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(54) **Valve for automatically directing a flow of fluid.**

(57) A valve for automatically directing the flow of fluid from a source of pressure to each side in turn of a double acting hydraulic actuator causing it to reciprocate. The valve assembly comprising a valve spool (12) which is acted on by a return spring (13) to urge the valve spool into a starting position, in which position fluid flows to one side of the actuator. Spring loaded valve means (17,25) controls the flow of fluid, when a predetermined pressure is exceeded, to a pilot spool (14) which acts on the valve spool to change over its position. The valve spool (12) is held in the change over position by a back pressure which is generated during the return of the actuator by the flow of fluid through a throttle (D) formed between the valve spool and the pilot spool.

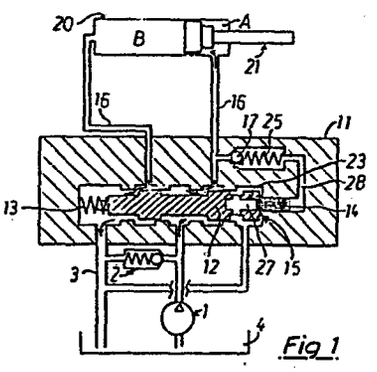

Fig 1

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DESCRIPTION

IMPROVEMENTS IN OR RELATING TO VALVES

The present invention relates to a valve for automatically directing the flow of fluid from a power pack to each side in turn of a double acting hydraulic actuator causing it to reciprocate.

A valve of this type is useful in, for example, such applications as hydraulic barn cleaners, bilge pumps and certain types of pipe bending equipment.

The known methods of achieving this automatic reciprocation are either electrically, for example by way of electrically operable solenoid valves, which can be unreliable, or with a much more complicated hydraulic valve.

According to the present invention there is provided a valve assembly comprising a valve body having therein a valve spool whose position controls the flow of fluid from a source to one side or the other of a double acting hydraulic actuator, and spring loaded valve means controlling the flow of fluid from a line downstream of the valve spool to a pilot spool to actuate same when a predetermined pressure is exceeded in said line to displace the valve spool against the force of a return spring and change over the position of the valve spool and commence the return stroke of the actuator, the valve spool being held in its changed over position displaced against the force of the return spring by a back pressure acting on the valve spool during the return stroke of the hydraulic actuator.

The back pressure is generated by providing a restrictor or throttle which restricts the flow of fluid from the actuator on the return stroke. When

the actuator reaches the end of the return stroke, or is stopped by other resistance, the back pressure decays, whereupon the valve spool is changed over to its starting position by the return spring. The cycle is repeated until the source of pressure is disconnected.

The spring load valve means is set to actuate the pilot spool at a pressure which is slightly below the setting of a relief valve for the system. When the actuator reaches its end position, or is stopped by other resistance, the pressure rises in said line so overcoming the resistance of the valve means and actuating the pilot spool. The line branches off a passageway leading to one side of the actuator. The actuator is typically an hydraulic cylinder/piston assembly.

The present invention will now be described further, by way of example only, with reference to the accompanying drawings of figures 1 to 4 which illustrate schematically a system for controlling the reciprocation of an hydraulic actuator showing a valve according to the invention in different operation positions.

A control system for an hydraulic actuator in the form of a double acting cylinder/piston assembly 20/21, has a pump 1 for feeding hydraulic fluid to the actuator and return channels 3 leading to a reservoir 4. A relief valve 2 is provided for controlling the maximum pressure delivered by the pumps to the system.

A valve assembly controls the flow of fluid from the source to the actuator. The valve assembly has a valve body 11 accommodating slidably therein a valve spool 12.

The valve spool 12 is biased into an end position by a return spring 13 in which position communication is established between the source of pressure and a chamber A of the cylinder 20. In this position a chamber B of the cylinder is in communication with the return channel 3. Two lines 16 lead from respective outlets in the valve body to the chambers A and B. A line 23 branches from the line leading to chamber A and has disposed therein valve means comprising a ball 17 which is urged into contact with a valve seat by a spring 25. The valve means is set to open at a pressure slightly below that of the relief valve 2. A pilot spool 14 is disposed in the line 23 and is co-operable with one end of the valve spool 12.

Figure 1 shows the valve spool in its starting position wherein fluid from the source is directed to chamber A to displace the piston rod 21 to the left, as illustrated. When the piston rod reaches its end position, as illustrated in figure 2, no further movement can occur, and there is a buildup in pressure in the chamber A until the pressure overcomes the force of the spring 25 when fluid passes down the line 23 and acts on one end of the pilot spool 14. This causes the valve spool 12 to be displaced against the force of the return spring 13 and thereby changes over the position of the valve spool so that fluid from the source is in communication with chamber B, and chamber A is in communication with the return channel 3. Thus, the piston rod 21 commences its return stroke - see figure 3.

During the return stroke fluid is forced from chamber A by the advancing piston, back to the reservoir 4. A throttle or restriction D is provided in the passage leading to the reservoir between an end face of the pilot valve 14 and an adjacent end of the valve spool 12. The valve spool has an orifice 27 therein by way of which the fluid has to pass on its return to the reservoir. The restriction to return flow of the fluid generates a back pressure which acts on the valve spool 12 in a direction against the return spring 13. Thus, the valve spool is maintained in its changed over position so long as the back pressure acting on the valve spool is greater than the spring force.

A radial hole 28 (or several such holes) in the spool provides relief of any pressure trapped in the end compartment 27 of the spool 12 during return shifting. The hole is sized so that the pressure drop through it is far greater than the pressure required to keep the spool in the shifted position against the spring.

The pilot valve is restricted in its return to its starting position in which position a flange or circlip 15 on the pilot spool engages the valve body, by virtue of the fact that the valve means, i.e. ball 17, closes off the line 23 so that fluid can only escape from this line by leakage past the pilot spool. Thus, return of the pilot spool is restricted by careful control of the leakage path C.

At the end of the return stroke of the piston rod 21, there is no more fluid forced from the chamber A and the back pressure ceases, whereupon the return

spring urges the valve spool towards its starting position to change over the position of the valve spool and so repeat the cycle. The valve spool contacts the pilot spool which is then urged toward its starting position. The fluid in the line 23 is forced past the pilot spool during this return stroke of the pilot spool.

The cycle repeats constantly until the hydraulic supply is switched off. When this is done, the valve re-sets itself into the starting position, shown in figure 1, under the action of the spring 13.

If an excessive resistance is encountered during operation of the actuator, the valve will automatically change over so that the stroke of the actuator is reversed. The cycle will then continue. This occurs because the resistance causes either a build up of pressure in chamber A so triggering the valve means or termination of the back pressure as a result of movement of the piston rod being obstructed.

CLAIMS

1. A valve assembly comprising a valve body (11) having therein a valve spool (12) whose position controls the flow of fluid from a source to one side or the other of a double acting hydraulic actuator, characterised by spring loaded valve means (17,25) controlling the flow of fluid from a line downstream of the valve spool to a pilot spool (14) to actuate same when a predetermined pressure is exceeded in said line to displace the valve spool (12) against the force of a return spring (13) and change over the position of the valve spool and commence the return stroke of the actuator, the valve spool (12) being held in its changed over position displaced against the force of the return spring (13) by a back pressure acting on the valve spool during the return stroke of the hydraulic actuator.

2. A valve assembly as claimed in claim 1 in which the spring loaded valve means comprises a ball (17), a valve seat and a spring (25), all of which are accommodated in the valve body, the ball being urged into contact with the valve seat by the spring.

3. A valve assembly as claimed in claims 1 and 2 in which the pilot spool (14) is slidable in a bore in the valve body, which bore opens into a chamber of the valve body accommodating the valve spool (12).

4. A valve assembly as claimed in claim 3 in which a leakage path (C) exists between the pilot spool (14) and the bore in which it is slidably received, which leakage path controls the return movement of the pilot spool to its starting position.

5. A valve assembly as claimed in claim 4 in which the starting position of the pilot spool (14) is defined by a collar (15) carried by the pilot spool (14).

6. A valve assembly as claimed in any preceding claim in which the back pressure is generated by providing a restrictor or throttle (D) which restricts the flow of fluid returning from the actuator on the return stroke.

7. A valve assembly as claimed in claim 6 in which the returning flow passes through an orifice or compartment (27) in the valve spool (12) and the restrictor or throttle is formed downstream of the orifice (27) between an end face of the pilot spool (14) and an adjacent end of the valve spool (12)

8. A valve assembly as claimed in claim 7 in which one or more bores (28) are disposed in the valve spool (12) and lead from the compartment (27) to the valve spool chamber to relieve any pressure trapped in the compartment during return shifting.

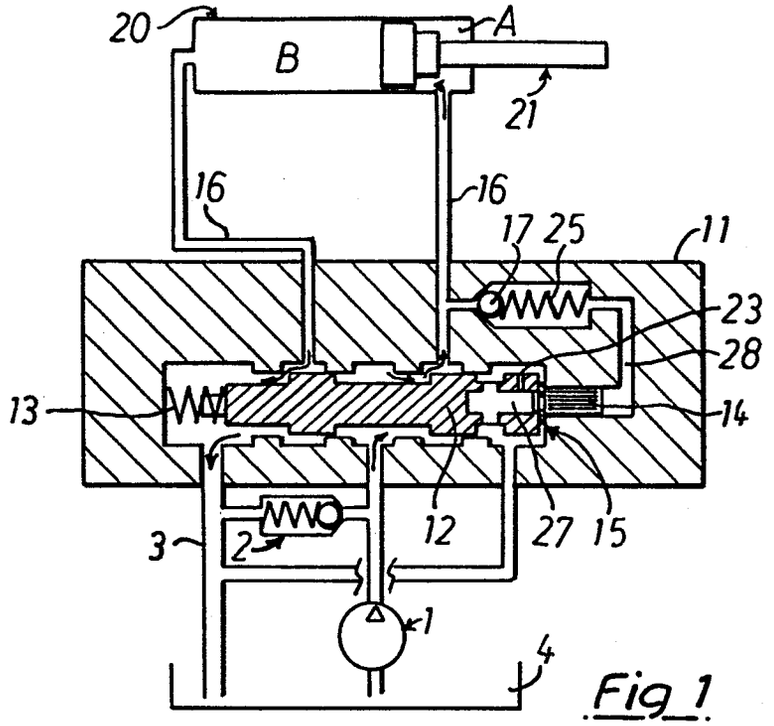

Fig 1

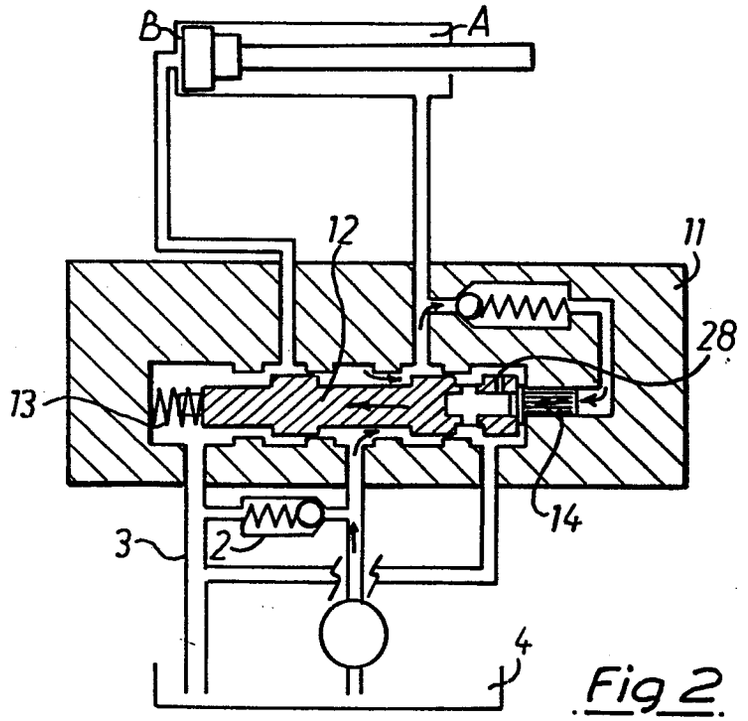

Fig 2

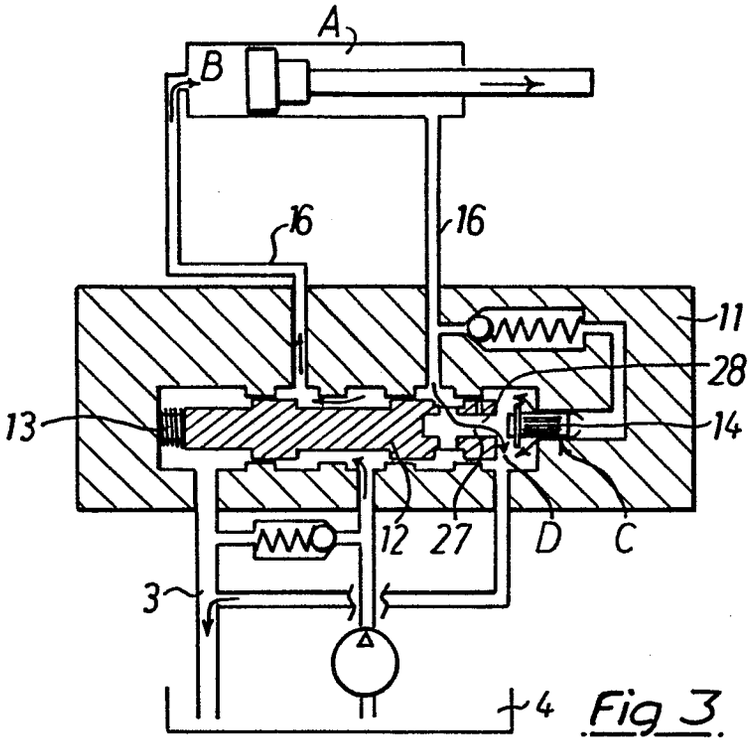

Fig 3.

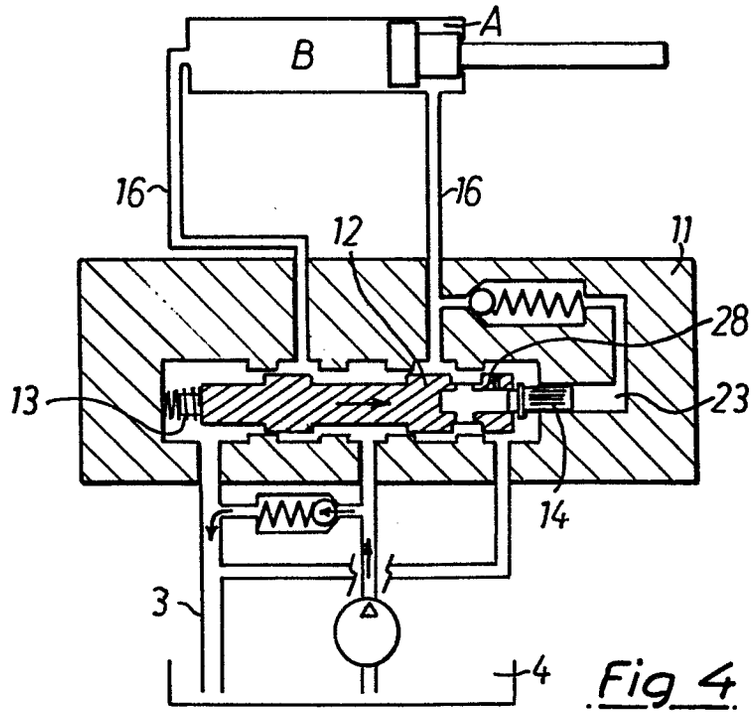

Fig 4.