

June 16, 1953

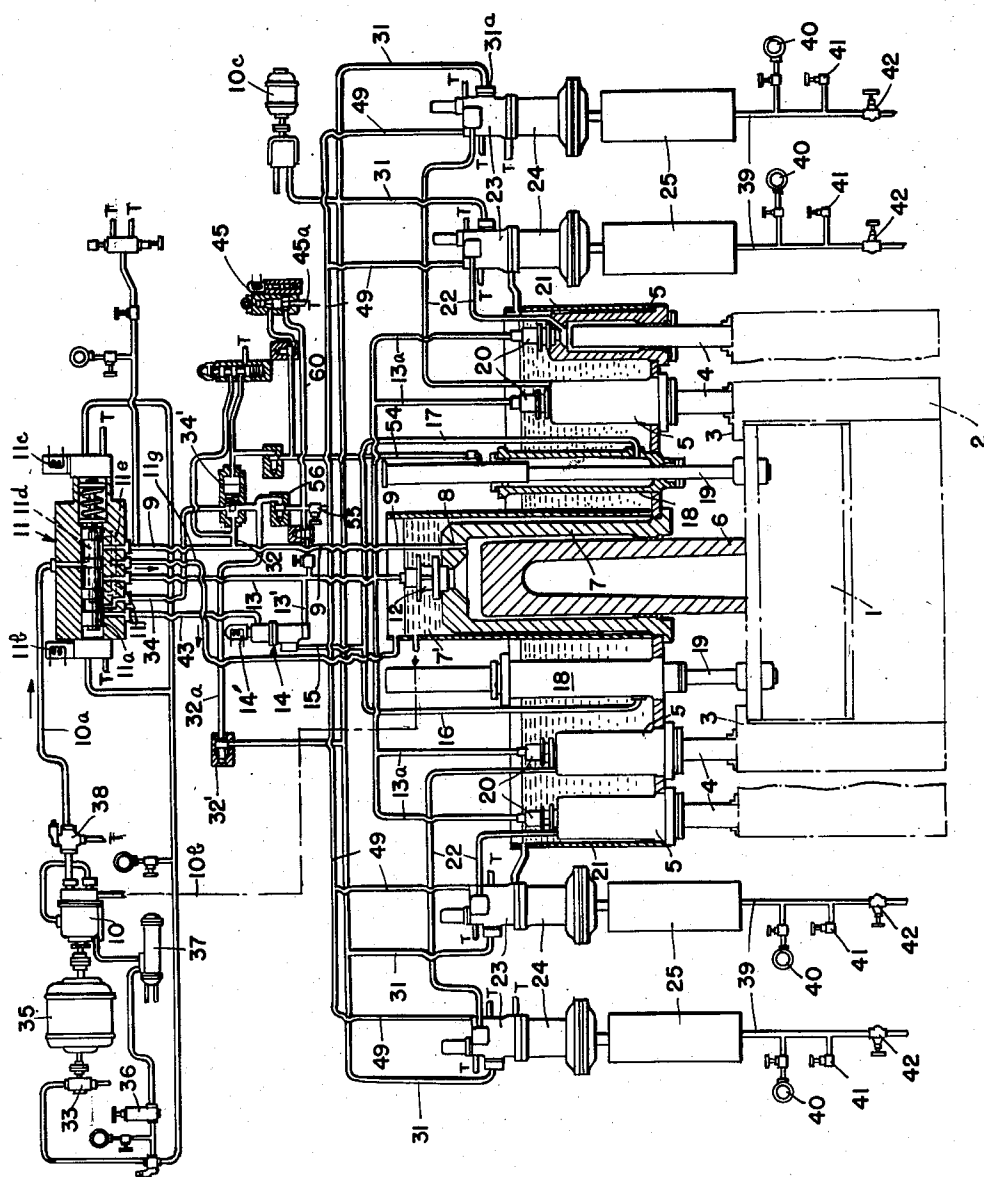
L. ZIMMERMAN

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HYDRAULIC PRESS

Filed Nov. 8, 1949

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2,642,023

Filed Nov. 8, 1949

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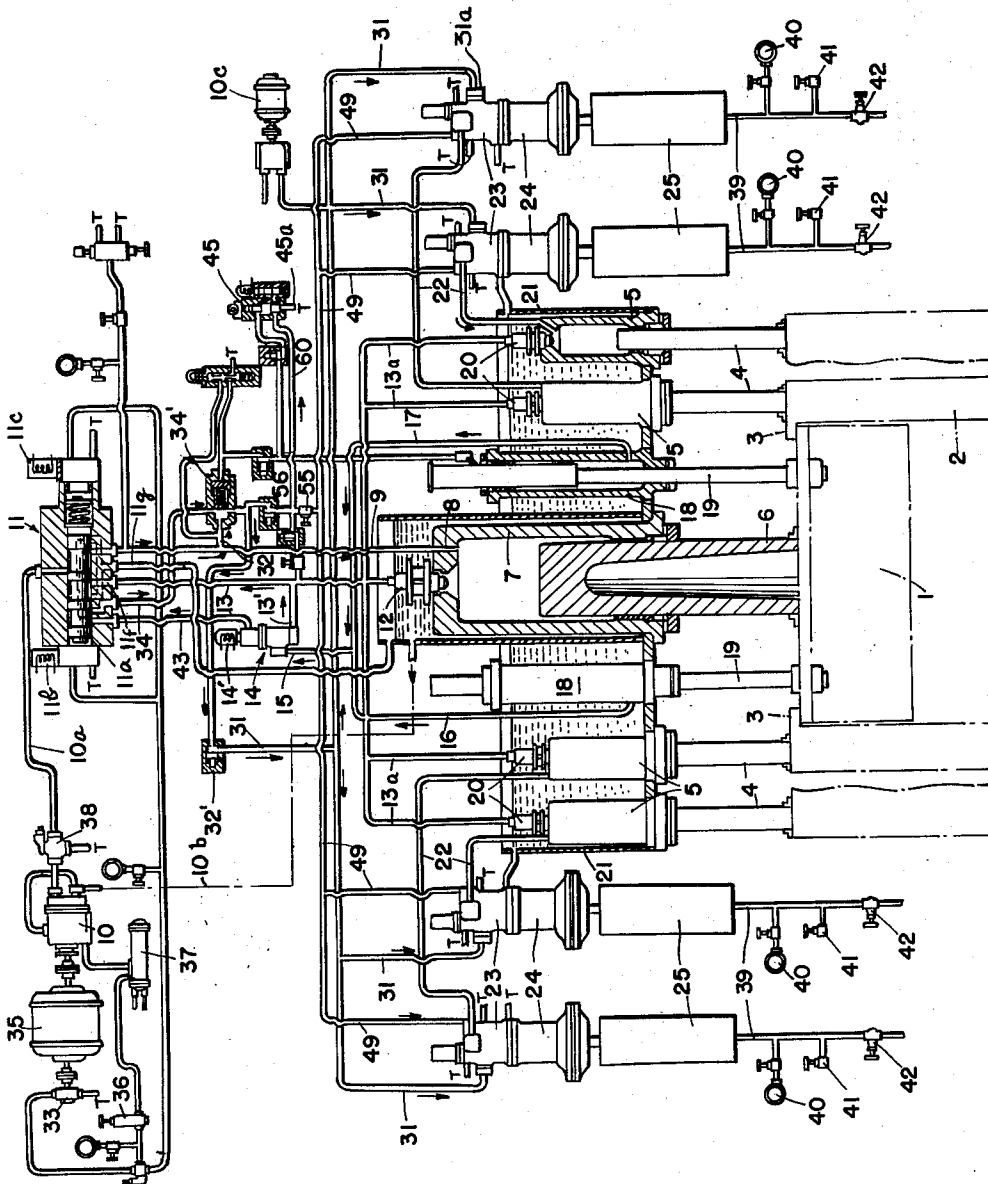


FIG. 2

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2,642,023

Filed Nov. 8, 1949

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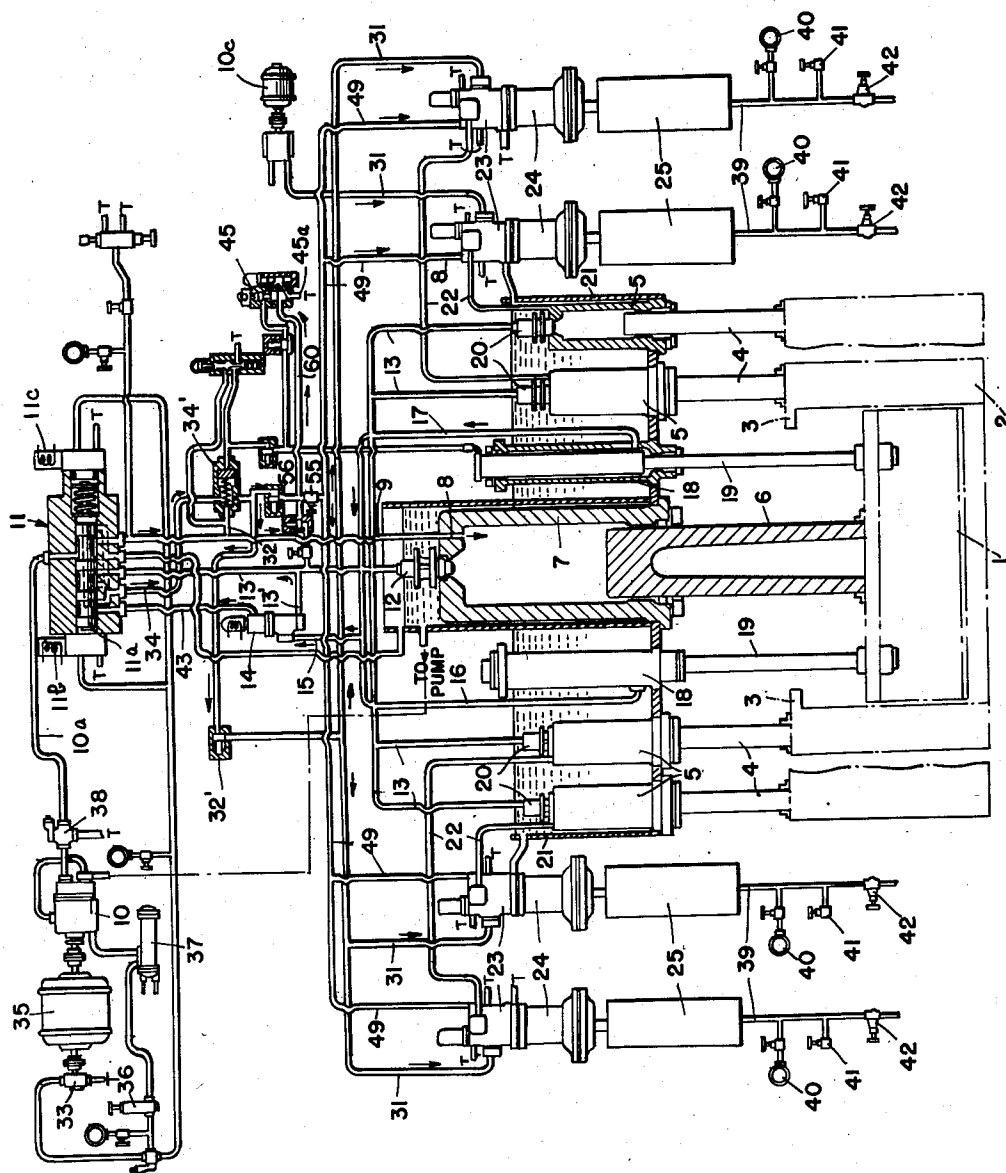


FIG. 3

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FIG. 5

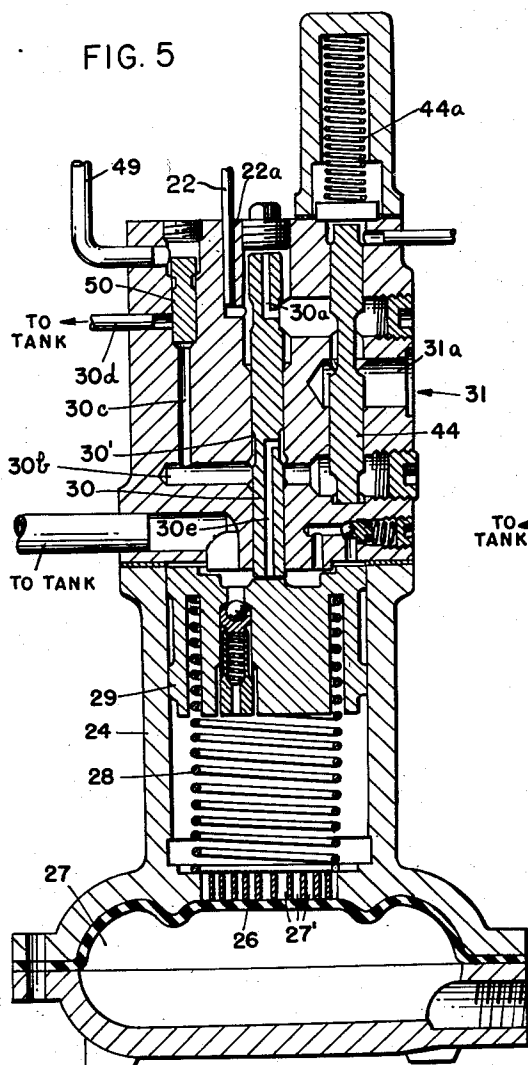


FIG. 6

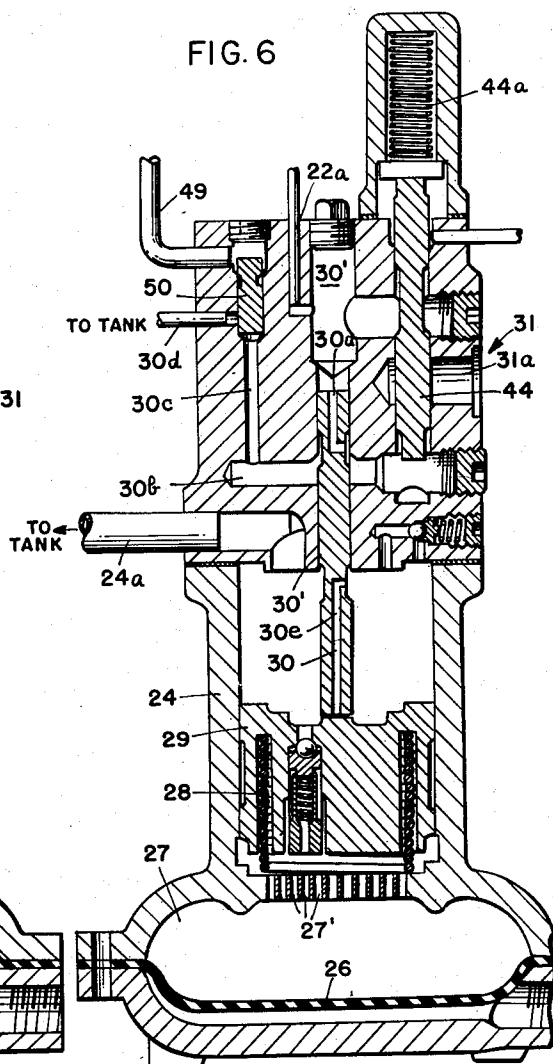
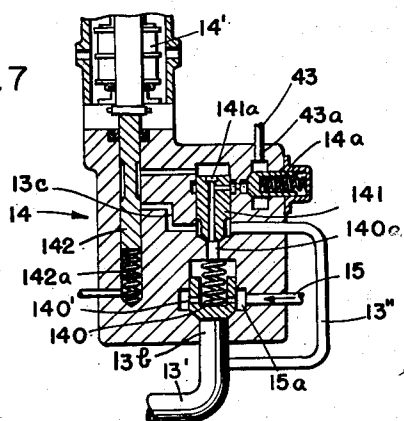


FIG. 7



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UNITED STATES PATENT OFFICE

2,642,023

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Application November 8, 1949, Serial No. 126,119
 In Great Britain November 9, 1948

4 Claims. (Cl. 113-45)

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This invention relates to hydraulic presses of the type employing two slides arranged as an inner or work-performing slide and an outer or work-holding slide, hydraulic fluid pressure operated means actuating the slides in the work-
 ing direction, the work-holding slide being supported by the work-performing slide to move therewith and also relatively thereto, means being provided to provide a lag between the engagement of the work by the work-holding slide and the effective engagement of the work-performing slide with the work, the work-holding slide being lifted away from the work by reason of the retraction of the work-performing slide.

According to the present invention a press of the aforesaid type is characterised by the combination with the work-holding slide of hydraulically operated pressure applying means adapted to apply a predetermined work-holding pressure to the work-holding slide and of means responding to the aforesaid predetermined pressure to isolate the said hydraulically operated pressure applying means from the source of fluid pressure when a predetermined work-holding pressure is reached, and also of adjustable fluid pressure means yieldingly opposing said isolating operation and adapted to maintain said predetermined pressure constant over the whole of the work-holding phase of the working cycle.

In an embodiment of the invention each accumulator consists of an air chamber separated by a diaphragm from a low pressure cylinder accommodating a spring loaded piston engaged by a high pressure piston valve operating in opposition to the said spring means and the air cushion, said piston valve operating across a supply conduit to the work-holding cylinders and being adapted to be actuated by fluid pressure from these work-holding cylinders when it exceeds a predetermined amount so as to act upon the spring loaded piston to displace the fluid in the said low pressure cylinder into the air receiver, this displacement of the said piston valve being adapted to expose a previously open shut-off valve against the influence of spring means to fluid pressure so as to move the shut-off valve to the closed position and isolate the work-holding cylinders from the source of supply of fluid pressure, and further means being provided whereby at the conclusion of the draw

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stroke fluid pressure in the work-holding cylinders is vented off to produce a pressure difference to effect opening of the said shut-off valve to provide a free flow from the work-holding cylinders to main supply tank.

In order that the invention may be clearly understood and readily carried into effect drawings are appended hereto illustrating an embodiment thereof, and wherein,

Figure 1 is a flow circuit diagram of the hydraulic press in the raised position of the slides.

Figure 2 is a view similar to Figure 1 but showing the position of the valve and other parts wherein the slides have been moved downwardly to the position where the blankholder or clamp slide is contacting the work.

Figure 3 is a view similar to Figure 2 but showing the draw slide at the end of the drawing stroke.

Figure 4 is a view similar to Figures 1, 2, and 3 but showing the main valve shifted to elevate the slides and illustrating the slides as they are moving upwardly away from the work.

Figure 5 is a sectional elevation of one of the air accumulators showing the parts thereof before pressure is exerted on the blankholder slide.

Figure 6 is a view similar to Figure 5 but showing the position of the parts of the accumulator when pressure is being applied to the blankholder slide.

Figure 7 is a diagrammatic view of the arrangement of ports and passages in a check and holding valve of the apparatus. In the various figures of the drawing the notation "T" adjacent a conduit line indicates that the line is connected to the fluid tank.

Referring to the drawings, the inner or work-performing slide 1, slides within the outer or work-holding slide 2, and the lag or lost motion which ensures that the work-holding slide will engage the work in advance of the work-performing slide can be obtained by providing flanges 3 on the outer slide overhanging the work-performing slide whereby the work-holding slide will be carried upwardly by the work-performing slide and permitted to move downwardly in advance thereof.

The outer or work-holding slide carries two pairs or other suitable number and symmetrical arrangement of upstanding pistons 4 slidable in

fixed vertical work-holding cylinders 5, and disposed along the vertical axis of the press is a ram 6, or number of rams disposed symmetrically with respect to said vertical axis, fixed to the head of the work-performing slide and operating within a fixed central cylinder 7 or number of cylinders. Assuming that there is only one cylinder 7, its head has an inlet 8 connected by a conduit 9 to the main pressure pump 10 via a four-way valve 11, the shuttle 11a of which is actuated alternately in opposite directions by a pair of solenoids 11b, 11c remotely controlled. The head of the cylinder 7 is also fitted with a "pre-fill" valve 12 communicating with the interior of the cylinder and with an oil supply pipe from the oil tank, or with an oil reservoir 7' surrounding the cylinder 7. A conduit 13 which supplies fluid pressure to open the pre-fill valve 12 of the cylinder 7 on the upstroke of the slides leads from the pre-fill valve 12 to another part of the said four-way valve 11, this latter conduit having a branch connection 13' to a "holding" check valve 14 from which extends a conduit 15 connected by branch pipes 16, 17 to the lower ends of two or other suitable number of "pull-back" cylinders 18 the pistons 19 of which are urged upwards when it is required to return the inner or work-performing slide to the raised position. The pistons 19 are connected to the inner slide 1.

The said conduit 13 extending from the pre-fill valve 12 of the main cylinder has branches 13a to pre-fill valves 20 of the work-holding cylinders 5, these latter pre-fill valves communicating with the main supply tank 21, and heads of the cylinders 5 communicating via lines 22 to the valve housings 23 surmounting low pressure cylinder heads 24 of air pressure accumulators 25. Each low pressure cylinder head 24 has its interior isolated from the appropriate air chamber 25 by a diaphragm 26 (see Figures 5 and 6) in a diaphragm chamber 27. A spring 28 urges a piston 29 upwardly within such cylinder to yieldingly oppose downward forcing of a piston valve 30 in a bore 30' in the valve housing 24. This piston valve 30 controls the supply of fluid pressure to the work-holding cylinders 5. The driving connection from the pump supply 10 to the work-holding cylinders 5 via the appropriate parts of the valve housings 24 containing the piston valves 30 is effected by branches 31 taken off the conduit 9 via a branch 32, through check valve 34', and branch 32a containing a check valve 32' having a decompression orifice, the conduit 9 being that connecting the aforesaid four-way valve 11 to the pressure inlet of the main cylinder 7.

Each pre-fill check valve 12, 20 may be of any desired construction but preferably comprises a piston valve element maintained in closed position by a coiled compression spring operating on the rod of a poppet valve and urged to open position against spring action by a fluid pressure actuated piston at the end of the rod remote from the valve, this fluid pressure being obtained from the conduit 13 leading from the aforesaid four-way valve and branches 13a therefrom. These pre-fill check valves 20 are opened by fluid pressure only when the ram 6 operating the inner slide 1 is being urged upwards. On the downward stroke, by reason of the connection of the pre-fill check valves 20 with the main tank 21, a pre-filling operation is obtained by reason of the suction generated inside the cylinders during the initial or idle pressure stage until the main pres-

sure takes charge for driving the pistons 4 of the work-holding cylinders 5.

Pilot pressure for actuating the valve 11 is obtained from a pilot pump 33 which may be driven off the motor 35 driving the main pump 10, suitable filtering means 36 and cooling means 37 being provided in association with these pumps, and a relief valve 38 being provided in the supply conduit from the pump to the four-way valve.

The aforesaid air accumulators 25 with their associated hydraulic fluid low pressure cylinders 24 and valve housings 23 accommodating the aforesaid piston valves 30 comprise units each of which acts as a work-holder pressure accumulator through which fluid passes to the work-holding cylinders 5 and which stop the flow of fluid thereto when a predetermined pressure is reached as well as maintain that pressure. Each air chamber 25 has a connection 39 from its lower end to an air pressure and tonnage gauge 40, a blow-off valve 41 and air pressure regulator 42, its upper end being in communication with the diaphragm chamber 27 having the integral upstanding cylinder comprising the said low pressure cylinder 24, the chamber 27 being perforated as at 27' where it forms the lower wall of the cylinder 24 and securing in position the diaphragm 26 which at the appropriate time yields to permit oil from the low pressure cylinder 24 to enter the chamber 27. The connection 22a to each line 22 is taken off the upper enlarged end of the bore 30'.

It will be appreciated from the foregoing that the valve housing 23 has a high pressure cylinder, i. e. the bore 30' containing the piston valve 30 which is co-axial with the low pressure cylinder. Hence, when the predetermined fluid pressure in each cylinder 5 is reached, as determined by the setting of the respective air pressure regulators 42 the fluid pressure reaction from each work-holding cylinder 5 becomes substantially wholly effective upon the piston valves 30 through line 22, and when the work holding stage has been reached the piston valves 30 will be urged downwards to the position shown in Figure 6 against the influence of the air accumulators 25 and springs 28. When this occurs communication will be established between the fluid pressure in bore 30' and passage 30b through bore 30a whereupon cut-off valves 44 loaded to a predetermined extent by springs 44a, are urged upwardly to the closed position of Figure 6 each across an associated inlet 31a receiving the appropriate line 31. The work-holder relief and decompression valve 45 normally remains closed and, when closed, the pressure of fluid in line 60 and its connecting lines 49 will maintain the check valves 50 in closed position, thereby enabling fluid pressure in passage 30b to close valve 44. Thus, flow of fluid through lines 31 will be stopped and pressure within the accumulator will be equalized to maintain the holding pressure in the blank holder cylinders 5, and the fluid within the accumulator will, in effect, have been isolated from the source of fluid supply.

Each valve housing 23 has an outlet 30d to the tank controlled by the check valve 50.

The holding check valve 14 (see Figures 3 and 7) is connected by the lines 15 and 16 to the pull back cylinders 18 via a bore 15a. This valve 14 is also connected to the line 13' via a bore 13b in which seats a spring loaded valve 140 having a transverse bore 140' communicating via a bore 140a with the branch 13' when valve

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141 is in its raised position. Valve 141 has a bore 141a communicating with a relief valve 14a acting to close off an outlet bore 43a receiving the line 43 leading to the work-holding cylinders 5 via the four-way valve and conduit 34 as afore-
 said. The bore 141a of the valve 141 is continued right through the valve so that when a shuttle valve 142 operated from the solenoid 14' closes by the action of its spring 142a fluid from conduit 15 will pass through valve 141 to the space thereabove and, because of the larger area, pressure will be created to seat the valve 141. When the solenoid is energized to move valve 142 downwardly communication will be established between the space above valve 141 and passage 13c to release the hydraulic pressure above the valve 141 back to the branch 13'.

The operation of the press is as follows:

Referring initially to Figure 1 of the drawings, the slides are shown in elevated position and at rest. In this position the fluid in pull-back cylinders 18 will hold the slides elevated and the fluid in hold-down cylinders 5 will have become substantially exhausted. The shuttle piston 11a of the four-way valve 11 will be in its neutral position as shown. The shuttle 11a contains therein an elongated bore 11d having an opening at one side thereof communicating with conduit 10a leading from the pump and has other openings at each end thereof communicating by means of passages 11e and 11f in the valve body with conduit 11g which extends to the fluid tank. The pump 10 pumps hydraulic fluid from tank 7' through conduit 10b and through line 10a to the valve 11. It will be evident, therefore, that in the position of the parts and the shuttle in the valve 11 in Figure 1 fluid will be pumped from the tank to the valve through bore 11d and through the passages 11e and 11f to the conduit 11g and back to the tank.

When it is desired to place the press in operation and to lower the slides, solenoid 14' will be energized to move the shuttle toward the left as it appears in Figure 2 of the drawings and solenoid 14' of valve 14 will also be energized to force shuttle valve 142 downwardly so that communication will be established between the passages above and below valve member 141 thereby releasing the pressure above valve member 141 and permitting it to be unseated. At this moment the weight of the slides connected to the pull-back cylinders 18 through the piston rods 19 will cause the slides to be lowered due to the release of the pressure on the fluid within the pull-back cylinders. The pressure is released because of the operation of valve 14 permitting a free flow of the fluid out of pull-back cylinders 18 through the conduits 16 and 17 through conduit 15 to valve 14. Referring now for a moment to Figure 7, the fluid entering conduit 15 will pass through the passages 140' and upwardly through the bore 140a. At this time, the solenoid 14' is energized so that the shuttle valve 142 is in its lowermost position, establishing communication between the area above valve 141 and passageway 13c. Since there is no pressure on member 141 and the pressure below it is now greater than the pressure on the top of valve member 141 this valve member will become unseated and permit the free flow of fluid through conduit 13' to conduit 13' out of the valve 14.

Referring back to Figure 2 again the arrows indicate passage of fluid from 13' to the connecting conduit 13 and upwardly therethrough into valve 11. The shuttle 11a having been moved

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toward the left, it will be seen that communication will be established between conduit 13 and passage 11f in the valve body which will carry the fluid back to the tank through conduit 11g.

At the same time the pump 10 is forcing fluid under pressure from the tank through conduits 10b and 10a into the valve and communication with conduit 10a is now established with conduit 9. Some of the fluid, therefore, will pass downwardly into cylinder 7 and some will also be bypassed from conduit 9 through conduit 32 to unseat check valve 34' whereupon the flow of fluid will continue in the direction of the arrows through valve 32' and the various lines 31 to the inlet 31a of each accumulator.

Referring for a moment to Figure 5, it will be seen that the fluid flow within the accumulator from bore 31a therein will be upwardly around valve member 44 and valve member 30 through passage 22a and into line 22 connected to the head of each of hold-down cylinders 5.

Since the movement downwardly of the various pistons 4 and the ram 6 is relatively fast in their initial stages the fluid being pumped into the cylinders 5 and the cylinder 7 cannot be relied upon to force the pistons and ram downwardly. The initial downward movement is due to the release of the fluid locked in the pull-back cylinders 18 and the suction created by the downward movement of pistons 4 and ram 6 will be sufficient to open the pre-fill valves 20 and 12 thus permitting additional fluid from the tank to enter the respective cylinders.

This downward movement continues until just before the clamp or blank holder slide reaches the blank whereupon the solenoid 14' in valve 14 is de-energized allowing spring 142a to move the shuttle 142 upwardly and stop further free flow of fluid therethrough. At this point fluid from the pull-back cylinders 18 through lines 16 and 17 to the conduit 15 will flow at a slower rate and will pass upwardly through the passage 141a in valve member 141. Since the fluid therein will be trapped, a sufficient pressure will be built up due to the larger area at the top of valve member 141 to seat this valve whereupon communication will be established between the branch of the passage 141a to the check valve 14a. This will cause a slowing down of the blank holder slide although it will not stop moving entirely because fluid from the pump is still being passed through the accumulators into the hold-down cylinders 5. Movement of the blank holder slide will, therefore, continue until the blank is reached whereupon continued flow of fluid into the hold-down cylinders 5 will build up pressure.

Since the clamp slide and draw slide connected with pistons 19 will still move downwardly but at a slower rate and the flow of fluid from the pull-back cylinders 18 through conduits 16, 17, and 15 is blocked by the seating of valve member 141, a pressure will be built up within valve 14 until the pressure of the spring which normally closes check valve 14a has been overcome. At this point the flow of fluid will then be through valve 14 outwardly through conduit 43 and back to valve 11 as indicated by the arrow in Figure 2 adjacent the conduit 43.

It will also be seen that when the shuttle 11a is in the position shown in Figure 2 the conduits 43 and 34 will be in communication whereupon the flow of fluid from valve 14 will be carried through conduit 34 and past the open check valve 34' to conduit 31 and thence to the various accumulators.

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This condition just described prevails after the blank holder slide is in clamping position whereupon pressure in the hold-down cylinders 5 will continue to increase. Since the fluid from pull-back cylinders 18 passing through the conduits 43 and 34 joins with the fluid being pumped through conduit 9 and some of which also is conveyed to conduit 32 and thence to line 31, it will be clear that this fluid from cylinders 18 will be used to charge the hold-down cylinder 5 in the clamping position of the blank holder slide. The air pressure against the diaphragm 26 in each of the accumulators may vary as between the individual accumulators or may be the same depending upon the setting of the various valves 42. The air pressure for each accumulator will be predetermined and preset. As the pressure in each hold-down cylinder 5 continues to build up, a point will be reached where the pressure therein will become equalized with the pressure in the head of the accumulator associated therewith. When this pressure reaches or exceeds the air pressure within the accumulator, then the shuttle valve 30 will be forced downwardly from its position in Figure 5 to its position in Figure 6. When this occurs the hydraulic fluid above valve 30 will pass through the bore 30a therein and into bore 30b. Valve 50 will be normally maintained in its closed position as shown in Figures 5 and 6 because of the connection of conduit 49 with valve 45 through line 60. Valve 45 being closed, the fluid in line 49 will be maintained under pressure. The continued building up of the pressure in bore 30b will thereupon elevate valve member 44 against the force of spring 44a from its position shown in Figure 5 to its position in Figure 6.

When the conditions of Figure 6 prevail the flow of fluid through lines 31 will be stopped because valve member 44 has closed the passage thereof through bore 31a. At this point the required clamping pressure will be exerted by the blank holder slide against the blank. The draw slide 1, however, will continue to move downwardly to perform the drawing operation on the blank and since the fluid being pumped from the tank through valve 11 is prevented from being carried any place else, it will pass downwardly through conduit 9 and within cylinder 7 against the head of ram 6. Sufficient pressure will have been built up by this time to enable the draw slide to perform its drawing operation.

As soon as the drawing operation begins, the solenoid 14' of valve 14 will again be energized to allow free flow of the additional fluid in pull-back cylinders 18 through lines 16, 17, and 15 and through valve 14 back to the four-way valve 11 to furnish additional fluid for pumping against the head of ram 6 to insure a sufficient build-up of pressure for performing the drawing operation. This condition prevails in Figure 3 at which time the drawing operation is completed and the valve 14 is open for free flow of fluid therethrough.

At the end of the drawing operation, solenoid 14' is again de-energized and the solenoid 11c is energized to move the shuttle 11a of the four-way valve 11 toward the right to the position shown in Figure 4. The various arrows adjacent the respective conduits in Figure 4 illustrate the flow of fluid on the upstroke of the slides. It must be remembered that the clamp slide must remain in place in clamping position while the draw slide is being elevated for stripping purposes. The pressure, therefore, remains in hold-down cylinders 5 until just before the clamp slide is picked up by the draw slide.

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Referring to Figure 4, with the shuttle 11a in the right-hand position all of the fluid pumped from the tank and passing to valve 11 through conduit 10a will pass out of valve 11 through conduit 13. Since conduit 13 is connected directly with pre-fill valve 12 in the head of cylinder 7, there will be sufficient pressure to open this valve and allow the upwardly moving ram 6 to force fluid from the cylinder outwardly through the valve back into the tank.

Since valve 14 is now again de-energized and the shuttle 142 is in its elevated position, the valve member 141 will be seated so that the fluid passing through conduit 13 will also pass through line 13' into valve 14 and will unseat valve 140 against the pressure of its spring to establish communication with the outlet 15 which conducts the fluid through conduits 16 and 17 into the bottom of the pull-back cylinder 18. This action will cause the pistons 19 to rise carrying with them the draw slide 1 and allowing fluid above ram 6 to be discharged through the now open pre-fill valve 12 into the tank.

This condition will prevail until just before the draw slide reaches the flanges 3 on the clamp slide to pick up the clamp slide and carry it upwardly. Just before such position is reached a slow-down of the draw slide is caused by opening valve 45. Any suitable switch means can be arranged to cause the operation of valve 45 at the proper time. The valve 45 is operated by a solenoid, and suitable switches (not shown) are mounted on the draw slide to energize and deenergize the solenoid to operate valve 45. The use of such switches to operate valves have not been shown herein since they form no part of the present invention. As soon as this occurs, fluid from line 49 will slowly pass through valve 55 and line 60 and outwardly through conduit 45a back to the tank. As soon as this occurs the pressure of the fluid in passage 30c in the accumulators will move valve 50 upwardly due to the release of pressure thereabove and permit some fluid to be carried back to the tank through conduit 30d. This will also cause a reduced flow of fluid through conduit 13' because some of the fluid through conduit 13 will now be free to pass through line 60 to valve 45 and outwardly through conduit 45a. This reduced flow of fluid through line 13' will obviously cause a slow-down of the movement upwardly of pistons 19 and, consequently, the draw slide connected thereto.

This condition prevails only momentarily, however, whereupon after contact is made between the draw slide and clamp slide flange 3, valve 45 is again closed and the full force of the fluid through line 13 will continue to elevate the pistons 19 of the pull-back cylinders and to maintain the various pre-fill valves in open position. The release of the pressure within the accumulators while valve 50 is open will be sufficient to cause the air pressure to take over and force valve member 30 upwardly to the position shown in Figure 5. The release of pressure in bore 30b will, at the same time, permit valve member 44 to be lowered and open the passage into conduit 31. Therefore, as the draw slide and clamp slide both move upwardly due to the pressure within pull-back cylinders 18, any fluid which does not pass through the pre-fill valves 20 into the tank will be caused to flow through conduits 22 from the hold-down cylinders 5 through the accumulators and outwardly through conduits 31 which will join the flow of fluid in conduit 13' to aid in the continued elevation of the draw slide.

This condition will continue until both slides have reached their uppermost position illustrated in Figure 1 whereupon the solenoids 11b and 11c will be deenergized and permit the shuttle 11a of valve 11 to again assume its neutral position through the force of the spring located at one end thereof to hold the fluid in the lines and maintain the lines elevated while the pump circulates fluid to and from the tank.

It may be advisable, if desired, to introduce into the system a small volume high pressure pump, 10c the discharge of which is connected to the common fluid pressure line 31 feeding the various accumulators. If for any reason such as minute leakage or expansion of the frame during the draw phase of the stroke cycle the work-holding capacity of the accumulators has been prematurely depleted, the pump 10c has the effect of maintaining this pressure by pumping additional fluid into the lines 31. It is evident, therefore, that the work-holding pressure can be maintained indefinitely and for purposes of die setting it can be built up and maintained independently of work-slide action.

From the foregoing description, it will be evident that two particularly novel features have been introduced into hydraulic presses by means of the present invention. The first and perhaps most important is the provision of the air pressure accumulators which can be independently regulated as to air pressure to thereupon cause the blank holder slide to exert different pressures at different points thereon against the blank by merely turning the regulator valve 42. This feature eliminates the necessity of the operator actuating the slide several times to determine what pressure is being obtained. In the present case the valve regulator is adjusted to the desired and predetermined air pressure and this pressure must be overcome by the hydraulic pressure before the blank holder slide will exert its clamping action. Since these accumulators are connected in the line which leads from the source of fluid supply to the hold-down cylinders, they allow the predetermined pressure to be built up in the hold-down cylinders and then stop any further flow of fluid to those cylinders as long as the pressure is maintained.

The other feature also of considerable importance is that which utilizes the fluid from the pull-back cylinders to charge the hold-down cylinders when the blank holder slide reaches clamping position. This is accomplished as stated above when the pressure in valve 14 is sufficient to unseat valve member 14a whereupon fluid from the pull-back cylinders flows outwardly through conduit 43 and line 34 and joins with the fluid in line 31 being pumped thereto from conduit 9.

I claim:

1. A hydraulic press comprising a draw slide for performing work on a blank, a clamp slide for clamping the work in place while work is performed thereon, fluid operated drive means to move said clamp slide to clamping position, fluid operated pull-back means to move said slides away from the blank, conduit means connected with said pull-back means to discharge fluid displaced therefrom by movement of the draw slide toward the blank, a source of fluid under pressure, a conduit connecting said source with said drive means for the clamp slide, a spring loaded valve in said last named conduit, adjustable fluid pressure accumulator means connected with said source and with said drive means to maintain said clamp slide at a steady predeter-

mined pressure against the blank, means to stop temporarily discharge of fluid from said pull-back means at a predetermined position of said clamp slide before it reaches clamping position to arrest movement thereof, yieldable means operable in response to continued movement of said draw slide to release and discharge further fluid from said pull-back means to said accumulator means until the pressure in said drive means for the clamp slide reaches a predetermined amount, and means responsive to said predetermined pressure to isolate said drive means from said source, whereby said predetermined pressure is maintained.

2. In a hydraulic press having a clamp slide and a draw slide for performing work on a blank, a plurality of hold-down cylinders, a fluid actuated piston in each of said cylinders connected to said clamp slide for moving said clamp slide to clamping position, a fluid actuated ram for moving said draw slide to perform a drawing operation, a plurality of pull-back cylinders, a fluid actuated piston in each of said pull-back cylinders connected to said draw slide for moving both of said slides in a direction away from the blank, a source of hydraulic fluid under pressure, an air controlled accumulator in the fluid line connecting said source with each of said hold-down cylinders, whereby fluid under pressure directed from said source to said hold-down cylinders will pass through said accumulators, means for regulating the air pressure in each of said accumulators to a predetermined amount, and means in each accumulator for stopping flow of fluid to its associated hold-down cylinder when the pressure therein reaches the predetermined air pressure, whereby the pressure on the clamp slide will be maintained.

3. In a hydraulic press having a clamp slide and a draw slide for performing work on a blank, a plurality of hold-down cylinders, a fluid actuated piston in each of said cylinders connected to said clamp slide for moving said clamp slide to clamping position, a fluid actuated ram for moving said draw slide to perform a drawing operation, a plurality of pull-back cylinders, a fluid actuated piston in each of said pull-back cylinders connected to said draw slide for moving both of said slides in a direction away from the blank, a source of hydraulic fluid under pressure, conduits connecting said source with said hold-down cylinders and with said pull-back cylinders, a valve in said conduits between said source and all of said cylinders, and means including said valve and conduits for charging said hold-down cylinders with hydraulic fluid discharged from said pull-back cylinders.

4. In a hydraulic press having a clamp slide and a draw slide for performing work on a blank, a plurality of hold-down cylinders, a fluid actuated piston in each of said cylinders connected to said clamp slide for moving said clamp slide to clamping position, a fluid actuated ram for moving said draw slide to perform a drawing operation, a plurality of pull-back cylinders, a fluid actuated piston in each of said pull-back cylinders connected to said draw slide for moving both of said slides in a direction away from the blank, a source of hydraulic fluid under pressure, conduits connecting said source with said hold-down cylinders and with said pull-back cylinders, a valve in said conduits between said source and all of said cylinders, means including said valve and conduits for charging said hold-down cylinders with hydraulic fluid discharged from said pull-

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back cylinders, an air controlled accumulator in the conduit between said source and each of said hold-down cylinders, whereby fluid under pressure directed from said source to said hold-down cylinders will pass through said accumulators, means for regulating and establishing a predetermined air pressure in each of said accumulators, and means in each accumulator for stopping flow of fluid to its associated hold-down cylinder when the fluid pressure therein reaches said predetermined air pressure, whereby the clamp slide pressure on the blank will be maintained.

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