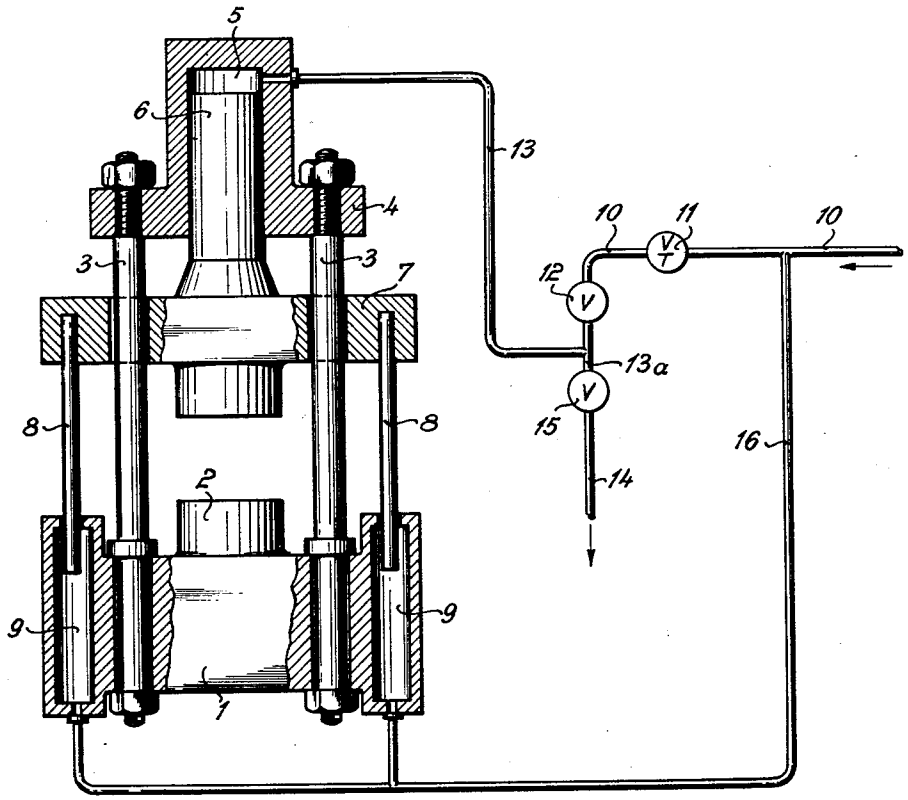
Nov. 28, 1961 H. ROBRA ET AL 3,010,432

CONTROLLING MEANS FOR A HYDRAULIC PRESS

Filed Jan. 21, 1958 4 Sheets-Sheet 1

FIG. 1



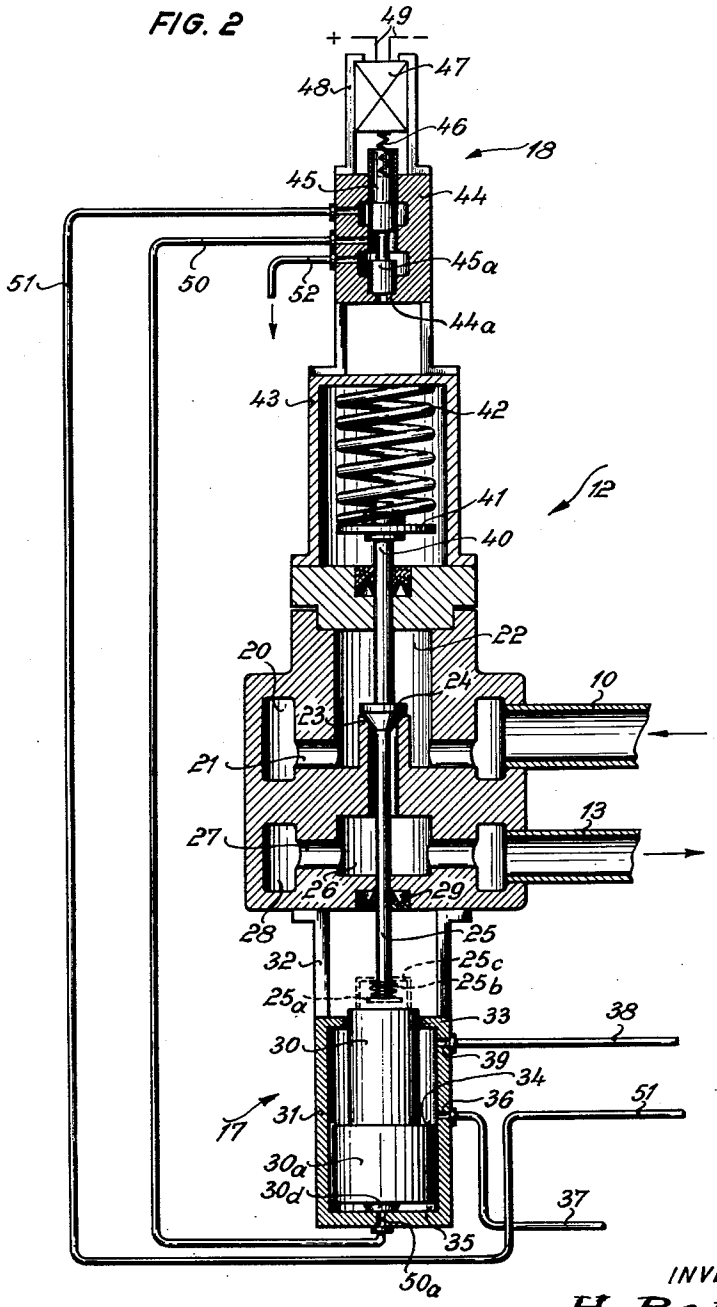
INVENTORS
H. Robra
P. Billen
M. Arenz
BY Hancock Downing & Leibold
ATTYS.

Nov. 28, 1961 H. ROBRA ET AL 3,010,432

CONTROLLING MEANS FOR A HYDRAULIC PRESS

Filed Jan. 21, 1958 4 Sheets-Sheet 2

FIG. 2



INVENTORS
H. Robra
P. Billen
M. Arenz

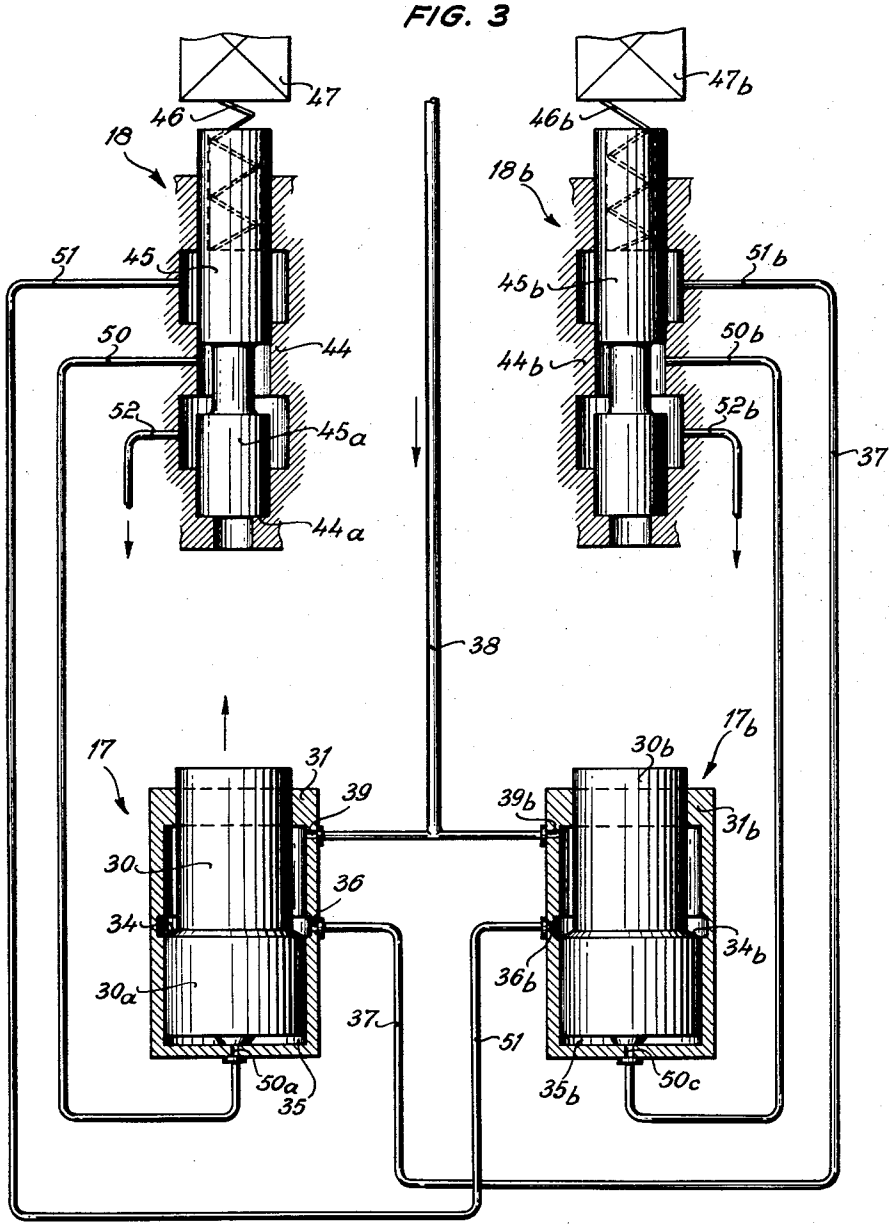
BY Glascock Downing Seebold
ATTYS.

Nov. 28, 1961 H. ROBRA ET AL 3,010,432

CONTROLLING MEANS FOR A HYDRAULIC PRESS

Filed Jan. 21, 1958 4 Sheets-Sheet 3

FIG. 3



INVENTORS
H. Robra
P. Billen
M. Arenz

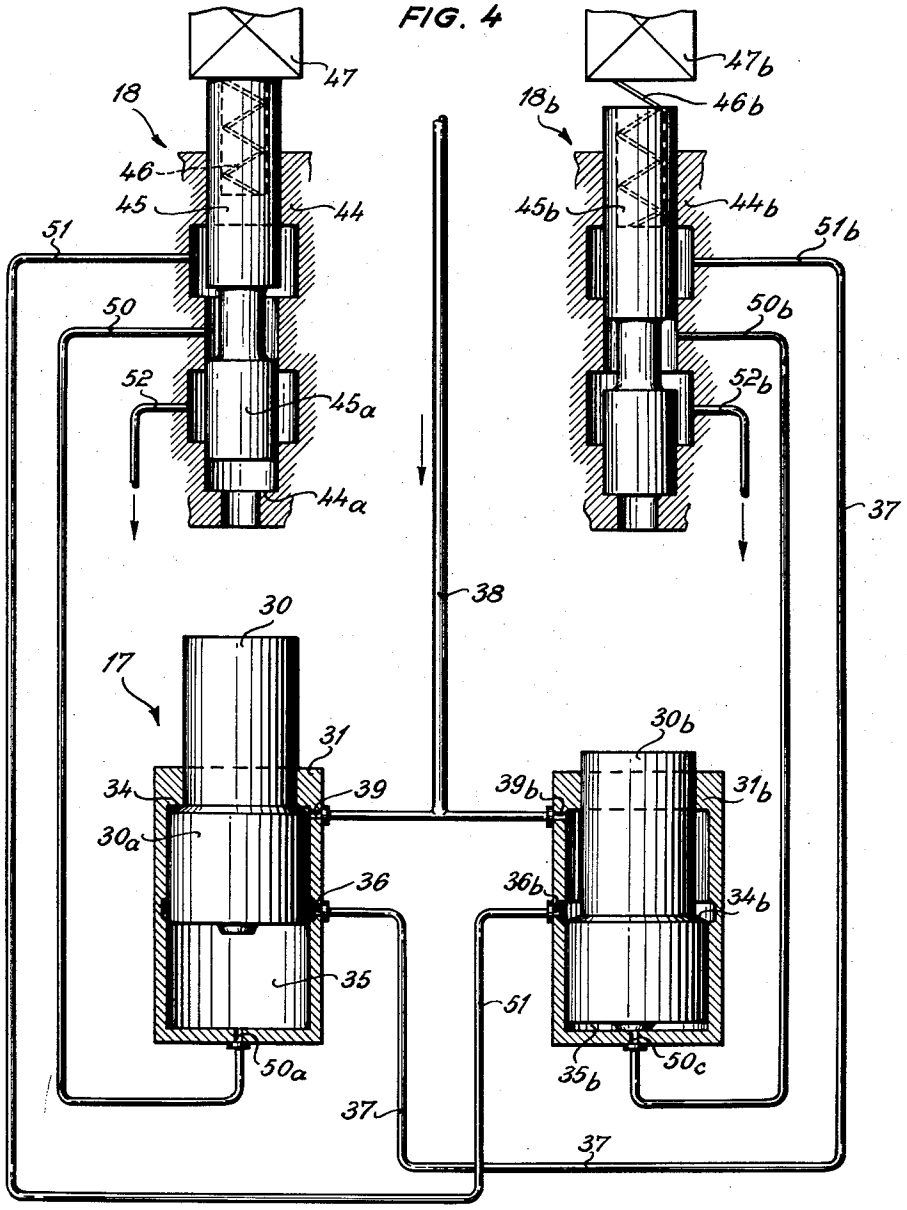
BY Glascock Downing & Seibold
ATTYS.

Nov. 28, 1961 H. ROBRA ET AL 3,010,432

CONTROLLING MEANS FOR A HYDRAULIC PRESS

Filed Jan. 21, 1958 4 Sheets-Sheet 4

FIG. 4



INVENTORS
H. Robra
P Billen
M. Arenz
BY Glascock Downing & Seebold
ATTYS.

United States Patent Office 3,010,432 Patented Nov. 28, 1961

3,010,432
CONTROLLING MEANS FOR A HYDRAULIC PRESS

Helmut Robra, Mulheim (Ruhr), Peter Billen, Leverkusen-Kuppersteg, and Matthias Arenz, Dusseldorf-Lintorf, Germany, assignors to Schloemann Aktiengesellschaft, Dusseldorf, Germany

Filed Jan. 21, 1958, Ser. No. 710,320
Claims priority, application Germany Jan. 30, 1957
12 Claims. (Cl. 121—38)

The valves of hydraulically or oil-hydraulically operated presses are usually controlled from a control shaft which has a plurality of cams, each cam serving to hold a valve open through definite angular positions of the control shaft. This arrangement has indeed the advantage that a valve is opened only when another valve, connected with it in some way, is closed. It is however a disadvantage that this control does not react promptly enough to controlling impulses, and is therefore unsuitable for rapidly working automatic controls. In particular, such presses do not admit of being brought to a standstill with certainty at a predetermined position. A motor actuation of the cam-control shaft has moreover the disadvantage that the control, in the event of a current failure, remains stationary in the particular position reached, so that movements already initiated are liable to be continued without limit until some parts of the press, such as auxiliary appliances, or the billet-charging appliances in extrusion presses and the like, are damaged or destroyed.

The object of this invention is to provide controlling means for hydraulic presses which will react very promptly to controlling impulses. A further object of the invention is to provide a controlling means which is suitable for the automatic control of presses, and which in particular will render it possible to bring a press to a standstill with certainty in a predetermined position.

Another object of the invention is to provide a controlling means which will guard against the continuance of a press movement already initiated, in the event of a failure of the electric current employed for actuating the controlling means. This involves constructing the controlling means in such a way that any press movement that may have been initiated will come to a standstill upon failure of the electric current.

In conjunction with one of the aforementioned purposes the invention seeks to construct the controlling means in such a way that a valve is so connected with another valve that the former valve can only be opened when the other valve is closed.

The invention accordingly consists in providing a hydraulic servo-motor for each valve, and introducing into the opening control of one servo-motor a lock which becomes operative, upon the insufficient closure of another valve, to prevent the opening movement of the said servo-motor.

According to a further development of the invention the lock is made dependent upon the position of the member of the other servo-motor that carries out the closing movement. Thus the controlling slide valve of the servo-motor is urged by a spring into that position in which the servo-motor is energized for the purpose of closing the valve, but the controlling slide valve can be displaced by an electro-magnet against the force of the spring into that position in which it passes the controlling liquid into the servo-motor for the opening of the valve.

In order that the magnet may not be able to operate when the other valve is still not closed, an electric switch might be included in its circuit, which would only be closed in the closed position of the other valve.

Since electric contacts are unreliable in the domain of rough press operation, an object of a further development

of the invention is to construct the lock purely hydraulically, this being done in such a way that one servo-motor shuts off the other servo-motor directly by hydraulic means, to the exclusion of electrical means. In other words, this further development of the invention consists in the feature that each servo-motor, in all positions that do not correspond to the complete closure of the valve allotted to it, shuts off the pressure-liquid pipe leading to the servo-motor of the other valve. This is most advantageously accomplished constructionally in such a manner that the controlling slide valve of the servo-motor selectively connects the pressure space beneath the piston of the servo-motor with the pressure pipe or with the liquid exhaust pipe, and that the pressure piping passes through the cylinder of the other servo-motor in such a way that it is open when the servo-motor piston is located in the position corresponding to the closed position of its valve, but is closed when the servo-motor piston is displaced out of the said position.

In order also to ensure, with such a construction, that in the event of a failure of electric current all the valves will be closed immediately, the construction is such that each controlling slide valve is urged by spring force into that position in which it connects the space beneath the associated servo-motor piston with the liquid outlet pipe, and is displaceable by an electro-magnet out of this position, against the force of a spring, into that position in which it connects the space beneath the servo-motor piston with the pressure-liquid pipe.

The invention is illustrated by way of example in the accompanying drawings, in which:

FIGURE 1 shows diagrammatically a press control to which the invention relates;

FIGURE 2 shows the press admission valve, with a servo-motor allocated to it, together with the slide valve controlling the servo-motor; and

FIGURES 3 and 4 show the servo-motors of two valves (press admission valve and press outlet valve) pertaining to the press, together with the controlling slide valves pertaining to these servo-motors, in different operative positions, the valve itself being omitted in each case for the sake of simplicity.

In FIGURE 1, the under part of 1 of a press, which carries an anvil 2, is connected by tie-rods 3 with the press cross-head 4, which carries the working cylinder 5, with the press piston 6. The press piston 6 is connected with the press cross-bar 7, which slides along the tie-rods 3. The cross-bar 7 also carries retraction plungers 8, which extend into return cylinders 9. Pressure liquid is supplied to the working cylinder 5 from a pipe 10, into which a manually adjustable throttle valve 11 is inserted, by the shifting of which the speed of movement of the press cross-bar 7 can be controlled. Moreover a pressure-liquid admission valve 12 is provided, which can shut off the admission of pressure liquid through a pipe 13 into the working cylinder 5. To the pipe 13 is connected moreover a liquid discharge pipe 14, into which a press outlet or exhaust valve 15 is inserted. By a pipe 16, which is connected to the pressure-liquid pipe 10, a connection to the return cylinders 9 is established. This pipe is permanently open, so that the retraction plungers 8 are always subject to hydraulic pressure. The press cross-bar 7 is therefore raised as soon as the space 5 above the piston 6 is connected with the waste-water pipe 14 by opening the outlet valve 15 of the press. If the press cross-bar 7 is moved downwards by opening the inlet valve 12 when the outlet valve 15 is closed, the piston 6, since it is acted upon over a much larger area by pressure liquid, will overcome the resistance which the retraction plungers 8 encounter in the pressure liquid of the return cylinders 9.

FIGURE 2 shows the press admission valve 12, with

the admission servo-motor 17 associated with it, and the controlling slide valve 18 pertaining to the latter. The pressure-water pipe is in this case also denoted by 10, and the pipe leading to the working cylinder 5 by 13. From the pipe 10 the pressure water passes into an annular passage 20, which is connected by ducts 21 with a valve space 22. The valve seat 23 is closed by a valve cone 24, which can be raised by means of a valve stem 25. By opening the valve 24 a connection is established between the valve space 22 and a valve space 26, which is connected by ducts 27 with an annular chamber 28, to which the pipe 13 is connected. The valve stem 25 projects downwards out of the valve casing, and is sealed by means of a packing 29. It can be lifted by a servo-motor piston 30, which is slidable in the cylinder 31 of the admission servo-motor 17. By arms 32 the cylinder 31 is connected with the valve casing of the valve 24. The servo-motor piston 30 is constructed as a differential piston, and is sealed at 33 in relation to the cylinder 31. The annular surface 34 of this piston can be acted upon by pressure liquid for the purpose of urging the differential piston downwards, whereas the upward movement of the differential piston, which serves for lifting the valve cone 24, is effected by admitting pressure liquid into the lower cylinder space 35. The lower part 30*a* of the piston, which rests on the bottom end of the cylinder 31, has a projection 30*d*, which closes an aperture 50*a* in the bottom of the cylinder when the piston 30 is in its lowest position. In this position the part 30*a* of the piston uncovers an admission port 36 in the wall of the cylinder 31. With this port a liquid supply pipe 37 is connected. A pressure-liquid pipe 38 has access to an aperture 39 in the upper part of the cylinder 31. The pipe 37 communicating therewith leads to a slide valve 18*b* (FIGURE 3) controlling a servo-motor 17*b* actuating the press outlet valve 15. This press outlet valve 15 corresponds in its design to the press inlet or admission valve 12 of FIGURE 2, but connects the pipe 13*a* and therefore the pipe 13 (FIGURE1) leading from the working cylinder with the pipe that in FIGURE 2 is marked 10, while the exhaust pipe 14 is connected to the pipe marked 13 in FIGURE 2.

Upon the valve cone 24 acts, by way of a valve rod 40 and a spring disc 41, a compression spring 42, which tends to push the valve cone into the closed position shown in the drawing. The spring bears against a spring casing 43, which is rigidly connected with the casing of the valve 12. Upon this casing (or at some other convenient place) is arranged the admission-controlling slide-valve 18 for the servo-motor 17. It comprises, as shown on a larger scale in FIGURES 3 and 4, a controlling slide-valve cylinder 44, in which is movable a controlling slide valve 45, which is urged by a spring 46 into the lowest position, shown in FIGURES 2 and 3, in which the part 45*a* of the piston of the slide valve 45 rests upon an abutment 44*a* of the slide-valve cylinder 44. The spring 46 bears against any convenient member, for instance an electro-magnet 47, which is connected with the controlling slide-valve cylinder 44 by carriers 48. When the magnet 47 receives current from an electric circuit 49, it draws the slide-valve piston 45 upwards. When the current is switched off, the spring 46 pushes the slide-valve piston 45 down again into the lower position shown. In this position a pipe 50, which leads from the lower aperture 50*a* of the servo-motor cylinder 31, is connected with an exhaust pipe 52. If however the slide-valve piston 45 is slid upwards by the magnet 47, as shown in FIGURE 4, the pipe 50 is connected with the pipe 51, which leads to a port 36*b* of the servo-motor cylinder 31*b*, the piston 30*b* of which is adapted, when moved upwards, to open the press outlet valve 15 (FIGURE 1).

As FIGURES 3 and 4 show, the control pipes between the slide-valve controls 18 and 18*b*, and between the servo-motors 17 and 17*b*, are constructed substantially as mirror images of one another. From the pressure supply pipe 38 a connection leads to the port 39*b* of the servo-motor 17*b*. The pipe 51, which comes from the controlling slide valve 18, opens at 36*b* into the servo-motor cylinder 31*b*. The port 50*c* of the servo-motor cylinder 31*b* is connected by the pipe 50*b* with the controlling slide-valve cylinder 44*b*. The pipe 37 connects the port 36 of the servo-motor cylinder 31 with the port 51*b* of the controlling slide-valve cylinder 44*b*, and corresponds to the pipe 51, which leads from the slide-valve control cylinder 44 to the servo-motor cylinder 17*b*. The exhaust pipe 52 corresponds to the exhaust pipe 52*b*.

In the position shown in FIGURE 3, the servo-motor pistons 30 and 30*b* are in the position that permits the spring 42 to close the valve 23, 24. Since the magnets 47 and 47*b* are without current, the springs 46 and 46*b* thrust the controlling slide valves 45 and 45*b* downwards. If the press admission valve 12 (PE) is to be opened, the magnet 47 receives current, and draws the controlling slide-valve piston 45 upwards, as shown in FIGURE 4. It thereby connects the pipes 50 and 51. If and as long as the piston 30*b* is located in its lowest position, oil under pressure can now pass by the path 38, 39*b*, 36*b*, 51, 50, 50*a* into the space underneath the servo-motor piston 30*a*. If however the servo-motor piston 30*b* does not occupy its lowest position, which corresponds to the complete closure of the pressure outlet valve 15 (PA), no pressure liquid from the pipe 38 can pass to the space underneath the servo-motor piston 30. The same applies conversely when the press outlet valve 15 (PA) is to be opened by exciting the magnet 47*b*; for the servo-motor piston 30*b* receives pressure liquid from below only when the path from the pressure pipe 38 through the ports 39 and 36 of the servo-motor cylinder 31 is open. So long therefore as the press inlet valve 12 (PE) is not completely closed, the press outlet valve 15 cannot be lifted.

The springs 46 and 46*b* always tend to push the controlling slide-valve pistons 45 and 45*b* downwards, that is to say, into the position in which the spaces 35 and 35*b* beneath the servo-motor pistons 30 and 30*b* are connected with the exhaust pipes 52 and 52*b*. Since no pressure then prevails underneath the pistons 30 and 30*b*, the liquid pressure entering through the apertures 39 or 39*b* is able, owing to the action upon the annular surfaces 34 or 34*b* of the pistons 30 and 30*b* to push these pistons downwards, so that both the valves 12 (PE) and 15 (PA) close immediately. Upon a failure of the current for the magnets 47 and 47*b*, therefore, both the press valves 12 and 15 are closed immediately, so that the press cannot execute any further movements.

In order to ensure a certain closing of the valve 12 independently of the force of the spring 42, the piston 30 of the servo-motor 17 may be connected with the valve cone. For example, the valve stem 25 may be provided with a plate 25*a*, upon which acts a compression spring 25*b* which bears against an annular flange 25*c* rigidly connected with the piston 30, as indicated in dotted lines in FIGURE 2.

We claim:

1. In a hydraulic press comprising: a press admission valve for admitting water under pressure to the working cylinder of the press, a press exhaust valve for discharging water from the working cylinder of the press, an admission servo-motor for opening and closing the press admission valve, piping for supplying water under pressure through the press admission valve to the working cylinder of the press, and piping for supplying water under pressure to the admission servo-motor, the provision of shut-off means permitting the supply of water under pressure to the admission servo-motor for opening the press admission valve when the press exhaust valve is closed, but preventing such supply when the press exhaust valve is open, and an admission valve controllable at will, interposed in the piping connecting the said shut-off means with the admission servo-motor, the said admission valve in one position admitting pressure water to one cylinder space of the admission servo-motor to open the press admission valve, and in another position

shutting off that cylinder space from the supply of pressure water and opening it to exhaust, pressure water being admitted to another cylinder space of the same servo-motor, tending to close the press admission valve.

2. In a hydraulic press as claimed in claim 1, the provision of an exhaust servo-motor for opening and closing the press exhaust valve, piping for supplying water under pressure to the exhaust servo-motor, further shut-off means permitting the supply of water under pressure to the exhaust servo-motor for opening the press exhaust valve when the press admission valve is closed but preventing such supply when the press admission valve is open, piping for exhausting water from the working cylinder of the press through the press exhaust valve, and an exhaust valve controllable at will, interposed in the piping connecting the said further shut-off means with the exhaust servo-motor, the said exhaust valve in one position admitting pressure water to one cylinder space of the exhaust servo-motor to open the press exhaust valve, and in another position shutting off that cylinder space from the supply of pressure water and opening it to exhaust, pressure water being admitted to another cylinder space of the same servo-motor tending to close the press exhaust valve.

3. In a hydraulic press as claimed in claim 2, incorporating the first-mentioned shut-off means in the exhaust servo-motor, and incorporating the further shut-off means in the admission servo-motor, the pistons in the servo-motor cylinder spaces for opening the press exhaust and admission valves being of greater cross-sectional area than the pistons in the servo-motor cylinder spaces for closing the press exhaust and admission valves respectively, the servo-motor cylinder spaces for closing these valves being permanently open to the supply of pressure water, and ports in the servo-motor cylinders being so located that pressure water from the supply pipe can pass out from the permanently open cylinder space of the admission servo-motor to the exhaust valve only when the press admission valve is closed, and from the permanently open cylinder space of the exhaust servo-motor to the admission valve only when the press exhaust valve is closed.

4. In a hydraulic press as claimed in claim 3, the admission and exhaust valves being slide valves, and electromagnets being provided to urge the slide valves in the direction for opening communication between the servo-motor cylinders and the supply of pressure water, and springs for returning the slide valves, when the electromagnets are de-energized, into positions in which the servo-motor cylinder spaces are opened to exhaust.

5. In a hydraulic press as claimed in claim 4, the provision of springs constantly tending to close the press admission and exhaust valves.

6. In a hydraulic press as claimed in claim 5, the provision of resilient tensile connections between the valve members of the press admission and exhaust valves and the pistons of the servo-motors that actuate them.

7. In a hydraulic press, comprising:

piping for supplying liquid under pressure to the working cylinder of the press,

a press admission valve controlling the flow of liquid through the said piping,

a press exhaust valve for controlling the discharge of liquid from the working cylinder of the press,

a hydraulic admission servo-motor for opening the press admission valve,

a hydraulic exhaust servo-motor for opening the press exhaust valve,

an admission slide valve and piping for supplying liquid under pressure to one end of the admission servo-motor cylinder for opening the press admission valve, and an exhaust slide valve and piping for supplying liquid under pressure to one end of the exhaust servo-motor cylinder for opening the press exhaust valve,

the provision of:

two ports in the exhaust servo-motor cylinder towards the other end thereof,

piping supplying liquid under pressure to this other end of the exhaust servo-motor cylinder through one of these ports,

and piping supplying liquid under pressure from this end of the exhaust servo-motor cylinder through the other of the said ports to the admission slide valve, to be passed on to the admission servo-motor cylinder for opening the admission valve, the ports in the exhaust servo-motor cylinder being so arranged that liquid can pass through them only when the exhaust servo-motor piston is in the position corresponding to closure of the exhaust valve.

8. In a hydraulic press as claimed in claim 7, the provision of means so connecting the admission servo-motor piston with the press admission valve that when the said piston is in the valve-closure position the press admission valve will be positively drawn on to its seat, and means so connecting the exhaust servo-motor piston with the press exhaust valve that when the exhaust servo-motor piston is in the valve-closure position the press exhaust valve will be positively drawn on to its seat.

9. In a hydraulic press, comprising:

piping for supplying liquid under pressure to the working cylinder of the press,

a press admission valve controlling the flow of liquid through the said piping,

a press exhaust valve for controlling the discharge of liquid from the working cylinder of the press, a hydraulic admission servo-motor for opening the press admission valve,

a hydraulic exhaust servo-motor for opening the press exhaust valve,

an admission slide valve and piping for supplying liquid under pressure to one end of the admission servo-motor cylinder for opening the press admission valve, and an exhaust slide valve and piping for supplying liquid under pressure to one end of the exhaust servo-motor cylinder for opening the press exhaust valve,

the provision of:

two ports in the admission servo-motor cylinder towards the end thereof remote from the end at which pressure liquid is admitted for opening the press admission valve,

piping supplying liquid under pressure to the admission servo-motor cylinder through one of these two ports, and

piping supplying liquid under pressure from the admission servo-motor cylinder through the other of the two said ports to the exhaust slide valve, to be passed on to the exhaust servo-motor cylinder for opening the exhaust valve,

the ports in the admission servo-motor cylinder being so arranged that liquid can pass through them only when the admission servo-motor piston is in the position corresponding to closure of the admission valve.

10. In a hydraulic press as claimed in claim 9, the provision of means so connecting the admission servo-motor piston with the press admission valve that when the said piston is in the valve-closure position the press admission valve will be positively drawn on to its seat, and means so connecting the exhaust servo-motor piston with the press exhaust valve that when the exhaust servo-motor piston is in the valve-closure position the press exhaust valve will be positively drawn on to its seat.

11. In a hydraulic press, comprising:

piping for supplying liquid under pressure to the working cylinder of the press,

a press admission valve controlling the flow of liquid through the said piping,

a press exhaust valve for controlling the discharge of liquid from the working cylinder of the press,

a hydraulic admission servo-motor for opening the press admission valve,

a hydraulic exhaust servo-motor for opening the press exhaust valve,

an admission slide valve and piping for supplying liquid under pressure to one end of the admission servo-motor cylinder for opening the press admission valve, and

an exhaust slide valve and piping for supplying liquid under pressure to one end of the exhaust servo-motor cylinder for opening the press exhaust valve.

the provision of:

two ports in the exhaust servo-motor cylinder towards the end thereof remote from the end at which pressure liquid is admitted for opening the press exhaust valve,

piping supplying liquid under pressure to the exhaust servo-motor cylinder through one of these ports,

piping supplying liquid under pressure from the exhaust servo-motor cylinder through the other of the said ports to the admission slide valve, to be passed on to the admission servo-motor cylinder for opening the admission valve, the ports in the exhaust servo-motor cylinder being so arranged that liquid can pass through them only when the exhaust servo-motor piston is in the position corresponding to closure of the exhaust valve,

two ports in the admission servo-motor cylinder towards the end thereof remote from the end at which pressure liquid is admitted for opening the press admission valve,

piping supplying liquid under pressure to the admission servo-motor cylinder through one of these two ports, and

piping supplying liquid under pressure from the admission servo-motor cylinder through the other of the two last-mentioned ports to the exhaust slide valve to be passed on to the exhaust servo-motor cylinder for opening the exhaust valve,

the ports in the admission servo-motor cylinder being so arranged that liquid can pass through them only when the admission servo-motor piston is in the position corresponding to closure of the admission valve.

12. In a hydraulic press as claimed in claim 11, the provision of means so connecting the admission servo-motor piston with the press admission valve that when the said piston is in the valve-closure position the press admission valve will be positively drawn on to its seat, and means so connecting the exhaust servo-motor piston with the press exhaust valve that when the exhaust servo-motor piston is in the valve closure position the press exhaust valve will be positively drawn on to its seat.

References Cited in the file of this patent

UNITED STATES PATENTS

1,136,899	Greer	Apr. 20, 1915
1,937,244	Pelton	Nov. 28, 1933
2,286,880	Traut	June 16, 1942
2,336,808	Simon	Dec. 14, 1943
2,464,986	Miller	Mar. 22, 1949
2,591,201	Rowand	Apr. 1, 1952