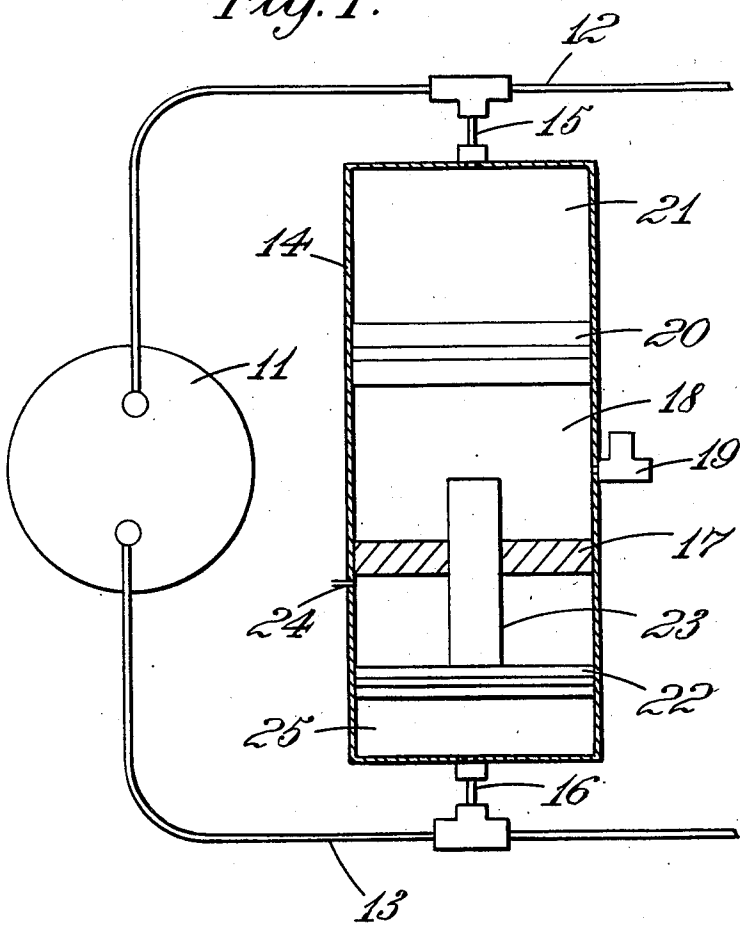
Oct. 2, 1956 J. H. STANBURY 2,764,999

HYDRAULIC ACCUMULATORS

Filed Aug. 29, 1952 2 Sheets-Sheet 1

Fig. 1.



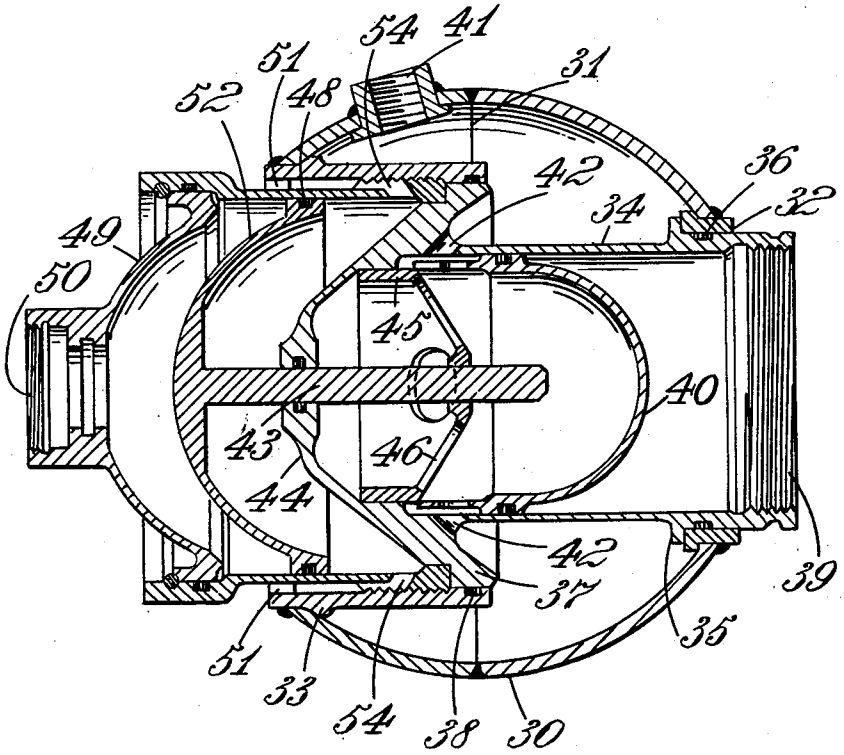
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Filed Aug. 29, 1952 2 Sheets-Sheet 2

Fig. 2.



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HYDRAULIC ACCUMULATORS

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Claims priority, application Great Britain August 31, 1951
10 Claims. (Cl. 138—31)

This invention comprises improvements in or relating to hydraulic accumulators and the like.

It is an object of the present invention to provide an apparatus which will not only act as a hydraulic accumulator but will also maintain simultaneously a reduced hydraulic pressure in a pipe-line connected to the accumulator; that is to say more than one pressure is maintained by the device in more than one circuit at the same time. Such an apparatus saves the necessity of using two different accumulators or their equivalent in certain hydraulic circuits. For example, it is essential on certain aerial weapons to use, for the hydraulic system, a hydraulic reservoir which is maintained under pressure so that the weapon can operate at high altitude. It is also essential to use an accumulator in the system to augment the output of the pump. Normally these two requirements would mean that two air volumes would have to be inflated in order to achieve the necessary pressurisation. The present invention relates to a means of achieving this result with a single air-chamber.

According to the present invention a hydraulic accumulator of the type which contains a sliding separator piston between a high pressure chamber and the high pressure hydraulic fluid chamber is employed, having an extension to constitute a low pressure chamber separated from the high pressure accumulator fluid chamber by a diaphragm or other separating wall, the low pressure chamber containing a sliding piston to bear upon the low pressure liquid therein and the sliding piston being connected to a ram or its equivalent of smaller area than the piston which enters the hydraulic pressure accumulator chamber.

By this means liquid in the low pressure chamber is maintained under a pressure relative to that of liquid in the high pressure chamber which depends on the ratio of the area of the sliding piston in the low pressure chamber and of the ram connected to it which enter the high pressure chamber.

One construction in accordance with the invention will now be described by way of example, reference being made to the accompanying drawings in which;

Figure 1 is a diagrammatic representation of the parts, and

Figure 2 is a longitudinal section through an accumulator.

In Figure 1 the pump **11** is connected to a delivery pipe **12** and draws from suction pipe **13**. An accumulator **14** is connected at one end by a branch **15** to the delivery pipe **12** and at the other end by a branch **16** to the suction pipe **13**. The accumulator is sub-divided by a diaphragm **17** and above the diaphragm is an air space **18** which can be inflated through fitting **19**. A sliding separator piston **20** separates hydraulic liquid in the chamber **21** from the air chamber **18**. A sliding piston **22** in the lower end of the accumulator carries a ram **23** which passes through the diaphragm **17**. The space above the piston **22** is connected to atmosphere through vent **24**.

The pressure in the chamber **21** is equal to the air pressure in chamber **18**. The pressure in the chamber **25** below the piston **22** is less than the pressure in the air chamber **18** in the ratio of the area of the ram **23** to the area of the piston **22**.

If the accumulator just described is used in a guided missile or high-altitude aircraft, the pump **11** may generate hydraulic pressure at, say, three thousand pounds per square inch and the chamber **18** will be correspondingly inflated. The delivery pipe **12** is connected to devices which are to be operated on the missile or aircraft. The suction tank connected to pipe **13** is kept under a moderate pressure by piston **22** irrespective of the atmospheric pressure at **24**.

Referring to Figure 2 filed herewith, this shows a particular construction of accumulator, still in accordance with the diagrammatic figure just described. An outer spherical shell **30** formed in two halves welded along line **31** has welded in it on opposite sides two co-axial retaining rings **32**, **33**. In the ring **32** is fitted a high-pressure accumulator cylinder **34** (corresponding to cylinder **14** already described). This is held in place by a flange **35** bearing against the interior of ring **32** and is sealed by a rubber gland-ring **36**. At its inner end it has a flange **37** which fits the ring **33** and is sealed by a gland-ring **38**. The outer end of the cylinder **34** is closed by a cover (not shown) screwed into screw-threads **39**.

In the cylinder **34** is a separator piston **40** (corresponding to piston **20** previously described). An inflator connection **41** (corresponding to **19**) is provided in the shell **30** and the air has access to the interior of cylinder **34** through ports **42** in its wall.

The inner end of cylinder **34** is closed in by a conical diaphragm **44** (corresponding to **17**) and through the diaphragm passes a ram **43** (corresponding to **23**). The ram is further guided by a spider **45** secured inside the diaphragm **44** and pierced by air-holes **46**. On the ram is a piston **52** (corresponding to **22**) which works in a cylinder **48** screwed into the retaining ring **33** and fitting against the back of flange **37**. This cylinder is closed by a cover **49** having a nipple **50** for attachment of a pipe connection corresponding to the connection **16**. The space behind the piston **52** is connected to atmosphere by ports **54** (corresponding to **24**) and an annular space between cylinder **48** and ring **33**. The cylinder **48** is buttressed against the ring **33** by lugs **51** which project from it at intervals all around.

It will be observed that in this construction all the parts of the previous figure are reproduced, but by enclosing them in the spherical shell **30** the stresses on the cylinder wall **34** are reduced (and so the thickness and weight is less) while the air-space is increased, and the spherical shell **30** is of the best shape for resisting internal pressure.

I claim:

1. A hydraulic accumulator comprising in combination a low pressure cylinder, a high pressure cylinder in line axially therewith, a diaphragm separating the two cylinders, a piston in the high pressure cylinder, a piston in the low pressure cylinder, a ram connected with the latter piston which ram is of smaller diameter than said piston and extends through the diaphragm into the high pressure cylinder, a hydraulic fluid pressure connection to one end of said high pressure cylinder, a hydraulic fluid connection to the low pressure cylinder on the other side of the piston therein from the ram, a substantially spherical outer vessel enclosing and providing an enclosed space around the high pressure cylinder, with connecting passages between the space in said vessel around the cylinder and the end of the cylinder opposite that having the hydraulic fluid pressure con-

nection, and an inflation connection in the wall of the spherical vessel.

2. An accumulator as claimed in claim 1 wherein a port is provided in the wall of the low pressure cylinder between the piston therein and the diaphragm, which port is open to atmosphere.

3. An accumulator as claimed in claim 1, wherein the end of the high pressure cylinder that communicates with the space in the spherical outer vessel is nearer the diaphragm, and the hydraulic connection thereto is to the end further from the diaphragm, said piston disposed in the high pressure cylinder serving to separate hydraulic fluid entering through the hydraulic fluid connection and air entering at the opposite end of the cylinder.

4. A hydraulic accumulator comprising a substantially spherical outer vessel, low and high pressure cylinders extending within said vessel from opposite sides thereof to meet one another, a diaphragm which separates the low pressure cylinder from the high pressure cylinder, sliding pistons in said cylinders, a ram connected with the piston of the low pressure cylinder which ram is of smaller diameter than the piston to which it is connected and extends slidably through the diaphragm in a fluid-tight manner into the high pressure cylinder, high and low pressure fluid connections to the outer ends of the high and low pressure cylinders respectively, an inflation connection in the shell of the spherical vessel, and passages connecting the space in the high pressure cylinder between the piston therein and the diaphragm with the space in the spherical vessel surrounding the cylinders.

5. A hydraulic accumulator comprising a substantially spherical outer vessel, low and high pressure cylinders having their axes in alignment and extending within said vessel from opposite sides thereof to meet one another, a diaphragm separating the low pressure cylinder from the high pressure cylinder which diaphragm is frusto-conical in form with its smaller diameter end directed into the low pressure cylinder, sliding pistons in said cylinders, a ram connected with the piston of the low pressure cylinder which ram is of smaller diameter than the piston to which it is connected and extends slidably through the diaphragm in a fluid-tight manner into the high pressure cylinder, high and low pressure fluid connections to the outer ends of the high and low pressure cylinders respectively, an inflation connection in the shell of the spherical vessel, and passages connecting the space in the high pressure cylinder between the piston therein and the diaphragm with the space in the spherical vessel surrounding the cylinders.

6. An accumulator as claimed in claim 5, wherein the pistons are substantially hemispherical in form, bulging toward the outer ends of the cylinders.

7. An accumulator as claimed in claim 5, wherein a spider is carried by the diaphragm on the high pressure side thereof to afford an additional guide for the ram during its sliding.

8. A hydraulic accumulator comprising a substantially spherical outer vessel, low and high pressure cylinders having their axes in alignment and extending within said vessel from opposite sides thereof to meet one another, the low pressure cylinder being of greater diameter than the high pressure cylinder, a diaphragm separating the low pressure cylinder from the high pressure cylinder which diaphragm is frusto-conical in form with its smaller diameter end directed into the low pressure cylinder, sliding pistons in said cylinders which pistons are each of substantially hemispherical form bulging toward the outer ends of the cylinders, a ram on the piston of the low pressure cylinder which ram is of smaller diameter than the piston which carries it and extends slidably through the diaphragm in a fluid-tight manner into the high pressure cylinder, a spider carried within the diaphragm cone on the high pressure side thereof and through which the ram passes so that the spider affords an additional guide for the ram during its sliding, high and low pressure hydraulic fluid connections to the outer ends of the high and low pressure cylinders respectively, an air inflation connection in the shell of the spherical vessel, and air passages connecting the space in the high pressure cylinder between the piston therein and the diaphragm with the space in the spherical vessel surrounding the cylinders.

9. An accumulator as claimed in claim 8, wherein passages are provided connecting the cylinder space between the diaphragm and the low pressure cylinder with atmosphere.

10. An accumulator as claimed in claim 4, wherein the low pressure cylinder extends through an opening at one side of the substantially spherical outer vessel, a support tube surrounding the low pressure cylinder has one end united to the shell of the outer vessel around said opening and extends inwardly therefrom into said vessel, the tube is internally screw threaded and the inner end of the low pressure cylinder is externally threaded and screwed into said tube, the external diameter of the low pressure cylinder outwardly of the screw threaded connection is smaller than the internal diameter of the tube so that an annular passage is provided between the tube and the cylinder, and ports in the wall of the low pressure cylinder at the inner end thereof serve to connect the space within said cylinder between its piston and the diaphragm to atmosphere by way of said annular passage.

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