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PRESS

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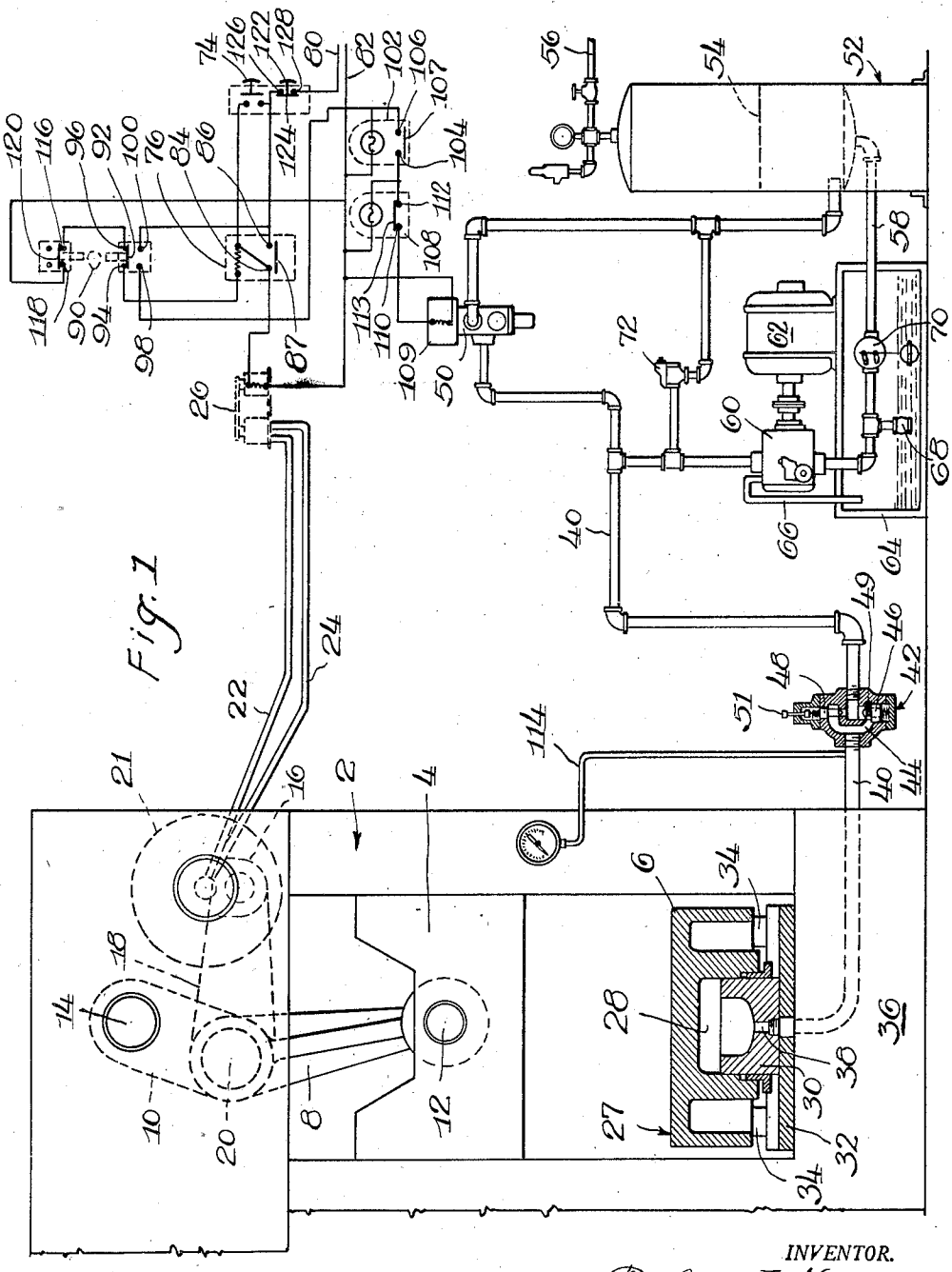


Fig. 1

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PRESS

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20 Claims. (Cl. 18—16)

1

My invention relates to presses and more particularly to presses used in the art of plastic molding.

The general object of my invention is to design a press in which opposed platens are mounted for reciprocation toward and away from each other, one of said platens being yieldable under thrust by the other of predetermined magnitude to afford a heating and breathing cycle for the plastic material which is compressed within dies between said platens, as will be clearly understood by those skilled in the art.

My novel press is so constructed that the yieldable platen, after a predetermined period of time, is actuated to close the dies and exert the necessary pressure thereon to mold the plastic material to its final form within the dies.

Another object of my invention is to provide an arrangement wherein a novel portable hydraulic unit may be inserted into a pre-existing mechanical press for the purpose of adapting said press to the molding of plastics. I provide novel control means for the press and the portable unit, which control means permit the hydraulically operated platen of the unit to yield under a predetermined pressure exerted by the mechanically actuated press platen which is automatically stopped in its advanced position, said control means being operable, after a predetermined period of time necessary for the breathing and heating cycle, to direct high pressure actuating fluid into the hydraulic unit, thereby causing its platen to exert the necessary pressure to close the dies between the two platens, whereby the plastic material is molded to its final form within the dies.

The high pressure is maintained within the hydraulic unit for a period of time necessary to insure solidification of the molded material, and thereafter, my novel control means is operable to by-pass this high pressure. Thereafter, the mechanical platen may be retracted, whereupon the low hydraulic pressure within the supply system for the unit is operable to move its platen to advanced position for a new cycle.

In the drawings, the figure illustrates a front elevation of my novel press with the portable unit shown in section. The hydraulic and electric circuits utilized in my novel arrangement are diagrammatically illustrated in this figure.

Describing my invention in detail, the press includes a press frame generally designated 2 and top and bottom platens 4 and 6, the top platen being actuated in conventional manner by a

2

toggle mechanism consisting of toggle links 8 and 10 pivoted respectively at 12 and 14 to the platen 4 and the frame 2. The toggle mechanism is actuated in usual manner by a crankshaft 16 which drives a connecting rod 18 pivoted at 20 to the center joint of the toggle mechanism. The crank shaft 16 is operated by a motor (not shown) to which it is connected by a conventional air actuated clutch indicated at 21, said clutch 21 being operated by air lines 22 and 24 connected to an air valve 26 which is operable to direct compressed air from a shop air line (not shown) to said pipes 22 and 24, thereby actuating the air clutch 21 to engage and disengage the crankshaft 16 with respect to the motor as will be clearly understood by those skilled in the art.

The lower platen 6 is part of a novel portable hydraulic unit generally designated 27 and shown and described in detail in my co-pending application, Serial No. 492,363, filed June 26, 1943, in the United States Patent Office for "Hydraulic safety bed." The platen 6 comprises a cylinder 28 within which is slidably fitted a ram 30 mounted on a base plate or bottom member 32 which also carries guide posts 34, 34 slidably engaged with the platen 6 as described in detail in said co-pending application. The base plate 32 of the unit 27 is seated on the bed 36 of the press frame 2 which thus affords convenient support for said unit. It will be understood that while the unit 27 is herein illustrated as a portable device, if desired, the unit may be built into the press by any suitable construction such as is conventional in the art, and it will also be understood that in the event that the unit 27 is built into the press, the upper platen may, if desired, be hydraulically operated by any suitable conventional hydraulic motor means.

Hydraulic actuating fluid for the unit 27 is conveyed to the cylinder 28 through a port 38 in the ram, and a supply line 40 is connected to said port, said supply line comprising a holding valve 42 including a chamber 44 with ports closed by two spring-pressed stems or seat members 46 and 48, the spring pressure on the member 46 being relatively light as compared with that on the member 48. It may be noted at this point that the member 46 is hollow and includes a port 49 in order to afford a balancing of the hydraulic pressures against said member 46, thus permitting its associated spring to urge it to closed position to positively prevent flow of fluid through the holding valve 42 in the direction away from the unit 27. Thus the hydraulic fluid within the

system may only flow in this direction through the port closed by the valve member 48 when the pressure within the cylinder 28 exceeds a predetermined maximum depending upon the adjustment of the screw 51. The function of the holding valve 42 will hereinafter be described in detail in connection with the operation of the press.

The supply line 40 is connected through a solenoid operated by-pass valve 50 to a tank or reservoir 52 containing a quantity of hydraulic liquid, such as oil, indicated at 54 and a charge of compressed gas, such as air. The compressed air is admitted to the upper end of the reservoir 52 by the shop air line 56. The reservoir 52 is connected at its lower end to the pump line 58 connected to the pump 60 which is driven by a motor 62, both the pump and the motor being mounted on a sump 64 which collects slippage or leakage oil from the pump 60 by means of a conduit 66 which communicates with the interior of the pump casing, as will be clearly understood by those skilled in the art. The pump 60 pumps oil from the sump 64 through a foot valve 68 and a float valve 70 in the pump line 58, said float valve opening whenever the liquid level in the sump reaches a predetermined low level. Thus, slippage or leakage oil from the pump is recovered and pumped back into the system. A relief valve 72 is provided for the purpose of preventing the building up of dangerous pressures by the pump, and this valve may be set to by-pass the pump into the reservoir 52 at any desired maximum pressure such as, for example, 2500 lbs. per square inch.

In operating my novel device, the operator pushes the start button 74, thereby closing a circuit through the relay 76 and the before-mentioned air valve 26, said circuit being established between the main leads 80 and 82 which are connected to any suitable source of electric power (not shown). Energization of the relay 76 closes a holding circuit therethrough and a holding circuit through the air valve 26 across the relay contact points 84 and 86 which are connected by a switch member 87 in the usual manner because of the energization of the relay 76.

At this stage of the cycle, the air valve 26 actuates the associated air clutch 21 to engage the crank shaft 16 with its associated motor, thus causing the upper platen 4 to be urged downwardly compressing the work (not shown) which may consist of plastic material between top and bottom dies, the bottom die being seated on the platen 6, as will be apparent to those skilled in the art. At this point, under the pressure of the top platen 4, the bottom platen moves downwardly forcing hydraulic fluid from the cylinder 28 through the supply line 40 and the holding valve 42 against the resistance of the spring-pressed stem 48 which is adjusted by the screw 51 to open at a predetermined pressure, for example, 300 lbs. per square inch. Thus, the plastic material to be molded is compressed to a limited extent between the associated dies which are not yet completely closed because of the yielding action of the bottom platen 6. At this stage of the cycle, the plastic material is thereby permitted to heat and to expel air bubbles from between the molds in what is known in the art as the heating and breathing period of the cycle.

When the top platen 4 reaches its lowermost or advanced position, a cam 90, driven in any convenient manner by the crank shaft 16 such as, for example, by a chain of gears (not shown) actuates the switch 92 opening the contact points 94 and 96 and closing the contact points 98 and 100. The opening of the contact points 94 and 96 breaks the before-mentioned holding circuits through the relay 76 and the air valve 26, causing the platen 4 to stop inasmuch as the air valve actuates its associated clutch 21 to disengage the crank shaft from its associated motor.

The closing of contact points 98 and 100 establishes a circuit through the conventional timer 102 which, after a predetermined length of time necessary to complete the heating and breathing period of the cycle, closes the contact points 104 and 106 by the switch member 107, thereby establishing circuits through the actuating solenoid 109 of the by-pass valve 50 and through the timer 108. This causes the by-pass valve to close, which permits the pump to build up a relatively high pressure, for example, 2000 lbs. per square inch in the supply line 40, thereby moving both stems 46 and 48 of the holding valve 42 to their open positions as the high pressure fluid flows through the supply line 40 into the cylinder 28 forcing the bottom platen 6 upwardly to close the molding dies against the upper platen 4, thereby compressing the plastic material within the dies to its final form. After a predetermined period of time necessary to permit the plastic material to "set" or solidify, the timer 108 opens contact points 110 and 112 by lifting the switch member 113 from engagement therewith in conventional manner, thus breaking the before-mentioned circuit through the by-pass solenoid 109 and thereby causing the by-pass valve 50 to open, whereupon pressure in the supply line 40 drops to the holding valve setting determined by the adjustable screw 51 and registered by the gauge 114.

The operator then pushes the starting button 74 again, closing circuits through the relay 76 and the air valve 26, the latter being operable to again cause rotation of the crank shaft 16 which thus moves the upper platen 4 to its uppermost or retracted position, whereupon the cam 90 opens the contact points 116 and 118 by moving the switch member 120 from engagement therewith. This breaks the circuits established through the relay 76 and the air valve 26, thereby stopping the upper platen in its uppermost or retracted position for the start of a new cycle. As the platen 4 moves upwardly, the air pressure in the reservoir 52, which may have a value, for example, of approximately 90 lbs. per square inch, causes the hydraulic fluid in the system to be urged through the supply line 40 and through the holding valve 42 by moving the valve stem 49 to its open position. This permits the fluid pressure within the system to move the bottom platen 6 to its uppermost or advanced position preparatory to a new cycle. The conventional timers 102 and 108, as will be clearly understood by those skilled in the art, automatically set to their original positions, as shown in the drawing, and the device is thus placed in condition for the start of a new cycle.

A stop button 122 is provided for operating a switch member 124, and it will be understood from a consideration of the drawing that by pushing the stop button in the event of an emergency, the press may be stopped at any point in its cycle inasmuch as the switch member 124 is moved out of engagement with the contact points 126 and 128 through which all of the above-mentioned electric circuits are closed.

If desired, the holding valve 42 may be eliminated and the compressed air within the reservoir 52 may be built up by means of a conventional compressor to the value at which it is desired to have the platen 6 yield under the thrust of the platen 4. This arrangement would, of course, require unusually strong stops limiting expansion of the unit 27 at the end of a cycle. However, it is conceivable that this arrangement may be possible under certain conditions, and it is to be understood that my invention is broad enough to cover such a system.

It is to be understood that I do not wish to be limited by the exact embodiment of the device shown which is merely by way of illustration and not limitation as various and other forms of the device will, of course, be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

I claim:

1. In a press, opposed platens, mechanical actuating means for reciprocating one of said platens, hydraulic motor means operatively associated with the other platen and including a cylinder and a ram slidably fitted therein, a fluid supply line connected to said cylinder, means for supplying hydraulic fluid under pressure to said line, a holding valve in said line between said cylinder and said last-mentioned means, said valve being adapted to accommodate flow of fluid therethrough in either direction whenever the pressure in said line reaches a predetermined value, and said valve being adapted to accommodate flow of fluid therethrough in the direction toward said cylinder when the pressure afforded by said supplying means is greater than that within said cylinder and greater than a predetermined value substantially lower than said first-mentioned value, said supplying means comprising a hydraulic circuit including a pump having its suction side connected to a reservoir of hydraulic fluid and its discharge side connected to said line, and fluid passage means including a by-pass valve connecting said reservoir to said line at a point between said pump and said holding valve, said reservoir including means for exerting a pressure on the fluid therewithin, said last-mentioned pressure being substantially less than said first-mentioned value and greater than said second-mentioned value, and electrically operated control means operatively associated with said actuating means for automatically rendering the same inoperative when said one platen reaches its advanced position, said control means including means for automatically closing said by-pass valve after a predetermined interval of time subsequent to the time at which said one platen reaches said advanced position.

2. In a press, opposed top and bottom platens, mechanical operating means for advancing and retracting said top platen toward and away from said bottom platen, actuating means associated with said bottom platen for advancing it toward said top platen, said actuating means comprising hydraulic motor means including a cylinder and a ram slidably fitted therein, a hydraulic supply line connected to said cylinder, a source of hydraulic pressure fluid connected to said line, a holding valve in said line between said source and said cylinder, said valve being adapted to accommodate flow of fluid in said line away from said cylinder when the pressure therein reaches a predetermined value, and said valve being adapted to accommodate flow of fluid in said line toward said cylinder when the pressure from said source is at a predetermined minimum value substantially lower than said first-mentioned value, said source comprising a reservoir of hydraulic fluid under pressure equal to said second-mentioned value, a pump having its suction side connected to said reservoir and its discharge side connected to said line, and a connection between said reservoir and said line at a point intermediate said pump and said valve, said connection comprising a by-pass valve, and control means operatively associated with said operating means and said by-pass valve for automatically stopping said operating means when said top platen reaches its advanced position and for closing said by-pass valve at a predetermined time interval after said top platen reaches said advanced position.

3. In a press, opposed platens, operating means for advancing and retracting one of said platens toward and away from the other, hydraulic motor means operatively associated with said other platen and including a cylinder and a ram slidably fitted therein, a hydraulic supply line connected to said cylinder, a hydraulic pressure system connected to said line, a holding valve in said line between said system and said cylinder, said valve being adapted to accommodate flow of fluid therethrough away from said cylinder when the pressure therein reaches a predetermined value, and said valve being adapted to accommodate flow of fluid therethrough toward said cylinder when the pressure from said system is greater than that within said cylinder and greater than a predetermined value substantially less than said first-mentioned value, said system comprising a reservoir of hydraulic fluid under pressure at least equal to said second-mentioned value, pump means for developing hydraulic pressure substantial y greater than either of said values, and valve means for by-passing said pump means, and electrically operated control means operatively associated with said operating means and said valve means for stopping movement of said one platen after it has reached its advanced position, said control means being operative to close said valve means after a predetermined time interval subsequent to the stopping of said one platen.

4. In a press, opposed top and bottom platens, operating means for reciprocating said top platen, actuating means associated with said bottom platen and comprising hydraulic motor means including a cylinder and a ram slidably fitted therein, a hydraulic supply line connected to said cylinder, a source of hydraulic pressure fluid connected to said line, a holding valve in said line between said source and said cylinder, said valve being adapted to accommodate flow of fluid in said line away from said cylinder when the pressure therein reaches a predetermined value, and said valve being adapted to accommodate flow of fluid in said line toward said cylinder when the pressure from said source is at a predetermined value substantially less than said first-mentioned value, said source comprising a reservoir of hydraulic fluid under pressure at least equal to said second-mentioned value, a pump having its suction side connected to said reservoir and its discharge side connected to said line and to said reservoir, and a connection including a by-pass valve between said line and said reservoir at a point in said line intermediate said pump and said holding valve, and electrically operated control means operatively associated with said operating means and said by-pass valve for automatically stopping said operating means when

said top platen reaches its advanced position, said control means being operative to close said by-pass valve after a predetermined time interval subsequent to the stopping of said operating means.

5. In a press, opposed platens, operating means for advancing and retracting one of said platens toward and away from the other, actuating means operatively associated with said other platen and including hydraulic motor means comprising a cylinder and a ram slidably fitted therein, a hydraulic fluid supply line connected to said cylinder, a hydraulic pressure system connected to said line, a holding valve in said line between said system and said cylinder, said valve comprising means for accommodating flow of fluid therethrough in the direction away from said cylinder when the pressure therein reaches a predetermined value resulting from the thrust of said first-mentioned platen, and said valve comprising means for accommodating flow of fluid in said line toward said cylinder when the pressure from said system exceeds the pressure within said cylinder, said system comprising a reservoir of hydraulic fluid under constant pressure and pump means for developing hydraulic pressure substantially greater than said value, valve means for by-passing said pump means, and control means operatively associated with said operating means and said valve means for stopping said operating means when said one platen reaches its advanced position and for opening said valve means after a predetermined time interval subsequent to the stopping of said operating means.

6. In a press, opposed platens, actuating means for reciprocating one of said platens, hydraulic actuating means operatively associated with the other platen and including a cylinder and a ram slidably fitted therein, a fluid supply line connected to said cylinder, means for supplying hydraulic fluid under pressure to said line, a holding valve in said line between said cylinder and said last-mentioned means, said valve being adapted to open whenever the pressure therein reaches a predetermined value, said supplying means comprising a hydraulic circuit including a pump having its suction side connected to a reservoir of hydraulic fluid and its discharge side connected to said line, and a connection between said reservoir and said line at a point therein intermediate said pump and said valve, said connection comprising a by-pass valve, said reservoir containing a charge of compressed gas exerting a pressure on the fluid therein, and electrically operated control means operatively associated with said first-mentioned actuating means for automatically stopping said one platen in its advanced position, said control means including means for automatically closing said by-pass valve after a predetermined interval of time subsequent to the stopping of said one platen.

7. In a press, opposed platens, actuating means for reciprocating one of said platens, actuating means associated with the other platen and including a cylinder and a ram slidably fitted therein, a fluid supply line connected to said cylinder, means for supplying hydraulic fluid under pressure to said line, a holding valve in said line between said cylinder and said last-mentioned means, said valve being adapted to open whenever the pressure in said cylinder reaches a predetermined value, said supplying means comprising a hydraulic circuit including a pump having its suction side connected to a reservoir of hydraulic fluid and its discharge side connected to said line, and a connection between said line intermediate said pump and said valve, said last-mentioned connection comprising a by-pass valve, said reservoir containing means for exerting a pressure on the fluid therein, and control means operatively associated with said actuating means for automatically stopping said one platen in its advanced position, said control means including means for automatically closing said by-pass valve after a predetermined period of time subsequent to the stopping of said one platen.

8. In a press, opposed platens, actuating means for reciprocating one of said platens, hydraulic motor means operatively associated with the other platen and comprising a cylinder and a ram slidably fitted therein, a fluid supply line connected to said cylinder, means for supplying hydraulic fluid under pressure to said line, said last-mentioned means comprising a hydraulic circuit including a pump having its suction side connected to a reservoir of hydraulic fluid and its discharge side connected to said line and also to said reservoir, and a by-pass valve in said circuit between said reservoir and the discharge side of said pump, said reservoir including means for exerting a pressure on the fluid therewithin, said pressure being substantially less than the capacity of said pump, and control means operatively associated with said actuating means for automatically stopping said first-mentioned platen in its advanced position, said control means comprising means for automatically closing said by-pass valve after a predetermined period of time subsequent to the stopping of said first-mentioned platen.

9. In a press, opposed platens, operating means for advancing and retracting one of said platens toward and away from the other, actuating means associated with said other platen and comprising hydraulic motor means including a cylinder and a ram slidably fitted therein, a hydraulic supply line connected to said cylinder, a source of hydraulic pressure fluid connected to said line, said source comprising a reservoir of hydraulic fluid under pressure, pump means for developing hydraulic pressure substantially greater than said first-mentioned pressure, and valve means for by-passing said pump means, and control means operatively associated with said operating means and said valve means for automatically stopping said one platen when the latter reaches its advanced position and for automatically closing said by-pass valve means after a predetermined time interval subsequent to the stopping of said one platen.

10. In a press, opposed platens, mechanical actuating means for reciprocating one of said platens, hydraulic motor means operatively associated with the other platen, a hydraulic fluid supply line connected to said motor means, a source of hydraulic pressure connected to said line and including a pump, a holding valve in said line between said source and said motor means, said valve being adapted to open when the pressure in said line reaches a predetermined value, and by-pass valve means connected to said pump, and electrically operated control means operatively associated with said actuating means for automatically rendering said actuating means inoperative when said one platen reaches its advanced position, said control means including means for automatically closing said by-pass valve means after a predetermined time interval subsequent to the time at which said one platen reaches its advanced position.

11. In a press, opposed platens, operating means for one of said platens, hydraulic motor means associated with the other platen and including a cylinder therein and a ram mounted on the press and slidably fitted within said cylinder, a hydraulic fluid supply line connected to said cylinder, a reservoir of hydraulic fluid under predetermined pressure connected to said line, pump means connected to said line for developing hydraulic pressure therein substantially greater than said first-mentioned pressure, means for by-passing said pump means, and control means operatively associated with said operating means and said by-pass means for stopping said one platen when it reaches its advanced position, said control means being operative to automatically close said by-pass means after a predetermined time interval subsequent to the stopping of said one platen.

12. In a press, opposed platens, operating means for one of said platens, hydraulic motor means for the other platen including a cylinder and a ram slidably fitted therein, a hydraulic fluid supply line connected to said cylinder, a reservoir of hydraulic fluid under predetermined pressure connected to said line, pump means connected to said line for developing hydraulic pressure therein substantially greater than said first-mentioned pressure, means for by-passing said pump means, and electrically operated control means operatively associated with said operating means and said by-pass means for stopping said one platen when it reaches its advanced position, said control means being operative to automatically close said by-pass means after a predetermined time interval subsequent to the stopping of said one platen.

13. In a press, opposed platens, actuating means for reciprocating one of said platens, hydraulic motor means operatively associated with the other platen, a hydraulic fluid supply line connected to said motor means, a source of hydraulic pressure connected to said line, a holding valve in said line between said source and said motor means, said valve being adapted to open when the pressure in said line reaches a predetermined value, said source including a pump, by-pass valve means connected to said pump, and control means for automatically stopping said one platen in its advanced position, said control means including means for automatically closing said by-pass valve means after a predetermined time interval subsequent to the stopping of said one platen.

14. In a device of the class described, opposed platens, actuating means for one of said platens, a hydraulic motor operatively associated with the other platen, a hydraulic circuit connected to said motor for actuation thereof, said circuit including a pump having its discharge side connected to said motor, and valve means for by-passing the discharge of said pump from said motor, and control means for automatically rendering said actuating means inoperative when said one platen reaches its advanced position, said control means comprising means for closing said by-pass valve means after said actuating means has been rendered inoperative, said hydraulic circuit comprising valve means between said motor and said pump for resisting flow of fluid from said motor until a predetermined pressure has been built up therein by the thrust of said one platen as the latter advances toward said other platen.

15. In a device of the class described, opposed platens, actuating means for one of said platens,

a hydraulic motor operatively associated with the other platen, a hydraulic circuit connected to said motor for actuation thereof, said circuit including a pump having its discharge side connected to said motor, and valve means for by-passing the discharge of said pump from said motor, and control means for automatically rendering said actuating means inoperative when said one platen reaches its advanced position, said control means comprising means for closing said by-pass valve means after said actuating means has been rendered inoperative.

16. In a hydraulic press, opposed platens, actuating means for reciprocating one of the platens, hydraulic motor means operatively associated with the other platen, a hydraulic circuit operatively connected to said motor means, said circuit comprising a line including holding valve means restricting flow of fluid from said motor means until a predetermined pressure has been built up therein, a reservoir of fluid under pressure, a pump having its suction side connected to said reservoir and having its discharge side connected to said line, a connection between said discharge side and said reservoir including a by-pass valve, and automatic means for stopping said one platen in its advanced position and for closing said by-pass valve at a predetermined period of time subsequent to the stopping of said one platen.

17. In a device of the class described, opposed platens, operating means for one of said platens, actuating means for the other platen including cylinder means and ram means reciprocal therein, a hydraulic circuit comprising a supply line connected to said cylinder means, an accumulator connected to said line and containing a body of hydraulic fluid under relatively low pressure, a source of relatively high pressure, and control means for automatically stopping said one platen in an advanced position thereof, said control means comprising means for automatically closing the connection of said accumulator to said line and for simultaneously directing pressure from said source into said line at a predetermined time subsequent to the stopping of said one platen.

18. In a device of the class described, opposed platens, actuating means for one of said platens, hydraulic motor means for the other platen including cylinder means and ram means reciprocal therein, a hydraulic circuit connected to said cylinder means, said circuit including a supply line, an accumulator connected to said line and containing a body of hydraulic fluid under relatively low pressure, a pump having its discharge side connected to said line and having its suction side connected to said accumulator, a by-pass valve in the connection between said accumulator and said line, and control means for automatically stopping said one platen in an advanced position thereof, said control means being operable to automatically close said by-pass valve after a predetermined time interval subsequent to the stopping of said one platen.

19. In a device of the class described, opposed platens, hydraulic motor means associated with one of said platens including cylinder means and ram means reciprocal therein, a hydraulic circuit comprising a supply line connected to said cylinder means, an accumulator containing a body of pressure fluid connected to said line, by-pass valve means in said last-mentioned connection, a pump having its discharge and suction sides connected to said line and said accumulator respectively, operating means operatively associated

with the other platen, and control means for automatically rendering said operating means inoperative when said other platen reaches an advanced position thereof, said control means being operable to close said by-pass valve means at a predetermined time subsequent to the stopping of said other platen.

20. In a device of the class described, opposed platens, hydraulic motor means associated with one of said platens including cylinder means and ram means reciprocal therein, a hydraulic circuit comprising a supply line connected to said cylinder means, an accumulator containing a body of pressure fluid connected to said line, by-pass valve means in said last-mentioned connection, a pump having its discharge and suction sides connected to said line and said accumulator respectively, operating means operatively associated with the other platen, control means for automatically rendering said operating means inoperative when said other platen reaches an advanced position thereof, said control means being operable to close said by-pass valve means at a predetermined time subsequent to the stopping of said other

platen, and valve means in said line adjacent said cylinder means for accommodating flow of fluid from said cylinder means when the pressure therein reaches a value exceeding that within said circuit by a predetermined amount, said valve means being adapted to accommodate flow of fluid through said line toward said cylinder means when the pressure afforded by said circuit exceeds that within said cylinder means and is at least equal to the minimum pressure within said accumulator.

RELZA J. HESS.

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