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VALVE MECHANISM FOR HYDRAULIC PRESSES

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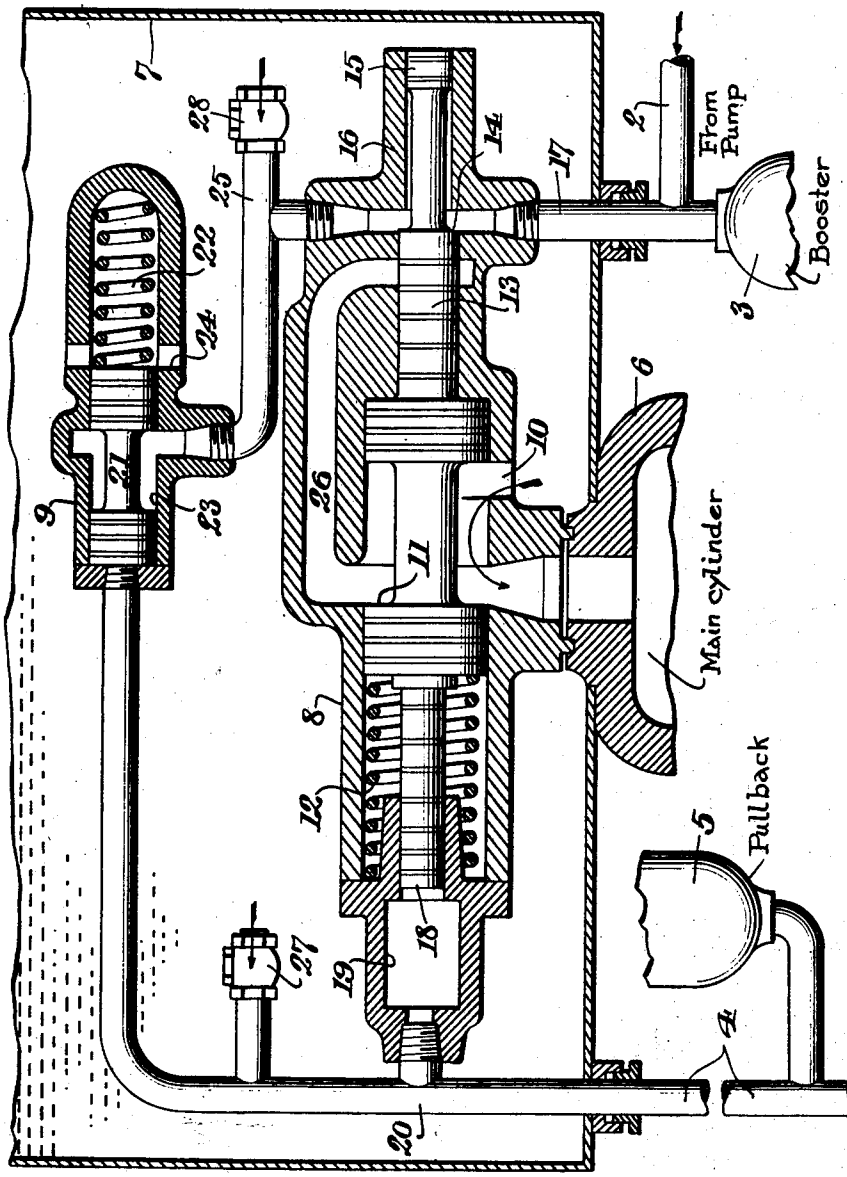

Fig. 2.

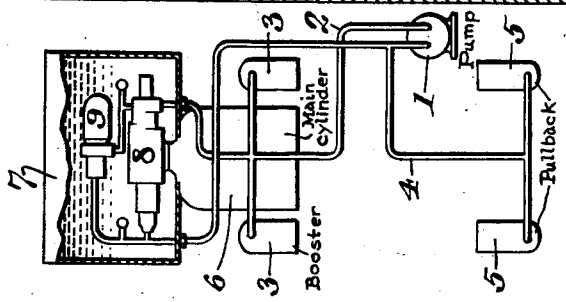

Fig. 1.

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VALVE MECHANISM FOR HYDRAULIC PRESSES

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This invention is intended as an improvement upon the valve construction shown in applicant's Patent 1,653,350, granted December 20, 1927. Although the mechanism disclosed in said patent is very efficient in operation, nevertheless, in the particular system shown, there is a time lag after the press ram reaches the bottom of the stroke. One slight and unavoidable cause of this lag is the fact that the cylinder will spread under pressure, while the oil will compress. Due to the particular arrangement of valves, however, there is a further and greater lag at certain points of operation which it is desirable to overcome.

The present invention discloses a simplified form of valve mechanism adapted to be used in the same type of press which will obviate all such lag. It also includes an arrangement of parts which is much more compact than that shown in the prior patent. Details of the invention will be apparent in the following description and in the appended claims.

In the drawings:

Figure 1 is a diagrammatic view with the supply tank in section showing the general arrangement of the various elements of the press mechanism and their relation to the valve mechanism.

Figure 2 is a longitudinal section through the valve mechanism and the tank containing the same.

This mechanism is adapted to be employed with a variable discharge, reversible pump indicated at 1, from which a pipe line 2 leads into one or more booster cylinders 3. A second pipe line 4 leads into the pull back cylinders 5. There is also the usual main cylinder 6, and, in this case, the surge or supply tank 7 is mounted on top of the main cylinder. This tank encloses all of the necessary valve mechanism and connections therebetween.

The valve mechanism consists of two main parts, one of a combination surge and shifting valve 8 and a compensating valve 9. The main cylinder communicates directly with a passage in the valve casing 8, which, through an opening 10, leads into the tank. A balanced piston valve 11 is mounted in a steel body and is fitted so closely that it is not necessary to employ packings. This piston valve is held in the position shown in Figure 2 by means of a spring 12. This piston is equipped at one side with a tail rod 13 formed as a differential piston having heads 14 and 15 which work in a chamber 16. This chamber communicates by a short pipe 17 with the pipe line 2 and the booster cylinders 3. The piston valve 11 has at its other side a tail piston 18 which is mounted in a cylinder 19 connected by a pipe 20 to the pipe line 4 and pull back cylinders 5.

The compensating valve 9 comprises a balanced piston 21 having spaced heads and being normally held in the position shown in Figure 2 by a spring 22 in which the valve is closed, but this valve is adapted to be moved against the tension of the spring to a position in which the chamber 23 will communicate through the passage 24 with the interior of the tank 7. A pipe 25 will afford communication between the chamber 16 of the main valve and that part of the chamber 23 of the compensating valve which lies between the valve heads when the valve 21 is in its closed position as shown in Figure 2, and the chamber 16 of the main valve. This main valve also includes a cored passage 26 adapted to afford communication at certain times between the chamber 16 and the inlet to the main cylinder 6.

Both pipe lines 20 and 25 are provided with check valves 27 and 28, respectively, which allow the oil or other fluid to enter the pipe line from the tank whenever leakage may occur in the system, but do not permit the fluid to flow out of the system into the tank.

Assuming that the parts are in the position shown in the drawings and the operator has set the pump to deliver pressure to the pipe line 2 and produce the downward stroke of press ram, the following will be the cycle of operation.

The radial pump will discharge directly through the pipe line 2 into the booster cylinder and cause a downward movement of the booster rams, and consequently of the press head. During this movement fluid will

flow by gravity from the tank through the opening 10, as indicated by the arrow, directly into the main cylinder. It is to be noted that this connection is made as short as possible. When the press ram meets sufficient resistance, the pressure will overcome the tension of the spring 12 and move the piston 11 toward the left in Figure 2, closing the opening 10 between the tank and cylinder and opening the passage from the chamber 16 to the passageway 26. Since this chamber 16 is connected directly to the pipe line 2, it is obvious that the fluid under pressure will pass directly from the pipe line 2 through the pipe 17, chamber 16, and passage 26 directly into the main cylinder. The movement of the press ram will then continue until the pressing stroke has been completed, this final movement of the ram being effected through the supply of fluid to both the main and booster cylinders. It will be observed that the amount of fluid required to be delivered to the main and booster cylinders together for a given amount of stroke is considerably greater than the amount of fluid which will be exhausted from the pull back cylinders during the same amount of stroke. This is due to the fact that the main cylinder and main ram are of much greater diameter than either the booster or pull back cylinders and rams. Since during the pressing stroke of the ram the pump is exhausting fluid from the pull back cylinders and delivering it to the main and booster cylinders, it is necessary that this deficiency of fluid be made up from the supply tank. The check valve 27 in the pipe line 4 provides for the admission to the pipe line and to the intake side of the pump sufficient fluid to supply the rapidly increasing volume of the main and booster cylinders. As indicated by the arrow on Figure 2, this make-up fluid enters the pipe line 4 from the supply tank. The pump will then be reversed either automatically or manually and will discharge pressure fluid directly into the pull back line 4 and pull back cylinders 5, and also through the pipe 20 against the compensating valve 21 in the valve casing 9. This will move the piston valve 21 against the force of the spring 22 irresponsive of the still high pressure in the pipe lines 2 and 17 until the chamber 23 is brought into communication with the interior of the tank by means of the opening 24. This will at once release the pressure which has hitherto existed in the chamber 23 which is in communication with the chamber 16 and, as soon as the pressure in the chamber 16 drops, the release of this pressure from the head 14 will permit the spring 12 and the pressure on the tail piston 18 to force the valve 11 back to the Figure 2 position, in which the fluid may pass out of the main cylinder and through the opening 10 into the tank.

It is very apparent that this arrangement will overcome all objections to the construction shown in the prior patent. The valve 11 will always permit free passage of the fluid to and from the main cylinder, and there can be no choking effect such as is produced by a check valve. The passages are so arranged that a minimum resistance is offered to the flow of the oil. Whenever pressure builds up in the booster ram sufficiently to overcome the spring 12, the fluid under pressure will be discharged directly into the main cylinder, and there is no possibility of escape of any of such fluid into the tank. When the reversal takes place, there is no possibility for the discharge from the pump to escape into the tank and the valve 21 must be opened, which will immediately release the pressure in the booster ram and in the chamber 16. Only a slight pressure drop is necessary to allow the piston 6 and spring 12 to operate the valve 11 and move the same back to the Figure 2 position.

It is obvious that various changes may be made in the precise embodiment of various details of the invention without in any way departing from the spirit thereof, and the invention is therefore to be regarded as limited only by the scope of the appended claims.

I claim as my invention:

1. In a hydraulic press mechanism having a main cylinder, a booster cylinder, a pull-back cylinder and a supply tank; the combination of a pipe line for supplying fluid under pressure to the booster cylinder, a second pipe line for supplying fluid under pressure to the pull-back cylinder, normally open means affording communication between the tank and the main cylinder, means for closing said communication when the pressure in the first pipe line reaches a predetermined value, and means for opening said communication when fluid under pressure is admitted into the second pipe line, said last-named means including a normally closed valve interposed between said first pipe line and the tank and being responsive to a pressure change in the second pipe line irrespective of the pressure in the first pipe line for relieving pressure in said first pipe line by opening communication between the latter and the tank.

2. In a hydraulic press mechanism having a main cylinder, a booster cylinder, a pull-back cylinder and a supply tank; the combination of a pipe line for supplying fluid under pressure to the booster cylinder, a second pipe line for supplying fluid under pressure to the pull-back cylinder, a normally open communication between the tank and the main cylinder, a valve operated by pressure in the first pipe line for closing said communication and opening communication between the first pipe line and the main cylinder, and means for returning the valve to normal position when fluid under pressure is admitted to the second pipe line, said last named means in-

cluding a normally closed valve interposed between said first pipe line and the tank and being responsive to a pressure change in the second pipe line irrespective of the pressure in the first pipe line for relieving pressure in said first pipe line by opening communication between the latter and the tank.

3. In a hydraulic press mechanism having a main cylinder, a booster cylinder, a pull-back cylinder, a pipe line for supplying pressure to the booster cylinder, and a pipe line for supplying fluid under pressure to the pull-back cylinder; the combination of a supply tank mounted on said cylinder and normally in direct communication therewith, and valve mechanisms for controlling the flow of fluid between the supply tank and the main cylinder, between the first pipe line and the main cylinder, and between the first pipe line and the tank, said valve mechanisms being located in the tank.

4. In a hydraulic press mechanism having a main cylinder, a booster cylinder, a pull-back cylinder, a pipe line for supplying pressure to the booster cylinder, and a pipe line for supplying fluid under pressure to the pull-back cylinder; the combination of a supply tank mounted on said cylinder and normally in direct communication therewith, a valve mechanism for controlling the flow of fluid between the supply tank and the main cylinder and between the first pipe line and the main cylinder, and a second valve mechanism for controlling the flow of fluid between the first pipe line and the tank and operated by pressure in the second pipe line, all of said valve mechanisms being located within the tank.

5. In a hydraulic press mechanism having a main cylinder, a booster cylinder, a pull-back cylinder, a pipe line for supplying pressure to the booster cylinder, and a pipe line for supplying fluid under pressure to the pull-back cylinder; the combination of a supply tank mounted on said cylinder and normally in direct communication therewith, valve mechanisms for controlling the supply of fluid between the main cylinder and tank, between the first pipe line and main cylinder, and between the first pipe line and the tank in proper sequence, and check valves for permitting fluid to enter each pipe line from the tank; all of said valve mechanisms being located within the tank.

6. The combination with a hydraulic press including a pressing cylinder and a pull back cylinder; of means forming a hydraulic circuit with said cylinders including a surge tank, a pipe line for supplying fluid under pressure to said pressing cylinder, and a second pipe line for supplying fluid under pressure to said pull back cylinder; and valve mechanism for said circuit including a surge valve for controlling communication between said tank and said pressing cylinder, and a compensating valve connected between said first pipe line and an exhaust, said compensating valve comprising a casing, a pressure-balanced piston valve slidably mounted therein, and means at one end of the casing for constantly urging said piston valve in one direction to its closed position in which said first pipe line communicates with the interior of the casing between the heads of the piston valve, said second pipe line communicating with the opposite end of the casing whereby pressure in said second pipe line will act upon said piston valve in opposition to said valve closing means, said valve being thereby adapted to be opened by pressure in the second pipe line irrespective of pressure in the first pipe line.

7. The combination with a hydraulic press including a pressing cylinder and a pull back cylinder; of means forming a hydraulic circuit with said cylinders including a surge tank, a pipe line for supplying fluid under pressure to said pressing cylinder, and a second pipe line for supplying fluid under pressure to said pull back cylinder; and valve mechanism for said circuit including a surge valve for controlling communication between said tank and said pressing cylinder, and a normally closed compensating valve connected between the first pipe line and an exhaust, said compensating valve comprising a casing, a pressure-balanced piston valve slidably mounted therein, and a spring connected to said piston valve for urging the latter in one direction to its closed position, in which said first pipe line communicates with the interior of the casing between the heads of said piston valve, said second pipe line communicating with one end of the casing whereby pressure in said second pipe line will act upon said piston valve in opposition to said spring, said valve being thereby adapted to be opened against the urge of said spring by pressure in the second pipe line irrespective of the pressure in the first pipe line.

8. The combination with a hydraulic press having main, booster, and pull back cylinders; of a supply tank; a pump; a pipe line for supplying fluid under pressure to said booster cylinder; a second pipe line for supplying fluid under pressure to the pull back cylinder; a normally open surge valve connected between said tank and main cylinder; means responsive to built-up pressure in said first pipe line for closing said valve; a normally closed valve connected between said first pipe line and said tank and being adapted to be opened by built-up pressure in said second pipe line to thereby relieve the pressure in the first pipe line; and means for thereafter opening said surge valve.

9. The combination with a hydraulic press having main, booster and pull back cylinders; of a supply tank; a pump; a pipe line

for supplying fluid under pressure to said booster cylinder; a pipe line for supplying fluid under pressure to the pull back cylinder; means normally providing communication between said main cylinder and tank; a surge valve responsive to built-up pressure in said first pipe line for closing said communication and for opening communication between said main cylinder and said first pipe line; a normally closed valve connected between said tank and said first pipe line and being movable to open position by pressure in the second pipe line to relieve the pressure in the first pipe line, said surge valve being adapted to be thereafter moved to its normally open position by pressure in the second pipe line.

In testimony whereof, I have hereunto subscribed my name.

WALTER ERNST.