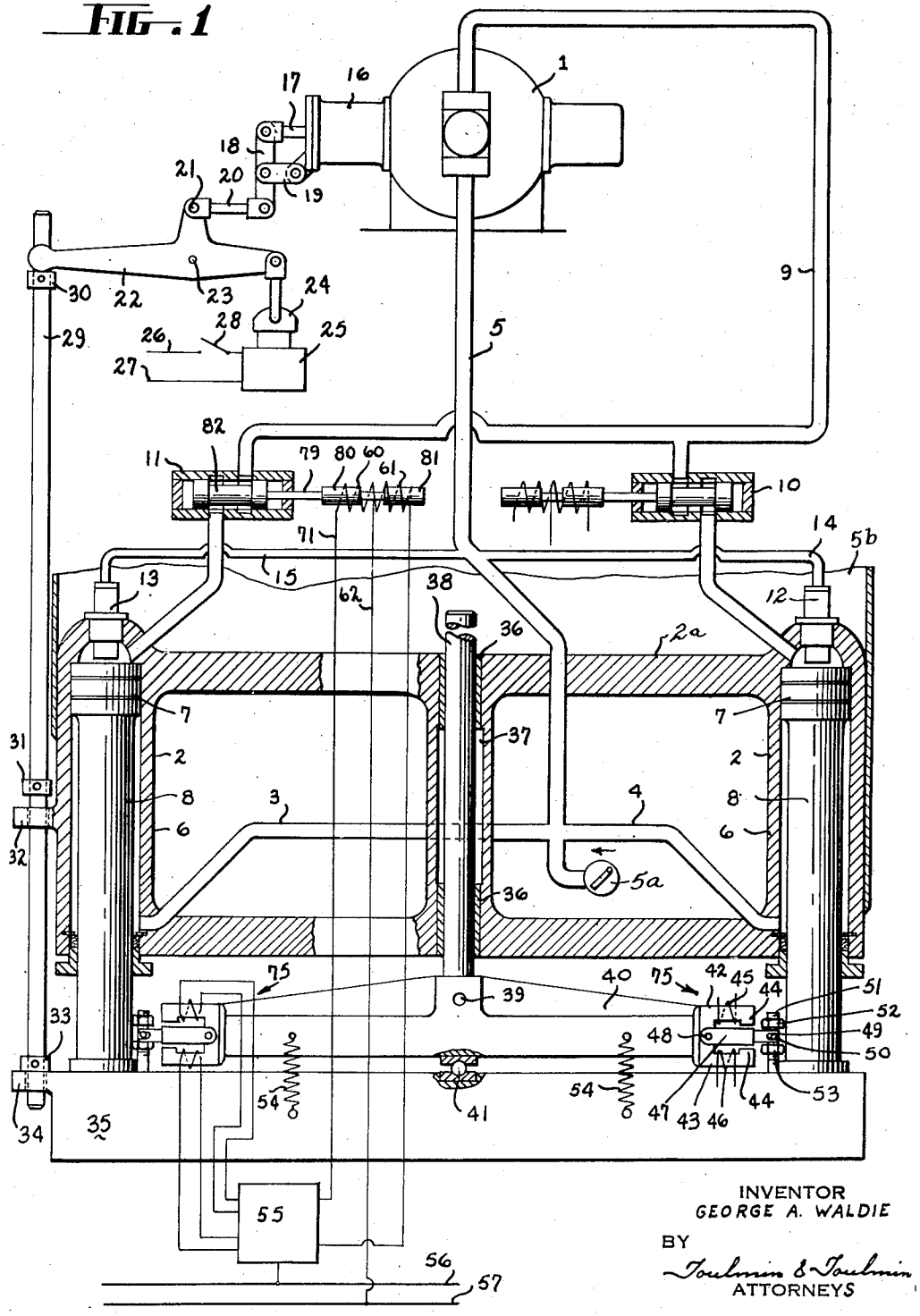
Aug. 28, 1951 G. A. WALDIE 2,565,639

PLATEN LEVELING MULTIPLE RAM PRESS

Filed Jan. 22, 1945 3 Sheets-Sheet 1

FIG. 1



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PLATEN LEVELING MULTIPLE RAM PRESS

Filed Jan. 22, 1945 3 Sheets-Sheet 2

FIG. 2

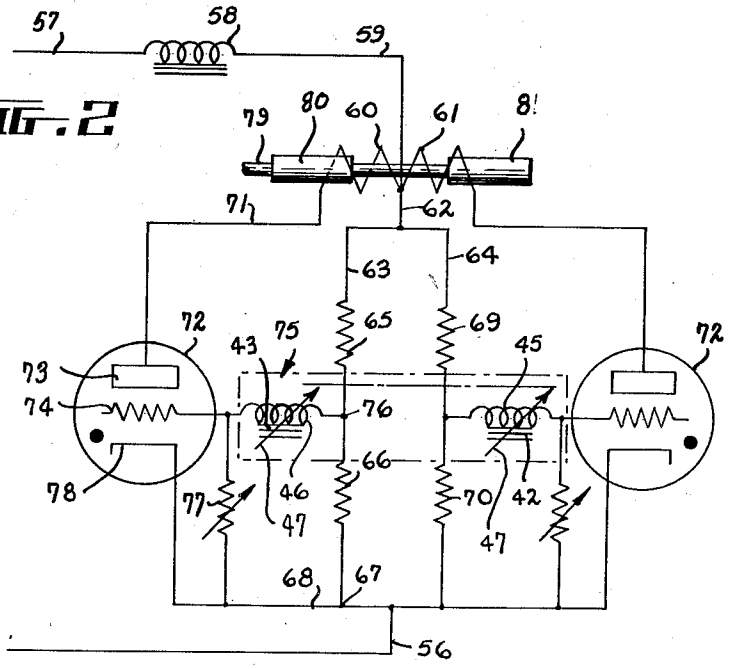
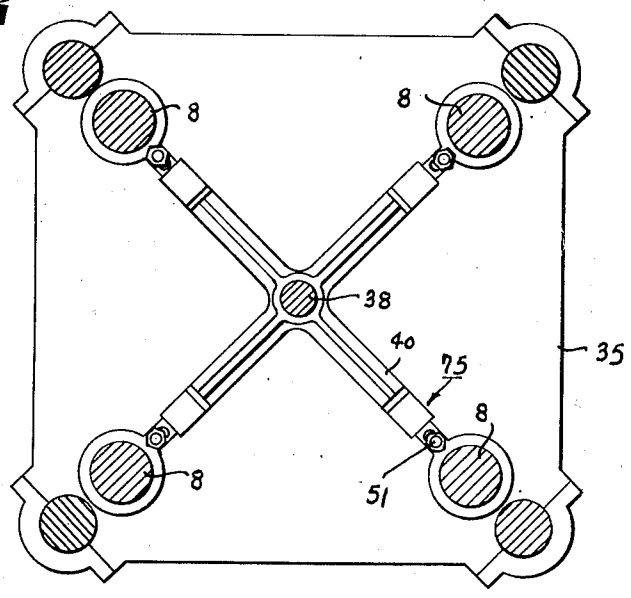


FIG. 3



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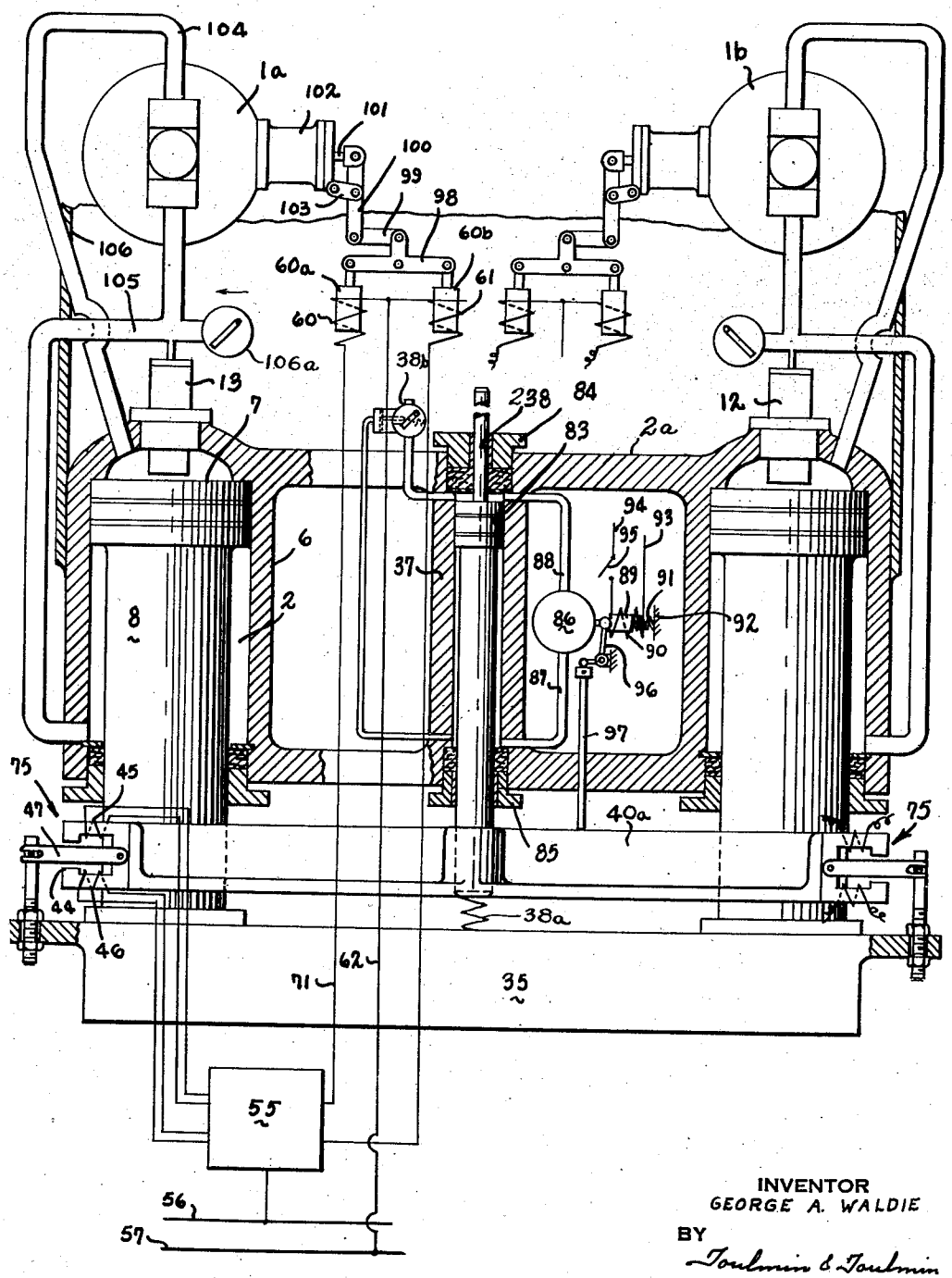
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FIG. 4



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UNITED STATES PATENT OFFICE

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PLATEN LEVELING MULTIPLE RAM PRESS

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Application January 22, 1945, Serial No. 574,013

11 Claims. (Cl. 100—71)

1

This invention relates to hydraulic mechanisms and machines and particularly to the correction of deflections of the pressing member as in platens of hydraulic presses in which deflections may occur during the pressing operation.

In particular, it is the object of this invention to provide an electrical control system for regulating the application of hydraulic pressure on a multiplicity of hydraulically actuated platen actuating members so as instantaneously to detect any inequalities in the pressing operation.

It is an object to provide an artificial horizon, the floating movements of which control the electrical circuits which in turn control the hydraulic circuits for the correction hydraulically of the platen movements.

It is a further object to provide mechanism in which a plurality of fluid power sources supplying hydraulic pressure to a plurality of platen actuating plungers or pistons are electrically controlled by the movement of the horizon bar and the horizon bar is hydraulically actuated.

In particular, it is the object of this invention to provide an electrical operating mechanism which depends for its actuation upon the condition of magnetic fields thereby eliminating any frictional factors or delays due to inertia in hydraulic circuits in connection with the control of hydraulic circuits that in turn convey fluid to actuate the platen.

It is a further object to provide electrically actuated valves which themselves have no work to do and, therefore, have the minimum of inertia and time lag as well as waste of power, with the consequence that the only mechanism involved is the hydraulic circuit directly connected to the platen actuators thereby increasing the speed of reaction and sensitivity of the controls.

Referring to the drawings

Figure 1 is a side elevation, partially in section, of a press head, platen and platen actuating mechanism together with the electrical and hydraulic circuits and pump mechanism shown diagrammatically. This view illustrates all of the essential elements of the invention;

Figure 2 is a diagrammatic view of the electrical and valve actuating mechanism;

Figure 3 is a section over the platen of a press having a plurality of actuating rams;

Figure 4 is a diagrammatic view of the electrical, hydraulic and mechanical arrangements of a press head, platen and control mechanism showing a modification by which the artificial horizon bar is fluid actuated.

Referring to the drawings, 1 indicates the reversible fluid pump adapted to deliver fluid to the cylinders 2 through the pipes 3 and 4, from the main line 5, to the under side of the pistons 7 of the platen plungers 8 and, through the line 9 and valves 10 and 11 to the top of the cylinders 2 above the pistons 7. The main line 5 is provided with a check valve 5a which has its inlet side in communication with a fluid reservoir 5b and which opens only in the direction of the pump 1 to supply make up fluid to the system when fluid is being pumped through the line 9. Indicated at 12 and 13 are standard type surge valves such as the type described in United States Patent No. 1,956,758, dated May 1, 1934, to Walter Ernst, for prefilling the cylinders 2 on the downward stroke of the piston 7 and for evacuating the fluid above the piston 7 during the retraction stroke. These valves are connected by the pipes 14 and 15 to the main pipe 5 and have internal movable valve members, not shown, which are operable in response to a predetermined pressure within the main pipe 5 to open the valves to permit fluid above the piston 7 to be exhausted.

2

The pump 1 is provided with a servo-motor 16 which has the piston rod 17 extending from one end. This motor is used for reversing the pump and the direction of flow through the pipes 5 and 9. The outer end of the piston rod 17 is connected by the lever 18, which is pivotally supported by the link 19, to a pitman 20 which in turn is pivotally connected at 21 to a bell crank 22 pivoted at 23. One end of this bell crank is connected to a solenoid core 24 operating within the coil 25 which in turn is connected to a source of electric power by the leads 26 and 27. The circuit thus formed is controlled by the switch 28. The other end of the bell crank lever 22 is engaged by the shift rod 29 having a collar 30 which engages with the bell crank 22. This shift rod is provided with a collar 31 which is adapted to engage with the eye 32 mounted on the press head 2a. The lower end of the shift rod 29 is provided with a third collar 33 which engages with an eye 34 on the platen 35. This platen is provided with piston rods 8, each of which has a piston 7 on its upper end and such piston rods and pistons respectively travel in the cylinders 2 in the head 2a.

Mounted in the press head 2a in spaced bearings 36 in the chamber 37 is the floating shaft 38 which is rigidly joined at 39 to the bar 40 which constitutes an artificial horizon or deflector bar. The bar 40 is carried upon the ball support 41, upon which it can freely rock relative to the platen 35. This rocking support 41 is mounted on the

top of the platen 35 and may comprise hardened wear pads which tend also to minimize friction.

The outer ends of this bar carrying C shaped magnetic members having the arms 42 and 43 with inwardly turned heads 44. Mounted on the respective arms of the magnetic structure are the coils 45 and 46, and between the arms is pivoted a core 47 as at 48. The outer end of this core is slotted at 49 to form a jaw riding upon a cross pin 50 mounted transversely of the stud 51 which has spaced stop nuts 52 and 53 mounted thereon. This stud is mounted upon the upper surface of the platen 35. The deflector bar or floating horizon bar 40 is continuously urged toward the platen by the opposed springs 54 which are connected at their respective ends to the platen 35 and bar 40.

It will be apparent that the movement of the bar 40 with respect to the platen 35 will move the core 47 relative to the arms 42 and 43 and will influence the coils 45 and 46 thereby varying the energization of the electrical mechanism through the amplifier generally designated 55. As the result of such amplification the solenoid operated valves 10 and 11 are respectively actuated as hereinafter explained.

It will be observed that in all these relationships there is the minimum of physical engagements of parts so as to provide for the maximum sensitivity of the control and correction of the pressure upon the platen or the retraction of a portion of the platen in order to maintain the platen on an even plane.

Referring to Figure 2 which illustrates in detail the amplifier 55, the power lines in which the amplifier is connected are designated respectively 56 and 57. The line 57 contains a choke coil 58. The choke coil 58 is connected with a line 59 to the coils 60 and 61. It proceeds through the wire 62 whence it is connected to the lines 63, 64 respectively. The line 63 contains the resistances 65 and 66 and is connected at 67 to the cross line 68 which in turn is connected to the line 56. The line 64 contains the resistances 69 and 70 and is in turn connected with the line 68.

The other end of the coil 60 is connected by the wire 71 to the plate 73 of the thyratron tube 72. The grid 74 is connected to the variable inductance 75, the free end of which is connected to the line 63 at 76, and the cathode 78 is connected to the wire 68. Connected across the variable inductance line and the wire 68 is an adjustment for sensitivity consisting of the variable resistance 77. The use of the adjustable or variable inductance permits of varying the current from zero to maximum.

There is a pair of such thyratron tubes 72, one of which is connected to the coil 60 and the other to the coil 61, the two coils being connected together to form a single solenoid. The core operable within such coils 60—61 consists of a valve stem 79 having the core members 80 and 81. The valve stem 79 is in turn connected to the valve member 82 which is reciprocated within the valve 11 to control the passage of fluid through the line 9.

It will be understood that the coils 45 and 46 are the coils indicated in Figure 2 within the variable inductance 75, as well as the core member 47.

In operation, the thyratron tubes are equally effective in passing current between the power lines 56 and 57 and through the coils 60 and 61 when the variable inductances at 45 and 46 are equal. When these inductances are varied by a

movement of the core 47 within the arms 42, 43, there is a phase shift in each of the grid networks of the thyratron tubes such that one passes increased current and the other decreased current. This produces a thrust on one of the armatures 60, 61, to move the control rod 79 in one or the other direction. It will be apparent that the differential in current flow and, therefore, the thrust on the double armature combination, is in a direction and proportional to the deflection of the platen relative to the reference bar. The thyratron circuit is initially balanced by an adjustment of the resistors 77 and the sensitivity of the entire arrangement is also influenced by the setting of these resistors.

Referring to Figure 4, this modification relates to independent controls directly connected to independent pumps which supply or remove fluid to their respective platen actuating cylinders to affect the pistons in those cylinders. Figure 4 also relates to the use of a fluid actuated reference bar or artificial horizon. In this manner, particularly in larger size presses, great sensitivity is provided and additionally positive and rapid action in responding to the sensitive controls heretofore described which are individually applied to the pump and cylinder combination.

Referring to Figure 4, the control system is arranged as follows. The shaft 238 has a relatively enlarged piston 83 working within the cylinder 37. The top and bottom of the cylinder are sealed with gaskets and retaining rings designated 84 and 85. The fluid chamber, thus formed below the piston 83, is supplied with fluid from the pump 86 through the pipe 87 and the pipe 88 supplies fluid to the part of the cylinder 37 above the piston 83. This pump in turn is actuated so far as being shifted to direct the fluid either through the pipe 87 or 88 through a solenoid core 89 working within the coil 90 and spring pressed in one direction by the spring 91 mounted on the abutment 92. The coil 90 is connected into an electrical circuit designated 93, 94 which is controlled by the switch 95.

The switch 95 can be closed in any desired manner whereupon an electric circuit will be completed through the coil 90 which will draw the armature 89 rightwardly against the thrust of the spring 91 and position the pump 86 to deliver into the conduit 88 while withdrawing fluid from the conduit 87. This brings about a downward movement of the piston 83 and bar 40*a*. After the work has been engaged and accomplished, the switch 95 may be opened in any suitable manner whereupon the spring 91 is effective to shift the core and armature 89 leftwardly to reverse the delivery of the pump 86 to bring about its discharge into the conduit 87 and the subsequent retracting movement of the piston 83 and reference bar 40*a*. It will be obvious that the switch 95 could be adapted for manual control.

At the conclusion of the cycle, the pump is brought to neutral by the movement of the bell crank 96 which in turn is actuated by the thrust rod 97 which engages with the floating horizon or reference bar 40*a*. Preferably, the differential or ratio between the advancing and retracting areas of the piston 83 is equal to the differential or ratio of the same areas of the pistons 7, and it will be noted that a surge valve 36*b* similar to the valves 12 and 13 is connected to the upper end of the cylinder 37. Thus, the rod 238 advances rapidly to working position and then proceeds at a reduced rate through the working

stroke. A spring 38a is effective, when the platen 35 engages the work and slows down, to check the travel of the rod 238 thereby to cause the surge valve 38b to close.

Coincident with these operations, the following operations take place in connection with the movement of the platen 35 as the result of the movement of the pistons 7 and piston rods 8 which are connected to the platen. The downward movement of the reference bar 40a through the action of the pump 86 results in moving the core arm 47 in closer relationship to the coil 45. The operation continues as heretofore described except for the fact that the coils 60 and 61 respectively embrace movable solenoid cores 60a and 60b which are pivotally connected to the bell crank 98 which in turn is connected by the pitman 99 and lever 100 to the shift rod 101 of the servomotor 102 that controls the pump 1a. The lever 100 is pivoted on the link 103 to provide a movable fulcrum point for the lever action. This results in the pump 1a being shifted so as to supply fluid through the pipe 104 to the top of the cylinder 6 above the piston 7. The pipe 105 is withdrawing fluid from beneath the piston 7 and returning it to the pump or withdrawing it from the sump tank 106, by way of a check valve 106a, as the necessity may arise. The descent of the platen serves to move the movable core member 47 away from the coil 45 and ultimately close to the coil 46. When this occurs the pump is reversed by the action of the solenoid 61 on its core 60b so that fluid pressure is delivered through the pipe 105 and fluid is withdrawn through the pipe 104. The platen 35 will continue downwardly until the switch 95 is manually opened. At that time the reference bar 40a will be moved upwardly and there will be a complete reversal of the pumps 1a and 1b. The controls for pump 1b are the same as for 1a but are not fully shown for the purpose of clarity.

There are, therefore, two primary stages to this operation: the movement down of the platen 35 which is held in engagement with the work for the desired period and the movement upwardly to the initial position; and then the second movements which are those adjusting movements of the several pistons 7 in the head 2a of the press for constantly adjusting the platen at its edges or corners to maintain it in a level condition. This is accomplished, as heretofore described, also through the same fluid suspended reference bar 40a and the adjustable solenoids designated 75 each consisting of the two coils 45 and 46, their cores 42 and 43 and the adjustable member 47 one end of which is pivoted on the reference bar and the other end of which is actuated by reason of its slidable connection with the platen 35. The combination of the leveling mechanism and circuits with the hydraulically actuated reference bar which performs the dual function of controlling, with its hydraulic circuit, the main pump action for main movements and the action of the main pumps for effecting minor leveling movements. It is this conception that is deemed unique. The advance in this construction shown in Figure 4 over the previous views is in providing the hydraulically actuated reference bar 40a which acts to both control the major movement of the press as well as the minor leveling movements. This means that all of the pumps must act in synchronism in connection with the major movements and the pumps must act in individual independent manner in connection with the leveling movements resulting from pump independent action.

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 hydraulic press; a press platen; spaced fluid operable plungers connected with said platen for actuating the same in translating movements; a source of fluid pressure connected to supply said plungers; control means controlling the relative supply of fluid to said plungers; reference means movable bodily with said platen and constrained to remain parallel to a predetermined position; spaced detecting means carried by said reference means and platen and responsive to relative movements therebetween for generating an electrical signal in proportion to said relative movement; and means continuously responsive to said electrical signal for actuating said control means for restoring said platen to its original position relative to said reference means.

2. In a hydraulic press; a reciprocable platen; a reciprocable reference means movable bodily with said platen and constrained to remain parallel to a predetermined position; electrical means carried by said reference means and responsive to relative movement between said reference means and platen to generate a signal proportional to said relative movement; control means connected to be actuated in direct proportion to said signal; and motor means connected to drive said platen at spaced points and having the power thereto controlled by said control means.

3. In a hydraulic press; a platen; spaced motor means connected with said platen; a reference means movable bodily with said platen comprising a bar constrained to remain parallel to a predetermined position; electrical means carried by said bar and platen and responsive to relative movements therebetween to generate a signal in proportion to said relative movements; an amplifier for amplifying said signal; control means for controlling the relative supply of fluid to said motors; and electrical means operated by said amplified signal for actuating said control means to vary the supply of fluid to said motors to maintain said platen and bar in a fixed relative position.

4. In a hydraulic press; a platen; a plurality of spaced plungers for actuating said platen; fluid pressure supply means for supplying actuating fluid to said plungers; electrical control means for controlling the supply of fluid to each of said plungers; reference means comprising a bar movable in the same direction as said platen and constrained to remain parallel to a predetermined position; means for actuating said bar in reciprocating movements independently of said platen; and means responsive to relative movements between said bar and platen for actuating said electrical means to control the delivery of fluid to said plungers whereby said platen follows and remains parallel with said bar.

5. In a hydraulic press; a main platen; an auxiliary platen movable in the same direction as said main platen and constrained to remain parallel in all positions; a plurality of spaced motor means for actuating said main platen; individual motor means for reciprocating said auxiliary platen; and means responsive to relative movement between said auxiliary and main platens

for controlling the speed of operation of the motor means connected with said main platen for maintaining said main platen substantially parallel at all times.

6. In a hydraulic press; a reciprocable main platen; a plurality of spaced plungers having advancing and retracting means connected with said main platen; fluid pressure supply means for supplying said advancing and retracting means; electrical means for controlling the supply of fluid to said advancing and retracting means; an auxiliary platen movable in the same direction as said main platen and constrained to remain parallel in all positions; auxiliary motor means for driving said auxiliary platen in both directions of movement; and electrical means continuously and proportionately responsive to tilting movements between said platens for controlling the supply of energy to said electrical control means whereby said main platen follows and remains in fixed relationship with said auxiliary platen.

7. In combination in a hydraulic press; a plurality of actuating pistons and piston rods and cylinders arranged at spaced intervals; a platen engaged by said piston rods; an artificial horizon bar moving with said platen, said platen being deflectable with respect to said bar, the ends of said bar being located adjacent said piston rods; electrical means associated with the ends of said deflector bar and said platen whereby any deflection of the platen with respect to the bar will instantaneously modify the condition of said electrical means; amplifier means to amplify the changes in said electrical means; and other electrical means continuously responsive to said amplified changes to bring about an application of hydraulic power to the associated piston and piston rod adjacent the part of the platen which is deflected.

8. In combination in a hydraulic press; a platen; hydraulic means for moving said platen arranged at spaced intervals thereon; an artificial horizon bar movable with said platen, said platen being adapted to deflect without deflecting said bar; electrical means associated with said bar for instantaneously electrically signalling any deflection of the platen adjacent spaced points on said bar; means for amplifying said signals; and means continuously and substantially instantaneously responsive to said amplified signals for electrically actuating a control for the application of hydraulic pressure to said platen at the point of deflection to restore it to normal.

9. In combination in a hydraulic press; a platen; a source of fluid power; hydralically actuated pistons and piston rods spaced on four corners of the platen; a reference bar movably mounted to move bodily with said platen and having arms extending to the corners of the platen adjacent said piston rods; means on the ends of said arms for continuously signalling electrically the deflection of the portion of the

platen adjacent thereto, means for amplifying said signal; and means continuously responsive to said signal for electrically controlling the application of fluid pressure to the piston and piston rod adjacent the deflection point of said platen to restore it to its normal position.

10. In combination in a hydraulic press; a platen; hydraulically actuated pistons and piston rods spaced on the four corners of said platen; a bar mounted to move bodily with said platen and having arms extending to the corners thereof adjacent said piston rods, means on the ends of said arms for generating an electric signal in proportion to the deflection of the portion of the platen adjacent thereto; means for amplifying said signal; means continuously responsive to the amplified signal for controlling the application of fluid pressure to the piston and piston rod adjacent the deflection point of said platen to restore it to its normal position; and means of maintaining said bar in parallelism with its original position throughout a press cycle.

11. In combination; a platen; a plurality of spaced pistons and piston rods for moving said platen, said piston rods engaging said platen, cylinders adapted to receive said pistons and piston rods; an artificial horizon bar comprising radiating arms terminating adjacent the points of engagement of the piston rods with said platen; means moving said artificial horizon bar independently of said platen; electrical means on the ends of said arms comprising means for varying an electric current upon and in proportion to the change of relationship of the adjacent portion of the platen with respect thereto; means for amplifying the changes in electric current; and electrical means controlled by said amplified changes adapted to vary the supply of fluid pressure to the adjacent piston and piston rod to vary the rate of travel of the platen whether the platen is deflected towards or away from the adjacent portion of the artificial horizon bar.

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