May 9, 1944. P. E. FLOWERS 2,348,676

ELECTRICALLY CONTROLLED HYDRAULIC PRESS

Original Filed Aug. 31, 1939 3 Sheets-Sheet 1

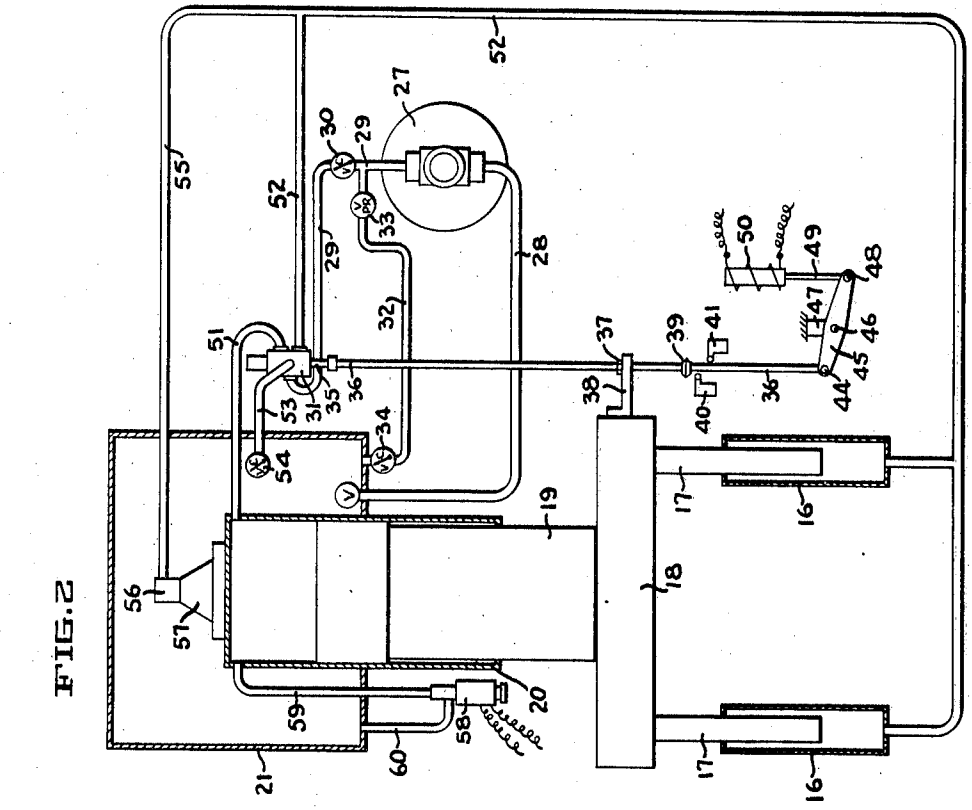


FIG. 2

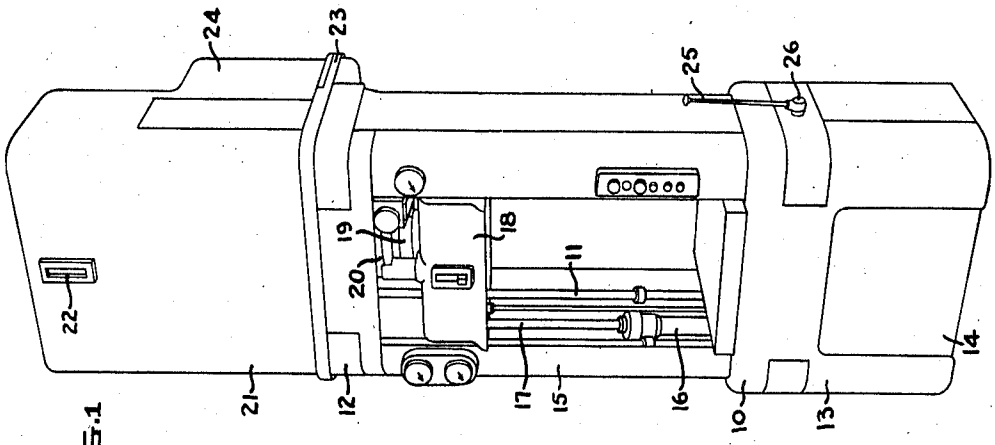


FIG. 1

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FIG. 3

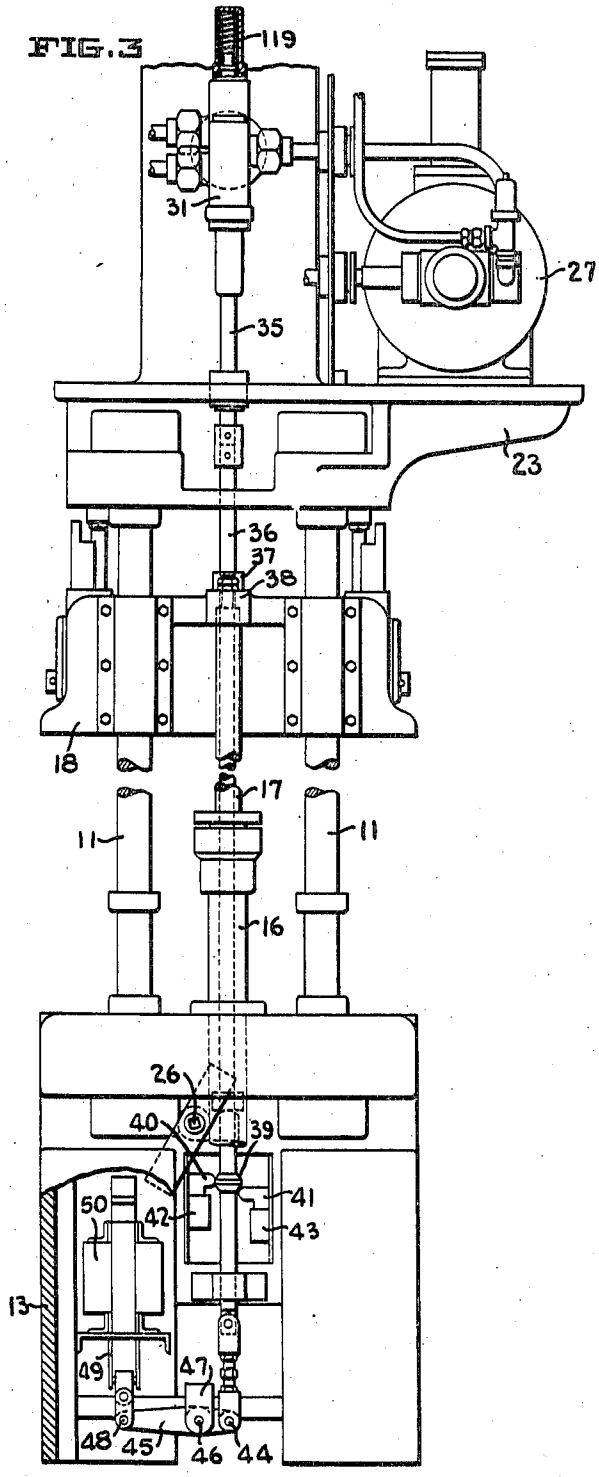


FIG. 4

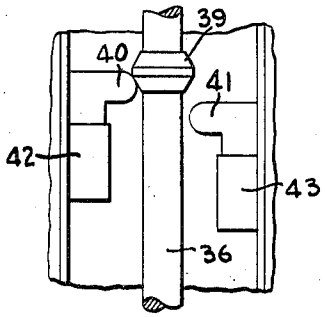
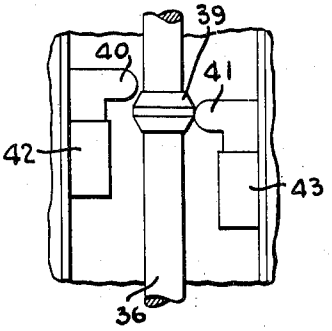


FIG. 5



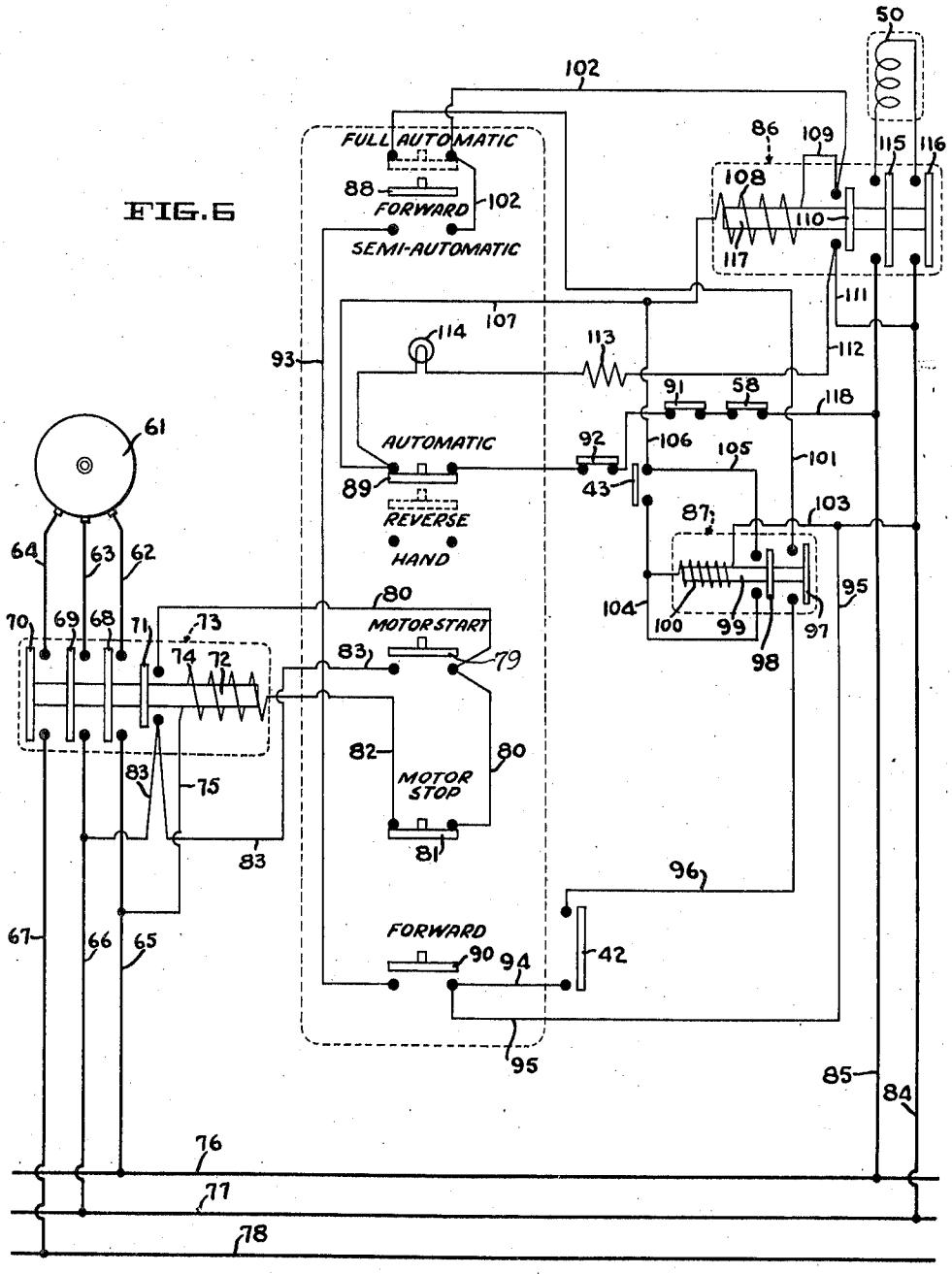
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Original Filed Aug. 31, 1939 3 Sheets-Sheet 3

FIG. 6



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Patented May 9, 1944

2,348,676

UNITED STATES PATENT OFFICE

2,348,676

ELECTRICALLY CONTROLLED HYDRAULIC PRESS

Paul E. Flowers, Mount Gilead, Ohio, assignor to The Hydraulic Development Corporation, Inc., Wilmington, Del., a corporation of Delaware

Original application August 31, 1939, Serial No. 292,934, now Patent No. 2,283,358, dated May 19, 1942. Divided and this application May 31, 1941, Serial No. 396,005

7 Claims. (Cl. 60—52)

This invention relates to presses and, in particular, to electrically-controlled hydraulic presses.

One object of this invention is to provide an electrically-controlled hydraulic press with its electrical and hydraulic units assembled in compact housings so as to conceal them and protect them from dust and other damaging influences.

Another object is to provide an electrically-controlled hydraulic press having its electrical and hydraulic units mounted in enclosed housings in the head and bed of the press, respectively, and arranged in compact yet easily accessible assemblies.

Another object is to provide a hydraulic press with a head member and a bed member, one of these members having the principal hydraulic units mounted thereon and enclosed by a housing, and the other member having the principal electrical units similarly mounted and enclosed.

Another object is to provide a hydraulic press having a pump and a flow-control member actuated by a press control rod, which in turn, is under the control of a solenoid mounted in the bed of the press.

Another object is to provide a hydraulic press control system, as set forth in the preceding paragraph, wherein the solenoid is under the control of one or more limit switches, means being provided to restrict the effective action of the switch to one direction only of actuation.

Another object is to provide a hydraulic press control system including an electrical circuit for selectively effecting semi-automatic and full automatic operation of the press ram under the control of a limit switch, which is effective only to change the energization of the circuit by actuation in one direction and not in the opposite direction.

Another object is to provide a hydraulic press control system having an electrical control circuit for selectively effecting semi-automatic and full automatic operation of the press, together with a pair of limit switches so arranged as to alter the energization of the electrical circuit by actuation in one direction but not in the opposite direction.

This is a division of my copending application, Serial No. 292,934, filed August 31, 1939, which has matured into Patent No. 2,283,358.

In the drawings:

Figure 1 is a perspective view of a commercial form of press embodying the control system of the present invention.

Figure 2 is a diagrammatic view, mainly in section, showing the hydraulic circuit for operating the press shown in Figure 1.

Figure 3 is a side elevation of the press shown in Figure 1, with the housings removed or cut away to disclose the operation mechanism therebeneath.

Figure 4 is an enlarged view of a portion of Figure 3, showing the press control rod and the associated limit switches in a position wherein the press-operating solenoid is energized for producing a forward stroke of the press.

Figure 5 is a view similar to Figure 4, but with the solenoid deenergized and the press control rod pushed down for effecting a return stroke of the press ram.

Figure 6 is a wiring diagram of the electrical control circuit employed in the press of Figures 1 to 5, inclusive.

General arrangement

In general, the hydraulic press control system of this invention is associated with a press having a reversible hydraulic motor, a source of pressure fluid and a flow-control member, whereby the pressure fluid is reversibly distributed to the motor. The control rod of the press which shifts the flow-control member associated with the source of pressure fluid, such as a pump, is actuated by a solenoid placed in the base of the press. Associated with the solenoid is a limit switch system which is rendered effective to energize the solenoid in but one direction of motion of the control rod. In one embodiment of the invention this uni-directional actuation is effected by the use of a pair of limit switches.

Hitherto, it has been difficult to completely enclose the operating parts of a hydraulic press, particularly as regards the electrical and hydraulic accessories. Nevertheless, it is frequently found advisable to do this because of the presence of dust or other damaging substances, which injure these accessories. It has also been found advisable in recent times to enclose these accessories within housings in order to present a more compact appearance and also to prevent the acci-

dental damage of these accessories by contact with external objects. At the same time the operator is protected from injury by the presence of these housings.

Hitherto, the flow-control member of the reversible variable delivery pump (in a closed circuit) or the valve member of the main control valve (in an open circuit) has been shifted in at least one direction by an electrical solenoid, shifting in the opposite direction having been usually accomplished by means of a spring. Previously the solenoid was mounted in a position adjacent the pump, or valve, but this position was remote from the switches, magnetic contactor and other electrical units additionally associated with the control circuit. This was particularly true where the pump and other hydraulic units were mounted upon the press head out of reach of the operator.

The present invention enables the solenoid to be mounted in the bed of the press adjacent the other electrical apparatus of the control circuit. Means, however, is provided for controlling the solenoid so that it is energized in but one direction of motion of the control rod. In one form of the invention the solenoid is under the control of a main limit switch and an auxiliary limit switch, the latter merely conditioning the circuit of the main limit switch for operation. These two limit switches are operated by a cam upon the press control rod so that full automatic operation of the press is brought about when the platen reaches the end of its retraction stroke and raises the control rod so as to actuate the limit switches and reenergize the solenoid. The invention enables the solenoid to be concealed within the base of the press adjacent the other electrical apparatus so that short wiring is permitted and a more compact distribution of the electrical units obtained.

External construction of press

Referring to the drawings in detail, Figure 1 shows a perspective view of a press embodying the control system of this invention. This press consists of a bed 10 connected by strain rods 11 to a head 12. The bed 10 is enclosed by a housing 13 having a closure or door 14 in the lower part thereof. The space within the housing 13 is utilized as a compartment for the electrical apparatus associated with the electrical control system. The bed 10 and head 12 are also interconnected by side members 15 serving to partially enclose the strain rods 11 and also the push-back cylinders 16, having push-back plungers 17 connected at their upper ends to the press platen 18. The latter is connected to the main plunger 19, reciprocable in the main cylinder 20, only the lower end of the latter being visible. Mounted upon the press head 12 is a fluid container or surge tank 21 having a gauge 22 for indicating the level of the oil or other working liquid therein. The press head 12 is provided with a shelf 23 upon which a housing 24 is supported. The housing 24 serves to receive and enclose certain of the hydraulic apparatus for the press, such as the pump and driving motor. A hand lever 25, mounted upon a shaft 26 supported in the press bed 10, serves for the manual control of the press when the electrical control system is not in operation.

Hydraulic circuit of press

The hydraulic circuit for actuating the press is shown diagrammatically in Figure 2. The platen 18 is connected on its upper side to the main plunger 19 reciprocating in the main cylinder 20, and is connected on its lower side to the push-back plungers 17 reciprocating in the push-back cylinders 16. Pressure fluid for operating these cylinders and advancing and retracting the respective plungers is provided by the pump 27, which may be of any suitable type. The pump 27 withdraws fluid through the suction line 28, and discharges pressure fluid through the line 29 leading by way of the check valve 30 to the main four-way control valve 31. A branch line 32 also leads from the line 29, by way of the pressure relief valve 33 and check valve 34, to the interior of the surge tank 21, and serves to discharge pressure fluid when the pressure delivered by the pump 27 exceeds the setting of the pressure relief valve 33.

The four-way valve 31 is provided with a valve rod 35 connected to the press control rod 36, which carries a collar 37 adapted to be engaged by the platen arm 38 extending laterally from the platen 18. The control rod 36 also carries a cam 39 adapted to engage and actuate the contact portions 40 and 41 of the automatic restarting switch 42 and the circuit-conditioning switch 43. The control rod 36 terminates at its lower end in a connection 44 joining it to one end of a lever 45, which is pivotally mounted as at 46 to a bracket 47 mounted on the press frame, and having a pivotal connection 48 with the armature 49 of a "push" type solenoid 50. The construction shown diagrammatically in Figure 2 is illustrated more in detail in Figure 3.

The four-way main control valve 31 is provided with discharge conduits 51 and 52, and an exhaust conduit 53 with a check valve 54. The exhaust conduit 53 leads to the interior of the surge tank 21, whereas the discharge conduit 51 leads to the upper end of the main cylinder 20. The discharge conduit 52, on the other hand, leads to the lower ends of the push-back cylinders 16, and has a branch conduit 55 leading to the operating chamber 56 of the surge valve 57 mounted in the upper end of the main cylinder 20. A pressure-responsive switch or tonnage control 58 is connected by the conduit 59 to the upper end of the main cylinder 20 and by the exhaust conduit 60 to the interior of the surge tank 21.

Electrical control circuit of press

The electrical control circuit for controlling the various movements of the press (Figure 6) includes a motor 61 operatively connected to the pump 27 and energized by the lines 62, 63 and 64 from the branch power lines 65, 66 and 67, by way of the switch blades 68, 69 and 70 attached, with the switch blade 71, to the armature 72 of the motor contactor 73 having an operating coil 74, one end of which is connected by the line 75 to the branch power line 65. The branch power lines 65, 66 and 67 are connected, respectively, to the main power lines 76, 77 and 78. The switch blade 71 of the contactor 73 serves as an interlock for providing sustained energization of the motor contactor operating coil 74 when the momentary motor starting switch or push-button switch 79 is released after being depressed by the operator. For this purpose the line 80 runs from one pole of the switch blade 71 to one pole of the motor starting push-button switch 79, and thence to one pole of the motor stopping push-button switch 81.

The starting push-button switch 79 is normally open and the stopping push-button switch 81

normally closed. The remaining pole of the latter is connected by the line 82 to the remaining end of the motor contactor operating coil 74. The remaining pole of the motor starting push-button switch 79 is connected by the line 83 to the remaining pole of the switch blade 71, and thence to the branch power line 66. As a consequence, when the motor push-button starting switch 79 is momentarily depressed by the operator, the consequent energization of the operating coil 74 closes the magnetic contactor 73 and energizes the motor 61. This starts the pump in operation and supplies pressure fluid to the press circuit. At the same time, the switch blade 71 interconnects the lines 83 and 80 to bridge the contacts of the motor starting push-button switch 79 so that the energization of the operating coil 74 is maintained even when the push-button switch 79 is released by the operator. If it is desired to stop the motor the operator merely depresses the normally closed push-button stopping switch 81.

The press control circuit is energized from the branch power lines 84 and 85, and includes a main magnetic contactor 86, the solenoid 50, an auxiliary magnetic contactor 87, the combined momentary contact and selector switches 88 and 89 and a forward push-button switch 90. The circuit also includes the limit switches 42 and 43, previously mentioned, for controlling the full automatic operation of the press, together with the pressure-responsive tonnage control limit switch 58. Also provided is an oil temperature limit switch 91, which is controlled by a thermostat to open when the temperature of the oil, or other working fluid, exceeds the setting of the thermostat. In such event the opening of the switches terminates the automatic operation of the press. A position-responsive limit switch 92, operated by the platen, is also provided as an additional safety feature for preventing overrun of the platen. The combined momentary contact and selector switches 88 and 89 in their details and of themselves are described in the copending application of Walter Ernst, Ser. No. 292,931, filed August 31, 1939, which has matured into Patent No. 2,281,276.

The switch 88 normally rests in the solid-line position designated "Forward," but it may be moved into the "semi-automatic" position or "full automatic" position and locked in these positions at the will of the operator. Thus the switch 88 serves not only as a push-button switch but also as a selector switch for selecting either semi-automatic or full automatic operation. Semi-automatic operation occurs when the press platen makes a forward stroke, reverses, makes a retraction stroke and then comes to a halt. Full automatic operation, on the other hand, occurs when the press platen makes a forward stroke, reverses, executes a retraction stroke and halts only momentarily before beginning another forward stroke, thereby repeating an indefinite number of working cycles until halted by the operator, or by one of the safety switches. The switch 89 is normally engaged in a position designated "Automatic," but it may be shifted into the reverse position indicated by the dotted lines in Figure 6. The position marked "Hand" is merely for the purpose of de-energizing the entire control circuit so that the press is controlled by the shifting of the hand lever 25.

The combined switch 88 is connected by the line 93 to one pole of the forward push-button switch 90, the opposite pole of which is connected by the lines 94 and 95 to one pole of the automatic restarting switch 42 and to the branch power line 84, respectively. From the opposite pole of the automatic restarting switch 42 the line 96 runs to one pole of the auxiliary contactor 87. The latter is provided with switch blades 97 and 98, upon an armature 99 actuated by the operating coil 100. From the opposite pole of the switch blade 97 the line 101 runs to one of the full automatic contacts of the combined switch 88, from the remaining contact of which the line 102 runs to one of the interlock contacts of the main contactor 86. The auxiliary contactor 87 is energized by the line 103 connected to the branch power line 84, and its opposite end is connected to the line 104 running to one pole of the circuit-conditioning switch 43, the other pole of which is connected to the line 105. The closing of the contactor 87 thus closes the circuit between the lines 96 and 101, through the switch blade 97, and between the lines 104 and 105 by way of the interlock switch blade 98.

Beyond the circuit-conditioning switch 43 the line 106 runs to a junction with the line 107 leading from one of the automatic poles of the combined switch 89 to one end of the operating coil 108 of the main magnetic contactor 86, the opposite end of which is connected by the line 109 to the same pole to which the line 102 is connected, namely, an interlock pole engageable by the interlock switch blade 110. The opposite pole of the latter is connected by the line 111 to the branch power line 84, and by the line 112 to an automatic pole of the combined switch 89 by way of the resistance 113 and pilot light 114. The main magnetic contactor 86 is also provided with switch blades 115 and 116 mounted on the same armature 117 upon which the interlock blade 110 is mounted, and operable to connect and disconnect the solenoid 50 from the branch power lines 84 and 85.

Operation

In the operation of the press shown in Figures 1 to 6, inclusive, the operator momentarily depresses the motor starting switch 79, thereby energizing the motor 61 by way of the contactor 73. The previously described holding circuit through the interlock switch blade 71 maintains the energization of the motor 61 when the push-button switch 79 is released. The operation of the motor 61 causes the pump 27 to deliver pressure fluid. For semiautomatic operation the operator then simultaneously depresses the switches 88 and 90 with his two hands, thus providing a safety feature preventing injury to his hands by inadvertently starting the press before he has removed his hands from the press. When the press has started, the operator releases the switches 88 and 90 which then automatically return to their open position.

The shifting of the switch 88 to the semi-automatic position energizes the main contactor 86, and as a consequence energizes the solenoid 50. The energization of the contactor coil 108 is accomplished by way of the lines 103 and 95, the forward push-button switch 90, the line 93, the combined switch 88, the lines 102 and 109, the line 107, the combined switch 89, the limit switch 92, the oil temperature limit switch 91, the tonnage control switch 58 and the line 118 to the branch power line 85. The energization is maintained by the closing of the interlock switch blade 110 upon its contacts.

The energization of the solenoid 50 pushes its armature 49 downwardly and raises the control rod 36 so as to shift the valve rod 35 into a position where the pump 27 will deliver pressure fluid to the top of the main cylinder 20 through the line 51. The main plunger 19 and platen 18 move downwardly and engage the work piece. When the resistance thus built up exceeds the pressure setting of the tonnage control switch 58, the latter opens the circuit in the line 118. This deenergizes the operating coil 108 of the main magnetic contactor 86 and consequently deenergizes the solenoid 50.

The deenergization of the solenoid 50 permits the spring 119 to force the control rod 36 downwardly into the Figure 5 position, closing the circuit-conditioning switch 43. Closure of the switch 43 establishes an energizing circuit for the solenoid 100 immediately after the tonnage control valve 58 has closed again, which latter closes automatically as soon as the pressure in the upper portion of main cylinder 20 drops. The energizing circuit for the solenoid 100 comprises main supply line 84, line 103, solenoid 100, line 104, switch 43, lines 106 and 107, switches 89, 92, 91, 58 and main supply line 85. Closure of solenoid 100 causes blades 97 and 98 to close. Closure of blade 97 has no effect at this time, since the "full automatic" terminals (Figure 6) are not bridged by the forward switch 88. Closure of the blade 98 establishes a holding circuit for solenoid 100, which holding circuit comprises main supply line 84, line 103, solenoid 100, line 104, blade 98, lines 105, 106, 107, switches 89, 92, 91, 58, line 118 and main supply line 85. It will be noticed that this holding circuit bypasses the switch 43.

In view of the downward movement of the control rod 36, mentioned above, the main control valve 31 reverses the flow of fluid by discharging pressure fluid into the push-back cylinders 16 and exhausting fluid from the upper part of the main cylinder 20 by way of the conduit 51. The main plunger 19 and platen 18 then rise, under the urge of the push-back plungers 17, until the platen arm 38 engages the collar 37 and lifts the control rod 36 and valve rod 35 as the platen 18 nears the upper end of its retraction stroke. The lifting of the valve rod 35 shifts the valve 31 into its neutral position, whereby the discharge of the pump 27 is bypassed back to the surge tank 21 and fluid is held in both the main cylinder 20 and push-back cylinders 16. The platen 18 thus comes to a halt at the upper end of its retraction stroke, and the press occupies its neutral position shown in Figure 3. In this position, the cam 39 on valve rod 36 closes the switch 42. However, although at this time solenoid 100 is and remains energized through lines 104 and 105 as outlined above, the closure of switch 42 at this time has no effect since the "full automatic" terminals are not bridged by the switch 88. On the other hand, the switches 88 and 90 had returned to their open position following the starting of the press cycle.

If full automatic operation is desired the operator, as before, depresses the combined switch 88 and the forward switch 90, but, following the starting of the press, moves the combined switch 88 to its full automatic position and locks switch 88 in the said automatic position by a locking device. Under these circumstances the platen 18 and main plunger 19 execute a forward stroke and a retraction stroke for their pressure-responsive reversal, as described above under semi-automatic operation. As the platen 18 nears the upper end of its retraction stroke, however, the cam 39 on the control rod 36, which depressed the circuit-conditioning switch 43 on the downward stroke of the control rod 36 following the deenergization of the solenoid 50, and thereby brought about energization of solenoid 100 as mentioned in connection with the description of the semi-automatic operation now depresses the automatic restarting switch 42 as the control rod 36 is lifted by the platen arm 38 engaging the collar 37.

Since, as has likewise been set forth above, the solenoid 100 stays energized through the interlock switch blade 98, when the circuit-conditioning switch 43 is released by the cam 39 on the upward stroke of the press control rod 36, the blade 97 will interconnect the lines 96 and 101 at the time the cam 39 closes the automatic restarting switch 42. It will, therefore, be clear, that, when at the end of the retraction stroke of the press ram, the cam 39 closes the switch 42, an energizing circuit for the contactor solenoid 108 will be established which circuit comprises the main supply line 84, the lines 103, 95 and 94, the now closed switch 42, the line 96, the switch blade 97, the line 101, the combined switch 88, the lines 102 and 109, the main contactor operating coil 108, the line 107, the switch 89, the limit switches 92, 91 and 58, the line 118 and the branch power line 85. The energization of the main contactor 86 causes reenergization of the solenoid 50. The latter again pushes its armature 49 downwardly to lift the control rod 36 into the position of Figure 4 and to shift the valve 31 to its ram-advancing position. The main plunger 19 then executes another forward stroke, and automatically reverses itself and returns in the manner previously described, continuing to execute an indefinite number of working cycles until halted by the operator or by one of the safety switches.

Thus the provision of the circuit-conditioning switch 43 permits the automatic restarting switch 42 to be effective to reenergize the main contactor 86 and solenoid 50 solely upon the upward stroke of the press control rod 36, and not upon the downward stroke thereof. This feature permits the solenoid 50 to be placed within the housing 13 (Figure 3) along with the other electrical apparatus, and thereby concentrates the electrical apparatus in one location. From the foregoing description of the operation of the device according to the invention, it will also be clear that, if the press has been operating in semi-automatic cycles and is idle in neutral position, movement of switch 88 into full automatic position will immediately start automatic cycles without reference to switch 90, provided the switch 88 is locked in full automatic position.

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

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

1. In a hydraulic press control system, the combination with reversible hydraulic motor means having a reciprocable ram and a source of pressure fluid therefor with a flow-control member for reversibly controlling the distribution of pressure fluid to said hydraulic motor means, of electrical means for actuating said flow-control member, a press control element interconnecting said electrical means and said flow-control member and operable to reciprocate the latter, said

press control element being engageable by said ram, a main circuit controlling said electrical means, a first limit switch and a second limit switch actuated in succession by said press control element when the latter moves in one direction at the end of the working stroke, a monitor circuit energized upon actuation of said second limit switch for partially closing said main circuit, said press control element being moved in the opposite direction by said ram near the end of its retraction stroke to again actuate said first limit switch to complete the closure of said main circuit for automatically starting a new working stroke of said ram.

2. In a hydraulic press control system, the combination with reversible hydraulic motor means having a reciprocable ram and a source of pressure fluid therefor with a flow-control member for reversibly controlling the distribution of pressure fluid to said hydraulic motor means, of electrical means for actuating said flow-control member, a press control element forming a connecting link between a portion of said electrical means and said flow-control member and being adapted to reciprocate in unison with the latter, said press control element being engageable by said ram, a main circuit controlling said electrical means, a first limit switch and a second limit switch actuated in succession by said press control element when the latter moves in one direction at the end of the working stroke, a monitor circuit energized upon actuation of said second limit switch for partially closing said main circuit, said press control element being moved in the opposite direction by said ram near the end of its retraction stroke to again actuate said first limit switch to complete the closure of said main circuit for automatically starting a new working stroke of said ram.

3. In a hydraulic press control system, the combination with reversible hydraulic motor means having a reciprocable ram and a source of pressure fluid therefor with a flow-control member for reversibly controlling the distribution of pressure fluid to said hydraulic motor means, of electrical means for actuating said flow-control member, a press control element forming a connecting link between a portion of said electrical means and said flow-control member and adapted to reciprocate the latter and engageable by said ram, a main circuit controlling said electrical means, a first limit switch and a second limit switch actuated in succession by said press control element when the latter moves in one direction at the end of the working stroke, a monitor circuit energized upon actuation of said second limit switch for partially closing said main circuit, said press control element being moved in the opposite direction by said ram near the end of its retraction stroke to again actuate said first limit switch to complete the closure of said main circuit for automatically starting a new working stroke of said ram.

4. In a hydraulic press control system, the combination with reversible hydraulic motor means having a reciprocable ram and a source of pressure fluid therefor with a flow-control member for reversibly controlling the distribution of pressure fluid to said hydraulic motor means, of electrical means for actuating said flow-control member, a press control element forming a connecting link between a portion of said electrical means and said flow-control member and adapted selectively to move the latter in one of two opposite directions, said press control element being engageable by said ram, a main circuit controlling said electrical means, a first limit switch and a second limit switch actuated in succession by said press control element when the latter moves in one direction at the end of the working stroke, a monitor circuit energized upon actuation of said second limit switch for partially closing said main circuit, said press control element being moved in the opposite direction by said ram near the end of its retraction stroke to again actuate said first limit switch to complete the closure of said main circuit for automatically starting a new working stroke of said ram.

5. In a hydraulic press control system, the combination with reversible hydraulic motor means having a reciprocable ram and a source of pressure fluid therefor with a flow-control member for reversibly controlling the distribution of pressure fluid to said hydraulic motor means, of electrical means for actuating said flow-control member, a reciprocable press control element positively connected to said flow-control member and said electrical means and engageable by said ram, a main circuit controlling said electrical means, a first limit switch and a second limit switch actuated in succession by said press control element when the latter moves in one direction at the end of the working stroke, a monitor circuit energized upon actuation of said second limit switch for partially closing said main circuit, said press control element being moved in the opposite direction by said ram near the end of its retraction stroke to again actuate said first limit switch to complete the closure of said main circuit for automatically starting a new working stroke of said ram.

6. In a hydraulic press control system, the combination with reversible hydraulic motor means having a reciprocable ram and a source of pressure fluid therefor with a flow-control member for reversibly controlling the distribution of pressure fluid to said hydraulic motor means, of electrical means for actuating said flow-control member, a press control element positively connected to a portion of said electrical means and also to said flow-control member so as to be reciprocable therewith, said press control element being engageable by said ram, a main circuit controlling said electrical means, a first limit switch and a second limit switch actuated in succession by said press control element when the latter moves in one direction at the end of the working stroke, a monitor circuit energized upon actuation of said second limit switch for partially closing said main circuit, said press control element being moved in the opposite direction by said ram near the end of its retraction stroke to again actuate said first limit switch to complete the closure of said main circuit for automatically starting a new working stroke of said ram.

7. In a hydraulic press control system, the combination with reversible hydraulic motor means having a reciprocable ram and a source of pressure fluid therefor with a flow-control member for reversibly controlling the distribution of pressure fluid to said hydraulic motor means, of electrical means for actuating said flow-control member, a reciprocable press control element forming a link in a lever system positively connected to said flow-control member and said electrical means and being engageable by said ram, a main circuit controlling said

electrical means, a first limit switch and a second limit switch actuated in succession by said press control element when the latter moves in one direction at the end of the working stroke, a monitor circuit energized upon actuation of said second limit switch for partially closing said main circuit, said press control element being moved in the opposite direction by said ram near the end of its retraction stroke to again actuate said first limit switch to complete the closure of said main circuit for automatically starting a new working stroke of said ram.

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