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PISTON-TYPE ACCUMULATORS

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FIG.1.

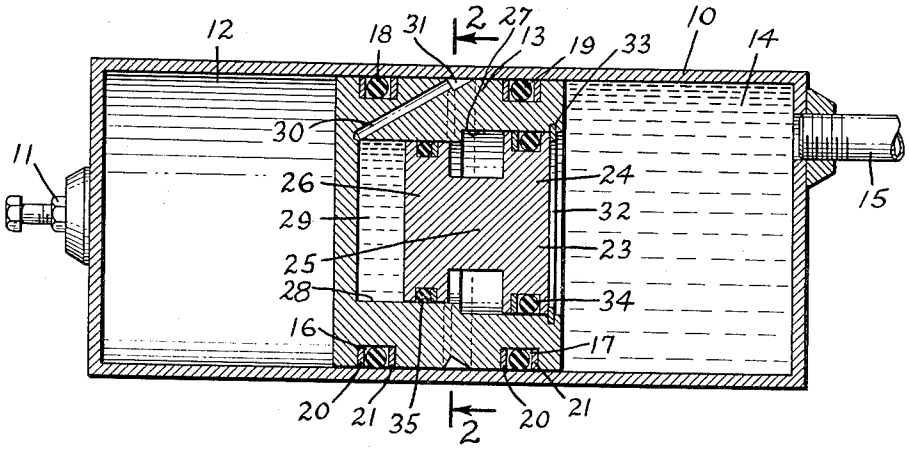
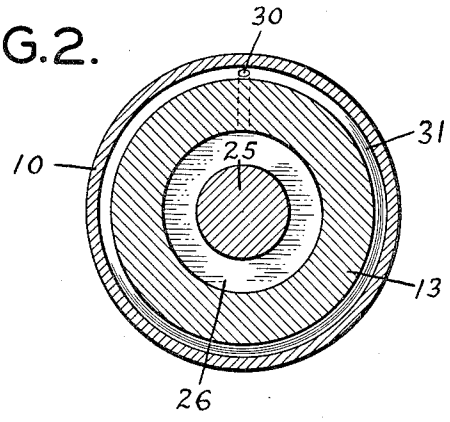


FIG.2.



INVENTORS.
BENJAMIN N. ASHTON
JOHN P. FRAIN
BY
Campbell, Brumbaugh, Free & Graves

THEIR ATTORNEYS.

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PISTON-TYPE ACCUMULATORS

Benjamin N. Ashton and John P. Frain, Kingston, N. Y., assignors to Electrol Incorporated, Kingston, N. Y., a corporation of Delaware

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This invention relates to improvements in piston type accumulators and it relates particularly to an improved type of piston and sealing construction for such accumulators to prevent the escape and mixing of gas and liquid on opposite sides of the piston of the accumulator.

It has been found that in hydraulic accumulators, shock absorbers and the like having a piston interposed between the gas pressure reservoir and the liquid reservoir, it is difficult to prevent leakage of the gas and the liquid past the rings on the piston. As a consequence, the gas and the liquid tend to mingle in the narrow zone around the circumference of the piston between the rings and as the pressure fluctuates this mixture of liquid and gas will escape past the rings with the result that the gas escapes into the liquid-receiving chamber and liquid escapes into the gas-receiving chamber. As the liquid leaks into the gas-receiving chamber, the capacity of the accumulator decreases. The escape of the gas into the hydraulic system is more serious for the presence of air or other gas has a tendency to change the characteristics of the system because of the compressibility of the gas.

The present invention overcomes the disadvantages of the prior piston type accumulators and the like by modifying the accumulator piston to include a reservoir and a differential pressure piston which introduces liquid into the zone between the rings of the accumulator piston and between the piston and the cylinder wall at a higher pressure than the pressure of either the gas or liquid in the accumulator. The higher pressure between the rings prevents the gas and the hydraulic fluid from leaking past the piston rings.

The differential piston includes a larger piston which is subjected directly to the pressure of the hydraulic fluid in the accumulator and acts upon a smaller piston to force liquid received in a reservoir in the accumulator piston out through suitable ports into a groove around the periphery of the accumulator piston between the sealing or piston rings thereon. By regulating the ratio of the areas of the piston portions of the differential piston, it is possible to produce a very substantially higher liquid pressure between the piston rings than the gas and the liquid pressures on the outer sides of the piston rings, thereby precluding escape of the gas into the hydraulic system.

For a better understanding of the present invention, reference may be had to the accompanying drawing in which:

Fig. 1 is a view in longitudinal section through a typical accumulator embodying the present invention; and

Fig. 2 is a view in section taken on line 2—2 of Fig. 1.

A typical accumulator, embodying the present invention, as illustrated in Figs. 1 and 2, may include a closed cylinder 10 having an air check valve 11 at one end thereof to permit air or other gas to be introduced under high pressure into the chamber 12 to the left of the accumulator piston 13. The hydraulic fluid from the hydraulic system (not shown) enters the chamber 14 to

the right of the piston 13 through a suitable pipe and coupling 15. The piston 13 is generally cylindrical in shape and is provided with piston ring grooves 16 and 17 near its opposite ends. Mounted within the grooves 16 and 17 are piston rings 18 and 19 which may be of the O ring type formed of rubber or synthetic rubber. These rings are capable of movement lengthwise of the grooves, between the wiper rings 20 and 21 in each groove which may be formed of steel or other metal and are in tight wiping and sealing engagement with the internal wall of the accumulator 10.

Even though the rings 18, 19, 20 and 21 afford a very tight seal, nevertheless after a period of operation some liquid may escape from the chamber 14 past the rings 19, 20 and 21 and some gas may escape past the rings 18, 20 and 21 toward the center line of the piston where they can mix and flow from one chamber to the other.

In accordance with the present invention escape of liquid and gas and mixing of the gas and liquid is prevented by providing the piston 13 with a differential piston 23 having a piston section 24 joined by an integral connecting rod 25 to a smaller piston section 26. The piston sections 24 and 25 are received in connected recesses 27 and 28 of corresponding size extending inwardly from the right-hand end of the piston 13. The space between the face of the piston portion 26 and the left-hand end of the piston forms a reservoir 29 to receive liquid. The reservoir 29 is connected by means of one or more passages 30 to a groove 31 which extends around the periphery of the piston 13 between the ring grooves 16 and 17.

The right-hand face of the piston section 24 is exposed directly to the pressure of the liquid in the reservoir or chamber 14 so that the differential piston 23, as a whole, is normally urged toward the left as viewed in Fig. 1. Inasmuch as the exposed surface of the piston section 24 is larger than the effective surface area of the piston section 26, the liquid in the reservoir 29 is subjected to a higher pressure per square inch than the pressure of the liquid in the chamber 14. Accordingly, any tendency of the liquid in the chamber 14 or the gas in the chamber 12, the pressures of which are balanced or equal, to flow inwardly past the rings 18, 19, 20 and 21 is opposed by the higher pressure of the liquid in the groove 31 and between the rings 18, 19, 20 and 21 so that while liquid may leak from the groove 31 into the air chamber 12 and into the liquid chamber 14, the gas from the chamber 12 cannot flow into the chamber 14 and liquid from the chamber 14 cannot flow into the chamber 12.

The differential piston may be retained in the recesses 27 and 28 in any suitable way, for example, such as by means of a snap ring 32 releasably received in a groove 33 in the piston 13 in the outer end of the recess 27.

The piston sections 24 and 26 are also provided with suitable sealing rings 34 and 35 to reduce leakage of the liquid from the chamber 14 and the chamber 29 into the interior of the piston 13. However, if leakage does occur, the space between the piston sections 24 and 26 is sufficient to accommodate a substantial amount of liquid without immobilizing the differential piston 23. Moreover, an undesirable increase of pressure of the air trapped in the space which might result in escape of air into the system cannot occur.

From the preceding description, it will be apparent that the piston structure of the accumulator disclosed herein prevents mixing of the gas and the liquid in the accumulator, and prevents the escape of the gas into the hydraulic system thereby overcoming the principal disadvantage of the prior types of piston type accumulators.

It will be understood that the accumulator is susceptible to modification and that its size and design may be

modified and that the ratios of surface areas at opposite ends of the differential piston may be related in accordance with requirements. Therefore, the form of accumulator disclosed herein should be considered as illustrative and not as limiting the scope of the following claims.

We claim:

1. An accumulator for hydraulic systems and the like comprising a hollow container having a hollow cylinder between its ends, a piston slidable axially in said cylinder and dividing said container into a gas receiving chamber and a liquid receiving chamber, piston rings on said piston in spaced relation, said piston having a recess extending inwardly from the end adjacent to said liquid receiving chamber, said recess having an inner cylinder portion with a closed end to receive a fluid and an outer larger diameter cylinder portion having an open outer end communicating with said liquid receiving chamber, a piston member having a small diameter piston portion at its inner end, a larger diameter piston portion at its outer end, and a rod portion interposed between and fixedly connected to said inner and outer piston portions and forming therewith an annular space between said piston portions, said smaller and larger diameter piston portions fitting slidably in said inner and outer cylinder portions, respectively, and said annular space forming a receptacle for receiving liquid leaking from said system and preventing unwanted increase in the pressure of gas trapped in said space, and a passage from said inner cylinder portion to the exterior of said piston between its ends to conduct fluid from said inner cylinder portion to the exterior of said piston between said rings and maintain therebetween a pressure higher than the gas and liquid pressures in said chambers.

2. An accumulator for hydraulic systems and the like comprising a hollow cylindrical container, a piston in said container dividing said container into a gas-receiving chamber and a liquid-receiving chamber, said chambers receiving gas and liquid under pressure, respectively, said piston being movable freely along said container to vary the capacities of said chambers, sealing rings encircling said piston in spaced-apart relation to form a seal between the piston and the inner wall of the container, a recess extending into said piston from the end adjacent to said liquid-receiving chamber, said recess having an inner cylindrical portion having a closed inner end and an outer cylindrical portion of larger diameter than said inner portion, a passage in said piston leading from the inner end of said recess to the periphery of said piston between said sealing rings, and another piston mounted in said recess for axial movement therein, said another piston having a smaller diameter inner portion fitting the inner cylindrical portion of said recess and forming therewith a reservoir for receiving fluid, said another piston having a larger diameter portion slidable in said outer cylindrical portion and having its end directly exposed to pressure in said liquid-receiving chamber.

3. An accumulator for hydraulic systems and the like comprising a hollow container having a tubular portion between its ends, a first piston slidable in said tubular portion and having sealing rings adjacent to its opposite ends engaging the tubular portion, said first piston dividing said container into separate chambers, said chambers being adapted to receive fluids under pressure, said first piston having a recess extending inwardly from one end, said recess being adapted to receive a fluid, a second piston

mounted in said recess for axial sliding movement relative to the first piston to exert pressure on fluid in said recess and to relieve said fluid of pressure, said second piston having an outer end portion exposed to the pressure of the fluid in the chamber adjacent thereto and movable thereby relative to the first piston, said second piston having an inner end portion of smaller cross-sectional area than the outer end portion fitting in said recess, and a passage through which fluid in said recess can be forced by said second piston extending from the inner end of said recess to the periphery of said first piston between said rings.

4. An accumulator for hydraulic systems and the like comprising a hollow container having a first hollow cylinder between its ends, a first piston slidable axially in said first cylinder and dividing said container into a gas-receiving chamber and a liquid-receiving chamber, piston rings at opposite ends of said first piston, a second cylinder in said first piston to receive a fluid, a second piston in said second cylinder movable in said second cylinder in response to pressure in said liquid-receiving chamber to apply to fluid in said second cylinder a higher pressure than the pressure in said liquid-receiving chamber, and a passage for fluid extending from said second cylinder to the exterior of said first piston between the rings on said first piston and first cylinder.

5. An accumulator for hydraulic systems and the like comprising a hollow container having a hollow cylinder between its ends, a piston slidable axially in said cylinder and dividing said container into a gas-receiving chamber and a liquid-receiving chamber, said piston having spaced apart piston rings thereon engaging said hollow cylinder, said piston having a recess extending inwardly from the end adjacent to said liquid-receiving chamber, said recess having an inner cylinder portion with a closed end and an outer larger diameter cylinder portion having an open outer end communicating with said liquid-receiving chamber, said inner cylinder portion being adapted to receive a fluid, a piston member having portions of different diameters on its inner and outer ends slidably mounted in and fitting the inner and outer cylinder portions, respectively, the outer end of said piston member being exposed directly in said liquid-receiving chamber, and a passage extending from said inner cylinder portion to the exterior of said piston between said rings.

6. An accumulator for hydraulic systems comprising a hollow container having a hollow cylinder between its ends, a piston slidable axially in said cylinder and dividing said container into a gas-receiving chamber and a liquid-receiving chamber, piston rings on said piston in spaced apart relation, said piston having an expansible and contractile chamber therein to receive liquid, a passage extending from the last-mentioned chamber to the periphery of said piston between said piston rings, and means responsive to pressure in said liquid-receiving chamber for contracting said expansible and contractile chamber to exert a greater pressure between said rings than the pressure in said liquid-receiving chamber.

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