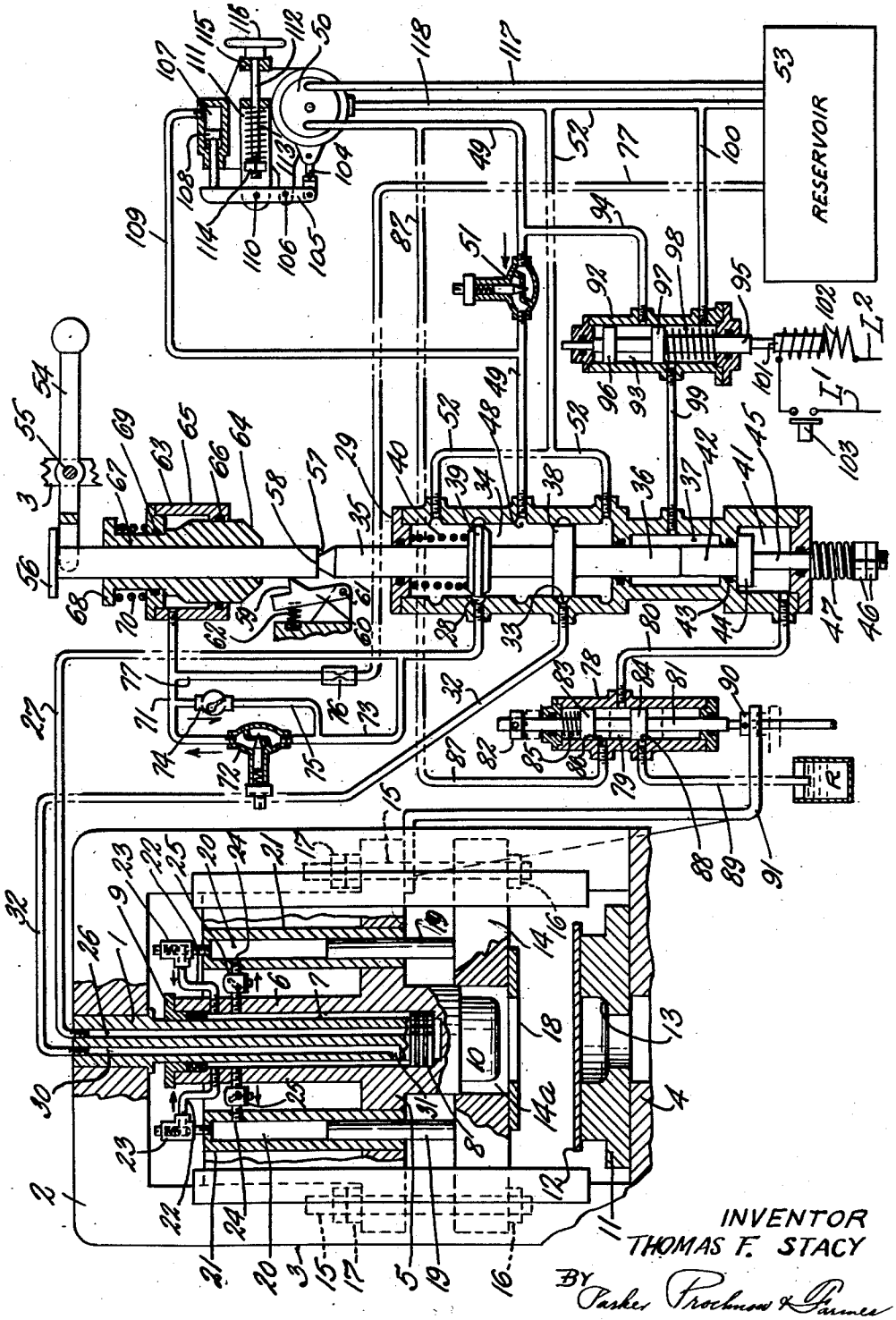
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FLUID OPERATED MOTOR

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FLUID OPERATED MOTOR

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This invention relates to fluid operated motors and also to an improved control for the same, and particularly to motors employing a clamping platen as well as a main platen or working member.

This application is a continuation in part of application bearing Serial No. 256,561 filed February 15, 1939, now Patent Number 2,320,759 granted June 1, 1943.

One object of the invention is to provide an improved fluid operated motor in which a blank to be operated upon may be clamped by fluid pressure of any selected amount while work is being performed on the blank; with which the clamping pressure may be varied as desired; with which the clamping pressure on different portions of the blank may be individually and selectively controlled; and which will be relatively simple, compact, practical and inexpensive.

Another object of the invention is to provide an improved, simple and inexpensive control for a hydraulic motor which will be suitable for use with different types of hydraulic motors, and which will utilize the pump pressure as a pilot source of power for moving the main controlling and reversing valve from reversing position to an intermediate position to stop operation of the motor when the working member of the motor is in a selected zone or range of its movement, whether the working member moves vertically or horizontally.

Other objects and advantages will be apparent from the following description of one example or embodiment of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawing, I have illustrated a simple, hydraulic motor and control therefor, constructed in accordance with this invention, the motor being of the type known as a "drawing press," in which a blank is clamped in selected zones while being operated upon by the drawing dies in another zone.

In the particular illustrated example of the invention, the motor includes a rod-like ram 1 fixed to a head 2 of the press or motor frame 3, with the ram 1 extending towards a bed or base 4. A main platen or working member 5 is mounted in any suitable manner between the side members of the frame 3 for movement back and forth in a direction between the head 2 and bed or base 4. Upon its face toward the head 2, the platen 5 is provided with a projecting, tubular boss 6 having a recess 7 which telescopes over the ram 1. The free end of the ram 1, which is the end within the recess 7, is provided with an enlargement 8 which serves as a piston head and fits the recess 7 and slides along the same as the platen 5 moves back and forth on the frame 3. This head may carry, in peripheral grooves in its periphery, suitable packing, such as split metallic piston rings similar to the piston rings of gasoline engines, which rings resiliently engage the walls of the recess 7 to provide a tight but sliding seal between the head and the recess wall.

The end of the recess 7 nearest the head 2 of the frame is provided with a stuffing box or gland 9 through which the ram 1 slides. This packing gland may be of any suitable construction, such as is commonly used in hydraulic presses for sealing the outer end of a hydraulic cylinder with a renewable packing. The opposite face of the platen 5 is provided with means to removably mount a drawing punch 10, and a complementary aligned drawing die 11 is mounted on the base 4. A suitable metal blank 12 to be operated upon may be disposed on the die 11, so that when the punch 10 approaches the die 11, the blank 12 therebetween will be drawn into a desired shape and size in a cavity or recess 13 in the die 11. A clamping platen 14 is also mounted in the frame 3 so as to slide back and forth in the same direction as the main platen 5, and is provided with an aperture 14a through which punch 10 carried by platen 5 may move. Bolts 15 extend loosely and slidingly through portions of the two platens at opposite sides thereof and carry nuts 16 and 17 on the ends thereof. These bolts 15 are sufficiently long, so that the clamping platen 14 may have relative movement in a direction away from the main platen 5 to the extent limited by the nuts 16 and 17, yet the platen 14 may remain stationary against the blank on the drawing die 11 while the main platen continues to descend or move toward the bed or base 4.

The lower face of the clamping platen 14 is provided with a clamping ring 18 which, when the clamping platen descends, will engage with the periphery of the blank 12 and clamp it against the die 11 around the drawing opening or cavity 13. The platen 14 is provided with a plurality of attached rods 19 forming small rams which extend into cylinders or chambers 20 that are provided in tubular members 21 fixed to the main platen 5, so as to extend parallel to the tubular boss or bushing 6 and in the same direction from

the platen. These chambers 20 may be called "clamping cylinders," and the rods 19 may be called "clamping rams," for purposes of identification. The closed end of each cylinder or chamber 20 is connected through a pipe or conduit 22 to the end of the recess 7 adjoining the packing gland 9, and each pipe 22 has therein an individual pressure relief valve 23 which opens in a manner to pass fluid from the chamber 20 toward the recess 7 whenever the pressure in that chamber exceeds a predetermined pressure for which the relief valve 23 is set. These valves are adjustable individually as to the pressure at which they will open, so that the pressure in any cylinder 20 which will open the valve in the pipe leading therefrom may be made the same as, or different from, other cylinders or chambers 20.

Also connecting the upper end of each chamber 20 to the end of the recess 7 adjacent the packing gland 9 is another pipe or conduit 24 having therein a free check valve 25 which opens freely to pass fluid from the recess 7 to that chamber 20, but closes automatically to prevent reverse flow. With such an arrangement, fluid may pass freely from the recess 7, at the end thereof adjacent the gland 9, to each of the clamping chambers or cylinders 20, but can escape from the latter only through the pressure relief valves 23.

The fixed ram 1 is provided with a bore or passage 26 which extends entirely from end to end thereof, that is, from the larger end face of the piston head 8, to the fixed end of the ram where it is connected to a pipe 27 leading to a port 28 in a main control valve 29. The fixed ram 1 is also provided with another and separate bore or passage 30 which extends from the fixed end to a point immediately back of the piston head 8, where it opens into the recess 7 through a port 31. The end of the passage 30 at the head 2 is connected to a pipe 32 which leads to another port 33, also provided in the valve 29. The ports 28 and 33 are spaced apart along a chamber 34 in the valve 29, and in this chamber 34 is a main valve element 35 which extends through one end of the housing of the valve 29, that is, upwardly in the drawing. The other end 36 of the valve element 35 extends out of the chamber 34 and into a second and separate chamber 37, but is sealed by packing as it passes from one of these chambers to the other. The valve element 35 within the chamber 34 carries a pair of lands 38 and 39, which are spaced apart, and aligned with the ports 28 and 33 when the valve element 33 is in a selected position intermediate the limits of its possible travel in the chamber 34.

A helical compression spring 40 is disposed within the chamber 34 between the land 39 and the adjacent end of the chamber 34, so as to yieldingly urge the valve element 35 into one end position, which would be downwardly in the drawing. The housing of the valve 29 is provided with still another chamber 41 which is aligned endwise with and adjoining the chamber 37, and a piston 42 extends through the wall separating the chambers 37 and 41, there being a suitable packing 43 around the piston 42 as it passes through the wall separating chambers 37 and 41. Within the chamber 41, the piston 42 is provided with a head 44 which, by engagement with the wall between the chambers 37 and 41, limits the possible movement of the piston 42 in a direction toward the end 36 of the valve element 35. The piston 42 carries a rod 45 of decidedly smaller diameter than the shank of the piston 42 which passes into the chamber 47, and this rod 45 extends through the adjacent end of the housing of the valve 29 where it carries adjustable nuts 46. A light, helical compression spring 47 surrounds the outer end of the rod 45 and is compressed between the nuts 46 and the adjacent end of the housing of the valve 29, so as to yieldingly urge the piston 42 back into the chamber 41 and remove it as far as possible, but not fully from the chamber 37. The end of the piston 42 within the chamber 37 abuts endwise against the end 36 of the valve element 35 and limits movement of the valve element 35 under the action of the spring 40.

The valve 29 is also provided with a port 48 opening into the chamber 34 approximately midway between ports 28 and 33, and this port 48 is connected by a pipe 49 to the delivery side of a continuously operating, variable delivery pump 50. Included in the pipe 49 is a check valve 51, such as a pressure relief valve, operating into open position by pressure from the pump at a relatively low pressure, so that there will be a sufficient back pressure on the pump to enable the pump to supply a pilot fluid for a purpose which will appear herein later. The ends of the chamber 34 are connected to branches of a pipe 52, which runs to a suitable reservoir 53. The land 39 is beveled or reduced in thickness at its peripheral edge, as shown in the drawing, so that when that land is in alinement with the port 28, it will not completely close that port, but fluid in the chamber 34 between the lands may pass around the beveled edge of the land 39 at the groove forming the port 28 and reach the end of the chamber 34 where it can pass through the pipe 52 to the reservoir 53.

The valve element 35 may be operated in a direction to compress the spring 40 and place the land 39 between the port 38 and the opening from the adjacent end of the chamber 34 into the pipe 52, in any suitable manner. For example, it may be operated by a lever 54 pivoted at 55 to a suitable part of the frame 3. One end of the lever 54 may be forked so as to engage beneath a head 56 on the end of the valve element 35. The valve element 35 is also provided with a peripheral notch 57 having a crosswise shoulder 58 which may be engaged by the nose 59 of a latch 60 pivoted at 61 to a suitable part of the frame 3. A compression spring 62 acts between the support for the pivot 61 and lever 60, and urges the latch 60 against the valve element 35 so that when the latter is shifted endwise in one direction, which would be upwardly in the drawing, the notch 57 will be brought into alinement with the nose 59 and the latch 60 may then be snapped automatically into latching engagement with the shoulder 58 of the valve element. The latch thus serves to latch the valve element 35 in the position in which it has been moved, with the spring 40 under compression.

A sleeve 63 is slidingly mounted on the valve element 35 outwardly beyond the notch 57, and at its end adjacent the notch 57 is provided with a bevelled surface 64 serving as a cam which will engage with the latch 60 and cam it away from the valve element 35 sufficiently to release the latter. The sleeve 63 extends through the open end of a casing 65, with suitable packing 66 at the open end of the casing through which the sleeve 63 extends. This sleeve has a reduced shank portion 67 which extends slidingly through an aperture in the opposite end of the casing 65 and at its outer end carries a flange 68. A suitable packing 69 is provided for the shank 67 of the

sleeve 63, where it passes through the end of the casing 65. A helical compression spring 70 surrounds the shank 67 and is compressed between the flange 68 and the adjacent end of the casing 65, so as to yieldingly retract the sleeve 63 into the casing 65. The casing 65, of course, is secured in fixed position to a suitable part of the frame 3 or to the same support which mounts the pivot 61 of the latch 60 and the pivot 55 of the operating lever 54.

The chamber of the casing 65, adjacent the end through which the shank 67 extends, opens into a pipe 71 which leads to the discharge side of a pressure relief valve 72, the input side of the valve being connected by a pipe 73 to the pipe 27. This pressure relief valve 72 is of the type which may be adjusted as to the pressure to which it will open. A free check valve 74 is included in a pipe 75 which also connects the pipes 71 and 73 in parallel across the pressure relief valve 72, and this check valve 74 opens only to pass fluid from the pipe 71 to the pipe 73 freely, and closes automatically to prevent reverse flow. A bleed port or valve 76 is included in a pipe 77 leading from the pipe 71 to the reservoir 53, and this bleed port 76 may be of fixed size or adjustable so as to provide a very slight leakage from the pipe 71 to the reservoir 53.

A two-way valve 78 has a valve chamber 79 which is connected by a pipe 80 to the chamber 41 adjacent the end thereof through which the rod 45 extends. Within the chamber 79 is a valve element 81, which extends through opposite ends of the housing of that valve. At one end, the valve element 81 carries a collar or adjustable stop 82 that engages with the adjacent end of the housing of that valve during the movement of the valve 81 in one direction, which would be downwardly in the drawing. The portion of valve element 81 within the chamber 79 carries fixed, spaced lands 83 and 84 which are always on the opposite sides of the opening into the pipe 80. A spring 85 acts between the land 83 and the adjacent end of the housing of that valve, so as to yieldingly urge the valve element 81 in a direction downwardly in the drawing, and carry the lands into the positions shown by the dash lines in the drawing, until limited by the engagement of stop 82 with the end of the housing of the valve 78.

The chamber 79 has a port 86 which is connected by a pipe 87 to the pipe 49 at a zone between the check valve 51 and the pump, so that the pump pressure will always be transmitted through the pipe 87. The port 86 is immediately below the land 83 so as to be in communication with the port opening into the pipe 80, when the valve element 81 is in the position shown in full lines in the drawing. The chamber 79 also has a port 88 which is closed by the land 84 when the valve element 81 is in the full line position shown in the drawing, but uncovered when the valve element moves land 84 into its dash line position. This port 88 is connected by a pipe 89 to a reservoir which is marked "R" on the drawing, and which may be considered as part of the reservoir 53. One end of the valve element 81, exteriorly of the housing of valve 78, carries an adjustable shoulder or collar 90 which is engaged by a laterally extending arm 91 carried by the main platen 5.

When the main platen 5 approaches the desired limit of return movement, determined by the adjustment of collar 90 along element 81, this arm 91 will engage collar 90 on valve element 81 and shift it into the full line position shown on the drawing, where the pipe 87 is connected to the pipe 80. This connects the pump, through the pipes 87 and 80, to the chamber 41, and thus fluid under pressure from the pump forces the piston 42 into the full line position shown in the drawing, where it engages against the end 36 of the valve element 35 and limits movement of the valve element 35 under the action of the spring 40, so that valve element 35 will be held in this intermediate position shown in full lines in the drawing, in which the land 38 closes the port 33 and the land 39 is alined with the port 28. When the main platen 5 advances (moves downwardly in the drawing), the arm 91 will release the collar 90 and the spring 85 will then move the valve element 81 in a direction to carry the lands 83 and 84 from the full to the dash line positions in the drawing, in which the land 83 will close port 86 leading to pipe 87, thus cutting off the pump pressure from the chamber 41. The land 84 will then uncover the port 88 and thus connect the pipe 80 to pipe 89, so as to enable escape of fluid from the chamber 41 to the reservoir.

A monitor valve 92 has a valve chamber 93 which is connected by a pipe 94 to the portion of pipe 49 between the check valve 51 and pump 50. Within the chamber 93, the valve 92 is provided with a valve element 95 which extends entirely through the chamber 93 and both ends of the valve housing, so as to be a pressure balanced valve. Within the chamber 93 the valve element 95 carries spaced lands 96 and 97, and a spring 98 acts between the land 97 and one end of the chamber 93 so as to yieldingly urge the valve element 95 in one direction, such as into the position shown in full lines in the drawing. A pipe 99 opens into the chamber 93 at the opposite side of the land 97 from the opening into the pipe 94 when the valve element 95 is in the position shown in the drawing, and the pipe 99 also opens into the chamber 37 of the main valve element 29. Another pipe 100 opens into the chamber 93 at the end thereof having the spring 98, but nearer the end of the housing than the opening in the pipe 99. Thus, when the valve element 95 is in the full line position shown in the drawing, the pipes 99 and 100 will be in communication, and pipe 94 will merely open into the chamber 93 between the lands.

One end of the valve element 95 is connected to the core 101 of a solenoid having a winding 102, so that when winding 102 is energized, it will operate the valve element 95 downwardly in the drawing, which will compress the spring 98 and carry the land 97 into a position between the openings into the pipes 99 and 100, but without moving the land 96 past the opening into pipe 94. This will place pipes 94 and 99 in direct communication with one another through chamber 93 between the lands, and communication between pipes 99 and 100 will be interrupted by the interposed land 97. The winding 102 is supplied with current through line wires L' and L^2 controlled by a switch 103 of any suitable type. The switch 103 may be of the normally open type, and which is operated into position to complete a circuit through winding 102 whenever an advance of the main platen 5 is desired.

As explained hereinbefore, the pump 50, while continuously operating, is preferably of the type known as a variable delivery pump, which automatically sets itself to no delivery position when the pressure on the delivery side exceeds a predetermined pressure for which the pump is set.

These pumps are well known in the art and hence pump 50 has been shown only diagrammatically or schematically in the drawing. Brief reference will be made thereto to illustrate certain operative parts thereof. The rate of delivery is varied from zero delivery to full delivery by the shifting of a yoke within the pump, which yoke has an outwardly extending, operating rod 104 which is hingedly connected to a lever 105 pivoted at 106 to the pump frame. The pump frame also carries a small pilot cylinder 107 in which reciprocates a pilot piston 108 having an outwardly extending shank that bears against one end of the lever 105. The chamber of the pilot cylinder 107 is connected by a pipe 109 to the portion of pipe 49 between the choke valve 51 and the port 48 of valve 29, so that the pressure in the cylinder 107 will always be the same as that at the port 48. Any fluid pressure in the cylinder 107 will tend to force the lever 105 counter-clockwise in the drawing, and shift the rod 104 in a direction to decrease the rate of delivery of the pump.

Hinged to the lever 105 at 110 is a link 111 through one end of which a rod 112 slidingly extends. A spring 113 is compressed between the end of the link 111 through which the rod 112 extends, and a nut 114 carried on the rod 112. The rod 112 is rotatably and non-slidably confined in a bearing 115 on the pump frame and may be rotated by a hand wheel 116. By turning the wheel 116, the nut 114, which is held against rotation relative to the link 111, will be shifted along the rod 112 so as to compress the spring 113 to different extents. The spring 113 opposes rocking of lever 105 in a direction to decrease the rate of delivery, so that until pressure in the pilot cylinder 107 is sufficient to overcome the spring 113, the latter will, through the link 111, keep the yoke rod 104 in a position to set the pump yoke for full delivery. The intake side of pump 50 is connected by pipe 117 to the reservoir 53, and a pipe 118 connects the pump to pipe 52 leading to reservoir 53, so as to return to the reservoir any slippage liquid in the pump.

The operation of this press and the controls therefor will now be described. The various parts shown in full lines in the drawing will be the positions occupied when the press is in idle position, with both platens retracted and with a blank 12 to be drawn or operated upon, in position against the die 11. The pump 50 is being driven continuously by a suitable source of power, not shown, and it draws its supply of operating liquid from the reservoir 53 through pipe 117. The pump delivers fluid under pressure through the pipe 49, and the pressure relief or choke valve 51 creates a minimum back pressure on the pump, which pressure is conducted through the pipe 94 to chamber 93 of the monitor valve 92. The fluid passing the choke valve 51 will enter the chamber 34 of main valve 29, pass around the land 39 and return to the reservoir through the pipe 52. The fluid under pressure from the pump is also communicated through pipe 87, valve 78 and pipe 80 to the chamber 41 where it acts on piston 42 to hold it in the active position shown in full lines, where it prevents movement of valve element 35 under action of spring 40 beyond the intermediate position shown in full lines. The land 38 closes port 33 that opens into pipe 32, so that no fluid can escape from chamber 7 at the smaller side of the piston head 8. The main platen 5 is thus held in elevated position or against advance, and the platen 5, through rods 15, holds the clamping platen also elevated in the position shown.

If now one desires to cause an advance of the main platen 5 and a drawing operation, after the blank 12 has been placed in position, the operator presses the switch 103 which temporarily closes a circuit through the winding 102. This causes an operation of valve element 95 into a position to connect the pipe 94 and 99, and thus transmit fluid under pressure from the pump into the chamber 37. This pump pressure in chamber 37 balances the pressure from chamber 41, but no movement of the piston 42 necessarily results or is material. The fluid pressure in chamber 37 forces the valve element end 36 toward chamber 34, which moves the valve element 35 in a direction to compress spring 40 and carry notch 57 into alinement with nose 59 of latch 60, and when that alinement occurs, the latch 60 snaps into latching engagement with valve element 35. This action is fairly rapid and, when completed, the attendant may release switch 103 and open the circuit through winding 102. The valve element 95 then returns to the position shown in full lines in the drawing, where it connects pipes 99 and 100 and relieves pressure from the chamber 37. The valve element 35, however, remains in the position into which it has been moved because of the action of the latch 60.

When the valve element 35 is in this latched position, the port 48 communicates with port 28 and the land 39 is between port 28 and the adjacent connection to the pipe 52, so that fluid entering chamber 34 at port 48 from the pump can no longer escape back to the reservoir, but instead will pass through the pipe 27 into passage 26 of the fixed ram, thence to the other end of the ram and into the closed end of the recess 7. This pressure in this closed end of the recess 7, which covers the entire end area of the piston head 8, will force the main platen 5 downwardly, or in an advancing direction toward the blank 12. The clamping platen 14 will move with the main platen toward the blank 12. During the advance of the platen 5, the liquid displaced from the smaller side of the piston 8 in recess 7 will escape through the port 31, passage 30 and pipe 32 to the valve 29, and thence directly across the chamber 34 to pipe 52, where it may return to the reservoir.

When the clamping ring 18 of the platen 14 engages the blank 12, no further movement of the clamping platen 14 will occur, and it will have relative sliding movement on the rods 15 as the main platen 5 continues to advance. When the two plates 5 and 14 are moving together as just explained, there is no relative movement of the small rams 19 in the cylinders 20 that are carried by the platen 5, but as soon as the clamping platen 14 stops its movement, due to engagement of the clamping ring with the blank, any further advance of the platen 5 will cause a relative movement of the rams 19 further into the cylinders 20 with the displacement of fluid therethrough. The check valves 25 will close automatically and hence all of the fluid from cylinders 20 will be forced to escape through pressure relief valves 23 to the retraction chamber of the recess 7, and thence through port 31, passage 30 and pipe 32 back to the reservoir. Inasmuch as fluid may escape from the cylinders 20 only when pressure is above a selected pressure for which the valves 23 are set, this will maintain a predetermined pressure on the clamping platen 14 and thus on the blank 12. If one desires to vary the clamping pressure at different zones of the clamped portion of the blank, one changes the setting of the

pressure relief valves 23 so that they will open at the desired pressure on the blank at the particular zone.

The continued advance of the main platen 5 causes the die 10 to engage the blank, and by cooperation with the die 11, draw the blank to the desired shape and size. When the blank is deformed in this respect, the pressure will then build up rapidly and will cause a release of the valve element 35 by disengagement of the latch 60 from the shoulder 64. It will also be understood that the latch 60 may be disengaged by the main platen 5 when it reaches a predetermined position instead of in response to pressure, because such position-release mechanism for a latch of a reversing valve is well known in the art and, for that reason, has not been illustrated. Such release mechanism may include a pilot circuit or it may be a fully mechanical mechanism.

To disengage the latch 60 by the mechanism illustrated, it will be noted that the pipe 73 is connected to the pipe 27 leading to the advancing chamber and, therefore, is subjected to the same fluid pressure as the advancing chamber. When the pressure in the advancing chamber on the main ram exceeds a pressure for which the pressure relief valve 72 is set, that valve opens and passes fluid to the chamber within the casing 65, where the pressure immediately forces the sleeve 63 towards the latch 60 and cams the latter out of engagement with the shoulder 64, thus releasing the valve element 35. The spring 70 is overcome by a lesser pressure than that necessary to open the valve 72, so that as soon as this valve 72 opens, the sleeve 63 will move promptly to release the valve element 35.

When the valve element 35 is released in this manner, the spring 40 moves it endwise so as to dispose the land 39 between the ports 28 and 48, and the land 38 between the port 33 and the opening of the pipe 52 into the adjacent end of chamber 34. This serves to connect the pipe 49 from the pump to the pipe 32 leading to the retracting chamber and to vent the pipe 27 leading to the advancing chamber directly to the pipe 52 leading to the reservoir. This causes a reversal of travel of the main platen 5, and as the platen 5 is retracted, the check valves 25 open freely to pass fluid from the retraction chamber into the cylinders 30, so that the pump pressure is then exerted in the cylinders 20. This holds the clamping platen against the blank while the main platen 5 moves upwardly far enough to disengage the draw punch 10 from the blank.

After the main platen 5 has completed a portion of its return travel, the nuts 16 will engage the clamping platen 14 and the two platens will then move together, through bolts 15, during the remainder of the retraction of the main platen 5. When the main platen 5 approaches the desired limit of its return movement, or retraction, the arm 91 will engage collar 90 and shift valve element 81 into a position to connect the pipes 87 and 80 and thus place the pump pressure in chamber 41. The pump pressure in chamber 41 forces the piston 42 endwise and the latter, through engagement with the end 36 of the valve element 35, will shift the latter endwise against the action of the spring 40 until it returns to the intermediate position shown in full lines in the drawing. This stops further retraction of the platen 5 and the parts will then remain in the same position until a new advance is initiated by the operation of the lever 54 or push button 103.

If the pressure in the pipe 49 beyond the check valve should become excessive, it will be transmitted to the pilot cylinder 107 of the pump and set the yoke of the pump in "no delivery" position. Thus, the pump, although continuously running, will not build up a dangerously high pressure.

When pressure in the advance chamber of recess 7 is reduced, which happens during a retraction of the main platen, fluid from casing 65 may pass through the check valve 74, so that spring 70 may retract sleeve 63 back into casing 65 and release latch 60 for re-engagement with valve element 35. The bleed port also vents casing 65 slowly for the same purpose.

I claim as my invention:

1. The combination of a fluid pressure actuated press including a main platen and its operating ram, and a pull-back chamber for said platen, a clamping platen movable relatively to the main platen, an operating ram and chamber for said clamping platen, means for the delivery and discharge of operating fluid back and forth between the pull back and clamping chambers, one way check passing fluid freely from the pull back chamber to the clamping platen chamber and automatically preventing reverse flow, and a relief valve acting responsive to pressure in the clamping chamber independently of the pressure in the pull-back chamber and controlling discharge of fluid from the clamping chamber, into the pull-back chamber and preventing reverse flow therethrough.

2. In a fluid operated press, a main platen, a clamping platen, means by which said main platen may be advanced, means by which said main platen may be retracted, ram means operable on said clamping platen for advancing it in a clamping direction, cylinder means in which said ram means operates in said direction by fluid pressure, means connected to said cylinder means for moving the same concurrently with said main platen in a direction to compress any operating fluid in said cylinder means and thereby exert a clamping pressure on said clamping platen when said main platen is advancing and the clamping platen encounters resistance, and a connection to said cylinder means for fluid flow between it and said retracting means and having therein means to pass fluid freely into said cylinder means and prevent reverse flow therein and also having therein a pressure release valve to release fluid from said cylinder means to said retracting means only in excess of a selected, desired clamping pressure.

3. In a fluid operated press, a main platen, a clamping platen, means including advancing and retraction chambers by which said main platen may be advanced and retracted, ram means operable on said clamping platen for advancing it in a clamping direction, cylinder means in which said ram means operates in said clamping direction by fluid pressure within said cylinder means, means connected to said cylinder means for moving the same concurrently with said main platen when advancing in a direction to compress any operating fluid in said cylinder means, and thereby exert a clamping pressure on said clamping platen, a connection from said retraction chamber to said cylinder means and having therein a check valve opening to pass fluid freely from said retraction chamber to said cylinder means and prevent reverse flow therethrough, and a pressure relief valve to release fluid from said cylinder means to said retraction chamber only in excess of a selected clamping pressure and in a

direction toward said retraction chamber, whereby the clamping pressure on said clamping platen during advance of said main platen and after the clamping platen has engaged work will be that determined by the pressure in said cylinder means not exceeding said selected clamping pressure and independent of the pressure in said pull-back chamber.

4. In a fluid operated press, a relatively fixed ram having a piston head, a main platen having a chamber therein opening from one end and into which said ram extends at said one end with said piston head within said chamber, means sealing the said ram at the open end of said chamber, means for admitting fluid to opposite sides of said piston head alternately so as to cause advances and retractions of said main platen, a clamping platen mounted for movement in the same direction as said main platen and having a clamping ram extending therefrom toward said main platen, said main platen having a recess therein forming a clamping chamber into which said clamping ram extends, a lost motion connection between said platens by which they may separate or approach one another to a limited extent, and move together as a unit, a connection from said first chamber at the smaller side of said piston head to the closed end of said clamping chamber, said connection having means therein to pass fluid freely from said pull-back chamber to said clamping chamber and to pass fluid in the reverse direction from said clamping chamber toward said pull-back chamber only when the pressure in said clamping chamber exceeds a selected pressure.

5. In a fluid operated press, a main platen, a clamping platen, means including advancing and retraction chambers, by which said main platen may be advanced and retracted, means for admitting fluid under pressure to said chambers alternately and releasing it from the other chamber, whereby said main platen may be caused to advance and be retracted, a plurality of rams movable with said clamping platen, cylinders into which said rams extend, said cylinders being movable with said main platen, a connection between said retraction chamber and said cylinders and including therein pressure operated relief valves, one for each cylinder, opening under selected pressures to pass fluid solely from said cylinders toward said retraction chamber, the connection also having a check valve opening to pass fluid freely in a direction from said pull-back chamber toward said cylinders but closing automatically against reverse flow so as to force operating fluid escaping from each of said cylinders through a related one of said pressure relief valves, said pressure relief valves being individually adjustable, whereby the pressure at which they will open may be varied individually, and a lost motion connection between said platens, whereby they may move together as a unit and also move relatively toward and from one another to a limited extent.

6. In a fluid operated press, a relatively fixed ram having a piston head, a main platen having a chamber therein opening from one end and into which said ram extends at said one end with said piston head within said chamber, means sealing the said ram at the open end of said chamber, means for admitting fluid to opposite sides of said piston head alternately so as to cause advances and retractions of said main platen, a clamping platen mounted for movement in the same direction as said main platen and having a plurality of clamping rams extending therefrom toward said main platen, said main platen having recesses forming cylinders into which said clamping rams extend, a lost motion connection between said platens by which they may separate or approach one another to a limited extent and also move together as a unit, a connection between said clamping cylinders and said chamber at the smaller side of said piston head and having individual pressure relief valves through one of which fluid must pass in leaving a related clamping cylinder, each of said valves being set to open, when the pressure in said related cylinder exceeds a predetermined pressure, and release fluid from said related cylinder, said valves being individually adjustable as to the pressures at which they will open, said connection also including a free check valve in parallel to each pressure relief valve and opening freely to pass fluid in a direction toward each of said clamping cylinders and closing automatically to prevent reverse flow through the check valves.

7. In a fluid operated press, a relatively fixed ram having a piston head on the free end thereof, a main platen having a chamber therein into which said ram extends, with said piston head within said chamber, means for sealing said ram at the open end of said chamber, means for admitting fluid to opposite sides of said piston head alternately and releasing it from the other side so as to cause advances and retractions of the main platen, a clamping platen supported by the main platen but movable thereon to a limited extent toward and from said main platen, said main platen having a plurality of recesses on the face toward said clamping platen and forming clamping cylinders, a ram in each of said cylinders, and operating by fluid pressure in said cylinders on said clamping platen to force it in a direction away from said main platen, fluid conducting means connecting each of said cylinders with said chamber on the smaller side of said piston head, said conducting means having therein pressure relief means passing fluid from said cylinders toward said chamber at the small side of said head when the pressure in said cylinders exceeds a predetermined pressure, said passage means also having means to permit free flow of fluid in a direction from said chamber at the small side of said piston head toward said cylinders.

8. In a fluid operated press, a relatively fixed ram having a piston head on the free end thereof, a main platen having a chamber therein into which said ram extends, with said piston head within said chamber, means for sealing said ram at the open end of said chamber, means for admitting fluid to opposite sides of said piston head alternately and releasing it from the other side so as to cause advances and retractions of the main platen, a clamping platen supported by the main platen but movable thereon to a limited extent toward and from said main platen, said main platen having a plurality of recesses on the face toward said clamping platen and forming clamping cylinders, a ram in each of said cylinders, and operating by fluid pressure in said cylinders on said clamping platen to force it in a direction away from said main platen, fluid conducting means connecting each of said cylinders with said chamber on the smaller side of said piston head, said conducting means having therein pressure relief means passing fluid from said cylinders toward said chamber at the small side of said head when the pressure in said cylinders exceeds a predetermined pressure, and also having one-way means to pass fluid solely in a direction from said chamber at the small side of said piston head toward said cylinders, said pressure relief means includ-

ing an individual pressure relief valve controlling the escape of fluid from each clamping cylinder and individually adjustable as to the pressure at which it will open, whereby the pressure in different clamping cylinders may be regulated by selective regulation of said pressure relief valves.

9. In a fluid operated press, a main platen, a clamping platen, means for causing advances and retractions of said main platen, a lost motion connection by which they may move together and said clamping platen may also move to a limited extent toward and from said main platen, ram means operable on said clamping platen to move the latter in a direction relatively away from said main platen, cylinder means movable with said main platen and telescoping with said ram means, means for allowing said cylinder means to fill with fluid when said clamping platen moves away from said main platen and preventing escape of fluid from said cylinder means, means for releasing fluid from said cylinder means to said means for causing retractions of said main platen when the fluid pressure in the cylinder means exceeds selected pressures, whereby when the clamping platen is held back while said main platen is advancing, the clamping platen will be urged in the direction of said advance by said selected pressures.

10. In a fluid operated press, a main platen, a clamping platen, means for causing advances and retractions of said main platen, a lost motion connection by which they may move together and said clamping platen may also move to a limited extent toward and from said main platen, ram means operable on said clamping platen to move the latter in a direction relatively away from said main platen, cylinder means movable with said main platen and telescoping with said ram means, means for passing fluid freely from retraction causing means to said cylinder means to fill the latter with fluid when said clamping platen moves away from said main platen and for preventing escape of fluid from said cylinder means, means for releasing fluid from said cylinder means to said means for causing retractions of said main platen when the fluid pressure per unit area in the cylinder means exceeds selected pressures, whereby when the clamping platen is held back while said main platen is advancing, the clamping platen will be urged in the direction of said advance by said selected pressures, said cylinder means comprising a plurality of individual cylinders, and said rams comprising a plurality of rams individually telescoping with said cylinders, and said fluid releasing means including an individual pressure relief valve for each cylinder and which is individually adjustable.

11. In a fluid operated drawing press of the type having a main platen, a clamping platen connected to the main platen with a lost motion in the direction of platen travel, an advancing chamber and a retraction chamber for causing movements of said main platen in opposite directions, and a hydraulic ram motor between said platens for urging the clamping platen yieldingly in a direction in advance of the main platen to the extent permitted by said lost motion, that improvement which comprises two passages between said ram motor and said retraction chamber, a one-way check valve in one of said passages passing fluid from said retraction chamber to said ram motor, and a pressure relief valve in the other of said passages and passing fluid from said ram motor back to said retraction chamber when the pressure per unit area in said ram motor exceeds that in said retraction chamber by a selected amount.

12. In a fluid operated drawing press of the type having a main platen, a clamping platen connected to the main platen with a lost motion in the direction of platen travel, an advancing chamber and a retraction chamber for causing movements of said main platen in opposite directions, and a plurality of ram motors between said platens for urging the clamping platen yieldingly in a direction in advance of the main platen to the extent permitted by said lost motion, and spaced apart around the periphery of the clamping platen, that improvement which comprises two passages between each of said ram motors and said retraction chamber, a one-way check valve in one of said two passages to each ram motor and passing fluid from said retraction chamber to that ram motor, and a pressure relief valve in the other of said passages to the same ram motor and passing fluid from that ram motor back to said retraction chamber when the pressure per unit area in that ram motor exceeds that in the retraction chamber by a selected amount, said pressure relief valves being individually adjustable to enable variation in the pressure urging the clamping platen forwardly at different zones of the clamping platen.

13. In a fluid operated drawing press, a relatively fixed ram, a cylinder sliding on said ram and forming a main platen, advancing and retraction chambers acting between said platen and fixed ram to advance and retract said platen, a plurality of clamping cylinders carried by said platen, a clamping ram in each clamping cylinder, a clamping platen attached to said clamping rams and urged in a direction in advance of said main platen by fluid pressure in said clamping cylinders, means limiting advance movement of said clamping platen to a selected extent, a pair of passages between each of said clamping cylinders and said retraction chamber, one passage of each pair having a one-way check valve passing fluid solely and freely from the retraction chamber to the related clamping cylinder, the other passage of that pair having a pressure relief valve passing fluid solely from that related clamping cylinder to said retraction chamber whenever the pressure per unit area in that related clamping cylinder exceeds that in said retraction chamber by a selected extent.

14. In a fluid operated drawing press, a relatively fixed ram, a cylinder sliding on said ram and forming a main platen, advancing and retraction chambers acting between said platen and fixed ram to advance and retract said platen, a plurality of clamping cylinders carried by said platen, a clamping ram in each clamping cylinder, a clamping platen attached to said clamping rams and urged in a direction in advance of said main platen by fluid pressure in said clamping cylinders, means limiting advance movement of said clamping platen to a selected extent, a pair of passages between each of said clamping cylinders and said retraction chamber, one passage of each pair having a one-way check valve passing fluid solely and freely from the retraction chamber to the related clamping cylinder, the other passage of that pair having a pressure relief valve passing fluid solely from that related clamping cylinder to said retraction chamber whenever the pressure per unit area in that related clamping cylinder exceeds that in said retraction chamber by a selected extent, said

pressure relief valves being selectively adjustable to open at different selected pressures, whereby the clamping pressures at different zones of a blank being operated upon may be made the same or selectively different.

15. The combination of a fluid pressure actuated press including a main platen and its operating ram, and a pull back chamber for said platen, a clamping platen movable relatively to the main platen, an operating ram and chamber for said clamping platen, means for the delivery and discharge of operating fluid to and from the pull back chamber, a connection having a one-way check valve for the free delivery of the fluid from the pull back chamber into said clamping chamber and preventing return flow therethrough, and a pressure relief valve which opens upon a predetermined pressure in the clamping chamber independently of the pressure in the pull back chamber to discharge fluid from the clamping chamber into the pull back chamber.

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