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PRESSURE VESSELS

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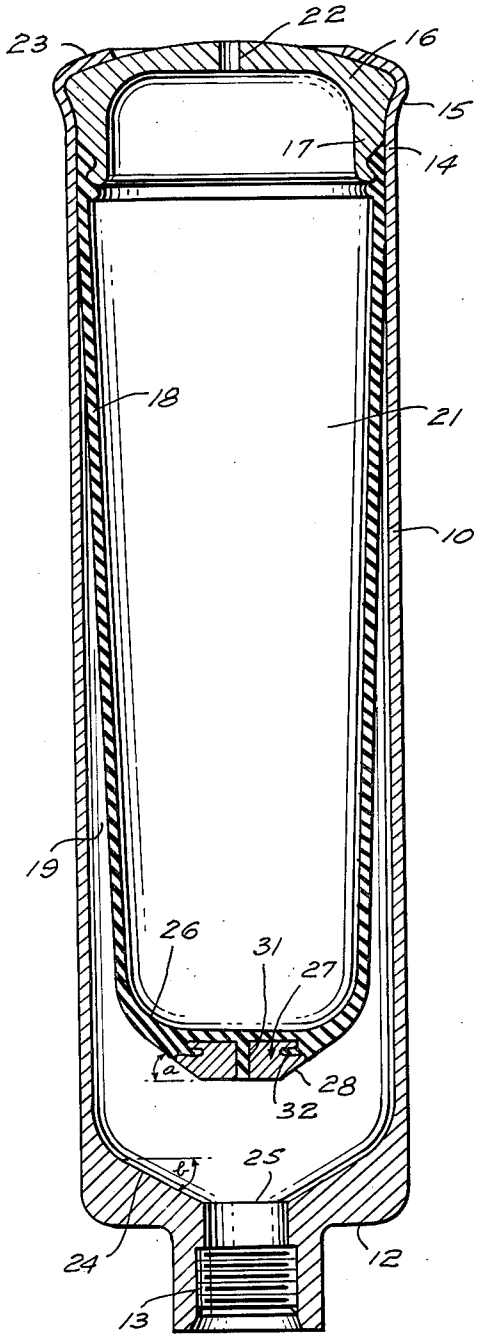

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PRESSURE VESSELS

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This invention relates to the art of pressure vessels, more particularly of the type having a flexible bladder intervening between two fluids in the pressure vessel.

It is among the objects of the invention to provide a pressure vessel of the above type that may readily be fabricated at low cost and which utilizes a sealing button carried by the bladder which will dependably move into engagement with a seat for said button about the liquid port of the pressure vessel to form a dependable liquid-tight seal and preclude extrusion of the bladder through the liquid port.

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

In the accompanying drawing in which is shown one of various possible embodiments of the several features of the invention, the single figure is a longitudinal sectional view of one embodiment thereof.

Referring now to the drawing, in the embodiment shown the pressure vessel comprises a container **10** of strong rigid material such as steel or aluminum capable of withstanding the pressure to which the unit is subjected.

The container **10** is substantially cylindrical and is closed at one end as at **12**, said end having an axial port **13** therethrough defining the liquid port of the pressure vessel.

The opposed end **14** of the container **10** is of slightly enlarged diameter as at **15** defining an annular shoulder to receive a cover member **16**. The cover member **16** has a depending portion **17** which fits into the container, said depending portion being conformed at its inner end to retain the mouth of a bladder **18** in fixed position with respect to the inner surface of the container.

The bladder is of resilient material such as rubber or synthetic plastic of like physical characteristics and is expansible and deformable in order to perform its desired function. The bladder **18** defines two chambers in the pressure vessel, i.e., an oil chamber **19** between the outer wall of the bladder and the inner surface of the container, which chamber **19** is in communication with port **13**, and a gas chamber **21** in the bladder which is in communication with an axial port **22** in the cover member **16**, said port having a suitable air valve (not shown) positioned therein for charging of the bladder **18**.

The cover member is securely retained in position in the illustrative embodiment shown by bending over the open end of the container as at **23**.

As the means for retaining the bladder in position and retaining the cover member in the container, per se forms no part of this invention and as the bladder may be retained in position by any suitable manner, the mount for the bladder will not be further described.

According to the invention, the closed end **12** of the container is in the form of a frustum of a cone defining an inclined surface **24**, the lower end **25** of which surface defines the inner end of port **13**.

In order to close the inner end **25** of port **13**, the free end **26** of the bladder **18** has a button **27** secured thereto and axially aligned with the longitudinal axis of the bladder **18**. The button is of material harder than that of the bladder and may, for example, be of neoprene, aluminum or other suitable material.

As is clearly shown in the drawing, the outer surface **28** of the button also has the form of a frustum of a cone. The angle of inclination of the outer surface **28** of the button and the angle of inclination of the inclined surface **24** of the end **12** of the container are approximately the same. The tangent of each angle must be greater than the tangent of the angle of friction, which angle is dependent upon the materials used, the finish of the materials as well as the fluid that is utilized in the container. More particularly, in the illustrative embodiment herein shown, the angles are in the order of approximately 35°, it being understood that this is merely for purpose of illustration.

The button **27** has a central bore **31** which preferably extends completely through the button and in addition, the button at the larger diameter portion thereof has an annular groove **32** in its periphery.

The button is molded integrally with the bladder so that the bladder material will enter the annular groove and also fill the axial bore of the button thereby securely retaining the button to the end **26** of the bladder.

By reason of the material extending through the axial bore, when the bladder is deformed in use, such as by expansion thereof, there will be practically no stress imparted to the bladder material in the axial bore with the result that the bond of such material to the wall of the bore will be unaffected, insuring dependable retention of the button to the bladder even with long repeated use.

By reason of the angles selected for the outer surface **28** of the button **27** and the inclined surface **24** of the container, if the button should not be axially aligned with the port **13**, which is the usual case since the bladder does not expand uniformly when the button strikes the inclined surface **24**, the button will readily slide down such inclined surface and tend to center itself with respect to the port **13**.

In view of the fact that there is a possibility, if the angles of the surface **28** of the button and the surface **24** are identical, that the button **27** will immediately center itself and complete closure of the port **13** may be effected before complete discharge of oil from the container, it is therefore preferred to have the angle at "*a*" of the surface **28** of the button slightly greater than the angle of the inclined surface **24** at "*b*."

As a result of such difference in angle, it is apparent that when the button surface **28** initially strikes the inclined surface **24** with the axis of the button out of alignment with the axis of the liquid port, although the button will slide down the surface **24**, the axis of the button will not be moved into alignment with the axis of the liquid port and a gap will exist between the surfaces **24** and **28** so that slight discharge of oil will still occur. However, as such discharge of oil is caused by expansion of the bladder, when the portion of the bladder adjacent the button expands to its utmost, so that all of the oil in the container is discharged, thereafter the bladder material will attempt to extrude through the gap caused by the differential between the angles of the surfaces **24** and **28**.

However, the differential between the angles is extremely small, not exceeding 2° and consequently the gap will be insufficient to permit extrusion of the bladder material, but rather the bladder material will wedge in the mouth of the gap closing the latter thereby preventing extrusion of such bladder and insuring complete discharge of oil.

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 claims, it is intended that all matter contained in the above description or shown in the accompanying drawing 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 an elongated container of rigid material having two ports, one of said ports being axially aligned with said container and defining the liquid port, a deformable bladder secured in said container separating said two ports from each other, said bladder extending axially in said container and being closed at one end, means securing the other end of said bladder in said container, the end of said container adjacent said liquid port having an inclined wall surface in the form of a frustum of a cone with its smaller diameter end defining the inner end of the liquid port, a button secured to the closed end of said bladder, said button having an inclined outer surface also in the shape of a frustum of a cone adapted to seat against the inclined surface of said container, said button having an axial bore therein, the material of said bladder at the closed end of the latter extending into said axial bore and being bonded to the surface thereof.

2. The pressure vessel set forth in claim 1 in which the larger diameter portion of the button has an annular groove in its periphery and the bladder material at the closed end of the bladder is positioned in said annular groove and bonded thereto as well as to the top surface of said button.

3. The pressure vessel set forth in claim 1 in which the angle of inclination of the inclined surface of the button differs from that of the inclined surface of the end of the container.

4. The pressure vessel set forth in claim 1 in which the angle of inclination of the inclined surface of the button is greater than that of the inclined surface of the end of the container.

5. The pressure vessel set forth in claim 4 in which the angle of inclination of the outer surface of the button is less than 2° greater than the angle of inclination of the end of the container.

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