

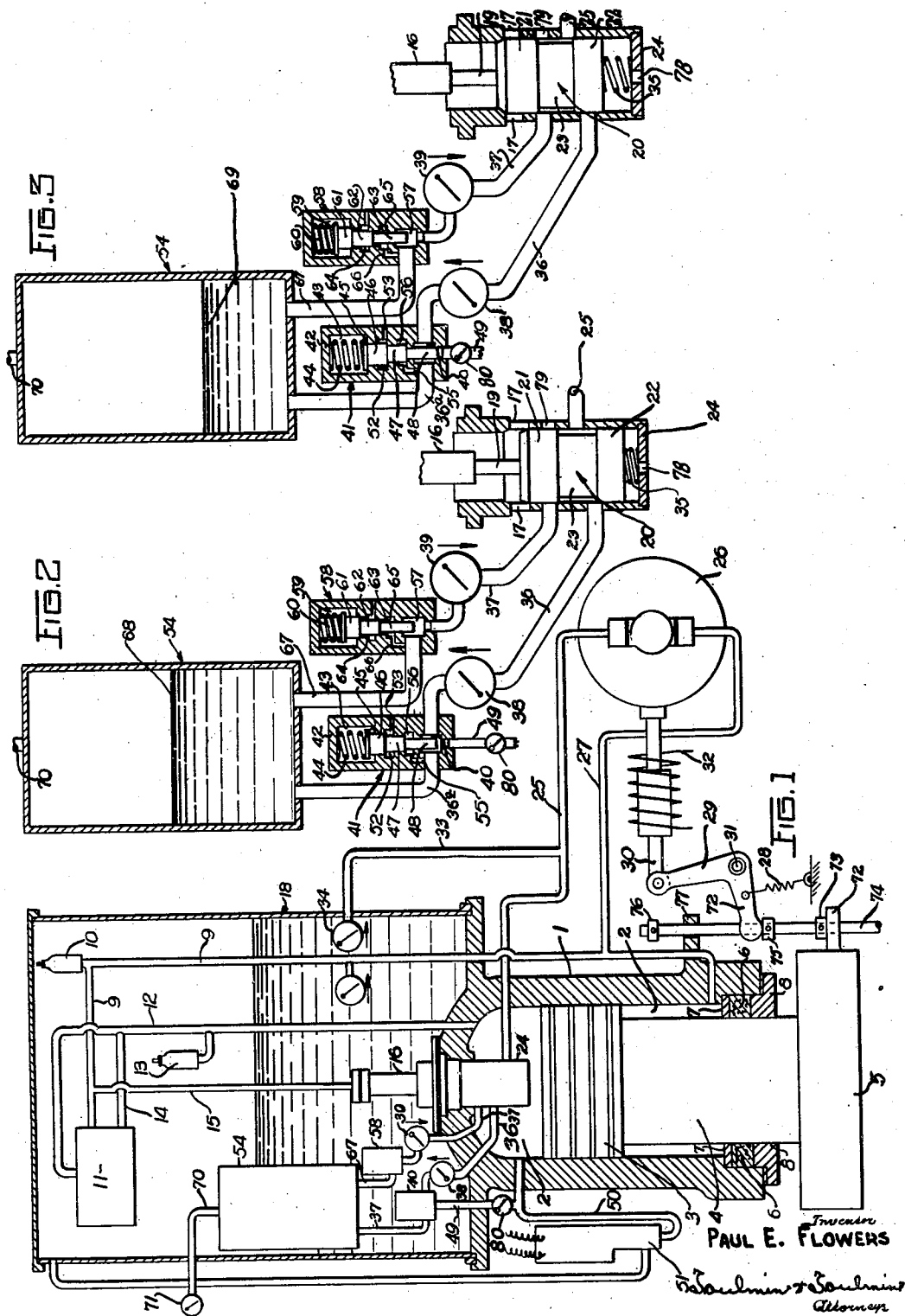
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MEANS FOR REDUCING THE DWELL IN HYDRAULIC PRESSES

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MEANS FOR REDUCING THE DWELL IN
HYDRAULIC PRESSES

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This invention relates to presses, and in particular to hydraulic presses with fast advancing movement of the press platen during the first portion of the working stroke.

In presses of the said character a dwell occurs during the shift from rapid advance to pressing speed, which dwell is caused by the fact that it takes the pump some time to build up pressure in a large cylinder and to compress the oil therein as well as to take care of slight cavitation due to the cylinder not being entirely filled at the time the shift takes place. The said dwell increases naturally with the size of the press, and in modern large presses appreciably increases the time required for a working cycle.

Accordingly, it is an object of the invention to provide a method of and device for reducing the time of the dwell that occurs in a large press during the shift from rapid advance to pressing speed.

It is another object of the invention to provide a hydraulic press with a rapid advance movement of the press platen during the first portion of the working stroke, in which additional fluid pressure is exerted upon the press platen at the time when the shift from rapid advance to pressing speed is effected.

It is a further object of the invention to provide a press of the type referred to above, in which, in response to the engagement of the work piece by the die connected with the press platen, valve means is operated for conveying additional pressure to the press platen.

A still further object of the invention consists in the provision of a press with rapid advance and slower pressing speed, in which a relatively small accumulator delivers pressure fluid to the press cylinder at the time when the shift from rapid advance to pressing speed is initiated.

Another object of the invention consists in the provision of a press as set forth in the preceding paragraph, in which pressure responsive means controls the unloading of the accumulator.

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

Figure 1 diagrammatically illustrates a press provided with the dwell reducing means according to the present invention.

Figure 2 shows the dwell reducing means of Figure 1 on a somewhat larger scale, said means being shown during the loading of the accumulator.

Figure 3 is a section similar to Figure 2, showing the accumulator while being unloaded.

General arrangement

In order to reduce the time of the dwell that occurs during the shift of the rapid advance to pressing speed, the press according to the present invention is provided with an accumulator which is charged with fluid during the rapid advance stroke of the press platen and unloads its fluid into the upper portion of the press cylinder as soon as the die supported by the press platen engages a work piece. To this end the accumulator is provided with valve means which is controlled by a combined surge unloading valve so that when the surge valve closes at the engagement of the die, carried by the press platen, with the work piece, communication is established between the accumulator and the upper portion of the press cylinder. The fluid in the accumulator then instantaneously rushes into the press cylinder, fills up any possible cavities and exerts a predetermined pressure on the fluid in the press cylinder so that the pump usually associated with the press for delivering the pressure fluid can immediately build up the necessary drawing pressure.

Structural arrangement

Referring now to the drawing in detail, 1 designates the press cylinder having a cylinder bore 2 in which a double-acting piston 3 is reciprocally mounted. The piston 3 has connected therewith a ram 4 carrying the press platen 5. To prevent leakage from the press cylinder bore 2, a packing 6 is provided at the lower portion of the press cylinder 1 and compressed against a press ring 7 by means of a gland 8. Communicating with the lower portion of the press cylinder 2 is a conduit 9 comprising a safety valve 10 and leading to a main cylinder relief and pump by-pass valve 11. The main cylinder relief and pump by-pass valve 11 does not form a part of the present invention and for a more detailed description thereof reference may be had to U. S. patent application, Serial No. 286,063 to Walter Ernst. The purpose of this valve 11 consists in relieving the pressure in the upper portion of the press cylinder for facilitating the retraction stroke of the press platen. Also communicating with the valve 11 is a conduit 12 connected to a safety valve 13 and leading to the upper portion of the cylinder bore 2. The conduit 12 also communicates with the valve 11 by a branch pipe 14. Branching off from the conduit 9 is a conduit

15 leading to a surge valve 16 which, as far as its upper portion is concerned, operates in the same manner and is similarly constructed as the surge valve disclosed in U. S. Patent No. 2,193,248 to Walter Ernst. The purpose of the said portion of the surge valve 16 consists in prefilling the upper portion of the press cylinder during the rapid advance of the press platen. To this end the surge valve 16 opens the bores 17 due to the suction effect caused in the press cylinder bore 2 by the downward movement of the piston 3 so that fluid stored in the surge tank 18 carried by the press cylinder 1 may flow through the bores 17 into the upper portion of the cylinder bore 2.

In addition to the features of the surge valve disclosed in U. S. Patent 2,193,248, the surge valve shown in the drawing has the further purpose of controlling the flow of additional pressure fluid into the upper portion of the cylinder 2. According to the invention, the shaft 19 of the surge valve 16 is provided with a valve member generally designated 20, which comprises two spaced pistons 21 and 22 interconnected by an interconnecting member 23 of smaller diameter than the pistons 21 and 22. The pistons 21 and 22 are reciprocally mounted in the surge valve cylinder 24 which communicates through a conduit 25 with one side of a reversible variable delivery pump 26, the other side of which communicates with a conduit 27 leading to the conduit 9. The variable delivery pump 26 is provided with a flow control member (not shown) in a manner well known to those skilled in the art, which, when shifted into one extreme position, causes the pump to deliver in one direction, whereas, when shifted into another position causes the pump to deliver in the opposite direction. The flow control member is furthermore adapted to occupy an intermediate or neutral position in which the pump delivers substantially no fluid. The flow control member is actuated in one direction by means of a spring 28 normally urging a bell crank lever 29 in anti-clockwise direction, said bell crank lever being pivotally connected with a rod 30 which, in its turn, is connected with the flow control member, and being shiftable about the pivot 31. Operatively connected with the rod 30 is a solenoid 32 which, when energized, causes movement of the rod 30 and thereby of the flow control member toward the right against the thrust of the springs 28.

Branching off from the conduit 25 is a conduit 33 leading into the fluid tank 18 and comprising a check valve 34.

The surge valve cylinder 24 comprises a spring 35 the lower end of which engages the bottom of the surge valve cylinder 24 whereas the upper end engages the surge valve piston 22. The spring 35 is arranged so as to continuously urge the pistons 21 and 22 upwardly. Provided in the bottom of the surge valve cylinder 24 is a bore 18 which communicates with the upper portion of the cylinder bore 2. The cylinder 24 also comprises a bore 19 adapted when released by the piston 21 to effect communication between the interior of the cylinder and the upper portion of the press cylinder bore 2. The surge valve cylinder 24 has connected therewith two conduits 36 and 37, each comprising a check valve, 38 and 39 respectively. However, while the check valve 38 opens in the direction away from the surge valve cylinder 24, the check valve 39 opens in a direction toward the surge valve cylinder 24. The conduit 36 leads to a recess 40 in an unloading valve generally designated 41. The unloading valve 41 comprises

a casing 42 with a spring chamber 43 housing a spring 44 which constantly urges the plunger 45 downwardly. The plunger 45 has interconnected piston portions 46 and 47, the latter of which carries a control plunger 48 adapted when in raised position to effect communication between the conduit 36 and the conduit 49 leading into a conduit 50, one end of which communicates with the upper portion of the cylinder bore 2, whereas the other end leads to a tonnage control valve 51. The tonnage control valve 51 is responsive to a predetermined pressure in the press cylinder and adapted, at the attainment of this pressure, to break the circuit comprising the solenoid 32 so that the latter is deenergized. The tonnage control valve 51 does not form a part of the present invention and for a more detailed description thereof reference may be had to U. S. patent application, Serial No. 214,772 to Walter Ernst, filed June 20, 1938, which has matured into Patent No. 2,224,957.

The plunger portion 46 is adapted to enter a recess 52 comprising a breather opening 53. The plunger portion 47 is adapted to be lifted by a predetermined pressure in the conduit 36a leading from the recess 40 to the accumulator 54 which pressure is conveyed from the conduit 36a through the passageway 55 into the recess 56 in the valve casing 42. The check valve 39 is adapted to communicate with the recess 57 in the unloading valve 58 which in its construction fully corresponds to the construction of the unloading valve 41. Thus the unloading valve 58 comprises a spring chamber 59 with a spring 60, plunger portions 61, 62, 63 and recesses 64 and 65. The recess 65 communicates through a passageway 66 with the conduit 67 leading to the accumulator 54. However, the unloading valve 58 is so set that the plunger portion 62 interconnected with the plunger portions 61 and 63 is lifted at a lower pressure than the plunger portion 47 of the unloading valve 41. The accumulator 54 is, in its loaded position, filled with fluid up to the level indicated at 68 whereas the lowermost level which the fluid in the accumulator may reach is indicated by the reference numeral 69. The unloading valve 58 is set so that it closes when the level 69 is reached. If desired, a floating valve may be arranged in the accumulator 54 which automatically closes the conduit 67 at the attainment of a predetermined lowermost level. The fluid, preferably oil, in the accumulator 54 is under the pressure of a gas, such as an inert gas, for instance nitrogen. The accumulator 54 is provided with a filling line 70 controlled by a shutoff valve 71 which, when in open position, allows filling of the accumulator with the desired gas.

The press platen 5 is provided with a platen arm 72 adapted to engage a collar 73 adjustably mounted on a control rod 74 which carries two further collars likewise adjustably mounted thereon. The collar 75 cooperates with the lever arm 72 of the bell crank lever 29 which arm, as previously stated, is urged by spring 28 into anti-clockwise direction. The collar 76 is adapted to engage the flange 77 on the press cylinder 1 for limiting the downward stroke of the control rod 74.

Operation.

Assume that all parts occupy the position shown in Figure 1 and that the plunger portion 63 of the unloading valve 58 interrupts communication between the conduit 37 and the conduit 67. If it is now desired to start the press on a working stroke, the pump 26 is started in

any convenient manner. Thereupon the operator closes the circuit comprising the solenoid 32 so that the latter is energized moving the pump to full stroke forward position. As soon as the pump begins to deliver fluid into the conduit 25 and, consequently, to withdraw fluid from the lower portion of the press cylinder bore 2 through the conduits 9 and 27, the press ram 4 with the platen 5 moves rapidly downwardly at the rate at which fluid is withdrawn from below the piston 3. The suction created by the downward movement of the piston 3 is conveyed through the bore 78 in the surge valve cylinder 24 and keeps the pistons 21 and 22 in their lowermost position so that communication between the conduit 25 and the conduit 36 prevails. While the space above the piston 3 during the downward movement thereof is filled with fluid passing from the tank 18 through the surge valve bores 17, fluid delivered by the pump 26 through the conduit 25 passes around the interconnecting member 23 into the conduit 36 from where it flows through the check valve 38, the recess 40 and the conduit 36a into the accumulator 54, thereby charging the latter. As soon as a predetermined pressure is built up in the accumulator 54, this pressure is conveyed through the conduit 67 and the passageway 66 in the unloading valve 58 upon the plunger portion 62 so that the latter together with the plunger portion 63 is lifted against the thrust of the spring 60. Pressure fluid from the accumulator 54 may then pass through the recess 57, the check valve 39 into the conduit 37. However, since the piston 21 closes the conduit 37, no fluid can escape from the said conduit. Before the die carried by the press platen 5 engages a work piece, the accumulator 54 is charged to a predetermined level so that the desired pressure is established therein. When the said level, for instance the level 68, has been reached, a predetermined pressure higher than the pressure necessary for opening the valve 58 is established. If now the pump 26 delivers fluid into the conduit 36 so that the pressure in the accumulator exceeds said last mentioned high pressure, this pressure acts through conduit 36a, passageway 55 and recess 56 upon the piston portion 47 so as to lift the plunger 48 against the thrust of the spring 44 thereby enabling fluid to pass from the conduit 36, through the recess 40 and the conduits 49 and 50 directly into the upper portion of the press cylinder bore 2.

As soon as the die carried by the platen 5 engages the work piece, the ram 4 stops temporarily so that the suction created in the upper portion of the press cylinder 2 is eliminated, whereupon the spring 35 lifts the pistons 22 and 21 to their uppermost position thereby closing the conduit 36 while establishing communication between the conduit 37 and the bore 79. As a result thereof, the pressure fluid accumulated in the accumulator 54 discharges through the conduit 67, the recess 57, check valve 39, conduit 37 and bore 79 into the upper portion of the press cylinder 2, thereby instantaneously filling any voids which may prevail above the piston 3 and also compressing the fluid above the piston 3. In this way the dwell heretofore observed with presses of the type under consideration is practically eliminated, thereby reducing the time required for a working cycle. It will be appreciated that the check valve 80 prevents the pressure fluid in cylinder 2 from acting upon valve plunger 48 through conduits 50

and 49, but allows pressure fluid to pass from conduit 49 into conduit 50.

When the fluid in the accumulator 54, during the unloading operation, falls below the level 68, the pressure in the accumulator is lower than the pressure exerted by the spring 44 so that the latter moves the plunger 48 downwardly thereby again interrupting communication between the conduit 36a and the conduit 49. The lower pressure unloading valve 58 remains open until the fluid in the accumulator 54 has fallen to the level 69. Figure 3 shows the position of the unloading valve during the unloading operation at a time when the fluid in the accumulator has reached a level intermediate the levels 68 and 69. When the press platen 5 has reached its lowermost position in which a predetermined pressure acts upon the piston 3, this pressure conveyed through the conduit 50 to the tonnage control valve 51 actuates the latter which, in its turn, breaks the circuit comprising the solenoid 32 thereby de-energizing the latter. The spring 28 now shifts the pump 26 to full stroke retracting position and thereby starts the retraction stroke of the press platen. Pressure fluid is then delivered by the pump 26 through the conduits 27 and 9 into the lower portion of the press cylinder bore 2. The pressure in the conduit 9 is conveyed through the conduit 15 to the surge valve 16 where it acts upon a piston (not shown) which is connected with the shaft 19 so as to move the pistons 21 and 22 downwardly into a position in which the conduit 25 again communicates with the conduit 36, while the openings 17 in the surge valve establish a free communication between the upper portion of the cylinder bore 2 and the interior of the tank 18. Consequently, fluid expelled by the piston 3 during the retraction stroke can escape through the bores 17 into the fluid tank 18. Since the conduit 25 is now the suction side with regard to the pump, the check valve 38 closes, thereby preventing the fluid in the accumulator 54 from falling below the level 69.

At the end of the upward stroke of the ram 4, the press platen 5 engages the collar 73 so as to lift the control rod 74 which in its turn, by means of the collar 75, shifts the bell crank lever 29 and the rod 30 pivotally connected therewith in such a manner as to move the pump 26 to neutral or no-delivery position. The ram 4 then comes to a standstill and the press is ready for a new cycle.

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. A hydraulic press comprising in combination a press ram, a first fluid source adapted to supply pressure fluid to said ram, a second fluid source adapted to supply additional pressure fluid to said ram, means for conveying pressure fluid from said first fluid source to said second fluid source to build up a predetermined pressure in the latter, means responsive to the establishment of said predetermined pressure in said second fluid source for establishing hydraulic connection between said first fluid source and said ram, means operable at the engagement of the work piece to be shaped by said ram or a die connected thereto for conveying fluid pressure from said second fluid source to said ram to speed up the start of the actual pressing stroke, and means

responsive to a predetermined discharge of said second fluid source for again interrupting hydraulic connection between said second fluid source and said ram, while said first fluid source remains hydraulically connected with said ram.

2. In combination in a hydraulic press, a press ram, a fluid reservoir, means responsive to the initiation of a working cycle of said ram for admitting fluid from said reservoir to said ram, a main fluid source adapted to supply pressure fluid to said ram, an additional pressure fluid source adapted to supply pressure fluid to said ram independently of said main fluid source, means responsive to the start of the advancing movement of said ram for causing said main fluid source to load said additional fluid source, means responsive to a predetermined pressure on said ram prior to the start of the actual pressing stroke thereof for interrupting hydraulic connection between said reservoir and said ram and for instantaneously supplying fluid from said additional fluid source to said ram to supplement the fluid from said main fluid source, and means responsive to a predetermined discharge from said additional fluid source to said ram to interrupt hydraulic connection between the latter and said additional fluid source, while said main fluid source continues to supply pressure fluid to said ram to cause the latter to effect its actual pressing stroke.

3. A hydraulic press comprising in combination a press cylinder, a press ram reciprocally mounted in said cylinder, a fluid source adapted to supply pressure fluid to said ram during the advancing and retraction stroke thereof, an additional fluid source adapted to supply pressure fluid to said ram only during the advancing stroke thereof, a fluid reservoir, means responsive to a suction effect in said cylinder for establishing hydraulic communication between said reservoir and said cylinder, means for controlling said additional fluid source so as to effect hydraulic communication between the latter and said ram prior to the start of the actual pressing action of said ram and to interrupt said hydraulic communication between said reservoir and said cylinder, and means for hydraulically disconnecting said additional fluid source from said cylinder while said ram continues its pressing stroke.

4. A hydraulic press comprising in combination, a press cylinder, a ram reciprocable in said cylinder, a surge tank, means responsive to a suction effect in said cylinder for hydraulically connecting the same with said tank, a fluid source adapted to supply pressure fluid to said ram for selectively causing an advancing and a retracting stroke thereof, a storage means for storing fluid under pressure, means operable prior to the start of the actual pressing action of said ram for interrupting hydraulic connection between said cylinder and said tank, and means operable concomitantly with said last mentioned means for instantaneously unloading fluid from said storage means into said cylinder to speed up the building up of pressure in said cylinder and to shorten the dwell of said ram prior to its actual pressing operation.

5. A hydraulic press comprising in combination a press cylinder, a ram reciprocable in said cylinder, means for initiating a fast advancing movement of said ram, a fluid source adapted to supply pressure fluid to said cylinder for advancing said ram, a fluid tank for supplying fluid to said cylinder during said fast advancing movement

of said ram prior to its slowing down to pressing speed for the actual pressing action, fluid storage means independent of said tank and adapted to be supplied with pressure fluid by said fluid source, controlling means adapted in response to a predetermined pressure condition in said cylinder during said fast advancing movement to move into a first position for establishing fluid connection between said fluid source and said storage means to load the latter, and also adapted at the end of said fast advancing movement to move into a second position for establishing fluid connection of said cylinder with both said fluid source and said storage means, while simultaneously interrupting fluid connection between said tank and said cylinder, and means responsive to a predetermined discharge of fluid from said storage means for interrupting fluid connection between said storage means and said cylinder without preventing the delivery of fluid from said fluid source to said cylinder.

6. A hydraulic press comprising in combination a press ram, means for initiating an advancing movement of said ram, a fluid source adapted to supply pressure fluid to said ram for advancing the same, fluid storage means for storing fluid under pressure, said fluid storage means being adapted to unload pressure fluid therefrom to said ram independently of said fluid source, means responsive to the start of the advancing movement of said ram for causing said fluid source to load said storage means, and pressure responsive means responsive to a predetermined pressure on said ram prior to the actual pressing action thereof for effecting hydraulic communication between said fluid storage means and said press ram to unload fluid from said storage means to said ram concomitantly with the supply of fluid from said fluid source to said ram.

7. In combination in a hydraulic press, a press ram, pumping means adapted to supply pressure fluid to said ram to actuate the same, means for storing fluid under pressure, means for hydraulically connecting the pressure side of said pumping means with said fluid storing means during the pressing stroke of said ram prior to the actual pressing action thereof to load said storing means, means responsive to a first predetermined pressure in said storing means for by-passing the discharge of said pumping means to said ram, means responsive to a predetermined pressure on said ram for unloading fluid from said storing means to said ram, and means responsive to a second predetermined pressure in said storing means lower than said first predetermined pressure for interrupting hydraulic communication between said pumping means and said fluid storing means while said pumping means delivers fluid to said ram to cause the latter to carry out its pressing action.

8. A hydraulic press comprising in combination a press ram, a fluid source adapted to supply pressure fluid to said ram for actuating the same, a fluid accumulator for storing fluid under pressure, a fluid tank for storing fluid independently of said accumulator, valve means for controlling hydraulic communication between said storage tank and said ram, a controlling valve adapted in response to a predetermined pressure in said accumulator to effect hydraulic communication between the latter and said valve means, and means operatively connected with said valve means for establishing hydraulic communication between said accumulator and said ram in response to a predetermined pressure on the latter.

9. In combination in a hydraulic press, a press ram, pumping means for supplying pressure fluid to said ram, fluid storage means for storing fluid under pressure, controlling means movable into a first position for unloading fluid from said fluid storage means to said ram and movable into a second position for establishing hydraulic connection between said storage means and said pumping means to cause the latter to load said storage means, means responsive to the movement of said controlling means into said first position for establishing hydraulic connection between said pumping means and said ram, means responsive to the initiation of an advancing movement of said ram for effecting movement of said controlling means into said second position, and means operable prior to the start of the actual pressing action of said ram for causing movement of said controlling means into said first position.

10. A hydraulic press comprising in combination a press ram having associated therewith fluid operable advancing and retracting means for reciprocating said ram, means for initiating an advancing stroke of said ram, pumping means adapted to supply pressure fluid selectively to said advancing or retracting means, fluid storage means adapted to supply additional fluid to said advancing means, means responsive to the initiation of an advancing stroke of said ram for conveying pressure fluid from said pumping means to said storage means to load the same while preventing fluid connection between said advancing means and said pumping means, means responsive to a predetermined resistance encountered by said ram during said advancing stroke for hydraulically connecting both said storage means and said pumping means with said advancing means, and means responsive to the unloading of a predetermined quantity of fluid from said storage means for again interrupting fluid connection between said storage means and said advancing means without preventing fluid connection between said advancing means and said pumping means to allow said advancing stroke of said ram to continue.

11. A hydraulic press comprising in combination a press ram, a fluid source adapted to supply pressure fluid to said ram, fluid storage means adapted to be loaded by said fluid source, means responsive to a predetermined pressure in said fluid storage means for interrupting the supply of pressure fluid from said fluid source to said storage means while establishing fluid connection between said fluid source and said ram, and means adapted to unload fluid from said fluid storage means to said ram in response to resistance offered by a work-piece to the advancing movement of said ram.

12. A hydraulic press comprising in combination a press cylinder, a press ram reciprocally mounted in said cylinder, a tank containing fluid, a surge valve adapted to effect communication

between said tank and said press cylinder to pre-fill said cylinder during the first portion of the working stroke of said ram, said surge valve being also adapted to interrupt said communication in response to a predetermined pressure in said cylinder, a fluid source for supplying pressure fluid to said cylinder, fluid storage means independent of said tank and adapted to be supplied with pressure fluid from said fluid source, controlling means operable by said surge valve for establishing hydraulic communication between said fluid storage means and said press cylinder, and means for interrupting the supply of pressure fluid from said fluid source to said fluid storage means during the actual pressing action of said ram.

13. In combination in a hydraulic press, a press ram, a fluid pressure pump for supplying fluid pressure to said ram, an accumulator adapted to be loaded by said pressure pump, a surge tank independent of said accumulator, means responsive to the initiation of a pressing cycle to establish hydraulic connection between said surge tank and said ram and between said pump and said accumulator for filling the latter, means responsive to a predetermined loading of said accumulator for conveying the discharge of said pump to said ram, means responsive to a predetermined resistance encountered by said ram or a die connected thereto for conveying fluid from said accumulator to said ram to shorten the dwell thereof, means operable concomitantly with the establishment of said last mentioned connection for interrupting hydraulic communication between said tank and said ram, and means responsive to a predetermined discharge of said accumulator for interrupting hydraulic connection between said accumulator and said ram while said pump continues to deliver fluid to said ram.

14. In combination in a hydraulic press, a press cylinder, a ram reciprocable in said cylinder, a fluid source adapted to supply pressure fluid to said cylinder for actuating said ram, fluid storage means adapted to be loaded by said fluid source, a control member movable from one position into another position, or vice versa, means responsive to the movement of said control member into one position for establishing hydraulic connection between said fluid source and said storage means to cause loading of the latter and also responsive to the movement of said control member into the other position for unloading fluid from said storage means into said cylinder in addition to fluid passing simultaneously from said fluid source into said cylinder, and means responsive to a predetermined decrease in pressure in said storage means during said unloading operation for interrupting hydraulic connection between said storage means and said cylinder without impairing the supply of fluid from said fluid source to said cylinder.

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