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3,148,706

PRESSURE VESSELS

Original Filed Sept. 29, 1958

FIG. 1

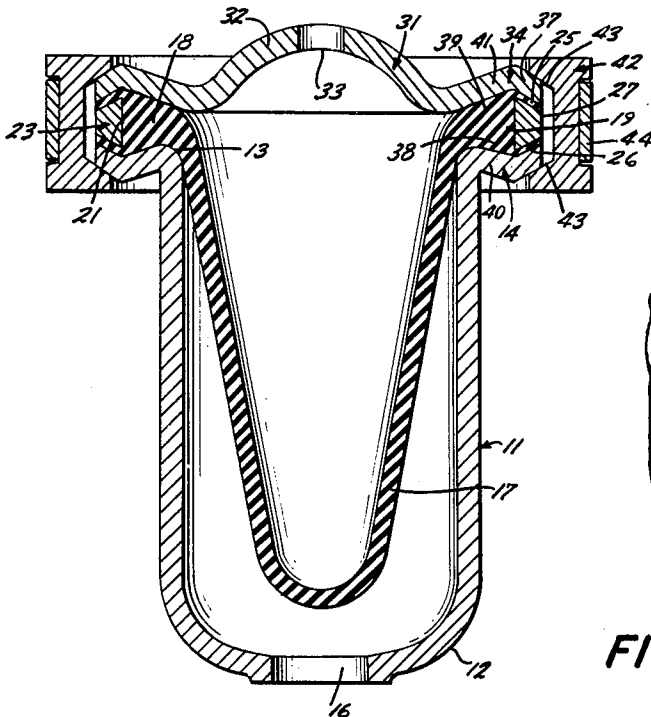


FIG. 2

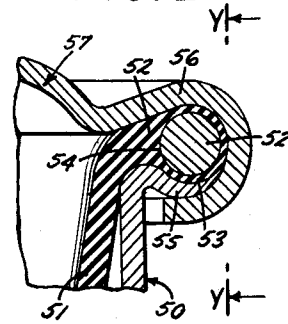


FIG. 8

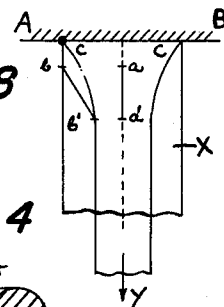


FIG. 3

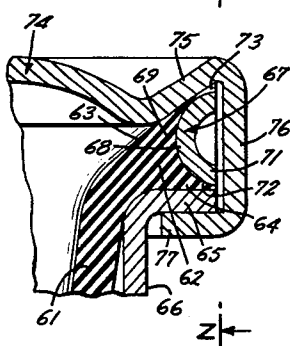


FIG. 4

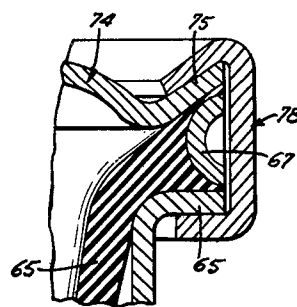


FIG. 5

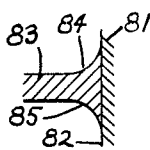


FIG. 6

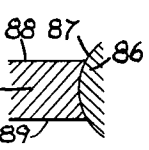
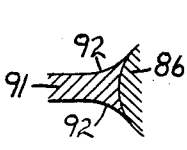


FIG. 7



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3,148,706

PRESSURE VESSELS

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Original application Sept. 29, 1958, Ser. No. 764,175.

Divided and this application Feb. 19, 1963, Ser. No. 259,573

Claims priority, application Germany Nov. 20, 1957

13 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 secured thereto as by molding. 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 division of co-pending application Serial No. 764,175, filed September 29, 1958.

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 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

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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 surface 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 periphery, i.e., where the periphery of the material is bonded to a flat surface, for example.

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' at the periphery, the material at the periphery of the elastic member will have been subjected to more stress than the material between the peripheries of the elastic member and will unstick as at c.

This problem is solved by making the length of the material at the periphery of the elastic member longer than its length between the peripheries so that the material at the periphery will not be subjected to greater stress than the material between the peripheries.

Thus, in the embodiment of FIG. 1, by reason of the inclined surfaces 38, 39 of the rim of the bladder, a greater length of material is 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 material at the periphery of the rim will not be more than on the material between the periphery 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.

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 a longer length of material 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 length of the material of the rim of the partition bonded to the supporting member be longer than the length of the intervening material.

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. 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 peripheral rim and extending across the container and intervening between said opening and said port, an annular supporting member of rigid material having a convex fastening surface bonded to said partition at the rim thereof, whereby stress is produced against the bonded surface in use of the pressure vessel, the length of the partition material at at least one of the wall surfaces of the partition adjacent the rim thereof being longer than the length of the partition material between the opposed wall surfaces of the partition adjacent the rim thereof, whereby the stress of the bonded portion of the rim of the partition against the supporting member at such longer wall surface in use of the pressure vessel will be reduced, 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 in use of the pressure vessel so as to maintain the direction of the stress of the partition material intervening between the exterior surfaces of the partition adjacent its rim, exerted against the bonding surface, at substantially right angles thereto, a cover plate adapted to extend over said opening 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, and defining the sole rigid spacing means therebetween.

2. The combination set forth in claim 1 in which the walls of the rim of said partition taper outwardly to define a widened periphery bonded to the concave fastening surface.

3. The combination set forth in claim 1 in which said supporting member is circular in cross section.

4. The combination set forth in claim 1 in which said supporting member is circular in cross section, the inner periphery thereof defining the convex fastening surface to which the rim of the partition is bonded and a layer

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of partition material covers the remaining surface of said supporting member.

5. The combination set forth in claim 1 in which the supporting member is circular in cross section and said mounting means and the opposed portion of the cover plate have conformations complementary to the supporting member positioned therebetween.

6. The combination set forth in claim 1 in which the supporting member is circular in cross section, the inner periphery thereof defining the convex fastening surface to which the rim of the partition is bonded, a layer of partition material covers the remaining surface of said supporting member and said mounting means and the opposed portion of the cover plate having conformations complementary to the supporting member positioned therebetween.

7. The combination set forth in claim 6 in which the mounting means is an annular flange having an annular concavity in its top surface, the opposed portion of the cover plate is concave on its undersurface and has a portion extending around the outer periphery of the supporting member and beneath the annular flange to clamp the rim of the partition therebetween.

8. The combination set forth in claim 1 in which the supporting member is arcuate in cross section, having its free edges along a line parallel to the longitudinal axis of the partition and its convex fastening surface, to which the rim of the partition is bonded, directed inwardly.

9. The combination set forth in claim 8 in which the mounting means is an annular flange the rim of said partition and the supporting member being positioned between said flange and the periphery of said cover plate, said periphery having a portion extending beneath said flange to clamp the rim of said partition and the supporting member therebetween.

10. The combination set forth in claim 8 in which the mounting means is an annular flange, the rim of said partition and the supporting member being positioned between the flange and the periphery of said cover plate,

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said periphery being inclined upwardly, and an annular member coacting with said inclined periphery and said flange to clamp the rim of said partition and the supporting member therebetween.

11. The combination set forth in claim 1 in which the walls of the rim of the partition adjacent the bonded portion thereof are concave to define a widened periphery bonded to the fastening surface.

12. The combination set forth in claim 1 in which the walls of the rim of the partition adjacent the bonded portion thereof are parallel to define a widened periphery bonded to the fastening surface.

13. As an article of manufacture, a partition of resilient deformable material for a pressure vessel, said partition having a peripheral rim and an annular supporting member of rigid material having a convex fastening surface bonded to said rim, whereby stress is produced against the bonded surface in use of the pressure vessel, the length of the partition material at at least one of the wall surfaces of the partition adjacent the rim thereof being longer than the length of the partition material between the opposed wall surfaces of the partition adjacent the rim thereof whereby the stress of the bonded portion of the rim of the partition against the supporting member at such longer wall surface in use of the partition will be reduced.

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