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Olmsted

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[54] HYDRAULIC PRESS

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[52] **U.S. Cl.**.....**100/269 B**

[51] **Int. Cl.**.....**B30b 1/32**

[58] **Field of Search**.....100/269; 17/39; 25/16, 55, 25/84, 91; 83/639; 72/453

[56] **References Cited**

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[57] ABSTRACT

A hydraulic press having a fluid chamber and a piston slidably mounted therein so as to separate said chamber into a pair of portions. A conduit of "excessive" length connects the chamber portions and functions as a valve in point of time to provide the desired isolation of the chamber portions from each other and also to provide intensified pressure on the desired side of the piston.

3 Claims, 5 Drawing Figures

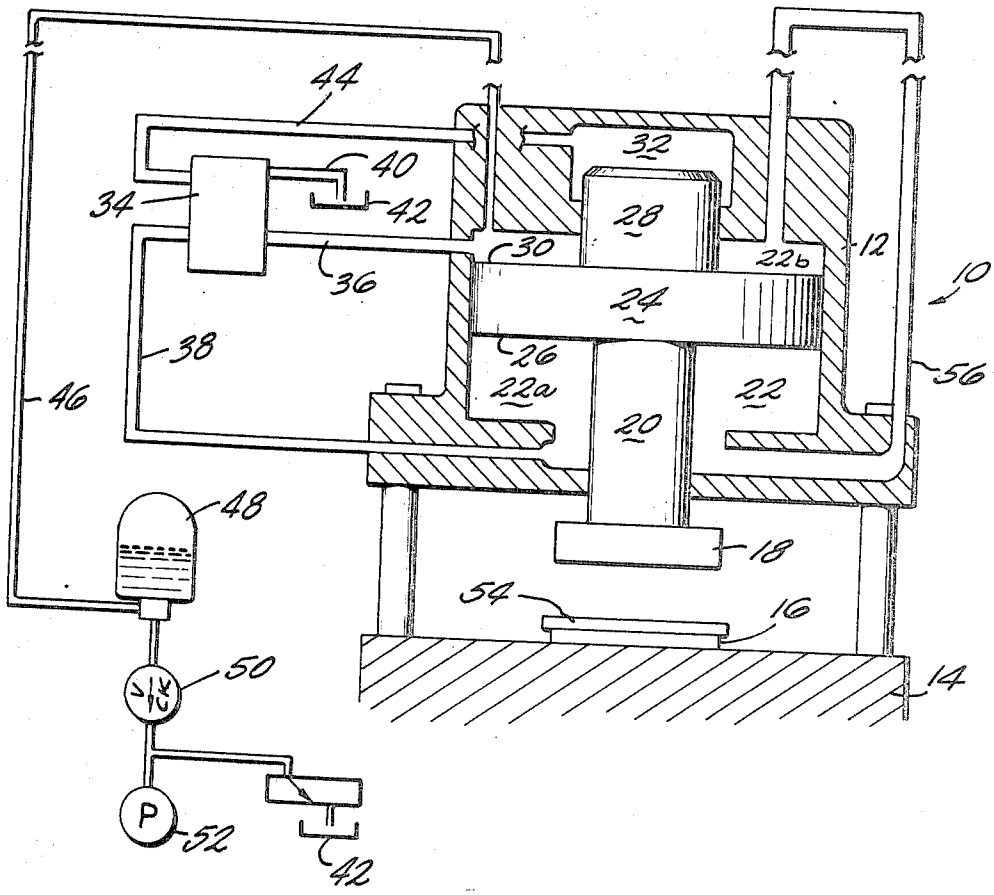

FIG. 1

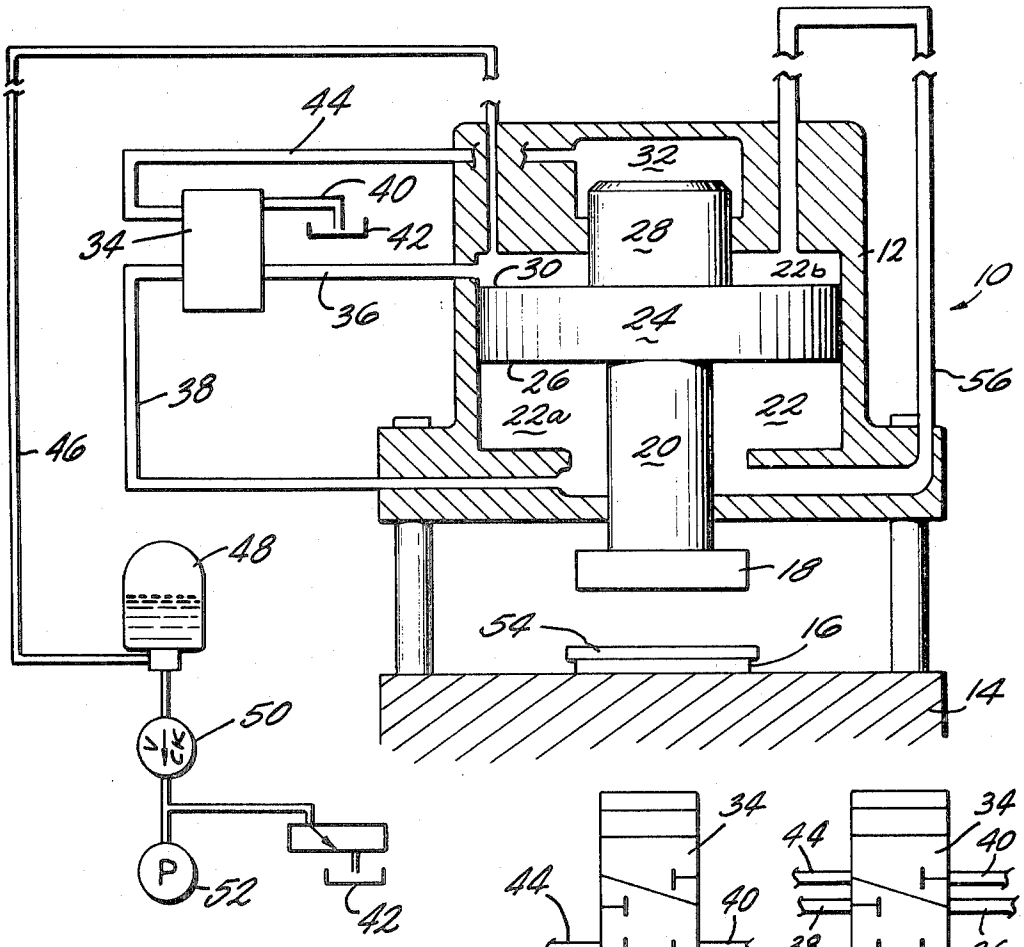

FIG. 2

FIG. 3

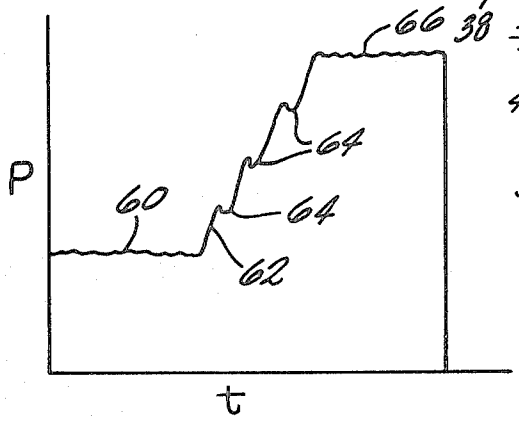

FIG. 5

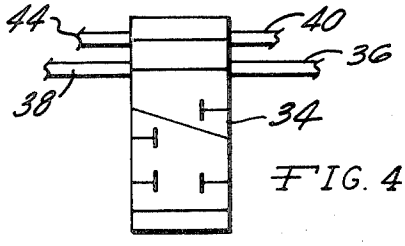

FIG. 4

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HYDRAULIC PRESS

This invention relates generally to presses and more particularly to a hydraulic press capable of high-speed operation and economical manufacture.

The press of this invention includes a pair of hydraulic chambers arranged in tandem. A piston slidably mounted in one of the chambers has a plunger secured to one of its sides and the plunger supports the usual movable press platen. A body on the opposite side of the piston projects into the second fluid chamber. A source of fluid communicates through a supply line with the first chamber on the body member side of the piston. A control valve is connected to the first chamber on both sides of the piston, to the second chamber, and to tank.

The most important feature of the press of this invention is the inclusion therein of a conduit of "excessive" length, sometimes referred to herein as a "long line" or a transfer line, connected to the first chamber on both sides of the piston. During the approach of the piston to the working portion of its stroke, the transfer line is operative to transfer fluid for regenerative action from the plunger side of the piston to the body member side of the piston to provide for high-speed movement of the piston with a relatively small size power supply. During the working portion of the stroke, the transfer line, by virtue of its length, provides the desired isolation of the chamber portions on opposite sides of the piston for a period of time so that the rapidly moving fluid in the transfer line imparts its momentum force to intensify fluid pressure in the body member side of the piston. The transfer line also acts to evacuate the plunger side of the chamber during the working portion of the stroke so as to increase the working stroke power of the press.

The principal object of this invention, therefore, is to provide an improved high-speed press which can be manufactured at a low cost.

Further objects, features and advantages of this invention will become apparent from a consideration of the following description, the appended claims, and the accompanying drawing in which:

FIG. 1 is an elevational view of the press of this invention, with some parts broken away and other parts shown in section for the purpose of clarity;

FIGS. 2, 3 and 4 are diagrammatic views of the control valve in the press of this invention, showing the control valve in progressively moved "stop," "power" and "return" positions; and

FIG. 5 is a graph illustrating a cycle of operation of the press of this invention through a working stroke.

With reference to the drawing, the press of this invention indicated generally at 10, is illustrated in FIG. 1 as including a housing 12 supported on a stationary frame 14 which carries the stationary platen 16 for the press 10. A movable platen 18 is secured to a plunger 20 which extends into a first fluid chamber 22 formed in the housing 12. A piston 24, slidably supported in the chamber 22, has the plunger 20 arranged so that it projects from one side of the piston 24. A body 28, of larger cross-sectional size than the plunger 20 projects from the opposite side 30 of the piston 24 into a second fluid chamber 32 formed in the housing 12.

A control valve, indicated generally at 34 in FIG. 1, is connected by a line 36 to the chamber 22 on the side 30 of the piston 24. The valve 34 is also connected by a conduit 38 to the chamber 22 on the opposite side of the piston 24. A conduit 40 connects the valve 34 to a tank or reservoir 42 and a conduit 44 connects the control valve 34 to the chamber 32. An elongated supply line 46 connects the chamber 22, on the side 30 of the piston 24, to a source of fluid under pressure, illustrated as an accumulator 48 connected through a check valve 50 to a pump 52 which also communicates with the reservoir 42.

In the operation of the press 10, assume that both fluid chambers are full of fluid and that the control valve 34 is in its "stop" position illustrated in FIG. 2. In this position of the control valve 34, it operates to communicate the conduits 36 and 38 with each other and block the conduits 40 and 44. As a result, the fluid pressures on opposite sides of the piston 24 are equal, which results in a higher force on the side 26 of the piston 24 by virtue of the increased area on the side 26. However, the piston 24 will not move because fluid is locked in the chamber 32.

Now assume that the control valve 34 is moved to its "power" position shown in FIG. 3. In this position of the control valve, it provides for communication of the conduits 36 and 44 and it blocks the conduits 38 and 40. As a result, the fluid pressure in the chamber 22 on the side 30 of the piston 24 is increased relative to the pressure on the side 26, and fluid is pumped into both the chambers 30 and 32. The piston 24 is thus rapidly forced downwardly to accelerate the platen 18 in a downward direction until the work, illustrated at 54 between the platens 16 and 18, is contacted so that it exerts an upward load on the platen 18. During this accelerating downward movement of the piston 24, fluid in the chamber 22 on the side 26 of the piston 24 is forced out of the chamber 22 through a conduit 56 which connects to the chamber 22 on the opposite side 30 of the piston 24.

The conduit 56 is unrestricted and is of "excessive" length, by which is meant it is significantly greater than that required to connect the portions 22*a* and 22*b* of chamber 22 on opposite sides of the piston 24. More specifically, as used herein, the term "excessive" length shall mean at least twice as long as necessary to connect the chamber portions 22*a* and 22*b*. As the piston 24 proceeds in a downward direction the pressure in chamber portion 22*a* will at some point in time be higher than the pressure in chamber portion 22*b* but this will not slow down the piston 24 because of the momentum of the piston 24 at such time. The long line 56 is of sufficient length to effectively isolate the chamber portions 22*a* and 22*b* so that the pressures therein are not equalized when the pressure in portion 22*b* later exceeds the pressure in chamber portion 22*a* by a substantial amount.

When the piston 24 slows down due to the platen 18 contacting the work 54, the momentum of fluid in long line 56 continues to provide for removal of oil from chamber portion 22*a* and deliver it to chamber portion 22*b* thus intensifying the pressure in chamber portion 22*b* and chamber 32 when such higher pressure is most useful. As a result, some evacuation of portion 22*a* takes place and the working pressures developed in chambers 22*b* and 32 exceed the pressure available from source 48. The transfer line 56 acts as a valve to isolate the chamber 22 on opposite sides of the piston 24 from each other for a period of time approximately equal to the time required for a pressure wave to travel the length of the transfer line 56. For this reason, the long line 56 is of a length equal to T×C where T equals the length of time in seconds that a near rated working force is required at the platen 18 to perform the desired work with the press 10, and C equals the velocity of sound in the working fluid measured in inches per second. In most cases the fluid used in the press 10 is a high density phosphate ester based fluid in which the velocity of sound is 50,000 inches per second.

Thus, by forming the transfer line 56 of this length, it acts to evacuate the chamber 22 when acceleration of the piston 24 is desired and to intensify the pressure on the piston 24 during the time that the work is being completed and the highest pressure is required. This is why the line 56 is of a length approximately equal to the length required for a pressure wave to travel the length of the pipe during the time work is being performed. Thus, in the case where a near rated working force is required for 0.006 second, the sound in the working fluid is 50,000 inches per second, a 300 inch transfer line 56 is required. Since the pressure in chamber portion 22 will at times exceed the pressure available at source 48, the supply line 46 should be at least half the length of long line 56 in order to avoid dissipating this increased pressure, which will occur when a pressure wave has travelled from chamber 22*b* through line 46 to source 48 and back again.

When the work has been completed and it is desired to raise the platen 18, the control valve 34 is moved to the return posi-

tion illustrated in FIG. 4. In this position of the control valve 34, the conduits 40 and 44 are connected and the conduits 36 and 38 are connected. As a result of the connection of the conduits 36 and 38, the fluid pressure on the larger area side 26 of the piston 24 is the same as the fluid pressure on the side 30. The result is a larger force on the side 26 than on the side 30 thereby causing the piston 24 to move upwardly and move the body 28 into the chamber 32 so as to force fluid therein to flow through the conduit 44 and the conduit 40 to the tank 42. The above cycle can then be repeated.

From the above description it is seen that this invention provides a hydraulic press 10 in which the piston 24 can be selectively held in one position, moved downwardly during the power stroke, or moved upwardly in the return stroke by manipulation of the control valve 34. By virtue of the cooperative relationship of the chambers 22 and 32 and the long line 56, the piston 24 is rapidly movable and the desired regenerative action is obtained on the power stroke. This action is illustrated in FIG. 5 in which the pressure in the chamber portion 22*b* on the side 30 of the piston 24 is plotted against time commencing with initial downward movement of platen 18. Prior to contact of the platen 18 with the work the pressure is relatively constant and is indicated at 60. As the platen 18 moves into the work the pressure rises along the line 62, the dips 64 in the line 62 being caused by movement of piston 24 faster than the supply of fluid to chamber portion 22*b*. Finally the pressure 66 necessary to achieve the desired near rated working force is reached and this pressure 66 remains nearly constant until it drops to zero at the end of the cycle. The length of the line showing pressure 66 is T in the above equation.

What is claimed is:

1. In a press having a fixed platen and a movable platen, means forming a fluid chamber, a piston slidably mounted in said chamber so that a first portion of said chamber is located on one side of said piston and another portion of said chamber is on the opposite side of said piston, a plunger on one side of said piston connected to said movable platen, means connected to said chamber for supplying fluid thereto on the opposite side of said piston, and unrestricted conduit means of "excessive" length extending between and connecting said chamber portions.

2. The structure according to claim 1 wherein said means for supplying fluid to said chamber comprises a source of fluid under pressure and a line connecting said source and said chamber, said line being of a length approximately equal to one half the length of said conduit means.

3. In a press having the structure set forth in claim 1 further including body means extending from the opposite side of said piston, said body means and said plunger being of relative sizes such that the area of said one side of said piston exposed to fluid in said chamber is greater than the area of said opposite side exposed to fluid in said chamber, means forming a second fluid chamber separate from said first chamber and located so that said body means projects into said second chamber, and control valve means connected to said first fluid chamber on both sides of said piston and connected to said second fluid chamber and to a tank.

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