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HYDRAULIC PRESS

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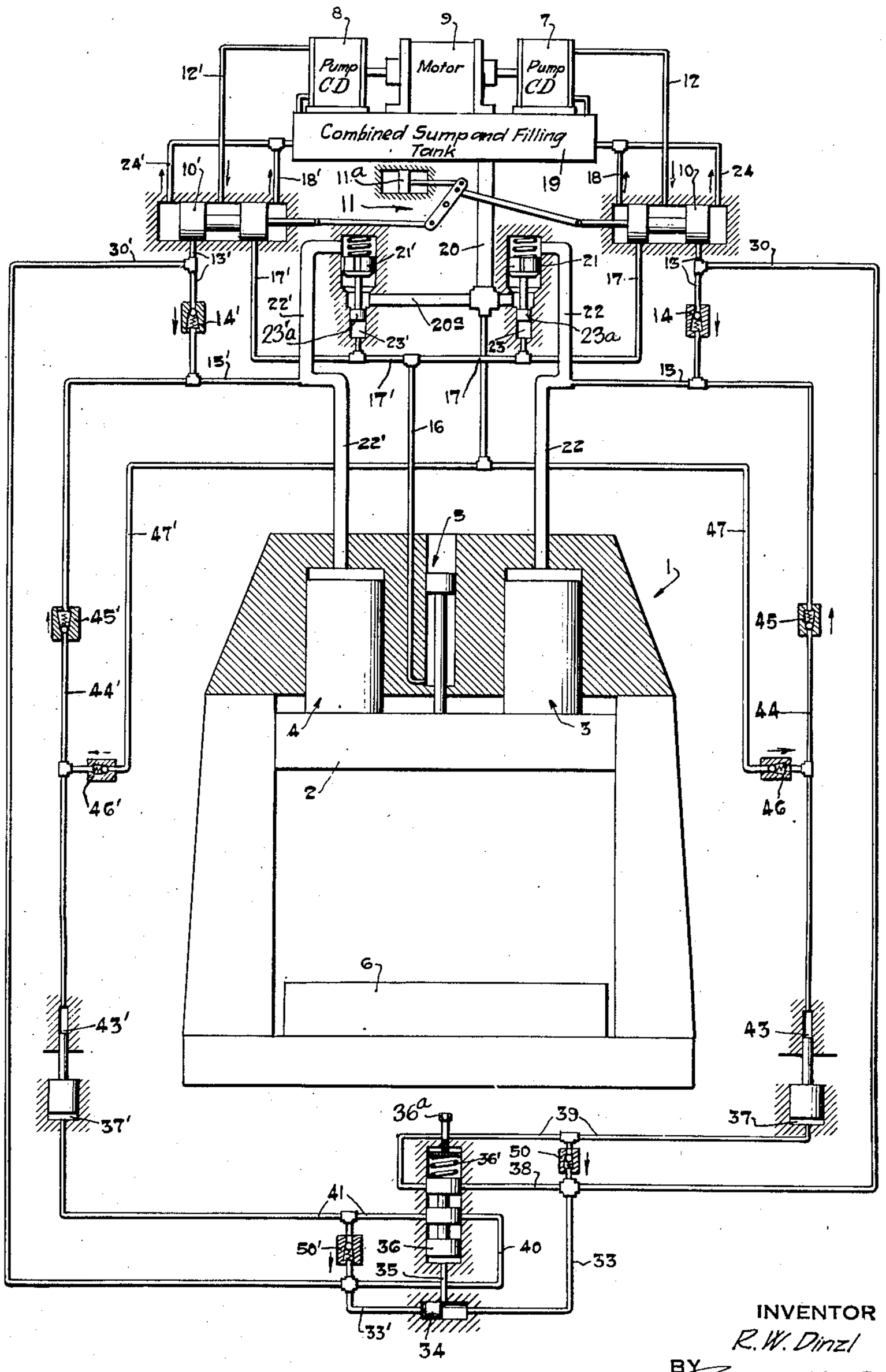

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HYDRAULIC PRESS

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This invention relates generally to hydraulic presses and more particularly to an improved combination whereby a press platen, or other corresponding movable press element, moves without any substantial tilting or canting action.

The problem has long existed with hydraulic presses of the type having a large platen, knife or other corresponding movable press element of considerable length, to insure uniform movement of such element at all points thereof so as to avoid tilting and the difficulties incident thereto. This problem is usually avoided in mechanical presses due to the use of crankshafts and connecting rods, and it has been heretofore avoided in hydraulic presses by so proportioning the press frame, guides and diameter of the operating ram so as to structurally resist any tendency of the platen to tilt. Tilting is caused by the dies having a higher portion at one end than at the other, whereby the sheet metal or other work piece creates greater resistance at the high end followed by greater resistance at the other end. Also non-uniform forces resisting movement of the element may be caused by the fact that such element is a knife whereby the cutting pressure varies irregularly along the length of the knife due to the character of material being cut or due to the knife being of the diagonal type whereby the cutting commences at one end thereof and progresses across to the other end.

It is an object of my invention to provide an improved hydraulic press and operating means therefor whereby all points of the movable press element are inherently moved substantially uniformly regardless of varying degrees of pressure that may be momentarily required at different points of the platen, as a result, I am able to avoid the necessity for large or excessively strong structural elements that would otherwise be required to obtain such uniform movement.

In one specific aspect of the invention I accomplish this improved result by employing a plurality of operating rams and cylinders and providing simultaneously driven positive displacement pumps, one for each cylinder, whereby each ram is moved at the same uniform speed regardless of whether movement of one ram is resisted by a greater force than that of another ram. It will of course be appreciated that while the pumps are preferably commonly driven to insure absolute uniform supply of liquid simultaneously to each cylinder, yet under certain circumstances the pumps may be driven by separate motors of a synchronous type or otherwise operated at the same speed, but in any event the displacement of each pump supplies fluid to its particular cylinder at such a rate that the rams in all cylinders move at the same uniform speed even though the operating pressures therein may vary widely at any given instant.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawing in which the figure is a diagrammatic outline of my improved press and control system.

The particular embodiment of the invention, which is disclosed herein merely for the purpose of illustrating one specific form among possible others that the invention might take in practice, comprises any suitable form of press diagrammatically shown at 1 having a movable press element 2 such as a platen, knife, die or other member. This element is specifically shown as being operated by a pair of rams and cylinders 3 and 4 located symmetrically with respect to element 2. A drawback ram and cylinder is diagrammatically indicated at 5 and a lower normally stationary opposed platen is provided at 6. For purposes of simplicity, the elements 2 and 6 regardless of whether the same are die platens, knives or other devices, will be all hereinafter referred to as platens.

The operating mechanism for the rams 3 and 4 comprises positive displacement pumps 7 and 8 simultaneously driven preferably by a common motor 9 so as to positively displace identical quantities of liquid, although it will of course be understood that if for any reason it is desired to have rams 3 and 4 of different diameters, then one or the other of the pumps would have a correspondingly reduced or enlarged capacity, but in either case the amount of fluid displaced by the individual pumps is in proportion to the operating rams so as to compel uniform movement thereof regardless of varying pressures that may be required simultaneously in the different cylinders to overcome varying forces resisting platen movement. The control and supply of liquid from the pumps to the ram cylinders 3 and 4 is through similar systems and hence it is only necessary to describe the apparatus for one of the same except when it is otherwise desirable to refer to the apparatus for both cylinders, the corresponding parts for the other cylinder having the same reference numbers, primed.

With the apparatus in the position as shown, platen 2 is held in its upper position by liquid locked in drawback cylinder 5. To initiate downward movement of the platen, control valves 10 and 10' are simultaneously moved outwardly by

any suitable operating mechanism such as a servo-motor 11*a* which operates a linkage generally indicated at 11. Fluid pressure thus flows from pumps 7 and 8 to the cylinders, for example, from pump 7 through pipe 12, valve 10, pipe 13, a check valve 14 and pipes 15 and 22 to ram cylinder 3. Simultaneously liquid from drawback cylinder 5 is discharged through pipes 16, 17 and 18 to a combined sump and filling tank 19. The various valves are merely diagrammatically shown and may take any of the usual forms in actual practice for accomplishing their intended purpose. The direction of normal flow through the various check valves is indicated by arrows adjacent thereto. As fluid is exhausted from the drawback cylinder 5, platen 2 and its rams will lower substantially by gravity without resistance and hence a large volume of low pressure fluid may be supplied from tank 19 to the cylinders, for example, through pipe 20 and horizontal pipe 20*a*, a check valve 21 and passage 22 to cylinder 3. So long as the platen moves freely downwardly without resistance, there will be no tendency for it to tilt, and hence the main ram cylinders 3 and 4 will be freely and equally supplied with low pressure liquid from the filling tank. Inasmuch as the pumps are also supplying fluid to the cylinders simultaneously with the supply from the filling tank, it will be seen that instantly when movement of the platen slows down to the point where the pumps alone can supply liquid to the cylinders, then the pumps will increase the pressure in the cylinders and also close check valves 21 and 21'. The equal supply of fluid from both pumps will cause a uniform rate of platen movement regardless of varying resistance that may be encountered simultaneously at different points of the platen, such variations in resistance being compensated for in that each pump can develop its own pressure as may be required to overcome the resistance adjacent its particular ram. It will also be understood that downward movement of platen 2 is controlled by the rate of discharge of liquid from drawback cylinder 5 through valves 10 and 10' so that if necessary under certain special circumstances, the movement of the platen may be slowed down by the control valves to insure closure of check valves 21 and 21' before platen 2 engages the work, and thus permit pumps 7 and 8 to constitute the sole supply just before platen 2 engages the work piece.

When full downward movement of platen 2 has been completed, the operator reverses valves 10 and 10' so as to admit pump pressure to the pull-back cylinder 5 as through pipes 12, 17 and 16. At the same time this pump pressure is transmitted, for example, to a cylinder 23 for raising check valve 21 by a plunger 23*a* and permitting reverse flow of liquid from cylinder 3 through pipes 22, 20*a* and 20 to tank 19.

When the platen is raised to its uppermost position, the operator returns control valves 10 and 10' to their neutral position as shown in the figure, thereby closing passages 17 and 17' to lock liquid in drawback cylinder 5 and hold the platen in its upper position.

From the foregoing disclosure it is seen that I have provided a very effective system for compelling uniform movement of platen 2. Any tendency of the platen to tilt during its downward movement would be only very slight and momentarily because the pump pressures would immediately automatically vary so as to exert a greater force on the lagging portion of the platen and thus return the platen to its horizontal position. The variations in pressure would at all times be accompanied by a uniform displacement of liquid from the pumps and hence the platen cannot be forced out of alignment by such variations in pressures but can be forced into alignment in the event of any tendency to tilt. It will of course be understood that any tendency to tilt would not be appreciable in actual practice and that it would be well within the clearance tolerance of the usual platen guides.

If it is desired to employ intensifier means, I have provided two similar intensifier systems, one for each pump and cylinder, adapted to have independent pressures but coordinated in their operation. For example, when valves 10 and 10' admit pump pressure to pipes 13 and 13' to initiate down movement of the platen, fluid is also transmited through pipes 30, 33 and 30', 33' to both ends of a shuttle valve 34. If pressure is greatest in line 30, then valve 34 is shifted to the left and vice versa if pressure is greatest in line 30'. The shuttle valve thus prevents fluid from one pumping system flowing into the other pumping system in case unequal pressures should occur therein and yet the shuttle valve will insure simultaneous operation of both intensifier systems regardless of the existence of unequal pressures. This last function of simultaneous operation is accomplished in that when the pressure of either pump reaches a predetermined value, it is transmitted through a pipe 35 to raise a three spool piston valve 36 against an adjustable spring 36' and simultaneously connect pump 7 with an intensifier cylinder 37 and connect pump 8 with an intensifier cylinder 37'. These connections are respectively made through pipes 30, 38, valve 36 and pipe 39; and pipes 30' and 40, valve 36 and pipe 41. The two intensifier systems are thus simultaneously operated to cause high pressure plungers 43 and 43' thereof to discharge identical quantities of fluid through pipes 44 and 44' and check valves 45 and 45' to the main ram cylinders 3 and 4. This intensified pressures closes check valves 14 and 14' thus causing the equal displacement from both pumps to be transmited to their respective intensifier systems and compel equal and uniform displacement of liquid therefrom to the main cylinders regardless of pressure fluctuations therein. The intensifier pressure also closes check valves 46 and 46' in pipes 47 and 47', these valves and pipe connections normally permitting fluid to be supplied from sump 19 to the high pressure side of the intensifier system during downward movement of the intensifier plungers. When control valves 10 and 10' are moved inwardly to raise the platen, fluid from the large intensifier cylinder 37 is discharged back through pipe 39, a check valve 50 and pipes 30 and 24 to sump 19. Similarly fluid from the intensifier cylinder 37' is discharged back through pipe 41, check valve 50' and pipes 30' and 24' to the sump. Check valves 50 and 50' are necessary in accomplishing the foregoing operation because valve 36 returns to its closed position when pipes 30 and 30' are connected to exhaust. Check valves 45 and 45' prevent flow of pump fluid through pipes 44 and 44' at the time when the pumps alone are initially supplying fluid through pipes 15 and 15' to the main ram cylinders.

The foregoing intensifier system will uniformly supply equal quantities of fluid to the main ram cylinders by reason of the large cylinders of the

intensifiers being uniformly and simultaneously supplied with equal quantities of fluid from the two pumps. Also these intensifier systems are rendered operative automatically only when the pump pressure reaches a predetermined value as determined by the adjustment of spring 36'.

Briefly summarized, the sequence of operations is as follows: With the control valves 10 and 10' in neutral position, liquid is locked in drawback cylinder 5 to hold platen 2 in its upper position. The platen is moved downwardly by shifting control valves 10 and 10' outwardly, thereby exhausting fluid from the drawback cylinder to permit downward platen movement. A large volume of low pressure fluid is supplied from filling tank 19, past check valves 21 and 21' and through pipes 22 and 22' to the main cylinders 3 and 4 during initial downward platen movement. Simultaneously therewith fluid is supplied from pumps 7 and 8 through pipes 12, 12', 15 and 15' so that when platen movement requires higher pressure, then the pump pressure will automatically build up and continue movement of the platen, the filling tank check valves 21 and 21' automatically closing. The pumps will, therefore, supply uniform quantities of fluid to each main cylinder 3 and 4 and compel uniform movement thereof regardless of pressure fluctuations that may simultaneously exist in said cylinders. To reverse the platen, valves 10 and 10' are shifted inwardly to supply pump pressure through pipes 17 and 16 to the pull-back cylinder 5 and at the same time supply fluid to cylinders 23 and 23' to open check valves 21 and 21' and thus permit fluid from the main ram cylinders 3 and 4 to be freely returned to the sump through pipes 22, 22', 20*a* and 20. If the pressure intensifying means are desired to be used, then spring 36' is adjusted to suitably open at a predetermined pump pressure transmitted through pipes 30 and 30' and thereby simultaneously and uniformly operate the intensifiers. Any usual threaded stem 36*a* screwed into the valve housing as shown may be employed to adjust the spring of valve 36 or other valves shown at various points of the system, and hence it is possible to render the intensifier means inoperative merely by holding valves 36 closed at all times.

From the disclosure herein it is seen that I have provided an improved combination of a press and operating means therefor whereby uniform platen movement is positively hydraulically effected in an efficient and simple manner, thereby permiting the press structure and operating system to be manufactured and operated in an economical manner without the necessity of providing a physical structure of abnormal size or strength such as might be required with prior arrangements.

It will of course be understood that various changes in details of construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. A hydraulic press comprising, in combination, a platen, a plurality of cylinders and rams simultaneously operative to move said platen, a plurality of commonly operated positive displacement hydraulic pumps one for each of said cylinders, said pumps being of such volumetric displacement and the cylinders respectively connected thereto being of such diameter that uniform operation of said pumps insures uniform movement of said platen, a plurality of control valves one between each pump and its cylinder, and means for simultaneously operating said valves to insure simultaneous communication between each pump and its respective cylinder.

2. A hydraulic press comprising, in combination, a platen, a plurality of cylinders and rams simultaneously operative to move said platen, a plurality of positive displacement pumps one for each of said cylinders, and rotary means for commonly mechanically driving said pumps at the same speed, said pumps being of such volumetric displacement and the cylinders respectively connected thereto being of such diameter that uniform movement of said platen occurs regardless of varying degrees of resistance, to the movement of said platen, that may exist simultaneously at different points thereon.

3. A hydraulic press comprising, in combination, a platen, a plurality of main cylinders and rams simultaneously operative to move the platen, a plurality of commonly actuated positive displacement pumps respectively having substantially uniform volumetric displacements under varying pressures, said cylinders being connectible with said pumps and of such diameters that substantial uniform movement of said platen occurs, a pullback cylinder and ram, a plurality of simultaneously operative valves for simultaneously establishing communication between said pumps and their respective main cylinders or for releasing fluid therefrom, and valve mechanism controlled by said plurality of valves thereby to establish communication between said pump and said pullback cylinder.

4. A hydraulic press comprising, in combination, a platen, a plurality of cylinders and rams simultaneously operative to move the platen, means for supplying low pressure liquid to said cylinders during initial movement of said rams, pumping means for additionally supplying liquid to said cylinders at a uniform rate independently of pressure fluctuations in the respective cylinders, a plurality of control valves one between each of said cylinders and said pumping means, and means for simultaneously operating said valves to insure simultaneous communication between said pumping means and said cylinders.

5. A hydraulic press comprising, in combination, a platen, a plurality of cylinders and rams simultaneously operative to move the platen, means for independently supplying low pressure liquid to said cylinders during initial movement of said rams, pumping means for supplying high pressure liquid to said cylinders at a uniform rate independently of pressure fluctuations in their respective cylinders, a plurality of control valves one between each of said cylinders and said pumping means, means for simultaneously operating said valves to insure simultaneous communication between said pumping means and said cylinders, and means for discontinuing said low pressure supply of liquid automatically when the rate of movement of the rams is such that the high pressure fluid can maintain said movement.

6. A hydraulic press comprising, in combination, a platen, a plurality of main cylinders and rams simultaneously operative to move the platen, means for supplying low pressure liquid to said cylinders during initial movement of said rams, pumping means for supplying high pressure liquid to said cylinders at a uniform rate independently of pressure fluctuations in their respective cylinders, a plurality of control valves one between each of said cylinders and said pumping means, means for simultaneously operating said

valves to insure simultaneous communication between said pumping means and said cylinders, means for discontinuing said low pressure supply of liquid automatically when the rate of movement of the rams is such that the high pressure liquid can maintain said movement, a pullback cylinder and ram, and means for releasing the high pressure liquid in said main cylinders and for supplying fluid from said pumping means to said pullback cylinder to reverse the movement of said platen.

7. A hydraulic press comprising, in combination, a platen, a plurality of cylinders and rams simultaneously operative to move the platen, means for supplying low pressure liquid to said cylinders during initial movement of said rams, pumping means for supplying high pressure liquid to said cylinders at a uniform rate independently of pressure fluctuations in their respective cylinders, a plurality of control valves one between each of said cylinders and said pumping means, means for simultaneously operating said valves to insure simultaneous communication between said pumping means and said cylinders, means for discontinuing said low pressure supply of liquid automatically when the rate of movement of the rams is such that the high pressure liquid can maintain said movement, means for reversing the movement of said platen, and means for discharging a large volume of fluid from said cylinders at a relatively low pressure during said reversing movement.

8. A hydraulic press comprising, in combination, a platen, a plurality of cylinders and rams simultaneously operative to move said platen, a filling tank, means for commonly supplying said cylinders with low pressure liquid from said filling tank during initial movement of said rams, a plurality of pumps having uniform rates of displacement for separately supplying high pressure operating liquid individually to said cylinders, a plurality of control valves one between each pump and its cylinder, means for simultaneously operating said valves to insure simultaneous communication between each pump and its respective cylinder, and means operated by said pump pressure for discontinuing said low pressure liquid supply automatically when the high pressure supply is initiated.

9. The combination set forth in claim 1 further characterized by the provision of pressure intensifier means operative to discharge liquid at a uniform rate when uniformly actuated, means for uniformly actuating said intensifier means by a constant rate of supply of liquid from said pumps, and means for supplying liquid to the press cylinders from said intensifier means.

10. The combination set forth in claim 1 further characterized by the provision of pressure intensifying means operated by said pumps for uniformly supplying liquid to said cylinders from said intensified means, and means for automatically rendering said intensifier means operative only after the pressure of the pumps reaches a predetermined value.

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