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HYDRAULIC CIRCUIT FOR HALTING RECIPROCABLE RAMS

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Fig. 1.

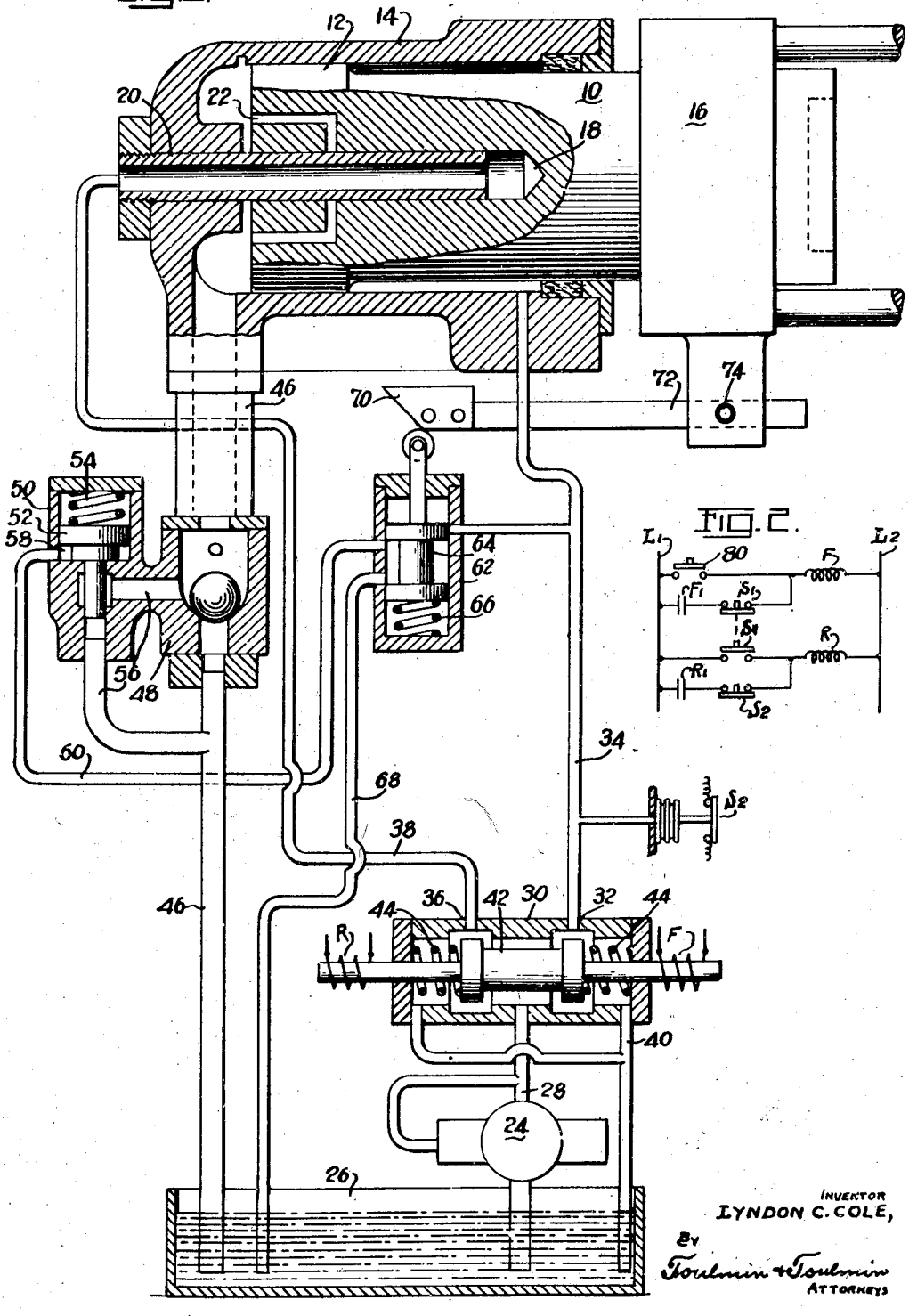


Fig. 2.

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HYDRAULIC CIRCUIT FOR HALTING RECIPROCABLE RAMS

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1

This invention relates to hydraulic apparatus and in particular to reciprocating hydraulic motors and control circuits therefor.

In the usual reciprocating hydraulic motor, there is an advancing means and a retracting means by which the ram of the motor is reciprocated. In reciprocating the motor, fluid is supplied to one of the means while the other is exhausted. To halt the reciprocation of the ram it is customary to interrupt the fluid supply to the one side or to bypass the fluid source to exhaust. This is ordinarily accomplished by electrically operated valves which are actuated in response to a predetermined ram position or in response to a predetermined pressure condition created when the ram halts against a fixed abutment.

It has been found, however, that electrically actuated valves are subject to sticking and the electric circuits for actuating the valves are a source of trouble because of contacts burning, wires breaking, etc.

The particular object of the present invention is to provide a system for a reciprocating ram which includes improved means for halting the ram by entrapping fluid in one end of the motor.

Another object is to provide means for halting a reciprocating hydraulic ram at one end of its stroke without the use of electrically actuated valves.

Still another object is to provide an operating system for a reciprocating hydraulic ram which operates to entrap fluid in one end of the motor cylinder to halt the ram by means of a valve which is operated by the ram.

It is still another object to provide a hydraulic operating circuit for a reciprocating ram in which the movement of the ram determines the point at which it will halt and in which the fluid source is bypassed when the ram comes to a halt.

These and other objects and advantages become more apparent upon reference to the following specification taken together with the accompanying drawings in which:

Figure 1 is a diagrammatic view of a reciprocating hydraulic ram having an operating and control circuit according to this invention; and

Figure 2 is a diagram of an electrical circuit adapted for controlling the valves in the circuit of Figure 1.

Referring to the drawings, there is shown a reciprocating ram 10 having a piston 12 slidable in the cylinder 14 and having connected therewith a platen 16. The ram is bored as at 18 to receive the hollow booster plunger 20 that is adjustably carried in the closed end of the cylinder 14.

2

The ram is provided with the bores 22 which communicate the working area of the booster with the advancing area of the piston 12 when the ram has advanced a predetermined distance.

For supplying actuating fluid to the cylinder 14 to actuate the ram 10, there is provided a pump 24 which is connected to draw fluid from a reservoir 26 and to discharge it under pressure through a conduit 28 to the inlet of a four-way valve 30. The valve 30 comprises a service port 32 that is connected by the conduit 34 with the retracting side of the piston 12, and a service port 36 that is connected by the conduit 38 with the bore in the booster plunger 20. The valve 30 also includes an exhaust connection 40 which returns fluid to the reservoir 26.

Reciprocable in the valve 30 is a valve member 42 that is normally held in its center position by the opposed springs 44. In this position the fluid supplied by the pump 24 is bypassed through the exhaust connection 40 back to the reservoir.

When the solenoid F at the right end of the valve is energized, the valve member 42 moves leftwardly to connect the conduits 28 and 38 while connecting the conduit 34 with exhaust. When the solenoid R at the left end of the valve is energized, the valve member 42 shifts rightwardly to interconnect the conduits 28 and 34 while connecting the conduit 38 with exhaust.

During the time that the ram is moving in the advancing direction due to fluid supplied to the booster plunger 20, the left end of the cylinder 14 is supplied with fluid through a conduit 46 which includes a surge check valve 48 that opens from the reservoir 26 toward the cylinder 14. When the ram 10 has advanced to the point that the bore 18 communicates with the bores 22, the check valve 48 closes and pressure may then be developed across the entire advancing surface of the piston 12.

When it is desired to retract the ram 10, fluid is supplied to the conduit 34 by shifting the valve member 42 and the left end of the cylinder 14 is exhausted directly to the reservoir through a valve 50 which is connected in parallel with the surge check 48. The valve 50 includes a valve member 52 normally urged by the spring 54 to interrupt the passage 56 which bypasses the check valve 48. In order to move the valve member 52 into position where it establishes the passage 56, there is provided the operating chamber 58 arranged in opposition to the spring 54

and connected by a conduit 60 with the conduit 34. Then, when the ram 10 moves in the retracting direction and reaches the point where the booster ram closes off the bores 22, fluid is entrapped in the left end of the cylinder 14 and pressure is developed in the conduit 34 sufficient to lift the valve member 52 and thus to exhaust the said left end of the cylinder to permit uninterrupted retracting movement of the ram 10.

To bring the ram 10 to a positive halt at a predetermined point in its retracting movement, there is provided a valve 62 in the conduit 60 which includes a valve member 64 normally urged by a spring 66 to maintain the continuity of the conduit 60. The valve chamber 64 is movable into a second position where the conduit 60 is interrupted and is connected instead with a conduit 68 that leads to the reservoir. With the valve member in this position, the chamber 58 is exhausted and the spring 54 returns the valve member 50 to its passage interrupting position so that fluid is entrapped in the left end of the cylinder 14, and the ram 10 comes to a positive stop against a body of cushioning fluid.

For actuating the valve member 64, there is preferably provided a cam 70 that is carried on an arm 72 that is adjustably secured to the platen 16 as by the set screw 74.

In order to bypass the pump 24 when the ram has been halted by the aforementioned entrapping of fluid, there is provided a normally closed pressure switch S2 which is connected with the conduit 34 to be opened in response to a predetermined pressure therein greater than the pressure normally required to retract the ram 10.

In Figure 2 is illustrated the electrical diagram for actuating the solenoids F and R and including the switch S2. In this view the power lines are indicated at L1 and L2 and connected therebetween in series with the solenoid F is a start switch 80 which, when closed, energizes the solenoid F to shift the valve member 42 to commence the advancing movement of the ram 10. The solenoid is maintained energized through the holding circuit which includes the blades F1 of the solenoid F and the normally closed switch S1. The ram continues on its advancing or working movement until the switch S1 is opened by a predetermined stimulus such as a pressure means, a positionally responsive means, other automatic means or by manual means.

Also connected between the lines L1 and L2, and in series with the solenoid R, is a second blade of the switch S1 which, when the said switch is actuated, closes to energize the solenoid R to shift the valve member 42 rightwardly to commence the retracting movement of the ram 10. The solenoid R is maintained and energized by the blades R1 thereof until the switch S2 is opened by a predetermined pressure developed in the conduit 34.

It will be seen that this invention provides means for halting a reciprocating ram at any point in its movement and does so without the use of unreliable electrical equipment including contacts, solenoids, etc., but employs instead a valve which is positively actuated into position to effect the said halting of the ram. Furthermore, the ram comes to halt against a body of fluid which is somewhat elastic and, therefore, has advantages over a solid abutment. In addition, this invention provides means for unloading the pump after the ram has been halted so that there is a minimum of power loss during the idle period of the ram regardless of its halting position.

It will be understood that this invention is susceptible to modification in order to adopt it to different usages and conditions and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In a hydraulic system; a fluid motor having an inlet and an outlet; a fluid source connected to said inlet; a normally closed bypass valve connected with said outlet; said motor having a valve actuating means; fluid pressure responsive means associated with said valve connected with said inlet and responsive to fluid pressure in the latter for actuating said valve into open position; other valve means, said other valve means having a protruding part normally projecting into the path of said valve actuating means to disconnect said pressure responsive means from said inlet and connect the same instead to exhaust; and a conduit from said other valve to said bypass valve whereby upon actuation of the protruding part of said other valve by said actuating means, fluid pressure is blocked off and said bypass valve is closed and vented to said exhaust by way of said other valve.

2. In a hydraulic system; a fluid motor having an inlet and an outlet; a pressure connection to said inlet and an exhaust connection to said outlet; a normally closed bypass valve means connected to said outlet; means responsive to a predetermined pressure of said inlet for actuating said valve means into an open position; said motor having a valve actuating means; other valve means having a part projecting into the path of said valve actuating means responsive to a predetermined movement of said motor; valve actuating means for actuating said part for disconnecting said other valve means from said inlet pressure, and connecting the same to said exhaust.

3. In a hydraulic system; a fluid motor having an inlet and an outlet; a fluid source connected to said inlet; a normally closed bypass valve connected with said outlet; said motor having a cam; fluid pressure responsive means associated with said valve connected with said inlet and responsive to fluid pressure in the latter for actuating said valve into open position; other valve means, said other valve means having a protruding part normally projecting into the path of said cam to disconnect said pressure responsive means from said inlet and connect the same instead to exhaust; and a conduit from said other valve to said bypass valve whereby upon actuation of the protruding part of said other valve by said cam, fluid pressure is blocked off and said bypass valve is closed and vented to said exhaust by way of said other valve.

4. In a hydraulic system, a fluid motor having an inlet and an outlet; a pressure connection to said inlet and an exhaust connection to said outlet; a normally closed bypass valve means connected to said outlet; means responsive to a predetermined pressure of said inlet for actuating said valve means into an open position, said motor having a cam; other valve means having a part projecting into the path of said cam responsive to a predetermined movement of said motor; said cam being constructed and adapted to actuate said part for disconnecting said bypass valve means from said inlet pressure, and connecting the same to said exhaust.

5. In a hydraulic system; a fluid motor having an inlet and an outlet; a fluid source connected to said inlet; a normally closed bypass valve connected with said outlet; said motor having a valve actuating means; fluid pressure responsive means associated with said valve connected with said inlet and responsive to fluid pressure in the latter for actuating said valve into open position; other valve means, said other valve means having a protruding part normally projecting into the path of said valve actuating means to disconnect said pressure responsive means from said inlet and connect the same instead to exhaust; and a conduit from said other valve to said bypass valve whereby upon actuation of the protruding part of said other valve by said actuating means, fluid pressure is blocked off and said bypass valve is closed and vented to said exhaust by way of said other valve; and a spring for biasing said other valve into its normally closed position.

6. In a hydraulic system; a fluid motor having an inlet and an outlet; a pump connected to said inlet; a normally closed bypass valve connected with said outlet; said motor having a valve actuating means; fluid pressure responsive means associated with said valve connected with said inlet and responsive to fluid pressure in the latter for actuating said valve into open position; other valve means, said other valve means having a protruding part normally projecting into the path

of said valve actuating means to disconnect said pressure responsive means from said inlet and connect the same instead to exhaust; and a conduit from said other valve to said bypass valve whereby upon actuation of the protruding part of said other valve by said actuating means, fluid pressure is blocked off and said bypass valve is closed and vented to exhaust by way of said other valve, a four-way valve, electrical means for actuating said last-named valve, said last-named valve being connected to the inlet and to the exhaust of said motor, and means connecting said four-way valve to the pressure side of said pump.

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