Nov. 5, 1968 R. L. BLANCHARD 3,409,167

CONTAINER WITH FLEXIBLE BOTTOM

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FIG. 1

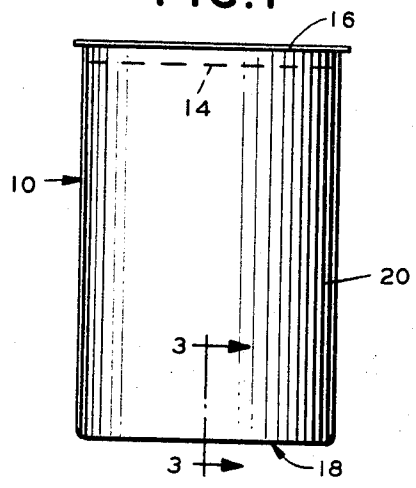


FIG. 2

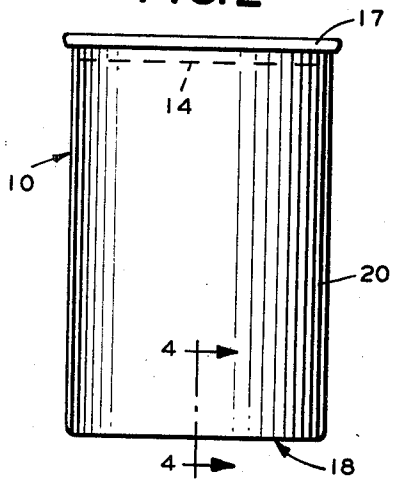


FIG. 3

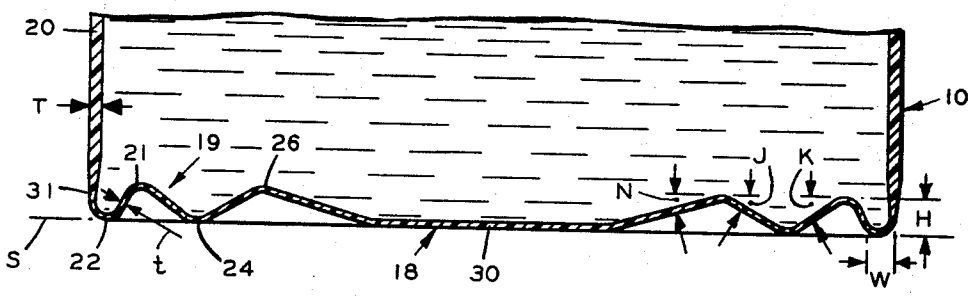
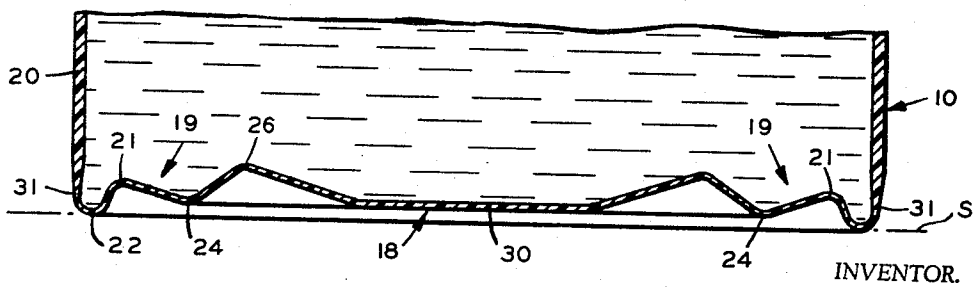


FIG. 4



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FIG. 5

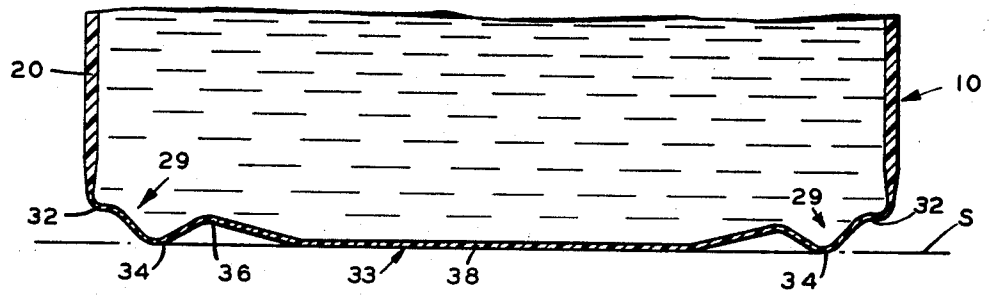


FIG. 6

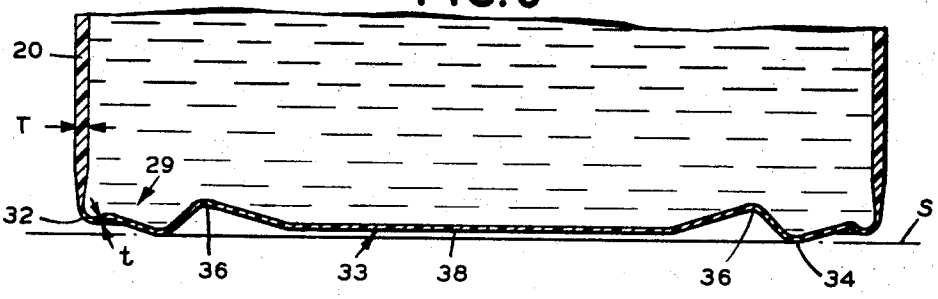


FIG. 7

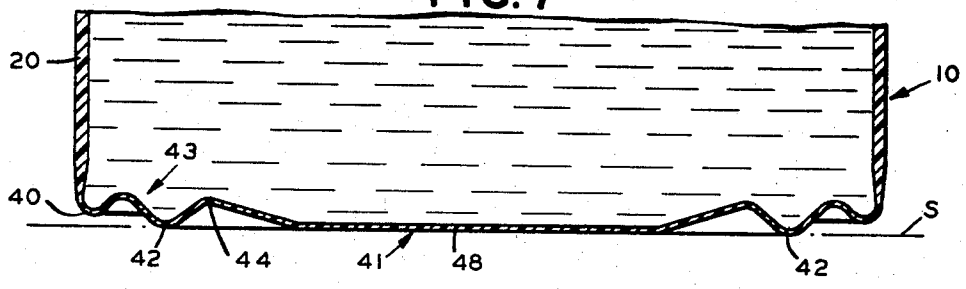
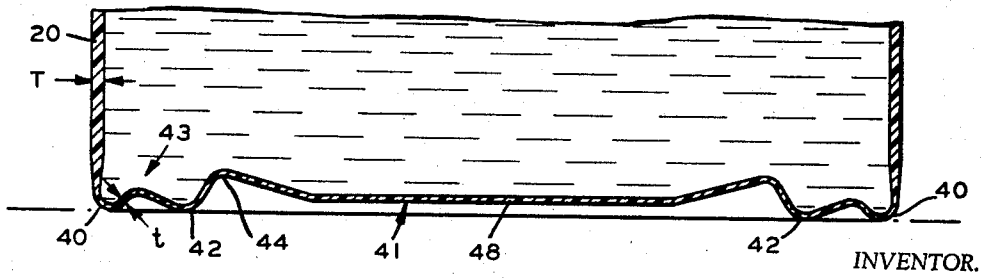


FIG. 8



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United States Patent Office 3,409,167
Patented Nov. 5, 1968

3,409,167

CONTAINER WITH FLEXIBLE BOTTOM

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Filed Mar. 24, 1967, Ser. No. 625,645
1 Claim. (Cl. 220—66)

ABSTRACT OF THE DISCLOSURE

A container constructed to compensate against the effects resulting from a reduction in internal pressure after sealing of the container. The container is provided with a flexible base which flexes inward when the internal pressure of the container is reduced due to chemical reactions, temperature changes and/or other causes. Through the flexure of the container base, deformation or paneling of the sidewalls of the container is prevented. In this manner, the stacking characteristics and appearance of the container are retained.

Background of the invention

After filling and sealing containers made of non-rigid materials (e.g., thermoplastic) with certain types of products (e.g., motor oil), it has been found that the sidewalls of the containers tend to panel or become deformed when the containers have been stored for a period of time. This deformation or paneling of the sidewall of the container results from a reduction of the pressure within the interior of the container. After the container has been filled and sealed, a small amount of air generally remains trapped within the container. Upon being stored, the contents of the container may chemically react with constituents of the residual air. Such chemical reactions cause the total pressure within the container to drop, and as a result the sidewall of the container will flex inward or panel in order to compensate for this internal pressure drop. When this condition occurs, the container assumes an undesirable appearance, and will not adequately support another container that may have been stacked on top of it. In some cases, the container may be filled with a heated product which reduces in volume upon subsequent cooling and which thereby tends to reduce the internal pressure in the sealed container.

Since the reduction in internal pressure cannot always be practically avoided, the present invention provides a novel container construction wherein the container base flexes in preference to the container walls.

Summary of the invention

In a thermoplastic container having a sidewall and bottom wall, flexure means are provided at the outer circumferential portion of the bottom wall, such flexure means including an annular bead at the juncture between the sidewall and the bottom wall. The container sidewall is thicker than the flexure means whereby upon a limited reduced pressure in the container, for example, when the oxygen of the air therein is consumed upon reacting chemically with the contents, the flexure means are operable to allow the bottom wall to distend inwardly, in preference to the sidewall, to effect a maximum volumetric inward displacement as the bottom wall flexes at said flexure means starting at said outer annular bead.

Description of the drawings

FIGURE 1 is an elevational view of a container, constructed in accordance with the present invention, when filled with fluid prior to being sealed;

FIGURE 2 is an elevational view of the container of FIGURE 1, after the container has been filled and sealed with an end closure;

FIGURE 3 is a partial cross-sectional view taken along the line 3—3 in FIGURE 1 showing the construction of the base of the container when in an unflexed condition;

FIGURE 4 is a partial cros-sectional view taken along line 4—4 in FIGURE 2 showing the container base when in a partially flexed condition due to a reduction in pressure within the container;

FIGURE 5 is a partial cross-sectional view of another embodiment showing the base of a container when in an unflexed condition;

FIGURE 6 is a partial cross-sectional view of the container base of FIGURE 5 when in a partially flexed condition due to a reduction in pressure within the container;

FIGURE 7 is a partial cross-sectional view of a further embodiment showing the base of a container when in an unflexed condition;

FIGURE 8 is a partial cross-sectional view taken of the container base of FIGURE 7 when in a partially flexed condition due to a reduction in pressure within the container.

Description of the prefered embodiments

Referring to the drawings and in particular to FIGURE 1, a container **10** is filled with a fluid, for example, motor oil. After the container has been filled, the fluid attains the level **14** just below the top rim **16** of the container. The container is sealed by an end closure **17** which may be affixed in any suitable manner, for example, by a double-seam, spin weld, or heat seal.

After the container has been filled and sealed with the end closure **17**, it appears as shown in FIGURE 2. An air space exists between the surface **14** of the fluid and the internal surface of the end closure **17**. This air space results from the condition that it is not practical or economically feasible to fill the container completely with fluid to eliminate all residual air spaces or voids. Since such containers are generally filled on production lines through filling and processing machinery, complex and intricate mechanisms would be required to assure that each container is filled to the extent that no space within the container is left vacant of fluid.

In the normal course of storing the filled container, it has been found that certain constituents of the fluid may react chemically with the air within the container. Such chemical reactions of the fluid result in a reduction of internal pressure in the container in that the reactions use up the oxygen from the residual air space, and the partial pressure, previously created by the oxygen, is no longer present and, consequently, the internal pressure in the container will be reduced. A similar result of reduced total internal pressure would prevail for chemical reactions between the fluid and any of the other constituents or gaseous components of the residual space. Further, if the container is initially filled with a heated product (e.g., heated oil to make it less viscous for filling), its subsequent cooling will tend to cause a reduction in the internal pressure.

With reduction of internal pressure, the atmosphere or surrounding environment acts upon the container to cause the sidewall of the container to buckle or panel. When the sidewall **20** of the container is thus deformed or paneled, various problems arise with respect to the storage of the containers. For example, it is not possible to stack any significant number of containers on top of one another in order to conserve storage space. This is so because when the sidewall **20** panels or becomes deformed, as a result of a reduction of the internal pressure, the top and bottom planes of the container are generally no longer parallel, thereby resulting in instability in the container stack. Another problem resulting from the deformed condition of the container is that it gives the container an undesirable appearance. Such deformed appearances of the containers often render the latter unmarketable, even though the contents of the container are

entirely usable and unaffected by the deformation of the sidewall.

The deformation or paneling of the sidewall of the container is prevented, in accordance with the present invention, through a novel construction of the bottom wall or base of the container wherein flexure means in the bottom wall provide preferential flexure in the latter. FIGURE 3 shows one embodiment of the invention wherein the base or bottom wall **18** includes a flexure means **19** comprising an outer bead or convex portion **22** located at the juncture between the sidewall **20** and the base **18**. The flexure means **19** further comprises a second bead or convex portion **24** along with the indentation or concave portion **21** disposed therebetween. Adjacent to the bead **24** is an indentation or concave portion **26** which runs into a central bottom portion **30**.

FIGURE 3 shows the natural condition of the container while FIGURE 4 shows the container base **18** after the container has been filled and the contents have chemically reacted or other action has taken place to initially reduce the pressure within the container. Because of the irregular configuration of the flexure means **19** and the fact that the thickness *t* of the flexure means is less than the thickness T of the sidewall **20**, such flexure means **19** will bend, in preference to the sidewall **20**, to compensate for the pressure reduction. When this bending or flexure occurs, maximum volumetric displacement is effected as the bottom wall **18** flexes from a position starting at the outer annular bead **22**. The flexure occurs at the beads **22** and **24**, continuing through the intermediate indentation **21**. The reason for this is that the irregular flexure means **19** is thinner than the sidewall **20** of the container, the numeral **31** indicating the transition from the thicker sidewall **20** to the thinner base **18**. Thus, the outer bead **22** tends to roll or hinge inwardly, allowing the entire base **18** to be displaced toward the inside of the container to effect a maximum volumetric, inward displacement when partial or limited vacuum is present therein. The degree of flexure of the various parts of the flexure means **19** will depend on the particular configuration, the thickness, and the type of material used. Since the central bottom portion **30** is displaced rather than flexed, its thickness may be selected as found most desirable to obtain best results. It may, for example, be the same thickness or thicker than the flexure means **19**.

Preferably, the height H of the outer bead **22** is the maximum allowable for its supporting function and is determined by the degree of thinning adjacent the bead **22**, i.e., the ratio between the base thickness *t* and sidewall thickness T. Greater bead heights H allow more flex but render the bead **22** too soft (i.e., not of sufficient rigidity) for its supporting function. The angle K is preferably less than 60 degrees. The smaller that angle K is, the easier the base **18** can flex inwardly, however, opposing this is the fact that too small an angle K will offer less total displacement or inward distention for higher degrees of vacuum. Consequently, it is preferable that angle K be the maximum at which the base **18**, due to its geometry, will effect a preferential flex inwardly prior to paneling of the sidewall.

Angle J may be within the range of 20–90 degrees. The larger angle keeps the radial distance from indentation **21** to indentation **26** to a minimum. This allows less material thickness between these portions and allows more flex due to a thinner section.

Another advantage of the outer bead **22** being of relatively weaker construction over a controlled height H, is that the height setting of the doubleseaming head for affixing the end closure **17** becomes less critical because the outer bead **22** acts as a cushion that flexes prior to buckling of the sidewall **20**. If the bead **22** is relatively sturdy and too much pressure is applied on the container during doubleseaming, the sidewall **20** might collapse sufficiently to cause problems in obtaining satisfactory

doubleseaming and sealing of the end closure **20** to the container.

As previously indicated, to facilitate the deformation of the base **18** of the container in preference to the sidewall **20** thereof, the material thickness of the flexure means **19** is less than that of the sidewall **20**. The base **18** is joined to the relatively heavier sidewall **20** through the transition indicated generally at **31**. Thus, the container base **18** is designed so as to be deformable in preference to the sidewall **20**. In this manner, any compensation for the reduction in pressure within the container is accomplished through deformation of the container base **18** rather than of the sidewall **20**.

The design of the container base is such that it may flex inward through a range of positions. If the internal container pressure drops further than that corresponding to the position shown in FIGURE 4, the bottom wall **18** may move or flex further inwardly. Accordingly, as the pressure within the container continues to drop, the base **18** of the container flexes inward to compensate for this pressure drop and, as a result, the sidewall **20** remains unaffected and undeformed.

In a typical (e.g., one quart) container construction, the preferred thickness T of the sidewall **20** may be within the range of 0.02 to 0.04 inch, and the thickness of the flexure means **19** within the range of 0.012 to 0.035 inch. The following indicates parameters of the construction shown in FIGURE 3.

	Range	Ideal
Width (W) of bead 22, inch	0.18–0.25	0.20
Height of bead 22, inch	0.085–0.12	0.10
Angle K, degrees	20–60	30–45
Angle J, degrees	20–90	70–83
Angle N, degrees	15–60	20–30

FIGURE 5 shows another embodiment for the design and construction of a flexible base for the container **10**. In this design, the flexure means **29** in base **33** comprises an outer bead or annular portion **32** joined to the sidewall **20**, the bead **32** joining an inner bead **34** which, in turn, leads to an indentation **36**. The latter terminates in the generally flat central portion **38**. Prior to being filled and when the container is in the undeformed state, the container is supported on the inner bead **34** and, depending on the thickness and configuration, it might also be supported on the central portion **38**. When the internal container pressure is initially reduced, the base **33** flexes, in an inward direction, to the position shown in FIGURE 6.

As in the case of the embodiment of FIGURE 3, the thickness *t* of the flexure means **29**, including the outer bead **32**, is less than the sidewall **20** thickness T of the container. Thus, the outer bead **32** allows the entire base **33** to be displaced toward the inside of the container when the aforesaid initial partial vacuum is present therein, thereby to provide maximum volumetric displacement, with flexure occurring at the beads **32** and **34** as the portion therebetween tends to rotate about bead **32**.

Assuming that the thickness of the sidewall **20** is within the range specified for the first embodiment of FIGURE 3 (i.e., 0.02 to 0.04 inch), the material thickness of the flexure means **29** for the embodiment of FIGURE 5 preferably would reside within the range of 0.012 to 0.035 inch. The internal diameter of the container for both of the embodiments of FIGURES 3 and 5 is nominally 4 inches, when associated with the preceding values.

In the embodiment of FIGURE 7, the base **41** is shaped intermediate between the two designs of FIGURES 3 and 5. An outer bead **40** of the flexure means **43** is joined to the sidewall **20**. In contrast with the outer bead **22** in FIGURE 3, the outer bead **40** does not provide support for the unfilled container (FIGURE 7). The outer bead **40** connects with an inner bead **42** which, in turn, leads to indentation **44**, the latter being joined to the central flat portion **48**.

In the initial stage of flexure, the central portion **48** is

displaced inward to the position shown in FIGURE 8. In this initial stage of flexure, the filled container is supported by the outer bead **40** and, depending on the thickness and configuration, it may also be supported on the inner bead **42**.

Assuming that the thickness of the sidewall **20** is within the range specified in the first embodiment in FIGURE 3 (i.e., 0.02 to 0.04 inch), the material thickness of the flexure means **43** in the embodiment of FIGURE 7 preferably would reside within the range of 0.012 to 0.035 inch. The internal diameter of the container is nominally 4 inches when associated with the preceding values.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing descriptions and it will be apparent that various changes may be made in the form, construction, and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. A container body of thermoplastic material or the like having a sidewall and a bottom wall, said bottom wall having flexure means at the outer annular portion thereof comprising a first annular bead disposed at the juncture between the container sidewall and the bottom

wall and a second annular bead disposed radially inwardly of the said first bead, said flexure means further comprising an annular concave portion joining said annular beads, said bottom wall having a central portion joined to said second annular bead by a second annular concave portion, said first annular bead being thinner than the adjacent sidewall with the transition in thickness occuring substantially at the juncture between the sidewall and said first annular bead, said central bottom wall portion being displaced inwardly, in preference to the sidewall, upon a relative reduction of pressure in the container, as the flexure means flexes from a position starting at the first annular bead and continuing through said first annular concave portion and said second annular bead.

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