Oct. 25, 1955 R. C. BUMB 2,721,446

ACCUMULATOR-RESERVOIR DEVICE

Filed March 17, 1952 2 Sheets-Sheet 1

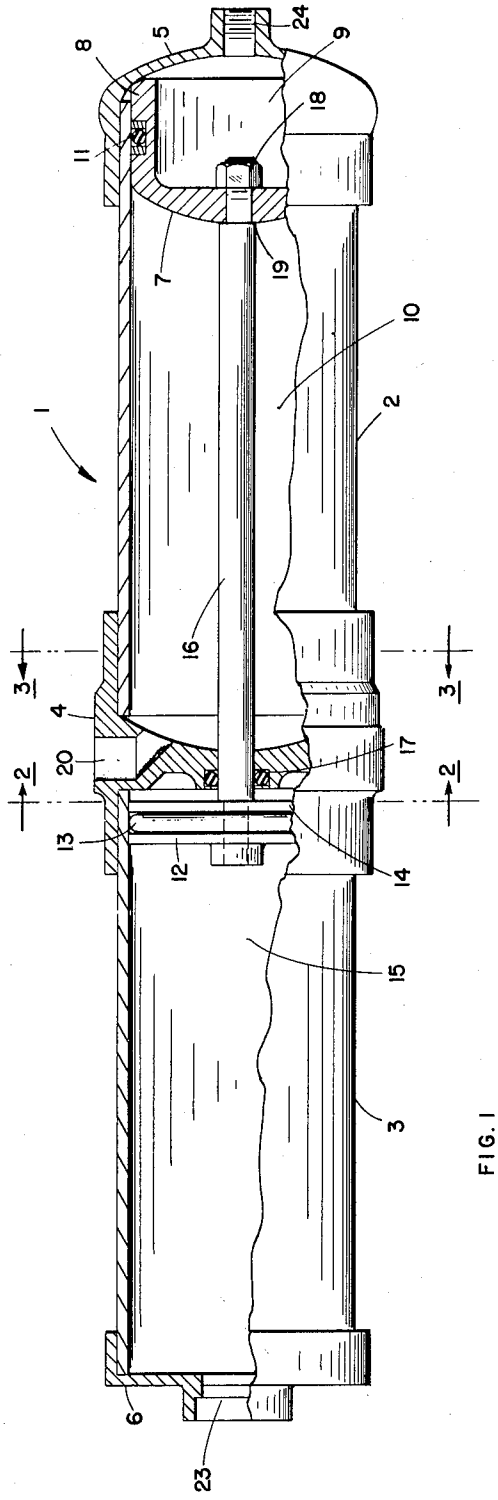


FIG. 1

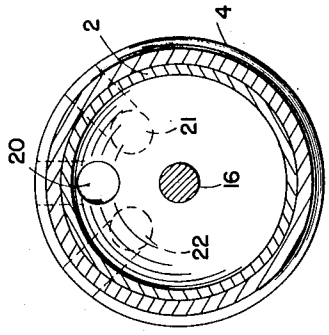


FIG. 3

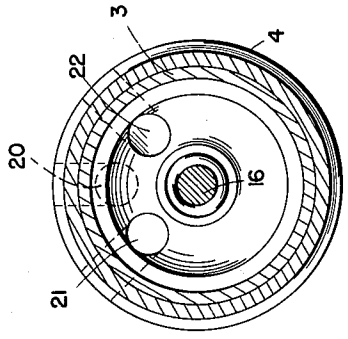


FIG. 2

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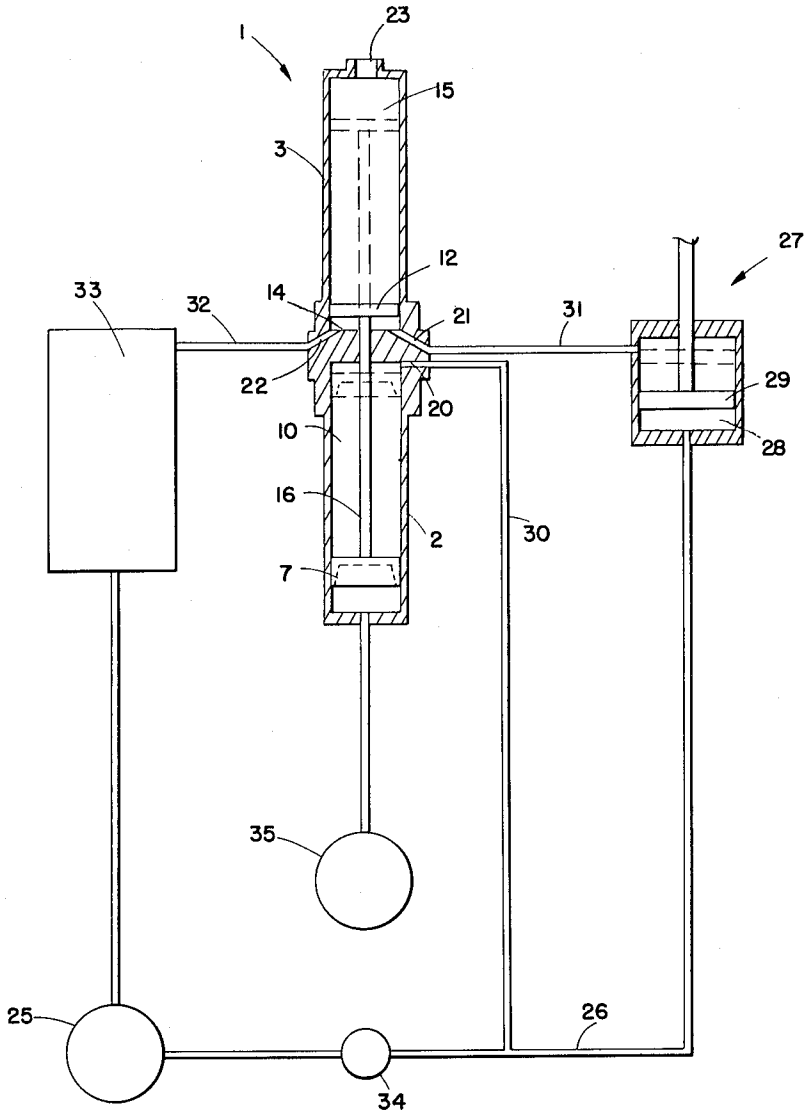


FIG. 4

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ACCUMULATOR-RESERVOIR DEVICE

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7 Claims. (Cl. 60—51)

This invention pertains to an accumulator reservoir device and more particularly to a self-compensating type of accumulator.

The ordinary accumulator is designed for installation in hydraulic systems wherein it will supply fluid on demand. This satisfactorily provides the pressurized fluid that the system may need but increases the total volume of fluid in the system outside of the accumulator in doing so. This increase of volume may prove disadvantageous in a system where no provison for accommodating additional fluid can feasibly be provided. In addition the ordinary type accumulator cannot be installed in existing hydraulic systems without thereupon redesigning the reservoir of the system to accommodate the accumulator volume.

It is therefore an object of this invention to provide an accumulator that will compensate for all of the fluid injected into the system by the accumulator.

Another object of this invention is to provide an accumulator particularly adaptable for systems having no provision for material expansion of fluid volume.

A further object of this invention is to provide an accumulator that may be installed in existing systems without redesign of any of the components of the system.

These and other objects will become apparent from the following detailed description taken in connection with the accompanying drawings in which

Fig. 1 is a side elevation of the accumulator, partially in section,

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1,

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1, and

Fig. 4 is a schematic view of the accumulator of this invention installed in a hydraulic system.

Accumulator 1 of this invention comprises two cylinders 2 and 3 of equal diameter. These cylinders may be attached together in axial alignment by means of a spacer member 4. Cylinder 2 is provided with a cylinder head 5 and cylinder 3 is provided with a cylinder head 6 so that both cylinders are closed at both ends. Reciprocal in cylinder 2 is a piston 7 which includes rearwardly projecting flange 8. This flanged portion assures that the system provides a chamber 9 between the piston and cylinder head 5 for all positions of the piston within the cylinder even when the piston is at one end of its stroke in engagement with cylinder head 5 as illustrated. The other side of piston 7 between the piston and the spacer 4 defines a chamber 10. Piston 7 is in sealing relationship with the interior of cylinder 2 and the seal may be provided in a suitable manner such as by O-ring 11 carried by portion 8 of the piston. In this manner chambers 9 and 10 are provided in the rearward and forward ends, respectively, of cylinder 2, and are sealed from each other. Reciprocal in cylinder 3 is a piston 12 which is in sealing engagement with the interior of cylinder 3 carrying O-ring 13 around its periphery. Piston 12 thus provides a chamber 14 between the piston

and the spacer 4 at the rearward portion of cylinder 3, and chamber 15 between piston and the cylinder head 6 at the forward portion of the cylinder.

Interconnecting the two pistons is a rod 16 which slidably passes through spacer 4 and may be sealed therefrom by O-ring 17. The rod may be attached to the pistons in any suitable manner. For example, on one end of the rod threaded nut 18 engages one side of piston 7 and shoulder portion 19 engages the other side of piston 7, while the opposite end of the rod is threadably received in piston 12. The rod is so dimensioned and arranged that when piston 7 is at the extreme end of its stroke as illustrated in Fig. 1 with flanged portion 8 engaging head 5 piston 12 is also at the end of its stroke but is not in engagement with spacer 4, chamber 14 always having a finite volume. It is thus apparent that pistons 7 and 12 will reciprocate simultaneously in cylinders 2 and 3 and will displace equal volumes in chambers 10 and 14. This results because the cylinders are both of the same diameter and rod 16 occupies an equal portion of the diameter in each of chambers 10 and 14.

A port 20 is provided in spacer 4 leading into chamber 10 of cylinder 2; similarly spacer 4 is provided with ports 21 and 22 which provide access to chamber 14 of cylinder 3. Chamber 15 of cylinder 3 is provided with a vent 23 which may comprise an opening in head 6. An additional aperture to the accumulator may be provided as opening 24 in head 5 of cylinder 2.

The accumulator may be installed in a fluid system such as shown schematically in Fig. 4. This system may typically include a pump 25 the outlet of which connects with pressure line 26 leading to unit 27 where the pressurized fluid is used. Unit 27 may comprise, for example, a hydraulic cylinder 28 in which piston 29 reciprocates. Port 20 of the accumulator may be connected with line 26 by means of a line 30, and the return line 31 from unit 27 may connect with port 21. A connection may also be made from port 22 of the accumulator to line 32 connecting with reservoir 33 which in turn leads to the pump inlet. In addition, the system may include a check valve 34 disposed in the pressure line 26. This system may be designed to be completely full of fluid with no provision in the reservoir or otherwise for addition of a further quantity of fluid to the system. Thus, as illustrated in the drawing, chamber 10 of the accumulator will be full of the system fluid and chamber 14 will be likewise full of fluid. A source of pressure is connected with aperture 24 of the accumulator which, in the preferred embodiment, is a source of compressed air leading from a suitable compressor 35.

In operation of the accumulator, pump failure or a sudden load on the pump, for example, may require that the accumulator supply the system with pressurized fluid to be utilized by unit 27. The pressure within chamber 9 from the compressed air connected with aperture 24 is such that when system pressure falls below a certain pressure the air pressure in chamber 9 will force piston 7 upwardly to the position shown in phantom displacing fluid out of chamber 10 through line 30 and into the system where it will pass through line 26 to unit 27. At the same time in a closed system of this type fluid will be transferred from unit 27 into return line 31. Because movement of piston 7 resulted also in movement of piston 12, by means of rod 16, to the position illustrated in phantom, chamber 14 will have increased in volume an amount exactly equal to the volume chamber 10 has lost as piston 7 moved upwardly. This increased volume in chamber 14 will accommodate the fluid forced into the system by the accumulator and transferred through line 26, unit 27, and return line 31. Thus reservoir 33 may remain entirely full of fluid at all times during operation of the system because the accumulator will automatically

compensate for all of the fluid it injects into the system. Vent 23 in the end of chamber 15 will assure that the accumulator does not meet with resistance in its reciprocal movement and check valve 34 in line 26 will assure that the fluid forced into the system by the accumulator flows in the proper direction toward unit 27. Should the pressure in the system then become such that pump 25 will force fluid back into chamber 10, thus forcing piston 7 downwardly, piston 12 will thereupon return a quantity of fluid to the system exactly equal in volume to the amount forced back into chamber 10.

If desired, cylinder 3 may be provided with only one port instead of the two as illustrated, this port connecting with the return line in a manner similar to the connection of port 20 to pressure line 26 as illustrated. However, when arranged as illustrated in the drawings with two ports in chamber 14 of cylinder 3 there is a positive assurance that the accumulator will compensate for all fluid displaced from cylinder 2. If chamber 14 were provided with only one port it is possible that under some circumstances the line losses in a line connecting with the single port would be so great that the accumulator would cavitate and an excess of fluid would be forced through the return line toward the reservoir. With chamber 14 connected in the system in series as shown, however, line losses will never become a factor and the accumulator will necessarily compensate for all fluid displaced from cylinder 2. It is further possible to provide cylinder 2 with two ports similar to those illustrated in the drawings for cylinder 3. In any event the operation of the accumulator is essentially the same and fluid displaced from one cylinder will be automatically compensated for by the accumulator so that an equal quantity is returned to the other cylinder.

As a further modification of the invention the source of pressure in chamber 9 of cylinder 2 could as satisfactorily be provided by a spring disposed within the chamber, or any other satisfactory means for applying a force to piston 7. Compressed air is used in the preferred embodiment only. In addition, movement of the two pistons could be satisfactorily effected by some means disposed in cylinder 3. For example, a tension spring could be attached to piston 12 and to cylinder head 6 whereby the spring would serve to draw the piston assembly toward one end of the cylinders providing the same type of movement as that supplied by compressed air within chamber 9.

It should be clearly understood that the foregoing detailed description is given by way of illustration only and is not to be taken by way of limitation, the spirit and scope of the invention being limited only by the appended claims.

I claim:

1. An accumulator-reservoir device for a hydraulic system comprising two elongated cylinders of equal diameter, a spacer member joining said cylinders in axial alignment, said spacer member including a wall portion separating said cylinders, each of said cylinders being provided with a port substantially at the location of said spacer member, a piston in each of said cylinders reciprocal therein in sealing relationship with the interior surface thereof, a rod interconnecting said pistons whereby said pistons are caused to move simultaneously, said spacer member having an opening therein for slidably receiving said rod, and a source of pressure disposed in one of said cylinders on the side of the piston therein remote from said rod whereby said source of pressure operates said pistons, means connecting said ports in said hydraulic system whereby such movement of said pistons displaces a quantity of fluid from said first cylinder and admits an equal quantity of fluid into said second cylinder.

2. In combination with a hydraulic system, an accumulator-reservoir device comprising a first and a second cylinder attached together in axial alignment; a piston in each of said cylinders reciprocal therein; rod means interconnecting said pistons whereby said pistons move simultaneously and displace equal volumes in said cylinders, said rod means being so dimensioned that when the piston in said first cylinder is in the rear portion thereof the piston in said second cylinder is in the rear portion of said second cylinder; fluid transfer means interconnecting the forward side of said first cylinder and said hydraulic system and interconnecting the rearward side of said second cylinder and said hydraulic system whereby movement of said pistons injects a quantity of fluid from said first cylinder into said hydraulic system and admits an equal quantity of fluid from said hydraulic system into said second cylinder.

3. A device as recited in claim 2 including, in addition, a cylinder head across the outer end of each of said cylinders; and a source of pressurized fluid connected with the cylinder head of said first cylinder for admitting pressurized fluid therein for operating said pistons, the cylinder head in the second of said cylinders being provided with a vent therein.

4. A device as recited in claim 2 in which said hydraulic system includs a return line, and in which said second cylinder is provided with two ports, said ports being connected in series in said return line.

5. In combination with a hydraulic system an accumulator-reservoir device comprising two cylinders of equal diameter; a spacer member interconnecting said cylinders in axial alignment and isolating one cylinder from the other; a piston reciprocal in each of said cylinders; means for sealing said pistons against the interior surfaces of said cylinders; a rod interconnecting said pistons, said spacer member having an aperture therethrough for complementarily receiving said rod in slidable sealing relationship, said pistons thereby reciprocating simultaneously and displacing equal volumes in said cylinders; port means in each of said cylinders immediately adjacent said spacer member, said port means being connected with said hydraulic system; fluid in said cylinders in the portions thereof between the piston therein and said spacer member; and a source of pressure in one of said cylinders on the side of the piston therein remote from said fluid for exerting a force against said pistons and causing simultaneous movement of said pistons for displacing a quantity of fluid from one of said cylinders into said hydraulic system and admitting an equal quantity of fluid from said hydraulic system into the other of said cylinders.

6. An accumulator-reservoir device comprising a pair of cylinders in axial alignment; a piston reciprocal in each of said cylinders; spacer means separating and isolating said cylinders; a rod interconnecting said pistons for causing said pistons to move simultaneously and displace equal volumes in said cylinders, the first of said cylinders having fluid therein ahead of the piston therein and being provided with a single port disposed ahead of the piston therein for all positions of the stroke of said piston for providing a connection to a hydraulic system having fluid therein, the second of said cylinders having fluid therein behind the piston therein and being provided with a port disposed behind the piston therein for providing a connection to such a hydraulic system, whereby upon simultaneous movement of said pistons fluid is displaced in equal volumes from one of said cylinders into said hydraulic system and from said hydraulic system into the other of said cylinders.

7. An accumulator-reservoir device comprising two elongated cylindrical members of equal diameter; a spacer member joining said cylinders in axial alignment, said spacer member including a wall portion separating and isolating said cylinders, each of said cylinders being provided with a port immediately adjacent the location of said spacer member, said ports being adapted for connection in a closed hydraulic system; a piston in each of said cylinders reciprocal therein in sealing relationship with the interior surface thereof; and means for ef-

fecting movement of said pistons in said cylinders for thereby causing one of said pistons to displace a quantity of fluid therefrom into a hydraulic system with which said unit is associated and causing the other piston to receive an equal quantity of fluid from said hydraulic system.

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