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HYDRAULIC DECOMPRESSION ARRANGEMENT

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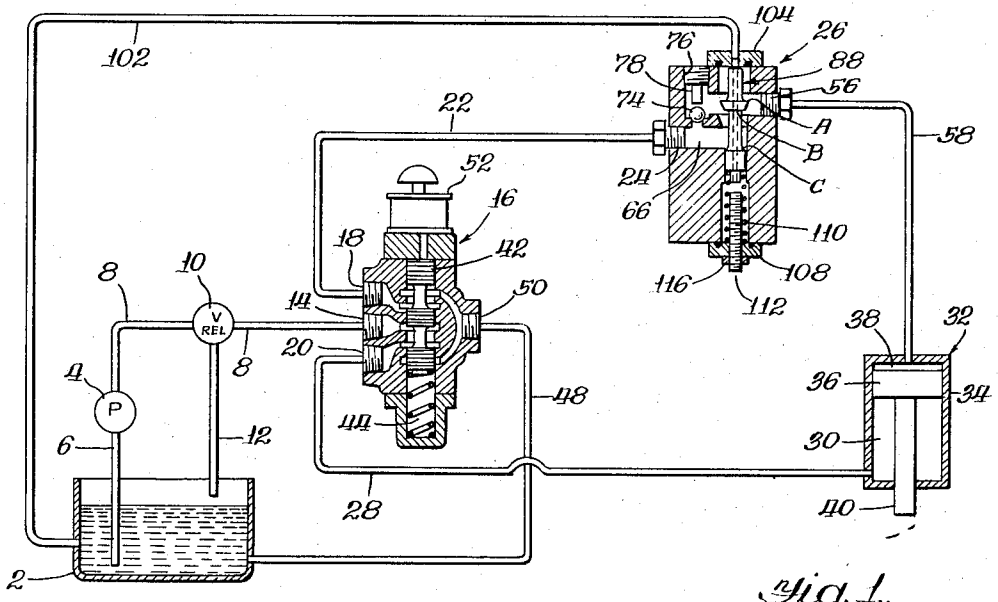


Fig. 1.

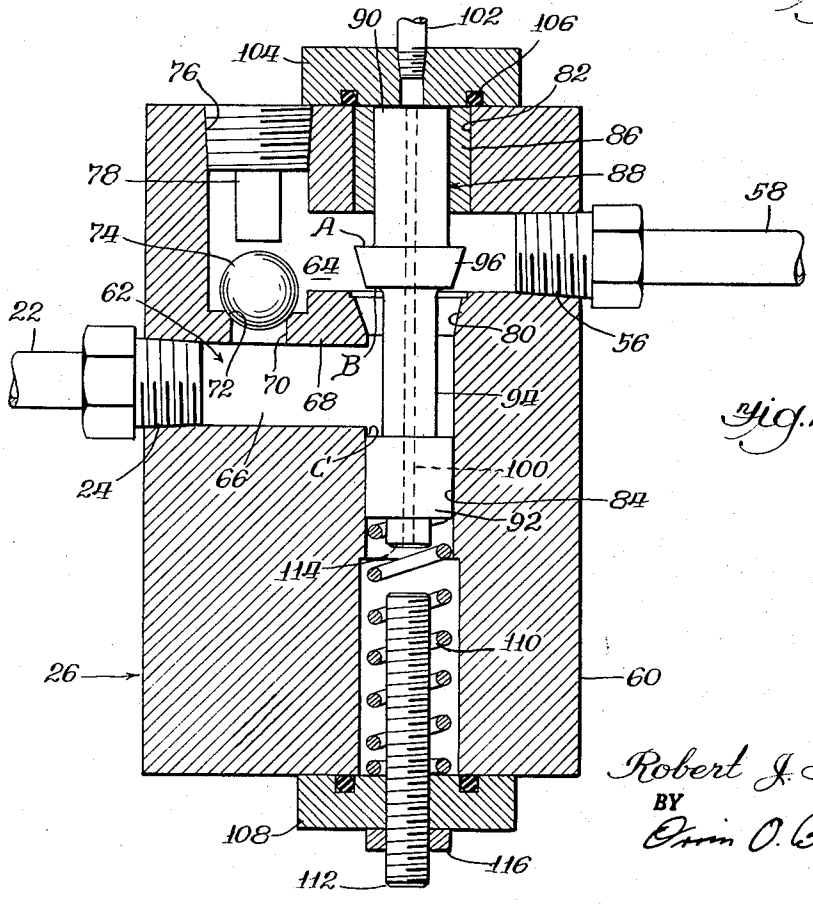


Fig. 2.

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HYDRAULIC DECOMPRESSION ARRANGEMENT

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3 Claims. (Cl. 137—505)

The invention relates to a novel hydraulic circuit and more particularly to such a circuit having incorporated therein a unique decompression arrangement.

The invention comprehends a novel hydraulic circuit that may be used to energize or operate a hydraulic motor, said motor serving as a source of power to accomplish some work, for example, to drive a ram on a hydraulic press. Particularly, the invention comprehends a novel decompression arrangement in said circuit wherein high pressure available to the motor to accomplish the work may be dissipated in a gradual manner thereby avoiding the hydraulic shock which normally ensues when an attempt is made to relieve said pressure. The gradual decompression is successfully completed by slowly bleeding the high pressure fluid in the motor to its drain at appropriate points in the cycle.

Additionally, the invention comprehends decompression arrangement which is variably responsive to the high pressure in the motor, whereby the bleeding or decompression occurs at a gradually increasing rate as the pressure is dissipated.

Accordingly, it is the general object of the invention to provide a novel hydraulic circuit for operating a hydraulic motor incorporating novel decompression means therein.

It is a specific object of the invention to provide a decompression valve in a circuit of the type described, wherein high pressure fluid from one side of the associated hydraulic motor is bled to gradually relieve said pressure.

It is another specific object of the invention to furnish such a decompression valve that will be operatively responsive to the degree of pressure in the motor and thereby variably control the dissipation of said pressure.

It is another specific object of the invention to provide manual means for regulating the action of the said decompression valve.

These and other objects of the invention will become apparent from an examination of the following specifications and the associated drawing, wherein:

Figure 1 is a schematic representation of an operative hydraulic circuit incorporating a detailed illustration of the novel decompression means, and

Figure 2 is an enlarged view of the decompression valve.

Describing the invention in detail in referring to the figures, the numeral 2 indicates a reservoir of hydraulic fluid suitable for use as a pressure transmission vehicle to operate a hydraulic motor. A pump indicated schematically at 4 draws fluid from the reservoir 2 via the conduit 6 and directs said fluid into conduit 8 which has a relief valve 10 therein, said relief valve serving to prevent the pressure in conduit 8 from exceeding a maximum desired value. The relief valve is provided with a conduit drain 12 to reservoir 2, whereby upon excessive pressure being present in the conduit 8, the valve opens and relieves the pressure by directing a certain portion of the fluid through the conduit 12 to the reservoir 2. The conduit 8 then carries the pressure fluid to an intake port

14 of a four-way control valve, indicated generally at 16. The valve 16 is provided with two exhaust ports 18 and 20. The port 18 communicates with a conduit or line 22, which in turn communicates with a port 24 of the decompression valve 26. The port 20 of the valve 16 communicates with a line or conduit 28, which in turn communicates with a return chamber 30 of an operating hydraulic motor indicated generally at 32. It should be noted that the hydraulic motor 32 comprises a cylinder 34 having a piston 36 disposed therein in fluid tight movable engagement therewith which divides said cylinder into the mentioned return chamber 30 and to an advance chamber 38. The piston 36 has a rod 40 connected thereto and arranged to move therewith, said rod being connectable to any desired working tool such as a ram (not shown) of a hydraulic press as will be well understood by those skilled in the art.

The four-way operating valve 16 has a spool 42 disposed internally thereof, said spool being movable within the valve body and spring loaded at one end thereof, as at 44, whereby the spool is urged to the return position thereof in which pressure fluid from the pump 4 is directed from the conduit 8 to the conduit 28 and thence to the return chamber 30 of the hydraulic motor 32. In the return position of the spool 42 communication is established between the conduit 22 and a drain conduit 48 which establishes communication between an exhaust port 50 of the valve 16 and the reservoir 2. It will be readily apparent that in the position illustrated, the pressure fluid being directed to the return chamber 30 of the motor 32, the piston 36 will be forced upwardly to the position shown and any hydraulic fluid in the advance chamber 38 will be forced into the reservoir 2.

The valve 16 additionally comprises an operating mechanism 52, said operating mechanism being either manually controlled or automatically responsive to the position of the piston 36 within the motor 32. This automatic operation is not illustrated as much as those skilled in the art will be readily acquainted with mechanical or electrical means for accomplishing this interlock. Sufficive now to say, that the mechanism 52 when actuated, urges the spool 42 downwardly to its advance position whereat communication is established between the pump conduit 8 and the advance conduit 22 and communication is also established between the return conduit 28 and the drain conduit 48.

As noted above, the advance conduit 22 communicates with the port 24 on one side of the decompression valve 26. Additionally, the valve is provided with another port 56 which communicates with conduit 58 which in turn communicates with the advance chamber 38 of the hydraulic motor 32. The valve 26 comprises a body 60 which defines therein a chamber, indicated generally at 62, said chamber being divided into segments or portions 64 and 66. The port 70 has on its upper edge an appropriately machined lip or seat 72 which is complementally formed to engage the surface of a ball 74 which may seat thereon. The valve body 60 is drilled and taped as at 76 directly above the port 70 whereby a fixed abutment 78 may be disposed therein to prevent the ball 74 from taking a position that would prevent it from engaging on the lip 72 during the action hereinafter described.

The valve 26 is additionally provided with bleeding or flow control means between the conduits 22 and 58, the preferred embodiment of the bleeding means comprising a port 80 formed in the wall 68 between the segments 64 and 66 of the chamber 62. It will be noted that the port 80 comprises a machined taper in the wall 68. The valve 26 is further provided with drilled and reamed holes 82 and 84 aligned vertically with the port 80. The hole 82 is bushed as at 86 to provide an accu-

rate upper guide for a movable member or piston 88. The piston 88 comprises an upper guide 90 disposed within the bushing 86 and lower guide 92 disposed within the hole 84. Intermediate the guides 90 and 92 the member is undercut as at 94 and is provided with a tapered male portion 96 formed to complement the peripheral surface of the port 80 formed in the wall 63 of the valve body 60. Thus it will be seen that the guided member 88 is arranged to move vertically within the body 60 and to carry the tapered portion 96 toward and away from the tapered port 80, whereby the size of the port 80 is diminished or increased depending on the direction of movement of the member 88. It will also be noted that the upper guide 90 and the lower guide 92 are machined to be in substantially fluid tight engagement with their respective holes in the body 60. However, inasmuch as perfect fluid tight engagement between movable parts is virtually impossible the movable member 88 is center drilled therethrough as at 100 to provide a drain via the conduit 102 to the reservoir 2 to remove any hydraulic fluid that may be trapped in the lower hole 84 of the valve body 60. The upper hole 82 of the valve body 60 is closed by the cap 104 which is provided with O ring seals 106 to prevent loss of the high pressure hydraulic fluid. Similar sealing construction at the lower end of the valve is provided by cap 108.

The movable member 88 is provided with horizontal pressure areas at A, B and C, the pressure area A and C being arranged to exceed in area the pressure area B whereby, under the fluid action hereinafter described, the pressure on said areas will urge the movable member 88 to move downwardly tending to close the port 80. Additionally, a spring 110 is disposed within the lower hole 84 and abuts at its opposite ends the lower plate 108 secured to the valve body 60 and the lower end of the movable member 88. The spring 110 serves as pressure means to urge the movable member upwardly which tends to increase the size of port 80 and is selected to afford a particular pressure depending on the fluid pressures which will be utilized in the entire circuit.

The lower plate 108 is center drilled and tapped to threadably receive an adjusting screw 112, said adjusting screw extending into the hole 84 whereat it is engageable with a knob 114 formed on the lower end of the movable member 88. The screw 112 serves as an abutment to restrict the downward movement of the member 88 and thus provide a manual adjustment whereby a minimum size of the port 80 may be selected. A locking screw nut 116 is provided to maintain the screw 112 in a selected position. From the above description it is believed that the operation of the circuit will be readily apparent to those skilled in the art but it will nevertheless here be briefly discussed.

With the circuit in the illustrated return position, the mechanism 52 may be energized when it is desired to move the piston 38 to its advanced position. The energizing of the mechanism 52 lowers the spool 42 and connects the pressure fluid to the chamber 38 through the advance conduit. The fluid is carried via the conduit 22 to the port 24 of the decompression valve and into segment 66 of chamber 62 of said valve. The fluid continues to flow to conduit through the port 80 and through the port 70 by unseating the ball 74. As the pressure fluid builds up in the advance chamber 38, the piston 36 is urged downwardly at a relatively rapid rate. At some point in the stroke the connected ram (not shown) engages a work piece causing resistance to its advance motion. As resistance increases, the pump 4 increases the pressure of the fluid in the chamber 38 to a maximum point whereby the desired work will be completed.

The high pressure in the chamber 38 is present in the conduit 58 and in the chamber 62 of the decompression valve. This maximum pressure exerted on the pressure areas A and C is sufficient to urge the movable member 88 downwardly against the resistance offered by the pressure of the fluid on surface B and the pressure of the spring 110. When the member 88 abuts the screw 112 the port 80 is reduced to a minimum size, accommodating only a bleeding flow of fluid there. As the piston 36 is still in an advanced portion of its stroke, fluid flow to the chamber 38 is accommodated through the port 70 and past the unseated ball 74. As the advanced stroke is completed, the mechanism 52 is again energized and the spool 42 is allowed to move upwardly to its return position. In the return position, the spool establishes communication between the conduit 8 of the pump 4 and the return conduit 28 and concurrently establishes communication between the line 22 and the drain line 48. Pressure fluid is now directed to the return chamber 30 of the operating motor 32.

At this point a quantity of extremely high pressure fluid is present in the advance chamber 38 and it is desirable to prevent the quick dissipation of said pressure fluid in order to avoid hydraulic shock throughout the system. As earlier noted, the pressure of the fluid in the advance chamber is now present in the segment 64 of the chamber 62, and this pressure exerted on surfaces A and C maintains the movable member in its low position whereby the port 80 is reduced to minimum size. With the movement of the valve 16 to its return position, the pressure is dissipated in line 22 and in segment 66 of the chamber 62 and the ball 74 seats on the lip 72 of the port 70, thus preventing return flow of fluid therethrough. With the port 80 reduced to minimum size the pressure fluid in chamber 64 is gradually bled therethrough whereby the pressure in the advance chamber 38 is slowly and easily dissipated.

As the pressure falls, the pressure available at surface B, together with the force exerted by the compressed spring 110, slowly equals itself to the sum of the pressures available at surfaces A and C, whereby the movable member 88 is urged gradually upwardly, slowly increasing the size of the opening 80. Thus as decompression occurs the action of the spring allows an increasing volume of the pressure fluid in the advance chamber 38 to escape thus accelerating the return stroke of the piston 36.

Thus it will be seen that I have provided a novel hydraulic circuit incorporating therein novel means for relieving or dissipating a quantity of stored high pressure fluid whereby hydraulic shock in the circuit is avoided. It will also be understood that the associated drawing is by way of illustration only and the essence of the circuit may be incorporated in any hydraulic arrangement where it is desired to gradually decompress or dissipate quantities of stored hydraulic pressure fluid.

I claim:

1. In a decompression valve for exhausting a high pressure chamber, a body, a fluid pressure chamber therein, a wall integral with said body dividing said chamber into separate intake and exhaust portions, a port in said wall establishing communication between said portions, an upper and a lower opening in said body vertically aligned with said port, a member guidably carried in said openings and extending through said port, said member having an enlarged portion above said port and engageable with said port for opening and closing thereof, said member having a second enlarged portion below said port, said enlarged portions being provided with opposed differential pressure areas such that fluid pressure in said chamber will urge said member downward tending to close said port when subjected to high pressure, stop means in said lower opening to limit the downward motion of said member, and resilient means in said lower opening urging said member upward to gradually open said port as the pressure in said high pressure chamber decreases.

2. In a decompression valve for a high pressure fluid motor, a body having a fluid pressure chamber therein, a wall dividing said chamber into separate intake and

exhaust portions, a port in said wall establishing communication between said portions, an upper and a lower opening in said body vertically aligned with said port, bleeding means associated with said port comprising a member guidably carried in said openings and extending through said port, said member having an enlarged portion engageable with said port for opening and closing thereof upon actuation of said member, differential pressure areas responsive to pressure in said exhaust portion to urge said member into engagement with said port, a stop to limit the amount of closing of said port, and resilient means associated with said member and disposed opposite said enlarged portion relative to said wall, said resilient means constantly urging said enlarged portion out of engagement with said port, said areas and said resilient means together accommodating slight fluid flow through said port during the high pressure surge at the beginning of decompression, and accommodating gradually increasing fluid flow through said port during decompression.

3. In a decompression valve for a high pressure fluid motor, a body having a fluid pressure chamber therein, a wall dividing said chamber into separate intake and

exhaust portions, a port in said wall establishing communication between said portions, a member guidably carried by said body and extending through said port, said member having an enlarged portion on one side of said port and engageable therewith for opening and closing thereof, said member having a second enlarged portion on the other side of said port, said enlarged portions comprising opposed differential pressure areas such that fluid pressure in said chamber will urge said member in a direction tending to close said port when subjected to high pressure, stop means to limit the motion of said member in said direction, and resilient means urging said member to gradually open said port as the pressure in said chamber decreases.

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