Nov. 8, 1960 J. MERCIER 2,959,194

BLADDER CONSTRUCTION FOR PRESSURE VESSELS

Filed Jan. 22, 1957

Fig. 3.

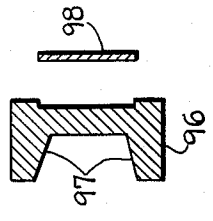


Fig. 5.

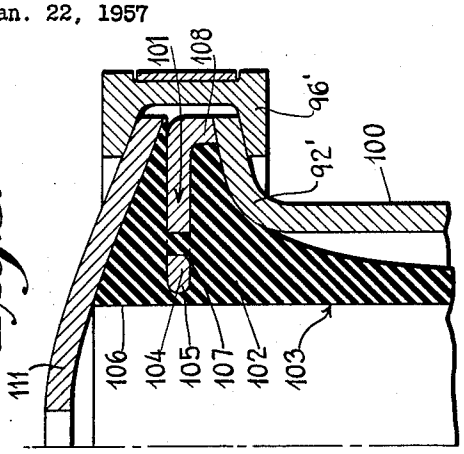


Fig. 2.

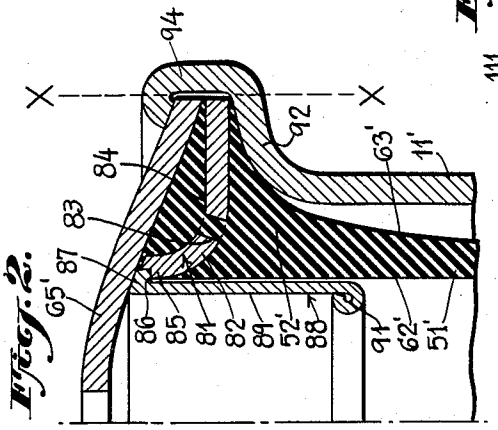


Fig. 4.

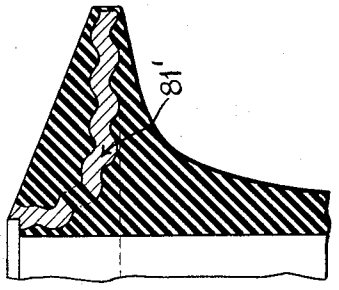


Fig. 1.

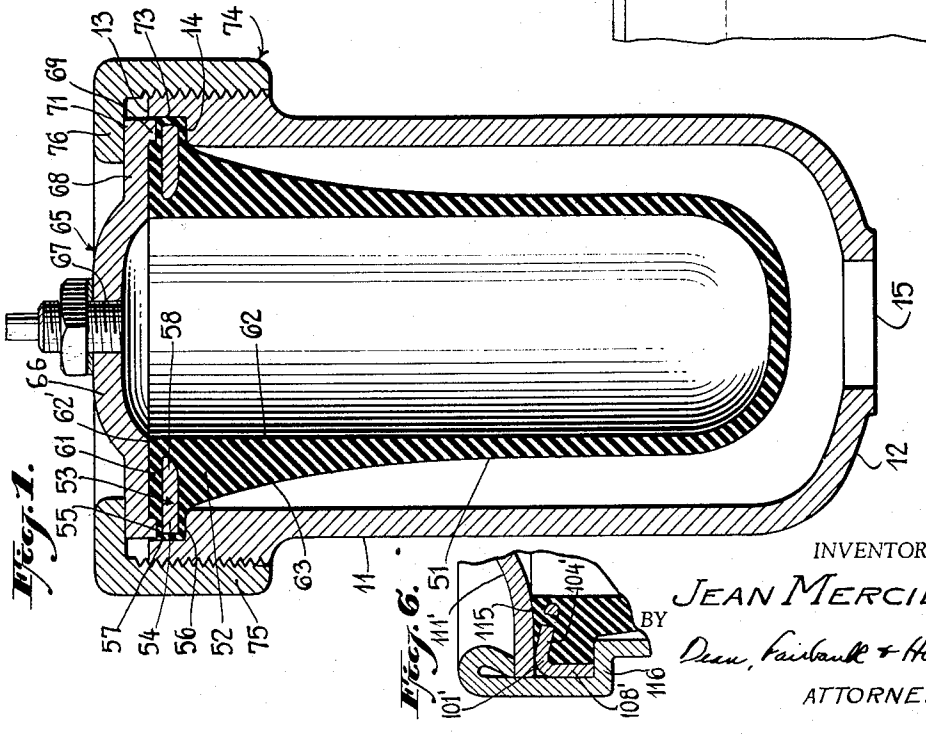


Fig. 6.

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BLADDER CONSTRUCTION FOR PRESSURE VESSELS

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8 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 isto 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 and extending inwardly from said periphery. 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.

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,

Fig. 3 is a sectional view of the clamping means for the embodiment shown in Fig. 2 after the partition therein is replaced,

Fig. 4 is a fragmentary detail view of another embodiment of the annular supporting member, and

Figs. 5 and 6 are views similar to Fig. 2 of other embodiments 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 end 13 illustratively being of reduced thickness to define an internal annular shoulder 14.

The end 12 of the container has an axial opening or port 15 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 51 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 52 to which an annular supporting member 53 is affixed, preferably by being bonded thereto or molded therein as illustratively shown. The supporting member 53 is a flat ring of rigid material such as steel, of outer diameter slightly less than that of the shoulder 14 and has its axis aligned with the longitudinal axis of the bladder 51 thereby normally lying in a horizontal plane as shown.

The supporting member or ring 53 is molded with the bladder so that the upper surface of the outer periphery 54 thereof has a relatively thin layer 55 of bladder material thereon which is also true of the corresponding bottom surface of the ring 53 and the outer periphery thereof as shown at 56 and 57 respectively. The inner periphery 58 of the ring 53 which is embedded in the thickened rim 52 of the bladder, has a rounded surface and the bladder material extends from the thin layer 55 laterally to and beyond such rounded surface 58 in a layer 61 that is of greater thickness than the thin layer 55.

The inner surface 62 of the wall of the bladder extends substantially vertically downward in the illustrative embodiment shown from the inner edge 62' of the thickened layer 61 and the outer surface 63 of the bladder wall tapers inwardly from the outer edge of the lowermost thin layer 56. If desired, the bladder may be conformed in conical shape to provide for progressive engagement of the bladder with the container in the manner shown in Patent No. Re. 23,437, dated December 4, 1951.

Means are provided to close the open end of the container 11 and to retain the bladder 51 and the supporting member 53 in position. To this end, a cover plate 65 is provided which has a substantially curved central portion 66 with a port 67 therein and an annular flange 68 with a depending lip 69 at its outer periphery 71.

The overall diameter of the cover plate 65 is slightly less than the outer diameter of shoulder 14 as shown in Fig. 1, and the inner diameter of lip 69 is slightly less than the outer diameter of the thicker layer 61.

Thus, when the bladder is positioned in the container 11 the layer 56 beneath the ring 53 will seat on the shoulder 14 with the layer 57 on the outer periphery of ring 53 against the wall portion 73 adjacent the shoulder 14.

With the bladder so mounted it will hang downwardly in the container 11. The cover plate 65 when positioned over the open end 13 of the container will have the undersurface of lip 69 against the thin layer 55 and the flange 68 against the thickened layer 61.

The cover plate is securely retained in position by means of a retaining ring 74, the side wall 75 of which is internally threaded to coact with complementary threads on the container 11. The top 76 of the retaining ring extends inwardly over the annular flange 68 so that when the retaining ring 74 is screwed downwardly, the cover plate will be clamped against the supporting ring 53 which in turn will be clamped against shoulder 14. By reason of the resilient layers 55, 56, 57 and 61 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 15 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 15, will expand to force liquid from the container.

It is well known that when an elastic member is bonded to a plate 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 material is bonded to a flat surface. However, by reason of the rounded periphery 58 of the supporting member, which provides longer fibers, the bladder material will adhere securely to such rounded surface so that with repeated expansion and construction 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 and corresponding parts have the same reference numerals primed.

The container 11' 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' with an annular supporting member 81 molded therein. The supporting member is desirably curved upwardly adjacent its inner periphery as at 82 and such curved portion has perforations 83 through which the material of the bladder will pass during the molding operation so that the supporting member will be securely retained in position. The bladder material completely fills the concavity 84 of the supporting member and desirably extends slightly beyond a line between the extremities of such concavity. The inner surface 62' of the wall of the bladder extends substantially vertically downwardly from near the inner periphery 85 of the supporting member and the outer surface 63' of said wall tapers inwardly from the outer periphery of the supporting member at its undersurface.

Desirably, the inner periphery 85 of the supporting member has a notch 86 on which is seated the annular lateral flange 87 of a reinforcing member 88, illustratively an annulus of resilient sheet material. The side wall 89 of the reinforcing member extends slightly below the supporting member 81 and is reversely bent as at 91.

The bladder 51' with its associated supporting member is positioned in the container 11', with the tapered portion of the bladder adjacent the outer periphery of the supporting member resting on the outwardly curved portion 92 of the mouth of the container 11'.

To close the mouth of the container, a curved cover plate 65' is provided of diameter substantially equal to that of the supporting member 81, the curvature of plate 65' being such that when the outer periphery of plate 65' rests against the outer periphery of supporting member 81', the inner periphery 85 of the supporting member 81 will be adjacent the undersurface of the cover plate 65' thereby securely retaining the reinforcing member 88 in position on notch 86.

To retain the cover plate in position, the mouth of the container is rolled over the top of the plate 65' as at 94. Thus, the resilient bladder material in the concavity of the supporting member as well as the material beneath such member will be compressed to provide a dependable seal.

In the event that the bladder has to be replaced, it is a relatively simple matter to cut the rolled portion 94 of the container along the line x—x. After the bladder has been replaced, the cover plate may be securely clamped in position by means of a pair of arcuate clamping rings 96 shown in Fig. 3. Each of the clamping rings 96 in cross section is substantially U-shaped, the opposed surface 97 of each of the legs having an incline substantially equal to the incline of the top surface of the cover plate 65' and the lower surface of the curved portion 92 of the container.

When the clamping rings are positioned so that the legs thereof straddle the cover plate and the curved portion of the container, and a belt 98 preferably of steel, encompassing the segments is tightened in any suitable manner, the clamping segments will be moved inwardly so that the curved portions of the leg will cam the cover plate downwardly to effect a tight seal.

By reason of the reinforcing member 88, which is of resilient material, as the bladder is compressed and contracts during operation of the equipment, it will abut against the reinforcing member which will deflect inwardly slightly. However, such reinforcing member will prevent sharp bending of the bladder, that is, it will limit the angle which the bladder wall may make with respect to the wall of the container so that fatigue of the bladder will be greatly reduced to increase its life. The curved supporting member 81 also providing the long fibers at the region of bonding thereto of the bladder material to provide for secure adherence as described with respect to the embodiment shown in Fig. 1.

The embodiment shown in Fig. 4 is substantially identical to that shown in Fig. 2 except for the construction of the supporting member 81'. Thus, as is clearly shown in Fig. 4, the supporting member has a shape substantially conforming to the shape of the supporting member shown in Fig. 2, but the supporting member of Fig. 4 is corrugated to enhance the gripping action of the bladder material thereto during the molding operation.

The embodiment shown in Fig. 5 is also similar to that shown in Fig. 3, except for the supporting member and the upper end of the accumulator container.

Thus, the accumulator container 100 shown in Fig. 5 has the curved portion 92', but does not have the rolled portion 94 to hold the cover plate in position, but utilizes the clamping rings 96' which are identical to the clamping rings 96 shown in Fig. 3. The supporting member 101 of the embodiment shown in Fig. 5 is an annulus of rigid material such as steel which is substantially L-shaped in cross section. The supporting member 101 is molded in the thickened rim 102 of bladder 103 so as to be axially aligned with the longitudinal axis of the bladder. The horizontal leg 104 of the supporting member 101 is rounded at its inner periphery as at 105 which is slightly spaced from the inner surface 106 of the wall of the bladder 103 and such horizontal leg has a plurality of perforations 107 through which the bladder material will pass during the molding operation, securely to retain the supporting member in position in such thickened rim. The vertical leg 108 of the supporting member is at the outer periphery thereof and is of outer diameter substantially equal to the outer diameter of the curved portion 92' of the container 100. The bladder material extends upwardly from the outer periphery of the horizontal leg 104 of the supporting member 101 on its top surface at an angle corresponding to the slope of the inner surface of the cover plate 111, said bladder material on the top surface of the horizontal leg being originally of thickness greater than the spacing between the horizontal leg 104 and the cover plate when the outer periphery of the latter is against the outer periphery of the horizontal leg. Similarly, the bladder material beneath the horizontal leg which is curved on its outer surface to conform substantially to the curvature of the curved portion 92' of the container 100 also is of thickness slightly greater than the distance between the undersurface of the horizontal leg and the curved portion of the container 100 when the leg 108 is resting against said curved portion.

As the result of such construction when the cover plate 111 is clamped against the supporting member 101 and the latter clamped against the curved portion 92' of the container, the bladder material on the top and bottom of the supporting member will be compressed to effect a dependable seal.

The embodiment shown in Fig. 6 is similar in many

respects to the embodiment shown in Fig. 5. In this embodiment the supporting member **101'** is also substantially L-shaped in cross section, but the leg **104'** thereon is bent downwardly from the vertical leg **108'** thereof to provide space for the bladder material between the leg **104'** and the adjacent portion **115** of the cover plate **111'** which is substantially horizontal.

The mouth of the accumulator container **100'** in the embodiment of Fig. 6 has an annular flange **116** on which the lower end of the vertical leg **108'** is positioned and the side wall of the container rises from said flange and is rolled over the periphery of the cover plate **111'** to retain the bladder and cover plate in fixed position.

In both of the embodiments of Figs. 5 and 6 by reason of the rounded inner periphery of the leg **104, 104'** of the supporting members, the bladder material will remain securely bonded thereto as previously described.

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 retension of the bladders in position in the container 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 conatiner, said partition extending across the container and intervening between said opening and said port, an annular supporting member of rigid material molded into the periphery of said partition and extending inwardly from said periphery, said supporting member adjacent its inner periphery having an upwardly curved convex surface to which the partition material is bonded, mounting means for the periphery of said partition at the periphery of said opening, 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.

2. The combination set forth in claim 1 in which said annular supporting member is substantially L-shaped in cross section having one leg extending inwardly from the periphery of the partition in a plane substantially at right angles to the longitudinal axis of the partition and the other leg extending outwardly from the partition in a plane substantially parallel to the longitudinal axis of the partition, the junction between said legs defining said upwardly curved convex surface.

3. The combination set forth in claim 1 in which the periphery of said partition is relatively thick, said supporting member has at least a portion thereof extending in a plane at right angles to the longitudinal axis of the partition.

4. The combination set forth in claim 1 in which the mouth of the container has an outwardly curved surface defining the mounting means for the periphery of the partition, and the curved surface is rolled over the periphery of the cover plate to clamp the periphery of the partition against said curved surface.

5. The combination set forth in claim 4 in which the inner periphery of said supporting member is adjacent the undersurface of the cover plate.

6. The combination set forth in claim 4 in which the inner periphery of said supporting member is adjacent the undersurface of the cover plate and an annular reinforcing member of flexible material is encompassed by said supporting member, said reinforcing member depending from the inner periphery of said supporting member.

7. As an article of manufacture a partition of resilient deformable material having an annular supporting member of rigid material molded therein at the periphery thereof, said supporting member having an upwardly curved convex surface at its inner periphery to which the partition material is bonded.

8. The combination set forth in claim 7 in which the periphery of the partition is relatively thick and the rigid annular supporting member has perforations through which the partition material extends.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 23,437	Mercier	Dec. 4, 1951
2,773,511	Mercier	Dec. 11, 1956