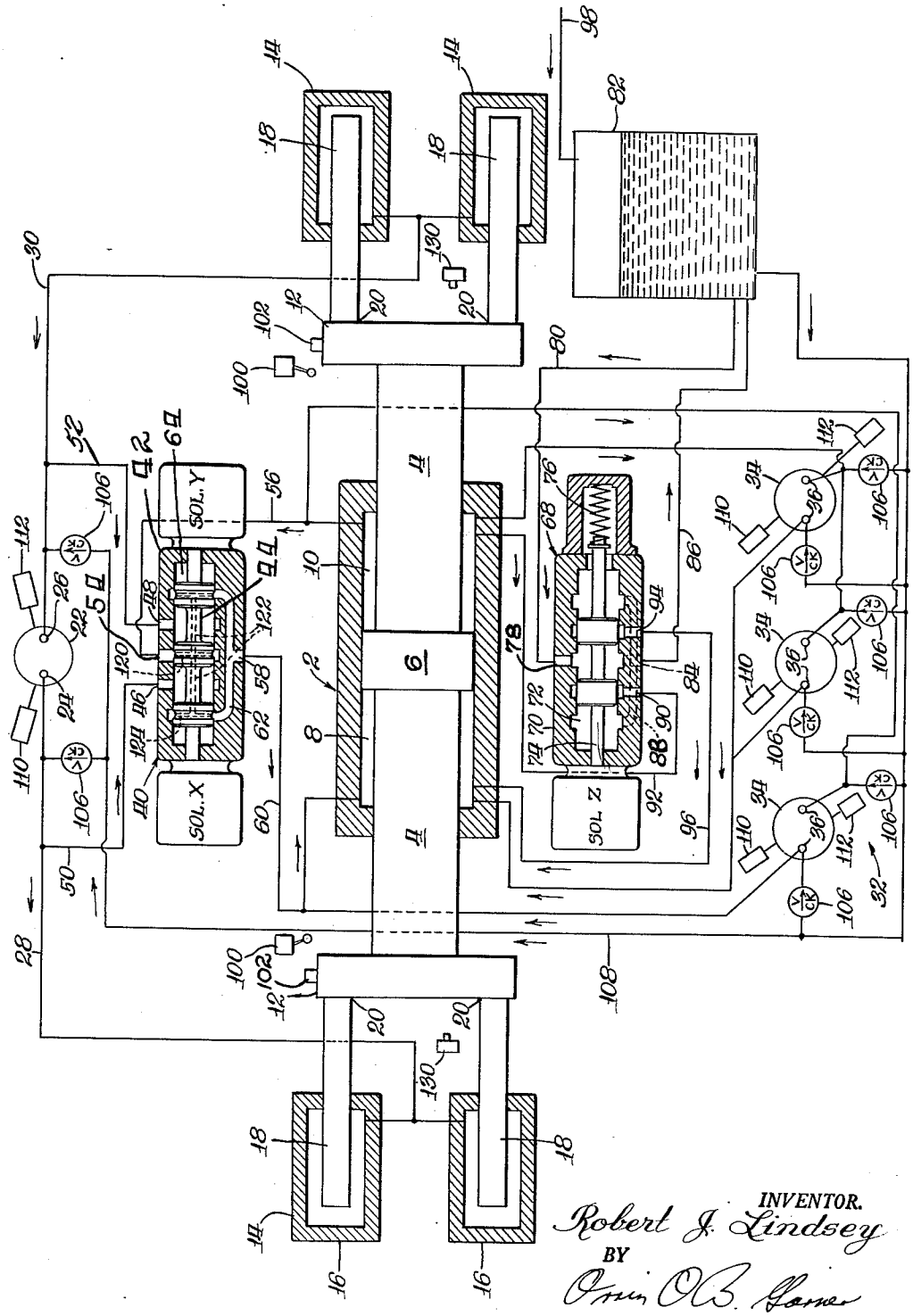
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HYDRAULIC PRESS CIRCUIT

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HYDRAULIC PRESS CIRCUIT

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The invention relates to a novel hydraulic circuit particularly adapted as a control circuit for a hydraulic press or like equipment.

It is a primary object of the invention to provide a novel control circuit for a hydraulic press or similar equipment.

It is another primary object of the invention to provide a novel circuit as above described particularly adapted to a double-ended reciprocating hydraulic press.

It is a more specific object of the invention to provide an arrangement as above described affording high speed rapid advance and a relatively slow speed pressure work stroke.

Specifically, it is an object of the invention to provide a plurality of pumps and a discharge control arrangement therefor, whereby the full pressure developed by all of the pumps in the circuit is available to deliver maximum tonnage during the working period of the stroke.

It is a further specific object of the invention to provide a hydraulic control arrangement as indicated, whereby all prefilling and exhaust of the operating cylinder is accomplished by means of pump and valve controlled flow of hydraulic fluid from opposed sides of said cylinder.

It is an additional specific object of the invention to provide an arrangement as above described which additionally affords the feature of proportional or partial circulation of operating fluid through a supply source or tank, whereby said fluid is cooled, thus avoiding heat build up normally found where an operating fluid is continually and operatively circulated.

It is a further specific object of the invention to design an arrangement as above described which affords a virtually constant volume of fluid in the supply tank even though the fluid is circulating continually, whereby extreme pressure variations in the source or supply tank are avoided.

These and other objects of the invention will become apparent in the course of the following description and from an examination of the associated drawings, wherein:

The figure is a diagrammatical illustrative circuit which discloses the novel operating features of the invention.

Describing the invention in detail, and directing attention to the figure, it will be seen that the novel hydraulic arrangement comprises a central operating cylinder 2, said cylinder having a ram 4 disposed therein. The ram 4 comprises a ram head 6 disposed internally of the cylinder dividing said cylinder into first and second chambers, indicated at 8 and 10, respectively. The ram additionally has platen means 12, 12 mounted on opposed ends thereof, the detail of said platen means is not herein disclosed in detail in view of the fact that such construction is not per se, part of the disclosed invention. It will be understood however, by those skilled in the art, that the platen means 12 may include die arrangements and the like (not shown) designed to accomplish certain

desired work, the detail of which would be left to the particular employment of the structure disclosed.

Auxiliary motor means 14, 14 or push back cylinders are arranged on the opposite sides of the central cylinder outboardly of the related platen means 12. In the preferred embodiment, each auxiliary means 14 comprise a pair of unidirectional operating cylinders 16 having pistons 18 disposed therein and extending outboardly of the cylinders 14 to operatively engage the adjacent platen means 12 as is schematically indicated at 20 in the figure.

Operating power means are provided for the circuit illustrated and in the first instance comprise a reversible delivery hydraulic pump 22 having opposed ports 24 and 26 on opposite sides thereof. Primary conduit lines 28 and 30 interconnect related ports of the pump 22 with the opposed auxiliary motor means 14. Additional operating pump means, indicated generally at 32, comprise a plurality or battery of three pumps 34, each being preferably of the reversible type and having outlet ports 36, 36, said outlet ports 36 being connected respectively by appropriate conduit means to the opposed chambers 8 and 10 of the operating cylinder 2. It should be noted that the several pump means herein shown are by way of illustration and not limitation and the particular batteries or arrangement of pumps may be varied and may still be within the scope of the invention herein disclosed.

The circuit is additionally provided with a four-way, solenoid operating valve indicated generally at 40. The valve 40 comprises a body 42 with a spool 44 movably disposed therein. The valve 40 is also provided with ports 46 and 48, each respectively connected by conduits 50 and 52 to the opposed ports and associated conduits of the pump 22. The valve 40 has also a port 54 therein, said port 54 being connected by conduit 56 to the second chamber 10 of the operating cylinder 2. Port 54 through its connection to the second chamber 10 is additionally connected to one side of the operating pump means 32. The valve 40 has another port 58 therein, said port 58 being connected through conduit 60 to the first chamber 8 of the operating cylinder 2 and through to the side of the pump means 32 opposite the last mentioned side. Port 58 communicates within the valve body 42 with the T-shaped passage 62, which in turn communicates with the chamber 64 which has the spool 44 movably disposed therein. Solenoids X and Y may be mounted on opposite sides of the valve 40 and through a standard connection control the positioning of the spool 44 within the valve body 42 as will be hereinafter more fully explained.

The circuit is also provided with another four-way operating valve 68, said valve 68 being of the single solenoid spring loaded type. The valve 68 comprises a valve body 70 having a chamber 72 therein, within which is movably disposed a spool 74. Solenoid Z is mounted on one side of the valve 68 and through mechanical connection with the spool 74 controls the position of the spool within the chamber 72 in cooperation with the spring 76 which abuttably engages the spool 74 on the side thereof opposite the connection to the solenoid Z. The valve 68 is provided with a port 78 which communicates, via conduit 80, with a reservoir or source 82 of pressure fluid. The valve 68 has another port 84 which also communicates with the reservoir 82 via the conduit 86. The port 84 connects internally of the valve body 70 with a T-shaped passage 88 which communicates at spaced points with the chamber 72 of the valve 68. A port 90 of the valve 68 communicates with the second chamber 10 of the operating cylinder 2 via conduit 92. A port 94 of the valve 68 communicates with first chamber 8 of the operating cylinder 2 via conduit 96.

It should be noted that as an optional feature of the invention, the reservoir 82 may be of the closed accu-

mulator type, which is familiar to those skilled in the art, and may have means, such as an air pressure line indicated at 98, to maintain the fluid within the reservoir 82 under a desired pressure.

The arrangement may also be provided with limit switches 100, 100 disposed adjacent the opposed platen means 12 and arranged to be engaged by abutment means at certain predetermined points in the stroke of the ram 4. The limit switches 100, 100 may be electrically interlocked (not shown), as is understood by those skilled in the art, respectively with the solenoids X and Y of the operating valve 40, whereby said solenoids may be alternately energized to accomplish repositioning of the spool 44 at particular points in the stroke or cycle, as will hereinafter be more clearly explained in connection with the operation of the arrangement.

A plurality of one-way check valves 106 may be arranged via conduit 108 to communicate with the respective ports or immediately associated conduits of the various pump means 22 and 32, said check valves 106 accommodating the one-way flow of fluid from the reservoir 82 to said respective ports thereby providing an assured supply of oil or hydraulic fluid flow during the action hereinafter described.

Operation of the pump means 22 and 32 may be controlled by conventional solenoids 110 and 112, said solenoids, in the preferred embodiment, being manually actuable, whereby the pumps are energized and the direction of fluid flow therefrom is determined.

The operation may best be described by assuming a typical cycle, wherein the ram 4 and its associated head 6 are disposed in full leftward position (the arrangement is illustrated in central position in the drawings). The spool 44 is centrally positioned in the body 42, as illustrated in the drawing, and the spool 74 is disposed at the left end of the body 70. To initiate the cycle, the solenoids X and Y are de-energized and all of the solenoids 110 and solenoid Z may be energized which starts the associated pump means 22 and 32 in such a manner as to draw hydraulic fluid from the chambers on the right-hand side of the drawing and transfer same to the chambers on the left-hand side of the drawing. At the same time, when solenoid Z is energized, the spool 74 will move from its extreme left position past its neutral position, illustrated in the drawing to the extreme right position, thereby establishing communication between port 90 and port 84 of the valve 68. During movement of the spool 74 between its extreme left position and extreme right position, a small quantity of fluid will pass from the tank 82, through conduit 80, ports 78 and 94 and thence through conduit 96 to the chamber 8. To clarify, with the solenoids Z and 110 energized, the pump means 22 will draw hydraulic fluid from the right-hand auxiliary motor and direct said fluid to the left-hand auxiliary motor 14 while concurrently, the pump means 32 will draw hydraulic fluid from the second chamber 10 and direct said fluid to the first chamber 8 of the central operating cylinder 2. The transfer of fluid between the chambers 10 and 8 of the cylinder 2 by the pump means 32 will initiate ram movement. To speed up said movement and in effect give a rapid transversing action to a ram 4, the pump means 22 directs hydraulic fluid to the left-hand auxiliary motors 14. In the usual circumstance, the action of the pump means 32 is insufficient to move the required quantity of hydraulic fluid from the chamber 10 to the chamber 8. Hence, to assist in that movement, the conduit 56 and port 54 are arranged to communicate with chamber 10, whereat hydraulic fluid may be deposited in the valve 40 and carried through the drilled and cross-drilled passages 120, 122 and 124 in the spool 44 to the T-passage 62 and thence, to the conduit 60, which carries said fluid to the chamber 8. To additionally assist in the transfer of fluid from the chamber 10 to the reservoir 82, the conduit 92 is arranged to communicate with chamber 10 and thence, to port 90 of the valve 68. As the solenoid Z is still energized, the spool 74 is in its extreme right position, whereby the fluid from chamber 10 is carried through port 90 into the chamber 72 and thence to passage 88 and to the reservoir 82 via the conduit 86. As heretofore described, a supply of additional fluid, if it is necessary, is available from the reservoir 82 via conduit 80 to the port 78 whereat it is directed during movement of the spool 74 to the right via chamber 72 to the port 94 and thence to the conduit 96, which may carry the fluid to the chamber 8 of the cylinder 2. Thus, it will be seen that a small portion of the hydraulic fluid in the operating circuit is constantly being circulated through the reservoir 82, whereby said fluid is allowed to cool, thus preventing any substantial increase in the temperature in the operating fluid.

At a predetermined point in the rightward movement in the ram 4, the abutment 102 may strike the operating limit switch 100, which energizes solenoid Y causing the spool 44 of the valve 40 to move from a central position to its extreme leftward position. The point at which the switch 100 is actuated may be set to coincide with the working stroke of the ram 4, whereby the flow of fluid from the port 24 of the pump means 22 may now additionally be directed through conduit 50 and spool passages 120 and 122 into the chamber 64 of the valve 40 and thence, to the T-shaped conduit 62 whereat it is carried via port 58 and conduit 60 to the chamber 8 of the operating cylinder 2. Thus, it will be seen that at the initial point of the working stroke of the ram 4, the full power of both pump means 22 and 32 may be directed to the operating cylinder to complement each other in the accomplishment of the working stroke.

Upon attaining of the desired pressure in chamber 8, or upon movement of the ram 4, a predetermined distance means may be provided to stop the stroke or to initiate the reversing stroke. Illustrative of said means, are the limit switches 130, which may be arranged to engage the adjacent platen means 12 and electrically interlocked (not shown), as will be understood by those skilled in the art, to de-energize the solenoids 110 of the respective pump means, whereby the pumps are stopped and the ram is brought to a halt. In the alternative, the limit switch 130 may be electrically interlocked (not shown) with the solenoids 110 and 112 on the respective pump means and the solenoid Y to energize the solenoids 112 and de-energize the solenoids 110 and Y, whereby the pumps reverse themselves and begin to withdraw fluid from the chambers on the left-hand side of the drawing and direct, or transfer fluid to the chambers on the right-hand side of the drawing.

De-energization of solenoid Y, of course, returns the spool 44 of the valve 40 to the central position illustrated, whereby the action above described, is duplicated except for the direction of fluid flow. In this latter arrangement, the control may be set up for automatic operation.

Thus, it will be seen that the arrangement illustrated and described provides a novel hydraulic circuit control adaptable particularly to a press of the double-ended reciprocal type and to other similar hydraulic arrangements and particularly satisfies the objects hereinbefore set forth.

I claim:

1. In a hydraulic press, a central operating cylinder, a piston which divides the cylinder into opposed operating chambers, a ram secured to said piston and having ends extending from opposite ends of said cylinder, platens connected to each end, a push back motor connected to each platen to coact with the piston to move the ram, and means operatively associated with the cylinder and push back motors for alternately transferring fluid from one of said chambers and its associated push back motor to the other chamber and its associated push back motor to actuate said piston and ram.

2. A hydraulic press according to claim 1, wherein said means comprises a reversible delivery pump arrange-

ment having opposed ports connected to the respective push back motors, and other reversible delivery pump arrangements having opposed ports connected to the said chambers.

3. A hydraulic press according to claim 2, and including valve means interconnecting the first mentioned pump arrangement and the chambers.

4. A hydraulic press according to claim 3, wherein said valve means establishes communication between the first mentioned pump arrangement and the chambers responsive to predetermined movement of the ram.

5. A hydraulic press according to claim 4, and including other valve means operative to establish communication between the chambers and a source of fluid.

6. In a hydraulic press, an operating cylinder having a movable ram therein, a piston on the ram dividing the cylinder into first and second chambers, work platen means connected to the ram, a rapid advance motor comprising a cylinder having a piston operatively connected to the ram, pump and valve means communicating with the first and second chambers of the cylinder and operative to draw hydraulic fluid from the second chamber and transfer said fluid to the first chamber, other pump and valve means operative to direct fluid to the advance motor, whereby said ram is moved at a relatively rapid rate during the initial operation of said ram, and means to connect said last mentioned pump and valve means to the first chamber at a predetermined point in the movement of the ram.

7. A hydraulic circuit according to claim 6, wherein said last mentioned means comprises a limit switch and a valve controlling solenoid interlocked therewith, said switch being actuable by movement of the ram.

8. In a hydraulic apparatus, a reservoir of hydraulic fluid, a primary operating cylinder, a ram having a piston in said cylinder dividing the latter into first and second chambers, said ram having its ends projecting from the opposite ends of the cylinder, platen means connected, to opposite ends of the ram, rapid advance motors having pistons connected to their respective platen means, reversible pump means having opposite ports communicating with said motors respectively, other reversible delivery pump means having opposite ports communicating with the first and second chambers respectively, first valve means controlling channels of communication between the opposite ports of said first mentioned reversible delivery pump means and first and second chambers and between said first and second said chambers, other valve means controlling channels of communication between the first and second chambers via the reservoir, said first mentioned pump means being operative during an initial phase of the cycle to draw fluid from one of said motors and transfer it to the other of said motors, said other pump means being operative to withdraw fluid from said second chamber and direct said fluid to said first chamber, means associated with said first valve means, whereby said first valve means during said initial phase of said cycle, assists in the transfer of fluid from the second chamber to said first chamber, means associated with said

other valve means arranged to transfer fluid from the second chamber to the reservoir and from the reservoir to the first chamber, and energizing means to actuate said first value means at a determined point in the cycle whereby communication between said first and second chambers through said first valve means is cut off and communication is established between said first mentioned pump means and said first chamber, whereby the full pressure of all of the pump means is available to said first chamber during a working phase of the cycle.

9. A hydraulic cycle controlling circuit according to claim 8, wherein said reservoir has means associated therewith to maintain hydraulic fluid therein under a pressure.

10. A hydraulic cycle controlling circuit according to claim 9, and including check valve means communicating between the respective opposed ports of said pump means and the reservoir and accommodating flow of fluid from the reservoir only.

11. A hydraulic cycle controlling circuit according to claim 8, and including reversing means to reverse the direction of fluid flow from each of said pump means, and other reversing means operative to re-position said first valve means to establish communication between said first and second chambers.

12. In a hydraulic circuit for a double ended press, movable ram means having opposed working means thereon, primary hydraulic means to move said ram means in opposite directions, auxiliary uni-directional motor means, each aranged to aid ram movement in one of said directions, reversible pump means operative to alternately withdraw fluid from one of said auxiliary motor means and discharge fluid to the other motor means, a second pump means to alternately transfer fluid from one of said primary hydraulic motor means to the other of said primary hydraulic motor means, and valve means operative to change the discharge of hydraulic fluid of said first mentioned reversible pump means in such a manner to complement the transfer fluid from said second pump means in response to a predetermined movement of said ram means.

13. A hydraulic circuit for a double ended press according to claim 12 and including other means to assist the transfer of said hydraulic fluid from one primary motor means to the other primary motor means.

14. A hydraulic circuit for a double ended press according to claim 13, wherein said other means comprises source means for storing said hydraulic fluid, and valve means operative to establish communication between one primary motor means and the reservoir means and between the reservoir means and the other primary motor means.

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