March 28, 1961 A. CHRISTIANSON 2,976,798

LEVEL OPERATING MULTIPLE RAM PRESS

Filed March 9, 1959 3 Sheets-Sheet 1

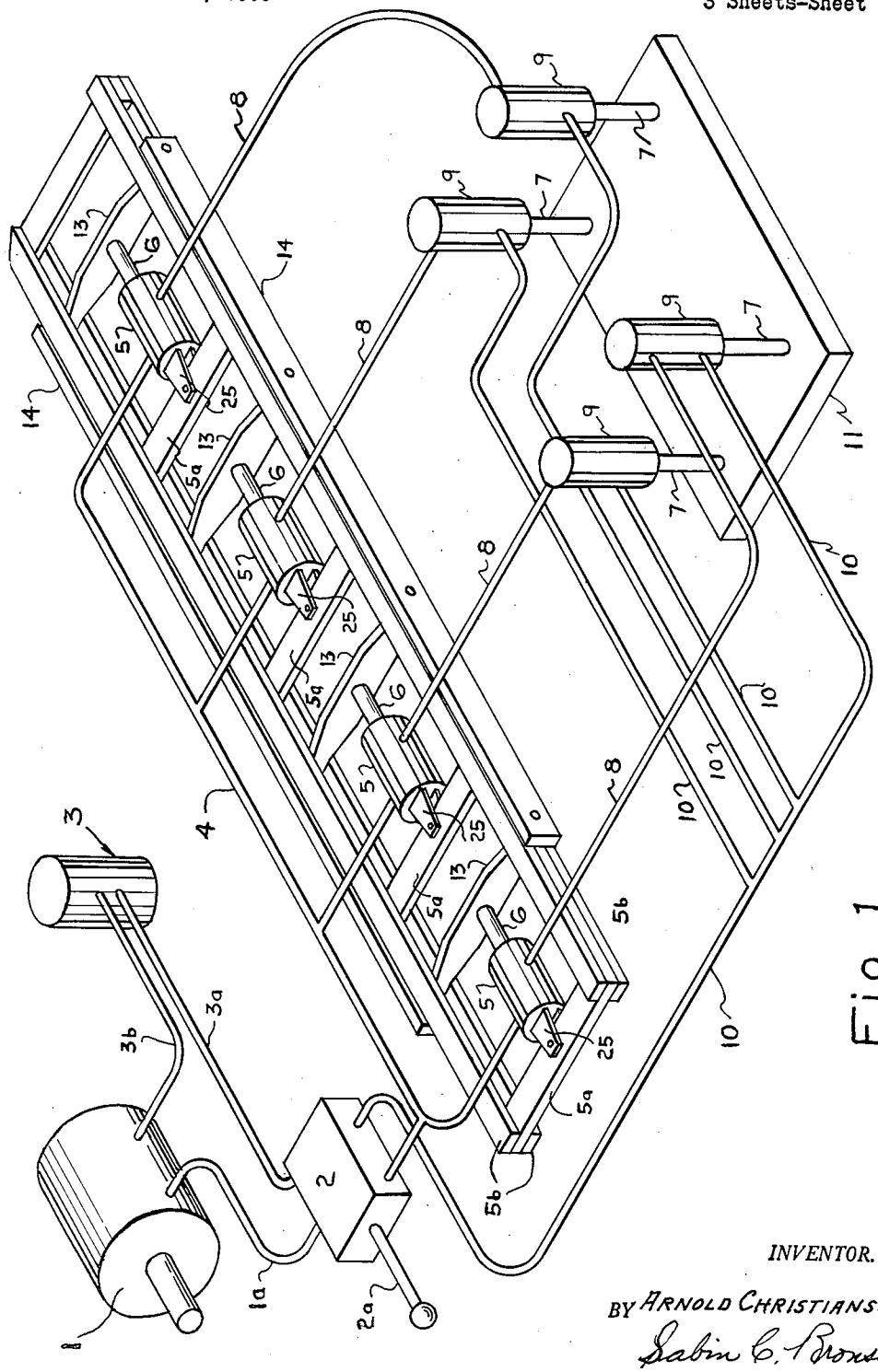


Fig. 1

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3 Sheets-Sheet 2

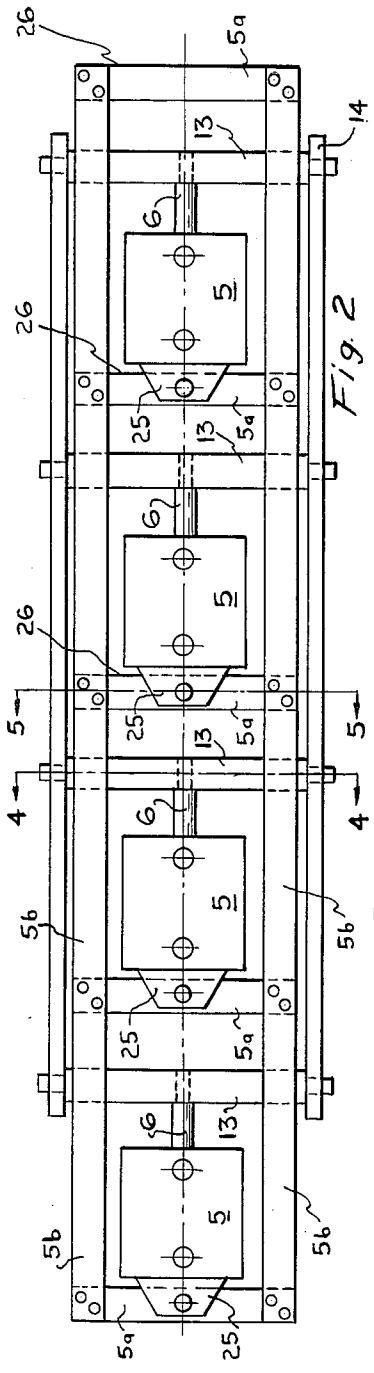


Fig. 2

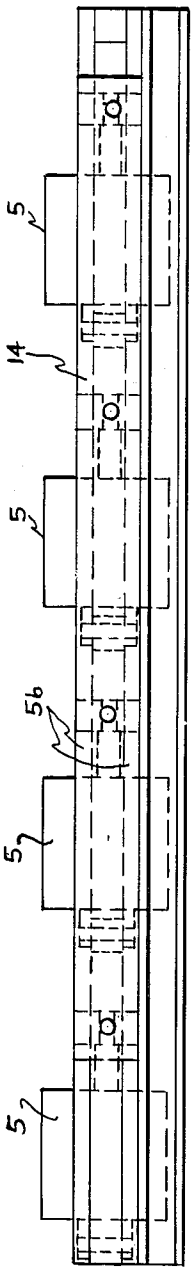


Fig. 3

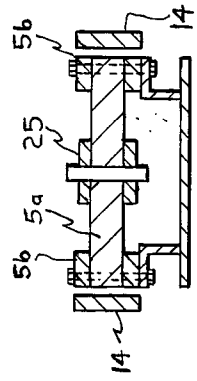


Fig. 5

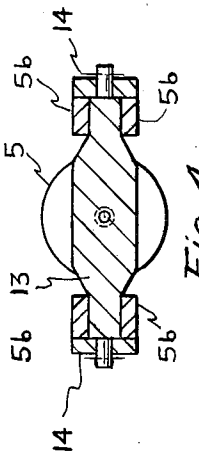


Fig. 4

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March 28, 1961 A. CHRISTIANSON 2,976,798

LEVEL OPERATING MULTIPLE RAM PRESS

Filed March 9, 1959 3 Sheets-Sheet 3

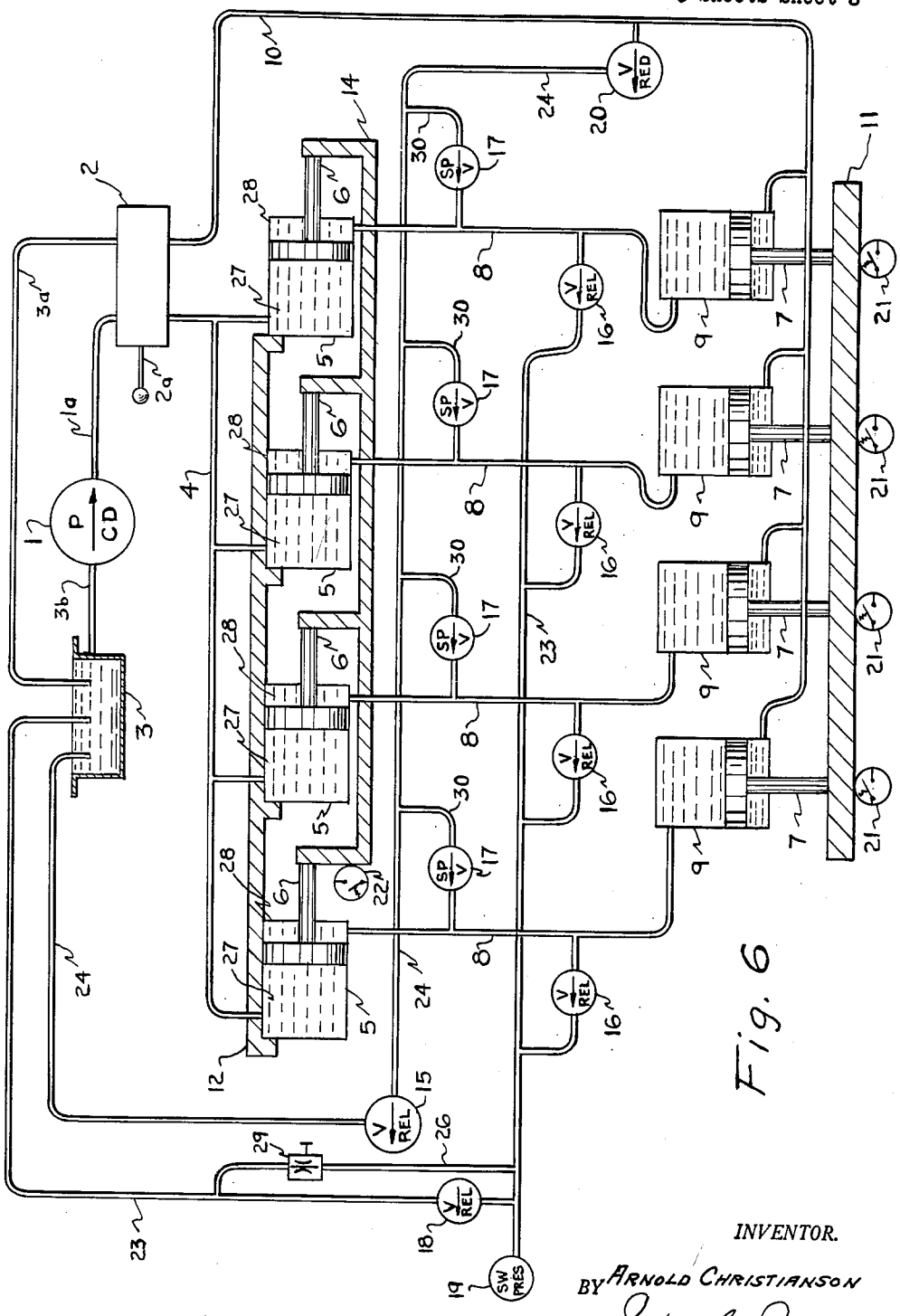


Fig. 6

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2,976,798

LEVEL OPERATING MULTIPLE RAM PRESS

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Filed Mar. 9, 1959, Ser. No. 798,122

7 Claims. (Cl. 100—258)

It is known that mechanically operated crank actuated presses have an even predetermined platen travel stroke at each cycle of the operating crank shaft, and that the movable platen is always the same predetermined travel position in relation to the fixed platen, or press bed. This, obviously is very desirable in any type of reciprocal press.

In hydraulic presses, difficulty has been encountered in that the movable platen does not always move evenly and equally and in the desired relation to the fixed platen. This may be due to variation in the hydraulic pressure in the various ram cylinders, or to differences in the load requirements of the rams, as where the work is all adjacent to one ram cylinder on the press bed.

My invention aims to correct this difficulty in hydraulic presses, and provides a series of driving or primary cylinders equal in number to the secondary or ram cylinders of the press and a confined hydraulic circuit for each cylinder. The primary cylinders are tied together in fixed stationary, axially aligned relation to each other, and the piston rods of the pistons therein are also tied together mechanically so that the pistons must move exactly the same and as a unit, regardless of unequal fluid force applied; just as a series of cranks on a crank shaft must move in unison as the shaft is rotated.

An object of the present invention, therefore, is to provide a controlled means for hydraulic platen presses or like machines which will insure that the movable platen will always move in desired relation toward the fixed platen regardless of differences in load requirements on the press cylinders, or differences in the fluid pressure to the primary cylinders during any pressing operation.

Other objects and advantages of the invention will appear in the following description thereof.

Referring now to the accompanying drawings forming part of this application and wherein like reference characters indicate like parts:

Figure 1 is an isometric perspective view of the basic hydraulic circuit of the press;

Figure 2 is a top plan view of a practical arrangement of control cylinders having bases fastened together and piston rods fastened together in order that operation will be in unison;

Figure 3 is a side elevation of Figure 2;

Figure 4 is a section on line 4—4 of Figure 2;

Figure 5 is a section on line 5—5 of Figure 2; and

Figure 6 shows the basic circuit of Figure 1 with a means to compensate for variations due to leakages in the pistons that may have occurred during an operating cycle, and as overload safeties, when the load on any given cylinder becomes higher than the predetermined maximum for that part of the press.

Referring now particularly to Figures 1 to 5 of the drawings, 1 represents a source of hydraulic power, in this instance a motor driven hydraulic pump. 2 represents a suitable electro-magnetic, solenoid, or manually operated four-way valve that is operated in either a

forward or reverse direction, returning to neutral position by spring action. 3 is a fluid reservoir for receiving the discharge of fluid from valve 2 that is forced out of the primary cylinders 5. 4 indicates the pipe line that carries the pressure fluid from pump 1 through pipe 1*a*, and through valve 2, when the manually, electromagnetically, or solenoid operated valve stem 2*a* is moved to connect the line 1*a* and line 4, to the top side 27 of pistons in cylinders 5. These cylinders 5 are fixed at one end 25 to the spaced, fixed cross bars 5*a* which are in turn fixed at their respective ends between the parallel side frame members 5*b*—5*b*, so that said side frame members are in prearranged spaced relation between the cross members 5*a*. The pistons in cylinders 5 and the rods 6 connected to said pistons are each connected to a slidable cross arm 13, the ends of which project between the side frame members 5*b*—5*b* and are slidable longitudinally therein with the ends of the cross arms 13 secured to a longitudinal slidable member 14 on the outside of each side rail 5*b*—5*b*. Thus as any piston in a cylinder 5 is moved, all other pistons in the cylinders 5 must likewise move because they are mechanically fastened together in line as just described.

The exhaust side 28 of cylinders 5 are connected by pipe lines 8 to the top side of the pistons in the hydraulic secondary ram cylinders 9, one at each corner of the movable press platen 11. The piston rods 7 from the pistons in cylinders 9 are each connected to its respective corner of the platen 11. The exhaust side of each piston in ram cylinders 9 are connected by pipe line 10 to return the exhaust fluid back through the valve 2 and line 3*a* to the fluid reservoir 3. When, however, the platen 11 is to be raised, the hydraulic fluid in reservoir 3 flows through pipe line 3*b*, then is acted upon by pump 1 and then under pressure flows through pipe 1*a* to and is channeled by the four way valve 2 through pipe 10 to the ports on piston rod end of cylinders 9, thus forcing the pistons upward and raising the press platen 11.

The operation of the basic hydraulic unit just described is as follows:

When fluid under pressure from the pump 1 is directed through valve 2 into pipe line 4 to the primary cylinders 5, the pistons therein and piston rods 6 will be forced out. Because the cylinders 5 are each fixed to the cross bars 5*a* of the fixed frame 5*b*—5*b*, and the piston rods 6 are fixed to a slidable cross bar 13 which in turn is fixed to the slidable side bar 14 the piston rods all move in unison at the same speed. In one typical case the bores of the cylinders 5 are of the same diameter; the pistons therein are of the same size, and the piston rods 6 are of the same diameter, and therefore the volume of fluid forced from cylinders 5 into the lines 8 will be the same. Also with all the secondary ram cylinders 9 being of the same size bore, the pistons therein of the same size, and the piston rods the same diameter, it is obvious that the piston movement in the ram cylinders 9 will be the same and hence the platen will move the same from end to end and corner to corner. The exhaust from cylinders 9 proceeds back through line 10 to and is directed by valve 2 through line 3*a* to the fluid reservoir 3. When the platen is to be raised, the valve 2 is actuated so that the fluid from fluid reservoir 3 passes through line 3*b* to pump 1, through line 1*a* through valve 2, and then through line 10 to cylinders 9, which raises the pistons therein and the movable platen 11. As the pistons in cylinders 9 are forced upwardly, the exhaust therefrom is forced back through lines 8 to cylinders 5 forcing the pistons therein to the other end of the cylinders, and the exhaust from which passes through line 4 and is directed by valve 2 through line 3*a* to the fluid storage reservoir. The platen having been

raised to its upward position the press is ready for another cycle of operation.

It will be noted that the primary cylinders 5 and connections are axially aligned, or in other words are symmetrical about a common axis. Therefore all forces are equalized about the axis. All cylinders 5, pistons therein and rods 6 are of the same dimensions and, due to the mechanical linkage described, must move together. Thus the discharge from each primary cylinder 5 can be calculated to be that desired for each stroke, or each primary and secondary cylinder is the same ratio to each other for each stroke.

Also it will be observed that during the fluid intake part of the work cycle, pressures in the discharge end of cylinders 5 are intensified or increased, due to the differences in area on the piston. Also if there happens to be an obstruction anywhere, or should the work being performed happen to be under one of the ram cylinders 9, even though each cylinder receives its share of driving fluid because of the closed fluid circuit, pressure, other than needed to move the press or machine part, is transferred to the one cylinder meeting resistance. It is therefore necessary that each cylinder and machine part be sturdy enough to withstand the total accumulated pressure force. Otherwise safety means must be installed in each closed fluid circuit, to act, should predetermined maximum pressures be exceeded.

Figure 6 shows substantially the basic hydraulic circuit just described, and the corresponding parts have been given the same reference characters to avoid repetition in the description. To this basic hydraulic circuit have been added features to safeguard the operation of the press. For example it is realized that there are times when foreign objects might carelessly be left in the press bed, let us say at one corner of the press. Should this happen and the press inadvertently be operated, the pressure fluid would cause the pistons in cylinders 5 to operate, forcing fluid therefrom into ram cylinders 9 and lowering the movable platen until the foreign object is contacted adjacent one ram cylinder. Since little resistance will be encountered by the other ram cylinders, the accumulating pressure from the "tied together" cylinders 5 will result in this case in a possible four times expected load on the one ram cylinder. To prevent machine damage, I have provided in each pressure line 8 from cylinders 5 to cylinders 9 high pressure relief valves 16 which are connected to overflow line 23 leading to the fluid reservoir 3. Overflow in line 23 is checked by a low pressure relief valve 18 therein which pressure in turn actuates an electrical pressure switch 19 that closes an electric circuit to the electro-magnetic master valve 2, causing the press to return to open position.

Relief valve 18 keeps just enough pressure in line 23 to operate the pressure switch 19. Pressure in line 23 exists only when the pressure in any line 8 from a cylinder 5 to cylinder 9 exceeds the pressure setting of the particular valve 16 in that line 8. This is just a safety measure and in ordinary use it is expected that the pressure in line 23 will be zero. The small manually regulated drain valve 29 in bypass 26 in line 23, permits regulated leakage thus reducing the pressure in line 23 to zero after the pressure switch 19 has operated.

It is recognized that leakages can occur in the packings of the respective cylinders, pistons and valves of any fluid circuit operating under pressure. To assure that the pressing cycle starts from the same point each time the press is operated, limit switches 21 are placed at ends or corners of the platen, at least one such switch being located closely adjacent each ram cylinder 9. There is also a similar limit switch 22 at the end of travel of the frame 14 tieing together the piston rods 6 of cylinders 5. Also there is a bypass line 24 leading from the line 10 to the fluid storage tank 3. Line 24 connects with each line 8 between the cylinders 5 and 9 by means of bypass lines 30. In each of the bypass lines 30 is installed a special four way valve 17, ¼" solenoid operated. In line 24 near its connection to line 10 is installed a pressure reducing valve 20, and also in line 24 adjacent fluid reservoir 3 is installed a relief valve 15 set so that should the volume of fluid on return cycle in line 8 be greater than at start of cycle, the excess will be permitted to return to the fluid reservoir. Line 24 serves as the filling circuit for lines 8. With this arrangement should there be any leakage in any of the cylinders during that part of the cycle when return pressure is in line 10, the first limit switch 21 contacted will actuate the special valves 17 connected to lines 8. All the switches 21 and the switch 22 are in the same circuit whereby the closing of any switch causes all valves 17 to open in all lines 8 and to remain open until all of the switches 21 and 22 are again closed, which condition causes valves 17 to close, thereby putting the press in condition to start another cycle of operation.

I claim:

1. In a hydraulic press having a movable platen and a plurality of rams symmetrically disposed about the center of the platen and to which pressure fluid is applied for causing the platen to move, a pump, a like number of axially aligned cylinder-piston assemblies, means for applying pressure fluid from said pump to each aligned cylinder at one side of the pistons therein, means causing the pistons in said cylinders to move as a unit, means for applying the discharge pressure fluid from the opposite side of the pistons of each cylinder to a single corresponding ram to cause said platen to move, the discharge pressure fluid from said cylinders being controlled as to volume and rate of flow by the related movement of said pistons.

2. In a hydraulic press having a movable platen and a plurality of hydraulic rams for operating the platen, a pump, an hydraulic cylinder and piston assembly for each ram, a fluid circuit from said pump to each cylinder and piston assembly above the piston therein, means causing the pistons in said assemblies to move as a unit, a second fluid circuit from the opposite side of the pistons of each of said assemblies to a single corresponding one of said rams to cause said platen to move, means controlling said second fluid circuit as to volume and rate of flow by the identical movement of the pistons in said cylinder and piston assemblies whereby the ram pistons travel at the same speed and distance.

3. In a hydraulic press having a movable platen and a plurality of hydraulic rams for operating the platen, a like number of cylinder and piston assemblies, a pressure fluid circuit to said cylinder and piston assemblies above the piston therein, a fluid circuit from each cylinder and piston assembly below the piston therein to a single corresponding ram, said cylinder and piston assemblies being fixed to the press in axial alignment, and the pistons being fixed to each other for identical movement in the same direction as a unit.

4. In a hydraulic press having a movable platen and a plurality of rams for operating the platen, a like number of control cylinder and piston assemblies for said rams, said cylinders being in axial alignment and fixed so as to be immovable with respect to each other, said pistons being fixedly attached to each other for movement as a unit, a fluid circuit from one side of the pistons of each control cylinder to a corresponding one of said rams, a pump, and means for applying pressure fluid from said pump to the other side of the pistons of each cylinder and piston assembly.

5. In a hydraulic press having a movable platen and a plurality of rams symmetrically disposed about the center of the platen to which fluid under pressure is applied for moving the platen, a like number of control cylinder and piston assemblies, one for each ram, said cylinders being in axial alignment and immovable with respect to each other, said pistons being fixedly attached

to each other so that pressure fluid applied to any piston of said assemblies will move all pistons the same distance and at the same speed, a pump for applying pressure fluid to one side of the pistons of said control cylinder and piston assemblies, and means directing the discharge from the opposite side of the pistons of each control cylinder and piston assembly to a corresponding ram.

6. The structure of claim 5, and a control valve responsive to leakage in said pressure fluid circuit to correct the volume of fluid therein and starting position of said rams before each operating stroke.

7. In a hydraulic press having a movable platen and a plurality of hydraulic rams for operating the platen, a like number of control cylinder and piston assemblies, for said rams, a pressure fluid circuit to each cylinder above the piston therein and an exhaust fluid circuit from

each cylinder below the piston therein to a single corresponding ram, each cylinder being fixed to the press in axial alignment and immovable with respect to each other, the pistons of said assemblies being fixed to each other for movement as a unit, and a control valve system in said fluid circuit responsive to leakage in the pressure fluid circuit to correct the volume of fluid in each circuit to assure the same starting position of said rams before each operating stroke of the press.

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