Oct. 29, 1957 E. M. GREER Re. 24,382

PISTON ACCUMULATOR

Original Filed May 23, 1952

FIG. 1.

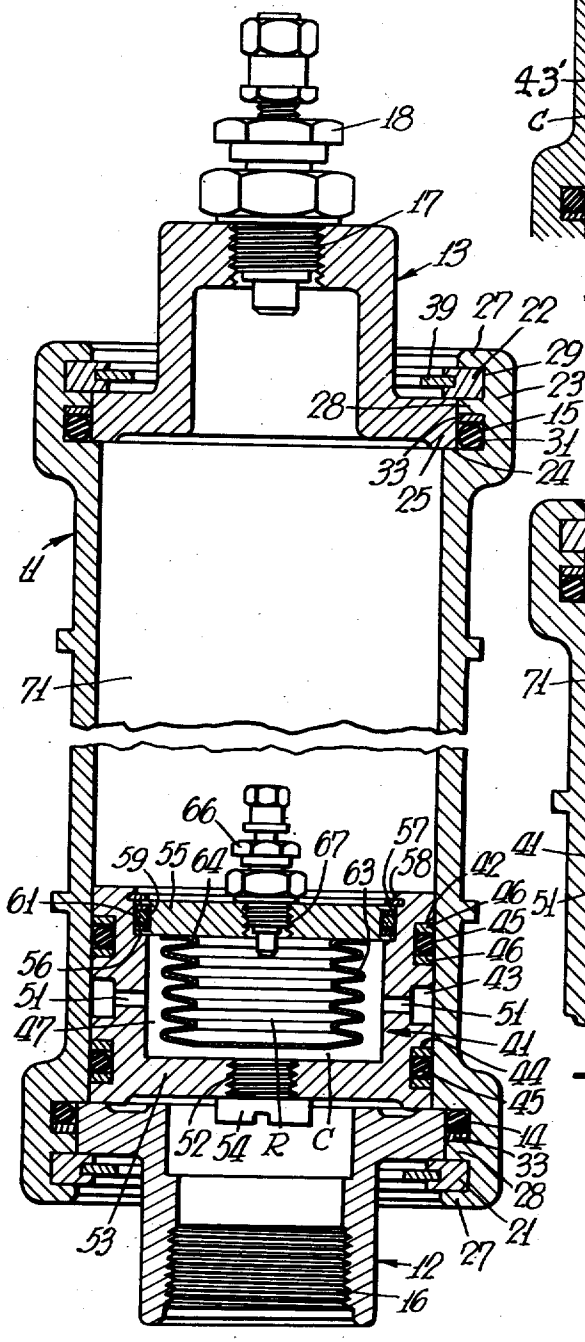


FIG. 4.

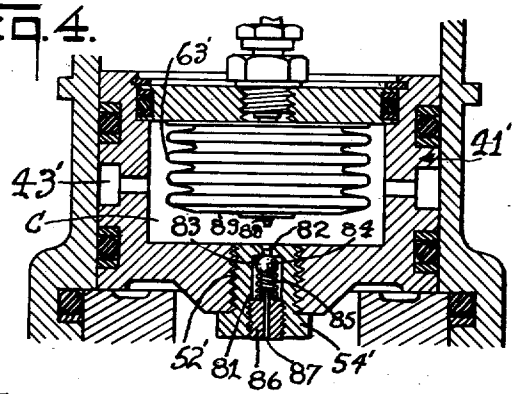


FIG. 2.

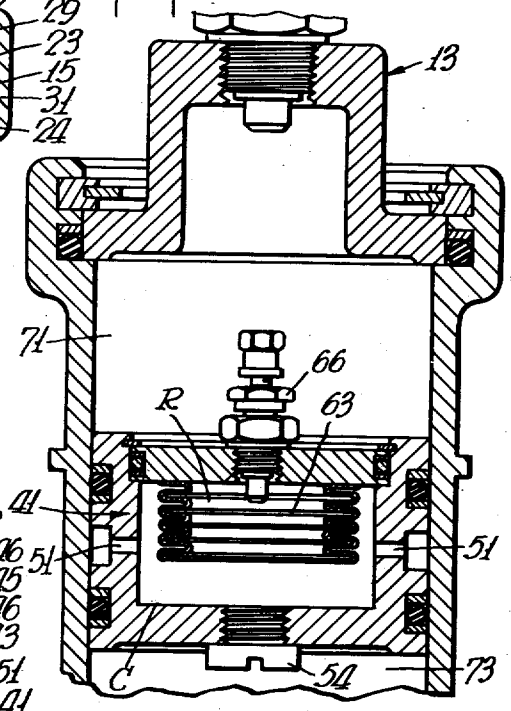
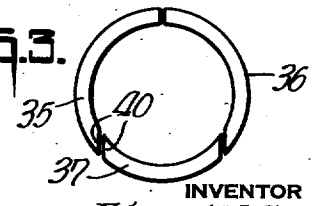


FIG. 3.



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PISTON ACCUMULATOR

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14 Claims. (Cl. 138—31)

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This invention relates to piston type pressure accumulators and more particularly to the piston seal between the gas and liquid chambers of the accumulator.

Where the piston seal between the gas and liquid chambers of a piston type pressure accumulator is not dependable, the resultant leakage of liquid, which generally is an oil, past said seal necessitates frequent servicing of the accumulator to drain this oil from the gas chamber.

As a result, the equipment in which the accumulator is installed must be specially designed so that the drain outlet of the accumulator is readily accessible and the accumulator and associated equipment must also be specially designed to enable removal of the oil from the gas chamber of the accumulator with a minimum loss of the gas charge.

It is also possible with such defective piston seal for the gas to leak into the oil chamber and enter the hydraulic system. This might be detrimental to the proper functioning of the unit to be operated by the accumulator, such as, for example, the hydraulic brakes of an aircraft, which would not operate dependably if a gas bubble entered the unit.

Where a single O ring type of seal is used for the piston, the effectiveness of such seal is poor when the pressure on both sides of the piston is identical, as is usually the case in piston type accumulators, for such seal only operates effectively when there is a greater pressure on one side than the other, which will force the O ring toward the low pressure side into the space between the piston and the adjacent wall of the accumulator to create an effective seal.

Where two O rings are used on a piston on each side of an annular groove therein, in an attempt to secure a differential between the pressure on opposite sides of the rings, it has been found that the wiping action of one seal results in a dry smooth surface for the second seal to slide upon. As a result, the second seal produces considerable friction and soon breaks down with resultant leakage of oil to the other side of the first seal. As a result the pressure on both sides of the first seal is equalized with resultant inoperativeness of such seal.

Where, to offset this condition, oil is introduced directly into the annular groove from the oil chamber of the accumulator, although the friction is reduced, the pressure on both sides of both seals will be identical and hence the seals will be ineffective for the reasons heretofore set forth.

It is accordingly among the objects of the invention to provide sealing means for the piston of a piston type pressure accumulator which will dependably prevent passage of liquid or gas therepast, yet will provide constant lubrication on the surface over which the piston seal slides so that the latter may be used for long periods with but a minimum of wear, which seal has but few parts, none of which are delicate or likely to become out of order and which may readily be assembled and disassembled for cleaning and maintenance.

According to the invention, a pair of resilient seals encompasses the periphery of the piston of a piston type accumulator and are positioned on each side respectively of an annular groove in the periphery of said piston. Means are provided to charge the groove with liquid such as grease or oil and to apply a pressure on such grease which is less than the pressure in the oil and gas chamber of the accumulator.

More specifically, the piston has a chamber therein which is in communication with the annular groove in the periphery of the piston. The chamber, which may be charged with grease or oil in any suitable manner, desirably has a deformable gas reservoir therein which may be charged to any desired pressure to exert a corresponding pressure on the grease or oil in the chamber to force the latter into the annular groove.

This application is a continuation-in-part of copending application, Serial No. 224,220 filed May 2, 1951.

In the accompanying drawings in which is shown one or more of various possible embodiments of the several features of the invention.

Fig. 1 is a longitudinal sectional view of the device prior to charging of the reservoir and chamber.

Fig. 2 is a fragmentary view similar to Fig. 1 with the reservoir and chamber charged.

Fig. 3 is a plan view of a typical retaining ring which may be used in the device, and

Fig. 4 is a fragmentary view similar to Fig. 1 of another embodiment of the invention.

Referring now to the drawings, the pressure accumulator desirably comprises a substantially cylindrical container or casing **11** which preferably has plugs **12** and **13** removably mounted at each end thereof and provided with suitable substantially identical seals **14** and **15** respectively to prevent leakage from the casing **11**. One of said plugs, illustratively plug **12** has an oil port **16** therein which may be connected by a suitable coupling (not shown) to the equipment to be operated by the accumulator and the other of said plugs, illustratively plug **13** has an air inlet port **17** therein with a suitable valve **18** controlling the same.

Although the plugs **12** and **13** could be retained in the casing **11** in any suitable manner, in the illustrative embodiment herein shown, retaining rings **21** and **22**, which may be identical, are provided for this purpose, associated respectively with the plugs **12** and **13**.

As shown in Fig. 1, the casing **11** is desirably of enlarged diameter at each end as at **23** defining an annular shoulder **24**. The plugs **12** and **13** which are positioned in the enlarged portions **23** of the casing are substantially cup-shaped and each has an annular lateral flange **25** which may be seated on the associated shoulder **24**. Each of the enlarged portions **23** of the casing **11** desirably has a pair of spaced inturned annular flanges **27** and **28** which define annular grooves **29** and **31**, the seals **14** and **15**, which are desirably resilient O rings of conventional type and encompass the periphery of the associated flange **25**, being positioned in the associated groove **31**, a split ring washer **33** also being provided in each of the grooves **31** preferably against the associated flange **28**.

Retaining rings **21** and **22** each preferably comprises a plurality of rigid arcuate segments illustratively three in number and designated **35**, **36** and **37**, the segments when assembled in the associated annular groove **29** forming an annulus. The arcuate segments desirably have their adjacent ends **40** parallel to a line extending diametrically across the annulus so that they may readily be inserted into the associated annular groove **31** and are retained in said groove by means of a snap ring **39** which coacts with the inner peripheries of the segments and is stressed to urge such segments into the associated groove **29**. The segments of each retaining ring **21**, **22** are of greater

width than the depth of the associated annular groove **29** and overlap the lateral flanges **25** of the associated plugs **12** and **13** securely to retain said plugs against the associated shoulder **24**.

The construction of the retaining ring above described per se forms no part of the present invention as any suitable retaining ring may be used.

According to the present invention, a substantially cylindrical piston **41** which has an outer diameter slightly less than the inner diameter of the casing so that it may slide therein is positioned in the cylinder between ports **16** and **17**. Piston **41** desirably has a plurality of spaced annular grooves in its outer periphery, illustratively three in number, designated by the numerals **42**, **43** and **44**. Each of the grooves **42** and **44** has a seal member **45** therein respectively, preferably of the O ring type which may be positioned between a pair of washers **46**, preferably of deformable leather.

The piston **41** has a cylindrical bore **47** extending longitudinally therethrough defining a chamber C in communication with annular groove **43** as by means of a plurality of lateral passageways **51** which extend through the wall of piston **41**. The chamber C may be charged with a suitable oil or grease through an axial port **52** in the end wall **53** of the piston, said port being normally closed by a threaded plug **54**.

In order to close chamber C, a plug **55** is seated on a shoulder **56** formed by an enlargement of bore **47** and retained on said shoulder as by means of a split ring **57** positioned in an annular groove **58** in the enlarged portion of bore **47**. Desirably the periphery of plug **55** has an annular groove **59** therein in which a seal ring **61**, preferably of the O ring type, is positioned to provide a liquid tight seal.

Positioned in chamber C is a deformable gas reservoir R desirably a collapsible and expansible bellows **63**, the mouth **64** of which is affixed in any suitable manner as by welding to the inner surface of plug **55**. The reservoir R may be charged with any suitable gas under pressure through a valve **66** threaded into an axial bore **67** in plug **55**.

In the operation of the device, with the air valve **66** open and with plug **13** removed, a supply of grease or oil is injected through open port **52** by means of a suitable grease gun or the like to charge the chamber C, lateral passageways **51** and annular groove **43**, and the port **52** is thereupon sealed by plug **54**. As the grease is forced into the chamber C, the deformable bellows **63** will be collapsed as shown in Fig. 2. In this condition, the grease or oil in chamber C, passageways **51** and annular groove **43** will be under only atmospheric pressure. The bellows **63** is thereupon charged with air or other gas through valve **66** to a pressure of say 100 p. s. i. and a corresponding pressure will be exerted on the grease or oil in chamber C, passageways **51** and annular groove **43**. The plug **13** is then mounted on the enlarged end **23** of the cylinder.

With the chamber **71** of the casing between piston **41** and plug **13** pre-charged with air through valve **18** to a pressure of say 1,000 p. s. i., oil is thereupon forced through the oil port **16** under a pressure greater than 1,000 p. s. i. As a result of such pressure against the adjacent surface of the piston **41**, the latter will move axially as the oil fills the oil chamber **73** between oil port **16** and piston **41** to decrease the volume of the air chamber **71**, thereby compressing the air therein. Assuming that the oil is applied under a pressure of say 3,000 p. s. i., the piston **41** will be displaced until the air in chamber **71** has been compressed to a pressure of 3,000 p. s. i., at which time the piston will be in a position of equilibrium as the pressure against both surfaces of the piston will be equal.

Although the pressures on both surfaces of the piston **41** are equal, i. e., 3,000 p. s. i. in the embodiment herein shown, as the charged bellows **63** is exerting a

pressure of only 100 pounds on the grease or oil in chamber C, passageways **51** and annular groove **43**, there will be a greater pressure against the sides of the O rings exposed to the pressure of the oil and gas from the chambers **73** and **71** than against the sides of the O rings adjacent groove **43**. Consequently, the O rings will be deformed and forced towards each other, pressing against the space between the outer wall of the piston and the adjacent wall of the casing, thereby to effect a highly efficient seal.

In addition, the use of the grease or similar lubricant in annular groove **43** serves to lubricate the inner wall of the cylinder so that as the piston **41** moves therealong, there will be but a minimum of friction and hence the seals **45** will be long-lasting.

Under certain conditions of operation such as where high temperatures are encountered, the oil in the system may become very viscous. As a result, as the piston **41** slides in the casing **11**, oil may seep past the O rings **45** into chamber C. Such seepage may also occur as the O rings wear with continuous use.

The seepage of oil into the chamber C will gradually cause the pressure therein to rise until it reaches the same value as the pressure on each side of the piston **41**. This would reduce the effectiveness of the O rings as a seal.

In order to bleed the chamber C, the construction shown in Fig. 4 is provided. As this construction is substantially identical to that shown in Figs. 1 to 3, corresponding parts will have the same reference numerals primed.

In the embodiment shown in Fig. 4, the port **52'** is sealed by means of a plug **54'** screwed into said port. The plug **54'** desirably has an axial bore **81** of reduced diameter at its inner end as at **82** forming a seat **83**. Positioned in bore **81** is a ball **84** normally retained on its seat **83** by a coil spring **85** compressed between the ball **84** and a screw **86** affixed in bore **81** and having an axial bore **87** therethrough.

The bellows **63'** shown in Fig. 4 is substantially identical to the bellows **63** shown in Figs. 1 to 3 and has a plug **88** affixed to its undersurface **89** and adapted to seal the reduced end **82** of bore **81**.

In the operation of the embodiment shown in Fig. 4 chamber C' is charged with oil and with the bellows normally charged with gas at a pressure of 100 p. s. i., the tension of coil spring **85** is selected to exert a force sufficient to retain ball **84** on its seat **83**.

As the pressure on both sides of piston **41'** is normally the same and greater than 100 p. s. i., the ball **84** will be retained on its seat. If the pressure in chamber C' should build up to the same value as the pressure on each side of the piston **41'** the effectiveness of the O ring seals would be reduced.

If at such time, a valve controlling the oil port of the accumulator should be opened to operate a hydraulic device, the pressure against the oil side of the piston **41'** would instantaneously be reduced considerably. As a result, due to the fact that the gas in bellows **63'** has been compressed to the same value as the pressure on the gas side of the piston **41'**, the oil in chamber C' being under such pressure would move the ball **84** off its seat and such oil would bleed from chamber C' into the oil chamber below. Such bleeding of oil would occur rapidly and continue until plug **88** sealed port **82** to insure that oil would remain in chamber C'.

As a result of such bleeding, the pressure in chamber C' would fall to provide the required differential of pressure between annular groove **43'** and the oil and gas chambers, when the pressure on the oil in the oil chamber stabilized at the pressure of the oil in the air chamber.

As many changes could be made in the above construction, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accom-

panying drawings shall be interpreted as illustrative and not in a limting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A pressure accumulator comprising a cylinder, having a gas inlet port and a liquid port, whereby said accumulator may be charged with gas and liquid, a piston slidably mounted in said cylinder intervening between said ports and defining a gas chamber and a liquid chamber, a pair of spaced annular grooves in the periphery of said piston, a resilient deformable annular seal in each of said grooves engaging the inner wall of said cylinder, a chamber in said piston, said chamber having an inlet providing communication thereto for charging with fluid, a third annular groove in the periphery of said piston between said pair of annular grooves, a passageway between said third annular groove and said piston chamber, and a deformable and compressable member in said chamber.

2. The combination set forth in claim 1 in which said resilient seals each comprises an O ring.

3. A pressure accumulator comprising a cylinder having a gas inlet port and a liquid port, whereby said accumulator may be charged with gas and liquid, a piston slidably mounted in said cylinder intervening between said ports and defining a gas chamber and a liquid chamber, a pair of spaced annular grooves in the periphery of said piston, a resilient deformable annular seal in each of said grooves engaging the inner wall of said cylinder, said piston having an axial bore defining a chamber, and having a port in one end wall thereof providing communication to said chamber, a third annular groove in the periphery of said piston between said pair of annular grooves, a passageway between said third annular groove and said chamber, a deformable reservoir in said chamber and a gas inlet port in communication with said reservoir for charging thereof.

4. The combination set forth in claim 3 in which the axial bore defines an opening in the other end wall of said piston and a plug is affixed in said opening to seal the latter.

5. The combination set forth in claim 3 in which the axial bore defines an opening in the other end wall of said piston, a plug is affixed in said opening to seal the latter, and said reservoir comprises a bellows affixed to said plug, said plug having a gas inlet leading into said reservoir.

6. The combination set forth in claim 3 in which a plug is positioned in the port in the end wall of said piston, said plug having a bore therethrough of reduced diameter at its inner end forming a ball seat, a ball positioned in said bore, and a coil spring normally retaining said ball on said seat.

7. The combination set forth in claim 6 in which said reservoir comprises a bellows, said bellows having a plug at one end adapted to seal the reduced end of said bore.

8. The combination set forth in claim 3 in which the axial bore defines an opening in the other end of said piston, said axial bore being of enlarged diameter to define a shoulder, a plug is seated on said shoulder to seal the opening and means provided to retain the plug on said shoulder.

9. The combination set forth in claim 8 in which said plug has an annular groove in the periphery thereof, and a deformable ring is positioned in said groove to provide a liquid tight seal between the plug and the wall of said bore.

10. The combination set forth in claim 8 in which the enlarged portion of said bore has an annular groove and the means to retain the plug on said shoulder comprises a split ring in said annular groove extending laterally beyond the periphery of said plug.

11. Equipment of the character described comprising a container for two fluids under pressure, said container having a port for flow therethrough of one of said fluids, a piston slidably mounted in said container defining a chamber on each side thereof, each adapted to be charged with one of said fluids, a pair of spaced annular seal rings encompassing said piston to define a seal between the fluids in said two chambers, said equipment having a space defined between said seal rings to receive fluid under pressure that leaks past said seal rings, and normally closed spring urged valve means controlling the pressure in the space between the seals, said valve means being biased for opening thereof for discharge of fluid collecting in such space into one of said chambers when the pressure on the fluid in such space reaches a predetermined amount.

12. Equipment of the character described comprising a container for liquid and gas under pressure, said container having a pair of ports, a piston slidably mounted in said container defining a chamber on each side thereof in communication respectively with said ports and adapted to be charged with liquid and gas respectively, a pair of spaced annular seal rings encompassing said piston to define a seal between the liquid and gas in said chambers, said equipment having a space defined between said seal rings to receive fluid under pressure that leaks past said seal rings, and normally closed spring urged valve means controlling the pressure in the space between the seals, said valve means being biased for opening thereof for discharge of liquid collecting in such space into the liquid chamber when the pressure on the liquid in such space reaches a predetermined amount.

13. The combination recited in claim 12 in which said piston has a pair of spaced annular grooves therein in each of which a resilient deformable annular seal is positioned engaging the inner wall of said container and a third groove intervenes between the grooves of said pair, a passageway in said piston leads from said intervening annular groove to said liquid chamber and said valve means comprises a one-way valve in said passageway arranged for flow in direction only from said intervening groove into said chamber.

14. A pressure accumulator comprising a cylinder having a gas inlet port and a liquid port whereby said accumulator may be charged with gas and liquid, a piston slidably mounted in said cylinder intervening between said ports and defining a gas chamber and a liquid chamber, a pair of spaced annular grooves in the periphery of said piston, a resilient deformable annular seal in each of said grooves engaging the inner wall of said cylinder, said equipment having a space defined between said seals to receive fluid under pressure that leaks past said seals, said piston having a chamber therein, a passageway leading into said chamber from the space between said pair of seals, a passageway in said piston leading from said piston chamber into said liquid chamber and a spring urged one-way valve in said last named passageway arranged for flow in direction only from said piston chamber into said liquid chamber, said valve being biased to open when the pressure on the fluid in said piston chamber reaches a predetermined amount.

References Cited in the file of this patent or the original patent

UNITED STATES PATENTS

2,349,253	Edmund	May 23, 1944
2,417,256	Kremiller	Mar. 11, 1947
2,440,065	Ashton	Apr. 20, 1948
2,592,613	Snyder	Apr. 15, 1952
2,688,984	Snyder	Sept. 14, 1954