June 30, 1964 J. MERCIER 3,139,112

PRESSURE VESSELS

Filed Sept. 29, 1958

FIG. 1

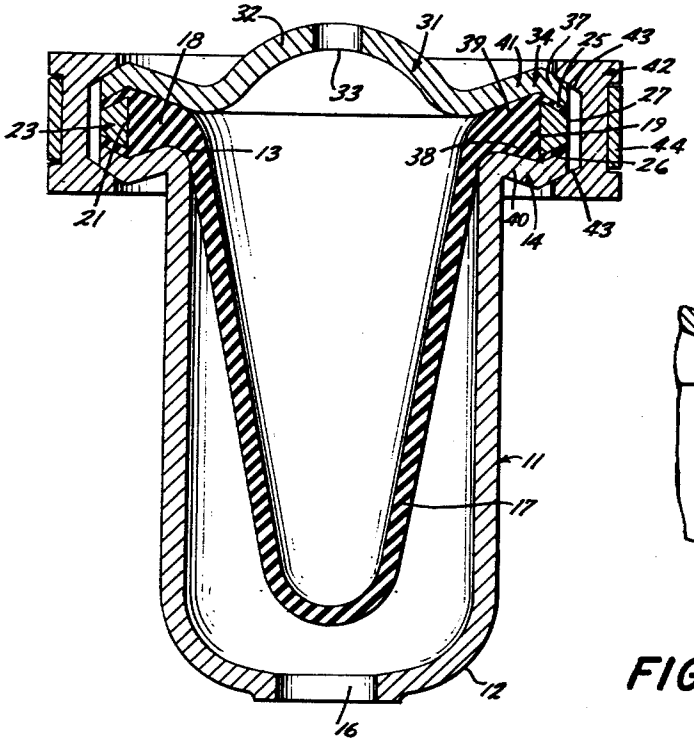


FIG. 2

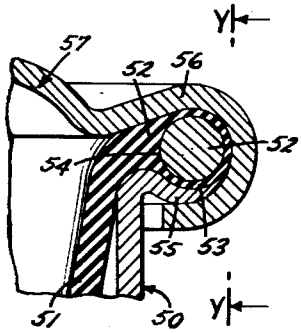


FIG. 8

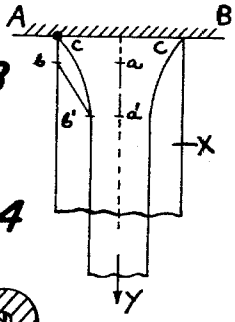


FIG. 3

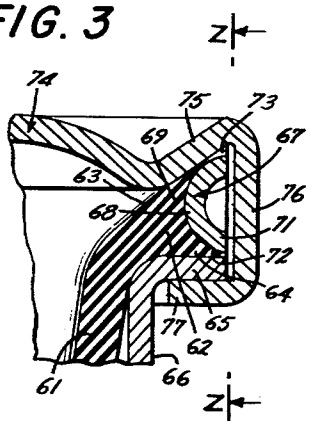


FIG. 4

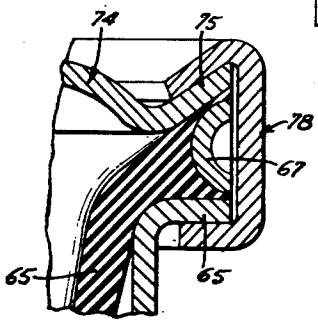


FIG. 5

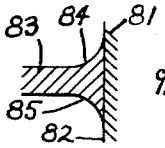


FIG. 6

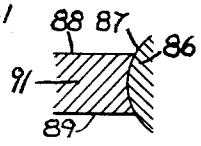
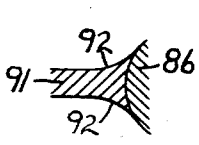


FIG. 7



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3,139,112

PRESSURE VESSELS

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4 Claims. (Cl. 138—30)

This invention relates to the art of pressure vessels generally known as pressure accumulators and more particularly to the deformable partition or bladder used in such accumulators.

It is among the objects of the invention to provide a pressure accumulator of relatively low cost, which may readily be fabricated and which will function without likelihood of breakdown or rupture of the deformable partition or bladder therein.

Another object is to provide a deformable partition or bladder to be used as a separator between two fluids in a pressure accumulator, which bladder has a relatively large open mouth to permit ready extraction therefrom of the core used in the molding thereof and which may be securely, yet releasably retained in position in a pressure accumulator without likelihood of rupture or breakdown of the material of the bladder adjacent its relatively large mouth.

According to the invention, the pressure accumulator is of the type having a relatively large opening or mouth and a port opposed to such opening. The accumulator has means adjacent the mouth to mount the periphery of a partition or bladder of resilient deformable material which is positioned in the accumulator to intervene between the opening and the port. The periphery of the partition which desirably is thickened, has a rigid annular supporting member molded therein. The mouth of the accumulator is closed by means of a cover plate, the rigid annular supporting member spacing said cover plate from the mounting means for the periphery of the partition. The rigid annular member is desirably conformed so that the elastic material of the bladder will securely adhere thereto without likelihood of separation between the partition material and the rigid annular member during use of the accumulator.

This invention is a continuation-in-part of co-pending application Serial No. 635,154, filed January 22, 1957, now Patent No. 2,959,194, granted November 8, 1960.

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 an accumulator according to one embodiment of the invention,

FIG. 2 is a fragmentary longitudinal sectional view of another embodiment of the invention,

FIGS. 3 and 4 are views similar to FIG. 2 of other embodiments of the invention,

FIGS. 5 to 7 are views illustrating other arrangements of the invention, and

FIG. 8 is a view illustrating the principle of the invention.

Referring now to the drawings, as shown in FIG. 1, the pressure accumulator comprises a container or pressure vessel **11** of a strong rigid material, such as steel, capable of withstanding high pressures, said container being substantially spherical at one end as at **12** and open at its other end as at **13**, said open end **13** having a V-shaped annular flange **14**.

The end **12** of the container has an axial opening or port **16** in which is mounted a closure assembly (not shown) of any suitable type such as is shown in United States Patent No. 2,469,171, dated May 3, 1949, through which a fluid under pressure, such as oil, may flow into and out of the container **11**.

Positioned in the container **11** is a deformable partition **17**, illustratively a collapsible and expansible bladder which desirably is of resilient material such as rubber or synthetic plastic of like physical characteristics.

The bladder has a thickened rim **18** which flares outwardly as shown, being of greater thickness at its outer periphery **19** and being substantially trapezoidal in cross section. Secured as by bonding to the outer periphery **19** of the bladder rim is the base **21** of a supporting member **23** which desirably is an annulus of rigid material such as steel, being substantially trapezoidal in cross section.

The supporting member or annulus **23** preferably is molded with the bladder so that a relatively thin layer **25**, **26** of bladder material lies respectively upon each of the non-parallel sides of the annulus **23**. If desired, the outer periphery **27** of the annulus may also be covered with the bladder material.

Means are provided to close the open end of the container **11** and to retain the bladder **17** and the supporting member **23** in position. To this end, a cover plate **31** is provided which has a substantially curved central portion **32** with a port **33** therein and an inverted V-shaped annular flange **34** complementary to the flange **14**.

The dimensions of the flanges **14** and **34**, the trapezoidal rim **18** and supporting member **23** are such that when the bladder is positioned in the container with its rim **18** seated on flange **14** it will hang downwardly therein with the layers **25** and **26** between the upwardly and downwardly inclined portions **36**, **37** of flanges **14** and **34** respectively, and with the inclined bottom and top surfaces **38**, **39** of rim **18** between the downwardly and upwardly inclined portions **40**, **41** of flanges **14** and **34**.

The cover plate is securely retained in position as by means of a pair of arcuate clamping segments **42**. Each of the clamping segments **42** in cross section is substantially U-shaped, the opposed surfaces **43** of each of the legs having an incline substantially equal to the incline of the outer portions **36**, **37** of flanges **14** and **34**.

When the clamping segments are positioned so that the legs thereof straddle the flanges **14** and **34** and a belt **44**, preferably of steel, encompassing the segments, is tightened in any suitable manner, the clamping segments will be moved inwardly so that the inclined portions of their legs will cam the cover plate downwardly to effect a tight seal. By reason of the resilient layers **25**, **26**, which will be compressed by such clamping action, a dependable seal will be provided which will prevent leakage of gas or liquid from the end **13** of the container.

With the construction above described, when a valve (not shown) controlling the liquid outlet port **16** is opened, the bladder which has previously been charged with gas under pressure and compressed by liquid forced into the container **11** through the port **16**, will expand to force liquid from the container.

It is well known that when an elastic member is bonded to a plane perpendicular to the direction of the stresses, the maximum fatigue is located at the periphery and that when elastic material, such as is used in the bladder, is molded or bonded to a rigid member, it tends to unstick first at the region of shorter fibers, i.e., where the periphery of the material is bonded to a flat surface.

This is clearly shown in FIG. 8 where, when an elastic member X is bonded to a flat plate A–B and is subjected to tension Y, the point *a* will move to *a'* and the point *b* will move to *b'*. As *aa'* is less than *bb'* (peripheral fibers will have been subjected to more stress than the central fibers and will unstick as at *c*.

This problem is solved by making the peripheral fibers longer than the central fibers so that the peripheral fibers will not be subjected to greater stress than the central fibers.

Thus, in the embodiment of FIG. 1, by reason of the inclined surfaces **38**, **39** of the rim of the bladder, longer fibers are provided at the periphery of rim **18** with respect to base **21** of the supporting member **23** to which they are bonded, than at the portion of the rim bonded to base **21** between such inclined surfaces. Consequently the bladder material will adhere securely to such flat base **21** since the strain on the peripheral fibers will not be more than on the central fibers and hence the bond is not likely to break at the periphery, so that with repeated expansion and contraction of the bladder in use of the accumulator, the bladder and the supporting member will remain securely bonded together.

By "fibers" is meant the line of stress in the bladder material when tension is applied thereto.

The pressure accumulator shown in FIG. 2 is similar in many respects to that shown in FIG. 1. Thus, the container **50** has an outlet port (not shown) identical to that shown in FIG. 1 and a collapsible and expansible bladder **51** is positioned in said container.

The bladder **51** has a thickened rim **52**, which also is substantially trapezoidal in cross section flaring outwardly as shown and with an annular supporting member **52** molded therein. The supporting member is desirably circular in cross section and its outer surface is completely covered by the bladder material as at **53**, the wider portion or periphery **54** of the rim being bonded to the supporting member. The flange **55** of the container **50** and the flange **56** of the cover **57** are curved to conform to the curvature of the supporting member **52**. The cover flange **56** is bent around and under the flange **55** securely to retain the cover and container together tightly to clamp the supporting member **52** therebetween. By reason of the layer **53** of bladder material around the supporting member **52**, a dependable seal is provided which will prevent leakage of gas or liquid from the container. If the bladder is to be replaced, the flange **56** is severed along the line Y—Y so that the bladder may be removed by taking off the cover **57**. After introduction of a new bladder, the cover disposed upon the container may again be fastened by clamping pieces **42** of the type shown in FIG. 1.

In the embodiment shown in FIG. 3, the bladder **61** has a thickened rim **62** which has an inclined top surface **63** and a relatively flat bottom surface **64** which rests on the lateral annular flange **65** at the mouth of the container **66**.

The supporting member **67** is substantially semicircular in cross section so that it can resiliently conform to axial pressure strains which may occur. The supporting member **67** is molded into the thickened rim **62** of the bladder with its convex surface **68** facing inwardly and bonded to the periphery **69** of the rim **62**, the bladder material extending to the outer rims **71** of the supporting member to define layers **72** and **73**.

The cover **74** has a flange **75** which is inclined upwardly as shown to conform to the inclination of the top surface of rim **62**. The flange **75** has a depending skirt **76** which is inwardly bent as at **77** to extend beneath the flange **65** of the container securely to clamp the rim **62** between flanges **65** and **75**, the layers **72**, **73** of bladder material providing a dependable seal to prevent leakage of gas or liquid from the container.

To replace the bladder it is merely necessary to sever the flange **75** along the line Z—Z and the container can then again be closed as by a crimped rim **78** (FIG. 4) encompassing the flanges **65** and **75**.

In the embodiments shown in FIGS. 2 and 3, the curved supporting member to which the bladder rim is bonded will provide longer fibers at the periphery of the bond than intermediate such periphery. Hence the strain will be the same at all portions of the bond and it is not likely to break at the periphery.

It is to be understood that it is within the scope of the invention to utilize other configurations of the partition rim and the fastening surface other than those above described.

Thus, as shown in FIG. 5, the supporting member **81** could have a flat fastening surface **82** and the walls of the rim of the partition **83** could be concave as at **84**, **85** to define a widened periphery bonded to the fastening surface. Where the supporting member **86** has a convex fastening surface **87**, as shown in FIG. 6, the walls **88**, **89** of the rim of the partition **91** bonded thereto could be parallel, or as shown in FIG. 7, they could be concave as at **92** to define a widened periphery.

In all cases, it is necessary that the peripheral fibers of the rim of the partition bonded to the supporting member be longer than the intervening fibers.

By reason of the constructions above described, a core used in the molding of the bladders may readily be removed therefrom and the reinforcing members at the relatively large mouth of the bladders will permit secure retention of the bladders in position in the containers and provide for long life of such bladders.

As many changes could be made in the above constructions, 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 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:

1. As an article of manufacture a partition of resilient deformable material having a substantially trapezoidal rim having its top and bottom surfaces tapering outwardly to define a widened periphery and an annular supporting member of rigid material substantially trapezoidal in cross section having a fastening surface extending substantially parallel to the longitudinal axis of the partition, said widened periphery of said rim being bonded to said fastening surface, the line of stress of the partition material exerted against the bonding surface of said supporting member at least at one of the exterior surfaces of the partition being longer than the line of stress of the partition material intervening between the exterior surfaces thereof exerted against the bonding surface of said supporting member, guiding means associated with said supporting member and the rim of said partition and extending laterally inwardly from said rim to maintain the direction of the line of stress of the partition material intervening between the exterior surfaces thereof exerted against the bonding surface at substantially right angles to said bonding surface whereby the stress on said bonding surface at least at the longer line of stress will be no more than at the intervening line of stress.

2. The combination set forth in claim 1 in which a layer of partition material extends over the non-parallel surfaces of the supporting member.

3. A pressure vessel comprising a rigid hollow container having an opening and an opposed port, a partition of resilient deformable material in said container, said partition having a substantially trapezoidal peripheral rim having its top and bottom surfaces tapering outwardly to define a widened periphery, said partition extending across the container and intervening between said opening and said port, an annular supporting member of rigid material substantially trapezoidal in cross section having a fastening surface extending substantially parallel to the longitudinal axis of the partition, said widened periphery of said rim being bonded to said fastening surface, the lines of stress of the partition material exerted against the bonding surface of said supporting member at the exterior surfaces of the partition being longer than the line of stress of the partition material intervening between the exterior surfaces thereof, exerted against the bonding surface of said supporting member, an annular flange defining mounting means for the rim of the partition at the

periphery of said opening and extending substantially laterally outward from said opening to guide the portion of the partition adjacent its rim so as to maintain the direction of the line of stress of the partition material intervening between the exterior surfaces of the partition exerted against the bonding surface at substantially right angles thereto, whereby the stress on said bonding surface at the exterior surfaces of the partition will be no more than at the intervening line of stress, a cover plate adapted to extend over said opening, said mounting means and the opposed portion of the cover plate having conformations complementary to the rim of the partition and the supporting member positioned therebetween, and means to retain said cover plate in closed position with respect to said opening, said rigid annular supporting member spacing said cover plate from said mounting means.

4. The combination set forth in claim 3 in which a layer of partition material extends over the non-parallel surfaces of the supporting member to serve as a gasket between the cover plate and the annular flange.

References Cited in the file of this patent

UNITED STATES PATENTS

1,885,457	Lord et al.	Nov. 1, 1932
2,175,460	Guilford	Oct. 10, 1939
2,340,125	Huebner et al.	Jan. 25, 1944
2,343,320	Parker	Mar. 7, 1944
2,773,511	Mercier	Dec. 11, 1950