UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MPL BRANDS NV, INC.

Petitioner,

v.

BUZZBALLZ, LLC

Patent Owner.

PTAB Case No. PGR2024-00035

U.S. Patent No. 11,932,441

DECLARATION OF NATHAN J. DELSON, PH.D., IN SUPPORT OF PETITION FOR POST-GRANT REVIEW OF U.S. PATENT NO. 11,932,441

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Appendix D	U.S. Patent No. 6,234,336 to Neiner
Appendix E	U.S. Patent No. 4,522,779 to Jabarin
Appendix F	U.S. Patent No. 8,468,785 to Thomasset

I. INTRODUCTION

1. My name is Nathan J. Delson. I am a Senior Teaching Professor at the University of California, San Diego (UCSD).

2. I have been engaged by MPL Brands NV, Inc. ("MPL") as a consultant in connection with MPL's Petition for Post-Grant Review of U.S. Patent No. 11,932,441 (the "'441 Patent").

3. I understand that the '441 Patent has been assigned to BuzzBallz, LLC ("BuzzBallz"). BuzzBallz is also referred to as the "Patent Owner" in this declaration.

4. This declaration is based on the information currently available to me. To the extent that additional information becomes available, I reserve the right to continue my investigation and study, which may include a review of documents and information that may be produced, as well as testimony from depositions that not yet been taken.

II. QUALIFICATIONS AND EXPERIENCE

A. Education and Experience

5. I obtained my Ph.D. degree in Mechanical Engineering from Massachusetts Institute of Technology (MIT) in 1994.

6. I have worked for 27 years as a faculty teaching mechanical engineering design, first at Yale University and now at the University of California at San Diego.

My current position is Senior Teaching Professor in the Department of Mechanical and Aerospace Engineering. I have performed research in Robotics, Medical Devices, and Design Education. I have also worked for 2 years in the Aerospace Industry for United Technologies. I have consulted in mechanical engineering for companies such as Design Continuum, Sixense, DriveCam, and others. I have received awards from the National Inventors Hall of Fame and for teaching design.

7. I have worked on and supervised a wide range of engineering projects. These projects have included ones with vessels under pressure or vacuum, and containers with seals to contain liquid or gas. I have worked on a project with a component that has a pre-weakened area that was created by a thinning of metal along a line which created a structure that remained intact under certain conditions but then detached under other conditions. I advise on material selection for products which include both metal and plastic components. I teach and supervise projects where Design For Manufacturability (DFM) is a primary consideration and where design decisions are based on reducing the cost of a product while maintaining its functional performance. I also teach Computer Aided Design where the geometric constraints of the parts need to be defined. I am familiar with technology and history of beverage contain design and fabrication, and how technology has improved over the years to meet a wide range of needs in the container industry.

8. This experience is directly relevant to the technology described in the patents in suit. The above outline of my experience with mechanical devices and manufacturing is not comprehensive of all of my experience over my years of technical experience. Additional details of my background are set forth in my curriculum vitae, attached to this declaration as Appendix A, which provides a more detailed summary of my education, work experience, publications, and teaching history.

B. Materials Reviewed

9. My opinions expressed in this declaration are based on documents and materials identified in this declaration, including the ’441 patent, the prior art references and background materials discussed in this declaration, and the other references specifically identified in this declaration. I have considered these materials in their entirety, even if only portions are discussed here. The following is an exemplary list of the materials on which I based my opinion.

Exhibit	Description
Ex. 1001	U.S. Patent No. 11,932,441 B1 (“’441 patent”)
Ex. 1004	Prosecution File History of ’441 patent
Ex. 1006	Coca-Cola Plastic Can Marketing Material
Ex. 1007	The American Heritage Dictionary
Ex. 1008	U.S. Patent No. 8,524,349 B2 to Protais et al. (“Protais”)
Ex. 1009	U.S. Patent No. 4,405,546
Ex. 1010	U.S. Patent No. 8,141,741 B2 to Metzger et al. (“Metzger”)

Exhibit	Description
Ex. 1011	U.S. Patent No. 4,465,204 to Kaminski ("Kaminski")
Ex. 1012	U.S. Patent No. 6,729,495 to Gardiner ("Gardiner")
Ex. 1013	U.S. Patent No. 6,585,123 to Pedmo ("Pedmo")
Ex. 1014	U.S. Patent No. 4,024,981 to Brown ("Brown")
Ex. 1015	The 1985 Los Angeles Times Article
Ex. 1016	The 1985 New York Times Article
Ex. 1017	Handbook of Engineering and Specialty Thermoplastics

10. I have also relied on my own experience and expertise in mechanical engineering and design technologies.

C. Level of Ordinary Skill in the Art

11. I am not an attorney and offer no legal opinions. I have been informed about certain aspects of the law for purposes of my analyses and opinions.

12. I understand that in analyzing questions of invalidity and infringement, the perspective of a person having ordinary skill in the art ("POSITA") is often implicated, and the Court may need assistance in determining that level of skill.

13. I understand that the claims and written description of a patent must be understood from the perspective of a POSITA. I have been informed that the following factors may affect the level of skill of a POSITA: (1) the educational level of the inventor; (2) the type of problems encountered in the art; (3) the prior-art solutions to those problems; (4) the pace of innovation; (5) the sophistication of the

technology; and (6) the educational level of active workers in the field. A person of ordinary skill in the art is also a person of ordinary creativity in the art.

14. Based on my experience with packaging design technologies, as well as my reading of the ’441 patent, it is my opinion that a person of ordinary skill with respect to the subject matter of the ’441 patent at either (a) the time of the alleged priority date of the ’441 patent in April 2010 or (b) the time the ’441 patent was filed in November 10, 2023 would have at least an associate’s or a bachelor’s degree in mechanical, industrial, or manufacturing engineering and would have at least two to three years of practical experience with designing or manufacturing mechanical products such as food or beverage packaging.

15. I am at least a person of ordinary skill in the art and was so on the date to which the ’441 patent claims priority. As shown by my qualifications, I am aware of the knowledge and skill possessed by a person of ordinary skill in the art at the time of the priority date of the ’441 patent. In performing my analysis, I have applied the standard set forth above.

D. Summary of Opinions

16. I have reviewed and analyzed the ’441 Patent.

17. Based on my review and analysis, it is my opinion that claims 1-20 of the ’441 patent are invalid based on the following grounds:

Ground	Basis	Reference(s)	Challenged Claims
1	§ 103	The Coca-Cola PET Can	1-8
2	§ 103	The Coca-Cola PET Can and Protais	9-20
3	§ 103	Metzger, Protais, and Kaminski	1-20
4	§ 103	Gardiner, Pedmo, and Brown	1-20

III. OVERVIEW OF THE TECHNOLOGY

A. Priority Date of the Claims

18. I have been informed that a U.S. patent application may claim the benefit of the filing date of an earlier patent application if the earlier patent application disclosed each limitation of the invention claimed in the later-filed U.S. patent application. I have also been informed that priority is determined on a claim-by-claim basis so that certain claims of a patent may be entitled to the priority date of an earlier-filed patent application even if other claims of the same patent are not entitled to that priority date.

19. I have also been informed that a patented claim is invalid if the claimed invention was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention, or the claimed invention was described in an issued patent or a published

patent application that was effectively filed before the effective filing date of the claimed invention.

20. I understand that the ’441 patent claims a priority date of April 19, 2010. I also understand that the ’441 patent was filed on November 10, 2023, and issued on March 19, 2023. (Ex. 1001, front page). I am informed and understand that the effective priority date may, in fact, be no earlier than November 10, 2023, due to the introduction of previously undisclosed new matter. For the purposes of this declaration, the prior art analyzed all predate the earliest priority date April 19, 2010.

B. Overview of the Relevant Technology When the ’441 Patent Was Filed

21. For decades, containers having an easy-open-end have been manufactured using a metal lid. Such metal lids have been attached to containers to create a variety of food packaging products. Containers with an easy-open lid are especially popular for marketing canned beverages such as beer or soda. As one example, the pop-top lid is fairly inexpensive to purchase and is popular among consumers due to its ease of use. Appendix B summarizes a brief history of innovation related to metal container lids. Decades of innovations in lid design have enhanced the ease of opening containers, reduced material and manufacturing expenses, reduced waste, and mitigated failure modes. The following patents describe just two examples from this extensive history:

- U.S. Patent No. 4,286,728 to Fraze, filed in April 1980 (Appendix C). Fraze described a “tab for easy opening ends” that included flanges to increase longitudinal rigidity of the tab. (Appx. C, Abstract). This tab could be manufactured with thinner sheet stock to reduce material costs, while still maintaining sufficient rigidity to open a container without bending. (Appx. C, 1:42-59; 2:41-46).
- U.S. Patent No. 6,234,336 to Neiner, filed in November 1996 (Appendix D). Neiner described a stay-on-tab lid that reduced stress across a scored panel on the lid's surface, thereby reducing the likelihood of stress-induced fatigue cracking. (Appx. D, Abstract).

22. When beverage containers have metal bodies, the container bodies are formed from cutting metal and drawing the metal to elongate the metal into a desired shape. Drawing and elongating the metal places restrictions on the types of shapes that can be made. Metal beverage container bodies are typically not cast into a mold in the modern era. Casting metal into a mold is relatively expense in a mass-produced product due to the requirement to heat the metal until it becomes a molten liquid, and the need for expensive heat-resistant molds. Thus, it is often difficult to achieve a distinctive design in order to increase the desirability of the metal beverage containers. In contrast, plastic containers are easier to mold into a wide range of

shapes, can be mass produced at low cost, and may therefore achieve various designs in order to increase the attractiveness and market value of the container.

23. Plastic containers for beverages or other food items have been in use for decades. Many of these containers are made from polyethylene terephthalate (PET), and many are produced by blow-molding. The following patents are illustrative snapshots within the history of plastic container innovation:

- U.S. Patent No. 4,522,779 to Jabarin, filed in November 1983, described a process for producing PET containers via blow molding. (Appendix E).
- U.S. Patent No. 8,468,785 to Thomasset, claiming priority to a European patent application filed in November 2007, described considerations for manufacturing heat-resistant PET containers, for example for hot-filled containers. (Appendix F).

C. The ’441 Patent

24. The specification of the ’441 patent is directed to a container for storing a liquid or solid which “may be formed from molding plastic or other appropriate material and a metal lid to cooperate with the container body which may include a pop top (or easy-open) lid.” (Ex. 1001, 2:17-20).

25. Figure 1 of the ’441 patent describes a container with a convex side wall 107 that forms a “truncated spherical body” (*id.*, 2:22-27, Fig. 1), while Figure

2 displays a second container with a cylinder side wall 107 that is substantially vertical (*id.*, 2:53-57, Fig. 2).

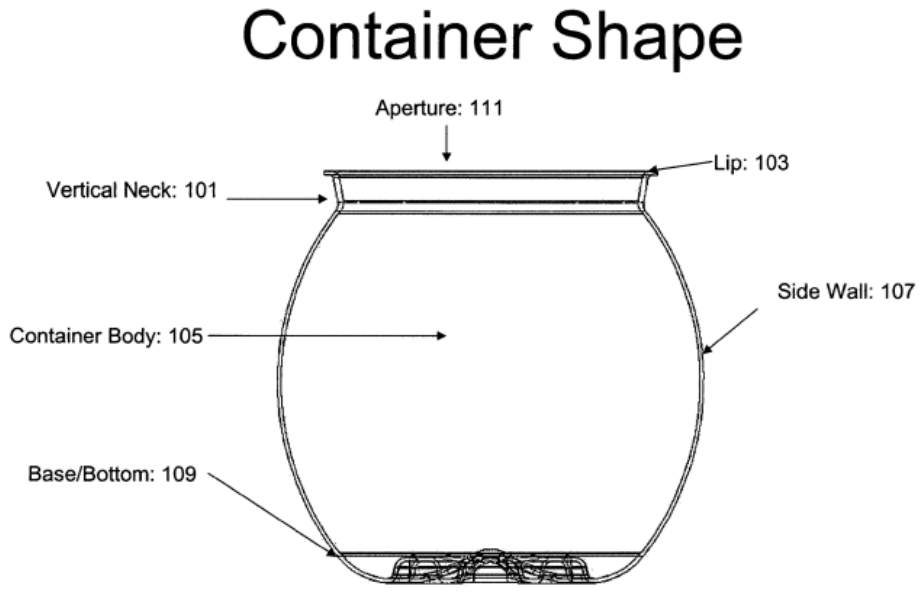


Figure 1

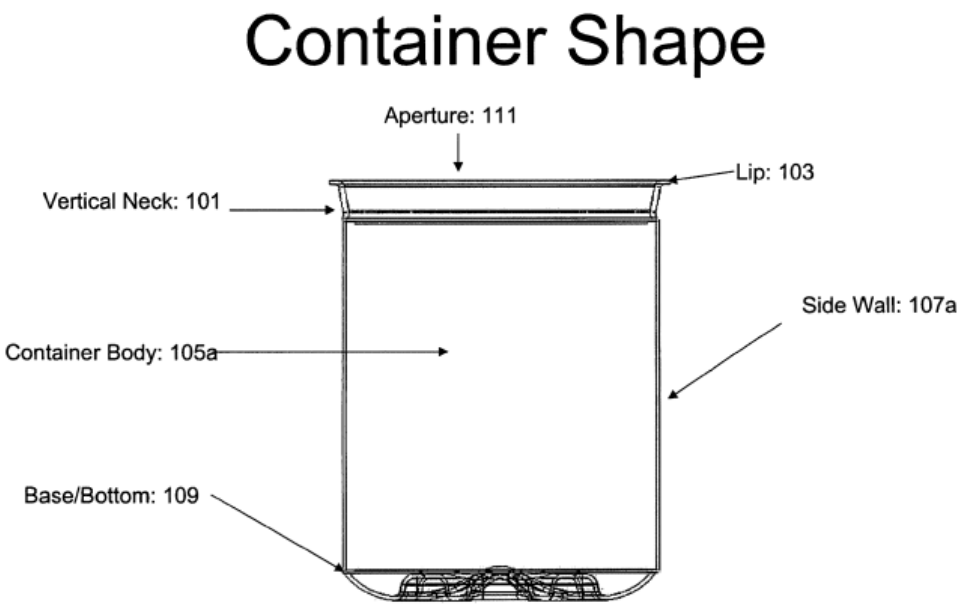


Figure 2

26. Figure 3 of the ’441 patent illustrates the bottom of the container which includes some depression 115, 115b. (*Id.*, 3:19-30). Figure 4 shows what appears to be a standard lid with a “pull top” arm that can be pivoted to deform a scored or weakened area of the lid to create an opening to allow access to the interior of the container. (*Id.*, 3:31-41).

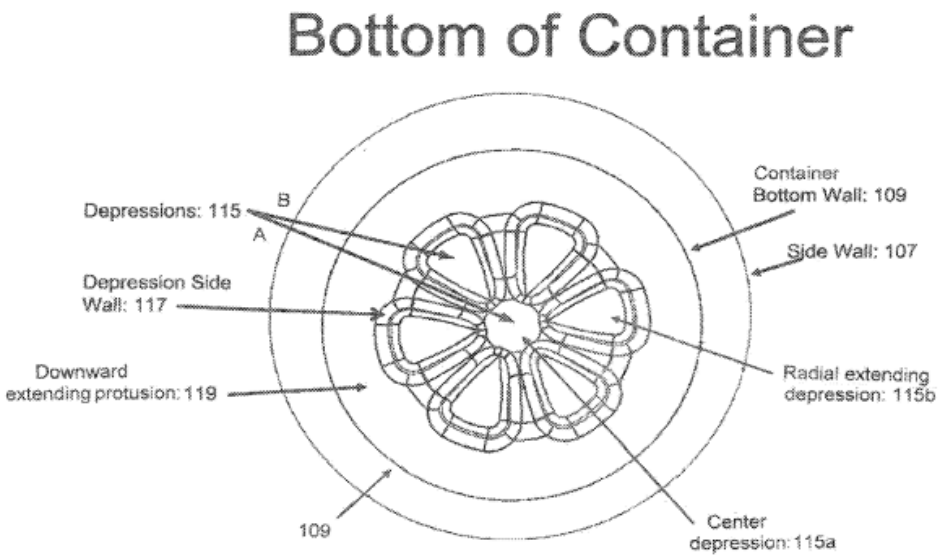


Figure 3

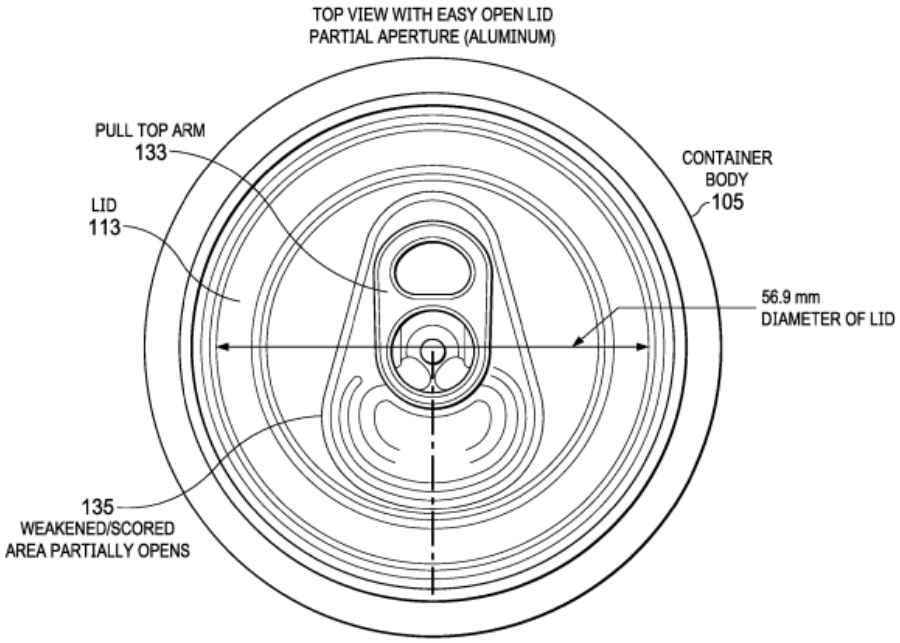


Figure 4

27. Figure 5 of the ’441 patent shows an exaggerated view of the lip of the container that engages with a corresponding lip of the lid to seal the container, which may hold a liquid or a solid therein. (*Id.*, 3:42-46, 2:64-3:3, Fig. 5).

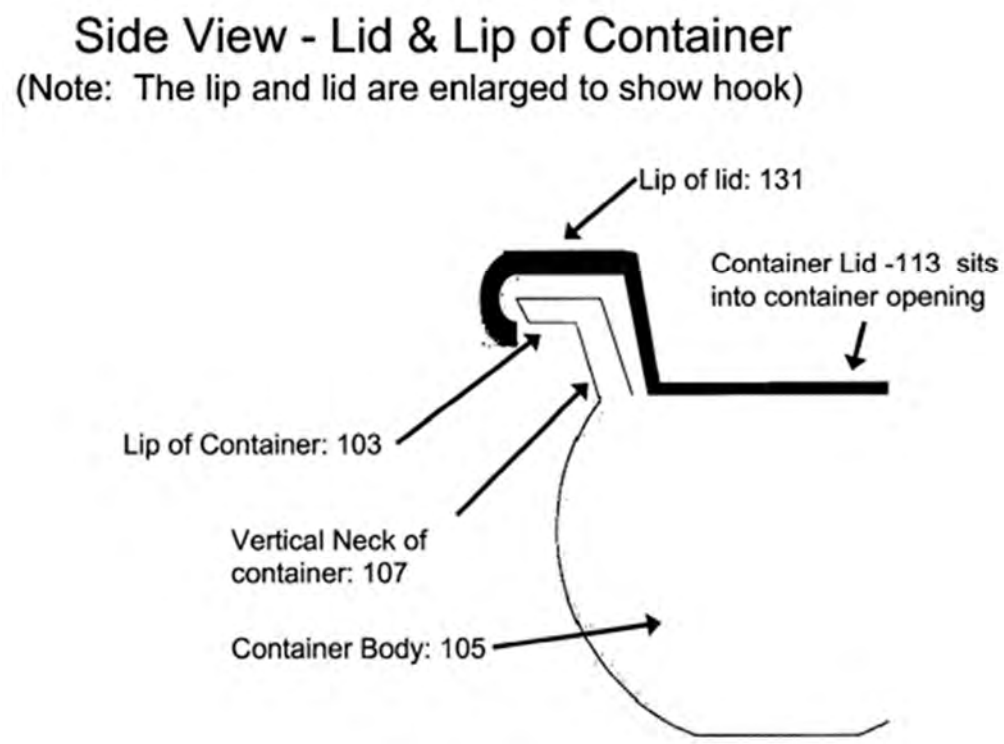


Figure 5

28. Figure 6 of the ’441 patent describes an alternate lid where substantially the entire lid can be pulled away using the tab. (*Id.*, 3:47-56; Fig. 6). Figures 7 and 8 present more detailed versions of Figure 1 with additional markings that designate dimensions. (*Id.*, 3:57-64). Figure 9 appears to be similar to Figure 3. (*Id.*, 3:57-64).

29. The ’441 patent has 20 claims and 2 independent claims.

D. Prosecution History

30. The claims 1-20 of the ’441 patent were filed on November 10, 2023, as part of patent application no. 18/506,711. (Ex. 1004, 3-38). Those original claims were allowed in a first-action allowance on February 12, 2024. (*Id.*, 211-215). The examiner stated that the claims were allowed because Zimmer (U.S. Pat. No.

10,336,496) did not describe the geometrical limitations of claims 1 and 15, as well as certain features including the container body being made of a resin and the lid being made of a metal. (*Id.*, 216-227).

E. The Challenged Claims

31. I understand that Petitioner is challenging claims 1-20 in the ’441 patent.

F. Claim Construction

32. I understand that claim terms generally are construed in accordance with the ordinary and customary meaning they would have to a POSITA at the time of the invention in light of the claim language, the specification, and the prosecution history. I understand that dictionaries and other extrinsic evidence may be considered as well, though such evidence is typically regarded as less significant than the intrinsic record in determining the meaning of the claim language.

33. For all terms of the challenged claims of the ’441 patent, I have interpreted them as they would have been understood by a POSITA at the time of the invention.

34. It is my opinion that there are no terms that require construction to address this petition; I do not address terms that may require construction in the district court.

IV. UNPATENTABILITY OF THE ’441 PATENT CLAIMS

A. Standards for Invalidity

1. Obviousness

35. I am informed and understand that a patent cannot be properly granted for subject matter that would have been obvious to a person of ordinary skill in the art at the time of the alleged invention, and that a patent claim directed to such obvious subject matter is invalid under 35 U.S.C. § 103. It is also my understanding that in assessing the obviousness of claimed subject matter, one should evaluate obviousness in light of the prior art from the perspective of a person having ordinary skill in the art at the time the alleged invention was made (and not from the perspective of either a layman or a genius in that art). It is my further understanding that the question of obviousness is to be determined based on:

- The scope and content of the prior art;
- The difference or differences between the subject matter of the claim and the prior art (whereby in assessing the possibility of obviousness on should consider the manner in which a patentee and/or a Court has construed the scope of a claim);
- The level of ordinary skill in the art at the time of the alleged invention of the subject matter of the claim; and

- Any relevant objective factors (the "secondary indicia") indicating nonobviousness, including evidence of any of the following: commercial success of the products or methods covered by the patent claims; a long-felt need for the alleged invention; failed attempts by others to make the alleged invention; copying of the alleged invention by others in the field; unexpected results achieved by the alleged invention; praise of the alleged invention by the alleged infringer or others in the field; the taking of licenses under the patent by others and the nature of those licenses; expressions of surprise by experts and those skilled in the art at the subject matter of the claim; and whether the patentee proceeded contrary to accepted wisdom of the prior art.

B. Ground 1: The Coca-Cola PET Can alone or in combination with Applicant Admitted Prior Art (AAPA) renders claims 1-8 obvious.

36. The Coca-Cola PET Can is a plastic container manufactured and distributed in the 1980s. The body of the Coca-Cola PET Can is formed from polyethylene terephthalate ("PET"). PET is a common thermoplastic polymer resin and is often used to manufacture clothing as well as food or liquid containers. The lid of the Coca-Cola PET Can is aluminum and features a widely used "pop-top" arm which allows the consumer to puncture an opening to the container.

37. Marketing material distributed in connection with the Coca-Cola PET can explains features of the can in order to educate the general public on the

products' differences when compared to traditional aluminum beverage cans. (Ex. 1006). The Coca-Cola Marketing Material displays a copyright date of 1985.

38. On May 6, 2024, I had the opportunity to examine one of the Coca-Cola PET Cans. The container body was made of plastic and had identification images of a Caffeine Free Sprite can. The top of the can was made of metal which had the properties of Aluminum. The can was unchanged from what it would have been on a supermarket shelf except for two small holes in the bottom, approximately 1-3mm in diameter, and that the fluid had been removed. I observed and made measurements of the exterior of the container. I used the tab to puncture the top, and indeed it operated as expected for a beverage can opening device. At that point a Perkins Coie employee used a hack saw to cut the plastic container across its longitudinal axis. This allowed me to observe and measure the geometry of the can in numerous locations, but did not allow me to observe the seal between the lid and the container. Accordingly, I returned on May 8, 2024, with a Dremel tool. I used this tool to cut perpendicular to the seam through the lid and container. Once cut, I could view the seam clearly. My observations were used to inform my conclusions which are described in the discussion below.

EX-1002 PGR2024-00035

1. Claim 1:

a. Element [1.Pre]: “A container comprising:”

39. The Coca-Cola PET Can is a container because it contained, or was capable of containing, a liquid or beverage. Photographs of one representative example of the Coca-Cola PET Can are provided below.

EX-1002 PGR2024-00035


Caffeine Free
Sprite
great lymon taste
Caffeine Free
Sprite
great lymon taste

b. Element [1.A]: "a container body, the container body defining a first opening to an interior of the container body; and"

40. The Coca-Cola PET Can has a container body, as identified in the photograph below. Although a lid is attached to the container body in these photographs, the lid covers a first opening to an interior of the container body. In the figure below, the right photograph has been annotated to highlight the claim limitations.

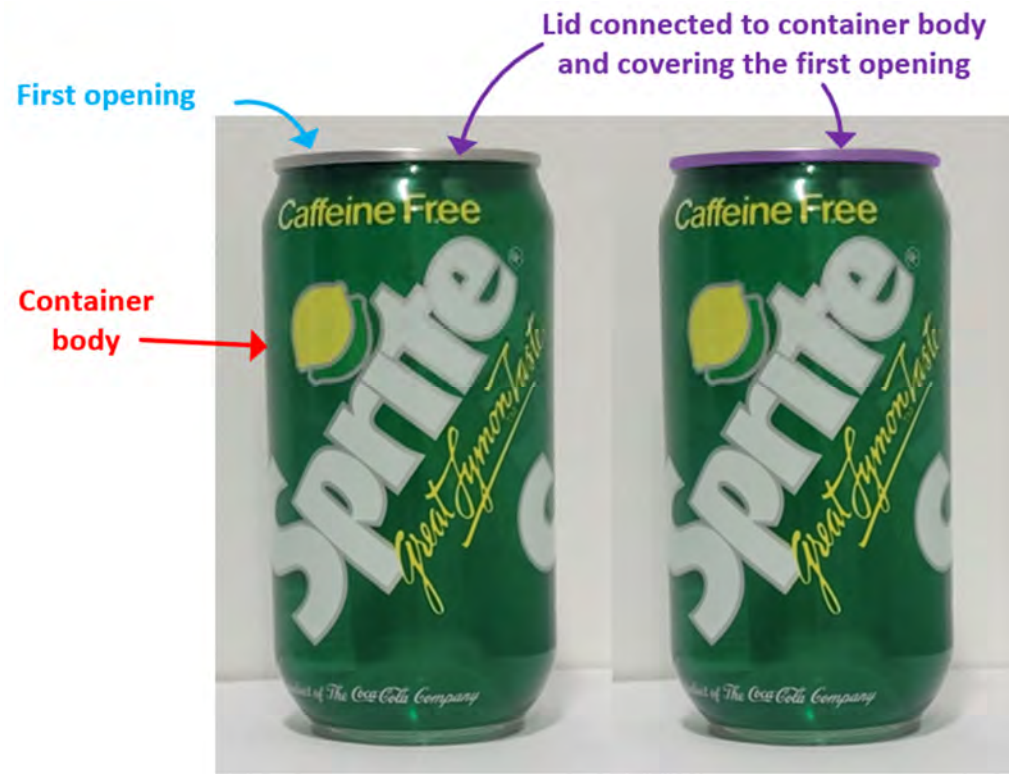


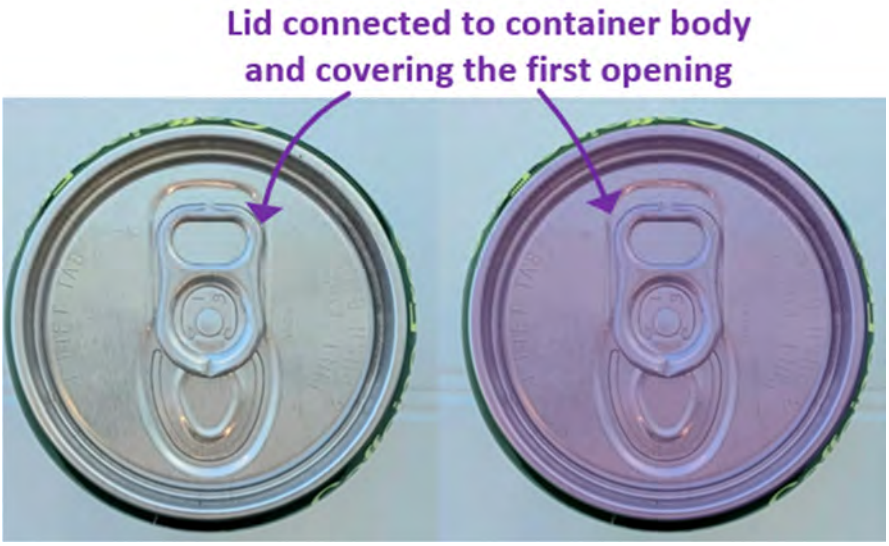
41. The first opening is also evident from the cross-sectional view of the top section of the Coca-Cola PET Can below, which was cut in my presence and then further cut by me.



c. Element [1.B]: "a lid connected to the container body and covering the first opening to the interior of the container body;"

42. The side and top view photographs of the Coca-Cola PET Can illustrate a lid, which is connected to the container body. The lid is connected to the body such that it covers the first opening to the interior of the container.





d. Element [1.C]: "wherein the container body is made out of a resin;"

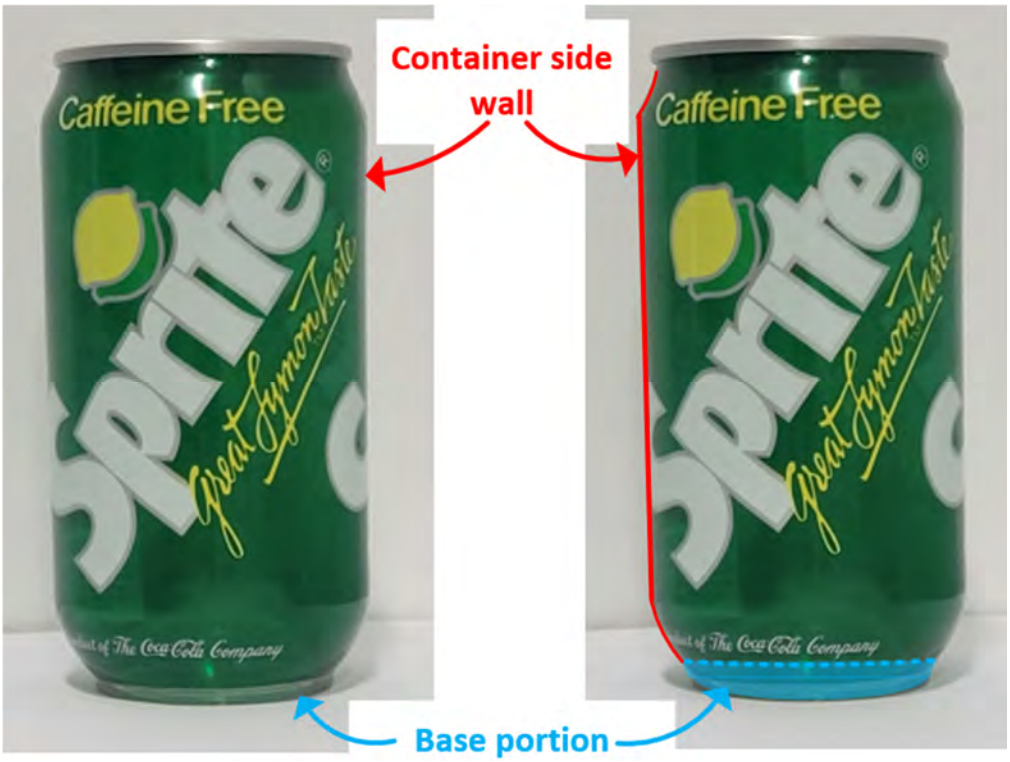
43. The Coca-Cola PET Can is made of polyethylene terephthalate (PET), which is a resin. (*See*, Ex. 1007, 5 (defining polyethylene as "a polymerized ethylene ***resin***, used especially for containers"). This claim is further rendered obvious based on the patent marking at the bottom of the Coca-Cola PET Can: "Petainer" and US Pat. 4,405,546. Petainer is a global company that provides packaging solutions, and according to their website (https://www.petainer.com/about/), started PET production in 1983, and PET refillable bottles in 1991. The patent on the bottom of the Can (U.S. Pat. No. 4,405,546 - Ex. 1009) also corroborates that the Can is made of PET based on its title, "Method for producing a tubular object of ***polyethylene terephthalate*** or similar thermoplastic material from a tubular blank of amorphous material," and explanations in the abstract and in the patent. (Ex. 1009).

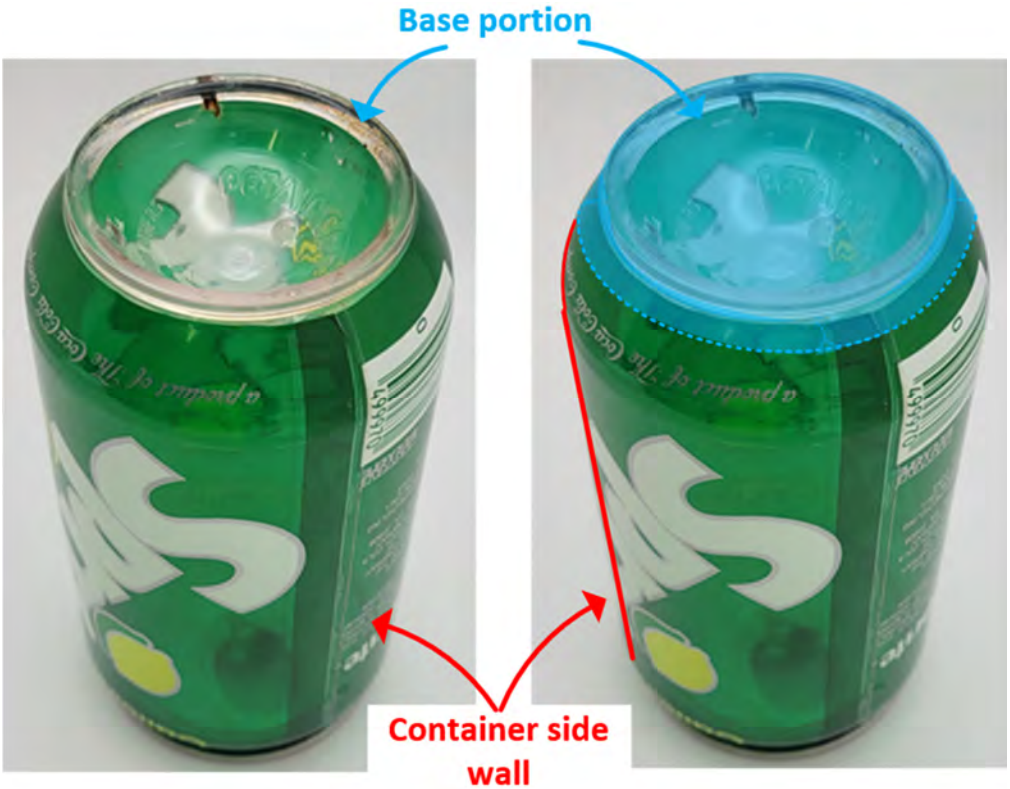
e. Element [1.D]: "wherein the lid is made out of a metal;"

44. As shown in the above photographs, the lid of the Coca-Cola PET Can is made of metal, specifically aluminum, which is explained in the Coca-Cola advertising material. (Ex. 1015). Based on my personal examination of the lid, it appeared to be made of Aluminum, similar to a typical Coke can.

f. Element [1.E]: "wherein the container body comprises a container side wall and a base portion connected to the container side wall;"

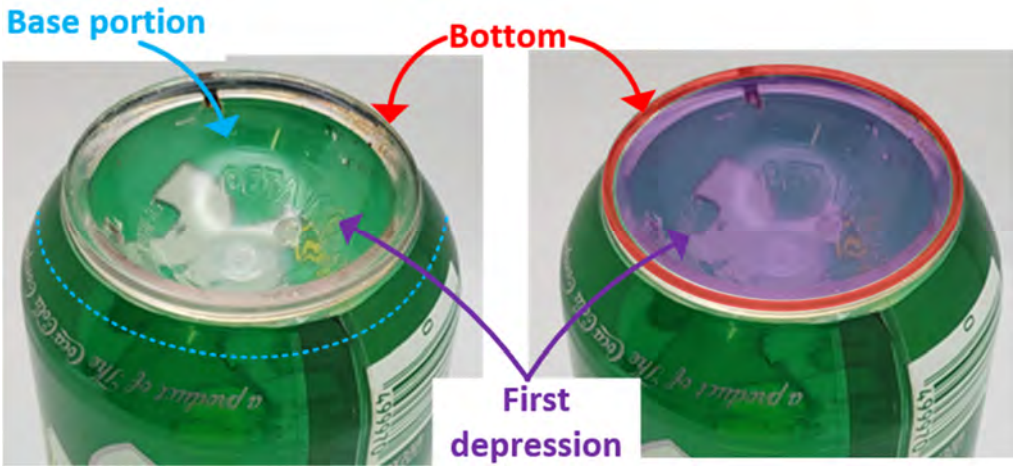
45. The photographs below illustrate that the container body of the Coca-Cola PET Can has a container side wall. Also annotated on the photographs is a base portion, representing a portion of a lower end of the container when the container is standing upright.


Container side wall
Caffeine Free
Sprite
Base portion


Base portion
Container side wall

g. Element [1.F]: "wherein the base portion comprises a bottom and a first depression formed therein, the first depression extending upwardly from the bottom;"

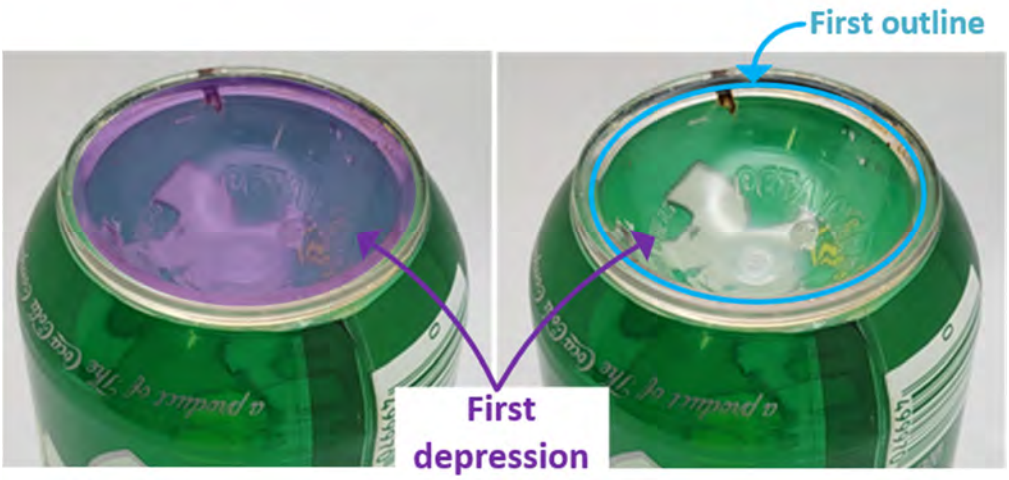
46. The base portion of the Coca-Cola PET Can has a bottom (e.g., a substantially flat surface on which the can rests when standing upright). Furthermore, the base portion of the Can has a first depression in the form of a hemispherical structure that extends upward from the bottom of the Can, toward the interior of the container.



h. Element [1.G]: "wherein the first depression at least partially defines a first outline;"

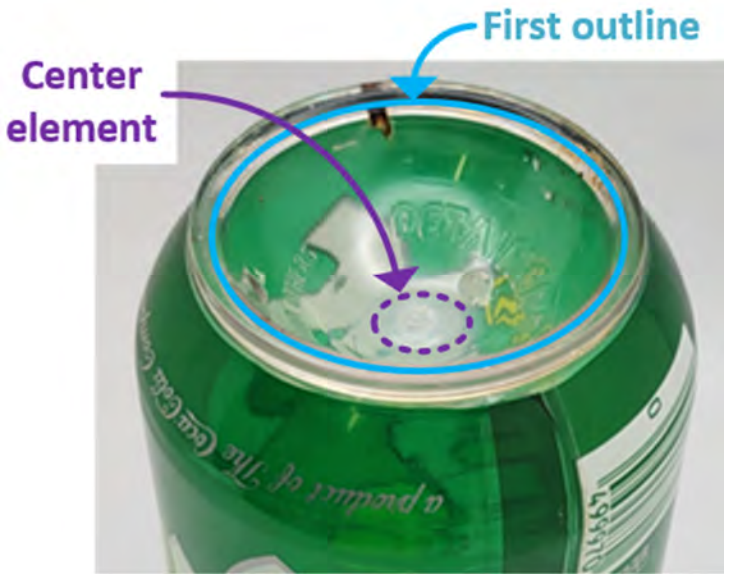
47. The '441 patent does not provide any explanations regarding an "outline," and this term is only recited in the claims. Consistent with its dictionary definition of "[a] line described in the plane of vision by the outer boundary of any object or figure" (Ex. 1007, 4), the Coca-Cola PET Can included the claimed outline. As shown above, the lower end of the Coca-Cola PET Can has a bottom surface on which the can rests when standing upright. An inner edge of this bottom surface

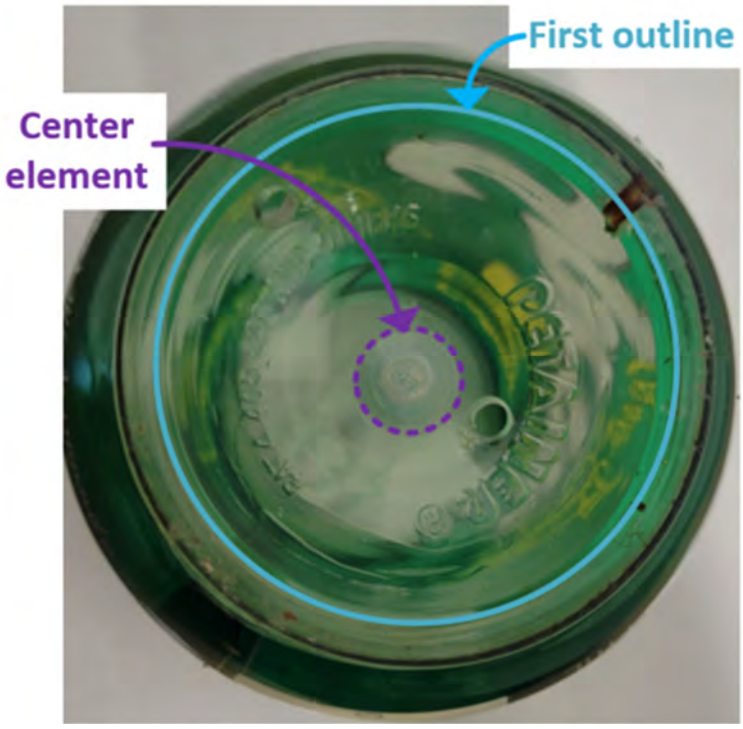
marks a transition between the bottom surface and the curvature of the depression. This inner edge represents a first outline that is at least partially defined by the depression.

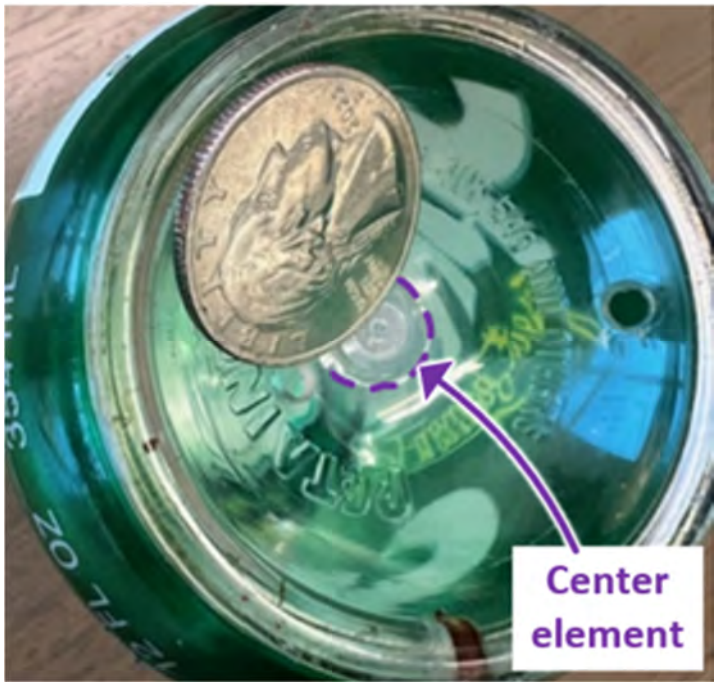


i. Element [1.H]: "wherein the base portion further comprises a center element centered with respect to the first outline at least partially defined by the first depression;"

48. This feature is taught or suggested by the Coca-Cola PET Can. The base of the Coca-Cola PET Can has central bump or discontinuity at the middle of the bottom surface of the depression, representing a center element. As shown in the annotated photographs below, the center element is centered, at least approximately, with respect to the first outline described in [1.G].

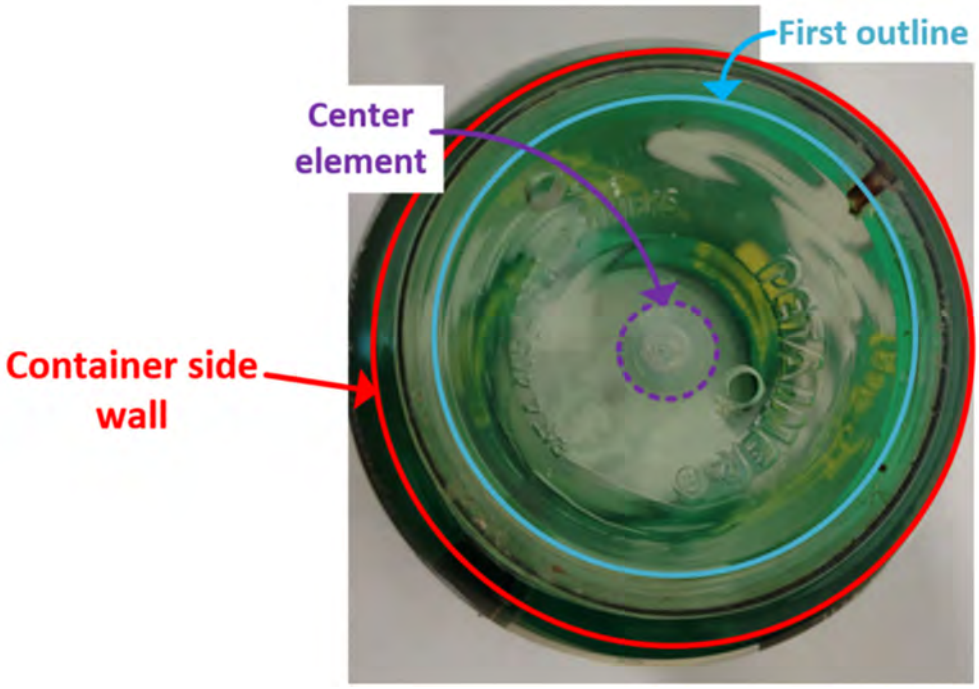

First outline
Center element


First outline
Center element



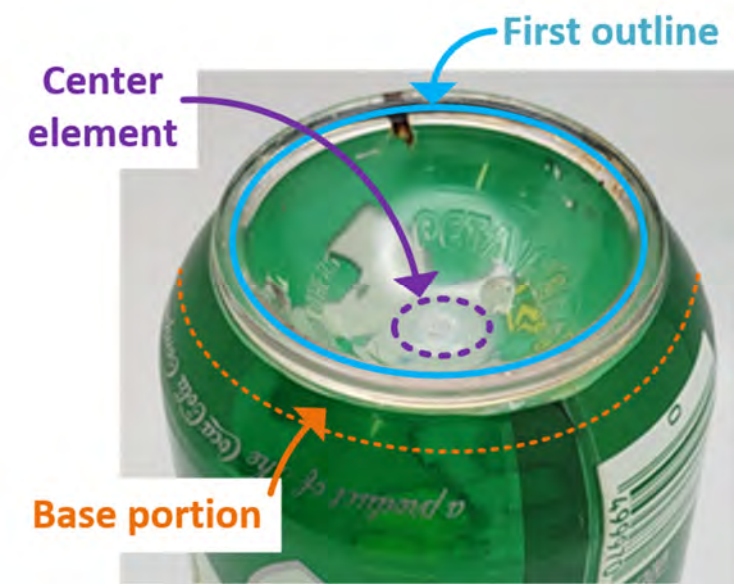
j. Element [1.I]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the container side wall;"

49. The central marking on the bottom of the Coca-Cola PET Can (the center element) is approximately centered with respect to the first outline and with respect to the container side wall, as shown in the photograph below. The first outline is also centered with respect to the container side wall, as shown below; thus, this feature is taught by or obvious in view of the Coca-Cola PET Can.



k. Element [1.J]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the base portion;"

50. As shown in the annotated photograph below, the center element and first outline are both centered with respect to the base portion of the Coca-Cola PET Can, rendering this limitation taught by or obvious in view of the Coca-Cola PET Can.



l. Element [1.K]: "wherein the cross-sectional diameter of the first opening to the interior of the container body is less than a cross-sectional diameter of a middle portion of the container side wall;"

51. The container side wall of the Coca-Cola PET container has a middle portion, as shown below.



52. As is apparent from the photographs, the cross-sectional diameter of the first opening to the can is less than the cross-sectional diameter of the middle portion of the can.



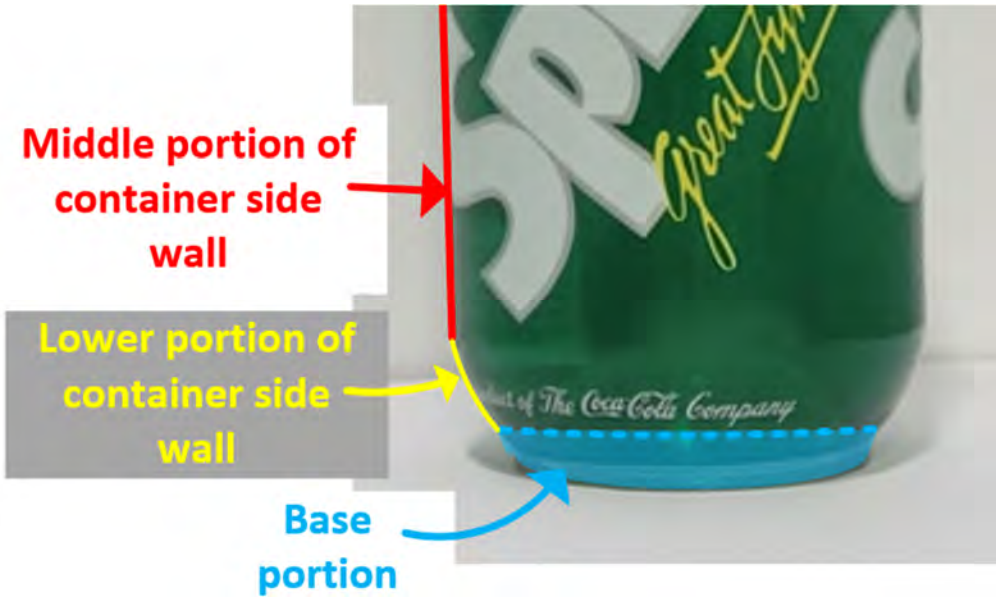
m. Element [1.L]: "wherein the base portion defines a diameter that is less than the cross-sectional diameter of the middle portion of the container side wall;"

53. As is apparent in the photographs of the Coca-Cola PET Can, the base portion has a diameter that is less than the cross-sectional diameter of the middle portion.

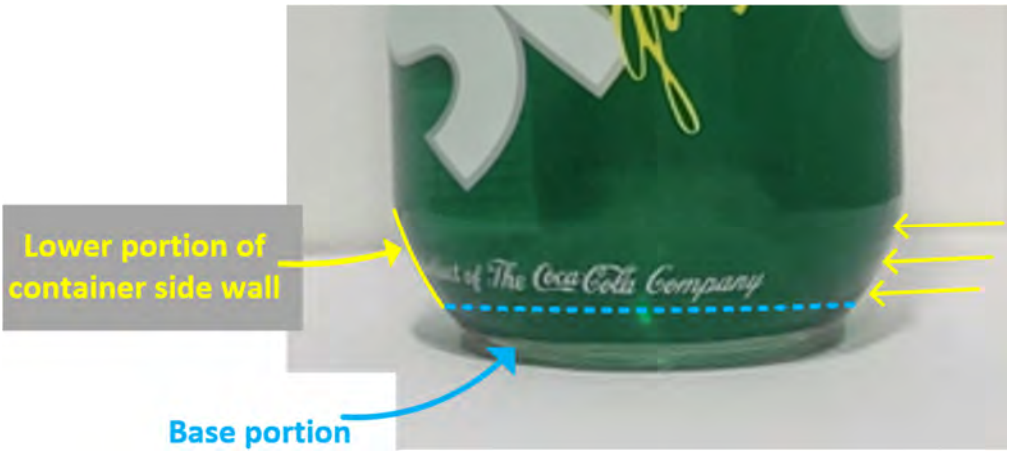

Caffeine Free
Sprite
Great Lymon Taste
Diameter defined by base portion
Cross-sectional diameter of middle portion of container side wall

n. Element [1.M]: "wherein a lower portion of the container side wall extends downwardly from the middle portion of the container side wall to the base portion of the container body, the lower portion along its entirety being greater in diameter along its entirety than the base portion, including the bottom, thereby rendering the container body stemless;"

54. The container side wall of the Coca-Cola PET Can has a lower portion (annotated in *yellow*) that extends downwardly from the middle portion to the base portion, as annotated on the photograph below:



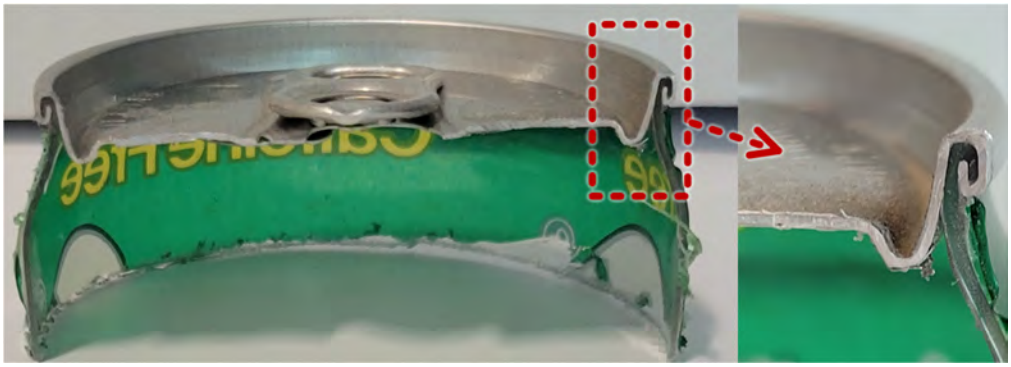
55. This lower portion has, or would be obvious to have, a greater diameter along its entirety than does the base portion because the lower portion has a monotonic slope that causes the cross-section to monotonically decrease from an upper side of the lower portion to the top of the base portion:



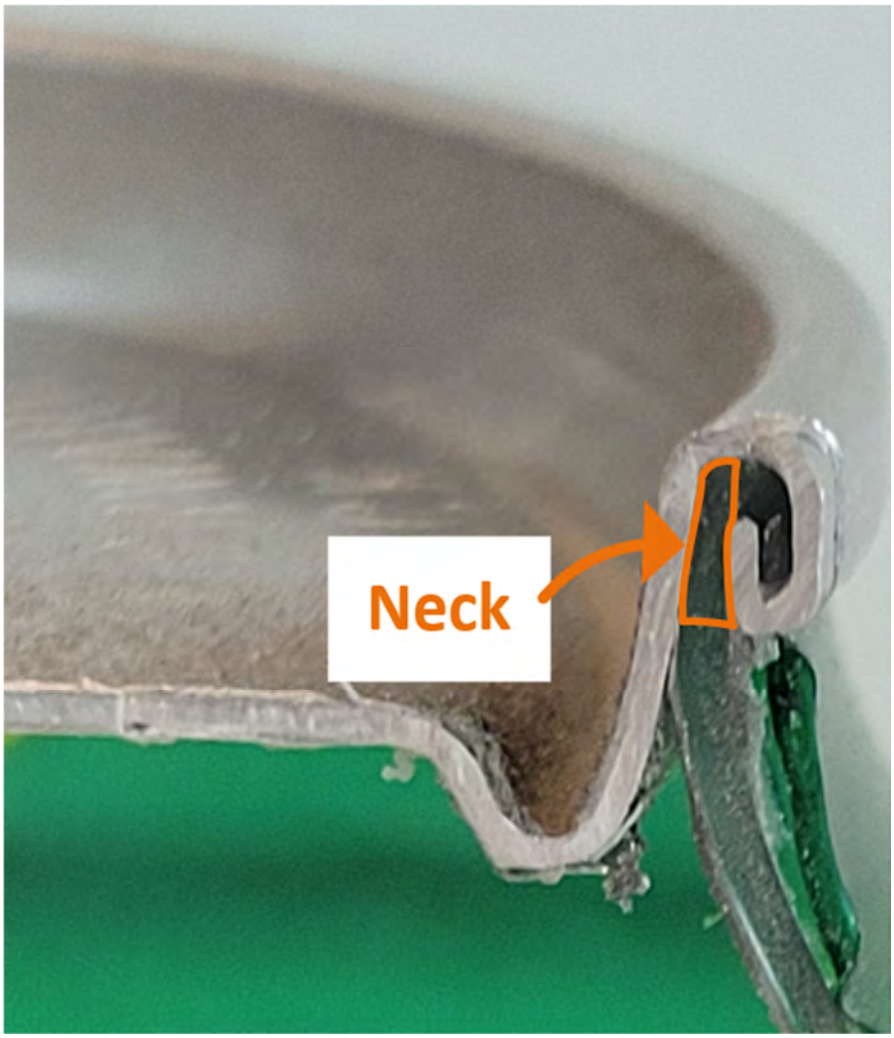
56. With respect to the clause, "thereby rendering the container body stemless," the '441 patent does not define a "stem" or what it means for a container to be "stemless." This clause is ambiguous, and it is not clear to me whether the earlier claim limitations are sufficient to make the container body stemless, or whether the container body must be stemless regardless of the limitations prior to the "thereby" clause. To the extent that the stated "stemless result" is given weight in the invalidity analysis, the Coca-Cola PET Can satisfies this limitation for the reasons explained above, because its lower portion along its entirety is greater in diameter along its entirety than the base portion, including the bottom. Further, even if the "thereby" transitional phrase is ignored and the "stemless" limitation is construed to require a stemless container body independent of the prior claim limitations, the Coca-Cola PET Can has a stemless body, as illustrated in the annotated figures above.

o. Element [1.N]: "wherein the container body further comprises a circular neck extending from the container side wall so that the container side wall extends between the circular neck and the base portion;"

57. The photographs below depict a cutaway view of the metal lid attached to the top of the container body of the Coca-Cola PET Can, showing how the lid wraps over a top portion of the plastic container body.



58. The portion of the container body that engages with the lid, outlined in orange in the annotated photograph below, is the claimed circular neck because it extends around a circumference of the can's top (and thus is circular).

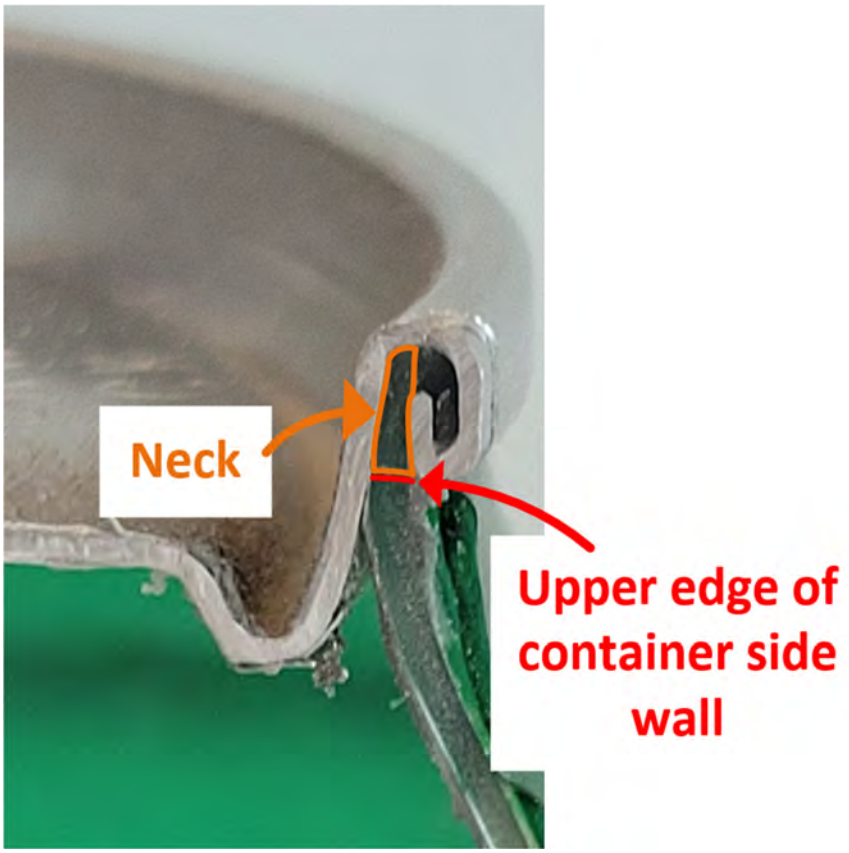


59. The container side wall of the Coca-Cola PET Can extends between the circular neck and the base portion.



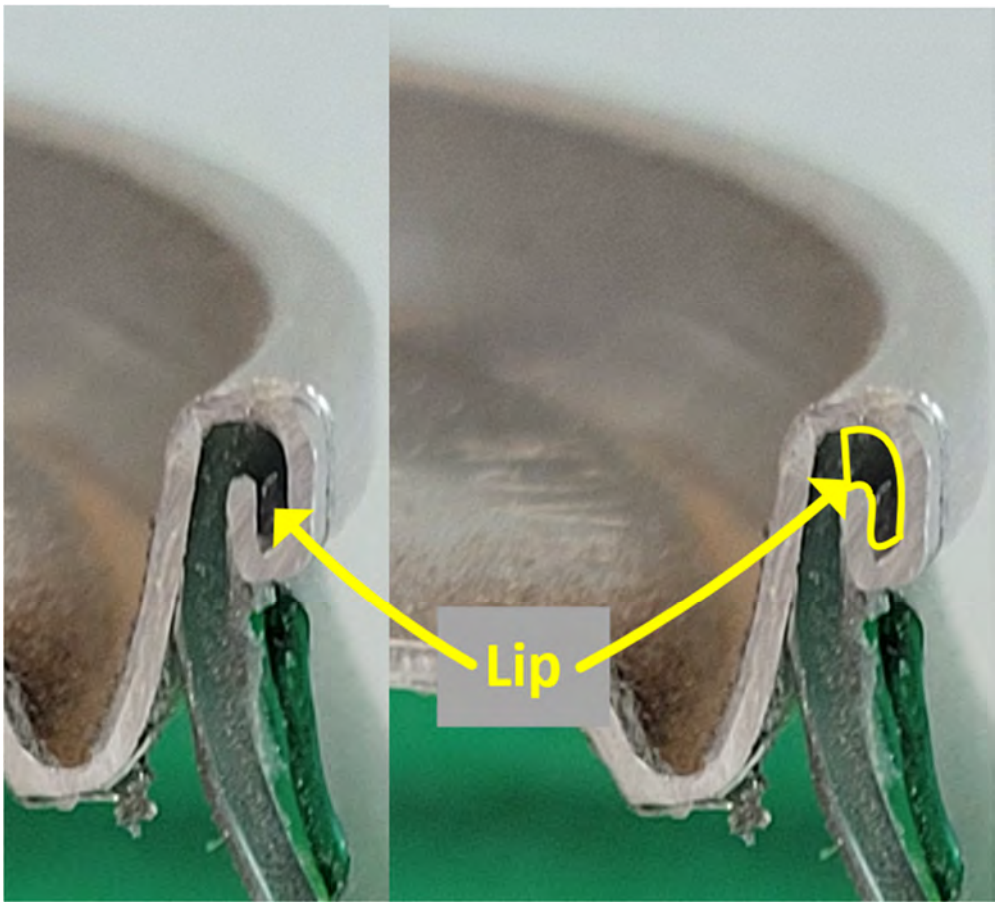
p. Element [1.O]: "wherein an upper edge of the container side wall is adjacent to the circular neck of the container body;"

60. The container side wall of the Coca-Cola PET Can has an upper edge right below the circular neck (and therefore adjacent to it), as shown in the annotated photograph below.

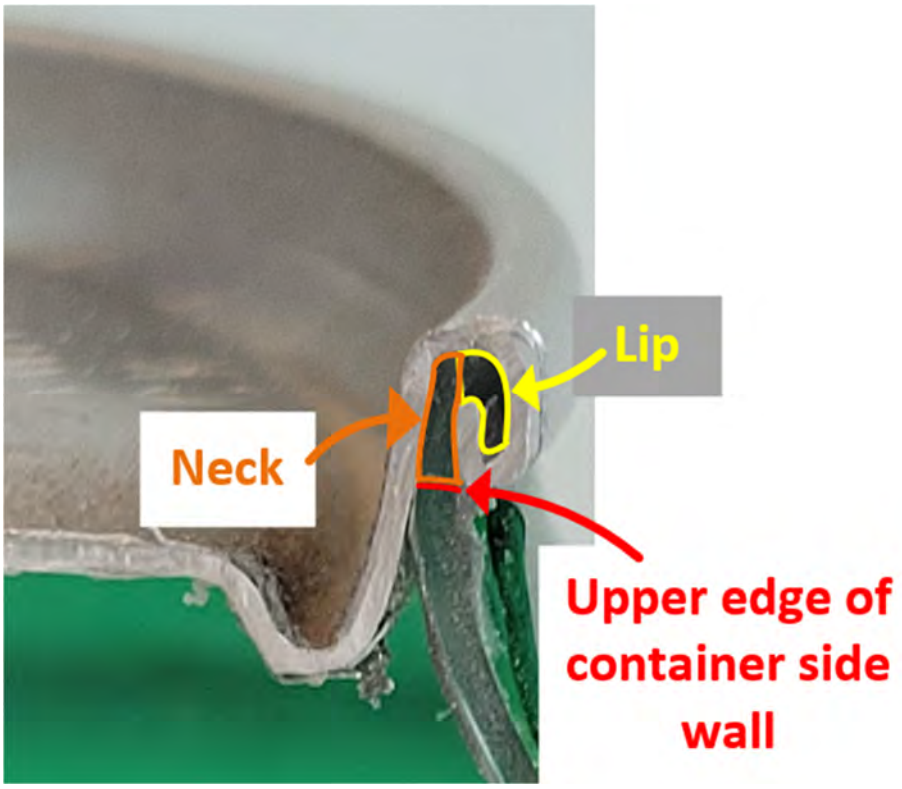


q. Element [1.P]: "wherein the container body further comprises a lip at an end of the circular neck opposite the upper edge of the container side wall;"

61. The lid of the Coca-Cola PET Can wraps around a section of the plastic container body (e.g., a lip, outlined in yellow).



62. This lip is at an end of the circular neck that is opposite the upper edge of the container sidewall. In particular, as shown in the annotated photograph below, the upper edge of the container side wall is at one end of the circular neck, and the lip is at an opposite end of the circular neck.

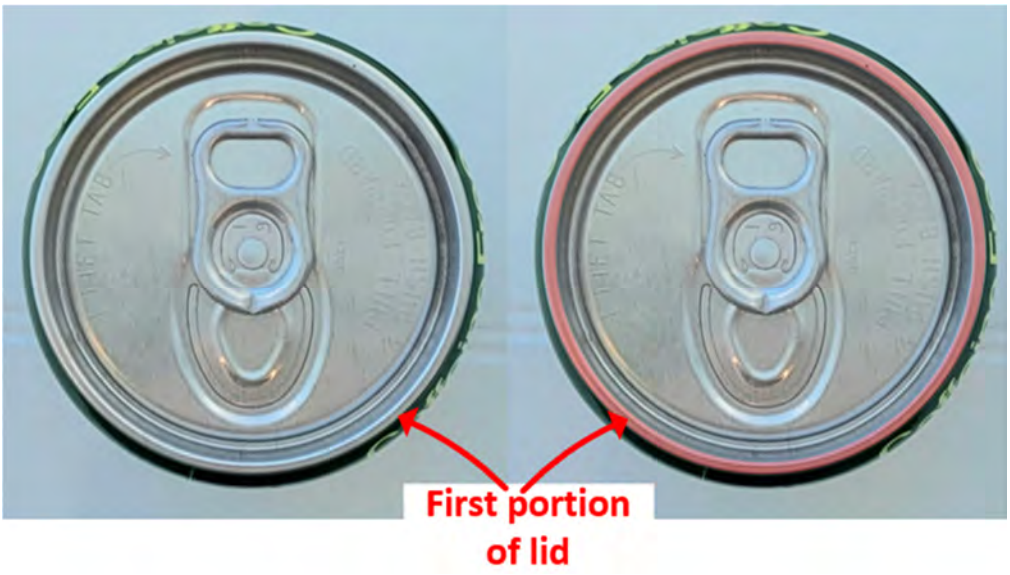


r. Element [1.Q]: "wherein the circular neck is adjacent to the lip;"

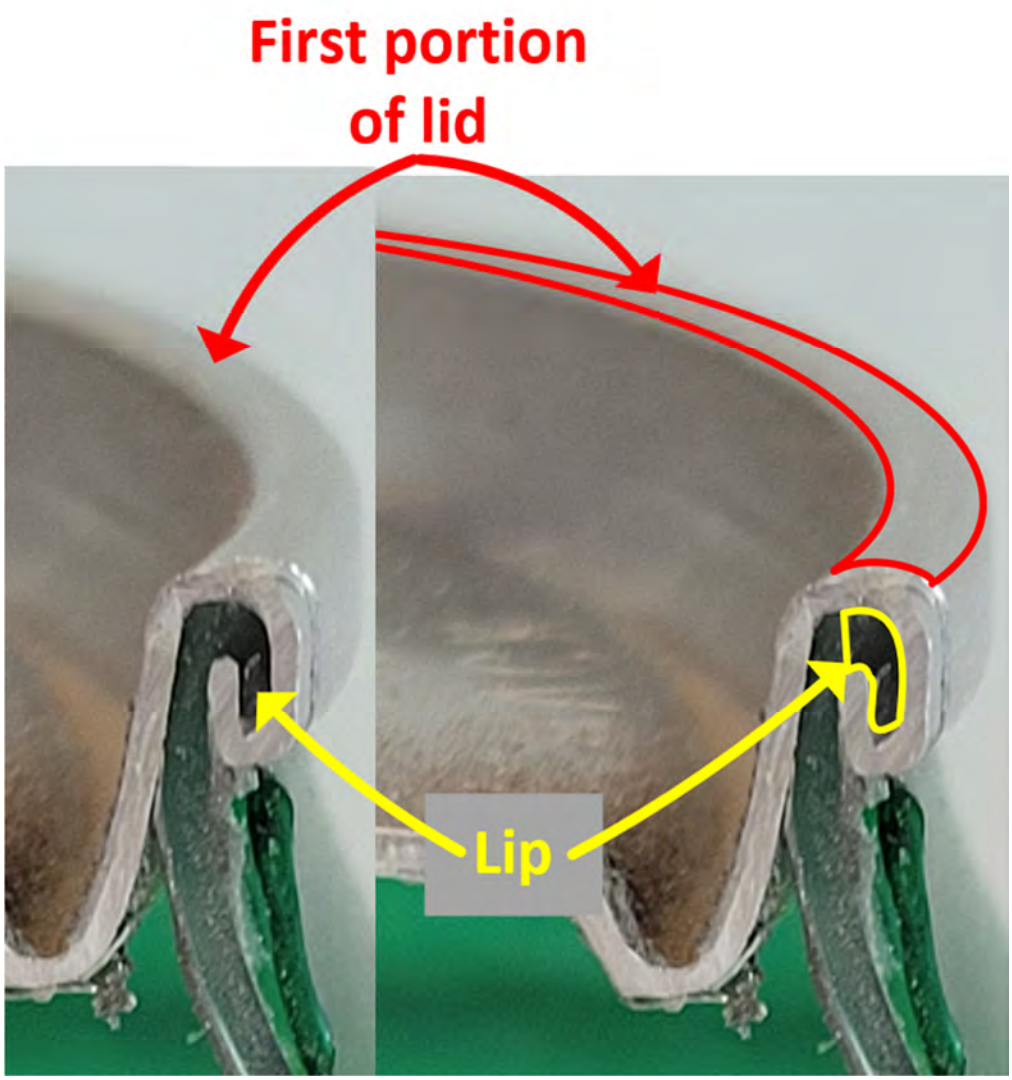
63. The annotated photograph in [1.P] illustrates that the circular neck of the Coca-Cola PET Can's body is adjacent to the lip outlined in yellow.

s. Element [1.R]: "wherein a first portion of the lid is above the lip of the container body;"

64. The lid of the Coca-Cola PET Can has an outer ring that forms a first portion of the lid.

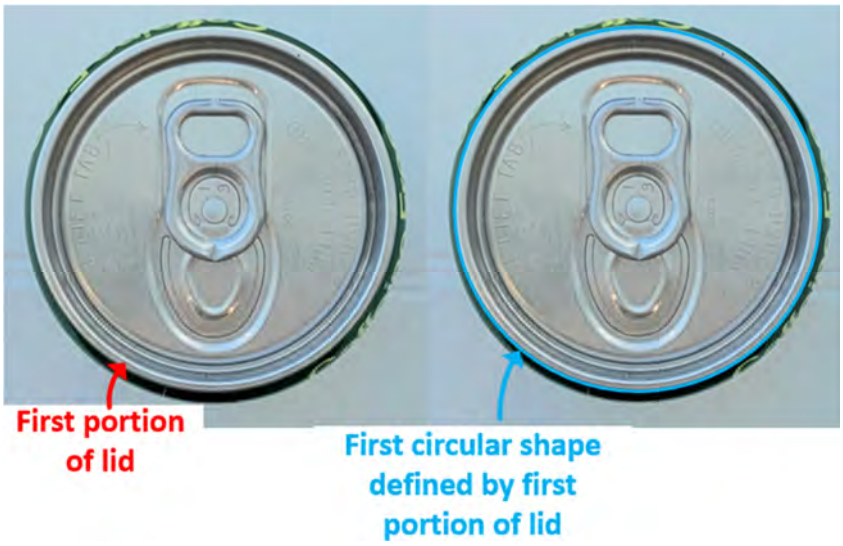


65. As shown in the annotated photograph below, this outer ring is above the lip (outlined in yellow) of the container body.



t. Element [1.S]: "wherein the first portion of the lid defines a first circular shape;"

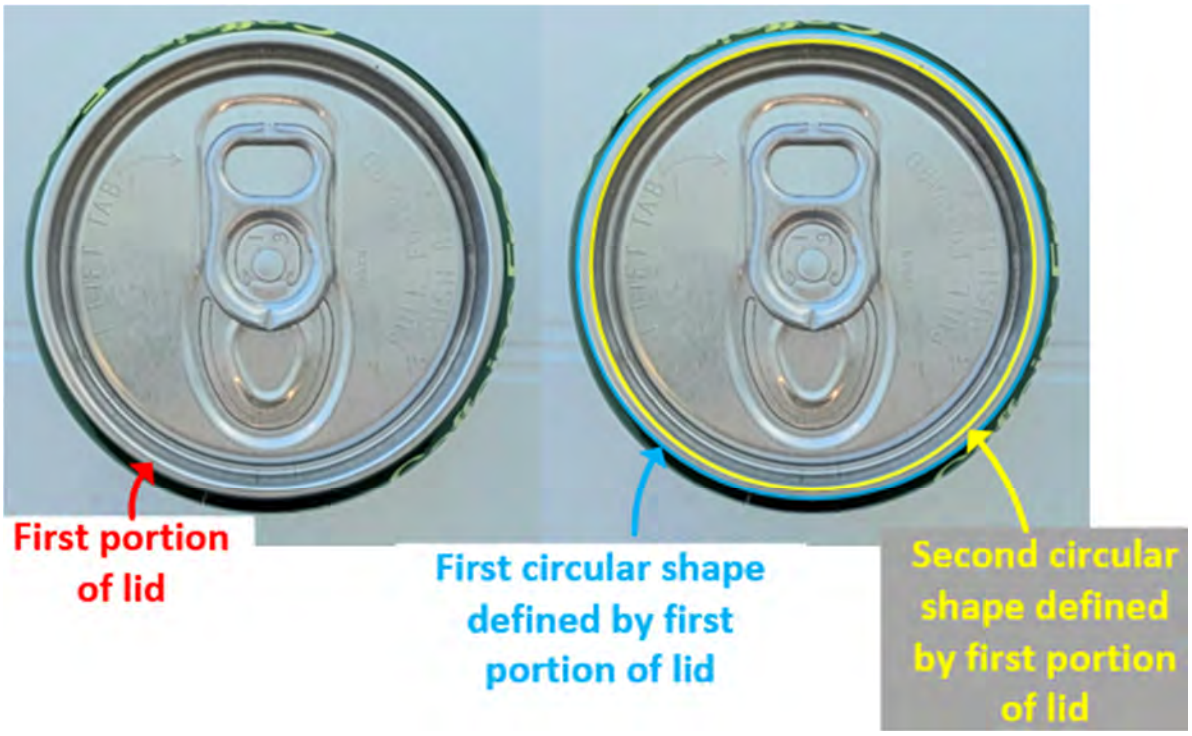
66. The outer ring of the Coca-Cola PET Can's lid (the first portion of the lid) has an outer edge that defines a first circular shape, as depicted in the annotated photograph below.



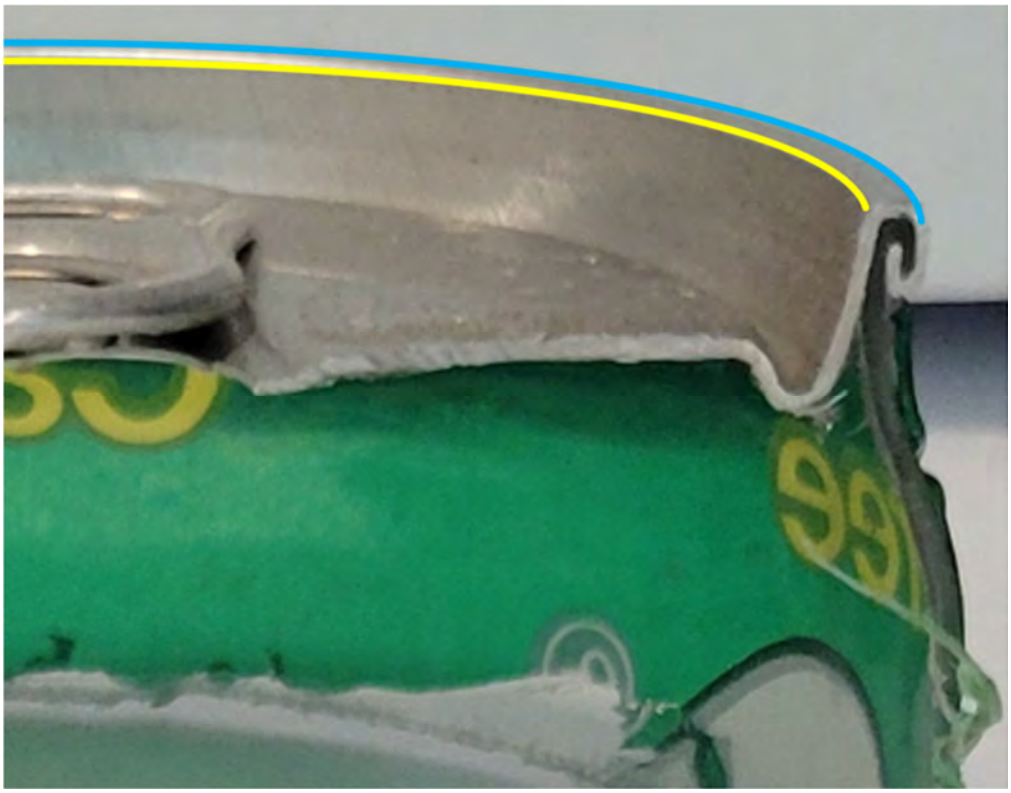


u. Element [1.T]: "wherein the first portion of the lid further defines a second circular shape around which the first circular shape circumferentially extends;"

67. The outer ring of the Coca-Cola PET Can's lid (the first portion of the lid) has an inner edge that defines a second circular shape (annotated in yellow in the photograph below).


First portion of lid
First circular shape defined by first portion of lid
Second circular shape defined by first portion of lid


First circular shape defined by first portion of lid
Second circular shape defined by first portion of lid



v. Element [1.U]: "wherein the second circular shape defined by the first portion of the lid is concentric with the first circular shape defined by the first portion of the lid;"

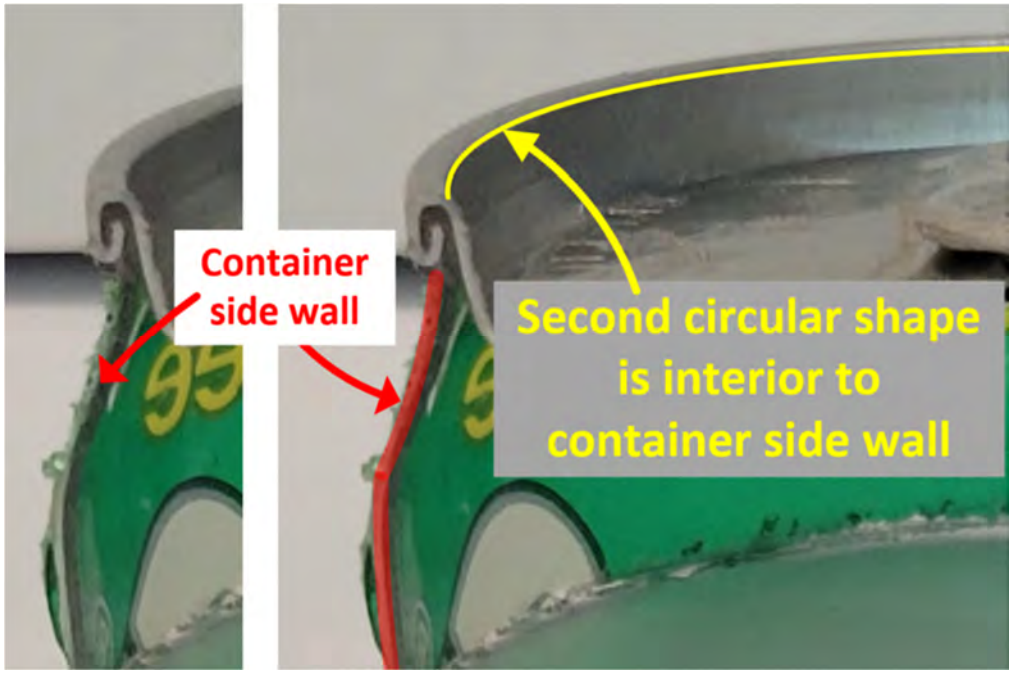
68. The annotated photographs in element [1.T] illustrate that the second circular shape defined by the inner edge of the lid's first portion is concentric with the first circular shape defined by the outer edge.

w. Element [1.V]: "wherein the first circular shape defined by the first portion of the lid is radially positioned between the container side wall and the second circular shape defined by the first portion of the lid;"

69. The annotated photographs shown in element [1.T] illustrate how the first circular shape is positioned outside of the second circular shape, such that the

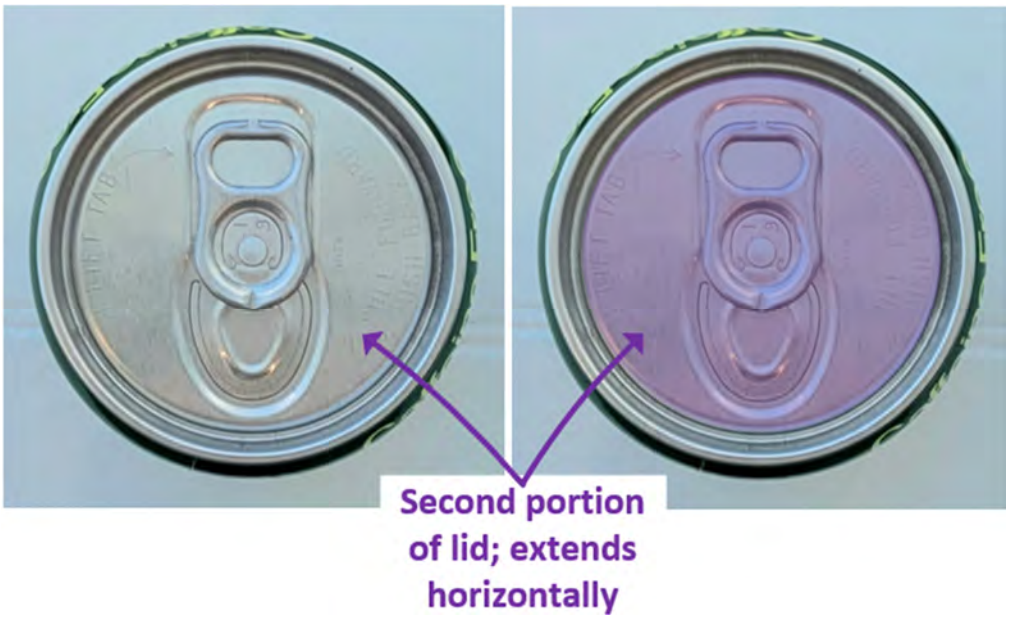
second circular shape is radially closer to a vertical centerline of the can. A side view of the can, annotated below, illustrates how the first circular shape is positioned radially closer to the vertical centerline (marked in purple) than the container side wall. Thus, the first circular shape is radially positioned between the container sidewall and the second circular shape.





x. Element [1.W]: "wherein a second portion of the lid extends horizontally and is positioned so that the second circular shape is radially positioned between the second portion of the lid and the first circular shape;"

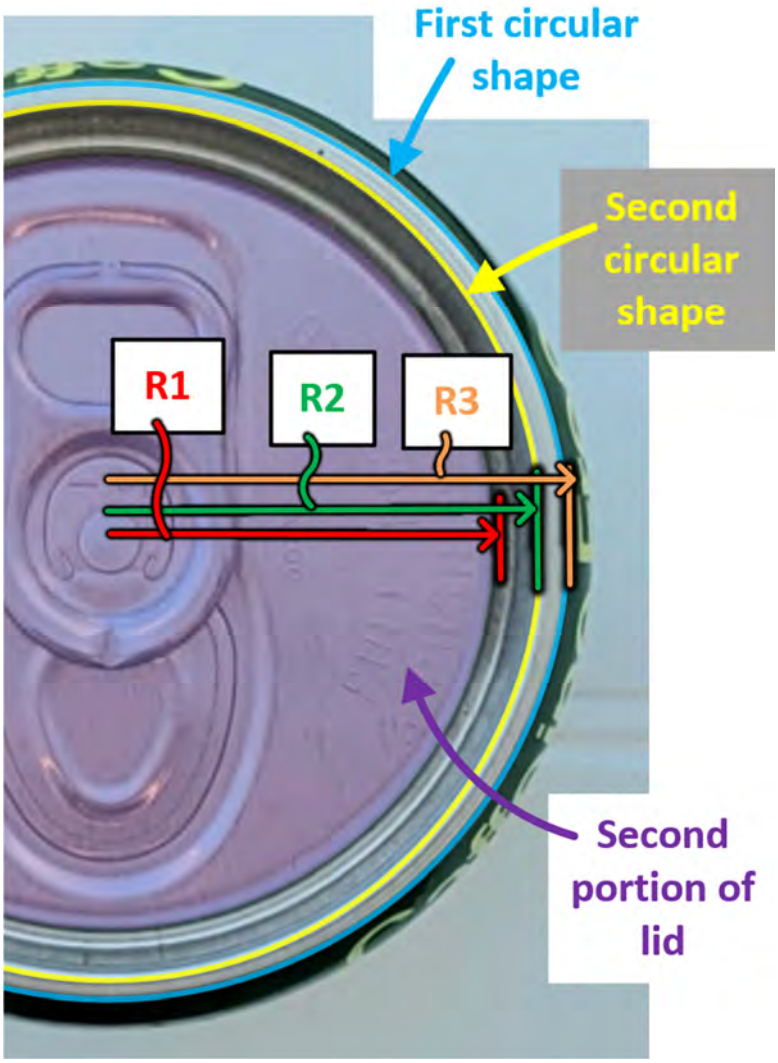
70. The lid of the Coca-Cola PET Can has a central region as annotated below, which forms a second portion of the lid that extends horizontally (when the Can is sitting upright).

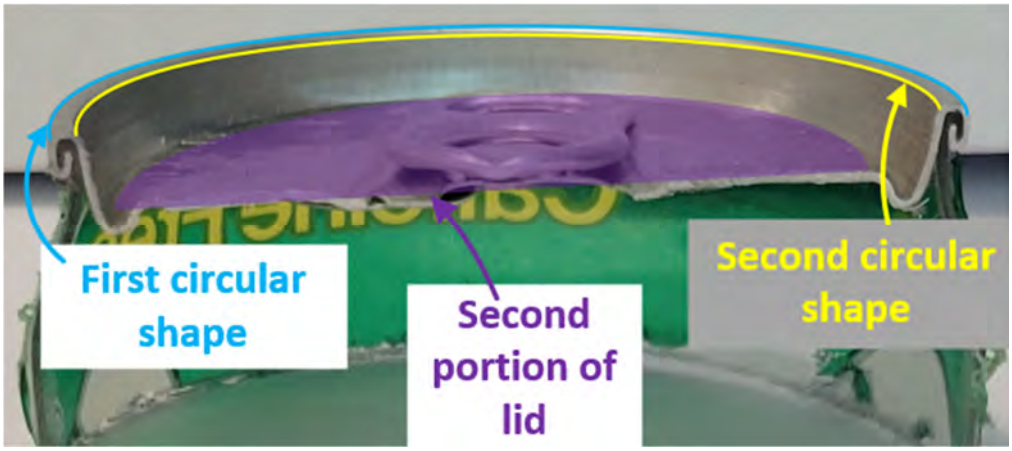


Below is a cutaway view of the central region of the lid, showing that it extends horizontally:



71. Finally, the annotated photographs below show how the second circular shape of the Coca-Cola can (*see* [1.T]) is positioned such that a radius from a centerpoint of the lid to the second circular shape (R2) is greater than a radius from the centerpoint to the outer circumference of the second portion of the lid (R1). A radius (R3) from the centerpoint to the first circular shape (*see* [1.T]) is in turn greater than the radius from the centerpoint to the second circular shape. Thus, the second circular shape of the Coca-Cola can's lid is radially positioned between the lid's second portion and the first circular shape.


First circular shape
Second circular shape
R1
R2
R3
Second portion of lid

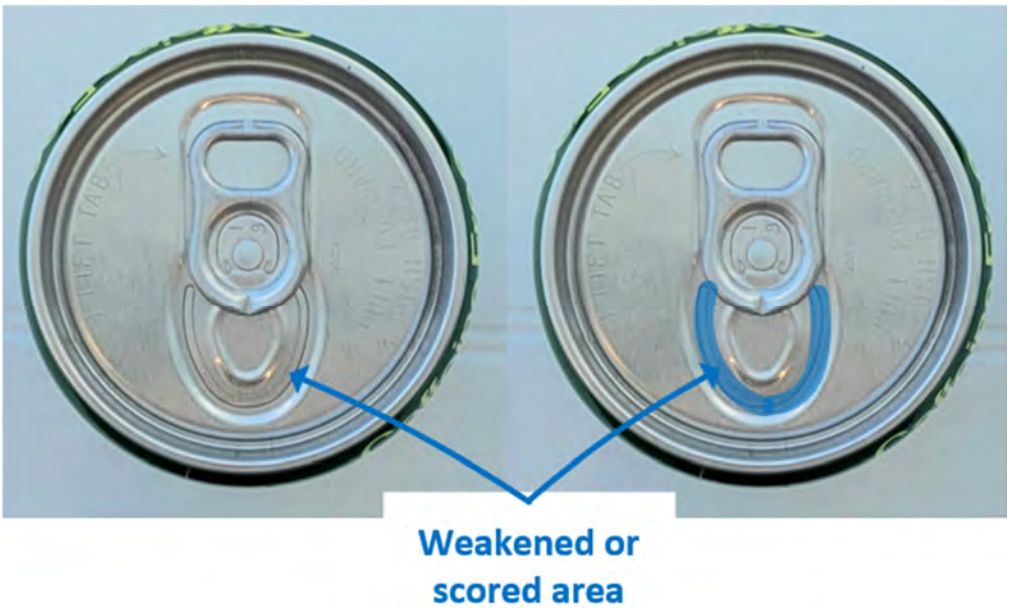

First circular shape
Second portion of lid
Second circular shape

y. Element [1.X]: "wherein the second portion of the lid defines a total area across which the second portion of the lid extends horizontally;"

72. *See* annotated photos in [1.W]; the central portion of the Coca-Cola PET Can's lid (the second portion of the lid) defines a total area across which the second portion extends horizontally.

z. Element [1.Y]: "wherein the second portion of the lid comprises a weakened or scored area;"

73. The central region of the Coca-Cola PET Can's lid has a weakened or scored area in the form of a weakened or scored, substantially elliptical line, as annotated in the photograph below. This weakened or scored line facilitates opening of the can for a user to consume the beverage inside the can.

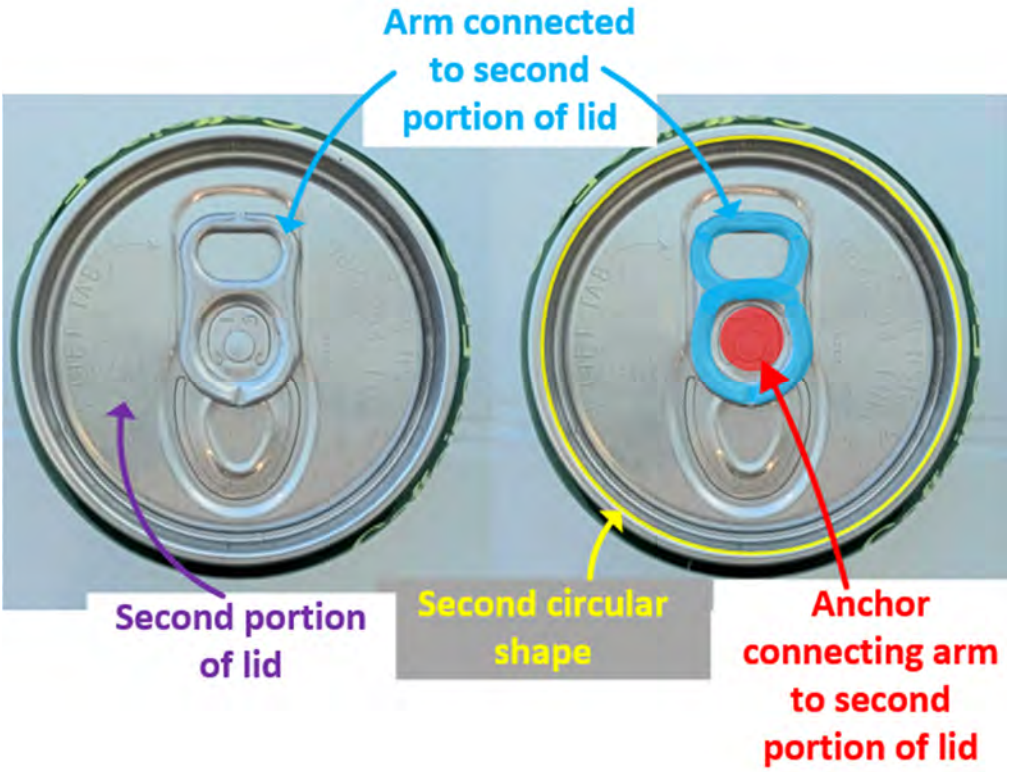


aa. Element [1.Z]: "wherein the weakened or scored area is less than the total area across which the second portion of the lid extends horizontally;"

74. *See* elements [1.W] and [1.Y]. As shown in the annotated photographs, the weakened or scored area (in [1.Y]) is less than the total area across which the second portion of the lid extends horizontally (in [1.W]).

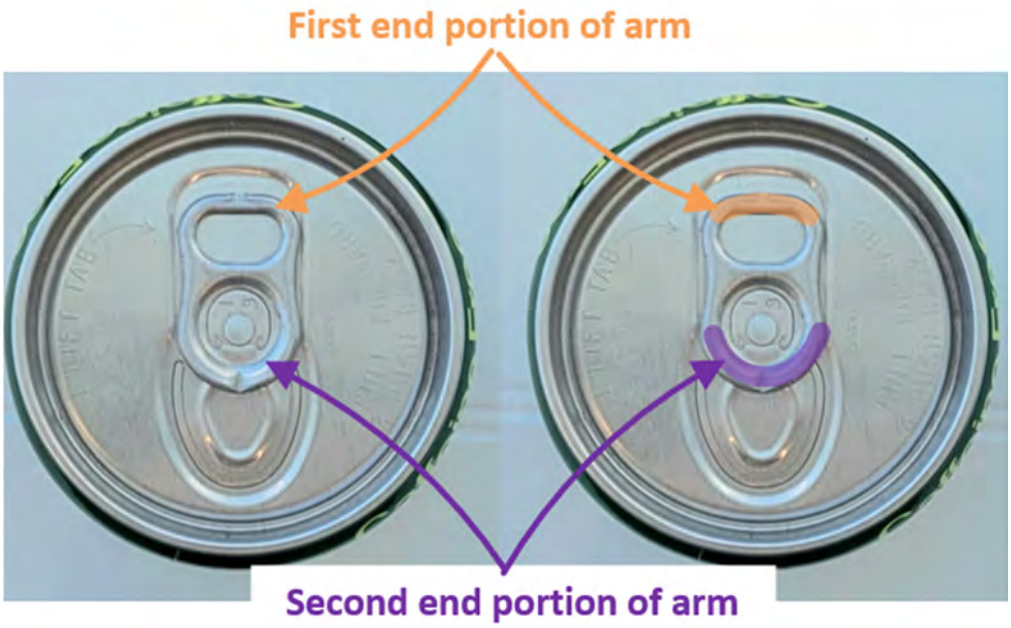
bb. Element [1.AA]: "wherein the lid further comprises an arm connected to the second portion of the lid and radially positioned within the second circular shape;"

75. The Coca-Cola PET Can's lid has an arm, as annotated in the photograph below. The arm is connected by an anchor to the central region of the lid (the second portion of the lid), radially inside the second circular shape annotated in yellow.



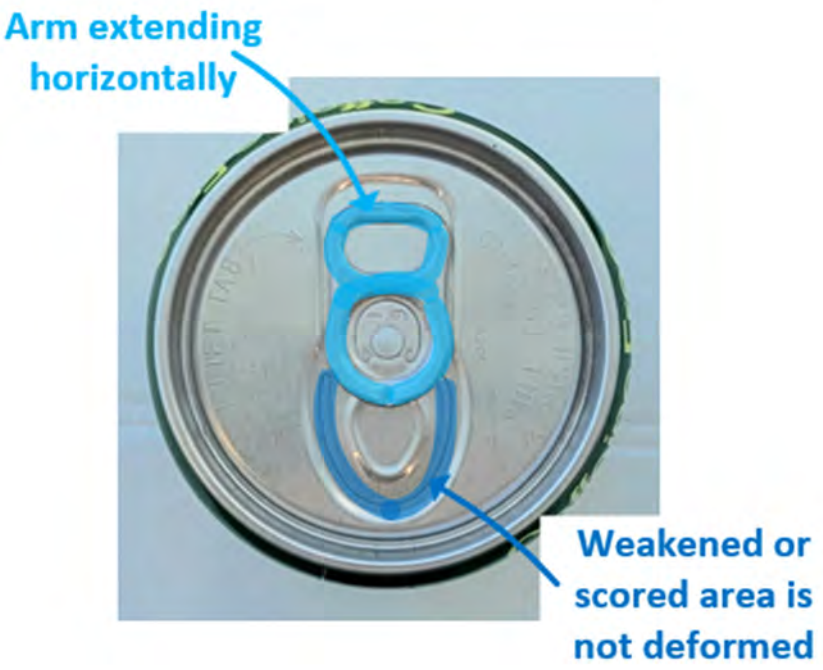
cc. Element [1.AB]: "wherein the arm comprises opposing first and second end portions;"

76. The arm of the Coca-Cola PET Can's lid has a first end portion (i.e., an end farther from the weakened or scored area) and a second end portion (i.e., an end nearer to the weakened or scored area), as annotated below.

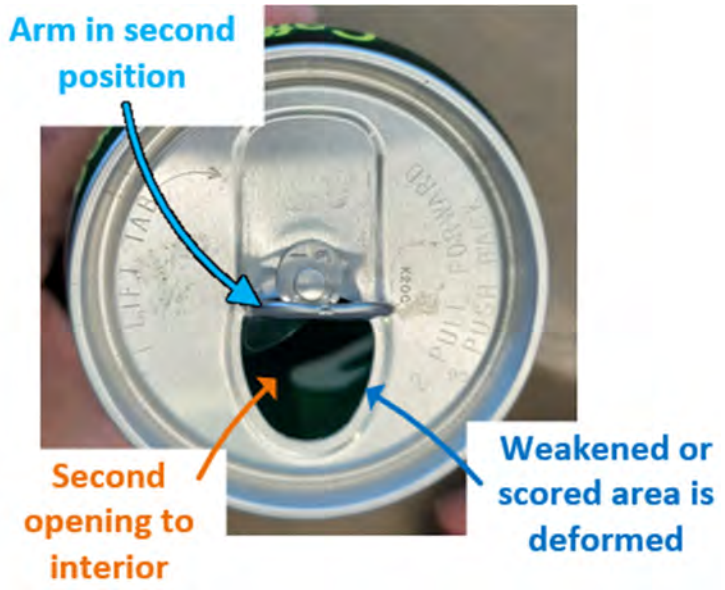


dd. Element [1.AC]: "wherein the arm is pivotable from a first position, in which the arm extends horizontally and the weakened or scored area is not deformed, to a second position, in which the arm does not extend horizontally and the weakened or scored area is deformed to provide a second opening to the interior of the container body;"

77. The arm of the Coca-Cola PET Can is pivotable. First, the arm has a first, horizontally extending position, as shown in the photograph below (when the can is upright).



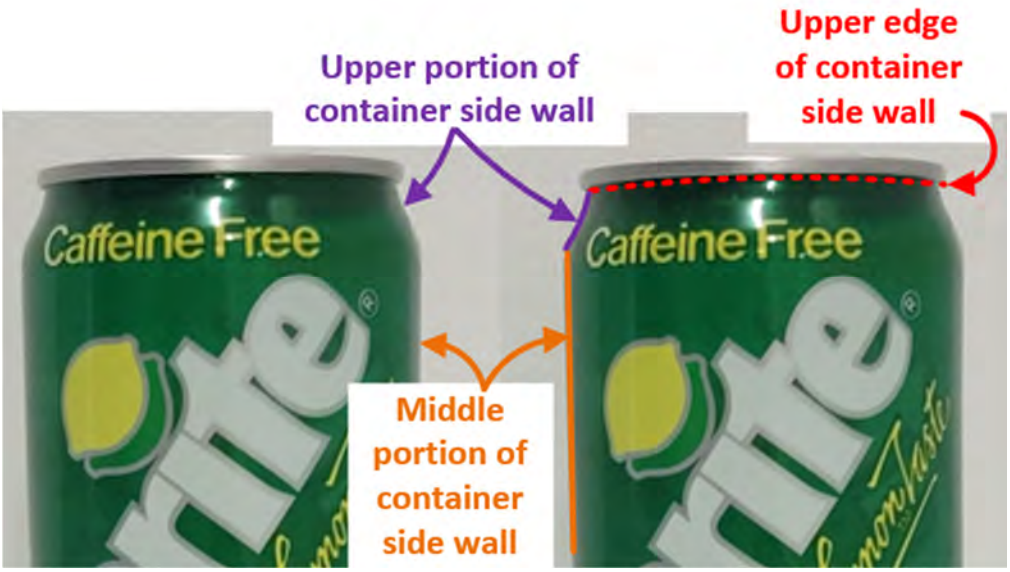
78. A second position of the arm is shown in the subsequent photograph. As can be seen, the arm in the second position does not extend horizontally (e.g., can protrude vertically from the lid or at an angle between horizontal and vertical). When the arm is in the second position, the weakened or scored area has been deformed (e.g., the score broken to cause a tab to be bent into the interior of the can) such that a second opening to the interior of the container body is provided. The lid of the Coca-Cola PET Can that I initially examined was in its original sealed position, and I used the tab to puncture the scored area of the lid to create the opening, as shown in photographs below.


Arm in second position
Second opening to interior
Weakened or scored area is deformed


Arm in second position
Weakened or scored area is deformed
Second opening to interior

ee. Element [1.AD]: "wherein an upper portion of the container side wall extends upwardly from the middle portion of the container side wall to the upper edge of the container side wall, the upper portion along its entirety being greater in diameter than the first opening to the interior of the container body;"

79. As discussed in element [1.O], the container side wall of the Coca-Cola PET Can has an upper edge at, for example, a point where the lid wrapped around the top of the container intersects the container sidewall. An upper portion of the container side wall (e.g., a section of the side wall as annotated below) extends upwardly from the middle portion of the container side wall to the upper edge.



80. As can be seen from visual inspection of the photograph, the upper portion of the container sidewall has a greater diameter along its entirety than does the first opening because the upper portion has a monotonic slope that causes the cross-section to monotonically decrease from the middle portion of the container

side wall to the upper edge. This feature is therefore taught by or obvious in view of the Coca-Cola PET Can.

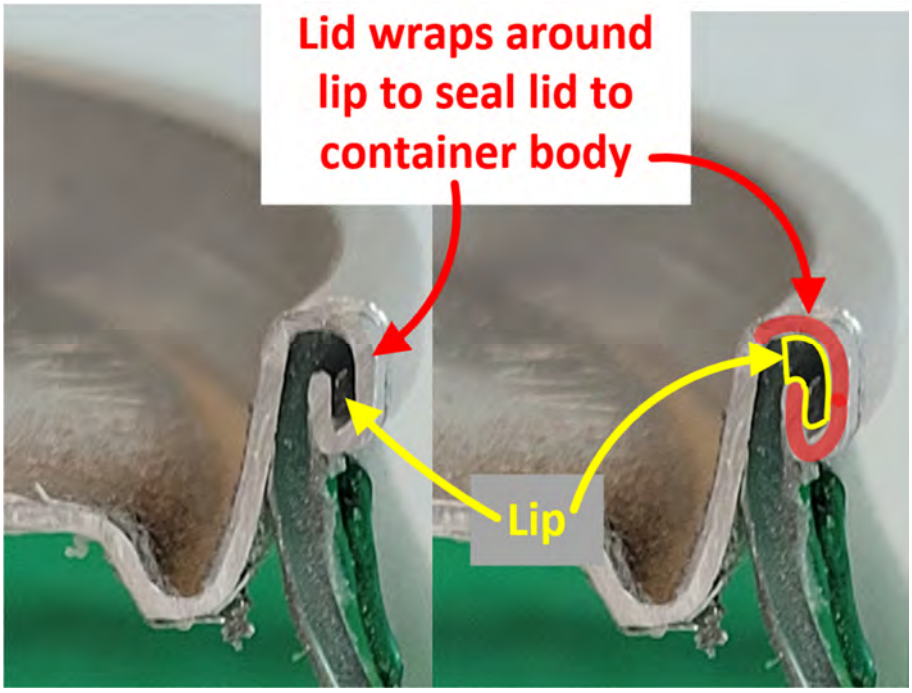


ff. Element [1.AE]: "wherein the container body contains a liquid therewithin;"

81. While the container shown in the photographs does not include a liquid inside, it would have been obvious to a POSITA that the Coca-Cola PET Can was configured to hold a liquid beverage, i.e., Sprite soda printed on the Can.

gg. Element [1.AF]: "wherein the lid cooperates with the lip to provide a seal so that the liquid contained within the container body is sealed against leaking out from between the container body and the lid;"

82. The lid of the Coca-Cola PET Can cooperates with the lip because it wraps around a portion of the top of the container body (a lip, outlined in yellow), as can be seen in the cutaway photograph below:

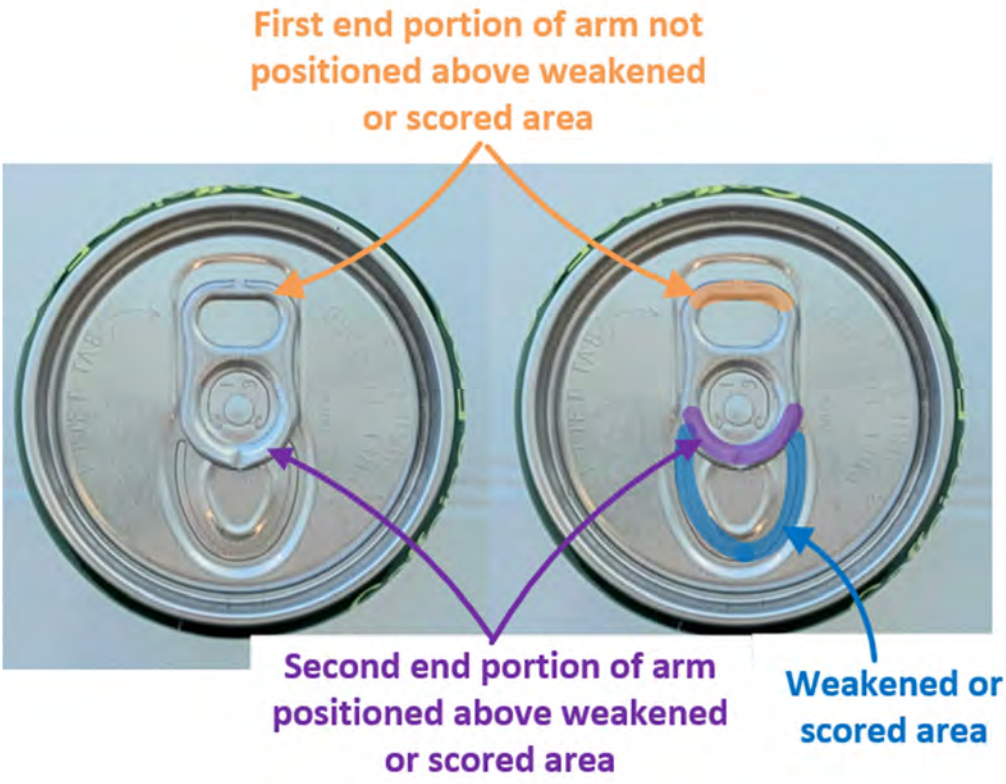


83. This wrapping is a cooperation between the lid and the lip that seals the can, which would have been obvious to a POSITA to ensure that the liquid beverage inside the Can would not leak from the connection point between the container body and the lid.

hh. Element [1.AG]: "wherein, when the arm of the lid is in the first position and the weakened or scored area is not deformed: the first end portion of the arm is not positioned above the weakened or scored area of the second portion of the lid; and at least a portion of the second end portion of the arm is positioned above the weakened or scored area of the second portion of the lid;"

84. As described with respect to element [1.AB], the arm of the Coca-Cola PET Can's lid has a first end portion (i.e., an end farther from the weakened or scored area) and a second end portion (i.e., an end nearer to the weakened or scored area).

As shown in the annotated photograph below, when the arm is in a first, horizontal position, the first end portion is not above the weakened or scored area while the second end portion is above this area.



ii. Element [1.AH]: "wherein the container side wall extends between the circular neck and the base portion so that:

the upper portion of the container side wall defines a first angle: between the upper portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the middle portion of the container side wall defines a second angle: between the middle portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the lower portion of the container side wall defines a third angle: between the lower portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the first angle is an acute angle;

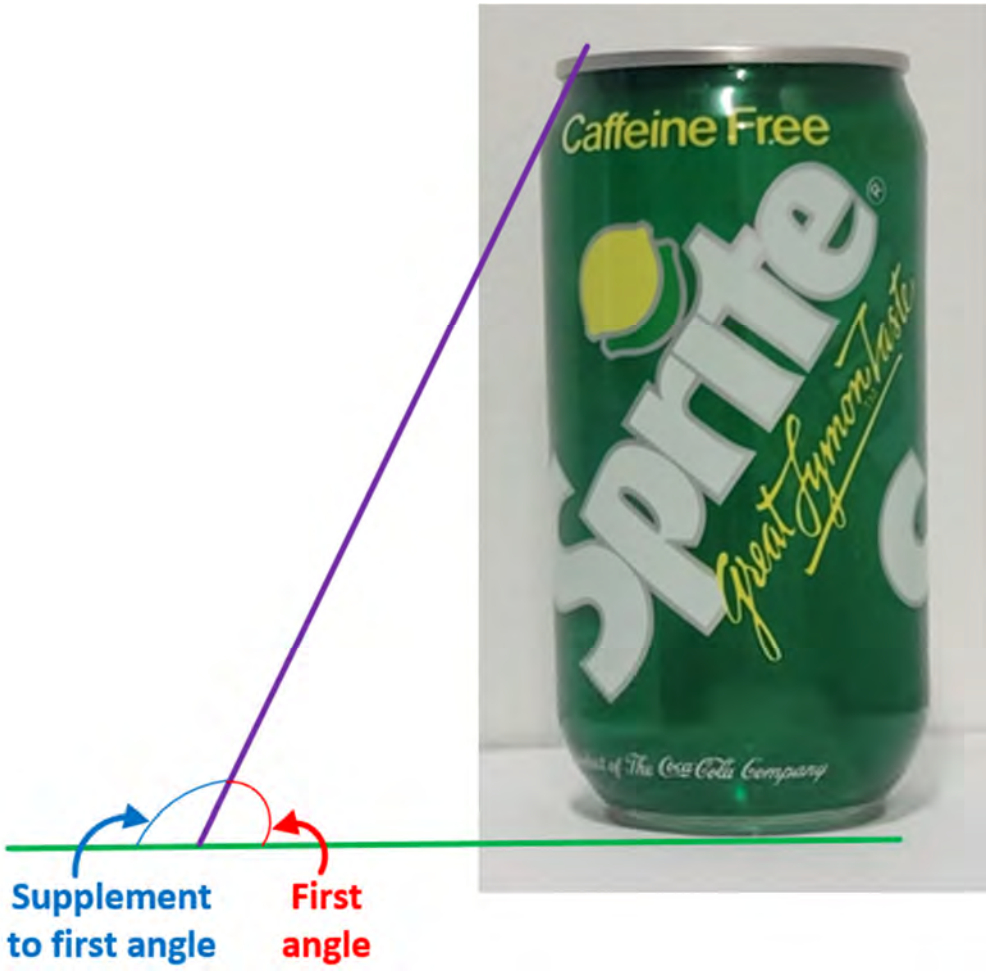
the third angle is an obtuse angle;

the second angle is greater than the first angle; and

the third angle is greater than the second angle;"

85. These features are taught by or obvious in view of the Coca-Cola PET Can. The container side wall of the Coca-Cola PET Can extends between the neck and the base portion, as discussed with respect to element [1.N]. A first angle can be defined between the upper portion of the container side wall and the bottom of the base portion. For example, as annotated on the photograph below, a tangent line to the upper portion of the side wall intersects a line parallel to the plane of the container's bottom, forming two supplementary angles that are defined "between the

upper portion of the container side wall and the bottom of the base portion." The angle facing the container satisfies the claimed requirement that the first angle be further defined "with respect to the bottom of the base portion." As shown, the first angle is acute.



86. A second angle can be defined between the middle portion of the container side wall and the bottom of the base portion, such as an angle at the intersection of a line parallel to the middle portion of the container side wall and the line parallel to the plane of the container's bottom (annotated below). Similar to the

first angle, the second angle facing the container at this intersection satisfies the claimed requirement that the second angle be further defined "with respect to the bottom of the base portion." As shown, the second angle is approximately 90 degrees.



87. A third angle can be defined between the lower portion of the container side wall and the bottom of the base portion, such as an angle at the intersection of a line tangent to the lower portion and the line parallel to the plane of the container's

bottom (annotated below). Like the first and second angles, the third angle (yellow) facing the container at this intersection satisfies the claimed requirement that the third angle be further defined "with respect to the bottom of the base portion." As shown, the third angle (yellow) is obtuse.



88. Finally, since the second angle is approximately 90 degrees while the first angle is acute, the second angle is greater than the first angle. Likewise, the third, obtuse angle is greater than the second, approximately 90-degree angle.

jj. Element [1.AI]: "wherein the interior of the container body extends continuously across the cross-sectional diameter of the middle portion at a height midway between the circular neck and the base portion so as to be interrupted, if at all, only by the liquid contained within the container body."

89. There is no obstruction in the can at a height midway between the circular neck and base portion that would interrupt any liquid contained in the can, as can be seen from the annotated photograph below.


Caffeine Free
Sprite
great lymon taste

2. Claim 2: "The container of claim 1, wherein the resin is a polyethylene terephthalate (PET) resin."

90. As described with respect to [1.C], the Coca-Cola PET Can is made of PET.

3. Claim 3: "The container of claim 1, wherein the container body is formed using a blow molding process."

91. For the reasons set forth above, the container body recited in claim 1 is obvious over the Coca-Cola PET Can. I understand that claim 3 is a product-by-process claim reciting a process by which the container body of claim 1 is formed, and that this process should not be given patentable weight. In my opinion the specification of the '441 patent does not attach any particular significance to the blow molding process for forming the container body because its provides a list of various blow molding variations "such as biaxial orientation blow molding process or direct blow molding process or injection blow molding," (*see e.g.*, Ex. 1001, 2:49-52; 3:15-18), but also explains that the body may be formed from molded plastic in sections which may be glued, welded or otherwise attached together (*id*., 3:6-8). However, the '441 patent provides no specific reason or significance to the different methods for forming the container body, and just lists them as different known alternatives.

92. Even if claim 3 were to be given patentable weight, blow molding is Applicant Admitted Prior Art for the '441 patent. For example, the '441 patent

describes in its background that plastic containers "have been molded into various shapes." (Ex. 1001, 1:36-37). Additionally, as explained above, the '441 patent characterizes all varieties of the blow molding process, namely, biaxial orientation blow molding, direct blow molding, and injection blow molding, as "***known molding processes***." (*Id.*, 2:49-52). By the earliest priority date of the '441 patent in 2010, blow molding techniques for making bottles or containers were well-known. See also Ex. 1017, 22: "Annual world PET production is around 60 million tons. PET materials were manufactured using extrusion, injection molding and blow molding techniques."

4. Claim 4: "The container of claim 1, wherein the metal is aluminum."

93. As described with respect to [1.D], the lid of the Coca-Cola PET can is made of aluminum.

5. Claim 5

a. Element [5.A]: "The container of claim 1, wherein the metal is aluminum; and"

94. The Coca-Cola PET Can disclosed this limitation, as explained above with respect to claim 4.

b. Element [5.B]: "wherein the resin is a polyethylene terephthalate (PET) resin."

95. The Coca-Cola PET Can disclosed this limitation, as explained above with respect to claim 2.

6. Claim 6

a. Element [6.A]: "The container of claim 1, wherein the container body is formed using a blow molding process; and"

96. This limitation is disclosed in AAPA, as explained above with respect to claim 3.

b. Element [6.B]: "wherein the resin is a polyethylene terephthalate (PET) resin."

97. The Coca-Cola PET Can disclosed this limitation, as explained above with respect to claim 2.

7. Claim 7

a. Element [7.A]: "The container of claim 1, wherein the metal is aluminum; and"

98. The Coca-Cola PET Can disclosed this limitation, as explained above with respect to claim 4.

b. Element [7.B]: "wherein the container body is formed using a blow molding process."

99. This limitation is disclosed in AAPA, as explained above with respect to claim 3.

8. Claim 8

a. Element [8.A]: "The container of claim 1, wherein the metal is aluminum;"

100. The Coca-Cola PET Can disclosed this limitation, as explained above with respect to claim 4.

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b. Element [8.B]: "wherein the resin is a polyethylene terephthalate (PET) resin; and"

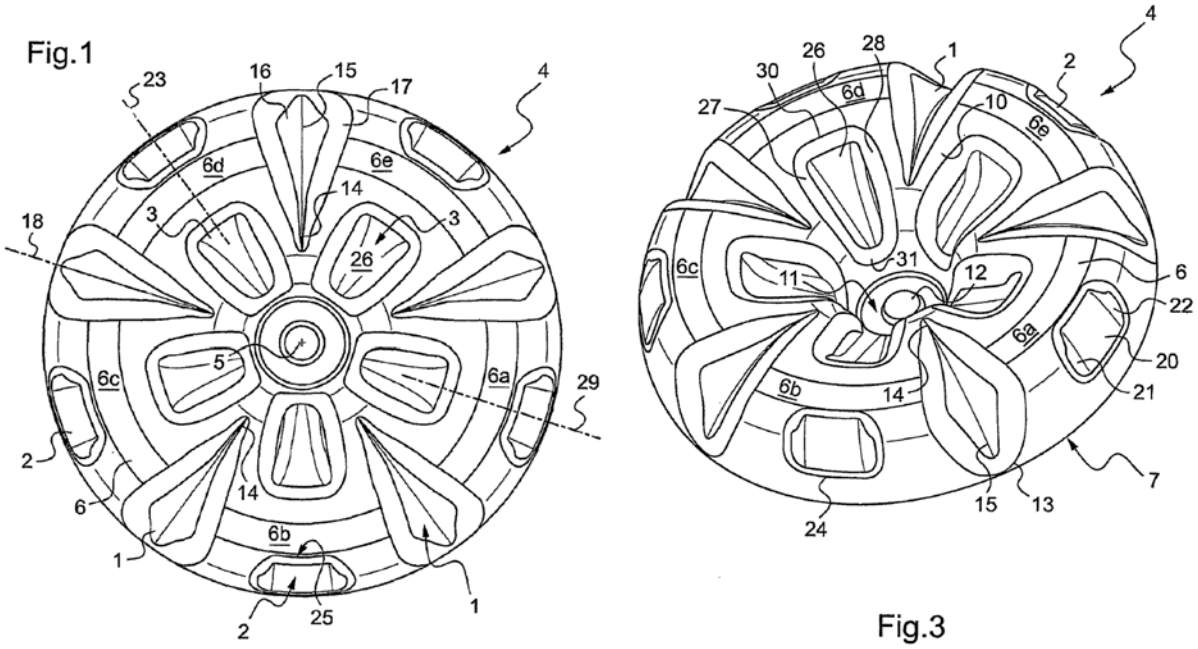
101. The Coca-Cola PET Can disclosed this limitation, as explained above with respect to claim 2.

c. Element [8.C]: "wherein the container body is formed using a blow molding process."

102. This limitation is disclosed in AAPA, as explained above with respect to claim 3.

C. Ground 2: The Coca-Cola PET Can and Protais render claims 9-20 obvious.

103. U.S. Patent No. 8,524,349 (B2) was issued to Protais et al. on September 3, 2013, and claims priority to a PCT filed on July 13, 2007. (Ex. 1008). Protais is directed to a thermoplastic bottom for hollow containers. (Protais, 1:7-9). The container bottom, as displayed below in Protais' Figures 1 and 3, contained various ribs, notches, and grooves that cooperated to function as a strong base for thinner walls when compared to other container bottoms. (*Id.*, 3:14-25; 6:20-27; 6:56-61). Furthermore, in the case of impact, the design of Protais' container bottom allowed for resistance from deformation. (*Id.*, 3:18; 6:47-48).



Protais, Figs. 1 and 3

1. Motivation to Combine the Coca-Cola PET Can and Protais.

104. A POSITA would have found it obvious to make a container that combined the container body and lid of the Coca-Cola PET Can with the disclosed features of Protais' container bottom.

105. The Coca-Cola PET can is a plastic, cylindrical container, and Protais described a base for a plastic container (Protais, 4:24-28). And, a POSITA would be able to add Protais' container bottom to any number of plastic bottles and containers, including the Coca-Cola PET Can that had a cylindrical container body. (*See* Protais, Figures 1 and 3 (illustrating a circular container base)).

106. Additionally, Protais explained the benefits associated with a container that incorporates Protais' base. Protais states that combining its base into a larger container allows for increased strength and resistance to deformation. (Protais, 3:14-25; 6:20-27; 6:56-61; 6:47-48). Therefore, a POSITA would have been motivated to modify the Coca-Cola PET Can to use the ribs, notches, and grooves of Protais in order to achieve this increased strength and resistance to deformation. This would have been consistent with objectives of the Coca-Cola PET Can (EX-1006 (describing how the Coca-Cola PET Can "is designed to be as strong and durable as soft drink packages to which consumers are already accustomed"). And adding the even more sturdy bottom section of Protais would have improved the resiliency of the Cans to rupture during shipping and storage, and especially in the event that the containers were accidentally dropped. Indeed, the Coca-Cola PET Can already includes a similar feature in the form the depression on the base of the can. (*See* [1.F] in Ground 1). But the Cans had to be made slightly taller than the standard Coke Cans. Adding the Protais' base would have allowed the for a Coca-Cola PET Can to retain a sturdy structure without having to include a larger curved bottom – and thus a taller can. In other words, this modification would have allowed the Coca-Cola PET Cans to have a similar to the height of an aluminum can, which would have helped with using the same standard filling and packaging equipment for both the aluminum-body and plastic-body containers.

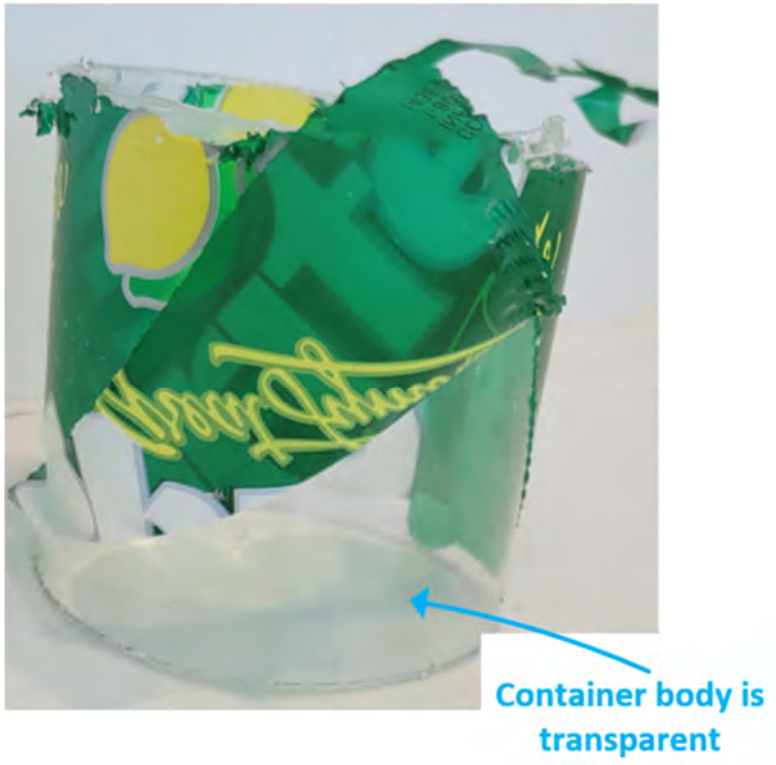
2. Claim 9

a. Element [9.A]: "The container of claim 1, wherein the first depression is visible through at least a portion of the container body;"

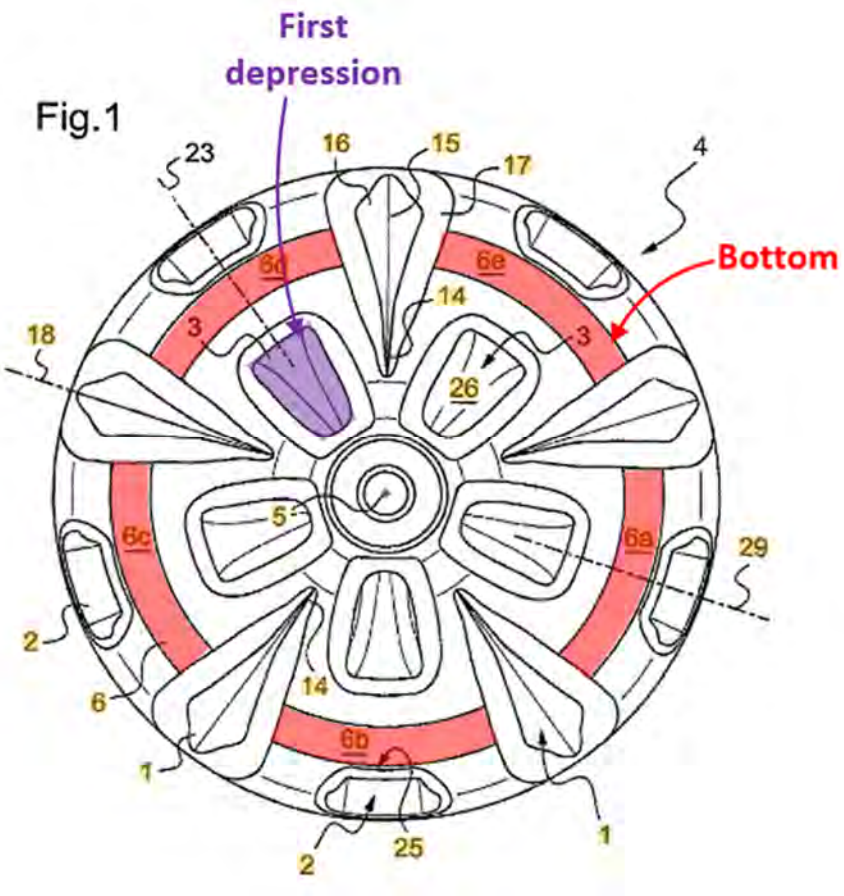
107. In the Coca-Cola PET can, the container side wall, with the Sprite plastic label that covers the side wall, is translucent such that the first depression is visible through the side wall, as shown in the photographs below.



108. In fact, once the label is removed from the container, the Coca-Cola PET Can's sidewall is transparent, as depicted in the photograph below.



109. The see-through properties of the Coca-Cola PET Can are further corroborated by the Coca-Cola Marketing Material indicating "[T]he new package is translucent and semi-transparent, so you can see inside." Ex. 1006. In the combination, Protais also disclosed a first depression. As illustrated in Protais' Figures 1 and 3, annotated below, the container bottom of Protais – forming at least part of the claimed base portion – had a "transverse support surface 6" (e.g., a bottom) and various reinforcing portions such as "reinforcing grooves 3." (*Id.*, 4:41-44; 4:55; 5:1-2; 5:62-6:3). At least one of the reinforcing grooves 3 formed a first depression, as annotated below.



Protais, Fig. 1 (Annotated)

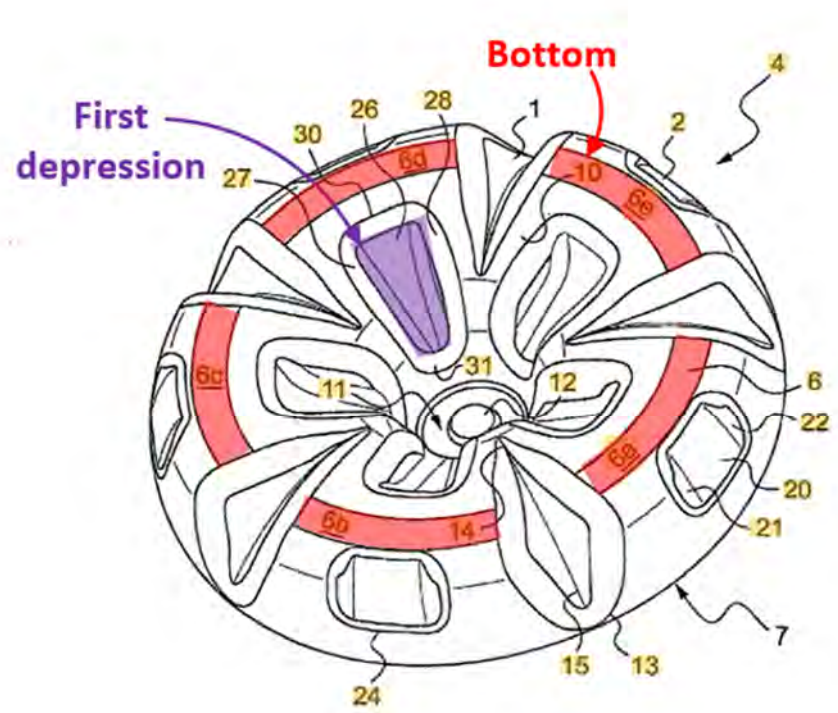
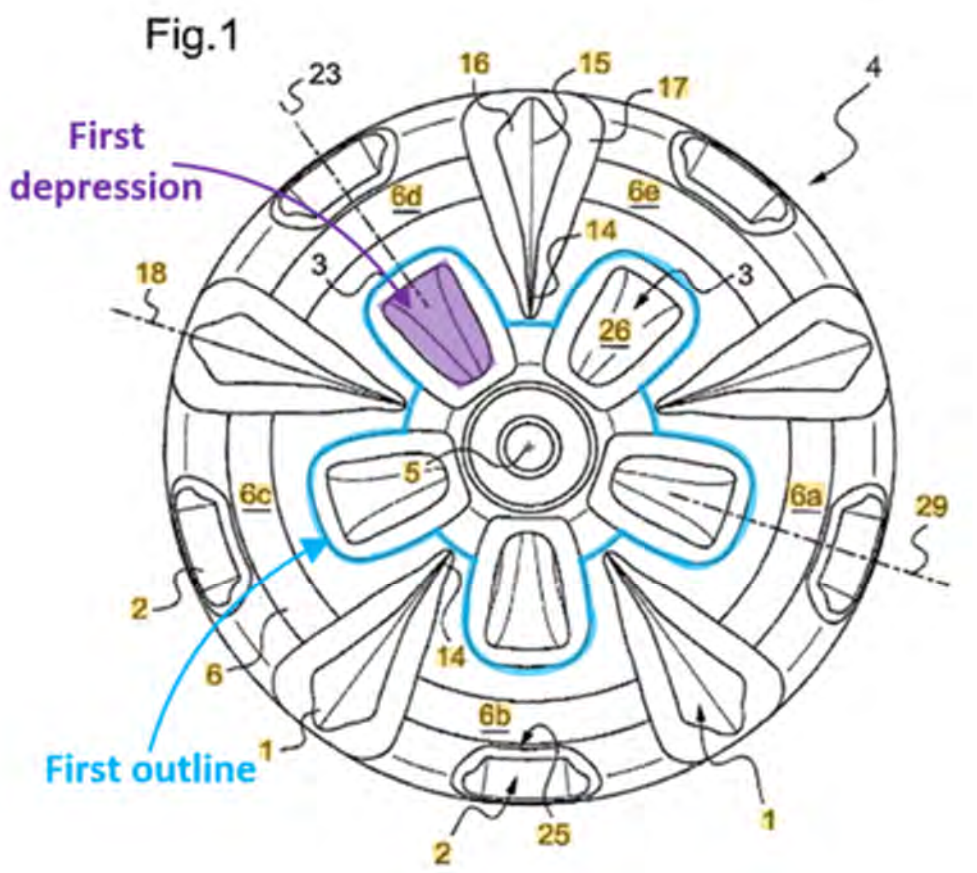


Fig.3

Protais, Fig. 3 (Annotated)

110. The reinforcing grooves 3 on Protais' container bottom each had an outer edge—that is, an edge farthest from the center of the bottom, when viewed from below as in Figure 1. These outer edges of the reinforcing grooves together formed a first outline that traced these outer edges. Accordingly, as shown in annotated Figure 1 below, the first reinforcing groove (first depression) at least partially defined the first outline because its outer edge formed part of the first outline.



Protais, Fig. 1 (Annotated)

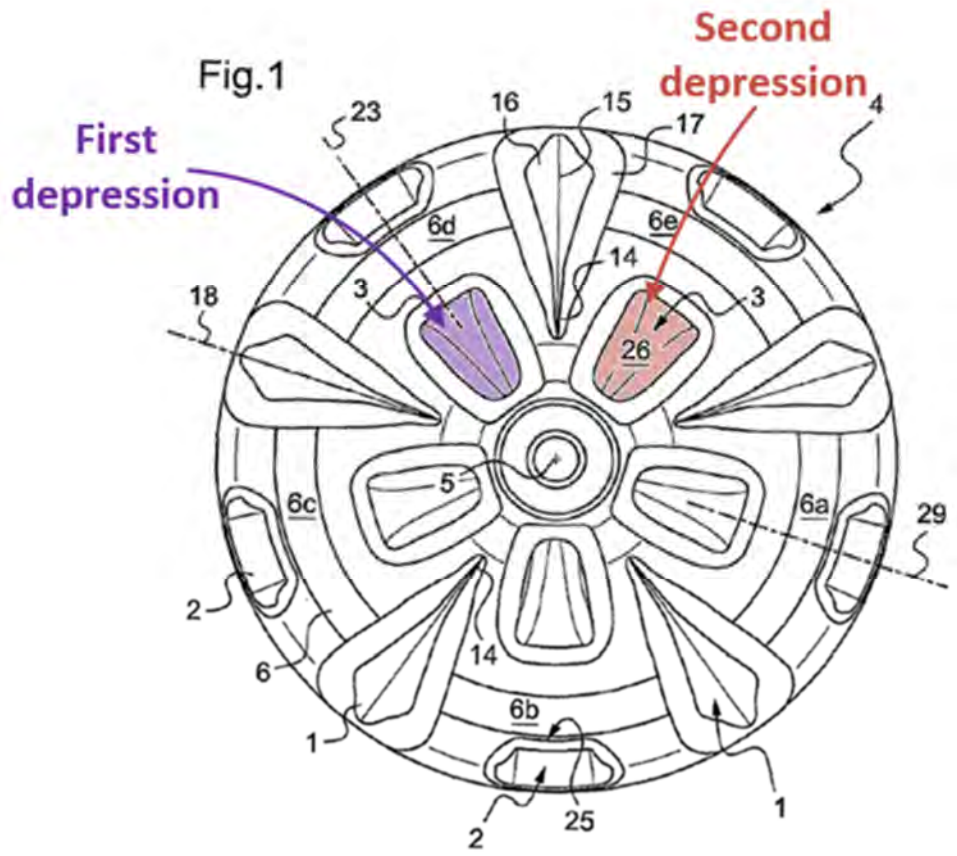
111. A POSITA would have been motivated to modify the Coca-Cola PET Can's base to include Protais' base which also had a first depression. Protais' bottom section was designed to improve prior art container bottoms by, for example, providing a base "capable of recovering its initial shape after being dropped and subsequent deformation." (*Id.*, 3:13-14). Furthermore, the base of Protais was, "[f]or an identical wall thickness…stronger than most previously known bottle bottoms" (*id.*, 3:19-21) and, "[f]or a desired strength…can be produced with less material"

(*id.*, 3:23-24). A POSITA therefore would have been motivated to combine Protais and the Coca-Cola PET Can to achieve these benefits.

112. In the combination with the Coca-Cola PET Can, the first depression of Protais' configuration would be visible through the container side wall for the same reasons the original depression of the Coca-Cola Can is visible – the container side wall is translucent or transparent, and the depression is visible as illustrated above. Moreover, the liquid in the representative Coca-Cola PET Can, namely Sprite soda, is also a clear liquid which does not affect visibility of depression through the container body.

b. Element [9.B]: "wherein the base portion further comprises a second depression adjacent the first depression; and"

113. As described above with respect to element [9.A], Protais disclosed a first depression in the form of a reinforcing groove 3. Protais' container bottom also had a second depression adjacent to the first depression, in the form of another, neighboring reinforcing groove 3 as shown in annotated Figures 1 and 3 below.



Protais, Fig. 1 (Annotated)

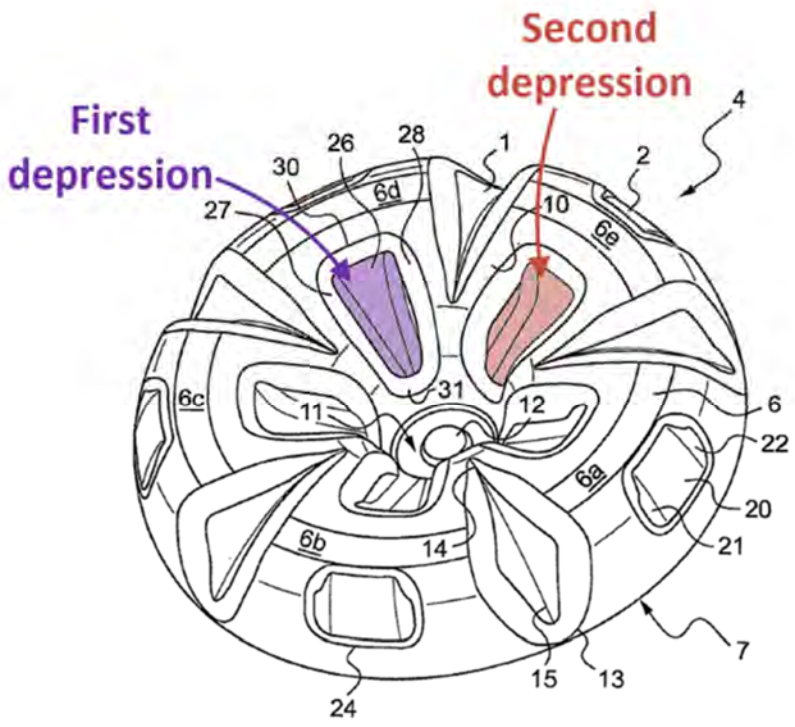


Fig.3

Protais, Fig. 3 (Annotated)

c. Element [9.C]: "wherein the second depression is visible through the at least a portion of the container body."

114. For the same reasons as discussed above with respect to element [9.A], for the first depression to be visible through the container resulting from the combination of the Coca-Cola PET Can and Protais, the second depression of Protais' container bottom would be visible through at least a portion of the container body. Protais disclosed that its base is for a plastic container, which a POSITA would

understand was a transparent material through which the second depression can be viewed.

3. Claim 10

a. Element [10.A]: "The container of claim 1, wherein at least a portion of the container body is transparent;"

115. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [9.A].

b. Element [10.B]: "wherein the first depression is visible through the at least a portion of the container body;"

116. In combination with Protais, the Coca-Cola PET Can disclosed this element for the same reasons discussed for element [9.A].

c. Element [10.C]: "wherein the base portion further comprises a second depression adjacent the first depression; and"

117. Protais disclosed this element for the same reasons discussed for element [9.B].

d. Element [10.D]: "wherein the second depression is visible through the at least a portion of the container body."

118. Protais disclosed this element for the same reasons discussed for element [9.C].

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4. Claim 11: "The container of claim 1, wherein the center element of the base portion is a downward extending protrusion."

119. As described with respect to [1.H], the Coca-Cola PET Can has a bump or discontinuity at the center of the base. While the center clement of the Coca-Cola PET Can projects downward (see photograph in [1.H] with a quarter leaning against the center element), in the combination, Protais also disclosed a center element that was a downward extending protrusion. Notably, Protais' container base had a center element in the form of an "axial disc 12 [that] projects in the transverse central part 11." (Protais, 5:11-12). The axial disk "project[s] downward, that is, out of the container provided with the bottom 4." (*Id.*, 5:12-13).

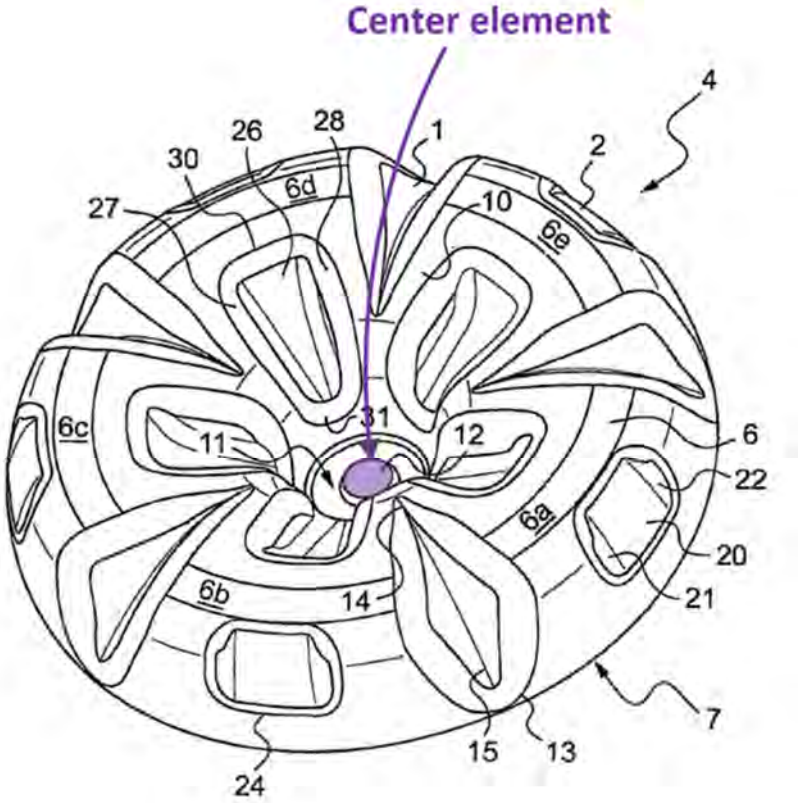


Fig.3

Protais, Fig. 3 (Annotated)

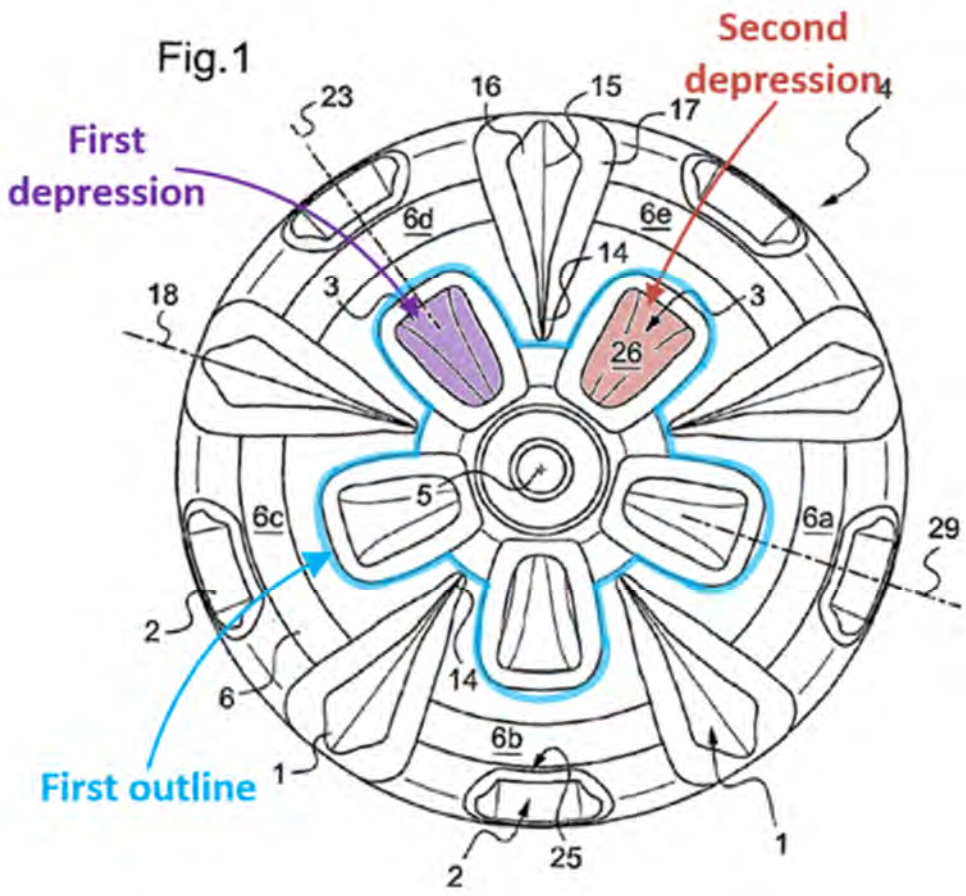
5. Claim 12

a. Element [12.A]: "The container of claim 1, wherein the base portion further comprises a second depression adjacent the first depression; and"

120. Protais disclosed this element for the same reasons discussed for element [9.B].

b. Element [12.B]: "wherein the second depression at least partially defines the first outline."

121. Protais discloses this feature in combination with the Coca-Cola PET Can. As described with respect to [9.B], Protais disclosed a second depression as a reinforcing groove 3, which neighbored the reinforcing groove that forms the first depression. Additionally, as described in [9.A], outer edges of the reinforcing grooves together formed the first outline. Accordingly, as shown in annotated Figure 1 below, the first reinforcing groove and second reinforcing groove each at least partially defined the first outline because each reinforcing groove had an outer edge that forms the first outline.



Protais, Fig. 1 (Annotated)

6. Claim 13

a. Element [13.A]: "The container of claim 1, wherein the center element of the base portion is a downward extending protrusion; and"

122. Protais disclosed this element for the same reasons discussed for claim 11.

b. Element [13.B]: "wherein the base portion further comprises a second depression adjacent the first depression."

123. Protais disclosed this element for the same reasons discussed for element [9.B].

7. Claim 14: "The container of claim 13, wherein the second depression at least partially defines the first outline."

124. Protais discloses this feature in combination with the Coca-Cola PET for the same reasons discussed for element [12.B].

8. Claim 15

a. Element [15.PRE]: "A container, comprising:"

125. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.PRE].

b. Element [15.A]: "a container body, the container body defining a first opening to an interior of the container body; and"

126. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.A].

c. Element [15.B]: "a lid connected to the container body and covering the first opening to the interior of the container body;"

127. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.B].

d. Element [15.C]: "wherein the container body is made out of a resin;"

128. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.C].

e. Element [15.D]: "wherein the lid is made out of a metal;"

129. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.D].

f. Element [15.E]: "wherein the container body comprises a container side wall and a base portion connected to the container side wall;"

130. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.E].

g. Element [15.F]: "wherein the base portion comprises a bottom and a first depression formed therein, the first depression extending upwardly from the bottom;"

131. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.F].

h. Element [15.G]: "wherein the first depression at least partially defines a first outline;"

132. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.G].

i. Element [15.H]: "wherein the base portion further comprises a center element centered with respect to the first outline at least partially defined by the first depression;"

133. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.H].

j. Element [15.I]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the container side wall;"

134. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.I].

k. Element [15.J]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the base portion;"

135. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.J].

l. Element [15.K]: "wherein a cross-sectional diameter of the first opening to the interior of the container body is less than a cross-sectional diameter of a middle portion of the container side wall;"

136. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.K].

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m. Element [15.L]: "wherein the base portion defines a diameter that is less than the cross-sectional diameter of the middle portion of the container side wall;"

137. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.L].

n. Element [15.M]: "wherein a lower portion of the container side wall extends downwardly from the middle portion of the container side wall to the base portion of the container body, the lower portion along its entirety being greater in diameter than the base portion, including the bottom, thereby rendering the container body stemless;"

138. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.M].

o. Element [15.N]: "wherein the container body further comprises a circular neck extending from the container side wall so that the container side wall extends between the circular neck and the base portion;"

139. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.N].

p. Element [15.O]: "wherein an upper edge of the container side wall is adjacent to the circular neck of the container body;"

140. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.O].

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q. Element [15.P]: "wherein the container body further comprises a lip at an end of the circular neck opposite the upper edge of the container side wall;"

141. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.P].

r. Element [15.Q]: "wherein the circular neck is adjacent to the lip;"

142. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.Q].

s. Element [15.R]: "wherein a first portion of the lid is above the lip of the container body;"

143. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.R].

t. Element [15.S]: "wherein the first portion of the lid defines a first circular shape;"

144. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.S].

u. Element [15.T]: "wherein the first portion of the lid further defines a second circular shape around which the first circular shape circumferentially extends;"

145. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.T].

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v. Element [15.U]: "wherein the second circular shape defined by the first portion of the lid is concentric with the first circular shape defined by the first portion of the lid;"

146. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.U].

w. Element [15.V]: "wherein the first circular shape defined by the first portion of the lid is radially positioned between the container side wall and the second circular shape defined by the first portion of the lid;"

147. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.V].

x. Element [15.W]: "wherein a second portion of the lid extends horizontally and is positioned so that the second circular shape is radially positioned between the second portion of the lid and the first circular shape;"

148. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.W].

y. Element [15.X]: "wherein the second portion of the lid defines a total area across which the second portion of the lid extends horizontally;"

149. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.X].

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z. Element [15.Y]: "wherein the second portion of the lid comprises a weakened or scored area;"

150. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.Y].

aa. Element [15.Z]: "wherein the weakened or scored area is less than the total area across which the second portion of the lid extends horizontally;"

151. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.Z].

bb. Element [15.AA]: "wherein the lid further comprises an arm connected to the second portion of the lid and radially positioned within the second circular shape;"

152. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.AA].

cc. Element [15.AB]: "wherein the arm comprises opposing first and second end portions;"

153. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.AB].

dd. Element [15.AC]: "wherein the arm is pivotable from a first position, in which the arm extends horizontally and the weakened or scored area is not deformed, to a second position, in which the arm does not extend horizontally and the weakened or scored area is deformed to provide a second opening to the interior of the container body;"

154. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.AC].

ee. Element [15.AD]: "wherein an upper portion of the container side wall extends upwardly from the middle portion of the container side wall to the upper edge of the container side wall, the upper portion along its entirety being greater in diameter than the first opening to the interior of the container body;"

155. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.AD].

ff. Element [15.AE]: "wherein the container body contains a liquid therewithin;"

156. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.AE].

gg. Element [15.AF]: "wherein the lid cooperates with the lip to provide a seal so that the liquid contained within the container body is sealed against leaking out from between the container body and the lid;"

157. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.AF].

hh. Element [15.AG]: "wherein, when the arm of the lid is in the first position and the weakened or scored area is not deformed: the first end portion of the arm is not positioned above the weakened or scored area of the second portion of the lid; and at least a portion of the second end portion of the arm is positioned above the weakened or scored area of the second portion of the lid;"

158. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.AG].

ii. Element [15.AH]: "wherein the container side wall extends between the circular neck and the base portion so that:

the upper portion of the container side wall defines a first angle: between the upper portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the middle portion of the container side wall defines a second angle: between the middle portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the lower portion of the container side wall defines a third angle: between the lower portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the first angle is an acute angle;

the third angle is an obtuse angle;

the third angle is greater than the second angle;"

159. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.AH].

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jj. Element [15.AI]: "wherein the interior of the container body extends continuously across the cross-sectional diameter of the middle portion at a height midway between the circular neck and the base portion so as to be interrupted, if at all, only by the liquid contained within the container body;"

160. The Coca-Cola PET Can disclosed this element for the same reasons discussed for element [1.AI].

kk. Element [15.AJ]: "wherein the metal is aluminum;"

161. The Coca-Cola PET Can disclosed this element for the same reasons discussed for claim 4.

ll. Element [15.AK]: "wherein the resin is a polyethylene terephthalate (PET) resin;"

162. The Coca-Cola PET Can disclosed this element for the same reasons discussed for claim 2.

mm. Element [15.AL]: "wherein the first depression is visible through at least a portion of the container body;"

163. In combination with Protais, the Coca-Cola PET Can disclosed this element for the same reasons discussed for element [9.A].

nn. Element [15.AM]: "wherein the center element of the base portion is a downward extending protrusion;"

164. Protais disclosed this element for the same reasons discussed for claim 11.

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oo. Element [15.AN]: "wherein the base portion further comprises a second depression adjacent the first depression; and"

165. Protais disclosed this element for the same reasons discussed for element [9.B].

pp. Element [15.AO]: "wherein the second depression is visible through the at least a portion of the container body."

166. Protais, in combination with the Coca-Cola PET Can, disclosed this element for the same reasons discussed for element [9.C].

9. Claim 16: "The container of claim 15, wherein the at least a portion of the container body is transparent."

167. The Coca-Cola PET Can disclosed this feature for the same reasons discussed for element [10.A].

10. Claim 17: "The container of claim 15, wherein the second depression at least partially defines the first outline."

168. Protais discloses this feature in combination with the Coca-Cola PET for the same reasons discussed for element [12.B] and claim 14.

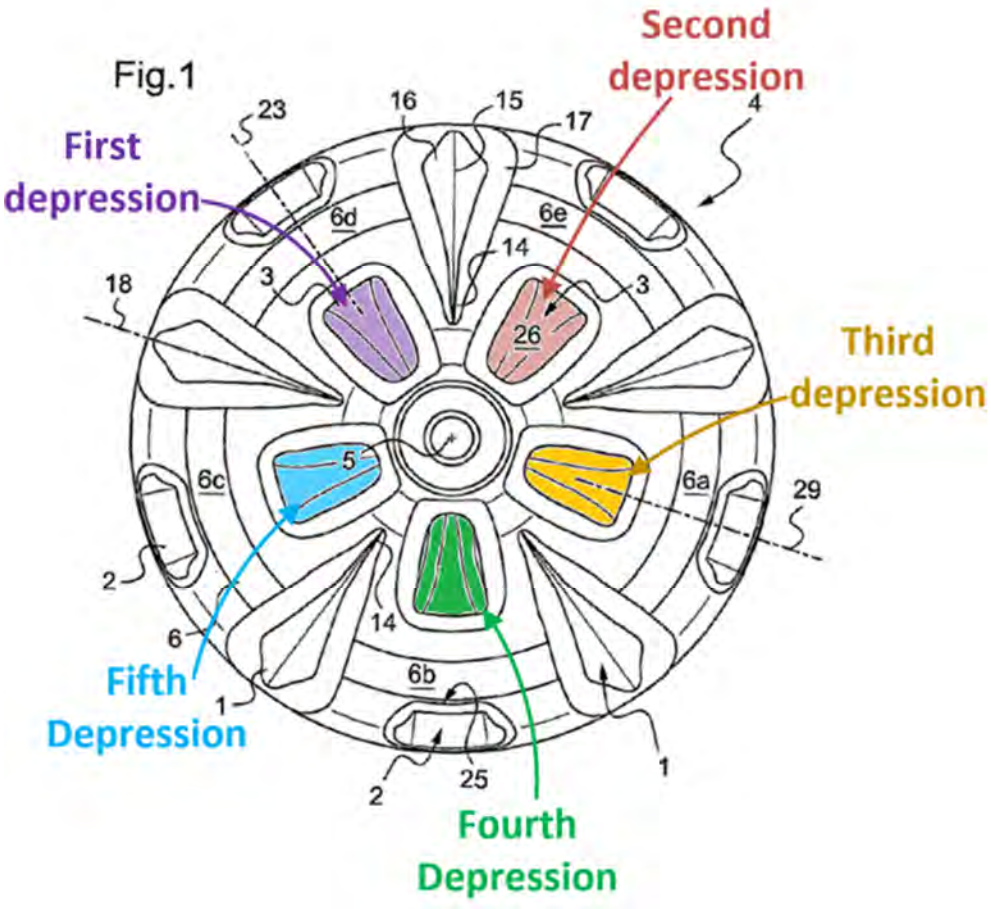
11. Claim 18

a. Element [18.A]: "The container of claim 17, wherein the base portion further comprises third, fourth, fifth, and sixth depressions; and"

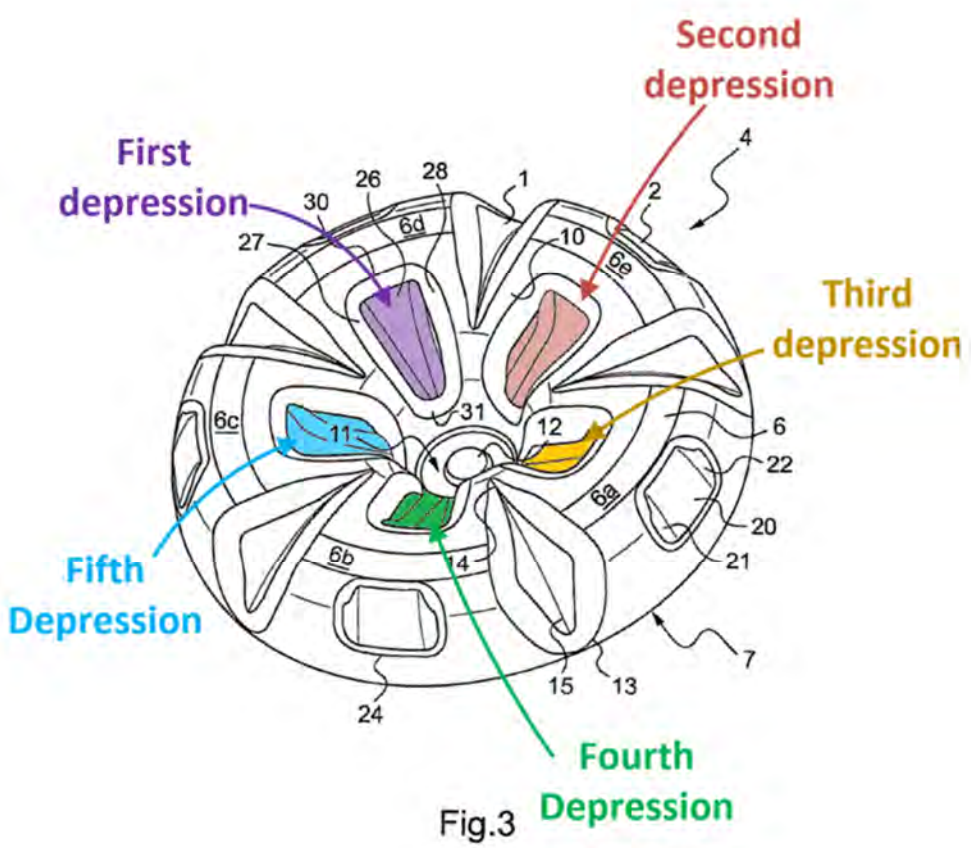
169. Claim 18 is obvious in view of the combination of Protais and the Coca-Cola PET Can. Protais discloses a container bottom with a plurality of depressions, including five reinforcing grooves as identified in annotated Figures 1 and 3 below.

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(Protais, 4:41-44; 4:55; 5:1-2; 5:62-6:3; Figures 1 and 3). Protais also teaches that, although the figures illustrate only five grooves, "[t]he number of . . . grooves can be greater than five." (*Id.*, 6:56-58). It would have therefore been obvious to a POSITA to add at least a sixth groove to the container bottom.



Protais, Fig. 1 (Annotated)

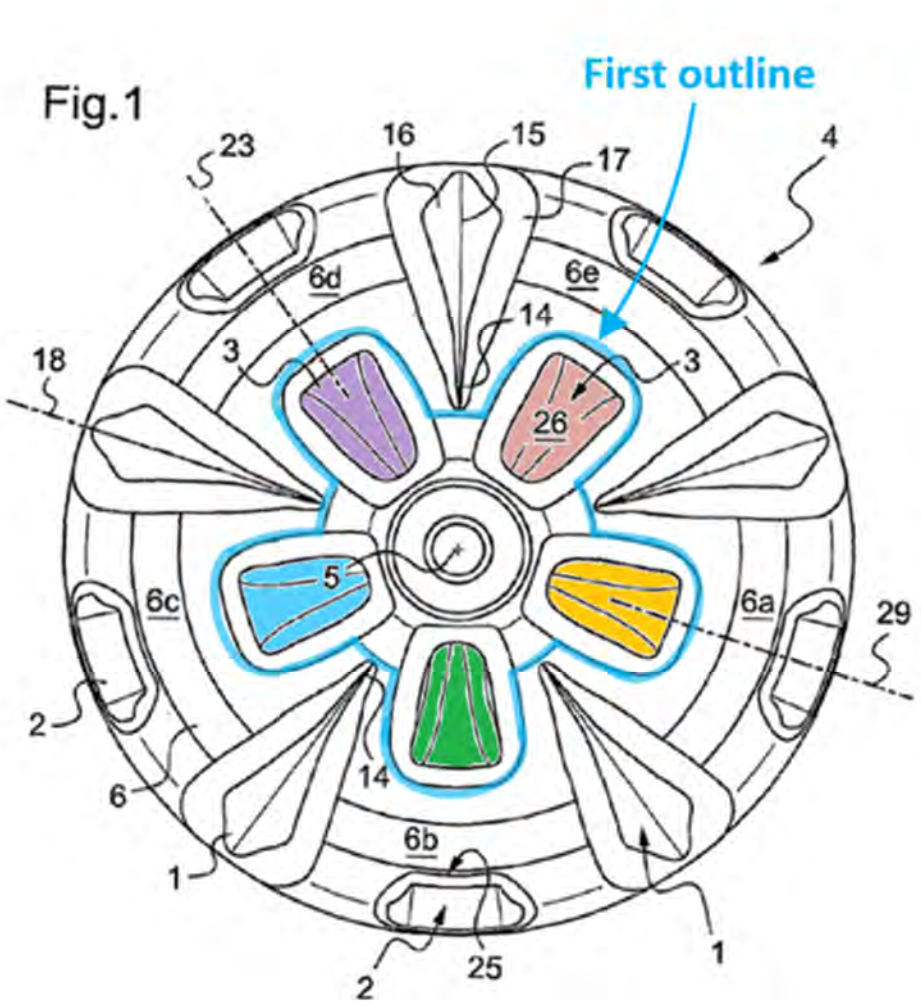


Protais, Fig. 3 (Annotated)

b. Element [18.B]: "wherein the third, fourth, fifth, and sixth depressions at least partially define the first outline."

170. As shown in annotated Figure 1 below, each of the first through fifth reinforcing grooves of Protais at least partially defined the first outline because each reinforcing groove had an outer edge that forms the first outline. *See* [12.B]. In addition, since Protais explained that the container bottom could have more than five reinforcing grooves (*see* Protais, 6:56-58) it would have been obvious for an outer edge of a sixth reinforcing groove on the container bottom to also partially define

the first outline in order to maintain rotational symmetry of the base (Protais, 4:9-12).

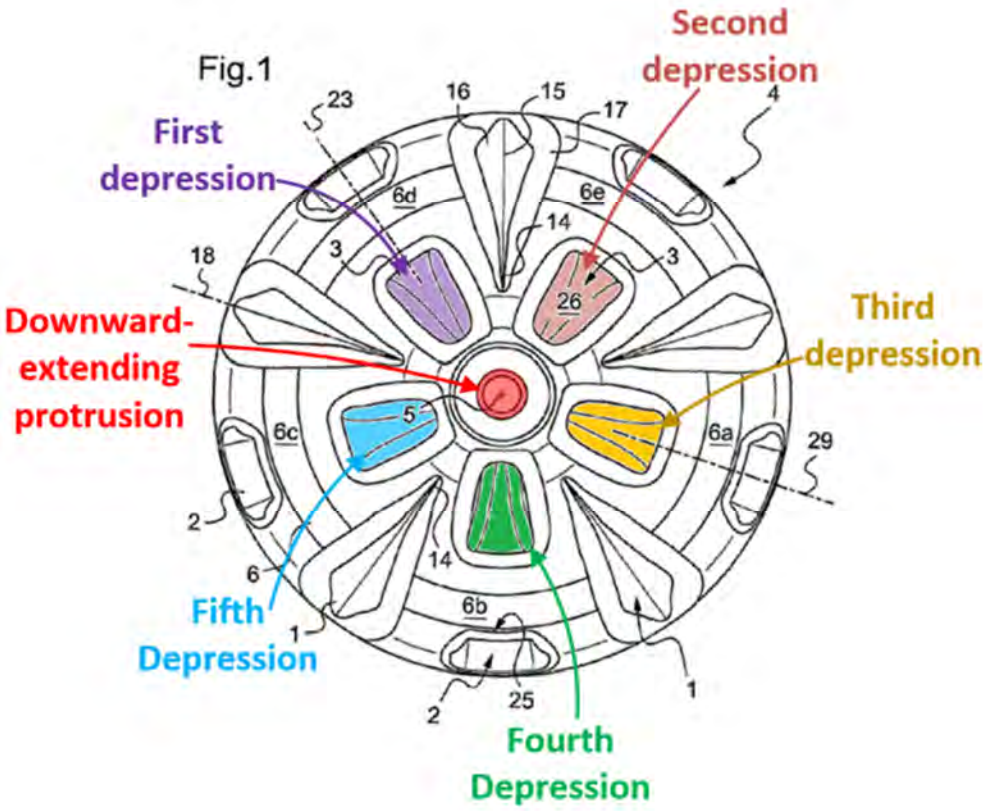


Protais, Fig. 1 (Annotated)

12. Claim 19: "The container of claim 18, wherein the downward extending protrusion is centered with respect to the first, second, third, fourth, fifth, and sixth depressions."

171. As described with respect to claim 11, Protais disclosed a downward extending protrusion in the form of an "axial disk 12" (Protais, 5:11-13; Figure 3), which "project[s] downward, that is, out of the container provided with the bottom

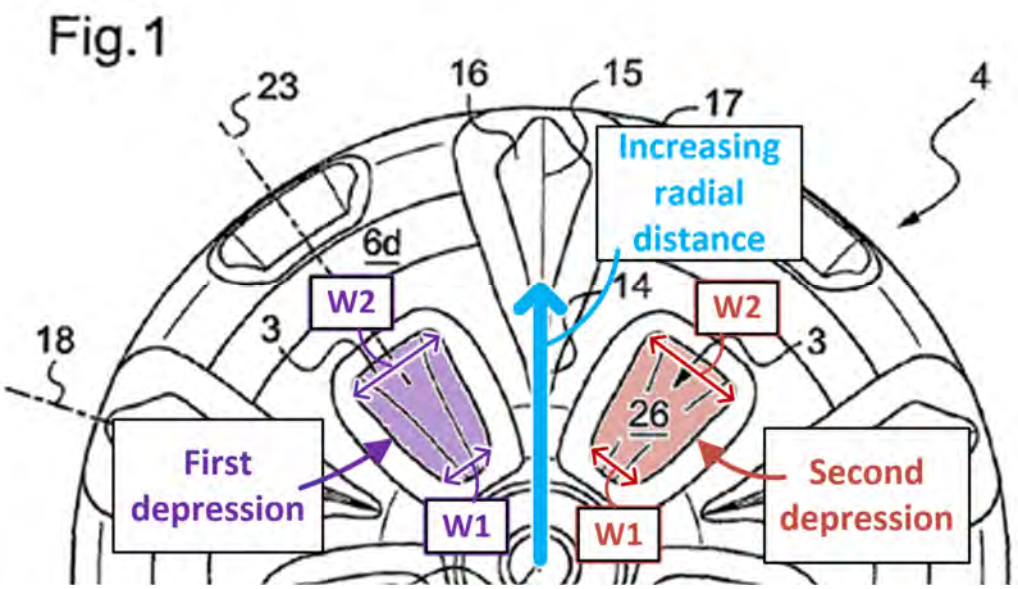
4" (*id.*). Figure 1, annotated below, shows that the axial disk 12 was centered with respect to the reinforcing grooves 3 (*i.e.*, first through fifth depressions). As discussed above, it would be obvious to add a sixth depression such that the downward protrusion remained centered for rotational symmetry. (Protais, 4:9-12).



Protais, Fig. 1 (Annotated)

13. Claim 20: "The container of claim 17, wherein each of the first and second depressions increases in width as the radial distance from a center of the bottom of the base portion increases."

172. In the combination, Protais disclosed this feature. Figure 1 of Protais illustrated that each of the reinforcing grooves 3 (forming at least first and second depressions) had a narrower width closest to the container bottom's center (W1 in annotated Fig. 1 below) and a wider width farthest from the center (W2 below). The grooves thus increase in width as the radial distance from the center increased.



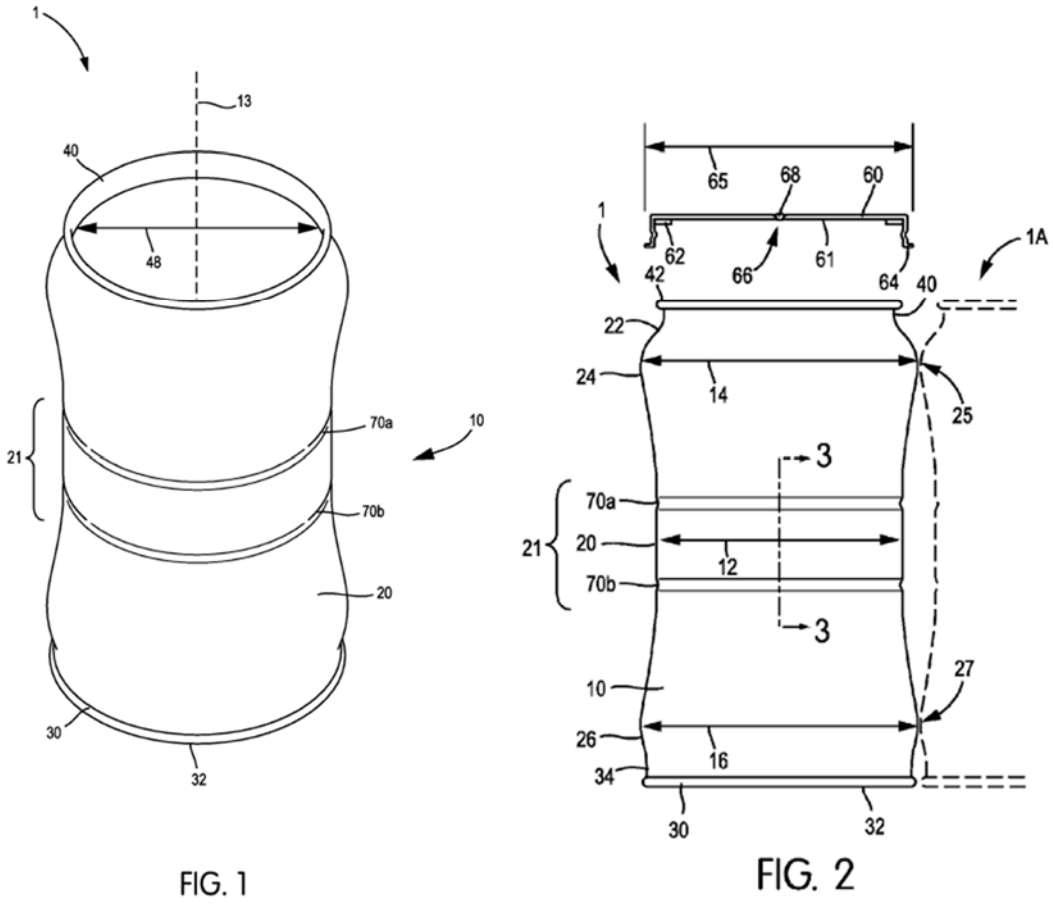
Protais, Fig. 1 (Enlarged and Annotated)

D. Ground 3: Metzger, Protais, and Kaminski render claims 1-20 obvious

173. U.S. Patent No 8,141,741 B2 was issued to Metzger et al. on March 27, 2012. Metzger was first published on August 27, 2009, as US 2009/0212004 A1. Metzger is titled "Vacuum Container with Protective Features" and is directed to

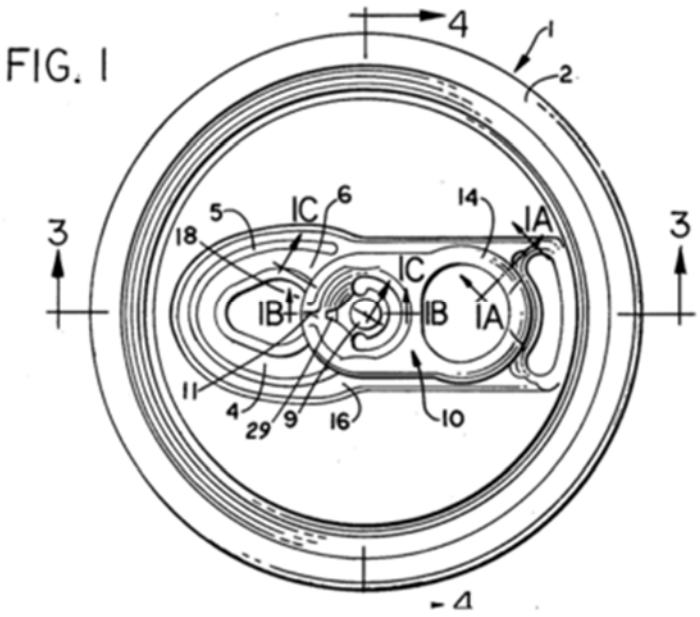
containers for food and beverages. (Metzger, 1:15; 1:21-25). Metzger's "protective features" improve the container by maintaining a vacuum when the container is used for hot-fill including food sterilization processes. (*Id.*, 1:45-49; 2:27-31). In addition, Metzger teaches that the container can resist forces during manufacture, filling, processing, sales and transport without deformation. (*Id.*, 1:50-53). The container can be manufactured using a wide array of materials (including plastics; *see id.*, 3:57-58), can be combined with a variety of container ends to seal the container (including "pop-top" or "pull top" lids; *see id.*, 3:43-47), and can be used to contain different types of food materials (including liquids; *see id.*, 3:51-56).

174. Figure 1 below illustrates a perspective view of Metzger's container without a container top. Figure 2 below displays a side view illustrating the container with one example type of container top.



Metzger, Figures 1 and 2

175. U.S. Patent No. 4,465,204 issued to Kaminski on August 14, 1984, and is directed to an easy-open pull tab for a can container. (Kaminski, Abstract; 2:65). The lid (referred to as the "can end") is manufactured from a "relatively ductile metal, such as aluminum." (*Id.*, 3:2-3). The lid attaches to a cylindrical container through cooperation with a "circumferentially extending raised edge 2." (*Id.*, 2:67-3:1). A top view of Kaminski's lid is shown in Figure 1, reproduced below.



Kaminski, Fig 1

1. Motivation to Combine Metzger, Protais, and Kaminski with a Reasonable Expectation of Success.

176. A POSITA would have found it obvious to combine the teachings and disclosures of Metzger, Protais, and Kaminski. Specifically, the teachings of Metzger would have directed a POSITA to enhance the body of Metzger's container using the improved base design of Protais through inclusion of features such as ribs, notches, and grooves. In addition, Metzger only explicitly describes a few limited configurations for the lid attached to Metzger's container end but does not require a specific type of lid to be used. (*See* Metzger, 3:43-46; 9:43-45). A POSITA would have been guided by the teachings of Kaminski and would have found it obvious not

only to try, but would have found it advantageous to implement Kaminski's easy-to-implement lid with marked improvements over other configurations.

177. The combination of these references would have involved only simple modifications to the base of a plastic container that were already described in Protais. The combination also only required a simple connection of Kaminski's lid to the combined plastic Metzger-Protais container.

178. A POSITA would have also had additional reasons to combine Metzger, Protais, and Kaminski. First, a POSITA would have been well aware of the rudimentary steps and methods necessary to combine Metzger's plastic container body with Protais' plastic container base. The resulting combination of Metzger and Protais would have been an entirely predictable result to a POSITA. Metzger itself teaches that a plastic container can have "sidewalls 20 and bottom end wall 32 [that] are contiguously formed or molded from a single piece of material." (Metzger, 7:58-60). In the same way, Protais described a thermoplastic container (a "hollow body"), which is "obtained by blowing or stretch-blowing of a preform, said hollow bodies comprising a side wall and a bottom joined to said side wall." (Protais, 4:24-28). Both Metzger and Protais' containers were configured to hold liquids. (Metzger, 3:51-55, 4:7-9; Protais, 2:24-35, 2:55-56). Additionally, a POSITA would have been motivated to use the features of Protais' base on the container body taught by Metzger, because the combined container would have increased strength and

resistance to deformation as a result of the ribs, grooves, and notches of Protais' base. (*Id.*, 3:14-25; 6:20-27; 6:56-61; 6:47-48).

179. The complete Metzger-Protais-Kaminski combination would have also been a simple combination of known elements. Metzger indicates that many different types of lids could be implemented with the container body (Metzger, 3:43-47). Metzger did not describe, in detail, the kinds of lids that could be used by one creating a container with Metzger's body. However, Kaminski does describe an example of such a lid and a POSITA would have found it obvious to look to Kaminski for teachings of a pull tab lid for a beverage container. (Kaminski, 1:5-8). Furthermore, a POSITA would have been motivated to use Kaminski's pull tab lid with Metzger's container because Kaminski explains how to configure a lid that retains the pull tab after the lid is opened for ecological and safety reasons, while using less metal and being easier to open than other can end styles. (Kaminski, 1:5-8; 1:14-17; 1:27-31). As such, a POSITA would have found it obvious to implement the designs of Protais and Kaminski when augmenting the container body of Metzger.

2. Claim 1:

a. Element [1.Pre]: "A container comprising:"

180. Metzger disclosed a container. (*See* Metzger, 3:59-60 ("Referring to FIG. 1, a perspective view of a container 1 is shown")). Figure 2 of Metzger,

reproduced below, illustrated "a side view of container 1 . . . including body 10 having a vertical axis 13 and a center portion 21." (*Id.*, 4:12-14).

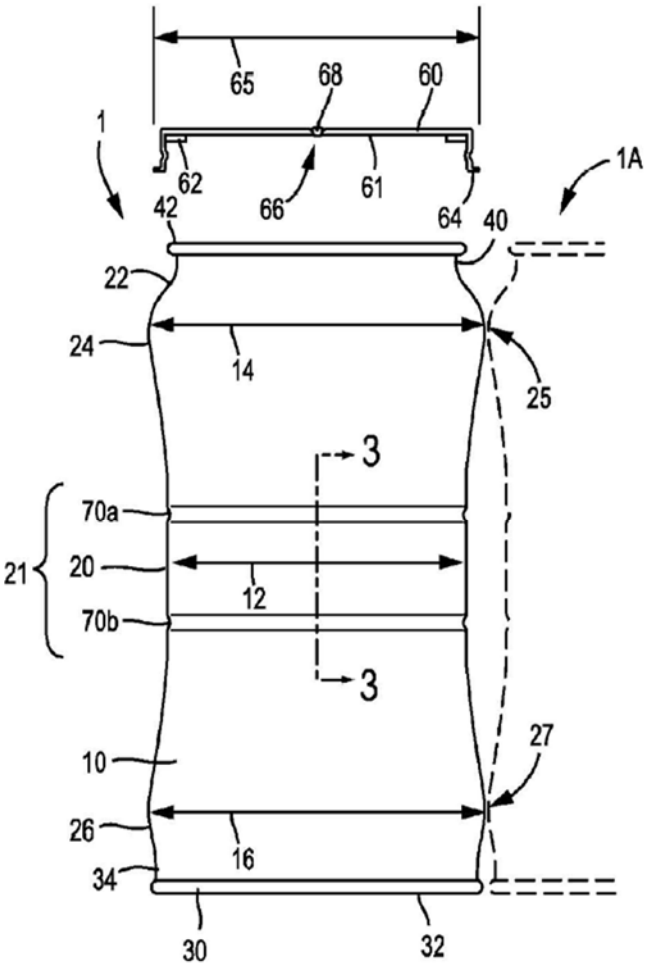


FIG. 2

Metzger, Fig. 2

b. Element [1.A]: "a container body, the container body defining a first opening to an interior of the container body; and"

181. Metzger disclosed a container body in the form of a "body 10" of container 1. (Metzger, 4:12-14, Figure 1, Figure 2). Metzger's container had a "neck opening 48" that forms a first opening. (*Id.*, 4:40-41, Figure 1).

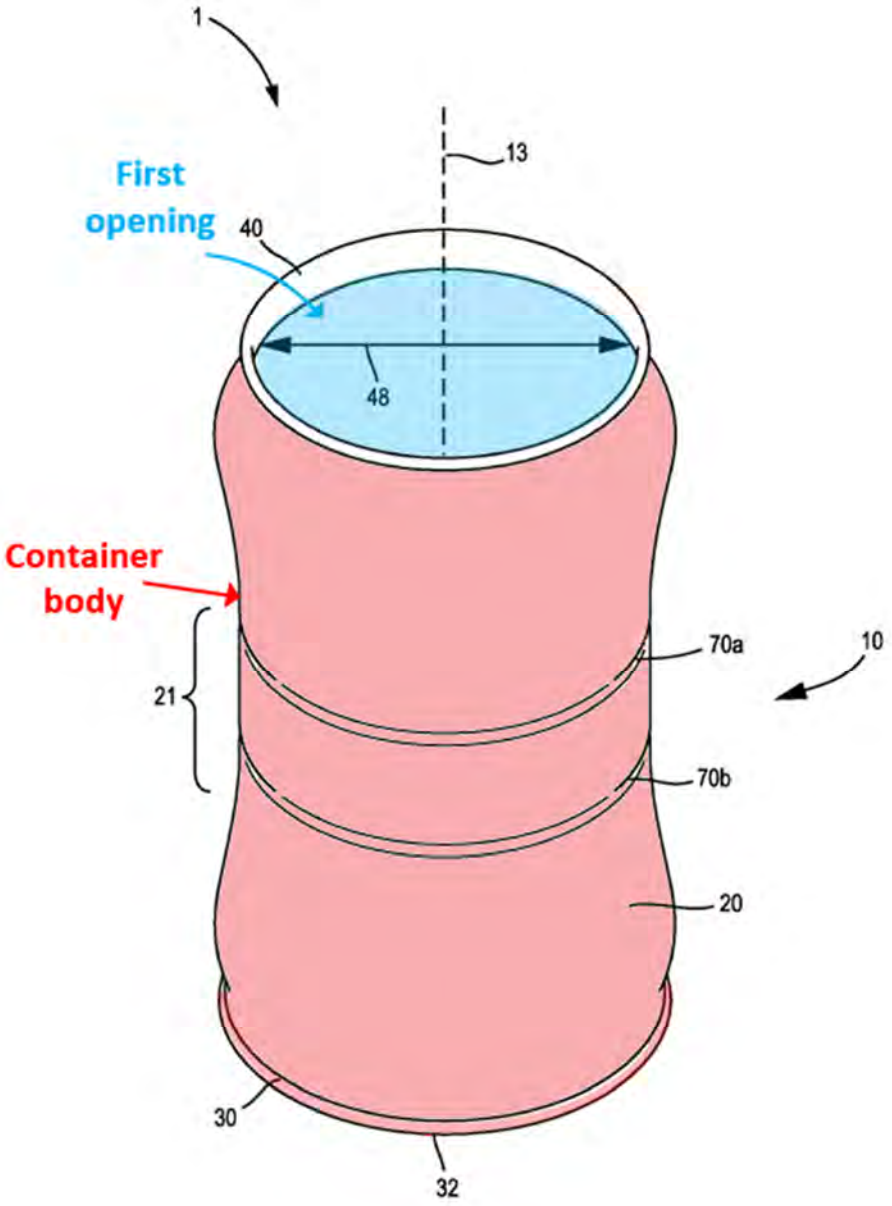


FIG. 1

Metzger, Fig. 1 (Annotated)

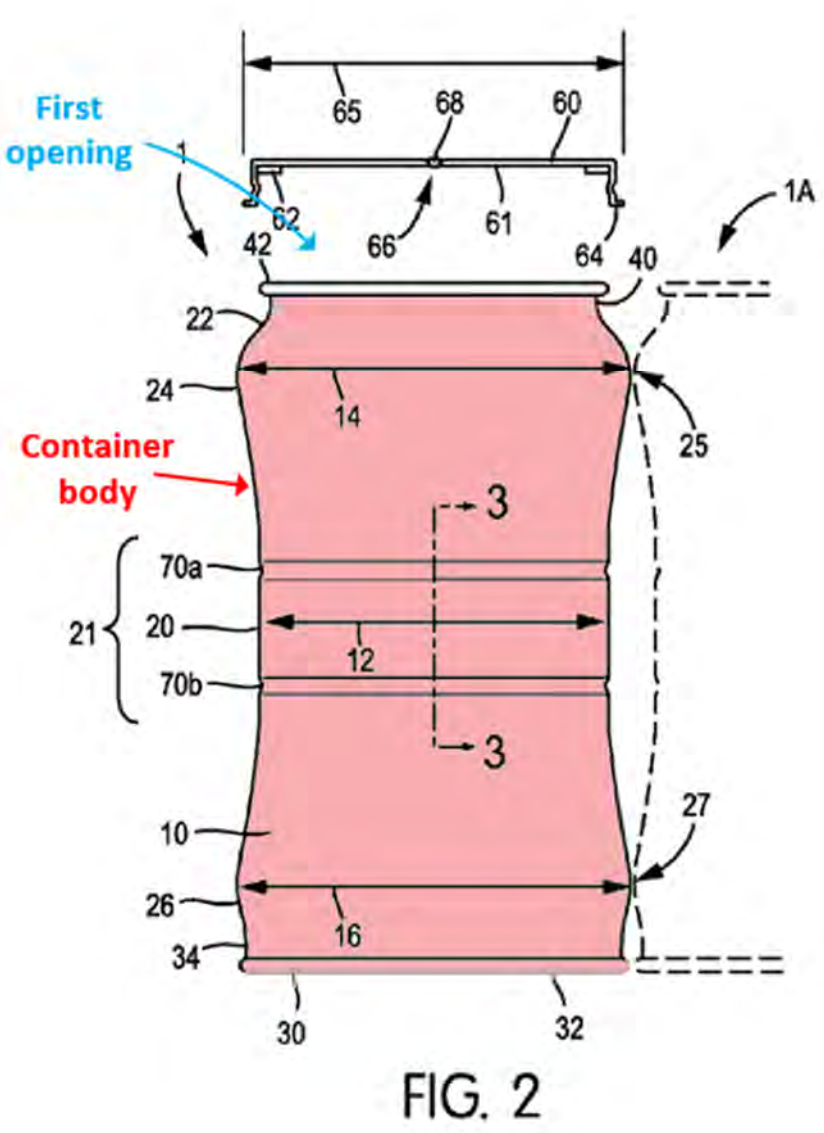


FIG. 2

Metzger, Fig. 2 (Annotated)

182. The container of Metzger was configured to hold contents (*see, e.g., id.* at 4:7-11); thus, it had an interior.

c. Element [1.B]: "a lid connected to the container body and covering the first opening to the interior of the container body;"

183. Metzger disclosed a variety of lids that could connect to the container body 10 to cover the first opening, including a "closure 60" illustrated in Figure 2 and a "pull off end 90" shown in Figure 6. (*See* Metzger, 4:29; 9:43-45; 9:54-59; Figures 2, 5, and 6). Annotated Figures 2 and 6 of Metzger below illustrate example lids that could be connected to the container body.

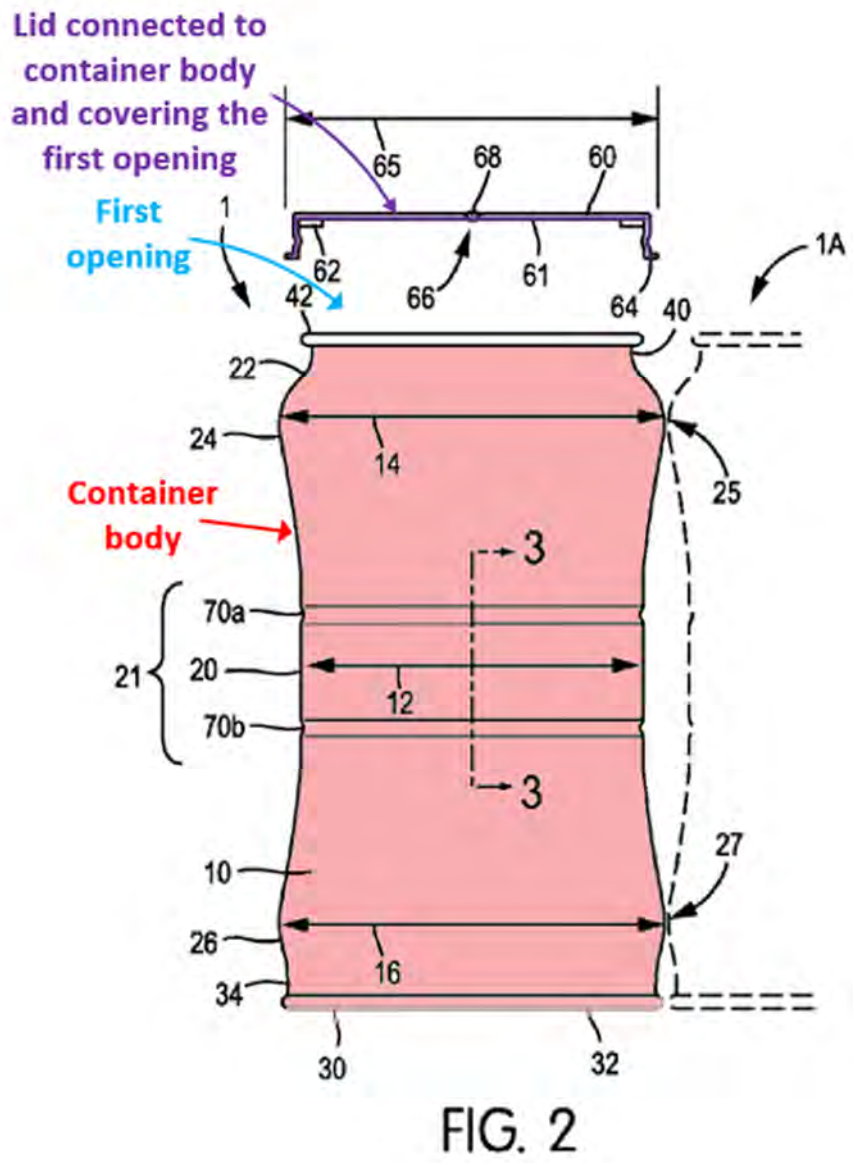


FIG. 2

Metzger, Fig. 2 (Annotated)

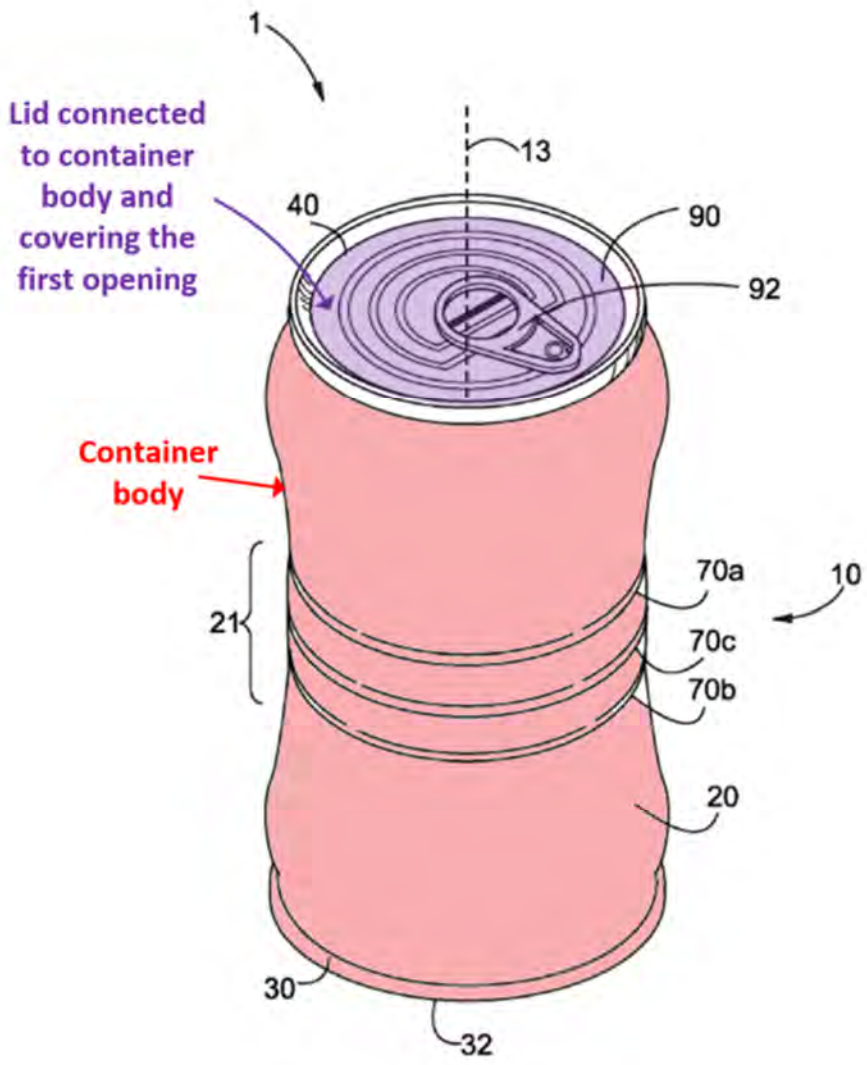
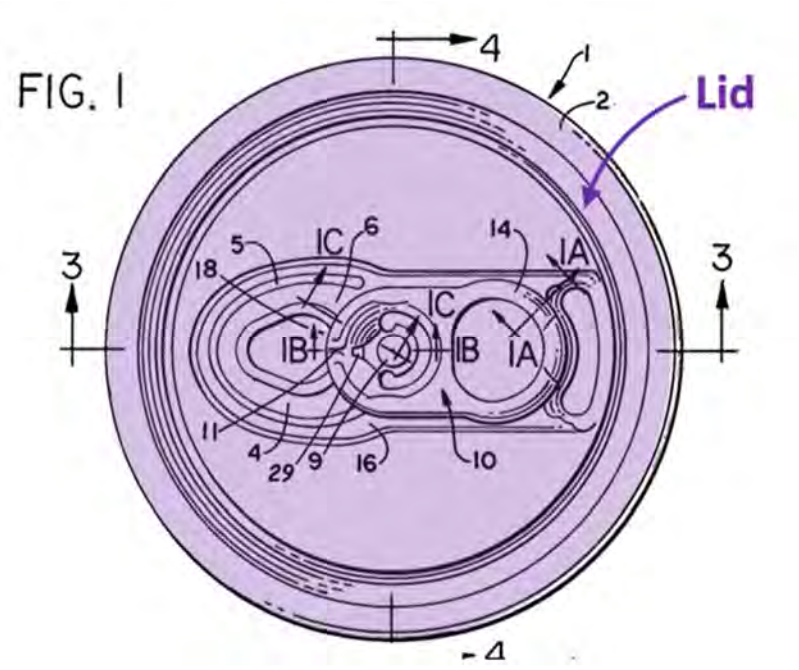


FIG.6

Metzger, Fig. 6 (Annotated)

184. However, although Metzger's figures illustrated only a couple types of container ends, Metzger explained that the container could be closed by any of a variety of suitable ends, including "pop-top" or "pull top" lids. (Metzger, 3:43-47).

185. Kaminski also disclosed a lid in the form of a "can end." (Kaminski, 2:68; Figure 1 (annotated below)). The can end was "of generally circular shape including a circumferentially extending raised edge 2 for attaching can end 1 to a suitable cylindrical beverage can 3." (Kaminski, 2:65-3:4).



Kaminski, Fig. 1 (Annotated)

186. Since Metzger described that its container could be used with any of a variety of can ends, a POSITA would have found it obvious to use a lid like Kaminski's with Metzger's container because Kaminski provided details about the configuration of a pull-tab lid that are not explicit in Metzger. A POSITA would have been motivated to use Kaminski's lid with Metzger's container because, as explained by Kaminski, its features simplify manufacturing, use less metal, and

make the can easier to open, while retaining the pull-tab for ecological and safety reasons. (Kaminski, 1:14-17; 1:27-31).

d. Element [1.C]: "wherein the container body is made out of a resin;"

187. Metzger disclosed a container that was made of a resin, such as "various plastics." (Metzger, 3:56-58). It would have been obvious to a POSITA that plastics can be made out of a resin. (*See* Ex. 1007 (defining resin as "any of numerous physical similar polymerized synthetics … to form plastics")). It was also recognized, and repeated in the '441 patent that the container body is made of plastic. (Ex. 1001, 2:43-45 (the "container body may be made of appropriate plastic/synthetic resin, typically polyethylene terephthalate (PET) resin;" *see also*, *id*., Abstract, 1:48-50, 2:15-21, 3:3-11).

e. Element [1.D]: "wherein the lid is made out of a metal;"

188. Metzger disclosed a "container end" (a lid) that was "made of metals, such as steel or aluminum." (Metzger, 3:49-50).

f. Element [1.E]: "wherein the container body comprises a container side wall and a base portion connected to the container side wall;"

189. The container of Metzger had a container side wall in the form of a "sidewall 20." (Metzger, 3:60-62). The container also had a "bottom seal structure 30 at the lower end of container body 10...[that] may couple and seal a bottom end

wall 32 to container body 10." (*Id.*, 7:51-54). Alternatively, the sidewall 20 and bottom end wall 32 were "contiguously formed or molded from a single piece of material." (*Id.*, 7:58-60). Thus, the bottom end wall 32 and, optionally, the seal structure 30, formed a base portion for the container. Figure 2 of Metzger is annotated below to illustrate the container's side wall and base portion.

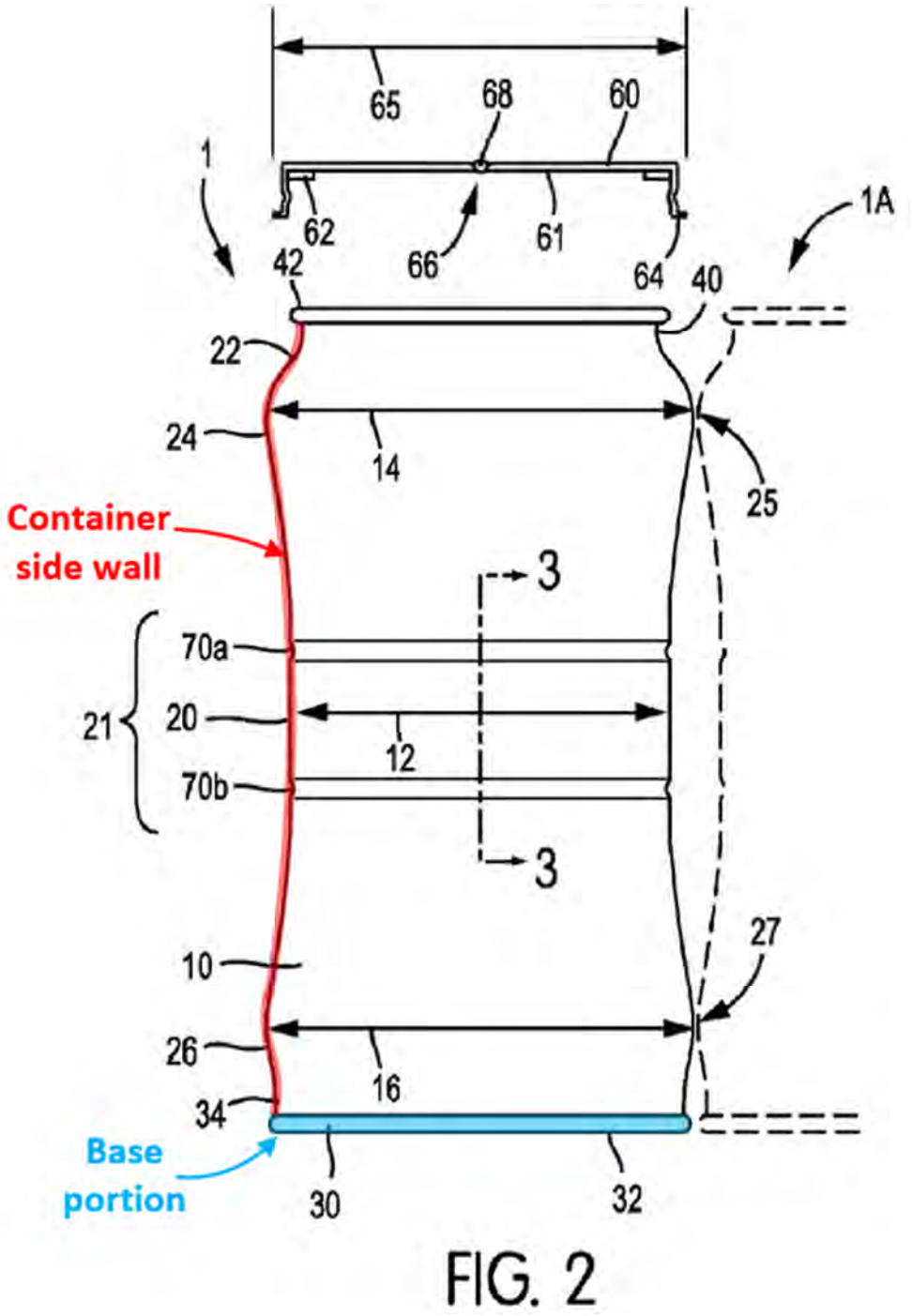


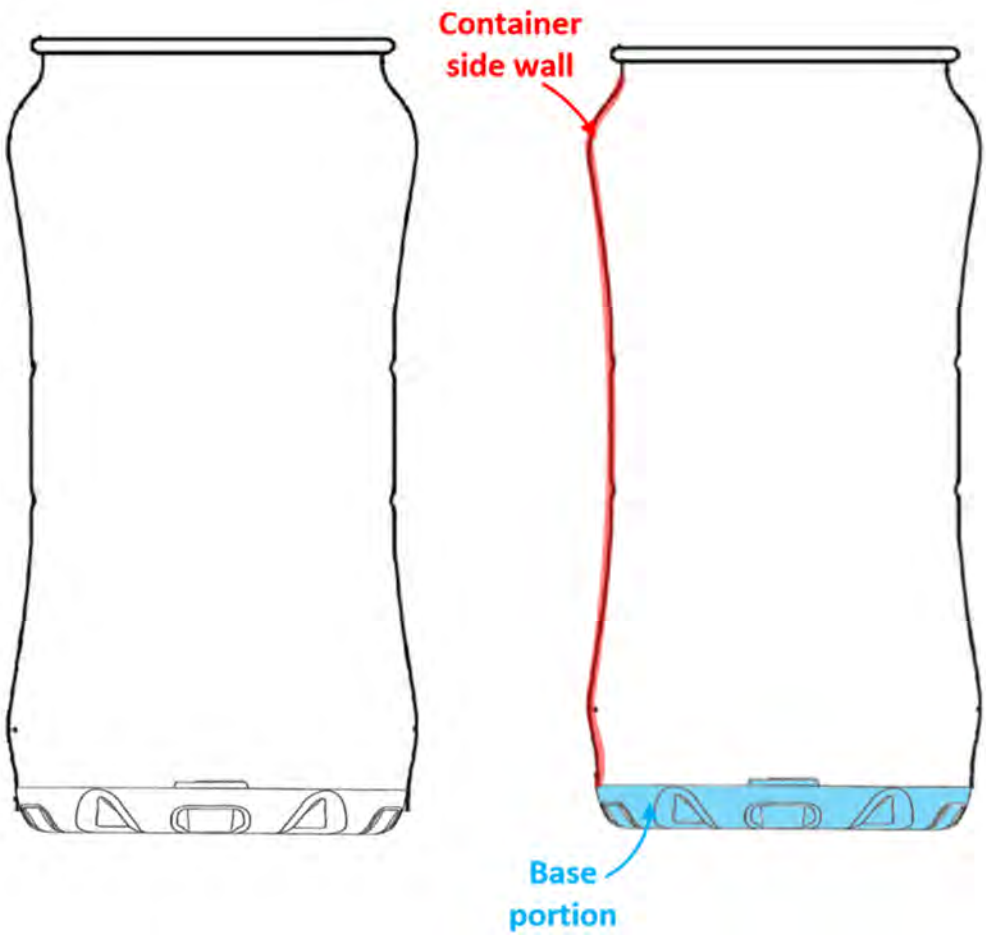
FIG. 2

Metzger, Fig. 2 (Annotated)

190. Protais supplemented Metzger's disclosure by further describing a base. Protais generally disclosed a bottom section (e.g., a base portion) for containers

made from thermoplastic materials. (Protais, Abstract; 1:7-12). Protais' bottom section was designed to improve prior art container bottoms by, for example, providing a base that was "capable of recovering its initial shape after being dropped and subsequent deformation." (*Id.,* 3:13-14). Furthermore, the base of Protais was, "[f]or an identical wall thickness…stronger than most previously known bottle bottoms" (*id.,* 3:19-21) and, "[f]or a desired strength…can be produced with less material" (*id.,* 3:23-24).

191. A POSITA would have been motivated to combine Metzger and Protais by using the design of Protais' container bottom section on Metzger's container to achieve the above-described benefits identified by Protais. A mockup of the combination of Metzger's container with Protais' base, based on Figure 2 of Metzger and Figure 2 of Protais, is illustrated below.

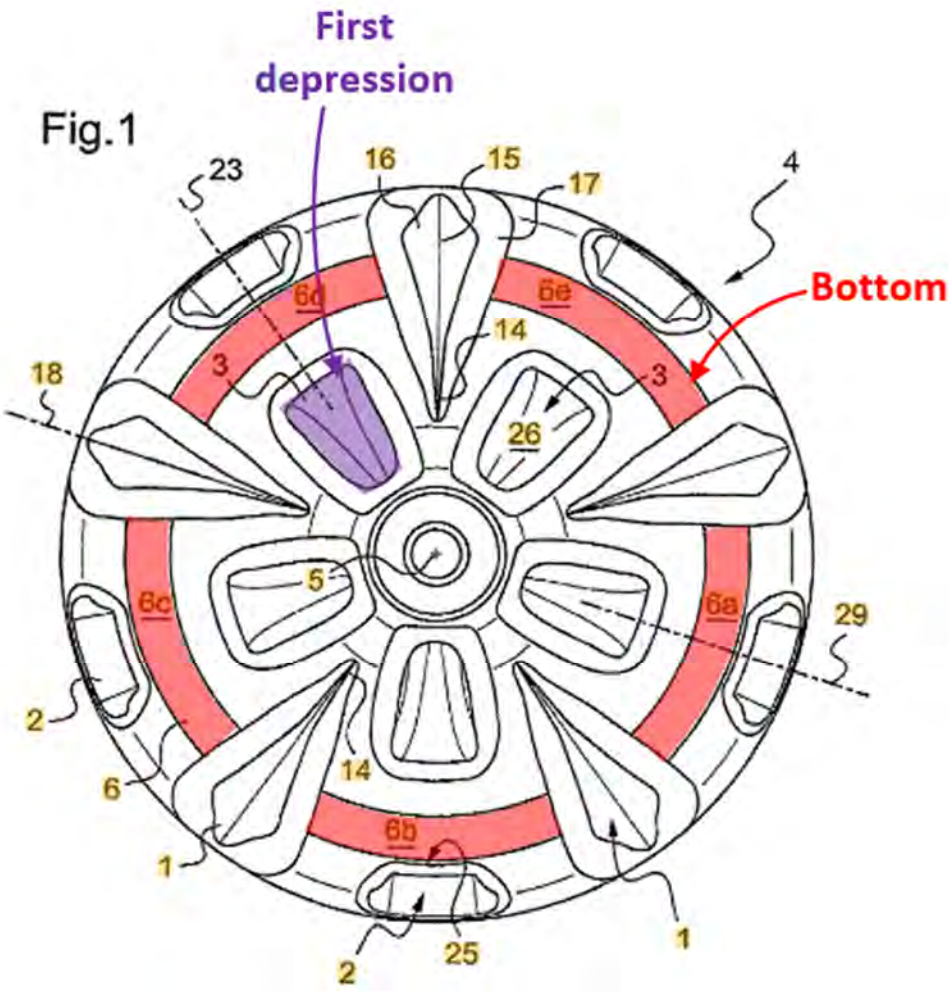


Example Combination of Metzger and Protais

g. Element [1.F]: "wherein the base portion comprises a bottom and a first depression formed therein, the first depression extending upwardly from the bottom;"

192. The bottom end wall 32 of Metzger (forming at least part of a base portion) had a bottom, in the form of a surface on which the container rests when standing on the bottom end wall 32 as shown in Figure 2. Furthermore, the bottom end wall 32 had a "concave recession." (Metzger, 7:60-64). However, Metzger did not provide details about the concave recession, but Protais did.

193. As illustrated in Protais' Figures 1 and 3, annotated below, the container bottom of Protais – forming at least part of the claimed base portion – had a "transverse support surface 6" (e.g., a bottom) and various reinforcing portions such as "reinforcing grooves 3." (*Id.*, 4:41-44; 4:55; 5:1-2; 5:62-6:3). At least one of the reinforcing grooves 3 forms a first depression.



Protais, Fig. 1 (Annotated)

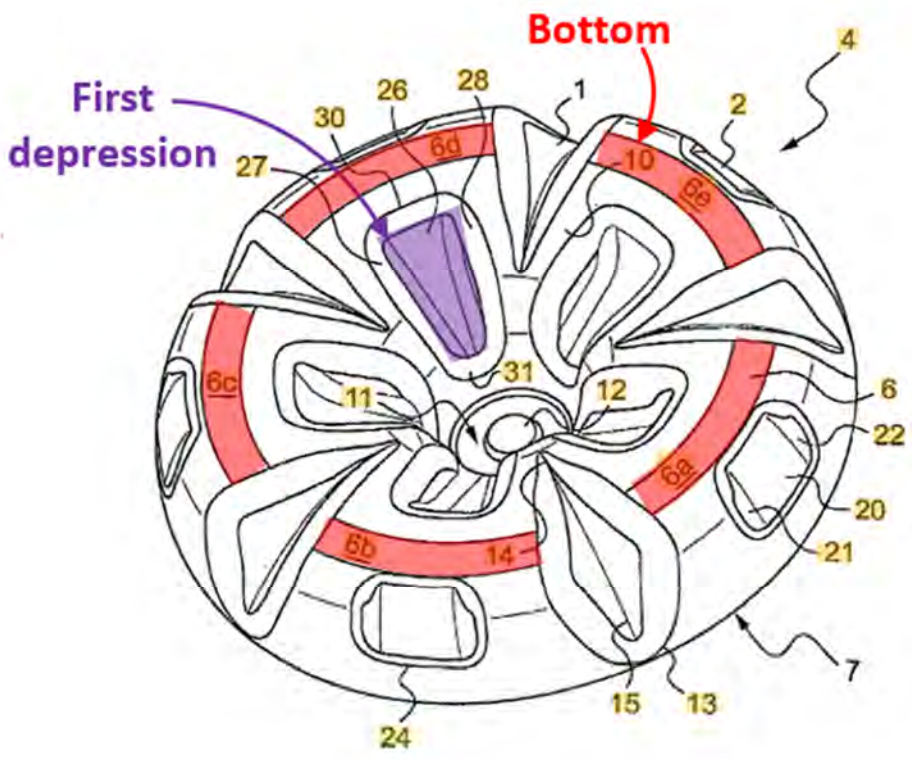


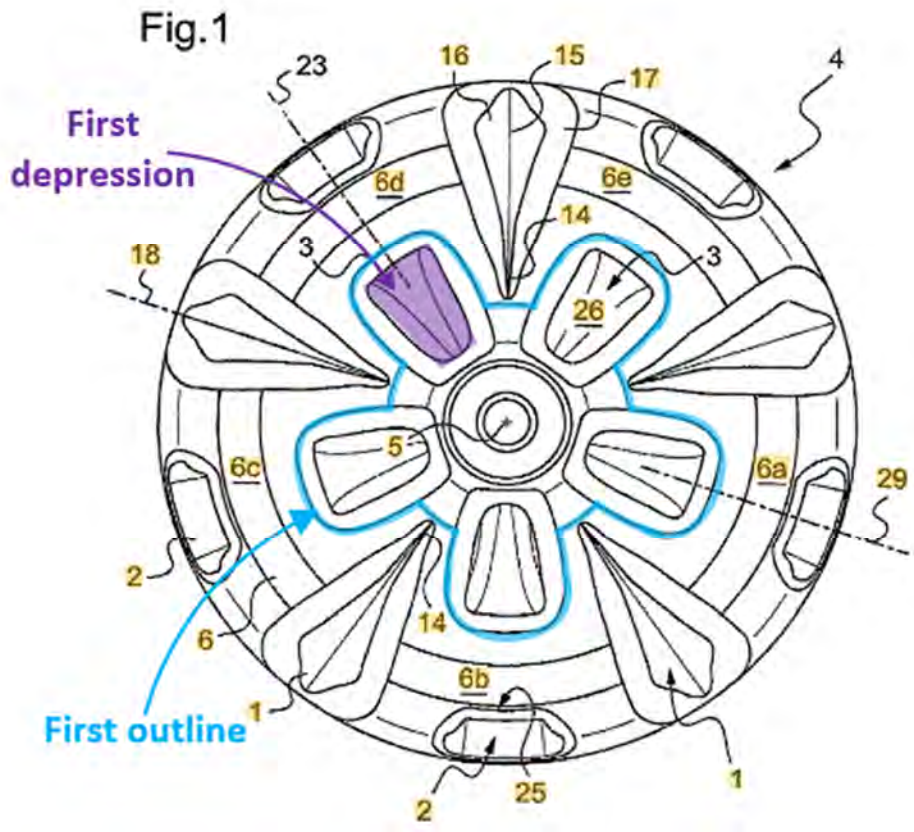
Fig.3

Protais, Fig. 3 (Annotated)

h. Element [1.G]: "wherein the first depression at least partially defines a first outline;"

194. The '441 patent does not provide any explanations regarding an "outline," and this term is only recited in the claims. Consistent with a dictionary definition of "[a] line described in the plane of vision by the outer boundary any object or figure" (Ex. 1007, 4) Protais disclosed this feature. The reinforcing grooves 3 on Protais' container bottom each have an outer edge – that is, an edge farthest from the center of the bottom, when viewed from below as in Figure 1. These outer

edges of the reinforcing grooves together formed a first outline that traces these outer edges. An example first outline is annotated on Protais' Figure 1 below. The first depression partially defined the first outline because its outer edge formed a portion of the outline.

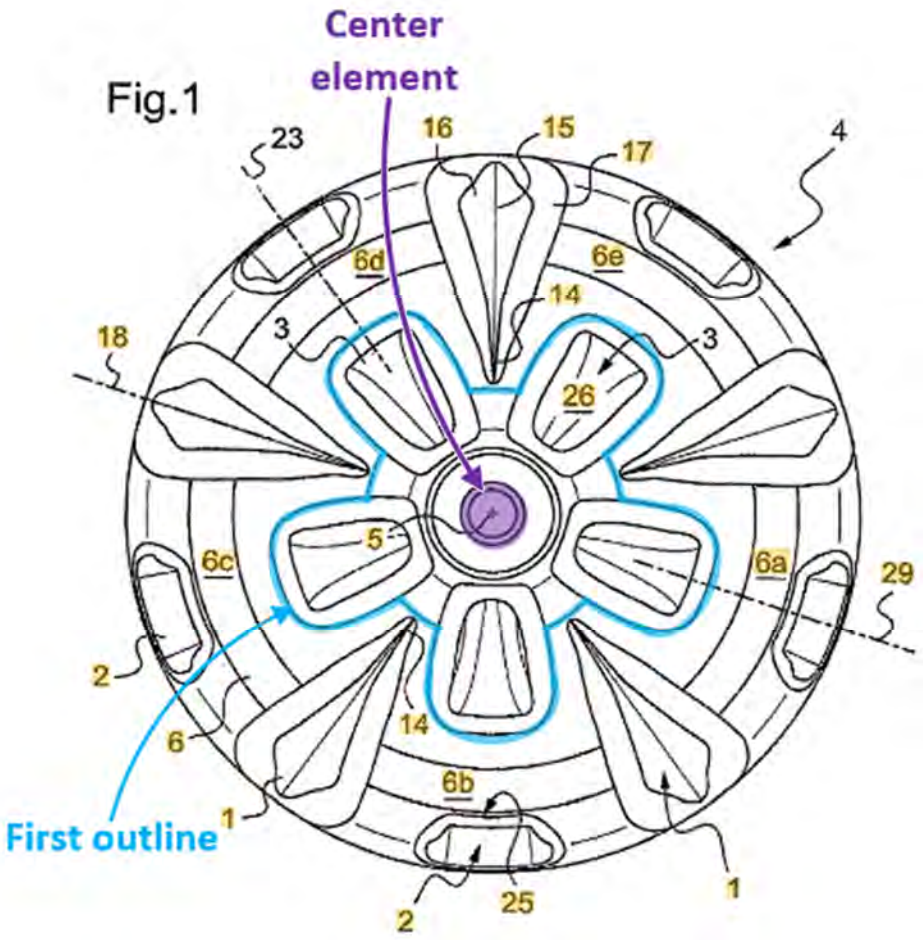


Protais, Fig. 1 (Annotated)

i. Element [1.H]: "wherein the base portion further comprises a center element centered with respect to the first outline at least partially defined by the first depression;"

195. Protais' container base had a center element in the form of an "axial disc 12 [that] projects in the transverse central part 11." (Protais, 5:11-12). The disc

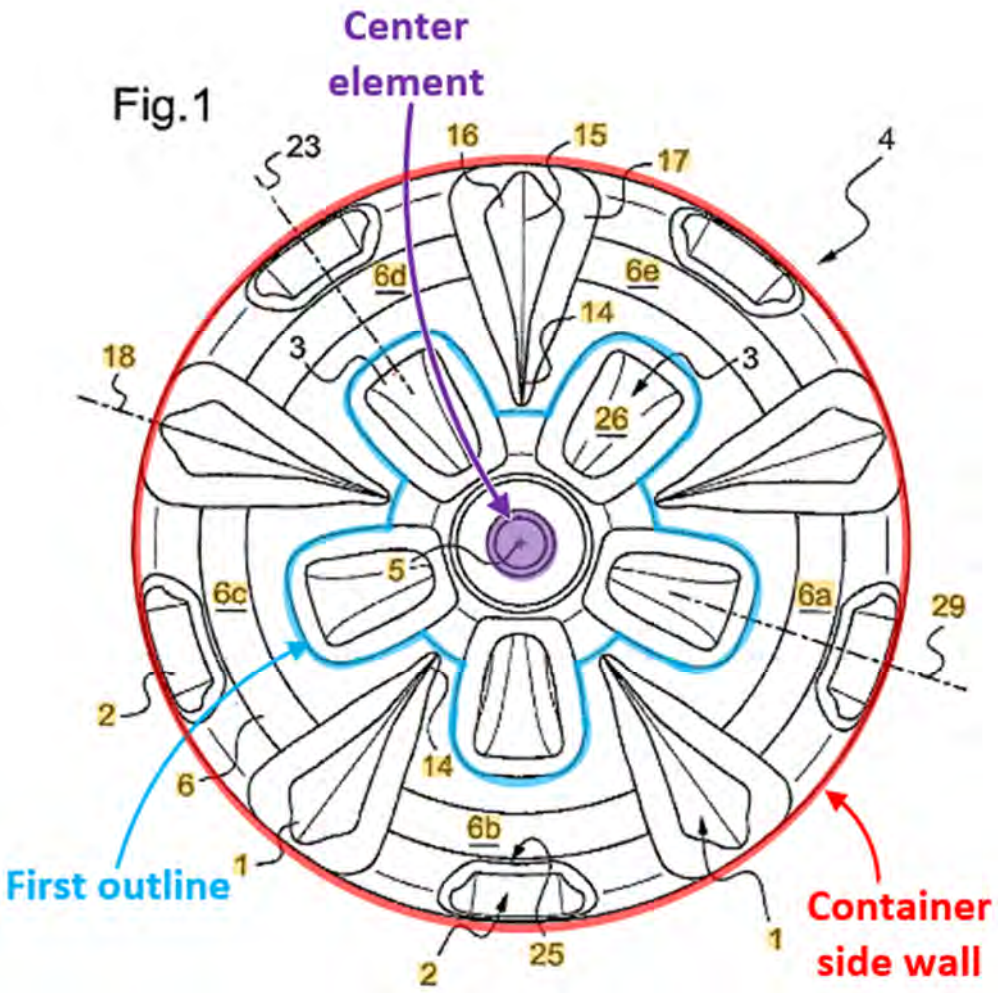
"correspond[s] to the injection point of the preform" from which the container base was manufactured. (*Id.*, 6:64-65; 7:3-5). As shown in annotated Figure 1 below, the axial disc 12 was centered with respect to the first outline formed according to the discussion in element [1.G].



Protais, Fig. 1 (Annotated)

j. Element [1.I]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the container side wall;"

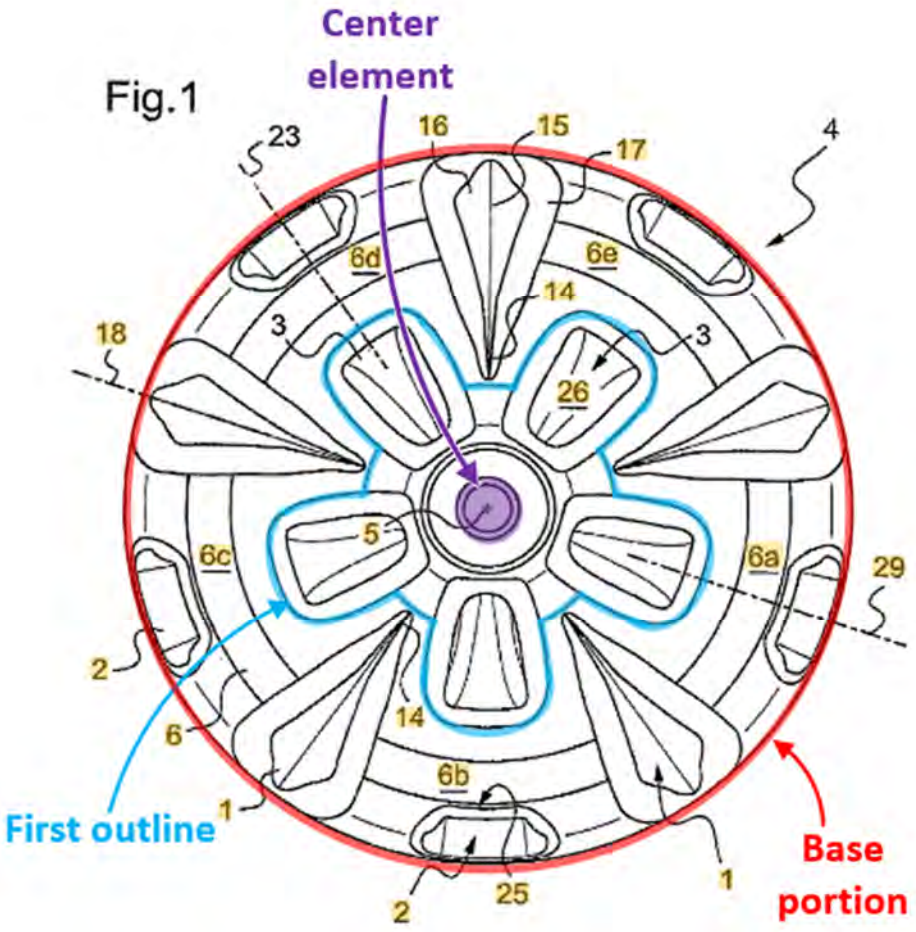
196. The axial disc 12 of Protais (center element) was centered with respect to the first outline, as discussed with respect to element [1.H]. As further shown in Figure 1, annotated below, both of these elements were centered with respect to the base portion. In the combination with Metzger, where Protais' base would have replaced the bottom end of Metzger's container, a POSITA would have understood and found it obvious that the center element and first outline would also be centered with respect to the container side wall as disclosed by Metzger because the base portion can be integrally formed with the container side walls (*see* Metzger, 7:58-60; Protais, 4:24-28). This would have been a simple substitution of the base, and would not have required changes to the sidewalls of Metzger's container. Thus, the base portion could be centered with respect to the container side wall such that the first outline and center element were also centered with respect to the container side wall.



Protais, Fig. 1 (Annotated)

k. Element [1.J]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the base portion;"

197. Protais' Figure 1, annotated below, illustrated that the axial disc 12 (center element) and the first outline are each centered with respect to the bottom 4 (base portion).



Protais, Fig. 1 (Annotated)

l. Element [1.K]: "wherein the cross-sectional diameter of the first opening to the interior of the container body is less than a cross-sectional diameter of a middle portion of the container side wall;"

198. Metzger disclosed this feature. As described with respect to element [1.A], Metzger's container had a "neck opening 48" that forms a first opening to the interior of the container body. (Metzger, Fig. 1, 4:40-41). The neck opening had a maximum opening width (cross-sectional diameter) that was, "[i]n an exemplary twenty-six ounce embodiment," about 2.89 inches. (*Id.*, 4:41-44). Metzger's

container had a “middle portion” in the form of a side wall section that extended between the “first protective feature 24” and the “second protective feature 26,” shown in annotated Figure 2 below. This middle portion of Metzger’s container varied in diameter but had, for example, a “principal diameter 12,” as shown in Figure 2. (*Id.,* 4:14-15). In the embodiment of the container that holds twenty-six ounces, the principal diameter 12 was 3.01 inches, which is greater than the 2.89-inch cross-sectional diameter of the neck opening 48. (*Id.,* 4:15-17). Furthermore, the middle portion of the container shown in Figure 2 had other cross-sectional diameters that were even greater than the principal diameter 12, including, for example, a “first feature diameter 14” and a “second feature diameter 16” that could each be 3.46 inches (*id.,* 6:19-20; 6:23-24; 6:62-65).

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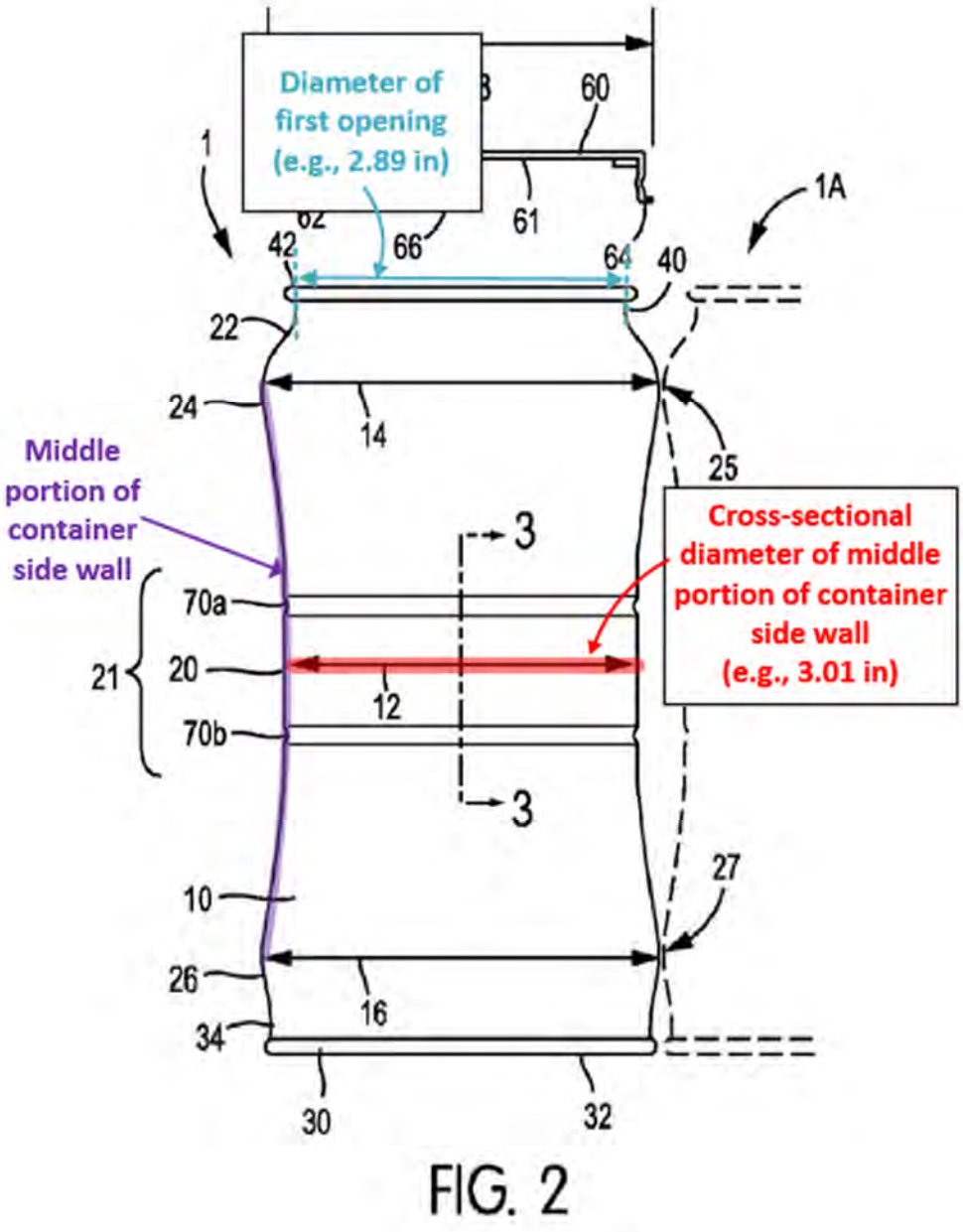


FIG. 2

Metzger, Fig. 2 (Annotated)

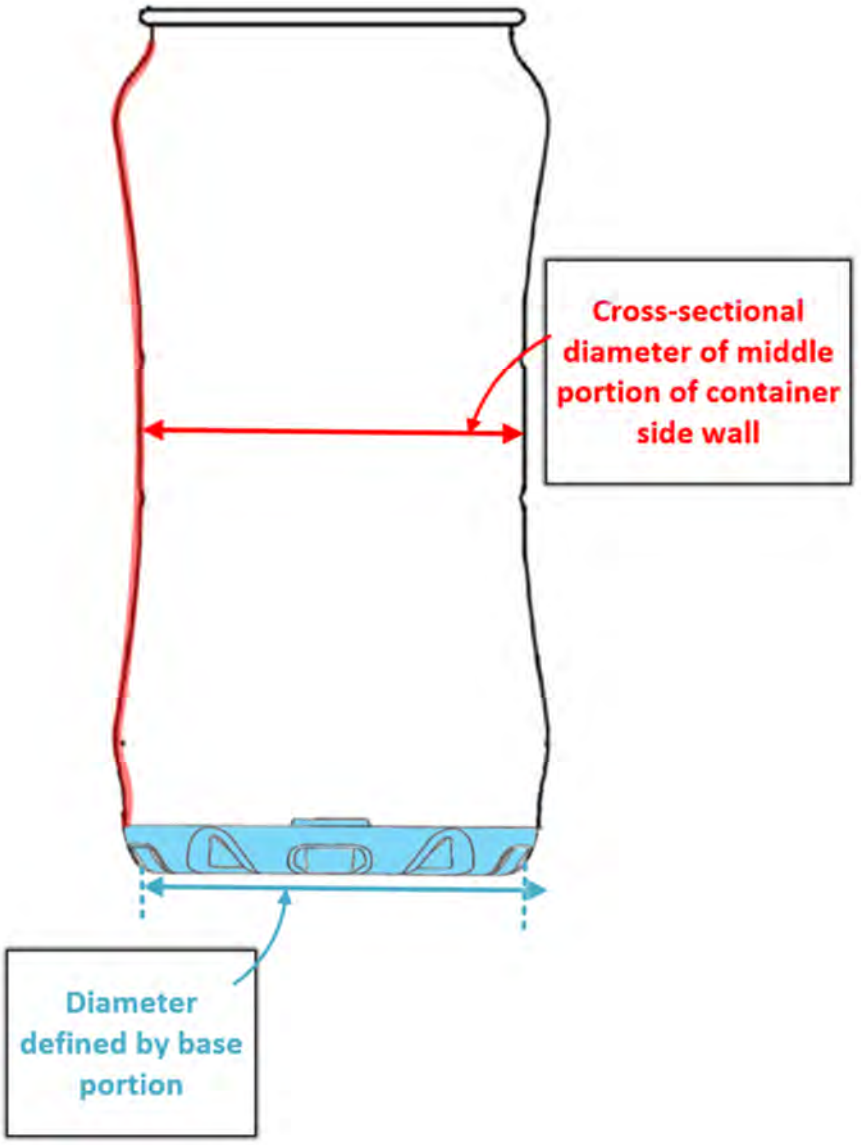
m. Element [1.L]: "wherein the base portion defines a diameter that is less than the cross-sectional diameter of the middle portion of the container side wall;"

199. Metzger and Protais teach or suggest this feature. As described with respect to element [1.K], the middle portion of Metzger's container had cross-

sectional diameters that range from a diameter of 3.01 inches, at a narrowest point, to 3.46 inches at its widest points. (Metzger, 4:15-17; 6:19-20; 6:23-24; 6:62-65; Fig. 2). As described with respect to element [1.E], Metzger disclosed a base portion that includes "bottom seal structure 30." (Metzger, 7:51-54; Fig. 2). In one example, the bottom seal structure had a diameter of 3.31 inches. (*Id.*, 7:24-26). However, Metzger explained that a "tapered transition 34," connecting a lower portion of the container to the bottom seal structure, could have a slope with "angles greater or lesser than 12 degrees" from the vertical axis. (*Id.*, 7:22-29). Increasing the slope of the tapered transition 34 from 12 degrees to a larger angle from the vertical axis would cause the cross-sectional diameter of the bottom seal structure 30 to decrease correspondingly. A POSITA would have found it obvious to increase or decrease the cross-sectional diameter of the bottom seal structure and correspondingly decrease or increase the slope of the tapered transition, since these modifications are contemplated by Metzger. A POSITA would have understood the scope of these changes to include forming a bottom diameter that was less than the middle body's narrowest cross-sectional diameter 12.

200. In the combination of Metzger's container with Protais' base discussed with respect to element [1.E], a POSITA would have found it obvious for the cross-sectional diameter of the base to be approximately equal to, or less than, the diameter of the bottom seal structure 30 discussed above in Metzger's disclosure because

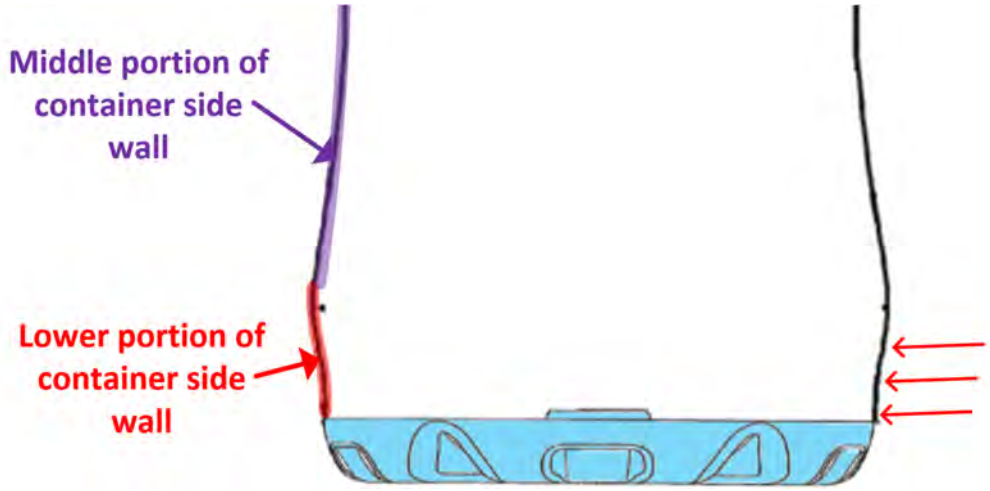
these sizes would have been merely ornamental and would have enabled the base to be formed integrally with the container body. (*See* Metzger, 7:58-60; Protais, 4:24-28). Accordingly, the base section of the combined container could define a diameter that was less than the diameter of the middle portion of the container side wall, as illustrated in the diagram of the example combination below.



Example Combination of Metzger and Protais

n. Element [1.M]: "wherein a lower portion of the container side wall extends downwardly from the middle portion of the container side wall to the base portion of the container body, the lower portion along its entirety being greater in diameter along its entirety than the base portion, including the bottom, thereby rendering the container body stemless;"

201. As discussed above, the combination of Metzger and Protais disclosed a container with a container side wall and a base portion. Furthermore, the "middle portion" of the side wall of Metzger's container can be defined as a portion of the wall extending between the "first protective feature 24" and the "second protective feature 26." (*See* 1.K]). Metzger's container side wall further had a "tapered transition 34" that connects the "second protective feature 26" of the container to the base. (Metzger, 7:22-24). This tapered transition, which formed a lower portion of the container side wall, was "angled from the vertical axis at an angle of about 12 degrees …[but] may be provided angles greater or lesser than 12 degrees." (*Id.,* 7:26-29). Since the tapered transition (lower portion of the sidewall) was angled from the vertical and this angle was towards the interior of the container as depicted in Metzger's Figure 2, the tapered transition caused the lower portion of the container side wall to decrease in diameter from the second protective feature 26 to the base. Thus, in the combination with Protais in which Metzger's container is integrally formed with Protais' container bottom, the tapered transition would have had a greater diameter along its entirety than the container bottom.



Example Combination of Metzger and Protais

202. The proposed combination satisfies the limitation that the container be rendered "stemless" for the reasons explained above, because its lower portion along its entirety is greater in diameter along its entirety than the base portion, including the bottom. Further, even if the "thereby" transitional phrase is ignored and the "stemless" limitation is construed to require a stemless container body independent of the prior claim limitations, the container in the combination is stemless, as illustrated in the annotated figures above.

o. Element [1.N]: "wherein the container body further comprises a circular neck extending from the container side wall so that the container side wall extends between the circular neck and the base portion;"

203. Metzger disclosed a neck in the form of "neck 40" that was circular because the container was circular. (Metzger, 4:21; Fig. 2; 3:62-65 ("Body 10 is generally a cylinder having a circular cross section.")) The neck 40 extended from the container side wall of Metzger's container. (*Id.*, 4:21-24 (the neck 40 "extend[s]

upward from a tapered transition 22 along the vertical axis of container body 10.")) As a result, Metzger's container had a container side wall that extended between the circular neck 40 and the base portion (e.g., bottom seal structure 30 and bottom end wall 32), as shown in annotated Figure 2 below.

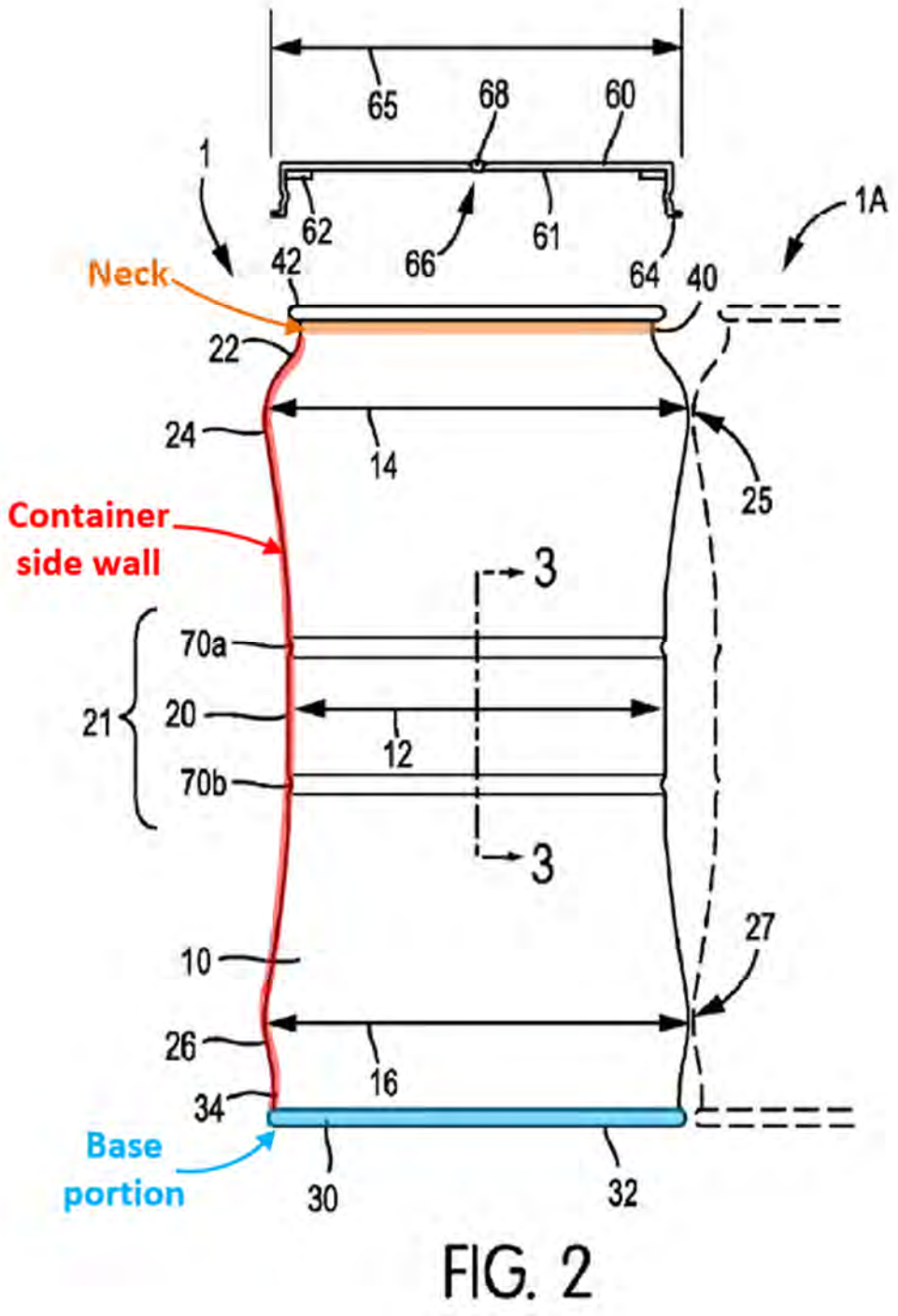


FIG. 2

Metzger, Fig. 2 (Annotated)

p. Element [1.O]: "wherein an upper edge of the container side wall is adjacent to the circular neck of the container body;"

204. The container side wall of Metzger's container had an upper edge that was adjacent to the neck 40, such as a top circumference of the side wall before the beginning of the neck 40, as annotated in Figure 2 below. (*See* Metzger, 4:21-24; Fig. 2).

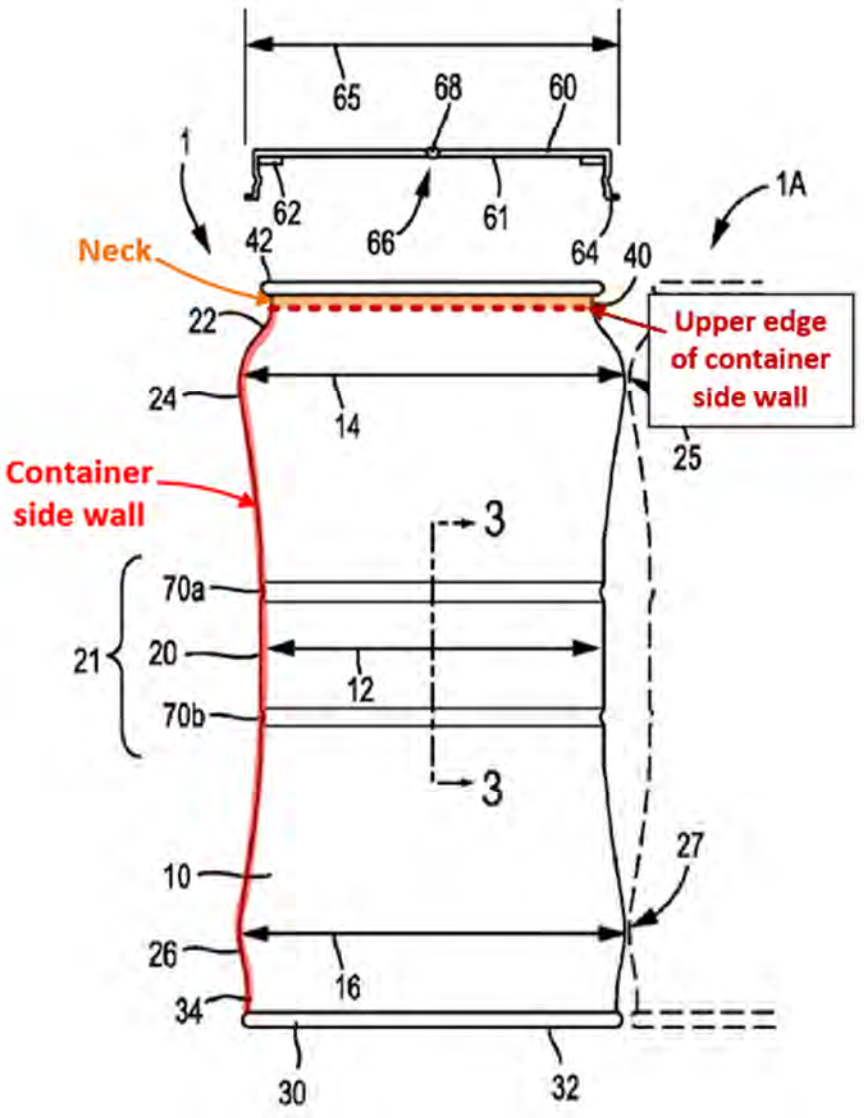
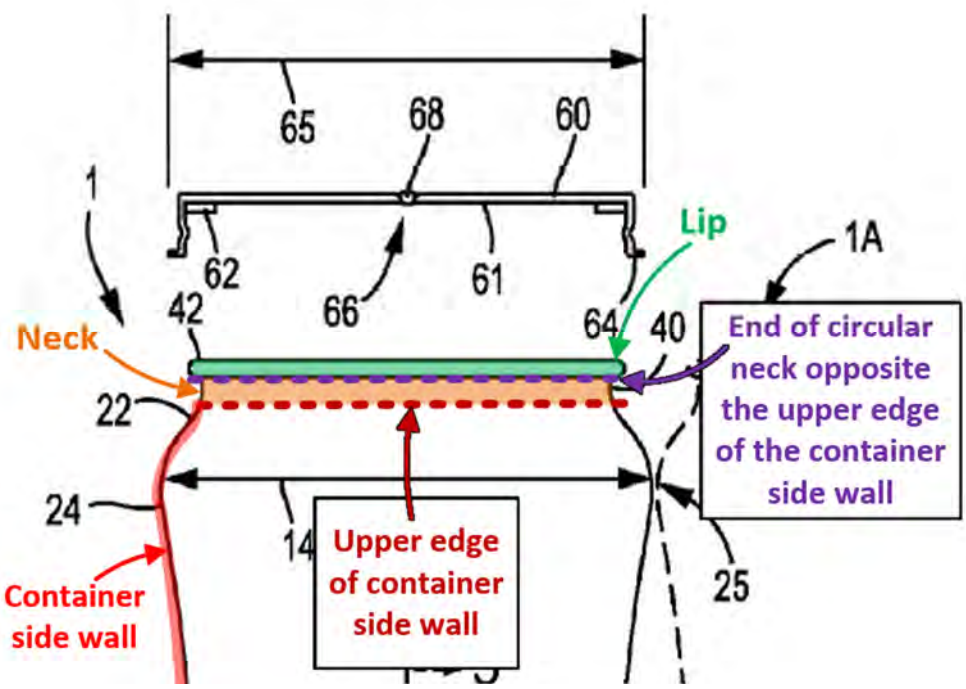


FIG. 2

Metzger, Fig. 2 (Annotated)

q. Element [1.P]: "wherein the container body further comprises a lip at an end of the circular neck opposite the upper edge of the container side wall;"

205. Metzger's container body 10 had a lip in the form of a "rim or lip, shown as neck edge 42, [that] may be curled or rounded to provide a suitable sealing surface." (Metzger, 4:32-33; Fig. 2). As shown in enlarged and annotated Figure 2 below, the neck edge 42 was at an end of the neck 40 that is opposite the upper edge of the container side wall (i.e., at a top of the neck 40 whose bottom is adjacent to the side wall's upper edge).



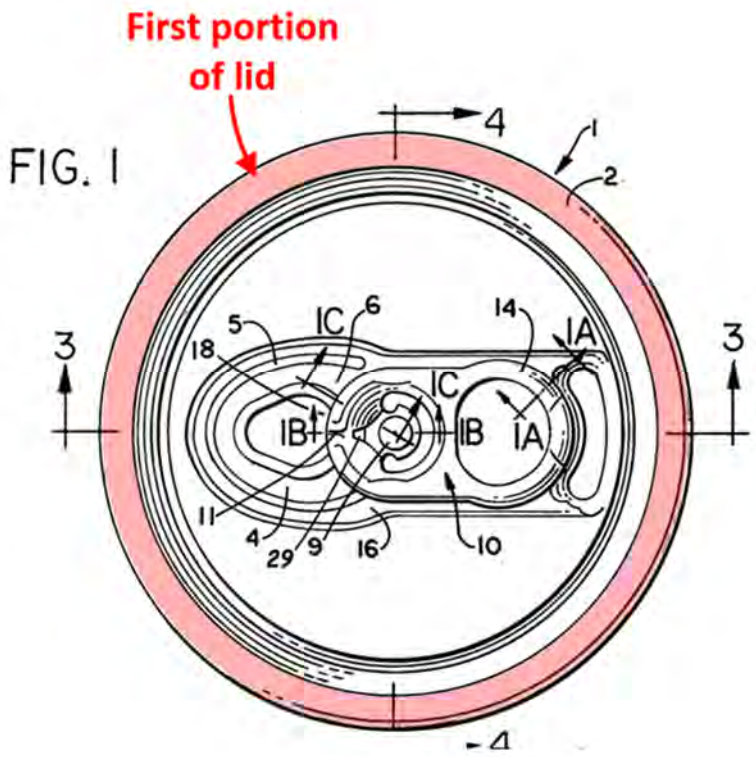
Metzger, Fig. 2 (Cropped and Annotated)

r. Element [1.Q]: "wherein the circular neck is adjacent to the lip;"

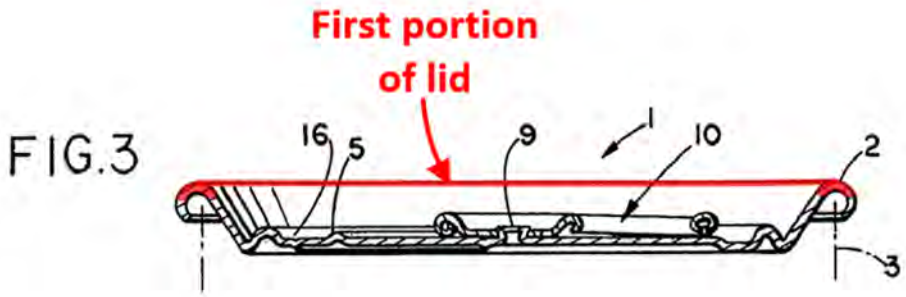
206. The annotations to Metzger's Figure 2 provided in element [1.P] illustrate that the neck 40 (circular neck) was adjacent to the neck edge 42 (lip).

s. Element [1.R]: "wherein a first portion of the lid is above the lip of the container body;"

207. Metzger and Kaminski disclose this feature. As described with respect to element [1.B], Metzger disclosed a variety of lids that can connect to the container body 10, including, for example, the closure 60 in Figure 2 and the pull off end 90 shown in Figure 6. (*See* Metzger, 4:29; 9:43-45; 9:54-59; Figures 2, 5, and 6). Since at least some of these lids attach to the top of the container body 10, a portion of such lids was above the neck edge 42 (lip) of the container body. Kaminski disclosed a lid that had a first portion in the form of "a circumferentially extending raised edge 2," as identified in annotated Figures 1 and 3 below. (Kaminski, 2:67-68; Figure 1, Figure 3).



Kaminski, Fig. 1 (Annotated)



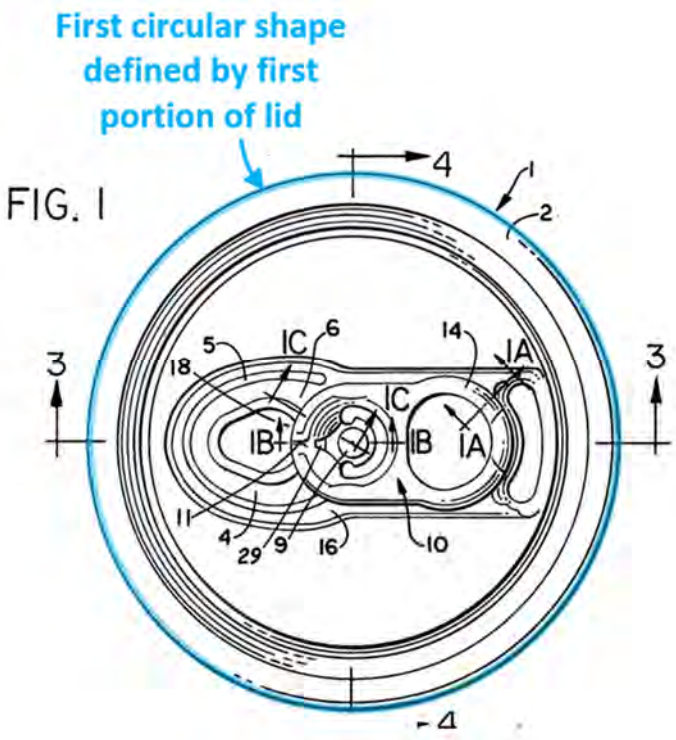
Kaminski, Fig. 3 (Annotated)

208. The raised edge facilitated "attaching can end 1 to a suitable cylindrical beverage can 3." (*Id.*, 2:68-3:1). Accordingly, and for the reasons discussed with respect to element [1.B], it would have been obvious for the raised edge of

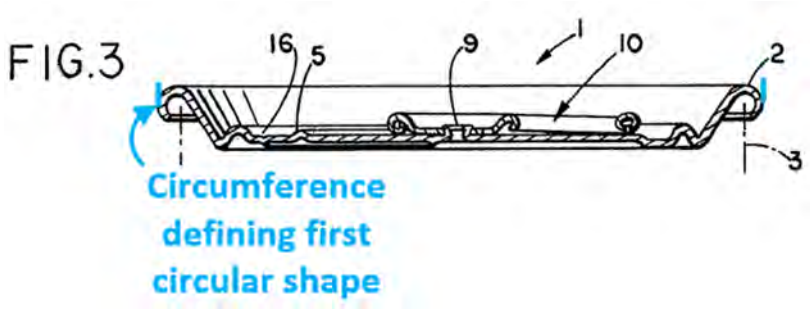
Kaminski's lid to attach to the neck edge 42 of Metzger's container to seal the combined container. In this configuration, the raised edge 2 of Kaminski's lid (the first portion of the lid) was above the neck edge 42 (lip) of the combined container.

t. Element [1.S]: "wherein the first portion of the lid defines a first circular shape;"

209. Kaminski disclosed this feature. As described in element [1.R], Kaminski disclosed a first portion of a lid in the form of the "raised edge 2." (Kaminski, 2:67-68; Figure 1, Figure 3). Annotated Figures 1 and 3 below show that the first portion of the lid defined a first circular shape by, for example, a circumference extending around the lid positioned at or near the outermost point on the raised edge.



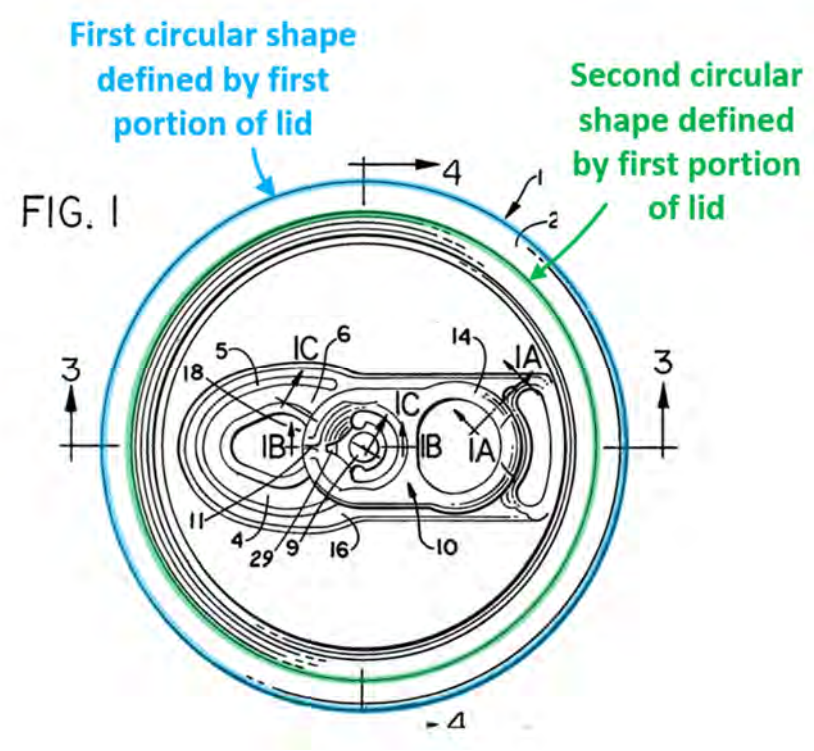
Kaminski, Fig. 1 (Annotated)



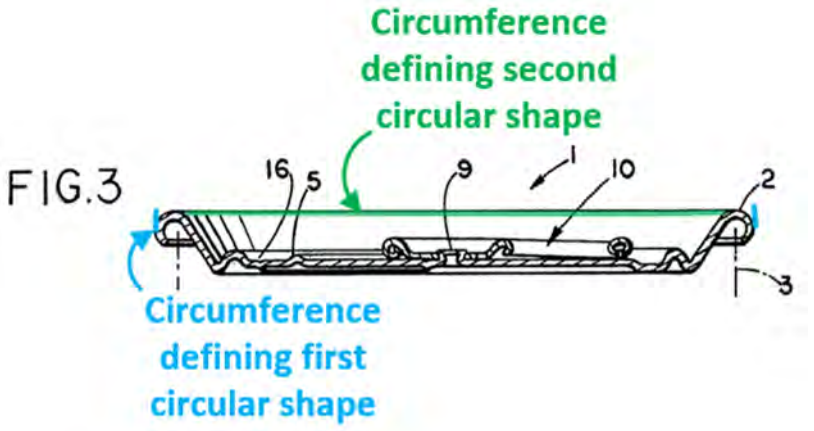
Kaminski, Fig. 1 (Annotated)

u. Element [1.T]: "wherein the first portion of the lid further defines a second circular shape around which the first circular shape circumferentially extends;"

210. Kaminski disclosed this feature. Annotated Figures 1 and 3 below show that the raised edge of Kaminski's lid (first portion of lid) defined a second circular shape by, for example, a circumference extending around the lid at or near an inner side of the raised edge. As further shown in these annotated figures, the first shape (*see* element [1.S] circumferentially extended around the second circular shape).



Kaminski, Fig. 1 (Annotated)



Kaminski, Fig. 3 (Annotated)

v. Element [1.U]: "wherein the second circular shape defined by the first portion of the lid is concentric with the first circular shape defined by the first portion of the lid;"

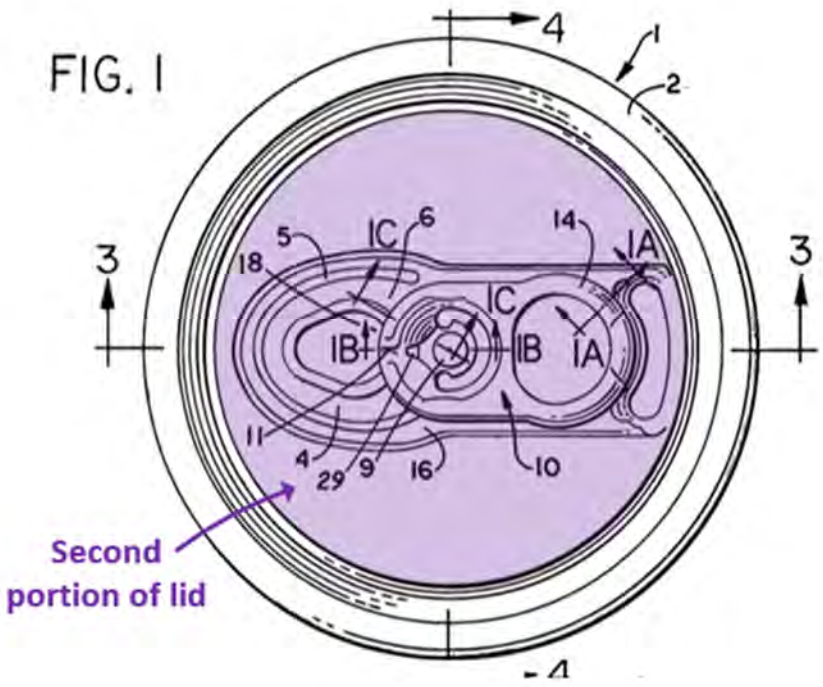
211. Kaminski's Figure 1, as annotated in element [1.T], shows that the second circular shape was concentric with the first circular shape.

w. Element [1.V]: "wherein the first circular shape defined by the first portion of the lid is radially positioned between the container side wall and the second circular shape defined by the first portion of the lid;"

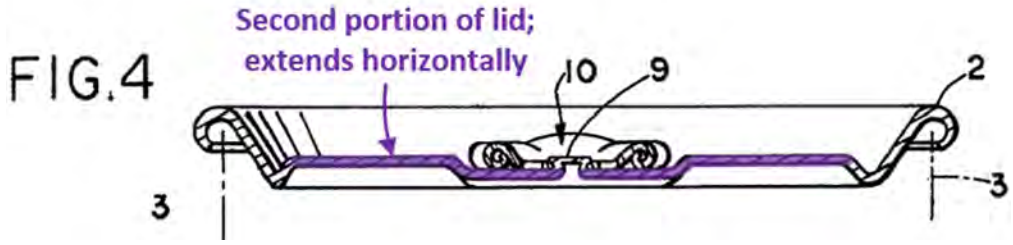
212. Metzger and Kaminski disclose this. As described with respect to [1.K], Metzger's container side wall varies in diameter but had, for example, a "principal diameter 12" and a "first feature diameter 14" that are each larger than a diameter of the container's neck opening. (Metzger, 4:14-17; 4:41-44; 6:19-20; 6:23-24; 6:62-65). When Metzger's container was combined with Kaminski's lid, the raised edge 2 of Kaminski's lid would interface with the neck edge 42 of Metzger's container. (*See* [1.B] and [1.R]). Since the raised edge defined the first circular shape by, for example, a circumference positioned at or near the raised edge's outermost point, a POSITA would have understood that the first circular shape had a smaller diameter than the container side wall at the principal diameter or first feature diameter. Thus, the first circular shape had a smaller radius than at least part of the container side wall, and a greater radius than the second circular shape.

x. Element [1.W]: "wherein a second portion of the lid extends horizontally and is positioned so that the second circular shape is radially positioned between the second portion of the lid and the first circular shape;"

213. Kaminski's lid had a second portion that extends horizontally, as shown in annotated Figures 1 and 4 below.

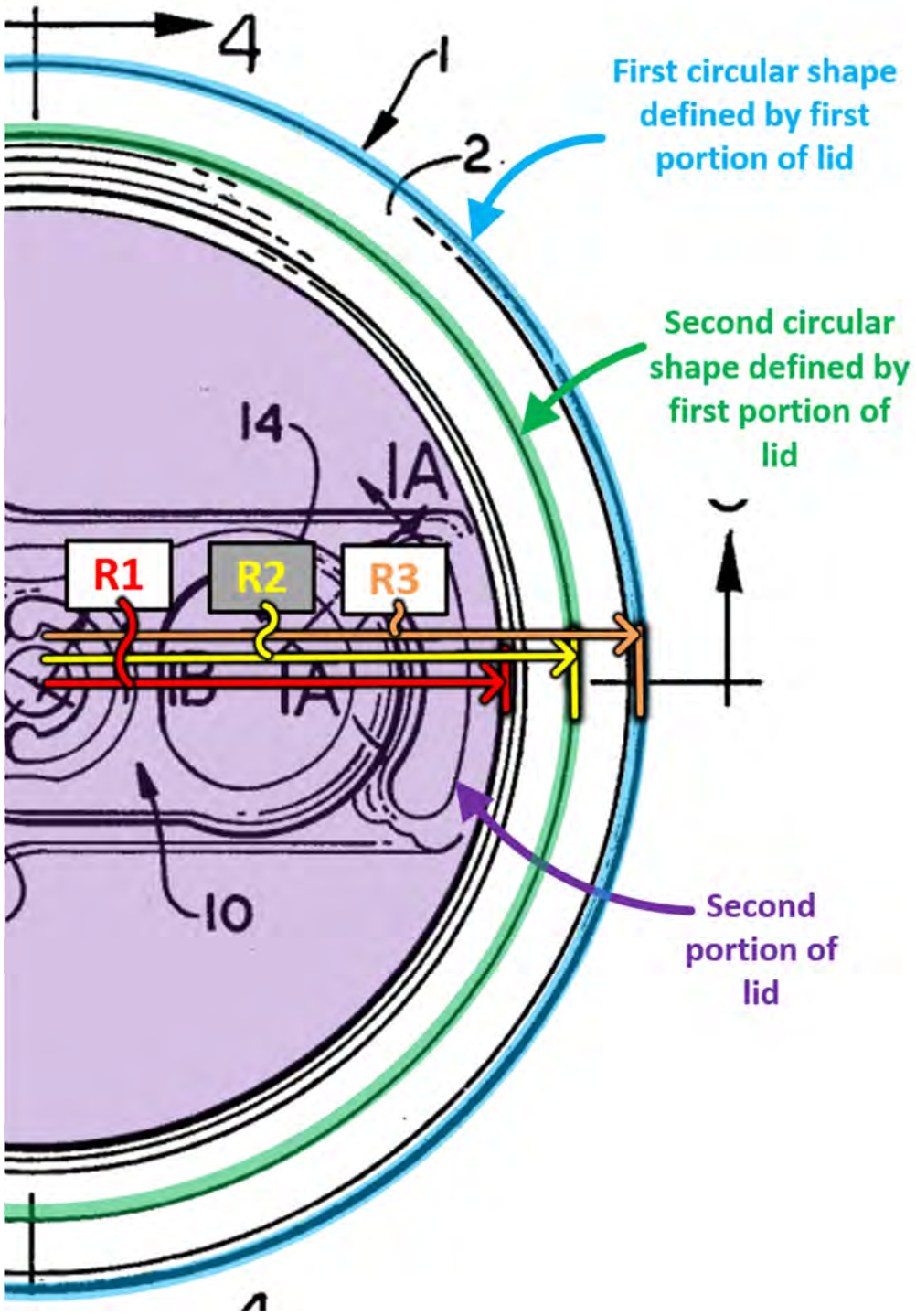


Kaminski, Fig. 1 (Annotated)



Kaminski, Fig. 4 (Annotated)

214. Furthermore, as the below annotations to an enlarged portion of Kaminski's Figure 1 demonstrate, the second circular shape discussed with respect to element [1.T] was positioned such that a radius from a centerpoint of the lid to the second circular shape (R2, below in yellow) was greater than a radius from the centerpoint to the outer circumference of the second portion of the lid (R1). A radius (R3) from the centerpoint to the first circular shape, as discussed with respect to element [1.S], was in turn greater than the radius from the centerpoint to the second circular shape. Thus, the second circular shape of Kaminski's lid was radially positioned between the lid's second portion and the first circular shape.



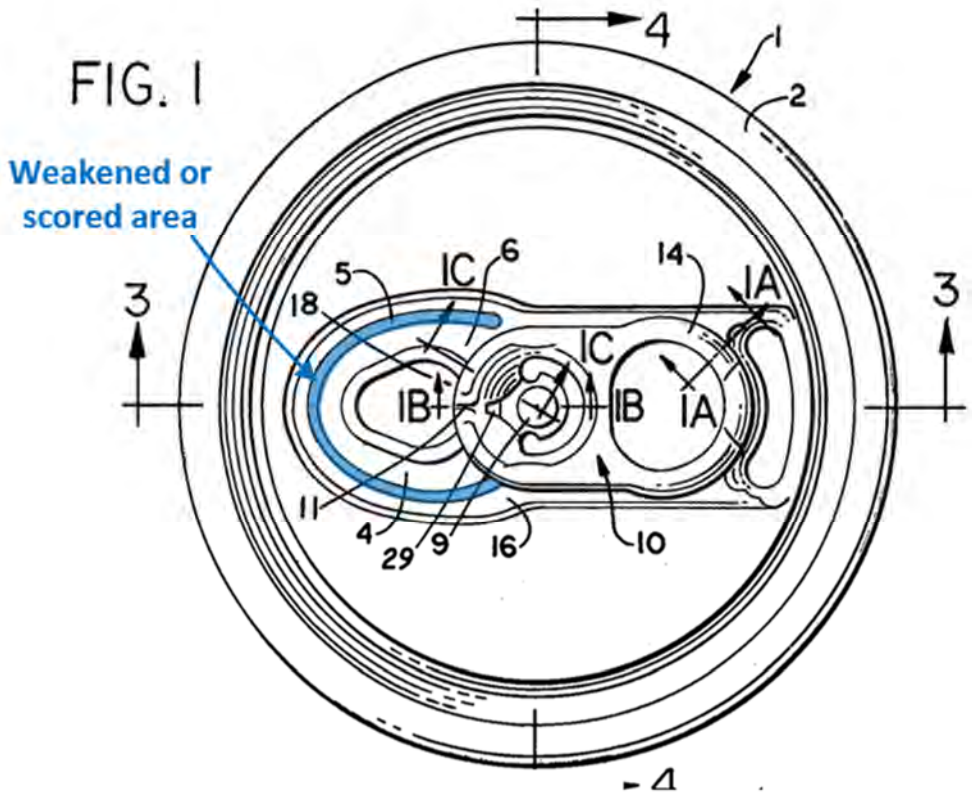
Kaminski, Fig. 1 (Cropped and Annotated)

y. Element [1.X]: "wherein the second portion of the lid defines a total area across which the second portion of the lid extends horizontally;"

215. The second portion of Kaminski's lid, described in element [1.W], had a total area that represented the area of the horizontal portions of the lid.

z. Element [1.Y]: "wherein the second portion of the lid comprises a weakened or scored area;"

216. The second portion of Kaminski's lid had a weakened or scored area in the form of a "score or tear line 5." (Kaminski, 3:7-10; Fig. 1). Raising a pull tab 10 on the lid would "initiate[] a tear along the score line 5" (*id.*, 3:49-51), causing "the score line 5…to tear therearound" (*id.*, 3:56-58).



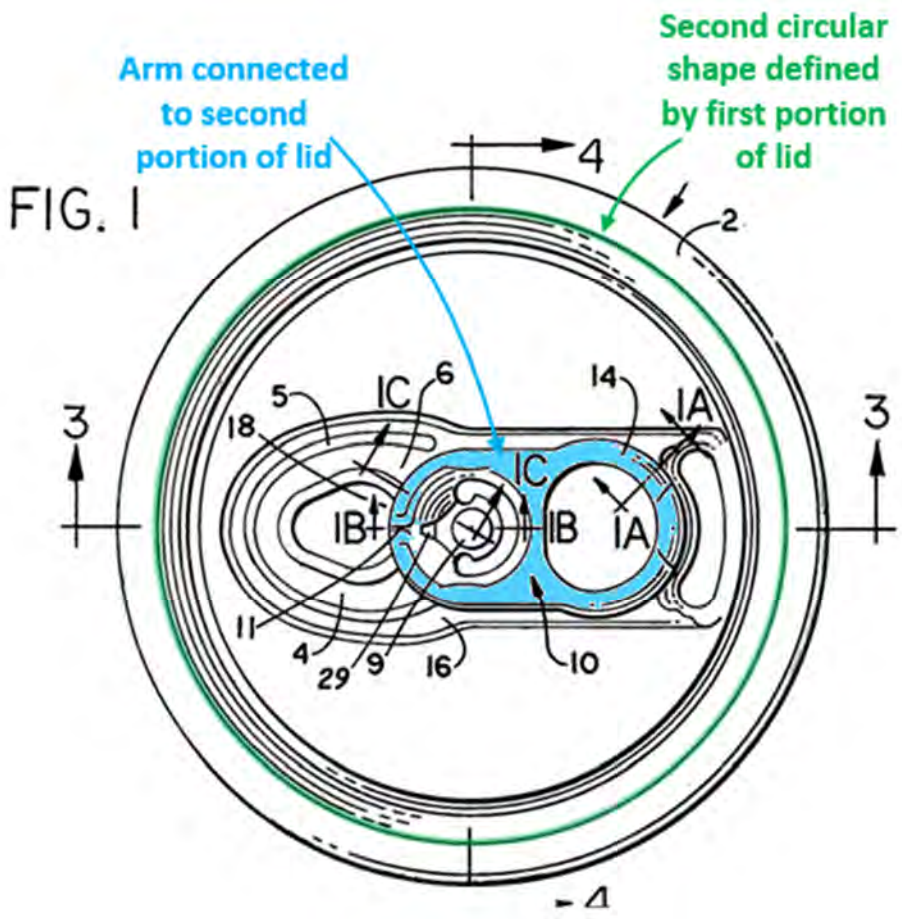
Kaminski, Fig. 1 (Annotated)

aa. Element [1.Z]: "wherein the weakened or scored area is less than the total area across which the second portion of the lid extends horizontally;"

217. Kaminski disclosed this feature. The annotated figures in elements [1.W] and [1.Y] demonstrate that the weakened or scored area was less than the total area across which the second portion of the lid extends horizontally.

bb. Element [1.AA]: "wherein the lid further comprises an arm connected to the second portion of the lid and radially positioned within the second circular shape;"

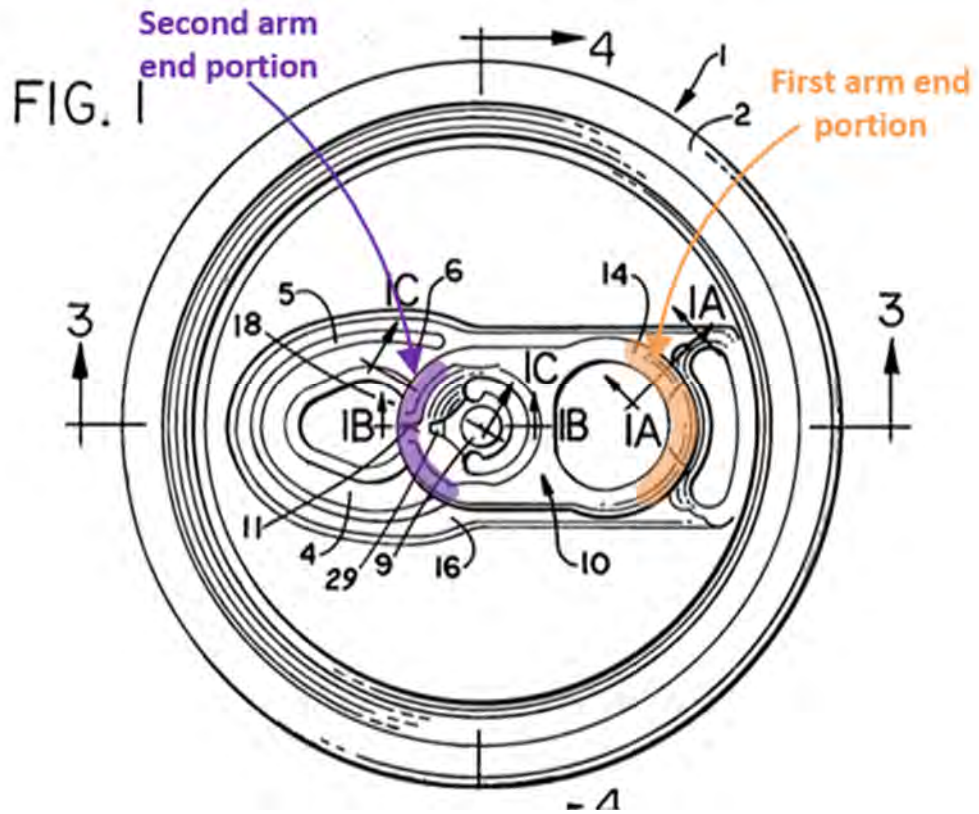
218. Kaminski's lid further included an arm in the form of "pull tab 10," labeled in annotated Figure 1 below. (Kaminski, 3:15-19; 3:49-52). The pull tab 10 was connected to the lid by a rivet 9. (*Id.*, 3:15-17). Finally, the pull tab 10 was radially positioned within the second circular shape, as identified in element [1.T], because the pull tab was inside of the radius of the second circular shape as viewed from the top of the can.



Kaminski, Fig. 1 (Annotated)

cc. Element [1.AB]: "wherein the arm comprises opposing first and second end portions;"

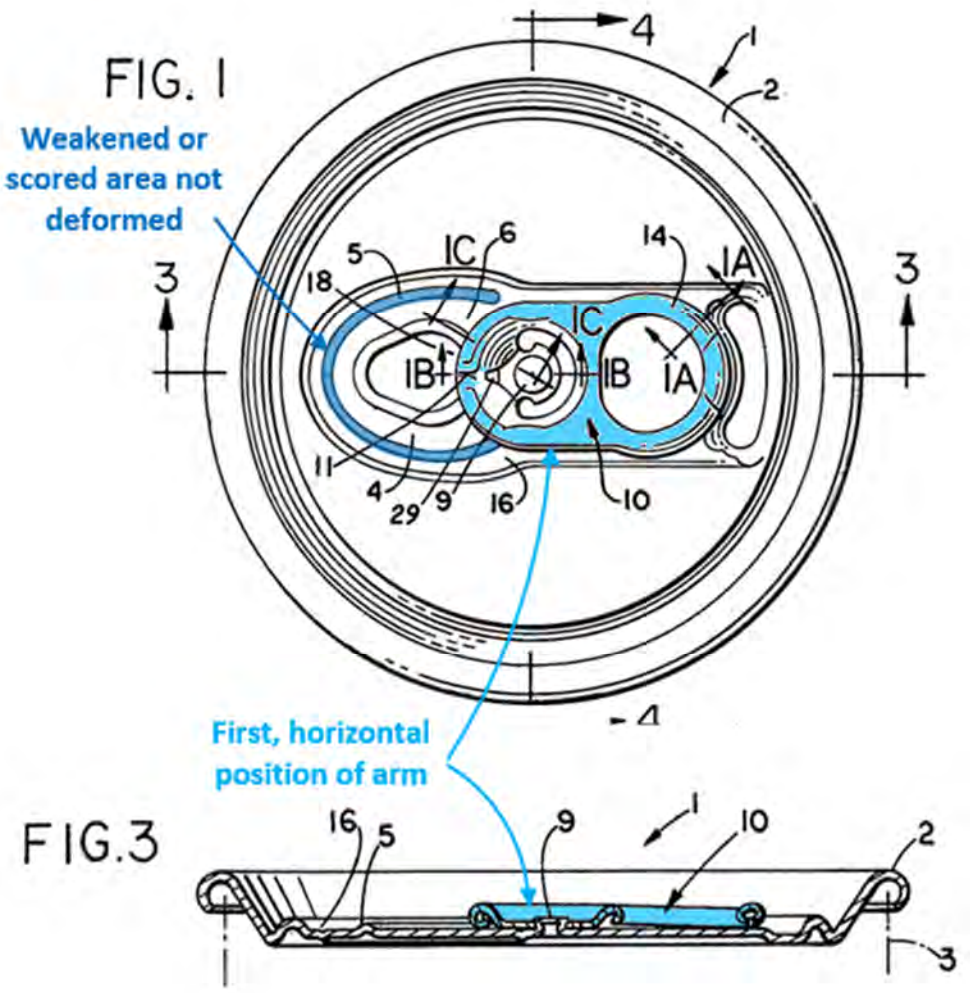
219. The pull tab (i.e., arm) disclosed by Kaminski had a "finger end 14" (e.g., a first end portion) and a "nose portion 11" (e.g., a second end portion). (Kaminski, 3:17-18; 3:27-29; Figure 1). As can be seen in Figure 1, annotated below, the finger end and nose portion are at opposite ends of the pull tab 10.



Kaminski, Fig. 1 (Annotated)

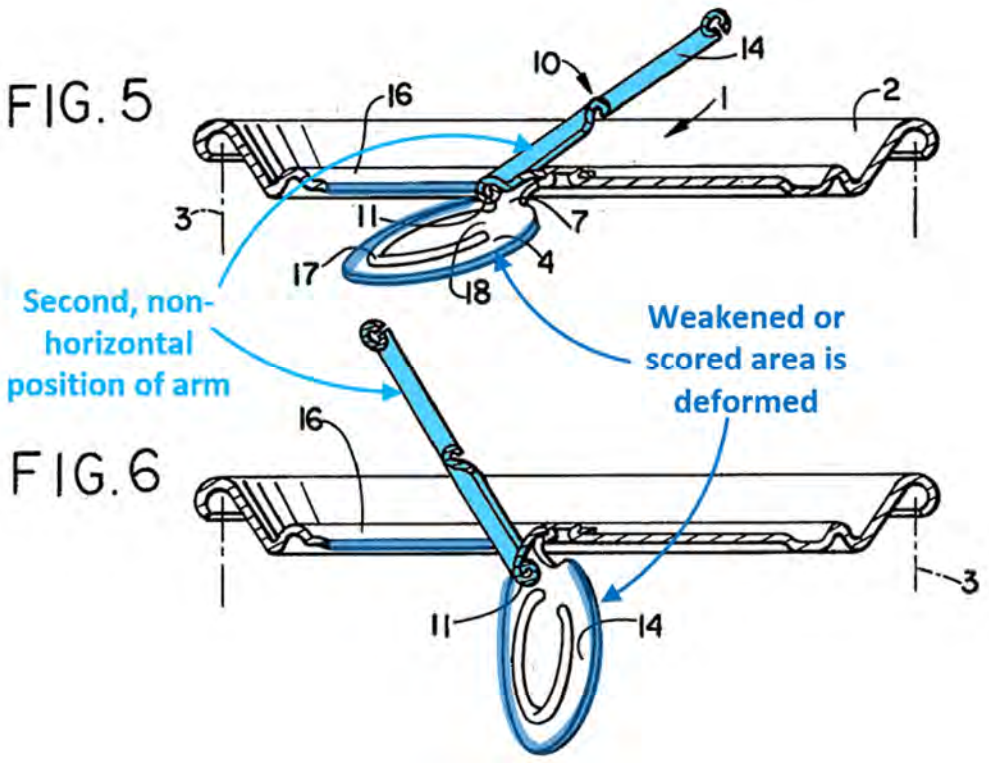
dd. Element [1.AC]: "wherein the arm is pivotable from a first position, in which the arm extends horizontally and the weakened or scored area is not deformed, to a second position, in which the arm does not extend horizontally and the weakened or scored area is deformed to provide a second opening to the interior of the container body;"

220. Kaminski's pull tab was pivotable, as illustrated in Figures 1, 3, and 5-6. First, Figures 1 and 3, annotated below, respectively depicted a top and side view of a first position in which the pull tab extends horizontally – that is, approximately parallel to the plane of the lid. In this position, the score or tear line 5 (i.e., weakened or scored area) was not deformed.



Kaminski, Figs. 1 and 3 (Annotated)

221. Then, Figure 5 illustrated how "when the pull tab 10 is raised" – pivoted to a second position in which it did not extend horizontally – "the nose portion 11 thereof initiates a tear along the score line 5" – deforming the score line. (Kaminski, 3:49-51).



Kaminski, Figs. 5 and 6 (Annotated)

ee. Element [1.AD]: "wherein an upper portion of the container side wall extends upwardly from the middle portion of the container side wall to the upper edge of the container side wall, the upper portion along its entirety being greater in diameter than the first opening to the interior of the container body;"

222. As discussed in element [1.O], the container side wall of Metzger's container had an upper edge at, for example, a top circumference of the side wall before the beginning of the neck 40, as annotated in Figure 2 below. (*See* Metzger, 4:21-24; Fig. 2). An upper portion of the container side wall, in the form of a "tapered transition 22," extended upwardly from the middle portion of the container side wall to the upper edge, as shown in annotated Figure 2 below. (*Id.*, 4:51-54). For example,

Metzger explained how the curvature of the tapered transition could "create an aesthetically pleasing container top, provide a user with increased leverage for opening the top, and/or prevent the container top and closure from experiencing some amount of the unavoidable contact that containers typically have with adjacent containers or other structures during manufacture, shipping, and/or use." (*Id.*, 5:5-11).

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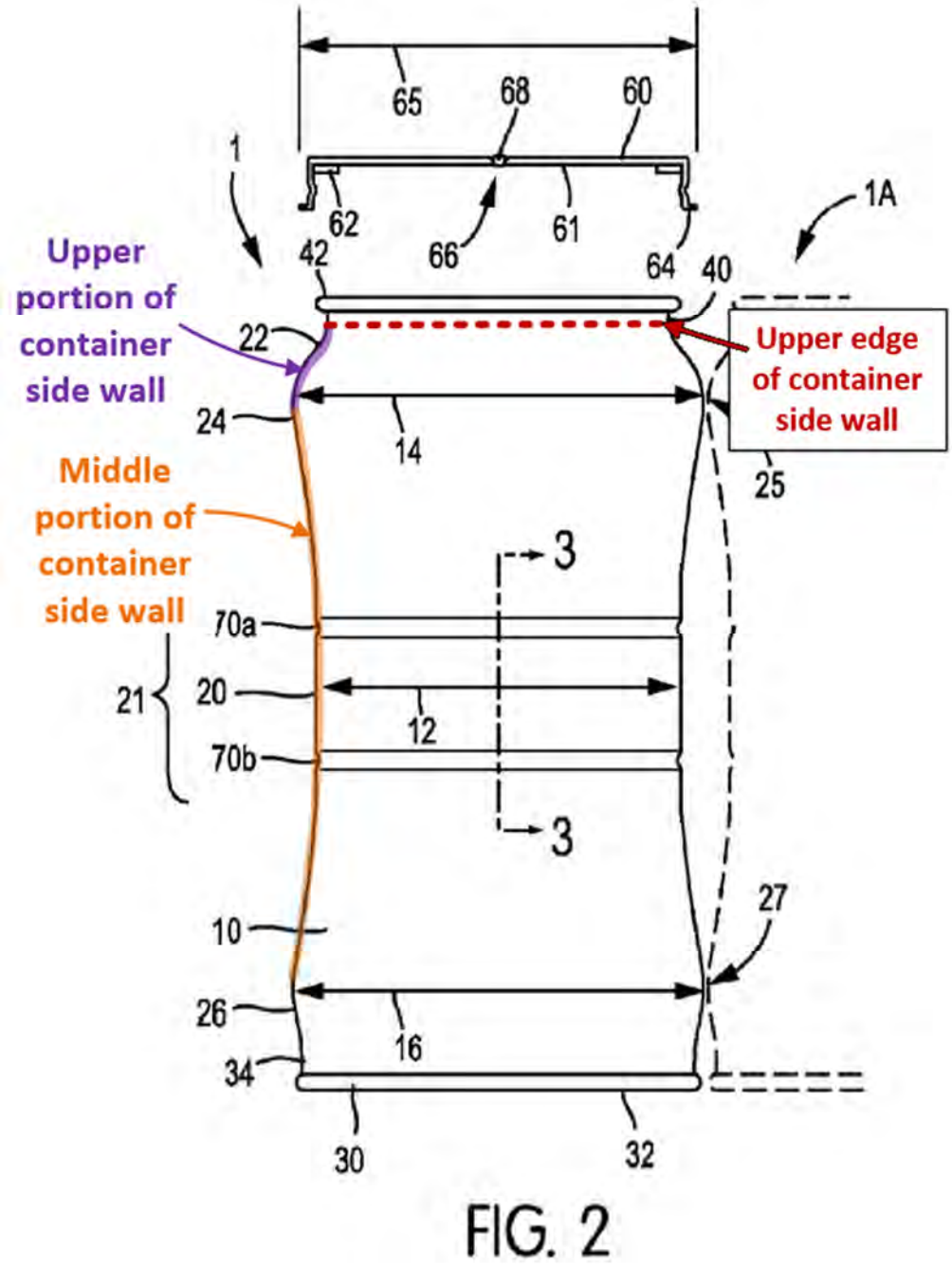
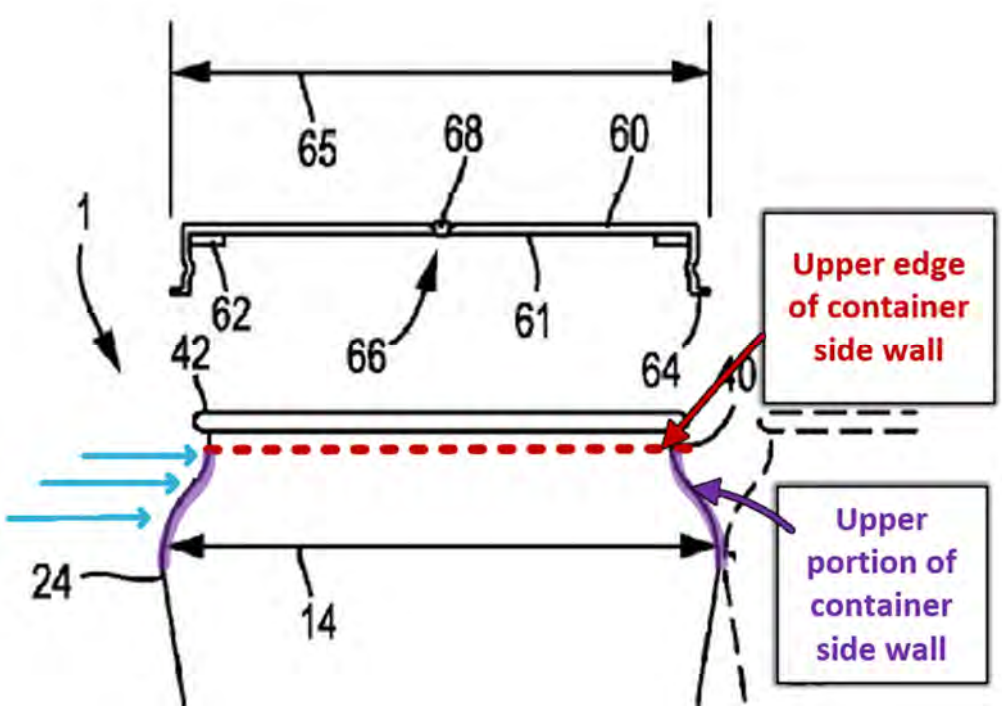


FIG. 2

Metzger, Fig. 2 (Annotated)

223. As shown in Figure 2, an enlarged portion of which is annotated below, the tapered transition was greater in diameter along its entirety than the diameter of the neck opening (i.e., the first opening to the interior of the container's body)

because the tapered transition had a monotonic slope that caused the cross-section to monotonically decrease from the middle portion of the container side wall to the upper edge.



Metzger, Fig. 2 (Enlarged and Annotated)

ff. Element [1.AE]: "wherein the container body contains a liquid therewithin;"

224. Metzger disclosed this feature. The container described by Metzger "may be sized to store about twenty-six ounces of ***liquid contents*** or combination of liquid and solid contents." (Metzger, 4:7-9; *see also* 3:51-55 (describing the container as a food container suitable to store liquid, among other substances)).

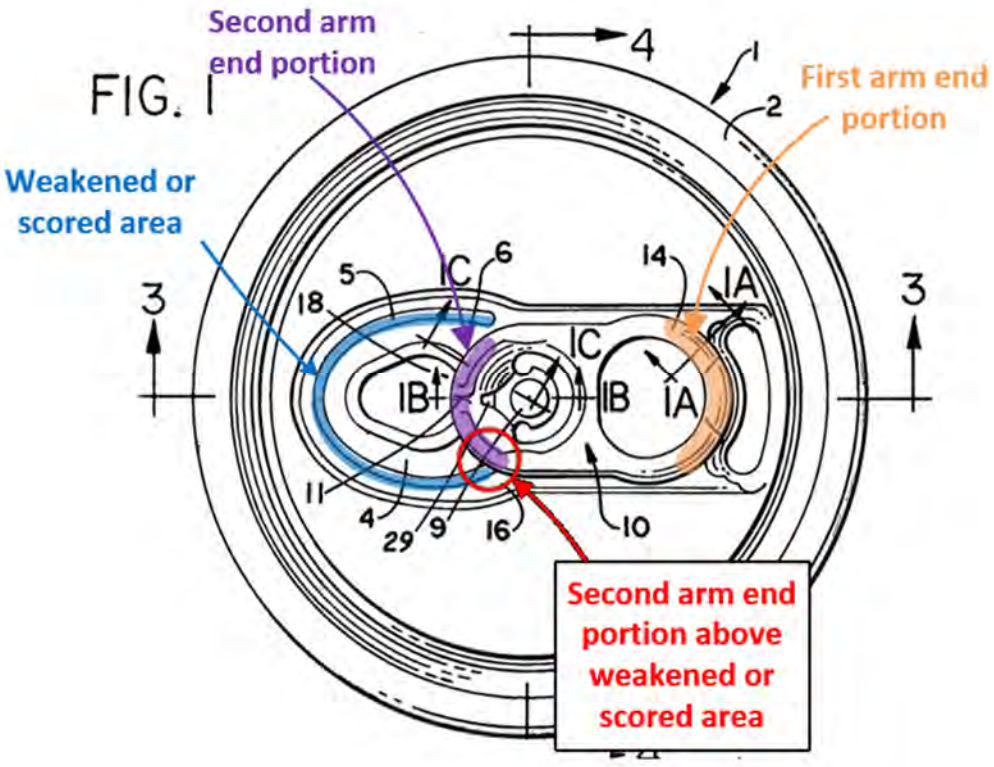
gg. Element [1.AF]: "wherein the lid cooperates with the lip to provide a seal so that the liquid contained within the container body is sealed against leaking out from between the container body and the lid;"

225. Metzger and Kaminski disclose this feature. Metzger described the "neck edge 42" (e.g., a lip) as being a "suitable sealing surface." (*Id.*, 4:32-33). Kaminski disclosed a can end that had a "raised edge 2 for attaching can end 1 to a suitable cylindrical beverage can 3." (Kaminski, 2:65-3:4). It would have been obvious for the raised edge of Kaminski's lid to cooperate with (e.g., seal against) Metzger's neck edge, because a POSITA would have been motivated to ensure that the container did not leak when it contains a liquid as disclosed by both Metzger and Kaminski. (*See* Metzger, 1:29-33; 3:47-48; 4:32-33; Kaminski, 3:1 (the container was a beverage can)).

hh. Element [1.AG]: "wherein, when the arm of the lid is in the first position and the weakened or scored area is not deformed: the first end portion of the arm is not positioned above the weakened or scored area of the second portion of the lid; and at least a portion of the second end portion of the arm is positioned above the weakened or scored area of the second portion of the lid;"

226. Kaminski disclosed this feature. As described with respect to element [1.AC], the pull tab (i.e., arm) of Kaminski's lid had a first, horizontal position as depicted in Figures 1 and 3. In this position, the "finger end 14" (first end portion) was not positioned above the score line 5 (weakened or scored area). (Kaminski,

3:27-29; Figure 1). At the same time, the "nose portion 11" (second end portion) was positioned above the score line 5, as illustrated in annotated Figure 1 below. (*Id.*, 3:17-18). For example, the nose portion 11 was positioned such that it "initiates a tear along the score line 5" when the pull tab was raised. (*Id.*, 3:49-51).



Kaminski, Fig. 1 (Annotated)

ii. Element [1.AH]: "wherein the container side wall extends between the circular neck and the base portion so that:

the upper portion of the container side wall defines a first angle: between the upper portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the middle portion of the container side wall defines a second angle: between the middle portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the lower portion of the container side wall defines a third angle: between the lower portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the first angle is an acute angle;

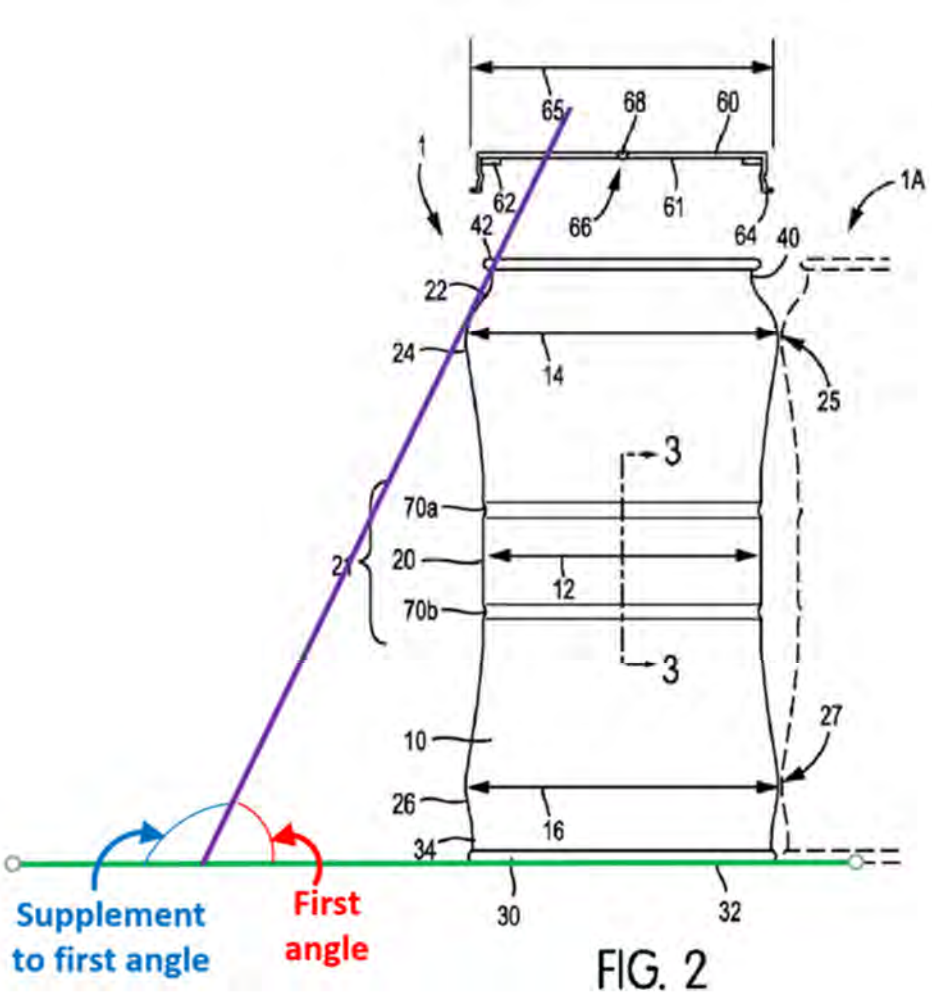
the third angle is an obtuse angle;

the second angle is greater than the first angle; and

the third angle is greater than the second angle;"

227. The container side wall of Metzger's container extended between the neck and the base portion, as discussed with respect to element [1.N]. A first angle can be defined between the tapered transition 22 (the upper portion of the container side wall; *see* Metzger, 4:51-52) and the bottom of the base portion. As annotated in Metzger's Figure 2 below, a tangent line to the tapered transition 22 intersects a line parallel to the plane of the container's bottom, forming two supplementary angles that are defined "between the upper portion of the container side wall and the bottom

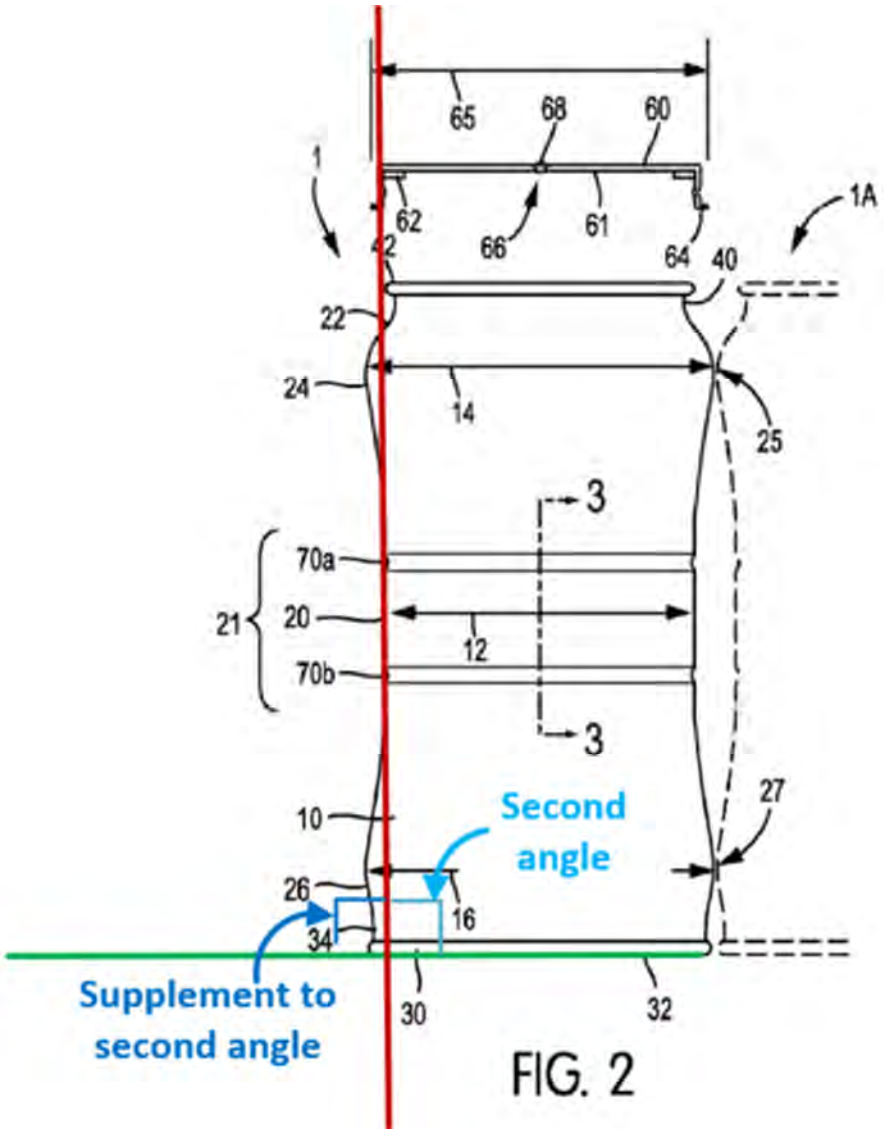
of the base portion." The angle facing the container satisfied the claimed requirement that the first angle be further defined "with respect to the bottom of the base portion." As shown, the first angle was acute.



Metzger, Fig. 2 (Annotated)

228. A second angle can be defined between a center portion 21 (the middle portion of the container side wall; *see id.*, 5:12-13) and the bottom of the base portion, at the intersection of a line parallel to the middle portion of the container side wall and the line parallel to the plane of the container's bottom (annotated in

Figure 2 below). The second angle facing the container at this intersection satisfied the claimed requirement that the second angle be further defined "with respect to the bottom of the base portion." As shown, the second angle was approximately 90 degrees.



Metzger, Fig. 2 (Annotated)

229. A third angle can be defined between the tapered transition 34 (the lower portion of the container side wall; *see id.*, 7:22-24) and the bottom of the base

portion, at the intersection of a line tangent to the tapered transition 34 and the line parallel to the plane of the container's bottom (annotated in Figure 2 below). Like the first and second angles, the third angle (yellow) facing the container at this intersection satisfied the claimed requirement that the third angle be further defined "with respect to the bottom of the base portion." As shown, the third angle was obtuse.

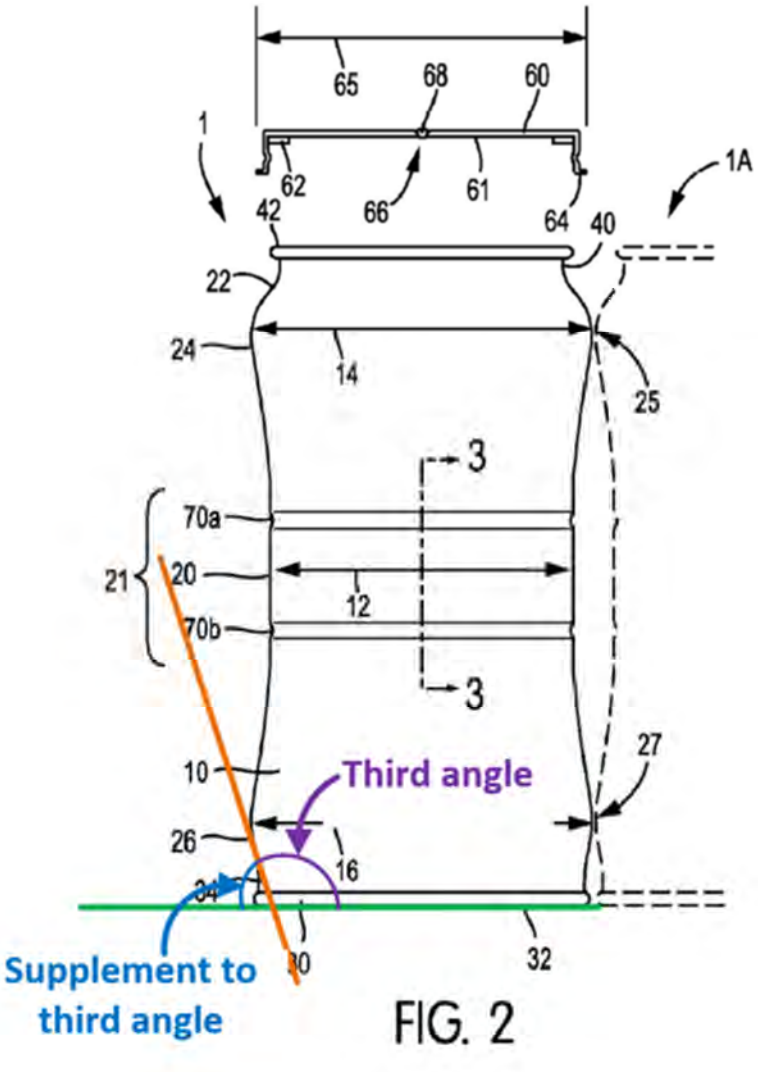


FIG. 2

Metzger, Fig. 2 (Annotated)

230. Finally, since the second angle was approximately 90 degrees while the first angle was acute, the second angle was greater than the first angle. Likewise, the third, obtuse angle was greater than the second, approximately 90-degree angle.

jj. Element [1.AI]: "wherein the interior of the container body extends continuously across the cross-sectional diameter of the middle portion at a height midway between the circular neck and the base portion so as to be interrupted, if at all, only by the liquid contained within the container body."

231. Metzger did not indicate that there was any obstruction in the container at a height midway between the circular neck and base portion that would interrupt any liquid contained in the can.

3. Claim 2: "The container of claim 1, wherein the resin is a polyethylene terephthalate (PET) resin."

232. Metzger described how its container can be made out of a variety of materials, including "various plastics." (Metzger, 3:56-58). However, Metzger did not explicitly disclose a PET resin. Instead, Protais provided this disclosure, explaining that PET was a common material for manufacturing containers of plastic materials. (Protais, 1:13-16). A POSITA would have been motivated to use PET to manufacture the container of the combination of Metzger, Protais, and Kaminski because, as Protais explained, PET had "good mechanical strength and thermal resistance." (*Id.*, 1:50-51). PET also was translucent when blow-molded (*id.*, 1:23-

25), which enabled presentation of the product contained in the container (*id.*, 1:61-63).

4. Claim 3: "The container of claim 1, wherein the container body is formed using a blow molding process."

233. For the reasons set forth above, the container body recited in claim 1 is obvious over the Metzger-Protais-Kaminski combination. In addition to the reasons for obviousness outlined in Ground 1, Protais also explained that blow-molding was a known process for manufacturing containers. (Protais, 1:10-12; 1:22-24; 1:31-36; 3:32-34; 4:25-27).

5. Claim 4: "The container of claim 1, wherein the metal is aluminum."

234. Metzger and Kaminski disclosed this feature. Metzger, for example, explained that a container end that can be attached to the container 1 "may be made of metals, such as … aluminum." (Metzger, 3:49-50). Kaminski, likewise, disclosed that its can end was manufactured from "a relatively ductile metal, such as aluminum." (Kaminski, 3:2-3).

6. Claim 5

a. Element [5.A]: "The container of claim 1, wherein the metal is aluminum; and"

235. Metzger and Kaminski disclose this feature for the same reasons discussed for claim 4.

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b. Element [5.B]: "wherein the resin is a polyethylene terephthalate (PET) resin."

236. Protais disclosed this feature for the same reasons discussed for claim 2.

7. Claim 6

a. Element [6.A]: "The container of claim 1, wherein the container body is formed using a blow molding process; and"

237. Protais and the AAPA each disclose the application of blow-molding for the same reasons discussed for claim 3.

b. Element [6.B]: "wherein the resin is a polyethylene terephthalate (PET) resin."

238. Protais disclosed this feature for the same reasons discussed for claim 2.

8. Claim 7

a. Element [7.A]: "The container of claim 1, wherein the metal is aluminum; and"

239. Metzger and Kaminski disclose this feature for the same reasons discussed for claim 4.

b. Element [7.B]: "wherein the container body is formed using a blow molding process."

240. Protais and the AAPA each disclose the application of blow-molding for the same reasons discussed for claim 3.

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9. Claim 8

a. Element [8.A]: "The container of claim 1, wherein the metal is aluminum;"

241. Metzger and Kaminski disclose this feature for the same reasons discussed for claim 4.

b. Element [8.B]: "wherein the resin is a polyethylene terephthalate (PET) resin; and"

242. Protais disclosed this feature for the same reasons discussed for claim 2.

c. Element [8.C]: "wherein the container body is formed using a blow molding process."

243. Protais and the AAPA each disclose the application of blow-molding for the same reasons discussed for claim 3.

10. Claim 9

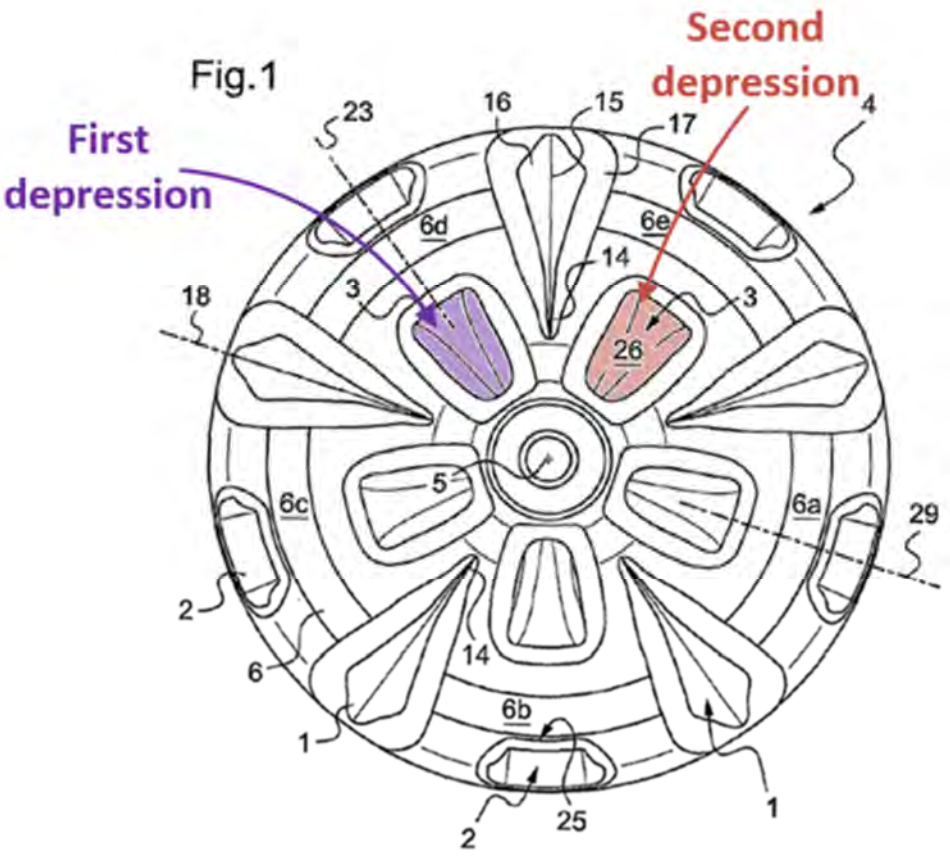
a. Element [9.A]: "The container of claim 1, wherein the first depression is visible through at least a portion of the container body;"

244. Protais disclosed or suggested this feature. As described with respect to element [1.F], Protais disclosed a first depression of a container bottom in the form of at least one of the "reinforcing grooves 3." (Protais, 4:41-44; 4:55; 5:1-2; 5:62-6:3; Figures 1 and 3). Furthermore, Protais explained that a PET container can be formed by blowing or stretch-blowing, which "causes a crystallization [of the PET] induced by deformation, leaving the material translucent." (Protais, 1:23-25). Since

Protais described a container with a translucent container body, a POSITA would have found it obvious that the reinforcing groove (the first depression) would have been visible through at least a portion of the translucent container body. Additionally, as I explain in connection with claim 10, it would have also been obvious to a POSITA that the PET Can be transparent. Therefore, the first depression would have been visible through the transparent body of the container.

b. Element [9.B]: "wherein the base portion further comprises a second depression adjacent the first depression; and"

245. Protais' container bottom also had a second depression adjacent to the first depression, in the form of another, neighboring reinforcing groove 3 as shown in annotated Figures 1 and 3 below.



Protais, Fig. 1 (Annotated)

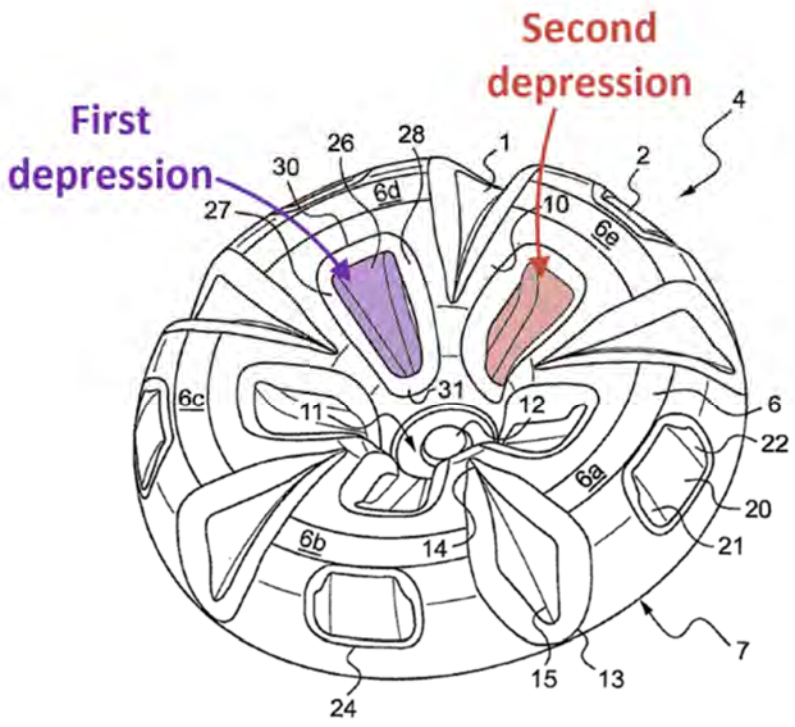


Fig.3

Protais, Fig. 3 (Annotated)

c. Element [9.C]: "wherein the second depression is visible through the at least a portion of the container body."

246. For the same reasons the first depression would have been visible through a blow-molded PET container discussed in [9.A], the second depression of Protais' container bottom would have been visible through at least a portion of the container body.

11. Claim 10

a. Element [10.A]: "The container of claim 1, wherein at least a portion of the container body is transparent;"

247. Element [10.A] is obvious over Metzger in view of Protais. Protais described that its container can be made of PET that was translucent. (Protais, 1:23-25). However, it was well known to a POSITA that PET could be translucent or transparent. (Ex. 1017, 23, 28). Therefore, it would have been obvious to form the PET container body in the Metzger-Protais-Kaminski combination from transparent PET because it would have been a simple choice between two well-known alternatives, and it would have improved aesthetics of the container and presentation of the product it contained. (Protais, 1:61-63).

b. Element [10.B]: "wherein the first depression is visible through the at least a portion of the container body;"

248. Protais disclosed this element for the same reasons discussed for element [9.A].

c. Element [10.C]: "wherein the base portion further comprises a second depression adjacent the first depression; and"

249. Protais disclosed this element for the same reasons discussed for element [9.B].

d. Element [10.D]: "wherein the second depression is visible through the at least a portion of the container body."

250. Protais disclosed this element for the same reasons discussed for element [9.C].

12. Claim 11: "The container of claim 1, wherein the center element of the base portion is a downward extending protrusion."

251. Protais disclosed this feature. As described above, Protais disclosed a center element in the form of an "axial disk 12." (Protais, 5:11-13; Figure 3). The axial disk "project[s] downward, that is, out of the container provided with the bottom 4." *Id.*

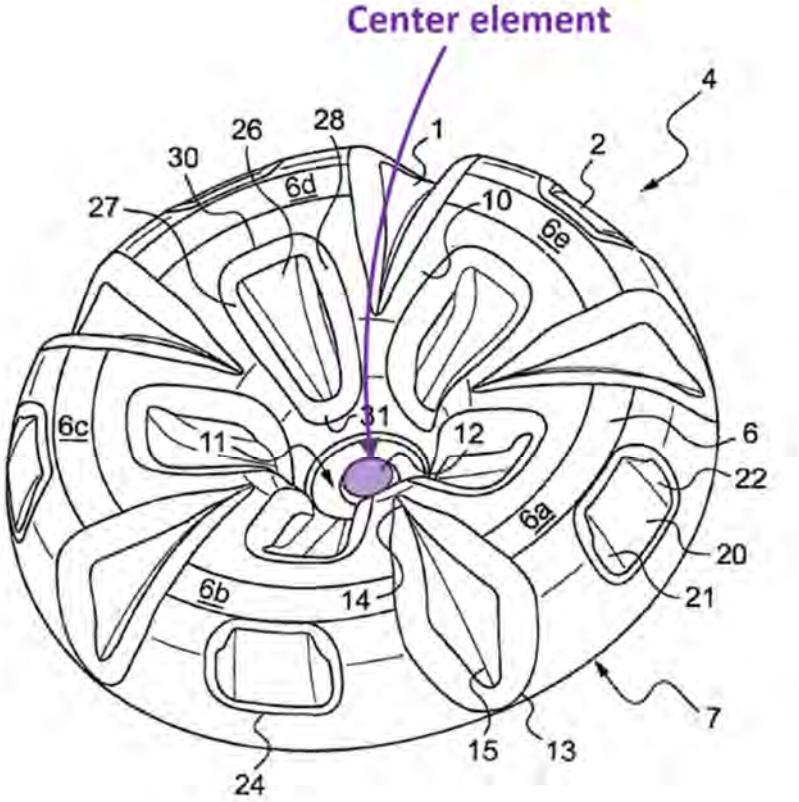


Fig.3

Metzger, Fig. 3 (Annotated)

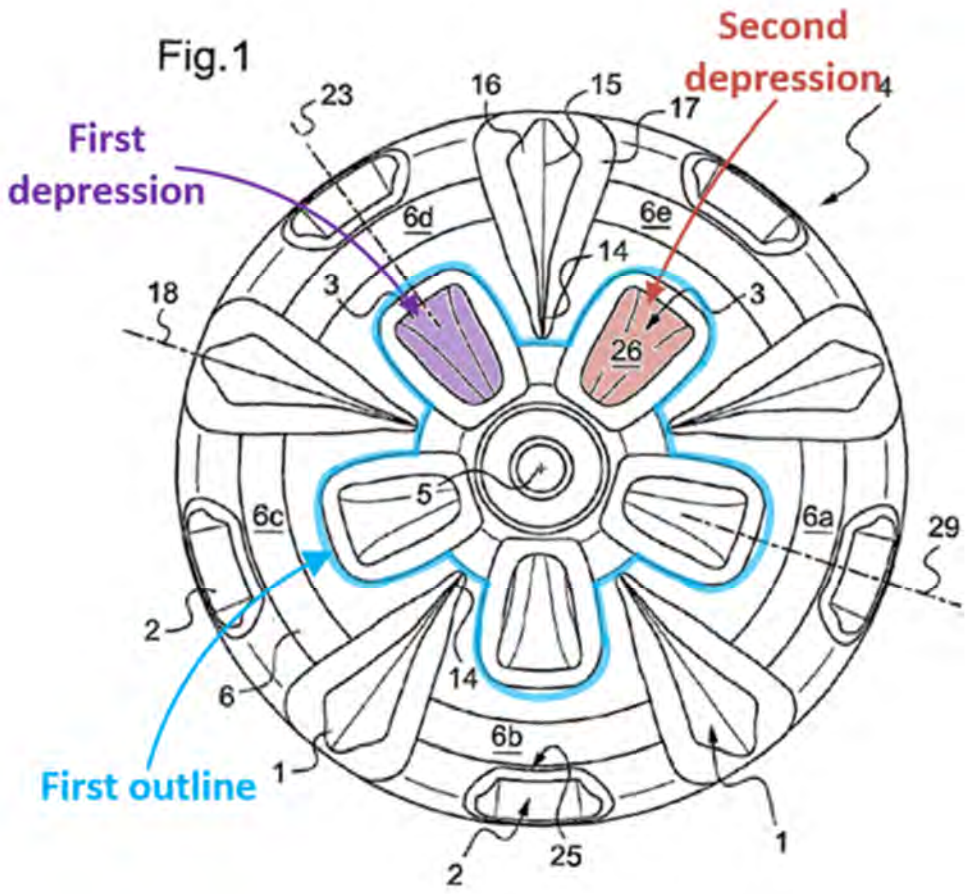
13. Claim 12

a. Element [12.A]: "The container of claim 1, wherein the base portion further comprises a second depression adjacent the first depression; and"

252. Protais disclosed this element for the same reasons discussed for element [9.B].

b. Element [12.B]: "wherein the second depression at least partially defines the first outline."

253. As described with respect to [9.B], Protais disclosed a second depression as a reinforcing groove 3, which neighbored the reinforcing groove that formed the first depression. As shown in annotated Figure 1 below, the second reinforcing groove, like the first reinforcing groove, at least partially defined the first outline because each reinforcing groove had an outer edge that formed the first outline. *See* [1.G].



Protais, Fig. 1 (Annotated)

14. Claim 13

a. Element [13.A]: "The container of claim 1, wherein the center element of the base portion is a downward extending protrusion; and"

254. Protais disclosed this element for the same reasons discussed for claim 11.

b. Element [13.B]: "wherein the base portion further comprises a second depression adjacent the first depression."

255. Protais disclosed this element for the same reasons discussed for element [9.B].

15. Claim 14: "The container of claim 13, wherein the second depression at least partially defines the first outline."

256. Protais disclosed this element for the same reasons discussed for element [12.B].

16. Claim 15

a. Element [15.PRE]: "A container, comprising:"

257. Metzger disclosed this element for the same reasons discussed above for element [1.PRE].

b. Element [15.A]: "a container body, the container body defining a first opening to an interior of the container body; and"

258. Metzger disclosed this element for the same reasons discussed above for element [1.A].

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c. Element [15.B]: "a lid connected to the container body and covering the first opening to the interior of the container body;"

259. Metzger and Kaminski disclose this element for the same reasons discussed above for element [1.B].

d. Element [15.C]: "wherein the container body is made out of a resin;"

260. Metzger disclosed this element for the same reasons discussed above for element [1.C].

e. Element [15.D]: "wherein the lid is made out of a metal;"

261. Metzger disclosed this element for the same reasons discussed above for element [1.D].

f. Element [15.E]: "wherein the container body comprises a container side wall and a base portion connected to the container side wall;"

262. Metzger and Protais disclose this element for the same reasons discussed above for element [1.E].

g. Element [15.F]: "wherein the base portion comprises a bottom and a first depression formed therein, the first depression extending upwardly from the bottom;"

263. Metzger and Protais disclose this element for the same reasons discussed above for element [1.F].

h. Element [15.G]: "wherein the first depression at least partially defines a first outline;"

264. Protais disclosed this element for the same reasons discussed above for element [1.G].

i. Element [15.H]: "wherein the base portion further comprises a center element centered with respect to the first outline at least partially defined by the first depression;"

265. Protais disclosed this element for the same reasons discussed above for element [1.H].

j. Element [15.I]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the container side wall;"

266. Protais and Metzger disclosed this element for the same reasons discussed above for element [1.I].

k. Element [15.J]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the base portion;"

267. Protais disclosed this element for the same reasons discussed above for element [1.J].

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l. Element [15.K]: "wherein a cross-sectional diameter of the first opening to the interior of the container body is less than a cross-sectional diameter of a middle portion of the container side wall;"

268. Metzger disclosed this element for the same reasons discussed above for element [1.K].

m. Element [15.L]: "wherein the base portion defines a diameter that is less than the cross-sectional diameter of the middle portion of the container side wall;"

269. Metzger and Protais disclosed this element for the same reasons discussed above for element [1.L].

n. Element [15.M]: "wherein a lower portion of the container side wall extends downwardly from the middle portion of the container side wall to the base portion of the container body, the lower portion along its entirety being greater in diameter than the base portion, including the bottom, thereby rendering the container body stemless;"

270. Metzger and Protais disclosed this element for the same reasons discussed above for element [1.M].

o. Element [15.N]: "wherein the container body further comprises a circular neck extending from the container side wall so that the container side wall extends between the circular neck and the base portion;"

271. Metzger disclosed this element for the same reasons discussed above for element [1.N].

p. Element [15.O]: "wherein an upper edge of the container side wall is adjacent to the circular neck of the container body;"

272. Metzger disclosed this element for the same reasons discussed above for element [1.O].

q. Element [15.P]: "wherein the container body further comprises a lip at an end of the circular neck opposite the upper edge of the container side wall;"

273. Metzger disclosed this element for the same reasons discussed above for element [1.P].

r. Element [15.Q]: "wherein the circular neck is adjacent to the lip;"

274. Metzger disclosed this element for the same reasons discussed above for element [1.Q].

s. Element [15.R]: "wherein a first portion of the lid is above the lip of the container body;"

275. Metzger and Kaminski disclosed this element for the same reasons discussed above for element [1.R].

t. Element [15.S]: "wherein the first portion of the lid defines a first circular shape;"

276. Kaminski disclosed this element for the same reasons discussed above for element [1.S].

u. Element [15.T]: "wherein the first portion of the lid further defines a second circular shape around which the first circular shape circumferentially extends;"

277. Kaminski disclosed this element for the same reasons discussed above for element [1.T].

v. Element [15.U]: "wherein the second circular shape defined by the first portion of the lid is concentric with the first circular shape defined by the first portion of the lid;"

278. Kaminski disclosed this element for the same reasons discussed above for element [1.U].

w. Element [15.V]: "wherein the first circular shape defined by the first portion of the lid is radially positioned between the container side wall and the second circular shape defined by the first portion of the lid;"

279. Metzger and Kaminski disclosed this element for the same reasons discussed above for element [1.V].

x. Element [15.W]: "wherein a second portion of the lid extends horizontally and is positioned so that the second circular shape is radially positioned between the second portion of the lid and the first circular shape;"

280. Kaminski disclosed this element for the same reasons discussed above for element [1.W].

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y. Element [15.X]: "wherein the second portion of the lid defines a total area across which the second portion of the lid extends horizontally;"

281. Kaminski disclosed this element for the same reasons discussed above for element [1.X].

z. Element [15.Y]: "wherein the second portion of the lid comprises a weakened or scored area;"

282. Kaminski disclosed this element for the same reasons discussed above for element [1.Y].

aa. Element [15.Z]: "wherein the weakened or scored area is less than the total area across which the second portion of the lid extends horizontally;"

283. Kaminski disclosed this element for the same reasons discussed above for element [1.Z].

bb. Element [15.AA]: "wherein the lid further comprises an arm connected to the second portion of the lid and radially positioned within the second circular shape;"

284. Kaminski disclosed this element for the same reasons discussed above for element [1.AA].

cc. Element [15.AB]: "wherein the arm comprises opposing first and second end portions;"

285. Kaminski disclosed this element for the same reasons discussed above for element [1.AB].

dd. Element [15.AC]: "wherein the arm is pivotable from a first position, in which the arm extends horizontally and the weakened or scored area is not deformed, to a second position, in which the arm does not extend horizontally and the weakened or scored area is deformed to provide a second opening to the interior of the container body;"

286. Kaminski disclosed this element for the same reasons discussed above for element [1.AC].

ee. Element [15.AD]: "wherein an upper portion of the container side wall extends upwardly from the middle portion of the container side wall to the upper edge of the container side wall, the upper portion along its entirety being greater in diameter than the first opening to the interior of the container body;"

287. Metzger disclosed this element for the same reasons discussed above for element [1.AD].

ff. Element [15.AE]: "wherein the container body contains a liquid therewithin;"

288. Metzger disclosed this element for the same reasons discussed above for element [1.AE].

gg. Element [15.AF]: "wherein the lid cooperates with the lip to provide a seal so that the liquid contained within the container body is sealed against leaking out from between the container body and the lid;"

289. Metzger and Kaminski disclosed this element for the same reasons discussed above for element [1.AF].

hh. Element [15.AG]: "wherein, when the arm of the lid is in the first position and the weakened or scored area is not deformed: the first end portion of the arm is not positioned above the weakened or scored area of the second portion of the lid; and at least a portion of the second end portion of the arm is positioned above the weakened or scored area of the second portion of the lid;"

290. Kaminski disclosed this element for the same reasons discussed above for element [1.AG].

ii. Element [15.AH]: "wherein the container side wall extends between the circular neck and the base portion so that:

the upper portion of the container side wall defines a first angle: between the upper portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the middle portion of the container side wall defines a second angle: between the middle portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the lower portion of the container side wall defines a third angle: between the lower portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the first angle is an acute angle;

the third angle is an obtuse angle;

the third angle is greater than the second angle;"

291. Metzger disclosed this element for the same reasons discussed above for element [1.AH].

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jj. Element [15.AI]: "wherein the interior of the container body extends continuously across the cross-sectional diameter of the middle portion at a height midway between the circular neck and the base portion so as to be interrupted, if at all, only by the liquid contained within the container body;"

292. Metzger disclosed this element for the same reasons discussed above for element [1.AI].

kk. Element [15.AJ]: "wherein the metal is aluminum;"

293. Metzger and Kaminski disclosed this element for the same reasons discussed above for claim 4.

ll. Element [15.AK]: "wherein the resin is a polyethylene terephthalate (PET) resin;"

294. Protais disclosed this element for the same reasons discussed above for claim 2.

mm. Element [15.AL]: "wherein the first depression is visible through at least a portion of the container body;"

295. Protais disclosed this element for the same reasons discussed above for element [9.A].

nn. Element [15.AM]: "wherein the center element of the base portion is a downward extending protrusion;"

296. Protais disclosed this element for the same reasons discussed above for claim 11.

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oo. Element [15.AN]: "wherein the base portion further comprises a second depression adjacent the first depression; and"

297. Protais disclosed this element for the same reasons discussed above for element [9.B].

pp. Element [15.AO]: "wherein the second depression is visible through the at least a portion of the container body."

298. Protais disclosed this element for the same reasons discussed above for element [9.C].

17. Claim 16: "The container of claim 15, wherein the at least a portion of the container body is transparent."

299. Metzger, in view of Protais, disclosed this element for the same reasons discussed for element [10.A].

18. Claim 17: "The container of claim 15, wherein the second depression at least partially defines the first outline."

300. Protais disclosed this element for the same reasons discussed for element [12.B] and claim 14.

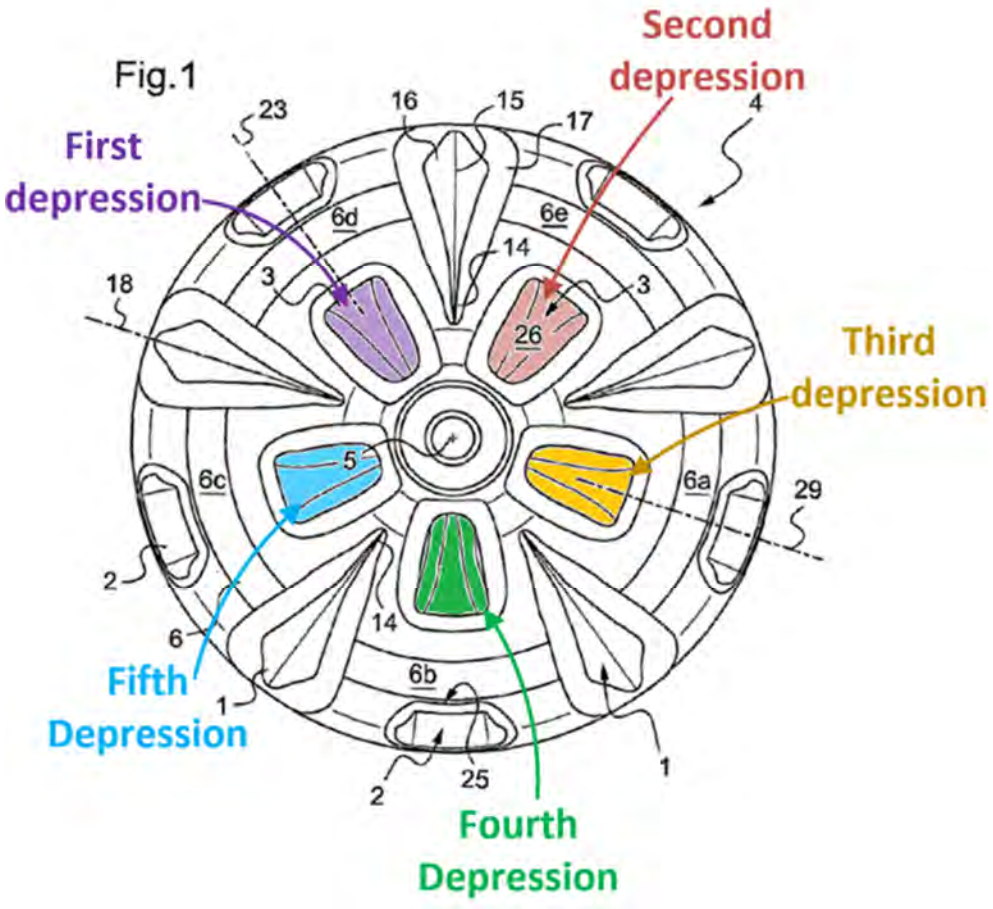
19. Claim 18

a. Element [18.A]: "The container of claim 17, wherein the base portion further comprises third, fourth, fifth, and sixth depressions; and"

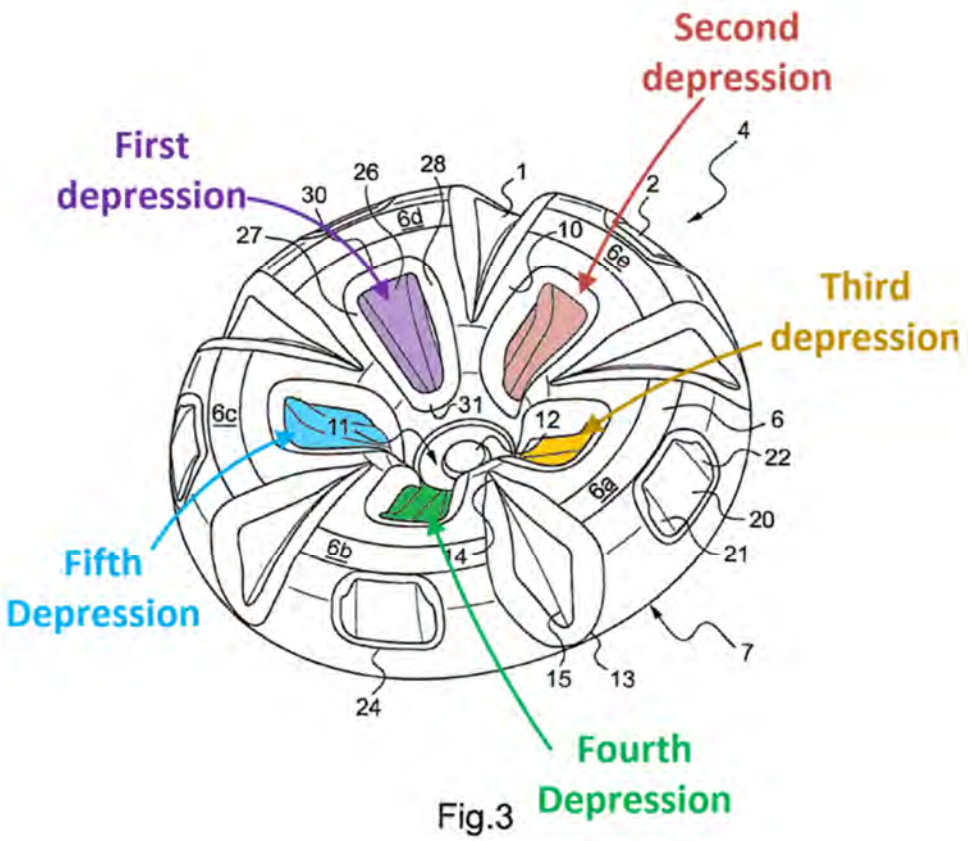
301. The features of claim 18 were obvious in view of Protais. Protais' container bottom included a plurality of depressions, including five reinforcing grooves 3 as identified in annotated Figures 1 and 3 below. (Protais, 4:41-44; 4:55;

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5:1-2; 5:62-6:3; Figures 1 and 3). Protais also explained that although the figures illustrate only five grooves, "[t]he number of…grooves can be greater than five." (*Id.*, 6:56-58). A POSITA therefore would have found it obvious to add at least a sixth groove to the container bottom.



Protais, Fig. 1 (Annotated)

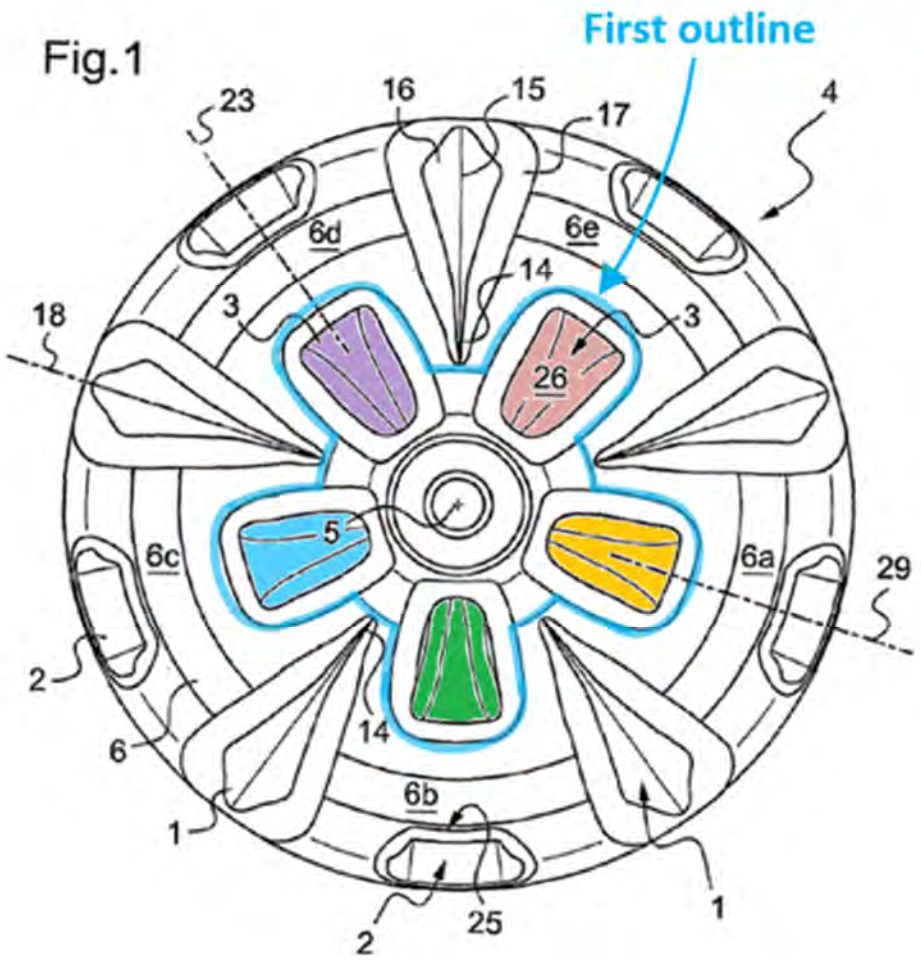


Protais, Fig. 3 (Annotated)

b. Element [18.B]: "wherein the third, fourth, fifth, and sixth depressions at least partially define the first outline."

302. As shown in annotated Figure 1 below, each of the first through fifth reinforcing grooves at least partially defined the first outline because each reinforcing groove had an outer edge that formed the first outline. *See* [1.G]. In addition, since Protais explained that the container bottom could have more than five reinforcing grooves (*see* Protais, 6:56-58) it would have been obvious for an outer edge of a sixth reinforcing groove on the container bottom to also partially define

the first outline in order to maintain rotational symmetry of the base (Protais, 4:9-12).

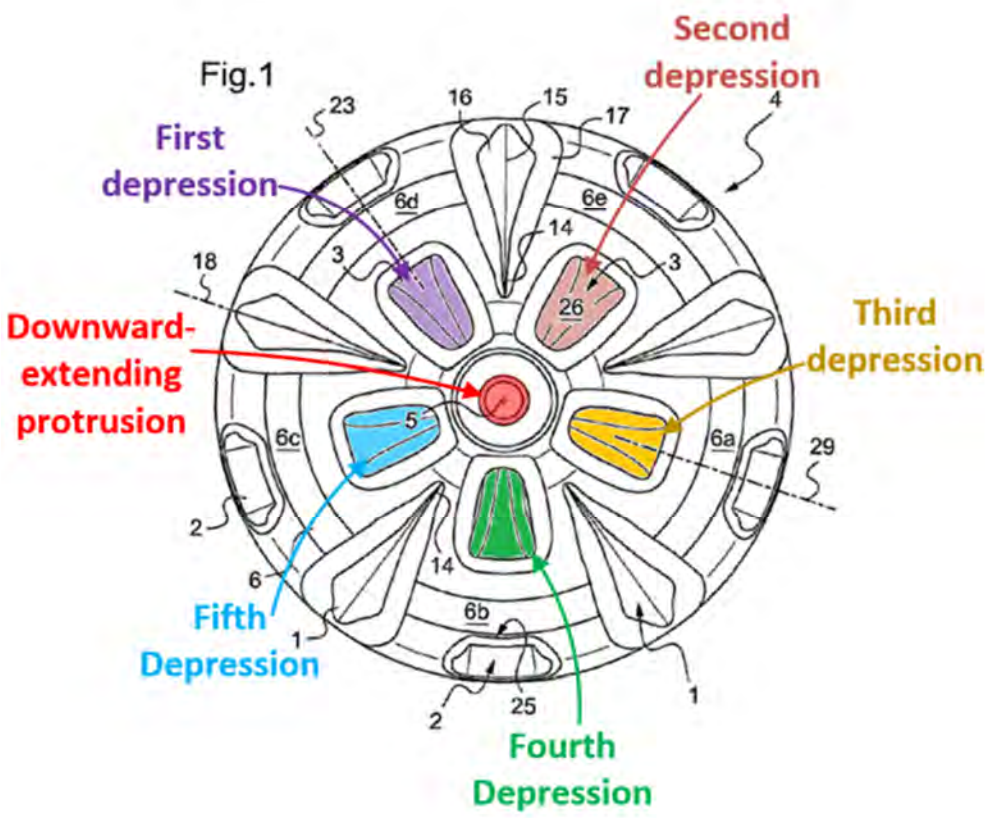


Protais, Fig. 1 (Annotated)

20. Claim 19: "The container of claim 18, wherein the downward extending protrusion is centered with respect to the first, second, third, fourth, fifth, and sixth depressions."

303. As described with respect to claim 11, Protais disclosed a downward extending protrusion in the form of an "axial disk 12" (Protais, 5:11-13; Figure 3), which "project[s] downward, that is, out of the container provided with the bottom

4." (*Id.*) Figure 1, annotated below, shows that the axial disk 12 was centered with respect to the reinforcing grooves 3 (i.e., first through sixth depressions).

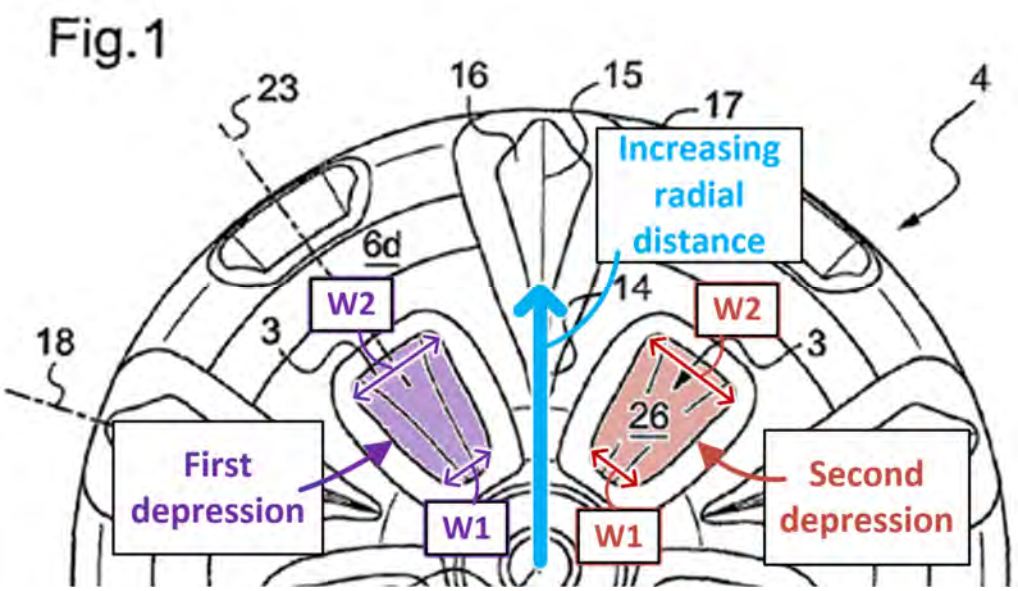


Protais, Fig. 1 (Annotated)

21. Claim 20: "The container of claim 17, wherein each of the first and second depressions increases in width as the radial distance from a center of the bottom of the base portion increases."

304. Protais disclosed this feature. Figure 1 of Protais illustrated that each of the reinforcing grooves 3 (forming at least first and second depressions) have a narrower width closest to the container bottom's center (W1 in annotated Fig. 1

below) and a wider width farthest from the center (W2 below). The grooves thus increased in width as the radial distance from the center increased.

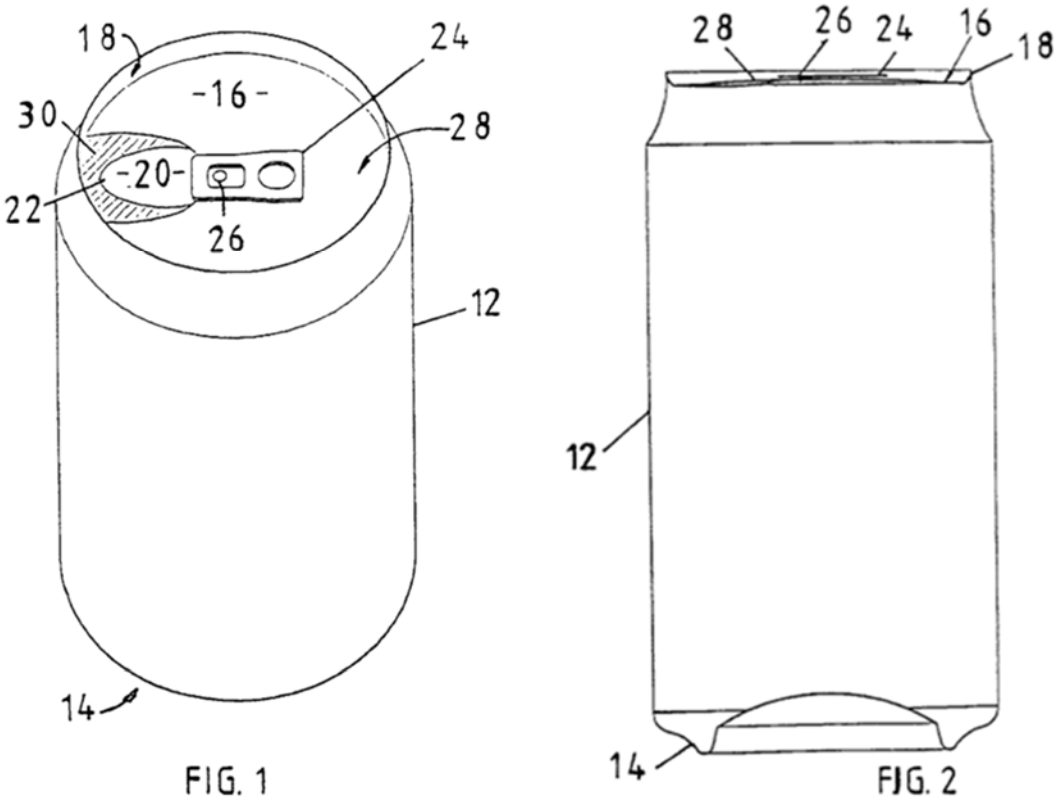


Protais, Fig. 1 (Enlarged and Annotated)

E. Ground 4: Gardiner, Pedmo, and Moen render claims 1-20 obvious

305. **Gardiner:** Gardiner was directed to a beverage container 10 that included a "tubular body member 12 with a top end and a bottom end." (Gardiner, Title; Abstract; 4:27; 4:32-33). A cap member (a lid) was "sealingly fixed to the periphery of the top open end" of the container body member. (*Id.*, 4:33-36). The container could be made of any of aluminum alloy, steel, or plastic. (*Id.*, 4:28-31).

306. Perspective and cross-sectional views of Gardiner's container are depicted in Figures 1 and 2.



Gardiner, Figs. 1 and 2

307. **Pedmo:** Pedmo described an "improved base" for container made of thermoplastic material. (Pedmo, Abstract). The base included an "inwardly extending portion" with a plurality of radially extending struts. (*Id.*, Abstract; 1:40-47; 1:51-54; 2:21-23; 2:46-58; Figures 2, 4, and 5). A central hub "having a downwardly extending button-like portion" was provided at a center of the base, such that the struts extended from the central hub toward an annular rim on which the container would sit. (*Id.*, 2:39-45). The configuration of the base described by Pedmo "provide[d] considerable increased strength in a critical location," such that

the base "[wa]s less susceptible to roll-out or bulging…and ha[d] improved impact properties." (*Id.*, 1:58-60; 2:61-66).

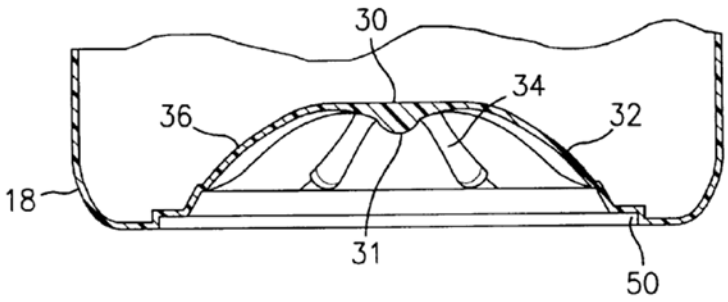


FIG. 4

Pedmo, Fig. 4

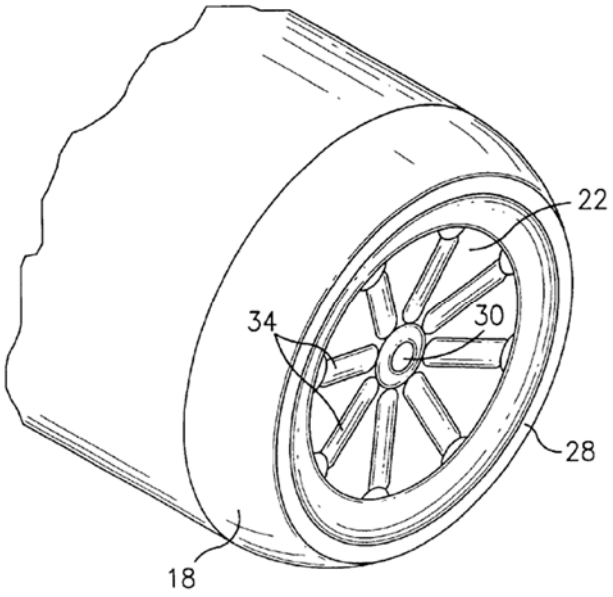
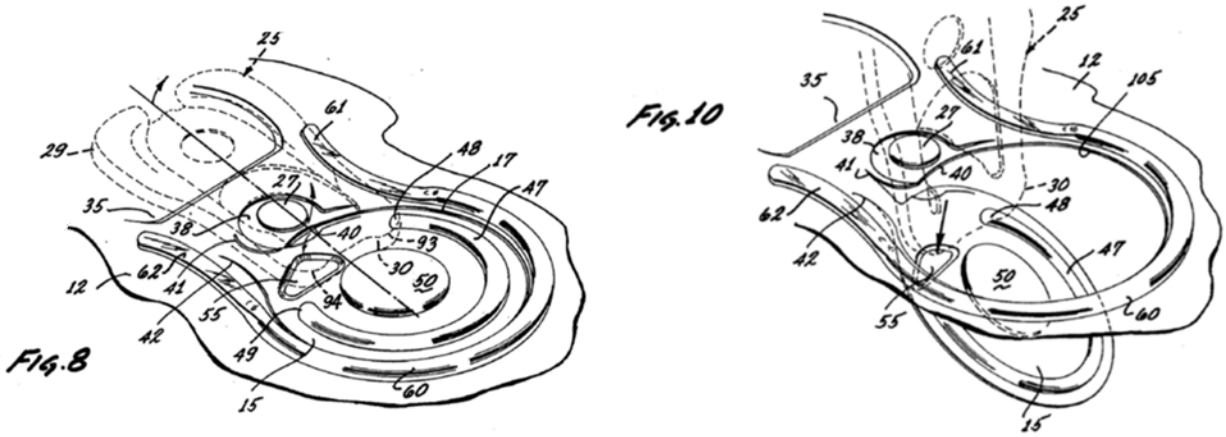


FIG. 5

Pedmo, Fig. 5

308. **Brown:** Brown described an "improved easy-opening end structure" (a lid). (Brown, Abstract). Brown's lid had a tab attached to the lid by a rivet and a

scoreline circumscribing a pour panel. (*Id.*, 5:3-9; 7:35-40). The tab operated as a lever to initiate rupture of the scoreline and to force the pour panel downward into a container to form an opening. (*Id.*, 5:14-21; 7:36-40; 10:15-16; 10:37-53; 10:61-68; Figures 8 and 10).



Brown, Figs. 8 and 10

309. **The Combination and Expectation of Success:** In my opinion, for the reasons given below, the combination of Gardiner, Pedmo and Brown rendered the challenged claims obvious. In the combination, a POSITA would have augmented the teachings of Gardiner regarding the body and the lid of a container with the teachings of Pedmo related to a container with the improved base to include Pedmo's hub and struts on the bottom of Gardiner's container. Further, while Gardiner described a lid having scored portion and a tab for puncturing the scored portion, and provided a picture of the tab for an unopened container, Gardiner did not explicitly show the obvious features of the tab's position when the container's lid

was punctured. But a POSITA, based on his/her knowledge of using a standard tab on Coke/Pepsi cans that were ubiquitous in 2010, would have known that the tab would puncture a section of the lid. Nonetheless, this was specifically shown in Brown that depicted a tab's position both before and after the tab had punctured a scored area of the lid, and the combination would have rendered the claimed elements obvious to a POSITA.

310. A POSITA would have had been able to easily make this combination because it involved simple modifications to the base of a plastic container that were already described in Pedmo, and included depiction of the tab's position after the container lid is punctured—which was known to a POSITA decades prior to the '441 patent's priority date.

311. **Motivation to Combine:** A POSITA would have found it obvious to make a container that had the container body shape and lid of Gardiner, the features of Pedmo's container bottom, and the lid opening mechanism of Brown. A POSITA would have been motivated to make these combinations for several reasons.

312. First, with respect to Gardiner-Pedmo, the combination would have been a simple combination of known elements, and as I explained above a POSITA would have had no difficulty implementing this combination. Gardiner described a "tubular" container, which can be made from plastic. (Gardiner, 4:31-32). Although Gardiner described an "end member" that was formed at the bottom end of the

container and appeared to depict a curved, upwardly extending portion within this end member (*see id.,* 4:33-34; Fig. 2), Gardiner did not provide details for the structure of this end member. Pedmo supplemented Gardiner's disclosure by describing a base for cylindrical plastic containers, analogous to Gardiner's container. (Pedmo, 1:4-5; 1:37-41; 2:15-17). Likewise, Pedmo's base included a "supporting annular rim for supporting the bottle on a surface" (*id.,* 1:42-43), a "continuous curved portion 32 extending upwardly from the annular rim" (*id.,* 2:43-44), which had a shape similar to the shape depicted in Gardiner's Figure 2.

313. Additionally, a POSITA would have been motivated to use the features of Pedmo's base to improve Gardiner's container. Pedmo described that its base included a plurality of struts that were "uniformly spaced around the central portion of the base, and extend outwardly from the plane of the base." (Pedmo, 2:46-43). A POSITA would have been motivated to use the features of Pedmo's base, including its annular rim, upwardly extending curved portion, and these struts, on the container body taught by Gardiner, because Pedmo's base would have imparted increased strength and improved impact properties to the combined container, as taught by Pedmo. (*Id.,* 32:59-66).

314. The Gardiner-Brown combination would have also been a simple combination of known elements. Gardiner described a lid for a container that includes a "scored portion 20" with a "score line 22" extending around it. (Gardiner,

5:2; 5:13-15; 5:27-28; Figure 1). A tab was connected to the lid and was "pivotally movable for separating the portion 20 and thereby presenting a pour aperture." (*Id.*, 4:45-53). However, Gardiner did not explicitly describe how the tab separated the scored portion to open the pour aperture. Brown explained how an analogous tab was pivotable to apply force to a scored area, thereby forming an opening in a container lid. (Brown, 5:14-21). A POSITA would have found it obvious to look to the teachings of Brown to understand how to operate the tab taught by Gardiner in order to open a pour aperture in Gardiner's lid, since these references are analogous and readily combinable to obtain predictable results. Additionally, a POSITA would have been motivated to use the teachings of Brown to configure a mechanism for opening the Gardiner-Pedmo container because Brown explained how its retained-tab style lid was easy to open and created less litter than the preexisting removable-tab cans. (Brown, 1:6-10; 1:32-37).

315. For the reasons below, I believe each and every feature of claims 1-20 of the '441 patent is rendered obvious by the combination of Gardiner, Pedmo, and Brown.

1. Claim 1:

a. Element [1.Pre]: "A container comprising:"

316. Gardiner disclosed a container in the form of a "beverage container 10." (Gardiner, Title, 4:27-28). Figure 1 of Gardiner, reproduced below, illustrated a

"perspective view of a beverage container according to an embodiment," (*id.*, 3:36-37), while Figure 2 was "a section view of the container shown on FIG. 1" (*id.*, 3:40-41).

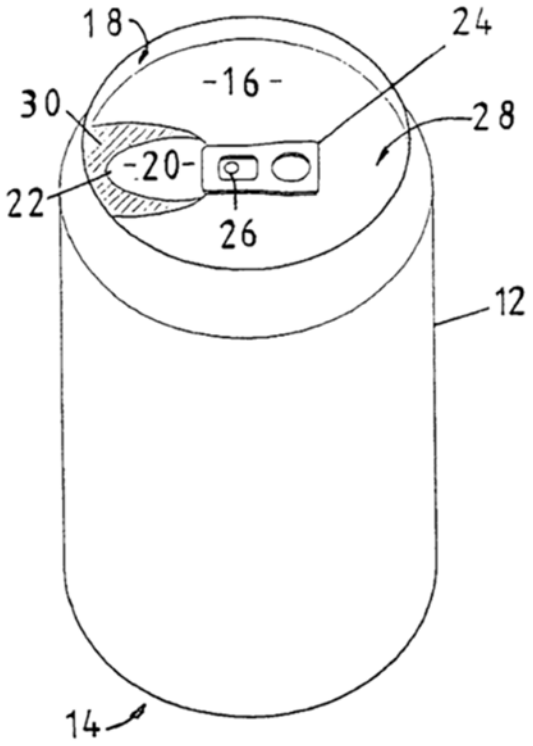
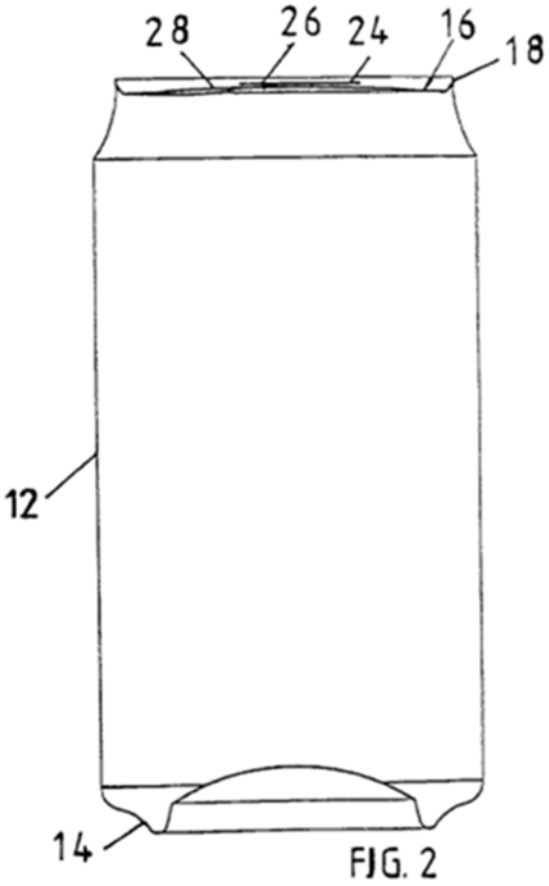


FIG. 1

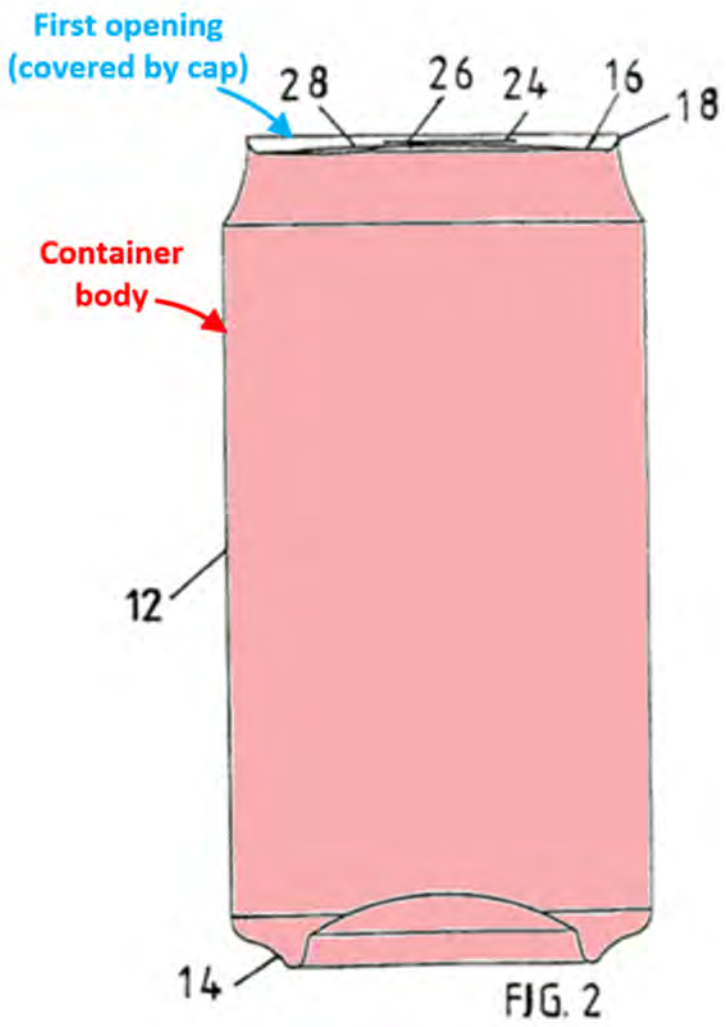
Gardiner, Fig. 1



Gardiner, Fig. 2

b. Element [1.A]: "a container body, the container body defining a first opening to an interior of the container body; and"

317. Gardiner disclosed a container body in the form of a "hollow body member with opposed ends." (Gardiner, 1:61-62; 4:32-33; 4:45-46). Since the body member was hollow, it had an interior. One end of the hollow body member had a "bottom member." (*Id.*, 1:63; 4:33-34; 4:45). The other end had an opening (e.g., a "first opening") that was covered by a cap member. (*Id.*, 1:63-64; 4:34-35; 4:46-48). See annotated Figure 2 of Gardiner below.



Gardiner, Fig. 2 (Annotated)

c. Element [1.B]: "a lid connected to the container body and covering the first opening to the interior of the container body;"

318. Gardiner disclosed a lid in the form of a "cap member" that "***cover[s] an opening***" at an end of the container opposite to the bottom member. (Gardiner, 1:63-65; 4:34-35; 4:46-48). The cap member was "sealingly fixed to the body member" – that is, connected to the container body. (*Id.*)

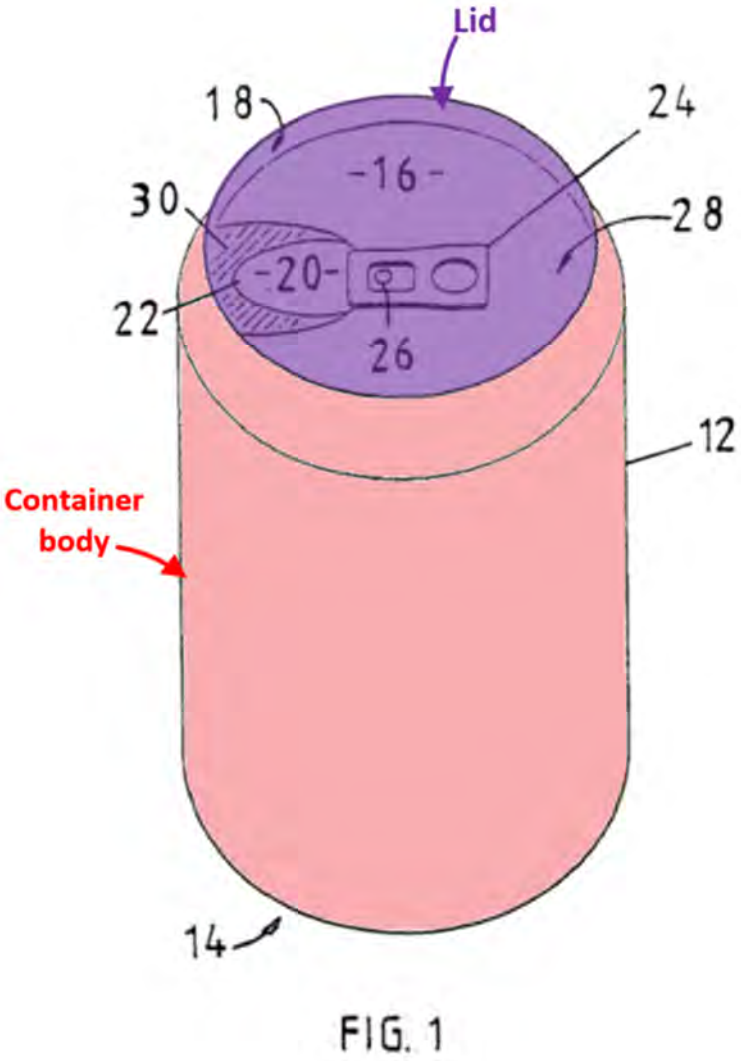
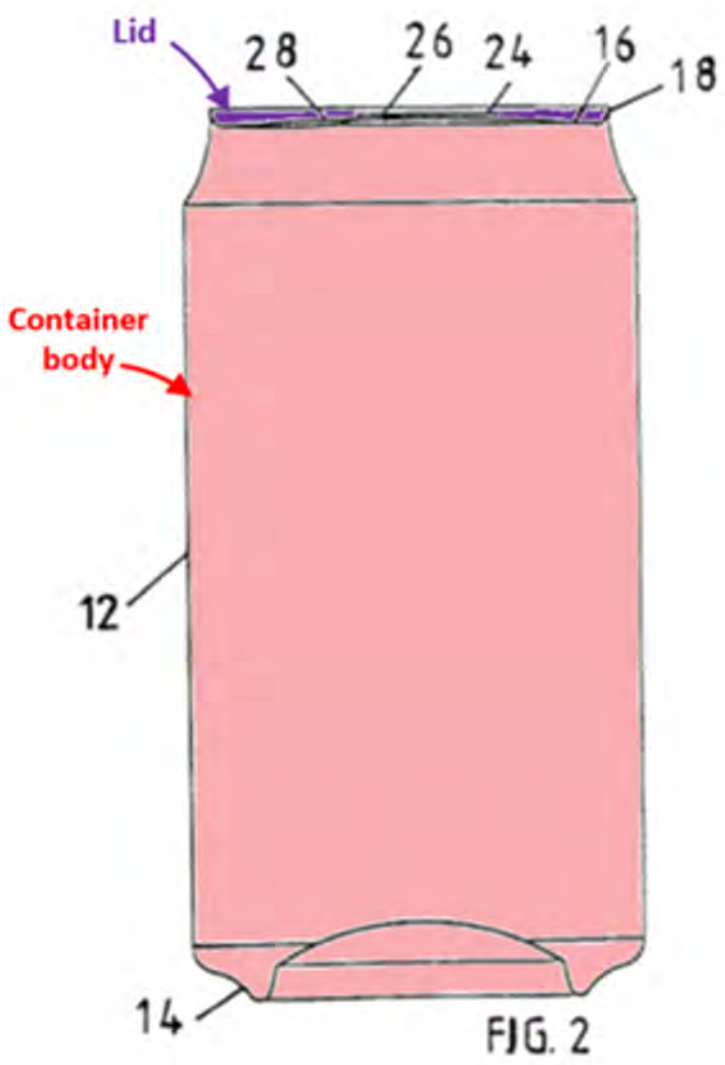


FIG. 1

Gardiner, Fig. 1 (Annotated)



Gardiner, Fig. 2 (Annotated)

d. Element [1.C]: "wherein the container body is made out of a resin;"

319. Gardiner taught or suggested this feature, explaining that its beverage container "can be made of any suitable material" ***including plastic***. (Gardiner, 2:22-23; 4:30-31). It would have been obvious to a POSITA that plastics can be made out of a resin. (*See also* [1.C] in Ground 1 *infra*). Since "[d]ifferent components of the

container can be made of different ones of the materials" that are listed in Gardiner's disclosure, it would have been obvious to select a plastic for manufacturing the container body. (*Id.*, 2:24-25).

e. Element [1.D]: "wherein the lid is made out of a metal;"

320. Gardiner disclosed this feature, explaining that a cap member (lid) was "made from a material comprising aluminum." (Gardiner, 7:30; *see also* 2:22-23 (listing various metals, including "[a]luminium, aluminium alloy, [and] steel" as being suitable materials for a container)).

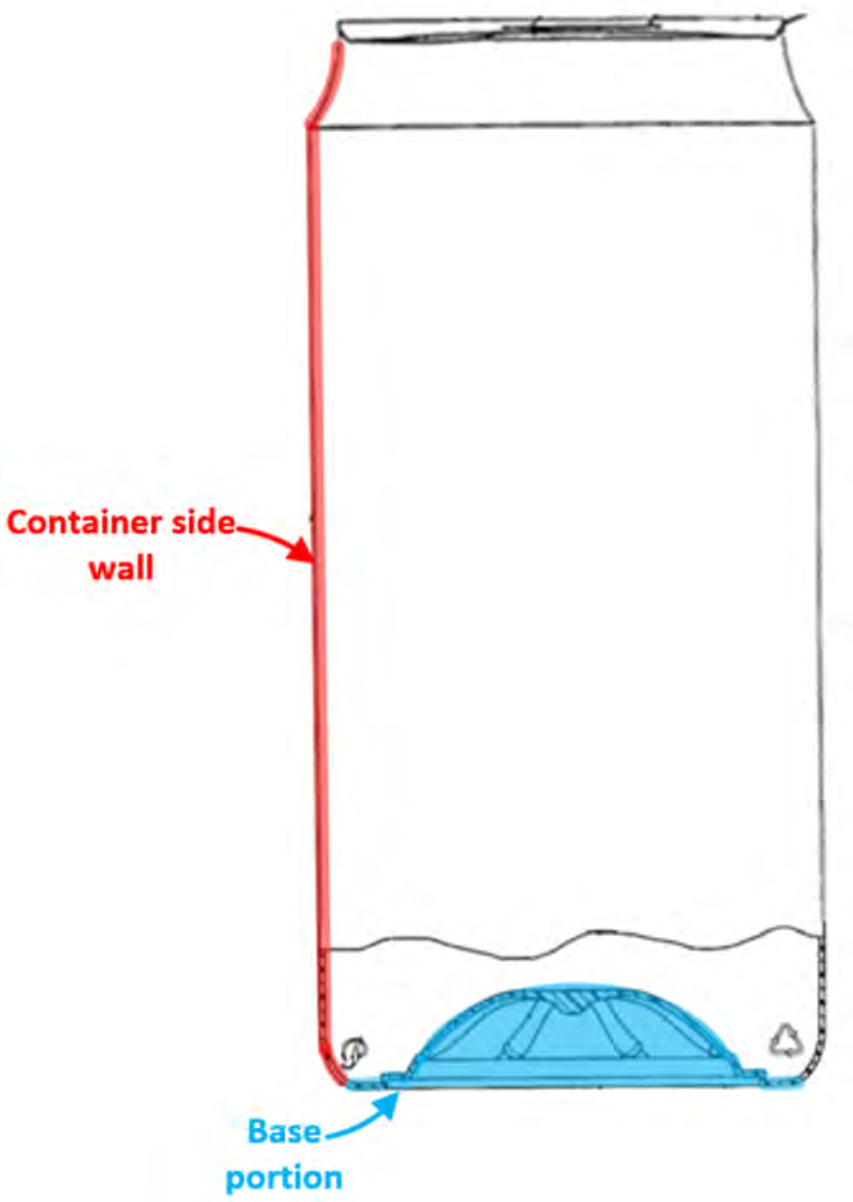
f. Element [1.E]: "wherein the container body comprises a container side wall and a base portion connected to the container side wall;"

321. This feature was apparent from Gardiner and Pedmo. Gardiner's beverage container had a container side wall in the form of the side walls that form the "hollow body member." (Gardiner, 1:61-62; *see also* 4:32-33 ("The can 10 has a tubular body member 12.")). The hollow body member also had a base portion in the form of a "bottom member" or "end member" that was connected to the body member (e.g., "formed at the bottom end" of the body member). (*Id.*, 1:63; 4:32-34).

322. Although Gardiner described that its container includes a bottom member, it did not provide details about the features of its bottom member. Pedmo supplemented Gardiner's disclosure by describing an "improved base" for a hollow plastic bottle. (Pedmo, Abstract). The base described by Pedmo had "an inwardly

extending portion…[and] a continuous outer supporting annular rim." (*Id.*, 1:40-42; Figures 1 and 5). The base further included a "plurality of struts extending radially from the central portion of the base towards said annular rim" in a space between a central portion of the base and the outer supporting rim. (*Id.*, 1:44-47). The container base described by Pedmo was "less susceptible to roll-out or bulging…and has improved impact properties." (*Id.*, 1:58-60).

323. A POSITA would have been motivated to combine Gardiner and Pedmo by using the design of Pedmo's base on Gardiner's container to achieve the above-described benefits identified by Pedmo. (*See* ¶¶ 311-313). A mockup of the combination of Gardiner's container with Pedmo's base, based on Figure 2 of Gardiner and Figure 1 of Pedmo, is illustrated below. As shown, the combined container includes a container side wall and a base portion.



Mockup of Combined Gardiner/Pedmo Container

g. Element [1.F]: "wherein the base portion comprises a bottom and a first depression formed therein, the first depression extending upwardly from the bottom;"

324. The base disclosed by Pedmo had a bottom in the form of a "continuous, outer supporting annular rim 28 for supporting the bottle 10 on a surface." (Pedmo, 2:39-41; Figures 1 and 5).

325. Pedmo also disclosed a first depression in two ways. First, Pedmo described a depression as an "inwardly extending portion 20" that extended into the container (that is, upwardly from the bottom of the container). (*Id.*, 2:21-22). This inwardly extending portion included a "continuous curved portion 32 extending upwardly from the annular rim 28." (*Id.*, 2:43-45). Figures 1 and 5 are annotated below to illustrate the bottom and first depression under this first interpretation.

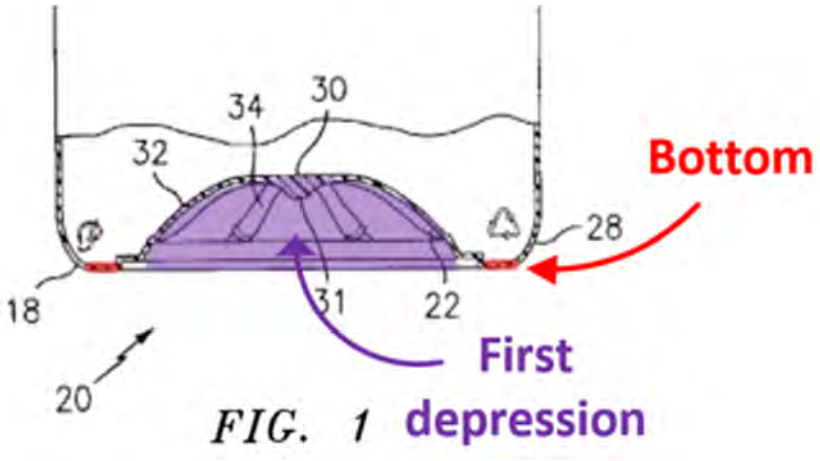


FIG. 1

Pedmo, Fig. 1 (Cropped and Annotated)

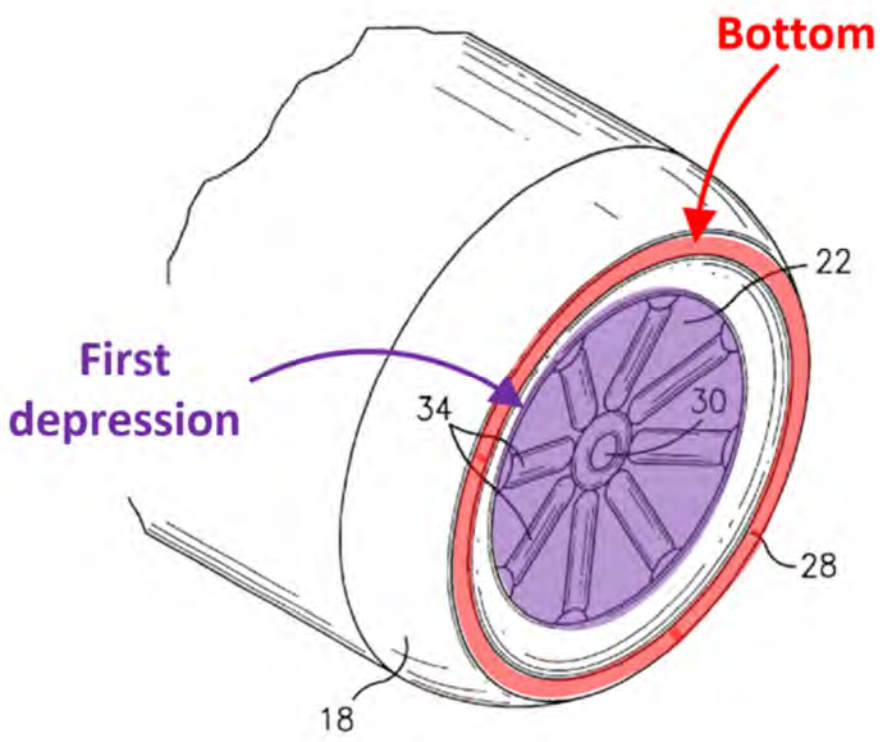


FIG. 5

Pedmo, Fig 5 (Annotated)

326. Second, Pedmo disclosed a first depression as a space between two of a "plurality of struts 23 [that] extend radially from the central portion of the base or hub 30 towards the annular rim 28." (*Id.*, 2:46-47). Since the struts "extend outwardly from the plane of the base" (*see id.*, 2:52-53), the sections of the plane of the base between each strut was inset from the outermost surface of the strut, and thus was a "depression." Figures 1 and 5 are annotated below to illustrate the bottom and first depression under this second interpretation.

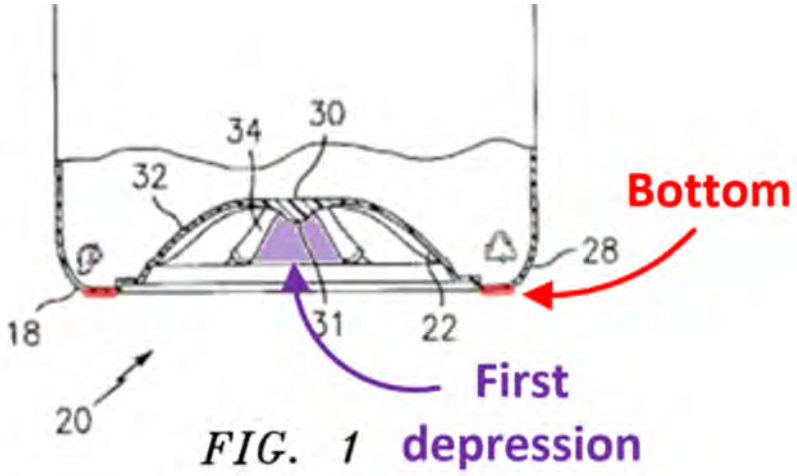


FIG. 1

Pedmo, Fig. 1 (Cropped and Annotated)

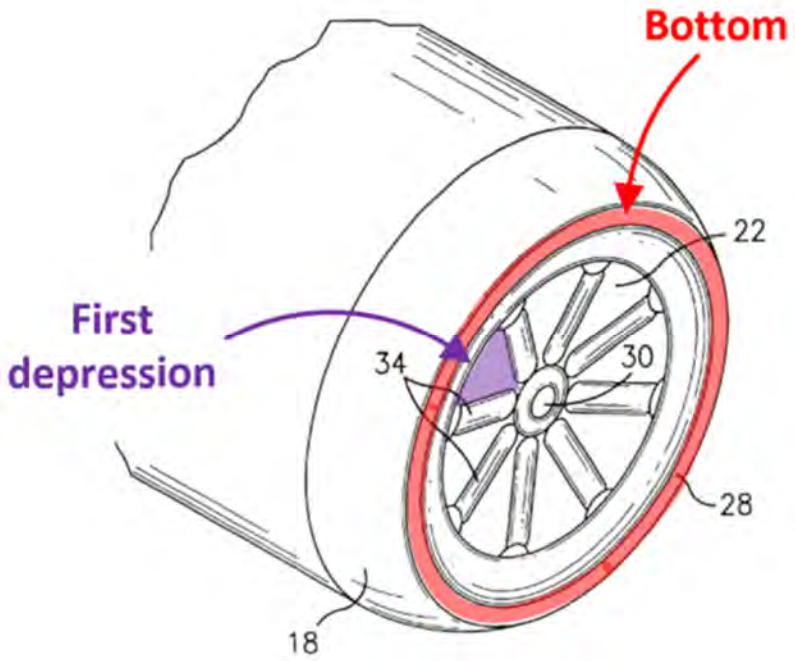


FIG. 5

Pedmo, Fig. 5 (Annotated)

h. Element [1.G]: "wherein the first depression at least partially defines a first outline;"

327. The '441 patent does not provide any explanations regarding an "outline," and this term is only recited in the claims. Consistent with a dictionary definition of "[a] line indicating the outer contours of boundaries of an object or figure" (EX. 1007, 4), Pedmo disclosed this feature in its Figures 2 and 5, annotated below, as a circular edge – forming a first outline – that traced a circumference around the "continuous curved portion 32" that extended upwardly from the bottom rim of the base (Pedmo, 2:43-45; Figures 2 and 5). As described with respect to [1.F], at least a portion of the continuous curved portion formed a first depression. Under either interpretation of Pedmo's disclosure of the first depression, the circular edge constituted the claimed first outline because some or all of the edges of the first depression formed and at least partially defined the first outline.

328. Annotated Figures 2 and 5 below illustrate the first outline and first depression according to the first interpretation of the depression, where the circumference of the first depression forms the first outline:

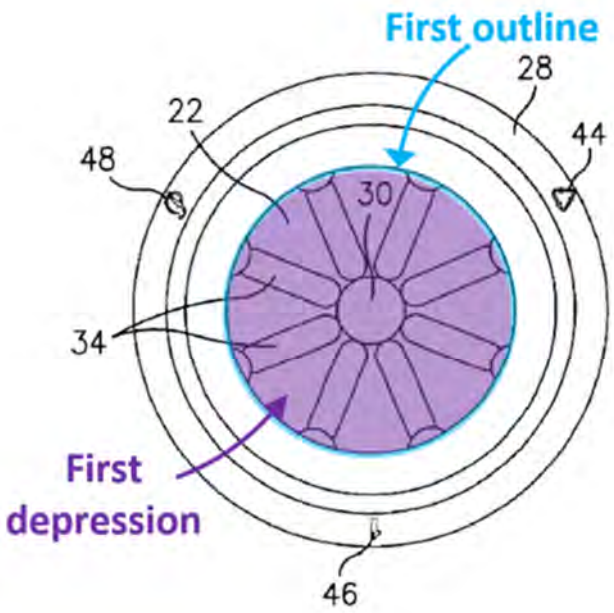


FIG. 2

Pedmo, Fig. 2 (Annotated)

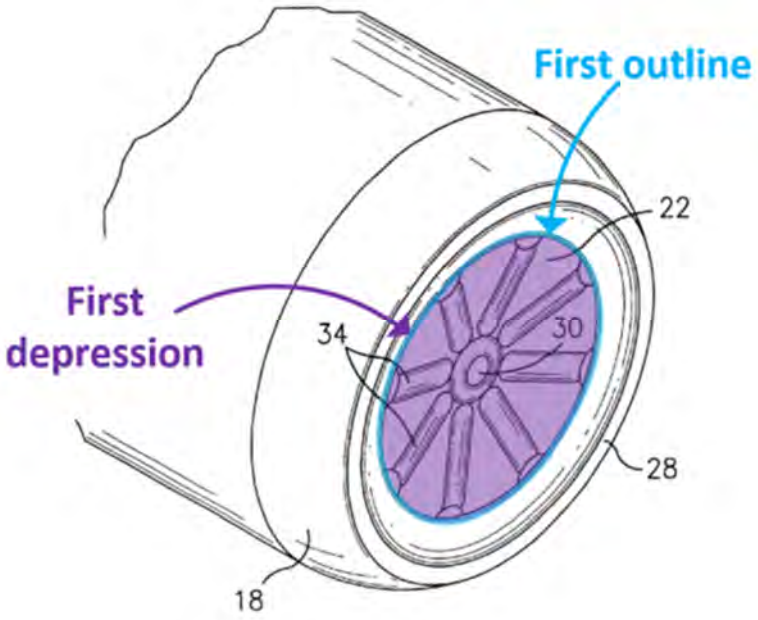


FIG. 5

Pedmo, Fig. 5 (Annotated)

329. The following annotations illustrate the first outline and first depression according to the second interpretation, where an outer edge of the first depression forms part of the first outline:

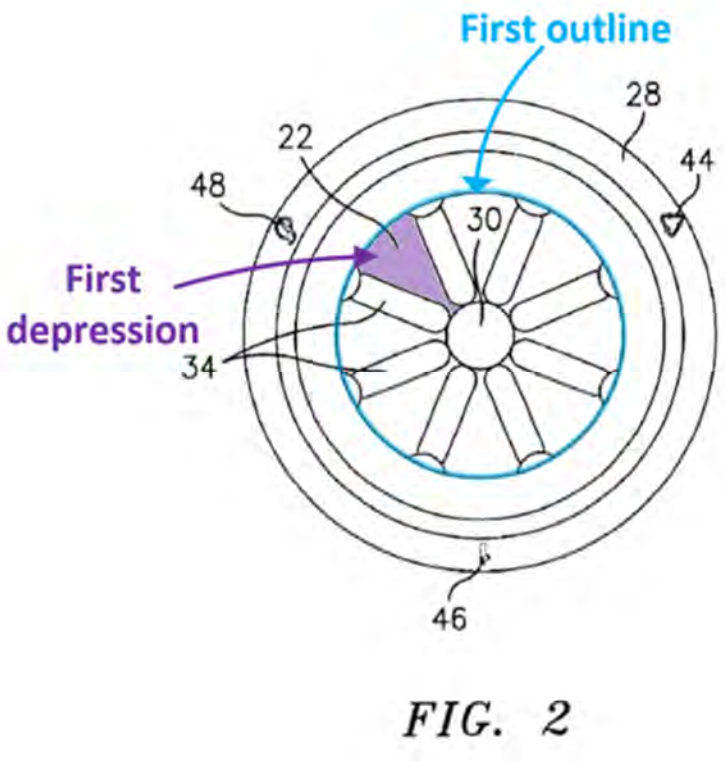


FIG. 2

Pedmo, Fig. 2 (Annotated)

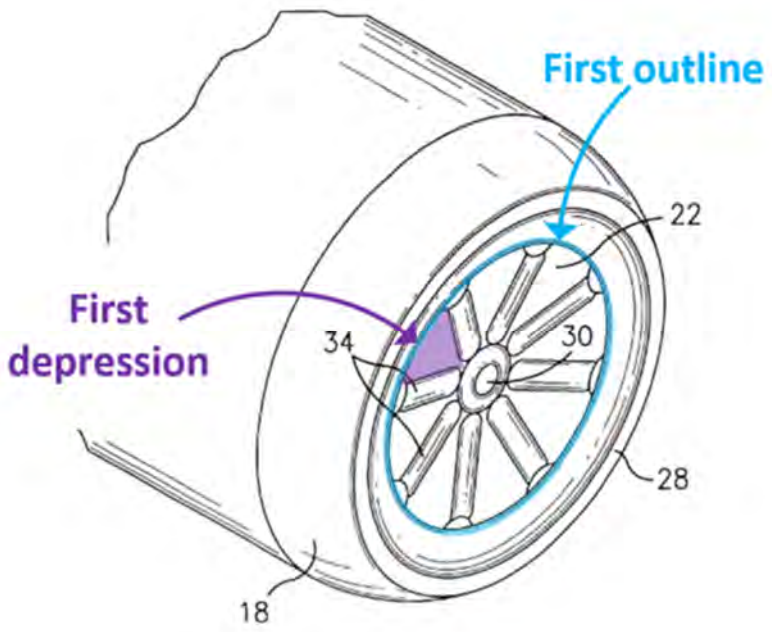


FIG. 5

Pedmo, Fig. 5 (Annotated)

i. Element [1.H]: "wherein the base portion further comprises a center element centered with respect to the first outline at least partially defined by the first depression;"

330. Pedmo's base included a center element in the form of "a central portion or hub 30." (Pedmo, 2:41-42; 2:47; 3:45). As can be seen in Figure 2, annotated below, the hub 30 was centered with respect to the first outline.

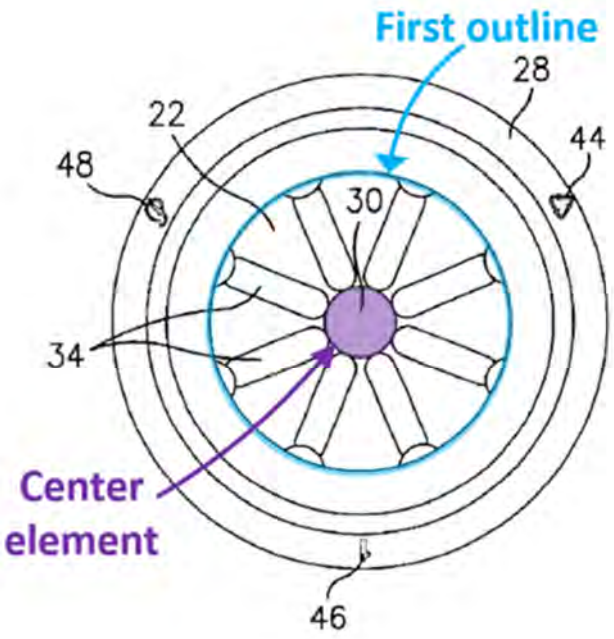


FIG. 2

Pedmo, Fig. 2 (Annotated)

j. Element [1.I]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the container side wall;"

331. The hub 30 of Pedmo (center element) was centered with respect to the first outline, as discussed with respect to element [1.H]. As further shown in Figure 2, annotated below, both of these elements were centered with respect to the container side wall of a container. In the combination with Gardiner, where Pedmo's bottom would have replaced Gardiner's bottom section, a POSITA would have understood and found it obvious that the center hub and first outline would similarly be centered with respect to the container side wall. This configuration would have

been a simple substitution of the base, and would not have required changes to sidewalls of Gardiner's container.

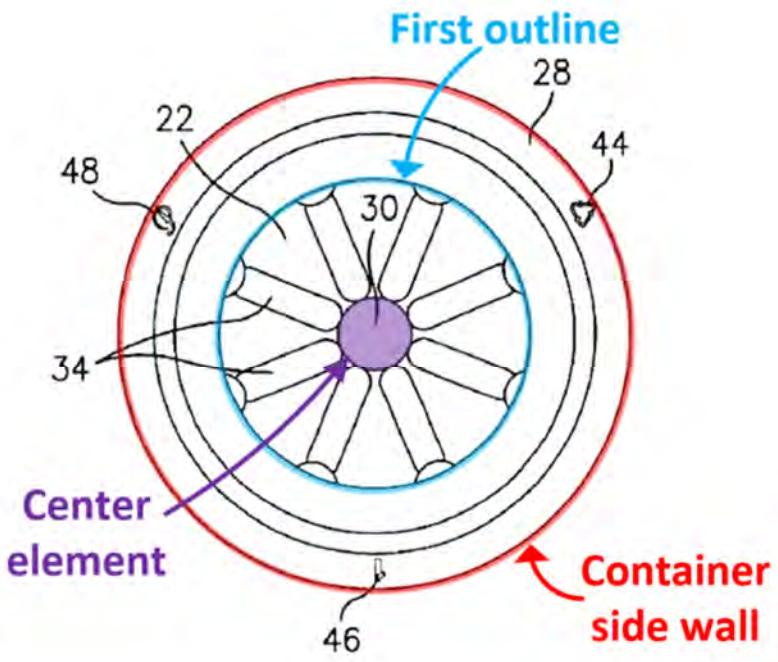
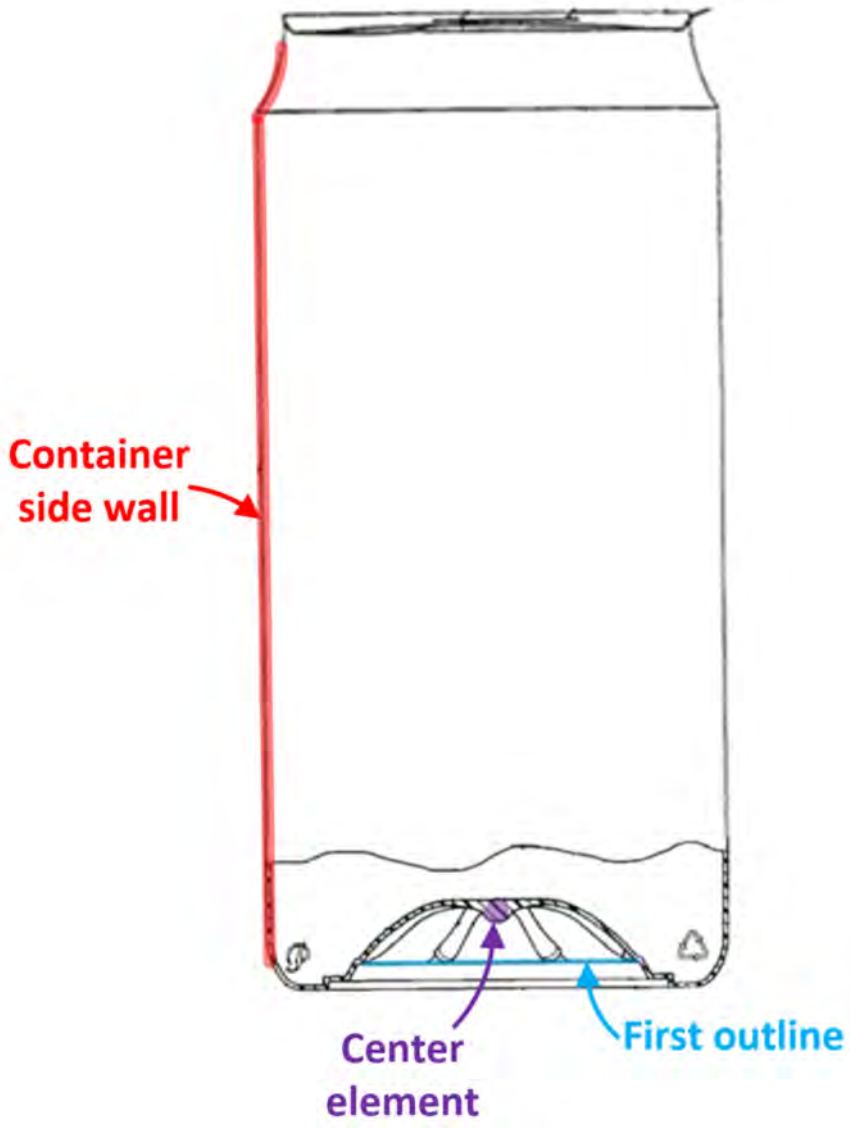


FIG. 2

Pedmo, Fig. 2 (Annotated)



Mockup of Combined Gardiner/Pedmo Container

k. Element [1.J]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the base portion;"

332. Pedmo's Figure 2, annotated below, illustrated that the hub 30 12 (center element) and the first outline are each centered with respect to the base portion.

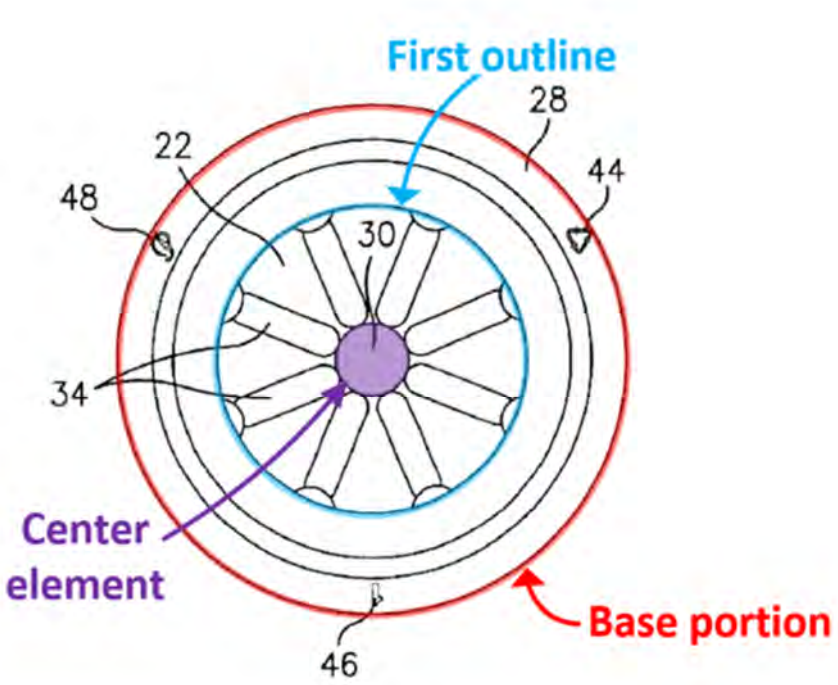


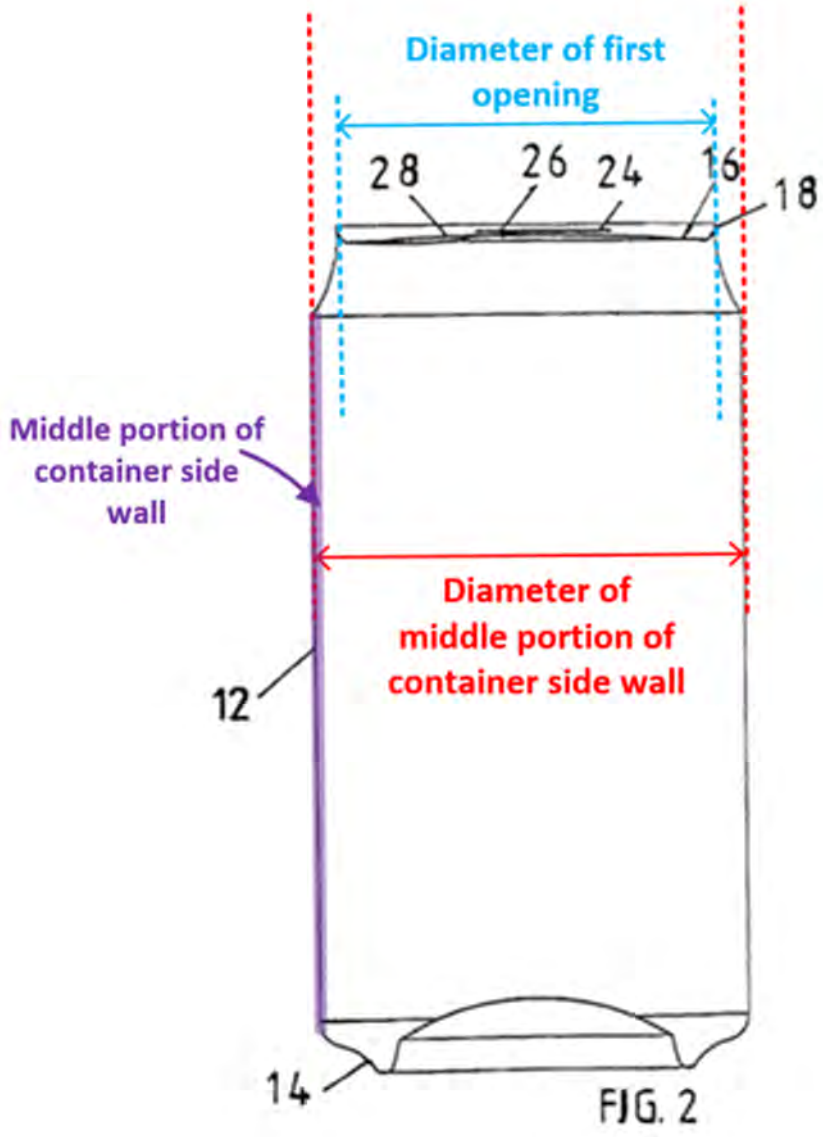
FIG. 2

Pedmo, Fig. 2 (Annotated)

l. Element [1.K]: "wherein the cross-sectional diameter of the first opening to the interior of the container body is less than a cross-sectional diameter of a middle portion of the container side wall;"

333. Gardiner disclosed this feature. As I described above with respect to [1.A], Gardiner's container had an opening (e.g., a "first opening") that was covered by a cap member. (Gardiner, 1:63-64; 4:34-35; 4:46-48). As shown in Figure 2, an upper portion of the container body angled inwards from a middle portion of the container side wall (marked in purple in annotated Figure 2 below). Although Gardiner's figures do not explicitly identify the diameter of the opening, it would be obvious to a POSITA based on the figures of Gardiner that the widest diameter of

the cap member – which would be the maximum diameter of the first opening – is less than a cross-sectional diameter of the middle portion of the side wall in Figure 2, as annotated below.



Gardiner, Fig. 2 (Annotated)

m. Element [1.L]: "wherein the base portion defines a diameter that is less than the cross-sectional diameter of the middle portion of the container side wall;"

334. The combination of Gardiner and Pedmo disclosed this feature. Pedmo's base defined a diameter by, for example, an inner circumference of the annular rim 28 that supported the container. In Pedmo's Figures 1 and 5, annotated below, a POSITA would have found it obvious based on viewing Pedmo's figures that the inner circumference of the annular rim 28 had a diameter that was less than a cross-sectional diameter of the container side walls connected to the base. In the combination with Gardiner, the diameter defined by the inner circumference of the annular ring would similarly be less than the cross-sectional diameter of the middle portion of the container side wall so as to not modify how the base was connected to or formed integrally with the walls of a container like Gardiner's.

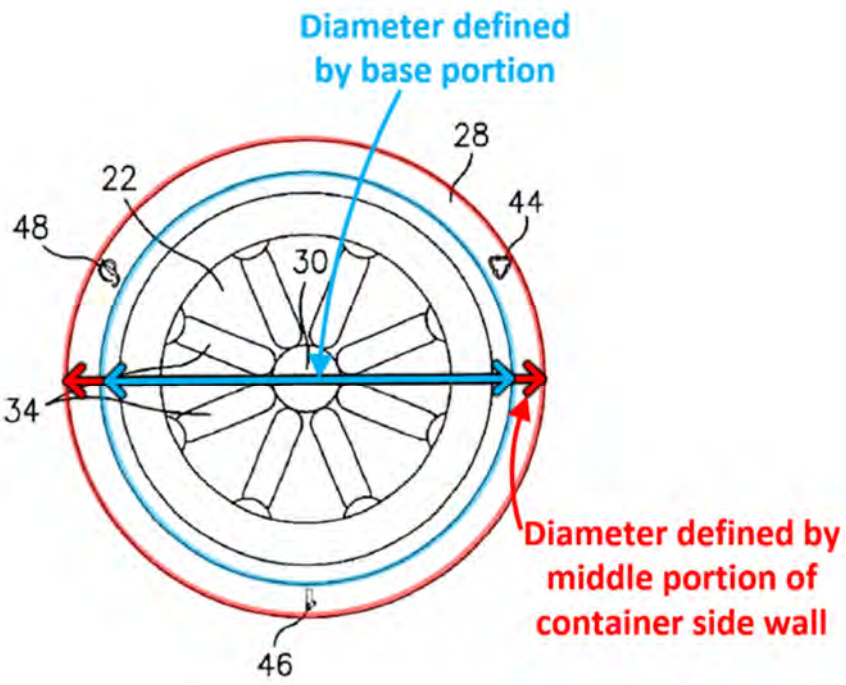
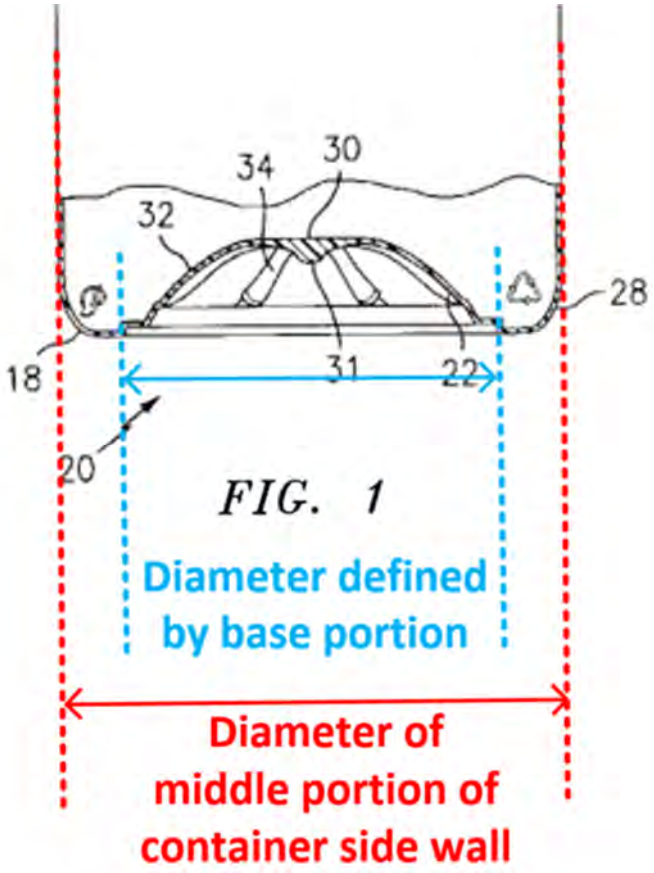


FIG. 2

Pedmo, Fig. 2 (Annotated)



Pedmo, Fig. 1 (Annotated)

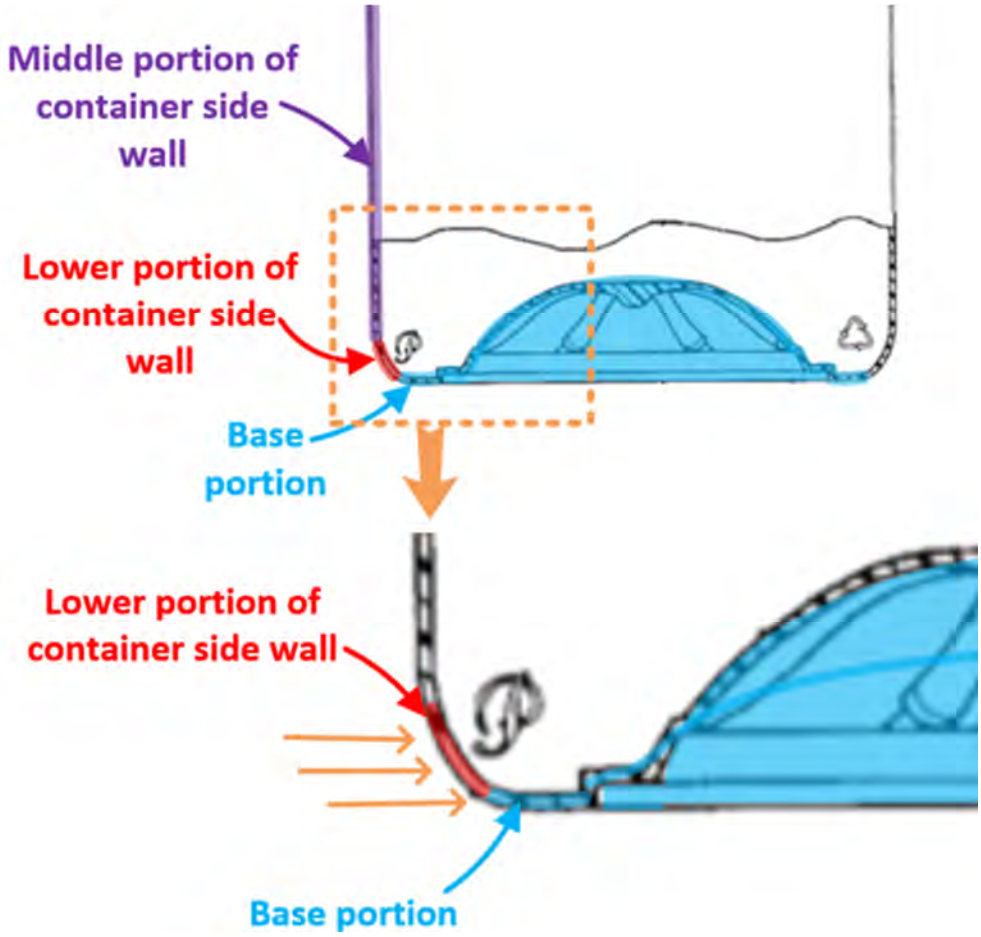
n. Element [1.M]: "wherein a lower portion of the container side wall extends downwardly from the middle portion of the container side wall to the base portion of the container body, the lower portion along its entirety being greater in diameter along its entirety than the base portion, including the bottom, thereby rendering the container body stemless;"

335. Gardiner and Pedmo disclosed this feature. As I discussed above, the combination of Gardiner and Pedmo disclosed a container with a container side wall and a base portion.

336. The side wall of Gardiner's container had a middle portion, as identified in the figure below illustrating the combination with Pedmo's base.

337. In Pedmo's Figure 1, the base portion connected to the side wall of the container by a curved wall section that transitioned from the vertical side wall to the horizontal rim on which the container sits (the bottom of the base; see [1.F]). This curved portion represented a lower portion of the container side wall, which, in the combination with Gardiner, extends downwardly from the middle portion of the container to the base portion, as identified in the figure below.

338. Since the curved lower wall section from Pedmo curved towards the center of the base, its diameter monotonically decreased from the point this curved section intersected the middle portion of the container side wall to the beginning of the base portion (at or near the bottom). As a result, the lower portion of the container side wall in the combination would have had a greater diameter along its entirety than the entirety of the base portion, including the bottom.

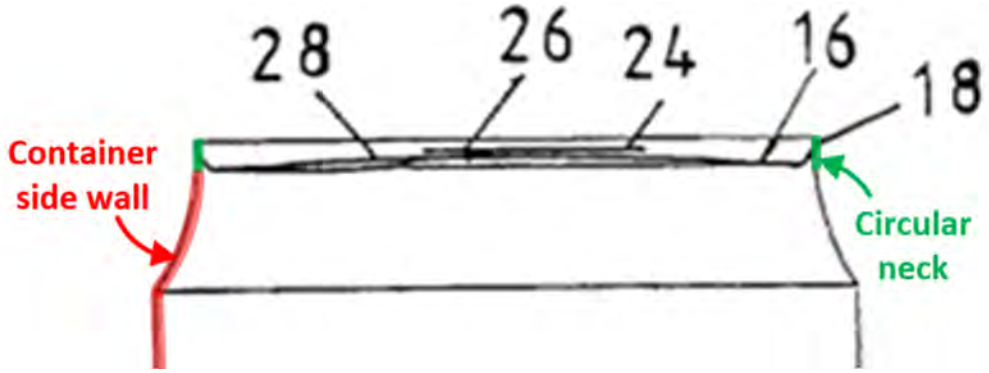


Mockup of Combined Gardiner/Pedmo Container

339. As discussed with respect to Ground 1, I am interpreting the clause, "thereby rendering the container body stemless," under its plain meaning – that a container body is stemless as a result of "the lower portion along its entirety being greater in diameter along its entirety than the base portion, including the bottom." The combination of Gardiner and Pedmo satisfies this limitation for the reasons explained above. I also consider the container in the combination to lack a stem.

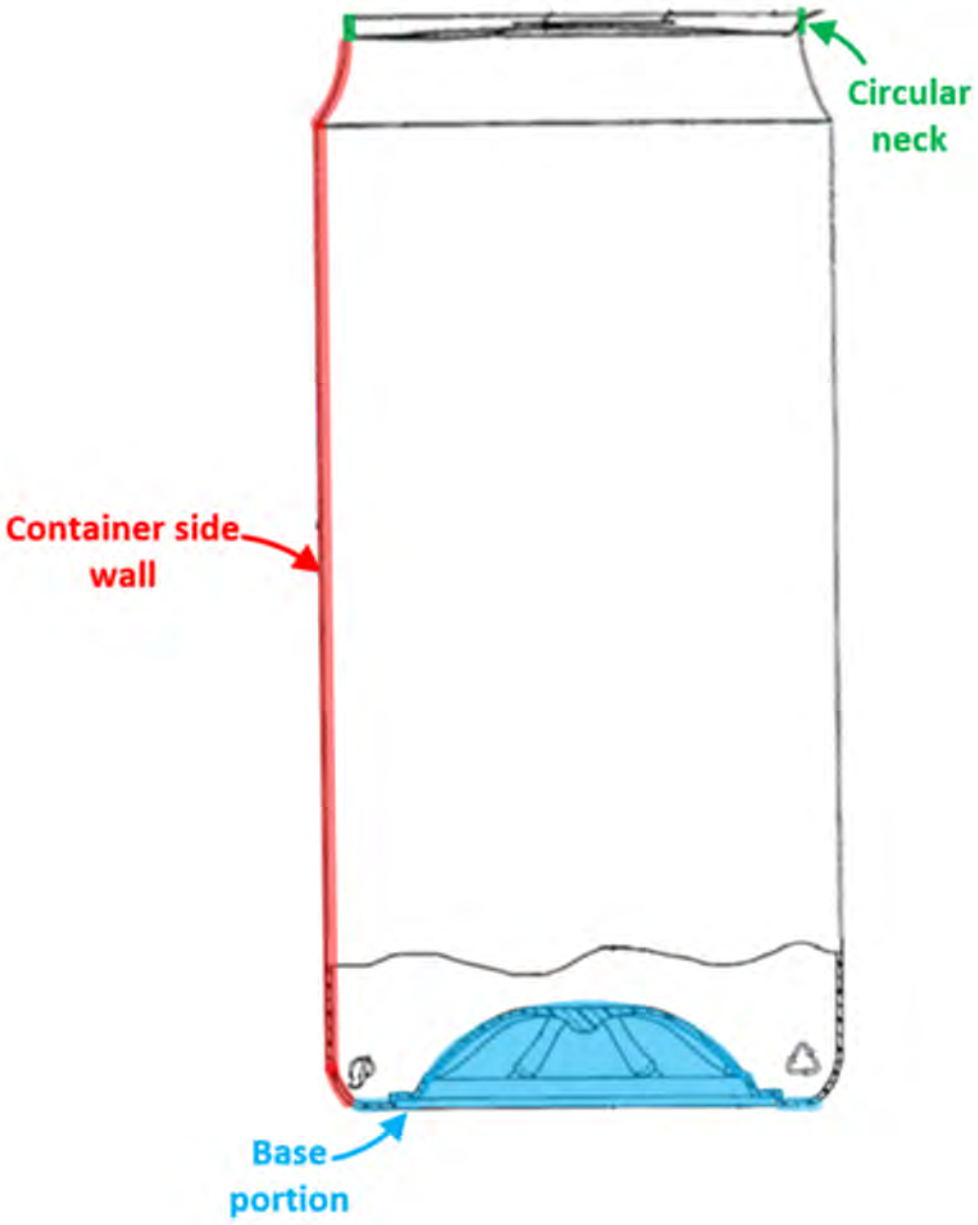
o. Element [1.N]: "wherein the container body further comprises a circular neck extending from the container side wall so that the container side wall extends between the circular neck and the base portion;"

340. Gardiner disclosed this feature. In Gardiner's Figure 2, annotated below, a circular neck was depicted by, for example, a substantially vertical section of the container body that approximately corresponded to a location of a cap that is sealed to the container body. This circular neck extends from the container side wall, as shown.



Gardiner, Fig. 2 (Cropped and Annotated)

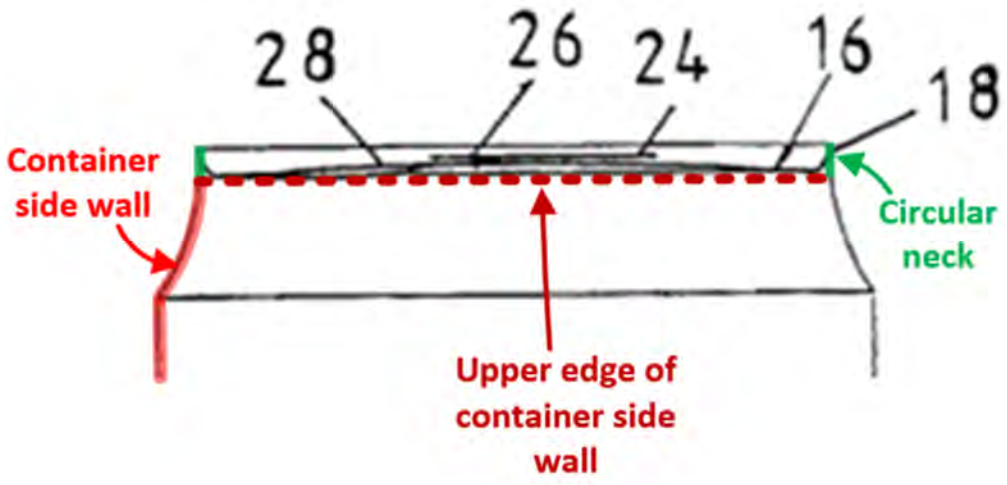
341. In the combination of Gardiner and Pedmo, the container side wall of Gardiner's container extends between the circular neck as identified above and the base portion as taught by Pedmo, as illustrated below.



Mockup of Combined Gardiner/Pedmo Container

p. Element [1.O]: "wherein an upper edge of the container side wall is adjacent to the circular neck of the container body;"

342. The container side wall of Gardiner's container had an upper edge that was adjacent to the neck identified in [1.N], such as a top circumference of the side wall before the beginning of the neck, as annotated in Figure 2 below.

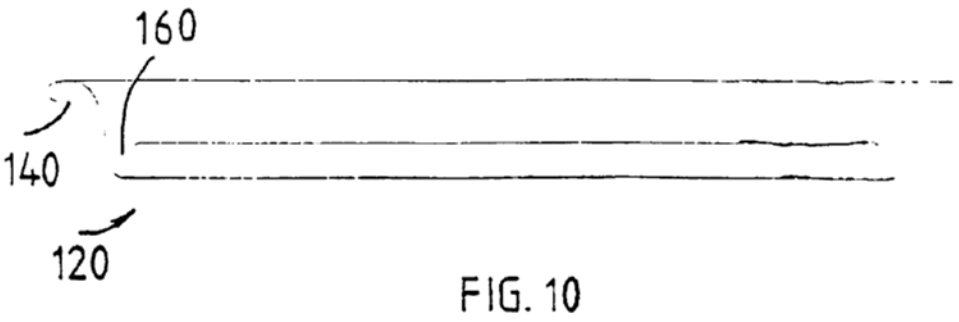


Gardiner, Fig. 2 (Cropped and Annotated)

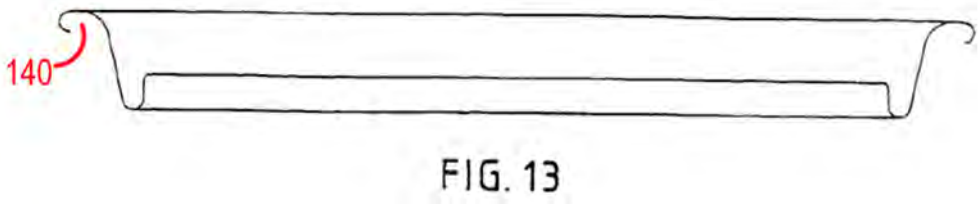
q. Element [1.P]: "wherein the container body further comprises a lip at an end of the circular neck opposite the upper edge of the container side wall;"

343. Gardiner suggested this feature. Gardiner explained that a cap connected to the body of Gardiner's container by "a peripheral 140 [that] is shaped to be positioned [] over an open end of a can body and seamed thereat to join to the

can body for forming a rim of the can." (Gardiner, 5:42-45). The peripheral 140 is labeled in Figure 10 but more clearly visible in Figure 13[1], as annotated below:



Gardiner, Fig. 10



Gardiner, Fig. 13 (Annotated)

344. As shown in Figure 13 above, the peripheral 140 had a hook-like shape. Since the "peripheral 140" was "shaped to be positioned" over the open end of the can body, a POSITA would have found it obvious that the can body would have a reciprocal shape (e.g., a lip) at the top of the can body, over which the peripheral

[1] Gardiner explains that Figures 13-15 differ from Figures 10-12 only in the structure of "wedge portions 200" that fix an "insert element 180" into a countersink 160. (Gardiner, 5:56-62). This difference does not affect and is not related to the shape of the peripheral 140.

140 was seamed to form a rim for the can, because this reciprocal shape would have enabled a lid to seal to the container body such that the container can hold a beverage. (*See* Gardiner, 1:44-50 (explaining how a cap was secured to a beverage can by seaming that was "sufficiently strong to prevent separation by internal pressures exerted by the carbonated drinks.")). Using the lid with a lip that engaged with a container's rim was routinely done to secure the lid to the container, as evidenced from numerous prior art references. (See ¶ 207)

r. Element [1.Q]: "wherein the circular neck is adjacent to the lip;"

345. Gardiner disclosed a circular neck, as discussed with respect to element [1.O]. The circular neck was adjacent to the lip discussed in element [1.P] because the circular neck extended to the top of the container body, where the lip was positioned.

s. Element [1.R]: "wherein a first portion of the lid is above the lip of the container body;"

346. Gardiner disclosed this feature. As discussed above, Gardiner described a cap (a lid) that had a "peripheral 140." (Gardiner, 5:42; Figures 10 and 13). The peripheral 140 formed a first portion of the lid (shown in annotated Figure 13 below), where this first portion was above the lip of the container body because it was "positioned [] over an open end of a can body." (Gardiner, 5:42-45).

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FIG. 13

Gardiner, Fig. 13 (Annotated)

t. Element [1.S]: "wherein the first portion of the lid defines a first circular shape;"

347. The peripheral 140 disclosed by Gardiner (a first portion of the lid) defined a first circular shape by, for example, a circumference at or near an outer side of the peripheral 140, annotated in Figure 13 below. The circumference defined at this point is circular because the cap is circular, as shown in Gardiner's Figure 1.

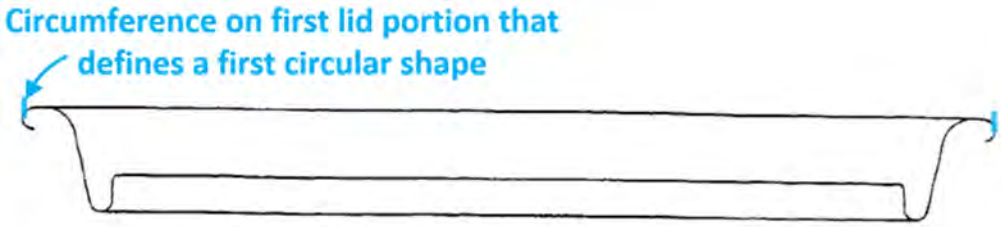


FIG. 13

Gardiner, Fig. 13 (Annotated)

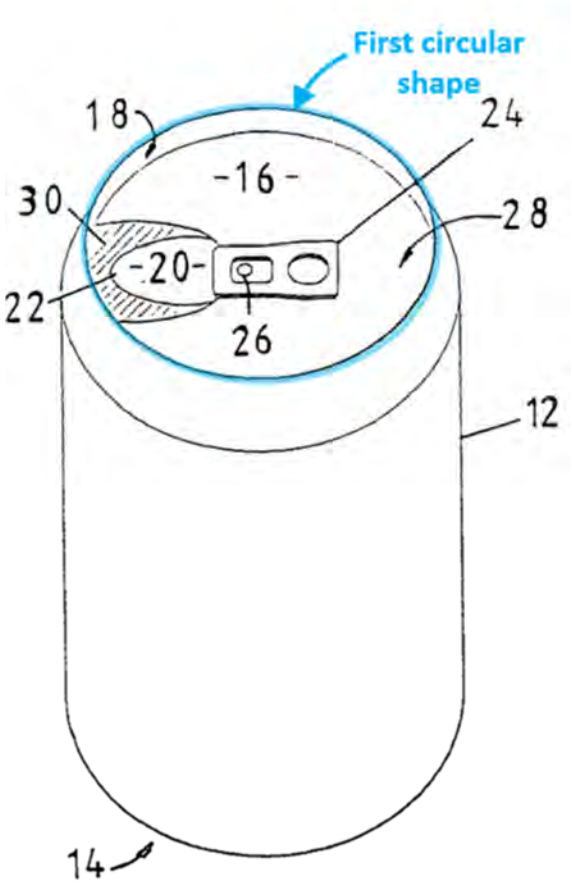


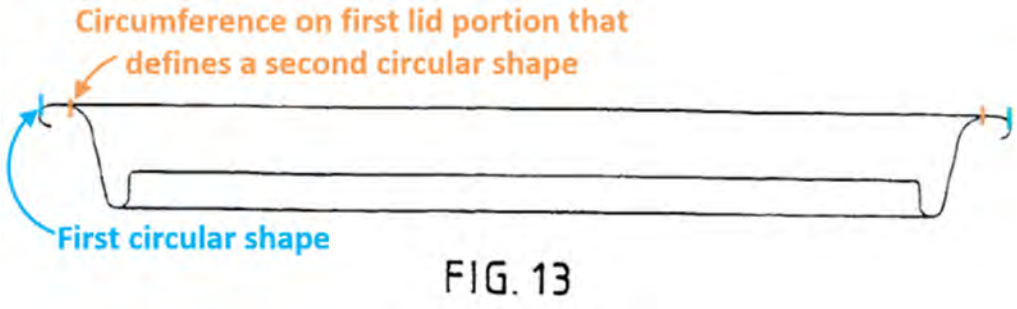
FIG. 1

Gardiner, Fig. 1 (Annotated)

u. Element [1.T]: "wherein the first portion of the lid further defines a second circular shape around which the first circular shape circumferentially extends;"

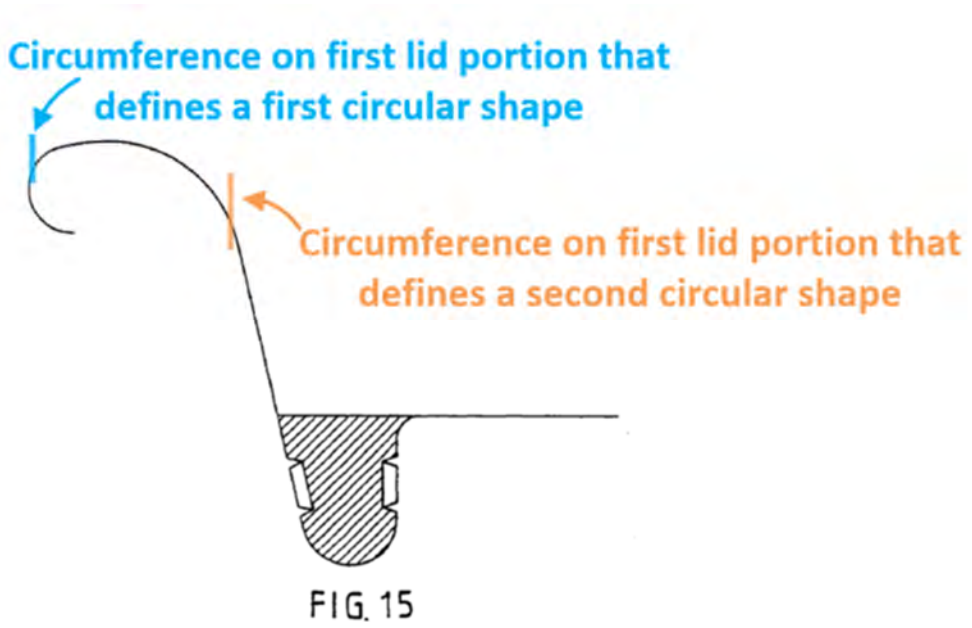
348. Gardiner taught or suggested this limitation. The peripheral 140 disclosed by Gardiner (a first portion of the lid) further defined a second circular shape by, for example, a circumference at or near an inner side of the peripheral 140, annotated in Figures 13 and 15 below. When the lid was attached to a container, the first portion of the lid would form a ledge around the seam 18 where, for example,

an outer edge of the ledge defines the first circular shape and an inner edge defines the second circular shape. (*See* Gardiner, 4:34-36 (describing the rim 18 formed at a seam between a lid and container body)). The locations of the circumferences on the first portion of the lid that respectively define the first and second circular shapes can be modified to form a lid that is slightly wider or slightly narrower, and such modifications would have been obvious variations of each other. Such changes in width would have still allowed containers with these lids to be stacked on top of one another, if desirable.



Gardiner, Fig. 13 (Annotated)

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Gardiner, Fig. 15 (Annotated)

349. The terms "first circular shape" and "second circular shape" do not appear in the specification of the '441 Patent. However, Gardiner's Figure 15 is analogous to an "enlarged" view of a container lid shown in Figure 5 of the '441 Patent.

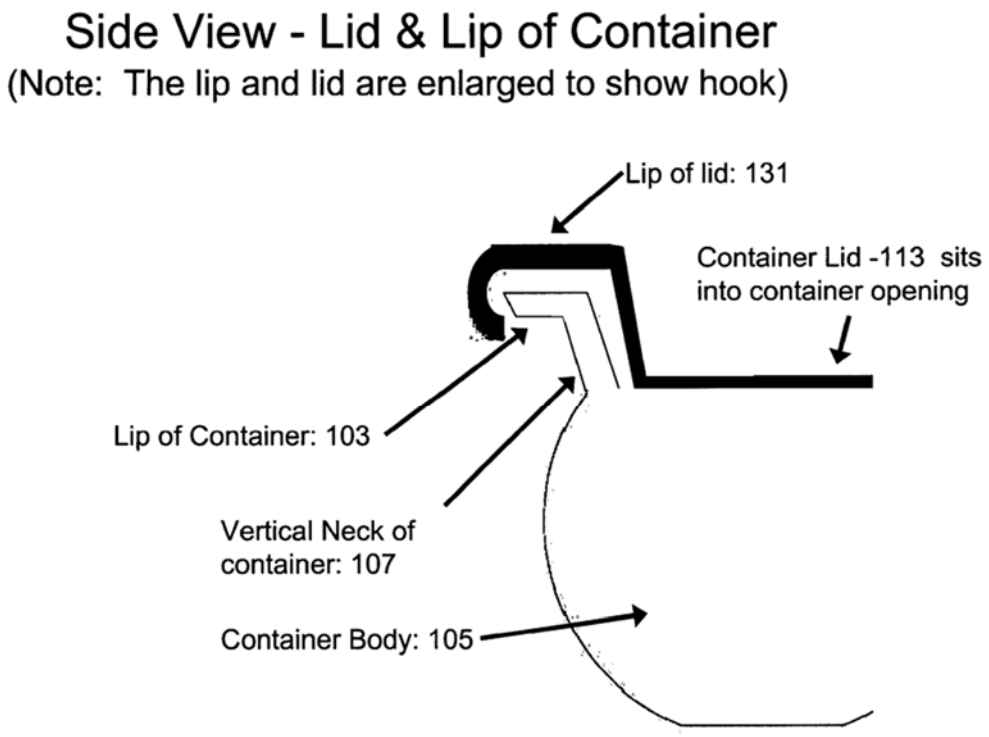
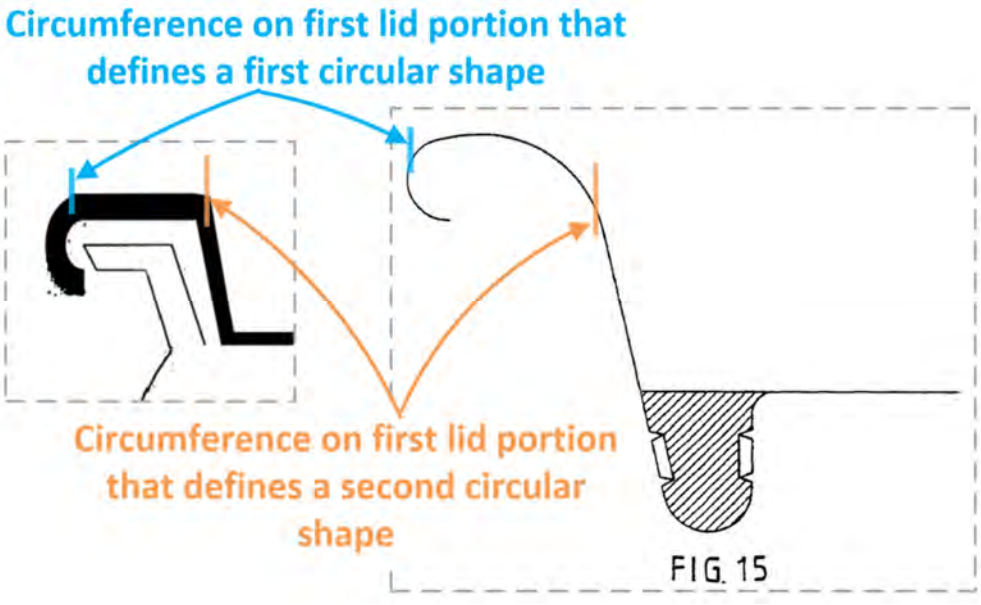


Figure 5

350. Below is a side-by-side comparison of the first lid portion of the ’441 Patent and Gardiner’s Figure 15.



Comparison of ’441 Patent’s Fig. 5 (Cropped) and Gardiner’s Fig. 15

351. The circumferences indicated above in Figures 13 and 15 are circular because the cap is circular, as shown in Gardiner's Figure 1.

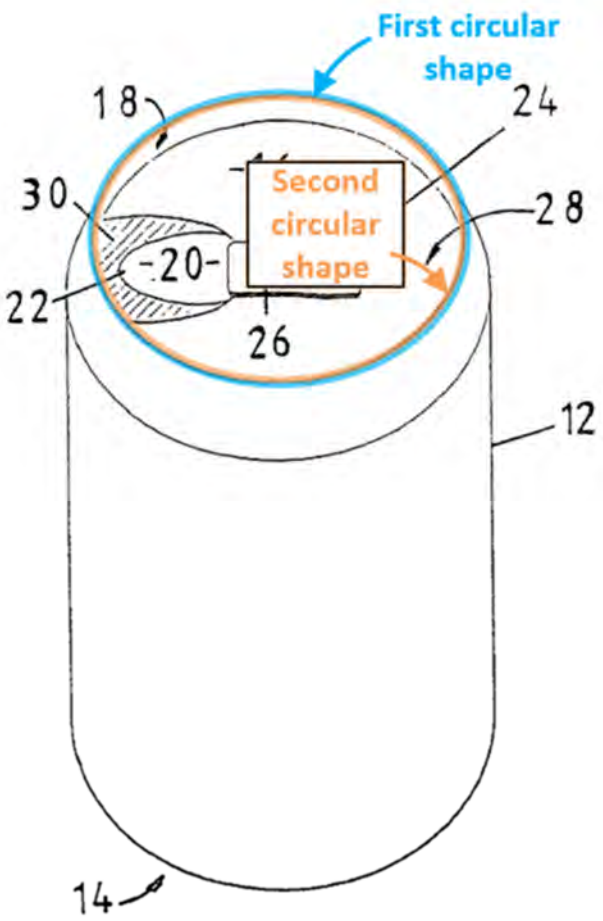


FIG. 1

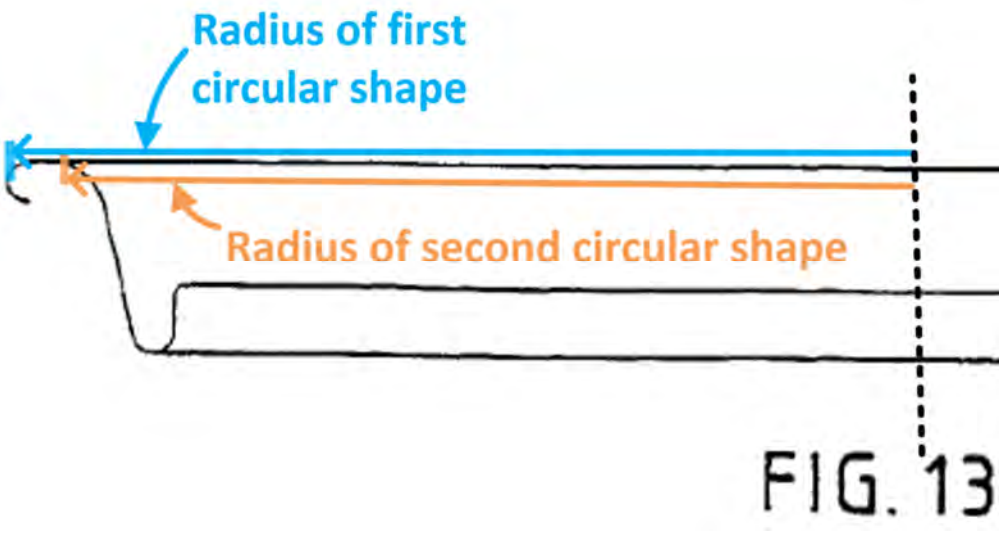
Gardiner, Fig. 1 (Annotated)

v. Element [1.U]: "wherein the second circular shape defined by the first portion of the lid is concentric with the first circular shape defined by the first portion of the lid;"

352. Gardiner's Figure 1, as annotated in element [1.T], showed that the second circular shape was concentric with the first circular shape.

w. Element [1.V]: "wherein the first circular shape defined by the first portion of the lid is radially positioned between the container side wall and the second circular shape defined by the first portion of the lid;"

353. Gardiner taught or suggested this feature. As shown in [1.T], the claimed first and second circular shapes were formed by respective circumferences of the peripheral 140 of Gardiner's cap. The first circular shape had a greater radius than the second circular shape because the first circular shape was defined by a circumference at or near an outer edge of the peripheral, while the second circular shape was defined by a circumference at or near an inner edge of the peripheral.

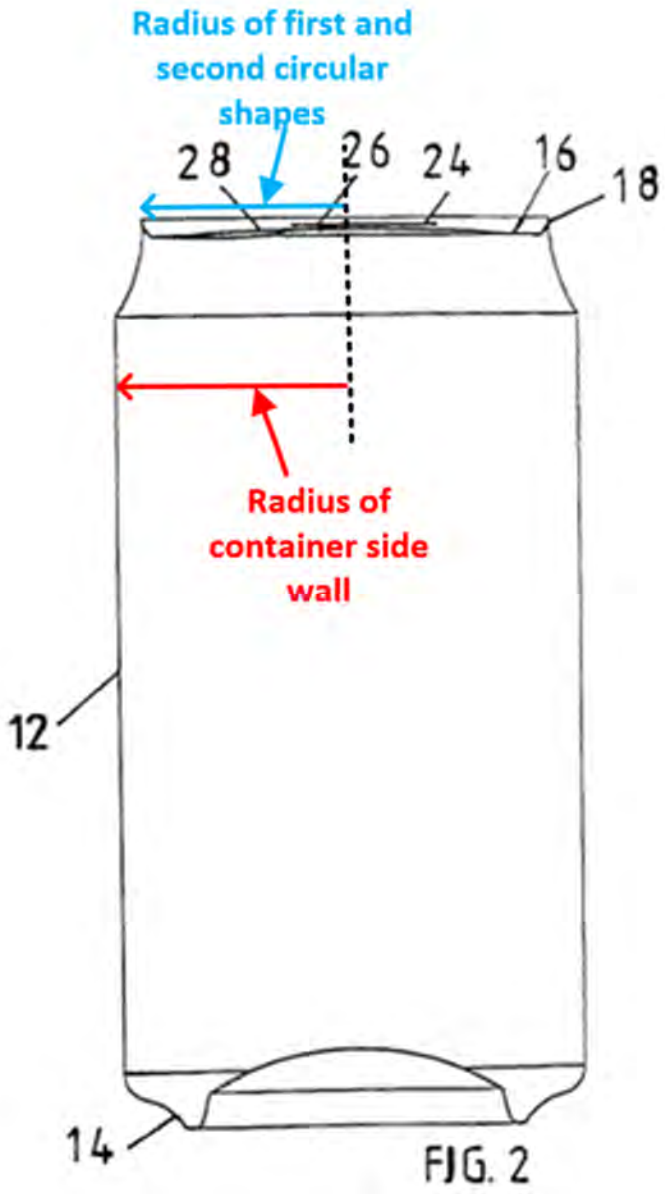


Gardiner, Fig. 13 (Cropped and Annotated)

354. An upper portion of Gardiner's container body angled inwards from a middle portion of the container side wall, as shown in Figure 2, such that the

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outermost diameter of the cap (first circular shape) had a smaller diameter than a middle portion of the container body.



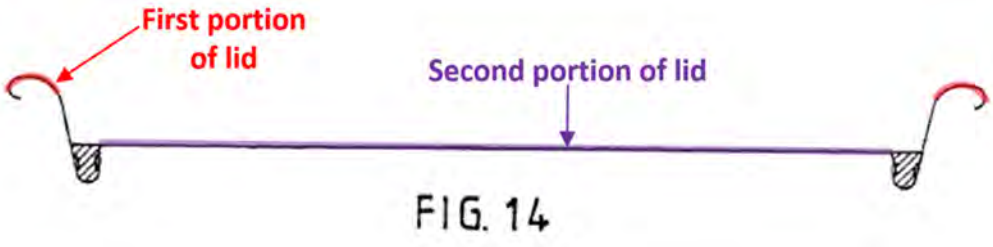
Gardiner, Fig. 2 (Annotated)

355. As a result, in the combination, the first circular shape would have a radius that was larger than the radius of the second circular shape but was smaller

than the radius of the container side wall. That is, the first circular shape was radially positioned between the container side wall and the second circular shape.

x. Element [1.W]: "wherein a second portion of the lid extends horizontally and is positioned so that the second circular shape is radially positioned between the second portion of the lid and the first circular shape;"

356. Gardiner's lid had a second portion in the form of a "radially inner part of the cap." (Gardiner, 5:53; Figure 11; Figure 14[2]). As depicted in Figures 1 and 14, annotated below, the second portion of the lid extends horizontally.



Gardiner, Fig. 14 (Annotated)

[2] As noted above, although Figures 10-12 depict a different embodiment than Figures 13-15, these embodiments differ only in the structure of their "wedge portions 200," which is unrelated to the peripheral 140 depicted in both embodiments.

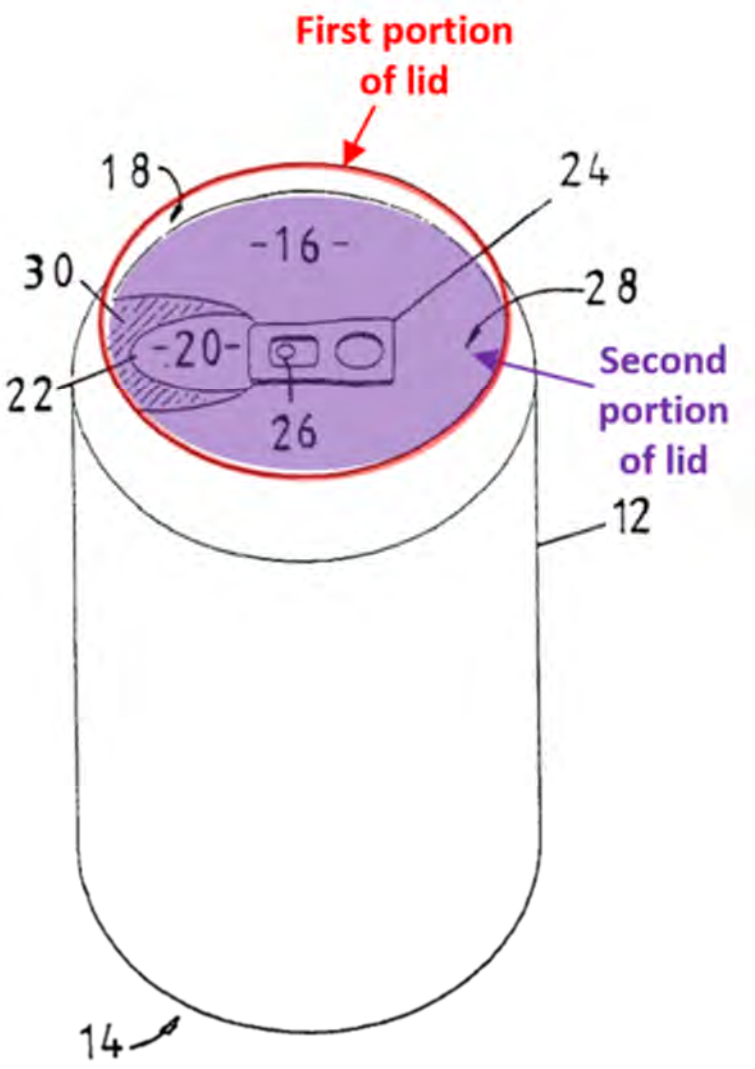
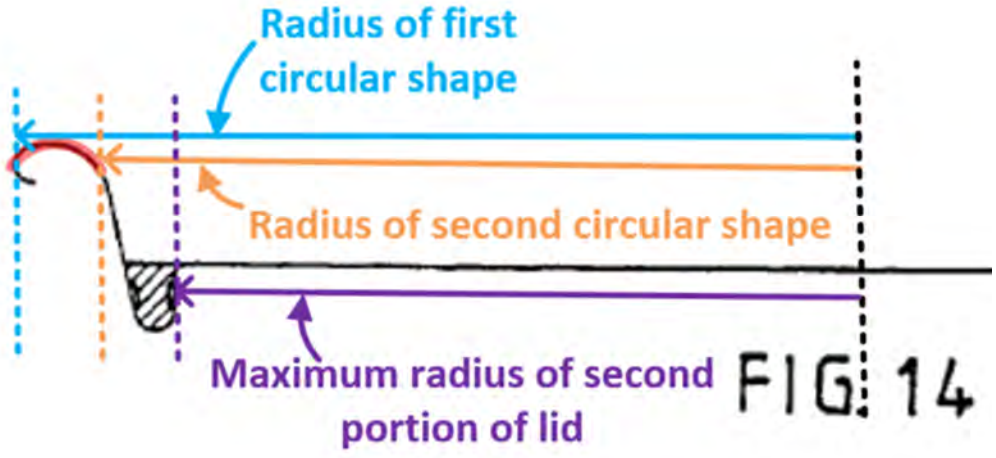


FIG. 1

Gardiner, Fig. 1 (Annotated)

357. Furthermore, as illustrated in annotated Figure 14 below, the second circular shape had a radius that was greater than a maximum radius of the second portion of the lid, but less than the radius of the first circular shape. Accordingly, the second circular shape was radially positioned between the second portion of the lid and the first circular shape. The radii illustrated in annotated Figure 14 below can be

larger or smaller than shown (e.g., to form different-sized ledges on the first portion of the lid; see [1.T]), while maintaining their same relative size ordering.



Gardiner, Fig. 14 (Cropped and Annotated)

y. Element [1.X]: "wherein the second portion of the lid defines a total area across which the second portion of the lid extends horizontally;"

358. The second portion of Gardiner's lid, described in element [1.W], had a total area that represented the area of the horizontal portions of the lid. The area is annotated in purple in Figure 1 below.

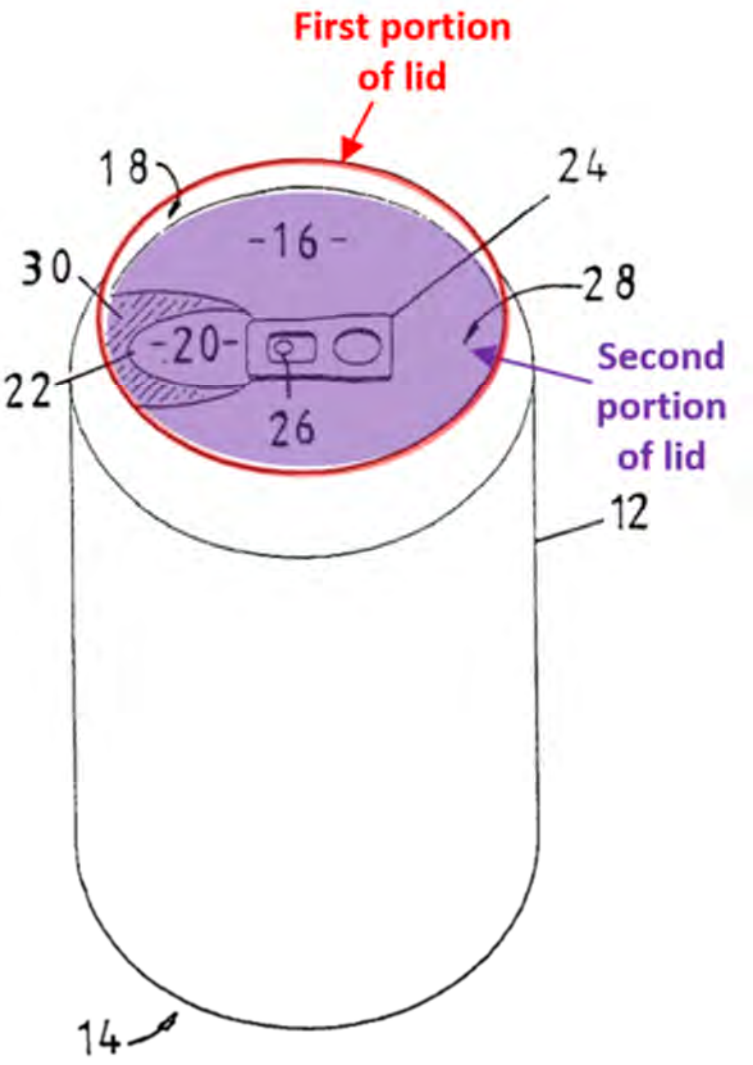


FIG. 1

Gardiner, Fig. 1 (Annotated)

z. Element [1.Y]: "wherein the second portion of the lid comprises a weakened or scored area;"

359. Both Gardiner and Brown disclosed this feature. Gardiner described a weakened or scored area in the form of a "score line 22" that extended around a "scored portion 20." (Gardiner, 5:2; 5:13-15; 5:27-28; Figure 1).

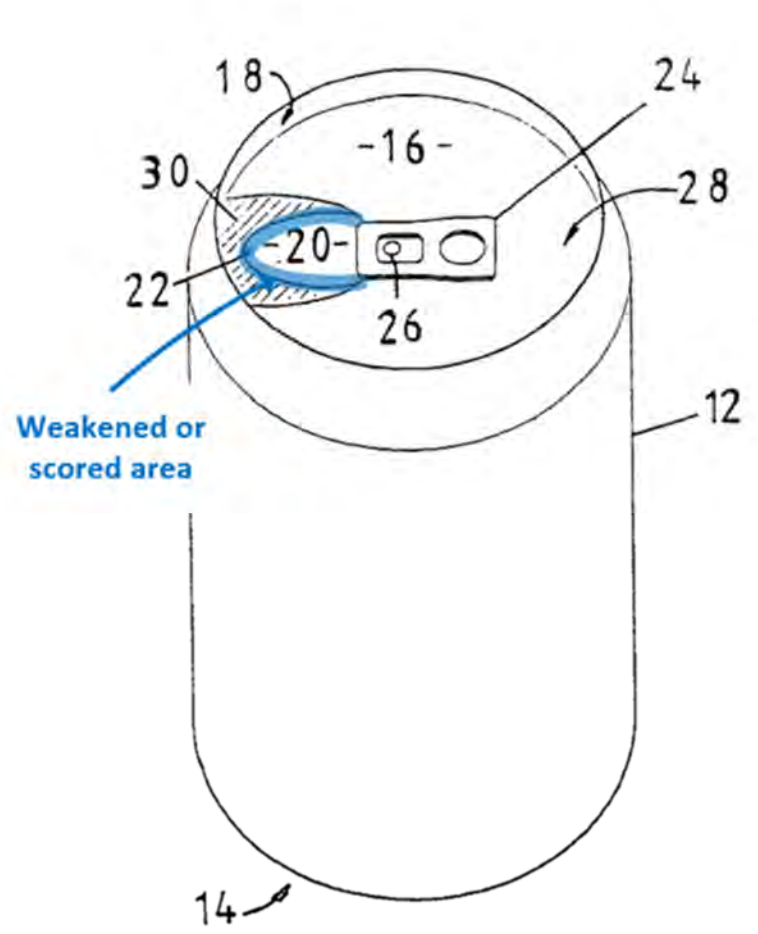
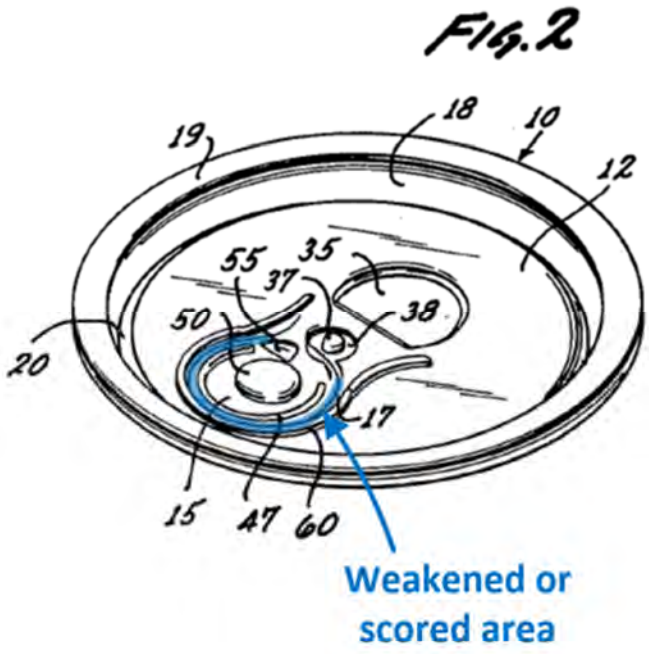


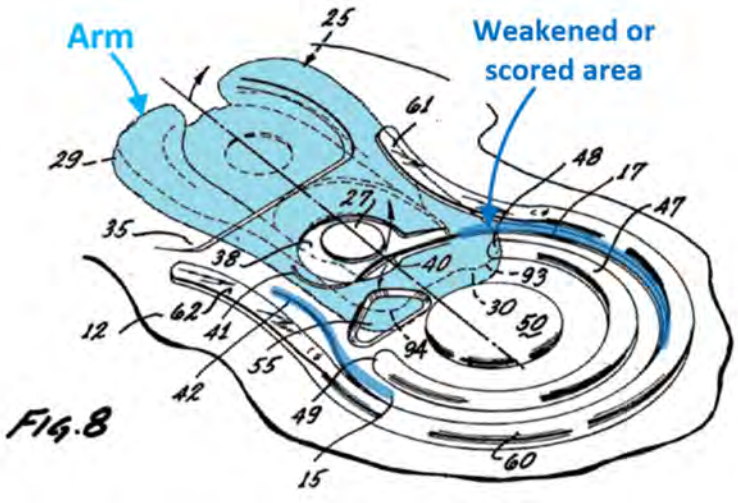
FIG. 1

Gardiner, Fig. 1 (Annotated)

360. While the teachings of Gardiner were sufficient to render this claim limitation obvious, Brown, which is used in the combination to render element [1.AC] obvious, corroborated the teachings of Gardiner. Notably, Brown described a similar weakened or scored area by its discussion of a "pour panel 15…being at least partially circumscribed by a scoreline 17 which was ruptured to form a pour opening in the end structure." (Brown, 7:37-40; see Figs. 2 and 8, annotated below).



Brown, Fig. 2 (Annotated)



Brown, Fig. 8 (Annotated)

361. The pour panel 15 of Brown is analogous to the scored portion of Gardiner, while Brown's scoreline 17 is analogous to Gardiner's score line; thus, in

my opinion, a POSITA would find these components to be readily combinable to yield predictable results. See [1.AC].

aa. Element [1.Z]: "wherein the weakened or scored area is less than the total area across which the second portion of the lid extends horizontally;"

362. Each of Gardiner and Brown disclosed this feature. The annotated figures in elements [1.W] and [1.Y] demonstrated that the score line 22 of Gardiner and "scoreline 17" of Brown (weakened or scored area) is less than the total area across which the second portion of the lid extends horizontally.

bb. Element [1.AA]: "wherein the lid further comprises an arm connected to the second portion of the lid and radially positioned within the second circular shape;"

363. Gardiner disclosed this feature. Gardiner's container lid had an arm in the form of a "ring pull tab" or "tab portion." (Gardiner, 4:45-53[3]; 4:67; 5:22). The tab portion was connected to the second portion of the lid by a rivet 26, such that the tab portion was "pivotally movable for separating the portion 20 and thereby presenting a pour aperture." (*Id.*, 4:45-53). As illustrated in annotated Figure 1 below, the arm was radially positioned within the second circular shape, as identified

[3] A Certificate of Correction modifies col. 4 lines 44-53 from the publication of Gardiner. Citations to these lines are a citation to the lines as corrected.

in element [1.T], because the pull tab was inside of the radius of the second circular shape as viewed from the top of the can.

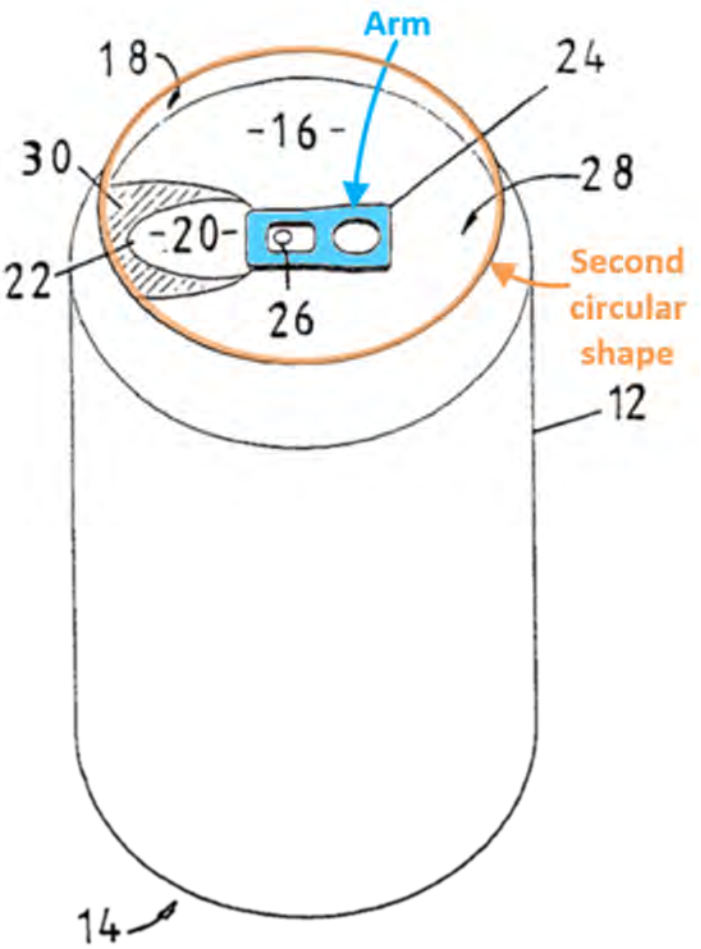
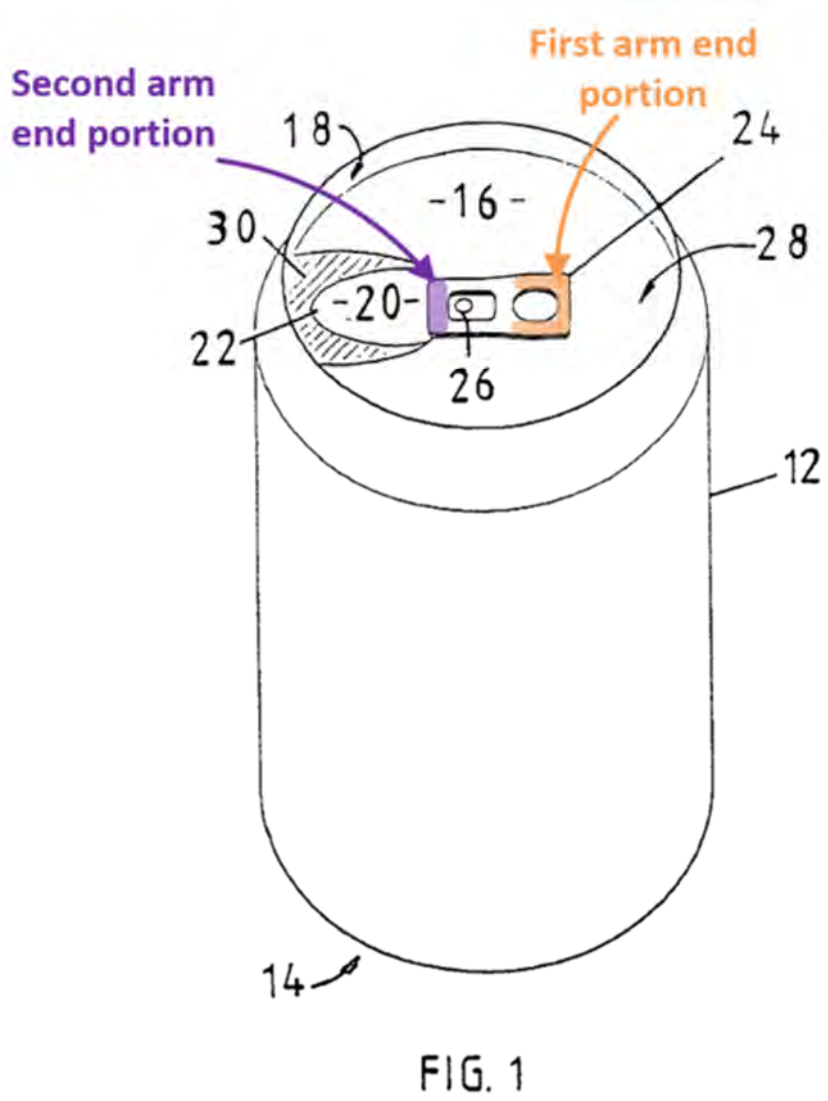


FIG. 1

Gardiner, Fig. 1 (Annotated)

cc. Element [1.AB]: "wherein the arm comprises opposing first and second end portions;"

364. The pull tab (arm) disclosed by Gardiner had first and second end portions at opposite ends of the pull tab, as illustrated in annotated Figure 1 below. (Gardiner, Fig. 1).

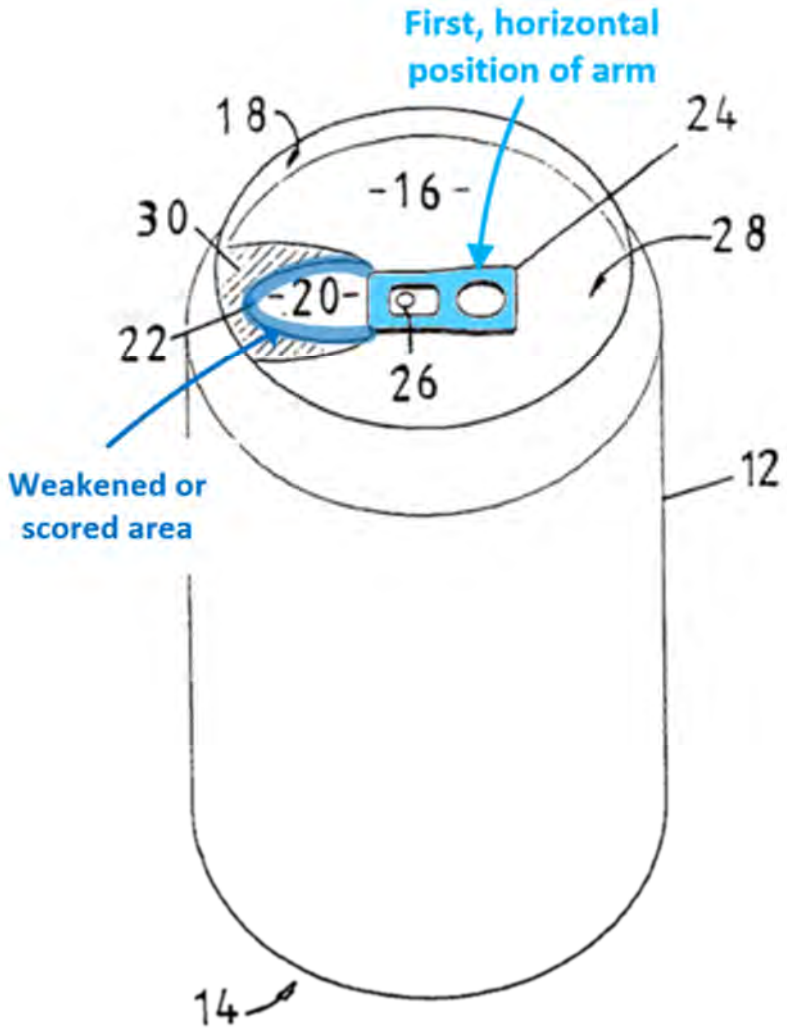


Gardiner, Fig. 1 (Annotated)

dd. Element [1.AC]: "wherein the arm is pivotable from a first position, in which the arm extends horizontally and the weakened or scored area is not deformed, to a second position, in which the arm does not extend horizontally and the weakened or scored area is deformed to provide a second opening to the interior of the container body;"

365. Gardiner and Brown disclosed this feature. In its Figure 1, annotated below, Gardiner illustrated the pull tab or tab portion (arm) at a first position where it extended horizontally. In this configuration, the score line 22 (weakened or scored area) that extended around the scored area 20 was not deformed.

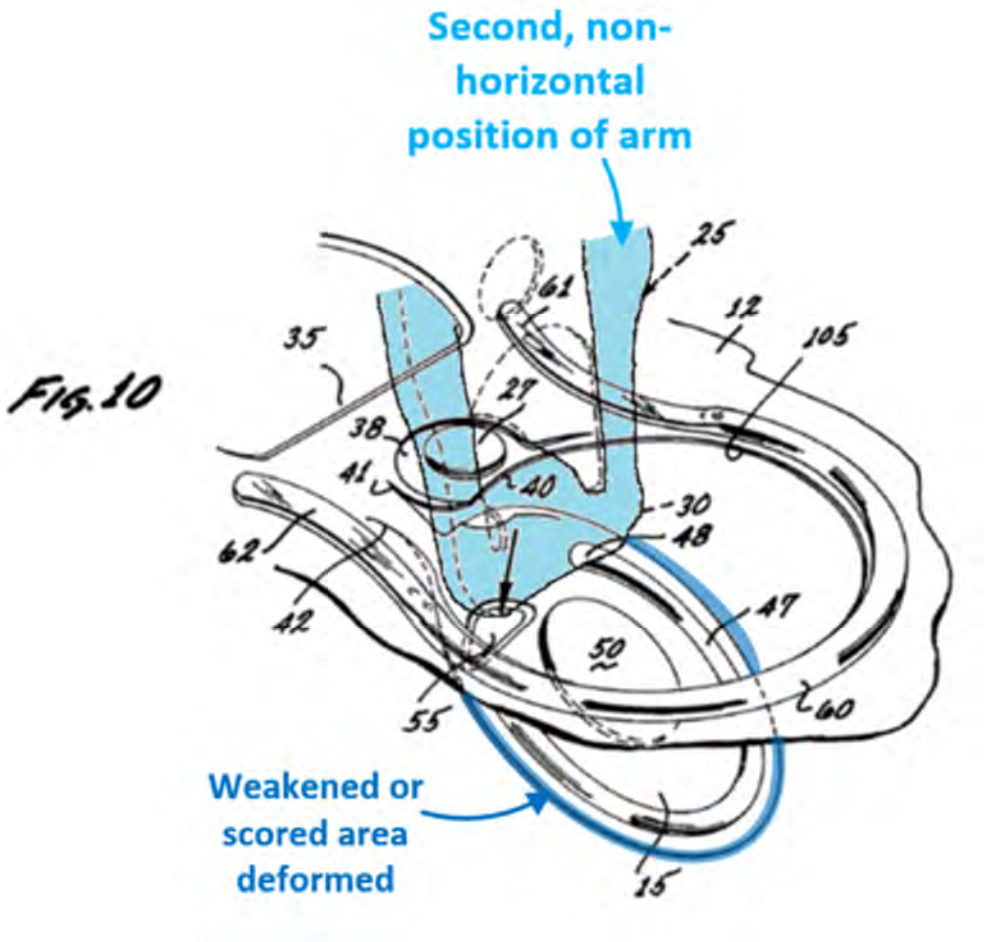
366. Gardiner further explained that the tab portion was "pivotally movable for separating the portion 20" in order to present a "pour aperture" (a second opening to the interior of the container body). (Gardiner, 4:45-53). Therefore, it would have been obvious to a POSITA that the tab would move from its horizontal position to a non-horizontal position to separate the scored portion and create a second opening for the pour aperture.



Gardiner, Fig 1 (Annotated)

367. While in my opinion Gardiner alone rendered this limitation obvious, Brown explicitly described how a pour aperture would be formed. As described by Brown, a tab (an arm) was attached to a container lid by a rivet (Brown, 5:5-8), such that the tab operated as a lever "upon lifting one end thereof to initiate rupture of the portion of the scoreline between the opening end and the rivet" (*id.*, 5:14-17). Brown

described how the tab would pivot to a second position in which the tab did not extend horizontally (e.g., "a position of approximately between 30 and 45º" (*id.*, 10:37-38)), causing the scoreline 17 (scored area) to rupture (deform) to provide the second opening to the interior of the container (*id.*, 10:37-41 (describing how "the scoreline 17 is progressively ruptured"); 10:61-68; 5:1-2; 5:14-21). Figure 10 of Brown, annotated below, illustrates the second, non-horizontal position of the arm and deformation of the weakened or scored area.

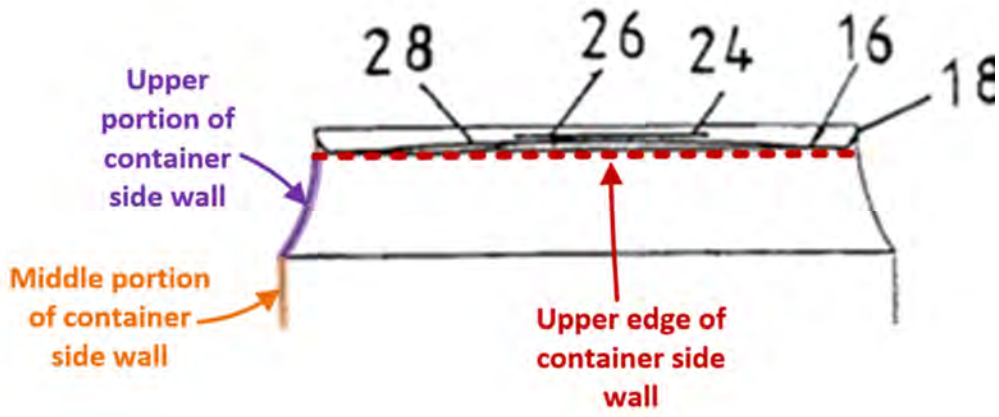


Brown, Fig. 10 (Annotated)

368. A POSITA would have found it obvious based on the teachings of Brown that the pivotable tab of Gardiner would have moved from its horizontal position to a non-horizontal position, as shown in Brown, to push in the weakened or scored area and to form a second opening for pouring out the liquid contents of the container. Brown's tab and scoreline 17 are analogous to Gardiner's "tab portion" and "scored area" respectively, and thus a POSITA would have seen that Brown's explanation for operating an arm to open a lid's scored area are readily applicable to Gardiner's disclosure to cause the predictable result of opening the lid.

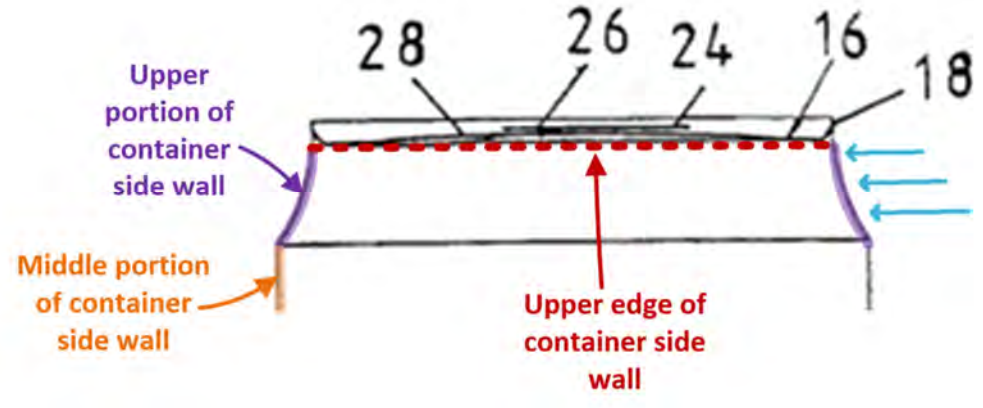
ee. Element [1.AD]: "wherein an upper portion of the container side wall extends upwardly from the middle portion of the container side wall to the upper edge of the container side wall, the upper portion along its entirety being greater in diameter than the first opening to the interior of the container body;"

369. As discussed in element [1.O], the container side wall of Gardiner's container had an upper edge at, for example, a top circumference of the side wall before the beginning of the neck, as annotated in Figure 2 below. An upper portion of the container side wall, as identified in the annotated figure below, extends upwardly from the middle portion of the container side wall to the upper edge.



Gardiner, Fig. 2 (Cropped and Annotated)

370. As shown in Gardiner's Figure 2, annotated below, the upper portion of the container side wall was greater in diameter along its entirety than the diameter of the first opening to the interior of the container's body because the upper portion had a monotonic slope that causes the cross-section to monotonically decrease from the middle portion of the container side wall to the upper edge.



Gardiner, Fig. 2 (Cropped and Annotated)

ff. Element [1.AE]: "wherein the container body contains a liquid therewithin;"

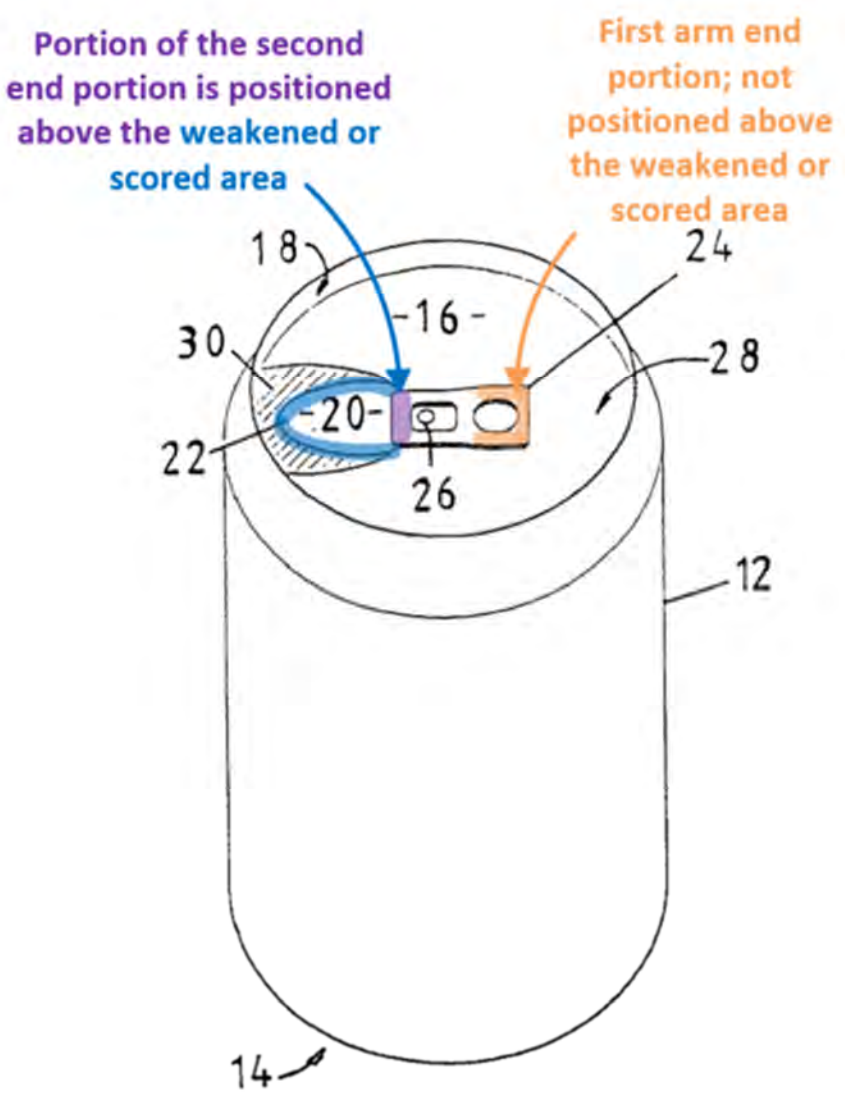
371. Gardiner disclosed that its container body was configured to hold a beverage, which is a liquid. (Gardiner, 1:15; 1:44-50; 4:28-30).

gg. Element [1.AF]: "wherein the lid cooperates with the lip to provide a seal so that the liquid contained within the container body is sealed against leaking out from between the container body and the lid;"

372. Gardiner disclosed this feature. Gardiner described a lid for a container that had a "peripheral 140 which is shaped to be positioned [] over an open end of a can body and ***seamed thereat*** to join to the can body for forming a rim of the can." (Gardiner, 5:42-45). Gardiner further explained: "[t]he cap member is ***sealingly fixed to the body member*** at said opposite end and in a manner forming a rim at about the periphery of said opposite end." (Gardiner, 1:64-67; see also *id*., 4:33-36, 4:44-48). As described in element [1.P], a POSITA would have understood that the can body would have an element with a reciprocal shape to the peripheral 140 (e.g., a lip) at the top of the can body, over which the peripheral 140 was seamed to form a rim for the can (that is, the lid cooperating with the lip to provide a seal). A seam formed between the peripheral 140 and the reciprocally shaped structure on the container body would have enabled a lid to seal to the container body such that the container can hold a beverage. (Gardiner, 1:44-50).

hh. Element [1.AG]: "wherein, when the arm of the lid is in the first position and the weakened or scored area is not deformed: the first end portion of the arm is not positioned above the weakened or scored area of the second portion of the lid; and at least a portion of the second end portion of the arm is positioned above the weakened or scored area of the second portion of the lid;"

373. Gardiner disclosed this feature. As described in element [1.AC], Gardiner disclosed a first position for an arm, in which a corresponding weakened or scored area of a lid is not deformed, and a corresponding first end portion of the arm is not positioned above the weakened or scored area of the lid, while a portion of the second end portion of the arm is positioned above the weakened or scored area. See annotated Figure 1 of Gardiner below.



Gardiner, Fig. 1 (Annotated)

ii. Element [1.AH]: "wherein the container side wall extends between the circular neck and the base portion so that:

the upper portion of the container side wall defines a first angle: between the upper portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the middle portion of the container side wall defines a second angle: between the middle portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the lower portion of the container side wall defines a third angle: between the lower portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the first angle is an acute angle;

the third angle is an obtuse angle;

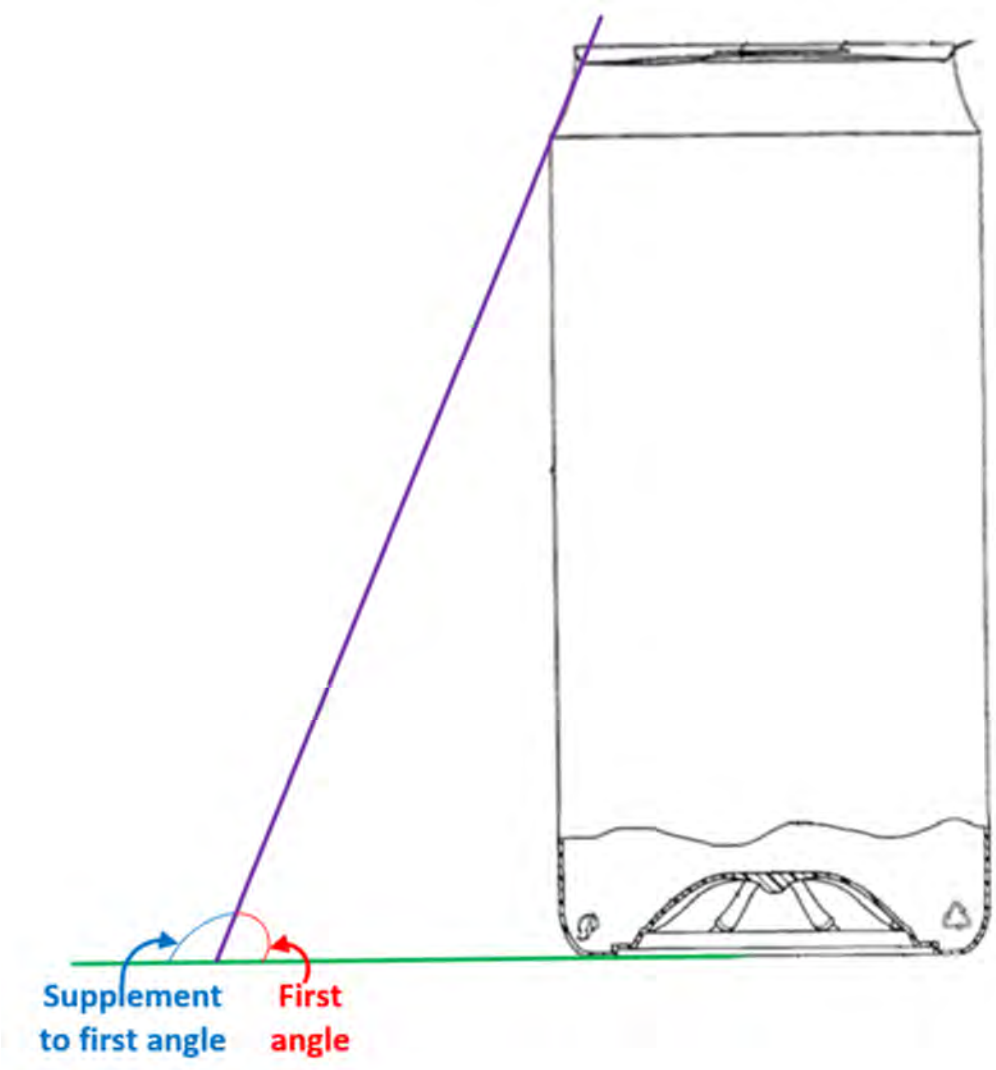
the second angle is greater than the first angle; and

the third angle is greater than the second angle;"

374. In the combination, Gardiner and Pedmo disclosed these features. The container side wall of Gardiner's container extended between the neck and the base portion from Pedmo, as discussed with respect to element [1.N].

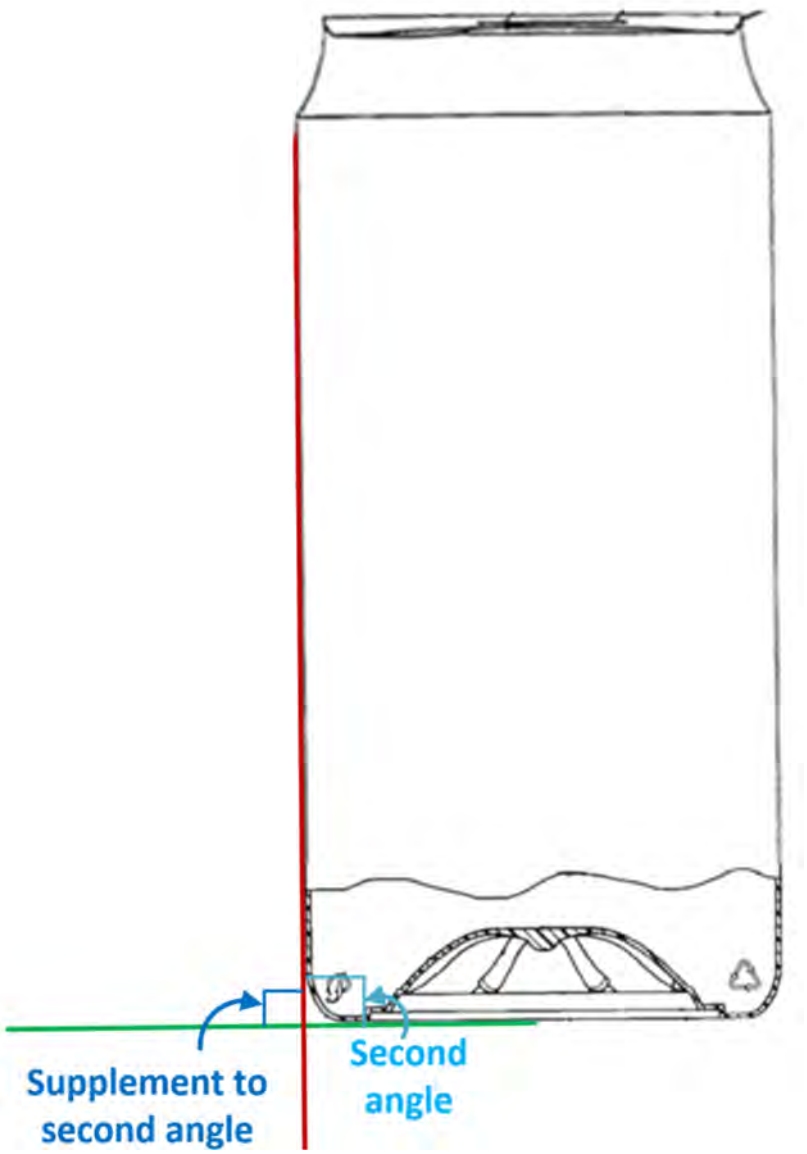
375. A first angle can be defined a portion of the container side wall that angles up to the lid (the upper portion of the container side wall) and the bottom of the base portion. As annotated in the image below combining Gardiner and Pedmo, a tangent line to the upper portion of the container side wall intersects a line parallel

to the plane of the container's bottom, forming two supplementary angles that are defined "between the upper portion of the container side wall and the bottom of the base portion." The angle facing the container satisfies the claimed requirement that the first angle be further defined "with respect to the bottom of the base portion." As shown, the first angle is acute.



Mockup of Combined Gardiner/Pedmo Container

376. A second angle can be defined between the central, vertical side wall portion of the combined container (the middle portion of the container side wall) and the bottom of the base portion, at the intersection of a line parallel to the middle portion of the container side wall and the line parallel to the plane of the container's bottom (annotated in the image of the combined Gardiner/Pedmo container below). The second angle facing the container at this intersection satisfies the claimed requirement that the second angle be further defined "with respect to the bottom of the base portion." As shown, the second angle is approximately 90 degrees.

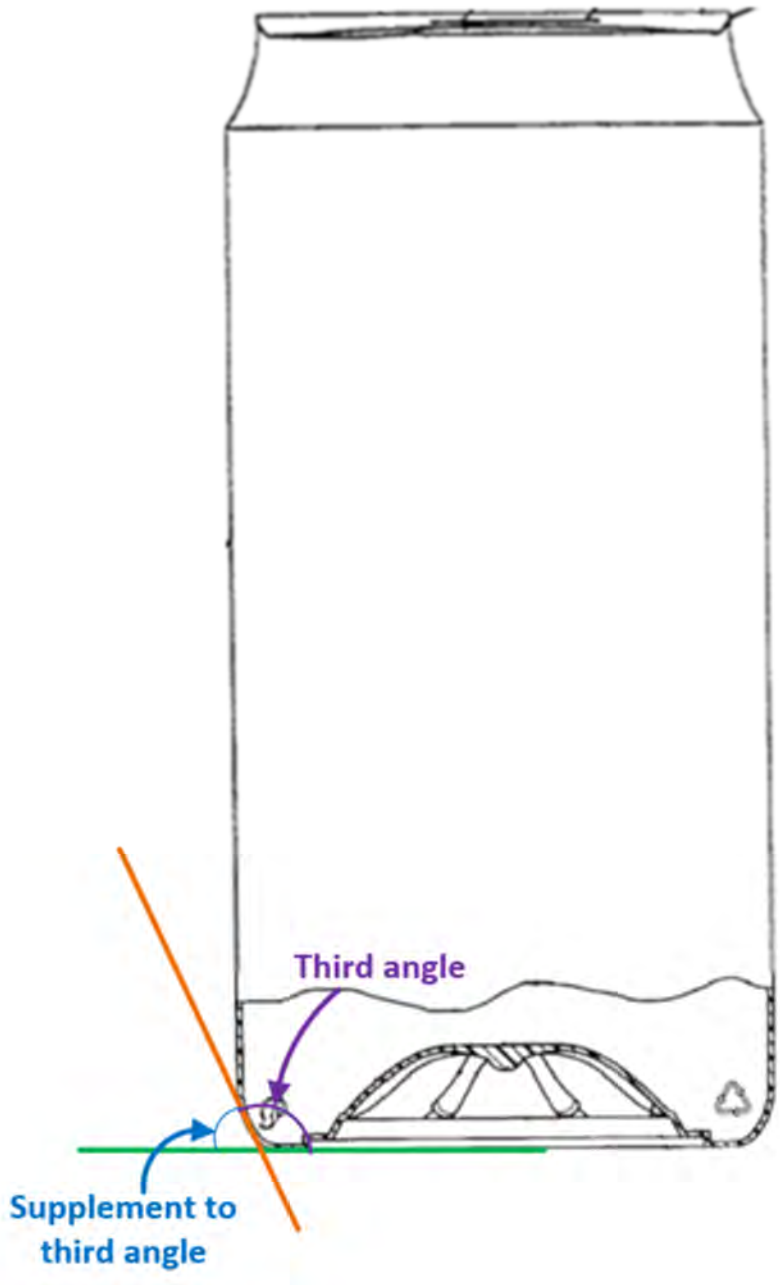


Mockup of Combined Gardiner/Pedmo Container

377. A third angle can be defined between the lower portion of the container side wall (*see* [1.N]) and the bottom of the base portion, at the intersection of a line tangent to the sidewall's lower portion and the line parallel to the plane of the container's bottom (annotated in the image of the combined Gardiner/Pedmo container below). Like the first and second angles, the third angle facing the

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container at this intersection satisfies the claimed requirement that the third angle be further defined "with respect to the bottom of the base portion." As shown, the third angle is obtuse.

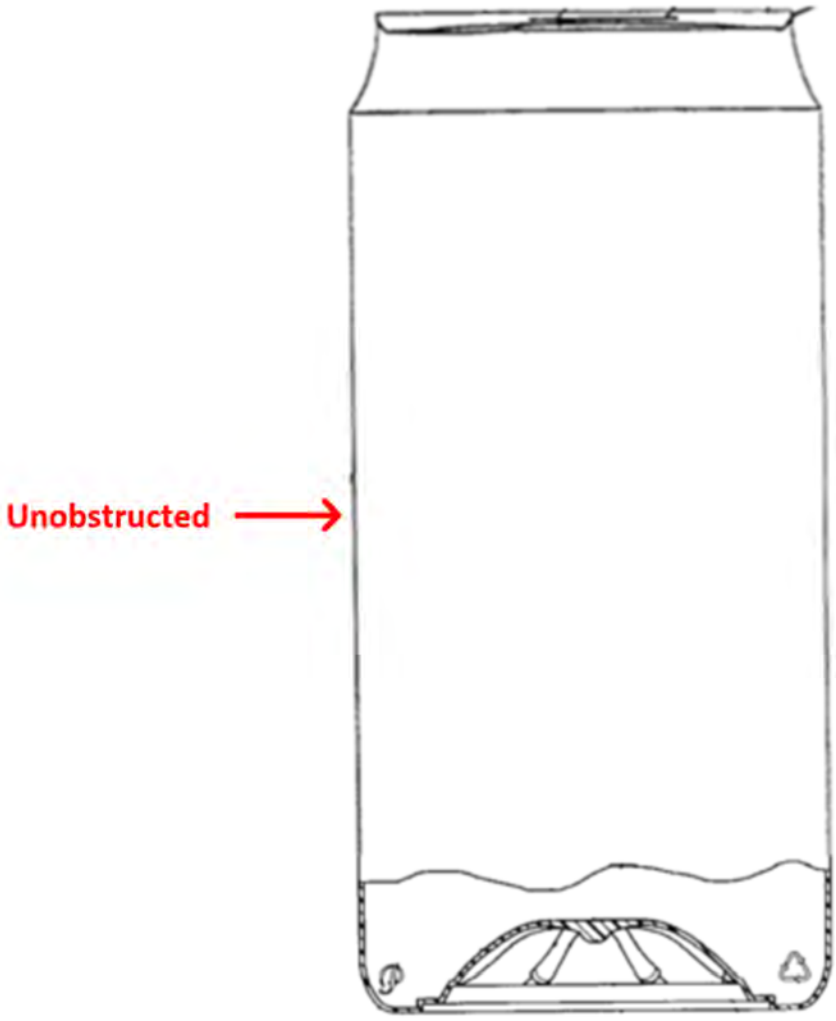


Mockup of Combined Gardiner/Pedmo Container

378. Finally, since the second angle is approximately 90 degrees while the first angle is acute, the second angle is greater than the first angle. Likewise, the third, obtuse angle is greater than the second, approximately 90-degree angle.

jj. Element [1.AI]: "wherein the interior of the container body extends continuously across the cross-sectional diameter of the middle portion at a height midway between the circular neck and the base portion so as to be interrupted, if at all, only by the liquid contained within the container body."

379. Gardiner did not indicate that there was any obstruction in the container at a height midway between the circular neck and base portion that would interrupt any liquid contained in the container. Therefore, a POSITA would have found it obvious that the container in the Gardiner-Pedmo-Brown combination would have a body with a cross-sectional diameter at its midpoint that is unobstructed and would only be interrupted with the liquid inside the container.



Mockup of Combined Gardiner/Pedmo Container

2. Claim 2: "The container of claim 1, wherein the resin is a polyethylene terephthalate (PET) resin."

380. Gardiner described how its container can be made out of a variety of materials, including plastic. (Gardiner, 2:22-24). However, Gardiner did not explicitly disclose a PET resin.

381. Instead, Pedmo provided this disclosure, explaining that PET was a material used to manufacture containers of plastic materials. (Pedmo, 3:9-10; 4:8-

9). In my opinion, a POSITA would have been motivated to use PET to manufacture the container of the combination of Gardiner, Pedmo, and Brown based on Pedmo's teaching that PET was a suitable plastic for containers (Pedmo, 3:9-10), and it was well-known to use PET for making plastic bottles (Ex. 1017, 22).

3. Claim 3: "The container of claim 1, wherein the container body is formed using a blow molding process."

382. Claim 3 is obvious at least because Pedmo explained that blow-molding is a known process for manufacturing containers. (Pedmo, 1:48-50). Also, as discussed in Grounds 1 and 3, claim 3 is obvious because claim 1 is obvious (and claim 3 recites only a process by which the container body of claim 1 is formed), and the features of claim 3 are Applicant-Admitted Prior Art.

4. Claim 4: "The container of claim 1, wherein the metal is aluminum."

383. Gardiner taught or suggested this feature because it explained that a cap member (lid) can be "made from a material comprising aluminum." (Gardiner, 7:30; see also 2:22-23 (listing various metals, including "[a]luminium, aluminium alloy, [and] steel" as being suitable materials for a container)).

5. Claim 5

a. Element [5.A]: "The container of claim 1, wherein the metal is aluminum; and"

384. The Gardiner-Pedmo-Brown combination disclosed this limitation, as explained above with respect to claim 4.

b. Element [5.B]: "wherein the resin is a polyethylene terephthalate (PET) resin."

385. The Gardiner-Pedmo-Brown combination disclosed this limitation, as explained above with respect to claim 2.

6. Claim 6

a. Element [6.A]: "The container of claim 1, wherein the container body is formed using a blow molding process; and"

386. This limitation is disclosed in AAPA, as explained above with respect to claim 3.

b. Element [6.B]: "wherein the resin is a polyethylene terephthalate (PET) resin."

387. The Gardiner-Pedmo-Brown combination disclosed this limitation, as explained above with respect to claim 2.

7. Claim 7

a. Element [7.A]: "The container of claim 1, wherein the metal is aluminum; and"

388. The Gardiner-Pedmo-Brown combination disclosed this limitation, as explained above with respect to claim 4.

b. Element [7.B]: "wherein the container body is formed using a blow molding process."

389. This limitation is disclosed in AAPA, as explained above with respect to claim 3.

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8. Claim 8

a. Element [8.A]: "The container of claim 1, wherein the metal is aluminum;"

390. The Gardiner-Pedmo-Brown combination disclosed this limitation, as explained above with respect to claim 4.

b. Element [8.B]: "wherein the resin is a polyethylene terephthalate (PET) resin; and"

391. The Gardiner-Pedmo-Brown combination disclosed this limitation, as explained above with respect to claim 2.

c. Element [8.C]: "wherein the container body is formed using a blow molding process."

392. The Gardiner-Pedmo-Brown combination disclosed this limitation, as explained above with respect to claim 2.

9. Claim 9

a. Element [9.A]: "The container of claim 1, wherein the first depression is visible through at least a portion of the container body;"

393. As described with respect to Claim 2, Gardiner described how its container can be made out of plastic (Gardiner, 2:22-24), while Pedmo disclosed that PET is a plastic that is suitable to manufacture containers (Pedmo, 3:9-10; 4:8-9).

394. A POSITA would have found it obvious that a container made from PET, as described in Pedmo, could be transparent or translucent. (Ex. 1017, 23, 28; Protais, 1:23-25). When the container body is made out of transparent or translucent

PET, a POSITA would have understood that the first depression would be visible through at least part of the container body.

395. Additionally, whether the depression is visible or not visible through the container body has no functional or structural significance whatsoever, and the '441 specification include no explanations related thereto. Therefore, this limitation merely relates to an ornamental design choice that would have been obvious to a POSITA.

b. Element [9.B]: "wherein the base portion further comprises a second depression adjacent the first depression; and"

396. In the combination, Pedmo taught or suggested this feature. As described with respect to [1.F], Pedmo disclosed a first depression in at least two ways, one of which included a first depression being a space between two of a plurality of struts 23 on the base. (Pedmo, 2:46-47; Figures 2 and 5).

397. Pedmo's container bottom also had a second depression in the form of another space between two struts. The second depression was adjacent to the first depression because both depressions were formed in part by the same strut, as illustrated in annotated Figures 2 and 5 below.

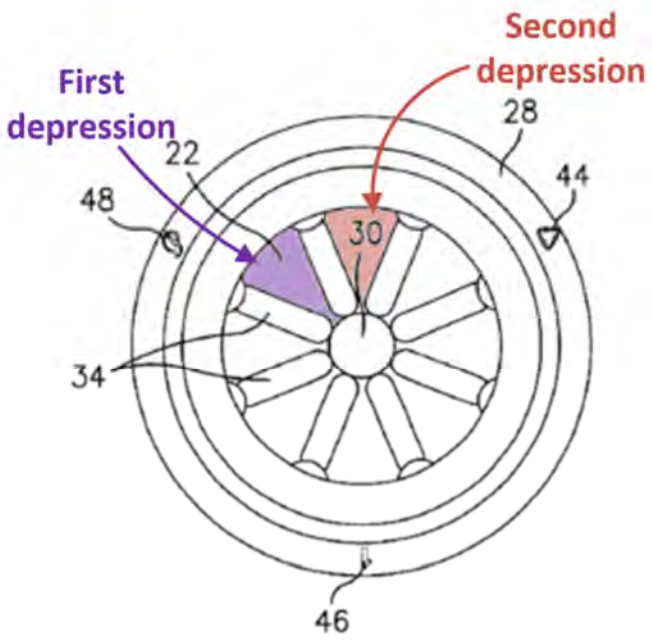


FIG. 2

Pedmo, Fig. 2 (Annotated)

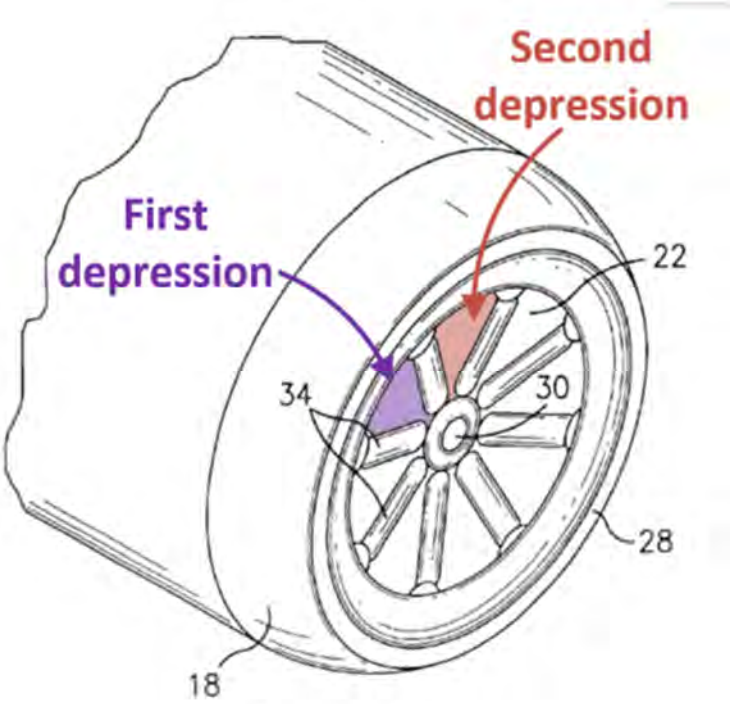


FIG. 5

Pedmo, Fig. 5 (Annotated)

398. This feature of Pedmo is similar to the '441 patent's depiction of multiple adjacent depressions (elements 115 and 115b) in Figure 3 below.

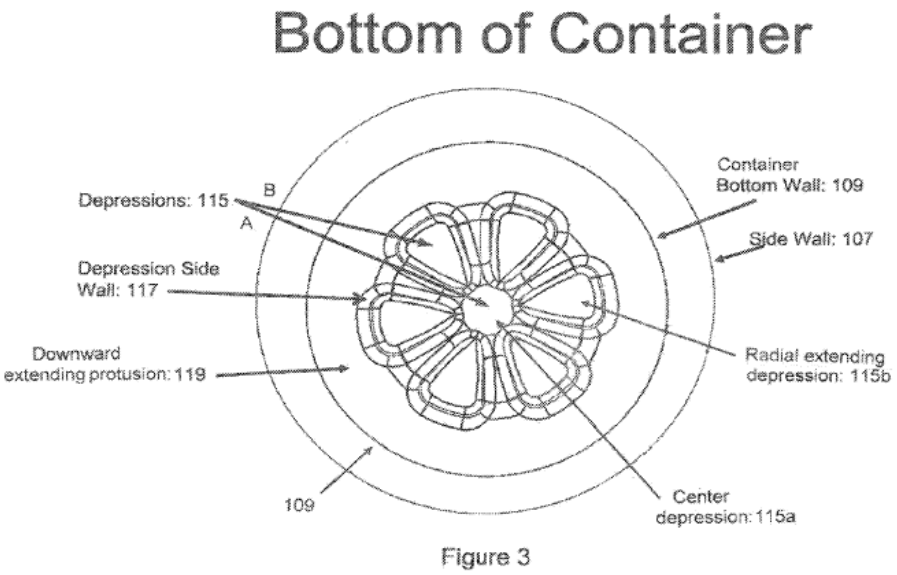


Figure 3

'441 Patent, Fig. 3

c. Element [9.C]: "wherein the second depression is visible through the at least a portion of the container body."

399. As described with respect to [9.A], a POSITA would have known that at least some plastic containers, including containers made of PET as taught by Pedmo, are translucent or transparent. Thus, for the same reason it would have been obvious for the first depression to be visible through at least a portion of the container body, it would have been obvious for the second depression to be visible through the at least a portion of the container body.

10. Claim 10

a. Element [10.A]: "The container of claim 1, wherein at least a portion of the container body is transparent;"

400. As described with respect to [9.A], a POSITA would have found it obvious that at least some plastic containers, including containers made of PET as taught by Pedmo, are transparent.

b. Element [10.B]: "wherein the first depression is visible through the at least a portion of the container body;"

401. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed for element [9.A].

c. Element [10.C]: "wherein the base portion further comprises a second depression adjacent the first depression; and"

402. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed for element [9.B].

d. Element [10.D]: "wherein the second depression is visible through the at least a portion of the container body."

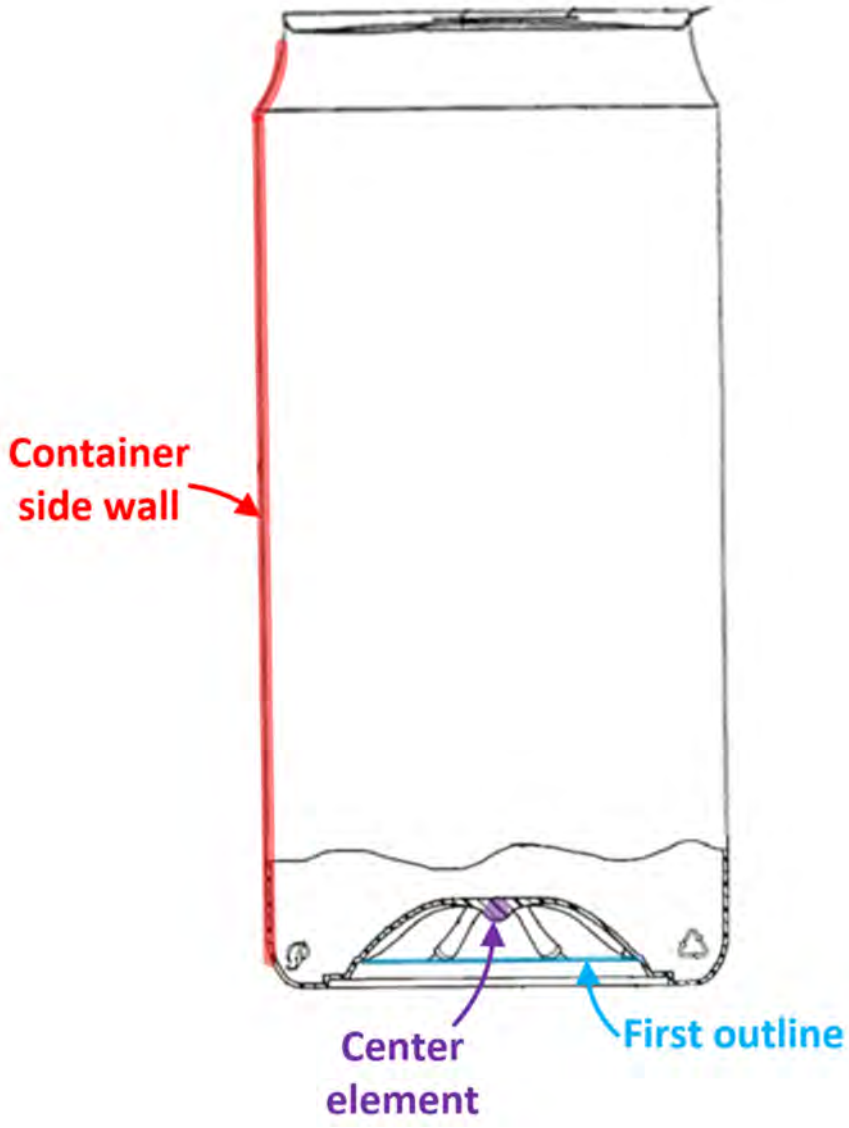
403. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed for element [9.C].

11. Claim 11: "The container of claim 1, wherein the center element of the base portion is a downward extending protrusion."

404. In the combination, Pedmo disclosed this feature. The hub 30 (center element) of the base portion disclosed by Pedmo was a downward extending

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protrusion because it had "a downwardly extending button-like portion 31." (Pedmo, 2:42-43). This also evident from the annotated figure below.



Mockup of Combined Gardiner/Pedmo Container

12. Claim 12

a. Element [12.A]: "The container of claim 1, wherein the base portion further comprises a second depression adjacent the first depression; and"

405. See element [9.B].

b. Element [12.B]: "wherein the second depression at least partially defines the first outline."

406. As described with respect to [9.B], Pedmo disclosed first and second depressions in the form of two neighboring sections of a base between struts of the base. In Figure 2, annotated below, a circular edge that traces a circumference around the "continuous curved portion 32" formed a first outline. (Pedmo, 2:43-45; Figures 2 and 5). The first and second depressions at least partially formed this first outline because an outer edge of each of the depressions partially formed the circular edge around the continuous curved portion.

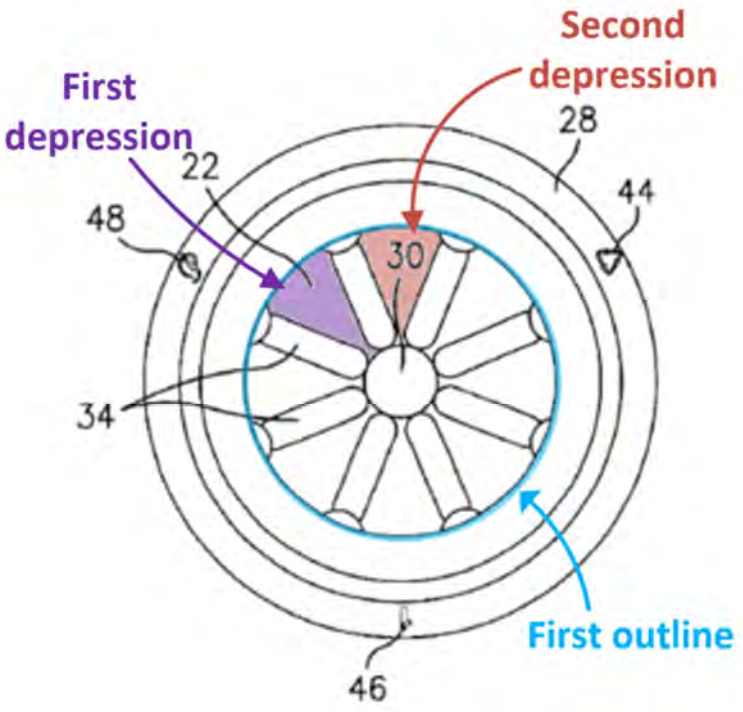


FIG. 2

Pedmo, Fig. 2 (Annotated)

13. Claim 13

a. Element [13.A]: "The container of claim 1, wherein the center element of the base portion is a downward extending protrusion; and"

407. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed for claim 11.

b. Element [13.B]: "wherein the base portion further comprises a second depression adjacent the first depression."

408. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed for element [9.B].

14. Claim 14: "The container of claim 13, wherein the second depression at least partially defines the first outline."

409. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed for element [12.B].

15. Claim 15

a. Element [15.PRE]: "A container, comprising:"

410. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.PRE].

b. Element [15.A]: "a container body, the container body defining a first opening to an interior of the container body; and"

411. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.A].

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c. Element [15.B]: "a lid connected to the container body and covering the first opening to the interior of the container body;"

412. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.B].

d. Element [15.C]: "wherein the container body is made out of a resin;"

413. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.C].

e. Element [15.D]: "wherein the lid is made out of a metal;"

414. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.D].

f. Element [15.E]: "wherein the container body comprises a container side wall and a base portion connected to the container side wall;"

415. The Gardiner-Pedmo-Brown combination disclose this element for the same reasons discussed above for element [1.E].

g. Element [15.F]: "wherein the base portion comprises a bottom and a first depression formed therein, the first depression extending upwardly from the bottom;"

416. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.F].

h. Element [15.G]: "wherein the first depression at least partially defines a first outline;"

417. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.G].

i. Element [15.H]: "wherein the base portion further comprises a center element centered with respect to the first outline at least partially defined by the first depression;"

418. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.H].

j. Element [15.I]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the container side wall;"

419. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.I].

k. Element [15.J]: "wherein each of the center element, and the first outline at least partially defined by the first depression, is centered with respect to the base portion;"

420. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.J].

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l. Element [15.K]: "wherein a cross-sectional diameter of the first opening to the interior of the container body is less than a cross-sectional diameter of a middle portion of the container side wall;"

421. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.K].

m. Element [15.L]: "wherein the base portion defines a diameter that is less than the cross-sectional diameter of the middle portion of the container side wall;"

422. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.L].

n. Element [15.M]: "wherein a lower portion of the container side wall extends downwardly from the middle portion of the container side wall to the base portion of the container body, the lower portion along its entirety being greater in diameter than the base portion, including the bottom, thereby rendering the container body stemless;"

423. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.M].

o. Element [15.N]: "wherein the container body further comprises a circular neck extending from the container side wall so that the container side wall extends between the circular neck and the base portion;"

424. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.N].

p. Element [15.O]: "wherein an upper edge of the container side wall is adjacent to the circular neck of the container body;"

425. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.O].

q. Element [15.P]: "wherein the container body further comprises a lip at an end of the circular neck opposite the upper edge of the container side wall;"

426. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.P].

r. Element [15.Q]: "wherein the circular neck is adjacent to the lip;"

427. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.Q].

s. Element [15.R]: "wherein a first portion of the lid is above the lip of the container body;"

428. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.R].

t. Element [15.S]: "wherein the first portion of the lid defines a first circular shape;"

429. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.S].

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u. Element [15.T]: "wherein the first portion of the lid further defines a second circular shape around which the first circular shape circumferentially extends;"

430. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.T].

v. Element [15.U]: "wherein the second circular shape defined by the first portion of the lid is concentric with the first circular shape defined by the first portion of the lid;"

431. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.U].

w. Element [15.V]: "wherein the first circular shape defined by the first portion of the lid is radially positioned between the container side wall and the second circular shape defined by the first portion of the lid;"

432. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.V].

x. Element [15.W]: "wherein a second portion of the lid extends horizontally and is positioned so that the second circular shape is radially positioned between the second portion of the lid and the first circular shape;"

433. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.W].

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y. Element [15.X]: "wherein the second portion of the lid defines a total area across which the second portion of the lid extends horizontally;"

434. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.X].

z. Element [15.Y]: "wherein the second portion of the lid comprises a weakened or scored area;"

435. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.Y].

aa. Element [15.Z]: "wherein the weakened or scored area is less than the total area across which the second portion of the lid extends horizontally;"

436. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.Z].

bb. Element [15.AA]: "wherein the lid further comprises an arm connected to the second portion of the lid and radially positioned within the second circular shape;"

437. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.AA].

cc. Element [15.AB]: "wherein the arm comprises opposing first and second end portions;"

438. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.AB].

dd. Element [15.AC]: "wherein the arm is pivotable from a first position, in which the arm extends horizontally and the weakened or scored area is not deformed, to a second position, in which the arm does not extend horizontally and the weakened or scored area is deformed to provide a second opening to the interior of the container body;"

439. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.AC].

ee. Element [15.AD]: "wherein an upper portion of the container side wall extends upwardly from the middle portion of the container side wall to the upper edge of the container side wall, the upper portion along its entirety being greater in diameter than the first opening to the interior of the container body;"

440. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.AD].

ff. Element [15.AE]: "wherein the container body contains a liquid therewithin;"

441. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.AE].

gg. Element [15.AF]: "wherein the lid cooperates with the lip to provide a seal so that the liquid contained within the container body is sealed against leaking out from between the container body and the lid;"

442. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.AF].

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hh. Element [15.AG]: "wherein, when the arm of the lid is in the first position and the weakened or scored area is not deformed: the first end portion of the arm is not positioned above the weakened or scored area of the second portion of the lid; and at least a portion of the second end portion of the arm is positioned above the weakened or scored area of the second portion of the lid;"

443. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.AG].

ii. Element [15.AH]: "wherein the container side wall extends between the circular neck and the base portion so that:

the upper portion of the container side wall defines a first angle: between the upper portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the middle portion of the container side wall defines a second angle: between the middle portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the lower portion of the container side wall defines a third angle: between the lower portion of the container side wall and the bottom of the base portion, and with respect to the bottom of the base portion;

the first angle is an acute angle;

the third angle is an obtuse angle;

the third angle is greater than the second angle;"

444. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.AH].

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jj. Element [15.AI]: "wherein the interior of the container body extends continuously across the cross-sectional diameter of the middle portion at a height midway between the circular neck and the base portion so as to be interrupted, if at all, only by the liquid contained within the container body;"

445. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [1.AI].

kk. Element [15.AJ]: "wherein the metal is aluminum;"

446. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for claim 4.

ll. Element [15.AK]: "wherein the resin is a polyethylene terephthalate (PET) resin;"

447. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for claim 2.

mm. Element [15.AL]: "wherein the first depression is visible through at least a portion of the container body;"

448. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [9.A].

nn. Element [15.AM]: "wherein the center element of the base portion is a downward extending protrusion;"

449. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for claim 11.

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oo. Element [15.AN]: "wherein the base portion further comprises a second depression adjacent the first depression; and"

450. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [9.B].

pp. Element [15.AO]: "wherein the second depression is visible through the at least a portion of the container body."

451. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed above for element [9.C].

16. Claim 16: "The container of claim 15, wherein the at least a portion of the container body is transparent."

452. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed for element [10.A].

17. Claim 17: "The container of claim 15, wherein the second depression at least partially defines the first outline."

453. The Gardiner-Pedmo-Brown combination disclosed this element for the same reasons discussed for element [12.B] and claim 14.

18. Claim 18

a. Element [18.A]: "The container of claim 17, wherein the base portion further comprises third, fourth, fifth, and sixth depressions; and"

454. In my opinion, Pedmo taught or suggested these features in the Gardiner-Pedmo-Brown combination. The plurality of struts of Pedmo's base (*see* Pedmo, 2:46-47; 2:52-53) formed additional depressions beyond the first and second

depression, including third, fourth, fifth, and sixth depressions as illustrated in annotated Figures 2 and 5 below.

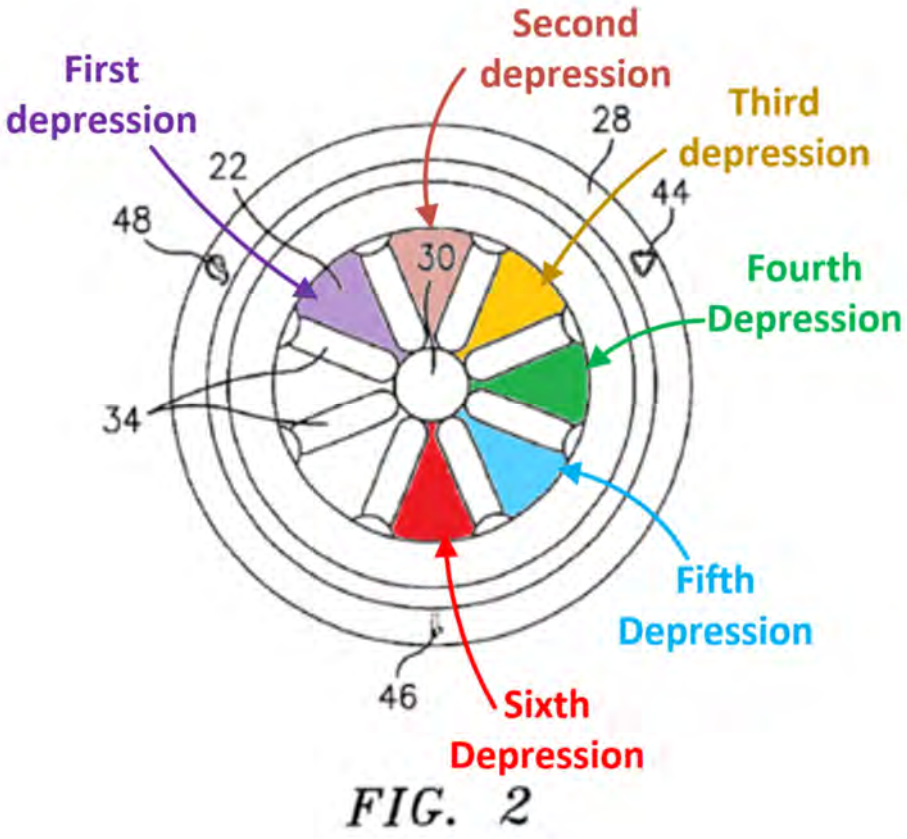


FIG. 2

Pedmo, Fig. 2 (Annotated)

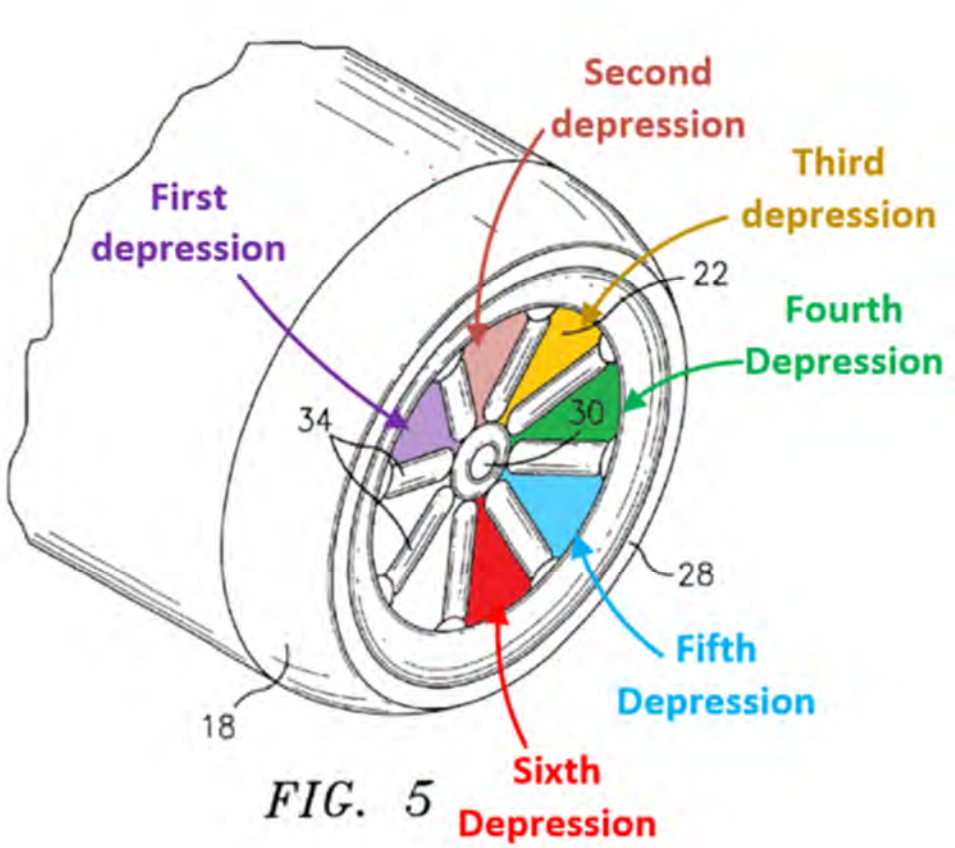


FIG. 5

Pedmo, Fig. 5 (Annotated)

b. Element [18.B]: "wherein the third, fourth, fifth, and sixth depressions at least partially define the first outline."

455. The third through sixth depressions in Pedmo further partially defined the first outline because each depression had an outer edge that formed part of the first outline. (*See* [12.B]).

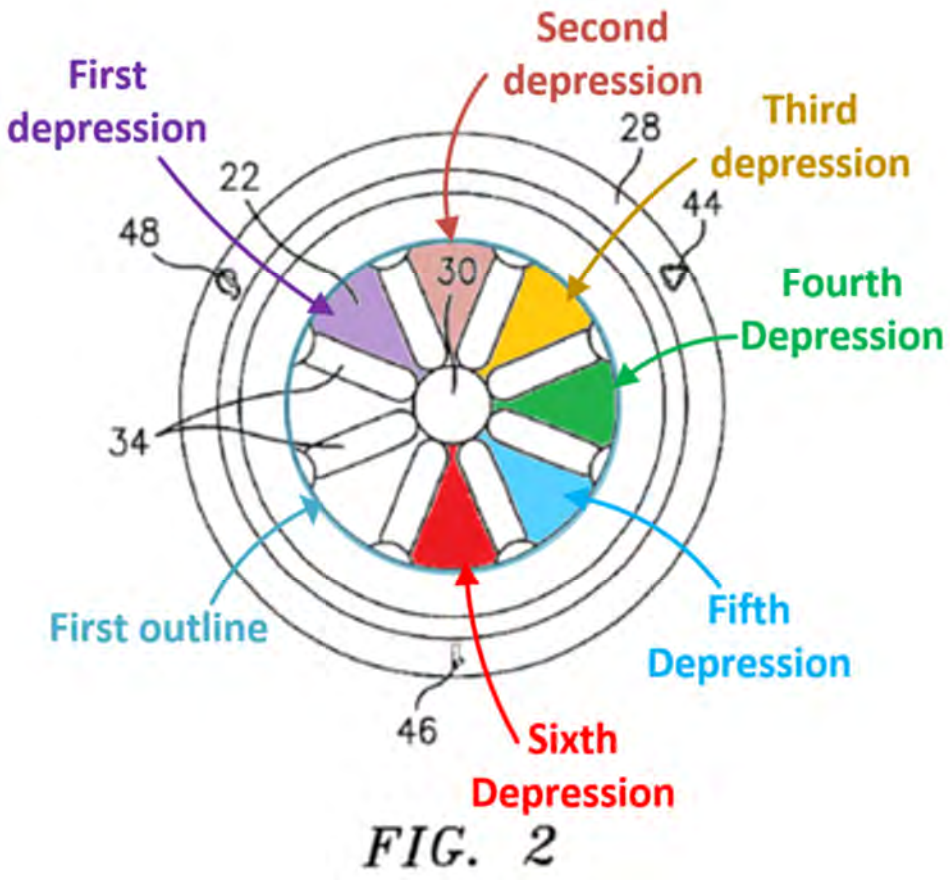


FIG. 2

Pedmo, Fig. 2 (Annotated)

19. Claim 19: "The container of claim 18, wherein the downward extending protrusion is centered with respect to the first, second, third, fourth, fifth, and sixth depressions."

456. As described with respect to claim 11, Pedmo disclosed a downward extending protrusion in the form of the hub 30. (Pedmo, 2:41-42; 2:47; 3:45). A POSITA would have found claim 19 obvious in the Gardiner-Pedmo-Brown combination because Figure 2 of Pedmo, annotated below, showed that the hub 30 (downward extending protrusion) was centered with respect to the first through sixth depressions formed between the struts 34.

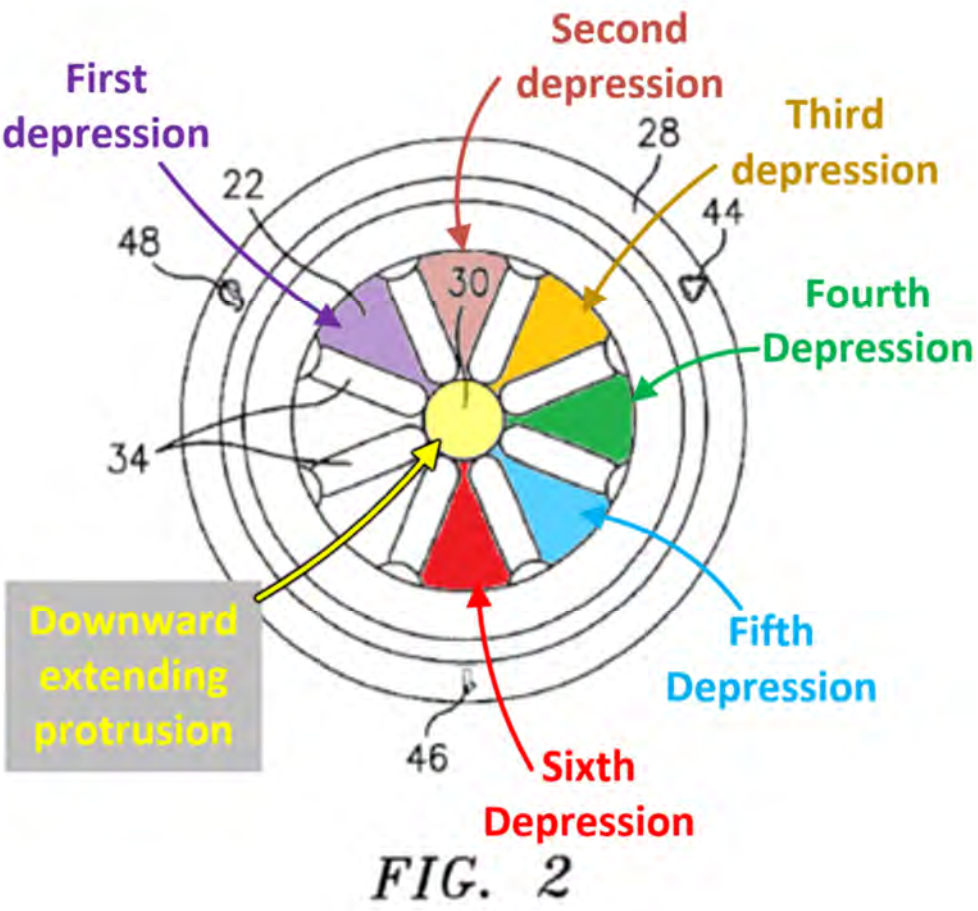


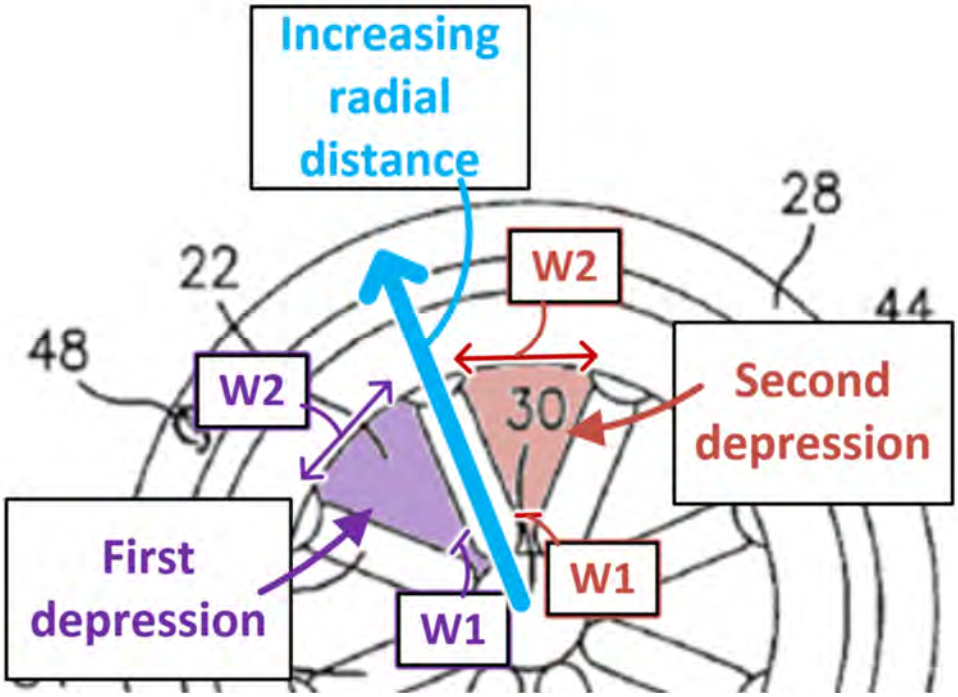
FIG. 2

Pedmo, Fig. 2 (Annotated)

20. Claim 20: "The container of claim 17, wherein each of the first and second depressions increases in width as the radial distance from a center of the bottom of the base portion increases."

457. In the combination, Pedmo taught or suggested this feature. Figure 2 of Pedmo, as annotated below, illustrated that wedge-shaped depressions (spaces between the struts of the base) had a narrower width W1 closer to the hub 30 (the center of the bottom of the base) and a wider width W2 farthest from the center. The

spaces between the struts thus increased in width as the radial distance from the center increases.



Pedmo, Fig. 2 (Cropped and Annotated)

V. CONCLUSION

458. Based on the foregoing analysis, it is my opinion that claims 1-20 of the ’441 patent are invalid.

I hereby declare that all the statements made in this declaration are based on my own true knowledge, that all statements made on information and belief are believed to be true, and that all statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001. I declare under the penalty of perjury under the laws of the United States that all statements made in this declaration are true and correct.

Dated this _6_ day of June, 2024



Nathan J. Delson, PhD

APPENDIX A

Nathan J. Delson

UC San Diego
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La Jolla, CA 92093-0411
Email: ndelson@ucsd.edu

INTERESTS Mechanical Design, Mechatronics, Robotics, Biomedical Devices, and Design Education.

EDUCATION

6/90-5/94 **Ph.D. in Mechanical Engineering**, Massachusetts Institute of Technology. Minor in Biomechanics. Thesis: "Robot Programming by Human Demonstration".

9/88 - 6/90 **Master of Science**, Massachusetts Institute of Technology. Thesis: "Design of Bracing End-Effectors for Dynamic Advantage with Application to Robotic Grinding".

9/81-6/86 **Bachelor of Science in Mechanical Engineering**
University of California at San Diego. Cum Laude.

ACADEMICS

7/20 – present **Senior Teaching Professor** Dept. of Mechanical and Aerospace Engineering, UC San Diego.

1/08 – 6/20 **Associate Teaching Professor** Dept. of Mechanical and Aerospace Engineering, UC San Diego.

1/16 – 6/19 **Inaugural Faculty Director** of EnVision: The Arts and Engineering Maker Studio.
Jacobs School of Engineering, UC San Diego.

7/99 – 12/07 **Academic Coord. and Director of the Mechanical Engineering Design Center**
Dept. of Mechanical and Aerospace Engineering, UC San Diego.

7/96 - 6/99 **Director of the Mechanical Engineering Design Studio**, Yale University Dept. of Mechanical Engineering.

7/95 – 6/99 **Lecturer**, Yale University, Dept. of Mechanical Engineering. Instruct design courses, and supervise senior and master level projects.

INDUSTRY

2016 – present **Co-founder of eGrove Education, Inc.** Developer of Educational Software.

1994 – present **Consultant**: Design Continuum, Sixense, Drivecam, and others.

6/96 – 1/08 **Co-founder of Coactive Drive Corporation.** Design of electromechanical actuator that was patented and licensed in the industry.

7/93 - 8/93 **Visiting Engineer**, Daikin Industries, LTD. Osaka, Japan.

6/92 - 6/94 **Co-founder of Sensor Lab Partnership** that developed a science education kit for handson physics and biomechanics educational experiments.

7/86 - 6/88 **Associate Structural Analysis Engineer**, United Technologies, Advanced Systems Division, San Diego CA. Structural analysis and design for manufacturability.

AWARDS

2015-16 **Best Teaching Award**, MAE Dept., Jacob School of Engineering Dean's Office
2015 **Chair's Award**, Engineering Design Graphics Division ASEE
2014 **Outstanding Teaching Award**, Warren College UC San Diego
2009-10 **Best Teaching Award**, MAE Dept., Jacob School of Engineering Dean's Office
7/05 **Best Paper Finalist**, 12th International Conference on Advanced Robotics
9/99 **Collegiate Inventors Competition Winner of Two Adviser Awards,** National Inventors Hall of Fame.

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APPENDIX B

A Clino-cladistic Look at Pull & Push Tab Patents ca.1950-1980

William D. Schroeder, M.S., R.P.A., PhD candidate—University of Montana; Cultural Heritage and Applied Anthropology

Abstract

Pull tabs revolutionized the way beverage cans and food containers were opened and their contents removed. Ermal Fraze is credited with this, yet he was not alone in the invention nor was he technically the first. Until recently, pull tabs were not considered diagnostic in Historical Archaeology because they had not yet met the 50-year-old threshold. As of 2015, ring pull tabs entered the historic era, yet relatively little is known about these artifacts. In order to place these artifacts in *terminus ante* and *post quem* timeframes for historical archaeologists who have located and will more frequently encounter these items of disposable material culture, a database with hyperlinks has been built to provide an archival reference. There are hundreds of patented variations and manufacturing methods in the United States Patent and Trademark Office filed and accepted between ca.1950 and 1980 yet really only two genl—pull and push, and four species—"snap top," ring pull, stay-tab, and push button. Taking a cue from biology, the inventions were arranged by family based on the first instance of a morphological characteristic (clade) and by progenitors (inventors) then put in numerical/chronological order based on their patent or design filing and/or acceptance dates (cline) thereby generating a genealogy or family tree thereby charting their evolution. Not all patents or designs saw nationwide production or distribution; some never saw production. Not all patents, designs, or innovations are represented here. And, one should keep in mind the "time lag" between a patent's filing, patent pending production, and its official acceptance. Products also had a use life and disposal period that often extended past its manufactured date range. Functional ease, compatibility with can manufacturing machinery, reduction of harm, and externalities also influenced the food and beverage container industry to "build a better mousetrap." Then there's "Sister Frange"....

1950

Key-wound tear strips were first used to provide a convenient means of opening sealed tin-plated steel food cans/containers in 1866. Over 100 tin manufacturers incorporated as the American Can Co. (ACCO) in 1901. Edwin Norton—a canner since 1866—renamed the Norton Tin Can and Plate Company and founded Continental Can Co. in 1904, the second largest can manufacturer in the US[1]. National Can Co., founded in 1929, became the third largest. The US Government sued the American Can Co. in 1913 stating the "Tin Can Trust" restrained trade and arbitrarily fixed prices and so should be dissolved[2]. All three restructured, renamed, and re-branded several times. All three devised means of opening can ends more reliably, easier, and safer.

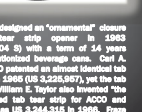
Ermal "Ernie" Cleon Fraze founded the Dayton Reliable Tool and Manufacturing Co. in 1946. Legend has it that Fraze invented the pull tab out of frustration and necessity while on a camping trip in 1959. There had to be an easier way to open a beverage can than with a church-key opener.

Over 76% of US beer producers adopted Fraze's can by 1965. John S. Bozek and John Henchert of the Continental Can Co., William E. Taylor of the American Can Co., and Daniel Cudzik of Reynolds Aluminum Co. improved on Fraze's patents and were his strongest competitors in opening means and designs. An exemplar from the first six-pack of Iron City Beer produced in 1963 featuring the new "Easy-open can" manufactured by the Aluminum Company of America (Alcoa, Inc.) is held in the Wright State University archives along with bench drawings and other Ermal Fraze memorabilia[3].

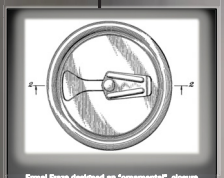
[1]https://www.britannica.com/biography/Edwin-Norton.
[2]New York Times, November 30, 1913. Retrieved on February 24, 2017.
[3]www.libraries.wright.edu/special/collections/rare/files/mss47.pdf



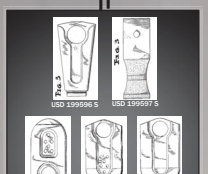




1960

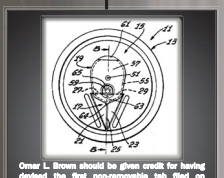


Ermal Fraze designed an "ornamental" closure with a tear strip opener in 1963 (USD 196,604 S) with a term of 14 years which revolutionized beverage cans. Carl A. Huth of ACCO patented an almost identical tab to Fraze's in 1965 (US 3,225,967), yet the tab is angled. William E. Taylor also invented "the same" angled tab tear strip for ACCO and published it as US 3,444,315 in 1966. Fraze responded with another very similar tab design featuring an elliptical rivet and a bulb opening (US 3,237,744) in 1966.

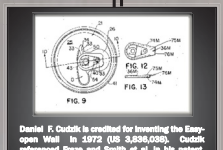


John S. Bozek invented and designed several can openers and closures for Continental Can Co. Design 239,056 was based on the shape of a garter supporter. Other designs featuring a solid riveted tab were called U-tabs because of their vernacular "U" shape. Bozek and Fraze competed neck and neck through the early 1960s for more efficient and utilitarian designs for beverage can opening devices.

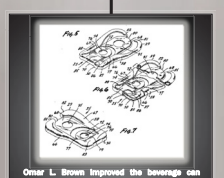
1970



Omer L. Brown should be given credit for having devised the first non-removable tab filed on October 13, 1967 (US 3,446,389). The idea underwent several refinements before it became a reliable opening means. Note the inward-folding triangular push panel of this patent. Later designs would feature round or oblong openings. Non-removable tabs and tear strips became a necessity for retaining valuable Aluminum.

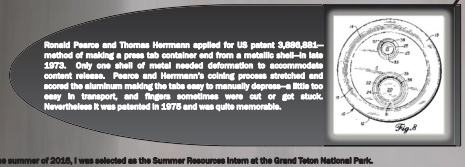


Daniel F. Cudzik is credited for inventing the Easy-open Well in 1972 (US 3,836,038). Cudzik referenced Fraze and Smith et al. in his patent. Cudzik designed for Reynolds Metals Co. and they became a competitor in the can market with the new apparatus in 1974. Cudzik donated a can to the Museum of Modern Art under Architecture and Design with Alcoa as the maker.

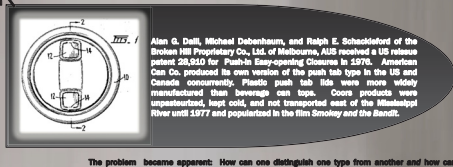


Omer L. Brown improved the beverage can opening experience as well as means with US patent 4,024,981. Ermal Fraze was assigned it in 1977. The new lift tab assembly was called an Easy-open Ecology End, more commonly referred to as a Non-detachable or Stay-tab.

1980

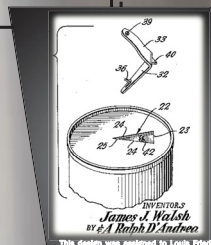


Ronald Pearce and Thomas Herrmann applied for US patent 3,896,961—method of making a press tab container and from a metallic shell—in late 1973. Only one shell of metal needed deformation to accommodate content release. Pearce and Herrmann's coining process stretched and scored the aluminum making the tabs easy to manually depress—a little too easy in transport, and fingers sometimes were cut or got stuck. Nevertheless it was patented in 1976 and was quite memorable.



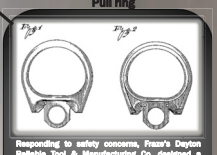
Alan G. Dalli, Michael Debenhaum, and Ralph E. Schackleford of the Broken Hill Proprietary Co., Ltd. of Melbourne, AUS received a US release patent 28,910 for Push-in Easy-opening Closures in 1978. American Can Co. produced its own version of the push tab type in the US and Canada concurrently. Plastic push tab lids were more widely manufactured than beverage can tops. Coors products were unpasteurized, kept cold, and not transported east of the Mississippi River until 1977 and popularized in the film *Smokey and the Bandit*.

1955

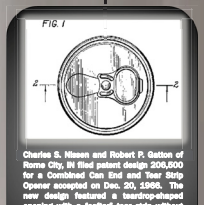


This design was assigned to Louis Fried and was based on the previously filed US patent 2,790,577 and Australian patent AU 19,570,2074, a container top and opener, in 1963. James J. Walsh, Jr. was a General Manager of Sales at Bethlehem Steel during his lengthy career. It is not known if Ralph D'Andrea and Louis Fried also worked there and created inventions with Walsh.

1965



Responding to safety concerns, Fraze's Dayton Reliable Tool & Manufacturing Co. designed a better beverage can opening device in 1965 which resembles Sellihen's and John E. Walsh's patents except that the ring pull is attached to a bung as opposed to being a solid metal ring or being soldered in place. Little is known about Omer L. Brown except he stayed in Dayton, OH until his death in 1999 at the age of 92. Brown provided Fraze's company with numerous designs and patents which were means assigned to Ermal Fraze including the "Pull Tab for a Tear Strip Opener" (USD 209,080 S).



Charles S. Nissen and Robert P. Gatton of Rome City, IN filed patent design 206,500 for a Combined Can End and Tear Strip Opener accepted on Dec. 20, 1966. The new design featured a teardrop-shaped opening with a "softer" tear strip without sharp "pointed" edges. The teardrop shape would dominate the market until ca. 1975 when the Stay-tab was widely produced. Variations on the teardrop shape included bowling-pin-shaped, propeller-like, "dog bone," and narrow rectangular tear strips ca. 1968.

1975



In evolutionary biological terms, there are two family lines based on morphological characteristics, i.e. clades: *Pull* and *Push*. There are four "species": *Pull solid*, *Pull ring*, *Push button* and *Push* Stay-tab. (And then there's "Frangle.") Their changes over time or historical trajectories might be said to constitute clines. I have arranged the evolution of beverage can opening means as if a genealogical family tree. There are hundreds of "patent children" that are not represented here; only the first patent (parent) for a particular "species" of opening type.

In the summer of 2015, I was selected as the Summer Resources Intern at the Grand Teton National Park. My assignment was to locate trace evidence of turn of the century Mormon and non-Mormon homesteads and settlements near the historic towns of Mormon Row and Kelly, WY within the park's boundaries. I was also tasked with locating previously unidentified irrigation network features that served the historic communities. While attempting to locate an irrigation ditch, I happened upon an area near Kelly, WY which was used for generations as the "town dump." Historic-era refuse before the Gros Ventre Slide of 1925 and Flood event of 1927 was washed away from the landscape. Large scour marks from the flood created pockets where refuse was later deposited until the 1990s when Park clean-up events took place. The resultant archaeological concentrations chronicle a small community's disposable material culture from ca.1930 to 1990 and contains numerous food and beverage cans, bottles, and other artifacts close to the surface. Having already devised a "key card" for handy field reference of beverage can pull tab types, I was delighted to find a nearly complete series of the most commonly and widely produced "snap top" and ring-pull tab types.

The problem became apparent: How can one distinguish one type from another and how can they be chronologically ordered so that their historic or non-historic (or not yet historic) status can be discerned? The only reliable form of information on this can be found in the United States Patent and Trademark Office (USPTO) records. There, the inventor(s), assignee(s), date of filing, date of acceptance, and any referenced, competing, or international patents and designs are all listed as well as full descriptions of the invention, innovation, or production method. The next task was to build a database of this information with images so that an artifact such as a pull tab or container end opener can be correctly identified and a date range ascribed. By searching the USPTO and Google Patents, I was able to locate predecessors and precursors that better elucidate the evolution of these innovations and inventions of material culture. Unfortunately, few obituaries or biographies were written about the inventors and designers; only Ermal Fraze, the purported inventor of the Snap Top and a prototype aluminum can donated to the Museum of Modern Art by Daniel Cudzik stand out as testaments to the progenitors of pop-tops. Often more is known about the factory or company than the employees who made them successful.

EX-1002 PGR2024-00035

APPENDIX C

United States Patent [19]

Fraze et al.

[11] **4,286,728**

[45] **Sep. 1, 1981**

[54] **TAB AND ECOLOGY END**

[75] Inventors: **Ermal C. Fraze**, 355 W. Stroop Rd., Dayton, Ohio 45429; **Omar L. Brown**, Dayton, Ohio

[73] Assignee: **Ermal C. Fraze**, Dayton, Ohio

[21] Appl. No.: **139,248**

[22] Filed: **Apr. 11, 1980**

[51] **Int. Cl.**[3] **B65D 17/34**

[52] **U.S. Cl.** **220/270**

[58] **Field of Search** 220/269, 1, 273

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,015,744	4/1977	Brown	220/269
4,024,981	5/1977	Brown	220/269
4,030,631	6/1977	Brown	220/269
4,084,410	4/1977	Brown	220/269
4,183,445	1/1980	La Cross	220/269

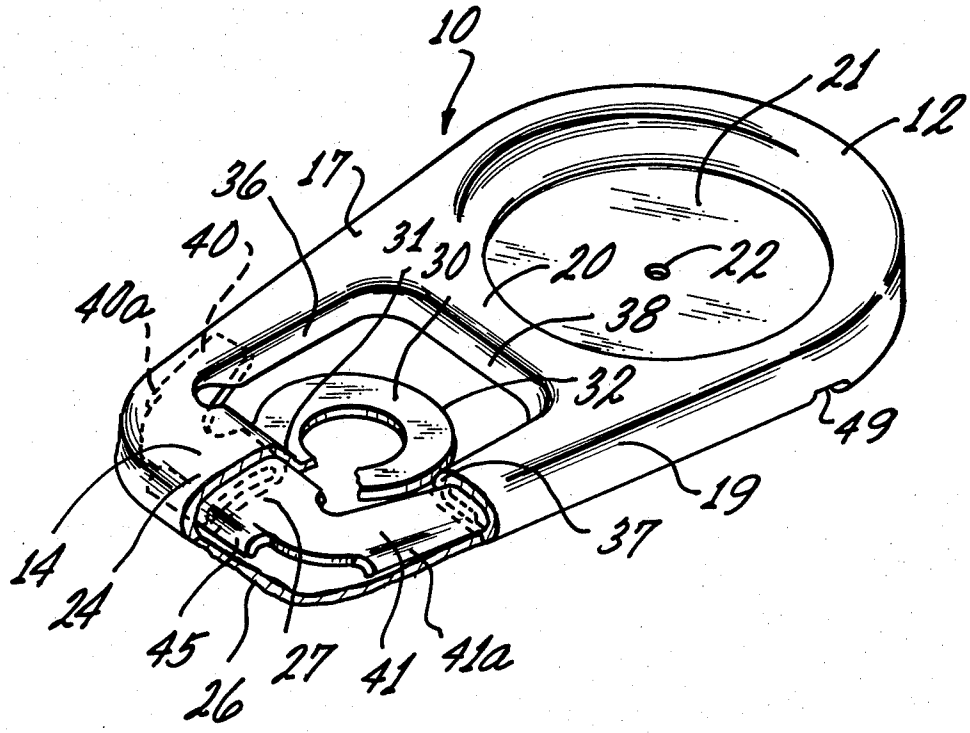
Primary Examiner—George T. Hall

Attorney, Agent, or Firm—Smyth, Pavitt, Siegemund & Martella

[57] **ABSTRACT**

A tab for easy opening ends including a lifting end and an opening end and spaced side legs is improved by the use of finger means extending from the opening end towards the lifting end, the finger means including flanges which stiffen the finger. The lifting end is formed of a smooth unbroken curl of sheet material.

14 Claims, 6 Drawing Figures



EX-1002 PGR2024-00035

Fig. 1

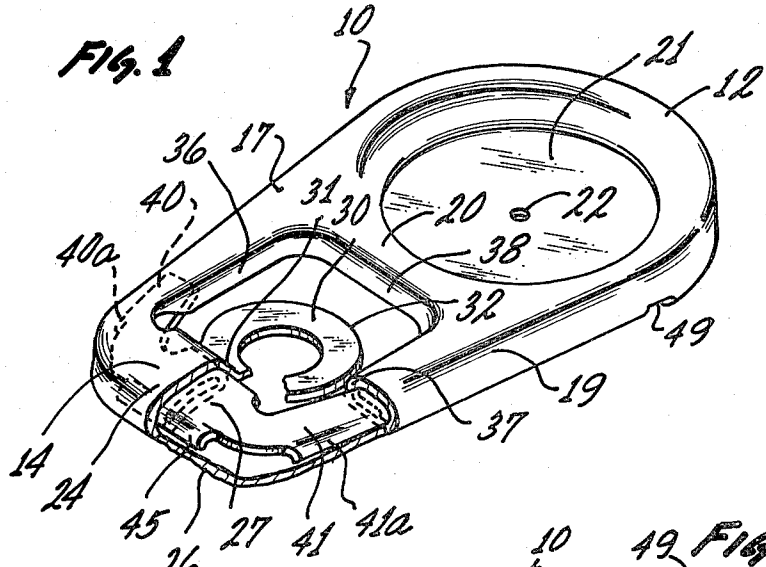


Fig. 2

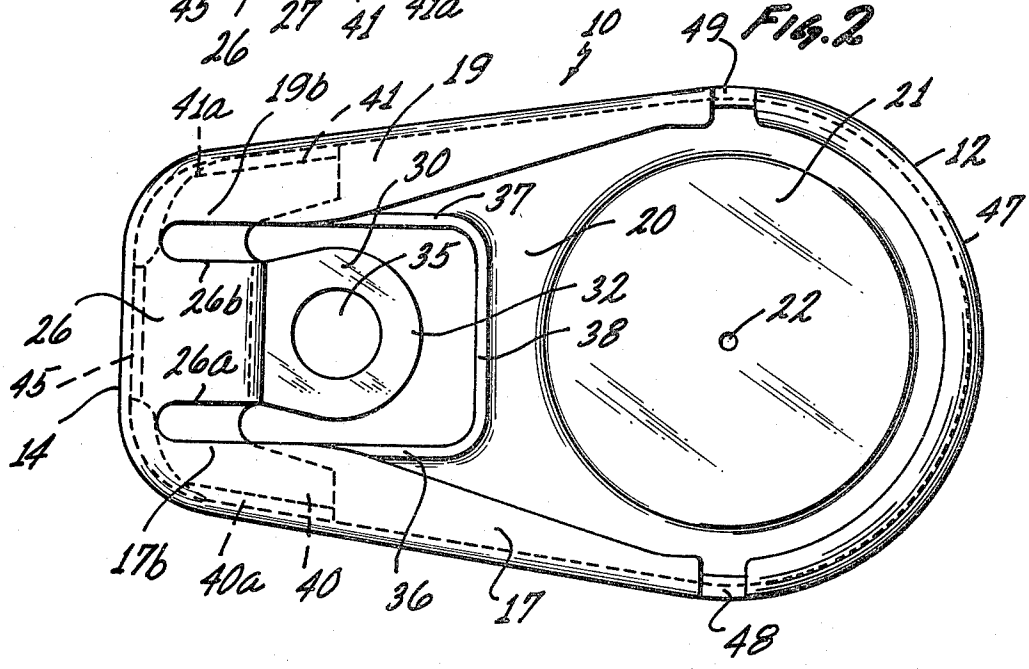


Fig. 3

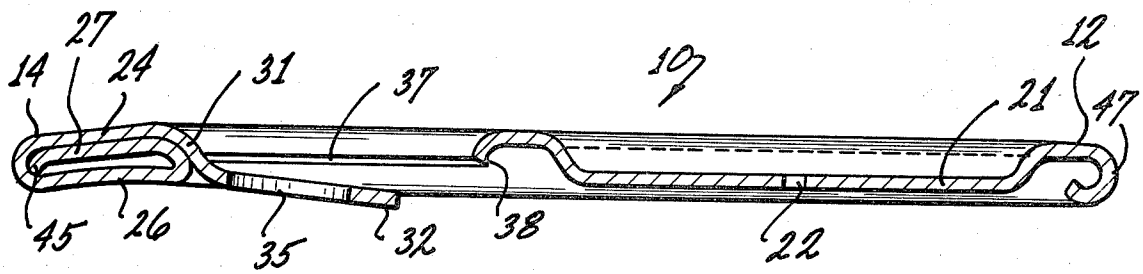


Fig. 4

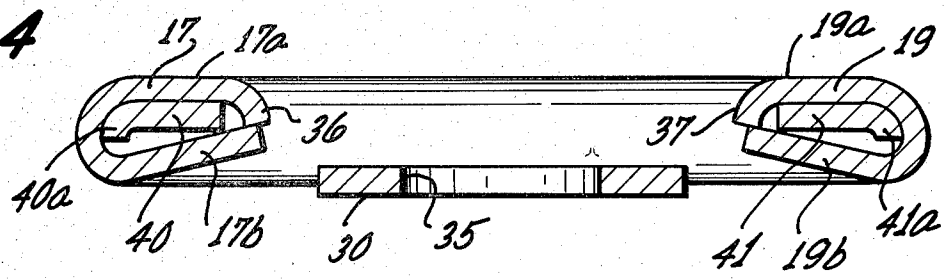


Fig. 5

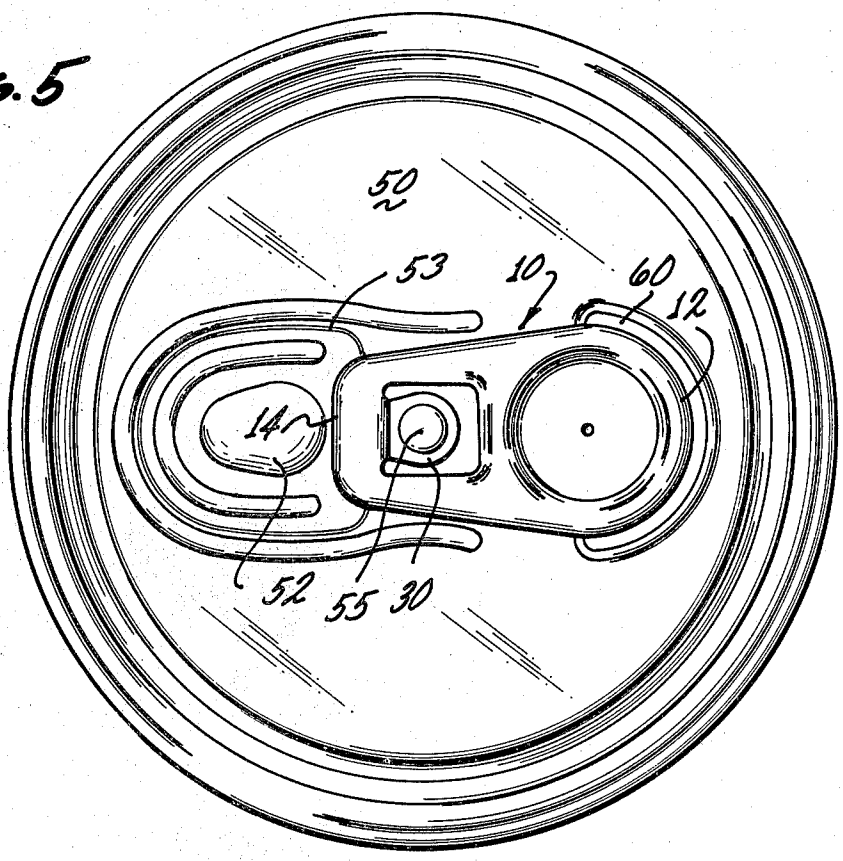
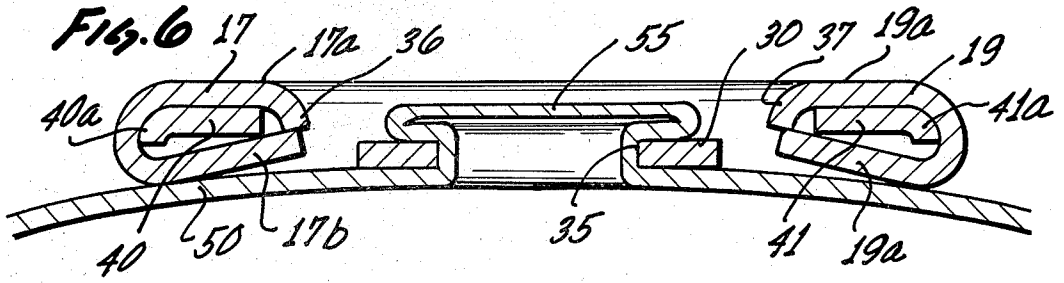


Fig. 6



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TAB AND ECOLOGY END

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to easy-opening can ends and more particularly to an improved tab of increased longitudinal strength for use as a retained tab on an improved ecology-type can end.

2. The Prior Art

It is known in the art to provide container end wall structures which include a retained tab and a retained tear strip so that in use, no container component is separated to form litter. These type containers and end structures have been referred to as ecology ends.

Typical of one form of ecology ends are those shown and described in U.S. Pat. Nos. 4,024,981 and 4,084,410 of May 24, 1977, respectively and Apr. 10, 1979, assigned to the same assignee.

U.S. Pat. No. 4,024,981 describes an improved longitudinally rigid tab and an improved end structure wherein the tab initially acts as a class 2 lever to initiate fracture of the portion of the scoreline immediately in front of the rivet. Thereafter the tab operates as a class 1 lever to complete fracture of the scoreline and to push the retained pour panel downwardly, the panel being retained on the end wall.

U.S. Pat. No. 4,084,410 relates to a tab with increased resistance to removal by bending of the tab through the provision of a plurality of bending regions.

Regardless of the details of the structure of the tab, those tabs intended to be used in ecology-type ends require substantial longitudinal rigidity especially if the tab is intended to function as a class 2 and then a class 1 lever in an opening sequence.

In the tabs described in the above patents, longitudinal rigidity was achieved by curling the side legs of the tab to provide a double thickness of metal extending essentially from the front to the rear of the tab. Additionally the front end of the tab is formed of multiple layers of sheet material, preferably of one piece.

Initially, tabs as described were manufactured from aluminum alloy sheet stock of 0.018 inch thickness, and operated satisfactorily. Such tabs included an intermediate web of material at the front end of the tab, the web including space finger elements extending rearwardly and disposed within the folds of the side legs and terminating approximately at the forward end of the aperture in the flap and through which the rivet extends to attach the tab to the end wall. This structure was found to be of sufficient longitudinal strength when the tab was fabricated of sheet stock of 0.018 inch thickness. The price of aluminum has, however, increased significally and thus, there has been a tendency to use thinner stock, i.e. 0.016 inch thick material, in the fabrication of tabs. The result has been that under certain circumstances there have been tab failures where the tabs have been fabricated of lighter stock in order to save in material costs.

For example, some beverages are packed under substantial pressure or exposed to substantial pressure during the packing operation. In such cases the scoreline normally includes a relatively high residual, i.e. the dimension of the unscored metal beneath the score area is comparatively high. The result was that in some instances, tabs of the lighter stock, i.e. 0.016 inch material, failed by bending in a zone in front of the rivet and to the rear of the front of the tab. The observed mode of

failure appeared to be the pulling of the fingers out from under the curls along the side legs, or actual bending of the side legs, or both. In other instances tab failure appeared to result from the fact that the tab was misaligned, i.e. rotated about the rivet with the result that a portion of the nose of the tab was over the end wall rather than being over the pour panel, with the result that tabs of the thinner stock exhibited a tending to fail by bending, as described.

It has also been noted, in some instances that the scoreline in front of the rivet was prematurely rupturing under certain circumstances. More particularly, the tab is attached to the end wall by a rivet which passes through an aperture in the ear of the tab, the ear being located to the rear of the nose or opening end of the tab, and the scoreline including a portion immediately in front of the rivet. In some instances the end wall of the packed container is slightly bulged due to pressure developed during packing or because of the internal pressure of the container, or both.

In such cases, it is believed that the entire tab is raised a very small distance above the end wall, i.e. there is a small vertical clearance between the underside of the tab and the end wall. Normally such a clearance presents no problem, except it has been observed in some instances that there was premature fracture of the portion of the scoreline to the front of the rivet. It is believed that such premature fractures, when they occur, are caused by the normal vibration of the stacked containers during shipping.

It is believed that the vibration is transmitted to the tab and through the tab ear to the rivet with the result that the portion of the end wall around the rivet is stressed through the vibration, in a vertical direction, of the tab, the latter being free to move up and down because of the small clearance between the underside of the tab and the end wall.

SUMMARY OF THE INVENTION

The improved tab and end structure of the present invention are achieved by substantially increasing the longitudinal rigidity of the tab to such an extent that even if fabricated of thinner sheet stock, the tab has sufficient longituidinal rigidity to overcome substantially failure by bending. The improved tab also is structured such that the tab may be mounted on the end was so as to contact the end wall so that forces created by vibration are transmitted over the entire tab and to the underlying end wall rather than through the ear of the tab and to the rivet.

To this end, the fingers have been increased in length to extend rearwardly from the opening end to approximately the midpoint of the rivet opening in the ear. The fingers are also provided with flanges, extending downwardly, and which operate to increase the strength of the fingers and thus the tab in a longitudinal direction. Increase longitudinal strength is also provided by providing flange means on at least a portion of the upper layer of the side legs so that in that portion, the fingers are clamped between the layers forming the side legs.

Further, the tab ear may be oriented with respect to the body of the tab so as to be angled in a downward direction prior to assembly of the tab to a container end wall. In this way, once assembly to the end wall by the rivet, the tab is in contact with the end wall so that forces transmitted to the tab, i.e. as the result of vibration in handling and shipping of the packed containers,

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is transmitted through the tab to the end wall rather than through the tab ear to the rivet for localized stressing of the end wall and possible rupture of the portion of the scoreline in front of the rivet.

As will be apparent from the following detailed description, a much improved tab and container end structure are disclosed, both with reference to a preferred form of the structure, it being understood that the configuration of the tab and its appearance may vary from that described, and yet may include the features and advantages of the present invention which may be best understood by reference to the following description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view in perspective, with portions thereof broken away, illustrating the tab structure of the present invention;

FIG. **2** is a plan view of the underside, i.e. what is sometimes called the non-public side of the tab of the present invention;

FIG. **3** is a view partly in section and partly in elevation taken along a line extending longitudinally through the center of the tab of this invention, which for purposes of illustration is of a slightly larger scale than is illustrated in FIG. **2**;

FIG. **4** is a sectional view of the tab of this invention taken transversely of the tab aproximately midway through the rivet hole;

FIG. **5** is a plan view of a container end wall having mounted thereon a tab in accordance with this invention;

and

FIG. **6** is a sectional view, similar to FIG. **4**, but illustrating the tab of this invention mounted on the end wall as shown in FIG. **5**.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings which illustrate a preferred form of the structural features of the present invention, FIGS. **1** and **2** show a tab **10** which may be formed of sheet material, for example, aluminum alloy sheet of a thickness of about 0.0016 inch or more, in the usual fashion through a progressive die set which performs a series of operations on tab sheet stock. The tab **10**, which may be formed of a single sheet of material, includes a lifting end **12** at the rear end thereof and an opening end **14** at the front end thereof.

Extending from the opening end to the lifting end of the tab are spaced longitudinally extending side legs **17** and **19** each of which may be formed of a curled double layer of sheet material, as illustrated. Extending between the legs **17** and **19** and towards the rear of the tab is an upper web of sheet material **20** including a depression **21** therein, the web and depression constituting a substantial portion the upper surface of the tab. As shown there is an indexing aperture **22** used as a pilot during progressive die formation of the tab.

As illustrated in FIGS. **1-3**, the opening end **14** of the tab may be formed of multiple layers of sheet material, as illustrated, including an upper layer **24**, a lower layer **26** and an intermediate layer **27**. Immediately to the rear of the opening end of the tab is an ear **30** which is formed as a continuation of the upper layer **24** but which extends rearwardly and downwardly through a bend area **31**. The rear end **32** of the ear extends below the front end of the tab, in the unmounted condition of the tab, as seen in FIG. **3** for reasons which will be explained. The ear is provided with an aperture **35** through which a rivet may pass for fastening the tab to an end wall.

In the form illustrated, the lower-most layer **26** has a width corresponding approximately to the width of the ear **30** in the bend area **31** and includes sides **26***a* and **26***b* which are spaced from the opposing portions lower curls **17***a* and **19***a*, respectively, at the forward end of the tab as seen in FIG. **2**. Moreover, the ear **30** is spaced from each of the side legs **17** and **19** which, in the area adjacent the ear, each includes a downwardly extending flange **36** and **37** which is continuous with a flange **38** located to the rear of the ear and which forms a part of the upper web **20** of sheet material. These flanges provide strength in addition to providing a smooth contour to reduce the possibility of finger laceration.

The center layer **27** of the front end of the tab, as seen in FIGS. **1** and **2**, extends the width of the front end of the tab and includes two fingers **40** and **41** extending towards the rear of the tab and terminating at approximately the centerline of the rivet aperture **35**. In the form shown, the free ends of the fingers are slightly narrower than the remaining portion such that the width dimension of the finger gradually increases from the rear to the forward end. The forward end of the center layer **27** includes a downwardly forward flange **45** which extends along the sides **40***a* and **41***a* of each of the fingers **40** and **41**, respectively to form a downwardly extending flange extending longitudinally along a substantial portion of the length of each finger. The longitudinally extending and downwardly depending flanges operate to increase longitudinal rigidity of the tab.

As seen in FIGS. **2** and **3**, the rear end of the tab includes a smooth outer peripheral surface forward by the curl **47** which, as shown, substantially prevents contact with the free edge of metal. In fact, except for segments **48** and **49** which are used to hold the tab blank in the progressive strip during manufacture, substantially the entire outer peripheral surface of the tab is smooth and unbroken. Segments **48** and **49** each include a small segment which is folded under the follow the outer curl contour and the rip-off point is space inwardly away from the outer side surface such that in plain view it is difficult to see the rip-off section. Since this type of tab is not a pull-ring type, but one in which the finger is inserted under the rear end in an opening sequence, a smooth rear configuration has practical advantages.

As seen in FIGS. **2** and **4**, each of the side legs **17** and **19** is curled to form a multiple layer leg, the upper layer **17***a* and **19***a* of which are essentially flat and coplanar with the web **20**. The lower layers **17***b* and **19***b*, respectively are angled upwardly, as seen in FIG. **4**, the width dimension of the legs in the vicinity of the fingers is greater than that of the respective finger such that layers substantially enclose the corresponding finger therebetween.

As shown, the inner surface **36** and **37** of the upper surface **17***a* and **19***a* of each of the legs is downwardly flanged to contact the respective lower layer **17***b* and **19***b* inwardly of the inner edge of the corresponding finger. In this way, the tendency to pull the finger out of the legs is substantially reduced. Further, the flanges **40***a* and **41***a*, respectively, on the fingers **40** and **41** and the flanges **36** and **37** respectively on the upper surface of the legs **17** and **19**, tend to increase the longitudinal

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strength of the tab forward of the rear end **32** of the ear **30** as compared to a structure absent such flanges and of the same stock thickness.

FIG. **4** also illustrates the relative position of the ear of the tab with respect to the under surface of the tab after formation of the tab and prior to assembly to a container end wall.

To understand better the substantial improvement represented by the present invention, reference is made to FIG. **5** illustrating the tab **10** of the present invention mounted on a container end wall **50**. Where applicable, the same reference numbers have been used for the parts already described. The end wall includes a pour panel **52** formed by a scoreline **53** a portion of which passes between the front end **14** of the tab and immediately in front of the rivet **55** which passes through the tab ear **30** to secure the tab to the end wall. For the remaining details of the end wall structure, reference is made to the patents previously mentioned.

In a normal opening sequence, a finger is inserted between the finger well **60** and the rear end **12** of the tab to lift the rear end. One can easily appreciate the advantage of having a tab with a smooth clean contour. Since the initial pop of the portion of the scoreline to the front of the rivet is by a class 2 lever action, lifting of the rear end of the tab causes the ear **30** to lift on the rivet, and the portion of the end wall around the rivet while the nose or front end of the tab contacts the pour panel. After the initial pop, the tab acts as a class 1 lever to break out the scoreline and push the pour panel downwardly. Thereafter the tab is normally pushed flat against the end wall.

As will be apparent, the initial pop phase of the opening sequence creates a significant stress on the tab which should remain longitudinally rigid throughout the opening sequence, especially the initial pop phase. What has been observed, especially with the prior art tabs formed of thinner sheet stock, is an occasional bending of the tab during the initial pop phase. If it occurs, the bending normally is across the width of the tab and in a band generally in the bend area **31** of the ear, and includes bending of the legs.

In come cases the tab, though initially properly secured on the end wall, may through handling in shipping and the like be rotated slightly so that the opening end of the tab overlies a portion of the end wall laterally of the pour panel, even though the end wall may be provided with dimples and the like to maintain proper tab alignment. Normally, the consumer does not align the tab, but attempts to open the container by the usual manipulation. In this circumstance what has been observed is an occasional bending of the prior art tab, as described, and in some instances the fingers of the prior art tabs have been pulled out of the curl.

The tab of the present invention, which is significantly more rigid longitudinally as compared to the prior art tabs described, substantially reduces failure by bending. Also, even if the tab is misaligned, the fingers are not pulled out of the curl, especially where the heavier grade of tab stock is used. Overall, the longitudinal rigidity has been increased through the use of flanges and extension of the finger length.

In addition the improved tab substantially reduces premature damage and even rupture of the scoreline in front of the rivet. Since most container end walls are bulged slightly (exaggerated in FIG. **6** for illustration purposes) the prior art tabs when assembled to the end wall were spaced a small distance above the wall. It is believed that vibration caused a stress to be transmitted through the tab, the tab ear to the rivet which stressed the metal around the rivet and the portion of the scoreline in front of the rivet. What was detected, on occasion, were hairline cracks in the scoreline with the result that the container contents lost all or some of the pressure i.e. became "flat" or actually leaked.

By this invention, such a problem is substantially reduced by positioning the tab ear below the underside of the tab body, as seen in FIGS. **3** and **4**, during tab manufacture Thus, as the tab is secured to the end wall, as seen in FIG. **6**, the underside of the tab is pulled tight against the end wall i.e. the clearance is eleminated, and downward stresses are transmitted to the end wall rather than to the rivet and the scoreline.

Accordingly, it will be seen that the structural features of the present invention have substantially improved the longitudinal rigidity of the tab, so much so that lighter tab stock may be used. Moreover, the tendency toward preventing fracture of the scoreline has been substantially reduced.

While the tab shown illustrates the preferred structural features of the present invention, it is understood that the shape and configuration of the tab may vary considerably. Thus, the panel **21** may be punched out or the rear end of the tab may be made boxier with rounded corners to provide a tab with a straight rather than curved section along the rear end. The portion of the tab to the rear of the web may be contoured to permit easy insertion of the finger.

Accordingly, various modifications may be made, as will be apparent from the above, without departing from the invention as set forth in the appended claims:

What is claimed is:

1. In a tab for use with an easy opening end structure wherein said tab is formed of metal sheet material, and which includes a lifting end and an opening end with an ear therebetween, the ear including an aperture through which a rivet may extend for attachment of said tab to an end wall, spaced side legs formed of a curled double layer of sheet material and extending between the opening end and at least to the rear of said ear, and wherein said opening end is formed of multiple layers of sheet material, the improvement comprising:

one of the multiple layers forming the opening end of said tab including finger means extending towards the lifting end of said tab and positioned within the double layer of said spaced side legs, and

said finger means including flange means extending lengthwise thereof to form ribs stiffing said tab along its length.

2. A tab as set forth in claim **1** wherein said flange means extends lengthwise at least as far as the aperture in said ear.

3. A tab as set forth in claim **1** wherein said flange means is located on the portion of said finger means located within the curl of said double layer,

one layer of the double layer forming the upper surface of said tab, and

said flange means being disposed to face away from the upper surface of said tab.

4. A tab as set forth in claim **1** wherein the double layer of said side legs includes an upper layer forming the top surface of the tab and a lower layer therebeneath, and

the lower layer overlying said finger to prevent said finger from being pulled out of said double layer during manipulation of said tab.

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5. A tab as set forth in claim 1 wherein the finger is so dimensioned with respect to the lowermost layer of said curl that the lowermost layer substantially completely covers the tip end of said finger to prevent movement of said finger relative to said side leg during normal use of said tab in an opening sequence.

6. A tab as set forth in claim 1 wherein the lowermost layer of said side legs overlies the lateral inside edge of said finger means to retain said finger means within said curl.

7. A tab as set forth in claim 1 wherein said tab is formed of a single piece of sheet material.

8. A tab as set forth in claim 1 wherein the opening end of said tab includes a triple layer of sheet material, and

said finger means being integral with the intermediate layer of said triple layer.

9. A tab as set forth in claim 1 wherein the opening end of said tab includes a triple layer of sheet material, and

said ear being integral with one of said triple layers and including a bend area to position said ear at an angle relative to the plane of the side legs.

10. A tab as set forth in claim 1 wherein said side legs include a continuous outer curled surface and a lower layer which is interrupted at a region to the rear of the rear curl of said ear.

11. A tab as set forth in claim 1 wherein said side legs include portions spaced from said ear, and the upper layer of said side legs spaced from said ear including flange means for providing strength.

12. A tab as set forth in claim 11 wherein the flange means on said finger means and the flange means on said side legs extend in the same direction.

13. A tab as set forth in claim 11 wherein the flange means on said side legs contacts at least a portion of the lower layer of said side legs and in said portion encloses the corresponding finger means.

14. In an easy opening end wall of the ecology type for use with a container wherein the end wall includes a retained tab and a retained pour panel and wherein the tab initially functions as a class 2 lever initially to pop a portion of the scoreline and as a class 1 lever to complete fracture of the scoreline, an improved tab comprising:

a body member having an opening end and a lifting end,

the opening end being formal of multiple layers of sheet material,

legs formed of curled sheet material extending from said opening end to said lifting end,

one of the multiple layers of the opening end including finger means received and secured within a portion of the corresponding leg, and

the lifting end of said tab which is contacted by the user's finger in an opening sequence being formed of a smooth unbroken curl of sheet material.

* * * * *

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APPENDIX D

US006234336B1

(12) **United States Patent**
Neiner

(10) **Patent No.: US 6,234,336 B1**
(45) **Date of Patent: *May 22, 2001**

(54) **STAY-ON-TAB CONTAINER CLOSURE HAVING TEAR PANEL WITH NO CONTOUR FEATURES ON THE UPPER SURFACE**

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(73) Assignee: **Metal Container Corporation**, St. Louis, MO (US)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/742,970**

(22) Filed: **Nov. 1, 1996**

(51) **Int. Cl.**[7] **B65D 17/34**
(52) **U.S. Cl.** **220/269**; 220/906
(58) **Field of Search** 200/269, 270, 200/906

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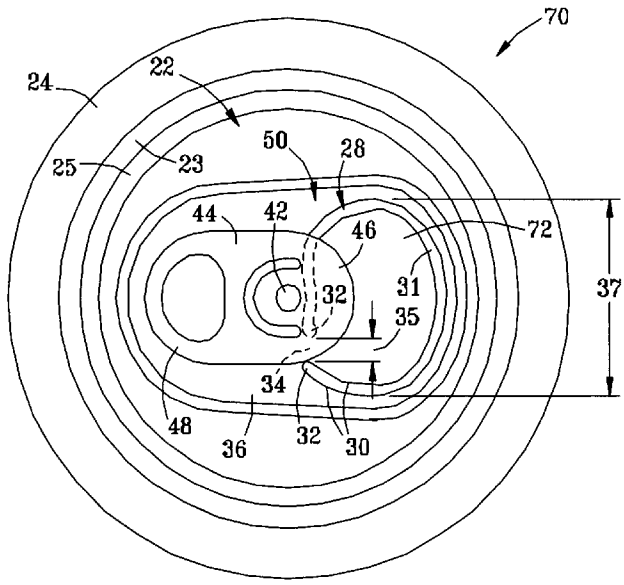
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Primary Examiner—Allan N. Shoap
Assistant Examiner—Robin A Hylton
(74) *Attorney, Agent, or Firm*—Carr & Storm, L.L.P.

(57) **ABSTRACT**

A stay-on-tab container closure suitable for use on beverage cans and the like, said closure including an center panel with an downwardly displaceable tear panel, which, in one aspect, has a smooth upper surface having no visually perceptible contour features, and which, in another aspect, has low-relief contour features on its upper surface. Closures according to the invention have reduced stresses across the score defining the tear panel, thereby reducing the likelihood of stress-induced fatigue cracking which can lead to score failure when the container closure is joined to a can body and the resulting can is internally pressurized.

7 Claims, 5 Drawing Sheets



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FIG. 1
(PRIOR ART)

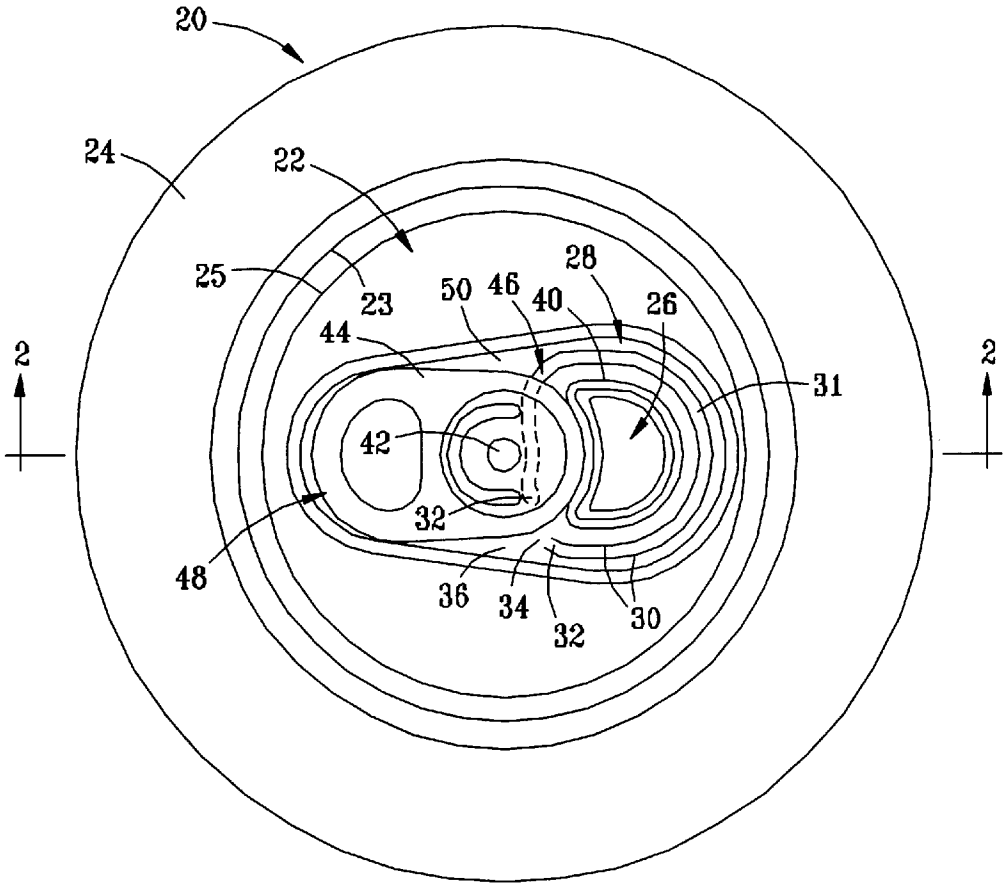


FIG. 2
(PRIOR ART)

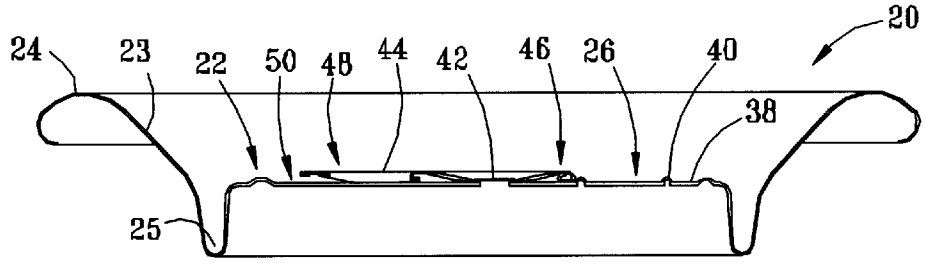


FIG. 3
(PRIOR ART)

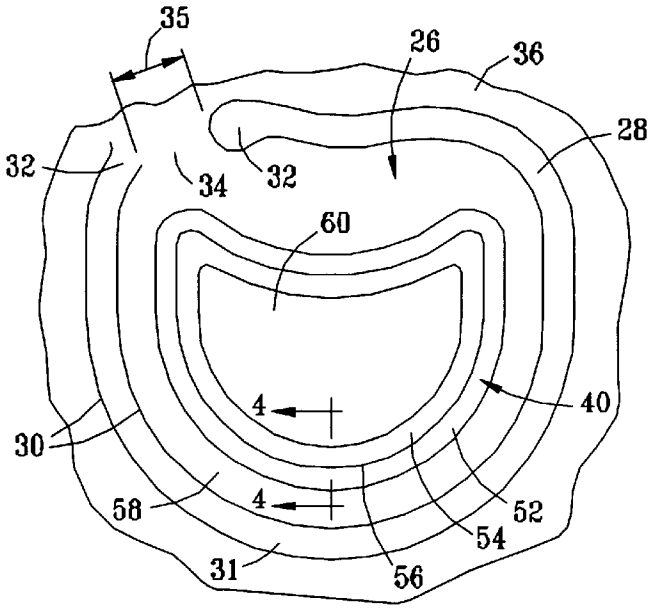


FIG. 4
(PRIOR ART)

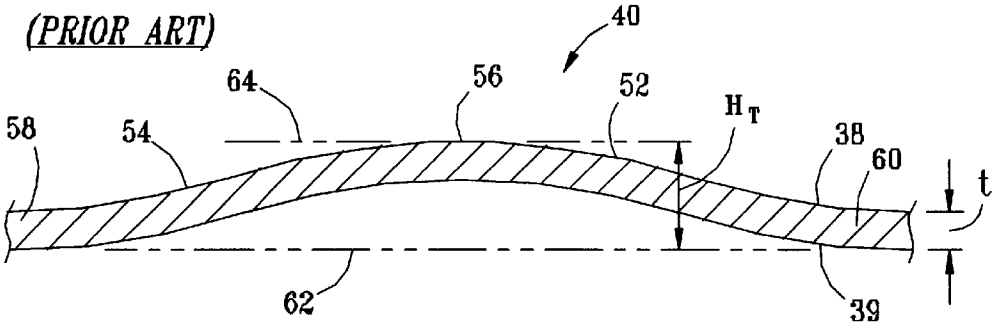


FIG. 5A

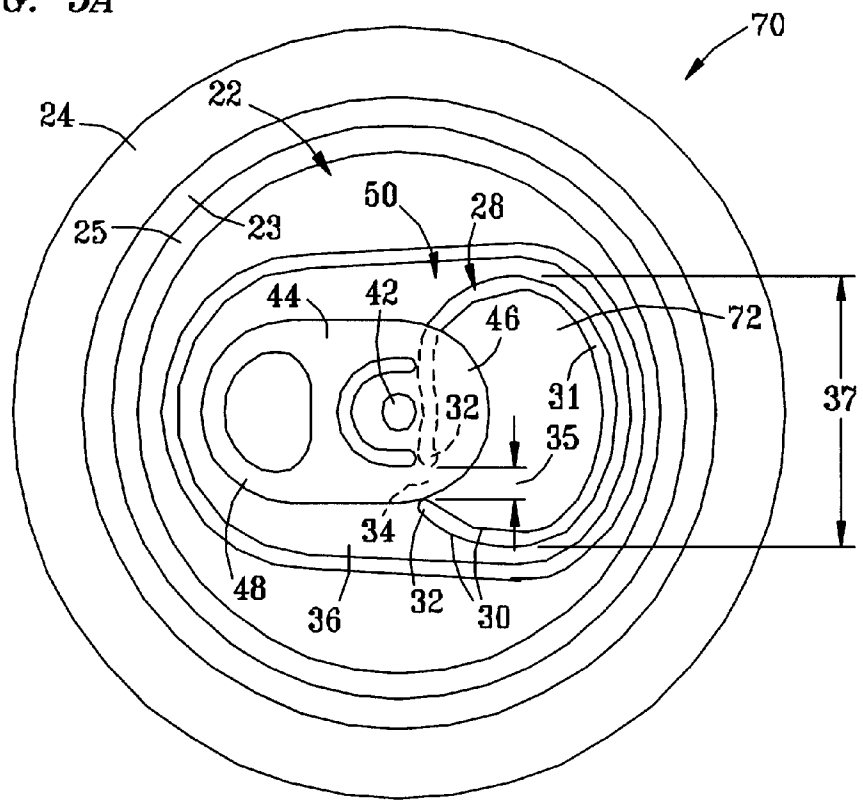

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30

FIG. 5B

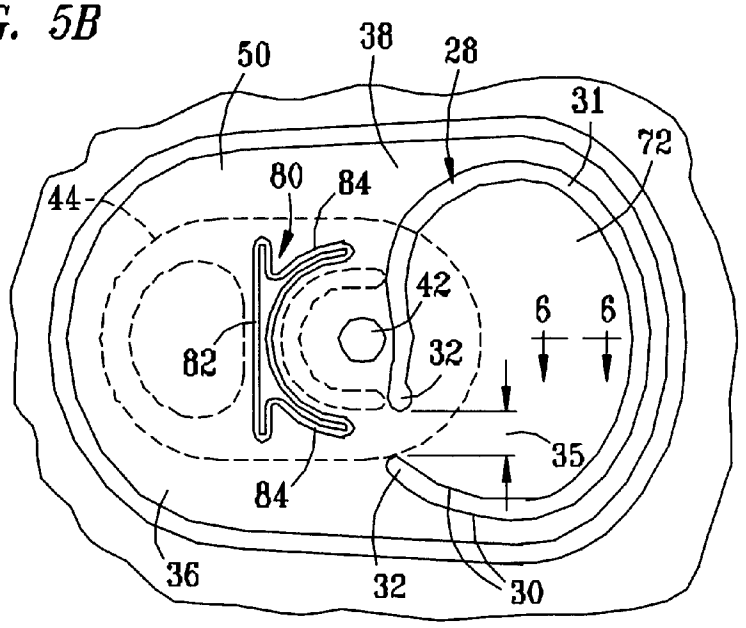

50
38
28
31
72
44
80
84
42
6
6
82
32
35
84
36
32
30

FIG. 6

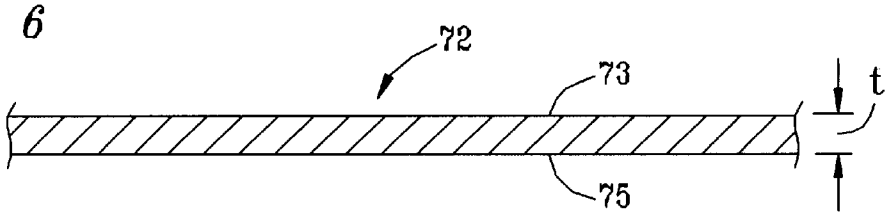


FIG. 7

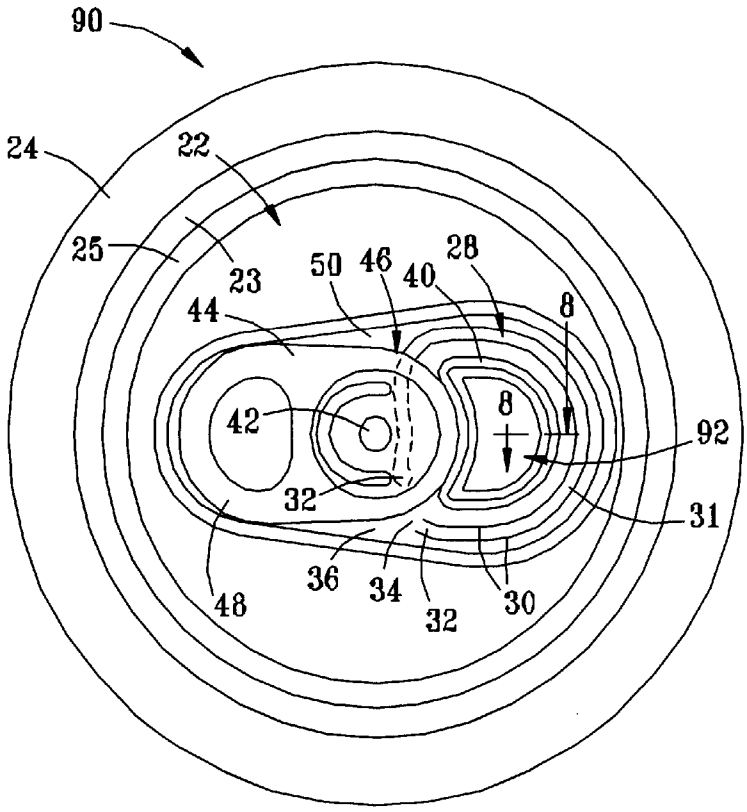


FIG. 8

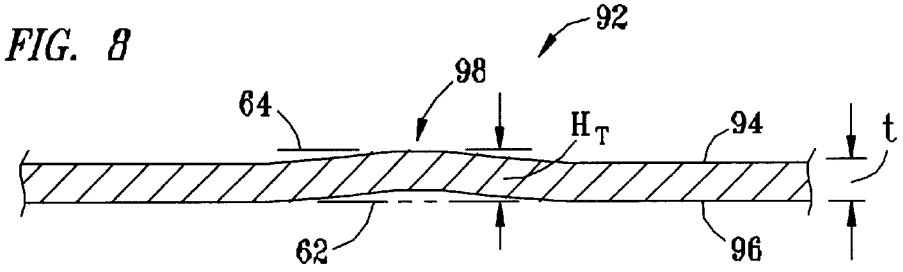


FIG. 9A

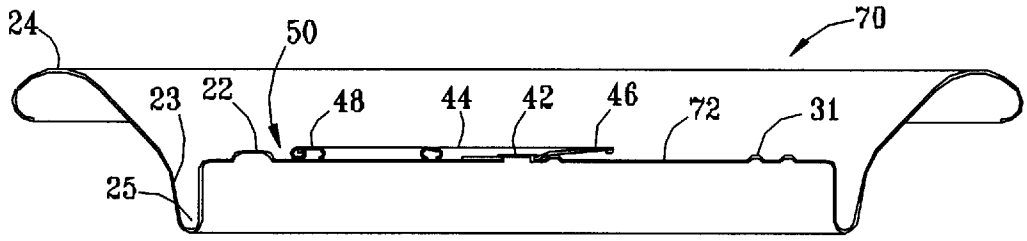


FIG. 9B

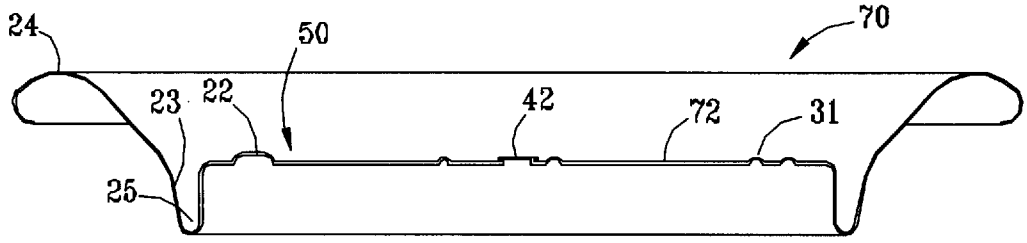
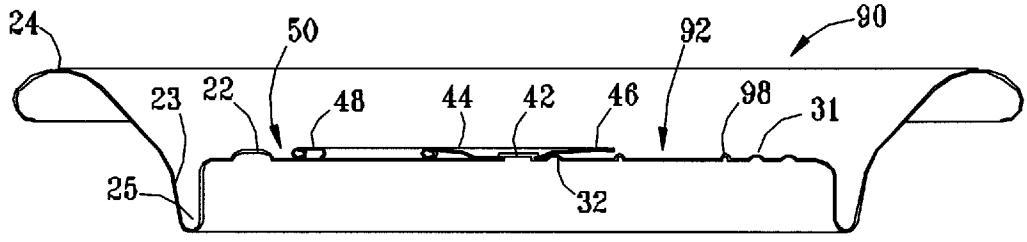


FIG. 10



STAY-ON-TAB CONTAINER CLOSURE HAVING TEAR PANEL WITH NO CONTOUR FEATURES ON THE UPPER SURFACE

TECHNICAL FIELD OF THE INVENTION

This invention relates generally to closures of the type used for metal beverage containers and, more particularly, to stay-on-tab closures in which an attached tab is lifted to partially sever and displace a tear panel to create an opening for dispensing the contents of the container. In one aspect, the current invention relates to a stay-on-tab closure having a tear panel with low-relief contour features on the upper surface.

BACKGROUND OF THE INVENTION

It is well known to use closures, also referred to as "ends" or "lids," for sealing metal beverage containers of the type used for packaging beer, carbonated soft drinks, juice, tea, water, and other liquids or fluids. These closures are typically formed of an aluminum alloy or steel, although other materials such as metal-plastic laminates or composites can also be used. A common type of closure, often referred to as a "stay-on-tab" closure, incorporates an attached tab which is lifted to partially sever and displace a tear panel defined by a frangible curvilinear score line. The downward displacement of the tear panel creates an opening for dispensing the contents of the container without the use of a separate opening tool. Both the tear panel and the tab remain attached to the closure after opening.

Conventional stay-on-tab closures typically include a center panel having a generally planar or slightly upwardly domed surface. A tear panel is defined by a curvilinear, but non-closed, frangible score line formed on the center panel which defines the general periphery of the tear panel but leaves a narrow integral hinge connecting the tear panel to the remainder of the center panel. An opening tab is secured to the center panel of the closure by a rivet or other such fastener hingedly connected to the tab. When one tab end is lifted upward, the tab applies forces to the tear panel and center panel to rupture the score line and displace the tear panel down into the associated container to form an opening through which the container contents can be dispensed. The non-closed portion of the score line forms a hinge which retains the tear panel with the closure. Similarly, the tab remains attached to the closure by its hinged connection to the rivet.

To facilitate the easy bending of the tear panel into the container during opening, conventional stay-on-tab closures connect the tear panel to the center panel using a narrow hinge, i.e., a hinge having a width less than about 25% of the maximum width of the tear panel. Unconventional container closures having displaceable panels and permanently affixed tabs are also known, such as described in U.S. Pat. No. 5,405,039 to Komura, and such closures may be referred to by some as "stay-on-tab" closures. The displaceable panels in such unconventional closures, however, are connected to the center panel by a hinge having a width significantly greater than 25% of the maximum width of the displaceable panel. For example, one closure in the previously mentioned Komura '039 patent provides a displaceable panel comprising approximately one-half of the top of the lid and a hinge having a width of approximately 100% of the maximum width of the displaceable panel. Because the forces relating to the opening and bending of such unconventional closures are significantly different than for conventional stay-on-tab closures, all further references to "stay-on-tab" closures in this application refer to closures having a hinge width less than about 25% of the maximum width of the tear panel.

All stay-on-tab container closures heretofore known include high-relief "contour features" formed in the tear panel and projecting substantially above the nearby generally planar surface of the tear panel. For the purposes of this application, a contour feature is considered to have "high relief" when the "total height", or H_T, of the feature is not less than about 2 times the thickness of the sheet material used to form the lid. The total height, H_T, of a contour feature is the vertical distance from the highest point on the upper surface of the contour feature to the level of the underside of the surrounding generally planar tear panel material. One contour feature commonly used on tear panels is a raised curvilinear ridge generally referred to as a "bead." It is known to use high-relief beads having a variety of configurations, when viewed from above, including a non-closed curve resembling the letter "C" (sometimes called a "C-bead"), a closed curve having one straight side resembling the letter "D" (sometimes called a "D-bead"), a closed curve of circular or oval shape, or an irregular closed or non-closed shape. For example, closures are known which are formed from sheet material having a thickness of about 0.0093 inches and having a high-relief bead on the tear panel with a total height, H_T, in the range of about 0.0200 to 0.0230 inches, as are closures formed from sheet material having a thickness of about 0.0090 inches and having a high-relief bead on the tear panel with a total height, H_T, of about 0.0180 inches. It must be noted that although beads are among the most common high-relief contour features found on tear panels, other high-relief contour features are also known, including ridges, panels, embossments, and various combinations of these features.

It was heretofore believed necessary to incorporate high-relief contour features on the tear panel of stay-on-tab container closures for one or more of the following reasons: 1) to serve as lateral stiffening or reinforcing structures on the tear panel so that the panel will not bow excessively or buckle during the opening operation, which can cause "nose failure" and "tuck-under" type failures; 2) to selectively distribute the forces of the opening tab across the tear panel to propagate the fracturing of the score line completely around the tear panel so the panel will not experience an "partial opening" type failure; and 3) to gather in the "slack metal" on the tear panel which results from the widening of the panel during formation of the score lines, thereby maintaining tension in the tear panel, the lack of which can also cause nose failure, tuck-under type failure, or partial opening type failure. A "nose failure" occurs when excessive bowing or buckling of the tear panel due to insufficient stiffness or insufficient tension allows the tab end to slip along the surface of the tear panel without rupturing the score line at all. A "tuck-under" type failure, also known as a "non-turn-under" type failure, occurs when the same factors cause the tab to only partially rupture the score line and not displace the tear panel far enough into the container to provide a useable opening. A "partial opening" type failure, also known as an "insufficient angle" type failure occurs when the score line fully ruptures, but bowing of the tear panel or inadequate distribution of tab forces prevents the tab from displacing the tear panel through a sufficient angle into the container to avoid obstructing the opening.

The operational problems described above are known for stay-on-tab container closures having "standard-size" openings, that is, openings defined by tear panels having an area of approximately 0.40 square inches, and the use of a high-relief bead or some other type of high-relief contour

feature on the tear panel was heretofore believed necessary to overcome such problems. It was heretofore further believed that such operational problems are exacerbated on container closures incorporating so-called "large-size" openings, that is, openings defined by tear panels having an area of approximately 0.59 square inches or larger, and thus that the use of a high-relief bead or other contour feature on the tear panel was of increased necessity. See, for example, European Patent Application No. EP 0 704 382 A2.

Another factor affecting the performance of container closures is the gauge, or thickness, of the material used to form the closures. At one time, stay-on-tab container closures were manufactured using sheet metal "stock" having a thickness of at approximately 0.0100 inches or greater. In order to conserve materials and decrease costs, however, stay-on-tab container closures are now being manufactured from metal stock having a thickness in the range of approximately 0.0091 inches to 0.0085 inches, and the thickness is anticipated to continue decreasing in the future. As the thickness of the sheet material used to make the container closures decreases, the operational behavior of the tear panel and its interaction with the tab also changes. Thus, container closure designs that function adequately for lids having a thickness of over 0.010 inches cannot be assumed to function identically for lids having a lesser thickness.

In fact, it has been discovered in connection with the development of the current invention that beverage containers using stay-on-tab container closures having a thickness of about 0.0091 inches or less and provided with high-relief contour features on the tear panels, as was heretofore thought necessary for proper opening function, experience an unacceptably high rate of score failure when the containers are internally pressurized to relatively high pressures, such as those normally encountered in a beverage pasteurizer or from handling during shipping. It should be noted that the absolute failure rate for such closures is very small, but due to the astronomical number of closures produced (tens of billions per year), a small change in the failure rate is of economic significance. Further, it has been determined that this score failure rate is highest on container closures having large-size openings, which are a growing segment of the closure market, adding to the economic significance. It has been determined in connection with the development of the current invention that the increased score failure rate is at least partially attributable to fatigue cracking of the container closure material along the score line. It is believed that the fatigue cracking is caused by excessive stress across the score line.

A need therefore exists, for a stay-on-tab container closure formed from sheet stock having a thickness, preferably of about 0.0091 inches or less, having conventional tear panel function and operation characteristics, and having reduced lateral stress across the score line to provide improved resistance to stress-induced cracking of the score line.

A need further exists for a stay-on-tab container closure having a large-size opening with an area of 0.59 square inches or greater, the container closure being formed from sheet stock having a thickness, preferably of about 0.0091 inches or less, having conventional tear panel function and operation characteristics, and having reduced lateral stress across the score line to provide improved resistance to stress-induced cracking of the score line.

SUMMARY OF THE INVENTION

For purposes of clarity and consistency some of the terms used in the specification and the claims hereof will now be defined. Directional terms such as "up," "down," "high,", "low," "upper," "lower," "top," "bottom," "side," "horizontal" and "vertical" refer to container closures as though they were disposed in operational relationship with an upright, level container body resting on a flat horizontal surface. Directional terms such as "in," "out," "inward" and "outward," relate to the interior of a can formed with a container closure.

It is an object of the current invention to provide a stay-on-tab container closure formed from sheet material having a thickness, preferably of about 0.0091 inches or less, having conventional tear panel function and operation characteristics, and having reduced lateral stress across the score line to provide improved resistance to stress-induced cracking of the score line.

It is a further object of the current invention to provide a stay-on-tab container closure having an opening defined by a tear panel having an area of approximately 0.59 square inches or greater, the closure being formed from sheet stock having a thickness, preferably of about 0.0091 inches or less, having conventional tear panel function and operation characteristics, and having reduced lateral stress across the score line to provide improved resistance to stress-induced cracking of the score line.

The above and other objects are realized by providing a stay-on-tab container closure comprising a generally circular center panel having upper and lower surfaces and being formed from a sheet material having a thickness. A frangible curvilinear score is formed on the upper surface of the center panel defining a displaceable tear panel, a hinge, and a fixed portion on the center panel. The tear panel has upper and lower surfaces and the upper surface of the tear panel is smooth, that is, it has no visually perceptible contour features. In a preferred embodiment, the sheet material has a thickness of 0.0091 inches or less. In a more preferred embodiment, supplemental contour features are provided on the fixed portion of the center panel. In a still more preferred embodiment, the area of the tear panel is 0.59 square inches or greater.

In another aspect of the current invention, a stay-on-tab container closure is provided comprising a generally circular center panel having upper and lower surfaces and being formed from a sheet material having a thickness. A frangible curvilinear score is formed on the upper surface of the center panel defining a displaceable tear panel, a hinge, and a fixed portion on the center panel. The tear panel has upper and lower surfaces and the upper surface of the tear panel has contour features projecting upward to a total height not greater than about 1.6 times the thickness of the sheet material. In a preferred embodiment of this aspect, the sheet material has a thickness of 0.0091 inches or less. In a more preferred embodiment of this aspect, the upper surface of the tear panel has contour features projecting upward to a total height not greater than 1.25 times the thickness of the sheet material. In a still more preferred embodiment of this aspect, the upper surface of the tear panel has contour features projecting upward to a total height not greater than 1.1 times the thickness of the sheet material. In still other embodiments of this aspect, supplemental contour features are provided on the fixed portion of the center panel. In yet another embodiment of this aspect, the area of the tear panel is 0.59 square inches or greater.

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In yet another aspect of the current invention, a method for producing container closures is provided, comprising the steps of:

a) cutting a lid blank from a sheet of material;

b) forming a lid shell having a featureless center panel;

c) moving the lid shell to a conversion press having a plurality of stations;

d) forming, at one said station of said conversion press, a score on the center panel, said score defining a tear panel, a hinge, and a fixed portion, but not forming any visually perceptible contour features on said tear panel at the same said station; and

e) forming, at another of said stations of said conversion press, a recessed panel encompassing said score, hinge, and tear panel, but not forming any visually perceptible contour features on said tear panel at the same said other station.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view of a PRIOR ART stay-on-tab container closure;

FIG. **2** is cross-sectional view of the PRIOR ART closure of FIG. **1** taken along line **2**—**2** of FIG. **1**;

FIG. **3** is an enlarged plan view of the score and tear panel of the PRIOR ART closure of FIG. **1**;

FIG. **4** is an enlarged cross-sectional view of the high-relief contour feature of the PRIOR ART closure of FIG. **1** taken along line **4**—**4** in FIG. **3**;

FIG. **5**A is a plan view of a container closure according to one aspect of the current invention;

FIG. **5**B is a partial plan view of the closure of FIG. **5**A with the opening tab shown in phantom to show the underlying panel;

FIG. **6** is an enlarged cross-sectional view of the tear panel of the closure of FIG. **5**A taken along line **6**—**6** in FIG. SB;

FIG. **7** is a plan view of a container closure according to a second aspect of the current invention; and

FIG. **8** is an enlarged cross-sectional view of the low-relief contour feature of the closure of FIG. **7** taken along line **8**—**8** in FIG. **7**;

FIG. **9***a* is a cross-sectional view of the container closure of FIG. **5***a;*

FIG. **9***b* is a cross sectional view of the container closure of FIG. **5***b;*

FIG. **10** is a cross sectional view of the container closure of FIG. **7**.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings in detail, and in particular to FIGS. **1**–**4**, a PRIOR ART container closure **20** is shown for comparison to the current invention. PRIOR ART container closure **20** is typical of conventional stay-on-tab container closures suitable for use on beverage cans and the like. As best seen in FIGS. **1** and **2**, PRIOR ART container closure **20** comprises a generally circular center panel **22** defined by an upstanding annular chuck wall **23** which is disposed within a peripheral flange **24** and countersink **25**. Center panel **22** has a tear panel **26** defined by a score **28** which forms a curvilinear pattern when viewed from above. In the closure shown, score **28** forms a generally oval pattern, however, other score line pattern shapes are known. Score **28** typically comprises two score grooves **30** disposed generally adjacent to one another and formed in the upper surface **38** of center panel **22** by pressing or stamping. Score **28** has a curving bend or "bight" portion **31** and two end portions **32** which are disposed adjacent to one another at the ends of the bight portion **31** and define therebetween a hinge portion **34** which permanently attaches tear panel **26** to a fixed portion **36** of center panel **22**. The hinge portion **34** has a hinge width **35** measured between the two end portions **32**. Tear panel portion **26** has a high-relief contour feature **40** which projects above upper surface **38** of tear panel **26**. In the PRIOR ART closure shown, contour feature **40** takes the shape, when viewed from above, of an uppercase letter "D", and therefore may also be referred to as a "D-bead", however, contour features of many other configurations are known. PRIOR ART container closure **20** further comprises a rivet **42** disposed on the fixed portion **36** of center panel **22** proximate hinge portion **34** and an opening tab **44** secured to center panel **22** by rivet **42**. Opening tab **44** has a forward portion **46** overlying tear panel **26** and a rear portion **48** overlying fixed panel portion **36**. In most cases, score **28**, tear panel **26**, rivet **42** and opening tab **44** are disposed together in a recessed area **50** formed on center panel **22** as shown in FIG. **1**. Recess **50**, while preferred, is not required.

Referring now to FIGS. **3** and **4**, enlarged views of the tear panel **26** of PRIOR ART closure **20** are shown. Note that in these FIGS., opening tab **40** is not shown for purposes of illustration. In the PRIOR ART tear panel **26** shown, contour feature **40** is a "D-bead" having a generally curvilinear profile, viewed in cross section, and having an outer slope **52**, an inner slope **54**, and an apex line **56**, which is the uppermost projection of the D-bead **40** above the generally planar portions **58**, **60**, of tear panel **26**. Other contour features are known in the art, including beads having various configurations, when viewed from above, beads having various other profiles, such as semicircular, when viewed in cross section, and other contour features such as embossments and panels.

Referring still to FIGS. **3** and **4**, the D-bead contour feature **40** of PRIOR ART container closure **20** is, like all of the contour features of PRIOR ART stay-on-tab closures, a "high relief" contour feature because the total height, H_T, of contour feature **40** is not less than about 2 times the thickness, t, of the sheet material used for forming the closure. Referring now to FIG. **4**, the total height, H_T, of contour feature **40** is the distance between a first line **62**, which constitutes an extension of the lower surface **39** of the generally planar areas **58** and **60** adjacent to contour feature **40**, and a second line **64**, which is generally parallel to first line **62** and passing through the uppermost point of the upper surface **38** of contour feature **40** (i.e., the apex line **56**). For example, if PRIOR ART closure **20** is formed from metal stock having a thickness, t, of approximately 0.0091 inches, then the total height, H_T, of heretofore known high-relief contour features is 0.0182 inches or greater.

As previously discussed, container closures having high-relief contour features on the tear panel, which were heretofore thought necessary, experience high rates of score failures when made from metal stock having a thickness of about 0.0091 inches or less, and especially when the closures incorporate large-size openings. It is believed that the formation of the high-relief contour features on the tear panel creates stresses running laterally across the score line having a magnitude that makes the score line region susceptible to fatigue cracking after the closure is incorporated into a container and subjected to the additional stresses from the pressurized contents of the completed container.

The current invention provides a stay-on-tab container closure formed from sheet material having a thickness,

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preferably of about 0.0091 inches or less, and having, in a first aspect, a tear panel with a smooth upper surface, that is, with no visually perceptible contour features. In an alternative aspect, the invention provides a closure having a tear panel with low-relief contour features. In both aspects of the invention, lateral stresses across the score line are reduced, thus providing improved resistance to stress-induced cracking of the score line and reduced score failure rates. The current invention has the further unexpected benefit of exhibiting conventional opening characteristics, e.g., the current invention does not experience operating problems such as nose failures, tuck-under failures, and partial opening type failures at rates significantly different than for comparable closures having the previously believed necessary high-relief contour features. The unexpected benefit of the current invention further extends to use on closures having large-size openings.

Referring generally now to FIGS. **5**A, **5**B, and **6**, a container closure **70** according to a first aspect of the invention is shown. Closure **70** is formed from sheet material having a thickness, preferably of approximately 0.0091 inches or less. Referring first to FIG. **5**A, closure **70** comprises a generally circular center panel **22**, and can include an annular chuck wall **23**, a peripheral flange **24**, a countersink **25**, and a recessed panel **50** similar to the PRIOR ART closure previously discussed and illustrated in FIGS. **1** and **2**. Alternatively, center panel **22** can be connected to other peripheral annular structures (not shown) as is known in the art to adapt the closure to the specific geometry of the associated container. Center panel **22** of closure **70** has a curvilinear score **28** defining a tear panel **72**, a hinge **34**, and a fixed portion **36**. In the embodiment shown, score **28** comprises two separate score grooves **30** disposed generally adjacent to one another and formed in the upper surface **38** of center panel **22** by pressing or stamping. While this configuration of score **28** is preferred, a score having a single groove or larger number of grooves is within the scope of the current invention. Score **28** has a curving bight portion **31** and two end portions **32** which are disposed adjacent to one another at the ends of the bight portion **31** and define therebetween the hinge portion **34** which permanently attaches tear panel **72** to the fixed portion **36** of center panel **22**. The hinge portion **34** has a hinge width **35** measured between the score end portions **32**. Hinge width **35** is less than 25% of the maximum width (shown as **37**) of the tear panel **72**. In the embodiment shown in FIG. **5**A, closure **70** is of the "large-size" type, because the tear panel **72** has an area greater than 0.59 square inches. It will be readily apparent, however, that the current invention is also applicable to container closures of the "standard-size" opening type. As best seen in FIG. **6**, the tear panel **72** of closure **70** has upper and lower surfaces **73**, **75**, respectively. Still referring to FIG. **6**, the upper surface **73** of tear panel **72** is smooth, that is, it has no visibly perceptible contour features projecting upward from the upper surface **73**. For the purposes of this application, "visually perceptible" contour features are features projecting upwards which can by perceived by an ordinary person using the unaided eye. Lettering or other indicia incised into the upper surface **73** of tear panel **72** could be visually perceptible, but would not constitute a contour feature because they do not project upwards. It should be noted that since the upper surface **73** of tear panel **72** is smooth, the cross section shown in FIG. **6** would apply to all regions of tear panel **72**.

Referring again to FIGS. **5**A and **5**B, container closure **70** further comprises a rivet **42** disposed on the fixed portion **36** of center panel **22** proximate hinge portion **34** and an opening tab **44** secured to center panel **22** by rivet **42**. Opening tab **44** has a forward portion **46** overlying tear panel **72** and a rear portion **48** overlying fixed panel portion **36**. In some cases, score **28**, tear panel **72**, rivet **42** and opening tab **44** may be disposed together in a recessed area **50** formed on center panel **22** as shown in FIGS. **5**A and **5**B, however, recess **50** is not required. The operation of closure **70** is similar to the operation of previous stay-on-tab closures: Lifting the rear portion **48** of opening tab **44** causes the tab to exert forces on tear panel **72** and fixed portion **36** of the center panel **22** to rupture score **28** and displace tear panel **72** downward into the associated container (not shown) to form an opening for dispensing the contents of the container. These opening procedures apply to closures with standard-size openings and to containers with large-size openings.

Referring now to FIG. **5**B, which shows opening tab **44** in phantom to reveal underlying structures on the center panel **22**, in a more preferred embodiment of the current invention, supplemental contour feature **80** is provided on fixed portion **36** of center panel **22** proximate rivet **42**. Supplemental contour feature **80**, while preferred, is not required. Supplemental contour feature **80** further stiffens and reinforces the center panel **22** to improve opening performance of the closure **70** without introducing lateral stresses across the score **28** which can lead to increased score failure rates. Supplemental contour feature **80** can therefore be of either "high-relief" or "low-relief" type, when viewed in cross section. In the embodiment shown in FIG. **5**B, the supplemental contour feature **80** has a configuration, when viewed from above, of a "picnic table" having a generally straight "top" feature **82**, which is spaced apart from rivet **42**, and two curvilinear "leg" features **84**, which are attached to top feature **82** and curve around rivet **42** at a generally constant radius. It will be appreciated that many other configurations for the supplemental contour feature **80** are within the scope of the current invention.

Referring now to FIGS. **7** and **8**, a container closure **90** according to a second aspect of the current invention is shown. Closure **90** comprises many of the same structures found in the closures previously discussed, as shown by their like-numbering in FIG. **7**. The tear panel **92** of closure **90**, however, has upper and lower surfaces **94**, **96**, respectively, and low-relief contour features **98** formed on upper surface **94**. As best seen in FIG. **8**, when viewed in cross section, the low-relief contour features **98** of tear panel **92** have a total height, H_T, that is not greater than about 1.6 times the thickness, t, of the sheet material used for forming the closure. For example, for a closure in which the thickness, t, of the stock metal is approximately 0.0091 inches, the total height, H_T, of low-relief contour features **98** on tear panel **92** will be less than about 0.0146 inches.

Referring now to FIGS. **9***a*, **9***b*, and **10**, which show cross sectional views of FIGS. **5***a*, **5***b*, and **7**, respectively. These views show that recessed area **50** of the container closure according to the present invention is recessed below, or at a lower elevation relative to, center panel **22**.

Container closures according to the current invention exhibit normal operating performance during opening, both for closures with standard-size openings and for closures with large-size openings. The low-relief contour features **98** of upper surface **94** of the tear panel **92** of the current invention does not cause an increase in operational problems such as nose failure, tuck-under type failure, or partial opening type failure as was heretofore predicted in the art. Further, because formation of the low-relief contour features **98** of the tear panel **92** gathers in the metal of the tear panel to a lesser extent than formation of the high-relief contour

features on the tear panel of previously known closures, the closures of the current invention have less stress running laterally across the score area. This relative stress reduction across the score area provides closures according to the current invention with a significant improvement in resistance to fatigue cracking relative to previously known closures. In addition, the low-relief contour features **98** do provide a visually perceptible contour feature on the tear panel **92**, which may be desirable for providing alignment or for aesthetic purposes.

In a more preferred embodiment of this aspect, low-relief contour features **98** have a total height, H_T, that is not greater than about 1.25 times the thickness, t, of the sheet material used for forming the closure. In a still more preferred embodiment of this aspect, low-relief contour features **98** have a total height, H_T, that is not greater than about 1.10 times the thickness, t, of the sheet material used for forming the closure. In each of the preferred embodiments, even less metal of the tear panel **92** is gathered in by the low-relief contour features **98**, to further reduce the tension in the metal, however, a visually perceptible contour feature is provided suitable for the purposes described above.

Closures according to the current invention having no contour features on the tear panel, such as closure **70** shown in FIG. **5**, have further advantages over the known art. Since no contour features need be formed on the tear panel **72**, the tooling required to produce the closures is simplified. In addition, the smooth flat upper surface of the tear panel **72** provides additional area on the closure **70** suitable for incising indicia as may be required by governmental regulations or business purposes.

Yet another aspect of the current invention provides a method for producing container closures having improved fatigue crack resistance, the method comprising the steps of:

a) cutting a closure blank from a sheet material having a thickness;

b) forming a closure shell having a featureless center panel;

c) moving the closure shell to a conversion press having a plurality of stations;

d) forming on said closure shell, at one of said stations of said conversion press, a score on the center panel, said score defining a tear panel, a hinge, and a fixed portion, but not forming any visually perceptible contour features on said tear panel at the same said station; and

e) forming on said closure shell, at another of said stations of said conversion press, a recessed panel encompassing said score, hinge, and tear panel, but not forming any visually perceptible contour features on said tear panel at the same said other station.

The details of each step of this aspect of the current invention are well known to those in the art. In addition, it will be readily appreciated, for example, that additional operations known in the art may be performed at conversion press stations preceding and subsequent to the two stages described in steps d) and e) above. It is the unique combination of steps described above which provides the unexpected benefit of increased fatigue crack resistance, especially for closures formed from sheet material having a thickness of about 0.0091 inches or less, and more especially for such closures having large size openings.

While the preferred embodiment of the invention has been disclosed with reference to particular aspects of container closures and the functioning thereof, it is to be understood that many changes in detail may be made as a matter of engineering choices without departing from the spirit and scope of the invention, as defined by the appended claims.

I claim:

1. A stay-on-tab container closure comprising:

(a) a circular center panel formed from a sheet material having a thickness;

said center panel having upper and lower surfaces;

(b) a recessed area formed on said center panel at a lower elevation than the remaining portions of said center panel;

(c) a frangible score formed on said upper surface of said center panel and disposed within said recessed area;

said score, when viewed from above, having a curvilinear bight portion and two end portions disposed at the ends of said bight portion in spaced-apart relation to one another;

said bight portion defining most of the periphery of a downwardly displaceable tear panel;

said end portions defining therebetween a hinge portion which permanently attaches said tear panel to a fixed portion of said center panel;

(d) said tear panel being flat and without axial curvature and having upper and lower surfaces;

said surfaces of said tear panel being smooth and without visually perceptible contour features;

(e) a rivet disposed on said fixed portion of said center panel within said recessed area proximate said hinge portion; and

(f) an opening tab hingedly secured to said rivet, said opening tab having a forward portion overlying said tear panel, said forward portion having a forward edge smoothly curving about said rivet.

2. A stay-on-tab container closure according to claim **1**, wherein said thickness of said sheet material is not more than about 0.0091 inches.

3. A stay-on-tab container closure according to claim **1**, wherein said tear panel has an area of at least about 0.59 square inches.

4. A stay-on-tab container closure according to claim **3**, wherein said sheet material is formed from a substance selected from the group consisting of aluminum and aluminum alloys.

5. A stay-on-tab container closure according to claim **2**, further comprising supplemental contour features formed on said fixed portion of said center panel proximate said rivet.

6. A stay-on-tab container closure according to claim **5**, wherein said supplemental contour features comprise a raised bead having a first straight portion spaced apart from said rivet and two curvilinear portions joined to said straight portion and disposed along a curved path about said rivet at a fixed distance from said rivet.

7. A stay-on-tab container closure according to claim **1**, wherein said sheet material is formed from a substance selected from the group consisting of aluminum and aluminum alloys.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

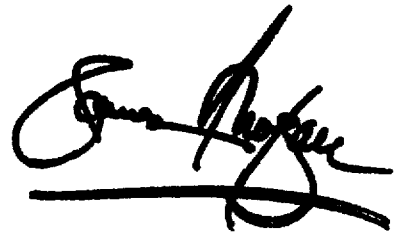
PATENT NO. : 6,234,336 B1
DATED : May 22, 2001
INVENTOR(S) : Neiner

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 5,
Line 37, delete "SB" insert --5B --

Signed and Sealed this

Nineteenth Day of February, 2002



Attest:

Attesting Officer

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

APPENDIX E

United States Patent [19]

Jabarin

[11] **Patent Number: 4,522,779**

[45] **Date of Patent: Jun. 11, 1985**

[54] **METHOD FOR PRODUCTION OF POLY(ETHYLENE TEREPHTHALATE) ARTICLES**

[75] Inventor: **Saleh A. Jabarin,** Holland, Ohio

[73] Assignee: **Owens-Illinois, Inc.,** Toledo, Ohio

[21] Appl. No.: **555,759**

[22] Filed: **Nov. 28, 1983**

[51] **Int. Cl.**[3] **B29C 17/07**

[52] **U.S. Cl.** **264/530;** 264/535

[58] **Field of Search** 264/523, 529, 530, 532, 264/535; 425/530

[56] **References Cited**

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Primary Examiner—Jan Silbaugh

Attorney, Agent, or Firm—Thomas L. Farquer; M. E. Click

[57] **ABSTRACT**

Improved plastic containers and process for their production are disclosed. In one embodiment, containers are blow molded in a first hot blow mold, then reblown to a larger size in a second cold mold of larger volume than the first hot mold. Such containers have improved physical properties, particularly very high hoop yield stresses. In a second embodiment, containers are blow molded in a hot blow mold, then reblown to a larger size in a second hot blow mold. Such containers show high resistance to shrinkage and gross deformation in shape upon exposure to high temperatures.

8 Claims, No Drawings

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METHOD FOR PRODUCTION OF POLY(ETHYLENE TEREPHTHALATE) ARTICLES

BACKGROUND OF THE INVENTION

This invention relates to improved methods of making hollow, biaxially oriented, heat-set partially crystalline articles. In another aspect, it relates to biaxially oriented, heat-set hollow poly(ethylene terephthalate) containers having excellent mechanical properties and low permeabilities to carbon dioxide and oxygen gas. The containers according to the present invention exhibit excellent gas barrier properties, that is low gas permeabilities, and significant mechanical property improvement in hoop yield strength, thermal stability and creep-resistant over prior containers.

In order to improve several physical properties of hollow articles such as containers made from poly(ethylene terephthalate), it has been suggested that biaxially oriented poly(ethylene terephthalate) hollow articles, made by orientation blow molding from a preform or parison under conditions to provide biaxial orientation and concomitant crystallization, be further heat-treated at higher temperatures than the orientation blowing temperature to further increase the density by increasing the crystallinity of the hollow article. Such increasing of the density or crystallinity by heating after shaping under orientation conditions is commonly known as heat-setting.

Wyeth et al. in U.S. Pat. No. 3,733,309 suggests such a process. However, the heat-setting process is mentioned only in passing and no specific examples including heat-setting are present in the patent. Of course, the extra step would ordinarily add considerable expense to the bottle making process. Such heat-setting processes typically take many minutes per container and are thus not well-suited to commercial speed container manufacture.

Collins in U.S. Pat. No. 4,039,641 discloses heat-setting containers of an organic crystallizable synthetic thermoplastic polymeric material. Among such materials disclosed are high density polyethylene, polypropylene homopolymers and copolymers and polyesters such as poly(ethylene terephthalate) and poly(butylene terephthalate), including polyesters such as ethylene terephthalate/isophthalate copolymers. In a preferred embodiment, heat-setting is accomplished by blowing the plastic parison in a heated blow-mold, preheated to the heat-setting temperature.

It is stated in the Collins patent that the heat-setting temperature used is that normally encountered in heat-setting of oriented films or fibers made from the given plastic material. It is not stated, however, what heat-setting temperatures are "normal" for making oriented films or fibers from poly(ethylene terephthalate).

It is also disclosed in Collins that after heat-setting, the container should be cooled down to a temperature, for instance, below about 60° C. In one example of Collins, the heat-setting temperature of the mold is 200° C. and in the other, it is 140° C.

In Japanese Patent Application No. 146,175, laid open Nov. 15, 1980, containers are stretch blow-molded under conditions to biaxially orient the polyester molecules. It is explained that as a result of the stretch blow-molding, the residual strain was large and that when heated subsequent to the molding, the residual strain was released, causing deformation of the container. To solve this problem, the reference recommends heat-setting the containers after blow-molding. It is also recommended that the heat-setting temperature in unstretched areas such as the neck be held to 95°–125° C. so that hazing will not occur in these areas. Other areas are heat-set at a higher temperature. It is recommended that the heat-setting of the highly strained areas of the container be in the range from 125° C. to 235° C.

In Japanese Patent Application No. 77,672, laid open June 21, 1979, is similar except that it is not taught to heat-set unoriented parts at a lower temperature than other parts. The highest temperature disclosed for heat-setting is 130° C. and in the only specific example, the oriented blow-molded container is heat-set by contacting with the hot blow-mold kept at 130° C. and then lowering the mold temperature to 100° C. to prevent container deformation when the container is discharged from the mold. In this reference,, it is stated that hazing occurs when higher heat-setting mold temperatures are used.

In Japanese Patent Application No. 21,463, laid open Feb. 17, 1979, a blown poly(ethylene terephthalate) container was heat-set by heating the container to 140° C. while still within the blow-mold.

In Japanese Patent Application No. 78,267, laid open June 11, 1978, there is disclosed stretch blow-molding a thermoplastic resin, in the example specifically poly(ethylene terephthalate) to make a hollow article, and while the article is still in the mold to introduce hot gases for the purposes of heat-setting. In the example, the hot gas is at 180° C. The example does not disclose cooling the heat-set article before removal from the mold, but the description of the drawing does describe this as an alternative treatment, using normal temperature compressed gas to cool the molded piece.

In Japanese Patent Application No. 66,968, laid open May 29, 1979, methods of reducing residual strain in biaxially oriented blown containers are disclosed. The methods are applied to unidentified, saturated polyester resins. In all of the methods, the container is heated after being formed by biaxial orientation blow-molding by one method or another. After the heat treatment the container is cooled, but the temperature to which the container is cooled is not disclosed. The heating step apparently includes heating the neck portion of the container, since in one method the heating is by passing steam through channels which include channels next to the neck, and in another method heating is carried out by high temperature pressurization of the interior of the container, which of course includes the neck.

In Japanese Patent Application No. 78,268, laid open June 11, 1978, a stretch blow-molded hollow body, including those made from poly(ethylene terephthalate) is heat-set by introducing hot gas under pressure into the interior of the container while in the mold. After the heat-setting, normal temperature gas can be optionally blown into the article to cool the article before removal from the mold, or the heat-set body can simply be exhausted to atmospheric. In an example, the heated gas for heat-setting is at 200° C. In the specific example, no cooling before removal from the mold was disclosed. Again, the heating includes heating of the neck portion of the bottle.

In Japanese Patent Application No. 41,973, laid open Apr. 3, 1979, it is disclosed to heat-set stretch blow molded containers, including those made from poly(ethylene terephthalate) by heating the blown containers at a high temperature and then rapidly cooling them

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to room temperature. Heat treatment can be within the mold while under pressure and the heating can be by means of a hot mold. It is disclosed that the heat treatment should be such that the density of the container following the heat treatment is no greater than 1.40 gms./cc. In the example given, steam at 179° C. is used for heating the mold in the heating step.

U.S. Pat. No. 2,823,421 to Scarlett discloses heat-setting of poly(ethylene terephthalate) films using heat-setting temperatures of 150°–250° C. after orientation stretching. This patent does not state, however, what "normal" polyester film heat-setting temperatures are. It does disclose that for a film streteched three times in each direction that a heat-setting temperature of 200° C. is preferred by Scarlett.

German Patent No. 2,540,930 discloses heat-setting of hollow articles. The blank or parison is blow-molded at 70°–140° C. and then cooled in the mold to below 70° C. Thereafter, the container can be reheated to the heat-setting temperature in the same mold or in a different mold. The heat-setting temperature is said to be 140° C. or higher. In the disclosed process, the entire container including the neck is heated in the heat-setting step to the same temperature and the neck of the container crystallizes to an opaque state.

In the Brady et al. patent, U.S. Pat. No. 4,233,022, a container oriented by blow-molding of polyester at 75°–100° C. is heat-set. Heat-setting is accomplished in a hot mold at a suitable heat-setting temperature; examples of such temperatures are given as 150° to 220° C. The patent features controlling different zones of the container at different temperatures, so that all the sidewall of the container is at the maximum heat-setting temperatures being used, but the finish or neck, for instance, is actually cooled to prevent crystallization thereof. In this patent after the heat-setting step, it is stated that the container is cooled to a self-sustaining condition.

Accordingly, a need exists for a process for the production, at commercially acceptable speeds, of biaxially oriented, heat-set polyester, particularly poly(ethylene terephthalate), containers which containers exhibit low gas permeability, high mechanical strength including creep-resistance, thermal stability and high hoop yield strengths.

SUMMARY OF THE INVENTION

The present invention relates to a process for forming biaxially oriented heat-set, polyester containers having excellent gas barrier and mechanical properties.

In one embodiment of the invention, a polyester parison is heated to the orientation temperature, expanded by internal pressurization to biaxially orient the parison in a first hot heat-setting blow-mold, which mold has heated walls and thusly the container is heat-set to induce crystallization therein within the first mold. The biaxially oriented heat-set container is then transferred, under reduced but substantial enough internal pressure to prevent shrinkage, to a second cold mold which is larger in volume than the first hot heat-setting mold and is itself not a hot heat-setting mold but rather a cold walled mold wherein the container derived from the first hot heat-setting mold is again expanded under internal pressure to further biaxially orient the previously biaxially oriented, heat-set container without further heat-setting. The container is subsequently removed from the second cold mold and cooled to room temperature in ambient air. Such containers show excellent barrier properties as well as good thermal stability, creep-resistance and hoop yield strength.

In another embodiment of the invention, a polyester parison is heated to the orientation temperature, inserted in a first hot heat-setting mold and expanded under internal pressure to biaxially orient the parison to produce a fully formed container, which is heat-set to induce crystallization under internal pressure in the hot heat-setting mold. The heat-set container is removed from the first hot heat-setting mold under reduced but substantial enough internal pressure to prevent shrinkage and transferred to a second, larger internal volume hot heat-setting mold which is also heated to provide hot mold walls wherein the fully formed container, derived from the first hot heat-setting mold, is again biaxially stretched by expansion under internal pressure and also heat-set by forcing the container wall against the hot walls of the second hot heat-setting mold. The second mold is larger in internal volume than the first hot heat-setting blow-mold in internal volume. Subsequently, the twice biaxially oriented, twice heat-set container is cooled to room temperature. The container produced by this embodiment of the invention has excellent barrier properties as well as excellent mechanical properties and thermal stability.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the first embodiment of the present invention, a process and resulting container is disclosed for forming biaxially oriented, heat-set, i.e. partially crystalline, polyester containers having excellent gas barrier and mechanical properties. The first embodiment of the invention includes the following steps:

a polyester parison is heated to a temperature in the orientation temperature range;

the parison at orientation temperature is expanded by internal pressurization within a hot heat-setting blow-mold, which mold has heated walls, to biaxially orient and partially crystallize by heat-setting at least the wall portions of the container, formed by expansion of the parison, within the first hot heat-setting mold;

the biaxially oriented, partially crystallized, heat-set container formed in the first heat-setting mold is transferred under reduced yet substantial internal pressurization to a second cold mold, such reduced pressure being substantial enough positive pressure to prevent shrinkage of the container and simultaneously prevent premature balooning of the hot container walls;

the second cold mold, which is larger than the first hot heat-setting mold is closed about the container derived from the first hot heat-setting mold, and the container is again inflated under internal pressurization to further biaxially orient the previously biaxially oriented, heat-set container. The second cold mold is a relatively colder mold than the first hot heat-setting mold and maintained at a lower temperature so as to prevent any significant additional heat-setting from taking place in the second cold mold; and

subsequent to the second blow molding step in the second, cold mold, the larger finished container, formed in the second cold mold, is removed from the cold mold and allowed to further cool to room temperature for filling or storage.

Such containers formed by the first embodiment of the invention disclosed above show excellent gas barrier properties with respect to the retention of carbon dioxide and the exclusion of oxygen from the internal

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spaces of the package. Also, containers so prepared show very high hoop yield stresses and thus superior resistance to sidewall deformation when used to package pressurized fluids. The characteristic of barrier properties are particularly important for oxygen sensitive foods and wines while high hoop yield stresses are needed for pressurized contents like soda and beer. Such containers also show excellent mechanical properties.

While the first embodiment of the invention disclosed immediately above is disclosed as relating to polyester parisons and the containers formed therefrom, the preferred embodiment of the invention relates to poly(ethylene terephthalate). Particularly preferred are poly(ethylene terephthalate) polymers having an inherent viscosity of at least 0.6 wherein the polymer contains at least 97% repeating units of ethylene terephthalate with the remainder being minor amounts of ester-forming components. Also useful are copolymers of ethylene terephthalate with up to about 10 mole percent of the copolymer being prepared from the monomer unit selected from butane-1,4-diol; diethylene glycol; propane-1,3-diol, poly(tetramethylene glycol); poly(ethylene glycol); poly(propylene glycol); 1,4-hydroxymethylcyclohexane and the like, substituted for the glycol moiety in the preparation of the copolymer, or isophthalic; naphthalene 1,4- or 2,6-dicarboxylic; adipic; sebacic; decane-1,10-dicarboxylic acids, and the like, substituted for the acid moiety (terephthalic acid) in the preparation of the copolymer.

Of course, the poly(ethylene terephthalate) polymer can include various additives that do not adversely affect the polymer or the processing according to the invention. For instance, some such additives are stabilizers, e.g., antioxidants or ultraviolet light screening agents, extrusion aids, additives designed to make the polymer more degradable, antistatic agents and dyes or pigments. Moreover, conventional cross-linking or branching agents can be included in small amounts in order to increase the melt strength of the preferred poly(ethylene terephthalate).

The invention is preferably practiced with conventional injection molded polyester parisons. Such parisons are generally elongate tubes of cylindrical cross-section which have an open upper threaded finish which accepts a closure; a cylindrical elongate main body portion; and a closed hemispherical bottom portion. The parison when expanded results in a narrow neck container having a generally cylindrical main body portion and a closed hemispherical bottom portion. Such parisons and final container shapes are preferred but other geometrical configurations may be selected within the scope of the present invention.

In the preferred mode of practicing the first embodiment of the present invention, the first hot heat-setting mold is maintained at a temperature of between 100°–250° C., which is a temperature sufficient to induce substantial crystallization in the formed container as it is being heat-set within the mold after biaxial stretching upon inflation. The time of residence of the biaxially oriented container, once its walls are in contact with the mold, is less than five minutes. It has been discovered according to the present process that time periods of from one to ten seconds are sufficient to induce substantial crystallization when coupled with the second expansion and concomitant biaxial orientation in a second, larger, cold mold to produce the superior containers according to the present process. In the preferred embodiment, the mold volume of the first hot heat-setting mold is 70% of the volume of the second cold mold, i.e. the second mold is preferably about 1.4 times larger in total internal volume than the first mold.

The hot heat-setting mold equipment, parison handling, container transfer and cold mold equipment are all of conventional design and are not part of the invention.

Preferably, the parisons are injection molded and are preheated to the orientation range by conventional parison preheaters available in the market place.

Typically, a transfer time between the two molds is between three and fifteen seconds. Similarly, the reduced pressure needed for such transfer operation is between 20 and 24 psi.

As indicated above, the second cold mold has a volume about 1.4 times the volume of the first hot heat-setting mold in the preferred embodiment. However, generally speaking, according to the present process, the mold need only be slightly larger than the first hot heat-setting mold to achieve advantageous features of the present invention over conventional containers. However, as indicated above, preferably the first hot heat-setting mold is about 70% of the internal volume of the second cold mold and of the same general internal shape.

The second cold mold is typically operated at less than 100° C. so no significant additional heat-setting occurs and most preferably, according to the present invention, at a temperature of less than 25° C. for such reasons.

This first embodiment of the present invention is particularly advantageous for the production of small poly(ethylene terephthalate) containers. It is particularly well-suited for producing containers on the order of one half-liter in container internal volume, for use in high carbonation beverages like soft drinks and beer. The containers, according to the first embodiment of the present invention, are also particularly advantageous for the packaging of gas-sensitive contents like wine, cosmetics and foodstuffs, wherein a high gas barrier for the retention of internal packaging gases and the exclusion of external oxygen is necessary.

In the second embodiment of the present invention, a process and resulting container is disclosed for forming biaxially oriented, heat-set, i.e. partially crystalline, polyester containers having improved properties. The second embodiment of the invention includes the following steps:

heating a polyester parison to the orientation temperature range;

insertion of the hot parison into a first hot heat-setting mold and enclosing the mold thereupon;

expansion of the preheated parison enclosed in the first hot heat-setting mold by internal pressurization to biaxially orient the parison by inflation to produce a fully formed container which is heat-set by the internal pressurization of the parison forcing the walls of the container into close contact with the hot heat-setting mold walls;

the thusly heat-set container is subsequently removed under reduced yet substantial enough internal pressurization to prevent shrinkage, from the first hot heat-setting mold and transferred under such pressure to a second, larger hot heat-setting mold;

the formed container derived from the first hot heat-setting mold is again inflated to induce biaxial orientation while enclosed within the larger second hot heat-

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setting mold and maintained in close contact with the hot walls of the second larger hot heat-setting mold, by the internal pressurization, to again heat-set the container in the second hot heat-setting mold; and

subsequently, the twice biaxially oriented, twice heat-set container is cooled to room temperature by removing the doubly oriented, doubly heat-set container from the second larger hot heat-setting mold under significant positive pressure and allowing the container to cool (a) externally, or (b) immediately transferring the doubly biaxially oriented, doubly heat-set container to a third cold mold which has approximately the same volume as the second hot heat-setting mold wherein it is cooled by contact with cold mold walls to a temperature of less than 100° C. and preferably a temperature of 25° or less, or in a third embodiment, (c) the doubly oriented, doubly heat-set container may be cooled in the second hot heat-setting mold itself by cooling the mold with a conventional heat transfer mechanism, for example, internal channeling for the passage of cold fluids through the mold.

In the preferred embodiment of practicing the second embodiment of the invention, the temperature of the first hot heat-setting mold is between 100°–250° C. and the residence time of the blown biaxially oriented container in the first mold is less than five minutes, preferably 1–10 seconds. The volume of the first hot heat-setting mold is approximately, in the most preferred embodiment, 70% of the volume of the second hot heat-setting mold such that the second hot heat-setting mold is approximately 1.4 times larger in total internal volume than the first hot heat-setting mold.

The formed container which is removed from the first hot heat-setting mold and transferred under significant positive pressure to the second larger hot heat-setting mold is most preferably transferred at between 20–24 psi pressure as set forth in the first embodiment of the invention.

The second larger internal volume hot heat-setting mold is, as disclosed above, in the most preferred embodiment about 1.4 times larger in total internal volume than the first hot heat-setting mold. While this is the most preferable volume ratio for the two hot heat-setting molds, a lesser volume differential may be used if desired and still achieve advantages relative to conventional containers. Typically, the second hot heat-setting mold is run at the same temperature as the first, i.e., 100°–250° C. The time of residence of the container in the second hot heat-setting mold after expansion is substantially less than 10 minutes and of the preferred process between one and five seconds.

The second embodiment of the invention is the most preferred process for forming highly thermally stable mechanically superior partially crystalline containers for pasturized foods like beer and foodstuffs. The first embodiment of the process is most preferred for forming containers which have high barrier properties, good mechanical properties and particularly high hoop yield stresses. The first embodiment is also particularly useful for containers for carbonated beverage packaging and oxygen sensitive food and cosmetics packaging.

All documents referred to herein are incorporated by reference.

The following Tables illustrate the superior properties of the containers formed according to the present invention as compared to conventional containers fabricated from PET, wherein PET represents poly(ethylene terephthalate) and where the containers are conventionally shaped narrow neck, cylindrical sidewalled containers having hemispherical bottoms.

Table I illustrates the improved characteristics of containers formed according to the first embodiment of the invention utilizing a first hot mold to induce heat-setting and a second larger internal volume cold mold to prevent additional heat-setting.

TABLE I

Physical Property	Container	Unheat-set biaxially oriented container of PET at Full size		Biaxially oriented singly heat-set container of PET at Full size		Biaxially oriented singly heat-set container of PET at 0.7× Full size		Biaxially oriented singly heat-set hot mold, biaxially oriented, cold mold at Full size	
↓	Type →	Axial	Hoop	Axial	Hoop	Axial	Hoop	Axial	Hoop
Modulus	Avg.	404	955	443	799	513	790	482	978
(psi × 10^3)	std. dev.	9	65	20	47	27	93	17	65
Yield Stress	Avg.	12.7	33.5	14.1	31.5	16.4	22.3	13.8	40.8
(psi × 10^3)	std. dev.	0.5	2.8	0.5	1.7	0.8	1.6	0.2	1.7
Yield Strain	Avg.	6.3	5.6	5.9	6.0	6.3	6.0	6.1	6.0
(percent)	std. dev.	0.4	0.4	0.2	—	0.1	—	0.2	—
Ultimate	Avg.	16.3	35.0	11.5	44.8	14.4	37.6	14.4	46.1
Strength	std. dev.	1.0	1.7	0.2	1.7	1.1	1.6	0.8	2.8
(psi × 10^3)									
Ultimate	Avg.	78	10	42	17	46	22	38	13
Elongation	std. dev.	8	1	9	4	8	2	10	1
Density									
Position 1		1.3599		1.3920		1.3950		1.3894	
Position 2		1.3590		1.3960		1.3970		1.3931	

As defined in Table I, position 1 is a sample of material taken from a position four inches from the top of the container while position two samples are taken from a position six inches from the top of the container.

The data illustrated in Table I was generated using PET parisons of 22 gram weight suited for forming one-half liter internal volume containers.

The half-liter beverage parison used has an overall length of 3.970 inches. The outer diameter of the body portion of the parison just below the finish region is 0.760 inch. There is a 0° 28 minute inward taper along the parison length resulting in a 0.728 inch outer diameter at the hemi-bottom end of the parison. The wall thickness is maintained at 0.134 inch throughout the body of the parison. The inside diameters in this regions are 0.626 inch at the finish end and 0.594 inch at the bottom end. The finish is a conventional beverage container finish. Three types of containers were prepared from parisons identical to the PET parisons used with the inventive process for comparison with the improved containers according to the first embodiment of the invention, they are:

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(1) A conventional blow molded PET container formed by blow molding the parison at orientation temperature in a cold mold at a final size of one-half liter so as to induce biaxial orientation;

(2) A container blow molded as above under conditions to biaxially orient the containers and simultaneously heat-set by contacting the container walls with a hot mold to induce heat-setting and concommitant increase in crystallinity and density, the size of the final continers being one-half liter;

(3) A container blow molded as above under conditions to biaxially orient the containers and simultaneously heat-set by contacting the container walls with a hot mold to induce heat-setting and thus partial crystallization except that the mold volume is 0.7 of the size of a one-half liter mold used for the containers of (1), (2) and (4) below; and

(4) A container of full one-half liter size manufactured as defined above according to the first embodiment of the invention and particularly with the first hot mold temperature at 230° C., time of residence after expansion in the first hot mold 1.3 seconds, transfer time between molds 8 seconds, transfer pressure in container of 22 psi, temperature of second cold mold at 25° C. and time of residence in second mold after completion of expansion at 1.3 seconds.

For containers (2) and (3), the heat-setting temperature was 225° C., the crystallization time after completion of inflation is 1.3 seconds.

As Table I clearly illustrates that containers fabricated according to the first embodiment of the invention are superior in overall mechanical properties and accordingly barrier properties to the other containers of the test.

Of particular importance is the recognition that the containers of this invention show an average hoop yield stress significantly higher than any of the other conventionally formed containers. As pointed out above, hoop yield stress is a critical property as it relates to the ability of small containers to hold highly pressurized food products, like carbonated soft drinks.

Note also that containers according to the present invention are also significantly higher in ultimate strengths than are either the unheat-set biaxially oriented containers at full size or the biaxially oriented singly head-set containers of 0.7 full size.

With respect to the physical properties described in Table I, such properties are defined herein as follows.

Modulus is the measure of the stiffness of the containers, as defined by ASTM standard D-638.

Yield stress is defined as the resistance to creep under heat and/or pressure of a container wall portion, as defined by ASTM standard D-638.

Yield strain is defined as the percent of elongation to which a section of containers may be subjected and then not return 100% to its original dimensions by elastic recovery, as defined by ASTM standard D-638.

Ultimate strength is a measure of the internal pressurization which a container can tolerate prior to irrevocable rupture, as defined in ASTM standard D-638.

Ultimate elongation is a measure of impact strength of the material, as defined in ASTM standard D-638.

To further define the manufacture condition of the containers represented in Table I, the extension ratios for the parisons blown in the 0.7× half-liter size mold were an average hoop extension of 3.99X and an average axial extention of 2.36X. For the overall extension of the parison from the preblown parison shape to the final shape when blown into a one-half liter mold the average hoop extension ratio was 4.69X and the average axial extension was 2.43X.

For the container according to the first embodiment of the invention which are twice expanded, i.e., once in the first hot mold and a second time in the cold mold, the cylindrical sidewall portion has a volume expansion of 1.37X; a hoop extension of 1.17X and an axial extension of 1.0X. The hemispherical bottom portion has a volume expansion of 1.53X; a hoop extension of 1.15X and an axial extension of 1.15X. The overall extension is a volume extension of 1.43X; a hoop extension of 1.17X and an axial extension of 1.02X.

Table II illustrates the improved resistance to shrinkage and to gross deformations in shape upon exposure to elevated temperature of containers prepared according to the second embodiment of the invention. In hot filled foods, like catsup or soy sauce, and pasteurized foods, like beer, it is critical that plastic containers not only have good barrier properties and mechanical strength but also resist shrinkage and gross deformation upon exposure to elevated hot filling and pasturization temperatures.

Table II compares unheat-set biaxially oriented containers blown against cold mold walls in a full size one-half liter mold and biaxially oriented heat-set in a hot mold of full one-half liter size with containers prepared by both the first and second embodiments of the present invention.

TABLE II

Physical Property ↓ / Container Type →	Unheat-set biaxially oriented container of PET	Biaxially oriented, singly heat-set container of PET	Biaxially oriented, heat-set hot mold, biaxially oriented, cold mold	Biaxially oriented heat-set hot mold, biaxially oriented heat-set hot mold
Volume Reduction after Exposure for 5 minutes at 90° C. (percent change)	16.4	1.4	8.9	0.9
Gross Deformation in Shape	yes	no	no	no
Production Conditions				
Temperature Mold One (°C.)	25	230	230	230
Time in Mold One (second)	1.3	1.3	1.3	1.3
Temperature Mold Two (°C.)	—	—	25	240
Time in Mold Two (seconds)	—	—	1.3	3–4

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As illustrated by the data, containers prepared by the dual hot mold, a second embodiment of the invention are superior to all other tested containers in both (1) resistance to shrinkage (shrinkage less than one percent) and (2) showing no gross deformation.

Additionally, the biaxially oriented, heat-set hot mold and subsequently biaxially oriented and heat-set again in hot mold containers described also have superior mechanical properties. The containers show a yield stress of 16,900 psi±500 psi axial and of 36,000 psi±1,800 psi hoop. Thus, the containers of the second embodiment show superior yield stress number than even singly heat-set containers. This is highly unexpected since it is generally known in films that any heat-setting step will lower the yield stress of the film article. I have discovered that not only do properties related to shrinkage improve with double heat-setting in a larger mold but so does the important mechanical property of yield stress.

Conventionally prepared biaxially oriented unheat-set containers show large shrinkage as well as gross structural deformation. Containers prepared by the first, i.e., hot mold, cold mold, embodiment of the invention, show good resistance to gross deformation but shrink in overall dimension to a large extent. Biaxially oriented containers which are singly heat-set show resistance to deformation but still are substantially more prone to shrinkage than are the containers of the second embodiment of the invention.

Accordingly, containers according to the first embodiment of the invention are excellent for the retention of pressurized food products due to good barrier properties and high mechanical properties particularly high hoop yield stress. Containers according to the second embodiment are also excellent in respect of barrier properties and mechanical properties but also show excellent resistance to shrinkage and gross deformation at elevated food packaging and processing temperatures.

Accordingly, what is claimed is:

1. A process for fabricating a partially crystalline, biaxially oriented hollow plastic container article comprising:

(1) enclosing a plastic parison which is at a temperature within its molecular orientation temperature range within a first blow which first blow mold is at a temperature sufficient to induce crystallization into said plastic upon contact of said plastic with said blow mold;

(2) expanding said plastic parison within said first blow mold by internal pressurization while still within the molecular orientation temperature range to induce biaxially orienting in said plastic and force said plastic parison into intimate contact and conformance with said first blow mold to form a biaxially oriented container and by such internal pressurization maintaining contact between said first mold and said biaxially oriented container for a time sufficient to induce partial crystallization into said biaxially oriented container;

(3) transferring said partially crystallized, biaxially oriented container from said first blow mold to a second blow mold, said transfer occurring with sufficient internal pressurization of said partially crystallized biaxially oriented container to prevent significant shrinkage during said transfer;

(4) enclosing said partially crystalline biaxially oriented container in said second blow mold, which said second blow mold is (a) at a temperature which is not sufficient to induce significant crystallization in said plastic of said container and (b) which is larger in internal volume than said first blow mold;

(5) expanding by internal pressurization said partially crystalline biaxially oriented container within said second blow mold into intimate contact and conformance with said second blow mold to form a larger container and again biaxially orient the material of said partially crystallized biaxially oriented container derived from said first blow mold; and

(6) subsequently removing the resultant container from said second blow mold and reducing the internal pressure to ambient pressure.

2. The process defined in claim **1** wherein said plastic is poly(ethylene terethalate) and said first blow mold is at a temperature between 100° C. and 250° C. and said second blow mold is at a temperature of about 100° C. or less.

3. The process defined in claim **1** wherein said plastic is maintained in contact with said first blow mold for a time between 1 second and 5 minutes.

4. The process defined in claim **1** wherein the internal volume of said first blow mold is about 0.7 times the internal volume of said second blow mold.

5. A process for fabricating a partially crystalline, biaxially oriented hollow plastic container article comprising:

(1) enclosing a plastic parison which is at a temperature within the molecular orientation temperature range in a first blow mold, which first blow mold is at a temperature sufficient to induce crystallization into said plastic upon contact of said plastic with said blow mold;

(2) expanding by internal pressurization said plastic parison within said first blow mold while still within the molecular orientation temperature range to induce biaxial orientation into said plastic and force said plastic parison into intimate contact and conformance with said first blow mold to form a biaxially oriented container and by such internal pressurization, maintaining contact between said biaxially oriented container and said first blow mold for a time sufficient to induce partial crystallization into said biaxially oriented container;

(3) transferring said partially crystallized, biaxially oriented container from said first blow mold to a second blow mold, said transfer occurring with sufficient internal pressurization of said partially crystallized biaxially oriented container to prevent significant shrinkage during said transfer;

(4) enclosing said partially crystallized biaxially oriented container in said second blow mold, which second blow mold is (a) at a temperature suffcient to induce additional crystallization into said partially crystalline biaxially oriented container upon contact with said second blow mold and (b) which is larger in internal volume than said first blow mold;

(5) expanding by internal pressurization said biaxially oriented partially crystallized container within said second blow mold into intimate contact and conformance with said second blow mold to form a larger container and to again biaxially orient and partially crystallize the biaxially oriented and partially crystallized container derived from said first blow mold; and

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(6) subsequently removing the resulting container from said second blow mold and reducing the pressure to ambient pressure.

6. The process defined in claim **1** wherein said plastic is poly(ethylene terephthalate) and said first and second blow molds are each at a temperature between 100° C. and 250° C.

7. The process defined in claim **1** wherein said plastic is maintained in contact with said first and second blow molds for a time between 1 second and 5 minutes.

8. The process defined in claim **1** wherein said first blow mold is about 0.7 times the internal volume of said second blow mold.

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APPENDIX F

US008468785B2

(12) **United States Patent**
Thomasset

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(54) **CONTAINER FOR HOT-FILLING**

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See application file for complete search history.

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(57) **ABSTRACT**

The invention relates to a process for manufacturing and hot-filling a PET container comprising the following steps:

a) providing a PET preform capable of being blow molded;
b) blow molding the preform in the cavity of a mold so as to form a container;
c) removing the container from the mold cavity;
d) filling the container with a liquid, the temperature of which is above 80° C.;
e) sealing the container in a leaktight fashion;
f) sterilizing and cooling the container; and
g) shrinking the container,

characterized in that:

in step a) a PET preform composed of a copolymer based on terephthalic acid is used;
in step a), at least one part of the preform is at a temperature greater than or equal to 110° C.;
the temperature of the mold used in step b) is less than or equal to 65° C.; and
during step g) the container is heated for a duration between 1 and 5 seconds at a temperature between 600 and 1000° C. in at least one part of the container so as to create a shrinkage and a reduction in the volume of the container.

The invention also relates to a container obtained using the process described above.

3 Claims, No Drawings

CONTAINER FOR HOT-FILLING

This application is the U.S. national phase of International Application No. PCT/IB2008/054797 filed 17 Nov. 2008, which designated the U.S. and claims priority to EP Application No. 07121609.7 filed 27 Nov. 2007, the entire contents of each of which are hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to a hot-filled polyethylene terephthalate (PET) container, and also to the process for filling said container. The process applies, in particular, to the packaging of a product at above 80° C. in a PET bottle that has not been manufactured with blow-molding processes that are referred to as "Heat Resistant" and that are more commonly denoted by the letters HR.

PRIOR ART

Polyethylene terephthalate (PET) bottles are used in many fields owing to their excellent properties of resistance, lightness, transparency and organolepticity. These bottles are manufactured at a high production rate by biaxially stretching a preform in a mold.

In the present text, the expression "hot-filling" should be understood to mean a filling where the temperature of the liquid is above ambient temperature, in general above 80° C.

The expression "cold-filling" is understood to mean ambient temperature or a temperature below ambient temperature.

The manufacture of PET bottles for cold-filled bottles resorts to the process of blow molding a preform in the cavity of a mold. The preform manufactured by injection molding resembles a tube, one end of which is plugged and the other end of which forms a neck. After heating this preform via infrared radiation up to 95/120° C., the amorphous PET is softened and undergoes a deformation by blow molding in the cavity of a mold. During the blow-molding phase, the preform is deformed biaxially due to the combined action of a stretching rod and due to the air introduced under pressure into the preform and that causes inflation. The molds are water-cooled in order to dissipate the heat of the PET by contact, which has the effect of setting the geometry of the bottle. The bottles obtained are said to be biaxially oriented since during their manufacture they have undergone biaxial stretching. The macromolecular chains thus oriented lead to excellent mechanical and optical properties at ambient temperature. The drawback of this biaxial orientation results from its reversible nature and the material seeks to return to its initial state as soon as the temperature increases; a phenomenon known as shape memory.

Thus, although these bottles offer many advantages, they have the drawback of deforming when their temperature is above 60° C. Filling these bottles with a product at a high temperature 85/95° C. causes such deformations that said bottles become unfit for use. Several processes for remedying the aforementioned drawback and allowing PET bottles to be hot-filled have been described in the prior art.

The most common solution for allowing a PET bottle to be filled with a hot liquid consists in jointly using a process known as a "Heat Resistant" bottle blow-molding process, and also a specific bottle design.

The processes known as "Heat Resistant" processes, and more commonly denoted by the letters HR, make it possible to improve the heat resistance of the bottles. Thus, there is a first HR process, referred to as a one-part process, which allows filling temperatures of 80 to 88° C. to be achieved. A second HR process, referred to as a two-part process, allows liquids to be packaged at temperatures of 88 to 95° C.

In the same way as HR bottle manufacturing processes, it is necessary to resort to different bottle designs. During packaging, the bottles must withstand the vacuum generated by the cooling of the liquid when said bottle has been stoppered at high temperature. The cooling causes a double contraction, that of the liquid and that of the air trapped in the bottle. Thus, hot-filled bottles comprise compensating panels that make it possible to absorb the variation in volume, and more rigid parts that prevent an uncontrolled deformation of the bottle. These designs require greater wall thicknesses and result in bottles for which the weight may range up to two times the weight of a cold-filled bottle.

The HR processes used to make bottles that are designed to be hot-filled also resort to the blow molding of a preform in the cavity of a mold, but with more sophisticated and more complex operating parameters. Specifically, the preform is heated at a higher temperature than in the case of blow molding a cold-filled container. The high blow-molding temperature makes it possible to minimize the shape memory of the PET and to relax some of the stresses due to the blow molding. In the case of the one-part HR process, the bottle is subjected to a heat treatment when it comes into contact with the walls of the mold. The high temperature of the walls of the mold has the effect of increasing the crystallization of the biaxially oriented PET chains and thus improving its temperature resistance. A circulation of air inside the bottle makes it possible to discharge the heat from the PET and thus solidify the walls of the bottle before the removal of the mold. In the case of the two-part HR process, the process makes it possible to attain a higher heat resistance but at the cost of a succession of more complex steps. Specifically, the first step consists in blow molding a preform, the volume of which is much greater than that of the bottle; this preform, having a high degree of crystallization, is then shrunk by heating beyond the glass transition; the shrunken preform is finally blow molded in the cavity of a mold corresponding to the dimensions of the bottle to be manufactured. The bottle has a high degree of crystallization, which allows filling at temperatures between 88 and 95° C.

However, the bottles that have undergone a heat treatment in order to allow the packaging of a liquid at high temperature have several drawbacks.

A first drawback is linked to the reduction in the bottle production rate because the heat-setting process slows down the blow-molding cycle. The HR processes are more complex than the conventional blow-molding process and consequently more costly to set up and to use.

A second drawback is linked to the weight and consequently to the cost of these bottles. As has been explained previously, the addition of material makes it possible to withstand the vacuum that is created in the container and the high filling temperature. However, the current solution uses an excess of material, which is not strictly necessary for good preservation of the product. Furthermore, the compensating panels detract from the appearance of the container, making it less attractive to the consumer.

Patent Application FR2887238 proposes to partly overcome the aforementioned drawbacks by producing thin-walled bottles suitable for hot-filling. These bottles are manufactured using a one- or two-part HR blow-molding process as explained previously and consequently have properties that allow hot-filling without shrinkage of the container. The bottles proposed in Application FR2887238 have many advantages since they do not comprise shrinkage panels, and have a reduced weight compared to the containers used by a

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person skilled in the art, this weight being substantially equivalent to that of the containers used to hold mineral water, at equal capacity. The container is of cylindrical shape, optionally with grooves to stiffen the body, with a light base like that of the containers for still mineral water, but reinforced. This container is hot-filled on a filler of known type, the liquid being brought to and maintained at a temperature of 60 to 95° C. depending on the targeted applications. After stoppering at high temperature and cooling, a vacuum is created in the bottle, which creates a significant deformation of the body of the bottle. The process, according to Application FR2887238, consists in reducing the volume of the bottle by causing a heat shrinkage of the walls of the bottle when the temperature of the liquid is below a transition of around 40 to 50° C. Despite the many advantages that it provides, Patent Application FR2887238 has several drawbacks.

A first drawback is linked to the method of manufacturing these bottles which requires a one- or two-part HR blow-molding process in order to render the container sufficiently temperature resistant. As has been explained previously, these manufacturing processes are complex and consequently more difficult to exploit. This has a repercussion on the cost of the containers produced.

The second drawback of the process proposed lies in the difficulty in shrinking the volume of the container by heating, bearing in mind that said container was manufactured by using a HR blow-molding process that makes it more temperature resistant.

General Presentation of the Invention

The invention proposes to overcome the aforementioned drawbacks by means of a novel container manufactured and hot-filled according to a novel process.

According to the invention, the PET container for hot-filling is manufactured using a conventional blow-molding process, that is to say a process commonly used for producing cold-filled containers. According to the invention, the container is blow molded in a "cold" mold, unlike the "Heat Resistant" or "HR" blow-molding processes that consist in blow molding the container in a mold at high temperature.

The filling process comprises an additional step compared to the hot-filling commonly used. This step consists in shrinking the walls of the container using a high-intensity heat source.

The container is differentiated from hot-filled containers by its geometry without compensating panels, by its base of petaloid or star type, by its low weight, by its low average density and by the spatial distribution of its density.

The invention makes it possible, in particular, to manufacture a low-weight container, the hot-fillability of which is not provided by a HR blow-molding process but by the unexpected combination of several factors including the geometry of the container, the composition of the container and the manufacturing and filling process.

The weight of the container according to the invention is substantially equivalent to that of a container, e.g. a bottle, intended to contain a cold-filled liquid.

It should be noted, furthermore, that the container according to the invention is designed to withstand the pressure and not the vacuum as is proposed in the prior art. Advantageously, the base of the container is designed to withstand a positive pressure in the container.

The invention also comprises a process of hot-filling a container, such as a PET bottle, which has not been manufactured using a HR process and of which the hot-fillability results from the combination of the design of the bottle and its method of manufacture. The filling process additionally comprises a step of shrinkage of the container, under the effect of an intense heat source, when the hot-filled liquid is completely or partly cooled.

DETAILED PRESENTATION OF THE INVENTION

The invention will be better understood below by means of an example that describes the manufacture of a hot-filled PET bottle which is manufactured from a preform according to a conventional blow-molding process that is not a HR process. The bottle has a high temperature resistance due to an unexpected synergy between the geometry of the bottle, the manufacturing and filling process and the resin used.

Unlike the solutions of the prior art which propose to increase the crystallinity of PET containers in order to improve their temperature resistance, the invention proposes the use of a container for which the lower degree of crystallization alone does not enable it to withstand the filling temperature. The heat resistance of the container results from the combined action of the degree of crystallization, of the geometry of the container and of the blow-molding and filling process. The invention is of great interest since it makes it possible to avoid the one- or two-part HR manufacturing processes used to increase the degree of crystallization of the container. These processes comprise complex steps that slow down the rate of production and that have a great impact on the cost of the containers produced.

As indicated above, the detailed example of the invention describes PET bottles, but it goes without saying that the invention is not limited to this type of object. Other types of containers, e.g. made of PET or similar resins, also form the subject of the invention. The bottle comprises a neck, a generally cylindrical body and a base. The weight of the bottle is similar to that of a bottle for mineral water or a carbonated drink, at equivalent capacity.

The neck is of reduced thickness compared to the necks of bottles manufactured using a HR process. For example, the neck of a bottle for a carbonated drink is particularly suitable.

The body of the bottle is generally of cylindrical shape, of small thickness and may comprise ribs that provide the rigidity. The bottle does not comprise the characteristic elements of hot-filled PET bottles, such as panels, band, bulb at the shoulder. According to one preferred embodiment of the invention, the cylindrical body comprises, however, a contracting zone intended to eliminate the vacuum in the bottle after partial or complete cooling of the liquid. The contracting zone is preferably localized. The filling process comprises a step of intense heating of said contracting zone, which has the effect of eliminating the vacuum in the bottle. Under the effect of the heat, the contracting zone shrinks and creates a reduction in the volume of the bottle.

Advantageously, the bottle comprises a base endowed with specific characteristics. Unlike what is proposed in the prior art, only the bases having a high pressure resistance may be used. Surprisingly, the bases of petaloid type used for the containers of carbonated drinks are barely deformed under the effect of the temperature. The bases of star type that are sufficiently pressure resistant may also be suitable.

The bottles are manufactured using a conventional blow-molding process without a post-stretching crystallization step in the cavity of the mold. A specific control of the blow-molding process is however necessary in order to obtain a bottle that is not deformed under the effect of the filling temperature.

This process comprises a first step that consists in heating a preform to the maximum permissible temperature, close to

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the crystallization. Advantageously, the preform is heated at a temperature above 110° C. The PET grades known to a person skilled in the art for producing bottles known as "heat set" bottles are used. These grades are generally high molecular weight products or copolymers of PET. The PET copolymers obtained from terephthalic and isophthalic acids are particularly suitable.

The preform is stretched and blow molded in the cavity of a mold of suitable geometry, the walls of which are cooled in order to dissipate the heat transmitted by contact, which has the effect of setting the walls of the bottle. Unlike the HR process where the mold is heated at a temperature generally between 115 and 140° C. in order to increase the crystallinity of the side walls of the bottle, the invention makes it possible to use the conventional blow-molding process that consists in using molds that are cooled or at the very most tempered at a temperature below the glass transition temperature of PET (around 65° C.). The part of the mold that forms the base of the bottle is advantageously cooled at a temperature below 20° C.

Astonishingly, it has been found that the colder the part of the mold that forms the base, the lower the deformation of the base of the bottle under the effect of the temperature. This surprising result goes against the current process which consists in increasing the temperature of the mold in order to increase the crystallization and relax the stresses of the polymer chains.

The bottles are produced at a high production rate in a similar manner to the bottles intended to contain mineral water or carbonated drinks.

Multilayer PET bottles manufactured and filled according to the process described in the invention are advantageously used to contain oxygen-sensitive and hot-filled products such as fruit juice. The bottles are manufactured from a multilayer preform blown in a mold, the temperature of which is below 65° C. The geometry of the bottle is similar to that of a single-layer bottle described in the invention. The bottle does not comprise the characteristic elements of hot-filled PET bottles, such as panels, band, bulb at the shoulder. According to one preferred embodiment of the invention, the cylindrical body comprises, however, a contracting zone intended to eliminate the vacuum in the bottle after partial or complete cooling of the liquid.

The hot-filling of single-layer or multilayer bottles may be carried out rapidly after blow molding the bottles, or after a variable period of time. An immediate filling is advantageous since the dry bottles have a better thermal stability. However, for logistical reasons, the bottles are generally filled after a relatively long storage time during which an equilibrium is produced between the moisture in the air and that in the walls of the bottle. This uptake of water slightly reduces the heat resistance of the bottle.

The filling of the bottle is differentiated from hot-fillings by the step of shrinking the contracting zone, a step that makes it possible to eliminate the vacuum created in the bottle after cooling.

The filling is generally carried out by gravity, the hot liquid flowing directly into the container. Depending on the products, the filling temperature is between 80 and 95° C.

When the hot liquid flows into the bottle, the wall of the container is rapidly heated without however deformations of the bottle being able to be observed. The container is then hermetically sealed using a stopper. The increase in the temperature of the air trapped in the head space has the effect of creating a slight pressure in the bottle after sealing.

Since the base has been designed to withstand the pressure, it does not deform despite the high temperature of the liquid in the bottle. The walls of the container are sterilized via the temperature of the product for a duration of around 3 minutes. The sterilization operation comprises an upturning of the bottle to ensure the sterilization of the inside face of the stopper and of the neck.

Next, the bottle is cooled rapidly by spraying cold water onto its outer wall. On cooling, the liquid and the head space contained in the container contract, creating a vacuum in the bottle. Under the effect of the negative pressure, the side walls of the bottle of thin thickness deform by "collapsing". It is advantageous to provide, in the design of the bottle, flexible zones that deform by collapsing under the effect of the negative pressure, and more rigid zones that do not deform. The deformation of the bottle is thus localized in one defined zone. It has been found that the flexible zone advantageously forms a cylindrical geometry of oval or circular cross section.

When the temperature of the liquid contained in the bottle has reached a temperature below 50° C., the bottle is heated at a high temperature at the contracting zone. The heating of the contracting zone has the effect of reducing the volume of the bottle by shrinking the contracting zone. The reduction in volume of the bottle created by the shrinkage compensates for the variation in volume of the liquid and cancels the vacuum inside the container.

Unlike what is proposed in the prior art, this heating is difficult to carry out by radiation since the supply of energy is not rapid enough to prevent a significant reheating of the liquid.

The shrinkage step requires an intense energy supply over a very brief duration. It has been found that the bottle could be heated by flame treatment, which causes a rapid and reproducible shrinkage of the contracting zone. As the wall of the bottle is in contact with a cold liquid on its inner face, the outer face may be brought into direct contact with a very high temperature flame for a very short time. Heating by hot air may also be used.

Compared to what is proposed in the prior art, it has been found that the bottle must be heated symmetrically, otherwise the bottle loses its verticality and the final geometry is not reproducible. Preferably, during the shrinkage step, the bottle is rotated in front of two heat sources that are positioned symmetrically with respect to the axis of rotation. Advantageously, the distance between the wall of the bottle and the heat source is constant.

Before the shrinkage step, the geometry of the contracting zone advantageously forms a homogeneous convex surface around the circumference of the bottle. The convex surface has several advantages with respect to a cylindrical, conical or concave surface. It has been found that the shrinkage of a convex surface stabilizes the shrinkage process and enables a high reproducibility of the final geometry of the bottle. When the contracting zone is not convex, great variations in the perpendicularity between the axis of the neck and the base of the bottle are sometimes observed.

The invention proposes the use of a container for which the lower degree of crystallization alone does not enable it to withstand the filling temperature. The heat resistance of the container results from the combined action of the degree of crystallization, of the geometry of the container and of the blow-molding and filling process. The bottle comprises a contracting zone having a degree of crystallization 2% greater than any other part of the bottle except for the neck when the latter is crystallized. The bottle therefore has a denser or more crystalline zone in the contracting zone. This zone is generally spread over the circumference of the bottle, thus forming a ring of higher density in the side wall of the bottle.

The invention was described previously for a bottle comprising an uncrystallized neck. Many processes are known by a person skilled in the art for improving the thermal stability of the necks when filling at a high temperature in order to prevent the latter from deforming. The processes used to obtain them may be easily combined with the present invention. However, against all expectations, it has been found that lighter neck geometries commonly used for the packaging of carbonated drinks could be used successfully in the context of the present invention.

The bottle obtained by the manufacturing and hot-filling process is distinguished from known bottles for hot-filling by:

- a low weight;
- the absence of compensating panels;
- a pressure-resistant base;
- a neck which may be of reduced weight;
- a contracting zone that forms a more crystalline ring; and
- a positive internal pressure after filling.

The positive internal pressure after filling has many advantages, in particular for the storage of the bottles. This is because, despite their low weight, these bottles have a high resistance to vertical compression due to the positive pressure in the container. The stacking height of the bottles is consequently increased. The positive pressure in the bottle after filling is also manifested during the opening of the bottle by the consumer. The bottles described in the prior art are under vacuum after filling and see their level decrease during opening whereas the bottle obtained according to the invention sees its level remain constant or increase slightly during opening.

Example

The bottle had a weight of 24 g for a capacity of 500 ml. The base was of petaloid type, the body had an upper cylindrical zone of small thickness, and a lower convex contracting zone. This bottle was obtained by blow molding a preform heated at 100° C. in a mold at 12° C. A PET copolymer based on terephthalic and isophthalic acids was used to mold the preforms (Cleartuf P85HF from M&G Polimeri Italia). The bottle was stored for 3 days before filling. The bottle was rinsed and filled at 85° C. according to the filling procedure used in the profession. After cooling the bottle, the upper zone was deformed under the effect of the vacuum in the bottle. The deformation of the upper zone created a reduction in the volume of the bottle substantially equal to 3.5%. The convex contracting zone was then heated by flame treatment for 1 to 5 s and advantageously for 3 s. During the shrinkage step, the bottle was rotated in front of two diametrically opposed flame treatment stations. After shrinkage, the vacuum in the bottle was eliminated; the upper zone regained its initial geometry and the initially convex contracting zone formed a cylindrical surface. The bottle comprised a contracting zone having a degree of crystallization greater than 34% whereas the degree of crystallization of the other parts of the bottle was less than or equal to 32%. The bottle therefore had a denser or more crystalline zone in the contracting zone. This zone was generally spread over the circumference of the bottle thus forming a ring of higher density in the side wall of the bottle.

The invention claimed is:

1. A process for manufacturing and hot-filling a PET container comprising the following steps:

a) providing a PET preform capable of being blow molded according to a conventional process which is not a heat resistant process,

b) blow molding the preform in a cavity of a mold so as to form a container;

c) removing the container from the mold cavity;

d) filling the container with a liquid, the temperature of which is above 80° C.;

e) sealing the container in a leaktight fashion;

f) sterilizing and cooling the container; and

g) shrinking the container,

wherein:

in step a) a PET preform composed of a copolymer based on terephthalic acid is used;

in step a), at least one part of the preform is at a temperature greater than or equal to 110° C.;

the temperature of the mold used in step b) is less than or equal to 65° C.; and

during step g) the container is heated for a duration between 1 and 5 seconds at a temperature between 600 and 1000° C. in at least one part of the container so as to create a shrinkage and a reduction in the volume of the container.

2. The process as claimed in claim **1**, wherein a bottom of the mold is maintained at a temperature below 20° C.

3. The process as claimed in claim **2**, wherein the bottom of the mold is maintained at a temperature between 1 and 15° C.

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