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(72) Inventors:
• **KIRA Go**
Tokyo 135-8631 (JP)
• **KOBAYASHI Toshiya**
Tokyo 135-8631 (JP)
• **MATSUTAKE Naoto**
Tokyo 135-8631 (JP)
• **BAGGETT Alysha**
Tokyo 135-8631 (JP)

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(74) Representative: **Vossius & Partner**
Patentanwälte Rechtsanwälte mbB
Siebertstrasse 3
81675 München (DE)

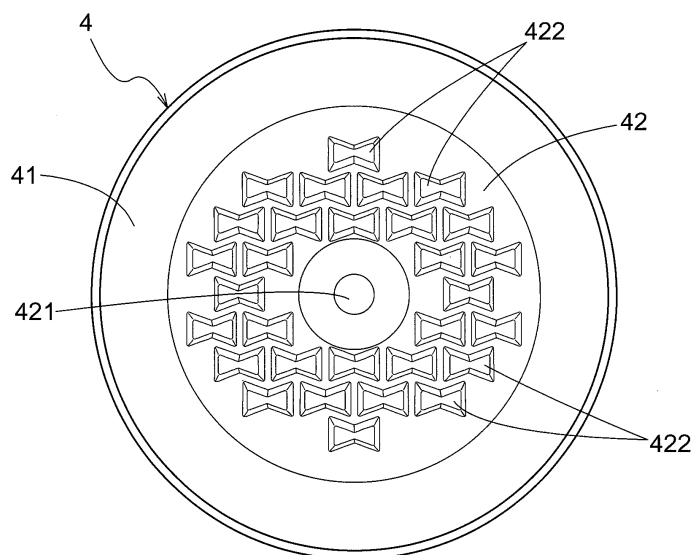
(71) Applicant: **Suntory Holdings Limited**
Osaka 530-8203 (JP)

(54) **PLASTIC BOTTLE**

(57) A plastic bottle comprises: a bottom portion 4 provided with a depression 422, wherein the depression 422 is in a direction from the bottom portion 4 toward inside the plastic bottle, the depression 422 is, in a plan view, in a shape of a concave hexagon with (i) four acute vertexes having respective interior angles that are each

acute and (ii) two reentrant vertexes having respective interior angles that are each larger than 180° and smaller than 360°, the acute vertexes are each adjacent to another one of the acute vertexes and one of the reentrant vertexes, and the reentrant vertexes are each adjacent to two of the acute vertexes.

Fig.8



Description

Technical Field

[0001] The present invention relates to a plastic bottle including a bottom portion having at least two depression rows each made up of a plurality of depressions in a row.

Background Art

[0002] Plastic bottles filled with beverages may become disadvantageously deformed as a result of a change in the internal pressure of the plastic bottles during production and distribution. Examples of a pressure change that can cause such deformation include (i) a change caused in the internal pressure by expansion and shrinkage due to a temperature change and (ii) application of a liquid pressure higher than the atmospheric pressure when the plastic bottles become filled with beverages. Various efforts have been made to strengthen the bottom portion of a plastic bottle to prevent deformation resulting from the pressure change.

[0003] As an example of such efforts, Patent Literature 1 discloses a plastic bottle having (i) a depressed portion that is depressed from the bottom surface of the plastic bottle toward inside the plastic bottle and (ii) a plurality of substantially spherical ribs that are arranged radially and that are depressed from the depressed portion further toward inside the plastic bottle. Since the plastic bottle has substantially spherical ribs, the bottom portion is capable of withstanding deformation caused by thermal contraction or self weight of the content.

[0004] Patent Literature 2 discloses a plastic bottle including a bottom portion having a moveable wall portion with a plurality of ribs. The plastic bottle is arranged such that the moveable wall portion deforms as it quickly responds to a change in the internal pressure of the plastic bottle. This effectively prevents deformation of the remaining portions of the plastic bottle. The plastic bottle is arranged such that the moveable wall portion, which has a plurality of ribs, is capable of absorbing a pressure change more effectively.

Citation List

Patent Literature

[0005]

Patent Literature 1 Japanese Unexamined Patent Application Publication, *Tokukaihei*, No. 7-112729
Patent Literature 2 International Publication No. 2012/43362

Summary of Invention

Technical Problem

[0006] While techniques such as those of Patent Literatures 1 and 2 allow a plastic bottle to sufficiently withstand deformation resulting from a pressure change caused spontaneously by, for example, a temperature change or self weight, the techniques do not allow a plastic bottle to sufficiently withstand a larger pressure change such as a pressure change due to a liquid pressure applied mechanically when the plastic bottle becomes filled with a beverage. A bottle may consequently be deformed such that the bottom portion is pushed out downward by the internal pressure. This requires a liquid pressure applied to a beverage during a filling step to be limited so that plastic bottles will not become deformed. Such a limit may decrease the efficiency in producing beverage products.

[0007] The above circumstances have led to a demand for a plastic bottle capable of more effectively withstanding deformation resulting from a change in the internal pressure.

Solution to Problem

[0008] A plastic bottle according to one or more embodiments of the present invention comprises: a bottom portion provided with at least one depression, wherein the at least one depression is in a direction from the bottom portion toward inside the plastic bottle, the at least one depression is, in a plan view, in a shape of a concave hexagon with (i) four acute vertexes having respective interior angles that are each acute and (ii) two reentrant vertexes having respective interior angles that are each larger than 180° and smaller than 360°, the acute vertexes are each adjacent to another one of the acute vertexes and one of the reentrant vertexes, and the reentrant vertexes are each adjacent to two of the acute vertexes.

[0009] With the above arrangement, the depression is capable of becoming deformed by both a load along the central axis and a load perpendicular to the central axis in such a manner as to follow such loads in those directions. This allows for an excellent capability to absorb a pressure change.

[0010] 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.

[0011] A plastic bottle as a preferable embodiment of the present invention is arranged such that the respective interior angles of the four acute vertexes are equal to one another, and the respective interior angles of the two reentrant vertexes are equal to each other.

[0012] With the above arrangement, the depression has a planar shape with a high degree of symmetry. This allows the depression to become deformed with high symmetry in following a load, and thereby allows for an

improved capability to absorb a pressure change.

[0013] A plastic bottle as a preferable embodiment of the present invention is arranged such that the at least one depression includes at least one depression row made up of a plurality of depressions in the bottom portion.

[0014] With the above arrangement, a plurality of depressions function together. This allows for an improved capability to absorb a pressure change.

[0015] A plastic bottle as a preferable embodiment of the present invention is arranged such that the plurality of depressions in the at least one depression row are adjacent to one another in such a manner that respective central axes of the plurality of depressions coincide with one another, the central axes being each an extension of a center line of a corresponding one of the plurality of depressions, the center line connecting respective center points of two opposite sides of the corresponding one of the plurality of depressions, each of the center points being present between two of the acute vertexes of the concave hexagon, and the at least one depression row includes at least two depression rows having respective central axes parallel to each other.

[0016] With the above arrangement, a plurality of depressions included in a plurality of depression rows function together. This allows for a further improved capability to absorb a pressure change.

[0017] A plastic bottle as a preferable embodiment of the present invention is arranged such that the at least two depression rows include a first depression row and a second depression row that are adjacent to each other, the first depression row and the second depression row are offset relative to each other in a direction along the respective central axes of the first depression row and the second depression row, a width of the offset is 40% to 60% of a length of each of the center lines, and one of the acute vertexes of a first depression included in the first depression row and one of the acute vertexes of a second depression included in the first depression row which second depression is adjacent to the first depression, the ones being adjacent to each other, are located, in a plan view, outside one of the reentrant vertexes of a depression included in the second depression row in such a pattern that the ones are fitted in said one of the reentrant vertexes in the plan view.

[0018] With the above arrangement, adjacent depressions have a mutually fitting arrangement. This reduces movement of the depressions along the bottom surface, and thereby prevents the bottom portion from becoming deformed. The above arrangement, as a result, allows the plastic bottle to withstand a load that could otherwise cause deformation, and advantageously prevents the entire plastic bottle from being deformed easily.

[0019] A plastic bottle as a preferable embodiment of the present invention is arranged such that the respective interior angles of the acute vertexes are each larger than 60° and not larger than 80°.

[0020] The depression, in the case where it has a planar

shape defined by the above range, allows for an improved capability to absorb a pressure change.

[0021] A plastic bottle as a preferable embodiment of the present invention is arranged such that the at least one depression has a dimension of 0.5 mm to 2.5 mm in the direction from the bottom portion toward inside the plastic bottle.

[0022] The depression, in the case where it has a depth within the above range, allows for an improved capability to absorb a pressure change.

[0023] A plastic bottle as a preferable embodiment of the present invention is arranged such that the concave hexagon has diagonals a longest one of which is 3 mm to 8 mm long.

[0024] The depression, in the case where it has a planar shape defined by the above range, allows for an improved capability to absorb a pressure change.

[0025] A plastic bottle as a preferable embodiment of the present invention is arranged such that the bottom portion includes a dome portion that is depressed inwardly of the plastic bottle as the dome portion extends from a ground portion of the plastic bottle radially inwardly of the plastic bottle, and the at least one depression is in a direction from the dome portion further toward inside the plastic bottle.

[0026] With the above arrangement, the plastic bottle benefits from both the pressure resistance of the dome portion and the pressure change absorbing capability of the depression. This allows the plastic bottle to withstand a pressure more effectively.

[0027] 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

[0028]

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

[0029] 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. 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.

[0030] 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]

[0031] The body portion 3 is provided with, in an upper region 3a thereof, a main circumferential rib 31 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, sub circumferential 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 sub circumferential rib 32.

[0032] 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.

[0033] 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.

[0034] As illustrated in Figs. 1 and 2, the body portion 3 may be provided with a plurality of sub circumferential ribs 32. The present embodiment involves three sub circumferential ribs 32 in the upper region 3a and two sub circumferential ribs 32 in the lower region 3c. The present embodiment is arranged such that the sub circumferential 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.

[0035] 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.

[0036] 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 sub circumferential 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]

[0037] The body portion 3 is provided with, in a middle region 3b thereof, a plurality of (for the present embodiment, six) panels 33 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] 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]

[0042] 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 (which are an example "depression") present over an area extending from the outer side of the dome central portion 421 to the inner side of the ground portion 41. The bottom portion depressions 422 are depressed from the dome portion 42 further toward inside the plastic bottle 100.

[0043] 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.

[0044] As illustrated in Figs. 8 and 9, the bottom portion depressions 422 form bottom portion depression rows 423 (which are an example "depression row") 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.

[0045] 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 (which are an example "first depression row" and an example "second depression row") 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 present 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.

[0046] 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.

[0047] 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 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]

[0048] 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.

[0049] 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 main circumferential rib, preferably includes at least one sub circumferential rib in addition to the main circumferential rib, more preferably includes at least five sub circumferential ribs in addition to the main circumferential rib.

[0050] 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 main 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 main circumferential rib preferably has six to nine largest-depth points and six to nine smallest-depth points.

[0051] The embodiment described above is an example arrangement in which the main circumferential rib 31 has a maximum depth of 4.5 mm and a minimum depth of 3.5 mm. The present invention is, however, not limited to such an arrangement. The circumferential rib may have a maximum depth of 4.0 mm to 5.5 mm and a minimum depth that is 0.5 mm to 1.5 mm smaller than the maximum depth. The circumferential rib has a maximum depth of preferably 4.1 mm to 5.2 mm, more preferably 4.2 mm to 5.0 mm. The circumferential rib has a minimum depth that is preferably 0.6 mm to 1.4 mm smaller than the maximum depth, more preferably 0.7 mm to 1.3 mm smaller than the maximum depth.

[0052] The embodiment described above is an example arrangement in which the main circumferential rib 31 has a dimension in the up-down direction of 8.0 mm at each largest-depth point 31a and 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 6 mm to 9 mm. The circumferential rib preferably has a dimension in the up-down direction of 6.2 mm to 8.8 mm, more preferably 6.5 mm to 8.5 mm.

[0053] 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.

[0054] The embodiment described above is an exam-

ple 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.

[0055] 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°.

[0056] 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.

[0057] 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.

[0058] 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.

[0059] 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.

Industrial Applicability

[0060] The present invention is applicable to, for example, a container for a soft drink.

Reference Signs List

[0061]

100	Plastic bottle
1	Mouth portion
2	Shoulder portion
3	Body portion
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	Sub circumferential rib
33	Panel
33a	First panel depression
33b	Second panel depression
33c	Panel protrusion
34	Body portion reference surface
34a	Ridge portion
4	Bottom portion
41	Ground portion
42	Dome portion
421	Dome central portion
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
C _L	Center line
A	Mutually fitting part of bottom portion depressions

Claims**1.** A plastic bottle, comprising:

a bottom portion provided with at least one depression, wherein
the at least one depression is in a direction from the bottom portion toward inside the plastic bottle,
the at least one depression is, in a plan view, in a shape of a concave hexagon with (i) four acute vertexes having respective interior angles that are each acute and (ii) two reentrant vertexes having respective interior angles that are each larger than 180° and smaller than 360°,
the acute vertexes are each adjacent to another one of the acute vertexes and one of the reentrant vertexes, and
the reentrant vertexes are each adjacent to two of the acute vertexes.

2. The plastic bottle according to claim 1, wherein the respective interior angles of the four acute ver-

texes are equal to one another, and the respective interior angles of the two reentrant vertexes are equal to each other.

3. The plastic bottle according to claim 1 or 2, wherein the at least one depression includes at least one depression row made up of a plurality of depressions in the bottom portion.

4. The plastic bottle according to claim 3, wherein the plurality of depressions in the at least one depression row are adjacent to one another in such a manner that respective central axes of the plurality of depressions coincide with one another, the central axes being each an extension of a center line of a corresponding one of the plurality of depressions, the center line connecting respective center points of two opposite sides of the corresponding one of the plurality of depressions, each of the center points being present between two of the acute vertexes of the concave hexagon, and the at least one depression row includes at least two depression rows having respective central axes parallel to each other.

5. The plastic bottle according to claim 4, wherein the at least two depression rows include a first depression row and a second depression row that are adjacent to each other, the first depression row and the second depression row are offset relative to each other in a direction along the respective central axes of the first depression row and the second depression row, a width of the offset is 40% to 60% of a length of each of the center lines, and one of the acute vertexes of a first depression included in the first depression row and one of the acute vertexes of a second depression included in the first depression row which second depression is adjacent to the first depression, the ones being adjacent to each other, are located, in a plan view, outside one of the reentrant vertexes of a depression included in the second depression row in such a pattern that the ones are fitted in said one of the reentrant vertexes in the plan view.

6. The plastic bottle according to any one of claims 1 to 5, wherein the respective interior angles of the acute vertexes are each larger than 60° and not larger than 80°.

7. The plastic bottle according to any one of claims 1 to 6, wherein the at least one depression has a dimension of 0.5 mm to 2.5 mm in the direction from the bottom portion toward inside the plastic bottle.

8. The plastic bottle according to any one of claims 1

to 7, wherein
the concave hexagon has diagonals a longest one
of which is 3 mm to 8 mm long.

9. The plastic bottle according to any one of claims 1 to 8, wherein
the bottom portion includes a dome portion that is
depressed toward inside the plastic bottle as the
dome portion extends from a ground portion of the
plastic bottle radially toward inside the plastic bottle,
and
the at least one depression is in a direction from the
dome portion further toward inside the plastic bottle.

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Fig.1

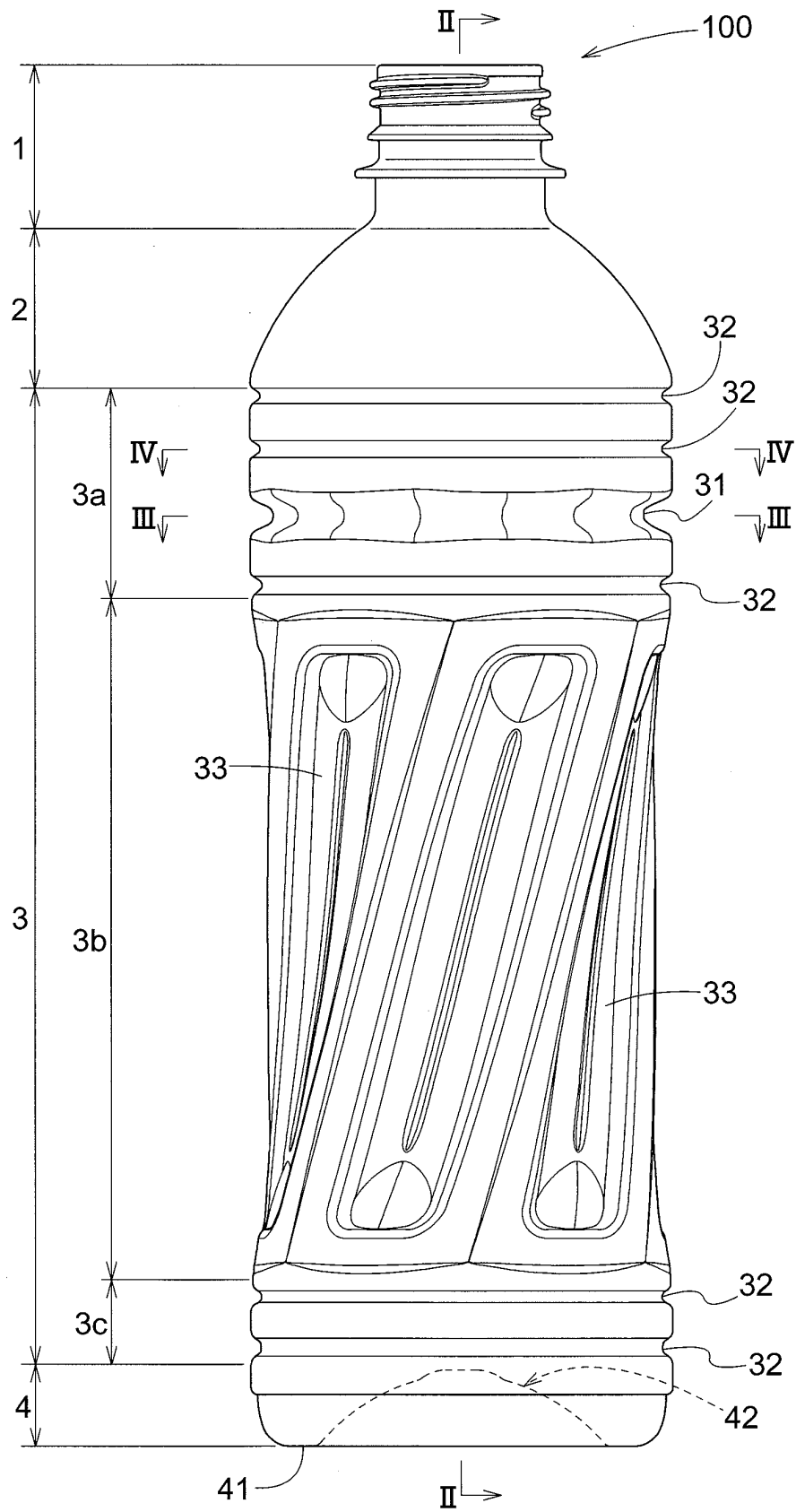


Fig.2

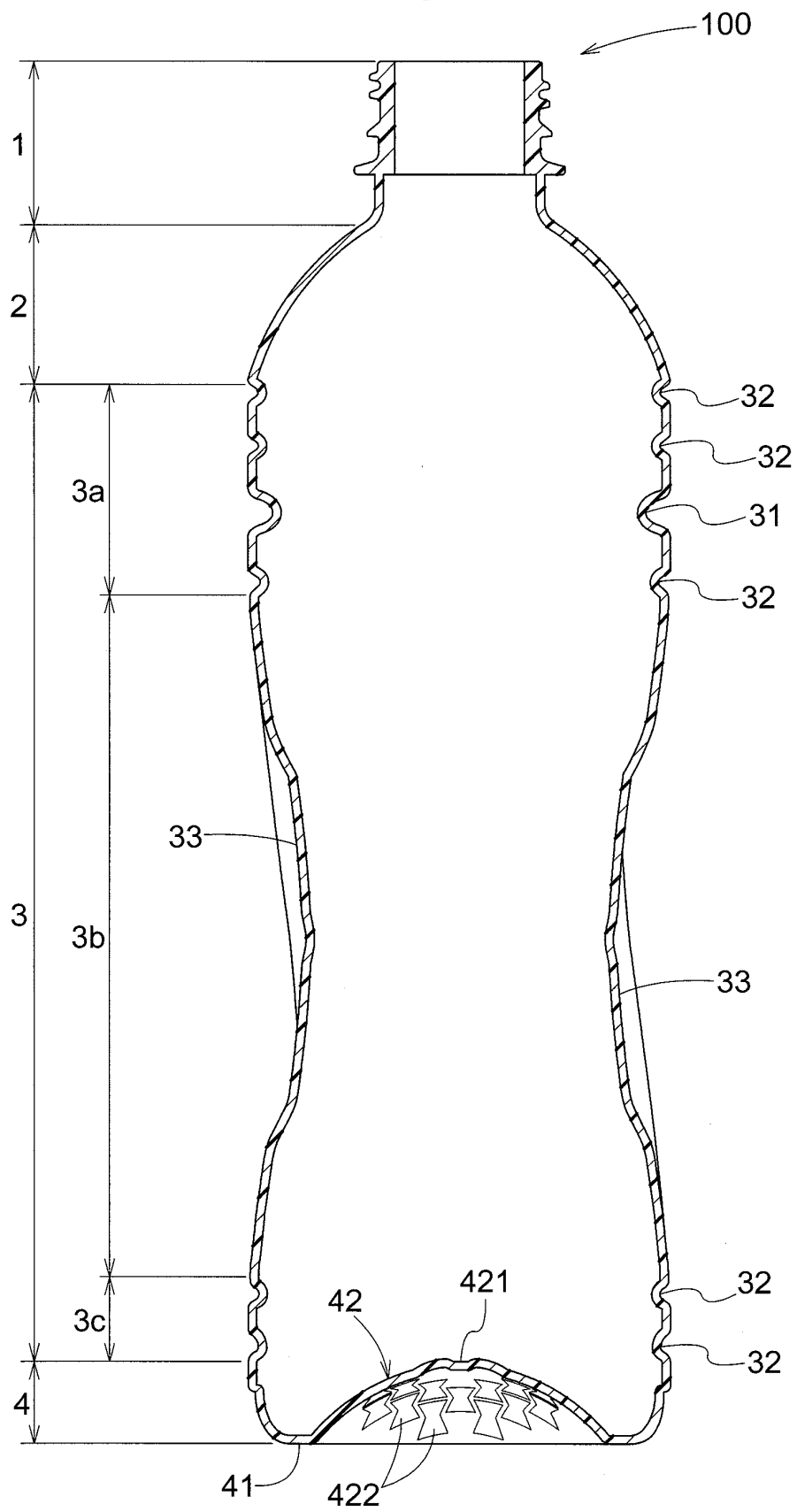


Fig.3

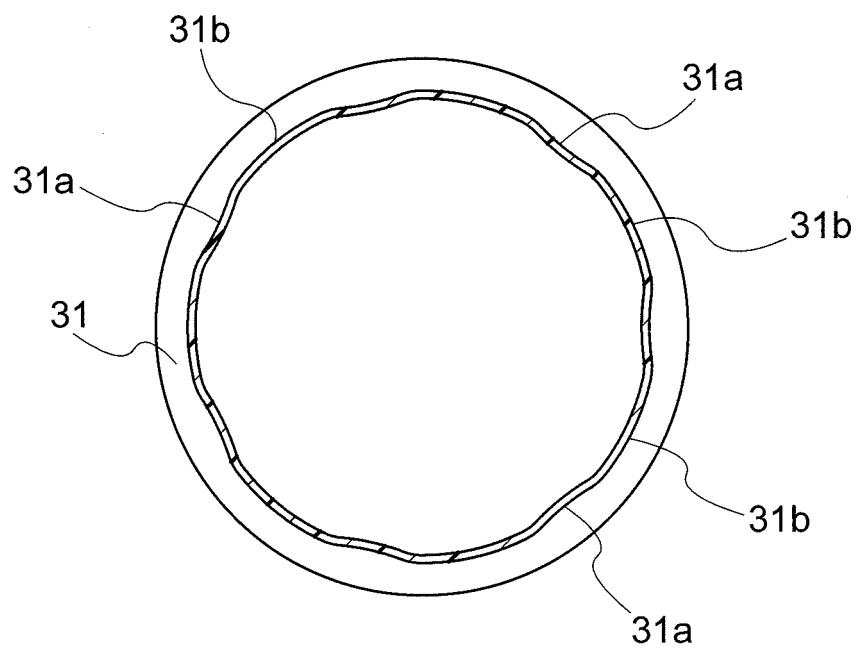


Fig.4

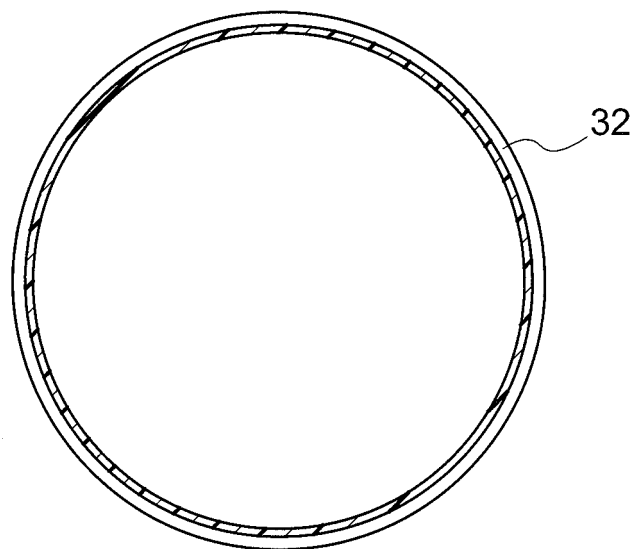


Fig.5

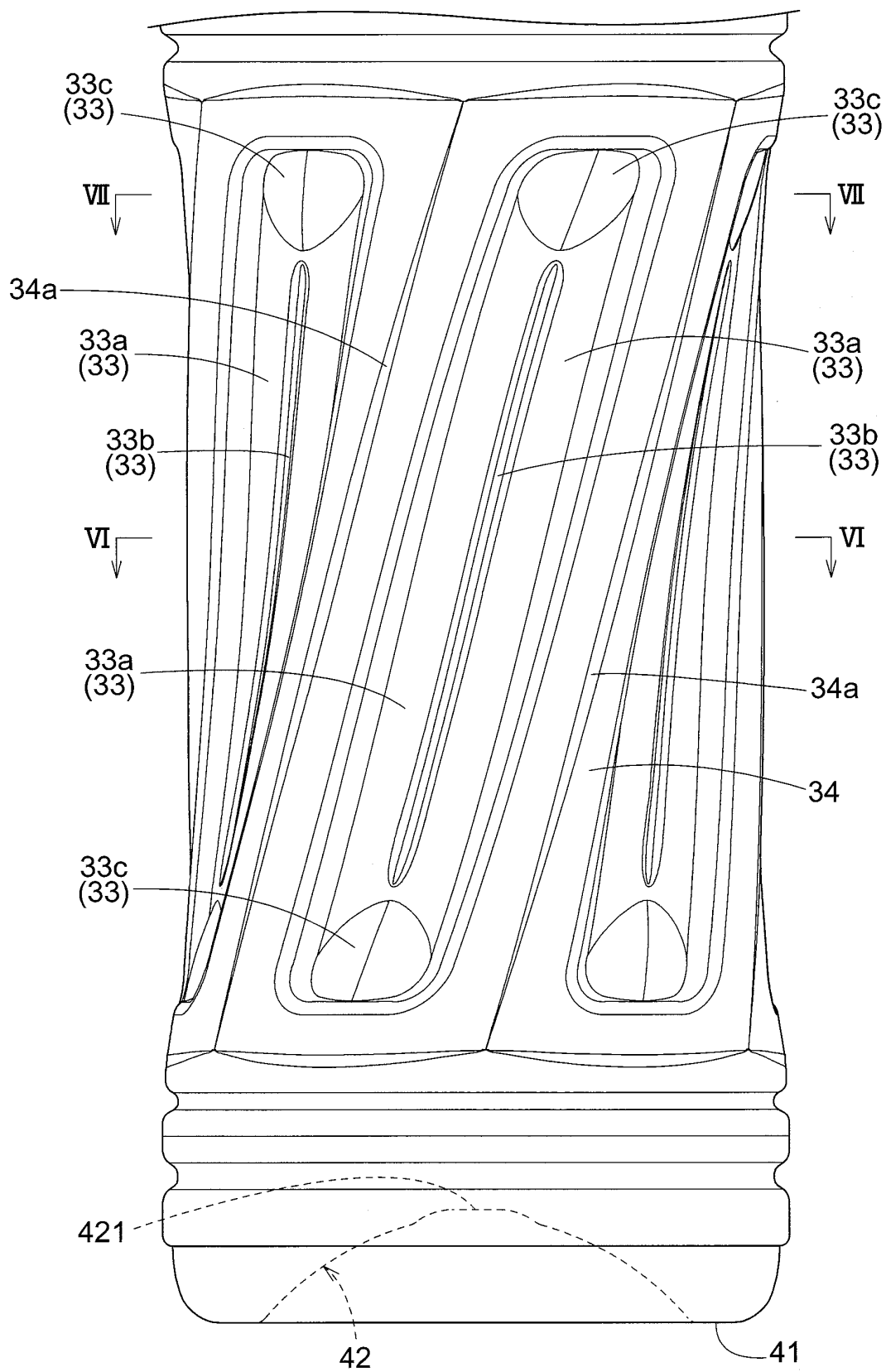


Fig.6

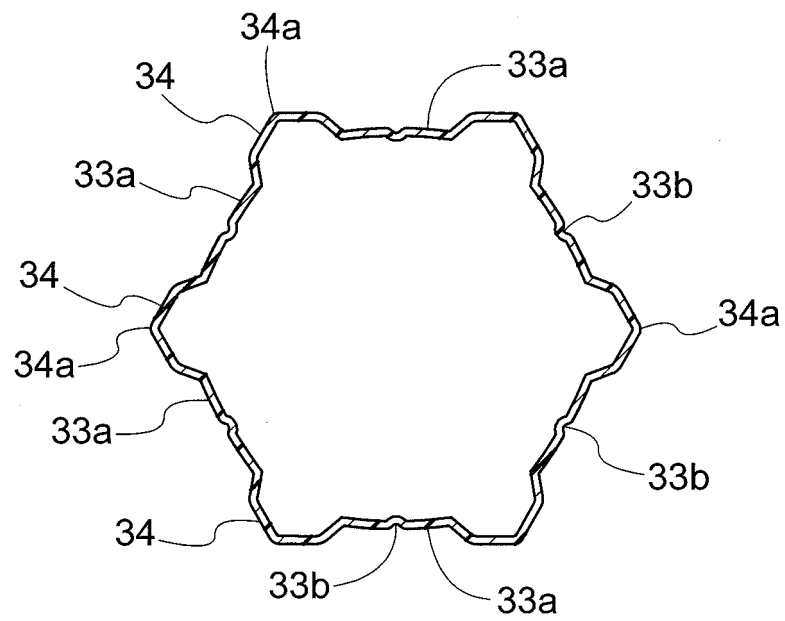


Fig.7

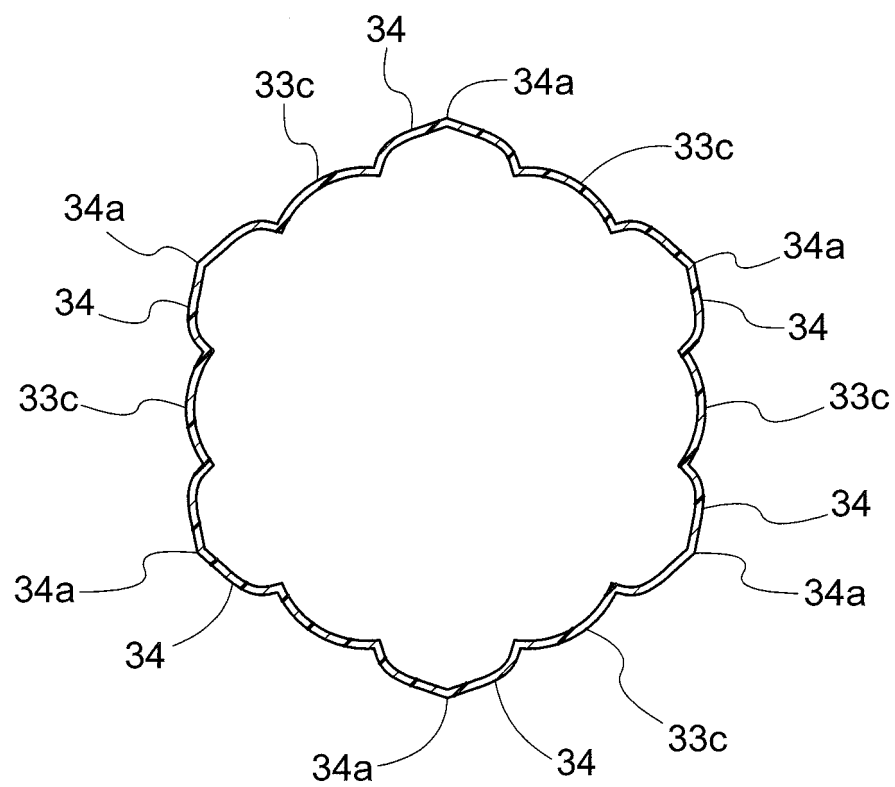


Fig.8

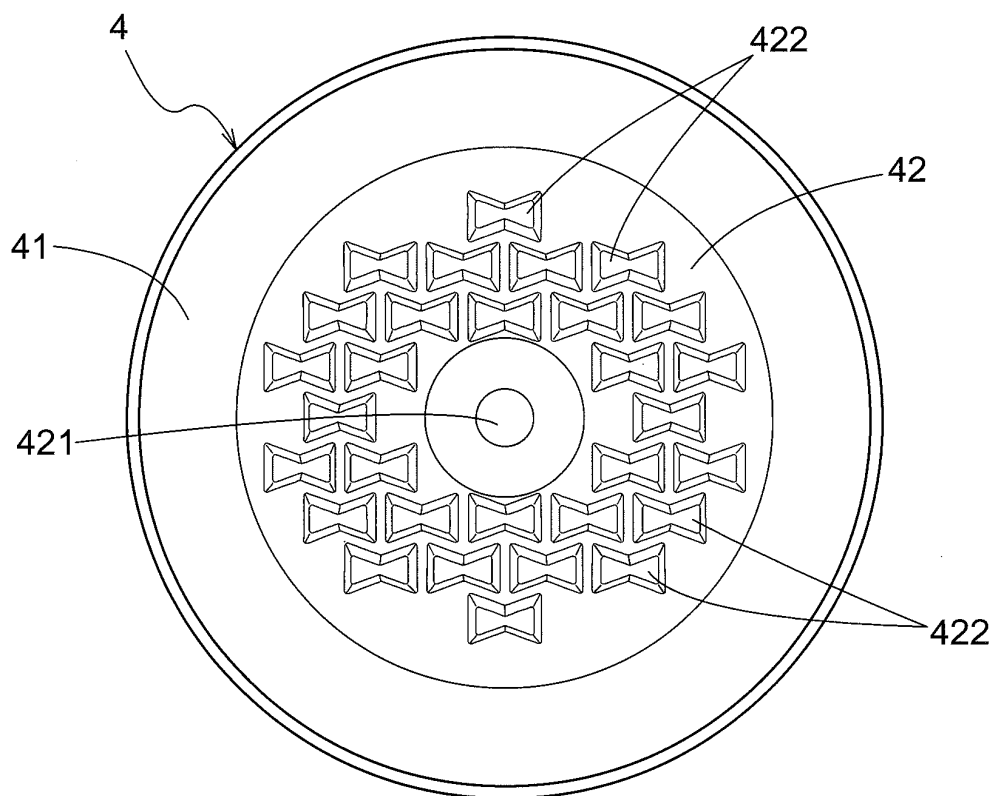
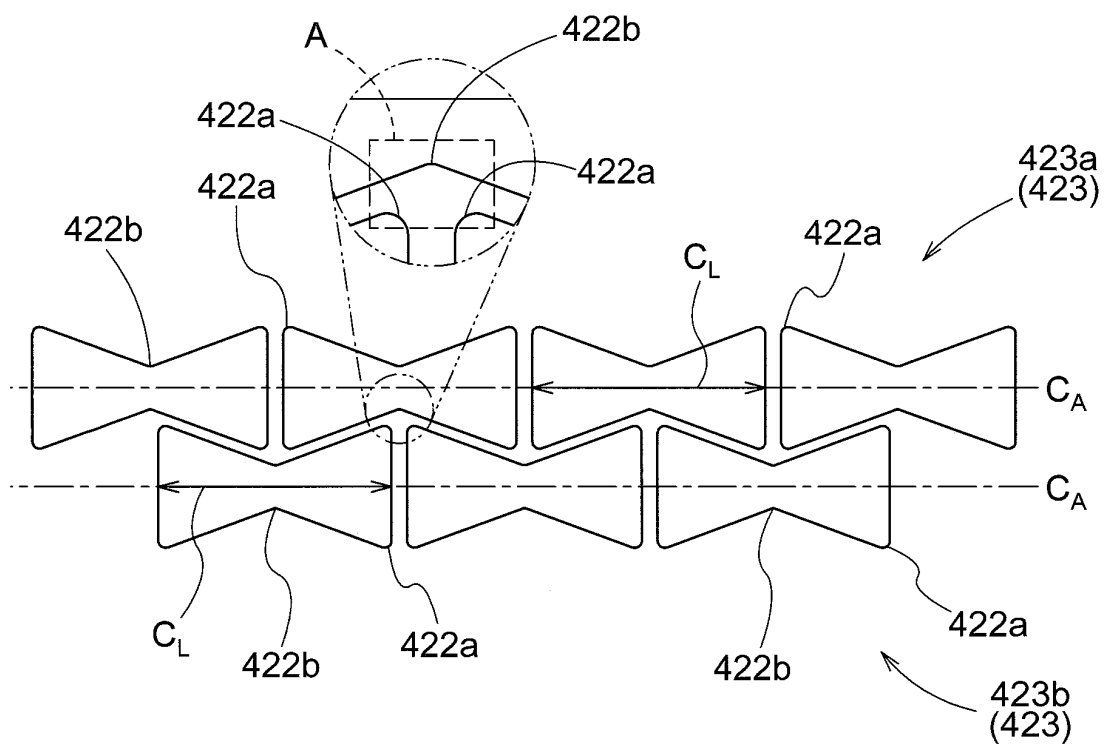


Fig.9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/001887

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. B65D1/02 (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

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 A	WO 2012/043362 A1 (YOSHINO KOGYOSHO CO., LTD.) 05 April 2012, paragraphs [0021], [0023], [0038]-[0039], fig. 2 & US 2013/0180998 A1, paragraphs [0031], [0034], [0061], [0067], fig. 2 & EP 2623427 A1 & KR 10-2014-0125279 A	1-3, 6-9 4-5
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 65850/1986 (Laid-open No. 177613/1987) (YOSHINO KOGYOSHO CO., LTD.) 11 November 1987, claims, problem to be solved by the invention, fig. 1-2 (Family: none)	1-3, 6-9 4-5



Further documents are listed in the continuation of Box C.



See patent family annex.

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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

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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

19 March 2019 (19.03.2019)

Date of mailing of the international search report

02 April 2019 (02.04.2019)

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/JP2019/001887

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	JP 2013-500909 A (AMCOR LIMITED) 10 January 2013, paragraph [0083], fig. 17 & US 2014/0061211 A1, paragraph [0095], fig. 17 & EP 1633640 B1 & KR 10-2008-0012904 A & CN 1822989 A	9 1-8
Y A	JP 7-112729 A (TOPPAN PRINTING CO., LTD.) 02 May 1995, paragraph [0007], fig. 1-2 (Family: none)	9 1-8
A	US 4732292 A (SCHMALBACH-LUBECA GMBH) 22 March 1988 (Family: none)	1-9
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 25889/1985 (Laid-open No. 144012/1986) (DAINIPPON INK AND CHEMICALS, INCORPORATED) 05 September 1986 (Family: none)	1-9
A	JP 2008-68898 A (TOYO SEIKAN CO., LTD.) 27 March 2008 (Family: none)	1-9

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 7112729 A [0005]
- JP 2012043362 A [0005]