

April 4, 1939.

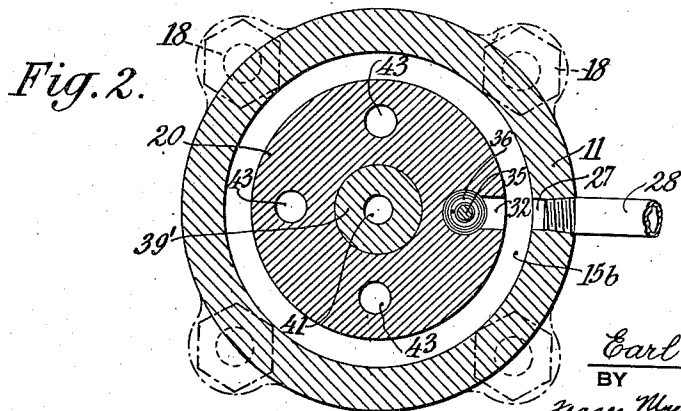
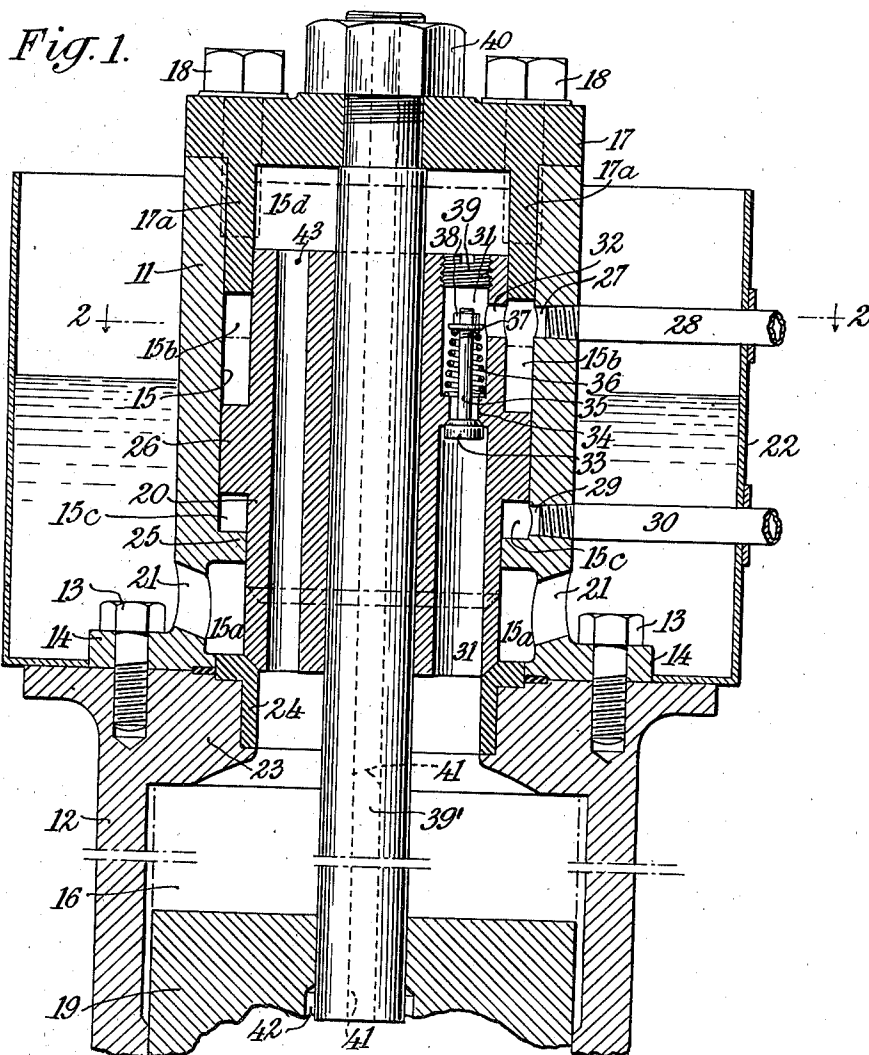
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2,152,870

PREFILL VALVE FOR HYDRAULIC PRESSES

Filed Jan. 21, 1937

3 Sheets-Sheet 1



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PREFILL VALVE FOR HYDRAULIC PRESSES

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3 Sheets-Sheet 2

Fig. 3.

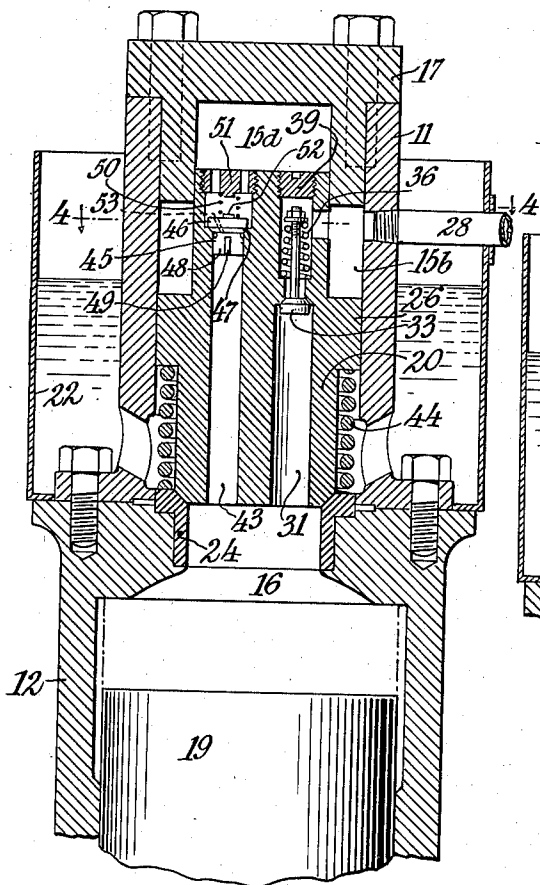


Fig. 5.

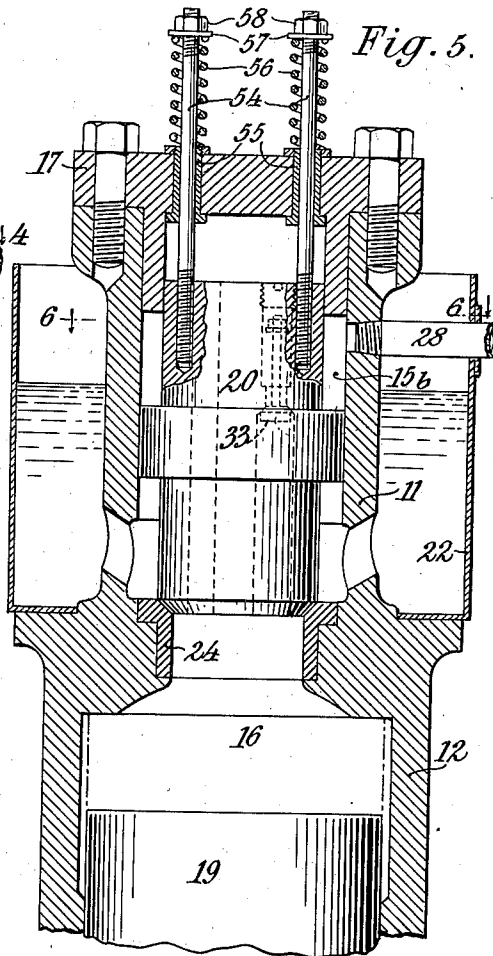


Fig. 4.

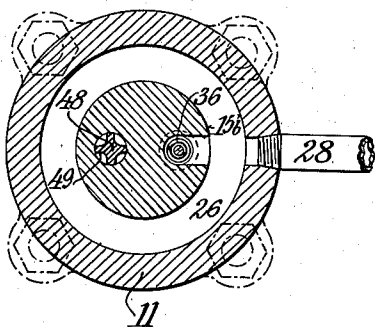
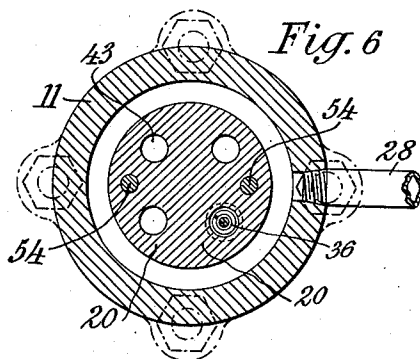


Fig. 6



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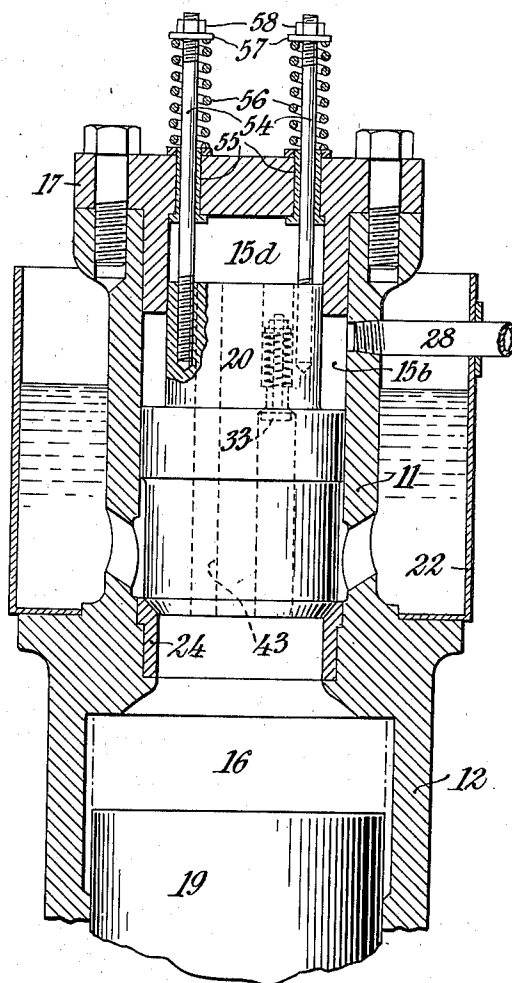
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3 Sheets-Sheet 3

Fig. 7.



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PREFILL VALVE FOR HYDRAULIC PRESSES

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Application January 21, 1937, Serial No. 121,528

19 Claims. (Cl. 121—38)

This invention relates to improvements in prefill valves (otherwise known as surge valves) for hydraulic presses, which valves are employed for permitting the rapid filling and exhaustion of the ram chamber of a hydraulic press with oil or other fluid during the operation thereof.

In the practical operation of a hydraulic press the filling of the ram chamber, prior to the establishment of a relatively high working pressure therein, ordinarily takes place as a result of suction which is set up in said chamber by the advance of the ram into initial engagement with the material being processed. Such advance of the ram may be accomplished by various means.

Hydraulic pressure may, for example, be applied directly to the ram, for the said purpose in the manner described and illustrated in my co-pending application, Serial No. 105,005, filed October 10, 1936 and issued as Patent No. 2,127,324 on August 16, 1938, or the advance of the main ram may be accomplished by independent means, such, for example, as auxiliary hydraulic rams which may be arranged to coact directly with the platen or die carried at the outer end of the main ram.

The present invention is particularly advantageous as employed in prefill valves of the type which are opened either by hydraulic pressure or by a spring, and are closed and held closed solely by hydraulic pressure. Such valves commonly have a valve element which reciprocates within a valve chamber between an open position wherein it is clear of the main fluid inlet to the ram work chamber, whereby to permit a free flow or surge of fluid therinto, and a closed position wherein said element seats across and closes said inlet whereby to permit the establishment of a relatively high working pressure within the ram chamber.

In such hydraulically closed prefill valves, heretofore developed, fluid, under pressure, is introduced into the valve chamber at the upper or outer side of the reciprocating valve element, causing the latter to move to a closed position, whereupon working pressure is established in said valve chamber and, by one means or another, passed through or by-passed around the reciprocating valve element into the prefilled ram chamber whereby to establish the desired working pressure therein and impose sufficient force upon the ram to accomplish the desired work. In such valves the means for by-passing the pressure from the valve chamber into the ram chamber are so arranged that substantially uniform pressure is maintained in both said chambers while the valve is closed, and as the effec-

tive upper or outer area of the valve element is greater than the lower or inner area thereof, a preponderous hydraulic force is, hence, exerted upon the outer side of the valve element and holds the latter in its closed position.

It will be perceived that the opening and closing of the valve, in such previously developed structures, involves the substantially complete filling and exhaustion of the valve chamber with each complete stroke of the press and that, as the valve chamber is of substantial volume because of the necessarily large area of the top of the valve element, the speed of operation of the press is substantially limited to the speed at which the valve chamber may be completely filled and exhausted. While, in actual practice, the stroke of such hydraulic presses is completed in a relatively short time, it will nevertheless be appreciated that any considerable increase in the working speed of the press yields considerable economies in operation.

An important object of my present invention is the provision of a prefill valve, of the general character hereinbefore referred to, which may be hydraulically closed by the more rapid introduction of a substantially lesser volume of fluid than is required in previously developed valves of similar dimensions, resulting in substantial economy in operation of such valves and associated hydraulic presses.

A further object of my invention is the provision of a prefill valve, of the general character referred to, wherein the pressure above the reciprocating valve element, holding the latter closed, is released substantially simultaneously with the pressure in the ram chamber below said valve element, when the valve is opened, whereby to alleviate harmful structural stresses which otherwise may be encountered in operation.

A still further object of my invention is the provision of a prefill valve, of the general character referred to, in which the displacement of fluid from above the valve element is somewhat retarded, as the latter is forced upwardly or outwardly to its open position, whereby to cushion the outward movement of said element and thus afford a further safeguard against harmful structural stresses.

These and other objects are accomplished by my invention, which, for illustrative purposes, is described herein and illustrated in the accompanying drawings as embodied in a vertically disposed prefill valve, although such valves may also, within the invention, be horizontally dis-

posed, or may be arranged in an inverted position or in various oblique positions.

Referring to the drawings:

Figure 1 is a substantially central vertical section of a prefill valve embodying my invention.

Fig. 2 is a horizontal section substantially on the line 2—2 of Fig. 1.

Fig. 3 is a substantially central vertical section of a prefill valve embodying a modification of my invention.

Fig. 4 is a horizontal section substantially on the line 4—4 of Fig. 3.

Fig. 5 is a substantially central vertical section of a prefill valve embodying a further modification of my invention.

Fig. 6 is a horizontal section substantially on the line 6—6 of Fig. 5.

Fig. 7 is a substantially central vertical section of a prefill valve embodying a slight variation of the modification disclosed in Fig. 5.

My invention as illustrated in Figs. 1 and 2 is embodied in a prefill valve in which the means for initially advancing the ram into engagement with the material being processed are directly associated with the valve structure, substantially as disclosed in my said co-pending application. In the embodiment illustrated in said figures, a substantially cylindrical valve casing 11 is secured to the upper end of a ram cylinder block 12 by bolts 13 which extend through holes in flanges or lugs 14 at the lower end of the valve casing and are threaded into the ram cylinder block.

The valve casing 11 and the cylinder block 12, respectively, enclose communicating chambers 15 and 16, the several parts of the former chamber being hereinafter more fully described and more specifically characterized, and the latter chamber being hereinafter referred to as a ram chamber. The upper end of chamber 15 is closed by a head 17 which is secured to the valve casing 11 by bolts 18.

A ram 19 is accurately fitted within the ram chamber 16 and is adapted to be reciprocated therewithin by hydraulic pressure. A reciprocating valve element or piston 20 is fitted within the chamber 15 of the valve casing and is adapted to be hydraulically reciprocated therewithin between a raised or open position as indicated in broken lines in Fig. 1, and a lowered or closed position as indicated in full lines.

One or more surge ports 21 are provided near the lower end of the valve casing 11 to permit fluid communication between a surge chamber 15a, at the lower end of the chamber 15, and a fluid tank 22 which is suitably mounted upon the ram cylinder block 12 and may enclose a substantial portion of the prefill valve.

The upper end of the ram cylinder block 12 is shouldered inwardly to form a neck 23 within which an annular valve seat element 24 is tightly and accurately fitted, said valve seat element and the periphery of the lower face of the piston 20 being complementally beveled to form seating surfaces which coact when the piston 20 is in its closed position whereby to break the fluid communication between the surge chamber 15a and the ram chamber 16.

An inwardly extending annular shoulder 25 is formed integrally with the valve casing 11 at a point immediately above the surge ports 21 and a ring 17a, which may be formed integrally with the head 17, is fitted accurately within the upper end of the chamber 15, thus reducing the diameter of the said chamber toward the upper and

lower ends thereof and providing an intermediate portion of said chamber with a relatively greater diameter.

The reduced diameters of the chamber 15 are preferably similar at the ring 17a and the shoulder 25, and the piston 20 is arranged to fit accurately within and work within said ring and shoulder. The said piston is enlarged circumferentially, intermediate its ends, to form a circumferential shoulder 26 which fits accurately within the greater diameter of the chamber 15 and partly defines an annular valve closing chamber 15b above said shoulder 26 and an annular valve-opening chamber 15c, below said shoulder.

A port 27, served by a pipe 28, extends through the valve casing 11 into the extreme upper portion of the valve-closing chamber 15b to permit filling and exhaustion of said chamber, and, similarly, a port 29 and pipe 30 are provided at the extreme lower portion of the valve-opening chamber 15c to permit filling and exhaustion thereof. It will be perceived from Fig. 1, that the several parts described are so arranged and proportioned that the volumes of the chambers 15b and 15c vary inversely with the reciprocation of the piston 20, and, further, that the ports 27 and 29 are at all times uncovered at their inner ends and afford unrestricted fluid passages into the chambers 15b and 15c, respectively, during the entire stroke of the piston 20.

Means are provided in the piston 20 for establishing fluid communication between the annular valve-closing chamber 15b and the ram chamber 16. The said means comprise an axial duct 31 extending from the bottom of the piston 20 almost to the top thereof, and a lateral passage 32 extending from the duct 31, and through the side wall of the piston 20 at a point at or near the top of the said duct, the passage 32, further, being so disposed that its outer end is uncovered, by the ring 17a, whereby to afford fluid communication between the duct 31 and the valve-closing chamber 15b, when the piston is in its closed position.

Means for providing a regulated uni-directional flow of fluid downwardly through the duct 31 comprise a normally spring-closed check valve 33, arranged within said duct to seat against the under side of an annular shoulder 34 therein. The said check valve has an upwardly-extending shank 35 around which extends a compression coil spring 36 seating against the upper side of the shoulder 34, and a washer 37, retained on the shank 35 by a nut 38 which is screwed onto the upper end of the said shank. The upper end of said shank is suitably threaded to receive the nut 38 and to permit adjustment of the tension of the spring 36 by adjustment of the said nut. A screw-plug 39 is screwed into the upper end of the duct 31, which, while preventing undesired fluid communication between the latter and the area above the top of the piston 20, may nevertheless be easily unscrewed and removed to afford access to the nut 38 for adjustment purposes.

In the structure illustrated in Fig. 1, the means for advancing or lowering the ram into initial engagement with the material being processed, comprises a rigid tube or pipe 39', which, at a reduced upper end thereof, is rigidly secured to the head 17 by a nut 40 and extends substantially vertically and centrally through a suitable hole in the said head, and also through suitable bores in the piston 20 and the ram 19, within which bores (particularly the bore in the ram) the tube 39' is accurately fitted to prevent fluid leak-

age therearound. The tube 39' has a longitudinal passage 41 extending throughout the entire length thereof and terminates in and opens into a quick advance chamber 42 in the interior of the ram 19.

The details of the quick advance chamber 42 and of hydraulic means for actuating the ram 19 on its return stroke (not shown herein) may be similar to comparable details disclosed in my said co-pending application, but as the present invention does not depend on such details, they have been omitted herefrom.

One or more axial passages 43 are provided in the piston 20 and afford a relatively unimpeded fluid communication between the area below the piston 20 and the area 15d, above the said piston, said latter area being hereinafter referred to as a pressure-balancing chamber 15d. The passages 43 are adapted to permit the filling and exhaustion of the chamber 15d and the size and number of such passages may be arranged to accomplish the said purpose in a desired period of time, due regard being had, of course, for the viscosity of the fluid which is to be employed in operating the press.

The pressure-balancing chamber 15d, and the ram chamber 16, being in fluid communication with each other when the piston 20 is in its closed position, will, at such times, be under uniform working pressures and as the effective area of the top of the piston 20 is greater than the effective area of the bottom thereof, it results that a preponderous force on the top of the piston will hold it closed while such uniform pressure is maintained in the chambers 15d and 16.

An understanding of the operation of the device hereinbefore described should be helpful in fully understanding the invention and the advantages thereof. Referring to Fig. 1, the cycle of operation may be considered as commencing with the ram 19 and the piston 20 in their uppermost positions, as indicated in broken lines, and with all the chambers, passages, and ducts hereinbefore referred to containing fluid at substantially atmospheric pressure. It should further be understood that the tank 22 contains a supply of fluid, at substantially atmospheric pressure, sufficient to provide for the operation of the device as hereinafter described.

With the ram 19 and the piston 20 in their uppermost positions, fluid is first introduced through the passage 41 in the tube 39' into the quick-advance chamber 42 in the ram, thus causing the latter to descend sufficiently to bring a die carried at the lower end thereof into initial engagement with the material being processed. The descent of the ram 19 creates suction in the ram chamber 16, thus drawing fluid from the tank 22, through the surge ports 21, into the surge chamber 15a and thence into the ram chamber, so that with the substantial completion of the descent of the ram 19, the ram chamber 16, substantially enlarged by the descent of the ram, is entirely occupied by fluid at substantially atmospheric pressure.

Fluid is then introduced into the valve-closing chamber 15b through the port 27, while the fluid in the valve-opening chamber 15c is simultaneously being exhausted through the port 29 (the said chambers and their respective ports being so arranged and connected to a source of fluid under pressure that when the one chamber is being filled, the other is simultaneously being exhausted, and vice versa), thus causing the piston

20 to descend to a closed position. While the piston 20 descends, the pressure-balancing chamber 15d above the piston increases in volume, and as the said chamber is entirely closed, except for the axial passages 43, there results an upward flow of fluid from the surge chamber 15a through said axial passages 43 and into the pressure-balancing chamber 15d, so that upon the piston reaching its closed position, the enlarged ram chamber 16, the axial passages 43, and the enlarged pressure-balancing chamber 15d are all full of fluid at substantially uniform pressure.

With the descent of the piston 20, the lateral passage 32 has moved to a point below the lower edge of the ring 17a, thus uncovering said lateral passage and establishing fluid communication between the valve-closing chamber 15b and the upper end of the axial duct 31, and continued introduction of fluid through the port 27, under pressure, causes the check valve 33 to open and establishes a suitable working pressure in the ram chamber 16 and a similar pressure in the communicating pressure-balancing chamber 15d, the pressure in said chambers being raised sufficiently to enable the press to perform the desired work. The effective area of the piston 20 which is subjected to downward pressure, when the valve is closed, being greater than the effective area thereof subjected to upward pressure, and all said areas being subjected to a substantially uniform pressure per unit of area, it is obvious that, while pressure is maintained in the chambers 15b, 15d and 16, there will be a predominant aggregate downward hydraulic force operating to keep the piston 20 in its closed position.

After the work of the down stroke of the ram has been completed, the return stroke is accomplished by simultaneously exhausting the valve-closing chamber 15b through the port 27 and introducing fluid under pressure through the port 29 into the valve-opening chamber 15c, at the same time raising the ram 19 by any suitable means which, for example, may be in the form of a hydraulic cylinder functioning directly with the said ram, as disclosed in my said co-pending application; the means for raising the ram, however, not being illustrated herein, as it forms no necessary part of the present invention.

When the valve-closing chamber 15b is exhausted and the high pressure is introduced into the valve-opening chamber 15c, the aggregate upward hydraulic force being exerted against the underside of the shoulder 26 on the piston and on the underside of the lower end of the piston is greater than the downward hydraulic force being exerted upon the upper end of said piston. This predominant upward force causes the piston 20 to move to its uppermost, or open, position, during which movement fluid from the pressure-balancing chamber 15d passes downwardly through the axial passages 43, unites with the fluid being expelled from the ram work chamber 16 and may pass out, in part through the surge chamber 15a and the surge ports 21 into the tank 22.

It will be seen from the foregoing explanation that, in order to close the prefill valve after the descent of the ram, it is only necessary to introduce into the valve a relatively small volume of fluid, equivalent to the difference between the volume of the relatively small valve-closing chamber 15b when the piston is in a closed position and the volume of said cylinder when the piston is in an open position, and it should be clear that the time element involved in introducing fluid

into the chamber 15b, as stated, would be substantially less than the time element involved in introducing fluid into a relatively large hydraulic chamber provided at the top of the piston.

5 This result has been accomplished by the present invention, in its broader aspects, by providing a valve-closing chamber which is of a minimum practical size suitable for effecting the closing of the valve and a separate chamber for
10 approximately balancing the upward hydraulic force imposed upon the piston when the ram is subjected to working pressure. The structure, if desired, may be so arranged that the pressure-balancing chamber alone would not achieve such
15 balancing effect, but it would then be essential that the downward force within the valve-closing chamber sufficiently augment the downward force within the pressure-balancing chamber so that both said chambers would afford an effective
20 pressure balance whereby to hold the piston in its closed position. Such an arrangement is illustrated in Fig. 7 and is hereinafter more fully described.

It will further be observed that the axial passages 43, in the piston, constitute means for rapidly filling the pressure-balancing chamber 15d while the piston is being moved to its closed position, thus obviating the necessity of providing means for filling said pressure-balancing chamber from the exterior of the valve structure.

It should also be apparent that, inasmuch as the chambers 15d and 16 are in fluid communication when the valve is closed, the pressure within both said chambers is simultaneously released at the instant the valve is opened, and hence, any structural stresses or shocks incident to the release of pressure would be minimized and substantially distributed and absorbed throughout the valve structure, and any possible harmful effects of such stresses or shocks would be substantially obviated.

Figs. 3 to 6, inclusive, illustrate prefill valves in which the principles involved in effecting closure thereof are similar to those hereinbefore described with reference to the structure disclosed in Fig. 1, but spring means are provided for opening the valve, supplanting the valve opening chamber 15c and the associated port 29 and pipe 30, as illustrated in Fig. 1. A further
50 difference between the valves of Figs. 3 to 6, inclusive, and Fig. 1 is that the former have no means directly associated therewith for advancing the ram into initial engagement with the material being processed. The means for advancing the ram, in the structures of said former figures, may be of any suitable type, such as, for example, independent hydraulic rams (not shown) which may be arranged to coact directly with the die normally secured to the lower
60 end of the ram.

Referring to the structure illustrated in Fig. 3, a compression coil spring 44 is disposed about a reduced lower portion of the piston 20, said spring seating at its lower end upon the valve seat element 24, and, at its upper end, against the under side of the shoulder 26 on the piston, thus normally holding the latter in its raised or open position. The relatively high pressure introduced into the valve-closing chamber 15b is sufficient to close the valve against the compression of the spring 44, it being understood, of course, that the adjustment of the tension of the spring 36 is such that the check valve 33 will not open until the valve is fully closed.

Only a single axial passage 43 is provided in

the structure as illustrated in Fig. 3, and a normally spring-closed retarding valve 45 is mounted in an enlarged upper end of said passage, said valve being adapted to retard the exhaustion of the pressure-balancing chamber 15d on the opening stroke of the piston 20 while nevertheless permitting rapid filling of said chamber on the closing stroke of the piston.

The retarding valve 45 is provided with a head 46, having a beveled, annular seating surface on the under side thereof coacting with a complementally beveled seating surface at the lower end of an enlarged portion of the passage 43, as at 47. The retarding valve 45 also has a shank 48, extending downwardly into a narrow
15 portion of the passage 43, with radial fingers 49 which coact with the wall of said passage to serve as guiding means for said valve.

The retarding valve 45 is held normally seated or closed by a compression coil spring 50 disposed between said valve and a perforate screw plug 51 which is screwed into the upper end of the passage 43 and is adapted to permit adjustment of the tension of the spring 50. The perforations in said screw plug permit fluid to pass
25 freely therethrough in either direction. Similar nipples 52, which are centrally disposed on the top and bottom, respectively, of the valve 45 and the screw plug 51, extend into the coil spring 50 whereby to maintain the latter in axial alignment with said valve. An exhaust passage 53 of relatively small diameter, extending through the head 46 of the retarding valve, permits a relatively gradual exhaustion of the pressure-balancing chamber 15d while the valve is opening. To the same end, it would be feasible, if desired, to provide an exhaust passage in the form of a second axial passage 43, of relatively small diameter, in the structure of the piston 20, instead of the passage 53 in the valve head 46.

It will be seen that, in the operation of a valve, according to Fig. 3, the retarding valve 45 would open upon the closing stroke of the piston 20 whereby to permit the rapid filling of the pressure-balancing chamber 15d, but that on the opening stroke of said piston the said retarding valve would not open and the exhaustion of the chamber 15d could only take place quite slowly through the small exhaust passage 53. The fluid remaining in the chamber 15d during the relatively slow exhaustion thereof would thus serve as a cushion which would oppose the normal tendency of the compression spring 44 to throw the piston suddenly upwardly and would thus obviate any undesirable shock which might otherwise be encountered. The extent of this cushioning effect would depend, in a substantial degree, upon the diameter of the exhaust passage 53 or its equivalent, and hence said passage may be suitably proportioned to achieve a desired cushioning effect.

Referring to the structure illustrated in Fig. 5, two or more stud bolts 54 extend through and are accurately fitted to slide within packing bushings 55 in the head 17 and are threaded into the upper part of the piston 20. Compression coil springs 56, disposed above the head 17 and about the upper ends of the stud bolts 54, seat against the bushings 55 and washers 57, the latter being held against displacement from the said bolts by nuts 58, which are adjustably screwed onto the upper ends of the bolts 54 whereby to permit adjustment of the tension of said springs. The springs 56, similarly to the spring 44 in Fig. 3, serve to keep the valve normally open.

In the structure of Fig. 5 the valve casing 11 and the cylinder block 12 are shown as being integrally formed, merely to indicate an available variation in the valve and press design. No retarding valve is employed in this structure as illustrated, although it is obvious that such a valve may be employed or not, as desired.

The structures of Figs. 3 and 5 operate substantially alike. After the ram 19 has been initially advanced by independent means (not shown), fluid is introduced, under pressure, into the valve-closing chamber 15b, thus closing the valve against the tension of the coil springs (spring 44 in Fig. 3 and springs 56 in Fig. 5), and the continued introduction of pressure causes the check-valve 33 to open and establishes sufficient working pressure in the chambers 15b, 15d, and 16 to enable the ram 19 to perform the desired work. The aggregate downward force upon the top of the piston 20 and upon the upper surface of the shoulder 26 on the piston is greater than the combined upward force upon the bottom of the piston and the force exerted by the springs 44 or 56, and hence the piston is held in its closed position while suitable pressure is maintained in the chamber 15b. The return or opening stroke of the piston 20 is accomplished by exhausting chamber 15b, whereupon the springs 44 or 56 urge the piston upwardly, the chamber 15d, meanwhile, exhausting through the axial passage or passages 43 and the ram 19 being independently raised. The opening of the valve disclosed in Fig. 3 would be slower than that of Fig. 5, and also would be cushioned because of the action of the retarding valve 45, as hereinbefore explained.

The structure illustrated in Fig. 7 differs from that of Fig. 5 only in that the lower end area of the piston 20 is slightly greater than the upper end area thereof. It will be observed that when the piston in this embodiment is in closed position, the fluid in chambers 15d and 16 are under substantially uniform pressure in view of the fact that said chambers are in communication through the vertical passage 43 and that the downward force exerted upon the top of the piston 20, through the chamber 15d, would be somewhat less than the upward force exerted upon said piston through the chamber 16, and hence, the chamber 15d would not alone suffice to hold the said piston in closed position. It should be observed, however, that the sum of the areas of the piston 20 subjected to downward force through chambers 15b and 15d is greater than the area of the bottom of the said piston and consequently when the piston is in closed position, the chambers 15b and 15d, both being under working pressure, operate to hold the piston in its closed position so that an adequate working pressure may be established and maintained. Where spring means, such as springs 56 are employed to hold the piston 20 normally in an open position, the differential between the areas of the piston 20, which are subjected to downward hydraulic force, and the area of the bottom of the piston, which is subjected to upward hydraulic force, should be sufficient to hold the piston 20 in closed position, not only against the hydraulic forces tending to throw it open, but also against the compressive force of said springs which likewise have a tendency to move the piston to its open position. It will be seen that with this structure, when the pressure is released in the chamber 15b for the purpose of opening the prefill valve upon the return stroke

of the ram whereby to permit exhaustion of the chamber 16, the hydraulic force exerted upon the bottom of the piston 20 would be greater than the hydraulic force exerted upon its extreme upper end and hence the opening stroke of the said piston will commence immediately upon the release of pressure in the chamber 15b and without any momentary locking, which, under some conditions, might take place under a different relationship in the sizes of the several hydraulic chambers.

It will be obvious from the foregoing description that the advantages of the present invention may be achieved by the application of the principles disclosed herein in a variety of valve and press structures and that the structures employed to give effect to such principles may be variously modified, without, however, departing from the invention and the spirit thereof, as defined in the appended claims.

What I claim is:

1. The combination in a hydraulic press or the like, of a source of supply of fluid at relatively high pressure, a source of supply of fluid at relatively low pressure, a substantially cylindrical reciprocating valve element having an inner end adapted to limit the flow of fluid between the latter source of fluid supply and an associated hydraulic press when the valve element is in a closed position, an annular hydraulic chamber, partly defined by an intermediate circumferential portion of said element and adapted to coact therewith whereby to move said element to a closed position, and a substantially separate hydraulic chamber, partly defined by the outer end of said element and adapted to coact therewith whereby to substantially hold the said element in a closed position.

2. A prefill valve for hydraulic presses and the like, comprising a valve casing, a valve element accurately fitted within said casing and adapted to be reciprocated therewithin between an outer position in which the valve is open and an inner position in which the valve is closed, and the said element is subjected at its inner end to the working pressure of fluid within the press, means for opening the valve, means for closing the valve, and means for holding the valve closed, the means for closing the valve comprising a relatively small valve-closing hydraulic chamber, partly defined by and coacting with a portion of said valve element whereby to move the latter inwardly to a closed position, and the means for holding the valve closed comprising a relatively large hydraulic chamber partly defined by the outer end of the valve element, and means affording fluid communication between the outer and inner end of said valve element when the valve is closed, a relatively larger area of the outer end of said element than of the inner end thereof being adapted to receive fluid working pressure when the valve is closed, whereby to hold the valve element in a closed position until said working pressure is released.

3. A prefill valve according to claim 2, the means affording fluid communication between the outer and inner end of said valve element, when the valve is closed, comprising a passage disposed within the valve element and extending from the outer end to the inner end thereof.

4. A prefill valve according to claim 2, the means affording fluid communication between the outer and inner end of said valve element, when the valve is closed, comprising a passage disposed within the valve element and extending

from the outer end to the inner end thereof, and a valve in said passage adapted to permit relatively rapid outward flow of fluid through said passage and to retard the inward flow of fluid therethrough.

5. A prefill valve according to claim 2, the means for opening the valve comprising a spring, coacting with a portion of the valve casing and a portion of the valve element whereby to urge the latter to an open position.

6. A prefill valve according to claim 2, the means for opening the valve comprising a hydraulic chamber, partially defined by and coacting with a portion of the valve element whereby to urge the latter to an open position.

7. A prefill valve for hydraulic presses and the like, comprising a port for exhausting and filling a ram chamber of a press, a duct for conveying fluid between said port and a source of fluid supply, a relatively large pressure-balancing hydraulic chamber, a reciprocating valve element having an inner end adapted to seat across said port whereby to close said port and duct against relative fluid communication, and said valve element, also, having an outer end partly defining said pressure-balancing chamber, an interior passage in said element for exhausting and filling said latter chamber and adapted to afford fluid communication between said latter chamber and said port, when the valve is closed, means for moving the valve element outwardly to open the valve, and a relatively small hydraulic chamber coacting with a part of the valve element whereby to move said element inwardly to close the valve, the parts of the valve element which are subjected to inward hydraulic pressure when the valve is closed being so proportioned that the force resulting from such pressure tending to urge the valve element to a closed position, is greater than all coexisting forces tending to open the valve.

8. A prefill valve for hydraulic presses and the like, according to claim 7, the said interior passage in the valve element having a valve therein adapted to permit relatively rapid outward flow of fluid through said passage whereby to permit the rapid filling of said pressure-balancing chamber and being further adapted to retard the inward flow of fluid through said passage whereby to retard the exhaustion of said chamber and to permit the fluid in said chamber to cushion the opening stroke of the valve element.

9. A prefill valve for hydraulic presses and the like, according to claim 7, further characterized in having a duct adapted to afford fluid communication between the said relatively small chamber and the ram chamber of the press, when the valve is closed, whereby to permit the introduction of fluid into the ram chamber through the said small chamber.

10. A prefill valve for hydraulic presses and the like, according to claim 7, further characterized in having a duct adapted to afford fluid communication between the said relatively small chamber and the ram chamber of the press, when the valve is closed, whereby to permit the introduction of fluid into the ram chamber through the said small chamber, said latter duct having a valve, associated therewith, adapted to permit the flow of fluid into the ram chamber only when the prefill valve is closed.

11. A prefill valve for hydraulic presses and the like, according to claim 7, further characterized in having a duct in the valve element adapted to afford fluid communication between the said

relatively small chamber and the ram chamber of the press, when the valve is closed, whereby to permit the introduction of fluid into the ram chamber through the said small chamber, said latter duct having a valve, associated therewith, adapted to permit the flow of fluid into the ram chamber only when the prefill valve is closed.

12. The combination with a hydraulic press having a ram chamber, a ram adapted to reciprocate within said chamber and having an interior quick advance chamber therein, and a fixed fluid-supply pipe extending within an axial bore in the ram and into said quick advance chamber, of a prefill valve comprising a casing within which the said pipe extends, a surge chamber in said casing communicating with the ram chamber, an opening in said casing arranged to permit the flow of fluid into said surge chamber, a reciprocating valve element slidably mounted upon said fixed pipe within said casing, a relatively small hydraulic chamber, partly defined by and coacting with a portion of the valve element and adapted to move the latter to a closed position wherein a portion thereof closes the ram chamber and surge chamber against relative fluid communication, and a substantially separate, relatively large hydraulic chamber, partly defined by and coacting with a portion of the valve element and adapted to hold the latter in such closed position.

13. A hydraulic press and a prefill valve therefor comprising a hydraulic ram chamber, a passage for filling and exhausting said chamber, a reciprocating valve element having an inner end adapted for closing said passage, means for reciprocating said element between open and closed positions, and a hydraulic pressure balancing chamber in continuous fluid communication with said ram chamber, the said inner end of the valve element, when said element is in closed position, being subject to a hydraulic force from within the ram chamber tending to move the said valve element toward an open position, and said valve element also having a surface which is subject to a hydraulic force from within the pressure-balancing chamber substantially equalizing the first-mentioned hydraulic force and opposing the latter's tendency to move the valve element toward an open position.

14. A hydraulic press and a prefill valve therefor according to claim 13, the means for moving said valve element to closed position comprising a separate hydraulic valve-closing chamber.

15. A hydraulic press and a prefill valve therefor, comprising a hydraulic ram chamber, a passage for filling and exhausting said chamber, a reciprocating valve element having an inner end adapted for closing said passage, a hydraulic pressure-balancing chamber in continuous fluid communication with said ram chamber, a hydraulic valve-closing chamber for moving said element from an open to a closed position, and means for moving said element from a closed to an open position, the said element having surfaces subject to hydraulic pressure from within said valve-closing and pressure-balancing chambers tending to urge said valve element towards its closed position, and the surface of said inner end of the valve element being subject to pressure from within the ram chamber, when the said element is in its closed position, tending to urge said element towards its open position, the latter surface being of less area than the areas of said first-mentioned surfaces and of greater area than the area of the said surface which is subject to pres-

sure from within the pressure-balancing chamber.

ment which tend to move the latter to an open position.

5 16. The combination with a hydraulic press having a ram chamber, a ram adapted to reciprocate within said chamber and having an interior
10 quick-advance chamber therein, and a fixed fluid-supply pipe extending within an axial bore in the ram and into said quick-advance chamber, of a
15 prefill valve comprising a casing within which the said pipe extends, a passage in said casing affording fluid communication between the exterior thereof and the said ram chamber, a reciprocating valve element within said casing through which valve element the said pipe extends, means
20 for moving said valve element from a closed position wherein such fluid communication is substantially cut off to an open position, a hydraulic valve-closing chamber adapted to impose pressure upon the valve element tending to move it from an open position to such closed position and
a substantially separate hydraulic chamber adapted to impose pressure upon the valve element, when the latter is in closed position, tending to oppose forces exerted upon said valve ele-

17. The combination according to claim 16, further characterized in including a passage which, when the valve element is in closed position, affords fluid communication between said last mentioned hydraulic chamber and the said ram chamber.

18. The combination according to claim 16, further characterized in including a passage 10 which, when the valve element is in closed position, affords fluid communication between said last mentioned hydraulic chamber and the said ram chamber, the said last mentioned passage constituting the sole means for filling and ex- 15 hausting said latter chamber.

19. The combination according to claim 16, further characterized in including a passage in said valve element which, when the latter is in closed position, affords fluid communication between said last mentioned hydraulic chamber and the said ram chamber. 20

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