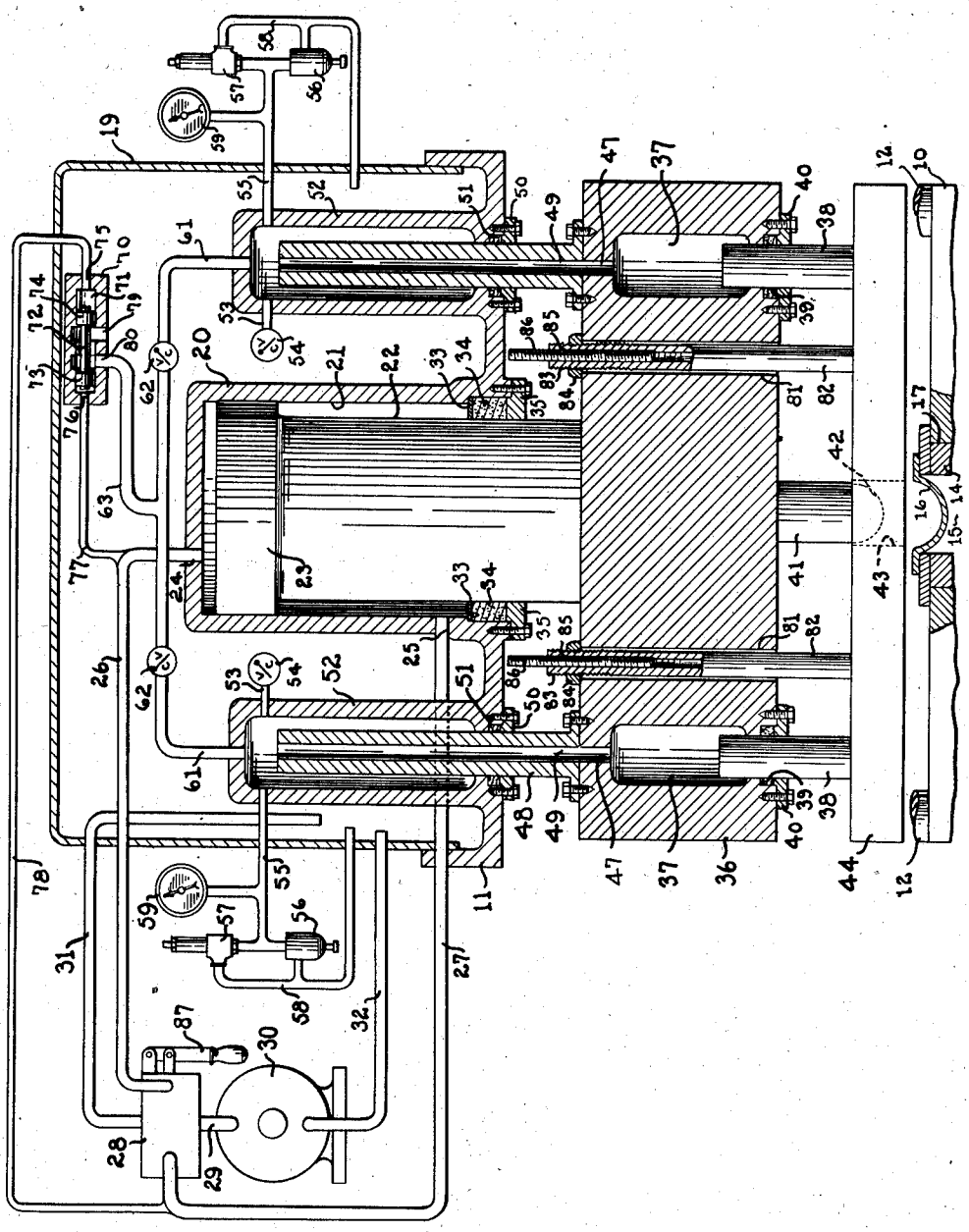
Aug. 18, 1942. W. ERNST 2,293,335

PRESS

Original Filed March 27, 1939



Inventor
WALTER ERNST
by Goudmin & Goudmin
Attorneys

Patented Aug. 18, 1942 2,293,335

UNITED STATES PATENT OFFICE

2,293,335

PRESS

Walter Ernst, Mount Gilead, Ohio, assignor to The Hydraulic Development Corp. Inc., Wilmington, Del., a corporation of Delaware

Original application March 27, 1939, Serial No. 264,311. Divided and this application December 6, 1940, Serial No. 368,899

5 Claims. (Cl. 113—45)

This invention relates to presses, and in particular, to hydraulic presses having clamping mechanism associated with drawing mechanism.

One object of this invention is to provide a hydraulic press having a drawing plunger and a clamping plunger, means being provided for releasing the pressure from the clamping plunger during the retraction stroke of the drawing plunger, together with means for preventing the release of this pressure during the drawing stroke.

Another object is to provide a hydraulic press having a drawing plunger and a clamping plunger, together with means responsive to the reversal of pressure fluid for retracting the drawing plunger in order to release the pressure in the clamping plunger.

Another object is to provide a hydraulic press having a drawing plunger and a clamping plunger, together with a valve shifted in response to the reversal of the drawing plunger by pressure fluid supplied for retracting the latter so that the valve for releasing the pressure from the clamping plunger is automatically actuated by the pressure condition existing in the drawing plunger circuit without the necessity for the provision of linkages or other mechanism interconnecting the drawing plunger with the valve.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing, which is a diagrammatic view, partly in section, showing the working elements of a hydraulic drawing press circuit according to one embodiment of this invention, wherein a reversing valve controls the distribution of fluid to the drawing plunger.

This is a divisional application of my copending application, Serial No. 264,311, which was filed March 27, 1939, and has matured into Patent No. 2,252,881.

General arrangement

In general, the drawing press of this invention consists of a drawing plunger and a plurality of clamping plungers having relief valves associated therewith for release of the pressure fluid therein at predetermined pressures, thereby enabling a predetermined clamping pressure to be exerted on the blank. The relief valves may be set at different loadings so as to provide different clamping pressures at different points upon the blank. Check valves are employed to prevent the interflow of fluid between the various clamping cylinders, thereby preventing equalization of clamping pressures. The hydraulic circuit also includes a two-way valve connected to the clamping cylinders, and operated in response to the admission of pressure fluid into the retraction circuit of the drawing plunger. By this arrangement it is impossible to release the clamping pressure until the retraction stroke of the drawing plunger has been started.

Hitherto, the provision of a platen-operated valve for releasing the pressure from the clamping cylinders has required complex mechanism, such as linkages actuated by the platen for shifting the valve. This, in turn, has required an individual adjustment of this mechanism to be made every time the dies are changed, and has always created the danger of erroneous adjustment whereby the valve would not be operated at all, or would be operated at the wrong position.

According to the present invention, however, the platen-operated mechanism for shifting the valve is entirely eliminated, and instead the valve is shifted by pressure fluid applied thereto when pressure fluid is admitted into the retraction circuit of the drawing plunger. This construction simplifies the external appearance of the press, results in economy of manufacture, avoids the possibility of maladjustment and saves the time hitherto required for adjusting the platen-operated mechanism to suit various dies. According to the present invention also the clamping pressure releasing valve is preferably mounted inside the oil reservoir so that leakage is of no consequence.

Structural arrangement

Referring to the drawing in detail, the structure shown therein illustrates diagrammatically a hydraulic metal drawing press having a base member 10 connected to a top member 11 by tie rods 12, the latter being cut off for simplicity of showing. Mounted in the base member 10 is a drawing die 14 having a die cavity 15 for receiving the blank 16. The die 14 is received within a bore 17 in the base member 10. The drawing press of the present invention may utilize either flat blanks or blanks which have already been subjected to one or more drawing operations. In the drawing the blank 16 is illustrated as having been previously subjected to one drawing operation and in position for another drawing operation, which will elongate it and cause it to be drawn downwardly into the die cavity 15.

Associated with the top member 11 of the press is a surge tank 19 or oil reservoir for containing the working fluid by which the press is actuated.

Also associated with the top member 11 is a main cylinder or drawing cylinder 20, having a bore 21 reciprocably receiving the double-acting main plunger or drawing plunger 22 having a piston head 23 thereon. The cylinder 20 is provided with upper and lower ports 24 and 25 on opposite sides of the piston head 23, and adapted by means of pipes 26 and 27 to supply pressure fluid to advance or retract the drawing plunger 22. The delivery of pressure fluid to the main cylinder 20 and the exhaustion of fluid therefrom are controlled by a four-way valve 28. This valve 28 is of any suitable type known to those skilled in the art, and its details form no part of the present invention.

Leading to the four-way valve 28 is a pressure line 29, connected at its opposite end to a hydraulic pump 30. An exhaust line 31 leads from the four-way valve 28 to the interior of the surge tank 19. The pump 30 is also provided with a suction line 32, likewise leading into the interior of the surge tank 19 for supplying fluid to the pump. The main or drawing cylinder 20 is provided, near its lower end, with a packing ring 33 having a packing 34 associated therewith and adapted to be compressed by a gland 35 in such a manner as to prevent leakage around the drawing plunger 22.

Mounted upon the lower end of the drawing plunger 22 is a platen 36 containing clamping cylinders 37, having clamping plungers 38 reciprocable therein. Each clamping cylinder 37 is provided with a packing 39 surrounding the clamping plunger 38, and compressed by a gland 40 for the prevention of leakage. Mounted upon the platen 36 is a drawing die member or punch 41, cooperating with the drawing die 14 and having a nose portion 42 approximately corresponding to the die cavity 15. The punch 41 is adapted to pass through an aperture 43 in a clamping member 44, the latter being secured to the outer ends of the clamping plungers 38.

The clamping cylinders 37 are provided with passages 47 connected to the bores 49 of tubular plungers 48, mounted upon the upper side of the platen 36. The hollow plungers 48 pass through glands 50 and packings 51, into cylinders 52 arranged on the press top member 11 and within the surge tank 19. From each cylinder 52 the line 53 leads through the check valve 54 to the interior of the surge tank 19. Each check valve 54 opens in the direction of the cylinder 52 so that the latter may draw in fluid upon the descent of the hollow plungers 48. The check valves 54, however, close and prevent the discharge of fluid upon the ascent of the plungers 48.

From each cylinder 52 a T-shaped line 55 leads also to a safety valve 56 and a pressure relief valve 57. The safety valve 56 is merely provided as an additional safety feature in the event of a jamming or other failure of the safety valve 57. The safety valve 56, however, is set to release pressure at a higher pressure than the safety valve 57, hence, does not become operative unless the safety valve 57 fails to release fluid in response to the accumulation of a dangerous pressure within the corresponding clamping cylinder 37. Each clamping cylinder 37 is provided with its own pressure-relief valve 57 and safety valve 56 so that a different pressure release point may be provided for each clamping cylinder 37, if desired. This, in turn, enables different clamping pressures to be exerted upon different portions of the periphery of the blank 16, a feature which is useful in certain classes of drawing work.

The valves 56 and 57 both discharge into the discharge line 58, leading to the interior of the surge tank 19. A pressure gauge 59 is connected to each line 55 to indicate pressure existing in the associated clamping cylinder 37. Extending from each clamping cylinder 52 is a line 61 having therein a check valve 62, opening in a direction away from its associated clamping cylinder 52 and toward a common line 63 connected thereto. The line 63 leads to a two-way valve 70, having a cylindrical bore 71 containing a valve member 72 with valve heads 73 and 74. The opposite ends of the cylinder bore 71 are provided with ports 75 and 76. A branch line 77 leads from the line 26 to the port 76, whereas a branch line 78 leads from the line 27 to the port 75. The cylinder bore 71 likewise contains a discharge port 79, opening directly into the interior of the surge tank 19, and an additional port 80 to which the line 63 is connected. The end portions of the valve bore 71 immediately adjacent the ports 75 and 76 serve as pilot chambers or valve-actuating chambers for shifting the valve member 72 in response to the reception of pressure fluid either along the line 78 or 77 from the line 27 or 26, respectively.

The platen 36 is provided with bores 81 adapted to receive rods 82, the lower ends of which are secured to the clamping platen 44 and the upper ends of which are externally threaded, as at 83, and provided with nuts 84 threaded thereon. The upper ends of the rods 82 are likewise provided with internal threaded bores 85, carrying the threaded rods 86. This construction provides means for stripping the workpiece from the punch 41 when the rods 86 encounter the press top member 11 upon the return stroke of the main plunger 22. The construction permits this ejection or knock-out point to be accurately adjusted for each different type of workpiece.

Operation

In the operation of the circuit shown in the drawing, the pump 30 is placed in operation, and the valve 28 is shifted by means of its operating lever 87 so that pressure fluid is admitted to the line 26, and thence to the upper part of the main cylinder 20 above the piston head 23. At the same time fluid is exhausted from beneath the piston head 23, through the line 27, and is discharged through the valve 28 to the line 31, and thence into the surge tank 19. When this occurs pressure fluid likewise passes through the line 77 and port 76, into the left-hand end of the cylinder bore 71, any fluid in the right-hand end of the cylinder bore 71 being discharged through the port 75 and line 78 by way of the valve 28 and line 31, into the surge tank 19.

Under the influence of the pressure in the line 77 the valve member 72 is pushed to the right so that the valve head 73 comes to rest between the ports 80 and 79. Under these conditions liquid is trapped in the left-hand end of the cylinder bore 71, and cannot escape through the port 79. Ordinarily, a surge valve is provided in the top of the main cylinder 20 to admit fluid freely upon the downward stroke of the drawing plunger 22, thereby accelerating the gravitational descent of the platen 36. This surge valve is omitted for simplicity of disclosure, and its use is well known to those skilled in the art.

As the main plunger 22 moves downward it carries with it the platen 36 and the clamping

assembly, which includes the clamping platen 44, the clamping plungers 38 and the tubular plungers 48. The suction thereby created in the cylinders 52 opens the check valves 54 and causes fluid to be drawn from the surge tank 19, into the cylinders 52. When the clamping member or clamping platen 44 has descended to a point where it engages the workpiece 16 it halts. The platen 36, however, continues to advance and moves the punch 41 into engagement with the workpiece 16. By reason of the relative motion thus created between the halted clamping plungers 38 and the moving clamping cylinders 37, fluid is displaced by the plungers 38 from the cylinders 37. The displaced fluid passes through the bores 49, into the cylinders 52. As the cross sectional area of the clamping plungers 38 is greater than the cross sectional area of the tubular plungers 48, however, more fluid is discharged from the clamping cylinders 37 into the cylinders 52 than there is room for. This results in pressure being built up in the cylinders 37 and 52, and this pressure acts against the heads of the plungers 48 and 38 to force the clamping member or clamping platen 44 firmly into engagement with the periphery of the workpiece 16.

When pressure in this clamping system exceeds the setting of the relief valves 57, the latter open and permit the excess fluid to be discharged through the lines 58, into the surge tank 19. The check valves 54 prevent the escape of fluid through the lines 53, and the closed position of the valve 70 prevents the discharge of fluid from the line 63 since the valve head 73 now stands between the ports 80 and 79. Consequently, the clamping platen 44 grips the periphery of the workpiece or blank 16 while the punch 41 is urged downward by the main platen 36, thereby performing the drawing operation upon the workpiece 16. When the required operation has been completed, the valve lever 87 is manipulated to shift the four-way valve 28 so that pressure fluid is discharged from the pump 30, into the line 27 leading to the retraction side of the main plunger 22. At the same time the space above the piston head 23 is open to exhaust through the line 26, the four-way valve 28 and the exhaust line 31 leading to the surge tank 19. Under these conditions the main plunger 22 and main platen 36 move upward.

The admission of pressure fluid to the retraction line 27 also admits pressure fluid to the line 78, this fluid entering the port 75 at the right-hand end of the cylinder bore 71 in the valve 70, and shifts the valve member 72 to the left into the position shown in the drawing. As the tubular plungers 48 move upward, therefore, the fluid displaced from the cylinders 52 escapes through the lines 61, the check valves 62, the line 63, the port 80, the valve bore 71 and the port 79, into the surge tank 19. This enables the tubular plungers 48 to be freely retracted along with the main plunger 22 and main platen 36. In the arrangement of the drawing, therefore, the valve 70 is automatically shifted to permit the escape of fluid from the cylinders 52 the instant that pressure fluid is admitted to the retraction side of the main plunger 22. There is thus no necessity for any leakage or any attention on the part of the operator for shifting the valve 70 to permit the escape of this fluid.

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

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

1. In combination with a hydraulic motor having a fluid operable ram reciprocable in a cylinder, means forming with said motor a ram-advancing circuit and a ram-retracting circuit for selectively operating said ram upon advance and retraction strokes respectively, a clamping motor, a fluid operable valve connected to said clamping motor for selectively entrapping fluid in said clamping motor or releasing said fluid therefrom, and means adapted concomitantly with the starting of the advancement of said ram to convey the advancing fluid pressure in said cylinder to said valve for shifting said valve to its fluid-entrapping position.

2. In combination with a hydraulic motor having a reciprocable ram, means forming with said motor a ram-advancing circuit and a ram-retracting circuit for selectively operating said ram upon advance and retraction strokes respectively, a clamping motor, a control valve adapted to be operated by fluid in two different directions and being connected to said clamping motor for selectively entrapping fluid therein or releasing fluid therefrom, pumping means to supply pressure fluid selectively to said ram-advancing or ram-retracting circuit, valve means movable selectively into a first position for establishing hydraulic connection between the pressure side of said pumping means and said advancing circuit, or into a second position for establishing hydraulic communication between the pressure side of said pumping means and said retracting circuit, and means responsive to the shifting movement of said valve means into said first position for conveying pressure fluid from said pumping means to said control valve to shift the same into its fluid-entrapping position.

3. In combination with a hydraulic motor having a fluid operable ram reciprocable in a cylinder, means forming with said motor a ram-advancing circuit and a ram-retracting circuit for selectively operating said ram upon advance and retraction strokes respectively, a clamping motor, a valve operable by fluid in two different directions and operatively connected to said clamping motor for selectively entrapping fluid in the clamping motor or releasing fluid therefrom, conduit means connected with said ram-retracting circuit and adapted at the admission of fluid pressure to said ram-retracting circuit to convey fluid pressure to said valve for shifting said valve to its fluid-releasing position, and conduit means connected with said cylinder and said valve and adapted at the admission of advancing fluid pressure to said cylinder to convey said advancing fluid pressure to said valve for shifting said valve to its fluid-entrapping position.

4. In combination with a hydraulic motor having a fluid operable double-acting ram with an advancing side and a retracting side, a fluid source for admitting pressure fluid selectively to said advancing or retracting side, a clamping motor, and a fluid operable valve connected to said clamping motor for selectively entrapping fluid therein or releasing fluid therefrom, said valve comprising a reciprocable valve member with two opposed piston areas hydraulically connected with said advancing and said retracting side respectively, so as to cause shifting move-

ment of said valve member into fluid entrapping position in response to the admission of pressure fluid to said ram-retracting side and to cause shifting movement of said valve member into its fluid-releasing position in response to the admission of pressure fluid to said ram advancing side.

5. In combination with a hydraulic motor having a ram reciprocably mounted in a main cylinder, means forming with said motor a ram-advancing circuit and a ram-retracting circuit for selectively operating said ram upon advance and retraction strokes respectively, a platen connected to said ram, a clamping motor mounted on said platen and movable therewith, a stationary auxiliary cylinder, a tubular plunger reciprocable in said auxiliary cylinder and connected to said clamping motor, a two-way valve operative in one position to entrap fluid within said clamping motor and auxiliary cylinder and in another position to release fluid therefrom, a first conduit connecting said ram-advancing circuit with one port of said valve, and a second conduit connecting said ram-retracting circuit with another port of said valve, said first conduit being adapted to convey the ram-advancing pressure in said main cylinder to said valve for shifting the valve to entrap the fluid in said clamping motor, and said second conduit being adapted to convey the ram-retracting pressure to said valve for shifting the same so as to release the fluid in said clamping motor.

WALTER ERNST.