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(54) **LEAK RESISTANT LID ASSEMBLY FOR A BEVERAGE CONTAINER**

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(57) **ABSTRACT**

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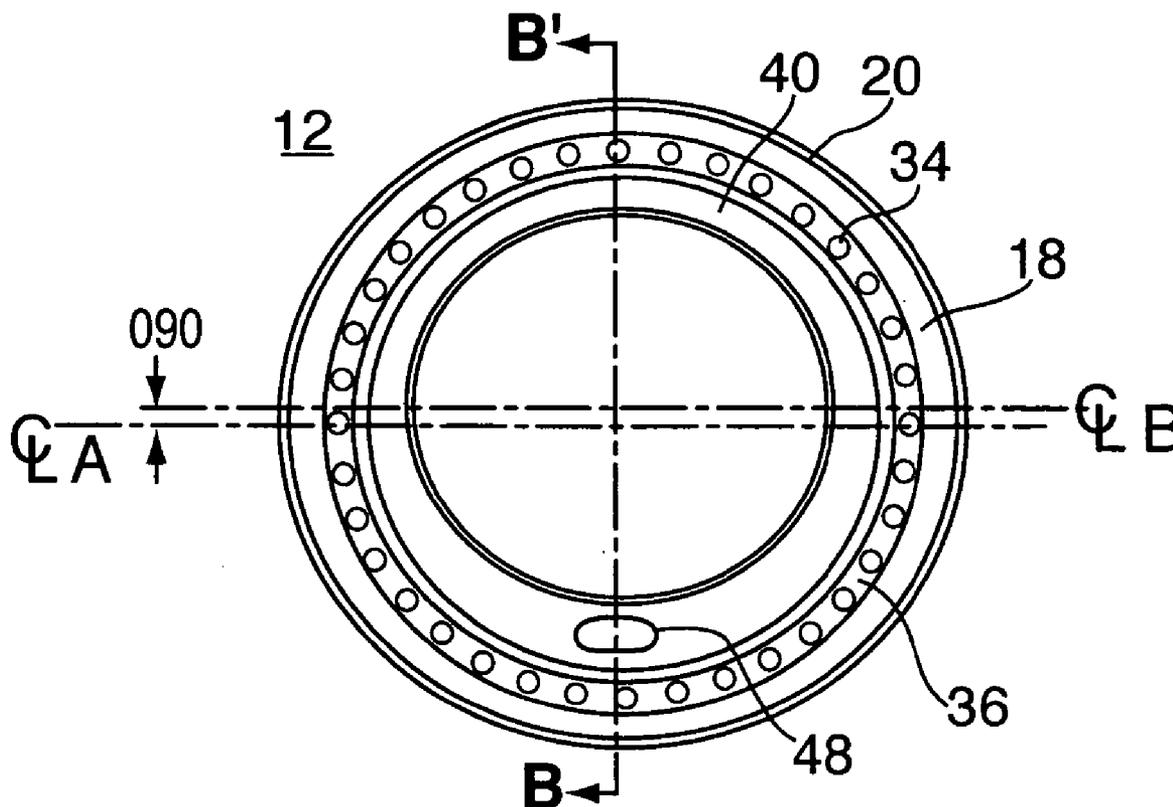
A leak resistant lid for a beverage container is formed with a depending skirt portion having one or more progressively decreasing diameter rings between a lower extremity and a sealing channel adapted to fit over the rim bead of the container. An inner wall of the channel extends downwardly inside the inner surface of the side wall of the container in a plug fit relationship. The relatively deep inside plug fit provides added surface area contact for sealing the interface between the lid and the container. An elevated and rigid central plateau supports a drinking orifice and is connected to the inner wall of the channel by a reinforced, rigid flange or web which maintains the channel and its inner wall in leak resistant relationship with the rim bead and container wall.

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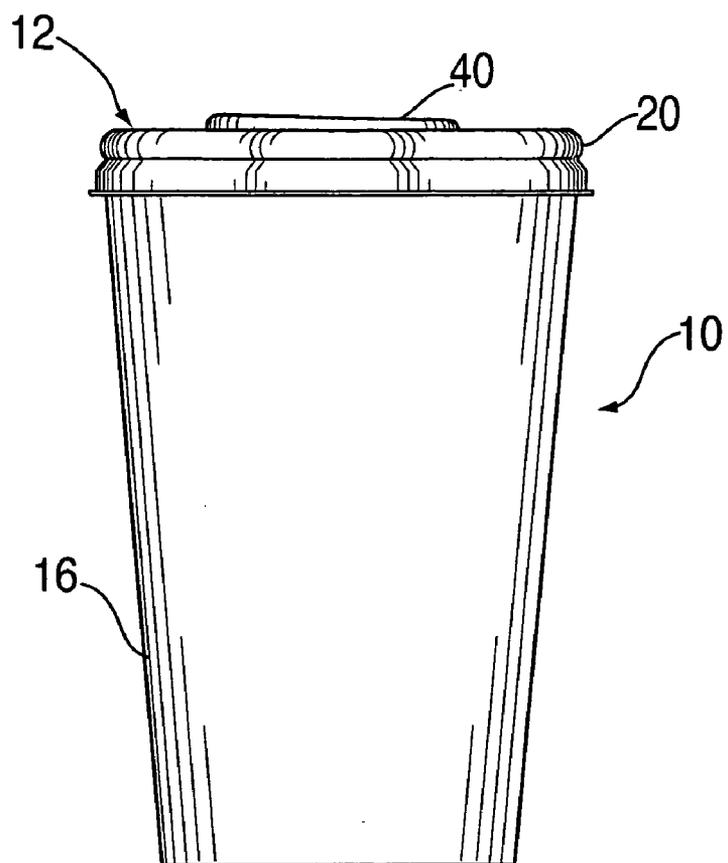


FIG. 1

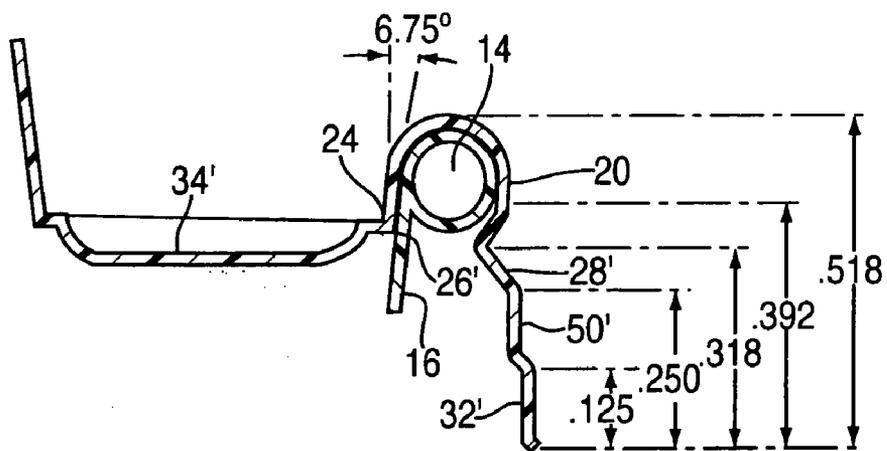


FIG. 6

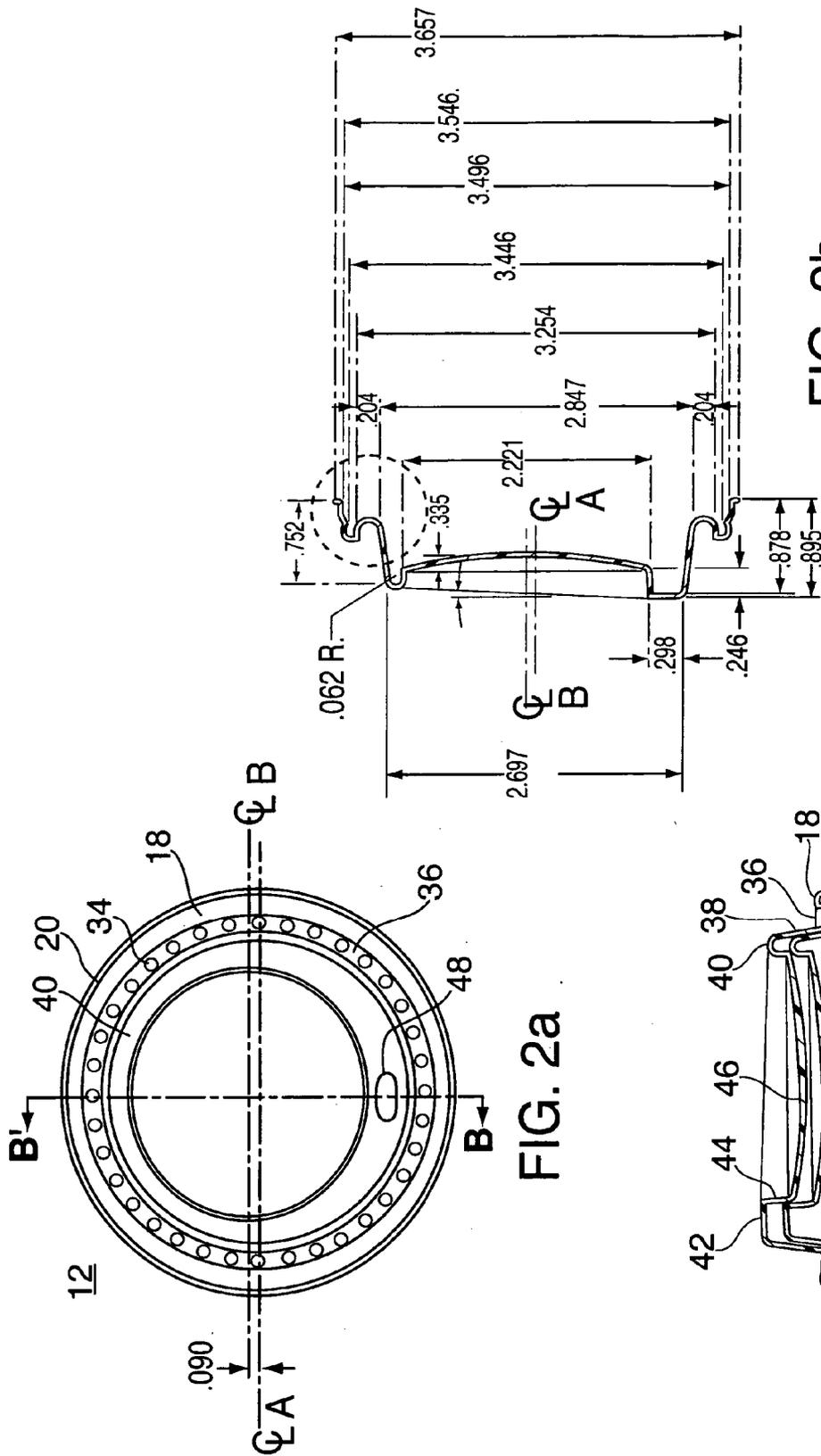


FIG. 2a

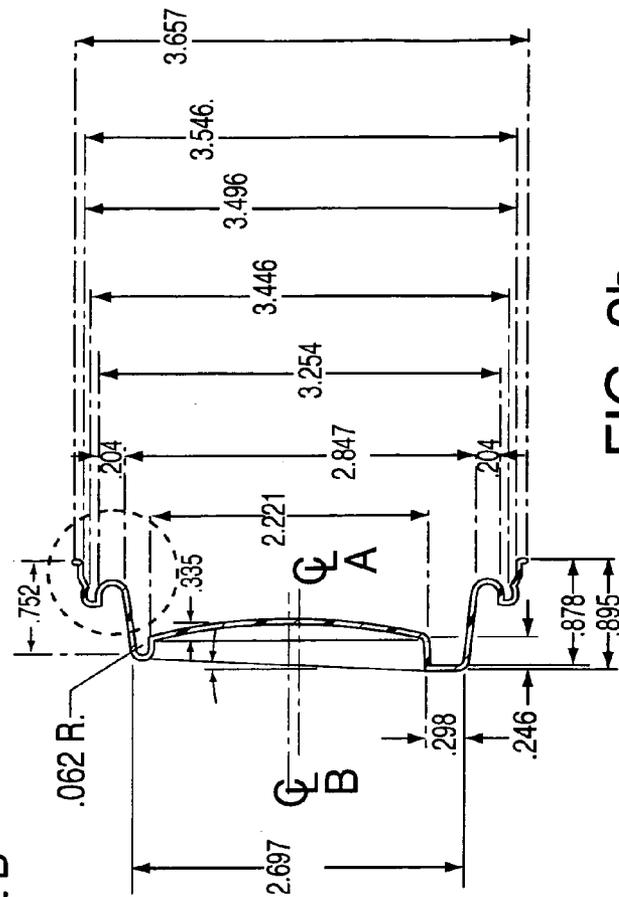


FIG. 2b

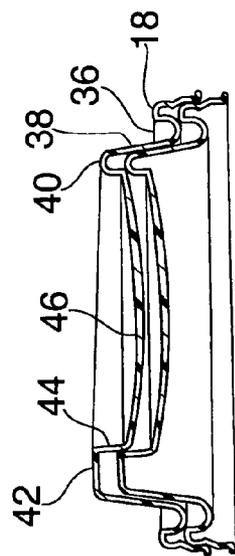


FIG. 2c

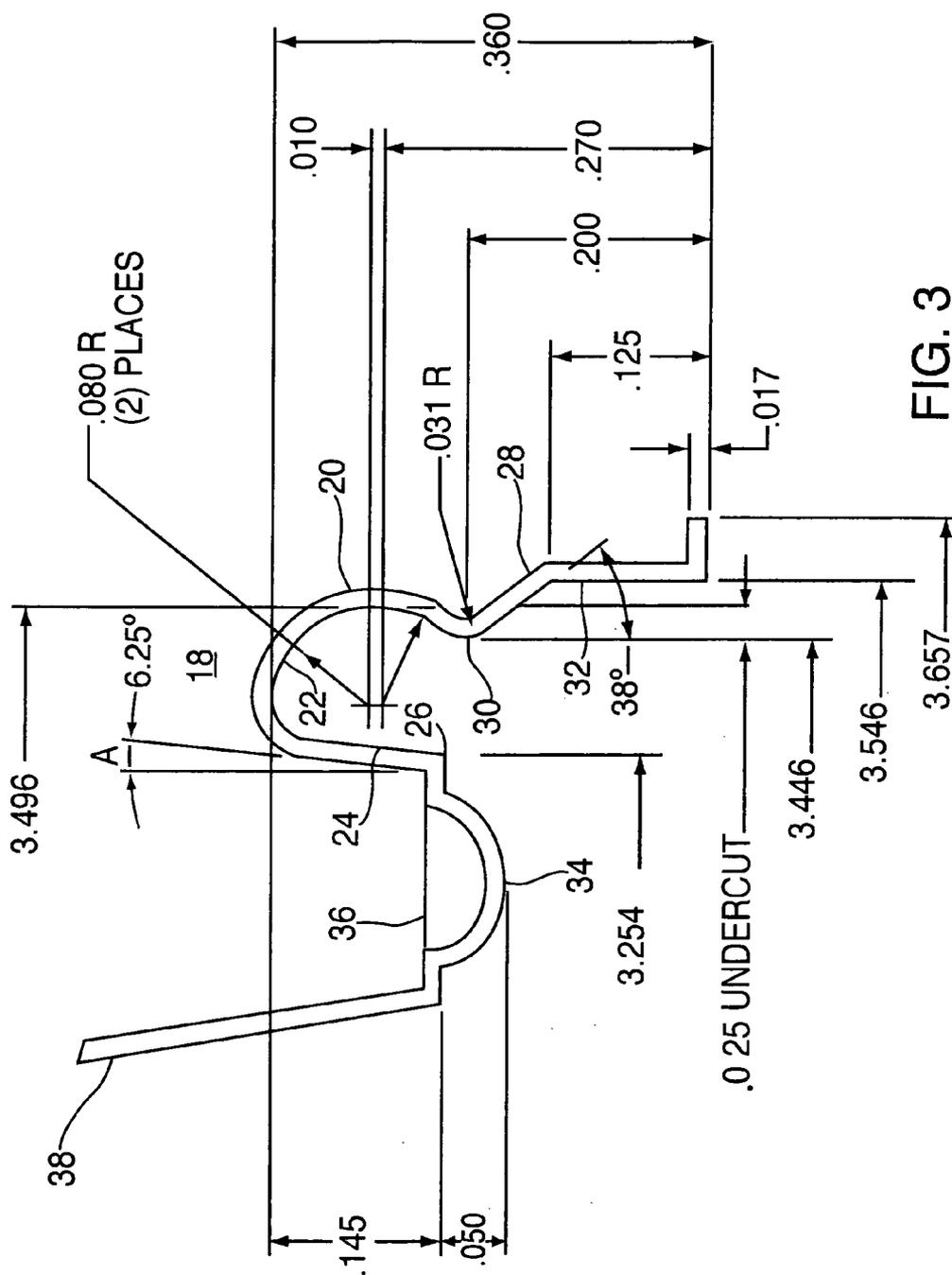


FIG. 3

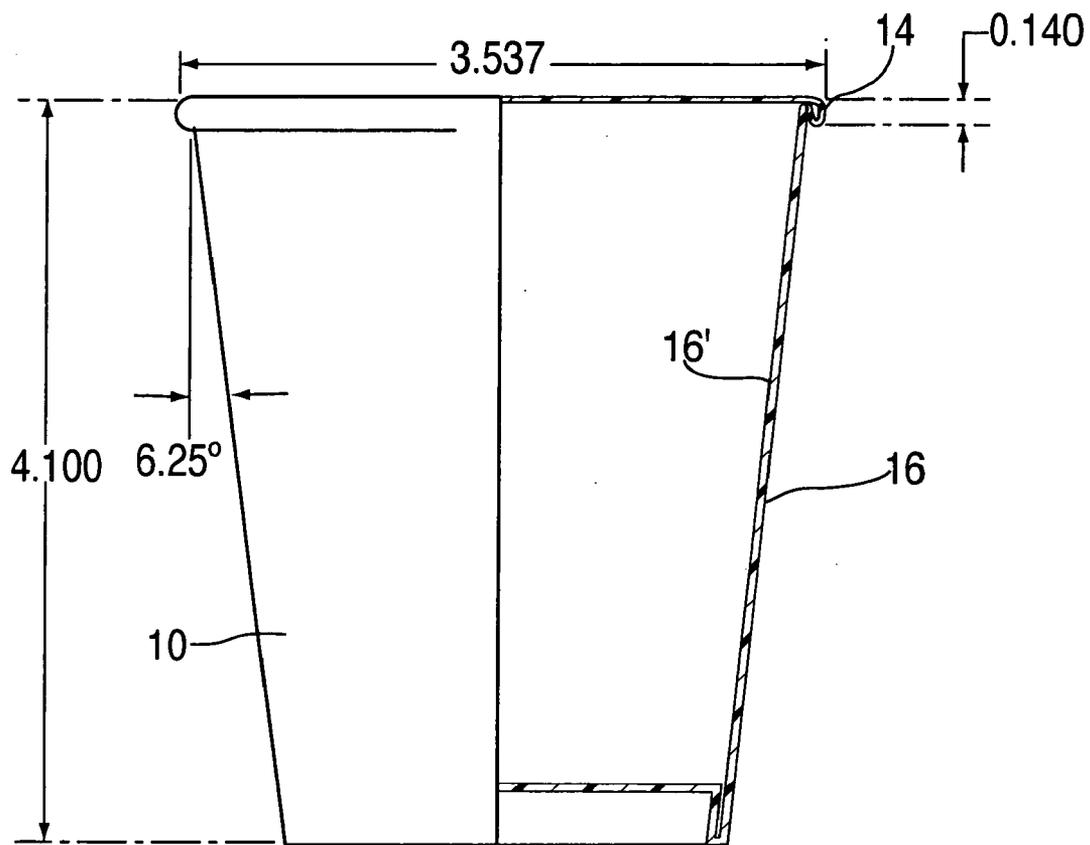


FIG. 4

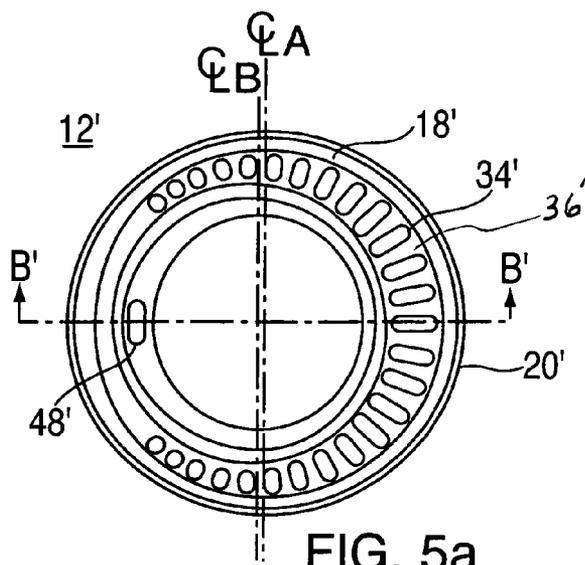


FIG. 5a

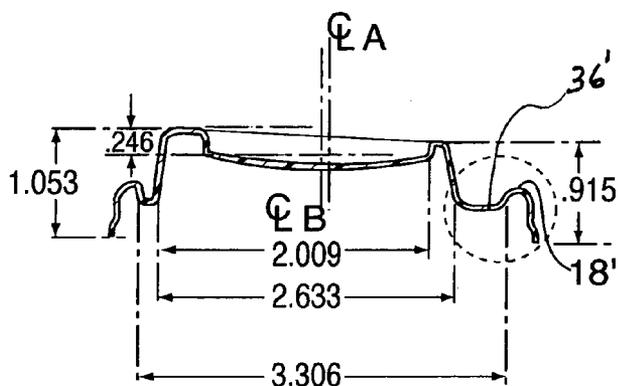


FIG. 5b

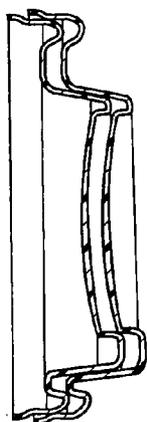


FIG. 5c

## LEAK RESISTANT LID ASSEMBLY FOR A BEVERAGE CONTAINER

### CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Not Applicable

### STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

### FIELD OF THE INVENTION

[0003] This invention relates to containers for liquids, to lids for such containers and, more specifically, to replaceable, leak resistant lids for containers or cups having a generally cylindrical or frusto-conical shape.

[0004] Although the invention described herein is particularly suitable for application to beverage drinking cups, a person skilled in this art readily may apply the invention to other similar containers which require a removable, leak resistant lid.

### SUMMARY OF THE INVENTION

[0005] In accordance with the present invention, a highly leak resistant "sipper" lid suitable for paper beverage cups is provided. The unintentional passage of liquid between the mating surfaces of a cup and a lid is effectively suppressed. This feature meets consumer expectations in that, when consumers purchase drinks in cups with lids applied, they expect the cup/lid combination to prevent leakage between the mating surfaces when the cup is inclined for drinking. However, many designs fall short of this important objective.

[0006] A particular problem arises in connection with some containers which are formed such that each of their side wall and rim are formed into a closed vessel by overlapping the material (relatively thick paper) at a joint or seam. When a lid having a spout or orifice for drinking is placed over such a thick seam, there is a tendency for leakage out of the lid in that area of the rim. One approach to this problem has been to attempt to educate customers to orient the lid on the cup so that the drinking orifice is diametrically opposite the joint or seam, thereby placing the leakprone area above the level of liquid in the cup when drinking is in progress. This approach is not entirely successful since many users do not receive, understand or remember this instruction.

[0007] In accordance with one aspect of the present invention, a lid adapted for use in connection with a container for liquids comprises a generally annular mounting ring or channel for sealably engaging an upper edge or rim of a container, an annular skirt extending downwardly from the mounting ring over an outer wall of the container, an annular flange extending radially inwardly from the mounting ring and an annular, upstanding wall extending from a radially inner extremity of the flange to a generally annular plateau. The plateau, in turn, is connected to a central region which serves to form a closed lid structure. A drinking orifice typically is provided in the plateau region.

[0008] The annular mounting ring is complementarily configured with respect to the container with which it is to

be combined so as to provide a plug fit against the inner wall of the container and to engage the rim thereof to provide a desired leak resistant seal. These and other objects and advantages of the present invention will become apparent from the following detailed description in conjunction with the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWING

[0009] In the drawings:

[0010] **FIG. 1** is a front elevation view of a cup or container having one form of a lid in accordance with an embodiment of this invention;

[0011] **FIG. 2a** is a plan view of a particular lid according to a preferred embodiment of the invention;

[0012] **FIG. 2b** is a cross-sectional view taken along the line B-B' of **FIG. 2a**;

[0013] **FIG. 2c** is a partial cross sectional view showing a stack of two of the lids of **FIG. 2a**;

[0014] **FIG. 3** is a partial, enlarged cross-sectional view of the portion of the lid enclosed in a dashed circle in **FIG. 2b**, showing relationships between the lid and container;

[0015] **FIG. 4** is a partially cut away elevation view of one type of standard container suitable for use in connection with this invention;

[0016] **FIGS. 5a, 5b** and **5c** are views similar to those shown in **FIGS. 2a, 2b** and **2c** of a second embodiment of the invention; and

[0017] **FIG. 6** is a partial, enlarged cross-sectional view of the portion of the lid enclosed in a dashed circle in **FIG. 5b**.

### DESCRIPTION OF ILLUSTRATIVE EMBODIMENT OF THE INVENTION

[0018] Referring to **FIG. 1**, a typical container or cup assembly **10** suitable for beverages and being formed from paper, plastic, plastic foam or the like, in a generally cylindrical or frusto-conical shape, is shown. A lid **12** constructed according to the present invention is shown sealably mounted at the top of container **10**. Lid **12** (other forms of which are shown in greater detail in others of the figures) preferably is produced by thermoforming a thin, flat sheet of clear or opaque (black, white or colored) plastic such as polystyrene onto a lid mold to form the desired lid shape which will be explained below. The lid may also be formed by injection molding while maintaining the desired properties and characteristics as set forth hereinafter. The thickness of the plastic for the lid typically is about 0.017 inches in its finished form.

[0019] The container **10** typically is a paper cup suitable for hot or cold beverages and will be referred to hereinafter as cup **10**. As is customary, such cups have a substantially tubular (circular cross section) bead **14** (see **FIG. 4**) formed at their upper edge and extending radially outwardly from the generally cylindrical or conical upright wall **16** of the cup.

[0020] As can be seen in **FIGS. 2a-3**, lid **12** comprises a generally inverted U-shaped sealing channel **18** having a cross-section (**FIG. 3**) with an interior wall **22** of generally the same curvilinear to straight shape as the combination of

the outer extremity of bead **14** and the upper end of the wall **16** of cup **10**. More specifically, on lid **12**, the outer (maximum diameter) portion **20** of channel **18** is generally tubular in shape and it transitions smoothly into a substantially vertical, straight, inclined inner wall member **24** which is outwardly inclined at its upper end. Wall member **24** is inclined at substantially the same angle A (e. g. 6.25 degrees) as the wall of the cooperating cup **10**. Inner wall member **24** is adapted to extend downwardly inside wall **16** of cup **10** in a "plug fit" relationship.

[0021] A negative clearance or plug interference fit such as 0.04 inches for a cup **10** having a specified maximum outside bead diameter of 3.54 inches is provided between the inner wall **24** of channel **18** and the inner surface **16'** of wall **16** of cup **10**. This deep inside plug fit provides the desired surface area contact for sealing the interface between the adjacent surfaces of lid **12** and cup **10**.

[0022] In addition, at a sloped transition region **28** between a lower extremity of channel **18** and an upper extremity of a skirt **32**, an undercut or reentrant wall **30** is provided which has an minimum inner wall diameter, for example, 0.05 inches less than the maximum inner wall diameter **30** of channel **18** as best seen in FIG. 3 ("0.025 UNDERCUT").

[0023] A lowermost inner corner **26** of inclined inner wall **24** is shown having a diameter of 3.25 inches. As shown in FIG. 4, the outermost diameter of the rim bead **14** for a corresponding cup **10** has a nominal value of 3.54 inches. The bead **14** itself is specified as having a nominal diameter of 0.14 inches. It can therefore be seen that the maximum opening at the top of cup **10** (measured at the uppermost point on rim bead **14** where the inner surface **16'** of cup wall **16** begins to slope downward and inwardly) is nominally 3.54 inches minus 0.14 inches or 3.50 inches. The lowermost inner corner **26** of inclined wall **24** of channel member **18** therefore will fit into the top of rim bead **14** with a clearance of about 0.07 inch on each side (diameter is nominally 0.14 inches smaller).

[0024] The inward slope of the inner surface **16'** of wall **16** (for example, nominally 6.25 degrees in some cups and 5 degrees in others), and the dimensions of cup wall **16** and inclined wall **24** of channel **18**, are arranged so that the lowermost inner corner **26** of channel **18** will come into contact with the inner surface **16'** of cup wall **16** before the lid **12** is fully seated on the top of rim bead **14**. In addition, the largest unstressed diameter inside the curvilinear portion **22** of channel **18** is typically selected to be 3.50 inches, a dimension approximately 0.04 inches less than the nominal largest diameter of rim bead **14**. This arrangement provides a negative (or interference) snap fit of the channel **18** over rim bead **14**. Thus, as the lid **12** is placed on cup **10**, the lower edge of a skirt region **32** (e.g. 3.55 inch diameter) of lid **12** passes over rim band **14** until sloped transition region **28** engages rim band **14**.

[0025] Skirt region **32** is then bowed outwardly as pressure is applied to the top of lid **12** until undercut **30** snaps over rim band **14** of the cup **10**. As additional pressure is applied around the entire top of lid **12**, the inner surface **22** of the upper curvilinear region of channel **18** seats along the top of rim bead **14** and the lowermost corner **26** of inclined wall **24**, along with a portion of wall **24**, forms an interference or plug fit seal against the inner surface **16'** of wall **16** of cup **10**.

[0026] It should be noted that the height from the lowermost corner **26** of wall **24** to the upper curvilinear portion **22** of channel **18** is arranged, in combination with the several diameters mentioned, to provide the desired result of a leak resistant seal between cup **10** and lid **12**.

[0027] Proceeding radially inwardly from the lowermost corner **26** of wall **24**, in the embodiment shown in FIGS. 2a-3, a substantially flat, concentric reinforcing web or flange **36** extends radially inwardly from channel **18** towards the center of lid **12** to a lower extremity of an inwardly inclined upstanding outer wall **38** of a central plateau region **40**. As shown in FIGS. 2b and 2c, wall **38** extends from the lowermost to above the uppermost extremity of sealing channel **18** (and rim bead **14**) so that plateau region **40** is displaced vertically above sealing channel **18**. The top surface **42** of plateau region **40** may be inclined as shown in FIG. 2b. A downwardly extending eccentric wall **44** extends from the top surface **42** to a closed center web section **46** of lid **12**. Center web section **46** may be flat, concave or convex but preferably is concave as shown. The top surface **42** of plateau region **40** is provided with a drinking orifice **48** shown as an oval hole in the highest and widest region of plateau region **40**. As should be apparent from FIG. 2b, this location of orifice **48** provides a maximum height and width for the portion of plateau **40** from which liquid is emitted to the person drinking from the cup **10**. The orifice **48** may therefore be sized appropriately for comfortable consumption of the liquid.

[0028] Taking into account the necessary height for wall **24** in order to provide a good seal around channel **18**, stiffening or reinforcing members such as hollow domes **34** (FIGS. 2a-3) or hollow elongated ridges or ribs **34'** (FIGS. 5a-6) molded in the radially extending flange **36**, or their equivalent, are provided to prevent deformation of the flange **36** and to maintain the required diameter at the lowermost corner **26** (or **26'**) for a continuous interference fit when the lid **12** is plug fit into cup **10**.

[0029] In an alternative embodiment of the invention shown in FIGS. 5a-6, reference numbers for corresponding elements are numbered the same as in the preceding figures but are followed by a ' (prime symbol). The alternative arrangement also illustrates a different set of dimensions for use in connection with a cup having a maximum diameter at its top of 3.66 inches and a rim bead of 0.18 inches. As can be seen by referring to FIGS. 5a-6, certain of the elements shown in those figures are eccentrically positioned to a greater extent than is the case in the embodiment shown in FIGS. 3a-4. One result of such greater eccentricity is that reinforcing flange or web **36'** occupies a greater area than the area occupied by reinforcing flange **36** in the FIG. 3a-4 embodiment. This is particularly evident in the portion of reinforcing flange **36'** which is diametrically opposite the portion thereof between the drinking orifice **48'** and the outer edge of lid **12'**.

[0030] In order to maintain a desired stiffness in flange **36'** so as to hold wall **24'** of lid **12'** in firm, sealing relationship against the adjacent inner surface **16'** of cup **10**, the reinforcing dimple members **34'** are elongated radially to the form of ribs of increasing length proceeding circumferentially away from drinking orifice **48'**. It should be noted that, in at least a portion of the flange **36'**, where the horizontal dimension of flange **36'** may be small, the upstanding walls

adjacent the flange are close to each other and there is no need (or space) for the reinforcing dimples, domes or ribs.

[0031] It should also be noted that the embodiment shown in FIGS. 5a-6 also includes an elongated skirt having an additional transition member 50' which will bring the low-ermost member 32' of the skirt further outward and along the side of cup 10.

[0032] Significant advantages of a lid according to the present invention are realized from the inside plug fit of the innermost wall of the sealing channel and cup wall, the relatively long single or multiple step outside skirt and the radial reinforcing slots or dimples in the reinforcing flange which maintain the sealing channel in contact with the cup wall. That is, the radial slots/dimples provide added interior support for the plugged lid surface and assist in holding the plug fit surface area of the lid in contact with the cup wall surface. The deep inside plug fit provides added surface area contact with which to seal the lid surface to the cup wall surface, thus preventing leakage between the surfaces. The outer skirt design, in conjunction with the reinforced deep plug, allows higher rim to lid interference levels which assist in preventing distortion on the outer portion of the lid, while applying more pressure to the cup rim.

[0033] The desired results are a greater lid to cup rim contact area, thus suppressing the flow of liquid between the lid and cup rim.

[0034] In view of the foregoing description, numerous modifications and alternative embodiments of the invention will be apparent to those skilled in the art. Accordingly, this description is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the best mode of carrying out the invention. Details of the structure may be varied substantially without departing from the spirit of the invention.

1. A lid for closing a container, the container having a generally circular rim and an outwardly projecting annular bead on said rim, and a downwardly extending wall portion having an inner surface adapted for containing liquid, the lid comprising:

- a central web;
- an upstanding generally annular plateau surrounding said central web, said plateau having an outer wall extending downwardly so that an extremity of said wall is within said rim of said container when said lid is attached to said container;
- a reinforcing web extending from said lowest extremity of said outer wall of said plateau to a radially inner wall of an annular sealing channel;
- said sealing channel being adapted for engagement with said rim of said container;
- said radially inner wall of said sealing channel having a downwardly extending wall portion adapted for engaging said inner surface of said container, and a curvilinear channel portion extending from said downwardly extending wall portion so as to engage said annular bead on said rim in a sealing relationship.

2. A lid according to claim 1 and further comprising:

- an annular skirt portion extending downwardly from said channel portion outside of said bead on said rim.

3. A lid according to claim 1 wherein;

said reinforcing web comprises an array of projections at a surface of said web for stiffening said web.

4. A lid according to claim 1 wherein:

said outer wall of said plateau has a lower extremity positioned to extend below said annular bead of the container and an upper extremity extending above said rim of the container when said lid is positioned on a container for use.

5. A lid according to claim 1 wherein:

said central web, said annular plateau and said reinforcing web form a substantially rigid annular rim along a lower edge of said sealing channel; and

said lower inside edge of said sealing channel is dimensioned to provide an interference plug fit with said inner surface of said wall portion of said container.

6. A lid according to claim 5 wherein:

said interference fit is associated with a diametric dimension of approximately the thickness of said wall of said container.

7. A lid according to claim 6 wherein:

said diametric dimension is of the order of 0.04 inches.

8. A lid according to claim 3 wherein:

said projections are disposed along adjacent radial lines.

9. A lid according to claim 8 wherein:

said projections are rib shaped.

10. A lid according to claim 8 wherein:

said projections are dimple shaped.

11. A lid adapted for use in connection with a container for liquids comprising:

a generally annular sealing channel having inner and outer walls;

an annular skirt extending downwardly from said outer wall of said channel;

a reinforcing flange extending radially inwardly from said inner wall of said annular channel towards the center of said lid and having radially disposed reinforcing projections extending from a surface thereof;

an annular upstanding wall extending from a radially inner extremity of said flange to a generally annular plateau;

a central web extending radially inwardly from said plateau to form a substantially closed lid, wherein

said inner wall of said channel is dimensioned for a plug interference fit within the inner wall of a container with which it is intended for use.

12. A lid according to claim 11 for use in connection with a container having

an annular rim bead at the top edge thereof wherein:

an outer wall of said plateau has a lower extremity positioned to extend below said annular bead of the container and an upper extremity extending above said rim of the container when said lid is positioned on a container for use.

**13.** A lid according to claim 12 wherein:

said central web, said annular plateau and said reinforcing web form a substantially rigid annular rim along a lower edge of said sealing channel; and

said lower inside edge of said sealing channel is dimensioned to provide an interference plug fit with said inner surface of said wall portion of said container.

**14.** A lid according to claim 13 wherein:

said interference fit is associated with a diametric dimension of approximately the thickness of said wall of said container

**15.** A lid according to claim 14 wherein:

said diametric dimension is of the order of 0.04 inches.

\* \* \* \* \*