Jan. 25, 1966 J. H. MERCIER 3,230,975

COMPOSITE MOVABLE PARTITION FOR PRESSURE VESSEL

Original Filed Dec. 9, 1959 2 Sheets-Sheet 1

FIG. 3

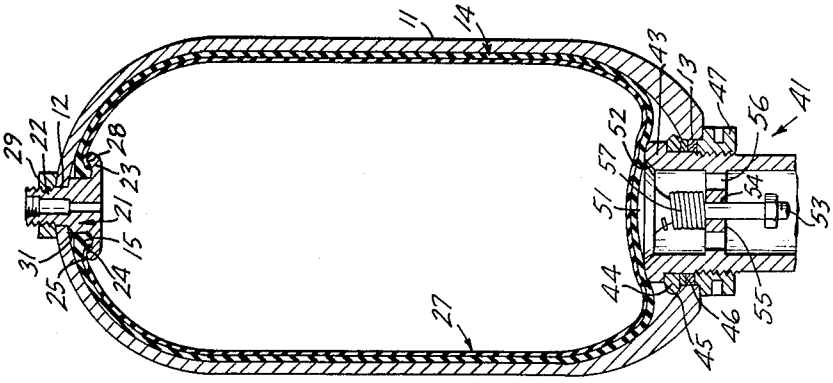

FIG. 1

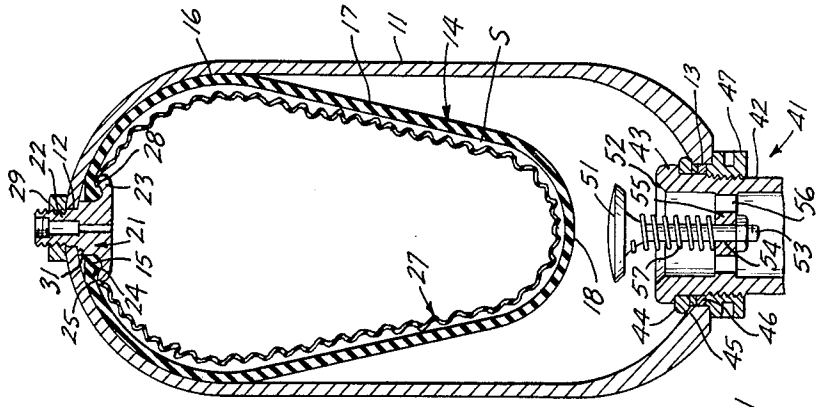

FIG. 4

FIG. 2

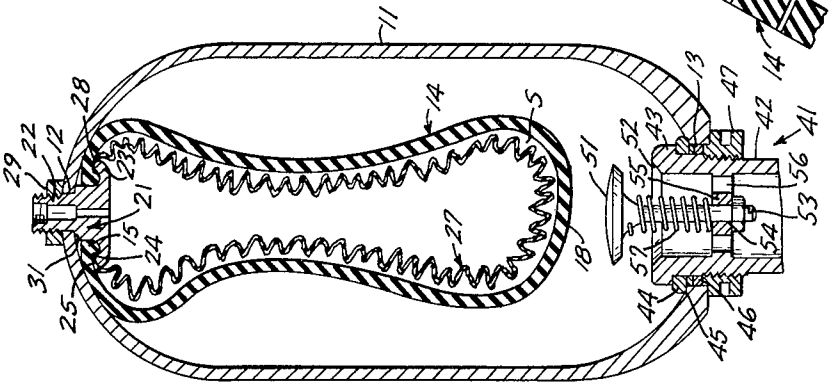

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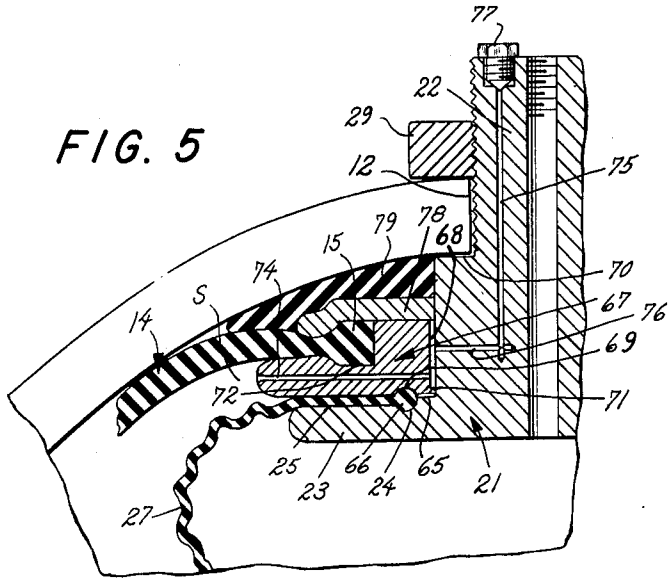
FIG. 5



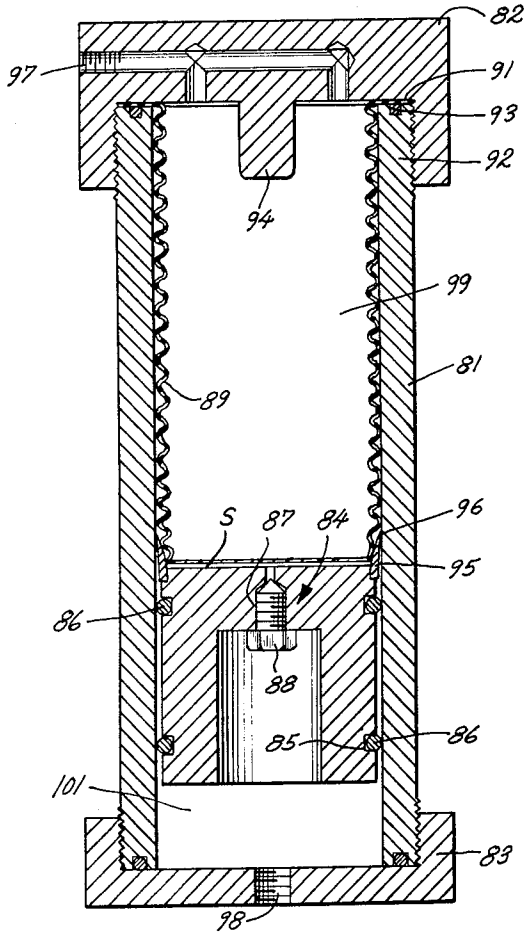


FIG. 6

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COMPOSITE MOVABLE PARTITION FOR PRESSURE VESSEL

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Original application Dec. 9, 1959, Ser. No. 858,349. Divided and this application Apr. 12, 1963, Ser. No. 272,761

1 Claim. (Cl. 138—30)

This application is a division of co-pending application Serial No. 858,349, filed December 9, 1959, now abandoned.

This invention relates to the art of pressure vessels and more particularly to pressure vessels in which two fluids are separated by a movable partition.

As conducive to an understanding of the invention, according to one aspect thereof, it is noted that in a pressure vessel, such as a pressure accumulator of the type having a rigid shell with a bladder therein intervening between the gas and oil ports thereof, in order to provide for substantially complete expulsion of the oil from the container the bladder must be capable of stretching progressively to engage the wall of the container as shown, for example, in Reissue Patent No. 23,437, to prevent formation of oil pockets, with resultant entrapment of oil.

To permit such progressive expansion of the bladder it is generally made of an elastomer, such as synthetic rubber, which, however, is substantially permeable to gas and, consequently, if the accumulator should stand for any considerable period with a gas and oil pre-charge, the gas would seep into the oil, with resultant pressure drop, which could have serious consequences such as when the accumulator operates a circuit breaker and the presence of gas in the oil would cause improper functioning of such circuit breaker.

It is accordingly among the objects of the invention to provide a pressure vessel of relatively low cost which will function without likelihood of mixture of the two fluids therein even after the pre-charged unit has been standing for a long period of time.

According to the invention, these objects are accomplished by the arrangement and combination of elements hereinafter described and more particularly recited in the claim.

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

FIG. 1 is a longitudinal sectional view of a pressure vessel according to the invention, with the bladder thereof in distended but substantially unstretched condition,

FIG. 2 is a view similar to FIG. 1, with the bladder in partially collapsed condition,

FIG. 3 is a view similar to FIG. 1, with the bladder in fully extended condition filling the container,

FIG. 4 is a fragmentary view showing another embodiment of the bladder,

FIG. 5 is a fragmentary view showing another embodiment of the bladder retaining means, and

FIG. 6 is a longitudinal sectional view of another embodiment of the invention.

Referring now to the drawings, the pressure vessel shown illustratively is a pressure accumulator which desirably comprises a container **11**, preferably of strong rigid material such as steel, cast aluminum or the like, capable of withstanding high pressure and having a gas inlet port **12** and a liquid port **13** therein preferably opposed to each other.

The container **11** may be spherical or cylindrospherical, as shown, and has a collapsible and expandable bladder

14 therein of resilient material such as rubber or synthetic plastic of like physical characteristics, which in distended but substantially unstretched condition, as shown in FIG. 1, is smaller than the cavity of container **11** and has its longitudinal axis aligned with ports **12** and **13**, the bladder defining a gas and oil chamber on opposed sides thereof.

In the illustrative example herein shown, the bladder is an elastomer such as synthetic rubber, which may be buna-N, butyl or the like, which can fold between its natural shape shown in FIG. 1 and its partially collapsed shape shown in FIG. 2, and which can expand to conform to the contour of the container as shown in FIG. 3. A bladder formed from such material is, however, substantially permeable to gas but is required for the reasons hereinafter set forth.

As shown in FIG. 1, the bladder has a port or mouth at one end, having a thickened rim **15**, and is of greatest diameter adjacent said mouth, as at **16**, the portion **17** of the bladder from said greatest diameter portion **16** to the free end **18** thereof being substantially conical in contour.

The bladder **14** is rigidly affixed in the container **11**, preferably by means of a fitting **21**, which desirably has a substantially cylindrical stem portion **22**, with a base disc presenting an outstanding lateral flange **23** at one end thereof which desirably has an annular groove **24** in its upper face **25** in which may be positioned the thickened rim **15** about the mouth of the bladder **14**.

Positioned in the bladder **14** is a secondary bladder **27** of thin deformable material whose natural shape is such as to substantially completely fill the interior of the container as shown in FIG. 3. The bladder **27** illustratively is of material which is substantially non-permeable and non-resilient. Typical of such materials are Du Pont polyurethane, sold under the trade name of "Mylar," and polyvinyl chloride, sold under the trade name of "PVC."

The mouth **28** of bladder **27** also is positioned in the annular groove **24** of fitting **21** and when the parts are assembled as shown in FIG. 1 the bladders **14** and **27** may be securely clamped in place by means of a nut **29** screwed upon the protruding threaded stem of the fitting, an annular shoulder **31** adjacent the root end of the stem abutting against the rim of the gas inlet port **12** to prevent cutting of the rim **15** of the bladder **14** and the mouth **28** of bladder **27** by excessive tightening of the nut.

Although the outlet port **13** of the accumulator could be controlled in any suitable manner, in the embodiment herein shown it is preferred to use the general construction shown in Patent No. 2,469,171, dated May 3, 1949, by the use of which an outlet closure assembly **41** affixed in said port **13** may be removed without likelihood of injury to the mechanic. As shown in FIG. 1, this assembly desirably comprises a housing **42**, preferably a tubular member which desirably has an external annular shoulder **43** at the upper end thereof of outer diameter less than that of port **13**. A locking member **44**, illustratively a ring of greater outer diameter than said port **13** and deformable to permit its insertion thereinto, encompasses said tubular member and is seated on the rim **45** of the port **13**, the inner diameter of said ring **44** being less than the outer diameter of shoulder **43** so that said shoulder may seat on said ring. Encompassing said tubular member and in juxtaposition with said port **13** is a rubber gasket **46** which serves effectively to prevent leakage between the wall of port **13** and the outer wall of tubular member **42** when a nut **47** is screwed on the external threaded portion of said tubular member **42**.

Desirably positioned in said tubular member **42** is a poppet valve comprising a valve head **51** adapted to seat on the bevelled mouth **52** of tubular member **42** and having a stem **53** preferably formed integral therewith. Stem **53** is slidably mounted in bearing opening **54** de-

sirably in a disc 55 mounted in the bore of tubular member 42, said disc having a plurality of openings 56 therethrough to permit the passage of fluid, said valve head being normally retained in open position by means of a coil spring 57 encompassing stem 53 between head 51 and disc 55. As the construction and operation of said outlet closure assembly per se forms no part of this invention, it will not be further described.

With the construction of the stretchable bladder 14 and the container 11 above described, the distance of the partly inflated bladder 14, as shown in FIG. 1, from the inner surface of the container 11 increases progressively from near the largest diameter portion 16 of the bladder toward the free end 18 thereof, and the size, shape and elastic characteristics of the bladder are selected so that in the further expansion of the bladder from its expanded but unstretched condition shown it will progressively engage such inner surface of the container 11 from the portion 16 of the bladder toward its free end.

Although the secondary bladder 27 is substantially non-resilient, since its normal shape is such that it would substantially fill the container as shown in FIG. 3, it is apparent that when the bladder 14 is compressed, as shown in FIG. 2, the secondary bladder 27 will be crumpled into a large number of folds and as the bladder 14 expands and stretches, the secondary bladder 27 will also expand to its fully distended shape shown in FIG. 3.

In normal operation of the unit, it is first precharged by forcing gas under pressure through the fitting 22 to fill the secondary bladder 27, causing the latter as well as the stretchable bladder 14 to expand to substantially the shape of the container. Thereupon, the fitting 22 is sealed and a fluid such as oil under pressure considerably greater than that pre-charged into the bladder 27 is forced through the tubular member 42 to compress the charged bladders so that they assume the position shown in FIG. 2, for example, and a valve (not shown) controlling the oil port 13 is then closed.

To use the charged unit, the valve controlling the liquid outlet port 13 is opened and the bladders 14 and 27 will expand to force liquid from port 13. Since the bladder 14 will progressively engage the container wall from the maximum diameter portion 16 thereof to the other end 18 thereof, no liquid pockets will be formed between the bladder and the rigid wall of the container.

As a result, substantially all of the fluid in the container 11 will be forced toward the outlet port 13 for expulsion therefrom. When the bladder has expanded sufficiently to engage the valve head 51, the latter will be moved onto its seat, thereby closing the oil portion to prevent extrusion of the bladder, this occurring when the bladder 14 has expanded to engage substantially the entire wall surface of the container and expelled substantially all of the oil from the container.

As the bladder 27 is substantially non-permeable, the pre-charged unit can remain standing for long periods of time without likelihood that any gas will escape into the oil with resultant loss of gas pressure when the unit is ultimately used, and also without likelihood of mixture of the gas and oil, which might be serious where the two are not compatible.

Where it is desired to provide communication from the space S between the two bladders 14 and 27, either for venting such space or for charging the latter with an additional fluid, the construction shown in FIG. 5 is preferred.

Thus, a fitting 21 is provided that has a substantially cylindrical stem portion 22 with a base disc presenting an outstanding lateral flange 23 at one end thereof, which desirably has an annular groove 24 in its upper surface 25 and an annular shoulder 65 adjacent the root end of stem 22 and in a plane above that of surface 25, the groove 24 carrying the thickened rim 66 about the mouth of bladder 27.

Associated with the stem 22 is a disc 67 having a central bore 68 through which the stem 22 extends. The portion

of disc 67 around the lower periphery of said bore is seated on shoulder 65 and an annular groove 69 is provided in the underface of disc 67 also to receive the rim 66 of bladder 27.

The disc 67 has an inwardly extending annular rim 71 at the lower end of the bore 68 which serves to space the remaining portion of said bore from the stem 22, and the upper surface of disc 67 has an annular groove 72 to receive the thickened rim 15 about the mouth of bladder 14.

Communication is offered from the space S between the bladders 14 and 27 to the exterior of the pressure vessel by means of a radial passageway 74 through said disc 67 which leads into the bore 68 thereof, said stem 22 having a longitudinal passageway 75 and a communicating lateral passageway 76 that leads into said bore 68.

Desirably, a plug 77 is provided at the outer end of passageway 75 to seal the latter.

The stem 22 is also encompassed by a rigid clamp plate 78 which extends over the thickened rim 15 of bladder 14 and a resilient disc 79 also encompasses the stem 22 between plate 78 and the container wall.

Thus, when a nut 29 encompassing the protruding portion of stem 22 is tightened, the mouths of bladders 14 and 27 will be securely retained in position, an annular shoulder 70 on said stem abutting against the rim of the gas inlet port 12 to prevent cutting of said disc 78 by excessive tightening of nut 29.

With this construction, the gas in the space S between bladders 14 and 27 may readily be evacuated, and if desired, an intermediary fluid may be introduced in such space. Thus, for example, where there is a radioactive fluid in contact with resilient bladder 14 and a non-radioactive fluid in contact with the non-permeable bladder 27, a protective fluid could be introduced into space S to prevent contamination of such non-radioactive fluid.

With the constructions shown in FIGS. 1 to 5, the stretchable and permeable bladders 14 of the configurations described will afford substantially complete expulsion of oil from the container, and the non-resilient and non-permeable bladders 27 will not in any way interfere with such complete expulsion of oil, yet will prevent leakage of any gas into the oil chamber.

In the embodiment shown in FIG. 6, the pressure vessel comprises a cylindrical casing 81 having closure caps 82, 83 secured to the ends thereof. Slidably mounted in the casing 81 is a piston 84, which desirably has a pair of spaced annular grooves 85 in its periphery in which O rings 86 are positioned to form a seal with respect to the wall of the casing. As shown in FIG. 6, the piston has an axial bore 87 therethrough closed by a plug 88.

Positioned in the casing 81 between piston 84, which acts as a partition, and the end cap 82, is a partition 89, illustratively a bladder of thin deformable material whose natural shape is such as to completely fill the interior of the container when the piston 84 is against the end cap 83.

The bladder 89 illustratively is of substantially non-resilient, non-permeable material such as the types previously described with respect to the embodiment of FIGS. 1 to 5.

The mouth 91 of the bladder 89 is positioned between the end 92 of casing 81, which desirably carries an annular gasket 93, and the end cap 82, and the latter has an axial stud 94 extending inwardly therefrom to limit the movement of piston 84 toward end cap 82 to prevent sharp folding of bladder 89.

To avoid extrusion of the bladder through the space between the wall of casing 81 and the piston 84, the latter is desirably provided with an annular lip 95 which is secured at one edge to the piston and has its other edge 96 resiliently engaging the casing wall.

With the construction above described, two fluids such as gas under pressure and oil may be charged through port 97 in end cap 82 and port 98 in end cap 83 into the chambers 99 and 101 on each side of the piston 84.

As the gas, for example, is contained in the non-permeable bladder 89, it will not escape from chamber 99 past the piston 84 into chamber 101 even after the pressure vessel has been standing for long periods of time.

The plug 88 may be removed to bleed the space S between the bladder 89 and piston 84, or if desired, a slight quantity of oil may be provided in the space S so as to avoid a dry contact between the non-permeable bladder 89 and the wall of casing 81 which could cause injury to the bladder upon movement of the piston 84.

With the constructions above described there is assurance that even after the pressure vessels have been standing idle with a pre-charge for long periods of time, there will be no mixture of the fluids contained therein.

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 claim, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

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

A pressure vessel comprising a rigid substantially cylindrical container having a gas port and a liquid port axially aligned at the respective ends of the container, a stretchable, resilient, substantially conical bag in said container in communication with one of said ports and fixed in said container so as to extend axially thereof, said bag having a greater cross section near the fixed end thereof than at its free end and when in substantially non-distended condition, having its side wall adjacent the fixed end thereof closely adjacent the wall of said container and its side wall near the free end thereof spaced from the wall of said container by a distance substantially greater than that between the side wall of the bag adjacent its fixed end and the adjacent wall of said container, the distance between the side wall of the bag and the wall of the container from near the fixed end of the bag to near its free end being progressively increasing, whereby upon collapse

of said bag and subsequent expansion thereof, during the operation of the pressure vessel the free end of said bag will not rub against the wall of said container, and a second partition in said container intervening between said ports, said partitions being concurrently movable between two extreme positions in said container, said second partition when in one of its extreme positions being at least of size substantially equal to that of the first partition when the latter has been fully expanded in said container to one of its extreme positions, said second partition being of substantially non-resilient and non-permeable material, and positioned internally of said stretchable partition between said stretchable partition and said gas port, said bag and said partition both being bladders, each having a mouth, a fitting having a stem extending through said gas port and having an annular flange at its inner end, a disc encompassing said stem and in juxtaposition to said flange, the mouth of said second partition being positioned between said disc and said flange, a clamp plate encompassing said stem, the mouth of said stretchable partition being positioned between said clamp plate and said disc, means to urge said flange, said disc and said clamp plate together securely to retain the mouths of the bladders in position, said disc having a passageway therethrough leading into the space between said bladders, and said stem having a passageway extending from the exterior of the pressure vessel and in communication with said disc passageway.

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