

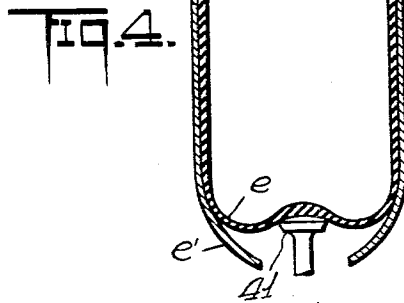
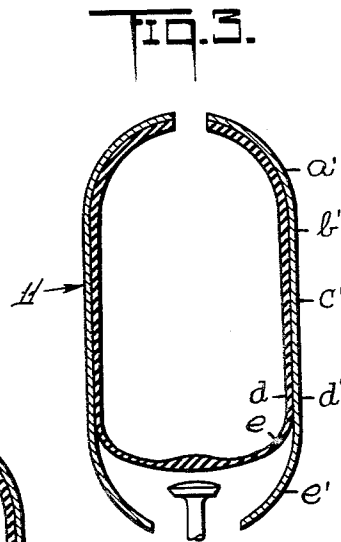
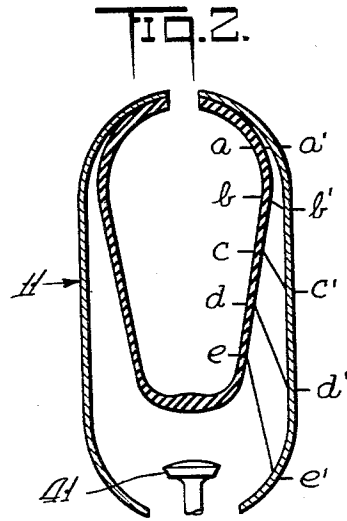
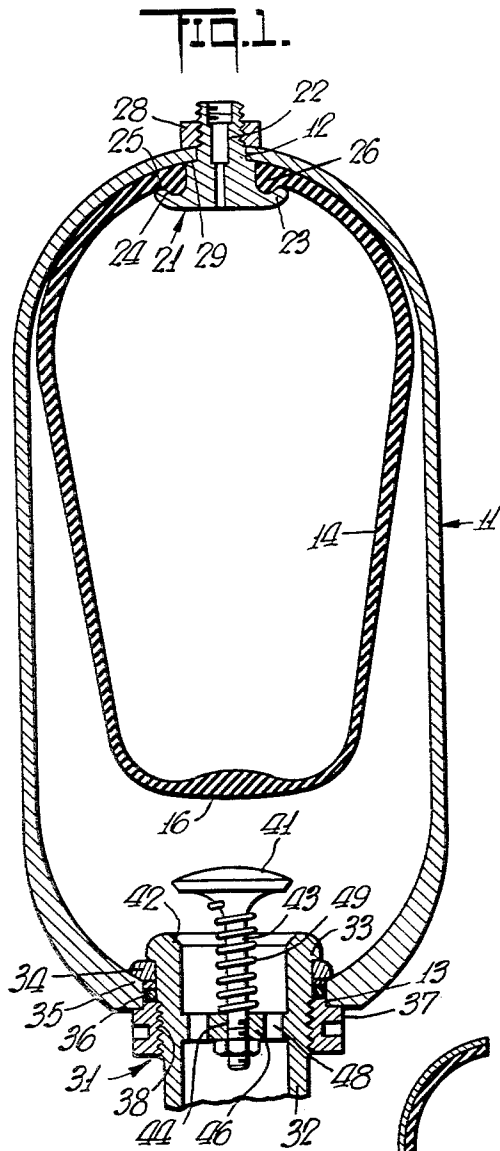
April 5, 1960

J. MERCIER
PRESSURE DEVICE

2,931,392

Filed Dec. 17, 1956

2 Sheets-Sheet 1



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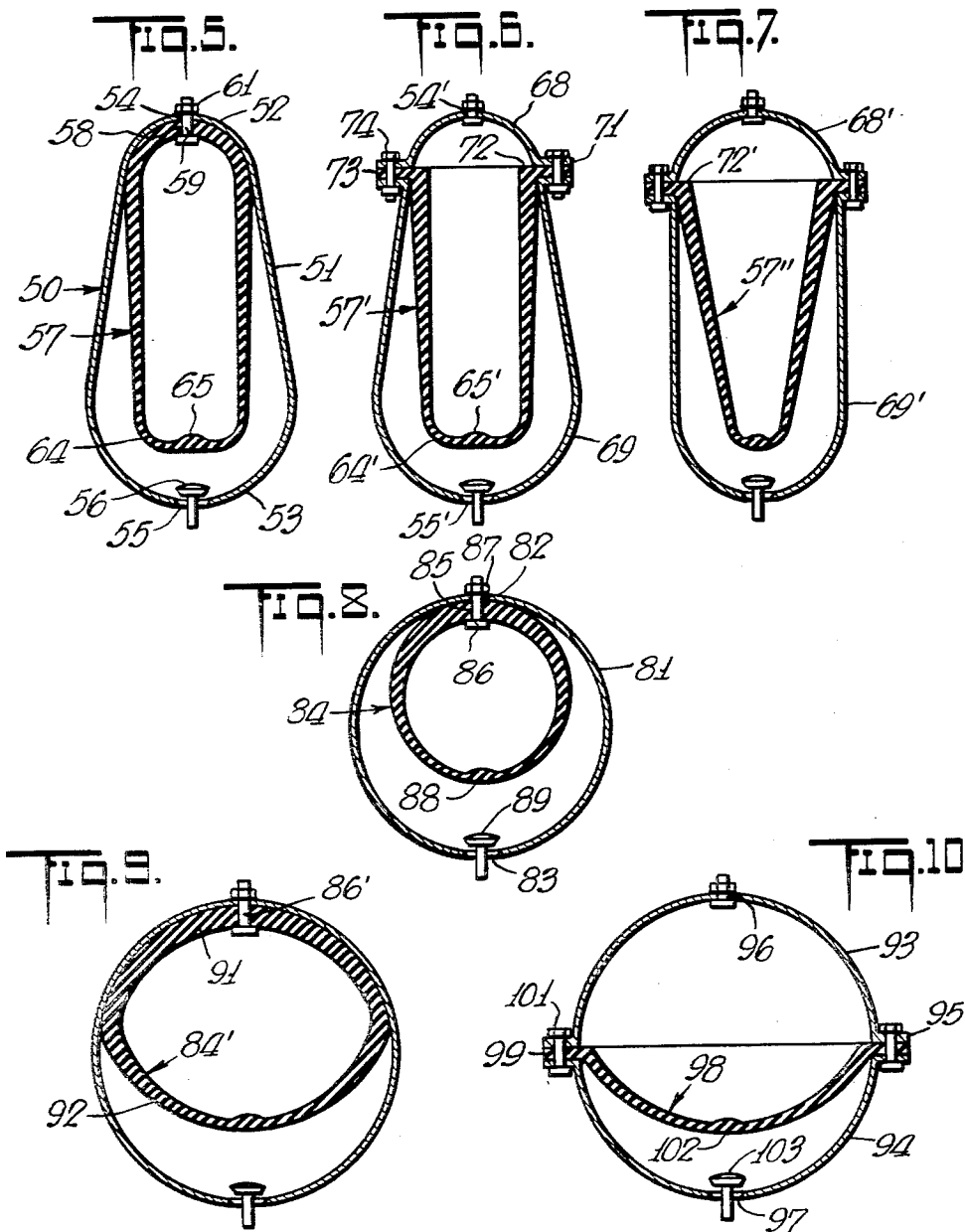
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PRESSURE DEVICE

Jean Mercier, New York, N.Y.

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2 Claims. (Cl. 138—30)

In pressure accumulators of the type including a rigid container having a pair of ports at its respective ends with a deformable partition or bladder affixed to one of said ports and separating two fluids such as gas and liquid under pressure, if, as the bladder expands to force liquid from the other of such ports, the wall of the bladder adjacent the free end thereof should contact the wall of the container before the portion of the bladder adjacent its affixed end, pockets may be formed filled with liquid which would not be expelled from the container. Thus, the accumulator would be inefficient in operation as only a portion of the liquid in the container would be utilized.

Where the bladder of a pressure accumulator serves to close the liquid outlet port when such bladder has expanded in the container to substantially its maximum amount, if such bladder in its inflated but undistended condition is of length substantially equal to that of the container, the liquid outlet port may be closed before substantially all of the liquid is expelled. If the bladder is considerably shorter than the container and upon expansion of the bladder, as fluid is forced from the container, when the major portion of the bladder wall engages the wall of the container, the free end of the bladder should be considerably spaced from the liquid outlet port, continued expansion of the bladder will cause the wall thereof to rub against the side wall of the container with resultant breakdown of such bladder. In addition, the lower end of the bladder would have to stretch excessively to reach the liquid port to close the latter, thereby subjecting the bladder to high stress with likelihood of rupture.

It is accordingly 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 bladder therein and with assurance that substantially all of the liquid will be expelled from the container.

According to the invention, a partition or bladder is positioned in a rigid container to separate two fluids therein and is affixed in the container in such manner that the partition defines two chambers for such fluids. The wall of the partition is of greatest thickness at the affixed portion thereof and progressively decreases in thickness toward the portion of the partition remote from the affixed portion thereof.

This application is a continuation-in-part of co-pending application Serial No. 407,947, filed February 3, 1954, now Patent No. 2,786,488, March 26, 1957.

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 accumulator,

Figs. 2, 3 and 4 are diagrammatic views illustrating the operation of the bladder of Fig. 1, and

Figs. 5 to 10 are diagrammatic views of other embodiments of the invention.

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Referring now to Fig. 1 of the drawings, the pressure accumulator desirably comprises a container or pressure vessel 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 cylindro-spherical as shown and has a partition therein between the gas and liquid ports, said partition illustratively being a collapsible and expansible bladder 14, desirably of resilient material such as rubber or synthetic plastic of like physical characteristics, which in distended but substantially unstretched condition is smaller than the cavity of the container 11 and has its longitudinal axis aligned with the ports 12 and 13. As shown in Fig. 1, the bladder is substantially conical in contour along its length with the thickness of the bladder wall gradually decreasing from the larger diameter or mounted end thereof shown at the top to the opposite end thereof, the latter end desirably being substantially flat as at 16 and preferably thicker than the adjacent wall portion of the bladder.

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 disk 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 ring 26 about the mouth of the bladder 14. Thus, when the parts are assembled as shown in Fig. 1, the bladder may be securely clamped in place by means of a nut 28 screwed upon the protruding threaded stem of the fitting, an annular shoulder 29 adjacent the root end of the stem abutting against the rim of the gas inlet port 12 to prevent cutting of the rim 26 of the bladder 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 United States Patent No. 2,469,171, dated May 3, 1949, by the use of which an outlet closure assembly 31 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 32, preferably a tubular member which desirably has an external annular shoulder 33 at the upper end thereof of outer diameter less than that of port 13. A locking member 34, illustratively a ring of greater outer diameter than said port 13 and deformable to permit its insertion therinto, encompasses said tubular member and is seated on the rim 35 of port 13, the inner diameter of said ring 34 being less than the outer diameter of shoulder 33 so that said shoulder may seat on said ring. Encompassing said tubular member and in juxtaposition with said port 13 is a rubber gasket 36 which serves effectively to prevent leakage between the wall of port 13 and the outer wall of tubular member 32 when a nut 37 is screwed on the externally threaded portion 38 of said tubular member 32.

Desirably positioned in said tubular member 32 is a poppet valve comprising a valve head 41 adapted to seat on the beveled mouth 42 of tubular member 32 and having a stem 43 preferably formed integral therewith. Stem 43 is slidably mounted in bearing opening 44, desirably in a disk 46 mounted in the bore of tubular member 32, said disk having a plurality of openings 48 there-through to permit the passage of fluid, said valve head being normally retained in open position by means of a coil spring 49 encompassing stem 43 between head 41 and disk 46. As the construction and operation of said outlet closure assembly per se forms no part of this invention it will not be further described.

In the embodiment shown in Fig. 5 the accumulator comprises a rigid container 50 the side wall 51 of which

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flares outwardly from its end 52 to its end 53 so that the container is substantially conical in contour. The container has axially aligned ports 54, 55 in its respective ends, the former defining a gas port and the latter a liquid port. Suitable valve means diagrammatically shown at 56 are provided to control liquid port 55.

Positioned in the container 51 is a substantially cylindrical-spherical bladder 57 of resilient material, for example, which has an opening 58 at one end through which a hollow bolt 59 extends, the latter having a gas valve 10 (not shown) therein. Thus, when a nut 61 on the outer end of the bolt extending through port 54 is tightened, the bladder 57 will be securely retained in position extending axially in the container.

The thickness of the bladder wall gradually decreases from the mounted end 58 thereof to its free end 64, the latter desirably having an axial thickened reinforcing portion 65 which when the bladder expands in use will register with the valve 56 to move the later to seal liquid port 55.

The embodiment shown in Fig. 6 is similar in many respects to the embodiment shown in Fig. 5 and corresponding parts have the same reference numerals primed.

The rigid container of Fig. 6 is desirable formed from two shells 68, 69 each with a lateral flange 71 at the mouth thereof. The bladder 57' positioned in the container between its gas and liquid ports 54', 55' is substantially cylindrical, closed at one end as at 64' with a thickened axial portion 65' and open at its other end as at 72 to define a mouth with a lateral rim 73 adapted to be positioned between flanges 71. Thus, when bolts 74 extending through flanges 71 and rim 73 are tightened the shells 68 and 69 and the bladder 57' will be securely retained in position, the shells 68, 69 forming a substantially conical container. The thickness of the bladder wall also gradually decreases from the rim 73 thereof to its free end 64'.

The embodiment shown in Fig. 7 is similar to the embodiment shown in Fig. 6 except that the container formed by the juxtaposed shells 68', 69' is cylindrical-spherical and the bladder 57'' is substantially conical having its larger diameter portion at its mouth 72'.

In the embodiment shown in Fig. 8 the container 81 is in the form of a hollow sphere having diametrically aligned gas and liquid ports 82 and 83. Positioned in the container 81 is a spherical bladder 84 of resilient material which has a port 85, a hollow bolt 86 with a gas valve therein, extending through ports 85 and 82 and secured by a nut 87 retaining the bladder in fixed position in the container.

The bladder is of diameter considerably less than that of the container 80 so that when in extended, but unstretched condition, substantially the entire outer surface of the bladder will be spaced from the wall of the container.

The wall thickness of the bladder gradually decreases from the mounted portion thereof at port 85 to the portion 88 thereof diametrically opposed to port 85, the portion 88 being thickened and being adapted to register with a valve 89 in liquid port 83 to close the latter when the bladder expands in use.

The embodiment shown in Fig. 9 is similar to the embodiment shown in Fig. 8 except that the bladder 84 when in extended but unstretched condition has the portion 91 thereof adjacent the mounting bolt 86' of dimensions such that it will be against the portion of the container adjacent bolt 86' and the contiguous portion 92 thereof spaced from the wall of the container.

The wall thickness of bladder 84' also progressively decreases from the mounted portion thereof to the portion diametrically opposed to such mounted portion.

In the embodiment shown in Fig. 10, the spherical container is defined by a pair of hemi-spherical shells 93, 94 each with a lateral flange 95 at its mouth. Positioned in the container and interposed between the gas and liquid

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ports 96, 97 thereof is a deformable partition 98 desirably of resilient material having its periphery 99 positioned between flanges 95. Thus, when bolts 101 extending through flanges 95 and periphery 99 are tightened, the shells will be retained together with the partition secured in position.

The partition is of diameter greater than that of the container so that it will hang downwardly into shell 94. The wall thickness of the partition gradually decreases from the periphery 99 thereof to its central portion which is thickened as at 102 and adapted to engage a valve 103 controlling liquid port 97 to close the latter.

As the mode of operation of all the embodiments herein is substantially identical, it will be described in detail only with respect to Fig. 1. Thus, with the construction above described of the bladder and the container, the distance of the partly inflated bladder as shown in Fig. 1, from the inner surface of the container 11, increases progressively from near the fixed end of the bladder toward the free end 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 undistended condition shown, it will progressively engage such inner surface of the container 11 from near the fixed end of the bladder toward its free end.

With this arrangement, when a valve (not shown) controlling the liquid outlet port 13, is opened and the bladder 14 expands to force liquid from port 13, no liquid pockets will be formed between the bladder and the rigid wall of the container since the bladder is progressively applied against such wall from the end thereof adjacent the point of connection of the bladder thereto to the other end thereof.

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 is in inflated but undistended condition the flat bottom 16 will act like a diaphragm to take up pulsation thereby avoiding stress on the side wall portion of the bladder.

When the bladder has expanded sufficiently to engage the valve head 41, by reason of the large surface area at the flattened end of the bladder engaging said valve head, stresses will not be concentrated and such bottom is desirably reinforced to prevent wear due to its abutment against said valve head.

As the bladder expands to force liquid from the container, both its length and diameter will increase. Inasmuch as the wall thickness progressively decreases from the upper end of the bladder to its lower end, each succeeding portion of the side wall of the bladder will increase in length at a greater rate than the previous portion as indicated in Fig. 2.

Thus, when the bladder is almost fully distended it will assume the position shown in Fig. 3 and the portion d of the bladder will engage the lower end of the container as at d' .

With additional but still not full distension of the bladder, the portion e thereof will only have to stretch a relatively short distance to move near the lower end of the container (Fig. 4) at which time the central or flat portion of the bladder will be against the valve head 41. Hence, only a slight additional expansion of the bladder is required to move the valve head to seated position to close the port 13.

With the construction of the bladder herein described in which the wall thickness progressively decreases, no undue stretching stress is applied to the portion e of the bladder as would occur if the wall thickness was constant or progressively increasing. In such latter cases the portion e of the bladder by reason of the limited elongation of such bladder would engage the wall of the container at approximately the point d' and hence would be stretched considerably with possible rupture to approach the point e' .

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With the construction above described in which the distance between the mounted portion of the bladder or partition and the container wall gradually increases, entrapment of liquid due to the formation of pockets is substantially precluded with resultant high efficiency in the operation of the accumulator due to the utilization of substantially all of the liquid in the container.

Furthermore, due to the decreasing wall thickness of the bladder, which permits each succeeding portion to increase in length at a greater rate than the previous portion, the portion of the bladder at its lower end will only have to stretch a relatively small amount before the outlet port is sealed thereby avoiding stress on such lower portion which might cause rupture of the bladder and failure of the unit.

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 elongated hollow container, having a port at each end aligned with the longitudinal axis of the container, a substantially cylindrical bladder of resilient deformable material in said container having a port at one end affixed to one of the container ports, said container tapering outwardly substantially its entire length from the mounted end of the bladder whereby the distance between said container wall and the bladder will progressively increase at least

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between the cylindrical portion of the bladder and the tapering portion of the container, the side wall thickness of said bladder progressively decreasing from its mounted portion toward its free end, said bladder when in substantially undistended condition having its longitudinal axis aligned with both of the ports in said container and having its side wall spaced from the container wall substantially the major portion of the length of said bladder.

2. A pressure vessel comprising a rigid hollow substantially spherical container having a pair of diametrically aligned ports, a substantially spherical bladder of resilient deformable material of smaller diameter than that of said container and mounted therein intervening between said ports, said bladder having a port affixed to one of said container ports, the thickness of at least a portion of the wall of said bladder progressively decreasing in direction toward the free end thereof, said bladder when in substantially undistended condition being aligned with both of the ports in said container and having at least a portion of its progressively decreasing thickness side wall spaced from the wall of the container.

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