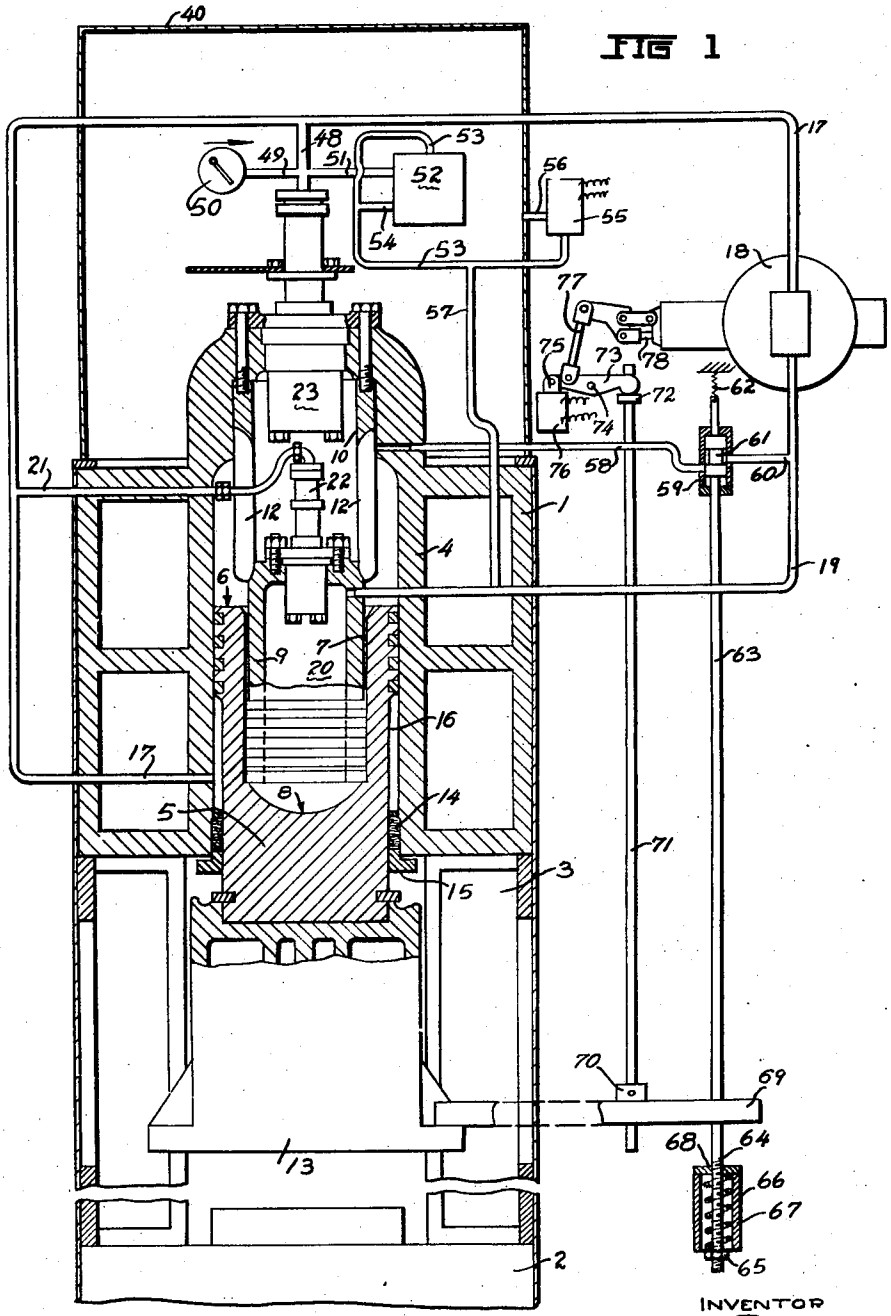
Feb. 29, 1944. P. E. FLOWERS 2,343,177

HYDRAULIC PRESS

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FIG 1



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FIG. 2

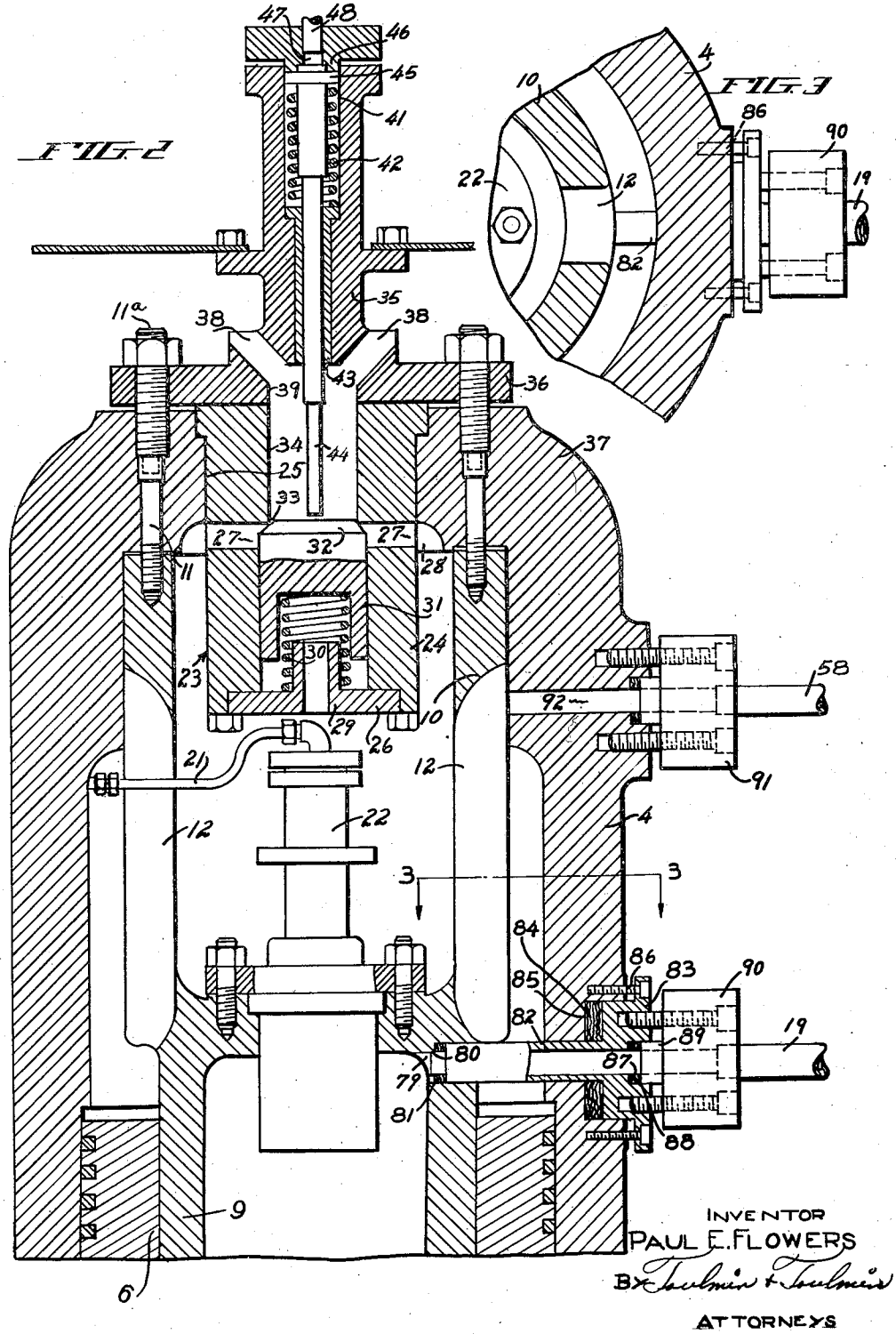


FIG. 3

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Patented Feb. 29, 1944 2,343,177

UNITED STATES PATENT OFFICE

2,343,177

HYDRAULIC PRESS

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Application June 25, 1941, Serial No. 399,681

7 Claims. (Cl. 60—97)

This invention relates to hydraulic presses and, in particular, to hydraulic presses in which, during the first portion of the pressing stroke, fluid is surged into the press cylinder through a surge valve.

Such presses are built with a ram having a one-pressure ram surface, and also with a compound ram, one portion of which is adapted to impart a relatively low pressing effect upon the press platen, while another portion, in cooperation with said first mentioned portion, may impart a relatively high pressing effect upon the platen. Heretofore, different cylinder castings were required, depending on whether the press was to be provided with a one-pressure ram or a compound ram. In the latter instance, a plurality of surge valves was needed, which surge valves were heretofore arranged side by side at the top of the press cylinder and, therefore, required an enlarged top portion of the press cylinder. On the other hand, when the press was provided with a one-pressure ram, the employment of such press cylinder with an enlarged top portion was not only unnecessary, but actually constituted a waste of material and casting costs, and even incurred additional costs and labor for plugging the superfluous surge valve hole or holes.

Accordingly, it is an object of the present invention to provide a press structure which will overcome the above mentioned drawbacks, while simplifying the casting for the press cylinder.

It is another object of the invention to provide a press structure in which one and the same press cylinder with only one surge valve opening may be used for a one-pressure ram press as well as for a compound ram press.

A further object of the invention consists in the provision of a press having a compound ram with an outer and an inner ram area, in which the surge valve admitting fluid to the inner ram area is arranged inside the press cylinder housing the ram.

Still another object consists in the provision of a press having a ram with an outer and an inner ram area, in which one surge valve is mounted at the top of the main cylinder housing the ram, while another surge valve is arranged on top of a tubular member inside the press cylinder.

It is a still further object of the invention to provide a compound ram press with an outer and an inner ram area, in which the surge valves for admitting fluid to the outer and inner ram areas are so arranged that one is located beneath the other.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic illustration of a press structure according to the invention.

Figure 2 shows, on a somewhat enlarged scale, the upper portion of the press cylinder of Figure 1.

Figure 3 is a section along the line 3—3 of Figure 2.

General arrangement

The press according to the invention comprises substantially a press cylinder with a surge valve on top thereof and a compound ram reciprocably mounted in the press cylinder. The compound ram has an outer annular ram surface and an inner ram surface, which latter cooperates with a tubular member having a surge valve mounted on top thereof.

A distributing valve is provided for admitting pressure fluid from the pressure fluid source either to the inside of the tubular member so as to exert pressure upon the inner ram surface, or to admit pressure fluid to the outer annular ram surface as well as the inner ram surface for exerting an increased pressure on the ram. In each instance fluid from a surge tank is admitted through both surge valves during the first portion of the pressing stroke prior to the engagement of the work piece by the platen.

The press structure according to the invention allows the employment of one and the same press cylinder and, if desired, even with one and the same surge valve, irrespective of whether the press is provided with a one-pressure ram or a compound ram.

In the last mentioned instance, the structure of Figure 1 may be used, whereas in the first instance, the compound ram and the tubular member inside the press cylinder is replaced by a one-pressure ram, while no changes in the structure of the press cylinder itself are required.

Structural arrangement

Referring to the drawings in detail, the press shown in Figure 1 comprises a press head 1 and a press bed 2 spaced from each other by side members 3 and interconnected by strain rods not shown in the drawings.

The press head 1 comprises a press cylinder 4 having reciprocably mounted therein a compound press ram 5 with an outer annular press area 6 and a bore 7, the bottom of which constitutes an inner press area 8. Stationarily mounted within

the press cylinder 4 and extending into the ram bore 7 is a tubular member 9 having a tubular extension 10 connected to the press cylinder 4 in any convenient manner, for instance by screws 11. The tubular extension is provided with radial slots 12.

Connected to the ram 5, in any convenient manner, is a platen 13 adapted to exert pressure on a work piece on the press bed 2. To prevent leakage between the press cylinder 4 and the ram 5, packing material 14 is provided compressed by a gland 15, which is connected to the lower portion of the press cylinder 4. The press ram 5 is a double-acting ram, the lower portion of which confines, with the wall of the cylinder 4, an annular space 16 communicating through conduit 17 with one side of a reversible variable delivery pump 18, the other side of which communicates through conduit 19 with the bore 20 of the tubular member 9.

Branching off from the conduit 19 is a conduit 21 leading to the upper end of a surge valve 22 mounted on and connected to the top portion of the tubular member 9. A similar surge valve 23, but of greater capacity, is connected to the upper portion of the press cylinder 4. Since both surge valves 22 and 23 are of the same construction, only the structure of the surge valve 23 will be described.

The surge valve 23 (Figure 2) consists of a tubular casing 24 mounted in the bore 25 of the press head 1 and containing an end cap 26. The tubular casing 24 is provided with outlet ports 27 leading from the interior of the casing 24 into the chamber 28 on top of the press cylinder 4, which chamber communicates with the interior of the tubular extension 10. The cap 26 is provided with a hollow projection 29 and serves as a seat for the coil spring 30, the opposite end of which urges the surge valve member 31 upwardly. The surge valve member 31 is provided with a beveled portion 32 adapted to engage a valve seat 33 in the casing 24 so as to interrupt hydraulic communication between the bore 34 in the casing 24 and the ports 27.

Mounted above the tubular casing 24 is a cylindrical casing 35 having a flanged portion 36 resting upon the outer wall of the cylinder 37 and connected thereto by stud bolts 11a arranged in alignment with the screws 11. The casing 24 is provided with passageways 38 leading from the bore 39 registering with the bore 34 into the fluid reservoir or surge tank 40. The cylindrical casing 35 is provided with a stepped bore 41, the upper portion of which houses a spring 42, while the lower portion houses a guiding sleeve 43. Passing through the bore in the guiding sleeve 43 is an operating rod 44 provided with a head 45 which is continuously urged by the spring 42 against the closure member 46 connected to the casing 35. Passing through the closure member 46 is a bore 47 connected to a conduit 48 which communicates with the conduit 17.

Fluid pressure admitted through the conduit 48 is adapted to act upon the head 45 so as to press the operating rod 44 downwardly against the thrust of the spring 42, thereby moving the surge valve member 31 downwardly away from the valve seat 33 and against the thrust of the spring 30.

Connected to the conduit 48 is a conduit 49 comprising a check valve 50 adapted to admit fluid from the surge tank 40 into the conduit 48, while preventing the flow in the other direction. Also branching off from the conduit 48 is a conduit 51 leading to a main cylinder release and pump by-pass valve 52 having pipe connections 53 and 54. The main cylinder release and pump by-pass valve 52 serves for relieving the pressure on top of the ram at the initiation of its retraction stroke, and for a more detailed description thereof, reference may be had to U. S. Patent No. 2,268,205 to Walter Ernst.

The pipe 53 leads to a tonnage control valve 55 which, in response to a predetermined pressure acting upon the advancing side of the press ram 5, establishes hydraulic connection between the pipe 53 and the conduit 56 leading to the surge tank 40. The tonnage control valve 55 may be of any desired type, preferably of the type disclosed in U. S. Patent No. 2,224,957 to Walter Ernst.

Communicating with the pipe 53 is a conduit 57 leading to the conduit 19. A conduit 58 communicates through the slots 12 with the upper portion of the press cylinder 4, and also leads to a distributing valve 59 which has connected thereto a conduit 60 communicating with the conduit 19. The distributing valve 59 is a two-way valve with a valve member 61 connected to the valve rod 63 and adapted to be controlled thereby so that when the valve rod 63 is shifted to its lower position, hydraulic communication is established between conduits 60 and 58, whereas normally a spring 62 connected to the valve member 61 holds the latter in uppermost position, thereby preventing hydraulic communication between the conduits 60 and 58.

The lower end of the valve rod 63 is provided with a threaded portion 64 to support a nut 65 upon which rests a coil spring 66 surrounded by a tubular cap 67 having a bore 68 therethrough through which passes the valve rod 63. The cap 67 is adapted to be engaged by the platen arm 69 connected to the platen 13 for shifting the valve rod 63 downwardly.

The platen arm 69 is also adapted, when the ram approaches the end of its return stroke, to engage a collar 70 adjustably mounted on a control rod 71, the upper portion of which has adjustably connected thereto a collar 72 for engagement with a two-arm lever 73 shiftable about the pivot 74. One end of the lever 73 is pivotally connected with an armature 75 controlled by a solenoid 76 which, when energized, puts the pump 18 in full delivery forward stroke position. The solenoid 76 is electrically connected with the tonnage control valve 55 so that it is de-energized when the tonnage control valve is actuated.

The lever 73 is also connected by a link system 77 with the flow-control member 78 of the pump 18. The movement of said flow-control member in one or the other direction is adapted to shift the pump 18 from neutral to full delivery forward stroke position or to full delivery retraction stroke position. The pump 18 which does not form a part of the present invention may be of any desired type, for instance, the type disclosed in U. S. Patent No. 2,184,665 to Ernst.

The connection of the conduits 58 and 19 with the cylinder 4 and the bore 20 respectively may be effected in any desired manner, for instance, in the manner shown in Figure 2. As will be seen therefrom, the passageway 79 at the upper portion of the bore 20 pertaining to the tubular member 9 is provided with a shoulder 80 having packing material 81 therein which is compressed by a tubular extension 82 of a gland 83 which also compresses packing material 84 in the recess 85.

The gland 83 which is connected by screws 86 to the cylinder 4 has a recess 87 with packing

material 88 compressed by a tubular extension 89 of a pipe connection 90 to which the pipe 19 is connected. A similar pipe connection 91 connects the conduit 58 with the passageway 92 leading into the press cylinder 4.

Operation

The press shown in the drawings may be operated in two different ways, depending on the nature of the work and the desire of the operator.

If it is desired to use only the inner ram area 8 of the press ram, such as for deep drawing work, where a maximum ram speed is essential on account of the long stroke under pressure, the cap 67 is lowered by turning the nut 65 upon the valve rod 63 so that it will not be engaged by the platen arm 69 during the downward movement of the platen 13.

When the pump 18 is started, and due to energization of the solenoid 76, the linkage 77 has shifted the pump to full delivery forward stroke position, pressure fluid delivered by the pump passes through conduit 19 into the bore 20 of the tubular member 9, while fluid is withdrawn from the annular space 16 through conduit 17 to the pump 18. As a result thereof, the ram 5 starts to move downwardly by gravity as fast as fluid is withdrawn from the annular space 16. As soon as the downward movement of the ram 5 starts, a suction effect is created within the bore 20 of the tubular member 9 and also in the upper portion of the cylinder 4, which suction effect causes the surge valve member 31 to move downwardly against the thrust of the spring 30 (Figure 2) and, similarly, causes the opening of the surge valve 22. Therefore, while the ram 5 moves downwardly, fluid is withdrawn from the tank 40 through the passageways 36 of the surge valve 23 into the upper portion of the press cylinder 4, and a part of the fluid thus surged into the upper portion of the press cylinder 4 passes through the surge valve 22 into the bore 20 of the tubular member 9. In this way, the increasing spaces above the outer ram area 6 and the inner ram area 8 are maintained filled with fluid.

When the platen 13 engages the work piece and encounters resistance, pressure builds up within the bore 20 of the tubular member 9, thereby causing closure of the surge valve 22. The pressure within the bore 20 continues to act against the inner ram area 8 for performing the actual pressing operation. When, at the end of the pressing operation, the pressure on the inner ram area 8 reaches a predetermined value, this pressure is conveyed through conduits 19, 57 and 53 to the tonnage control valve 55, causing the latter to break the energizing circuit for the solenoid 76, whereupon a spring (not shown) in the servomotor pertaining to the pump 18 shifts the pump to full delivery retraction stroke position.

Fluid pressure is now delivered by the pump 18 through conduit 17 into the annular space 16, and also through conduits 21 and 43 to the surge valves 22 and 23 respectively.

After the main cylinder release and pump bypass valve 52 has relieved the pressure in the bore 20 of the tubular member 9, the surge valves 22 and 23 open and the retraction stroke of the ram 5 starts. Opening of the surge valve 23 is effected by the pressure fluid acting through conduit 48 upon the head 45 connected to the operating rod 44, thereby causing the latter to engage and move downwardly the valve member 31 against the thrust of the springs 42 and 30. The opening of the surge valve 22 is effected similarly.

Fluid expelled by the upwardly moving ram 5 passes from the bore 20 of the tubular member 9 through the surge valve 22 into the upper portion of the press cylinder 4 and from there through surge valve 23 into the tank 40.

When the press ram 5 approaches the end of its retraction stroke, the platen arm 69 engages the collar 70 and lifts the control rod 71 so that the latter, by means of the collar 72 and linkage 77, shifts the pump 18 to neutral or substantially no delivery position. The ram 5 then comes to a standstill and the press is ready for a new cycle.

If now it is desired to use the outer annular ram area 6 as well as the inner ram area 8 to employ the maximum pressure of the press, the cap 67 is moved upwardly along the valve rod 63 by turning the nut 65 so that the platen arm 69, when moving downwardly, will engage the cap 67 at a desired point. The pump 18 is then started and, in the manner previously described by energization of the solenoid 76, is shifted to full delivery forward stroke position. Pressure fluid is then passing from the pump 18 through the conduit 19 into the bore 20 of the tubular member 9 as before, while fluid is withdrawn from the annular space 16 through the conduit 17. The ram 5 then moves downwardly by gravity in the same manner as previously described.

When the platen 13 has moved downwardly to such an extent that the platen arm 69 engages the cap 67, further downward movement of the platen 13 causes the platen arm 69 to shift the valve rod 63 downwardly, thereby establishing hydraulic connection between the conduit 19 and the conduit 58 so that pressure fluid from the pump 18 also passes through conduit 58 into the upper portion of the press cylinder 4, thereby acting on the annular outer ram area 6. From now on, both ram areas, 6 and 8, are subjected to pressure fluid from the pump 18. It is, of course, understood that the surge valves 22 and 23 had closed prior to or concomitantly with the downward movement of the valve member 63.

As soon as, at the end of the pressing stroke, the pressure on the ram 5 has reached a predetermined value, this pressure is again conveyed to the tonnage control valve 55 through conduits 19, 57 and 53, so as to cause the tonnage control valve to break the energizing circuit for the solenoid 76. The pump 18 is then reversed and causes the retraction stroke of the ram 5 in the manner described above.

As soon as the platen arm 69 has released the cap 67, the latter is restored to its previous position with regard to the valve rod 63 by means of the spring 66, while the spring 62 connected to the valve member 61 in the distributing valve 59 returns the valve member 61 and the valve rod 63 to their upper positions. At the end of the retraction stroke, the platen arm 69 again engages the collar 70 and, by means of the control rod 71, arm 73 and link system 77, shifts the pump 18 again to neutral position for bringing the press to a halt.

As will be obvious from the above, the press structure according to the present invention constitutes a material simplification over compound presses heretofore known. In particular, the casting of the press cylinder 4 is materially simplified, since it does not require an enlarged upper portion and since only one hole for receiving one surge valve is required. Moreover, the cast-

ing 4 may be used for a compound ram as shown in the drawings as well as for a one-pressure area ram without requiring any changes in its structure.

The provision of the surge valve 22 pertaining to the inner ram area 8 inside the press cylinder 4 results in a concentrated arrangement of the surge valves 22 and 23, thereby simplifying the press structure and giving the same a highly streamlined appearance. The total height of the press is not, or only very slightly, increased over previous structures, since the surge valve pertaining to the inner ram area, which in previous structures took up a certain space in the surge tank 40, has been taken out from the latter, thereby allowing a reduction of the size of the surge tank 40.

It should also be noted that the surge valve 22 need by no means be arranged vertically as shown in the drawings, but may also be inclined to the longitudinal axis of the tubular member 9, thereby enabling a reduction of the total length of the press cylinder 4. The specific construction of the surge valves 22 and 23 referred to above has been given merely as an example, and it is obvious that other surge valves may be used instead thereof.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In combination, a cylinder, a tubular member arranged inside said cylinder and connected thereto, said tubular member being open at its top and bottom and having a partition separating the upper portion from the lower portion and also having a slot in the upper wall portion, a first surge valve arranged adjacent the upper end of said cylinder and extending into the upper portion of said tubular member, a second surge valve mounted in the partition of said tubular member and extending into the upper and lower portions of said tubular member, a ram reciprocably mounted in said cylinder with an outer ram area and a chamber slidably surrounding the lower portion of said tubular member and having an inner ram area, means for supplying pressure fluid selectively to said inner ram area or to said inner and outer ram areas, and means for admitting fluid through said surge valves.

2. In combination, a cylinder, a ram having an outer ram area and a chamber with an inner ram area, a tubular member having an upper portion and a lower portion separated from each other by a partition, screws passing through said cylinder and entering the upper portion of said tubular member for rigidly connecting the same to said press cylinder, a slot in the upper portion of said tubular member for effecting hydraulic communication between the inside of said upper tubular portion and said outer ram area, a fluid storage tank mounted on said cylinder, a first surge valve mounted on said cylinder and hydraulically connected to said storage tank, screw members arranged in alignment with said bolts for connecting said first surge valve to said press cylinder, a second surge valve mounted in said partition of said tubular member and extending into the upper and lower portions of said tubular member, said second surge valve being operable to effect hydraulic communication between said upper portion of said tubular member and said inner ram area, a fluid pressure source, and means for selectively supplying pressure fluid from said fluid source to said inner ram area alone, or to both said inner ram area and said outer ram area.

3. In combination, a cylinder, a ram reciprocable in said cylinder and having an outer ram area and a chamber with an inner ram area, a tubular member stationarily mounted with respect to said cylinder and extending into said chamber, said tubular member and said chamber being adapted in cooperation with each other to act as a cylinder-piston-assembly, fluid storage means, first valve means adapted in response to a suction effect in said cylinder to allow fluid to pass therethrough from said storage means into said cylinder, second valve means associated with said tubular member and arranged inside said cylinder, said second valve means being adapted in response to a suction effect in said chamber to admit fluid from said cylinder to said inner ram area, pressure fluid means, and control means associated with said pressure fluid means and operable for admitting pressure fluid from said fluid pressure means selectively to said inner ram area only or jointly to said inner ram area and said outer ram area for respectively actuating said ram at a high or at a lower pressure.

4. In combination, a cylinder, a ram reciprocable in said cylinder and provided with an outer ram area and an inner ram area, a first fluid source, a first surge valve associated with said cylinder and operable to establish hydraulic communication between said first fluid source and said outer ram area, a cylindrical member stationarily mounted within said cylinder for cooperation with said inner ram area, a second surge valve mounted in spaced relationship to and below said first surge valve, said second surge valve being adapted in response to a suction effect in said cylindrical member to admit fluid from said cylinder to said inner ram area, and a second fluid source for admitting pressure fluid selectively to said inner area only or jointly to said inner area and said outer area.

5. In combination, a cylinder, a ram reciprocable in said cylinder and provided with a first area and a second area separated from each other, fluid storage means, a first surge valve mounted on and extending through said cylinder for admitting fluid from said storage means to said first area in response to a suction effect in said cylinder, a second surge valve spaced from said first surge valve and arranged completely within said cylinder, said second surge valve being adapted in response to a suction effect exerted thereupon to admit fluid passing from said storage means through said first surge valve, to said second area, a pressure fluid source, and means operable for admitting pressure fluid from said fluid source selectively to said second area only or jointly to said first and second areas.

6. In combination, a cylinder, a plunger reciprocable in said cylinder and provided with a first effective area, cooperating with a first working chamber in said cylinder, and also provided with a second effective area, cooperating with a second working chamber in said cylinder, a first fluid source adapted to supply fluid to said first and second working chambers to prefill the same, first valve means operable to establish fluid connection between said first fluid source and said first chamber, second valve means operable to establish fluid connection between said first and said

second chambers, and a second fluid source independent of said first fluid source for selectively supplying pressure fluid to said second chamber only, or to both said first and said second chambers, for actuating said plunger.

7. In combination, a cylinder, a tubular member stationarily mounted in said cylinder, a plunger reciprocable in said cylinder and provided with a first area forming with said cylinder a first chamber, and also provided with a second area forming with said tubular member a second chamber, a first fluid source, first valve means operable to establish fluid connection between said first fluid source and said first chamber to allow flow of fluid from said first fluid source into said first chamber to prefill the same, or vice versa to allow escape of fluid from said first chamber, second valve means operable to establish fluid connection between said first and second chambers to allow, in cooperation with said first valve means, prefilling of said second chamber with fluid from said fluid source or to permit escape of fluid from said second chamber to said fluid source, a second fluid source, and means operable to convey pressure fluid from said second fluid source selectively to said second chamber only, or to said first and second chambers jointly, to actuate said plunger.

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