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(54) CONTAINERS AND REMOVABLE COVER MEMBERS THEREFOR

(71) I, JAMES IAN MACDONALD, a Citizen of Canada, and resident of Calgary, Alberta, whose full post office address is 708, 7th Avenue, S.W. Calgary, Alberta, Canada, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to containers, provided with cover members, having utility for the storage and transportation of liquid materials generally and foodstuffs specifically.

The retention of a releasable planar cover member made of a non-rigid flexibly distortable material fitted on the open end of a container has, in one prior arrangement, depended on axially engaging an inward bead edge carried by a depending peripheral flange of the cover to hook under an outwardly extending bead or projection of the rim of the container, and, in another prior arrangement, on pressing an annular groove defined by continuous side walls of an annular raised peripheral portion of the cover about the edges of the open end. The sealing action in either of said prior arrangements depends on the adhesion of a radially distended peripheral portion of the cover to the exterior surface of the end portion of the container. While the holding effect provided by such covers in smaller sizes of containers subjected to gentle handling has proven adequate, the nature of the seal permits any moderate increase in internal pressure or occurrence of a fluid surge to lift the cover, causing leakage. Furthermore, any downward movement of the container in handling causing the exterior to strike an obstacle may inadvertently strip the cover by applying lifting force along some part of its periphery. In addition, radial squeezing may so distort the rim despite provision of an offset in the container sidewall as to make

the seal ineffective along the distorted sectors unless the thickness of the parts is very considerably increased.

I have found that a novel and highly advantageous locking seal may be provided for an open-ended container wherein the sealing action does not depend on the adhesion of a distended annular portion of the cover, but rather on the radial compressive strength of a peripheral flange portion of the cover which is seated into and is gripped between the exterior of the container and a hook flange carried by the outer end of a rigidifying annular frusto-conical flange rising outwardly from the container side wall at an acute angle. This arrangement transfers the axial load on the cover resulting from internal fluid pressure to the seated annular flange, and by resolution of component forces increases the radial horizontal pressure between the cover flange and the container, thus enhancing the sealing action. In addition, due to the fact that the nested and interlocked annular flanges of the container and the cover cooperate to increase radial stiffness of the closed container, its resistance to deformation by lateral shocks is greatly improved as compared with prior art forms. Since no part of the cover projects radially beyond the rigidifying flange, inadvertent release of the cover as a result of vertical movement cannot occur. Finally, the provision of the integral rigidifying flange rising outwardly below the mouth of the container at an acute angle and terminating in a hook flange at about the level of the rim tends to greatly stiffen and maintain the cross-section of the open end in filling and pouring.

According to the invention, there is provided a container, and a removable cover member therefor, said container comprising a hollow body having an enclosing side wall, the upper end of said side wall terminating in a rim defining a mouth opening and said side wall having an integral rigidi-

fyng member which reinforces said rim, and is in the form of an annular flange joined with or meeting said side wall along a junction spaced below said rim and, viewed in cross-section, rising outwardly and rectilinearly from said junction, or from the vicinity of said junction, at an acute angle to the side wall, as far as an upwardly inturned hook flange which is carried by said flange and which extends continuously along the periphery of said rigidifying flange and which has, spaced outwardly of the aforesaid rim, an inner marginal edge for receiving thereunder a peripheral sealing portion of the aforesaid cover member when the cover member is applied in closing relation upon said mouth opening, at least one of the said rigidifying flange and the said sealing portion being flexibly distortable to allow said engagement of the sealing portion under the said inner marginal edge. The removable cover member may have a rim-girdling depending side wall carrying a peripheral annular sealing flange which, viewed in cross-section, slopes outwardly and rectilinearly from the lower part of said side wall and is adapted to nest upon the upper surface of the said rigidifying flange and has an outer marginal edge adapted to seat under said hook flange.

In the construction of the container, which may be a pail, by a molding operation, using for example, high-density linear polyethylene, the core mold may be provided with a slight taper in the side wall and the exterior mold may be provided with a break plane intersecting the junction of the rigidifying flange with the hook flange. In an example where the cover member has the aforesaid sealing flange and is moulded of polyethylene or similar flexibly distortable material, the peripheral sealing flange is shaped to conform to the plan form of the rigidifying flange and the rim-girdling depending side wall is shaped to closely engage the exterior of the rim, i.e. the plan form will be generally either circular, or rectangular with rounded corners. The cover member may also be constructed, according to one alternative, with the intermediate portion axially depressed below the level of the rim, by providing two depending flanges radially spaced and forming an inverted channel portion, defining an upward groove having an axial extent such that the rim is seated in the groove bottom when the sealing flange is nested upon the rigidifying flange.

The container may alternatively be closed by using a relatively simple sheet member shaped as a disc or to the plan form of the container, or as a planar member having a depending peripheral side wall carrying an outward bead which may be engaged under the hook flange to effect

covering; such cover members however would provide less effective sealing, and the enhanced sealing described for the cover with the aforesaid rectilinearly sloping sealing flange would not be present. Such cover members may be used where the fluid-tight sealing action is not necessary and where handling is gentle.

It is entirely feasible to construct the container of metal or other rigid material having a cover molded of a flexibly distortable material, or vice versa, provided only that at least one of the rigidifying flange of the container and the sealing portion of the cover member have the required distortability when the cover is axially pressed down to engage its margin inside the hook flange.

Embodiments of a container and cover member constructed according to the invention and having utility as a shipping pail will, by way of example, be described hereinafter, in conjunction with the accompanying drawing, wherein

Figure 1 is a perspective view of one embodiment showing a cover at an initial stage of its removal from a wide container mouth opening;

Figure 2 is a perspective view showing handling and pouring of the pail contents from the wide mouth opening;

Figure 3 is an axial diametral section in enlarged scale taken on line 3—3 of Figure 1 showing the engagement of the cover in closing relation on a rim and locked with a rigidifying flange;

Figure 4 is a view similar to Figure 3 showing the cover axially separated at the position it initially engages the rim;

Figure 5 is an analytic diagram relating to Figure 3 illustrating sealing force and locking action;

Figure 6 is a section similar to Figure 3 showing a cover modified to provide an inverted rim-engaging channel;

Figure 7 is a cross-sectional view showing a modified shorter rigidifying flange disposed at a larger acute angle wherein the container is made of metal and the cover of polyethylene; and

Figures 8 and 9 show alternative cover members and rim heights employing a disc cover and a cap cover.

Referring to Figures 1 to 5 of the drawing, a container or pail generally designated 10 having a flat bottom wall 11 is formed with an upwardly extending side wall 12 shaped as a frustum of a cone, having a wall taper of a few degrees, the side wall being formed with an offset portion 13 providing improved radial wall rigidity. The upper end of the side wall terminates in a rim 14.

Below the rim 14 a continuous peripheral rigidifying flange 15 of annular plan form

extends integrally from the container side wall at a junction 16 therewith, rising, viewed in cross-section, rectilinearly at an acute angle designated ϕ which may range from about 15 to about 75 degrees with respect to the side wall, a preferred angle as shown being about 45 degrees. The outer margin 17 of the flange 15 carries an upwardly intumed edge flange 18 having a blunt marginal edge 19 and a frusto-conic annular under surface 20 disposed to provide a contained angle of 90 degrees or slightly less than 90 degrees with respect to the upper surface 21 of the rigidifying flange. The upper margin of the edge flange is in a plane disposed close to the plane of the rim 14, or preferably slightly below it.

The exterior portion 22 of the container between the rim 14 and the junction 16 is preferably formed with a reduced taper and may be nearly vertical, or may be provided with a small taper opposite to that of the interior of side wall 12, to facilitate applying or removing the cover generally designated 23. The container is preferably molded of high-density linear polyethylene or other structural material which is similarly flexibly distortable, i.e., having a capacity of returning to its original shape after release of a limited deforming pressure. The cover 23 may be molded, as shown, of the same or similar material, and is provided with an intermediate planar portion 24 which may be disclike, or slightly dished inwardly as shown.

A depending flange 25 defining the periphery of the intermediate portion 24 is so dimensioned that the inner surface 26 may be axially forced into close engagement about the rim and side wall portion 22. The lower margin 27 of flange 25 is formed with a lateral nose or inward continuous projection disposed at the same diametral distance from the container axis as the surface 26, or preferably at a slightly lesser radius. The flange is integral with a peripheral sealing flange 28 of frusto-conical annular form, the under-surface 29 of which is disposed at about the same or a slightly greater angle than is the surface 21. As shown in Figures 3 and 6, the angular relationship should be such that preferably the sealing flange in nested relation upon the upper surface 21 of the rigidifying flange with a small clearance between the adjacent conic surfaces in the vicinity of junction 16.

The flange 28 has a length as measured along a radial element of the generating cone which is a multiple of the thickness of the flange, to provide sufficient flexure to permit axial insertion under the flange surface 20. The distance between the outermost marginal edge 30 of the flange 28, which is shaped to a rounded profile, and

the inward projection 27, is made slightly flange compressive stress C are each diminished flange surface 20 and the exterior surface 22 so that insertion of flange 28 causes a slight distention outwardly of hook flange 18. It has been found that injection molding methods favour the inherent radial contraction of marginal edge 27 so that deliberate provision in the making of the molds may be unnecessary to secure an inward protuberance. It is to be understood however that compressive sealing may be obtained even when the inner margin of flange 28 is flush with the internal surface of flange 25.

As may best be seen from Figure 4, the horizontal extent of flange 28 between the marginal edge portions 27 and 30 is larger, by the distance "d", than the minimum horizontal distance between the nose 19 of hook flange 18 and the exterior side wall 22. Consequently, axial engagement of the cover will tend to inwardly distort the container rim 14 as edge 27 slides down along the outer surface 22, and when edge 30 encounters the nose 19 the flange 28 will tend to be flexed as edge 30 lifts due to interference, along a sector being forced into locking engagement; flange 18 will be distended along such sector until edge 30 has seated under surface 20 in contact therewith.

In the seated position of cover 23 its sealing flange 28 will therefore be under radial compressive stress while rigidifying flange 15 will be under slight tensile stress. Referring to the stress diagram, Figure 5, the effect of internal pressure within the closed container is to apply a vertical axial load, which exerts a force F along a unit sectoral length, transmitted by tension link 125 representing the depending flange 25. Since the materials are flexibly distortable, the section cannot strictly be analysed as though the structural elements were pin-jointed linkages; however use of this method will at least serve to illustrate the locking and sealing actions enhanced by internal pressure.

The sectoral element 128 of the sealing flange may be taken as an end-loaded strut which is pivotally held at one end by a frame 120 and bearing in free sliding relationship against vertical frame 122 at its other end, which is pin-connected to the end of tension link 125. When the angle between the elements 125 and 128 is ϕ , the compressive load is $F/\cos \phi$, the horizontal sealing pressure H against frame 122 is $F \tan \phi$, and the tension load T in the structural member 115 acting along line $b-b$ is $F/\cos \phi$. The total compressive load in the sealing flange, as well as the sealing pressure, will be increased by the contribution due to flexing of flange 18

resulting from initial seating of the cover.

When ϕ is 45 degrees, the horizontal sealing pressure H exerted between marginal edge 27 and the container side wall will be substantially equal to the axial load F carried by the flange 25. Since the area of contact along edge 27 is relatively small, the unit sealing pressure developed between contiguous surfaces is greatly increased as compared with the unit internal pressure which produces the axial load F. At the same time, the unit sealing pressure exerted between the edge 30 and the surface 20 will be even higher, since at 45° the magnitude of $F/\cos \phi$ is about 1.4F.

The line of action of the compressive stress, designated z—z, will tend to make a slight angle with respect to the upper surface 21 as the edge 27 is lifted slightly away from junction 16 due to distortions resulting from the axial load. The rigidifying flange will tend to elongate slightly and because of the finite distance "x" between the line z—z and the median tension line b—b in the rigidifying flange, a torque will be exerted tending to spread the flange 18. However, due to the favorable beam strength of the latter even at moderate wall thicknesses, considerable internal pressure may be resisted without noticeable distortion.

In general, the containers according to the invention will be used with internal pressures not greatly different from atmospheric, and variations therefrom within the container 10 will in part be taken up by flexing of the intermediate portion 24. Fluid surges and up-ending of filled containers however will produce local internal pressure differences either above or below atmospheric, and the efficacy of seal-enhancing in resisting loss of fluid under such disturbances is excellent.

When filled containers are to be shipped in stacked grouping the alternative cover member of Figure 6 is preferred, wherein an addition flange 32 extending upwardly is provided inwardly of flange 25, the flanges being joined by a rounded annular portion 33 overlying the rim 14. Due to taper of the side wall, the lower end will seat inwardly of side wall 32 upon shelf 34 formed at the junction of intermediate planar portion 24 with the flange 32. It will be evident that large axial loads applied tending to press annular portion 33 down on the rim will have little effect since side wall 12 is radially stiffened and gains high resistance to buckling or crushing due to support by closely-engaging flanges 25 and 32. Any increase in internal pressure resulting from the axial load of stacked pails and contents acts on the annular under-surface of portion 3, tending to lift this area and

consequently enhancing the sealing pressure on edge 27.

When angle ϕ is made smaller, the horizontal sealing pressure H and the sealing flange compressive stress C are each diminished while use of angles greater than 45° tends to increase both H and C and to bring them to a more nearly equal higher value. When the container wall is rigid, as shown in Figure 7, an angle ϕ which may be as large as 75° is practically feasible when the compressive strength of the flange 28 is made suitably large.

If the internal pressure of the container of Figure 3 should fall considerably below atmospheric, the axial load F is reversed, and the under-surface 31 of the cover will be pressed against rim 14. Radial inward distortion produced in the marginal area of the cover portion 24 will develop tension in flange 25, consequently enhancing the sealing pressure H on side wall 22.

Throughout the foregoing discussion it has been shown that the cover member 23 is securely locked and sealed whether internal pressure is above or below atmospheric. It is nevertheless easy to remove the cover once any sectoral portion of edge 30 has been disengaged from under flange 18. To facilitate stripping the cover from the mouth opening, an integral tab is provided as shown in Figure 1, attached along a short arcuate length of the upper side of flange 28 adjacent edge 30. When the tab is grasped and pulled upwardly and inwardly until some part of edge 30 is exposed and a gap 36 is provided, adjoining sectoral portions of flange 28 may be freed by axial pull on them, or by prying them free with a tool slid under the surface 29.

In those use applications where a cover member providing low resistance to internal pressure may be substituted, a disc having a peripheral edge 37 as shown in Figure 8 is shaped to the plan of the hook flange 18, so that the edge 37 may be sectorally advanced in engagement under the surface 20. The level of rim 14 is advantageously either slightly lower than surface 20 or at nearly the same level so that the marginal zone may be flexed slightly and pressed upon rim 14. Where the rim 14 lies in a plane considerably above the plane of surface 20, the cap cover of Figure 9 is used, being provided with a depending side wall 25 and a bead or other outward continuous protuberance 38 shaped to snap under the nose 19 and spring outwardly against surface 20.

It is to be understood that although the description has been directed to embodiments having tapering enclosing side walls terminating in a rim whose diameter is the largest diameter of the body, it is entirely

feasible to construct containers of constant cross-sectional dimensions along their axial length, i.e., to provide cover members which in effect form removable end walls for cylindrical bodies such as tubes or pipes.

WHAT I CLAIM IS:—

1. A container, and a removable cover member therefor, said container comprising a hollow body having an enclosing side wall, the upper end of said side wall terminating in a rim defining a mouth opening and said side wall having an integral rigidifying member which reinforces said rim, and is in the form of an annular flange joined with or meeting said side wall along a junction spaced below said rim and, viewed in cross-section, rising outwardly and rectilinearly from said junction, or from the vicinity of said junction, at an acute angle to the side wall, as far as an upwardly turned hook flange which is carried by said flange and which extends continuously along the periphery of said rigidifying flange and which has, spaced outwardly of the aforesaid rim, an inner marginal edge for receiving thereunder a peripheral sealing portion of the aforesaid cover member when the cover member is applied in closing relation upon said mouth opening, at least one of the said rigidifying flange and the said sealing portion being flexibly distortable to allow said engagement of the sealing portion under the said inner marginal edge.

2. A container and cover member, as set forth in claim 1, wherein the container is of flexibly distortable structural material and the rigidifying flange integrally joins said container side wall at said junction and commences its rectilinear sloping at said junction.

3. A container and cover member, as set forth in claim 1 or 2, wherein the said rim defines a circular mouth opening, said inner marginal edge of the hook flange being spaced radially of said rim, and said annular rigidifying flange being frusto-conical in shape.

4. A container and cover member as set forth in claim 1, 2 or 3 wherein the removable cover member has a planar intermediate portion and the sealing portion of said cover member is a continuous peripheral outward protuberance adapted to be distortably received in locking engagement under said hook flange.

5. A container and cover member as set forth in claim 1, 2 or 3 wherein the removable cover member has a planar intermediate portion and a depending side wall continuous with said intermediate portion, said depending side wall carrying a continuous peripheral outward sealing protuberance adapted to be distortably re-

ceived in locking engagement under said hook flange.

6. A container and cover member as set forth in claim 5 wherein said outward protuberance is a bead formed along the lower margin of said depending side wall.

7. A container and cover member as set forth in claim 5 wherein said side wall carries a peripheral annular sealing flange which, viewed in cross-section, slopes outwardly and rectilinearly from the lower part of said side wall and is adapted to nest upon the upper surface of said rigidifying flange and has an outer marginal edge adapted to seat under said hook flange.

8. A container and cover member as set forth in claim 5, 6 or 7 wherein said depending side wall has a length greater than the distance (if any) between the plane of said mouth rim and said hook flange but less than the distance between said rim and said junction.

9. A container and cover member as set forth in claim 7 wherein said removable cover member has a continuous inward protuberance formed along the inner margin of said peripheral sealing flange adapted to engage the exterior of the hollow body of the container along a peripheral seal zone spaced adjacently above said junction.

10. A container and cover member as set forth in claim 9 wherein said depending side wall is joined with the upper surface of said annular sealing flange adjacent said inward protuberance.

11. A container and cover member as set forth in claim 1, 2, 3, 4 or 10 wherein said hook flange lies in a plane spaced adjacently below the plane of said rim.

12. A container and cover member as set forth in claim 1, 2, 3, 4 or 10 wherein said hook flange lies in a plane spaced axially above the plane of said rim.

13. A container and cover member as set forth in claim 4, 7 or 9 wherein said hook flange has an under surface which is inclined with an included angle to the upper surface of said rigidifying flange which is a right angle or slightly less than a right angle.

14. A container and cover member as set forth in claim 1, 3, 4, 7 or 10 wherein said acute angle is between 15 degrees and 75 degrees.

15. A container and cover member as set forth in claim 1, 2, 3, 4, 7 or 10 wherein said acute angle is 45 degrees.

16. A container and cover member as set forth in claim 1, wherein one of said container and said cover member is made of a relatively rigid material and the other of a flexibly distortable material.

17. A container and cover member as set forth in claim 9 or 10 wherein said

feasible to construct containers of constant cross-sectional dimensions along their axial length, i.e., to provide cover members which in effect form removable end walls for cylindrical bodies such as tubes or pipes.

WHAT I CLAIM IS:—

1. A container, and a removable cover member therefor, said container comprising a hollow body having an enclosing side wall, the upper end of said side wall terminating in a rim defining a mouth opening and said side wall having an integral rigidifying member which reinforces said rim, and is in the form of an annular flange joined with or meeting said side wall along a junction spaced below said rim and, viewed in cross-section, rising outwardly and rectilinearly from said junction, or from the vicinity of said junction, at an acute angle to the side wall, as far as an upwardly intumed hook flange which is carried by said flange and which extends continuously along the periphery of said rigidifying flange and which has, spaced outwardly of the aforesaid rim, an inner marginal edge for receiving thereunder a peripheral sealing portion of the aforesaid cover member when the cover member is applied in closing relation upon said mouth opening, at least one of the said rigidifying flange and the said sealing portion being flexibly distortable to allow said engagement of the sealing portion under the said inner marginal edge.

2. A container and cover member, as set forth in claim 1, wherein the container is of flexibly distortable structural material and the rigidifying flange integrally joins said container side wall at said junction and commences its rectilinear sloping at said junction.

3. A container and cover member, as set forth in claim 1 or 2, wherein the said rim defines a circular mouth opening, said inner marginal edge of the hook flange being spaced radially of said rim, and said annular rigidifying flange being frusto-conical in shape.

4. A container and cover member as set forth in claim 1, 2 or 3 wherein the removable cover member has a planar intermediate portion and the sealing portion of said cover member is a continuous peripheral outward protuberance adapted to be distortably received in locking engagement under said hook flange.

5. A container and cover member as set forth in claim 1, 2 or 3 wherein the removable cover member has a planar intermediate portion and a depending side wall continuous with said intermediate portion, said depending side wall carrying a continuous peripheral outward sealing protuberance adapted to be distortably re-

ceived in locking engagement under said hook flange.

6. A container and cover member as set forth in claim 5 wherein said outward protuberance is a bead formed along the lower margin of said depending side wall.

7. A container and cover member as set forth in claim 5 wherein said side wall carries a peripheral annular sealing flange which, viewed in cross-section, slopes outwardly and rectilinearly from the lower part of said side wall and is adapted to nest upon the upper surface of said rigidifying flange and has an outer marginal edge adapted to seat under said hook flange.

8. A container and cover member as set forth in claim 5, 6 or 7 wherein said depending side wall has a length greater than the distance (if any) between the plane of said mouth rim and said hook flange but less than the distance between said rim and said junction.

9. A container and cover member as set forth in claim 7 wherein said removable cover member has a continuous inward protuberance formed along the inner margin of said peripheral sealing flange adapted to engage the exterior of the hollow body of the container along a peripheral seal zone spaced adjacently above said junction.

10. A container and cover member as set forth in claim 9 wherein said depending side wall is joined with the upper surface of said annular sealing flange adjacent said inward protuberance.

11. A container and cover member as set forth in claim 1, 2, 3, 4 or 10 wherein said hook flange lies in a plane spaced adjacently below the plane of said rim.

12. A container and cover member as set forth in claim 1, 2, 3, 4 or 10 wherein said hook flange lies in a plane spaced axially above the plane of said rim.

13. A container and cover member as set forth in claim 4, 7 or 9 wherein said hook flange has an under surface which is inclined with an included angle to the upper surface of said rigidifying flange which is a right angle or slightly less than a right angle.

14. A container and cover member as set forth in claim 1, 3, 4, 7 or 10 wherein said acute angle is between 15 degrees and 75 degrees.

15. A container and cover member as set forth in claim 1, 2, 3, 4, 7 or 10 wherein said acute angle is 45 degrees.

16. A container and cover member as set forth in claim 1, wherein one of said container and said cover member is made of a relatively rigid material and the other of a flexibly distortable material.

17. A container and cover member as set forth in claim 9 or 10 wherein said



removable cover member comprises an intermediate planar portion connected with a continuous upwardly extending side wall integrally joined with an annular rounded portion joined integrally with a depending side wall, said depending side wall being adapted when said cover is applied in covering relation upon said rim to engage the exterior of said container side wall above said junction and said annular rounded portion being adapted to bear upon said rim.

18. A container and cover member as set forth in claim 1 or 2, or in claims 4 or 10 insofar as they are not dependent on claim 3, wherein said mouth opening is rectangular with rounded corners and said rigidifying flange which rises rectilinearly viewed in cross-section comprises, viewed in plan, straight side portions merging with rounded corner portions.

19. A container and cover member as set forth in claim 3 or in claims 4 or 10 inso-

far as they are dependent on claim 3 wherein said rim has the largest diameter of said body.

20. A container and cover member as set forth in claim 1, 2, 3, 4, 7 or 10 wherein said body has constant cross-sectional dimensions between said junction and said rim.

21. A container and cover member as set forth in claim 2 or 16, wherein said flexibly distortable material is linear high-density polyethylene.

22. A container and cover member substantially as herein defined with reference to Figures 1 to 5, or Figure 6, or Figure 7, or Figure 8, or Figure 9, of the accompanying drawings.

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