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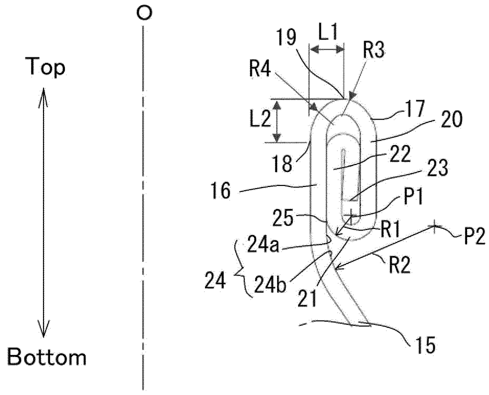
(54) **STRUCTURE FOR OPENING CURL PART OF BOTTLE-TYPE CAN**

(57) A structure of an opening curled portion of a bottle-shaped can possible to enhance the durability of a curled portion against a load applied from above so as to ensure tamper evidence function. The curled portion 10 comprises: an inner circumferential wall 16; an upper rounded portion 17; an outer circumferential wall 20; a lower rounded portion 21; a folded end 22; and a leading edge 23. A tapered wall 15 is formed below the inner circumferential wall 16 to be joined to a threaded section while increasing an outer diameter thereof downwardly. A margin surface area 24 is formed between the inner circumferential wall 16 and the tapered wall 15, in such a manner as to extend downwardly from a lowest end 25 of a contact area with the folded end 22, to locate a curvature center P2 thereof outside of the neck section, and to set a curvature radius R2 thereof longer than a curvature radius R1 of the lower rounded portion 21 in a cross-section along a center axis O of the neck section.

FIG. 3



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Description

TECHNICAL FIELD

[0001] This invention relates to a bottle-shaped can made of metal that is resealable by a cap, and more specifically, to a structure of a curled portion formed on an opening of the bottle-shaped can.

BACKGROUND ART

[0002] Examples of the bottle-shaped can are disclosed in the publication of Japanese Patent No. 4293349 and Japanese Patent Laid-Open No. 2019-177932. An opening of the bottle-shaped can of this kind is closed by a cap, and a consumer drinks a beverage contained in the bottle-shaped can while putting his/her mouth on the opening after dismounting the cap from the opening. Therefore, a curled portion is formed on the opening of the bottle-shaped can. Specifically, the curled portion is formed by curling the opening of the bottle-shaped can so that an edge of a metal sheet material is confined in the curled portion. According to the teachings of Japanese Patent No. 4293349 and Japanese Patent Laid-Open No. 2019-177932, the curled portion is formed by curling the edge of the opening into multiple layers, and then the curled portion is flattened. For example, according to the teachings of Japanese Patent No. 4293349, the curled portion is formed by folding an opening edge of a cylindrical neck portion outwardly into two layers, and thereafter folding the folded portion outwardly again. Consequently, the opening edge of the cylindrical neck portion is folded into three layers to form the curled portion. Thus, the curled portion the having three layers is formed by folding the opening of the neck portion two times. The curled portion may be folded into four layers by folding the curled portion the having three layers one more time.

[0003] As described, the above-explained curled portion is formed by folding the opening of the neck portion and pressing the folded layers in a thickness direction. Since the curled portion thus formed is folded into three or four layers, an upper end of the curled portion is rounded. As also described, the edge of the metal sheet material is confined in the curled portion. Therefore, given that the bottle-shaped can is formed of a steel sheet material, corrosion of the sheet material from the edge may be prevented. In addition, given that the bottle-shaped can is formed of an aluminum or aluminum alloy sheet material, abrasion of a resin film covering the sheet material at the edge may be hidden.

[0004] The curled portion is formed on the upper end of the neck portion not only to ensure safety of the bottle-shaped can and to improve the appearance of the bottle-shaped can, but also to enhance a sealing ability of the bottle-shaped can and to provide a tamper-evidence (TE) function with the bottle-shaped can. In order to close an opening of the neck portion, a cap in which a sealing member (i.e., a liner) made of molding resin is attached to an inner surface of a top panel is mounted on the neck portion. Consequently, the sealing liner is brought into tightly contact with an upper end of the curled portion while being elastically deformed so that the opening of the neck portion is sealed liquid-tightly and air-tightly. That is, the sealing ability of the bottle-shaped can is affected by an accuracy of the curled portion.

[0005] The TE function is a function to inform a consumer of the fact that the cap has been opened at least once. Specifically, the TE function is a function to present the fact that the cap is dismounted from the neck portion by a change in the configuration of the cap. As explained in Japanese Patent No. 4293349 and Japanese Patent Laid-Open No. 2019-177932, the TE function is affected by a relation between a bead (or bulging) portion formed below a threaded portion and the curled portion. Specifically, a female thread is formed on the cap mounted on the neck portion and a male thread mating with the female thread is formed on the neck portion by a roll-on caping method. At the same time, a plurality of slits (i.e., perforation) are formed on a lower portion of the cap thereby forming a band portion below the slits, and a lower end of the band is rolled to engage with the bead portion from outside. In this situation, the above-mentioned sealing member (i.e., a liner) is elastically deformed thereby pushing up the cap elastically. In addition, such elastic force derived from such elastic deformation of the sealing liner is also applied to the threaded portion and a tapered wall formed between the curled portion and the threaded portion. Therefore, the cap is pushed upwardly also by the elastic force acting between the neck portion and the cap. In this situation, therefore, the band (of the cap) and the bead engaging with each other are subjected to a preload such that the band is pushed downwardly by the bead and that the bead is pulled upwardly by the band. For these reasons, given that the curled portion is formed as designed, the cap is moved upwardly from the neck portion by rotating the cap in an opening direction. As a result, bridges formed between the slits to connect the band and the cap are ruptured thereby presenting the fact that the cap is dismounted from the neck portion of the bottle-shaped can.

[0006] The diameter of the curled portion required to have the above-explained function isshorter than that of the threaded portion. For example, as described in Japanese Patent No. 4293349 and Japanese Patent No. 4375706, the curled portion is formed by forming the tapered wall by drawing a portion extending upwardly from the thread, and folding a cylindrical portion extending from the tapered wall outwardly. When mounting the cap on the neck portion by the roll-on capping method, the curled portion is subjected to a load as a capping pressure from above. Therefore, as described in Japanese Patent No. 4293349 and Japanese Patent Laid-Open No. 2019-177932, a lower folded portion (protruding downwardly) of the curled portion is brought into contact with the tapered wall expanding gradually toward the threaded portion. That is, the tapered wall serves as a support section supporting the curled portion from below.

Summary of Invention

Technical Problem to be Solved by the Invention

[0007] The curled portion having the above-mentioned hemmed structure will be discussed in more detail. In the curled portion, the lower folded portion (hereinafter tentatively referred to as the lower rounded portion) being in contact with the tapered wall is a free end as viewed in a vertical cross-section. That is, the portion of the curled portion folded outside of the neck portion has a structure such that the lower rounded portion is easy to be expanded from an upper end of the curled portion joined to the neck portion. Whereas, the tapered wall with which the curled portion comes into contact and a curved portion joined to the curled portion are tapered to expand downwardly. Specifically, the lower rounded portion is brought into contact obliquely with the tapered wall or the curved portion. Therefore, when the curled portion is subjected to the capping pressure or the vertical collision load, a component of such pressure or load is applied to the lower rounded portion in a direction to push the lower rounded portion radially outwardly. Thus, in the conventional curled portion having the above-explained structure, the lower rounded portion is easily expanded outwardly by the load acting in the axial direction such as the capping pressure. In addition, an innermost wall of the curled portion would be warped radially inwardly by a reaction force of the load expanding the lower curved portion. If the curled portion is deformed in the above-explained manner, a level of the curled portion is lowered thereby detaching the upper end of the curled portion from the sealing liner.

[0008] If the lower rounded portion is expanded outwardly by the vertical load such as the capping pressure, the above-mentioned TE function may not be preserved, that is, the bottle-shaped can loses quality. Specifically, the sealing liner is pushed onto an outer surface of the upper end of the curled portion as a result of drawing a circumferential corner of the cap by the roll-on capping. Consequently, the sealing liner is compressed by the vertical load applied thereto from above, and a circumferential portion of the sealing liner is radially pushed out of the curled portion to wrap around an outer surface of the curled portion. However, if the lower rounded portion of the curled portion is expanded radially outwardly, the outer circumferential surface of the curled portion is somewhat tapered upwardly. In this case, therefore, the portion of the sealing liner wrapping around the curled portion is pushed upwardly by the tapered surface of the curled portion. That is, the sealing liner itself is deformed along the outer circumference of the curled portion such that an inner diameter of the portion wrapping around the curled portion is increased. Therefore, when the sealing liner is lifted together with the cap, the portion at which the inner diameter thereof is increased is lifted toward the opening end to be detached easily from the curled portion. In this case, when the cap is rotated slightly in the opening direction, a clearance would be created between the sealing liner and the curled portion without rupturing the bridges of the perforation. Consequently, air would intrude into the clearance and beverage would leak from the clearance. That is, TE function may not be exerted.

[0009] The present invention has been conceived noting the above-explained technical problem, and it is therefore an object of the present invention to provide a structure of the opening curled portion of the bottle-shaped can container possible to enhance the durability of the curled portion against the load applied from above so as to ensure the tamper evidence function.

Means for Solving the Problem

[0010] According to the present invention, there is provided a structure of an opening curled portion of a bottle-shaped can comprising: a shoulder section that is formed on an upper portion of a can trunk in a manner such that a diameter thereof is reduced toward an upper side; a cylindrical neck section that is formed integrally above the shoulder section; a threaded section that is formed on the neck section; a cap that is mounted on threaded section of the neck section; a bead that is formed below the threaded section to be engaged with a tamper evidence band of the cap; and the curled portion that is formed on an opening end of the neck section above the threaded section. In order to achieve the above-explained objective, according to the present invention, the curled portion comprises: an inner circumferential wall leading upwardly from the threaded section; an upper rounded portion bent outwardly in a radial direction of the neck section from an upper end of the inner circumferential wall; an outer circumferential wall leading downwardly from the upper rounded portion in parallel to the inner circumferential wall; a lower rounded portion bent inwardly in the radial direction from a lower end of the outer circumferential wall; a folded end erecting upwardly from the lower rounded portion while being in contact with an outer surface of the inner circumferential wall; and a leading edge leading from the folded end and confined between the inner circumferential wall and the outer circumferential wall. In the bottle-shaped can, a tapered wall is formed below the inner circumferential wall to be joined to the threaded section an outer diameter of the tapered wall being increased toward a lower portion thereof. In addition, a margin surface area is formed between the inner circumferential wall and the tapered wall, in such a manner as to extend downwardly from a lowest end of a contact area of the inner circumferential wall with the folded end, to locate a curvature center of the margin surface area outside of the neck section, and to set a curvature radius of the margin surface area longer than a curvature radius of the lower rounded portion in a cross-section along a center axis of the neck section.

[0011] According to the present invention, the curvature center of the margin surface area may be located at a same level as the curvature center of the lower rounded portion or at a level lower than the curvature center of the lower rounded portion in a direction along the center axis of the neck section.

[0012] In addition, according to the present invention, the upper rounded portion may include an apex as a tip of the curled portion in the direction along the center axis of the neck section. In addition, a length from an inner surface of the inner circumferential wall to the apex of the curled portion measured in the radial direction of the neck section may be shorter than a length from an starting point of the upper rounded portion in the inner circumferential wall side to the apex of the curled portion measured in the direction along the center axis of the neck section.

Advantageous Effects of Invention

[0013] According to the present invention, the margin surface area is formed below the curled portion in the tapered wall between the inner circumferential wall and the threaded section. Specifically, the margin surface area extends downwardly from the lowest end of the contact area of the inner circumferential wall with the folded end, and the curvature radius of the margin surface area is longer than the curvature radius of the lower rounded portion joined to the lower portion of the folded end (that is, the margin surface area includes a plane whose curvature radius is infinity). That is, even when the curled portion is deformed downwardly by a vertical load applied thereto from above, the lower rounded portion will not be brought into contact with any portion. In this situation, therefore, the lower portion of the curled portion will not be expanded radially outwardly. Specifically, an outer circumferential surface of the curled portion will not be tapered upwardly. Therefore, a sealing liner attached to an inner surface of the cap to fit onto the upper portion of the outer circumferential surface of the curled portion will not be pushed upwardly. For this reason, the bottle-shaped can may be sealed tightly and the tamper evidence function of the bottle-shaped can may be ensured.

[0014] In addition, since the lower rounded portion will not be brought into contact with the inner circumferential wall and the tapered wall when the curled portion is subjected to the load from above, the inner circumferential wall and the tapered wall will not be deformed. That is, buckling strength may be improved.

[0015] Further, according to the present invention, the upper rounded portion of the curled portion is shaped into a new shape which is not available in the prior art, and the length from the inner surface of the inner circumferential wall to the apex of the curled portion measured in the radial direction of the neck section is set shorter than the length from the starting point of the upper rounded portion in the inner circumferential wall side to the apex of the curled portion measured in the direction along the center axis of the neck section. Therefore, most of the load applied to the curled portion from above is received by the inner circumferential wall. That is, a moment expanding the curled portion radially outwardly may be reduced, and hence deformation of the curled portion may be prevented. Since the plastic deformation of the curled portion is reduced, an elasticity of the curled portion in the vertical direction may be ensured so that the close contact between the sealing liner and the curled portion is maintained. For these reasons, the bottle-shaped can may be sealed tightly and the tamper evidence function of the bottle-shaped can may be ensured.

Brief Description of Drawings

[0016]

Fig. 1 is a front view showing one example of the bottle-shaped can to which the present invention is applied.

Fig. 2 is a front view showing a partial cross-sectional view showing a can trunk to which a bottom lid has not yet been attached, and a rough material of the cap to be mounted on the can trunk by a roll-on capping method.

Fig. 3 is an enlarged cross-sectional view showing a cross-section of the curled portion in an enlarged scale.

Figs. 4 is a table showing results of examples 1 and 2 and a comparative example.

Fig. 5 is a table showing results of examples 3 to 5.

Description of Embodiment(s)

[0017] Exemplary embodiments of the present invention will now be explained with reference to the accompanying drawings. Note that the embodiments shown below are merely examples of the present disclosure which should not limit a scope of the present invention.

[0018] Here will be explained a bottle-shaped can having the curled portion according to the present invention. The present invention may be applied to a bottle-shaped can formed of a metal sheet material such as a steel can and an aluminum can. The bottle-shaped can includes a two-piece type bottle-shaped can in which a bottom and the can trunk are formed integrally, and a three-piece type bottle-shaped can in which a bottom lid is seamed to the can trunk. In any of those the bottle-shaped cans, a shoulder section is formed integrally above the can trunk, and a cylindrical neck section is formed integrally above the shoulder section. An upper end opening of the neck section is rolled outwardly to form the curled portion. The cap is mounted on the neck section, and threaded together with the neck section.

[0019] Turning now to Fig. 1, there is shown one example of a wide-open type bottle-shaped can 1 made of steel. The bottle-shaped can 1 comprises: a cylindrical can trunk 2; a shoulder section 3 that extends upwardly from the can trunk 2 and that is reduced in its diameter toward the upper side; and a neck section formed above the shoulder section 3. A cap 4 is mounted on the neck section to close an upper opening of the neck section, and a thread is formed around the cap 4. In addition, a bottom lid 5 is seamed to a bottom of the can trunk 2.

[0020] Turning to Fig. 2, there are shown the can trunk 2 before the bottom lid 5 is seamed to the bottom thereof, and a rough material 7 of the cap 4 to be mounted on the neck section 6. The neck section 6 extends upwardly from the shoulder section 3. In the neck section 6, a bead 8 and a threaded section 9 are formed integrally above the shoulder section 3, and a curled portion 10 is formed on an opening of an upper end of the neck section 6. The bead 8 is formed to serve a tamper evidence function. To this end, specifically, the bead 8 is formed entirely around the neck section 6 below the threaded section 9 to protrude radially outwardly from an upper end of the shoulder section 3. Accordingly, a portion between the bead 8 and the shoulder section 3, that is, a portion below the bead 8 is depressed. In the threaded section 9, one or two rows of spiral male threads is/are formed. Specifically, the male thread(s) and the bead 8 are formed by rolling rollers on an inner surface and an outer surface of the neck section 6. The curled portion 10 is formed by curling the opening end of the neck section 6 outwardly. Therefore, a sharp edge of the metal sheet material is confined in the curled portion 10 so that the opening end of the neck section 6 is smoothened to serve as a pourer. A structure of the curled portion 10 will be explained later.

[0021] On the other hand, the rough material 7 of the cap 4 is made of aluminum alloy, and comprises a top panel 11 and a cylindrical section. The female thread(s) is/are formed on an intermediate portion of the cylindrical section in the axial (or vertical) direction, and a plurality of slits (i.e., perforation) 12 are formed intermittently around a lower portion of the cylindrical section thereby forming a band (as a tamper evidence band) 13 on a lower end of the cylindrical section. The band 13 serves a tamper evidence function together with the above-mentioned bead 8. To this end, in the rough material 7 mounted on the neck section 6, a lower portion of the band 13 is rolled to engage with the bead 8 from below. A sealing member (i.e., a liner) 14 made of molding resin is attached to at least a circumferential portion of an inner surface of the top panel 11. The sealing liner 14 is pushed tightly onto an upper end of the curled portion 10 so that the sealing liner 14 is elastically deformed to seal the opening end of the neck section 6 liquid-tightly and air-tightly. In order to bring the sealing liner 14 tightly in contact with the curled portion 10, to form the thread(s) on the cylindrical section, and to engage the band 13 with the bead 8, the rough material 7 mounted on the neck section 6 is subjected to a roll-on capping. Specifically, a capping pressure is applied to the rough material 7 mounted on the neck section 6 from above, and a forming load is applied to the cylindrical section from outer side by rolling a thread roller on the outer circumferential surface of the cylindrical section.

[0022] Turning to Fig. 3, there is shown a cross-section of the curled portion 10 in an enlarged scale. According to the example shown therein, the curled portion 10 is folded into four layers and compressed in a thickness direction. The curled portion 10 having the above-explained structure is joined to a tapered wall 15 leading from the threaded section 9 while being tapered upwardly. That is, a diameter of the tapered wall 15 is reduced toward an upper portion thereof. Specifically, an upper portion of the tapered wall 15 is bent to be parallel to a center axis O of the neck section 6 so as to form a cylindrical inner circumferential wall 16, and an upper portion of the inner circumferential wall 16 is bent outwardly in the radial direction of the neck section 6 so as to form an upper rounded portion 17 that is rounded smoothly to protrude upwardly. As illustrated in Fig. 3, a boundary between the inner circumferential wall 16 erecting linearly and the upper rounded portion 17 bent radially outwardly is an starting point 18 of the upper rounded portion 17, and a tip of the upper rounded portion 17 (that is, an upper end of the bottle-shaped can 1) is an apex 19 of the curled portion 10.

[0023] A curvature radius of the upper rounded portion 17 is not constant. Specifically, a curvature radius of each portion on both sides of the apex 19 (i.e., a portion leading from the apex 19 toward the starting point 18 and a portion leading from the apex 19 toward the opposite side) is referred to as a curvature radius R3, and a curvature radius of each portion individually leading from said each portion on the both sides of the apex 19 is referred to as a curvature radius R4. The curvature radius R4 is longer than the curvature radius R3. That is, a length L1 from an inner surface of the inner circumferential wall 16 to the apex 19 of the curled portion 10 measured in the radial direction of the neck section 6 is shorter than a length L2 from the starting point 18 to the apex 19 of the curled portion 10 measured in the direction along the center axis O of the neck section 6 (L2>L1).

[0024] An outer circumferential wall 20 extends downwardly from the upper rounded portion 17 in the outer circumferential side of the curled portion 10. Specifically, since the curled portion 10 is compressed in the thickness direction, the outer circumferential wall 20 extends substantially parallel to the inner circumferential wall 16. A lower end of the outer circumferential wall 20 is bent radially inwardly to form a lower rounded portion 21. Specifically, the lower rounded portion 21 is bent at approximately 180 degrees, and a curvature radius R1 of the lower rounded portion 21 may be constant. Otherwise, the curvature radius R1 may also be an average curvature radius from an starting point of the lower rounded portion 21 on the outer circumferential wall 20 side to an end point of the lower rounded portion 21 on the inner circumferential wall 16 side. In Fig. 3, a curvature center of the lower rounded portion 21 is indicated as "P1".

[0025] A folded end 22 erects upwardly in Fig. 3 from the lower rounded portion 21. Specifically, the folded end 22 extends substantially parallel to the inner circumferential wall 16 and the outer circumferential wall 20 while being in contact with an outer surface of the inner circumferential wall 16. An upper portion of the folded end 22 is bent outwardly so that a leading edge (cut end) 23 of the metal sheet material of the bottle-shaped can 1 is confined between the outer circumferential wall 20 and the folded end 22. The curled portion 10 having the above-explained structure may be formed by the methods and the procedures disclosed in the above-mentioned Japanese Patent No. 4293349 and Japanese Patent No. 4375706. That is, forming processes of the curled portion 10 is executed in the order opposite to the order of the above explanations. Specifically, the bending processes are executed in the order of forming the leading edge 23 of the folded end 22, the lower rounded portion 21, and the upper rounded portion 17.

[0026] Unlike the conventional structure of the curled portion, the curled portion 10 described above is isolated away from the tapered wall 15, that is, the curled portion 10 is not supported by the tapered wall 15 from below. Instead, according to the exemplary embodiment of the present invention, a margin surface area 24 is formed between the curled portion 10 and the tapered wall 15. Specifically, in order to avoid interference between the lower rounded portion 21 and the tapered wall 15 when a load is applied to the curled portion 10 from above, the margin surface area 24 is formed below the inner circumferential wall 16, that is, above the tapered wall 15.

[0027] More specifically, the margin surface area 24 extends downwardly from a lowest end 25 of a contact area of the inner circumferential wall 16 with the folded end 22 (or from a boundary between the lower rounded portion 21 and the folded end 22). As illustrated in the cross-sectional view shown in Fig. 3, the margin surface area 24 includes a flat surface extending in the vertical direction and a curved surface protruding toward the inner side of the neck section 6. In other words, as viewed in the cross-section shown in Fig. 3, a curvature center P2 of the margin surface area 24 is located outside of the neck section 6, and a curvature radius R2 of the margin surface area 24 (including infinity) is longer than the curvature radius R1 of the lower rounded portion 21.

[0028] Specifically, the curvature center P2 of the margin surface area 24 is located at the same level as or at a level lower than the curvature center P1 of the lower rounded portion 21 in the vertical direction along the center axis O of the neck section 6. According to the example shown in Fig. 3, the curvature center P2 is located at the level lower than the curvature center P1 of the lower rounded portion 21. That is, the margin surface area 24 comprises: a cylindrical surface 24a (illustrated as a flat surface in the cross-sectional view shown in Fig, 3) extending linearly downwardly from the lowest end 25 of the outer circumferential surface of the inner circumferential wall 16 to the level of the curvature center P2 thereof; and a curved surface 24b joined smoothly from the cylindrical surface 24a to the tapered wall 15. Nonetheless, given that the curvature center P1 of the lower rounded portion 21 and the curvature center P2 of the margin surface area 24 are located at the same level, the cylindrical surface 24a (illustrated as a flat surface in the cross-sectional view shown in Fig, 3) is omitted and only the curved surface 24b serves as the margin surface area 24.

[0029] For example, the load is applied to the curled portion 10 from above in Fig. 3 when mounting the cap 4 by the roll-on capping method, when the bottle-shaped can 1 is dropped upside down, or when some falling object hits the cap 4. In those cases, the inner circumferential wall 16, the tapered wall 15, and the portion between those walls would be deformed elastically, and the curled portion 10 would descend downwardly in Fig. 3.

[0030] As described, according to the present invention, the margin surface area 24 is formed such that a lower end (of the lower rounded portion 21) of the curled portion 10 is isolated from the tapered wall 15. In this situation, therefore, the curled portion 10 is pushed substantially straight down. That is, although the tapered wall 15 is tapered such that the outer diameter thereof increases gradually toward the lower portion, the curled portion 10 will not be brought into contact with the tapered wall 15. For this reason, the lower rounded portion 21 will not be expanded radially outwardly even if a load is applied thereto.

[0031] Thus, according to the present invention, the curled portion 10 is allowed to maintain the shape of the cylindrical outer circumferential surface thereof when a vertical load is applied to the curled portion 10 from above. Therefore, the sealing liner 14 may be pushed tightly onto the upper portion of the outer circumferential surface of the curled portion 10 by mounting the cap 4 by the roll-on capping method. In addition, such close contact between the sealing liner 14 and the upper portion of the outer circumferential surface of the curled portion 10 may also be maintained even when the cap 4 is rotated on the neck section 6 in the opening direction. Specifically, when the cap 4 is rotated in the opening direction so that the cap 4 is lifted slightly upwardly on the neck section 6, the sealing liner 14 fitting onto the upper portion of the outer circumferential surface of the curled portion 10 is also moved upwardly while being in contact tightly with the outer circumferential surface of the curled portion 10. In this situation, therefore, the bottle-shaped can 1 is still sealed tightly. Thereafter, when the cap 4 is further lifted so that the sealing liner 14 is detached from the upper end of the curled portion 10, bridges connecting the band 13 to the cap 4 formed between the slits (i.e., perforation) 12 are ruptured. That is, the band 13 is detached certainly from the cap 4 when the bottle-shaped can 1 is opened. Therefore, the tamper evidence function of the bottle-shaped can 1 may be ensured.

[0032] Specifically, when the load is applied to the curled portion 10 from above, such load acts on the upper end portion of the curled portion 10 in the form of moment. In this situation, the starting point 18 of the upper rounded portion 17 serves as a reference point, and the moment acts on the apex 19 of the curled portion 10 as a point of action. Specifically, a so-called "arm" of such moment as a distance from the reference point to the point of action corresponds to the above-mentioned length L1. As described, the length L1 is shorter than the length L2 from the starting point 18 to the apex 19 of the curled portion 10, therefore, the moment is reduced. In this situation, a portion in the outer circumferential side (i.e., the leading end side) of the apex 19 is supported by the portion between the starting point 18 and the apex 19. Nonetheless, the length L2 is set longer as explained above. Therefore, it is possible to prevent downward deformation of the end portion of the curled portion 10 leading from the apex 19 and deformation of the apex 19 itself. For these reasons, the sealing liner 14 is allowed to stick tightly to the curled portion 10 thereby sealing the bottle-shaped can 1 tightly. That is, the tamper evidence function of the bottle-shaped can 1 may be ensured.

[0033] Here will be explained assessments of examples of the present invention and a comparison example. First of all, structures of the bottle-shaped cans prepared for the examples and the comparative example will be explained. In order to prepare the bottle-shaped cans, a large blank was cut out of a coil of a metallic sheet (i.e., a steel sheet whose thickness was 0.15) coated with a printed resin film, and then blanks for manufacturing the bottle-shaped cans were cut out of the large blank. The blank was rolled and overlapped edges thereof were welded together. Then, the rolled blank was expanded to increase a diameter thereof to ø 53 (53mm) to form a can trunk of a welded three-piece can. One of opening ends of the can trunk was necked to form a shoulder section and a bead, and a cylindrical portion above the bead is drawn to form a neck section. Thereafter, the neck section is threaded and a curled portion was formed on an opening end of the neck section. The other opening end of the can trunk was also necked and an opening edge of the other opening end was formed into a flange to which a bottom lid is attached. Consequently, the can trunk shown in Fig. 2 was formed. Specifically, the curled portion having four layers was formed by the procedures described in the publication of Japanese Patent No. 4293349. By thus forming the curled portion, corrosion of a cut end of the steel material may be prevented, and the opening end of the bottle-shaped can may be smoothened.

[0034] The above-mentioned margin surface area 24 was formed in each of the bottle-shaped cans having the above-explained structures, and advantageous effects of the margin surface areas 24 in the examples were individually evaluated.

[Example 1]

[0035] The curled portion 10 was formed such that the curvature center P1 of the lower rounded portion 21 and the curvature center P2 of the margin surface area 24 were located at the same level. The cap was mounted on the curled portion 10 thus formed by the roll-on capping method while applying a capping pressure to the cap, and deformation of the curled portion 10 was evaluated.

[Example 2]

[0036] The curvature center P2 of the margin surface area 24 was located at the level lower than the curvature center P1 of the lower rounded portion 21. In this case, the cylindrical (or flat) surface 24a was formed below the inner circumferential wall 16 within an area corresponding to a difference between the levels of the curvature centers P1 and P2, and the curved surface 24b was formed below the cylindrical surface 24a. The cap was mounted on the curled portion 10 thus formed by the roll-on capping method while applying a capping pressure to the cap, and deformation of the curled portion 10 was evaluated.

[Comparative Example]

[0037] A portion extending downwardly from the lowest end 25 of the contact area of the inner circumferential wall 16 with the folded end 22 (or from the boundary between the lower rounded portion 21 and the folded end 22) was formed into a curved surface having an arcuate cross-section. Specifically, the curved surface was curved such that a curvature center P20 thereof was located at a level higher than the curvature center P1 of the lower rounded portion 21. The cap was mounted on the curled portion 10 thus formed by the roll-on capping method while applying a capping pressure to the cap, and deformation of the curled portion 10 was evaluated.

[Evaluation]

[0038] Evaluations of the examples 1 and 2, and the comparison example are shown in Fig. 4. Specifically, Fig. 4 shows relations among levels (i.e., positions in the vertical direction) P1y, P2y, and P20y of the above-mentioned curvature centers, and evaluations of shapes of the curled portions before applying the capping pressure to the curled portions and postures of the curled portions after applying the capping pressure to the curled portions. In Fig. 4, the reference numeral "14" represents the sealing liner. According to the example 1, a posture of the curled portion 10 was not changed after applying the capping pressure to the cap. That is, the curled portion 10 according to the example 1 had no defect, and hence the evaluation of the final product according to the example 1 was "o". According to the example 2, the inner circumferential wall 16 was slightly warped thereby displacing the curled portion 10 to a certain extent. In this case, however, it is still possible to form a recess on which the outer circumferential portion of the sealing liner 14 is fitted on the outer circumferential surface (of the outer circumferential wall 20) of the curled portion 10. That is, the sealability of the sealing liner 14 will not be reduced by such displacement of the curled portion 10. Therefore, the evaluation of the final product according to the example 2 was also "o". Whereas, according to the comparison example, the curled portion 10 was pushed downwardly along the tapered wall 15 thereby expanding the lower rounded portion 21 radially outwardly. Such deformation is the problem to be solved by the present invention. Therefore, the evaluation of the final product according to the comparison example was "X".

[0039] Thereafter, a relation between the length L1 and the length L2 was examined. As described, the length L1 is a distance between the inner surface of the inner circumferential wall 16 to the apex 19 of the curled portion 10 measured in the radial direction, and the length L2 is a height of the apex 19 of the curled portion 10 from the starting point 18 (measured in the direction along the center axis O of the neck section 6).

[Example 3]

[0040] In the foregoing bottle-shaped can, the position of the curvature center P2 of the margin surface area 24 was set lower than the curvature center P1 of the lower rounded portion 21, and the length L1 was set longer than the length L2 (L1 >L2). That is, the apex 19 of the curled portion 10 was isolated away from the inner circumferential wall 16. The cap was mounted on the curled portion 10 thus formed by the roll-on capping method while applying a capping pressure to the cap, and deformation of the curled portion 10 was evaluated.

[Example 4]

[0041] In the foregoing bottle-shaped can, the position of the curvature center P2 of the margin surface area 24 is set lower than the curvature center P1 of the lower rounded portion 21, and the length L1 and the length L2 were equalized to each other (L1 =L2). That is, the distance between the apex 19 of the curled portion 10 and the inner circumferential wall 16 was set to a medium distance. The cap was mounted on the curled portion 10 thus formed by the roll-on capping method while applying a capping pressure to the cap, and deformation of the curled portion 10 was evaluated.

[Example 5]

[0042] In the foregoing bottle-shaped can, the position of the curvature center P2 of the margin surface area 24 was set lower than the curvature center P1 of the lower rounded portion 21, and the length L1 was set shorter than the length L2 (L1 <L2). That is, the distance between the apex 19 of the curled portion 10 and the inner circumferential wall 16 was shortened. The cap was mounted on the curled portion 10 thus formed by the roll-on capping method while applying a capping pressure to the cap, and deformation of the curled portion 10 was evaluated.

[Evaluation]

[0043] Evaluations of the examples 3 to 5 are shown in Fig. 5. Specifically, Fig. 5 shows the relations between the length L1 and the length L2, and evaluations of shapes of the curled portions before applying the capping pressure to the curled portions and postures of the curled portions after applying the capping pressure to the curled portions. In Fig. 5, the reference numeral "14" represents the sealing liner.

[0044] According to the example 3, the upper rounded portion 17 was bent or deformed downwardly at a portion close to the inner circumferential wall 16 thereby displacing the lower rounded portion 21 downwardly. Therefore, it was confirmed that the margin surface area 24 has to be maintained to a certain extent in the height direction (along the center axis O of the neck section 6). Taking account of such deformation, the evaluation of the example 3 was "acceptable".

[0045] According to the example 4, the capping pressure was received mainly by the inner circumferential wall 16 and the portion of the upper rounded portion 17 leading from the inner circumferential wall 16. Therefore, those portions were warped thereby displacing the lower rounded portion 21 downwardly. Therefore, it was also confirmed that the margin surface area 24 has to be maintained to a certain extent in the height direction (along the center axis O of the neck section 6). Taking account of such deformation, the evaluation of the example 4 was "acceptable".

[0046] According to the example 5, most of the capping pressure was received by the inner circumferential wall 16. Therefore, although the inner circumferential wall 16 was compressed in the vertical direction, the inner circumferential wall 16 was warped only slightly. That is, the curled portion 10 (or the lower rounded portion 21) was not pushed down significantly. For this reason, the evaluation of the example 5 was "good".

[0047] As can be seen from the evaluations of the foregoing examples 1 to 5 and the comparison example, in the bottle-shaped can according to the exemplary embodiment of the present invention, it is preferable to set the curvature radius of the margin surface area 24 longer than the curvature radius of the lower rounded portion 21 and set the position of the curvature center P2 of the margin surface area 24 lower than the curvature center P1 of the lower rounded portion 21. In addition, it is preferable to set the length L1 from the inner surface of the inner circumferential wall 16 to the apex 19 of the curled portion 10 measured in the radial direction of the neck section 6 shorter than the length L2 from the starting point 18 to the apex 19 of the curled portion 10 (measured in the direction along the center axis O of the neck section 6) (L1 <L2).

REFERENCE SIGNS LIST

[0048]

1: bottle-shaped can
2: can trunk
3: shoulder section
4: cap
5: bottom lid
6: neck section
7: rough material of the cap
8: bead
9: threaded section
10: curled portion
11: top panel
12: slit (perforation)
13: band
14: liner
15: tapered wall
16: inner circumferential wall
17: upper rounded portion
18: starting point
19: apex of the curled portion
20: outer circumferential wall
21: lower rounded portion
22: folded end
23: leading edge
24: margin surface area
24a: cylindrical surface
24b: curved surface
25: lowest end
O: center axis
P1, P2, P20: curvature centers
R1, R2, R3, R4: curvature radii

Claims

1. A structure of an opening curled portion of a bottle-shaped can comprising: a shoulder section that is formed on an upper portion of a can trunk in a manner such that a diameter thereof is reduced toward an upper side; a cylindrical neck section that is formed integrally above the shoulder section; a threaded section that is formed on the neck section; a cap that is mounted on threaded section of the neck section; a bead that is formed below the threaded section to be engaged with a tamper evidence band of the cap; and the curled portion that is formed on an opening end of the neck section above the threaded section,
characterized in that:

the curled portion comprises

an inner circumferential wall leading upwardly from the threaded section,
an upper rounded portion bent outwardly in a radial direction of the neck section from an upper end of the inner circumferential wall,
an outer circumferential wall leading downwardly from the upper rounded portion in parallel to the inner circumferential wall,
a lower rounded portion bent inwardly in the radial direction from a lower end of the outer circumferential wall,
a folded end erecting upwardly from the lower rounded portion while being in contact with an outer surface of the inner circumferential wall, and
a leading edge leading from the folded end and confined between the inner circumferential wall and the outer circumferential wall;

a tapered wall is formed below the inner circumferential wall to be joined to the threaded section, an outer diameter of the tapered wall being increased toward a lower portion thereof; and
a margin surface area is formed between the inner circumferential wall and the tapered wall, in such a manner as to extend downwardly from a lowest end of a contact area of the inner circumferential wall with the folded end, to locate a curvature center of the margin surface area outside of the neck section, and to set a curvature radius of the margin surface area longer than a curvature radius of the lower rounded portion in a cross-section along a center axis of the neck section.

2. The structure of the opening curled portion of the bottle-shaped can as claimed in claim 1, wherein the curvature center of the margin surface area is located at a same level as the curvature center of the lower rounded portion or at a level lower than the curvature center of the lower rounded portion in a direction along the center axis of the neck section.

3. The structure of the opening curled portion of the bottle-shaped can as claimed in claim 1 or 2,

wherein the upper rounded portion includes an apex as a tip of the curled portion in the direction along the center axis of the neck section, and
a length from an inner surface of the inner circumferential wall to the apex of the curled portion measured in the radial direction of the neck section is shorter than a length from a starting point of the upper rounded portion in the inner circumferential wall side to the apex of the curled portion measured in the direction along the center axis of the neck section.

FIG. 1

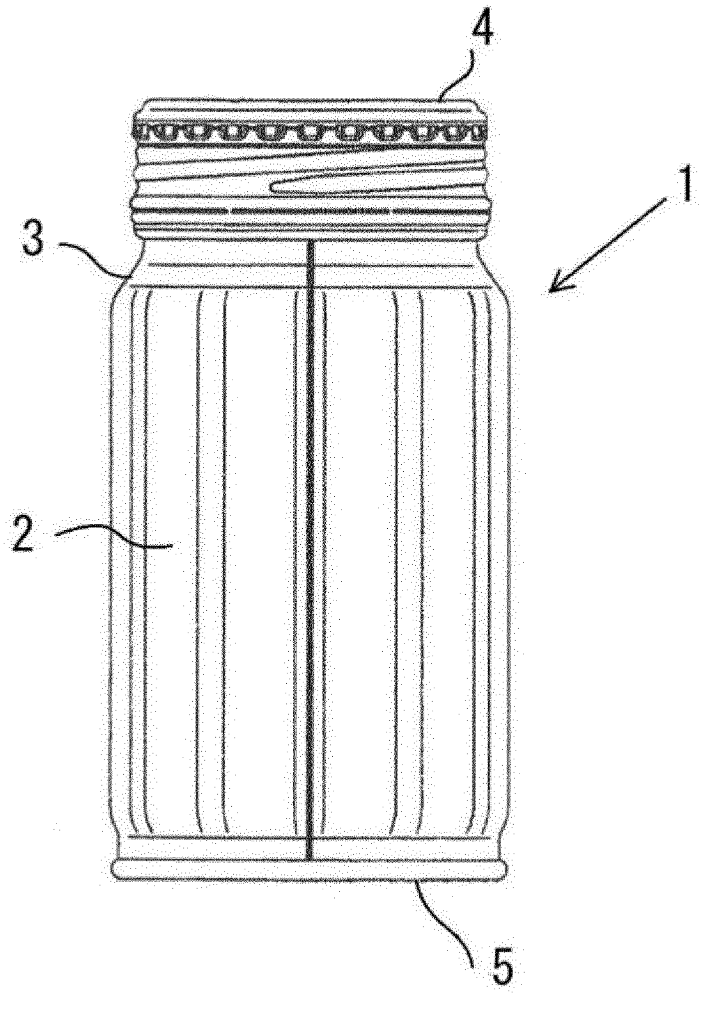


FIG. 2

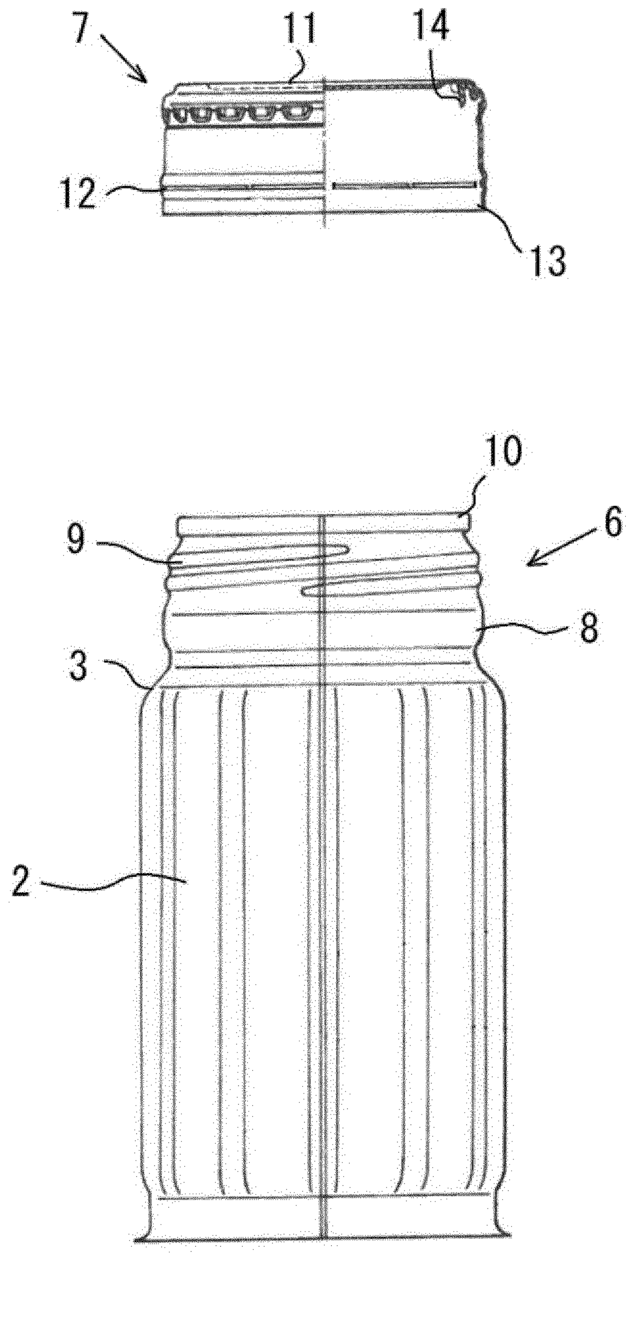


FIG. 3

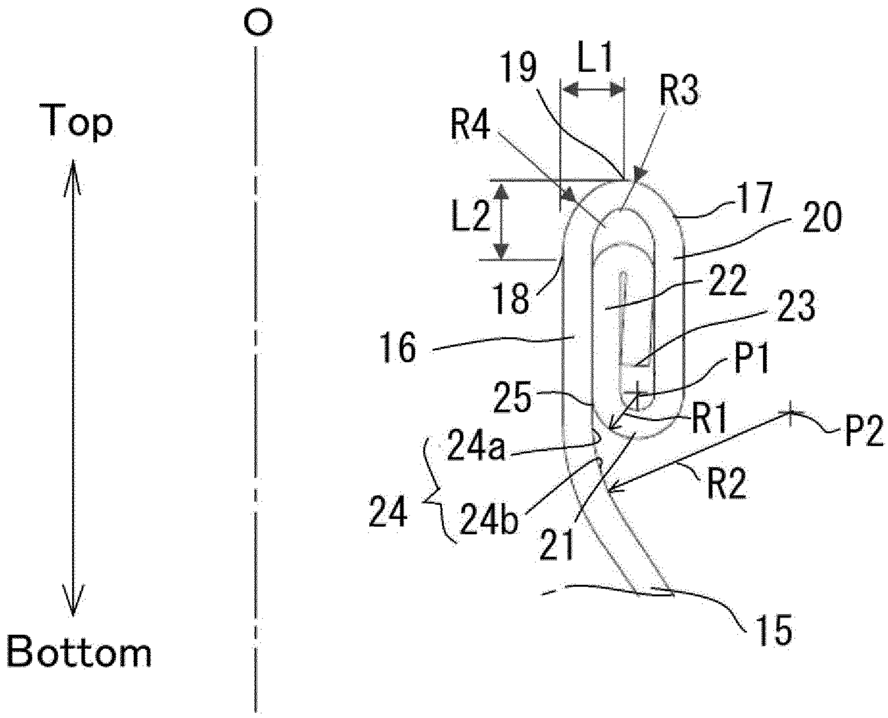

O
Top
Bottom
19
L1
R3
R4
L2
17
20
18
22
23
16
P1
25
R1
P2
24a
R2
24
24b
21
15

FIG. 4

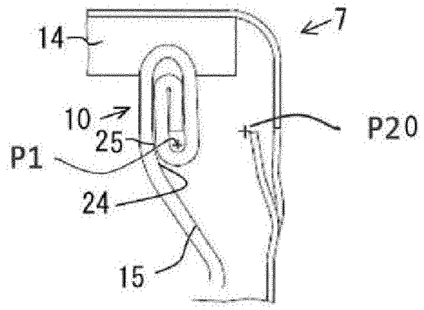
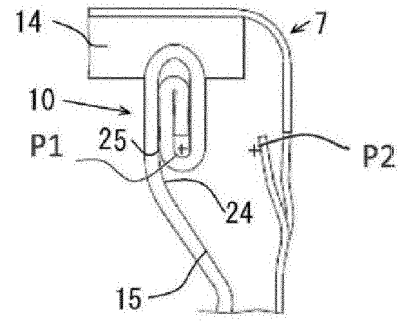
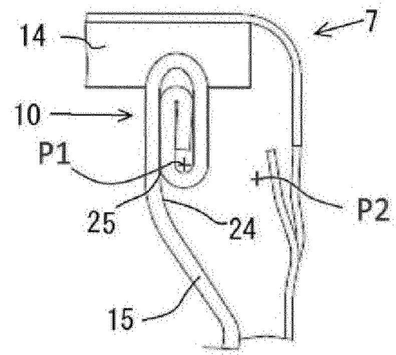
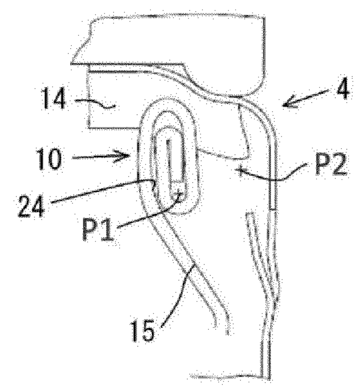
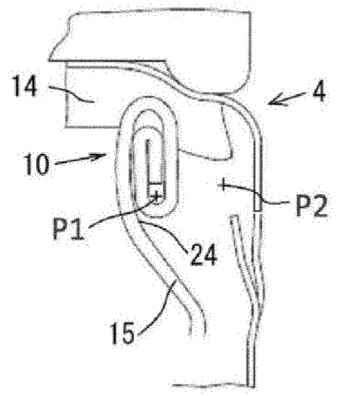
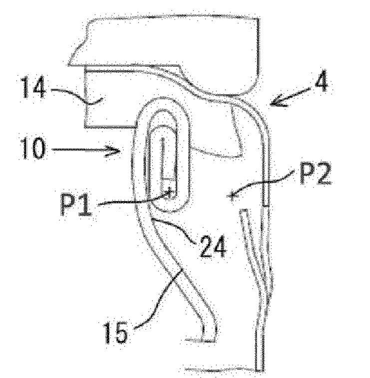
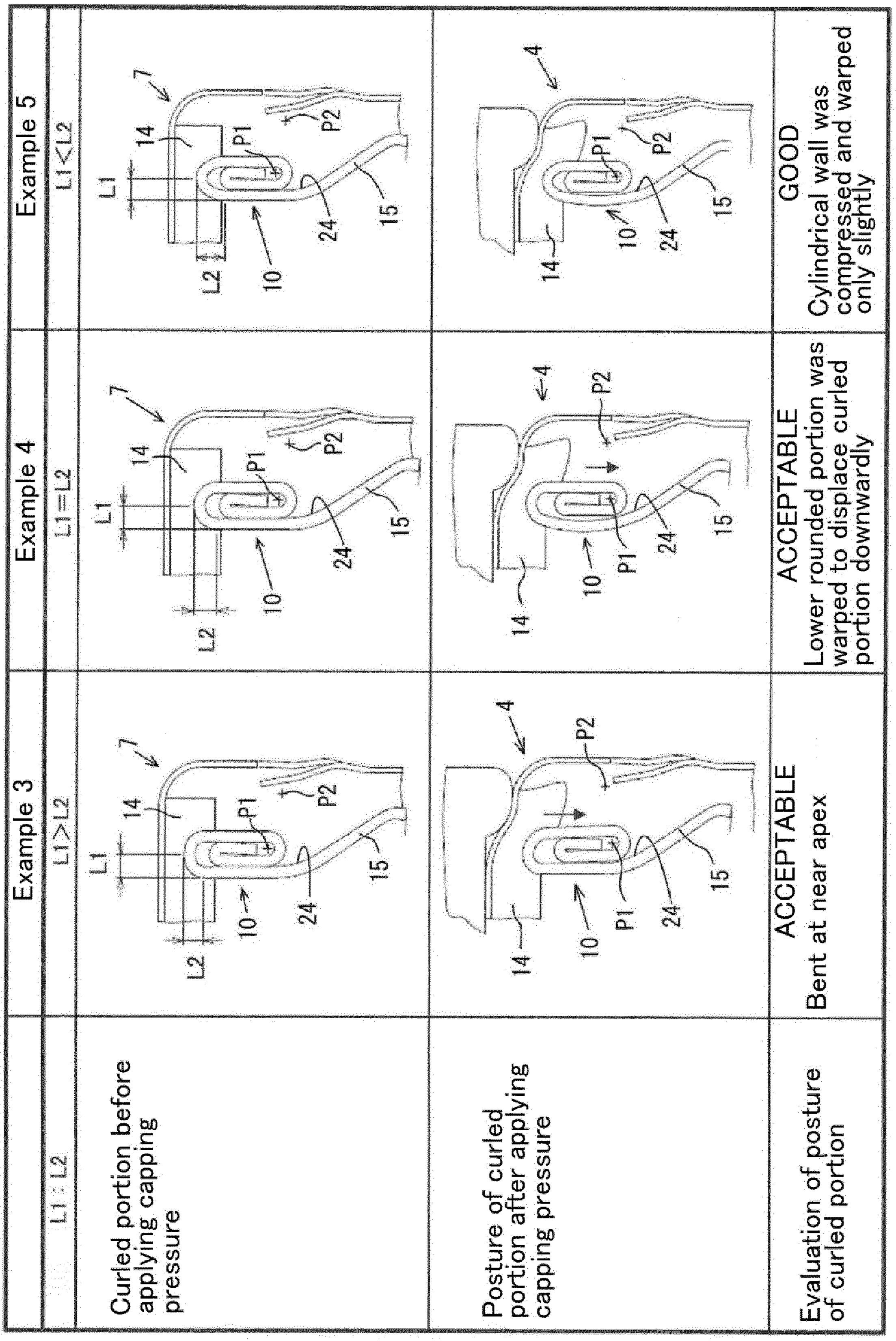
	Comparison Example	Example 1	Example 2
Relation between curvature centers	P1y < P20y	P1y = P2y	P1y > P2y
Shape of curled portion after shaping			
Posture of curled portion after applying capping pressure			
Evaluation	X (Lower portion of curled portion was expanded)	○ (Posture of curled portion was not changed)	○ (Posture of curled portion was not changed)

FIG. 5


L1 : L2
Example 3
L1>L2
Example 4
L1=L2
Example 5
L1<L2
Curled portion before applying capping pressure
Posture of curled portion after applying capping pressure
Evaluation of posture of curled portion
ACCEPTABLE
Bent at near apex
ACCEPTABLE
Lower rounded portion was warped to displace curled portion downwardly
GOOD
Cylindrical wall was compressed and warped only slightly
L1
L2
P1
P2
4
7
10
14
15
24

INTERNATIONAL SEARCH REPORT

International application No. **PCT/JP2022/045621**

A. CLASSIFICATION OF SUBJECT MATTER

B21D 51/38(2006.01)i; ***B65D 8/02***(2006.01)i; ***B65D 1/02***(2006.01)i
FI: B65D1/02 212; B65D8/02 C; B21D51/38 D

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)

B21D51/38; B65D8/02; B65D1/02

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2013-82488 A (DAIWA CAN CO., LTD.) 09 May 2013 (2013-05-09) paragraphs [0026]-[0039], fig. 1, 2	1-2 3
Y	JP 2004-26306 A (DAIWA CAN CO., LTD.) 29 January 2004 (2004-01-29) paragraphs [0032], [0033], fig. 2	3
A	JP 2005-22663 A (MITSUBISHI MATERIALS CORP.) 27 January 2005 (2005-01-27) entire text, all drawings	1-3
A	JP 2019-177932 A (DAIWA CAN CO., LTD.) 17 October 2019 (2019-10-17) entire text, all drawings	1-3
A	JP 2004-224417 A (DAIWA CAN CO., LTD.) 12 August 2004 (2004-08-12) entire text, all drawings	1-3

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 January 2023	**17 January 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/045621

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2013-82488 A	09 May 2013	(Family: none)	
JP 2004-26306 A	29 January 2004	US 2005/0218140 A1 paragraphs [0089]-[0092], fig. 2 WO 2003/093121 A1 EP 1500598 A1 CA 2483666 A1	
JP 2005-22663 A	27 January 2005	(Family: none)	
JP 2019-177932 A	17 October 2019	US 2021/0016915 A1 entire text, all drawings WO 2019/188813 A1 CN 110316447 A	
JP 2004-224417 A	12 August 2004	US 2005/0218140 A1 entire text, all drawings WO 2003/093121 A1 EP 1500598 A1 CA 2483666 A1	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4293349 B **[0002] [0005] [0006] [0025] [0033]**
- JP 2019177932 A **[0002] [0005] [0006]**
- JP 4375706 B **[0006] [0025]**