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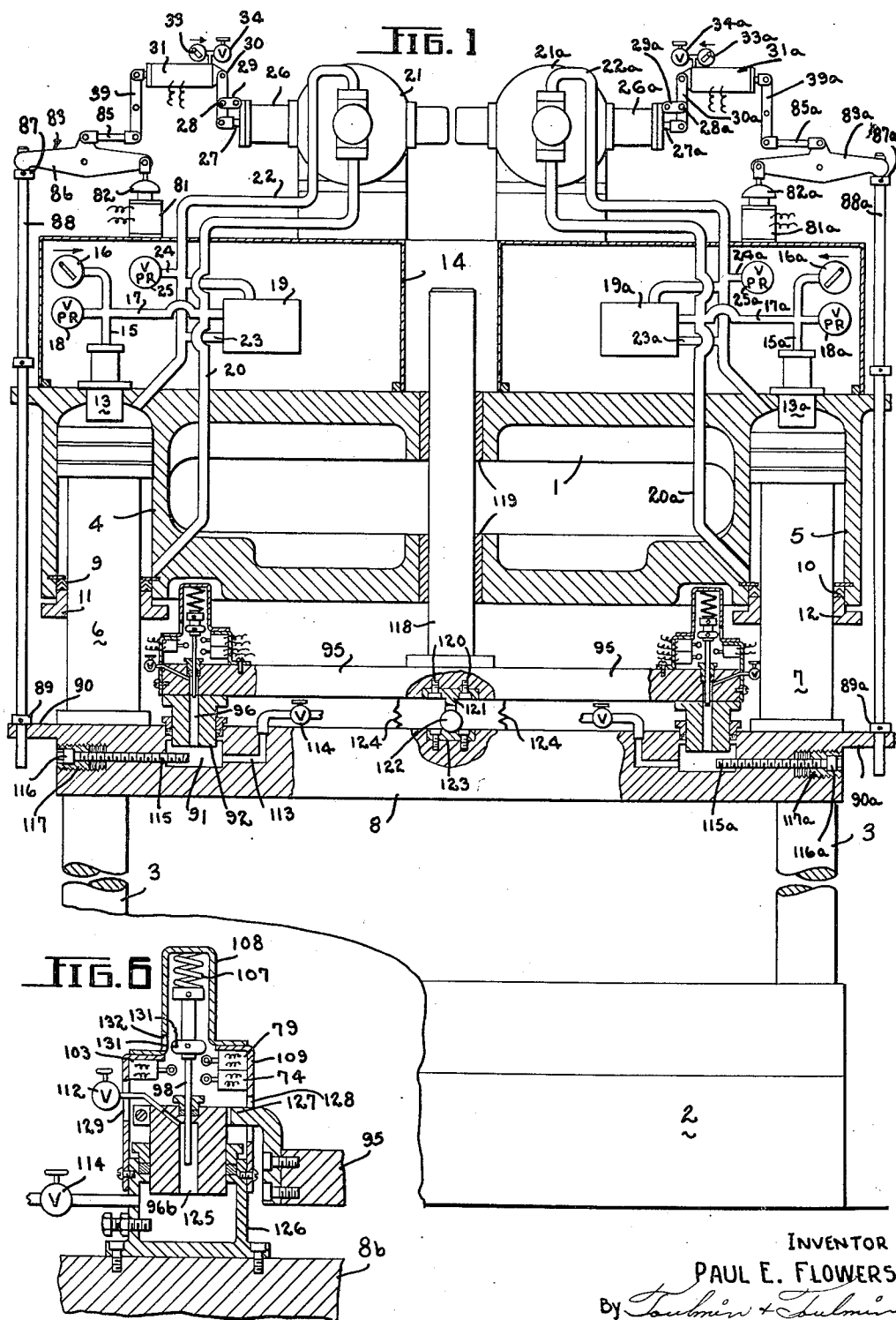
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2,309,944

PLATEN LEVELING DEVICE

Filed June 21, 1941

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

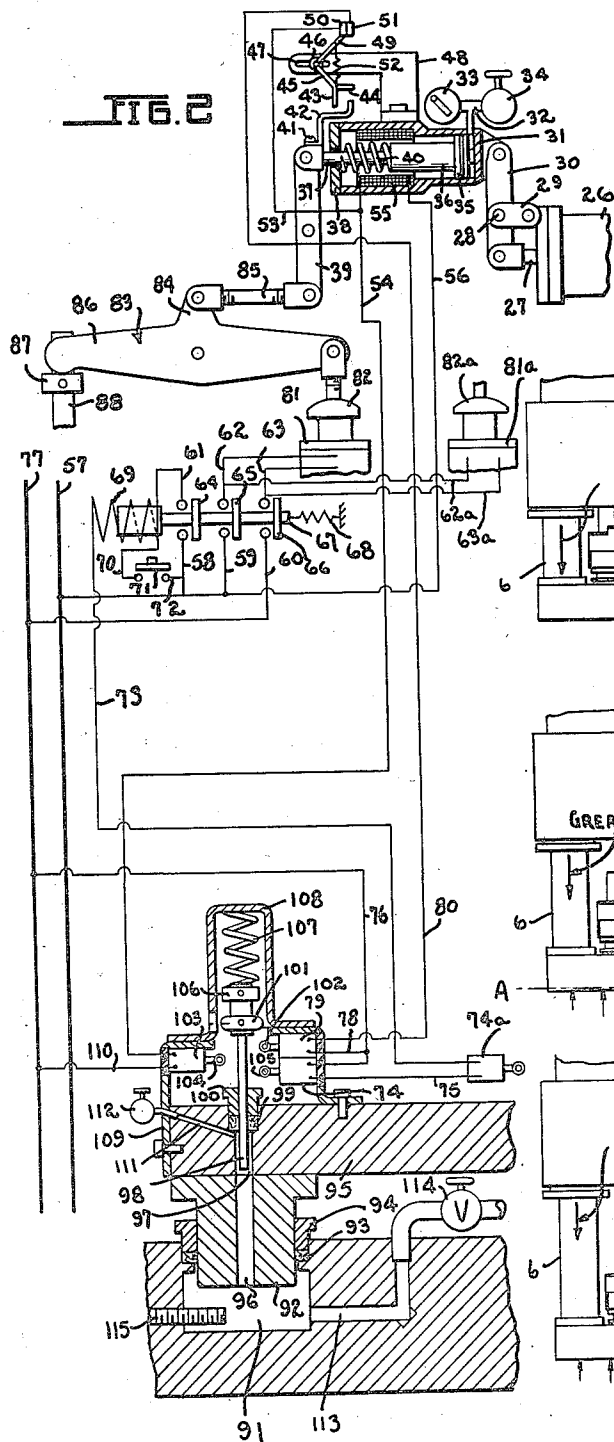


FIG. 3

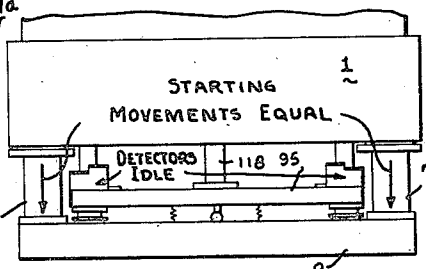


FIG. 4

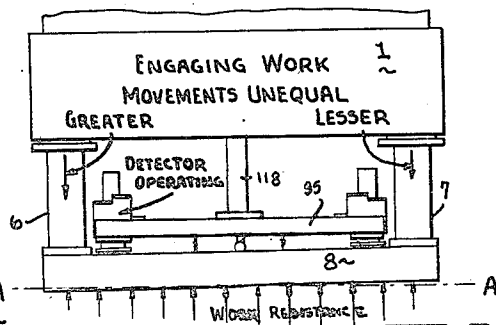
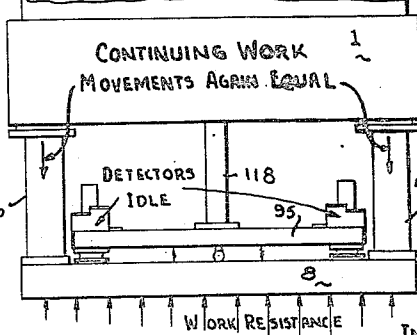


FIG. 5



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UNITED STATES PATENT OFFICE

2,309,944

PLATEN LEVELING DEVICE

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Application June 21, 1941, Serial No. 399,169

18 Claims. (Cl. 100-71)

This invention relates to hydraulic machines and, in particular, to the correction of deflections in platens of hydraulic presses which may occur during the pressing operation of such presses.

It is an object of the invention to provide a hydraulic press, in which the press platen is so controlled that any deflections of the platen which may possibly occur during the pressing operation remain below a predetermined value.

It is another object of the invention to provide a hydraulic press, in which any minute deflections or tilting movements of the platen which may occur during a pressing operation and exceed a predetermined value are instantaneously detected and corrected.

It is a further object to provide a press with a hydraulically advanced press platen, in which the supply of pressure fluid for advancing the platen is controlled in response to a predetermined deviation of the platen from a plane parallel to the normal plane of the platen, i. e., the plane of the platen when the latter is in its retracted or idle position.

Another object of the invention consists in the provision of a press having a platen with a plurality of fluid operable cylinder-piston-assemblies for advancing the platen, in which the supply of fluid to each cylinder-piston-assembly is individually controlled in response to a predetermined deviation or tilting movement of the platen.

It is another object to provide a press as set forth in the preceding paragraph, in which various predetermined deviations or tilting movements of the platen automatically cause correcting movements of various extent.

It is still another object to provide a press with a plurality of double-acting plungers for advancing and retracting the press platen, in which the supply of pressure fluid to the advancing side of said plungers is individually controlled in response to predetermined deviations or tilting movements of the platen, while the supply of pressure fluid to the advancing sides of said plungers is concomitantly reversed when said deviations or tilting movements exceed a predetermined value.

Another object consists in the provision of a hydraulic press, in which deflections or tilting movements of the press platen act upon a fluid operable plunger adapted to bring about a variation in the supply of fluid to a fluid motor for reciprocating the press platen.

These and other objects and advantages of the invention will appear more clearly from the fol-

lowing specification in connection with the accompanying drawings in which:

Figure 1 illustrates diagrammatically a hydraulic press in connection with a detecting and correcting device for deviations of the press platen.

Figure 2 illustrates a part of the detecting and correcting device according to the invention together with the electric circuit therefor.

Figures 3, 4 and 5 illustrate various stages of the press platen during a pressing cycle.

Figure 6 is a slightly modified embodiment of the detecting and correcting device of the invention.

General arrangement

The detecting and correcting device for deviations of the press platen which may occur during the pressing operation comprises substantially a reciprocable member which is in constant contact with the press platen and translates deviations of the latter from its normal plane to a control cylinder-piston-assembly including a control plunger which is constantly urged in a predetermined direction.

Deviations of the press platen translated to the said cylinder-piston-assembly cause a variation in the pressure condition prevailing in said cylinder-piston-assembly which in turn causes movement of the control plunger in one or the other direction.

Responsive to the movement of the control plunger, a mechanism is actuated which varies the supply of fluid to fluid operable means for advancing the press platen in such a manner that the advancement of that portion of the press platen which is running ahead is automatically retarded, thereby allowing the platen to return to its normal plane.

Structural arrangement

Referring to the drawings in detail, the press diagrammatically shown in Figure 1 comprises a press head 1 and a press bed 2 interconnected with each other by strain rods 3.

The press head 1 comprises two cylinders 4 and 5 of substantially equal shape and dimension, in which respectively are reciprocably mounted a ram 6, 7, connected to the press platen 8. The rams 6 and 7 are surrounded at the lower portion of the cylinders 4 and 5 by packing material 9 and 10 respectively compressed by glands 11 and 12.

Mounted at the upper end in each cylinder 4, 5, is a surge valve 13. 13a, which extends into

the fluid reservoir or surge tank 14 mounted on top of the press head 1. The surge valve 13 communicates with a conduit 15 comprising a check valve 16 and communicating with a conduit 17, one end of which leads to a pressure relief valve 18, while the other end of the conduit 17 leads to a main cylinder release and pump by-pass valve 19.

The surge valve 13 and the main cylinder release and pump by-pass valve 19 do not form a part of the present invention and for a more detailed description thereof reference may respectively be had to U. S. Patent 2,193,248 and U. S. patent application, Serial 286,063, filed July 24, 1939, both to Ernst.

The purpose of the surge valve 13 is to prefill the cylinder 4 when the ram 6 moves downwardly by gravity, while the main cylinder release and pump by-pass valve 19 serves to relieve the pressure in the upper portion of the cylinder 4 at the initiation of the retraction stroke of the press platen 8.

Communicating with the conduit 17 is a conduit 20, one end of which leads to the lower end of the cylinder 4, while the other end leads to one side of a reversible variable delivery pump 21. The other side of the pump 21 is connected to the conduit 22 which leads to the upper portion of the press cylinder 4. The conduit 22 is connected to a branch line 23 leading to the main cylinder release and pump by-pass valve 19, and is also connected with a conduit 24 comprising a pressure relief valve 25. The pump 21 comprises a servomotor 26 which is supplied with pressure fluid from an auxiliary pump (not shown), and its operation is controlled by means of the servomotor valve rod 27 by moving the servomotor valve rod 27 in or out. The servomotor 26 may be caused to shift the flow control ring (not shown) of the pump 21 in opposite directions and thus change the quantity and direction of the pressure fluid supplied by the pump 21. The details of this servomotor control system form no part of the present invention and for a more detailed description thereof reference may be had to U. S. Patent 2,184,665 to Ernst.

Pivotally connected with the servomotor valve rod 27 and shiftable about the pivot 28 of the link 29 is the link 30 which in its turn is pivotally connected to the collapsible link cylinder 31. Communicating with the end of the cylinder 31 is a T-shaped conduit 32, one end of which leads to a check valve 33, while the other end leads to an adjustable choke valve 34. Reciprocally mounted in the link cylinder 31 is a piston 35 connected to an armature 36 of smaller diameter which in its turn is connected to a link 37 passing through the end wall 38 of the cylinder 31 and pivotally connected to the arm 39. Mounted between the armature 36 and the end wall 38 is a spring 40 continuously urging the armature 36 and piston 35 away from the end wall 38.

Connected for instance by a screw 41 with the link 37 is a latch 42 adapted to cooperate selectively with the arm 43 or 44 of the snap lever 45 which is shiftable about the pivot 46. The pivot 46 is adjustable in a slot 47 of a supporting arm 48 connected, in any convenient manner, with the link cylinder 31. The snap lever 45 comprises an arm 49 carrying a contact 50 adapted to engage a contact 51. The contacts 50 and 51 are continuously urged into engagement with each other by a snap spring 52.

The contact 50 is connected with a line 53 leading to the line 54, one end of which is connected to the solenoid 55 which is stationarily mounted in the link cylinder 31 and adapted, when energized, to actuate the armature 36. The other end of the solenoid 55 is connected to the line 56 leading to the main supply line 57.

Branching off from the line 56 are lines 58, 59 and 60 adapted respectively to be connected with lines 61, 62 and 63 by closure of the blades 64, 65 and 66. The blades 64, 65 and 66 are carried by the armature 67 which is continuously urged to open position by a spring 68 and is adapted to be moved into closed position against the thrust of the spring 68 by energization of the solenoid 69. One end of the solenoid 69 is connected with the line 61 and with a line 70, which in its turn is adapted by closure of the starter button 71 to be connected with the line 72 leading to the line 58. The other end of the solenoid 69 is connected to a line 73 which leads to a normally closed limit switch 74a, which latter is connected by line 75 with a similarly normally closed limit switch 74. The limit switch 74 is connected with a line 76 leading to the main supply line 77. The line 76 is also connected to the line 78 leading to a normally open limit switch 79. Also connected to the limit switch 79 is a line 80 which leads to the contact 51.

The lines 62 and 63 lead to a solenoid 81 adapted, when energized, to attract an armature 82, which is pivotally connected with a three-arm lever, generally designated 83. Connected with the lines 62 and 63 are lines 62a and 63a leading to a similar solenoid 81a. The arm 84 of the three-arm lever 83 is pivotally connected by a link 85 with the arm 39, while the arm 86 of the three-arm lever 83 is adapted to be engaged by a collar 87 adjustably mounted on a push rod 88 which is reciprocable in the press head 1. The push rod 88 also carries at the lower end thereof an adjustable collar 89, adapted to be engaged by the platen arm 90.

The press platen 8 comprises a control cylinder 91 in which is reciprocally mounted a plunger 92 surrounded by packing material 93 compressed by a gland 94, which is connected to the platen 8 in any convenient manner. The plunger 92 connected to the reference bar 95 has a longitudinal bore 96 therethrough, which registers with a bore 97 in the reference bar 95.

Reciprocally mounted in the bore 97 is a control plunger 98 surrounded by packing material 99 compressed by a gland 100. The control plunger 98 carries a cam member 101 which is adapted selectively to close the switch 79 by actuating its arm 102 or to close the switch 103 by actuating its arm 104. The cam member 101 is also adapted to open the normally closed switches 74 and 74a by actuating the switch arm 105 pertaining to the switch 74. The upper end of the control plunger 98 carries an adjustable collar 106 abutting one end of a spring 107, the other end of which abuts a cap 108 which is connected to a casing 109 carried by the reference bar 95 and housing the switches 79, 74 and 103. The switch 103 is connected to the line 54 and is also connected by means of line 110 with the main supply line 77.

Communicating with the bore 97 in the reference bar 95 is a passageway 111 which leads to a valve 112 and is adapted to release air trapped in the bore 97. The control cylinder 91 communicates with the passageway 113 provided in the platen 8 and leads to a shut-off valve 114

which is connected to a fluid source, for instance a hydraulic pressure pump (not shown). When the valve 114 is open, fluid passes therethrough into the control cylinder 91. To effect fine adjustments in the pressure prevailing in the control cylinder 91, a threaded plunger 115 is provided in the platen 8 and extending into the control cylinder 91. The adjustment of the threaded plunger 115 may be effected from the outside of the press by turning the plunger head 116. A lock nut 117 likewise operable from the outside of the press is provided for maintaining the threaded plunger 115 in its adjusted position.

While the detecting and correcting device and the hydraulic system so far described pertains to the ram 6 only, it is of course understood that similar means are associated with the ram 7. However, since the last mentioned means are identical with those pertaining to the ram 6, a description thereof appears to be superfluous and the corresponding parts have been numbered with the same reference numerals as those pertaining to the ram 6, however, with the additional letter a.

The reference bar 95 is connected with a plunger 118 reciprocable in sleeves 119 provided in the press head 1. Connected to the lower side of the reference bar 95, for instance by screws 120, is an upper bearing member 121 resting with its spherical surface on a ball 122 which in its turn is journaled in a lower bearing member 123 connected to the platen 8. Normally the weight of the plunger 118 and the reference bar 95 will be sufficient to positively hold the upper bearing member 121 in contact with the ball 122. However, if desired, two springs 124 may be provided for securing constant contact between the upper bearing member 121 and the ball 122.

Referring to Figure 6, the structure shown therein is similar to that shown at the lower end of Figure 2. However, in contrast to the arrangement shown in the latter, the control cylinder 125, corresponding to the control cylinder 91 of Figure 2, is provided in a separate casing 126, which is threaded or otherwise detachably connected to the press platen 8b. Furthermore, the control plunger 98 is reciprocable in the bore 96b of the plunger 92b, which is connected by a clamp ring 127 with the reference bar 95. Since in the embodiment of Figure 6 the casing 109 is connected to the casing 126, a slot 128 is provided in the casing 109 to allow movement of the reference bar relative thereto, while a slot 129 is provided in the casing 109 to allow movement of the valve 112 carried by the plunger 92b and adapted to communicate with the upper portion of the bore 96b.

Operation

Supposing that all parts of the press occupy the position shown in Figures 1 and 2, and that it is now desired to perform a working cycle.

To this end the operator actuates the starter button 71 so as to connect the line 70 with the line 72 (Figure 2). As a result thereof, current flows from the main supply line 57, through line 58, starter button 71, line 70, solenoid 69, line 73, normally closed switches 74a and 74 and line 76 to the main supply line 77. In this way the solenoid 69 is energized, thereby causing the switch blades 64, 65 and 66 to move into closing position. Closure of the switch blade 64 establishes a holding circuit for the solenoid 69, which comprises the main supply line 57, line 58, switch

blade 64, line 61, solenoid 69, line 73, switches 74a and 74, line 76 and the main supply line 77.

Closure of the switch blades 65 and 66 establishes a holding circuit for the solenoid 81, which comprises the main supply line 57, line 56, line 59, switch blade 65, line 62, solenoid 81, line 63, switch blade 66, line 60 and main supply line 77. This causes energization of the solenoid 81 and also of the solenoid 81a, which is connected by lines 62a and 63a with the lines 62 and 63.

Energization of the solenoid 81 shifts the three-arm lever 83 in clockwise direction so that the link 37 and due to its spring connection with the cylinder 31, also the latter is shifted toward the left with regard to Figures 1 and 2, which in turn causes shifting movement of the servomotor valve rod 27 toward the right, thereby moving the pump 21 into full delivery forward stroke position. Similarly the energization of the solenoid 81a moves the pump 21a simultaneously into full delivery forward stroke position. As a result thereof, the pump 21 delivers pressure fluid through conduit 22 into the upper portion of the cylinder 4, while the pump 21a delivers pressure fluid through the line 22a into the upper portion of the cylinder 5. Since, as mentioned above, the pumps 21 and 21a and the cylinders 4 and 5 are substantially identical, the cylinders 4 and 5 receive the same quantity of fluid from their respective pumps. Due to the withdrawal of fluid from the lower portion of the cylinders 4 and 5 through the conduits 20 and 20a respectively, the rams 6 and 7 move downwardly by gravity. During this downward movement, the supply of fluid from the pumps 21 and 21a is supplemented by fluid from the tank 14 passing through the surge valves 13 and 13a respectively. As soon as the platen or the die connected thereto engages the work piece, pressure starts to build up in the cylinders 4 and 5, which causes the surge valves 13 and 13a to close. While the pumps 21 and 21a continue to remain in full delivery forward stroke position and to supply fluid into their respective cylinders 4 and 5, the actual pressing starts.

Assuming now that the press platen 8 starting from the position shown in Figure 3 encounters unequally distributed forces during the pressing stroke, which forces are shown in Figure 4 and represented by arrows of different length according to their magnitude. As will be seen from Figure 4, the greatest force acts upon the right side of the platen 8, thereby deflecting the platen from its normal plane A-A. This deflection results in an increase in the distance between the lower side at the left end of the reference bar 95 and the lower side at the left end of the platen 8.

It will be noted that the tilting movement of the platen cannot cause a tilting movement of the reference bar 95 since the latter has no positive connection thereto and is separated from the platen by the ball 122 which constitutes a universal link between the platen 8 on one hand and the reference bar 95 and the plunger 118 on the other hand, which latter is guided in the stationary press head 1.

Due to the above mentioned increase in distance between the left ends of the reference bar 95 and the platen 8, also the distance between the bottom portion of the plunger 92 and the bottom of the cylinder 91 increases, with the result that the fluid pressure in the cylinder 91 decreases. Consequently, the spring 107 shifts

the plunger 98 downwardly until it is again balanced by the pressure in the cylinder 91.

It may be assumed that the plunger 98 has moved downwardly to such an extent that the cam member 101 actuates the switch arm 102, thereby closing the normally open switch 79. Closure of this switch establishes a circuit comprising the main supply line 77, line 76, lines 78 and 80, contacts 51 and 50, line 53, solenoid 55, line 56 and main supply line 57. As a result thereof the solenoid 55 is energized and since it is stationarily mounted in the casing 31 while the three arm lever 83 is held in its position by the solenoid 81, the cylinder 31 is shifted toward the right, thereby causing the servomotor valve rod 27 to move toward the left and thereby to reduce the delivery of the pump 21. During this rightward movement of the cylinder 31 relative to the piston 35, the increasing space between the latter and the right end wall of the cylinder 31 is filled with air entering through the check valve 33. In this way the correcting device according to the invention tries to bring the platen back to its normal plane.

As soon as the cylinder 31, due to the energization of the solenoid 55, is moved toward the right, the arm 48 connected to the cylinder 31 brings the lower end of the snap lever 45 into engagement with the latch 42 so that the contacts 50 and 51 are spaced from each other. This immediately breaks the energizing circuit for the solenoid 55 with the result that the spring 40 starts returning the cylinder 31 toward its left end position. However, this leftward movement of the cylinder 31 does not take place with the same speed as the previous rightward movement of the cylinder 31, since the air entrapped between the piston 35 and the right end wall of the cylinder 31 can escape only through the choke valve 34. The rate of the leftward movement of the cylinder 31 is, therefore, determined by the adjustment of the choke valve 34.

Under normal conditions the above mentioned action of the correcting device will be sufficient to bring the platen practically into its normal plane. However, if for some reason the distance between the left ends of the platen 8 and the reference bar 95 should, instead of being decreased, have further increased, the corresponding increase between the bottom of the cylinder 91 and the bottom of the plunger 92 will allow the spring 107 to push the control plunger 98 downwardly to such an extent that the cam member 101 actuates the switch arm 104 pertaining to the switch 103 so as to close the normally open switch 103. This establishes a circuit comprising the main supply line 77, switch 103, line 54, solenoid 55, line 56 and main supply line 57. The solenoid 55 is, therefore, energized and, in the manner previously described, causes the cylinder 31 to move toward the right, while the shifting member of the pump 21 places the latter on reduced stroke. However, it will be noted that in this instance the stroke of the cylinder 31 and, thereby, of the servomotor valve rod 27 is greater than in the previously described instance because the breaking of the contacts 51 and 50 after a portion of the stroke of cylinder 31 has no effect on the energization of the solenoid 55. In other words, while in the above mentioned instance the energization of the solenoid 55 is interrupted, due to the breaking of the contacts 51 and 50 after the cylinder 31 has moved by a predetermined distance but before it has reached the end of its rightward move-

ment, the cylinder 31 now performs a complete rightward stroke. Consequently, the reduction in the supply of pressure fluid to the cylinder 4 is greater in the last mentioned instance than in the first mentioned instance. This reduction in the supply of fluid to the cylinder 4 will, for all normal, practical purposes, be sufficient to immediately start the leveling action of the platen, i. e., to bring the latter back to its normal plane.

As soon as, during this leveling action the distance between the bottom portion of the plunger 92 and the bottom of the cylinder 91 decreases again, the increase in pressure in the cylinder 91 acts upon the control plunger 98 and lifts the latter against the thrust of the spring 107. This upward movement of the control plunger 98 causes the cam member 101 to release the switch arm 104 so that the switch 103 opens again. As a result thereof the energizing circuit for the solenoid 55 is interrupted and the spring 40 begins to return the cylinder 31 to its left end position and, consequently, to restore the pump 21 to its full delivery forward stroke position. As previously mentioned, the return movement of the cylinder 31 toward its left end position and, therefore, also the rate of the shifting movement of the pump 21 to its full delivery forward stroke position depends on the adjustment of the choke valve 34.

When the platen has reached the end of its pressing stroke, a mechanism is actuated either in response to the press platen or in response to a predetermined pressure in the cylinders 4 and 5 in a manner well known in the art, which mechanism then shifts the flow control or shifting ring of the pumps 21 and 21a so as to place the said pumps into full delivery retraction stroke position. Pressure is then delivered by the pumps 21 and 21a into the lower portion of the cylinders 4 and 5, respectively, through the conduits 20 and 20a, while the conduits 22 and 22a become the suction lines.

After the release of pressure in the upper portion of the cylinders 4 and 5 by the main cylinder release and pump by-pass valves 19 and 19a at the initiation of the retraction stroke, the rams 6 and 7 begin to move upwardly. When the rams 6 and 7 have reached the end of their retraction stroke, the platen arms 90 and 90a engage the collars 89 and 89a on the push rods 88 and 88a, thereby causing the collars 87 and 87a on said push rods to shift the three-arm lever 83 in clockwise direction and the lever 83a into anti-clockwise direction so as respectively to move the pumps 21 and 21a to neutral or no delivery position. The press then comes to a standstill and is ready for a new cycle.

Supposing now that, during the pressing operation, an extraordinary situation is encountered, in which the above mentioned leveling action was not successful and that the distance between the left ends of the platen and reference bar had further increased with the result that the cam member 101 was moved downwardly to such an extent that it engages the switch arm 105. This actuation of the switch arm 105 will then immediately open the normally closed switches 74 and 74a and, therefore, break the holding circuit for the solenoids 81 and 81a. As a result thereof a spring (not shown) in the servomotors 26 and 26a of the pumps 21 and 21a immediately reverse the delivery of the pumps 21 and 21a so that pressure fluid is delivered from the said pumps into the lower portions of the cylin-

ders 4 and 5, thereby returning the platen to its retracted or starting position, as previously described.

With regard to the embodiment shown in Figure 6, the operation thereof is the same as that described above so that a particular description of the operation of Figure 6 appears superfluous.

While the press described above has been shown with two pumps each of which pertains to one of the rams, it is of course understood that the operation of the detecting and correcting device according to the invention would by no means be affected if the two pumps were replaced by a single pump and the detecting and correcting device shown in the lower portions of Figures 2 and 6 would actuate admission valves controlling the flow of fluid to the rams instead of the servomotor 26, 26a as previously described. In other words, the electric control system actuated by the detecting and correcting device of the invention could be used for actuating an admission valve in the conduit 22, 22a respectively, while one single pump is adapted to supply pressure fluid through said admission valves into the cylinders 4 and 5 respectively.

It should furthermore be noted that while the correcting device shown in the drawings is provided with two correcting switches, namely, 79 and 103, it is of course possible and in many cases quite sufficient to provide only one switch, namely 103, in which instance the contacts 50 and 51, the arm 48, the snap lever 45 and the latch 42 are superfluous. In this instance the conduits 53 and 54 and the conduit 76 are, of course, also superfluous. The device will then operate as previously described in connection with the actuation of the switch arm 104. The provision of the switch 79 with the electric mechanism pertaining thereto merely constitutes a refinement of the device inasmuch as it tends to nip any deflections of the platen from its normal position at the very point when it begins, while the switch 103 allows a predetermined deflection and then immediately starts to correct the deflection of the platen. As previously brought out, the actuation of the switch arm 102 pertaining to the switch 79 merely causes a partial stroke of the link cylinder 31, while actuation of the switch arm 104 pertaining to the switch 103 causes a full stroke of the link cylinder 31.

The correcting device according to the invention is very simple in structure and allows minute adjustment by actuation of the threaded plunger 115. To facilitate such adjustment, the cam member 101 is preferably provided with a mark 130 which, when properly adjusted, may register with a corresponding mark 131 in a window 132 of the cap.

While the detecting and correcting device according to the invention has been illustrated and described so as to bring about the leveling operation or correction of the platen deflection when the space between the adjacent ends of the platen and the reference bar increases, it is, of course, understood that the cam member 101 and switches 74, 79 and 103 may, if desired, be so arranged that the leveling action is brought about in response to a decrease in the distance between the adjacent ends of the reference bar and the platen.

It is of course also understood that instead of providing only two platen actuating rams as shown in the drawings, also a greater number of platen actuating rams may be connected with the platen. Furthermore, the rams may be con-

nected with the platen at any convenient place although it is preferable to mount one ram at each corner of the platen.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims and the invention.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a press having a press platen, a plurality of fluid operable means for advancing said platen, a fluid source for supplying pressure fluid to said fluid operable means, and electrically operable control means responsive to a predetermined deflection of said platen for varying the supply of fluid to one of said fluid operable means to reduce said deflection.
2. In a press having a press platen, a plurality of fluid operable advancing means for advancing said platen, a fluid source for supplying pressure fluid to said means, a reciprocable member arranged coaxially with said platen, and electric means operable by said member in response to deflections or tilting movements of said platen for controlling the relative speed of movement of said fluid operable means.
3. In a press having a hydraulically operable press platen, a press head, a control member reciprocably mounted in said head and responsive to the movement of said platen in vertical direction only, and electric means controlled by said control member in response to deflections or tilting movements of said platen for correcting said deflections or tilting movements.
4. In a press having a press platen, a plurality of identical cylinder-piston-assemblies operatively connected with said platen, a fluid source for supplying pressure fluid to said cylinder-piston-assemblies, each of said cylinder-piston-assemblies having associated therewith identical fluid supply control means, reference means common to said control means and resting substantially on the center portion of said platen, guiding means for guiding said reference means in vertical direction while simultaneously preventing said reference means from following deflections or tilting movements of said platen, and means associated with the ends of said reference means and responsive to deflections or tilting movements of said platen for actuating said control means to thereby vary the supply of fluid to said cylinder-piston-assemblies to correct said deflections or tilting movements.
5. In a press having a press platen, a plurality of double-acting fluid operable plungers for advancing and retracting said press platen, a fluid source for supplying pressure fluid to said plungers, means for controlling the supply of pressure fluid to the advancing side of said plungers individually in response to a predetermined deviation or tilting movement of the platen, and means for concomitantly reversing the flow of fluid between said fluid source and said plungers in response to a deviation or tilting movement of said platen in excess of said predetermined deviation or tilting movement.
6. In a press having a press platen, a plurality of independently operable fluid motors for reciprocating said platen, a plurality of independently operable control means associated respectively with said motors for controlling the speed thereof, and fluid operable plunger means responsive to deflections or tilting movements of said platen for actuating one of said control

means to bring about a change in the speed of one motor without changing the speed of another motor, thereby leveling said platen.

7. In a press having a press platen, a plurality of fluid operable cylinder-piston-assemblies for advancing said platen, a fluid source for supplying pressure fluid to said cylinder-piston-assemblies, electrically operable controlling means for individually controlling the supply of fluid to said cylinder-piston-assemblies, and a plurality of control elements operatively connected with each of said controlling means and adapted responsive to predetermined different deviations or tilting movements of the platen to effect different controlling actions of said controlling means to correct said deviations or tilting movements.

8. In a press having a press platen, a plurality of fluid operable motors for actuating said platen, a fluid source for supplying pressure fluid to said motors, controlling means adapted individually to control the supply of fluid to said motors, electric means operable to cause actuation of said controlling means, and a reciprocable member movable in response to a deflection or tilting movement of said platen for actuating said electric means to bring about correction of said deflection or tilting movement.

9. In a press having a press platen, a plurality of fluid operable motors associated with said platen for actuating the same, a fluid source for supplying pressure fluid to said motors, controlling means for individually controlling the supply of fluid to said motors, a press head, a reciprocable member vertically movable in said head, and a plurality of control cylinders corresponding in number to said motors and each having reciprocably mounted therein a control plunger, each of said control plungers being connected to said reciprocable member and being adapted in response to a deflection or tilting movement of said platen to cause adjustment of one of said controlling means.

10. In a press having a press platen, a plurality of fluid operable motors for actuating said platen, a fluid source for supplying pressure fluid to said motors, each of said motors having associated therewith controlling means for individually controlling the supply of fluid from said fluid source to said motors, a press head, a vertically reciprocable member mounted in said head and supported by said platen, means associated with said platen for allowing universal movement of the latter relative to said reciprocable member, and means operatively connected with said reciprocable member and responsive to deflections or tilting movements of said platen for actuating said controlling means.

11. In a press having a press platen, a plurality of fluid operable cylinder-piston-assemblies for actuating said platen, and a plurality of reversible variable delivery pumps corresponding in number to the number of said cylinder-piston-assemblies and adapted to supply pressure fluid to the latter each of said pumps having associated therewith servomotor means, a plurality of control means respectively associated with said servomotor means and operable in response to a predetermined deflection or tilting movement of the platen for actuating the respective servomotor means, each of said control means being operable to vary the delivery of one pump without causing a change in the delivery of another pump.

12. In a press having a press platen, a plurality of fluid operable cylinder-piston-assemblies for actuating said platen, fluid supply means hy-

draulically connected with each of said cylinder-piston-assemblies and having controlling means associated therewith for individually controlling the supply of fluid from said fluid supply means to said cylinder-piston-assemblies, a reciprocable member vertically guided in said press and connected with said platen by a universal joint, detecting means operatively connected with said reciprocable member for detecting deflections or tilting movements of the platen and comprising a plunger movable in response to the deflections or tilting movements of said platen, and means operable by said plunger in response to a predetermined deflecting movement of said platen for actuating said controlling means to vary the flow of fluid from said supply means to at least one of said cylinder-piston-assemblies to bring about a correction of said deflecting movement of said platen.

13. In a press having a press platen, a plurality of fluid operable cylinder-piston-assemblies for actuating said platen, fluid supply means hydraulically connected with each of said cylinder-piston-assemblies and having controlling means associated therewith for individually controlling the supply of fluid from said fluid supply means to said cylinder-piston-assemblies, a plurality of detecting devices corresponding in number to said cylinder-piston-assemblies and each comprising a plurality of switch means operatively connected with said controlling means, and a plunger adapted in response to different predetermined deflections or tilting movements of said platen to actuate different switch means for variably adjusting said controlling means to correct said deflections or tilting movements of said platen.

14. In a press having a press platen, a plurality of fluid operable cylinder-piston-assemblies for actuating said platen, fluid supply means hydraulically connected with each of said cylinder-piston-assemblies and having controlling means associated therewith for selectively, individually or collectively controlling the supply of fluid from said fluid supply means to said cylinder-piston-assemblies, a plurality of detecting devices corresponding in number to said cylinder-piston-assemblies, each of said detecting devices comprising a plunger reciprocable in response to tilting movements of said platen, and a plurality of actuating members operable by said plunger and operatively connected with said controlling means, one of said actuating members being adapted in response to a predetermined tilting movement of the platen to reduce the supply of fluid from said fluid supply means to the respective cylinder-piston-assembly, and another of said actuating members being adapted in response to a tilting movement of the platen in excess of said predetermined tilting movement to reverse the flow of fluid from said fluid supply means between all cylinder-piston-assemblies and the fluid supply means pertaining thereto to cause retraction of said platen.

15. In a press having a press platen, a plurality of fluid operable cylinder-piston-assemblies, each having associated therewith a reversible variable delivery pump for supplying pressure fluid to the respective cylinder-piston-assembly, servomotor means associated with each of said pumps for controlling the supply of fluid from each pump to its respective cylinder-piston-assembly, each of said servomotor means having associated therewith a collapsible link operable selectively to be actuated in collapsible or non-collapsible position, starter means operatively connected with

said collapsible links and adapted to start all pumps simultaneously, and a plurality of controlling members corresponding in number to said cylinder-piston-assemblies, each of said controlling members being operatively connected with one of said links and adapted to operate said link in response to a predetermined tilting movement of said platen for actuating the respective servomotor means.

16. In a press having a press platen, a plurality of cylinder-piston-assemblies operatively connected with said platen for reciprocating the same, a plurality of reversible variable delivery pumps corresponding in number to the number of said cylinder-piston-assemblies, each of said pumps having associated therewith a servomotor with a collapsible link for controlling the supply of fluid from the respective pump to the cylinder-piston-assembly pertaining thereto, said collapsible link comprising two elements movable relative to each other, one of said elements being connected with said servomotor and carrying a solenoid, and the other movable element being connected with a link system operable by starter means, yielding means interposed between said two movable elements, and a plurality of detecting devices corresponding in number to said cylinder-piston-assemblies and being adapted in re-

sponse to a predetermined tilting movement of said platen to energize one of said solenoids.

17. In a press having a press platen, fluid operable means for advancing said platen, fluid supply means for supplying pressure fluid to said fluid operable means, control means associated with said fluid supply means and comprising collapsible link means for controlling said control means, and detecting and correcting means responsive to predetermined tilting movements of said platen and operatively connected with said collapsible link means for variably expanding said collapsible link means in response to different predetermined tilting movements of said platen to correct said tilting movements.

18. In a press having a press platen, a plurality of fluid operable plungers for advancing said platen, a plurality of control elements independent of each other and respectively associated with said plungers for controlling the supply of fluid thereto, and means responsive to a predetermined deviation of one end of said platen in one or the other direction for actuating only one of said control elements to vary the supply of fluid to one of the plungers without charging the supply of fluid to another plunger.

PAUL E. FLOWERS.

CERTIFICATE OF CORRECTION.

Patent No. 2,309,944.

February 2, 1943.

PAUL E. FLOWERS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 7, second column, line 25, for "charging" read --changing--; 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 6th day of April, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.