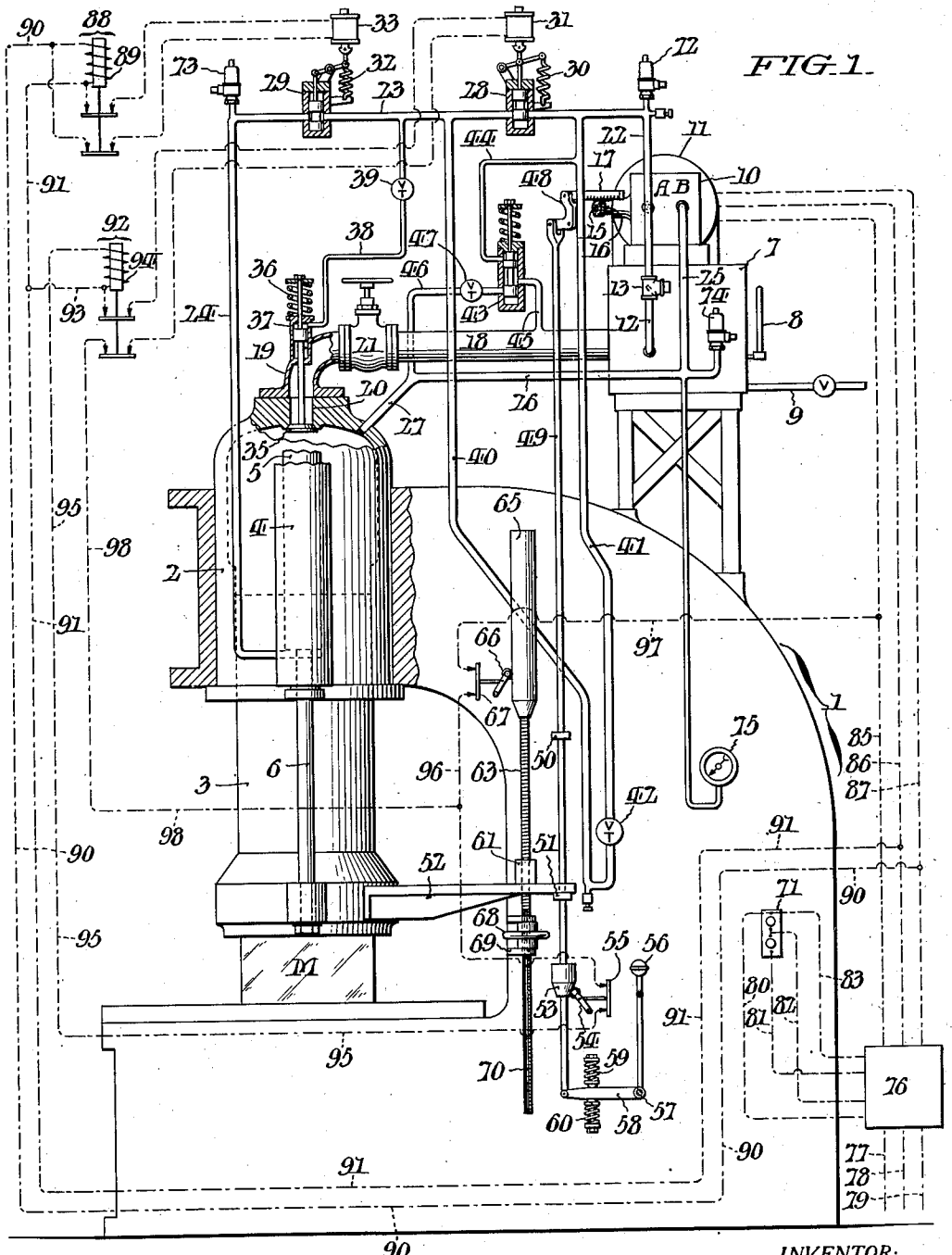
Jan. 8, 1946. L. A. CAMEROTA 2,392,644

CONTROL SYSTEM FOR HYDRAULIC PRESSES

Filed July 1, 1943 5 Sheets-Sheet 1

FIG. 1.



WITNESSES:

Thomas W. Kerr, Jr.

Evalyn L. Fullerton.

INVENTOR:

Louis A. Camerota,

BY Paul & Paul

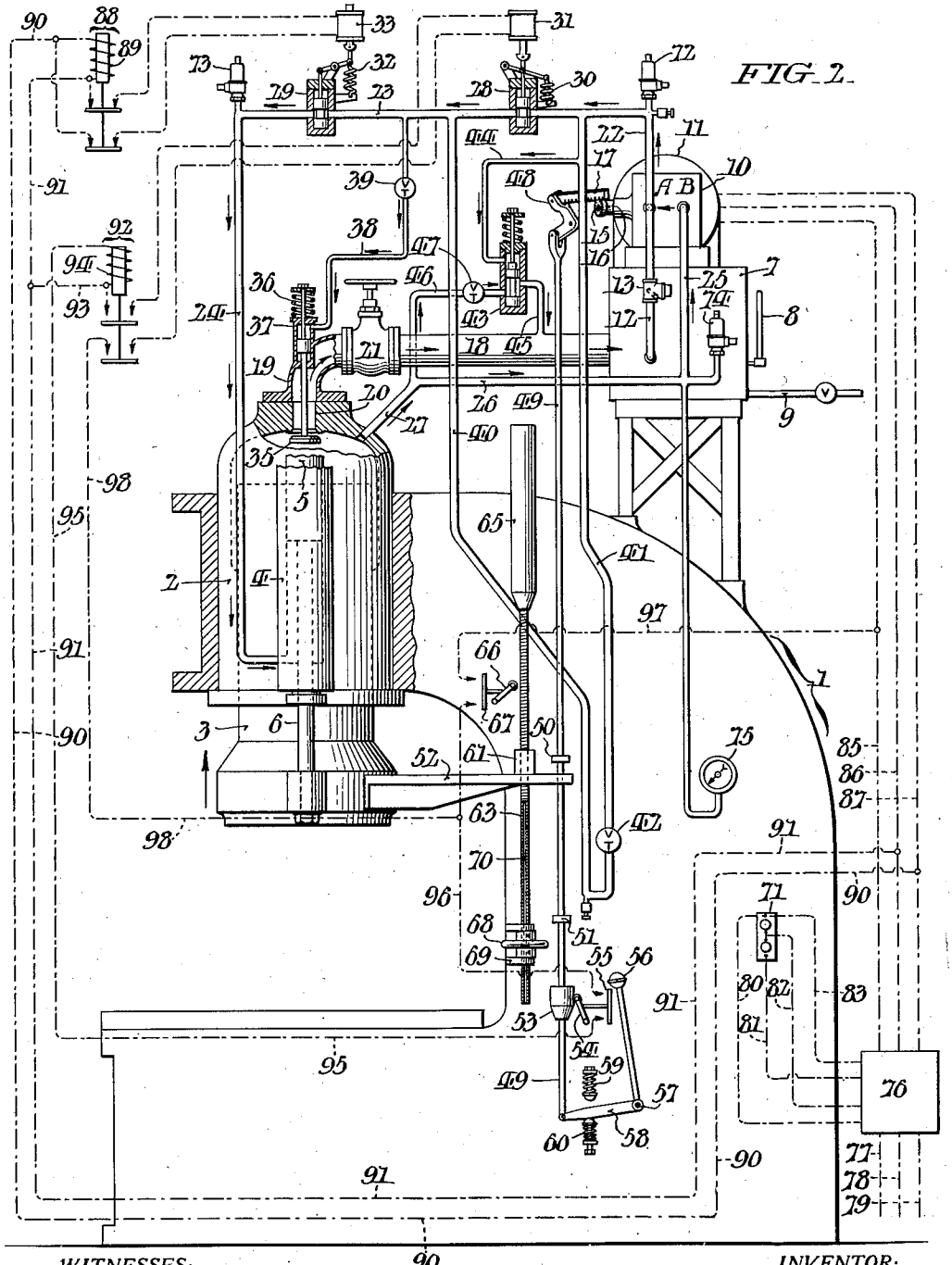
ATTORNEYS.

Jan. 8, 1946. L. A. CAMEROTA 2,392,644

CONTROL SYSTEM FOR HYDRAULIC PRESSES

Filed July 1, 1943 5 Sheets-Sheet 2

FIG. 2.



WITNESSES:
Thomas W. Kerr, Jr.
Evalyn L. Fullerton.

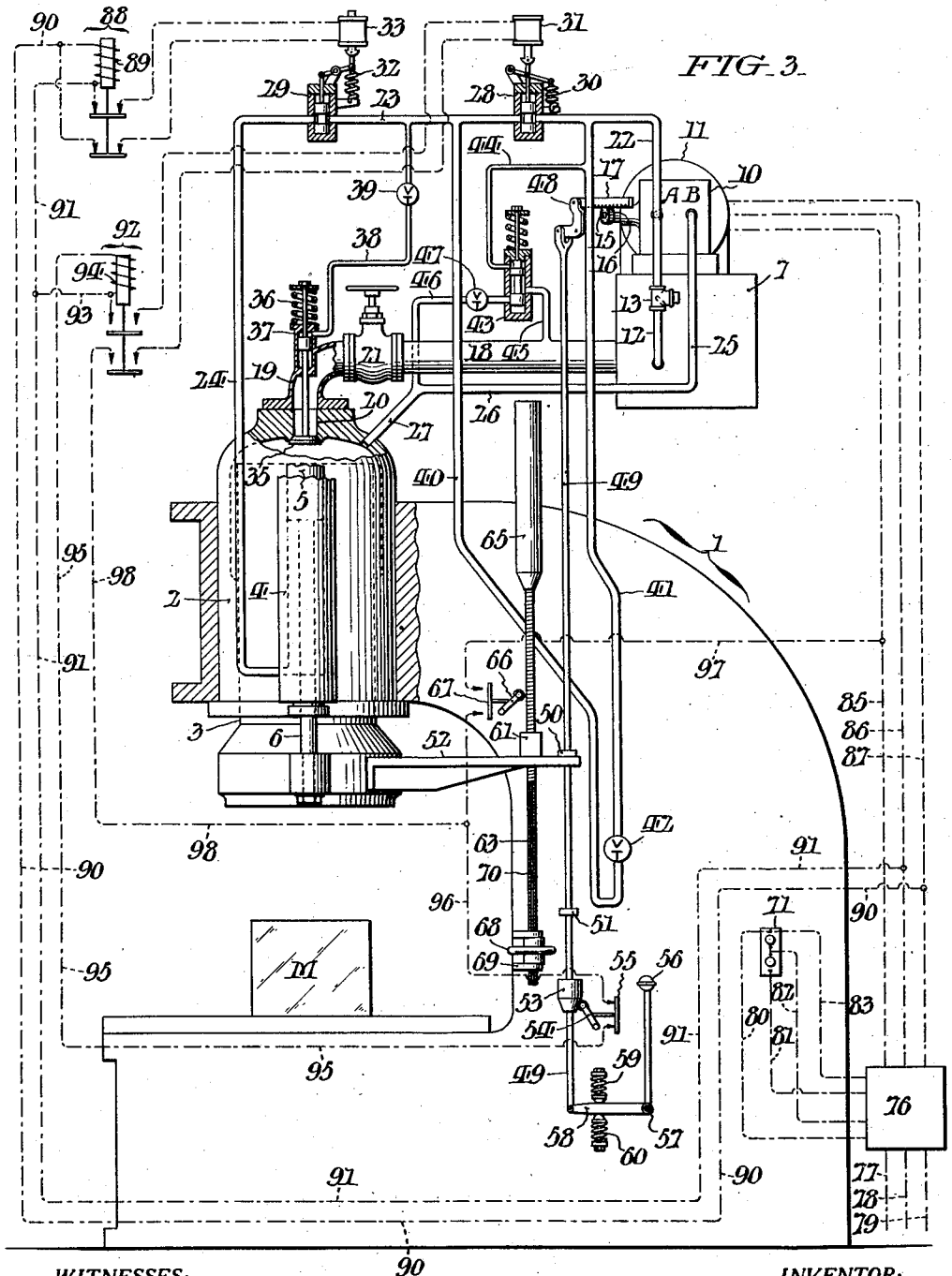
INVENTOR:
Louis A. Camerota,
BY Paul & Paul
ATTORNEYS.

Jan. 8, 1946. L. A. CAMEROTA 2,392,644

CONTROL SYSTEM FOR HYDRAULIC PRESSES

Filed July 1, 1943 5 Sheets-Sheet 3

FIG. 3.



WITNESSES:
Thomas W. Kerr, Jr.
Evalyn L. Fullerton.

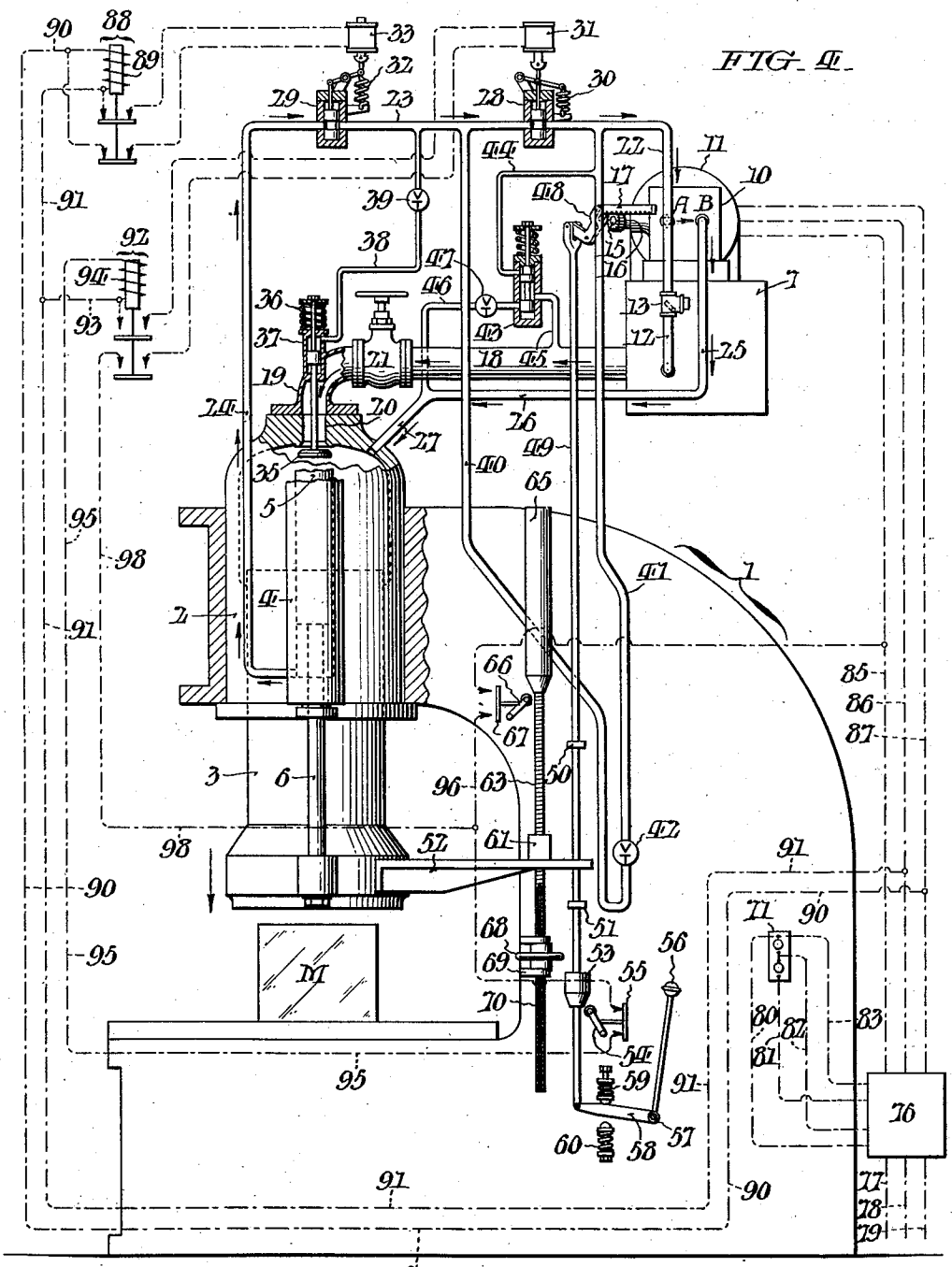
INVENTOR:
Louis A. Camerota,
BY Paul & Paul
ATTORNEYS.

Jan. 8, 1946. L. A. CAMEROTA 2,392,644

CONTROL SYSTEM FOR HYDRAULIC PRESSES

Filed July 1, 1943 5 Sheets-Sheet 4

FIG. 4.



WITNESSES:

Thomas W. Kerr, Jr.

Evalyn L. Fullerton

INVENTOR:

Louis A. Camerota,

BY Paul & Paul

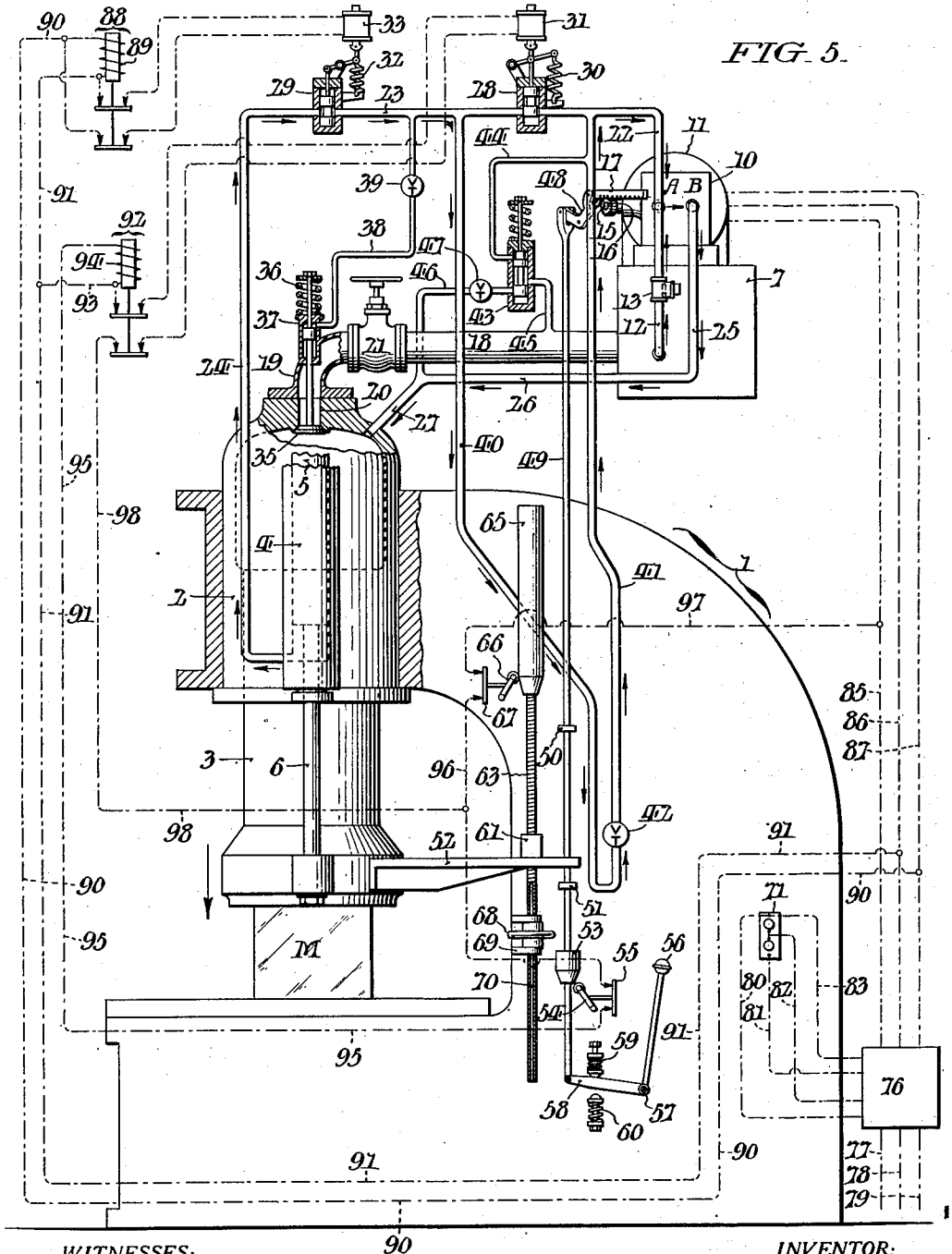
ATTORNEYS.

Jan. 8, 1946. L. A. CAMEROTA 2,392,644

CONTROL SYSTEM FOR HYDRAULIC PRESSES

Filed July 1, 1943 5 Sheets-Sheet 5

FIG. 5.



WITNESSES:

Thomas W. Kerr Jr.

Evelyn L. Fullerton

INVENTOR:

Louis A. Camerota,

BY Paul & Paul

ATTORNEYS.

Patented Jan. 8, 1946 2,392,644

UNITED STATES PATENT OFFICE

2,392,644

CONTROL SYSTEM FOR HYDRAULIC PRESSES

Louis A. Camerota, Burlington, N. J., assignor to Florence Pipe Foundry & Machine Company, Florence, N. J., a corporation of New Jersey

Application July 1, 1943, Serial No. 493,061

4 Claims. (Cl. 60—52)

This invention relates to control systems for hydraulic presses, and is more especially concerned with control systems for hydraulic presses having single reversely-acting ram and pull-back cylinders.

The chief aim of my invention is to make possible more rapid operation of presses of the kind referred to with a view toward securing increased output from them to the avoidance of injurious shocks or strains in the presses as the rams near the completion of their strokes in opposite directions.

How the foregoing and other objects with attendant advantages are realizable in practice will appear from the following description of the accompanying drawings, wherein Fig. 1 is a diagrammatic view partly in elevation and partly in section of a hydraulic press and a control system therefor conveniently embodying the present improvements, with the ram shown quiescent in its fully lowered or compressing position.

Fig. 2 is a view like Fig. 1 with the ram nearing the completion of its upward stroke.

Fig. 3 shows the ram quiescent in its fully raised position.

In Fig. 4, the ram has started on its downward stroke; while

Fig. 5 shows the ram nearing the completion of its downward stroke.

With reference first more particularly to Fig. 1 of these illustrations, the hydraulic press to be controlled is comprehensively designated by the numeral 1, the same having a single-acting cylinder 2 for the ram 3, and a pair of single-acting pull-back cylinders whereof one is shown at 4 with its plunger 5 connected by a rod 6 to said ram, the other pull-back cylinder being at the opposite side of said ram cylinder. Oil or other liquid for operating the press 1 is stored in a reservoir 7 which is provided with a liquid level gauge 8 and a draw-off pipe 9. Mounted on the reservoir 7 is a pump 10 which, let it be understood, may be of any approved and well known reversible, rotary, variable delivery type, driven in the illustrated instance by an A. C. multi-phase electric motor 11, and which draws liquid from said reservoir by way of a pipe 12 wherein the flow is restricted to one direction by a check valve 13. As shown, the pump 10 has a laterally-protruding governing shaft 15 with a gear pinion 16 and rack 17 whereby said shaft may be rotated in opposite directions from a normal neutral position. Leading horizontally from the reservoir 7 is a pipe 18 of comparatively large diameter, which, through an elbow 19, is connected to a port 20 centrally of the top of the ram cylinder 2, and in which is interposed a manually adjustable gate valve 21. Connected to the side or port A of the pump 10 is a pipe line 22, 23, 24 which extends to the lower end of the pull-back cylinder 4; and connected to the side or port B of said pump is a pipe line 25, 26, 27 which leads to the top of the ram cylinder 2 adjacent the port 20.

The provisions which have been made, in accordance with the present invention, for controlling the press include a solenoid-actuated control valve 28 and a solenoid-actuated master valve 29, which are interposed in the pipe 23. The control valve 28 is biased by a spring 30 which tends to keep it open and is arranged to be closed upon energization of a solenoid magnet 31 associated with it. The master valve 29 on the other hand is oppositely biased by a spring 32 which tends to close it, and which is opened by means of a solenoid magnet 33. Cooperative with the port 20 at the top of the ram cylinder 2 is a suction-responsive filling check valve 35 which is yieldingly urged toward closed position by a spring 36, and which is operable by a fluid pressure cylinder 37 connected by a branch pipe 38 of smaller caliber, with the pipe 23 at a point between the control and master valves 28 and 29. Liquid flow in the pipe 38 may be regulated by the manually operable throttle valve shown at 39.

Connected to the pipe 23 across the control valve 28 is a shunt loop 40, 41 with an interposed adjustable throttle valve 42 to restrict flow therein. A normally closed pressure-responsive pilot-operated bleed valve 43 has its actuating cylinder connected by a small-caliber branch pipe 44 with the leg 41 of the shunt loop 40, and its ports by small branch pipes 45 and 46 respectively with the pipes 18 and 26, flow through the branch 46 being regulatable by a manually adjustable throttle valve 47. The pump governing elements 15—17 are arranged to be manually operated, through a bell-crank lever 48, by a vertical stroke rod 49 having spaced stop collars 50 and 51 thereon in the path of a lateral projection 52 on the ram 3. Somewhat below the stop collar 51 the stroke rod 49 also carries a tapered cam piece 53 to coact with the actuating arm 54 of a limit switch 55 which is affixed to the side of the press frame. The starting lever shown at 56 is affixed to a rock shaft 57 together with a horizontal arm 58 whereof the outer end is pivotally connected to the lower end of the stroke rod 49. The spring devices shown at 59 and 60 react upon the arm 58 from above and below to normally keep it and the pump governing elements 15—17 in neutral position

with the pump 11 idling. Threadedly engaged in a boss 61 of the lateral projection 52 on the ram 3 is a vertical rod 63 which at its upper end has an elongated cam head 65 to cooperate with the actuating arm 66 of another limit switch 67 affixed like the limit switch 55, to the side of the press frame at a higher elevation. For the purpose of adjusting the rod 63 in the projection 52, there is shown a hand-wheel 68 which is rotatively supported in a fixed bearing bracket 69 having a spline in engagement with a longitudinal groove 70 in said rod. Also mounted on the side of the press frame is a double push-button switch 71 for starting and stopping the pump motor 11. The system is safe-guarded against derangement or injury by the safety valves 72, 73 and 74 respectively connected to the pipes 22, 24 and 26, the pressure in the latter pipe being at all times registered by the sight gauge shown at 75.

In addition to the electrical instrumentalities already referred to, the control system further includes a starter box 76, which may be of any suitable conventional type to which current is carried, through conductors 77, 78 and 79 from a power line, not shown, and from which leads 80, 81, 82 and 83 extends to the motor-starting button switch 71. Also extending from the box 76 are leads 85, 86 and 87 that carry the current to the motor 11. The energization of the solenoid 33 of the master valve 29 is controlled by a relay 88, said valve 29 being held open while the motor 11 is running by reason of the fact that the coil 89 of said relay is connected across one phase of the current supply circuit of said motor by leads 90 and 91. As a consequence of this arrangement, it will be evident that upon stopping of the motor 11, the relay 88 will open and allow the valve 29 to close. The energization of the solenoid 31 of the control valve 28 is subject to a relay 92 under control of the limit switches 55 and 67 so that said valve is opened and closed during different conditions of press operation as later on explained. The wiring connections through which such operation is made possible includes a conductor 93 which extends from one terminal of the magnet coil 94 of the relay 92, and a conductor 95 which extends from the other terminal of said coil to one of the contacts of the limit switch 55. As shown, the limit switch 55 is connected in series with the limit switch 67 through conductors 96 and 97 whereof the latter extends to the lead 85 of the motor supply line. Still another conductor 98 extends from one of the lower contacts of the relay 92 to the conductor 96.

The operation of my improved control system is as follows: In Fig. 1, let it be assumed that the motor 11 is running, by movement of the starting button switch 71 in an obvious manner, and the press closed with the ram 3 all the way down, after having compressed the material M with the pump 10 in neutral condition and idling. Incidental to the conditions just stated, it will also be readily seen that the control valve 28 will be in closed position, due to the solenoid magnet 31 being energized, with no flow of operating fluid through the pipe line 22, 23, 24 due to the pump 10 idling. To effect opening of the press, the operating lever 56 is thrown to the left as shown in Fig. 2 and the rod 49 thereby drawn downward, as a result of which the pump 10 is adjusted through the bell-crank 48, rack 17 and the pinion 15, to deliver liquid under pressure from its A side into the pipe 22. Concurrent with starting of such downward movement of the rod 49 the cam piece 53 thereon operates the actuating lever 54 of the limit switch 55 to open the latter. The circuit through the relay 92 is thereby broken and the solenoid 31 of the valve 28 de-energized to permit the control valve 28 to be opened by its spring 30, the valve 29 being already open by reason of being directly connected in circuit with the motor 11 as previously explained. Thus the liquid delivered from the A side of the pump 10 will pass through the piping 22, 23 and 24 and the valves 28 and 29 into the bottom ends of the pull-back cylinders 4 to raise the ram 3. Immediately as the pressure in the pipe 23 builds up sufficiently to start lifting the ram 3, the accumulating pressure in the branch pipe 44 will cause the valve 43 to be opened to relieve the pressure in the ram cylinder 2. The pumped liquid passing by way of the branch pipe 38 into the small cylinder 37 at the top of the elbow fitting 19 will thereupon become immediately effective to open the valve 35 for relief of the pressure in the ram cylinder, and permit rapid draining of said cylinder by way of the large pipe 18 into the storage reservoir 7. As the ram 3 begins to rise, the cam piece 65 will pass beyond the actuating lever 66 of the limit switch 67 which will thereby be opened without any change however in the set up. Somewhat thereafter, the lateral projection 52 on the ram 3 will engage the collar 50 and lift the rod 49. By this action the pump governing means is gradually moved toward neutral position with attendant decrease in the pressure and rate of delivery of the liquid to the pull-back cylinders 4, and at the same time the starting lever 56 will be shifted toward its normal upright position. As the fluid pressure decreases, the valves 35 and 43 will be moved to the closed positions in which they are shown in Fig. 3, under the influence of their springs, whereupon the remaining fluid in the top of the ram cylinder 2 will be obliged to traverse the smaller piping 27, 26, 25 at a greatly reduced rate. In this way the ram 3 will be effectively cushioned as it nears the completion of its up stroke and said ram comes gently to rest in the fully raised position as shown in Fig. 3 without jarring or straining of the press.

To lower the ram 3, the starting lever 56 is moved to the right as shown in Fig. 4 to raise the rod 49 and thereby cause reverse action of the pump 10 so that the liquid is now delivered under pressure from the B side of said pump through the piping 25, 26, 27 to the top of the ram cylinder 2. Immediately as the ram 3 starts to move, the valve 35 will open under the suction incidentally created and allow liquid to pass through the large pipe 18 from the reservoir 7 to the cylinder 2, while at the same time the pull-back cylinders 4 will be permitted to drain by way of the piping 24, 23 and 22, the control valve 28 being still open as shown in Fig. 4. Under these conditions, the ram 3 will drop rapidly until it meets with resistance in encountering the material M on the platen of the press as shown in Fig. 5, whereupon the valve 35 will close automatically to trap the liquid in the cylinder 2. Since at this stage the lever 56 is still in its rightward position, the pump 10 will suck liquid through the check valve 13 in pipe 12 and such liquid will be forced by the pump 10, via the B side of said pump and the pipe line 25, 26, 27, to the ram cylinder so that the ram 3 will thereafter be subjected to the full pressure of the liquid so delivered by said pump to com-

press said material M during its further downward travel. As the ram 3 nears the completion of its down stroke, the cam piece 65 on the threaded rod 63 will engage the actuating lever 66 of the limit switch 67 to close the latter, with attendant closing of the circuit through the magnet coil 94 of the relay 92 and energization of the solenoid 31 to close the control valve 28. As a consequence, the discharge from the lift cylinders 4 will be obliged to by-pass around the now closed control valve 28 through the loop 40, 41 and so act to cushion further downward movement of the ram 3. Finally, as the ram 3 reaches the end of its down stroke, the projection 52 thereon will engage the collar 51 on the rod 49 to depress the latter, as understandable from Fig. 5 with resultant gradual decrease in the rate of liquid delivery by the pump 10. Thus here again the movement of the ram 3 will be effectively checked to preclude jarring and excessive straining of the press. It is to be particularly noted that the construction of my improved control system is such as will enable stoppage of the ram 3 at any time simply by moving the actuating lever 56 to upright position to shift the pump governing means to neutral position.

The speed of press closing after the ram 3 has reached a definite point at maximum speed in its downward stroke can be varied by adjusting the throttle valve 42.

Having thus described my invention, I claim:

1. A control system for a hydraulic press having a single acting ram cylinder and a single acting pull-back cylinder, said system including a reversible variable capacity pump with means for governing its operation; an electric motor for driving the pump; manually operable switch means for starting and stopping the motor; pipe lines respectively connecting the ram cylinder and the pull-back cylinder with the opposite sides of the pump; an electro-magnetically closable control valve in the pipe line of the pull-back cylinder; a by-pass shunting the control valve with interposed throttle means for retricting flow therethrough; means operative to open the control valve with initiation of pressure liquid flow to the pull-back cylinder and, as the ram nears the completion of its down stroke, to cause gradual decrease in the pump output and closing of the control valve so that the liquid draining from the pull-back cylinder is obliged to traverse the by-pass aforesaid; a self-closing master valve in the pipe line of the pull-back cylinder between the latter and the by-pass; and electromagnetic actuating means for the master valve connected in circuit with the motor to keep said master valve open while the motor runs.

2. The invention according to claim 1, wherein the control valve is biased by spring means tending to keep it open but is closed by the electromagnetic means; wherein a switch operated upon commencement of the up stroke of the ram breaks the circuit through said magnetic means and permits the control valve to open; and wherein said switch can be automatically operated by the ram as the latter nears the completion of its down stroke, to re-establish the circuit through said magnetic means and thereby effect re-closing of said control valve.

3. A control system for a hydraulic press having a ram cylinder and a pull-back cylinder, said system including a reversible variable capacity pump with means for governing its operation; pipe lines respectively connecting the ram cylinder and the pull-back cylinder with the opposite sides of the pump; a coutrol valve in the pipe line of the pull-back cylinder operable by magnetic means; a by-pass shunting the control valve with an interposed throttle means for restricting flow therethrough; a stroke rod for manually actuating the pump governing means; a pair of switches in circuit with the magnetic operating means of the control valve; cam means on the stroke rod for opening one of the switches, as said rod is shifted to initiate delivery of the liquid by the pump to the pull-back cylinder, and thereby to de-energize the magnetic operating means and effect opening of the control valve; and means carried by the ram and adapted as the ram nears the completion of its down stroke to close the other switch and effect re-energization of the magnetic means for closing of the control valve whereby the liquid, at that time displaced from the pull-back cylinder, is obliged to traverse said by-pass.

4. A control system for a hydraulic press according to claim 3, in which the means carried by the ram for actuating the second switch is in the form of an axially-adjustable rod with cam means thereon to cooperate with the other or second mentioned switch.

LOUIS A. CAMEROTA.