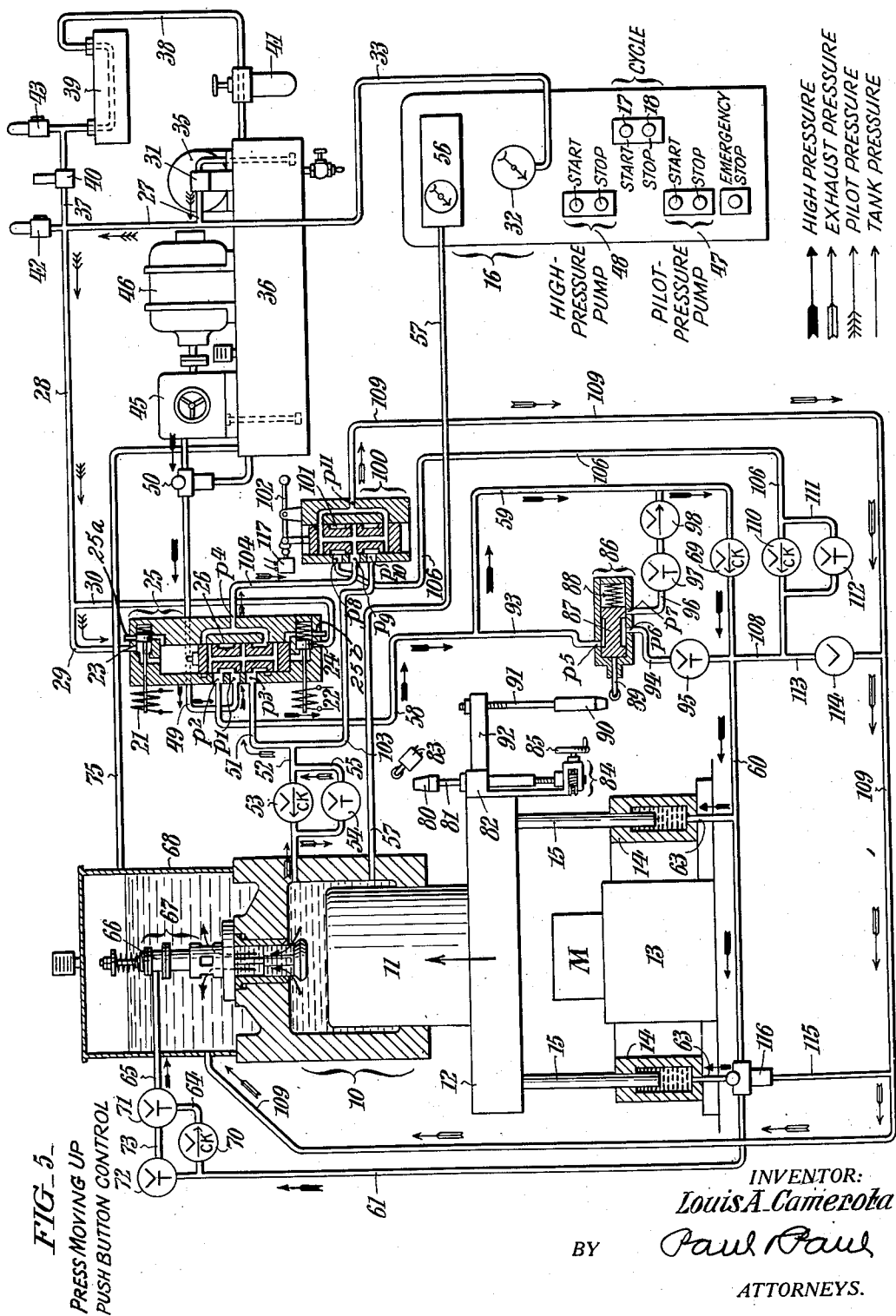
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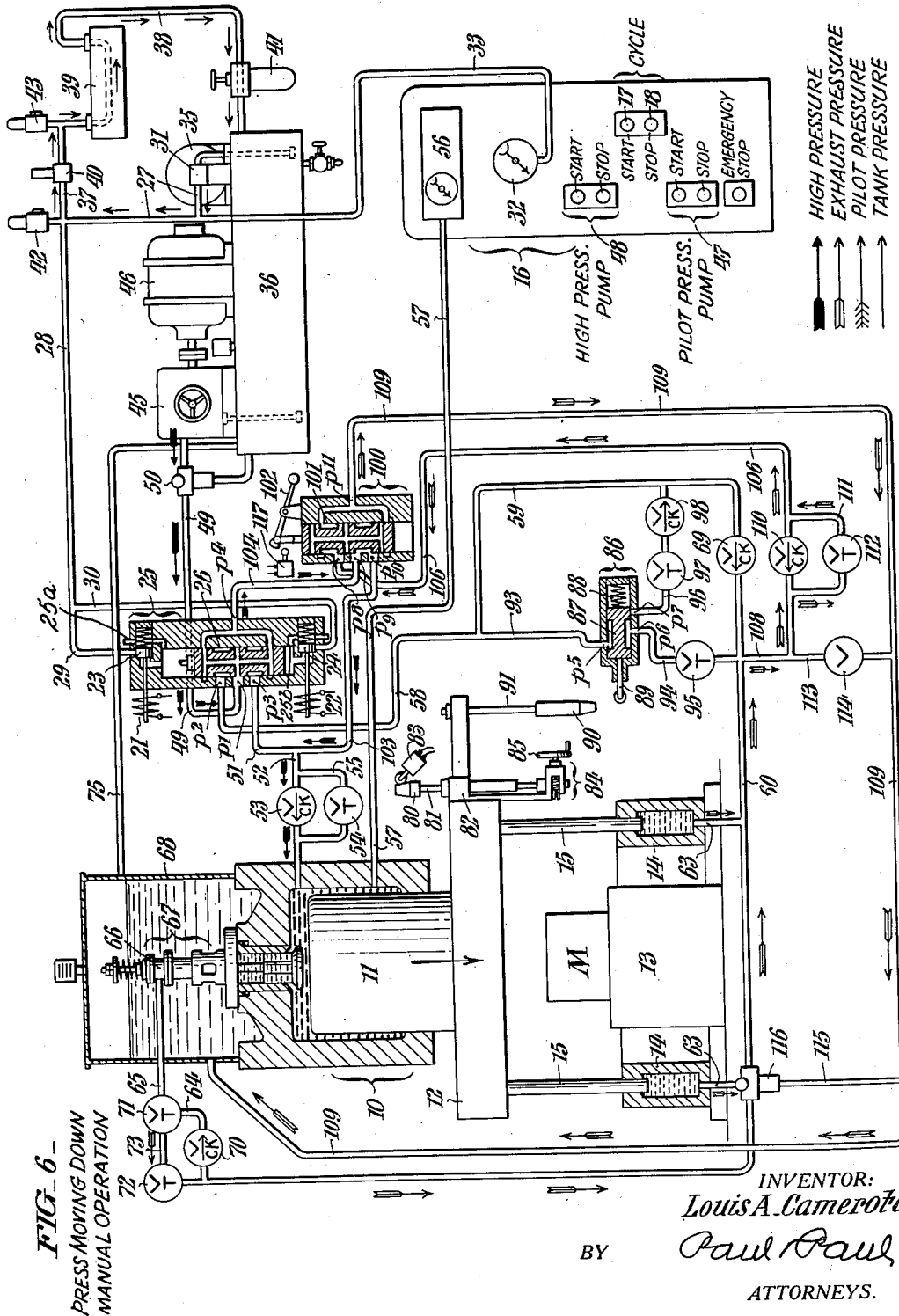
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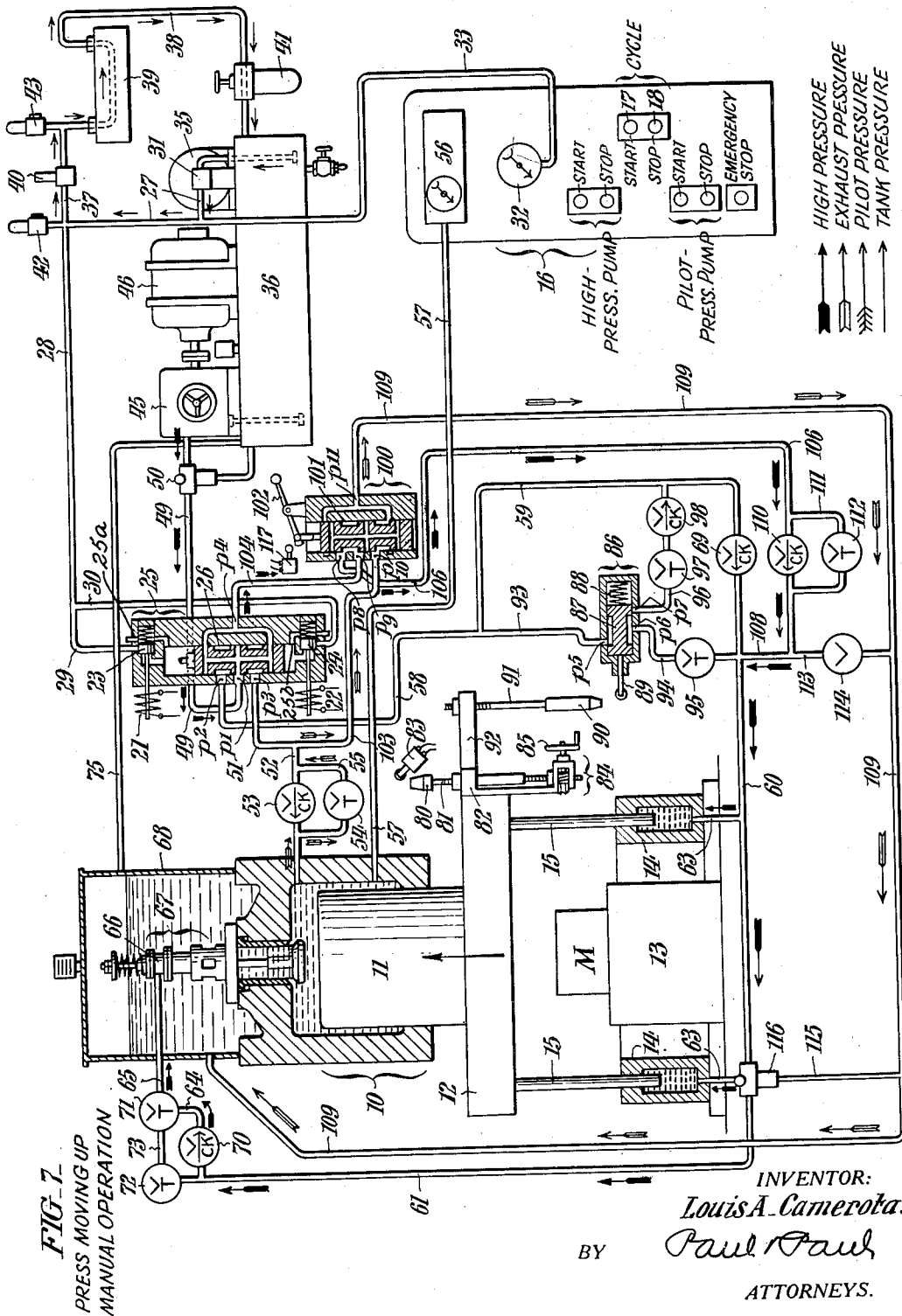


FIG. 7.

PRESS MOVING UP
MANUAL OPERATION

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Oct. 28, 1952

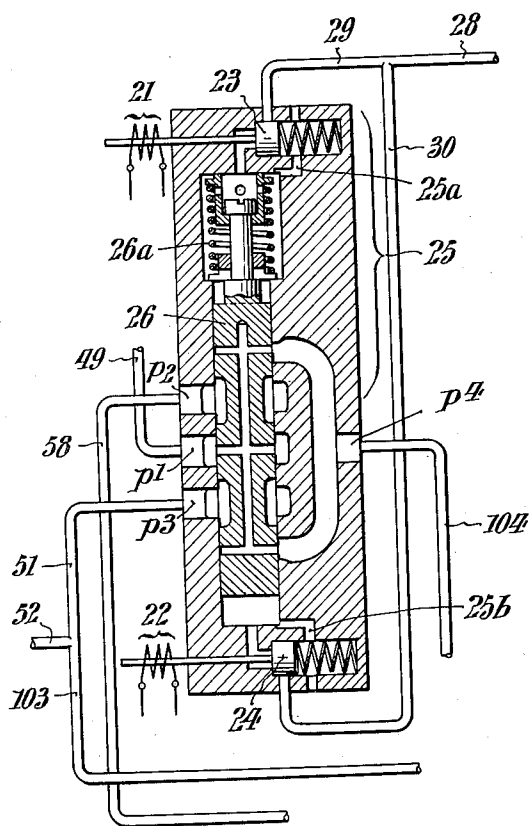
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FIG. 8-



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UNITED STATES PATENT OFFICE

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Application July 7, 1949, Serial No. 103,507

5 Claims. (Cl. 60—52)

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This invention relates to hydraulic presses. More specifically, it is concerned with hydraulic presses in which the flow of the pressure fluid to the ram and lift cylinders is governed by solenoid actuated reversible valves, the solenoids being interposed in circuits controlled by push buttons. In most such hydraulic presses as heretofore constructed, the speed of the ram plungers is constant through their active strokes, and accordingly, the approach of the plungers to the material being operated upon is attended by considerable impact, with consequent creation of objectionable noises and vibrations, as well as imposition of severe strains on the presses. Moreover, in hydraulic presses of the kind particularly referred to, "jog" buttons are ordinarily utilized to control the presses for impartation of intermittent movements to the ram plungers when repairs or adjustments are to be made, or when dies are to be interchanged. Due to the inability to properly govern flow of the pressure fluid in this way, it is impossible to accurately control the movements of the ram plungers.

The chief aim of my invention is to overcome the foregoing difficulties and drawbacks. This desideratum is realized in practice, as hereinafter more fully disclosed, through provision of simple and reliable automatic means whereby the movement of the ram plungers of the presses is decelerated as they near the end of their active strokes so that they will meet the material worked upon gently, with avoidance of noise and of sudden impact such as would be likely to overstrain the presses; and through the further provision, likewise, of simple and reliable manually-operable means whereby the flow of pressure fluid to and from the ram and lift cylinders can be governed to a nicety to effect smooth and accurate movements of the ram plungers and instant stoppage thereof at any desired point within the limits of their travel in either direction when necessary, for convenience of making repairs or adjustments, or incident to interchanging dies.

Other objects and attendant advantages will appear from the following detailed description of the attached drawings, wherein

Fig. 1 is a diagrammatic view of a press and a control system therefor conveniently embodying my invention, with the press shown in its normal open position.

Figs. 2 and 3 are views like Fig. 1 showing how the press is controlled during the active or descending stroke of the ram plunger.

Fig. 4 is a view like Fig. 1, showing the press closing under high pressure under manual control.

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Fig. 5 is a similar view showing the press moving up under manual control.

Figs. 6 and 7 are views in turn like Fig. 1, respectively showing the press moving down and up under manual control; and

Fig. 8 is a sectional view of a master valve used in the automatic control of the press.

With more detailed reference to these illustrations, 10 designates the ram cylinder of the press, and 11 the ram plunger whereto is secured the movable platen 12 which is opposed by the fixed platen at 13 in compacting material M placed on the latter platen. The press is provided with ram plunger lift cylinders 14 which are arranged on each side of the stationary platen 13 and which have their plungers 15 affixed to the movable platen 12. Ordinarily, the operation of the press is controlled from a panel 16 provided with cycle "start" and "stop" push buttons 17, 18, which, through means presently described, cause the press to be opened and closed. The buttons 17 and 18 are interposed in a wiring circuit (not illustrated) with solenoids 21 and 22 which are arranged to operate the pilot valves 23 and 24 of a reversible four-way master valve of well known construction conventionally represented at 25 in Fig. 1 and shown in greater detail in Fig. 8, having a ported plunger 26. The pilot valves 23, 24 serve to admit oil or other actuating fluid, delivered at a relatively low pressure through piping 27, 28, 29, 30 by a pump 31, into opposite ends of the casing of the master valve 25. Normally the valve 25 is vented top and bottom through the by-pass ports indicated at 25a, 25b, respectively, with its plunger or piston held in neutral position by a spring 26a, as best seen in Fig. 8. The pressure of the pilot actuating fluid is indicated by a gauge 32 on the panel 16, said gauge being connected to the end of a branch pipe 33 which extends from the pipe section 27. The pump 31, together with a driving motor 35 therefor, is mounted upon a supply tank 36 from which the fluid is drawn. Connecting with the pipe section 27 is a pipe line 37, 38 which extends to the rear of tank 36, part of said line passing through a cooler 39. Flow through the pipe section 37 is restricted by a restraining valve 40, and any solids passing through the section 38 are trapped by a strainer indicated at 41. The devices represented at 42 and 43 are safety valves. Also mounted on the tank 36 is a pump 45 with a drive motor 46, which delivers fluid at high pressure used to operate the ram 10 of the press on its power stroke, the flow of this fluid being governed by the master valve 25 in a manner later on explained. Starting and

stopping of the pilot pressure and the high pressure pump motors 35 and 46 is effected by separate pairs of start and stop push buttons 47 and 48 on panel 16. As shown, a pipe line 49 with a safety valve 50 therein extends from the pump 45 to the port p^1 of master valve 25, and a pipe line 51, 52 from the port p^3 of said valve to the top of the ram cylinder 10, the check valve at 53 permitting flow only in the direction indicated by the arrow thereon. A regulatable throttle valve 54 is provided to control flow through a shunting by-pass 55 around the check valve 53. The pressure of the fluid is subject to the control of a pressure governor 56 mounted on the panel 16 and connected by a pipe line 57 to the bottom of ram cylinder 10. Leading from the port p^2 of master valve 25 is a pipe line 58, 59, 60, 61 with branches 63 and 64, 65 connecting respectively into the bottoms of the lift cylinders 14 and into the actuating cylinder 66 of a filling check or relief valve 67 within a fluid tank 68 above the ram cylinder 10. Check valves 69 and 70 in the pipe sections 59 and 64 permit flow only in the direction indicated by the arrows, in-flow to the cylinder 66 of the filling check valve 67 being regulatable by an adjustable throttle valve 71, and outflow by a throttle valve 72 in a by-pass 73 around said check valve 70. Excess fluid accumulating in the tank 68 overflows, by way of a pipe 75, into the storage tank 36. The rising movement of the platen 12 is terminated automatically through engagement of the tapered head 80 at the top of a rod 81 carried by a lateral bracket 82 on said platen, with a limit switch 83 in circuit with the push buttons 17 and 18. The rod 81 is threadedly engaged in the bracket 82 and, as shown, is adjustable through worm gearing 84 operable by a hand wheel 85.

For the purpose of decelerating the ram plunger 11 as it approaches the material M in its descent and thereby damping its impact with the latter, there is provided in accordance with my invention, means including a special speed governing choke valve 86 with a circumferentially grooved piston 87 within its casing adapted to control flow between oppositely disposed ports p^5 , p^6 , p^7 , said piston being subject to the influence of a spring 88. Extending from the piston 87 through one end of the casing of valve 86 is a rod 89 with a roller thereon in the path of a tapered head 90 of another rod 91 pendent from a lateral arm 92 of bracket 82 on the movable platen 12, said rod being also adjustable up or down relative to said platen. As shown, the port p^5 of choke valve 86 is connected to the pipe 58 by a branch 93. The port p^6 of valve 86 is in turn connected by a branch pipe 94 to the pipe 60, with interposition in the latter of a regulatable throttle valve 95, and the port p^7 of said valve 86 is in communication, through the pipe 59 by way of a branch 96, with throttle and check valves 97 and 98 respectively interposed therein.

In place of the usual jogging buttons for controlling intermittent movements of the press during interchange of dies, or while repairs or adjustments are being made, there is further provided in accordance with my invention, a special reversible auxiliary manually-operable reversible control valve 100 which is generally similar in construction to the master valve 25, but in which the ported piston 101 is operable by means of a hand lever indicated at 102. This special valve 100 has ports p^8 , p^9 , p^{10} , and p^{11} . The port p^{10} is connected by a pipe branch 103, to the pipe 75

52; the port p^9 by a pipe 104 to the port p^4 of master valve 25; the port p^8 by means of piping 106, 108 to the branch 94; and the port p^{11} by a pipe line 109 to the reservoir 68, above the ram cylinder 10. Interposed in the pipe 106 is a check valve 110 which permits flow in the direction indicated thereon by the arrow, and which is shunted by a loop 111 with an interposed regulatable throttle valve 112. The pipe 108 is extended as at 113 to connect with pipe line 109, and interposed in this extension is a normally closed hand valve 114. There is also a cross connection 115 between the pipes 60 and 109 with a safety valve 116 therein. The switch shown at 117 is in circuit with the solenoid coils 21 and 22 of the master valve 25, and is arranged to be actuated by the hand lever 102 of the manual switch 100 for a purpose later on explained.

Normally with the solenoids 21 and 22 both de-energized and the pilots 23 and 24 of master valve 25 closed, the piston of the manually operable valve 100 in neutral position, and the press open and dormant as in Fig. 1, the following conditions obtain: The pilot actuating fluid drawn from the tank 36 by pump 31 is circulated idly through the piping 27, 37, 38 and the tank 36. Fluid at the same time delivered by the pump 45 at high pressure flows through pipe 49 to the port p^1 of master valve 25 and by-passes through the channeled piston 26 to port p^4 , then continues through pipe 104 to port p^9 of valve 100 and then by-passes through the channeled piston 101 of the latter valve to the port p^{11} . From thence the flow proceeds through pipe line 109 and discharges into the reservoir 68 above the ram cylinder 10, wherefrom the overflow is conducted, by the pipe 75, back into the tank 36. The platen 12 is prevented from descending by reason of fluid trapped in the lift cylinders 14 and in the piping 58, 59, 60, 61, 63, 93 and 94. Safety valve 116 serves merely as a means for preventing intensified pressure in the line. When valves 25 and 100 are positioned as in Fig. 1 and valve 114 is closed, the fluid is trapped in the cylinders 14.

Automatic cycle operation

The platen 12 is ordinarily lowered under push button control, the cycle being initiated by energization of solenoid 22 and opening of the lower pilot 24 of master valve 25 for admission of pressure fluid from the pump 31 via pipes 27, 28 and 30 as push button 17 is de-pressed, with consequent shifting of piston 26 of said valve upward to the position in which it is shown in Fig. 2. As a consequence, exhausting of the lift cylinders 14 will take place through the pipes 63, 60, 94, valve 86, pipes 93, 58, master valve 25, pipe 104, valve 100 and pipe 109 to the reservoir 68. As the ram plunger 11 begins to descend, the fill check valve 67 opens automatically in response to suction, thereby allowing down flow of fluid from the reservoir 68 into the ram cylinder 10. At the same time, fluid is injected into the ram cylinder 10 from the tank 36 by action of the pump 45 through pipe 49, master valve 25 (now set as above explained) and pipes 51, 52. The platen 12 will thus descend rapidly until it nears the material M, when, by contact of the cam head 90 of rod 91 on said platen with the actuating rod 89 of valve 86, the piston of the latter will be shifted to the position in which it is shown in Fig. 3. Under these conditions the exhaust from the lift cylinders 14 will be by-passed between the ports p^6 and p^7 of valve 86 enroute from pipe 60 to pipes 59, 58, and thus traverse the

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throttle valve 97 in pipe 96, the latter valve thus determining the rate of descent of the ram plunger 11 and platen 12. The filling check valve 67 will be closed by action of its spring upon cessation of the suction when the platen 12 eventually contacts the material M as in Fig. 4, whereupon pressure is built up to the required degree in the ram cylinder 10 by the continued operation of pump 45. As the platen 12 continues in its descent, the cam head 90 of rod 91 will eventually contact the rod 89 and thereby cause the piston 87 of valve 86 to be shifted rightward to the position in which it is shown in Fig. 3, with consequent closing of port p^6 and establishment of communication between ports p^6 and p^7 . The exhaust from the lift cylinders 11 will therefore take place now by way of pipes 63, 60, 94, 96, throttle valve 97, check valve 98, pipes 59, 58 master valve 25, pipe 104 valve 100 and pipe 109 to the reservoir 68. The ram plunger 11 will then move more slowly to the completion of its downward stroke to compress the material M. By regulating the throttle valve 97, it is possible to determine the rate of deceleration during the final portion of the down stroke of the ram plunger 11. In this way, it will be seen that contact of the platen 12 with the material M will be effectively damped, with avoidance of any attendant jar or noise or impartation of sudden harmful jars or strains to the press. When the maximum pressure predetermined by the governor 56 is reached, the latter functions through its electrical contacts (not illustrated) to cause de-energization of the solenoid 22 and energization of solenoid 21 and reversal of master valve 25, i. e. depression of the piston 26 of the latter as in Fig. 5, whereby the pressure in the ram cylinder 10 is slowly relieved to prevent shock in the pipe lines, said piston 26 being shifted by the pilot pressure fluid conducted into the top of said valve from the pump 31 through pipes 27, 28, and 29. By this reversal of master valve 25, high pressure fluid from pump 45 will flow by way of pipe 49 to said valve, by pass between the ports p^1 , p^2 , then continue through pipes 58, 59, 60, 63 to the lift cylinders 14 to elevate the ram plunger 11. Under these conditions, exhaust from the ram cylinder 10 will take place at the same time through the by pass pipe 55 containing throttle valve 54, pipes 52, 51, ports p^3 and p^4 of master valve 25, pipe 104, ports p^9 , p^{11} of valve 100, and pipe 109 to the reservoir 68. In this connection it will be noted that the throttle valve 54 prevents rapid release of a built up pressure in cylinder 10 and thus prevents line shock. The filling check valve 67 will be opened as in Fig. 5 to permit up-flow of fluid from the ram cylinder 10 into the reservoir 68 and more rapid rise of the ram 11, through actuation of its cylinder 66 as pressure builds up within pipes 65 and 61. When the head 90 of rod 91 passes beyond the actuating rod of valve 86, the piston 87 of the latter will be thrust forward by the spring 88 to its original position for re-establishment of communication between the ports p^5 and p^6 . Finally, upon actuation of the limit switch 83 as the ram plunger 11 nears the end of its up stroke, the electric circuits will be broken and the master valve 25 will resume its neutral inactive position for restoration of the parts to the condition of Fig. 1. Valve 86 performs no useful function during the retraction or rising stroke of the ram plunger 11.

Manual control

Control of the press incident to making re-

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pairs, interchanging dies, etc., and particularly in emergencies, is accomplished, in accordance with my invention, by manual actuation of the special reversible valve 100. For the lowering of the ram plunger 11, the hand lever 102 of valve 100 is depressed as in Fig. 6, with incidental tripping of the switch 117. As a consequence, all power supply to the press is interrupted except to the pump motors 35 and 46, the pressure governor 56 and the limit switch 83 being thereby rendered ineffective and the solenoids kept de-energized for maintenance of the master valve 25 in neutral position as also shown in Fig. 6. Under these conditions, high pressure fluid delivered by the pump 45 will flow by way of pipe 49 to port p^1 of master valve 25, continue through the channeled piston 26 of the latter to port p^4 , then through pipe 104 to port p^9 of valve 100, by pass to port p^{10} , and finally, by way of pipes 103 and 52, into the top of the ram cylinder 10 to force the plunger 11 downward. Exhaust of fluid from the lift cylinder 14 is allowed to take place at the same time, the flow being by way of pipes 63, 60, 108, 111, 106 communicating ports p^8 and p^{11} of valve 100 and pipe 109 into the reservoir 68 above the ram cylinder 10. The rate of descent of the ram being in this instance governed by the regulatable throttle valve 112 in the pipe 111. The valve 86 will of course be actuated during the drop of the ram plunger 11, but without accomplishing any useful function. By moving the operating lever 102 of the manual control valve 100 to horizontal position, the ram plunger 11 may be stopped at any desired position in its descent.

When the ram plunger 11 is to be elevated under manual control, the operating lever 102 of valve 100 is lifted as shown in Fig. 7, with the result that switch 117 is actuated, as before, for maintenance of master valve 25 in its normal position, within the piston 101 of said valve 100 lowered. Under the latter conditions, high pressure fluid delivered by pump 45 will flow through pipe 49 to port p^1 of master valve 25, by pass to port p^4 then flow through pipe 104 to port p^9 of manual control valve 100, by pass to port p^8 into pipe 106, from whence the flow continues through pipes 108, 60 and 63 into the lift cylinders 14 to elevate the ram 11. At the same time, part of the liquid will flow by way of pipes 61, 64, and 65 to the then open fill check valve 67 and permit upward discharge from the ram cylinder 10 into the reservoir 68.

From the foregoing it will be seen that the manual valve 100 can be used at will by the press attendant to control movement of the press in either direction regardless of the position of the ram and the platen, and during any stage of the operating cycle of the press.

Having thus described my invention, I claim:

1. A control system for a hydraulic press having a ram cylinder, a fixed platen opposed by the plunger of the ram cylinder, a lift cylinder for raising the plunger of the ram cylinder after each press operation, a supply source of pressure fluid and piping connecting the ram cylinder and the lift cylinder with the supply source; said control system including a power-actuated master valve having a bore and a piston therein which, when shifted in one direction from a normal neutral position permits delivery of pressure fluid to the ram cylinder to close the press, and when shifted in the other direction permits delivery of pressure fluid to the lift cylinder for opening the press, and having incorporated selectively-operable mag-

netically-actuated pilot valves for admitting pressure fluid from another supply source to admit pressure fluid into opposite ends respectively of the bore to shift the piston in one direction or the other as aforesaid, and a manually-operable auxiliary valve interposed in the piping in serial relation with the master valve and having a piston with means whereby the latter can be shifted from a neutral position in one direction or the other while the master valve is maintained in neutral position, to permit delivery of pressure fluid to the ram cylinder for closing of the press, or admitting pressure fluid into the lift cylinder for opening of the press.

2. A control system for a hydraulic press according to claim 1, further including automatic means for throttling exhaust of fluid from the lift cylinder as the plunger of the ram cylinder nears the end of its compressing stroke under the influence of the pressure fluid during press closing.

3. A control system for a hydraulic press, according to claim 1, further including exhaust piping through which the lift cylinder exhausts freely by way of the master valve during the greater portion of the active stroke of the ram plunger, a choke valve interposed in said exhaust piping, and means on the plunger of the ram cylinder for actuating the choke valve as said plunger nears the end of its active stroke to restrict the exhaust flow from said lift cylinder and thereby retard the ram plunger while it completes its active stroke.

4. A control system for a hydraulic press, according to claim 1, further including a check valve interposed in the piping between the ram cylinder and the master valve and adapted to close during exhausting of said cylinder, a by-pass around said check valve, and a throttle valve in said by-pass for throttling the exhaust flow

from the ram cylinder to determine the speed of the ram plunger during its return stroke.

5. A control system for a hydraulic press, according to claim 1, further including a surge tank above the ram cylinder, a relief valve for controlling flow of the fluid between the ram cylinder and the tank, means automatically operated to open the relief valve, and keep it open for upward passage of fluid from the ram cylinder during the greater portion of the rise of the ram plunger, means automatically operated as the ram plunger nears the limit of its upward stroke to close said relief valve, a check valve interposed in the piping between the ram cylinder and the master valve and adapted to close during exhausting of said cylinder, a by-pass around the check valve, and a throttle valve in said by-pass for throttling the flow from the ram cylinder to retard the movement of the ram plunger after closing of the relief valve while said plunger completes its return stroke.

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