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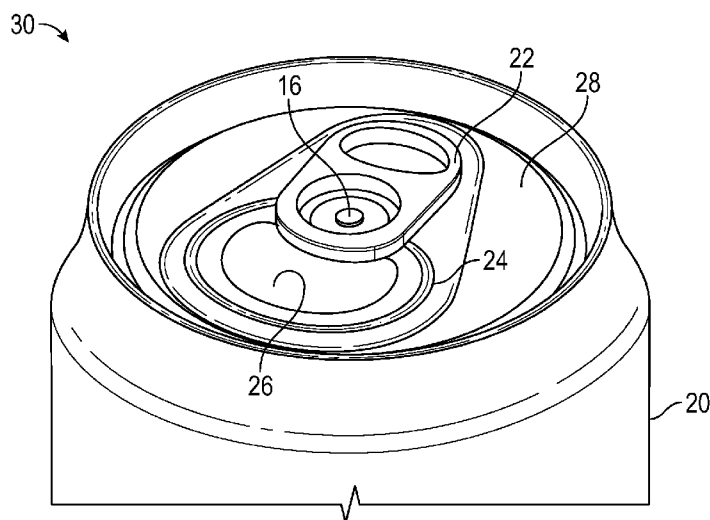


FIG. 1

(57) Abstract: A system for forming a score in a material includes an aluminum can and a tool. The aluminum can includes a can end, and an interior of the can end includes a coating. The tool includes a tool holder and a scoring knife. The scoring knife includes a proximal end configured to form the score in the can end. The proximal end has a width configured to minimize feathering of the coating when the score is punctured.

BEVERAGE CAN END SCORE TOOLING

REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application No. 62/172,536, filed June 8, 2015 and entitled IMPROVED BEVERAGE CAN END SCORE TOOLING, which is incorporated in its entirety by this reference.

FIELD OF THE INVENTION

[0002] This invention relates to tooling used for scoring an aluminum can end.

BACKGROUND

[0003] Aluminum cans are designed to hold and dispense beverages, food, and other liquid products. In most cases, the interior of the can includes a protective coating to prevent the contents of the can from reducing the integrity of the can. Typically, aluminum can end stock materials are coated on both sides of the sheet with layers of coatings that are cured in ovens. These liquid coatings that have been applied and cured may also include internal and external lubricants that help with the end forming process. In the past, these coatings were typically made of epoxy resins that harden when cured. In recent years, there has been a push to move away from epoxy resins due to concerns associated with Bisphenol A (BPA). Alternate coating systems using a laminate technology are potentially safer from a health perspective, but they are softer than traditional epoxies. Because laminates are softer, they are more prone to feathering and/or inconsistent ripping when the score profile is broken to reveal the opening of the can end. Feathering is a condition where the coating fails to break or rips improperly and unwanted residual coating remains after the score is broken.

SUMMARY

[0004] The terms “invention,” “the invention,” “this invention” and “the present invention” used in this patent are intended to refer broadly to all of the subject matter of this patent and the patent claims below. Statements containing these terms should be understood not to limit the subject matter described herein or to limit the meaning or scope of the patent claims below. Examples of the invention covered by this patent are defined by the claims below, not this summary. This summary is a high-level overview of various aspects of the invention and introduces some of the concepts that are further described in the Detailed Description section below. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used in isolation to determine the scope of the claimed subject matter. The subject matter should be understood by reference to appropriate portions of the entire specification of this patent, any or all drawings and each claim.

[0005] Described herein are improved scoring instruments for reducing or eliminating feathering along a coated aluminum can end once the scored profile is punctured and the opening is formed. In particular, the profile of the scoring tool is configured so that it decreases/minimizes the pressure exerted by the scoring tool when forming the score. Decreasing/minimizing the pressure while scoring reduces the likelihood that feathering will result when the score profile is punctured.

[0006] In some examples, a system for forming a score in a material includes an aluminum can and a tool. The aluminum can includes a can end and an interior of the can end includes a coating. The tool includes a tool holder and a scoring knife. In some examples, the scoring knife includes a proximal end configured to form the score in the can end. The proximal end has a width configured to minimize feathering of the coating when the score is punctured.

[0007] In some cases, the coating on the interior of the can end is a laminate coating. In various examples, the width of the proximal end of the scoring knife is between approximately 0.0005 inches and approximately 0.0020 inches. In some examples, the width of the proximal end is between approximately 0.0005 inches and approximately 0.0015 inches. In other examples, the width of the proximal end is between approximately 0.0005 inches and approximately 0.00125 inches. In certain cases, the width of the proximal end is between approximately 0.0005 inches and approximately 0.00075 inches.

[0008] In various cases, the scoring knife comprises sides that, when viewed in cross-section, are separated from one another by approximately 50 degrees to approximately 75 degrees. In some examples, the sides are separated from one another by approximately 60 degrees to approximately 70 degrees. In some cases, the sides are separated from one another by approximately 65 degrees to approximately 70 degrees.

[0009] In various examples, the proximal end is configured to form a coating depression in the coating that is less than approximately 0.0004 inches. In some examples, the coating depression is less than approximately 0.0003 inches. In certain examples, the coating depression is less than approximately 0.0002 inches. In other examples, the coating depression is less than approximately 0.0001 inches.

[0010] Various implementations described in the present disclosure can include additional systems, methods, features, and advantages, which can not necessarily be expressly disclosed herein but will be apparent to one of ordinary skill in the art upon examination of the following detailed description and accompanying drawings. It is intended that all such systems, methods, features, and advantages be included within the present disclosure and protected by the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Illustrative examples of the present invention are described in detail below with reference to the following drawing figures:

[0012] Figure 1 is a perspective view of an end of a beverage can.

[0013] Figure 2 is a schematic showing a depression made in the metal on the interior of a can from pressure exerted while scoring the can end.

[0014] Figure 3A illustrates a cross-sectional view of a proximate end of a scoring knife according to an example.

[0015] Figure 3B illustrates a cross-sectional view of a proximate end of a scoring knife according to an example.

[0016] Figure 3C illustrates a cross-sectional view of a proximate end of a scoring knife according to an example.

[0017] Figure 4 is a contour plot depicting the heights of depressions in the scored area on the interior of a can end by score knives having various widths and score angles.

[0018] Figure 5A illustrates a perspective view of a score profile formed in a can with the scoring knife of Figure 3A.

[0019] Figure 5B illustrates a perspective view of a score profile formed in a can with the scoring knife of Figure 3B.

[0020] Figure 5C illustrates a perspective view of a score profile formed in a can with the scoring knife of Figure 3C.

[0021] Figure 6 illustrates as produced and post-testing feathering rates for the score knives of Figures 3A-C.

[0022] Figure 7 illustrates a can end with reduced feathering after the score profile has been punctured and partially opened.

DETAILED DESCRIPTION

[0023] The subject matter of examples of the present invention is described here with specificity to meet statutory requirements, but this description is not necessarily intended to limit the scope of the claims. The claimed subject matter may be embodied in other ways, may include different elements or steps, and may be used in conjunction with other existing or future technologies. This description should not be interpreted as implying any particular order or arrangement among or between various steps or elements except when the order of individual steps or arrangement of elements is explicitly described.

[0024] Disclosed herein is a tool for scoring the end of an aluminum can, the tool including a scoring knife holder and an improved scoring knife for scoring a can end plate. The scoring knife holders can be any suitable (current or future) scoring knife holder.

[0025] Figure 1 illustrates a can 20 with an end plate 28 having an integrated “pop-top” or “pop-tab” opening feature 30. The opening feature 30 is a score 24 that defines an oval, round or other suitably shaped area 26. After the score 24 has been formed, a metal rivet 16 secures an aluminum tab (such as tab 22 in Figure 1) to the end plate 28 proximate to the score 24. When the tab 22 is raised, the forces of the tab 22 “pop” or crack the score 24 and push the area 26 inward toward the interior of the can 20. This action creates an opening that provides access to the contents of the can 20.

[0026] During the end manufacturing or conversion process, the end plate 28 that attaches or is seamed to the can 20 is scored by a sharp contoured instrument or scoring knife 10 (illustrated in Figure 2) that incises or cuts the oval, rounded, or other suitably shaped score 24 into the end plate 28. This score 24 must be deep enough to “pop” or crack and open completely when the tab 22 applies its opening forces. On the other hand, the score 24 must be shallow

enough that it does not cause a premature release to the internal contents of the can 20, which are under pressure. A premature release of pressure and possible contents has the potential to cause injury to those handling the can 20.

[0027] As mentioned above, the interior of the can 20 may include a protective coating to prevent the contents of the can 20 (which are potentially corrosive) from reducing the integrity of the can 20. These coatings are prone to feathering and/or inconsistent ripping when the score profile is broken to reveal the opening. Feathering occurs when the coating fails to break or rips improperly and unwanted residual coating remains attached to the area 26 and/or the opening that is revealed after the score 24 is broken.

[0028] The coating is also more likely to feather if it is damaged during the score forming process. In particular, during the scoring process, the bottom side of a cutting instrument or scoring knife 10 (illustrated in Figure 2) can ultimately create highly compressive forces in the metal and the forces transfer to the product side coatings or laminates on the side of the end plate 28 opposite of the score 24. These compressive scoring forces can create unwanted coating depressions along the bottom of the score 24 on the product side coating. Figure 2 illustrates an example of a coating depression 18 created during the score forming process because of the high scoring pressures exerted by the cutting instrument or scoring knife 10. These highly compressive scoring forces in softer laminates have a tendency to damage, shatter, crack, or break the laminate, which leads to increased de-lamination, which in turn results in a higher susceptibility to feathering when the score 24 is punctured by the tab 22.

[0029] Figures 3A-C illustrate cross-sectional views of non-limiting examples of profiles 40A-C of the scoring knife 10 for scoring the can end plate 28. As illustrated, the scoring knife 10 has a proximal end 12 and sides 17A-B. The proximal end 12 has a width 14 and the sides 17A-B are angled at an angle θ relative to the proximal end 12. In various examples, the angle θ

and width 14 of the scoring knife 10 can be configured to minimize the creation a score 24 that is susceptible to feathering upon puncturing. In some examples, the angle θ and width 14 of the scoring knife 10 can be optimized to minimize the pressure exerted on the can end plate 28 when the score 24 is formed.

[0030] In various examples, depressions 18 with a height h less than or equal to about 0.0004 inches have less risk of feathering when the score 24 is punctured. In various examples, depressions 18 can be less than or equal to about 0.0004 inches, such as less than or equal to about 0.0003 inches, less than or equal to about 0.0002 inches, or less than or equal to about 0.0001 inches. In some examples, the width 14 of the scoring knife 10 can be from about 0.0005 inches to about 0.0020 inches, such as from about 0.0005 inches to about 0.0015 inches, from about 0.0005 inches to about 0.00125 inches, or from about 0.0005 inches to about 0.00075 inches. In various examples, the angle θ of the scoring knife 10 can be from about 50° to about 75° , such as from about 60° to about 70° or from about 65° to about 70° .

[0031] Scoring knives 10 with angles θ and widths 14 within or approximate these respective ranges can be used to form scores 24 having reduced depression heights, and therefore reduced risk of feathering. For example, a scoring knife 10 with the angle θ and width 14 exerts less pressure and/or force on the can 20 and reduces or minimizes the height h of the depression 18 in the can end plate 28 along the score 24. This in turn can reduce the de-lamination of the laminate or other coating on the product side (the side opposite the scored side of the can end plate 28). Reduced de-lamination can improve/reduce the risk of feathering when the score 24 is punctured as the pop top opening feature 30 is popped to open the can 20. In particular, the score 24 made from the improved scoring knife 10 is configured such that, when punctured, the score 24 cleanly rips so there is reduced feathering.

[0032] Figure 3A illustrates an example of a scoring knife 10A that has a profile 40A with a width 14 of about 0.0014 inches and an angle θ of about 49.3° . Figure 5A illustrates the score 24 formed in can 20 using the scoring knife 10A. Figure 3B illustrates an example of a scoring knife 10B that has a profile 40B with a width 14 of approximately 0.0027 inches and an angle θ of approximately 44.2° . Figure 5B illustrates the score 24 formed in can 20 using the scoring knife 10B. Figure 3C illustrates an example of a scoring knife 10C that has a profile 40C with an angle θ of approximately 71.4° and a width 14 of approximately 0.0016 inches. Figure 5C illustrates the score 24 formed in can 20 using the scoring knife 10C.

[0033] Figure 4 is a contour plot illustrating the heights h of the depressions 18 formed in the can end plate 28 when the can end plate 28 is scored with score knives 10 having various angles θ (shown along the horizontal axis) and various widths 14 (shown along the vertical axis). As illustrated in Figure 4, a scoring knife 10 with a higher angle θ and a narrower width 14 can be utilized to create depressions 18 having reduced heights. In some examples, the combination of a wide angle θ and a narrow width 14 of the proximal end 12 of the scoring knife 10 helps reduce the risk of feathering, as described above.

[0034] Figure 6 illustrates feathering rates for scores in can ends having either a developmental polyester laminate labeled 12-2 ("coating 1") or a developmental polyester laminate labeled 4-2 ("coating 2") using the scoring knives 10A-C. In particular, "score design 1" corresponds to the scoring knife 10A, "score design 2" corresponds to the scoring knife 10C, and "score design 3" corresponds to the scoring knife 10B. The first score tested (identified in Figure 6 as "1-2") was a score formed by the scoring knife 10C in a can having the laminate 12-2 coating. The second score tested (identified in Figure 6 as "1-1") was a score formed by the scoring knife 10A in a can having the laminate 12-2 variable. The third score tested (identified in Figure 6 as "1-3") was formed by the scoring knife 10B in a can having the laminate 12-2

variable. The fourth score tested (identified in Figure 6 as “2-2”) was formed by the scoring knife 10C in a can having the laminate 4-2 variable. The fifth score tested (identified in Figure 6 as “2-1”) was formed by the scoring knife 10A in a can having the laminate 4-2 variable. The sixth score tested (identified in Figure 6 as “2-3”) was formed by the scoring knife 10B in a can having the laminate 4-2 variable.

[0035] As illustrated in Figure 6, five samples of each score were tested under two different conditions. Specifically, the feathering rates for these scores were determined at or around the time the scores were created (“Rating of Feathering – As Produced”), as well as after the interior of the can had been exposed to a corrosive substance for a period of time (“Rating of Feathering – After 5 Day L85 Testing”). The 5 Day L85 Testing referenced in Figure 5 refers to a 5-day accelerated pack test that uses water, citric acid, phosphoric acid, and sodium chloride as a medium. A test end is attached to a can filled with these components and put into a controlled temperature room and held at 47.8 °C for 5 days. Testing has shown that this 5 day accelerated exposure effectively simulates 6 months of exposure using typical commercial sodas.

[0036] Five samples for each score formed from the coating and score design combinations were obtained and measured for feathering, and an average measurement for each coating and score design combination was determined. As indicated in Figure 6, if any of the samples had a fail rating, then the entire sample set was given a fail rating; otherwise, the majority of the ratings was used to determine the mean rating. Regarding the feathering for each of the scores at the time the scores were created (“As Is Feathering”), the score 1-2 had a mean rating of pass, the score 1-1 had a mean rating of fail, the score 1-3 had a mean rating of fail, the score 2-2 had a mean rating of pass, the score 2-1 had a mean rating of pass, and the score 2-3 had a mean rating of pass. Regarding the feathering for each of the after the interior of the can had been exposed to a corrosive substance for 5 days (“Post 5 Day Liquor 85 Feathering”), the

score 1-2 had a mean rating of fail, the score 1-1 had a mean rating of fail, the score 1-3 had a mean rating of fail, the score 2-2 had a mean rating of pass, the score 2-1 had a mean rating of fail, and the score 2-3 had a mean rating of borderline.

[0037] Overall, based on the results of Figure 6 and based on the understanding that if any of the samples had a fail rating, then the entire sample set has a fail rating, score 1-2 and score 2-2, both formed from the scoring knife 10C (with the angle θ of approximately 71.4° and the width 14 of approximately 0.0016 inches), had a reduced likelihood of feathering when punctured as compared to scores formed the scoring knives 10A and 10B (i.e. scores 1-3, 1-1, 2-3, and 2-1). In particular, scores formed with the scoring knife 10C in both the laminate 12-2 coating (coating 1) and the laminate 4-2 coating (coating 2) passed testing at the time the scores were created. Scores formed with the scoring knife 10C in the laminate 4-2 coating (coating 2) also passed after 5-day L85 testing. Scores formed with the scoring knife 10A in the laminate 4-2 coating (coating 2) passed after testing both at the time the scores were created and after 5-day L85 testing. The other scores formed with the scoring knife 10C had a mean rating of fail. Scores formed with the scoring knife 10B in the laminate 4-2 coating (coating 2) passed testing at the time the scores were created and were borderline after 5-day L85 testing. The other scores formed with the scoring knife 10B had a mean rating of fail.

[0038] Figure 7 illustrates an example of the can end plate 28 with a score 24 formed by the scoring knife 10C with reduced feathering after the score 24 has been punctured and partially opened.

[0039] It should be understood that the above examples are exemplary values and any suitable combination that reduces or minimizes feathering is envisioned.

[0040] Also disclosed is a method of applying computer modeling to determine the optimal profile for the cutting instrument. In some examples, determining the optimal profile

involves determining the optimal angle and optimal width of the cutting instrument for creating the scoring in the can end. The optimal profile will vary depending on factors such as customer preferences, the shape and/or diameter and/or area of the desired opening in the can end, the material and/or the thickness of the can end.

[0041] A collection of exemplary examples providing additional description in accordance with the concepts described herein is provided below. These examples are not meant to be mutually exclusive, exhaustive, or restrictive; and the invention is not limited to these examples but rather encompasses all possible modifications and variations within the scope of the issued claims and their equivalents.

[0042] Example 1. A system for forming a score in a material comprising: an aluminum can comprising a can end, wherein an interior of the can end comprises a coating; and a scoring knife comprising a proximal end configured to form the score in the can end, the proximal end having a width configured to minimize feathering of the coating when the score is punctured.

[0043] Example 2. The system of any of the preceding or subsequent example combinations, wherein the coating is a laminate coating.

[0044] Example 3. The system of any of the preceding or subsequent example combinations, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.0020 inches.

[0045] Example 4. The system of any of the preceding or subsequent example combinations, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.0015 inches.

[0046] Example 5. The system of any of the preceding or subsequent example combinations, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.00125 inches.

[0047] Example 6. The system of any of the preceding or subsequent example combinations, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.00075 inches.

[0048] Example 7. The system of any of the preceding or subsequent example combinations, wherein the scoring knife comprises sides that, when viewed in cross-section, are separated from one another by approximately 50 degrees to approximately 75 degrees.

[0049] Example 8. The system of any of the preceding or subsequent example combinations, wherein the sides are separated from another by approximately 60 degrees to approximately 70 degrees.

[0050] Example 9. The system of any of the preceding or subsequent example combinations, wherein the sides are separated from another by approximately 65 degrees to approximately 70 degrees.

[0051] Example 10. The system of any of the preceding or subsequent example combinations, wherein the proximal end is configured such that a mean size of any coating depressions formed in the coating is less than approximately 0.0004 inches.

[0052] Example 11. The system of any of the preceding or subsequent example combinations, wherein the mean size of any coating depressions is less than approximately 0.0003 inches.

[0053] Example 12. The system of any of the preceding or subsequent example combinations, wherein the mean size of any coating depressions is less than approximately 0.0002 inches.

[0054] Example 13. The system of any of the preceding or subsequent example combinations, wherein the mean size of any coating depressions is less than approximately 0.0001 inches.

[0055] Example 14. A tool for scoring an end of an aluminum can, the tool comprising: a tool holder; and a scoring knife comprising a proximal end, the proximal end having a width configured form a score in the aluminum can and to minimize feathering of a coating of the aluminum can when the score is punctured.

[0056] Example 15. The tool of any of the preceding or subsequent example combinations, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.0020 inches.

[0057] Example 16. The tool of any of the preceding or subsequent example combinations, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.0015 inches.

[0058] Example 17. The tool of any of the preceding or subsequent example combinations, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.00125 inches.

[0059] Example 18. The tool of any of the preceding or subsequent example combinations, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.00075 inches.

[0060] Example 19. The tool of any of the preceding or subsequent example combinations, wherein the scoring knife comprises sides that, when viewed in cross-section, are separated from one another by approximately 50 degrees to approximately 75 degrees.

[0061] Example 20. The tool of any of the preceding or subsequent example combinations, wherein the sides are separated from another by approximately 60 degrees to approximately 70 degrees.

[0062] Example 21. An aluminum can comprising a can end, wherein an interior of the can end comprises a coating and wherein a mean size of any coating depressions in the coating is less than approximately 0.0004 inches.

[0063] Example 22. The aluminum can of any of the preceding or subsequent example combinations, wherein the mean size of any coating depressions in the coating is less than approximately 0.0003 inches.

[0064] Example 23. The aluminum can of any of the preceding or subsequent example combinations, wherein the mean size of any coating depressions in the coating is less than approximately 0.0002 inches.

[0065] Example 24. The aluminum can of any of the preceding or subsequent example combinations, wherein the mean size of any coating depressions in the coating is less than approximately 0.0001 inches.

[0066] Example 25. The aluminum can of any of the preceding or subsequent example combinations, wherein an exterior of the can end comprises a score, and wherein the coating depressions are aligned with the score.

[0067] Example 26. A method of forming an aluminum can comprising a can end and an interior, the interior comprising a coating, the method comprising: attaching the can end to the can; and creating a score in the can end using a scoring knife, wherein the scoring knife comprises a proximal end having a width configured to minimize feathering of the coating when the score is punctured, and wherein a mean size of any depressions formed in the coating is less than approximately 0.0004 inches.

[0068] Example 27. The method of any of the preceding or subsequent example combinations, wherein the width of the proximal end of the scoring knife is between approximately 0.0005 inches and approximately 0.0020 inches.

[0069] Example 28. The method of any of the preceding or subsequent example combinations, wherein the width of the proximal end of the scoring knife is between approximately 0.0005 inches and approximately 0.0015 inches.

[0070] Example 29. The method of any of the preceding or subsequent example combinations, wherein the width of the proximal end of the scoring knife is between approximately 0.0005 inches and approximately 0.00125 inches.

[0071] Example 30. The method of any of the preceding or subsequent example combinations, wherein the width of the proximal end of the scoring knife is between approximately 0.0005 inches and approximately 0.00075 inches.

[0072] Example 31. The method of any of the preceding or subsequent example combinations, wherein creating the score in the can end comprises forming depressions in the coating having a mean size of less than approximately 0.0003 inches.

[0073] Example 32. The method of any of the preceding or subsequent example combinations, wherein creating the score in the can end comprises forming depressions in the coating having a mean size of less than approximately 0.0002 inches.

[0074] Example 33. The method of any of the preceding or subsequent example combinations, wherein creating the score in the can end comprises forming depressions in the coating having a mean size of less than approximately 0.0001 inches.

[0075] Different arrangements of the components depicted in the drawings or described above, as well as components and steps not shown or described are possible. Similarly, some features and subcombinations are useful and may be employed without reference to other

features and subcombinations. Examples of the invention have been described for illustrative and not restrictive purposes, and alternative examples will become apparent to readers of this patent. Accordingly, the present invention is not limited to the examples described above or depicted in the drawings, and various examples and modifications can be made without departing from the scope of the claims below.

CLAIMS

That which is claimed is:

1. A system for forming a score in a material comprising:
an aluminum can comprising a can end, wherein an interior of the can end comprises a coating; and
a scoring knife comprising a proximal end configured to form the score in the can end, the proximal end having a width configured to minimize feathering of the coating when the score is punctured.
2. The system of claim 1, wherein the coating is a laminate coating.
3. The system of claim 1, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.0020 inches.
4. The system of claim 3, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.0015 inches.
5. The system of claim 3, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.00125 inches.
6. The system of claim 3, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.00075 inches.
7. The system of claim 1, wherein the scoring knife comprises sides that, when viewed in cross-section, are separated from one another by approximately 50 degrees to approximately 75 degrees.

8. The system of claim 7, wherein the sides are separated from another by approximately 60 degrees to approximately 70 degrees.
9. The system of claim 7, wherein the sides are separated from another by approximately 65 degrees to approximately 70 degrees.
10. The system of claim 1, wherein the proximal end is configured such that a mean size of any coating depressions formed in the coating is less than approximately 0.0004 inches.
11. The system of claim 10, wherein the mean size of any coating depressions is less than approximately 0.0003 inches.
12. The system of claim 10, wherein the mean size of any coating depressions is less than approximately 0.0002 inches.
13. The system of claim 10, wherein the mean size of any coating depressions is less than approximately 0.0001 inches.
14. A tool for scoring an end of an aluminum can, the tool comprising a tool holder and the scoring knife of claim 1.
15. The tool of claim 14, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.0020 inches.
16. The tool of claim 15, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.0015 inches.
17. The tool of claim 15, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.00125 inches.

18. The tool of claim 15, wherein the width of the proximal end is between approximately 0.0005 inches and approximately 0.00075 inches.
19. The tool of claim 14, wherein the scoring knife comprises sides that, when viewed in cross-section, are separated from one another by approximately 50 degrees to approximately 75 degrees.
20. The tool of claim 19, wherein the sides are separated from another by approximately 60 degrees to approximately 70 degrees.

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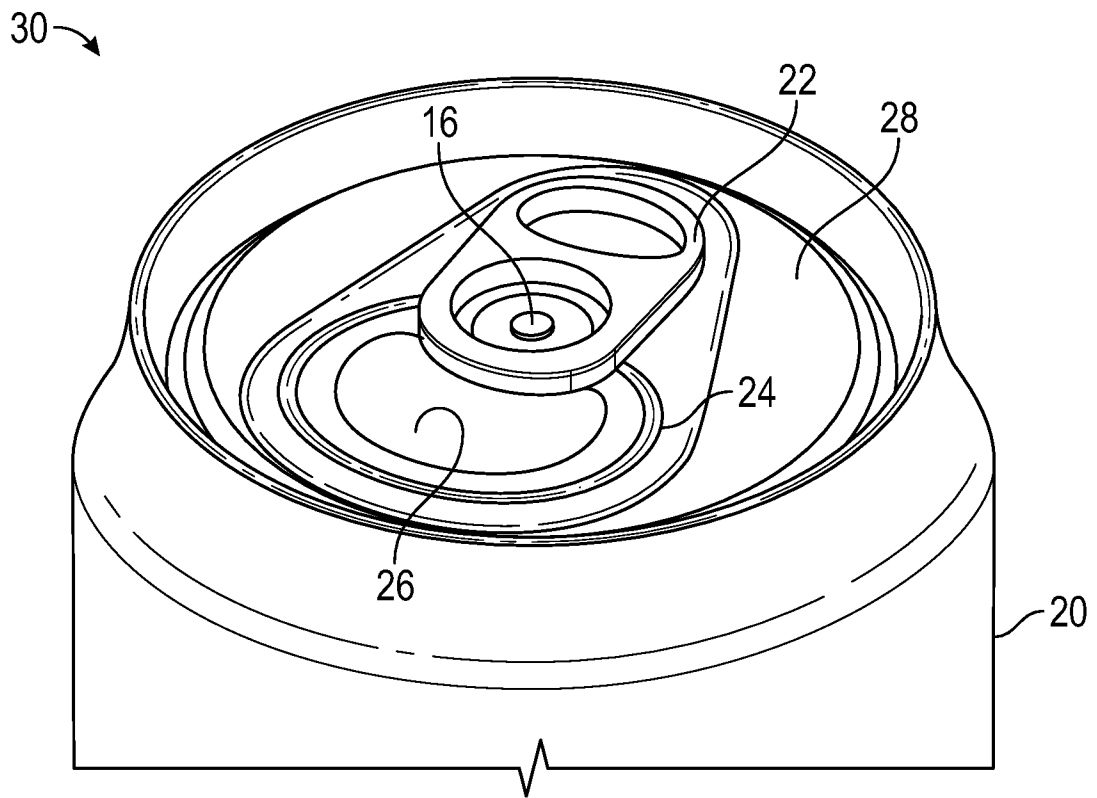


FIG. 1

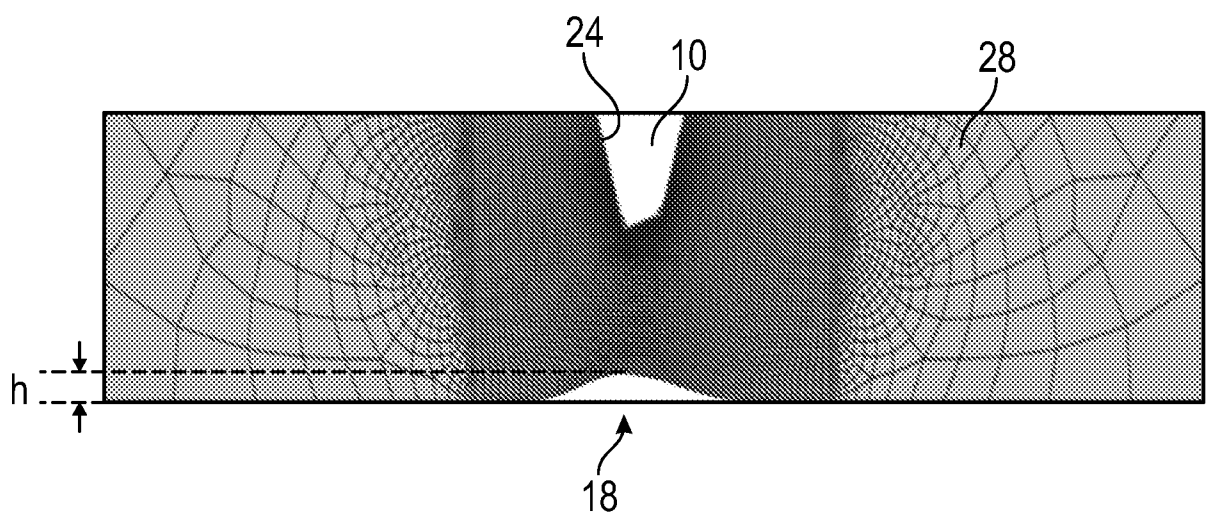


FIG. 2

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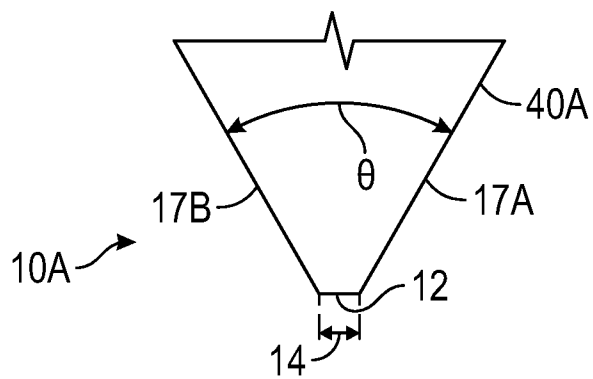


FIG. 3A

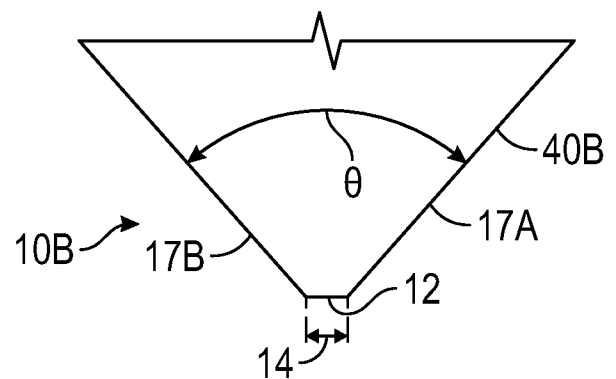


FIG. 3B

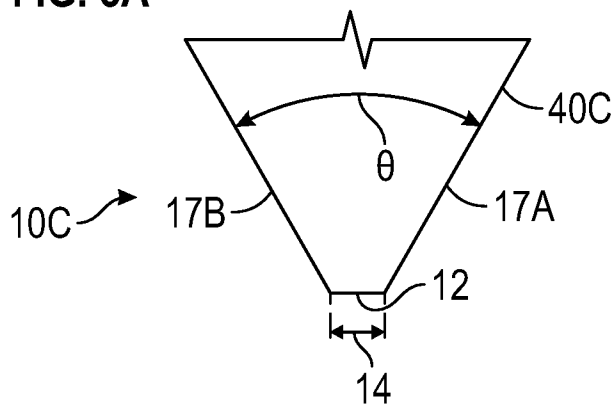


FIG. 3C

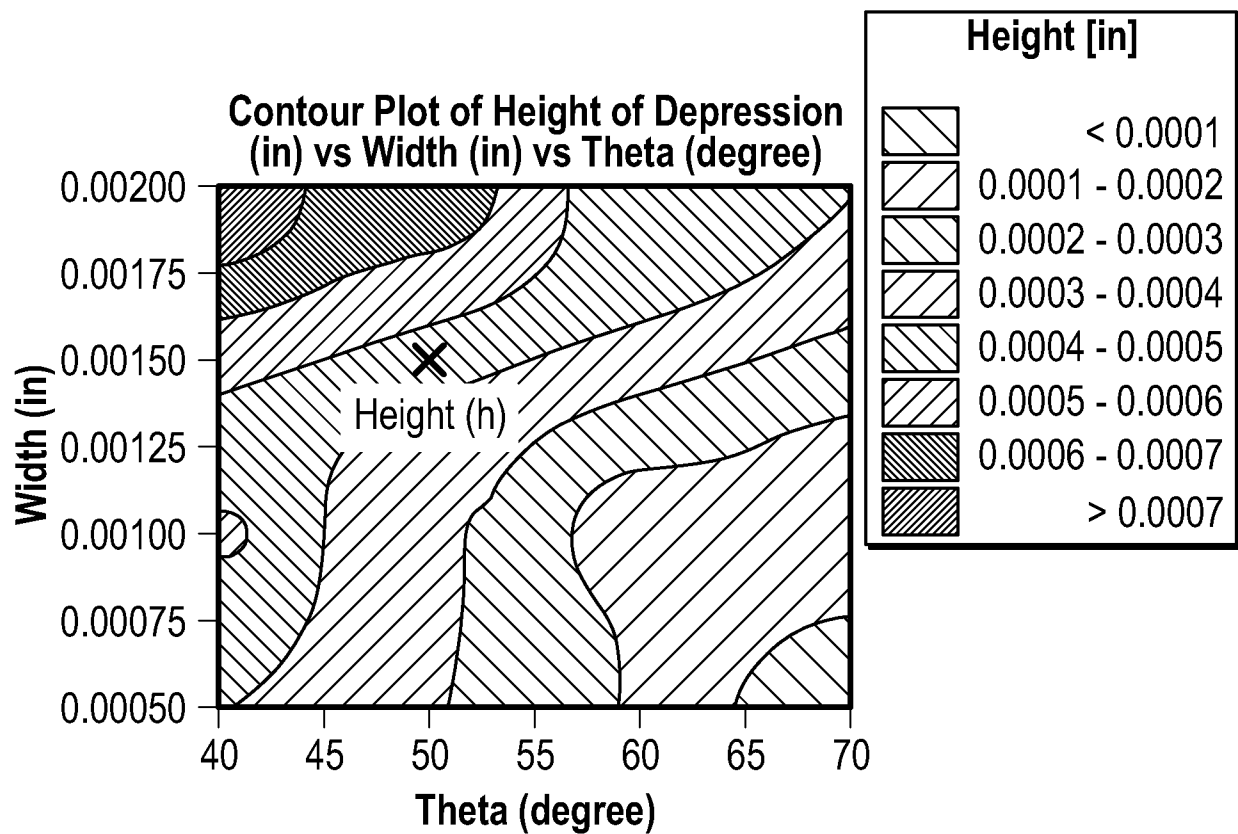


FIG. 4

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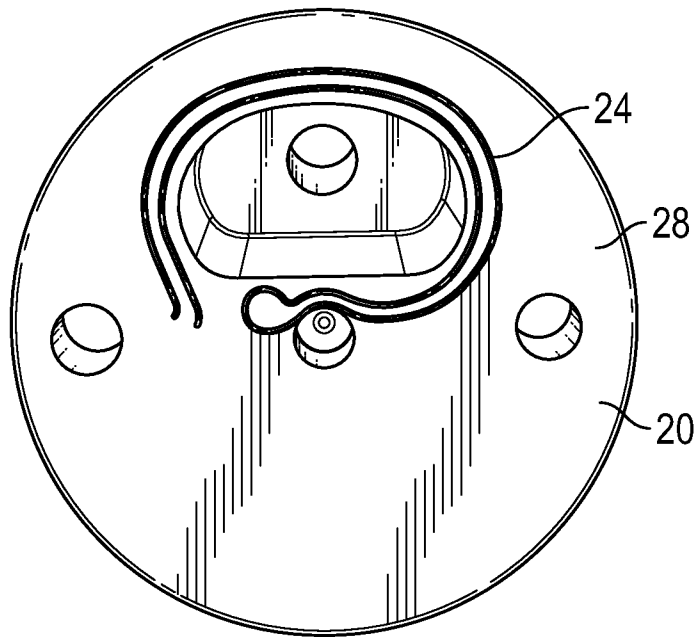


FIG. 5A

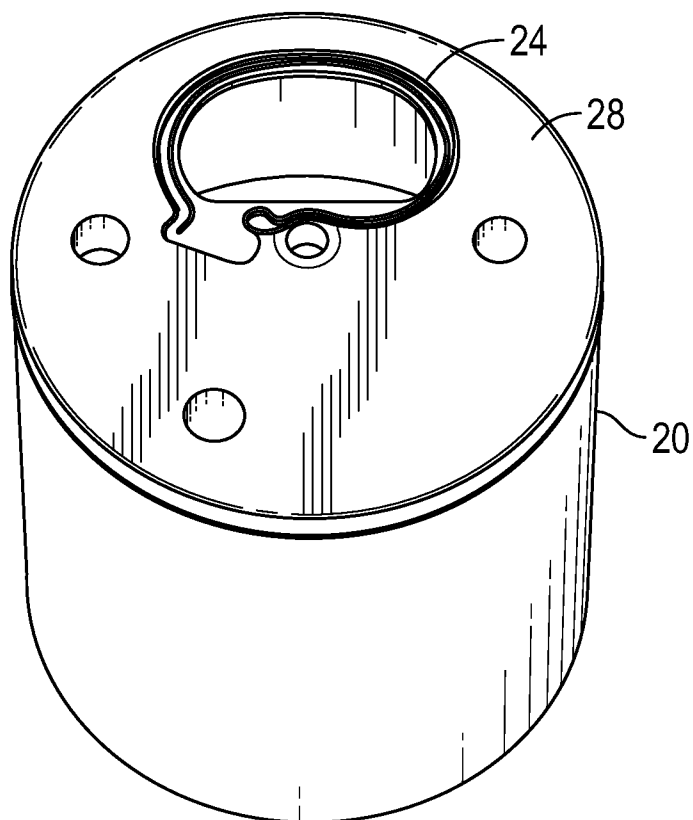


FIG. 5B

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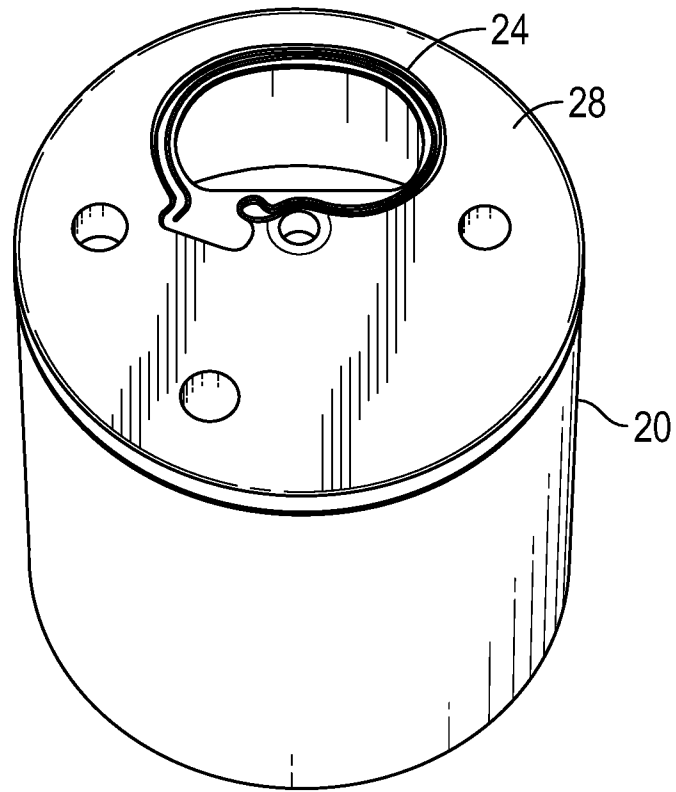


FIG. 5C

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Sample Legend = 1st # is Coating and 2nd # is Score Design
 Example : 2-2 is Laminate 4-2 With 71.4 deg. Score Angle & 0.0014" Land Width

P=Pass

BL=Borderline

F=Fail

*Any Sample With Fail Rating Means Sample Set has
 Failed Otherwise, Majority of Ratings=Sample Mean

Rating of Feathering - As Produced

	As Is Feathering					
Sample	1-2	1-1	1-3	2-2	2-1	2-3
1	P	F	P	BL	P	P
2	P	F	BL	P	BL	P
3	P	F	P	P	P	P
4	P	F	F	P	BL	P
5	BL	F	F	P	P	P
Mean*	P	F	F	P	P	P

Rating of Feathering - After 5 Day L85 Testing

	Post 5 Day Liquor 85 Feathering					
Sample	1-2	1-1	1-3	2-2	2-1	2-3
1	F	F	BL	P	P	BL
2	F	F	F	P	F	BL
3	F	P	F	P	BL	BL
4	F	F	F	P	P	P
5	F	P	F	P	P	BL
Mean*	F	F	F	P	F	BL

Coating

- | | |
|---|-------------------------------------|
| 1 | Laminate 12-2 (0.0086" Metal Gauge) |
| 2 | Laminate 4-2 (0.0086" Metal Gauge) |

Score Design

- | | |
|---|--|
| 1 | Control - 49.3 deg. Score Angle & 0.0014" Land Width- Rex363019 |
| 2 | 71.4 deg. Score Angle & 0.0016" Land Width - AL16916 (Predicted Best) |
| 3 | 44.2 deg. Score Angle & 0.0027" Land Width - AL16917 (Predicted Worst) |

FIG. 6

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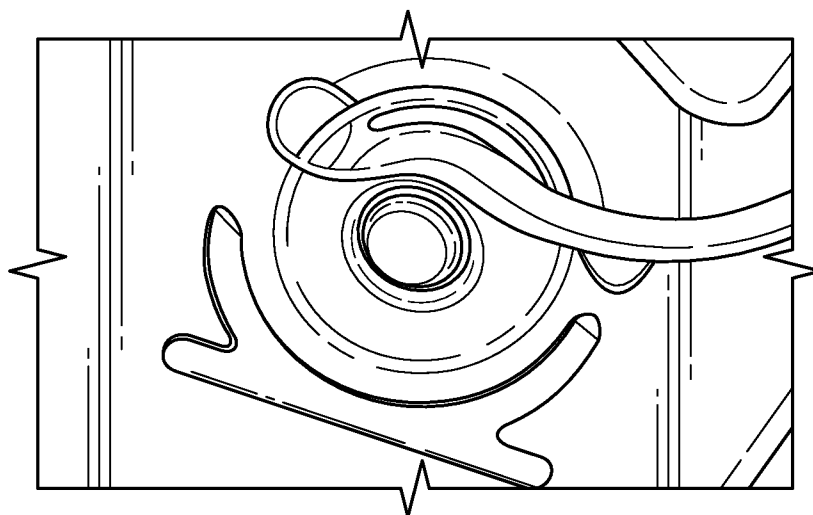


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/036199

A. CLASSIFICATION OF SUBJECT MATTER
INV. B21D51/38 B65D17/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B21D B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 738 237 A (MCELDOWNEY CARL [US]) 14 April 1998 (1998-04-14) column 3, lines 65-67 column 4, lines 41-48; figures 1,3,5 column 6, lines 1-12 column 7, lines 3-8 -----	1-20
X	US 4 122 791 A (BROWN OMAR L) 31 October 1978 (1978-10-31) column 2, lines 50-56 column 3, lines 8-11 column 4, lines 51-61 column 5, lines 31-65; claim 12; figures 2-4 ----- -/--	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

20 July 2016

Date of mailing of the international search report

28/07/2016

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Nikolaou, Ioannis

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2016/036199

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 3 688 718 A (SCHRECKER HOWARD D) 5 September 1972 (1972-09-05) column 2, lines 26-51 column 3, line 50 - column 4, line 5; claim 7; figures 3,5 -----	1,2,14
A	US 5 064 087 A (KOCH DOUGLAS F [US]) 12 November 1991 (1991-11-12) the whole document -----	3-13, 15-20
A	US 2005/199627 A1 (HEINICKE PAUL R [US]) 15 September 2005 (2005-09-15) paragraph [0030]; claims 1,13; figure 12 -----	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/036199

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