



US 20190283938A1

(19) **United States**(12) **Patent Application Publication**
Strachan(10) **Pub. No.: US 2019/0283938 A1**(43) **Pub. Date: Sep. 19, 2019**(54) **LID FOR SEALING ON CONTAINERS OF
VARIABLE INNER WALL ANGLE****Related U.S. Application Data**

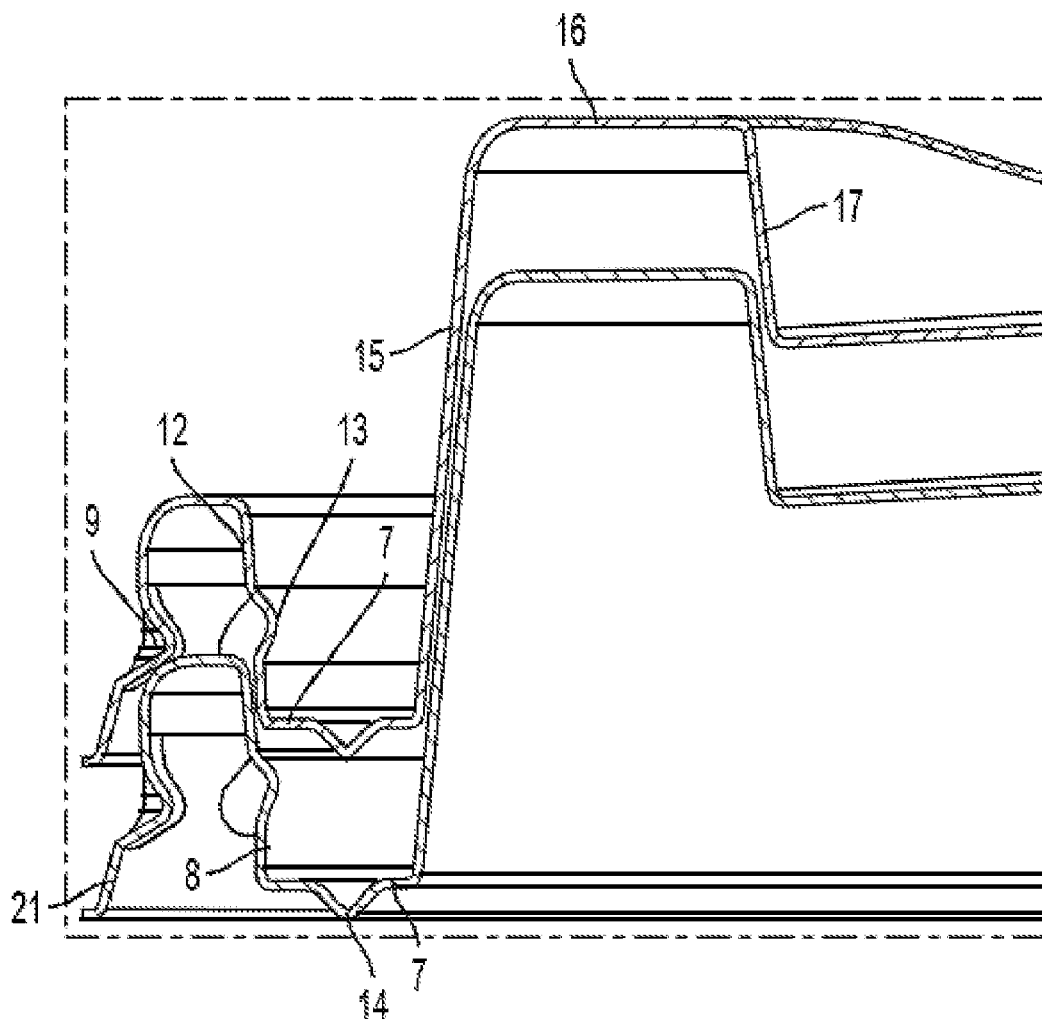
(60) Provisional application No. 62/426,768, filed on Nov. 28, 2016.

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SOLUTIONS, LLC**, Great Neck, NY
(US)**Publication Classification**(51) **Int. Cl.**
B65D 43/02 (2006.01)
B65D 43/06 (2006.01)(72) Inventor: **Mark Strachan**, Jupiter, FL (US)(52) **U.S. Cl.**
CPC **B65D 43/0208** (2013.01); **B65D 43/065**
(2013.01); **B65D 2543/00027** (2013.01); **B65D**
2543/00046 (2013.01); **B65D 2543/00092**
(2013.01); **B65D 2543/00731** (2013.01); **B65D**
2543/00351 (2013.01); **B65D 2543/00509**
(2013.01); **B65D 2543/00638** (2013.01); **B65D**
2543/00685 (2013.01); **B65D 2543/00296**
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(US)(21) Appl. No.: **16/463,539**(22) PCT Filed: **Nov. 28, 2017**(86) PCT No.: **PCT/US2017/063352**

§ 371 (c)(1),

(2) Date: **May 23, 2019**(57) **ABSTRACT**

A lid with a flexible inner seal portion for fitting onto containers having differently angled inner walls.



SEE FIG. 1E

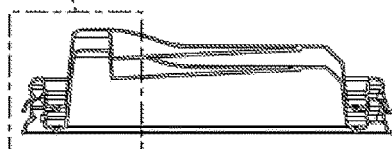


FIG. 1A

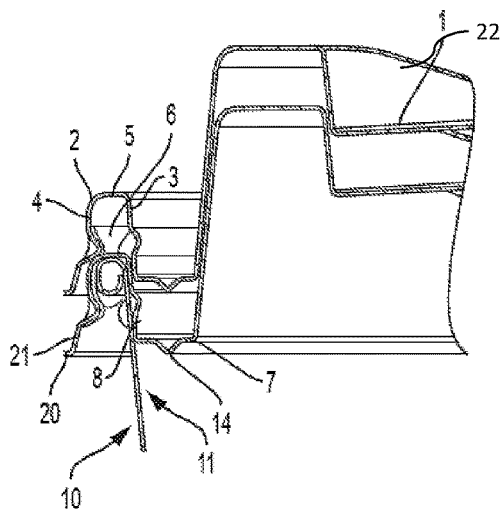


FIG. 1B

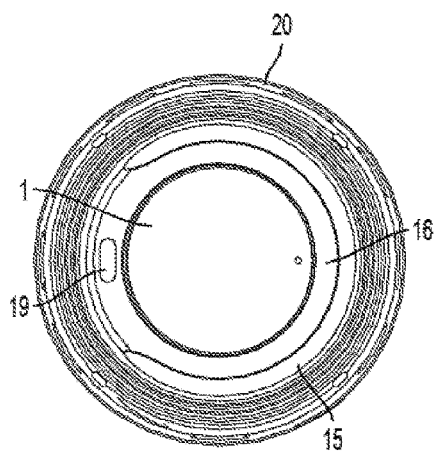


FIG. 1C

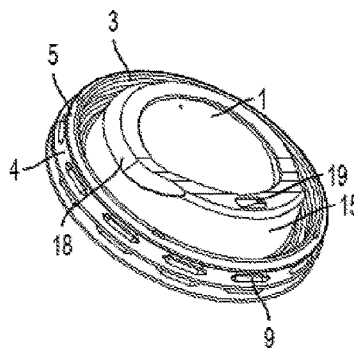


FIG. 1D

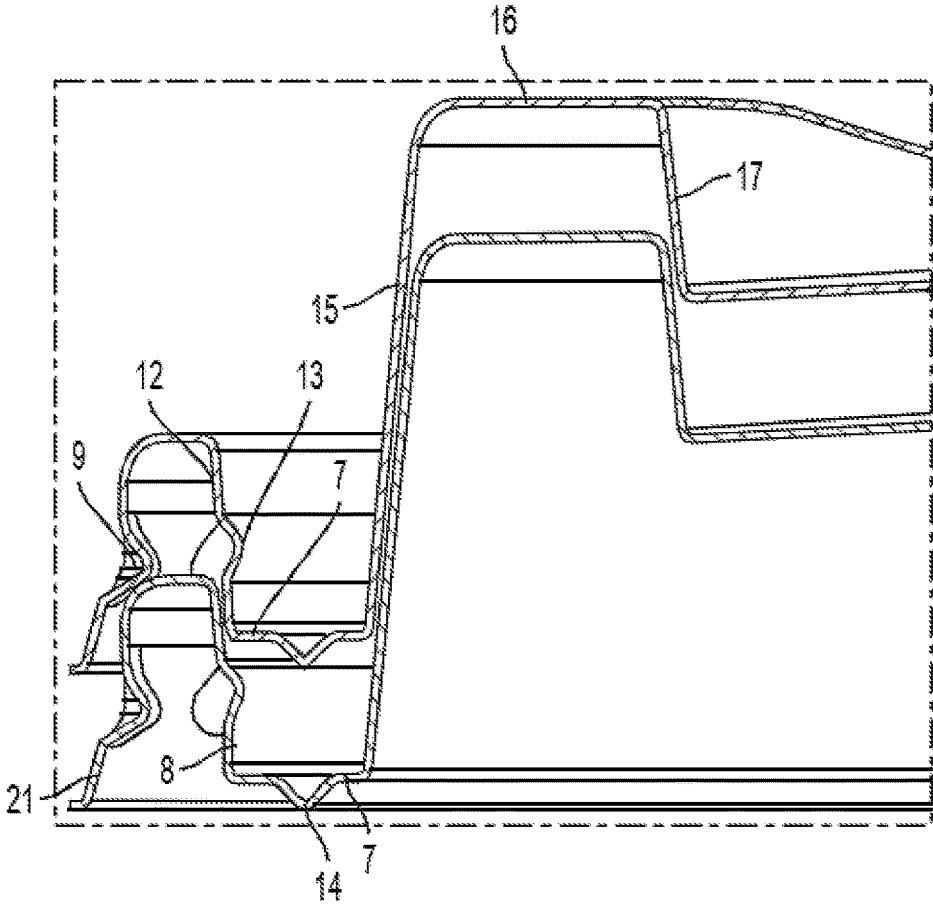


FIG. 1E

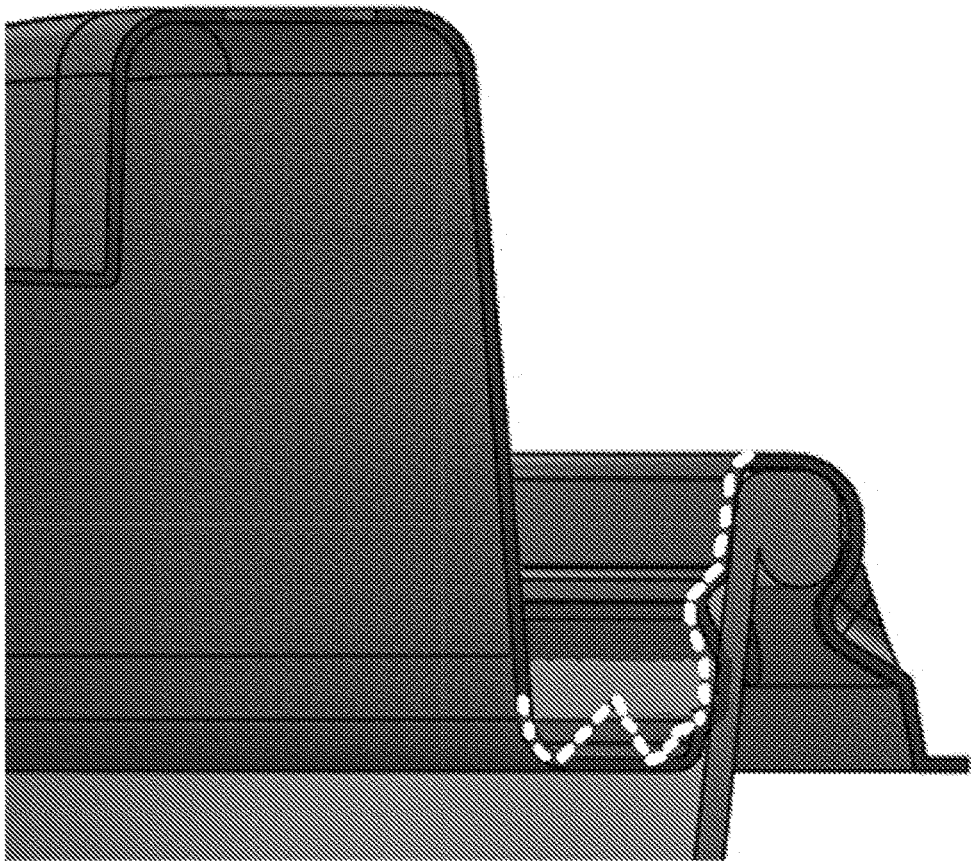


Fig. 2

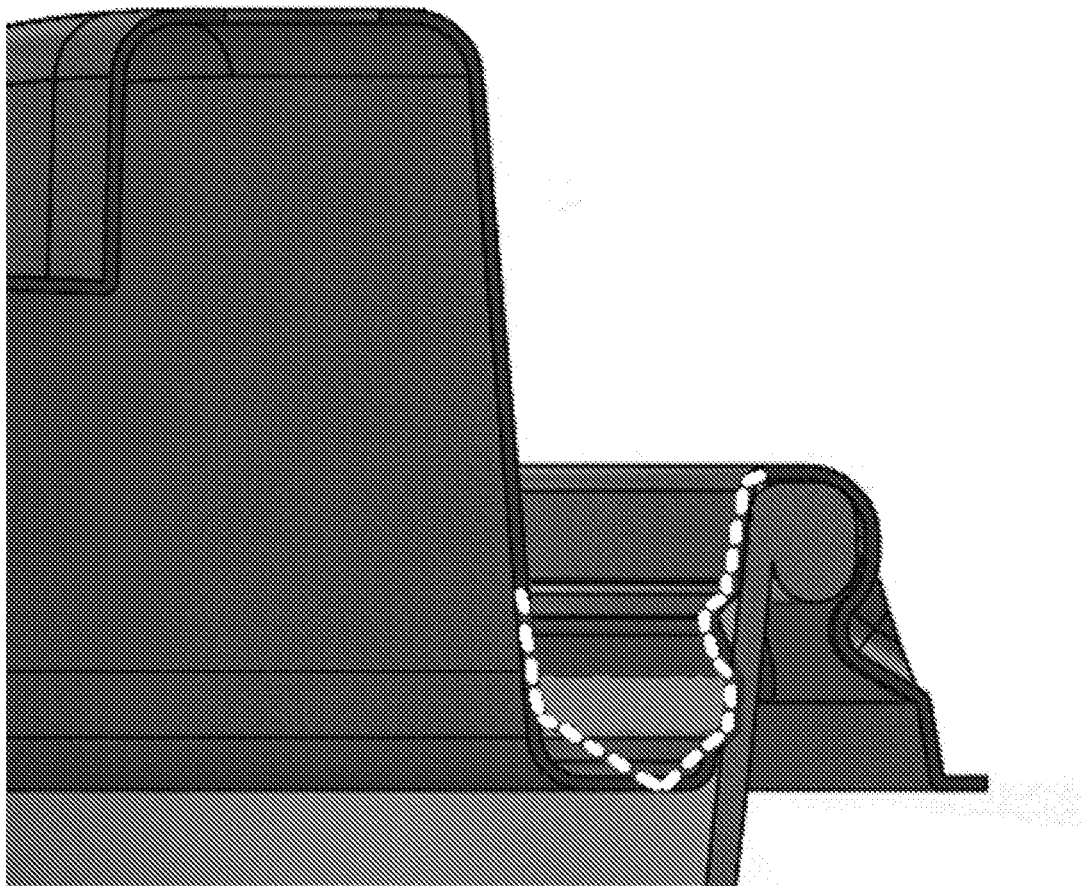


Fig. 3

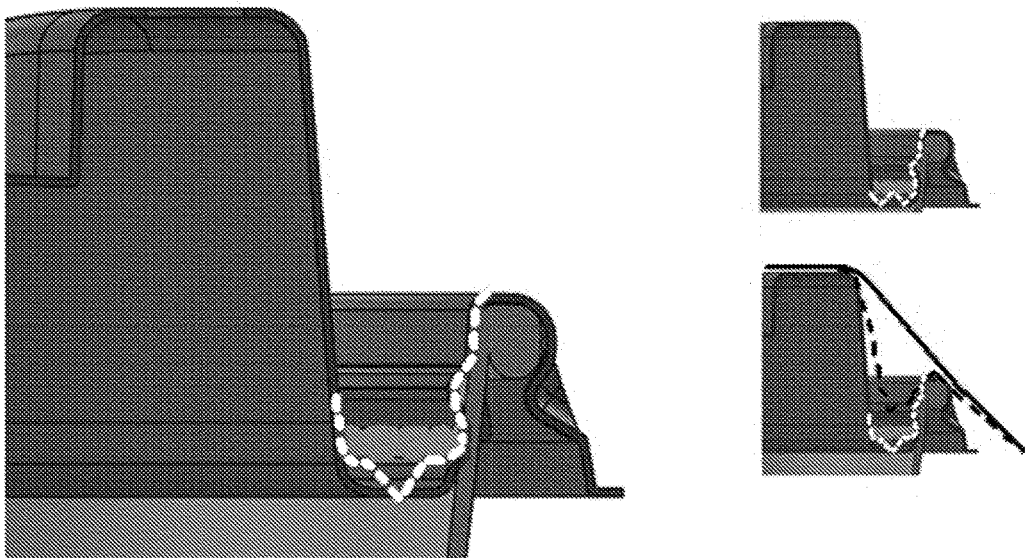


Fig. 4

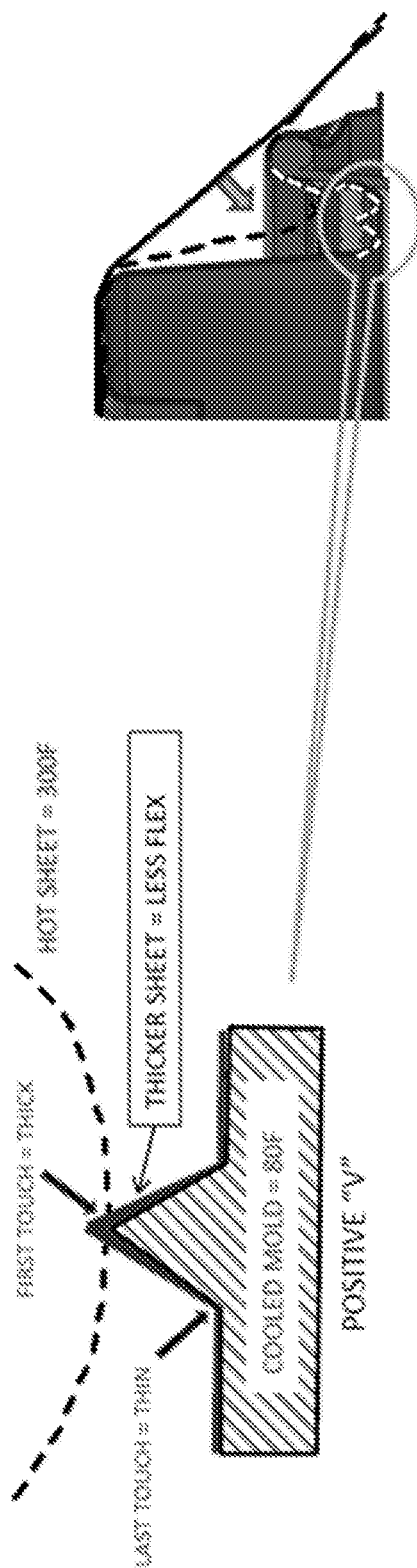


Fig. 5

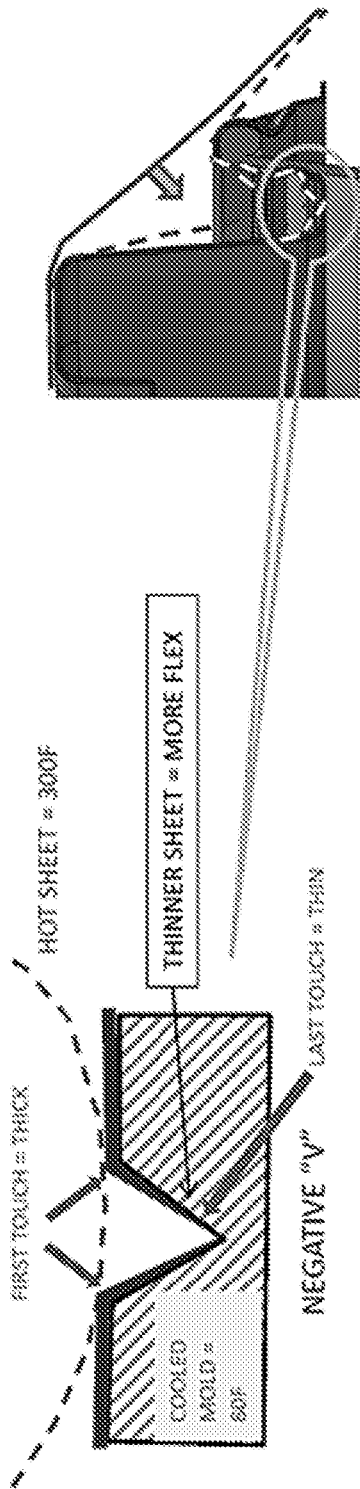


Fig. 6

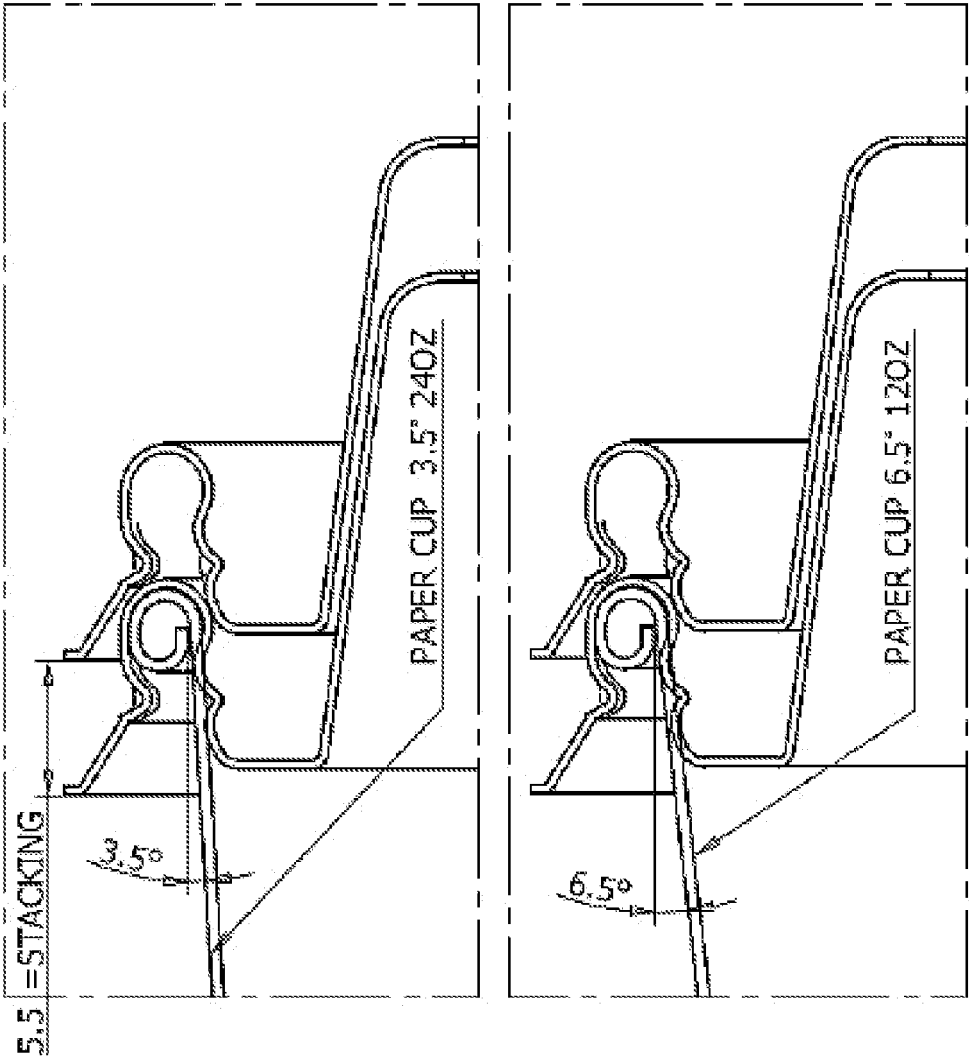


FIG. 7A

FIG. 7B

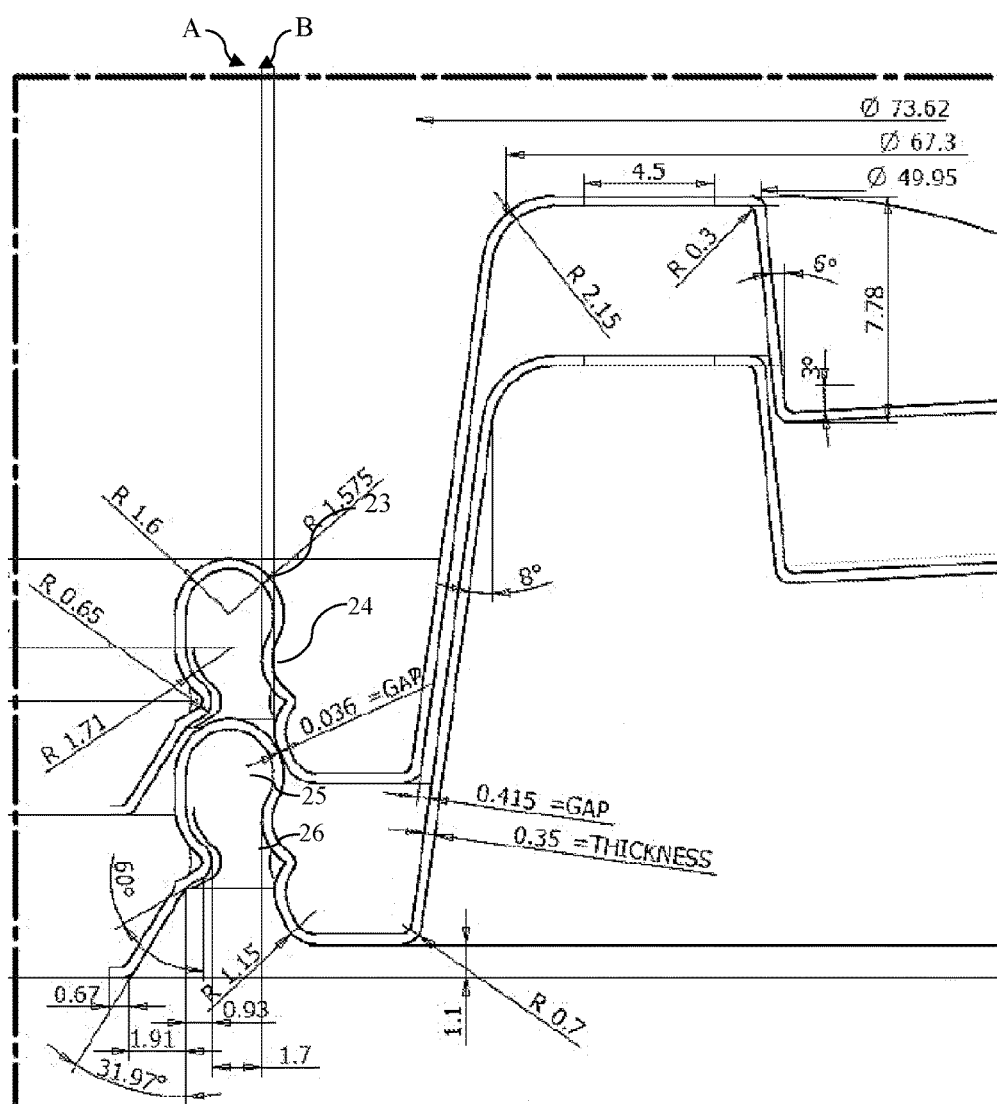


FIG. 8

LID FOR SEALING ON CONTAINERS OF VARIABLE INNER WALL ANGLE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit of U.S. Provisional Application No. 62/426,768, filed Nov. 28, 2016, the contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] A major problem with container lids in the beverage industry is the different wall angles of various beverage containers having the same diameter opening, with smaller volume containers generally having a more extreme inner wall angle than the larger volume containers. One solution is to provide differently angled lids to match the different wall angles. However, it is preferable that a single lid can make a watertight seal on all containers of different volumes having the same diameter opening.

SUMMARY OF THE INVENTION

[0003] An object of the present invention is to provide a lid that can seal tightly on containers of variable inner wall angle.

[0004] A lid is provided with an annular planar portion that is flexible for fitting onto containers having differently angled inner walls, the lid comprising:

a central planar portion;

a brim sealing channel surrounding the central planar portion, forming a circumference; wherein the brim sealing channel comprises an inner sidewall, and outer sidewall, the inner and outer sidewalls each having a main axis substantially perpendicular to a topwall, wherein the inner sidewall, outer sidewall, and top sidewall form the brim sealing channel;

an annular planar portion around the central planar portion and depressed relative to the topwall and relative to the central planar portion, which annular portion connects with a lower portion of the inner sidewall;

at least one indentation disposed annularly on the outer sidewall, distal to the top wall, and projecting into the brim sealing channel relative to a main plane of the outer sidewall main axis substantially perpendicular to the topwall which indentation presses against an outer side wall of a container on which the lid is placed; a lower portion of the inner sidewall, distal to the topwall, which lower portion seals against an inner side wall of a container on which the lid is placed;

an upper portion of the inner sidewall, proximal to the topwall, which upper portion optionally seals against an inner side wall of a container on which the lid is placed, wherein the lower portion of the inner sidewall and the upper portion of the inner sidewall are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel;

wherein the annular planar portion comprises at least one groove therein having a bottom portion below a plane of the remainder of the annular planar portion and below a plane of the central planar portion when the lid is placed in an upright position, and wherein the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion.

[0005] Also provided is a method of manufacturing a lid with a flexible inner seal portion for fitting onto containers having differently angled inner walls, the lid comprising:

a central planar portion;

a brim sealing channel surrounding the central planar portion, forming a circumference; wherein the brim sealing channel comprises an inner sidewall, and outer sidewall, the inner and outer sidewalls each having a main axis substantially perpendicular to a topwall, wherein the inner sidewall, outer sidewall, and top sidewall form the brim sealing channel;

an annular planar portion around the central planar portion and depressed relative to the topwall and relative to the central planar portion, which annular portion connects with a lower portion of the inner sidewall;

at least one indentation disposed annularly on the outer sidewall, distal to the top wall, and projecting into the brim sealing channel relative to a main plane of the outer sidewall main axis substantially perpendicular to the topwall which indentation presses against an outer side wall of a container on which the lid is placed;

a lower portion of the inner sidewall, distal to the topwall, which lower portion seals against an inner side wall of a container on which the lid is placed;

optionally, an upper portion of the inner sidewall, proximal to the topwall, which upper portion seals against an inner side wall of a container on which the lid is placed, wherein the lower portion of the inner sidewall and the upper portion of the inner sidewall are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel;

wherein the annular planar portion comprises at least one groove therein having a bottom portion below a plane of the remainder of the annular planar portion and below a plane of the central planar portion when the lid is placed in an upright position, and wherein the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion,

and wherein the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion,

comprising drawing a polypropylene sheet at a temperature of 250° F. or above into mold comprising a V-shaped groove, wherein the V-shaped groove in a solid is below 100° F., so as to form the lid.

[0006] A lid is provided comprising:

a base member comprising a central planar portion;

an inner sidewall that surrounds the base member and that comprises a bottom portion configured to be in contact with a side wall of a container on which the lid is placed;

an outer sidewall that surrounds the inner sidewall and that comprises at least one indentation that projects towards the inner sidewall, the indentation configured to be in contact with the side wall of the container on which the lid is placed; a top wall that connects the inner sidewall with the outer sidewall;

a brim sealing channel that extends around the base member and that is defined by the inner and outer sidewalls and the top wall;

an annular planar portion that connects the bottom portion of the inner sidewall with the base member, the annular planar portion positioned below the topwall and the base member;

an upper portion of the inner sidewall, which is proximal to the topwall, and above a first generally concave rib which has an apex extending into the brim sealing channel, which first generally concave rib is positioned above a second generally concave rib which has an apex extending into the brim sealing channel, but wherein the apex of the first rib extends away from a plane of the inner sidewall further into the brim sealing channel than the apex of the second rib extends into the brim sealing channel, and wherein both the first apex and second apex seal against an inner side wall of a container on which the lid is placed, and wherein the second rib is positioned above a connection of the inner sidewall with the annular planar portion, and wherein a lowermost portion of the first rib and an uppermost portion of the second rib are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel towards a center of the lid.

BRIEF DESCRIPTION OF FIGURES

[0007] FIGS. 1A-1E: An embodiment of the invention showing features of a preferred lid and also the stackability of the lids (see 1A-1E). 1A shows two stacked lids. In 1B, a central planar portion (1) is shown, and an optional rounded junction (2) between the topwall of the brim sealing channel and an upper portion of the outer sidewall, as well as an inner sidewall (3) of the brim sealing channel, an outer sidewall (4) of the brim sealing channel, a topwall (5) of the brim sealing channel, a brim sealing channel (6), an annular planar portion (7) depressed relative to the topwall (5) and to the central planar portion (1), a lower portion of the inner sidewall (8), an outer sidewall of a container (10), an inner sidewall of a container (11), an outer sidewall comprising a lowermost portion (21) which flares outward (20) away from the central planar portion of the lid. 1C shows a top view of a lid with features (1) and (20) as shown in 1B, and a raised circular base member (15), a raised portion (16) of the circular base member, and a sipping aperture (19). 1C also shows small optional apertures in the outer portion of the lid (in this case four apertures in the topwall of the brim sealing channel, one in each quadrant of the brim). 1D shows two stacked lids at an angle with features (1), (3), (4), (5), as described in 1B and features (15) and (19) as described in 1C, and shows an indentation (9) disposed annularly on the outer sidewall and a chamfered portion (18) of the raised circular base. 1E showing a partial cross section of two stacked lids, shows features (7), (8), (14), (21) as shown in 1B and features (15) and (16) as shown in 1C, and shows an indentation (9) disposed annularly on the outer sidewall as shown in 1D, as well as an upper portion of the inner sidewall (12), an everted portion of the inner sidewall (13), and an inner portion (17) of a raised circular base member connecting a central planar portion with a top surface of a raised circular base member.

[0008] FIG. 2: A schematic showing the a first method of dispersing the distortion to minimize upward force during application and stop wrinkling of inner lower seal. With an inverted V-fold, as shown here, the problem is that if the inner seal is pushed in too far, there is nowhere for the plastic to go except to wrinkle, which results in leaks.

[0009] FIG. 3: A schematic showing a second method of dispersing the distortion to minimize upward force during application and stop wrinkling of inner lower seal—an asymmetric V-fold at the trough and sloping up to the side

walls should allow for some flex in the inner seal area, allowing for an e.g. 3 deg. swing in wall angle.

[0010] FIG. 4: A schematic showing a third method of dispersing the distortion to minimize upward force during application and stop wrinkling of inner lower seal—adding a substantially symmetric V-fold to the base of the trough. The plastic is drawn down into the ‘V’ groove (instead of over the ‘V’) thus causing it to thin out substantially and thus allow more flexing. It is advantageous to create the V-fold as a negative V-fold (see FIG. 6).

[0011] FIG. 5: Illustration of how the heated plastic sheet is formed over and into the mold cavity and how a positive ‘V’ affects the functionality.

[0012] FIG. 6: Illustration of how the heated plastic sheet is formed over and into the mold cavity and how a negative ‘V’ affects the functionality. When the hot sheet is drawn down into a negative ‘V’ configuration in the mold, the tips of the ‘V’ will be thinner and thus will allow for more flex. Compare with FIG. 5 where a positive ‘V’ configuration is utilized, and the tips of the ‘V’ are thicker and less likely to flex.

[0013] FIGS. 7A-7B: An embodiment of the invention showing features of a preferred lid and also the stackability of the lids (7A-7B). With the upper rib displaced into the brim sealing channel relative to the lower rib, a tight seal is achieved against an inner cup wall angle of 3.5° (7A), and also of 6.5° (7B).

[0014] FIG. 8: An embodiment of the invention showing features of a preferred lid and also the stackability of the lids. A cross-section through portions of two stacked lids are shown. Each lid shown comprises a base member comprising a central planar portion; an inner sidewall that surrounds the base member and that comprises a bottom portion configured to be in contact with a side wall of a container on which the lid is placed; an outer sidewall that surrounds the inner sidewall and that comprises at least one indentation that projects towards the inner sidewall, the indentation configured to be in contact with the side wall of the container on which the lid is placed; a top wall that connects the inner sidewall with the outer sidewall; a brim sealing channel that extends around the base member and that is defined by the inner and outer sidewalls and the top wall; an annular planar portion that connects the bottom portion of the inner sidewall with the base member, the annular planar portion positioned below the topwall and the base member; (all the preceding having equivalent structures as shown in FIG. 1); an upper portion (23) of the inner sidewall, which is proximal to the topwall, and above a first generally concave rib which has an apex (25) extending into the brim sealing channel, which first generally concave rib is positioned above a second generally concave rib which has an apex (26) extending into the brim sealing channel, but wherein the apex of the first rib extends away from a plane of the inner sidewall further into the brim sealing channel than the apex of the second rib extends into the brim sealing channel (see difference between apex marking lines A and B), and wherein both the first apex and second apex seal against an inner side wall of a container on which the lid is placed, and wherein the second rib is positioned above a connection of the inner sidewall with the annular planar portion, and wherein a lowermost portion of the first rib and an uppermost portion of the second rib are connected to each other

via an everted portion (24) of the inner sidewall that projects away from the brim sealing channel towards a center of the lid.

DETAILED DESCRIPTION OF THE INVENTION

[0015] A lid is provided with an annular planar portion that is flexible for fitting onto containers having differently angled inner walls, the lid comprising:

a central planar portion;

a brim sealing channel surrounding the central planar portion, forming a circumference;

wherein the brim sealing channel comprises an inner sidewall, and outer sidewall, the inner and outer sidewalls each having a main axis substantially perpendicular to a topwall, wherein the inner sidewall, outer sidewall, and top sidewall form the brim sealing channel;

an annular planar portion around the central planar portion and depressed relative to the topwall and relative to the central planar portion, which annular portion connects with a lower portion of the inner sidewall;

at least one indentation disposed annularly on the outer sidewall, distal to the top wall, and projecting into the brim sealing channel relative to a main plane of the outer sidewall main axis substantially perpendicular to the topwall which indentation presses against an outer side wall of a container on which the lid is placed; a lower portion of the inner sidewall, distal to the topwall, which lower portion seals against an inner side wall of a container on which the lid is placed;

optionally, an upper portion of the inner sidewall, proximal to the topwall, which upper portion seals against an inner side wall of a container on which the lid is placed, wherein the lower portion of the inner sidewall and the upper portion of the inner sidewall are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel;

wherein the annular planar portion comprises at least one groove therein having a bottom portion below a plane of the remainder of the annular planar portion and below a plane of the central planar portion when the lid is placed in an upright position, and wherein the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion.

[0016] Preferably, the at least one groove is V-shaped in cross-section with a tip of the V being the lower portion of the groove. The groove separates an inner portion of the annular planar portion from an outer portion of the annular planar portion. For best performance the groove is flexible, preferably about a vertical axis perpendicular to the annular planar portion of the lid. The groove can permit flexion of the outer portion of the annular planar portion, and/or of the lid, so as to seal against an inner wall of a container on which the lid is placed, for example, wherein the inner wall has an angle of from 2° to 8° away from a vertical axis perpendicular to the longest axis of the lid, and away from a center of the lid. The groove can permit flexion of the outer portion of the annular planar portion and/or of the lid, such that the lower portion of the inner sidewall seals against the inner side wall of a container on which the lid is placed wherein the inner wall has an angle of from 2° to 8° away from a vertical axis perpendicular to the longest axis of the lid, and away from a center of the lid.

[0017] In an embodiment, the lid is manufactured from polypropylene. In an embodiment, it is manufactured from polypropylene sheet thickness 0.3 to 0.4 mm. In an embodiment, it is manufactured from polypropylene sheet thickness 0.35 mm. In an embodiment, the lid is thermoformed over a cooled mold, cooled relative to the polypropylene being thermoformed. In an embodiment, the lid is made from a polymer, e.g. polypropylene, such that the tip of the groove portion is pulled into a negative mold, for example a negative V-mold as shown in FIG. 6. In an embodiment, the trough of the V-shaped groove is thinner than the thicker portions (or “tips”) of the V that are adjacent to and continuous with the annular portion. (See FIG. 6 for an exemplary embodiment). This results in improved flexion over a positive molded groove. This improved flexion in turn results in less plastic “wrinkle” of the inner sidewall of the brim sealing channel when the cup is placed on containers having different inner wall draft angles as compared to a lid with less flexion.

[0018] Preferably, the central planar portion is circular. In an embodiment, the central planar portion is raised relative to the annular planar portion when the lid is in an upright position (e.g. with sipping aperture uppermost). In an embodiment, the central planar portion comprises a raised circular base member raised relative to the annular planar portion, and further comprising an inner central planar portion which is depressed relative to the circular base member but raised relative to the annular planar portion when the lid is in an upright position.

[0019] In an embodiment, the lid further comprises a sipping aperture—for example, in situations where it is desirable that the user be able to sip the contents of the container without removing the lid. The sipping aperture is preferably positioned on the raised circular base member. The raised circular base member can be chamfered on at least 50% of an outside diameter thereof. In an embodiment, the sipping member is positioned on a raised portion of the raised circular base member. The sipping member can be positioned on a portion of the raised circular base member which is not chamfered.

[0020] In an embodiment, the lid further comprises at least one aperture in the topwall of the brim sealing channel such that sealing of the lid onto the brim of a container is visually ascertainable through the aperture. In an embodiment, the lid comprises at least one aperture in each quadrant of the topwall of the brim sealing channel.

[0021] The outer sidewall can comprise a lowermost portion which flares outward away from the central planar portion of the lid.

[0022] In one embodiment, the groove has inside angle of between 60 and 130 degrees. In one embodiment, the groove has inside angle of between 70 and 120 degrees. In one embodiment, the groove has inside angle of between 80 and 110 degrees. In an embodiment, the groove has inside angle of 90 degrees.

[0023] The lid can be structured such that the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion.

[0024] Also provided is a method of manufacturing a lid with a flexible inner seal portion for fitting onto containers having differently angled inner walls, the lid comprising:

a central planar portion;

a brim sealing channel surrounding the central planar portion, forming a circumference;

wherein the brim sealing channel comprises an inner sidewall, and outer sidewall, the inner and outer sidewalls each having a main axis substantially perpendicular to a topwall, wherein the inner sidewall, outer sidewall, and top sidewall form the brim sealing channel;

an annular planar portion around the central planar portion and depressed relative to the topwall and relative to the central planar portion, which annular portion connects with a lower portion of the inner sidewall;

at least one indentation disposed annularly on the outer sidewall, distal to the top wall, and projecting into the brim sealing channel relative to a main plane of the outer sidewall main axis substantially perpendicular to the topwall which indentation presses against an outer side wall of a container on which the lid is placed;

a lower portion of the inner sidewall, distal to the topwall, which lower portion seals against an inner side wall of a container on which the lid is placed;

optionally, an upper portion of the inner sidewall, proximal to the topwall, which upper portion seals against an inner side wall of a container on which the lid is placed, wherein the lower portion of the inner sidewall and the upper portion of the inner sidewall are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel;

wherein the annular planar portion comprises at least one groove therein having a bottom portion below a plane of the remainder of the annular planar portion and below a plane of the central planar portion when the lid is placed in an upright position, and wherein the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion,

and wherein the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion,

comprising drawing a polypropylene sheet at a temperature of 250° F. or above into mold comprising a V-shaped groove, wherein the V-shaped groove in a solid is below 100° F., so as to form the lid.

[0025] In an embodiment of the method herein, the polypropylene sheet drawn into the mold touches a flat planar surface of the mold before it touches the inside of the V-shaped groove in the mold. For example, see FIG. 6. The lid produced can comprise thinner polypropylene at a bottom portion of the groove than the thickness of the polypropylene of the annular planar portion. In an embodiment the polypropylene is high-impact polypropylene.

[0026] In an embodiment, the lid has an outermost diameter of 92-95 mm.

[0027] A lid is provided comprising:

[0028] a base member comprising a central planar portion; an inner sidewall that surrounds the base member and that comprises a bottom portion configured to be in contact with a side wall of a container on which the lid is placed;

an outer sidewall that surrounds the inner sidewall and that comprises at least one indentation that projects towards the inner sidewall, the indentation configured to be in contact with the side wall of the container on which the lid is placed; a top wall that connects the inner sidewall with the outer sidewall;

a brim sealing channel that extends around the base member and that is defined by the inner and outer sidewalls and the top wall;

an annular planar portion that connects the bottom portion of the inner sidewall with the base member, the annular planar portion positioned below the topwall and the base member;

an upper portion of the inner sidewall, which is proximal to the topwall, and above a first generally concave rib which has an apex extending into the brim sealing channel, which first generally concave rib is positioned above a second generally concave rib which has an apex extending into the brim sealing channel, but wherein the apex of the first rib extends away from a plane of the inner sidewall further into the brim sealing channel than the apex of the second rib extends into the brim sealing channel, and wherein both the first apex and second apex seal against an inner side wall of a container on which the lid is placed,

and wherein the second rib is positioned above a connection of the inner sidewall with the annular planar portion, and wherein a lowermost portion of the first rib and an uppermost portion of the second rib are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel towards a center of the lid.

[0029] In an embodiment, the annular planar portion further comprises at least one groove therein having a bottom portion below a plane of the remainder of the annular planar portion and below a plane of the central planar portion, and wherein the at least one groove is thinnest at a bottom portion of the groove.

[0030] In an embodiment, the apex of the first rib extends away from a plane of the inner sidewall further into the brim sealing channel than the apex of the second rib extends into the brim sealing channel such that both apexes seal against an inner wall of a container on which the lid is placed, wherein the inner wall of the container is angled from 2° to 8° relative to a vertical axis in a direction away from a center of the lid.

[0031] In an embodiment, the lid is manufactured from polypropylene. In an embodiment, the central planar portion is circular. In an embodiment, the central planar portion is raised relative to the annular planar portion.

[0032] In an embodiment, the base member further comprises a peripheral rim portion that is raised relative to the annular planar portion, and the central planar portion is depressed relative to the peripheral rim portion and raised relative to the annular planar portion.

[0033] In an embodiment, the lid further comprises a sipping aperture. In an embodiment, the sipping aperture is positioned on the peripheral rim portion. In an embodiment, the peripheral rim portion is chamfered on at least 50% of an outside diameter thereof. In an embodiment, the sipping member is positioned on a raised portion of the peripheral rim portion. In an embodiment, the sipping member is positioned on a portion of the peripheral rim portion which is not chamfered.

[0034] In an embodiment, the lid further comprises at least one aperture in the topwall that defines the brim sealing channel such that sealing of the lid onto the brim of a container is visually ascertainable through the aperture. In an embodiment, the lid comprises at least one aperture in each quadrant of the topwall that defines the brim sealing channel.

[0035] In an embodiment, the outer sidewall comprises a lowermost portion which flares outward away from the central planar portion of the lid.

[0036] In an embodiment, the lid is 92-95 mm in diameter. In an embodiment, the polypropylene of the lid is 0.5 to 0.6 mm thick. In an embodiment, the polypropylene of the lid is 0.53 mm thick. In an embodiment the lid comprises high-impact polypropylene.

[0037] In an embodiment, the arc length of the apex of first and second rib is substantially the same. In an embodiment, the cross-section sector size of the first and second rib is substantially the same.

[0038] “And/or” as used herein, for example, with option A and/or option B, encompasses the separate embodiments of (i) option A, (ii) option B, and (iii) option A plus option B.

[0039] Where a numerical range is provided herein, it is understood that all numerical subsets of that range, and all the individual integers contained therein and one tenth portions thereof, are provided as part of the invention as individual embodiments. Thus, a lid for which the range provided is from 90-95 mm in diameter includes lids which are 90.0 mm, 90.1 mm, 90.2 mm, 90.3 mm and so forth in diameter, as well as lids which are 92-94 mm in diameter, 92-95 mm in diameter and so forth.

[0040] All combinations of the various elements described herein are within the scope of the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

[0041] Since different volume frusto-conical cups having the same diameter circular mouth will each have a different wall draft angle (for example, wall draft angles of 6.5 deg., 5 deg., 4 deg., and 3.5. deg. for exemplary 12 fl. oz., 16 fl. oz., 20 fl. oz. and 24 fl. oz. cups, respectively, having a mouth (or opening) diameter of 89.5 mm) providing a single lid that will fit independently on all of the different cup sizes presents a challenge in at least making one or more liquid-tight seals against the different wall draft angles. A lid which seals on the outside of the cup does not have this challenge—since it depends merely on the diameter of the opening which is consistent among the different volume cups. But a cup that has an inner seal or two inner seals, is a more problematic situation. For example, cup draft angle can affects the integrity of both the upper and lower inner seals in the case of a lid having both upper and lower inner seals. A lid that can meet the requirements of sealing against a wall draft angle range of 6.5 deg. to 3.5 deg. must meet a 3 deg. swing.

[0042] In general, in the case of a lid having both a lower and upper inner seal, the lower inner seal is preferably formed thinner so that it will flex and take the contour of the cup and the paper cup join as much as possible. Allowing for, e.g. a 0.01" (0.29 mm) interference between the wall of the cup and the lid at the lower inner seal, creates a more definite lower seal. This means that the lower seal is actually forced against the side wall of the cup, while the upper seal merely sits snugly against the wall. However, in the case of, e.g., 12 fl. oz. vs 24 fl. oz. frusto-conical cup, because the lower inner seal of the lid has more interference with the side wall of the 12 fl. oz. cup, it is harder to push the lid on to the cup and thus the useful “snap” sound of sealing is lost. In contrast, the lid fits easily onto the 24 fl. oz. cup as there is less interference and thus less resistance to applying the lid and thus a better “snap.” A solution is disclosed herein,

including the illustrations in FIGS. 1A-1E. Different methods of having a flexible joint in the lid within the rim from the inner seal are illustrated in FIGS. 2-6.

[0043] FIGS. 1A-1E show features of a lid and also the stackability of the lids according to an exemplary embodiment of the present invention. As shown in the partial cross-sectional view of the stacked lids, each lid 30 has a generally circular profile with an elevated base member 15 surrounded by a brim. The elevated base member 15 includes central planar portion 1. The brim includes an annular planar portion 7 that forms a trough and a brim sealing channel 6 that extends upwards relative to the annular planar portion 7. The brim sealing channel 6 includes an inner sidewall 3, an outer sidewall 4, and a topwall 5 between the inner and outer sidewalls 3, 4. Although the topwall 5 is shown with a rounded profile in the figures, it should be appreciated that the topwall 5 may have any suitable profile shape. The outer sidewall 4 has a lowermost portion 21 that flares outward and terminates in a rim 20. As shown in FIG. 1B, the lowermost lid 30 in the stack may be placed on a container, which includes a sidewall having an outer surface 10 and an inner surface 11, so that the sidewall extends into and is fixed in the brim sealing channel 6.

[0044] The elevated base member 15 includes a peripheral rim portion 16 in which is formed a sipping aperture 19. FIG. 1C shows small optional apertures in the outer portion of the lid (in this case four apertures in the topwall 5 of the brim sealing channel 6, one in each quadrant of the brim). As shown most clearly in FIG. 1D, indentations 9 may be formed in the outer sidewall 4 and the peripheral rim portion 16 may include a chamfered portion 18. As shown in FIG. 1D, the inner sidewall 3 has an upper portion 12, a lower portion 8 and a protruding portion 13 disposed between the upper and lower portions 12, 8, and an annular wall 17 extends between the central planar portion 1 and the peripheral rim portion 16.

[0045] A problem that occurs during application of the lid onto a container is that upward force causes wrinkling of the inner sidewall 3, in particular the lower portion 8 of the inner sidewall 3, of the brim sealing channel 6 of the lid 30. In order to address this issue, as shown in FIG. 2, an inverted V-fold (also referred to herein as a “positive V-fold”) may be formed in the annular planar portion 7. However, even with the inverted V-fold, as shown here, if the lower portion 8 of the inner sidewall 3 is pushed in too far due to the sidewall angle of the container, the lower portion 8 will wrinkle, which results in leaks.

[0046] As shown in FIG. 3, according to an exemplary embodiment of the present invention, an asymmetric V-fold is formed in the annular planar portion 7, with the legs of the V-fold sloping up to the inner side wall 3 of the brim sealing channel 6 and the side wall of the elevated base member 15. This construction allows for some flex in the inner side wall 3, which in turn allows for a swing in wall angle (e.g., 3 degrees) without wrinkling.

[0047] As shown in FIG. 4, according to another exemplary embodiment of the present invention, a symmetric V-fold (also referred to herein as a “negative V-fold”) is formed in the annular planar portion 7. As shown in FIG. 6, this constructions causes the plastic of the lid 30 to be drawn down into the ‘V’ groove (instead of over the ‘V’) during molding of the lid 30, which results in substantial thinning of the plastic to allow more flexing without wrinkling.

[0048] FIG. 5 is an illustration of how the heated (e.g. 300° F.) plastic sheet, e.g. polypropylene, is formed over and into the mold cavity (preferably cooled relative to the sheet—e.g. 80° F.) and how a positive “V” affects the functionality. The preferred method is shown in FIG. 6, where the heated plastic sheet is formed over and drawn into the mold cavity. When the hot sheet is drawn down into a negative “V” configuration in the mold, the tips of the “V” will be thinner and thus will allow for more flex. Compare with FIG. 5 where a positive “V” configuration is utilized, and the tips of the “V” are thicker and less likely to flex.

[0049] Also provided is a lid with a flexible annular planar portion for fitting onto containers having differently angled inner walls, the lid comprising: a central planar portion; a brim sealing channel surrounding the central planar portion, forming a circumference; wherein the brim sealing channel comprises an inner sidewall, and outer sidewall, the inner and outer sidewalls each having a main axis substantially perpendicular to a topwall, wherein the inner sidewall, outer sidewall, and top sidewall form the brim sealing channel; an annular planar portion around the central planar portion and depressed relative to the topwall and relative to the central planar portion, which annular portion connects with a lower portion of the inner sidewall; at least one indentation disposed annularly on the outer sidewall, distal to the top wall, and projecting into the brim sealing channel relative to a main plane of the outer sidewall main axis substantially perpendicular to the topwall which indentation presses against an outer side wall of a container on which the lid is placed; a lower portion of the inner sidewall, distal to the topwall, which lower portion seals against an inner side wall of a container on which the lid is placed; optionally, an upper portion of the inner sidewall, proximal to the topwall, which upper portion seals against an inner side wall of a container on which the lid is placed, wherein the lower portion of the inner sidewall and the upper portion of the inner sidewall are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel; wherein the annular planar portion comprises at least one groove therein having a bottom portion below a plane of the remainder of the annular planar portion and below a plane of the central planar portion when the lid is placed in an upright position, and wherein the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion.

[0050] Another solution to the problem is provided herein and exemplified in FIGS. 7A, 7B and 8. Existing “over cap” style lids do not rely on a double inner seal like the lid in FIGS. 7 and 8 disclosed herein. Instead, the sealing in current “over cap” lids exists around the outer perimeter of the lid and cup. In such a situation, as long as the cup diameters stay the same, the angle of the side walls has no bearing on the effectiveness of the seal. However, in the case of an inner seal, the different wall angles create a problem situation. A lid relying on the double inner seals against the inside of the cups to ensure a leak proof seal is challenged when the side wall angles of the cups change, such as is the case between the 8 oz, 12 oz, 16 oz and 24 oz paper coffee cups. The outer diameters of these cups are the same, and thus an over cap style lid works for the same range of cups. However a standard “plug fit” style lid with inner seals, especially more than one inner seal, will not function (seal) properly with such a range of wall angles.

[0051] To address this problem, a lid with differentially positioned double inner ribs is provided. As exemplified in an embodiment in FIG. 8 (which shows exemplary but non-limiting angles and sizings), each lid shown comprises a base member comprising a central planar portion; an inner sidewall that surrounds the base member and that comprises a bottom portion configured to be in contact with a side wall of a container on which the lid is placed; an outer sidewall that surrounds the inner sidewall and that comprises at least one indentation that projects towards the inner sidewall, the indentation configured to be in contact with the side wall of the container on which the lid is placed; a top wall that connects the inner sidewall with the outer sidewall; a brim sealing channel that extends around the base member and that is defined by the inner and outer sidewalls and the top wall; an annular planar portion that connects the bottom portion of the inner sidewall with the base member, the annular planar portion positioned below the topwall and the base member; (all the preceding having equivalent structures as shown in FIG. 1); an upper portion (23) of the inner sidewall, which is proximal to the topwall, and above a first generally concave rib which has an apex (25) extending into the brim sealing channel, which first generally concave rib is positioned above a second generally concave rib which has an apex (26) extending into the brim sealing channel, but wherein the apex of the first rib extends away from a plane of the inner sidewall further into the brim sealing channel than the apex of the second rib extends into the brim sealing channel (see difference between apex marking lines A and B), and wherein both the first apex and second apex seal against an inner side wall of a container on which the lid is placed, and wherein the second rib is positioned above a connection of the inner sidewall with the annular planar portion, and wherein a lowermost portion of the first rib and an uppermost portion of the second rib are connected to each other via an everted portion (24) of the inner sidewall that projects away from the brim sealing channel towards a center of the lid. The difference between apex marking lines A and B is a demonstration of the extent that the apex of the first rib extends away from a plane of the inner sidewall further into the brim sealing channel than the apex of the second rib extends into the brim sealing channel. Exemplary embodiments are an AB difference of 0.05 to 1.05 mm. In an embodiment, the AB difference is 0.8-0.95 mm. In an embodiment, the AB difference is 0.85-0.90 mm. In an embodiment, the AB difference is 0.87-0.88 mm.

1. A lid comprising:

- a base member comprising a central planar portion;
- an inner sidewall that surrounds the base member and that comprises a bottom portion configured to be in contact with a side wall of a container on which the lid is placed;
- an outer sidewall that surrounds the inner sidewall and that comprises at least one indentation that projects towards the inner sidewall, the indentation configured to be in contact with the side wall of the container on which the lid is placed;
- a top wall that connects the inner sidewall with the outer sidewall;
- a brim sealing channel that extends around the base member and that is defined by the inner and outer sidewalls and the top wall;

- an annular planar portion that connects the bottom portion of the inner sidewall with the base member, the annular planar portion positioned below the topwall and the base member;
- optionally, an upper portion of the inner sidewall, proximal to the topwall, which upper portion seals against an inner side wall of a container on which the lid is placed, wherein the lower portion of the inner sidewall and the upper portion of the inner sidewall are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel;
- wherein the annular planar portion comprises at least one groove therein having a bottom portion below a plane of the remainder of the annular planar portion and below a plane of the central planar portion, and wherein the at least one groove is thinnest at a bottom portion of the groove.
2. The lid of claim 1, wherein the at least one groove is V-shaped in cross-section with a tip of the V being the bottom portion of the groove.
3. The lid of claim 1 or 2, wherein the groove separates an inner portion of the annular planar portion from an outer portion of the annular planar portion.
4. The lid of claim 3, wherein the groove is flexible about a vertical axis perpendicular to the annular planar portion of the lid.
5. The lid of claim 4, wherein the groove permits flexion of the outer portion of the annular planar portion, and/or of the lid, so as to seal against an inner wall of a container on which the lid is placed, wherein the inner wall of the container is angled from 2° to 8° relative to a vertical axis in a direction away from a center of the lid.
6. The lid of claim 1, wherein the at least one groove permits flexion of the outer portion of the annular planar portion and/or of the lid, such that the lower portion of the inner sidewall seals against the inner side wall of a container on which the lid is placed wherein the inner wall is angled from 2° to 8° relative to a vertical axis in a direction away from a center of the lid.
7. The lid of claim 1, wherein the lid is manufactured from polypropylene.
8. The lid of claim 1, wherein the central planar portion is circular.
9. The lid of claim 1, wherein the central planar portion is raised relative to the annular planar portion.
10. The lid of claim 1, wherein the base member further comprises a peripheral rim portion that is raised relative to the annular planar portion, and the central planar portion is depressed relative to the peripheral rim portion and raised relative to the annular planar portion.
11. The lid of claim 1, further comprising a sipping aperture.
12. The lid of claim 11, wherein the sipping aperture is positioned on the peripheral rim portion.
13. The lid of claim 11, wherein peripheral rim portion is chamfered on at least 50% of an outside diameter thereof.
14. The lid of claim 13, wherein the sipping member is positioned on a raised portion of the peripheral rim portion.
- 15-20. (canceled)
21. A method of manufacturing a lid with a flexible inner seal portion for fitting onto containers having differently angled inner walls, the lid comprising:
- a central planar portion;
- a brim sealing channel surrounding the central planar portion, forming a circumference;
- wherein the brim sealing channel comprises an inner sidewall, and outer sidewall, the inner and outer sidewalls each having a main axis substantially perpendicular to a topwall, wherein the inner sidewall, outer sidewall, and top sidewall form the brim sealing channel;
- an annular planar portion around the central planar portion and depressed relative to the topwall and relative to the central planar portion, which annular portion connects with a lower portion of the inner sidewall;
- at least one indentation disposed annularly on the outer sidewall, distal to the top wall, and projecting into the brim sealing channel relative to a main plane of the outer sidewall main axis substantially perpendicular to the topwall which indentation presses against an outer side wall of a container on which the lid is placed;
- a lower portion of the inner sidewall, distal to the topwall, which lower portion seals against an inner side wall of a container on which the lid is placed;
- optionally, an upper portion of the inner sidewall, proximal to the topwall, which upper portion seals against an inner side wall of a container on which the lid is placed, wherein the lower portion of the inner sidewall and the upper portion of the inner sidewall are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel;
- wherein the annular planar portion comprises at least one groove therein having a bottom portion below a plane of the remainder of the annular planar portion and below a plane of the central planar portion when the lid is placed in an upright position, and wherein the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion,
- and wherein the material from which the lid is fabricated is thinner in the bottom portion of the groove than portions of the groove adjacent to the remainder of the annular planar portion, comprising drawing a polypropylene sheet at a temperature of 250° F. or above into mold comprising a V-shaped groove, wherein the V-shaped groove in a solid is below 100° F., so as to form the lid.
22. The method of claim 21, wherein the polypropylene sheet drawn into the mold touches a flat planar surface of the mold before it touches the inside of the V-shaped groove in the mold.
23. The method of claim 21, wherein the lid produced comprises thinner polypropylene at a bottom portion of the groove than the thickness of the polypropylene of the annular planar portion.
24. (canceled)
25. A lid comprising:
- a base member comprising a central planar portion;
- an inner sidewall that surrounds the base member and that comprises a bottom portion configured to be in contact with a side wall of a container on which the lid is placed;
- an outer sidewall that surrounds the inner sidewall and that comprises at least one indentation that projects

towards the inner sidewall, the indentation configured to be in contact with the side wall of the container on which the lid is placed;

a top wall that connects the inner sidewall with the outer sidewall;

a brim sealing channel that extends around the base member and that is defined by the inner and outer sidewalls and the top wall;

an annular planar portion that connects the bottom portion of the inner sidewall with the base member, the annular planar portion positioned below the topwall and the base member;

an upper portion of the inner sidewall, which is proximal to the topwall, and above a first generally concave rib which has an apex extending into the brim sealing channel, which first generally concave rib is positioned above a second generally concave rib which has an apex extending into the brim sealing channel, but wherein the apex of the first rib extends away from a plane of the inner sidewall further into the brim sealing channel than the apex of the second rib extends into the brim sealing channel, and wherein both the first apex and second apex seal against an inner side wall of a container on which the lid is placed,

and wherein the second rib is positioned above a connection of the inner sidewall with the annular planar portion, and wherein a lowermost portion of the first rib and an uppermost portion of the second rib are connected to each other via an everted portion of the inner sidewall that projects away from the brim sealing channel towards a center of the lid.

26. The lid of claim **25**, wherein the annular planar portion further comprises at least one groove therein having a bottom portion below a plane of the remainder of the annular planar portion and below a plane of the central planar portion, and wherein the at least one groove is thinnest at a bottom portion of the groove.

27. The lid of claim **25**, wherein the the apex of the first rib extends away from a plane of the inner sidewall further into the brim sealing channel than the apex of the second rib extends into the brim sealing channel such that both apexes seal against an inner wall of a container on which the lid is placed, wherein the inner wall of the container is angled from 2° to 8° relative to a vertical axis in a direction away from a center of the lid.

28.-40. (canceled)

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