Nov. 28, 1967 G. N. LEVESQUE 3,354,908

PRESSURE FLUID CONTROL VALVE

Filed Sept. 29, 1965

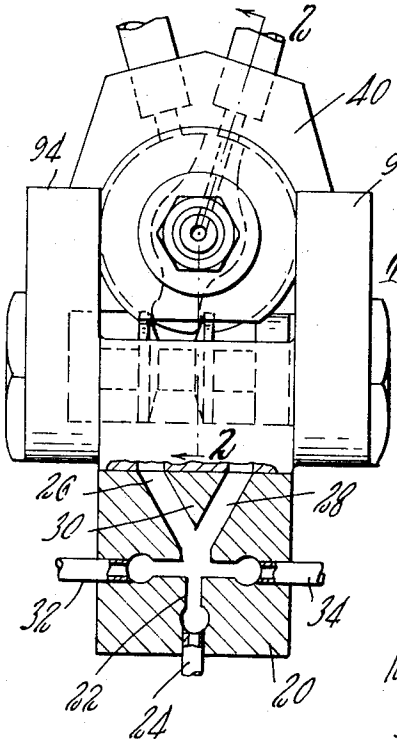

Fig. 1.

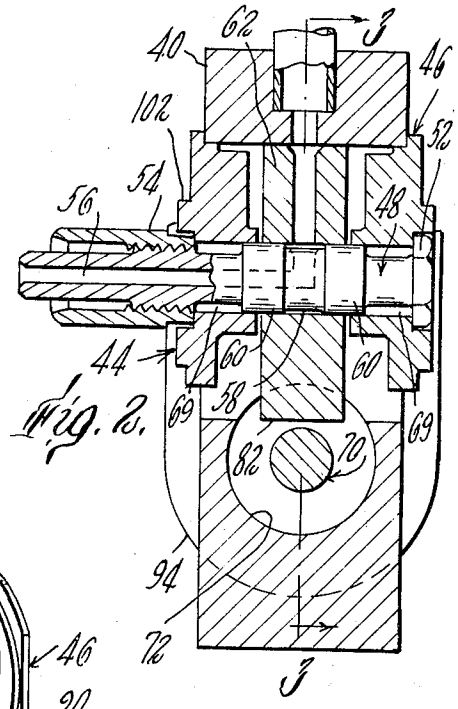

Fig. 2.

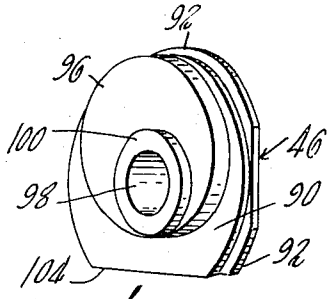

Fig. 5.

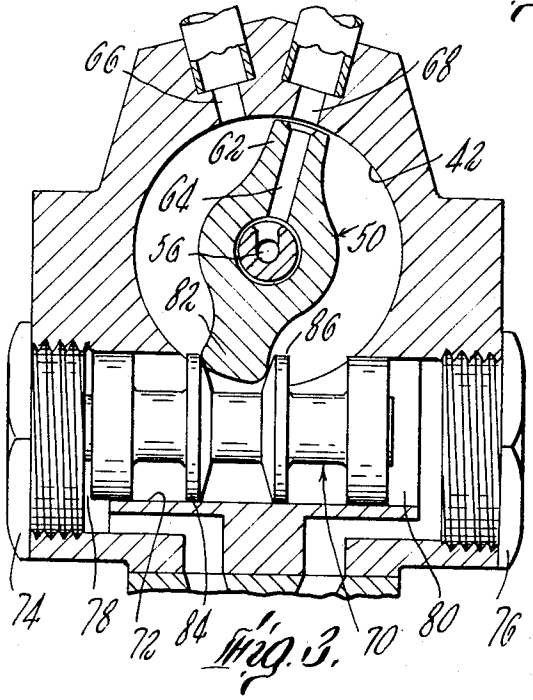

Fig. 3.

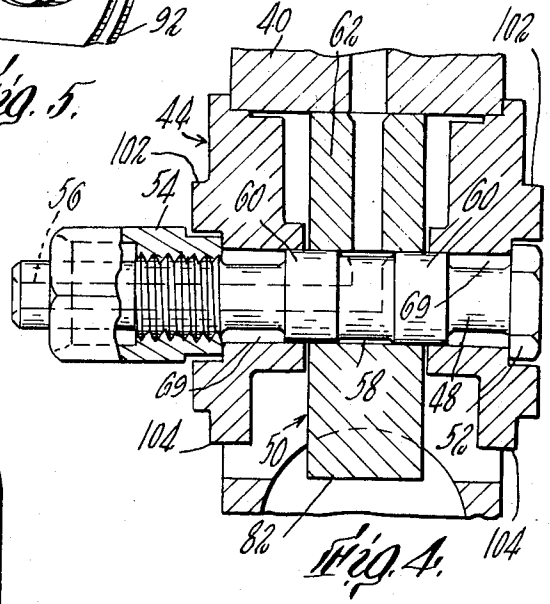

Fig. 4.

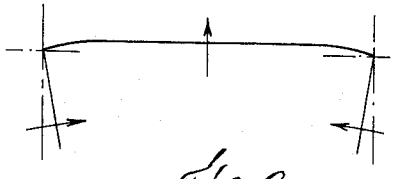

Fig. 6.

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PRESSURE FLUID CONTROL VALVE

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8 Claims. (Cl. 137—610)

The present invention relates to an improved fluid power amplifier, and more particularly to a novel and improved pressure fluid control valve comprising a housing providing therein a cylindrically walled aperture with alternatively available circumferentially spaced outlet ports, an axle, and a valve body rotatable on said axle having a portion thereof fitted to said wall including a nozzle outlet through which a pressure fluid is directed alternatively to one or the other of said ports.

In the preferred form of the invention shown, the valve body is power operated by a wall attachment amplifier and switch, as a fluid logic power amplifier.

It is a principal object of the invention to provide a novel and improved pressure fluid control valve for directing a pressure of fluid stream from one to another path, which is of simple construction, is substantially leak-proof, and is at the same time so constructed and arranged as to be moved surely and accurately from one to another position at the direction of a very low power operator, as for example, the wall attachment amplifier here shown.

It is more specifically an object of the invention to provide an improved pressure fluid control valve of this general description in which the supporting elements for the rotatable supported valve body are constructed and arranged to be distorted by the application of a tightening pressure to control in a simple and effective manner the clearance between the cylindrically walled aperture and the nozzle outlet carrying portion of the rotatable valve body.

It is a further object of the invention to provide a simple and at the same time highly efficient fluid logic power amplifier of the general type described having, in combination, a pressure fluid control valve and a wall-attachment amplifier and switch of the general type shown.

With these and other objects in view as may hereinafter appear, the several features of the invention will be readily understood by one skilled in the art from the following description taken in connection with the accompanying drawing in which:

FIG. 1 is a view in side elevation, partly in sertion, of a fluid logic power amplifier illustrating in a preferred form the several features of the invention;

FIG. 2 is a sectional view taken on a line 2—2 of FIG. 1, but on a larger scale, illustrating particularly the pressure fluid control valve of FIG. 1, the parts being shown in the position taken before adjustment by tightening;

FIG. 3 is a sectional view taken on a line 3—3 of FIG. 2;

FIG. 4 is a sectional view of the valve housing, valve body and axle shown in FIG. 2, but on a still larger scale, the parts including the axle being shown in a slightly bowed position of adjustment produced by tightening the two supporting end bearing caps on the axle;

FIG. 5 is a perspective view of one of the bearing caps mounting the valve body supporting axle adapted to be distorted for effecting adjustment of the valve body clearance within the valve housing; and

FIG. 6 is a diagram illustrating the manner in which the axle is bowed by a controlled distortion of said end bearing caps.

The fluid logic power amplifier illustrated in the drawing comprises a wall attachment amplifier and switch 20

consisting of a block apertured to provide a main fluid pressure passageway 22 extending upwardly from an inlet port 24 in the bottom of the block and branching outwardly at its upper end in the form of a Y to provide two outlet ducts 26 and 28 separated by a V shaped area 30 described as a splitter. Two control air jets are directed into the passageway 22 from opposite sides through control ports 32 and 34.

The power jet introduced through the inlet port 24 is forced into either output duct 26 or 28 by input from the opposite control port. The power jet locks to the wall of this output duct until a signal from its adjacent control duct drives it over to the opposite output duct where it locks similarly. This flip-flop is bistable, it locks on either output leg as long as fluid is supplied through the inlet port 24. It will be understood that the power jet introduced through the inlet port 24 may be in the order of 15 p.s.i. the control jets may be as low as 1 or 2 p.s.i. and the output through the selected output duct 26 or 28 may be in the order of 5 p.s.i. While the wall attachment amplifier above described has been found to operate in a satisfactory manner, it will be understood that fluid logic elements of other description having an output in the order of 5 p.s.i. may be substituted therefor.

In the present construction, the wall attachment amplifier and switch above described are employed to control the position of a pressure fluid control valve comprising a valve housing 40 which is attached to the wall-attachment amplifier and switch block 20. The upper portion of the housing 40 is provided with a cylindrically walled transverse aperture 42 closed at its two ends by end bearing caps 44 and 46 which are journalled to provide bearing supports for an axle 48 and a rotatable valve body 50. The caps 44 and 46 and also the axle 48 are formed of a metallic material preferably soft steel capable of being distorted substantially under pressure within the limits of elasticity of the material employed. The axle 48 is formed at one end with a hexagonal head 52 which is fitted into a similarly shaped recess in the end bearing cap 46 and at its other end is threaded to receive a tightening nut 54 which abuts the outer face of the end bearing cap 44.

A pressure fluid is brought into the valve through an axial inlet conduit 56 in the axle 48, which connects with an annular recess 58 providing a hydraulic balancing groove which is formed between two bearing surfaces 60 on which the valve body 50 is supported to turn. The valve body 50 is formed with an upward, extending nozzle outlet portion 62 having a nozzle passageway 64, said nozzle outlet portion 62 being closely fitted to the peripheral wall of the aperture 42. Pressure fluid is directed from the annular recess 58 through the radially disposed nozzle passageway 64 to one of two valve outlet ports 66 and 68 which connect with the peripheral surface of the cylindrical aperture 42. It will be noted that the axle 48 is formed at each side of the bearing surfaces 60 with a necked portion 69, of which the diameter is reduced as much as possible to cause the axle, when stressed at each end, to bend at these points while the central portion remains relatively straight as indicated in the diagrammatic FIG. 6.

The wall attachment amplifier and switch 20 is employed to rock the valve body 50 from one to the other of two alternative positions in which the nozzle 62 including the passageway 64 is connected with one or the other of outlet ports 66 and 68 by means of a piston 70 mounted in a transverse cylindrically formed aperture 72 in the lower portion of the valve housing 40. The aperture 72 is set at right angles to, and cuts into the lower side of the valve body containing aperture 42, providing an opening therebetween. Two plugs 74, 76 screw threaded into opposite ends of the aperture 72 provide

pressure chambers 78 and 80 into which the two ends of the piston 70 are fitted. The outlet ducts 26 and 28 from the wall attachment amplifier and switch 20 are connected with pressure chambers 78 and 80 respectively so that the pressure of the power air jet directed into one or the other chamber will shift the piston axially from one limit position to the other. Movement of the piston 70 is operative to shift the valve body from one position to the other by means of connections comprising a gear tooth shaped downward extension 82 of the valve body 50 which engages between two flanges 84 and 86 of a rack on the piston 70. The fluid logic power amplifier herein described is constructed with a minimum of moving parts, consisting only of the piston 70 and rotor 50, which are readily shifted by the low pressure air jet above described independently of the magnitude of the pressure controlled or diverted by the shifting of the valve.

In order to ensure an effortless positive operation of the valve and at the same time to avoid excessive leakage between relatively moving pressure fluid carrying elements of the valve, and adjustment is provided for controlling the amount of clearance permitted between the tip of the nozzle outlet portion 62 of valve body 50 and the adjacent wall of the cylindrical aperture 42 of the valve housing 40. To this end the end bearing caps 44 and 46 are especially constructed so that the upper half of each cap or disc is approximately twice the thickness of the lower half. When the nut 54 is now tightened on the axle 48 the two caps 44 and 46 tend to be distorted within the elastic limit of the material of which the caps are made in such a manner as to bow the middle portion of the axle 48 upwardly, so that the valve body 50 is moved bodily upwardly to correspondingly reduce the clearance between the nozzle outlet supporting extension 62 and the wall of the cylindrical aperture 42. Adjustment is readily accomplished in the following manner. Pressure fluid is admitted to the valve before the nut 54 is tightened. Since an excessive gap will now exist between the nozzle outlet supporting extension and housing wall, pressure fluid is forced out of the fitting with an audible hiss. The nut 54 is now tightened until the hiss disappears indicating that a correct tolerance, in the order of .001 inch has been achieved, matching a similar tolerance of .001 inch between the valve body 50, and bearing surfaces 60 of the axle.

One of the two end bearing caps 44 and 46, which are identical in construction, is shown in pespective in FIG. 5, comprising a disc area 90 of generally circular shape having a cylindrical rim surface which fits within the housing aperture 42 and an overlying flange 92 which engages against the end wall of the housing 40. Two slabbed off side edges of the flange 92 are engaged against abutments 94 of the housing, so that the end bearing cap is keyed in the desired angular position in the housing. On the inner face of the cap opposite from the flange 92 there is provided a circular boss 96 offset from the central axis of the cap, providing a relatively thicker portion of the disc at one side of said axis. The bearing aperture 98 of the cap 44 is extended still further axially by means of a boss 100 providing a somewhat longer bearing support through which a tilting distortion is imparted to the axle mounted therein. On the outer or flange face of the cap there is provided an axially centered annular boss 102 having an internal configuration adapted to receive the hexagonal nut or head 52 or alternatively the small diameter end portion of the screw threaded nut 54. It will be noted further that the bottom edge of the end bearing cap is slabbed off at 104 providing an exhaust port for air from the housing 40, and also a further unbalance in the end bearing cap structure, so that axial distortion of the bearing area of the cap will produce the desired proportionate tilting movement of the ends of the axle.

It will be understood that the invention in its broader aspects is not limited to the preferred construction of a bearing end cap above described and illustrated, and that end bearing supports of other description may be employed so constructed and arranged that an axial distortion of the bearing area of the support will produce a proportionate tilting movement of the bearing axis.

The invention having been described, what is claimed is:

1. A power operated valve comprising, a valve housing having a cylindrically walled valve aperture with circumferentially spaced ports opening through said walls into one side of said aperture, an axle disposed within said aperture having formed therein a pressure fluid inlet conduit, a rotatively shiftable valve body on said axle having a nozzle outlet portion thereof fitted to said wall including a radially disposed nozzle passageway connected with said axle inlet conduit and shiftable into alignment alternatively with each of said ports, bearing supports disposed across said aperture providing bearings for said axle along an axis within said aperture at opposite sides of said valve body constructed and supported so that deformation of said bearing supports along said axis within the elastic limit of the material produces a corresponding tilting deformation of the bearing support portions of the bearing axis, said bearing supports being oriented so that a relative deformation of said bearing elements along said axis produces tilting movement of both bearing axes to bow said axle toward the side wall of said aperture having said ports, and adjusting means for effecting a said relative axial deformation of said bearing elements and thereby for adjusting the clearance of said nozzle extension of said valve body relative to said aperture wall.

2. A power operated valve according to claim 1, in which said axle is formed with a centrally disposed cylindrical valve body supporting surface of substantial diameter, and with neck portions of substantially reduced diameter at each side of said valve body supporting surface, said neck portions being disposed between said valve body and said bearings respectively, whereby said axle is bowed at the location of said neck portions while the centrally disposed valve body supporting surface remains substantially straight.

3. A power operated valve according to claim 1, in which said bearing supports are bearing caps overlying each end of said aperture, each bearing cap having a centrally located bearing comprising a bearing aperture, and an outwardly extending disc area of varying thickness, that portion of said disc area lying at one side of the bearing being of greater thickness than that portion of said disc area lying at the other side of said bearing so that axial displacement of said bearing within the elastic limit of the material produces an uneven distortion of said disc area and a tilting movement of said bearing axis.

4. A power operated valve according to claim 3, in which each bearing cap comprises a generally circular disc having a bearing comprising a bearing aperture, through said disc along a central axis, and on one face of said disc a circular boss providing a thickened portion of said disc area offset from said axis, whereby an axial distortion of said bearing relative to said disc area produces a tilting distortion of the bearing axis.

5. A power operated valve according to claim 4, in which each bearing cap comprises a cylindrically shaped disc having a cylindrical rim surface adapted to be fitted within said cylindrically walled aperture, and an adjacent flange overlying a portion of said housing, adjacent said aperture and with the bottom edge of said disc slabbed off to facilitate an upwardly tilting distortion of said bearing axis.

6. A power operated valve according to claim 3, in which abutments including a tightening screw and nut connection are mounted on said axle engaging said bearings there between for effecting a relative axial deformation of said bearing caps.

7. A power operated valve according to claim 1 having

in combination, actuating mechanism for rocking said valve body from one to the other alternative position, including a reversible air operated piston motor.

8. A power operated valve according to claim 1 having in combination, actuating mechanism for rocking said valve body from one to the other alternative position, including a revrsible air operated pilot valve, a rack and tooth connection between said pilot valve and said rockable valve body, and a wall attachment amplifier and switch connected with said reversible pilot valve.

References Cited

UNITED STATES PATENTS

2,548,071	4/1951	Saulsberry	137—610 X
3,081,787	3/1963	Meulendyk.	
3,124,999	3/1964	Woodward	137—81.5 X
3,180,346	4/1965	Duff	137—81.5
3,273,594	9/1966	Mayer	137—81.5 X

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