May 14, 1940. C. F. SCHNUCK 2,200,998

HYDRAULIC PRESS

Filed June 3, 1937 2 Sheets-Sheet 1

Fig. 1.

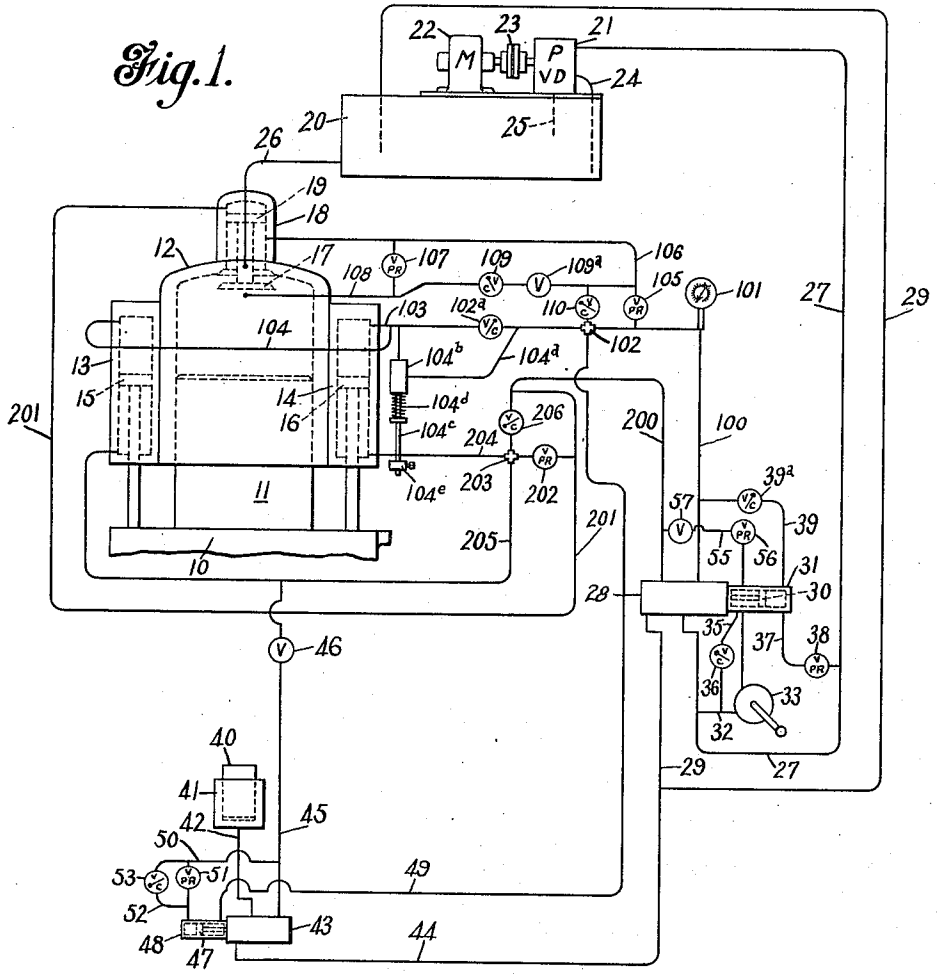
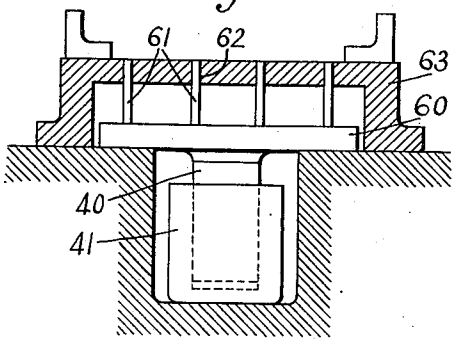


Fig. 2.



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Fig. 3.

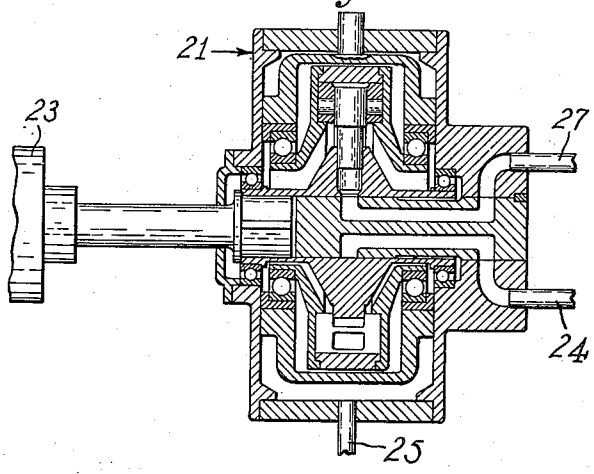


Fig. 5.

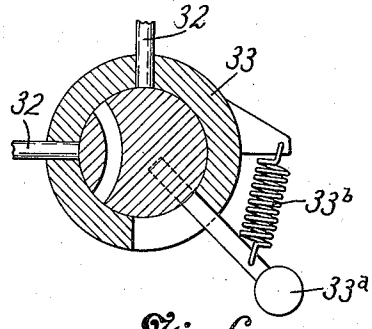


Fig. 6.

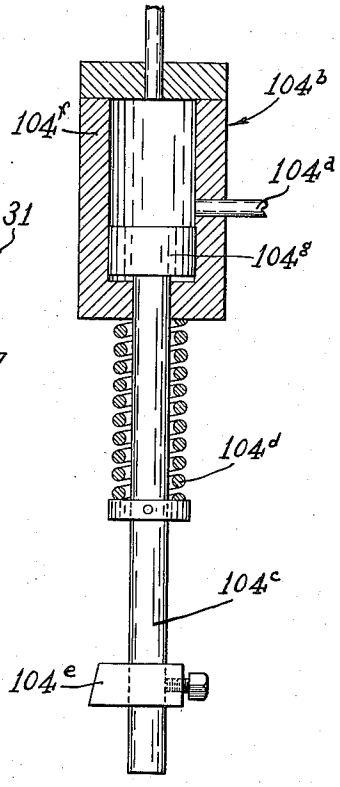


Fig. 4.

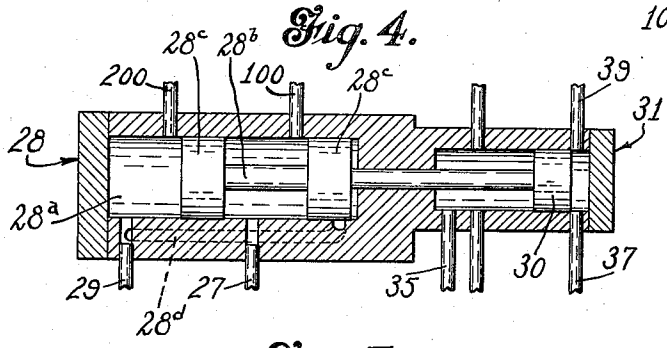
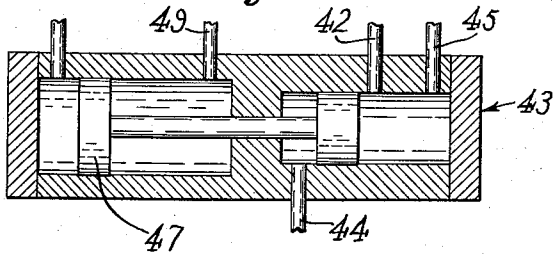


Fig. 7.



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UNITED STATES PATENT OFFICE

2,200,998

HYDRAULIC PRESS

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Application June 3, 1937, Serial No. 146,316

11 Claims. (Cl. 100—71)

This invention relates to hydraulic presses, and more particularly to controls for hydraulic presses, such that they may be made automatic to a large extent, and completely automatic if desired. In the operation of presses of this character, it is desirable to be able to start the press in motion, and to provide for its continued operation through a given cycle automatically, so that the parts return to the position of rest from which the action was started. Moreover, it is also advantageous to effect this result entirely by means of fluid pressure or hydraulic pressure, and without the use of mechanical contrivances, such as levers or the like, which not only add to the complexity of the device but probably render it less positive in operation.

In the present instance the cross head or platen of the press is brought to a closing position against the work under one degree of pressure, and after the work has been encountered, a higher operating pressure is brought into effect on the main ram to actually perform the pressing operation. The pressure is then released, the cross head returned to its original position, and if desired, ejectors are provided to automatically eject the work from the press. Moreover, these operations are all performed smoothly and without shock, as the pressure in the various parts of the device is changed from one degree to another.

One object of the invention is the provision of an automatic or semi-automatic hydraulic press, which when set into operation, will be caused to automatically effect a given cycle of operations and return the parts to the original position, ready to begin a second or repeat cycle.

Another object of the invention is the provision of an hydraulic press of the character described such that the various operations will be caused to take place under the control of hydraulic or fluid pressure in a single circuit having a minimum and maximum pressure range, without the necessity for use of mechanical contrivances, or secondary sources of power.

To these and other ends the invention consists in the novel features and combinations of parts to be hereinafter described and claimed.

In the drawings:

Fig. 1 is a diagrammatic view of an hydraulic press and control system therefor;

Fig. 2 is a conventional view of the ejector plate and associated parts.

Fig. 3 is a sectional view of the pump;

Fig. 4 is a sectional view of the main controlling valve of the hydraulic press;

Fig. 5 is a sectional view of the starting valve which controls the operation of the main valve;

Fig. 6 is a sectional view of the stop valve; and

Fig. 7 is a sectional view of the three-way valve controlling the ejector.

To illustrate a preferred embodiment of my invention, I have shown an hydraulic press comprising a cross head 10 secured at the bottom of a main ram 11, which ram operates in a main cylinder 12. At the side of the main cylinder are disposed auxiliary cylinders 13 and 14 in which reciprocate the pistons 15 and 16 attached to the cross head 10 at their lower ends. These auxiliary cylinders may be termed pull-back or lift cylinders, as they serve to lift the cross head from the work after an operation has been completed. It may also be pointed out, however, that in addition to this operation these auxiliary cylinders also serve to lower or drive the cross head against the work prior to the introduction of pressure fluid into the main cylinder 12.

At the upper portion of the cylinder 12 is provided a reciprocating valve 17, which may be called a pre-filling valve, and above this valve is a cylinder 18 within which operates a piston 19 secured to and designed to operate the valve 17. This valve, as will be explained hereinafter, is designed to permit the hydraulic fluid to flow into the cylinder 12 when the ram is lowered by means of the auxiliary pistons 15 and 16, before fluid under heavy pressure is introduced into the cylinder 12, so that this cylinder will be ready for the application of the high pressure fluid when the cross head has reached its final position against the work. The fluid tank or reservoir is shown at 20, upon which is mounted a variable pressure and variable delivery pump 21 driven by a motor 22 through a flexible coupling 23. This pump is adapted to draw fluid from the tank through the line 24, and a line 25 also connecting the pump to the tank provides a pump slippage drain usual in such devices to prevent the building up of excessive pressure. As a pump of this character is well known in the art and is substantially like that shown in United States Patent No. 1,077,979 to Hele-Shaw et al., November 11, 1913, no further description thereof is believed to be necessary, as the details of the pump per se form no part of the present invention. The tank 20 is connected by a fluid line 26, with the chamber above the pre-filling valve 17. While the fluid from the tank will normally tend to flow through this line by gravity, it has been found desirable to provide a certain amount of air pressure in the tank so as to force the

pressure fluid (which is usually oil) to flow quickly into the main cylinder 12 past the valve 17, particularly if a high speed press is being used, this practice of placing the fluid source or supply under pressure having been in effect for many years for inducing rapid flow.

From the pump 21 a fluid pressure line 27 leads to a four-way valve 28, and a return line 29 leads from this valve to the tank. One form of such valve is illustrated in Fig. 4 of the drawings, wherein, as illustrated, the valve casing provides a cylinder 28a within which is mounted a piston rod 28b having piston heads 28c. A by-pass 28d is formed in the casing, which, as will be apparent, serves to connect the pipe 29 which is adjacent one end of the cylinder with the opposite end of the cylinder when such communication is permitted by the piston head 28c. The piston rod of the valve 28 is designed to be operated by a piston 30 mounted in a cylinder 31, this cylinder being connected on one side of the piston with the pressure line 27 by the line 32, in which is mounted a starting valve 33, preferably of the automatic return type, that is, a valve which, when thrown, will return to its original position. A conventional disclosure of such a valve is shown diagrammatically in Fig. 5, wherein the operating handle 33a is biased by a spring 33b so that it will normally be held in position to close this valve. This portion of the cylinder 31 is also adapted to bleed into the line 32, when the valve 33 is closed, by means of the return line 35, in which is mounted the check valve 36. Also the pressure line 27 is connected to the cylinder 31 upon the other side of the piston 30 by the duct 37, which leads through a pressure relief valve 38, this valve operating to permit pressure from the line 37 to reach the end of the cylinder 31 beyond the piston 30 only when pressure in the line 27 has been built up to a sufficient extent to overcome the set of the relief valve and burst through this valve, as will be explained hereinafter.

From the four-way valve 28 lead two fluid lines 100 and 200 which may be pressure or exhaust (return) lines, depending upon the position of the valve 28. The fluid line 100 leads upwardly to a pressure gauge 101, and through a suitable fitting 102 and check valve 102a to branches 103 and 104, and thence to the pull-back or lift cylinders 13 and 14 above the pistons 15 and 16.

A by-pass line 104a is provided about the check valve 102a to permit exhaust of or return flow from the cylinders 13 and 14 above the pistons 15 and 16. The return flow through this by-pass line is controlled by a stop valve 104b operated by a rod 104c, a spring 104d normally holding this rod downwardly, and thus holding this valve in open position. Such a stop valve is shown conventionally in Fig. 6 of the drawings, the valve comprising a cylinder 104f in which operates a piston 104g carried on the rod 104c. This valve, when closed, will check the discharge from the upper side of the pistons 15 and 16 on the return of the press, and thus stop the pistons at any desired point in their return strokes, depending upon the time of closing of this valve.

The rod 104c may carry an adjustable arm or stop 104e to be engaged by the cross head 10 or some movable part secured thereto, and thus move the valve 104b to closed position at any desired point in the upward travel of the cross head.

The line 100 is also connected through the pressure relief valve 105 with a line 106 leading into the pre-filling valve control cylinder 18 below the piston 19. Line 106 is in turn connected through a pressure relief valve 107 with a line 108 leading into the cylinder 12 of the main ram. It will also be observed that the lines 106 and 108 are connected through check valves 109 and 110 with the fitting 102 in line 100. A needle valve 109a is placed just beyond check valve 109 to regulate the back flow from the main cylinder 12 to effect the bleeding of this cylinder at a safe rate. A bleed or return line 39 in which is mounted a check valve 39a connects the outer end of cylinder 31 with the main fluid line 100.

The fluid line 200 is connected with a branch line 201 leading to the pre-filling valve control cylinder above the piston 19. This line 201 is also connected through the pressure relief valve 202, and through a fitting 203, with branch lines 204 and 205 leading to the pull-back or lift cylinders 13 and 14 below the pistons 15 and 16.

In connection with some forms of press work, it is desirable to provide a work ejector, and for this purpose I have shown an automatic ejector arrangement which may or may not be used, as desired. An ejector ram is shown at 40 operating in an ejector cylinder 41, which cylinder is connected by a fluid line 42 with a three-way valve 43, this valve having a passage connected by the line 44 with the return line 29 to the tank 20. A conventional form of three-way valve construction which may be employed is shown in Fig. 7, and as the details of construction of such valve form no part of the present invention, it is believed that no further description will be required. Also connected with a passage in this valve is a fluid line 45 connected to the line 205, previously mentioned. In the line 45 is a shut-off valve 46, so that the ejector may be cut off if desired. It will be understood that the valve 43 will connect the line 42 with the line 44 or line 45 selectively, depending upon whether pressure fluid is to be admitted to the line 42 or whether it is to be permitted to exhaust into the tank.

The valve 43 is actuated by a piston 47 operating in a cylinder 48. One end of this cylinder is connected by the fluid line 49 with the fitting 102 and fluid line 100 leading to the main four-way valve 28. The cylinder at the other side of the piston is connected with the line 45 through the fluid line 50 and pressure relief valve 51. A bleed or relief line 52 is provided to by-pass the relief valve 51, in which line 52 is a check valve 53 to permit the passage of fluid in one direction only, so as to permit the bleeding or exhausting of the end of the cylinder 48 beyond the piston 47.

When the discharge from the upper side of pistons 15 and 16 has been stopped, as previously described, by closing of the valve 104b, the press can of course open no farther, and since delivery of fluid pressure from the pump continues, a pressure will be built up in line 200 which is higher than is necessary for lifting purposes. This pressure may be utilized to again start the closing of the press and thus render it completely automatic. For this purpose, line 200 may be connected through passage 55 and pressure relief valve 56, with cylinder 31 at the left of the control valve piston 30, so that when pressure in line 200 builds up by reason of the stopping of the opening of the press to a sufficient extent to overcome the setting of pressure relief valve 56, such increased fluid pressure will be admitted to cylinder 31 and drive piston 30 toward the right, thus initiating another closing movement of the press.

If desired, a manually operated stop valve 57 may be provided in line 55 to cut off this line if it is not desired to take advantage of full automatic operation. If stop valve 57 is closed, succeeding press operations will be initiated by means of the starting valve 33 after the opening of the press has been stopped by the closing of valve 104b.

In Fig. 2 of the drawing I have shown in somewhat conventional form of an ejector plate 60 to which is secured the ejector ram 40, the ejector plate carrying ejector pins 61 projecting through openings 62 in a bolster 63 to eject the work from the press when the ram 40 is operated.

The operation of my device may be briefly described as follows: At the beginning of a cycle of operations, it will be understood that the cross head 10 is in raised position, being so held by means of pressure in the cylinders 13 and 14 below the pistons 15 and 16, which is the condition obtaining when the main pump pressure line 27 is connected through the four-way valve 28 with the line 200 leading upwardly on the drawing from the valve 28. The operator, being ready for a pressing operation, actuates the valve 33, permitting pressure fluid to pass through the line 32 to the cylinder 31 at the left of the piston 30, thus driving this piston to the right and moving the valve 28 to connect the main pump pressure line 27 with the line 100. The valve 33 may be immediately released, and it may return to its original position, the piston 30, however, remaining at the right. Pressure fluid now travels through line 100, fitting 102, check valve 102a, and branch lines 103 and 104 to the auxiliary cylinders 13 and 14 to drive those cylinders down and cause the cross head to be set against the work.

It will be understood that when valve 28 has been moved by the travel of piston 30 to the right, and line 100 has been connected to pressure line 27, line 200 has at that time been connected to return line 29, so that the auxiliary cylinders 13 and 14 below the pistons 15 and 16 are connected through lines 204 and 205 and check valve 206 with the line 200, and the pressure fluid in the cylinders below the pistons is permitted to exhaust to permit the pistons to lower.

It will be seen that back pressure from the lower side of pistons 15 and 16 will be transmitted through line 201 to the upper side of piston 19 to provide for the maintenance in open position of the pre-filling valve 17 during the rapid closing of the press by the auxiliary pistons 15 and 16.

As soon as the cross head is set against the work by the auxiliary cylinders, pressure builds up in line 100 until it overcomes the setting of relief valve 105, when this fluid under pressure bursts through this valve into line 106 and prefilling valve control cylinder 18 below the piston 19, thus causing this piston to rise and the prefilling valve 17 to close.

It may be noted at this point that up until the fluid under pressure breaks through relief valve 105, the pre-filling valve 17 has remained open, and the cylinder 12 above the main ram 11 has been filled with oil through the fluid line 26, as the ram is lowered by auxiliary pistons 15 and 16.

When the ram has been set against the work by the auxiliary pistons, and the cylinder 12 has been filled with oil through the pre-filling valve and the fluid line 26, the pre-filling valve 17 is closed, as described above, and the device is in readiness for the application of pressure to the main cylinder 12.

This occurs by the building up of fluid pressure in the line 106 after the pre-filling valve has been closed, until it bursts through the relief valve 107 and enters the main cylinder 12 of the ram 11. It will be noted that the fluid pressure now available for the ram has been built up to a considerable extent, depending upon the setting of the various relief valves, and when it has been built up in the cylinder 12 to the amount desired, which may be different for each class of work and for which the relief valve 38 must be set, the fluid pressure now overcomes the resistance upon this valve, and is permitted to enter the cylinder 31 through the line 37, which drives the piston 30 to the left, operating the four-way valve 28 and effecting communication between the pressure line 27 and the line 200, and also opening the line 100 to the exhaust or return line 29. It will be seen, therefore, that when the pressure upon the main ram has reached the desired amount, as determined by the setting of the pressure relief valve 38, the four-way valve 28 is actuated by pressure entering the cylinder 31, and the conditions of pressure and exhaust formerly existing in lines 100 and 200 are reversed.

Now that line 100 communicates with the return or exhaust line 29, pressure is at once relieved above the main ram in the cylinder 12, and also in the auxiliary cylinders 13 and 14 above the pistons 15 and 16. The pressure in the cylinder 18 is also relieved, the lines 108 and 106 communicating with the fitting 102, which is open to line 100 through the check valves 109 and 110.

The pressure now obtaining in line 200 passes through line 201 to the pre-filling valve cylinder 18 above the piston 19, and opens the pre-filling valve 17, the cylinder exhausting through the line 106. This opening of the pre-filling valve is slightly delayed as it will not take place until the pressure in the cylinder of the main ram is relieved through the regulating needle valve 109a. This regulating valve therefore insures against the shock which often takes place upon reversal of pressure in an apparatus of this kind. When the pre-filling valve has been opened, fluid pressure will build up sufficiently in line 201 to break through or overcome the resistance of relief valve 202, and through branch lines 204, 205 enter the cylinders 13 and 14 below the pistons 15 and 16 to raise these pistons, and with them the main ram 11 and cross head attached thereto. During the raising of the ram 11, the cylinder 12 will be emptied through the pre-filling line 26, as the pre-filling valve 17 is now open, and through the line 108 past needle valve 109a.

During the raising of the ram by the auxiliary pistons 15 and 16, the pressure fluid in the cylinders above the pistons 15 and 16 is permitted to flow to line 100 through by-pass line 104a and stop valve 104b. When the press has been opened to a sufficient extent for the cross head to actuate rod 104c to close the valve, this will shut off the exhaust of the pressure fluid above pistons 15 and 16, and prevent further opening of the press. If the stop valve 57 is open, the increased pressure built up in line 200 by reason of the stoppage of pistons 15 and 16 will break through pressure relief valve 56 and move the valve-controlling piston 30 to the right, thus initiating a new closing movement of the press. It will be understood, of course, that if the valve 57 is closed, complete automatic operation of the press does not take place, and in such case a new closing movement of the press must be initiated

by movement of the manually operated control valve 33.

When the piston 30 of the four-way valve 28 is moved to the left by fluid pressure entering the cylinder 31 from the line 37, the space in the cylinder 31 to the left of the piston 30 may bleed into the line 27 through line 35 and check valve 36. It will be understood that line 27 is under fluid pressure at all times, and that the pressure in the cylinder 31 will at this time be the same upon one side of the piston 30 as upon the other, but the piston nevertheless will travel toward the left, due to its larger area on the side adjacent the line 37.

The operation of the ejector will now be described. When the press is set into operation, fluid pressure in line 100 enters line 49 through fitting 102, and drives piston 47 to the left in cylinder 48. At this time any pressure fluid which may lie in cylinder 48 at the left of piston 47 is permitted to pass out through line 52, check valve 53, line 45, into line 205, which is connected through check valve 206 with exhaust line 200. When the piston 47 is moved to the left, three-way valve 43 connects the fluid line 42 with the fluid line 45. As no pressure is existing in line 45 at this time, the ram 40 will not be raised. However, when the pressing operation has been completed and the four-way valve 28 has been operated to connect line 200 with pressure line 27, pressure will flow through line 45, which is connected with line 200, as soon as pressure builds up in this line to a sufficient extent to break through the relief valve 202 and raise the ram 11. This fluid pressure will flow from line 45 through line 42 and raise the ejector ram 40. Fluid pressure in line 45 passes in to line 50, and as soon as it has built up to a sufficient extent, it will break through pressure relief valve 51 and enter cylinder 48 at the left of the piston 47, thus driving this piston to the right and actuating the three-way valve 43 so as to connect the line 42 with the line 44, thus opening line 42 and the cylinder 41 to the exhaust or return line 29 and permitting the ejector ram to fall. At the time that fluid pressure is admitted upon the left of piston 47 into cylinder 48, the right-hand side of this piston is open to line 100, which is now the return line.

It will be apparent that all of the press operations are performed from a single source of pressure, and that these operations take place by reason of the increase of fluid pressure built up by increments in the system, and controlled entirely by pressure relief valves, which may be set to operate at a predetermined pressure. The various incremental increases in pressure control not only the various operative steps in the closing movement of the press, but also serve to initiate a reverse movement of the press and also control the various operations taking place during its opening.

While I have shown and described a preferred embodiment of my invention, it will be understood that it is not to be limited to all of the details shown, but is capable of modification and variation within the spirit of the invention and within the scope of the appended claims.

What I claim is:

1. In an hydraulic press having relatively movable pressing members to act on the work, means to effect relative approaching and pressing movements of said members comprising main and auxiliary fluid pressure motors, a single source of variable fluid pressure, fluid connections from said source to said motors, means actuated by fluid pressure in said connections for opening said connections to said main motor only after said members have been engaged with the work by said auxiliary motors, means to pre-fill said main motor prior to supply thereto of fluid pressure from said source, said means including a valve, a fluid-pressure motor for closing said valve, and means controlling admission of fluid pressure to said valve motor to close said valve prior to supply of fluid pressure to the main motor, said means also being actuated by pressure in said connections independently of the actuation of the means opening the connection to the main motor.

2. In an hydraulic press having relatively movable pressing members to act on the work, means to effect relative approaching and pressing movements of said members comprising main and auxiliary fluid pressure motors, a single source of variable fluid pressure, fluid connections from said source to said motors, means actuated by fluid pressure in said connections for opening said connection to said main motor only after said members have been engaged with the work by said auxiliary motors, means to pre-fill said main motor prior to supply thereto of fluid pressure from said source, said means including a valve, a fluid-pressure motor to open and close said valve, means to admit pressure to said latter motor to close said valve prior to supply of fluid pressure to the main motor, said means being actuated by pressure in said connections independently of the actuation of the means opening the connection to the main motor, means for reversing the flow of pressure fluid through the connections to said motors to cause a separation of said pressing members, and means to reverse conditions of pressure and exhaust in said latter motor for opening said pre-filling valve prior to such separation.

3. In an hydraulic press having relatively movable pressing members to act on the work, means to effect relative approaching and pressing movements of said members comprising main and auxiliary fluid pressure motors, a single source of variable fluid pressure, fluid connections from said source to said motors, means opening said connection to said main motor only after said members have been engaged with the work by said auxiliary motor, means to pre-fill said main motor prior to supply thereto of fluid pressure from said source including a pre-filling valve, a fluid-pressure motor for actuating said valve, a connection from said pressure source to said valve motor, a relief valve in said connection, and a second relief valve in the connection to the main motor, said first relief valve opening under a lower degree of pressure than the second to close said pre-filling valve prior to supply of fluid pressure to the main motor.

4. In an hydraulic press having relatively movable pressing members to act on the work, means to effect relative approaching and pressing movements of said members comprising main and auxiliary fluid pressure motors, a single source of variable fluid pressure, fluid connections from said source to said motors, means to pre-fill said main motor prior to supply thereto of fluid pressure from said source, said means including a pre-filling valve and a fluid-pressure motor for actuating said valve, a connection from said pressure source to said valve motor, a relief valve in said connection, a second relief valve in the connection from the pressure source to the main mo-

tor, pressure-fluid-actuated means to reverse the flow of pressure fluid in all of said connections, said means being connected to said pressure source, a third relief valve in said last-named connections, each of said relief valves opening under a higher degree of fluid pressure than the preceding relief valve whereby said pre-filling valve will be operated, fluid pressure supplied to the main motor, and the flow of fluid pressure through said connections reversed, in sequence, in the order named.

5. In an hydraulic press having relatively movable pressing members to act on the work, a single source of variable fluid pressure, means actuated by fluid from said source under one degree of pressure to set said members against the work, and by fluid from the same source under a higher degree of pressure to complete the pressing operation, means operable by fluid pressure from said source only after a predetermined maximum working pressure has been developed to effect a separating movement of said members, a work ejector, a fluid pressure motor automatically actuating said ejector after a separating movement of said members, means including a pressure relief valve to reverse automatically conditions of pressure and exhaust in said motor and return said ejector to its original position after completion of the separating movement of said pressing members.

6. In an hydraulic press having relatively movable pressing members to act on the work, a single source of variable fluid pressure, means actuated by fluid from said source under one degree of pressure to set said members against the work, and by fluid from the same source under a higher degree of pressure to complete the pressing operation, means operable by fluid pressure from said source only after a predetermined maximum working pressure has been developed to effect a separating movement of said members, a work ejector, including a pressure relief valve to reverse automatically conditions of pressure and exhaust in said motor, a fluid pressure motor automatically actuating said ejector after a separating movement of said members, and means including a pressure relief valve to reverse automatically conditions of pressure and exhaust in said motor to thereafter return said ejector means to its original position only after completion of the separating movement of said pressing members.

7. In an hydraulic press having relatively movable pressing members to act on the work, a single source of variable fluid pressure, means actuated by fluid from said source under one degree of pressure to set said members against the work, and by fluid from the same source under a higher degree of pressure to complete the pressing operation, means operable by fluid pressure from said source only after a predetermined maximum working pressure has been developed to effect a separating movement of said members, a work ejector, fluid pressure means automatically actuating said ejector after a separating movement of said members, and means to thereafter return said ejector means to its original position, said last-named means being fluid-pressure-actuated and operable under a higher degree of fluid pressure than said ejecting means.

8. In a hydraulic press having relatively movable pressing members to act on the work, main and auxiliary fluid-pressure motors for operating one of said members, a pre-filling valve associated with said main motor, a fluid-pressure motor to operate said valve, a single source of variable fluid pressure, a control valve, delivery and return pressure lines from said source to said control valve, fluid-pressure lines leading from said valve, said valve being movable to reverse conditions of pressure and exhaust in said second-named lines, one of said second-named lines leading to said auxiliary motors and having a branch leading to the pre-filling valve motor, a pressure relief valve controlling delivery of fluid pressure through said branch line and biased to operate said pre-filling valve motor only after operation of said auxiliary motors, a second branch fluid-pressure line leading to said main motor from said control valve, and a pressure relief valve controlling delivery of fluid pressure through said second branch line and biased to admit fluid pressure thereto only after operation of said pre-filling valve motor.

9. In a hydraulic press having relatively movable pressing members to act on the work, main and auxiliary fluid-pressure motors for operating one of said members, a pre-filling valve associated with said main motor, a fluid-pressure motor to operate said valve, a single source of variable fluid pressure, a control valve, delivery and return pressure lines from said source to said control valve, fluid-pressure lines leading from said valve, said valve being movable to reverse conditions of pressure and exhaust in said second-named lines, one of said second-named lines leading to said auxiliary motors and having a branch leading to a pre-filling valve motor, a pressure relief valve controlling delivery of fluid pressure through said branch line and biased to operate said pre-filling valve motor only after operation of said auxiliary motors, a second branch fluid-pressure line leading to said main motor from said control valve, a pressure relief valve controlling delivery of fluid pressure through said second branch line and biased to admit fluid pressure thereto only after operation of said pre-filling valve motor, a fluid-pressure motor to operate said control valve, a pressure line leading to said motor, and a pressure relief valve in said line biased to admit fluid pressure to said motor after operation of said main motor.

10. A hydraulic press comprising a crosshead, main and auxiliary fluid-pressure motors to operate said crosshead, a pre-filling valve associated with said main motor, a fluid-pressure motor to operate said pre-filling valve, each of said motors comprising a cylinder and a piston operating therein, a single source of variable fluid pressure, a main control valve, delivery and return lines leading from said source to said control valve, fluid-pressure lines leading away from said control valve, said valve being movable to reverse conditions of pressure and exhaust in said last-named lines, one of said last-named lines leading to said main motor and to one side of the piston in said auxiliary motor and said pre-filling valve motor, the second of said lines leading to the other side of the piston in said auxiliary motor and said pre-filling valve motor, an ejector, a fluid-pressure motor controlling the operation of said ejector, said second line having a branch leading to said motor, and a relief valve in said branch line biased to admit pressure fluid to said last-named motor to operate said ejector only after operation of said auxiliary motor by admission of fluid pressure thereto from said second line.

11. In an hydraulic press having relatively movable pressing members to act on the work.

means to effect relative approaching and pressing movements of said members comprising main and auxiliary fluid pressure motors, a single source of variable fluid pressure, a fluid connection from said source to said auxiliary motors, means to prefill said main motor prior to supply thereto of fluid pressure from said source, said prefilling means including a valve and a fluid pressure motor to open and close said valve, a fluid line leading to said valve motor from said fluid connection, a pressure relief valve controlling said fluid line, and a branch fluid line leading from said first-named fluid line to the main motor, and a second pressure relief valve controlling said branch line whereby pressure is admitted to the valve motor and to the main motor in predetermined sequence.

CARL F. SCHNUCK.

CERTIFICATE OF CORRECTION.

Patent No. 2,200,998. May 14, 1940.

CARL F. SCHNUCK.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, lines 42, 43 and 44, claim 6, strike out the words "including a pressure relief valve to reverse automatically conditions of pressure and exhaust in said motor"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of July, A. D. 1940.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)