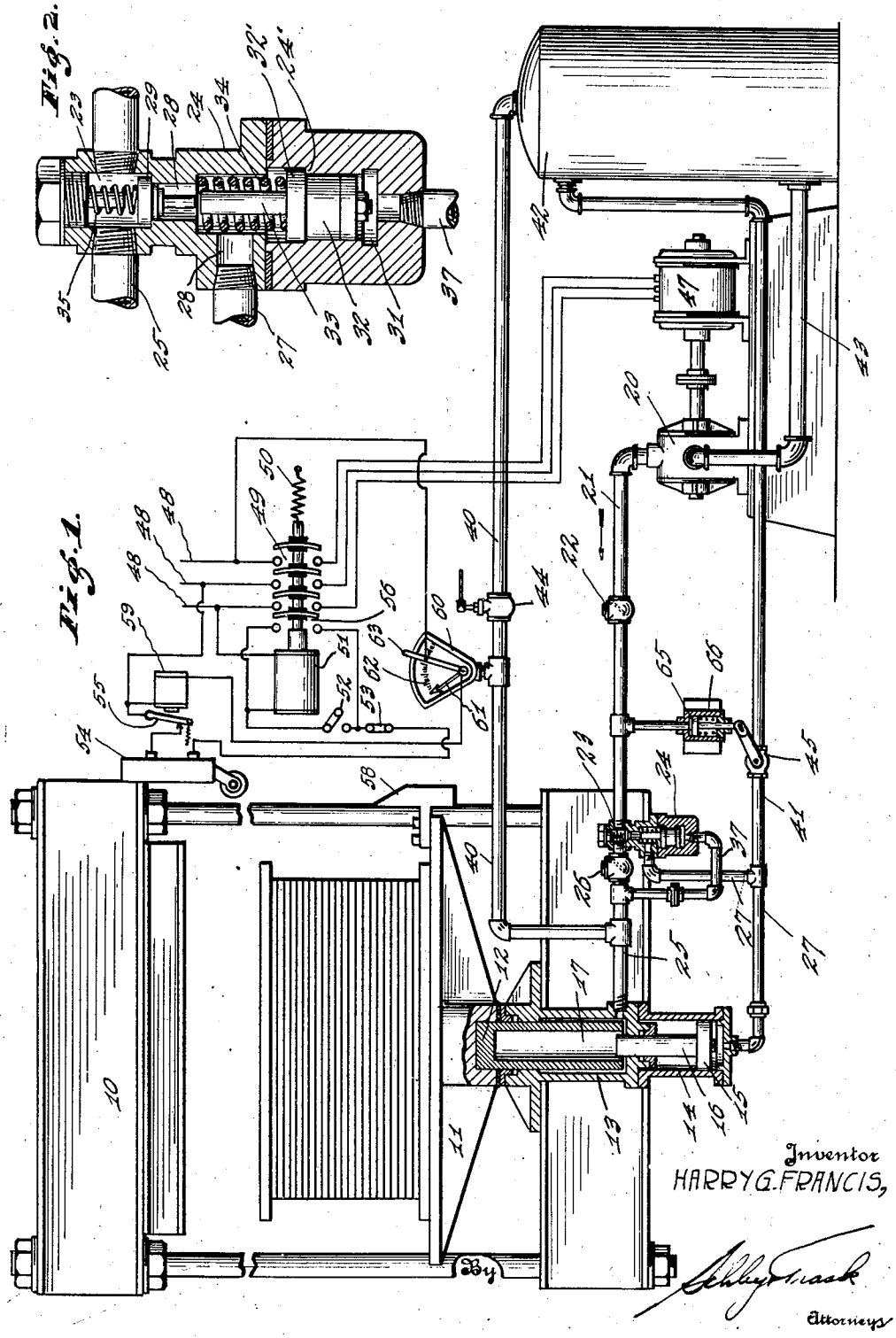
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HYDRAULIC PRESS CONTROL

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HYDRAULIC PRESS CONTROL

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My invention is concerned with hydraulic or fluid-pressure presses, and among the more specific objects of my invention are to produce press-operating mechanism which will impart to the platen or movable member of the press a continuous steady movement, to provide for relatively rapid movement of the press-platen at low pressure and relatively slow movement at high pressure, to provide means for automatically changing from low-pressure high-speed movement of the platen to high-pressure low-speed thereof, and to provide means for automatically stopping the operation of the pressure creating means when the work being pressed has been subjected to a predetermined maximum pressure.

In carrying out my invention, I employ a press provided with a platen operatively connected to a piston in the cylinder. Associated with this press I provide a pressure intensifier, and as a source of pressure for both the intensifier and the press I employ a rotary pump. The rotary pump is connected to the press cylinder and to the intensifier through an automatic valve which operates to direct the liquid supplied by the pump from the press cylinder to the intensifier at the proper time. In addition, I provide means for automatically interrupting the operation of the pump when the pressure exerted on the work in the press reaches a predetermined maximum.

The accompanying drawing illustrates my invention: Fig. 1 is an elevation of the press with its associated pressure-supplying mechanism parts of the device being broken away to indicate the construction more clearly; and Fig. 2 is a section on an enlarged scale through the automatic valve employed in the piping system illustrated in Fig. 1.

The press with which my invention is associated may be of any desired construction. That shown in the drawing has a head 10 and a movable platen 11, between which and the head the work to be pressed is placed. As illustrated, the head 10 is disposed above the platen and the work is placed upon the platen and elevated into engagement with the head by upward movement of the platen.

The platen 11 is shown as being mounted upon the upper end of a piston 12 which is vertically slidable in the press-cylinder 13, so that the platen can be raised by supplying liquid under pressure to the press-cylinder.

As previously indicated, I associate with the press a pressure intensifier. Conveniently, although not necessarily, the intensifier is arranged in direct association with the press-cylinder 13 in order to conserve space. To this end, the intensifier embodies a cylinder 14 which is mounted below and in alinement with the press cylinder 13. Axially slidable in the cylinder 14 is a piston 15 with which there is movable a cylindrical rod 16 of smaller cross-sectional area. The rod 16 projects through suitable packing into the lower end of the cylinder 13, as is clear from Fig. 1. Preferably, in order to conserve space vertically, the piston 12 is provided with a downwardly opening central recess 17 into which the rod 16 may move, the recess 17 being of larger diameter than the rod in order to avoid any contact between the rod 16 and the piston 12.

From the construction described it will be apparent that by supplying fluid under pressure to the cylinder 14 below the piston 15 an increased pressure can be built up in the press cylinder 13, the ratio of the pressure in the cylinder 13 to that of the cylinder 14 being equal to the ratio between the cross-sectional area of the intensifier piston 15 and the rod 16.

For the purpose of supplying liquid under pressure to the press and intensifier cylinders 13 and 14, I employ a pump 20 which is preferably of the rotary type in order to supply liquid to the press and intensifier cylinders at a substantially constant rate. The liquid discharged from the pump 20 is conducted through a pipe 21 past a check valve 22 to a valve chamber 23 in the casing 24 of an automatic valve. From the valve chamber 23, a pipe 25 leads past a check valve 26 to the press cylinder 13.

The intensifier cylinder 14 is connected to the valve casing 24 through a pipe 27. The valve casing 24 is provided interiorly with a passage 28 affording communication between the valve chamber 23 and the pipe 27, liquid flow through this passage being controlled by a suitable valve 29. In Fig. 2, the valve 29 is shown in its lower or closed position in which it prevents communication between the valve chamber 23 and the pipe 27.

Automatic means, responsive to fluid-pressure, is employed for controlling movements of the valve 29. To this end, a cylinder 31 is formed in the lower part of the valve casing 24, and a piston 32, slidable in such cylinder, is connected as by a stem 33 to the valve 29 for joint movement therewith, this connection being shown as a thrust-transmitting connection preferably having a slight amount of lost-motion. A spring 34 acting between the piston 32 and a suitable abutment within the valve casing 24 serves normally to hold the piston at the limit of its downward

movement or in the position shown in Fig. 2, with a shoulder 32' on the piston in contact with and co-operating with a shoulder 24' in the valve casing. A spring 35, which acts between the valve 29 and a stationary abutment, serves normally to hold the valve 29 closed.

The cylinder 31 is connected through a pipe 37 with the pipe 25 at a point between the press cylinder 13 and the check valve 26, in order that liquid within the valve cylinder 31 may be subjected to the same pressure as that which exists in the press cylinder 13. The piston 32 is made of somewhat larger cross-sectional area than the valve 29.

If the pump 20 is placed in operation with the parts of the device in the positions indicated in Figs. 1 and 2, the liquid discharged from the pump 20 will flow through the pipe 21, valve chamber 23, and pipe 25 to the press cylinder 13 to raise the piston 12 and platen 11. As the valve 29 is closed there will be no liquid supplied to the intensifier cylinder 14. Because of the pipe 37, which interconnects the pipe 25 and valve cylinder 31, substantially equal unit-pressures will exist in the cylinder 31 and in the valve chamber 23. The former pressure acts upwardly on the piston 32 and the latter pressure acts downwardly on the valve 29; and as the effective cross-sectional area of the piston 32 is greater than that of the valve 29, a tendency for the valve 29 and piston 32 to move upwardly is created. The springs 34 and 35 are made of sufficient strength to counteract this tendency toward upward movement of the valve 29 and piston 32 until the work on the platen 11 engages the head 10. When this occurs, pressure builds up in the pipes 21 and 25, in the valve chamber 23, and in the cylinder 31. Eventually, this pressure will reach such a value that the tendency of the piston 32 and valve 29 to move upwardly will overcome the downward force exerted jointly by the springs 34 and 35, and the piston and valve will then move upwardly to open the valve and to provide communication between the valve chamber 23 and the pipe 27. Thereafter, the liquid discharged from the pump 20 will flow through the pipe 21 to the valve casing 23, and through the valve casing 24 and pipe 27 to the intensifier cylinder 14. The liquid thus discharged into the intensifier cylinder will move the piston 15 therein upwardly to cause the rod 16 to build up an increased pressure in the press cylinder 13 as above set forth.

When the desired pressure is reached within the press cylinder 13, the pump 20 is stopped; and after the work in the press has been subjected to pressure for the desired length of time, the liquid in the cylinders 13 and 14 is removed to permit the platen 11 to descend under the influence of gravity.

For the purpose of controlling this release of pressure, liquid discharge pipes 40 and 41 may be provided. The pipe 40 communicates with the press cylinder 13, desirably by being connected to the pipe 25 at a point between the press cylinder and the check valve 26, while the pipe 41 communicates with the intensifier cylinder 14 as by being connected to an intermediate point of the pipe 27. Both pipes 40 and 41 discharge into a liquid-supply tank 42 from which liquid is supplied to the pump 20 through a supply pipe 43. The two pipes 40 and 41 are respectively provided with valves 44 and 45 which are closed during the pressing operation but which may be opened to release the pressure in the press and intensifier cylinders 13 and 14 to permit the liquid therein to be discharged into the supply tank 42.

Preferably, the pump 20 is controlled by suitable manual and automatic devices such as those illustrated in Fig. 1, which contemplate that the pump 20 will be driven by a three-phase electric motor 47. Supply current from line wires 48 to the motor 47 is under the control of a magnetic switch 49 biased toward open position as by a spring 50 and adapted to be closed by the energization of a solenoid 51. As shown in the drawing, one end of the winding of the solenoid 51 is connected to one of the line wires 48 while the other end is connected to another of such line wires through suitable manually controlled switches 52 and 53 and through two automatically operable switches 54 and 55.

The switches 52 and 53 comprise a form of push-button control commonly used in association with electrically operated devices. The switch 52 is normally open and has associated with it a holding circuit embodying a switch 56 which is adapted to be closed when the motor control switch 49 is closed. The manual switch 53 and automatic switches 54 and 55 are normally closed; so that when the manual switch 52 is momentarily closed a circuit is completed through the solenoid 51, the resultant energization of the solenoid closing the motor control switch 49 and the switch 56 of the holding circuit. Because of the presence of the holding circuit embodying the switch 56, only momentary closing of the switch 52 is necessary to cause operation of the motor 47 and pump 20. If the circuit of the solenoid 51 is interrupted as by opening of any of the switches 53, 54, and 55, the spring 50 will operate to open the motor control switch 49 as well as the holding circuit switch 56 to stop the operation of the motor 47 and pump 20.

The automatic switch 54 is shown in the drawing as being a limit switch adapted to prevent the platen 11 from striking the head 10 of the press if an attempt should be made to close the press without any work on the platen. To this end, the platen is provided with an abutment 58 which is movable with the platen and which is adapted to engage the switch 54 if the platen approaches too closely to the head 10.

As shown in the drawing, the switch 55 is a normally closed switch adapted to be opened by the energization of an associated electro-magnet 59. For the purpose of controlling energization of the electro-magnet 59, I provide a pressure-responsive switch 60 responsive to pressures in the press cylinder 13. Conveniently, the switch 60 embodies an indicating hand 61 which is movable across a suitable scale 62 to indicate the pressure existing in the press cylinder 13. The switch also embodies a movable member 63 which can be adjusted to be engaged by the hand 61 at any desired pressure. The member 63 will be set at the pressure corresponding to the maximum pressure which is to be created in the press cylinder 13, and when this pressure is obtained in the press cylinder, the switch 60 will be closed to energize the magnet 59, open the switch 55, and de-energize the solenoid 51 to interrupt the supply of current to the motor 47.

Preferably, the pressure release valve 45 in the pipe 41 is automatically controlled. To this end, it may be connected to a piston 65 in a cylinder 66, the cylinder 66 being connected to the pipe 21 in order that the piston 65 may be responsive to pressures therein. The valve 45 is biased toward open position and is adapted to be closed

by pressure in the pipe 21. When the device is at rest, the valve 45 is open, but when sufficient liquid has been supplied to the press cylinder 13 to bring the work on the platen 11 into engagement with the head 10, pressure will be built up in the pipe 21 and will close the valve 45 before the valve 29 is opened to supply liquid to the intensifier.

As shown in the drawing, the work to be pressed is indicated as in place on the platen, and the parts of the device are shown in the positions they occupy when the press is not being operated. To operate the press, it is necessary only to close momentarily the switch 52. As above indicated, the momentary closing of the switch 52 will close the motor control switch 49 to start the motor and pump 20. The pump 20 draws liquid from the supply tank 42 through the pipe 43 and discharges it as above set forth to the press cylinder 13. When the work on the platen engages the press-head 10, pressure builds up in the pipe 21, and eventually reaches a value sufficient to close the valve 45. At a somewhat higher pressure, the valve 29 is opened and liquid is supplied to the intensifier cylinder 14 to build up an increased pressure in the press cylinder. When this press-cylinder pressure reaches a desired maximum, the pressure-responsive switch 60 is closed to energize the electro-magnet 59 and open the switch 55, thus de-energizing the solenoid 51 and interrupting the supply of current to the motor 47, with the result that the supply of liquid to the press ceases. When the work has been subjected to the pressure for the desired length of time, the valve 44 is opened, thus permitting the platen and work to descend under the influence of gravity and to force the liquid in the press cylinder 13 through the pipe 40 to the tank 42. As the pressure in the press cylinder decreases, the valve 29 will be closed to return it to the position illustrated in Fig. 2, and the valve 45 will somewhat subsequently be opened to permit liquid to flow from the intensifier cylinder 14 to the storage tank 42.

I claim as my invention:

1. In combination, a press-cylinder, an intensifier associated therewith, a source of fluid under pressure, a press-cylinder supply pipe connecting said source with said press-cylinder, an intensifier supply pipe, a normally closed valve openable to connect said two supply pipes together, pressure responsive means for opening said valve when the pressure in said press-cylinder reaches a predetermined value, a check-valve between said first mentioned valve and said press-cylinder, a press-cylinder discharge pipe connected to said press-cylinder on the cylinder side of said check-valve, a valve in said press-cylinder discharge pipe, a discharge pipe for said intensifier connected thereto on the intensifier side of said first mentioned valve, a valve in said intensifier discharge pipe, and means in addition to said first mentioned valve for stopping the supply of fluid to said intensifier.

2. The invention set forth in claim 1 with the addition of pressure-responsive means for opening the valve in the intensifier discharge pipe when press-cylinder pressure is below a predetermined value and for closing the valve in the intensifier discharge pipe when the press-cylinder pressure is above such predetermined value.

3. In a fluid-pressure press having relatively movable heads, a press-cylinder, a pressure intensifier associated therewith, a pump with pipe lines and connections arranged to supply fluid from said pump to said press-cylinder and intensifier, means in said pipe lines for preventing return flow of fluid from said press-cylinder and intensifier to said pump, valve means for directing fluid from said pump either to said press-cylinder or to said intensifier, means responsive to pressure in said press-cylinder for operating said valve means to direct fluid from said pump to said intensifier, a release valve for controlling release of fluid from said press-cylinder and intensifier, an electric motor for driving said pump, a main switch for controlling the supply of current to said motor, a holding switch, said main switch and holding switch being biased toward open position, electro-magnetic means for maintaining said main switch and holding switch closed, a normally closed auxiliary switch connected in series with said holding switch and electro-magnetic means, and adjustable means operative upon the occurrence of a predetermined maximum pressure on work between said heads for opening said auxiliary switch.

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