Oct. 24, 1967 J. MERCIER 3,348,578

PRESSURE VESSELS

Original Filed Sept. 2, 1959

FIG. 1

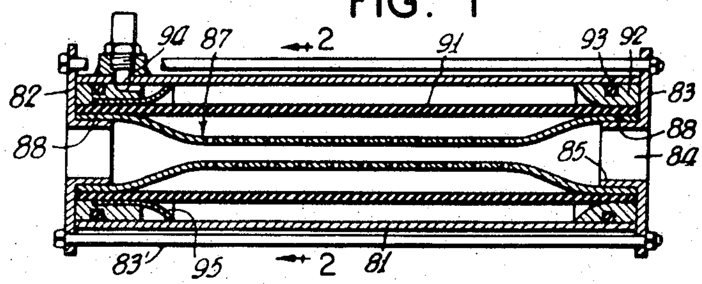


FIG. 2

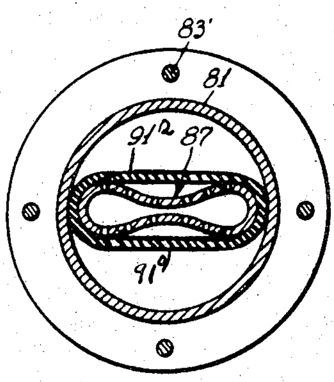


FIG. 3

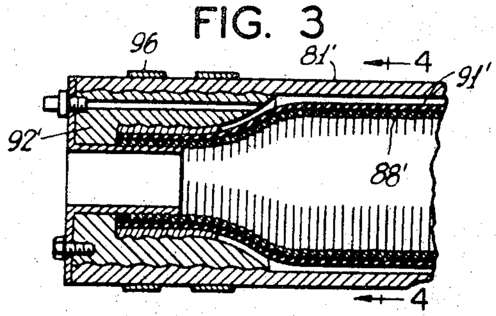
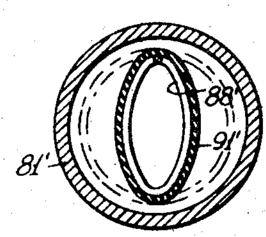


FIG. 4



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PRESSURE VESSELS

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Original application Sept. 2, 1959, Ser. No. 837,693, and Apr. 26, 1963, Ser. No. 275,847. Divided and this application Nov. 22, 1965, Ser. No. 508,901
4 Claims. (Cl. 138—30)

This application is a division of copending application Ser. No. 275,847, filed Apr. 26, 1963, now abandoned which was a continuation-in-part of copending application Ser. No. 491,611, filed Mar. 2, 1955, now abandoned and a division of copending application Ser. No. 837,693, filed Sept. 2, 1959, now abandoned.

This invention relates to the art of pressure vessels and more particularly of the type having a deformable partition separating two fluids under pressure.

It is among the objects of the invention to provide a device of the above type that may readily be fabricated and is strong and durable and capable of operation for long periods and the handling of large quantities of fluid without likelihood of rupture of the deformable partition therein either by the formation of sharp folds which render the partition subject to breakdown or by excessive stretching of the partition in an attempt to secure the benefit of the maximum available volume of the device.

Another object is to provide a pressure system utilizing a device of the above type that dependably prevents injury to the deformable partition therein if the differential between the pressures on the two fluids should exceed a predetermined amount.

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

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 one embodiment of the invention,

FIG. 2 is a transverse sectional view taken along line 2—2 of FIG. 1,

FIG. 3 is a fragmentary longitudinal sectional view of another embodiment of the invention, and

FIG. 4 is a transverse sectional view taken along line 4—4 of FIG. 3.

Referring now to the drawings, in the embodiment shown in FIGS. 1 and 2, a cylindrical shell **81** is provided having caps **82, 83** closing the ends thereof, the caps and the shell being retained together by bars **83'**.

Each of the caps **82, 83** has an axial opening **84** therethrough with an inwardly extending nipple **85** associated therewith. Extending longitudinally through shell **81** is a perforated rigid sleeve **87** which forms a core or barrier. The ends **88** of the sleeve **87** are cylindrical and are mounted as by force fit on the associated nipple **85**. The sleeve **87** between its ends **88** is flattened so as to form substantially an oval in cross section, the ends of the major axis of the oval being rounded and the side walls of said oval illustratively being concave.

Encompassing the rigid sleeve **87** and extending the length thereof is a sleeve **91** desirably of resilient material such as rubber, which is clamped at its ends against the ends **88** of sleeve **87** by collars **92** in the shell. To prevent leakage between such collars **92** and the shell, suitable resilient seals **93** are provided. As the sleeve is slightly stretched, in its normal or intermediate position it will form two substantially straight walls **91a** extending across the concavity of the rigid sleeve **87**.

To charge the space between the shell **81** and the sleeve **91** with a gas such as air under pressure, a passageway **94** is desirably provided. This passageway is covered

by a screen **95** to prevent extrusion of the sleeve **91** into passageway **94**.

In the embodiment shown in FIGS. 3 and 4 the sleeve **88'** is formed from a coil spring, having tightly wound convolutions, which is oval shaped in cross section between its ends and the shell **81'** is a flexible but substantially rigid hose secured to the collars **92'** by clamps **96**.

The diameter of the resilient sleeve **91'** is such that when it encompasses the sleeve **88'**, it will be under slight tension so that it will be oval in cross section between the ends of the coil spring core **88'**. When the resilient sleeve **91'** is placed under pressure it will first tend to expand according to a cylinder having a diameter equal to the major axis of the oval. Consequently, the sleeve, during the major part of its expansion, will bear against the two extremities of the major axis of the core and practically never leave the core. As a result, rubbing of the sleeve **91'** against the core **88'** is negligible.

In the embodiments shown in FIGS. 1 to 4, the configuration of the sleeves **87, 88'**, in addition to providing security against sharp folding which could be accomplished by having such members circular in cross section, also affords the maximum available volume of fluid that can be expelled or handled with a minimum of stretching of the bladder or sleeve as the case may be. This is accomplished by having the core or sleeve at least between its ends of cross sectional area that is substantially less than that of a circle of the same perimeter as said core or sleeve.

Thus, for example, referring to FIG. 3, if the sleeve **88'** and encompassing resilient sleeve **91'** should be circular in cross section when not inflated and such resilient sleeve has a diameter d and the cylindrical rigid shell **81'** has a diameter $2d$, by the formula Area$=\pi R^2$, where R=radius, the area of the cross section of the resilient sleeve when inflated would be four times that of the sleeve when not inflated. At the same time, by the formula Circumference$=2\pi R$, the circumference of the cross section of the sleeve when inflated would be twice that of the sleeve when not inflated.

Thus, as the volume would be proportional to the area, with a stretching of 100 percent of the resilient sleeve, the volume of oil expelled would be three times that of the circular resilient sleeve.

As the maximum area for the minimum circumference is defined by a circle, by forming the sleeve **88'** and resilient sleeve **91'** with an original diameter d into an oval, for example, the cross sectional area of the resilient sleeve **91'** when not inflated would be greatly reduced depending upon the length of the minor axis of the oval, which in the illustrative embodiment shown is relatively small.

Thus, when the oval shaped resilient sleeve expanded to the diameter $2d$ of the shell **81'**, the volume of fluid forced from the container in the manner above described would be greater than that of the volume of fluid forced from the container with a circular sleeve and the stretching of the resilient oval sleeve for such result would be the same as that of the circular resilient sleeve.

To illustrate the foregoing, assuming that the diameter d of a circular resilient sleeve when not inflated is 10 inches, the circumference of such sleeve is 31.4 inches and the cross sectional area is 78.5 square inches. The circumference of such sleeve when inflated to a diameter $2d$ is 62.8 inches and the cross sectional area is 314 square inches. Thus, a volume of oil proportional to 235.5 inches of area would be expelled with a stretching of 100 percent of the resilient sleeve.

If the oval resilient sleeve has a perimeter of 31.4 inches and an area of say 23.8 square inches, when it is inflated to a diameter $2d$, it would have a circumference of 62.8 inches and a cross sectional area of 314 square inches. Thus, a volume of oil proportional to 290.2 inches of area would be expelled with the same stretching of 100 percent of the resilient sleeve.

With the euipment above described, the pressure vessel is capable of handling large quantities of fluid without likelihood of rupture even after long use due to either the formation of sharp folds in the resilient partition or of excessive stretching of the partition in an attempt to secure the benefit of the maximum available volume of the device.

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 shell 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 tubular casing for two fluids under pressure, a hollow elongated core in said casing extending the length thereof, said core comprising an elongated coil spring having tightly wound convolutions, an elongated sleeve of deformable resilient material positioned in said casing encompassing said core, said sleeve defining a chamber on each side thereof to separate the fluids in said casing, said core and said casing having circular ends, means securely retaining said ends in fixed position and clamping the respective ends of said sleeve therebetween, said core being oval shaped between its ends, said resilient sleeve being normally slightly stretched on said core.

2. The combination set forth in claim **1** in which the perimeter of said core is constant along substantially its entire length.

3. The combination set forth in claim **1** in which one of the ends of said core defines an outlet port for discharge of one of said fluids and the other end of said core defines an inlet port and means to charge the chamber between the resilient sleeve and the casing with gas under pressure.

4. The combination set forth in claim **1** in which one of the ends of said core defines an outlet port for discharge of one of said fluids and the other end of said core defines an inlet port, the perimeter of said core is constant along substantially its entire length, and means are provided to charge the chamber between the resilient sleeve and the casing with gas under pressure.

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