

July 31, 1945.

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2,380,866

BLADDER STIFFENER

Filed April 25, 1944

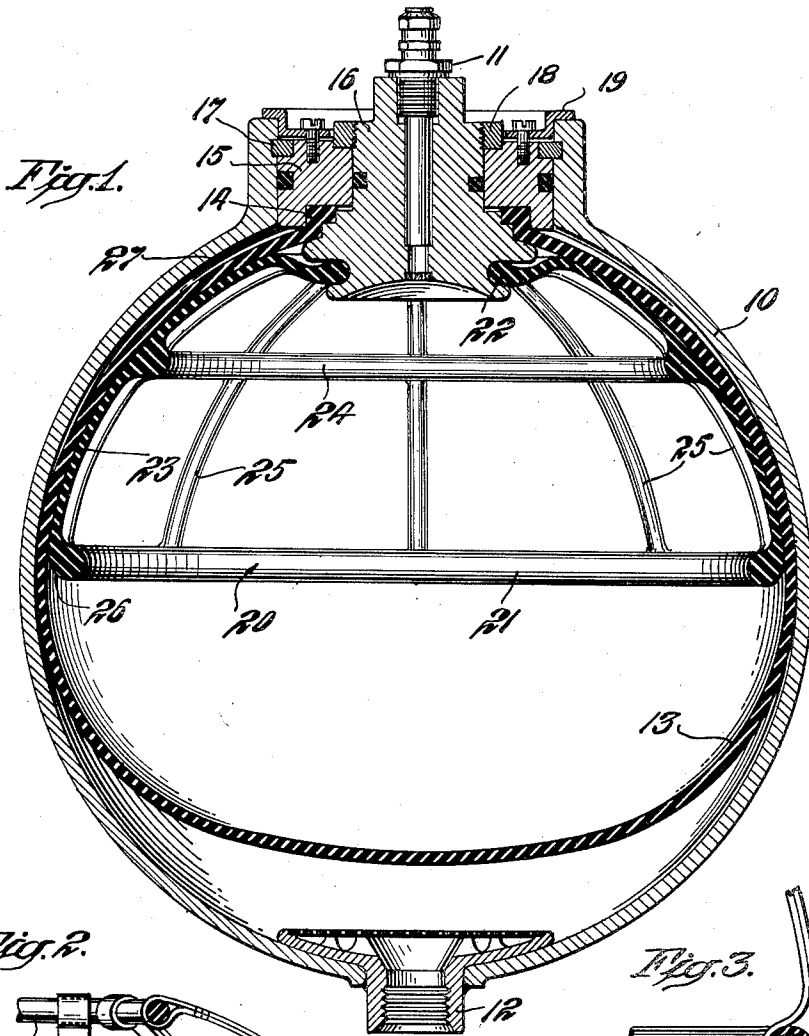


Fig. 2.

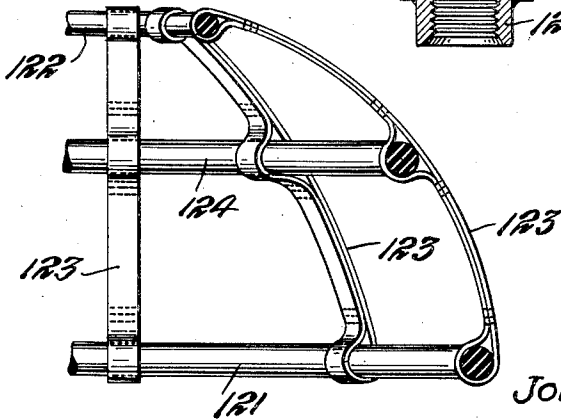
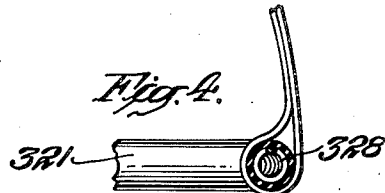


Fig. 3.



Fig. 4.



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2,380,866

BLADDER STIFFENER

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Application April 25, 1944, Serial No. 532,580

6 Claims. (Cl. 138-30)

This invention relates to pressure jars or vessels such as accumulators and surge reliefs wherein a fluid is stored under pressure and more particularly to such vessels having a novel bladder stiffener as a component part.

General objects of the invention are to provide pressure vessels of the mentioned types having improved reliability and efficiency in expelling contained fluid into the service line.

In the pressure accumulator type of vessel, as used on aircraft and elsewhere, there is usually a strong pressure shell having an internally disposed membrane or bladder separating the shell into an air and an oil compartment. The hydraulic service line is connected with the oil compartment, and air under pressure is trapped in the air compartment. In a typical illustrative installation, air may be introduced at a pressure of 600 p. s. i. and oil thereafter pumped into and stored in the accumulator at a pressure of 1500 p. s. i., so that the air volume is correspondingly reduced and the separating bladder flexed or collapsed to accommodate itself to the new condition. This bladder may either be of a bag-like form attached near one end of the accumulator shell or of diaphragm form attached at its edges about medially of the shell which in this case is made sectionally in halves with the diaphragm clamped therebetween.

The first mentioned bag-like form has certain relative advantages, such as allowance of the use of a strong seamless shell, and the avoidance of undue flexure near the attaching edges, which often leads to early fatigue and tearing of the diaphragm types of membranes. One disadvantage of the bag-like end-attached form of bladder, however, is that it may trap oil between itself and the shell walls, especially in the upper section remote from the oil plug if operated when inverted or in some other non-upright attitude. It is desirable, particularly, in aircraft installations, that the accumulator size and weight be kept at the lowest limits commensurate with the volumetric requirements of the hydraulic system, and to this end one of the test requirements for such accumulators is an efficiency of 95% in expelling contained oil to the system lines in all attitudes. Trapping or cutting off of pockets of oil from access to the oil passage or plug at the end of the accumulator accordingly may, if present in a substantial amount, result in test failure and rejection as well, of course, as in inefficient operation during use.

More particular objects of the present invention are to provide accumulators having the ad-

vantages of a bag-type bladder, wherein provision is made to prevent undue oil trapping.

Further objects of the invention are to provide an accumulator wherein the bladder is held extended by a separate inner bladder stiffener which serves to hold at least the upper portion of the bladder outwardly against the shell walls so as to avoid formation of oil trapping pockets and to control and guide the flexing and collapsing action of the membrane.

Additional objects of the invention are to provide a bladder stiffener having advantages such as those described, which can be separately applied to existing as well as to new accumulator assemblies, and which permits the use of a thin uniformly walled bladder which is easy to cure properly and has a relatively small heat-retaining mass.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth, and the scope of which invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Fig. 1 is a vertical medial sectional view through a pressure accumulator embodying features of the invention.

Fig. 2 is a fragmentary vertical sectional view showing a modified form of bladder stiffener usable in an assembly such as that shown in Fig. 1.

Figs. 3 and 4 are fragmentary views partly in section showing, respectively, additional forms of stiffening rings usable in the bladder stiffeners of Fig. 1 or 2.

Referring more particularly to the drawing and first to the form of device shown in Fig. 1, there is shown a pressure accumulator comprising a shell 10 having an air back-check valve 11 at one end and an oil passing plug 12 at the other. A bladder 13 is attached within the shell with its interior in communication with the air introducing valve 11 in the form shown. It will be understood however that the benefits of the present invention will obtain if the liquid fluid is contained within the bladder and the gaseous fluid is trapped within the shell outside the bladder, and if desired either of these arrangements may

be employed. The bladder 13 is of a flexible and preferably elastic material such as synthetic rubber or other rubber-like compound having the requisite elasticity, strength, and ability to function over a wide temperature range. Materials best filling all of these requirements are usually a rather gummy stock and it is important to protect them as far as possible against tearing forces and against the formation of sharp folds and creases as the bladder collapses or crumples during operation.

As shown the bladder 13 is of bag-like form attached within the shell near one end thereof. In the illustrated form it is attached to a closure of the general type shown and claimed in my co-pending application Ser. No. 515,933, filed December 28, 1943. The bladder terminates in beaded attaching edges 14 which are clamped between a collar 16 and an outwardly slidable stopper 18 which is urged outwardly under interior accumulator pressure into tight sealing engagement with the bladder neck 14. Outward movement of the collar 16 is prevented by a segmented locking ring 17 seated in an annular groove within the shell mouth, while inward dropping of the stopper with respect to the collar is prevented by a stop nut 19 and inward dropping movement of the collar 16 with respect to the shell is prevented by a stop ring 19 to which the collar is pinned.

The oil plug 12 may be of any suitable construction and is preferably of the form particularly described and claimed in my co-pending application Ser. No. 515,934 filed December 28, 1943.

The accumulator structure thus far described is generally of known construction and does not form part of the present invention except insofar as it is employed in combination with the novel bladder stiffener about to be described. This stiffener, which is generally designated 20, comprises a stiffening ring 21 which is adapted to urge the bladder into extended position toward or against the shell walls at a point intermediate the top and bottom of the bladder and preferably at a point approximately midway of the height of the shell in the case of a spherical accumulator of the kind illustrated. An attaching bead or neck 22 is snapped or seated in an annular fillet provided therefore on the lower end of the stopper 16 and a supporting web 23 serves to suspend the stiffening ring 21 from such attaching neck. If desired one or more intermediate stiffening rings or beads 24 may be provided as well as vertically extending stiffening ribs 25 which, if employed, may be distributed in suitable number, say 6 or 8, about the suspending web structure. As illustrated in Fig. 1 the stiffening ring or rings, the attaching neck and the supporting web are all integrally molded from synthetic rubber or other suitable stock which is capable of collapsing so as to be insertable through the shell mouth but which is formulated and cured to have sufficient stiffness and approach to rigidity to spring outwardly into bag supporting relation when permitted to do so.

The main stiffening ring 21 at the lower terminal edge of the bladder stiffener has an appreciably large diameter and a gently curving peripheral contour 26 not only to give it the requisite stiffness and strength but also to guide and control the bladder as it flexes and invaginates upon itself during operation of the accumulator. This prevents the formation of sharp folds and also guides and controls the flexing action of the bladder so as to prevent indiscriminate and uncontrolled collapsing and crumpling of the

bladder. This, coupled with the supporting action of the bladder stiffener which holds the upper part of the bladder out toward the shell walls, serves to avoid the formation of pockets and the trapping of oil between the bladder and shell walls where it would be cut off from return to the pressure system through the plug 12. Preferably a slight amount of oil may be trapped in the space 27, but this is merely to prevent squeezing of the bladder into the joint crevices in and around the stopper and is not present in a quantity sufficiently large materially to affect the volumetric efficiency of the accumulator.

In the form of bladder stiffener shown in Fig. 2, a collapsible resilient stiffening ring 21 is provided which may be made of synthetic rubber. An attaching neck 22 of similar material is also provided and is adapted to seat in a fillet in the accumulator closure stopper in the same manner as the neck 22 in the first described form. If desired one or more intermediate stiffening rings 24 may be provided. Here the web or supporting means for suspending the stiffening rings from the attaching neck are in the form of separate flexible straps 23 preferably formed of textile material such as canvas or duck which is folded around the attaching neck and stiffening rings and suitably stitched so as to confine and support the latter. If desired the supporting straps 23 may be formed of synthetic rubber, leather or other like material suitably stitched, vulcanized, or cemented in place. In the form shown in Fig. 2 the entire supporting structure comprises a skeletal framework which is light and which involves little added heat retaining mass. This last characteristic is highly desirable. Heretofore efforts have been made to combat the oil trapping problem by building bladders with an integrally thickened upper wall section terminating in some cases with an integral thickened bead around which the lower portion of the bladder, which is left of normally thin dimension, is adapted to fold. It is difficult to vulcanize or cure such a thick and thin walled bladder structure properly and with uniformly predictable results, and an even more serious handicap is that the thick integral upper walls of such a structure have a considerable mass which forms a heat retaining body which is very undesirable in an oil containing high pressure accumulator wherein the adiabatic compression of the gas involves considerable rise in temperature. With a thick heat retaining bladder wall the heat thus generated is stored cumulatively during successive compressions and expansions of the gas instead of being substantially dissipated during the expanding cycle. It will be seen that with the light skeletal textile framework of Fig. 2 such heat storing problems are largely avoided while yet securing the desired bladder stiffening and extending action which serves to prevent oil trapping.

In Fig. 3 a modified form of stiffening ring is shown which may be incorporated in or attached to the bladder stiffeners of either Fig. 1 or 2. Here the stiffening ring 221 has an interior stiffening coil spring 28 embedded and molded therein so as to increase the outward expanding bias of the ring.

In Fig. 4 a somewhat similar arrangement is shown involving a stiffening ring in the form of an outer tube 321 of synthetic rubber or the like within which is inserted a coil stiffening spring 328. Other forms of interior stiffeners such as steel bands, whale bone, etc., may be embedded in the various stiffening rings in lieu of the springs

28 or 328, and may be similarly embedded in the vertical ribs 25 or straps 123.

It will be seen that there have been provided bladder stiffeners which are capable of being applied either to existing or to specially formed accumulator shell and bladder assemblies, which may be of the spherical types shown, or of elongate cylindrical or any other desired form. In this connection it will be obvious that the particular attaching means such as the bead or neck 22 may be adapted to the requirements of the particular accumulator assembly with which the bladder stiffener is used, the illustrated form of elastic snap ring and grooved stopper being convenient in the particular arrangement illustrated. In general the attaching neck or bead for the bladder stiffener may partake of the same attaching means employed to secure the attaching edges of the bladder itself within the accumulator shell. It will also be seen that with the present form of bladder stiffener the bladder may be of normally thin and substantially uniformly walled structure which is easy to cure properly and does not have undesirable heat retaining characteristics, and that in general the described constructions are suited to fulfill their intended functions.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, 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.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A pressure accumulator comprising, a shell having fluid passages therein, a bladder attached within said shell in communication with one of said passages, and a separate bladder stiffener

attached within said bladder and arranged to hold the portion adjacent the attached end of said bladder extended outwardly toward said shell while leaving the remainder thereof relatively free to flex.

2. A pressure accumulator comprising, a shell having fluid passages therein, a bladder attached within said shell in communication with one of said passages, and a separate bladder stiffener within said bladder and comprising a ring of stiffening material which ring is less collapsible than said bladder tending to hold it extended against the walls of said shell.

3. A pressure accumulator comprising, a shell having fluid passages therein, a bladder attached within said shell in communication with one of said passages, and a separate bladder stiffener attached within said bladder comprising a stiffener positioned to extend said bladder intermediate its ends and a supporting web suspending said stiffener from its place of attachment.

4. A pressure accumulator comprising, a shell having fluid passages therein, a bladder attached within said shell in communication with one of said passages, and a separate bladder stiffener attached within said bladder comprising a stiffener positioned to extend said bladder intermediate its ends and a supporting web suspending said stiffener from its place of attachment, said web being in the form of a plurality of spaced straps.

5. A pressure accumulator comprising, a shell having fluid passages therein, a bag-like bladder attached within said shell in communication with one of said passages, and a plurality of contractible resilient stiffening rings within said bladder, said rings being separate from and more resistant to collapse than said bladder and urging it into extended position toward the shell walls.

6. A bladder stiffener for holding an accumulator bag extended, comprising a stiffening ring, an attaching neck adapted to be fitted to the accumulator, and means suspending said ring from said neck.

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