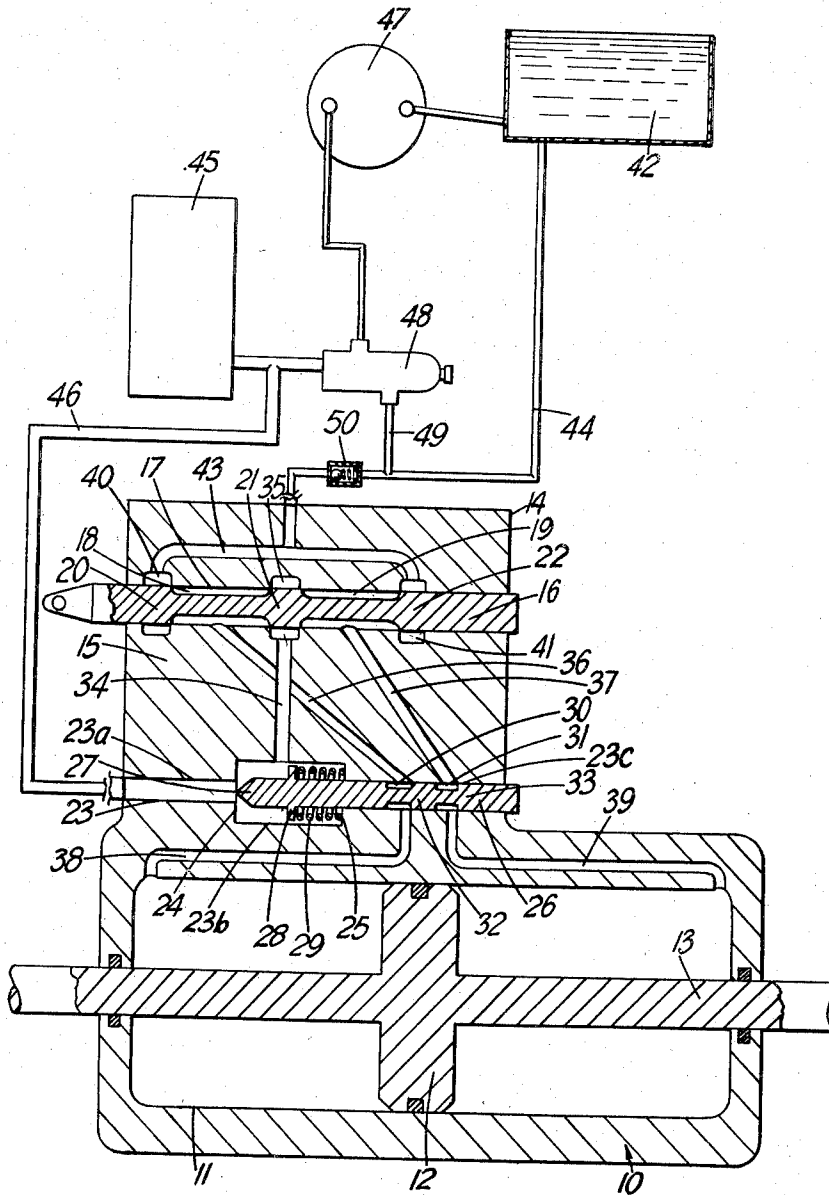


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SERVO-MOTOR SYSTEMS
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SERVO-MOTOR SYSTEMS

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4 Claims. (Cl. 121-47)

This invention relates to servo-motor systems, and is concerned with liquid pressure servo-motor systems of the kind comprising a cylinder, a double acting piston sliding in the cylinder, a servo-control valve for the cylinder, a source of liquid pressure, a low pressure reservoir, liquid pressure supply and exhaust lines connecting said source and said reservoir with the servo-control valve, and passages connecting the servo-control valve with each end of the hydraulic cylinder.

Hydraulic servo-systems where the piston is locked in the position to which it is set by trapping the liquid in the hydraulic cylinder, can suffer from certain defects, such as creep and cavitation within the hydraulic cylinder, caused by external forces acting upon the element operated by the piston.

An object of this invention is to provide a servo-motor system which tends to reduce these defects and is also improved in other respects.

According to the invention there is provided a liquid pressure servo-motor system comprising in combination, a hydraulic cylinder having a double acting hydraulic piston movable therein, a servo-control valve for the cylinder, a low pressure reservoir, a liquid pressurizing and distributing means supplied from the reservoir, liquid pressure supply and exhaust lines connecting said pressurizing means and said reservoir with the servo-control valve, passages connecting the servo-control valve with either end of the hydraulic cylinder, and valve means in said passages, which valve means act independently of the servo-control valve and permit flow of liquid through said passages under normal operating conditions but operate to close off and isolate simultaneously the passages upon the pressure of the liquid supply falling below a predetermined value.

Preferably, a valve is located in the liquid pressure supply line of the servo-control valve, which valve closes automatically when the pressure of the liquid supply drops below a predetermined minimum value to shut off the supply, said "shut-off" valve and the said "isolating" valve means being coupled together so that closing of the one is accompanied by closing of the other.

One embodiment of the invention is hereinafter described by way of example, and with reference to the accompanying diagrammatic drawing, which shows a liquid pressure servo-motor according to the invention.

Referring to the drawing, the servo-motor which is generally indicated at 10 comprises a cylinder 11 in which is slidable a piston 12 mounted on a rod 13 which projects through both ends of the cylinder 11. The rod is of uniform diameter so that the effective areas of both faces of the piston are equal to one another.

A servo-control valve 14, the body 15 of which is mounted on the hydraulic cylinder 11 includes a plunger 16 slidable in a bore 17 in the body 15. The plunger is provided with two spaced circumferential grooves 18 and 19 bounded by three lands 20, 21, and 22. A second bore 23 in parallel relation to bore 17 is provided in the servo-control valve casing and disposed between the bore 17 and the cylinder 11. This bore 23 is increased in

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diameter at its centre part 23b thereby forming steps 24 and 25. The left-hand part 23a of the bore 23 forms the pressure liquid inlet to the hydraulic cylinder 11. The centre and right hand parts 23b and 23c, together house an isolating valve 26. This valve has a conical portion 27 at its left-hand end and adjacent to this conical portion is provided with a flange 28. A coil spring 29 is interposed between this flange and the step 25. That part of the isolating valve 26 housed within the right-hand parts 23c of the bore 23 is provided with two circumferential grooves 30 and 31 and thus with lands 32 and 33 respectively to the right of each groove. These lands are a lapped fit in the bore.

A passage 34 connects the centre part 23b of bore 23 with an annulus 35 surrounding the land 21 of the valve plunger 16, while passages 36 and 37 respectively place the circumferential grooves 18 and 19 in communication with the circumferential grooves 30 and 31 when the valve 26 is held against the pressure of the coil spring 29 in its rightward position. Passages 38 and 39 respectively lead from the circumferential grooves 30 and 31 to the left and right-hand ends of the hydraulic cylinder 11. Annuli 40 and 41 surrounding the lands 20 and 22 of the plunger 16 are connected to a reservoir 42 through a common passage 43 and conduit 44.

Liquid under pressure for operating the piston is supplied by a liquid pressure accumulator 45 from which a conduit 46 leads to the liquid pressure inlet 23a. Pressure is maintained in the accumulator 45 by a pump 47 which draws liquid from the reservoir 42. A cut-off valve 48 is provided which acts in known manner to connect the output of the pump 47 to the accumulator 45 when the pressure in the latter falls to a predetermined lower limit, and when the pressure in the accumulator rises to a predetermined higher limit disconnects the output of the pump from the accumulator and connects it to the low-pressure reservoir 42 through a conduit 49 which branches into conduit 44. A non-return valve 50 is provided in conduit 44 between the passage 43 and the point at which conduit 49 branches into conduit 44.

In operation, when the servo-control valve plunger 16 is in its neutral position the lands 20 and 22 thereof close over the annuli 40 and 41 and thus both ends of the hydraulic cylinder 11 are isolated from the liquid return passage 43. Also the land 21 closes over the annulus 35 and thus prevents pressure liquid from entering either of the circumferential grooves 18 and 19 of the valve.

Under normal operating conditions liquid under pressure is admitted from the delivery conduit 46 through the inlet bore 23a and acts upon the conical end 27 of the isolating valve 26 so as to lift it from its seating, formed by the step 24, against the effort of coil spring 29. Thus pressure liquid is permitted to pass into the passage 34 and the annulus 35 and as long as the pressure is maintained above a predetermined value the isolating valve 26 will remain open and pressure fluid will be maintained in the passage 34 and the annulus 35.

If the servo-control valve plunger 16 is moved to the right in the drawing the land 21 opens the annulus 35 to the circumferential groove 18 so that pressure liquid can pass from the annulus into the circumferential groove 18 and therefrom through passage 36, through the circumferential groove 30 in the isolating valve 26, and through passage 38 to the left-hand side of the piston 12. Consequently the piston 12 and rod 13 move to the right. Liquid on the right-hand side of the piston is exhausted through passage 39, circumferential groove 31, passage 37, circumferential groove 19, annulus 41, passage 43 and conduit 44 to the reservoir 42. If the servo-control valve plunger 16 is moved to the left the system works in a reverse manner to move the piston 12 and rod 13 to the left.

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If however for some reason, such as for example conduit fracture, leakage or blockage, the pressure of the liquid at the inlet bore 23a drops below the aforementioned predetermined value, the isolating valve 26 moves to the left under the effort of coil spring 29, conical part 27 closing on to its seating. Consequently lands 32 and 33 close off passages 38 and 39 from passages 36 and 37. Thus the piston 12 and rod 13 become positively hydraulically locked with respect to the cylinder 11 and no outside force, acting upon the element which the servo-motor controls, can displace them.

I claim:

1. A liquid pressure servo-motor system comprising in combination a hydraulic cylinder having a double acting hydraulic piston movable therein, a servo-control valve for the cylinder, a low pressure reservoir, liquid pressurizing and distributing means supplied from the reservoir, liquid pressure supply and exhaust lines connecting said pressurizing means and said reservoir with the servo-control valve, passages connecting the servo-control valve with either end of the hydraulic cylinder, and valve means in said passages, which valve means act independently of the servo-control valve and permit flow of liquid through said passages under normal operating conditions but operate to close off and isolate simultaneously the passages upon the pressure of the liquid supply falling below a predetermined value.

2. A system as claimed in claim 1 wherein a valve is located in the liquid pressure supply line of the servo-control valve, which valve closes automatically when the pressure of the liquid supply drops below a predetermined

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minimum value to shut off the supply, said "shut-off" valve and the said "isolating" valve means being coupled together so that closing of the one is accompanied by closing of the other.

3. A system as claimed in claim 2, wherein the isolating valve means comprises a valve spool sliding in a bore in a valve block, one end of the valve spool projects into a chamber in the valve block through which the pressure liquid from the supply line passes on its way to the servo-control valve, and the end of the valve spool in the chamber is formed as the shut-off valve to seat over the liquid pressure inlet to the chamber, the valve spool being spring urged toward said inlet but being held off it during normal operation by the supply line pressure.

4. A system as claimed in claim 3, wherein the servo-control valve also comprises a valve spool sliding in a valve bore and the bores of the servo-control and isolating valves are formed parallel to one another in a common valve block mounted on the hydraulic cylinder, the isolating valve being positioned between the servo-control valve and the hydraulic cylinder.

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