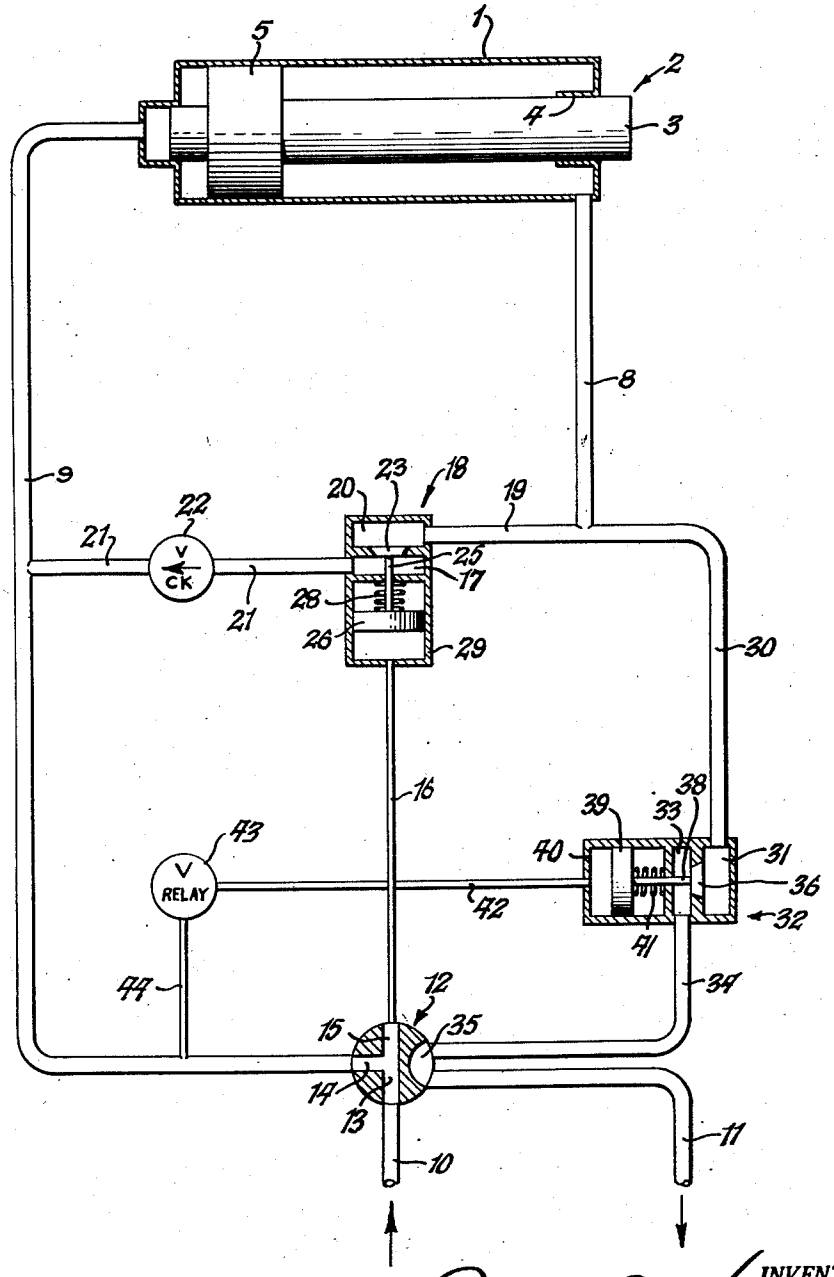
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HYDRAULIC CIRCUIT FOR HEAVY DUTY PRESSES AND THE LIKE

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HYDRAULIC CIRCUIT FOR HEAVY DUTY PRESSES AND THE LIKE

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This invention relates to a hydraulic circuit for heavy duty presses and the like and more particularly to a so-called runaround circuit which conducts liquid in the cylinder of a press ram from the return pressure end to the working pressure end thereof so as to permit initial rapid closing movement of the ram. When resistance is encountered, as when the workpiece is engaged, the liquid in the return pressure end of the cylinder is discharged through an exhaust line into a tank or reservoir.

One of the principal objects of the invention is to provide such a runaround circuit for the ram cylinder of a hydraulic press or the like which is composed of a small number of simple components which operate automatically to set up a runaround circuit between opposite ends of the ram cylinder to permit the rapid initial closing of the ram but which, when resistance is encountered by the ram, cuts out the runaround circuit and instead discharges the liquid in advance of the ram through an exhaust line to a storage tank or reservoir.

Another object is to provide such a circuit in which the changeover is effected as a function of the change in hydraulic pressure in the circuit.

Another object is to provide such a circuit in which the components are reliable in operation and will stand up under conditions of severe and constant use without getting out of order or requiring repairs.

Other objects and advantages of the invention will be apparent from the following description and drawings in which the figure is a diagrammatic representation of a hydraulic circuit for the ram of a heavy duty press or the like and which embodies the present invention.

The numeral 1 represents the cylinder for a ram 2, this ram being of cylindrical form and having a reduced end 3 projecting through a slideway or opening 4 at one end of the ram cylinder 1, the ram 2 also has an enlarged cylindrical part 5 fitted within the cylinder 2 and forming the piston thereof.

The ram 2 is used in connection with a heavy duty hydraulic press or the like, an example of such use being to close and open the dies of a metal forming press in forming a metal workpiece into the desired form. In such use, it is desirable that each cycle of the press be completed rapidly in order to obtain the maximum capacity of the press. To this end, it is desirable that the initial part of the closing stroke of the ram 2 in bringing the dies toward each other be accomplished rapidly since no work during this part of the closing stroke is being done. After both dies have been engaged with the work piece, it is necessary that the ram 2 be under heavy hydraulic pressure in order to effect the required forming operation. The present invention is directed to a circuit for accomplishing these results. After the working stroke has been completed, hydraulic fluid under pressure is admitted to the return pressure end of the cylinder to open the dies and return the ram to its open position. This fluid fills the return pressure end of the cylinder.

The return pressure end of this cylinder 1 has a return line 8 for the hydraulic fluid. The working pressure

line 9 connects with the working pressure end of the cylinder 1. The numeral 10 represents a source of hydraulic fluid under the pressure required to operate the ram 2 and the numeral 11 represents an exhaust line leading to a storage tank or reservoir (not shown) which retains the hydraulic fluid for reuse.

The numeral 12 represents a four-way main control valve designed to be moved to "on" and "off" positions and which can be operated in any suitable manner. This valve is shown as having passages 13, 14 movable to connect the source 10 of pressurized fluid with the working pressure line 9 of the cylinder 1 and as having a passage 15 arranged to connect the source of hydraulic fluid under pressure with a pilot line 16 to provide pilot pressure to a second normally closed piston actuated valve 18. A line 19 connects the return line 8 of the ram cylinder with the inlet chamber 20 of the piston actuated valve 18. The outlet chamber 17 of this valve is connected by a line 21 with the working pressure line 9. The line 21 includes a check valve 22 which opens toward the working line 9 and closes toward the piston actuated check valve 18 so as to prevent escape of fluid from the working pressure line 9. The piston actuated check valve has a valve head 23 which closes toward the outlet chamber 17 and has a stem 25 connected with a piston 26, a spring 28 biasing the piston head to its closed position. The piston 26 is enclosed within a cylinder 29 and pilot pressure is supplied at that end of the cylinder 29 to act against that end of the piston 26 to open the valve head 23. The lines 19, 21 form a connecting line between the return line 8 and the working pressure line 9 and the valves 18 and 22 are in this connecting line in the order shown.

The return line 8 is also connected by a line 30 with the inlet chamber 31 of a second piston actuated valve 32. This piston actuated valve 32 has an outlet chamber 33 which is connected by a line 34 with a passage 35 in the fourway valve 12. When this fourway valve 12 is open, this passage 35 establishes communication between the line 34 and the exhaust line 11 through which the hydraulic fluid is returned to the usual storage tank or reservoir (not shown).

The piston actuated valve has a valve head 36 which closes toward the outlet chamber 33 and is provided with a piston rod 38 connecting the head with a piston 39 operating in a cylinder 40. A spring 41 biases the valve head 36 toward its closed position and a line 42 supplies pilot pressure from a relay valve 43 to that end of the cylinder 40 which, when pressurized, moves the piston 39 to open the valve head 36. A line 44 connects the relay valve 43 with the working pressure line 9 which supplies fluid under pressure to the ram cylinder for closing the dies. When the pressure in the line 9 exceeds a predetermined value, the relay valve 43 admits fluid under pressure to the line 42 to operate the piston operated check valve 32.

In operation, assuming the ram 2 to be withdrawn toward the left-hand end of the cylinder, as shown, to move the ram 2 to the right in the closing stroke of the press, the four-way valve 12 is turned to its open position shown. In this position, hydraulic fluid under the required operating pressure is supplied from the supply line 10 through the passages 13, 14 of the fourway valve 12 and through line 9 to the working pressure or left-hand end of the cylinder 1.

To permit rapid closing movement of the ram 2, pilot pressure is supplied at this time by the fourway valve 12 to the pilot line 16 leading to the piston actuated valve 18. This pressure acting against the piston 26 operates to open the valve head 23. Accordingly, hydraulic fluid in the return pressure or right-hand end of the cylinder 1 on the advancing side of the piston 5 is

free to pass from the return line **8** through the line **19** past the open piston actuated valve **18** into the line **21**. Since the check valve **22** opens toward the working pressure line **9**, this hydraulic fluid is free to pass through the check valve **22** into the working line **9**. It will accordingly be seen that the hydraulic liquid which must be displaced from the right-hand side of the cylinder **1** in order to permit closing movement of the ram **2** is passed directly to the left-hand end thereof. This movement is a function of the differential in effective sizes of the piston **5** and reduced end **3** of the ram **2**.

This so-called runaround flow of the hydraulic liquid continues until the ram **2** encounters resistance such as by engagement with the metal blank to be formed. When such resistance is encountered, hydraulic pressure in the working pressure line **9** builds up and when this pressure reaches the value for which the relay valve **43** is set, this relay valve admits pilot pressure through the line **42** to the second piston actuated valve **32**. This pilot pressure moves the piston **39** to open the valve head **36**. Accordingly, the fluid trapped in the right-hand end of the ram cylinder **1** is free to escape through the lines **8** and **30** to the piston actuated check valve **32** and from the inlet chamber **33** thereof past the open valve head **36** into the outlet chamber **33** thereof. From the outlet chamber, the hydraulic fluid passes through the line **34** and passage **35** of the fourway valve **12** into the line **11** which conducts it to the usual storage tank or reservoir (not shown) for reuse.

Accordingly, when the ram **2** encounters resistance, the hydraulic fluid at the advancing side of its piston is connected to exhaust and full operating pressure can be applied through the working pressure line **9** to the trailing side of the ram **2** for forming the workpiece into the desired shape. Loss of this operating pressure during the working stroke of the press is prevented by the check valve **22** which prevents a reverse flow of hydraulic fluid through the runaround circuit.

From the foregoing, it will be seen that the present invention provides a very simple and reliable circuit for permitting rapid closing movement of the ram of a press or the like and thereafter permits of the application of full operating pressure on the work piece during this closing stroke.

I claim:

1. In a hydraulic circuit for a press or the like having a ram including a piston arranged in a cylinder and said ram also including an end of smaller diameter than said piston sliding in an opening through one end of said cylinder comprising a working pressure line connected with the other end of said cylinder, a return pressure line connected with said one end of said cylinder, a line connecting said working pressure and return lines, a piston actuated valve controlling the flow of fluid through said connecting line and opening in response to fluid pressure applied to its piston, a check valve in said connecting line and arranged between said piston actuated valve and said working pressure line, and a main control valve arranged simultaneously to admit fluid to said working pressure line and to apply fluid pressure to the piston of said piston actuated valve.

2. A hydraulic circuit as set forth in claim 1 wherein a second piston actuated valve is arranged in said return line on the side of said connecting line remote from said cylinder and opens in response to fluid pressure applied to its piston, a relay valve is responsive to the pressure in said working pressure line, and a pilot line connects said relay valve with said second piston actuated valve to open said second piston actuated valve when the pressure in said working pressure line reaches a predetermined value.

3. A hydraulic circuit as set forth in claim 2 wherein said main control valve has another passage, and wherein an outlet line from said second piston actuated valve and a fluid exhaust line simultaneously communicate with another passage in said main control valve when said main control valve is opened.

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