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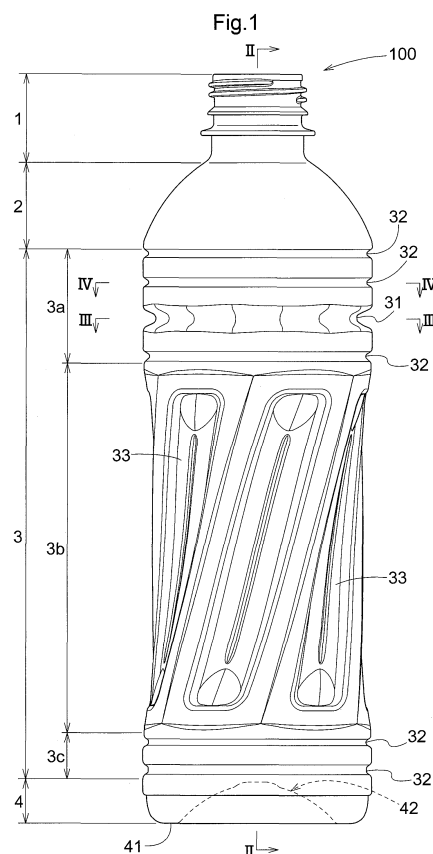
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(54) **PLASTIC BOTTLE**

(57) A plastic bottle 100 according to one or more embodiments of the present invention comprises: a body portion 3 provided with at least one circumferential rib 31 in a shape of a depression, wherein the circumferential rib 31 has a wavy horizontal cross-sectional shape with a depth in a direction from a surface of the plastic bottle 100 toward inside the plastic bottle 100 which depth varies continuously in a circumferential direction of the plastic bottle 100, and the depth of the circumferential rib has a maximum value of 4.5 mm to 6.0 mm and a minimum value of 3.5 mm to 4.4 mm.



Description

Technical Field

5 **[0001]** The present invention relates to a plastic bottle including a body portion provided with at least one circumferential rib in the shape of a depression.

Background Art

10 **[0002]** Plastic bottles filled with beverages may become disadvantageously deformed by a load thereon during production and distribution. Examples of a load that can cause such deformation include (i) a load in the horizontal direction that occurs as a result of plastic bottles pressing each other on a conveyor during a beverage production process and (ii) a load in the up-down direction that occurs as a result of plastic bottles being placed on top of one another during distribution. Various efforts have been made to strengthen plastic bottles for prevention of deformation by the load.

15 **[0003]** As an example of such efforts, Patent Literature 1 discloses a plastic bottle having a reinforcement relief for an increased structural strength. The plastic bottle effectively withstands a vertical compression without having a thickened wall.

[0004] Patent Literature 2 discloses a plastic bottle having a plurality of wavy depressions to ensure sufficient strength against an impact or load on the side surface of the container. The plastic bottle effectively withstands a load in the horizontal direction without having an increased thickness.

Citation List

Patent Literature

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[0005]

Patent Literature 1 International Publication No. 2007/118966

Patent Literature 2 Japanese Unexamined Patent Application Publication, *Tokukai*, No. 2012-126448

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Summary of Invention

Technical Problem

35 **[0006]** The technique of Patent Literature 1 may unfortunately fail to allow a plastic bottle to sufficiently withstand a load in the horizontal direction. Such plastic bottles may become deformed as a result of bumping against one another during a step of, for example, placing and carrying the plastic bottles on a conveyor. Such an issue has been a particular concern in the case where the carrying step involves a heating operation for sterilization, because such a heating operation decreases the strength of the plastic bottles.

40 **[0007]** The technique of Patent Literature 2 may unfortunately fail to allow a plastic bottle to sufficiently withstand a load in the up-down direction. Thus, it has been difficult to increase the number of layers of plastic bottles in the up-down direction during distribution, which may decrease the distribution efficiency.

[0008] The above circumstances have led to a demand for a plastic bottle capable of withstanding both a load in the vertical direction and a load in the horizontal direction.

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Solution to Problem

[0009] A plastic bottle according to one or more embodiments of the present invention comprises: a body portion provided with at least one circumferential rib in a shape of a depression, wherein the at least one circumferential rib has a wavy horizontal cross-sectional shape with a depth in a direction from a surface of the plastic bottle toward inside the plastic bottle which depth varies continuously in a circumferential direction of the plastic bottle, and the depth of the at least one circumferential rib has a maximum value of 4.5 mm to 6.0 mm and a minimum value of 3.5 mm to 4.4 mm.

[0010] With the above arrangement, the circumferential rib has a wavy horizontal cross-sectional shape. This allows the plastic bottle to be structured such that a load thereon is not easily concentrated, and thereby advantageously prevents the plastic bottle from becoming easily deformed in the horizontal direction. Further, the circumferential rib, which has a dimension within the above ranges, effectively absorbs a load in the up-down direction. This advantageously prevents the plastic bottle from becoming easily deformed in the up-down direction.

[0011] The description below deals with preferable embodiments of the present invention. The preferable embodiments

described below as examples do not limit the scope of the present invention.

[0012] A plastic bottle as a preferable embodiment of the present invention is arranged such that the at least one circumferential rib has a dimension in an up-down direction which dimension is 7 mm to 9 mm.

[0013] The above arrangement allows for an increased effect of absorbing a load in the up-down direction, as compared to a plastic bottle having a circumferential rib with a dimension in the up-down direction which dimension is not within the above range.

[0014] A plastic bottle as a preferable embodiment of the present invention is arranged such that the body portion is further provided with a reduced pressure absorbing panel portion, and the at least one circumferential rib is present at that portion of the body portion which is above or below the reduced pressure absorbing panel portion

[0015] With the above arrangement, the reduced pressure absorbing panel portion absorbs an increase in the internal pressure of the plastic bottle to prevent the plastic bottle from becoming deformed.

[0016] A plastic bottle as a preferable embodiment of the present invention is arranged such that the at least one circumferential rib is a single circumferential rib.

[0017] The above arrangement allows for an increased effect of absorbing a load in the up-down direction, as compared to a plastic bottle having a plurality of circumferential ribs each having a wavy horizontal cross-sectional shape.

[0018] A plastic bottle as a preferable embodiment of the present invention further comprises: at least one circumferential sub rib in a shape of a depression, wherein the at least one circumferential sub rib has a circular horizontal cross-sectional shape, the at least one circumferential sub rib has a depth in the direction from the surface of the plastic bottle toward inside the plastic bottle which depth is smaller than the minimum value of the depth of the at least one circumferential rib, and the at least one circumferential sub rib has a dimension in the up-down direction which dimension is smaller than the dimension of the at least one circumferential rib in the up-down direction.

[0019] The above arrangement allows the circumferential rib and the circumferential sub rib to function together as a spring, and thereby allows for an increased effect of absorbing a load in the up-down direction.

[0020] Additional features and advantages of the present invention will be made clearer by the description of the exemplary and non-limiting embodiments below, which are described with reference to the drawings.

Brief Description of Drawings

[0021]

Fig. 1 is a front view of a plastic bottle.

Fig. 2 is a frontal cross-sectional view of a plastic bottle.

Fig. 3 is a cross-sectional view taken along line III-III in Fig. 1.

Fig. 4 is a cross-sectional view taken along line IV-IV in Fig. 1.

Fig. 5 is an enlarged front view of a body portion of a plastic bottle.

Fig. 6 is a cross-sectional view taken along line VI-VI in Fig. 5.

Fig. 7 is a cross-sectional view taken along line VII-VII in Fig. 5.

Fig. 8 is a bottom view of a bottom portion of a plastic bottle.

Fig. 9 is an enlarged view of bottom portion depressions in a bottom portion of a plastic bottle.

Description of Embodiments

[0022] The description below deals with a plastic bottle as an embodiment of the present invention with reference to drawings. The present embodiment is a plastic bottle 100 including, as illustrated in Fig. 1, (i) a mouth portion 1 as a spout for liquid, (ii) a shoulder portion 2 continuous with the mouth portion 1 and having a diameter that gradually increases toward the bottom surface, (iii) a body portion 3 continuous with the shoulder portion 2 and having a cylindrical shape, and (iv) a bottom portion 4 as the bottom of the plastic bottle 100. The description below uses the term "vertical direction" to refer to the direction of a straight line connecting the respective centers of the mouth portion 1 and the bottom portion 4 and the term "horizontal direction" to refer to a direction of a plane perpendicular to the above straight line. Further, in the description below, the "depth" of a structure at the surface of the plastic bottle 100 means how much the surface of the plastic bottle 100 is depressed inwardly.

[0023] The plastic bottle 100 as the present embodiment can be produced with a thermoplastic resin such as polyethylene, polypropylene, or polyethylene terephthalate as a main material and molded integrally by a stretching and molding method such as biaxial stretching blow molding. The plastic bottle 100 may have any capacity. The capacity may be approximately from 200 mL to 2 L such as 280 mL, 350 mL, or 500 mL, as of a common plastic bottle. The plastic bottle 100 may be filled with any liquid. Examples include (i) beverages such as drinking water, tea, fruit juice, coffee, cocoa, soft drink, alcoholic beverage, milk beverage, and soup and (ii) liquid seasonings such as Worcester sauce and soy sauce.

[Rib Structure]

[0024] The body portion 3 is provided with, in an upper region 3a thereof, a single main circumferential rib 31 (which is an example "circumferential rib") in the shape of a depression. The body portion 3 is also provided with, in the upper region 3a and a lower region 3c thereof, a plurality of circumferential sub ribs 32 each in the shape of a depression. As illustrated in Fig. 2, the main circumferential rib 31 has a depth and a dimension in the up-down direction that are larger than those of each circumferential sub rib 32.

[0025] As illustrated in Fig. 3, the main circumferential rib 31 has a wavy horizontal cross-sectional shape with a depth that varies continuously in the circumferential direction of the plastic bottle 100. The depth has a maximum value of 4.5 mm and a minimum value of 3.5 mm. The main circumferential rib 31 has seven largest-depth points 31a and seven smallest-depth points 31b. The horizontal cross-sectional shape of the main circumferential rib 31 is a wavy shape formed by connecting the largest depth points 31a and the smallest depth points 31b smoothly and alternately one after another. The horizontal cross-sectional shape is, in other words, formed with a closed curve that protrudes toward outside the plastic bottle around each largest-depth point 31a, that protrudes toward inside the plastic bottle around each smallest-depth point 31b, and that has an inflection point between each largest-depth point 31a and each smallest-depth point 31b adjacent thereto.

[0026] The main circumferential rib 31 has a dimension in the up-down direction of (i) 8.0 mm at each largest-depth point 31a and (ii) 7.2 mm at each smallest-depth point 31b.

[0027] As illustrated in Figs. 1 and 2, the body portion 3 may be provided with a plurality of circumferential sub ribs 32. The present embodiment involves three circumferential sub ribs 32 in the upper region 3a and two circumferential sub ribs 32 in the lower region 3c. The present embodiment is arranged such that the circumferential sub ribs 32 each have a circular horizontal cross-sectional shape with a depth of 1.5 mm and a dimension in the up-down direction of 4.9 mm.

[0028] A horizontal load on the plastic bottle 100 may deform the plastic bottle 100 such that the horizontal cross-sectional shape becomes elliptical. However, the plastic bottle 100 as the present embodiment, which has a main circumferential rib 31 with a wavy horizontal cross-sectional shape, is structured such that a load on the plastic bottle 100 is not easily concentrated. The horizontal load thus does not easily deform the plastic bottle 100.

[0029] A load on the plastic bottle 100 in the up-down direction may also deform the plastic bottle 100 in the up-down direction. However, the plastic bottle 100 as the present embodiment, which has a main circumferential rib 31 and circumferential sub ribs 32 with different depths and dimensions in the up-down direction, allows those ribs to function together as a spring to alleviate the load in the up-down direction. The load in the up-down direction thus does not easily deform the plastic bottle 100.

[Panel Structure]

[0030] The body portion 3 is provided with, in a middle region 3b thereof, a plurality of (for the present embodiment, six) panels 33 (which are an example "reduced pressure absorbing panel portion") that are sunk in the radial direction and that are arranged in the circumferential direction of the middle region 3b at even intervals. As illustrated in Fig. 5, the panels 33 are each shaped to extend in the up-down direction of the middle region 3b, and are each also twisted in shape in the circumferential direction of the plastic bottle 100 with the central axis of the plastic bottle 100 as the center. The panels 33 are each surrounded by a body portion reference surface 34.

[0031] As illustrated in Figs. 5 to 7, the panels 33 each include a first panel depression 33a, a second panel depression 33b, and panel protrusions 33c. The first panel depression 33a has a planar shape and is depressed from the body portion reference surface 34 toward inside the plastic bottle 100. The second panel depression 33b is present at the circumferential center of the first panel depression 33a and depressed in the direction from the first panel depression 33a further toward inside the plastic bottle 100.

[0032] In the panel protrusions 33c, the opposite ends of the first panel depression 33a in the up-down direction are each in the form of a curved surface that protrudes from the first panel depression 33a toward outside the plastic bottle 100 over the entire circumferential width of the first panel depression 33a. The panel protrusions 33c each have a dimension in the up-down direction which dimension is smallest at the opposite circumferential ends of the panel protrusion 33c and largest at the circumferential central portion of the panel protrusion 33c.

[0033] Two body portion reference surfaces 34 extending from two different first panel depressions 33a join each other at a ridge portion 34a. The body portion reference surfaces 34 are apart from the central axis of the plastic bottle 100 by the largest distance at the ridge portions 34a.

[0034] Conventional plastic bottles include reduced pressure absorbing portions that suffer from such strength issues as follows: The reduced pressure absorbing portions are easily deformable radially outwardly when the bottle is pressurized to be filled with a beverage, and are easily depressed due to shrinkage (so-called shrink mark) when the bottle is molded. The plastic bottle 100 as the present embodiment includes panels 33 each reinforced with panel protrusions

33c, and does not easily suffer from the above problematic deformation.

[Bottom Portion Structure]

[0035] As illustrated in Figs. 5, 8, and 9, the bottom portion 4 includes (i) a ground portion 41 configured to come into contact with a placement surface of a table or the like and (ii) a dome portion 42 that is depressed toward inside the plastic bottle 100 (upward in Fig. 5) as it extends from the ground portion 41 radially inwardly. The dome portion 42 includes (i) at a central portion thereof a flat dome central portion 421 and (ii) a plurality of bottom portion depressions 422 present over an area extending from the outer edge of the dome central portion 421 to the inner edge of the ground portion 41.

[0036] As illustrated in Fig. 9, the bottom portion depressions 422 are, in a plan view, each in the shape of a concave hexagon (so-called bowtie shape) with four acute vertexes 422a each having an interior angle of 70° and two reentrant vertexes 422b each having an interior angle of 220° . Each acute vertex 422a is adjacent to another acute vertex 422a and a reentrant vertex 422b, whereas each reentrant vertex 422b is adjacent to two acute vertexes 422a. The concave hexagon has sides each measuring 3 mm, and has diagonals of which the longest are 6 mm long. The bottom portion depressions 422 each have a depth of 1.2 mm.

[0037] As illustrated in Figs. 8 and 9, the bottom portion depressions 422 form bottom portion depression rows 423 each made up of a plurality of bottom portion depressions 422 arranged in a row. The bottom portion depression rows 423 are each made up of a plurality of bottom portion depressions 422 adjacent to one another in such a manner that the respective central axes C_A of the plurality of bottom portion depressions 422 coincide with one another, the central axes C_A being each an extension of the center line C_L of the corresponding bottom portion depression 422, the center line C_L connecting the respective center points of two opposite sides of the corresponding bottom portion depression 422, each of the center points being present between two acute vertexes 422a.

[0038] As illustrated in Figs. 8 and 9, the plurality of bottom portion depression rows 423 have respective central axes C_A parallel to one another. Two adjacent bottom portion depression rows 423a and 423b are offset relative to each other along each central axis C_A , and the width of the offset is 2.6 mm, which is half the length (5.2 mm) of the center line C_L . The term "offset" as used herein means that a plurality of bottom portion depression rows 423 are shifted along each central axis C_A so that there is no coincidence between (i) a straight line connecting the two reentrant vertexes 422b of each bottom portion depression 422 included in a first bottom portion depression row 423a and (ii) a straight line connecting the two reentrant vertexes 422b of each bottom portion depression 422 included in a second bottom portion depression row 423b adjacent to the first bottom portion depression row 423a. The term "width of the offset" indicates the distance between such two straight lines.

[0039] Further, three bottom portion depressions 422 adjacent to one another are arranged in such a pattern that two acute vertexes 422a and one reentrant vertex 422b are close to one another. Stated differently, two respective acute vertexes 422a of two adjacent bottom portion depressions 422 included in the bottom portion depression row 423a which acute vertexes 422a are adjacent to each other are located, in a plan view, outside a reentrant vertex 422b of a bottom portion depression 422 included in the bottom portion depression row 423b in such a pattern that the acute vertexes 422a are fitted in the reentrant vertex 422b in a plan view (see part A in Fig. 9). Such a fitting arrangement is formed by any three bottom portion depressions 422 adjacent to one another.

[0040] Conventional plastic bottles may, when pressurized to be filled with beverages, be deformed such that the bottom portion is pushed out downward by an internal pressure. The plastic bottle 100 as the present embodiment, which has bottom portion depressions 422 with a mutually fitting arrangement as described above, reduces movement of the bottom portion depressions 422 along the bottom surface. This prevents the bottom portion 4 from being deformed. This effect allows the plastic bottle 100 to withstand a load that could otherwise cause deformation, and advantageously prevents the entire plastic bottle 100 from being deformed easily.

[Other Embodiments]

[0041] Finally, the description below deals with plastic bottles as other embodiments of the present invention. The arrangement disclosed for any embodiment below is combinable with the arrangement disclosed for any other embodiment unless such a combination causes any convenience.

[0042] The embodiment described above is an example arrangement including a single main circumferential rib 31. The present invention is, however, not limited to such an arrangement. The plastic bottle according to the present invention may alternatively include a plurality of circumferential ribs. For a better effect of alleviating a load in the up-down direction, the plastic bottle, as with the embodiment described above, preferably includes a single circumferential rib, preferably includes at least one circumferential sub rib in addition to the circumferential rib, more preferably includes at least five circumferential sub ribs in addition to the circumferential rib.

[0043] The embodiment described above is an example arrangement in which the main circumferential rib 31 has

seven largest-depth points 31a and seven smallest-depth points 31b. The present invention is, however, not limited to such an arrangement. The circumferential rib may have any number of largest-depth points and any number of smallest-depth points as long as those numbers are equal to each other and are each two or more. For a better effect of preventing concentration of a horizontal load, the circumferential rib preferably has six to nine largest-depth points and six to nine smallest-depth points.

[0044] The embodiment described above is an example arrangement in which the main circumferential rib 31 has a maximum depth of 4.5 mm. The present invention is, however, not limited to such an arrangement. The circumferential rib may have a maximum depth of 4.5 mm to 6.0 mm. The circumferential rib has a maximum depth of preferably 4.5 mm to 5.5 mm, more preferably 4.5 mm to 5.1 mm.

[0045] The embodiment described above is an example arrangement in which the main circumferential rib 31 has a minimum depth of 3.5 mm. The present invention is, however, not limited to such an arrangement. The circumferential rib may have a minimum depth of 3.5 mm to 4.4 mm.

[0046] The embodiment described above is an example arrangement in which the main circumferential rib 31 has a dimension in the up-down direction of 7.2 mm at each smallest-depth point 31b. The present invention is, however, not limited to such an arrangement. The circumferential rib may have a dimension in the up-down direction of 7 mm to 9 mm at each smallest-depth point of the circumferential rib. The circumferential rib preferably has a dimension in the up-down direction of 7.1 mm to 8.8 mm, more preferably 7.2 mm to 8.6 mm, particularly preferably 7.2 mm to 8.4 mm, at each smallest-depth point of the circumferential rib.

[0047] The embodiment described above is an example arrangement in which two body portion reference surfaces 34 extending from two different first panel depressions 33a join each other at a ridge portion 34a. The present invention is, however, not limited to such an arrangement, and may be arranged, for instance, such that two body portion reference surfaces join each other in a region having a planar connection portion.

[0048] The embodiment described above is an example arrangement in which the first panel depressions 33a each have a planar shape. The present invention is, however, not limited to such an arrangement. The first panel depression may, for instance, have a rib for reduced pressure absorption.

[0049] The embodiment described above is an example arrangement in which the acute vertexes 422a each have an interior angle of 70°, and the reentrant vertexes 422b each have an interior angle of 220°. The present invention is, however, not limited to such an arrangement. The acute vertex may have an interior angle of larger than 60° and not larger than 80°. The acute vertex preferably has an interior angle of not smaller than 63° and not larger than 87°, more preferably not smaller than 65° and not larger than 75°.

[0050] The embodiment described above is an example arrangement in which the concave hexagon has diagonals of which the longest are 6 mm long. The present invention is, however, not limited to such an arrangement. The longest diagonals may be 3 mm to 8 mm long. The longest diagonals are preferably 4 mm to 7 mm long, more preferably 5 mm to 7 mm long.

[0051] The embodiment described above is an example arrangement in which the bottom portion depressions 422 each have a depth of 1.2 mm. The present invention is, however, not limited to such an arrangement. The bottom portion depression may have a depth of 0.6 mm to 2.4 mm. The bottom portion depression preferably has a depth of 0.5 mm to 2.5 mm, more preferably 0.7 mm to 2.3 mm.

[0052] The embodiment described above is an example arrangement in which the width of the offset between two bottom portion depression rows 423a and 423b adjacent to each other is 2.6 mm, which is half the length (5.2 mm) of the center line C_L . The present invention is, however, not limited to such an arrangement. The width of the offset may be 40% to 60% of the length of the center line. The width of the offset is preferably 45% to 55%, more preferably 48% to 52%, particularly preferably 50%, of the length of the center line.

[0053] Embodiments of any arrangement other than the above that is disclosed in the present specification are also mere examples in all respects, and do not limit the scope of the present invention. A person skilled in the art will easily understand that the embodiments may be modified as appropriate without departing from the object of the present invention. The present invention thus naturally covers in its scope any embodiment as modified without departing from the object of the present invention.

Examples

[0054] The description below deals with Examples and Comparative Examples for the present invention. The present invention is not limited by the Examples below.

[Shapes for Examples and Comparative Examples]

[0055] The respective bottles of the Examples and Comparative Examples each had a shape generally as illustrated in Figs. 1 to 9 except for the dimensions of individual portions. The description below defines each bottle on the basis

of $D_{\max}$, $D_{\min}$, and $W_{\min}$, where $D_{\max}$ indicates the depth of the main circumferential rib 31 at each largest-depth point 31a of the main circumferential rib 31, $D_{\min}$ indicates the depth of the main circumferential rib 31 at each smallest-depth point 31b of the main circumferential rib 31, and $W_{\min}$ indicates the dimension in the up-down direction of the main circumferential rib 31. Table 1 below shows the dimensions of each bottle together with the results of evaluation tests described below.

[Stress Test for Vertical Load]

[0056] A vertical stress was applied to each of the respective bottles of the Examples and Comparative Examples with use of a publicly known tester to plot a stress-deformation curve. A bottle passed the test if the plotted curve reached a maximum stress value of not less than 210 N indicative of a property allowing the bottle to withstand an environment during distribution or storage in a warehouse. A bottle failed the test if the plotted curve did not reach a stress value of 210 N. The bottle of the present invention is preferably capable of withstanding a vertical load of not less than 210 N, particularly preferably not less than 500 N.

[Stress Test for Horizontal Load]

[0057] A stress of 20 N was applied to each of the respective bottles of the Examples and Comparative Examples from outside the body portion 3 with use of a publicly known tester. With the stress being applied, the horizontal width of the body portion 3 of each bottle was measured in (i) a direction parallel to the line of action of the stress and (ii) a direction perpendicular to the line of action. A bottle passed the test if the difference between the two was not more than 4 mm. A bottle failed the test if the difference between the two was more than 4 mm.

[Evaluation Results]

[0058] Table 1 shows the dimensions of each of the respective bottles of the Examples and Comparative Examples and the results of evaluation of each bottle.

[Table 1]

	Dimensions of individual portions [mm]			Strength evaluation	
	$D_{\max}$	$D_{\min}$	$W_{\min}$	Vertical direction	Horizontal direction
Example 1	4.5	3.5	7.2	Passed	Passed
Example 2	4.8	4.0	7.8	Passed	Passed
Example 3	5.1	4.4	8.4	Passed	Passed
Comparative Example 1	3.3	1.8	4.9	Passed	Failed
Comparative Example 2	3.9	2.6	6.0	Passed	Failed

[0059] Table 1 shows that all the bottles of Examples 1 to 3 and Comparative Examples 1 and 2 passed the stress test for a vertical load. Each bottle withstood a vertical load of not less than 500 N. These results should indicate that for each bottle, the main circumferential rib 31 and the circumferential sub ribs 32 effectively alleviated the load in the vertical direction.

[0060] The bottles of Examples 1 to 3 passed the stress test for a horizontal load, while the bottles of Comparative Examples 1 and 2 failed the test. This should be because for Comparative Examples 1 and 2, the main circumferential rib 31 had a depth smaller than those for Examples 1 to 3 and failed to sufficiently produce the effect of preventing concentration of the load.

Industrial Applicability

[0061] The present invention is applicable to, for example, a container for a soft drink.

Reference Signs List

[0062]

100	Plastic bottle
1	Mouth portion
2	Shoulder portion
3	Body portion
5	3a Upper region of the body portion
	3b Middle region of the body portion
	3c Lower region of the body portion
	31 Main circumferential rib
	32 Circumferential sub rib
10	33 Panel
	33a First panel depression
	33b Second panel depression
	33c Panel protrusion
	34 Body portion reference surface
15	34a Ridge portion
	4 Bottom portion
	41 Ground portion
	42 Dome portion
	421 Dome central portion
20	422 Bottom portion depression
	422a Acute vertex of the bottom portion depression
	422b Reentrant vertex of the bottom portion depression
	423 (423a, 423b) Bottom portion depression row
	C _A Central axis
25	C _L Center line
	A Mutually fitting part of bottom portion depressions

Claims

- 30
1. A plastic bottle, comprising:

35 a body portion provided with at least one circumferential rib in a shape of a depression, wherein the at least one circumferential rib has a wavy horizontal cross-sectional shape with a depth in a direction from a surface of the plastic bottle toward inside the plastic bottle which depth varies continuously in a circumferential direction of the plastic bottle, and the depth of the at least one circumferential rib has a maximum value of 4.5 mm to 6.0 mm and a minimum value of 3.5 mm to 4.4 mm.
 - 40 2. The plastic bottle according to claim 1, wherein the at least one circumferential rib has a dimension in an up-down direction which dimension is 7 mm to 9 mm at a smallest-depth point.
 - 45 3. The plastic bottle according to claim 1 or 2, wherein the body portion is further provided with a reduced pressure absorbing panel portion, and the at least one circumferential rib is present at that portion of the body portion which is above or below the reduced pressure absorbing panel portion.
 - 50 4. The plastic bottle according to any one of claims 1 to 3, wherein the at least one circumferential rib is a single circumferential rib.
 - 55 5. The plastic bottle according to any one of claims 1 to 4, further comprising: at least one circumferential sub rib in a shape of a depression, wherein the at least one circumferential sub rib has a circular horizontal cross-sectional shape, the at least one circumferential sub rib has a depth in the direction from the surface of the plastic bottle toward inside the plastic bottle which depth is smaller than the minimum value of the depth of the at least one circumferential rib, and the at least one circumferential sub rib has a dimension in the up-down direction which dimension is smaller than the dimension of the at least one circumferential rib in the up-down direction.

Fig.1

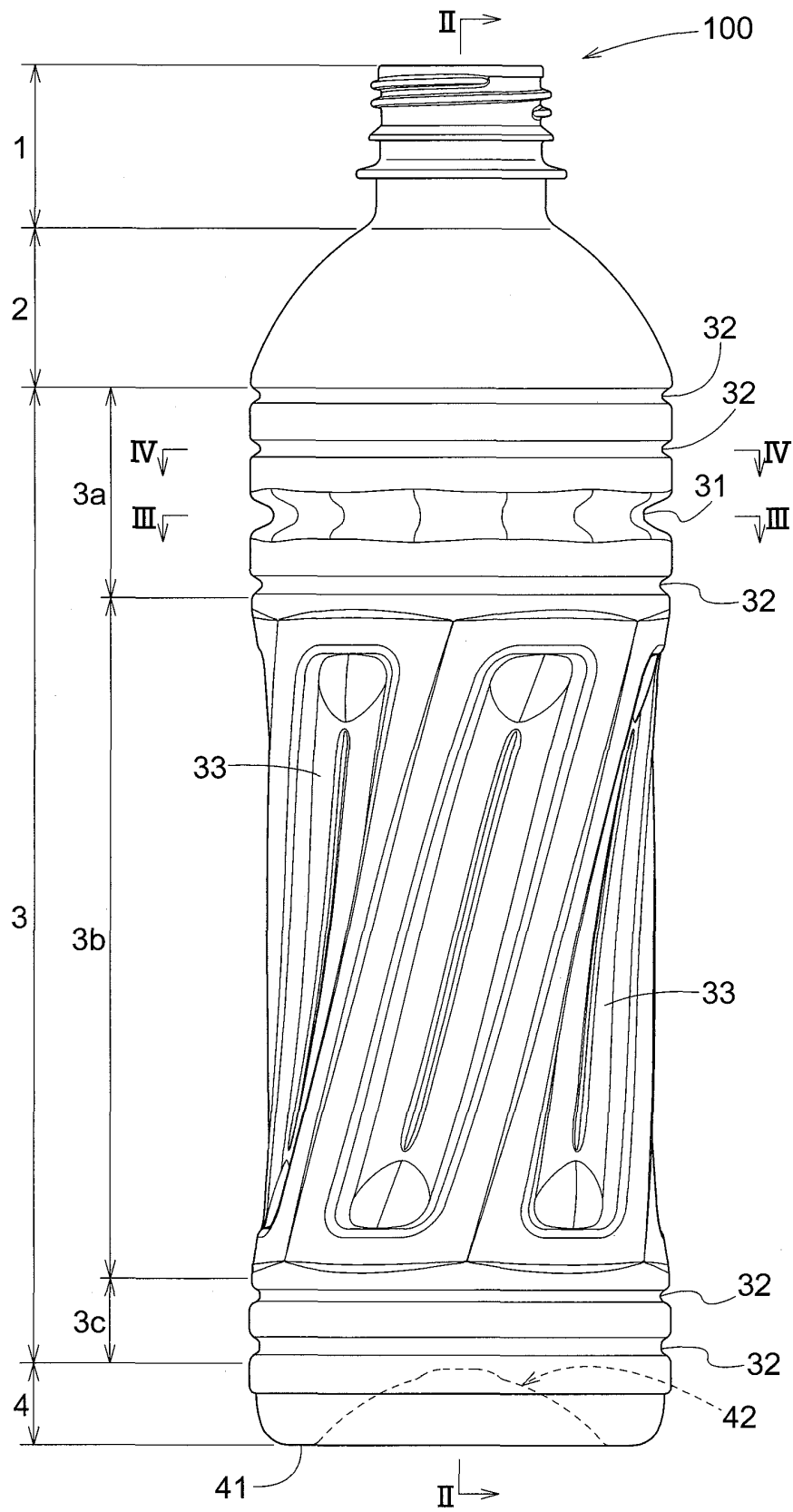


Fig.2

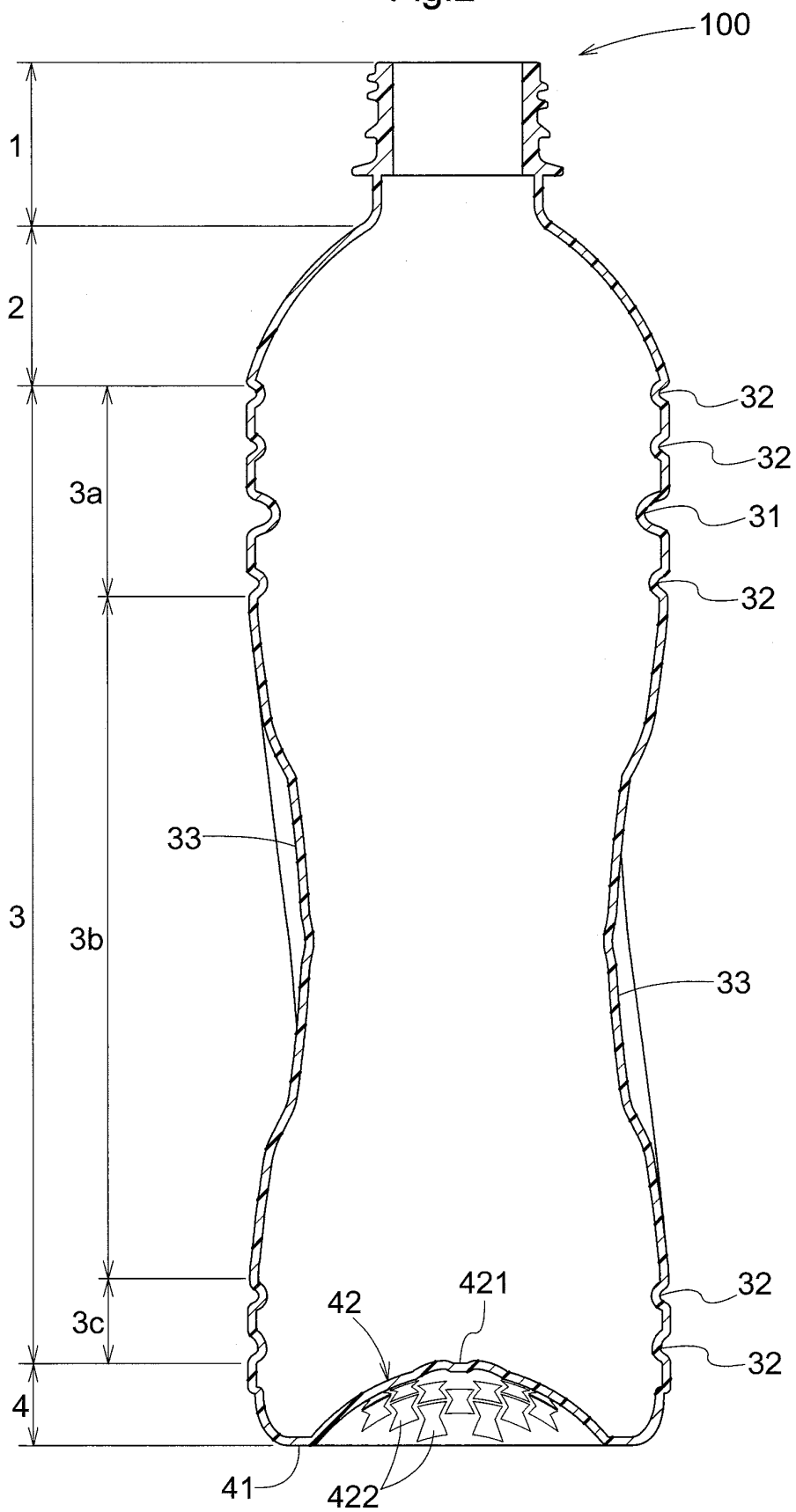


Fig.3

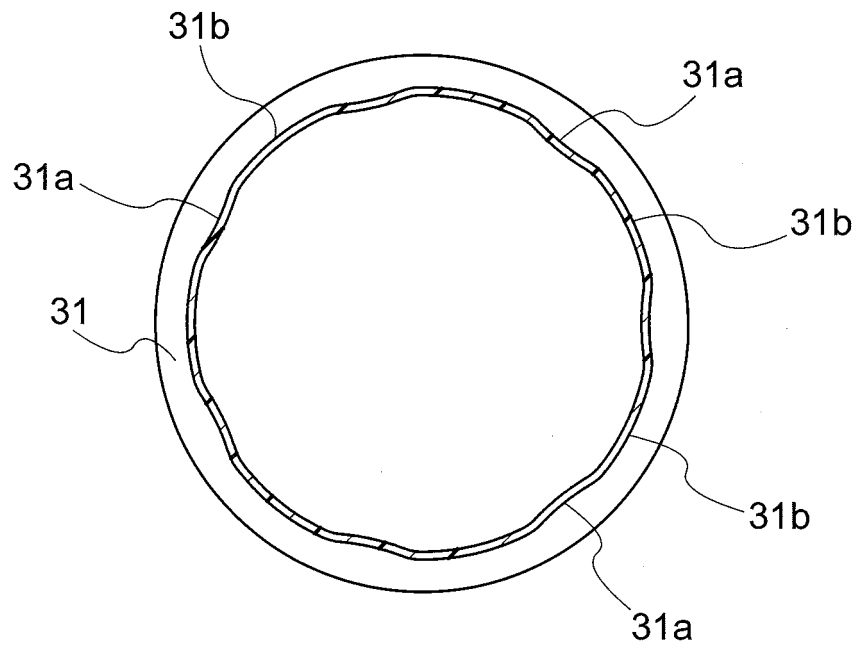


Fig.4

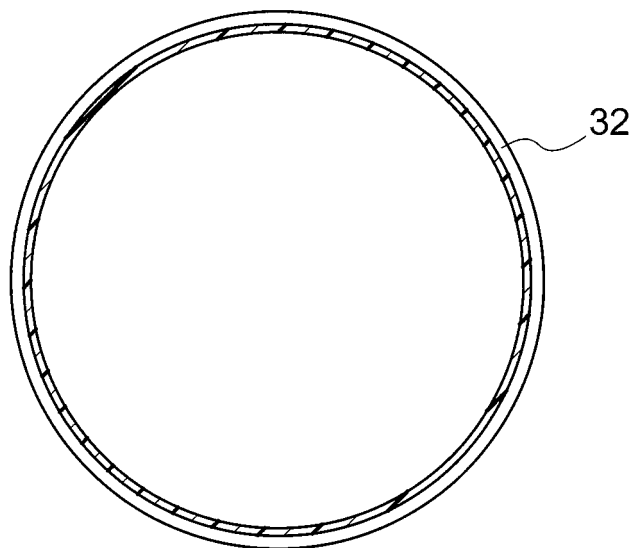


Fig.5

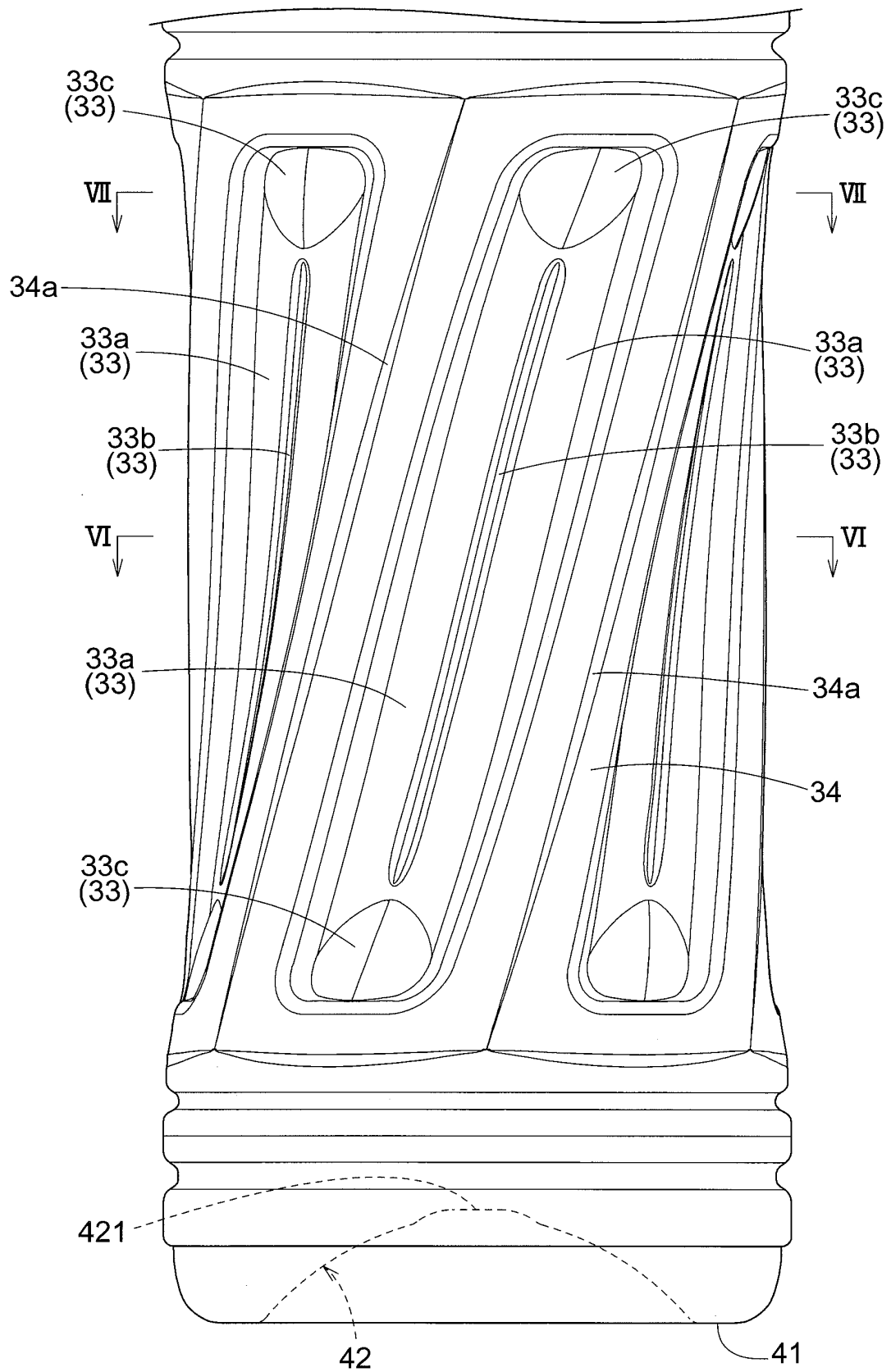


Fig.6

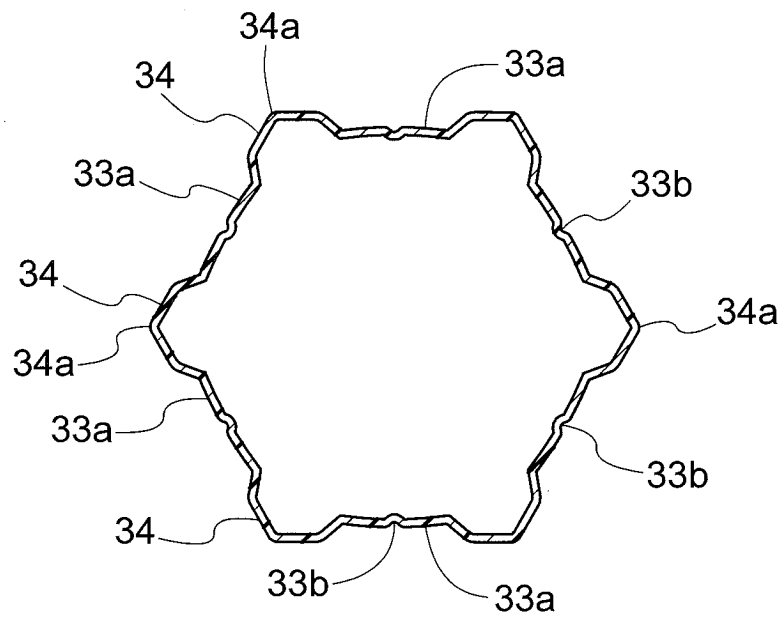


Fig.7

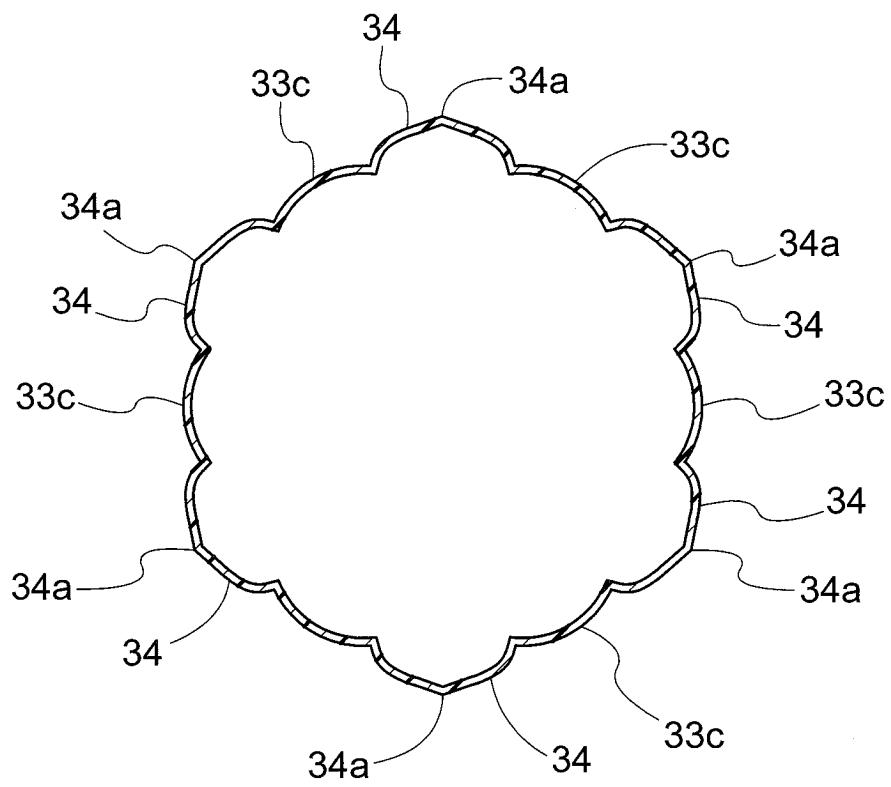


Fig.8

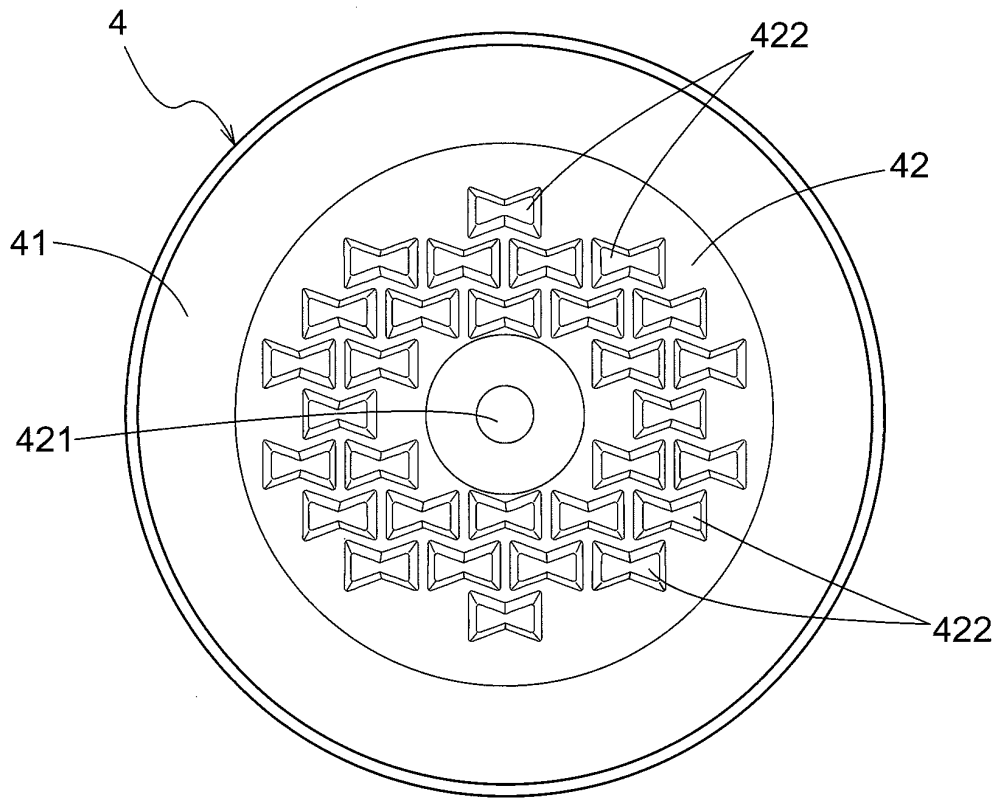
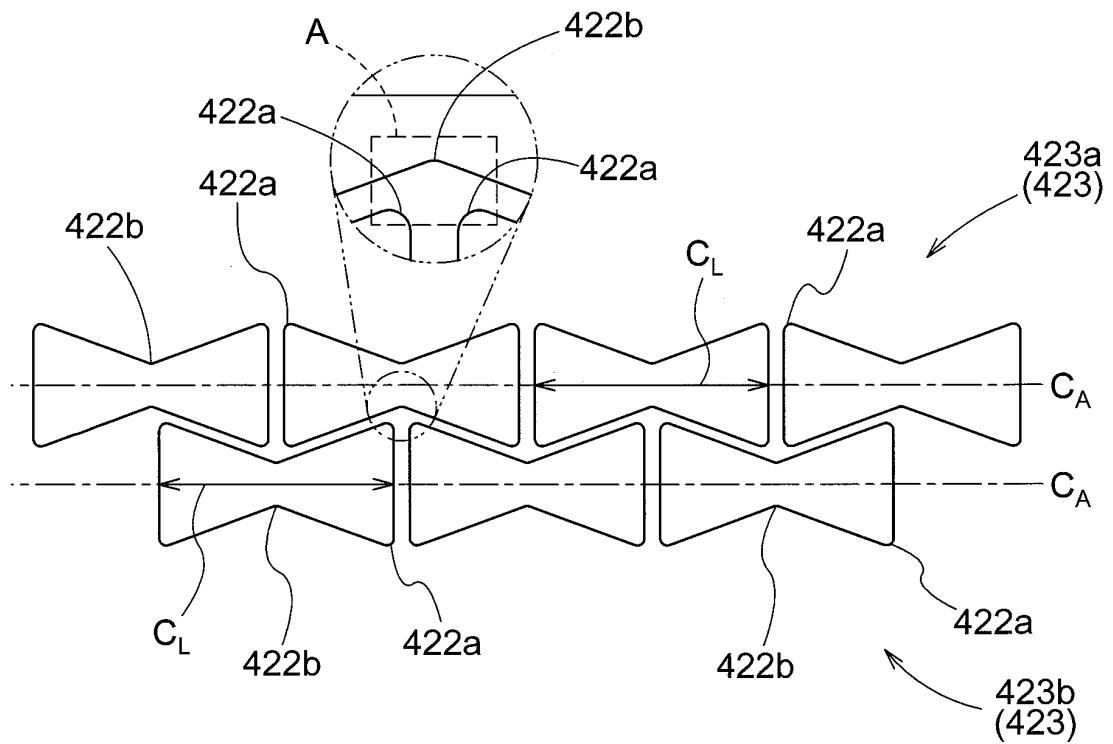


Fig.9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/007871

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. B65D1/02 (2006.01) i, B65D1/44 (2006.01) i

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)

Int. Cl. B65D1/02, B65D1/44

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	1971-2019
Registered utility model specifications of Japan	1996-2019
Published registered utility model applications of Japan	1994-2019

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.
Y	JP 2012-126448 A (SUNTORY HOLDINGS LIMITED) 05 July 2012, claim 1 (Family: none)	1-5
Y	JP 2016-132503 A (DAINIPPON PRINTING CO., LTD.) 25 July 2016, claims 2-3, paragraph [0035] (Family: none)	1-5



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

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"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

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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

12 April 2019 (12.04.2019)

Date of mailing of the international search report

23 April 2019 (23.04.2019)

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/007871

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 79725/1993 (Laid-open No. 34907/1994) (HOKKAI CAN CO., LTD.) 16 August 1994, paragraphs [0004], [0006], fig. 1, 3 (Family: none)	3-5 1-2
A	JP 4573193 B2 (YOSHINO KOGYOSHO CO., LTD.) 04 November 2010 (Family: none)	1-5
A	JP 3682559 B2 (YOSHINO KOGYOSHO CO., LTD.) 10 August 2005 (Family: none)	1-5

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2007118966 A [0005]
- JP 2012126448 A [0005]