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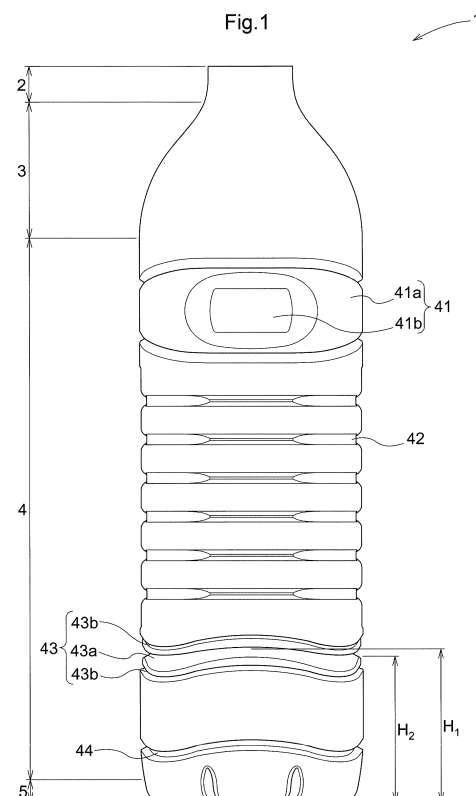
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(54) **PLASTIC BOTTLE**

(57) A plastic bottle includes: a body 4 including a cushion 43, the cushion 43 having a groove 43a extending entirely around the body 4, a first small recess 43b disposed above the groove 43a and extending entirely around the body 4, and a second small recess 43b disposed below the groove 43a and extending entirely around the body 4, the first and second small recesses 43b being shallower than the groove 43a, the cushion 43 being shaped to have a position in an up-down direction which position varies continuously.



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Description

FIELD

5 **[0001]** The present invention relates to plastic bottles.

BACKGROUND

10 **[0002]** Plastic bottles are in common use for distribution and sale of liquid products such as beverages. Efforts to save resources have been made by reducing the thickness of plastic bottles as compared to conventional levels and thereby reducing the amount of plastic material being used. In particular, various designs have been proposed to reduce the thickness and prevent a decrease in the mechanical strength at the same time.

15 **[0003]** Japanese Patent No. 6388467 (Patent Literature 1), for example, discloses a resin container including a body with a cushion. The resin container is configured such that the cushion is in an accordion form and allows elastic deformation of the resin container in the up-down direction. This allows the resin container to absorb a load in the up-down direction, and thereby prevents the resin container from buckling.

CITATION LIST

20 PATENT LITERATURE

[0004] Patent Literature 1: Japanese Patent No. 6388467 (U.S. Patent No. 1051363, specification)

BRIEF SUMMARY

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TECHNICAL PROBLEM

30 **[0005]** The technique of Patent Literature 1 strengthens a resin container against a load applied in the up-down direction, but fails to impart sufficient strength against a load applied in the lateral direction. Thus, while the resin container of Patent Literature 1 filled with a beverage product is being conveyed on a conveyor, for instance, the resin container may be shaken by a load applied in the conveyance direction (that is, the lateral direction of the resin container) and topple over.

35 **[0006]** Further, when two or more resin containers are packaged in a stretchable film, the technique of Patent Literature 1 may let those resin containers which are in direct contact with the film bend as a result of receiving a load caused by contraction of the film. Resin containers may be packaged as above when they are, for instance, distributed to retail stores or the like in the form of a so-called shrink package or loaded on a palette in a factory, a warehouse or the like.

[0007] Resin containers having an insufficient strength against a lateral load as above may decrease productivity during production or distribution of beverage products. These circumstances have led to a demand for a plastic bottle capable of withstanding both a load applied in the up-down direction and a load applied in the lateral direction.

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SOLUTION TO PROBLEM

45 **[0008]** A plastic bottle according to the present invention includes: a body including a cushion, the cushion having a groove extending entirely around the body, a first small recess disposed above the groove and extending entirely around the body, and a second small recess disposed below the groove and extending entirely around the body, the first and second small recesses being shallower than the groove, the cushion being shaped to have a position in an up-down direction which position varies continuously.

50 **[0009]** With the above configuration, the plastic bottle is capable of withstanding both a load applied in the up-down direction and a load applied in the lateral direction. Further, the cushion has a position in the up-down direction which position varies continuously, and thereby achieves a unique visual effect that may allow the appearance of the plastic bottle to give a particular impression.

[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.

55 **[0011]** A plastic bottle as a preferable embodiment of the present invention is configured such that the groove and each of the first and second small recesses are separated from each other by a boundary portion having a dimension in the up-down direction which dimension is smaller than a dimension of the groove in the up-down direction.

[0012] The above configuration facilitates the groove and the small recesses acting integrally as a spring, and thereby facilitates the load absorption.

[0013] A plastic bottle as a preferable embodiment of the present invention is configured such that the cushion is disposed at a portion of the body which portion has a substantially rectangular transverse cross-sectional shape.

[0014] The above configuration facilitates the load absorption by the cushion.

[0015] A plastic bottle as a preferable embodiment of the present invention is configured such that the cushion is in a shape of a wave including alternating upper and lower portions in the up-down direction and having vertices at respective corners of the body.

[0016] The above configuration facilitates the load absorption by the cushion.

[0017] A plastic bottle as a preferable embodiment of the present invention is configured such that the groove has a depth of 3 mm to 10 mm.

[0018] The above configuration facilitates the load absorption by the cushion.

[0019] A plastic bottle as a preferable embodiment of the present invention is configured such that the groove has a dimension of 3 mm to 10 mm in the up-down direction.

[0020] The above configuration facilitates the load absorption by the cushion.

[0021] 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

[0022]

FIG. 1 is a front view of a bottle as an embodiment.

FIG. 2 is a top view of a bottle as an embodiment.

FIG. 3 is a cross-sectional view of the bottle in FIG. 2 as taken along line III-III.

FIG. 4 is a front view of a bottle as Comparative Example 1.

FIG. 5 is a front view of a bottle as Comparative Example 2.

FIG. 6 is a diagram illustrating how a lateral load test was conducted.

DESCRIPTION OF EMBODIMENTS

[0023] The description below deals with a plastic bottle as an embodiment of the present invention with reference to drawings. The description below deals with, as an example plastic bottle according to the present invention, a plastic bottle 1 configured to contain a liquid product for distribution and sale (hereinafter referred to simply as "bottle 1").

[Configuration of Bottle]

[0024] The bottle 1 as the present embodiment is made of polyethylene terephthalate, and is a colorless, transparent container. The bottle 1 is produced from a polyethylene terephthalate preform by biaxially oriented blow molding. The bottle is not necessarily made of polyethylene terephthalate, and may alternatively be made of polyethylene or polypropylene, for example.

[0025] The bottle 1 as the present embodiment has a capacity of 2 L. The bottle 1 may, however, 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.

[0026] The bottle 1 is intended to be filled with a liquid product, examples of which include (i) beverages such as soft drinks (for example, carbonated drinks, fruit-based drinks, coffee beverages, tea-based drinks, mineral water, soy milk based drinks, vegetable-based drinks, sports drinks, and cocoa beverages), alcoholic beverages, and milk beverages, (ii) liquid foods such as soup, and (iii) liquid seasonings such as Worcester sauce and soy sauce.

[0027] The bottle 1 as the present embodiment includes a mouth 2, a shoulder 3, a body 4, and a bottom 5 (see Fig. 1). The description below, in referring to the up-down direction of the bottle 1, assumes that the bottle 1 is oriented with the bottom 5 in contact with the ground on which the bottle 1 is placed (that is, the bottle 1 is oriented as illustrated in Fig. 1). In other words, the mouth 2 is on the upper side of the bottle 1, whereas the bottom 5 is on the lower side of the bottle 1. Further, the lateral direction (or horizontal direction) of the bottle 1 is orthogonal to the up-down direction; in other words, it is the left-right direction in Fig. 1 or the direction orthogonal to the drawing.

[0028] The bottle 1 is substantially rectangular as viewed from above (see Fig. 2). This means that the bottle 1 has a substantially rectangular transverse cross-sectional shape at each of the shoulder 3, the body 4, and the bottom 5. The expression "substantially rectangular" indicates that the shape is not necessarily rectangular as technically defined in a mathematical sense and may be essentially rectangular with rounded corners and/or the like as of an industrial product.

[0029] The mouth 2 has an opening for entry of a liquid product to be charged into the bottle 1 and exit of the liquid product having been charged. The mouth 2 has an outer surface provided with an external thread engageable with a cap (not illustrated in the drawings). The shoulder 3 is that portion of the bottle 1 which gradually increases in size from

the mouth 2 to the body 4. The bottom 5 is, when the bottle 1 is placed on a surface such as a tabletop, in contact with that surface. The mouth 2, the shoulder 3, and the bottom 5 are similar in structure and function to those of a publicly known plastic bottle, and are not described in detail herein.

[0030] The bottle 1 as the present embodiment is configured such that the body 4 has a depression 41, a plurality of linear ribs 42, a cushion 43, and a wavy rib 44.

[0031] The depression 41 is in an upper portion of the body 4. The depression 41 has a two-stage depression structure including a first-stage section 41a receding inward of the bottle 1 and two second-stage sections 41b each receding further inward of the bottle 1 from the first-stage section 41a. The first-stage section 41a extends entirely around the body 4. The second-stage sections 41b are each on one of those two faces 4a of the body 4 which correspond to the long sides of the transverse cross-sectional shape. The user can catch one of the second-stage sections 41b with the thumb and the other second-stage section 41b with a finger such as the index finger or middle finger to hold the bottle 1 in a stable orientation. In this state, the palm is along that portion of the first-stage section 41a which is on a face 4b of the body 4, the face 4b corresponding to a short side of the transverse cross-sectional shape. As described above, the depression 41 helps the user to hold the bottle 1 stably.

[0032] The plurality of (for the present embodiment, six) linear ribs 42 are in a vertically central portion of the body 4. The linear ribs 42 each extend horizontally and entirely around the body 4. The linear ribs 42 reinforce the body 4.

[0033] The linear ribs 42 for the present embodiment each have a depth D_L of 2.5 mm and an up-down width W_L of 8 mm (see Fig. 3). The depth of a linear rib refers to how much the linear rib recedes inward of the bottle 1 relative to the outermost surface of the body 4. The up-down width of a linear rib refers to the dimension that the linear rib has on its open side along the outermost surface of the body 4.

[0034] The cushion 43 and the wavy rib 44 are in a lower portion of the body 4. The cushion 43 has (i) a groove 43a extending entirely around the body 4 and (ii) two small recesses 43b extending entirely around the body 4, one of which is above the groove 43a and the other of which is below the groove 43a. The groove 43a and the small recesses 43b are ribs in actuality although they are termed differently for discrimination. The cushion 43, which has a groove 43a and two small recesses 43b, may itself be regarded as a single rib.

[0035] The cushion 43 is shaped to have a position in the up-down direction which position varies continuously around the body 4. Specifically, the cushion 43 is in the shape of a wave around the body 4, the wave being convex downward at the corners 4c, which correspond to the respective vertices of the transverse cross-sectional shape of the body 4. In other words, the cushion 43 has a height H_1 above a height H_2 , where H_1 denotes the portions of the cushion 43 on the respective faces 4a and 4b, which correspond to the sides of the transverse cross-sectional shape of the body 4, and H_2 denotes the portions of the cushion 43 at the respective corners 4c, which correspond to the vertices of the transverse cross-sectional shape of the body 4 (see Figs. 1 to 3). The position of the cushion 43 in the up-down direction is represented by the position of a vertically central portion of the groove 43a in the up-down direction.

[0036] The groove 43a has a depth D_1 of 4.7 mm. The small recesses 43b each have a depth D_2 of 2 mm, which is smaller than the depth D_1 of the groove 43a (see Fig. 3). As described above, the cushion 43 has a relatively deep groove 43a and two relatively shallow small recesses 43b, one of which is above the groove 43a and the other of which is below the groove 43a. This allows the groove 43a and the small recesses 43b to act integrally as a spring, which allows the cushion 43 to, in response to an external force being applied to the bottle 1, move in such a manner as to absorb the external force and thereby prevent the bottle 1 as a whole from being greatly deformed by the external force. The cushion 43 being in the shape of a wave prevents deformation of the bottle 1 regardless of whether the external force is applied to the bottle 1 in the up-down direction or in the lateral direction.

[0037] The groove 43a and the small recesses 43b are separated from each other by a boundary portion that recedes inward from the outer surface of the body 4. This allows the groove 43a and the small recesses 43b to act integrally as a spring,

[0038] The cushion 43 as a whole has an up-down width W (a dimension in the up-down direction) of 16 mm. The groove 43a has an up-down width W_1 (a dimension in the up-down direction) of 7 mm. The small recesses 43b each have an up-down width W_2 of 3 mm (see Fig. 3). The up-down width W_1 of the groove 43a should, as in this example, preferably be not larger than 0.4 times the up-down width W of the cushion 43 as a whole. The up-down width W_2 of each small recess 43b is smaller than the up-down width W_1 of the groove 43a.

[0039] The boundary portion between the groove 43a and each small recess 43b has a dimension in the up-down direction (i.e. an up-down width) of 1.5 mm, which is smaller than the up-down width W_1 of the groove 43a. The groove 43a and the small recesses 43b are thus adjacent to each other with substantially no gap therebetween. This allows the groove 43a and the small recesses 43b to act integrally as a spring.

[0040] The wavy rib 44 is, similarly to the cushion 43, shaped to have a position in the up-down direction which position varies continuously around the body 4. The wavy rib 44 differs from the cushion 43 in that it is a single rib. The wavy rib 44 is similar to the cushion 43 in that the portions on the respective faces 4a and 4b are above the portions at the respective corners 4c.

Alternative 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 inconvenience.

[0042] The embodiment described above is an example bottle 1 having a substantially rectangular transverse cross-sectional shape at each of the shoulder 3, the body 4, and the bottom 5. The plastic bottle according to the present invention, however, does not necessarily have a particular transverse cross-sectional shape at each section; the transverse cross-sectional shape may be circular or polygonal, for example. The terms "circular" and "polygonal" refer to not only the shapes as technically defined in a mathematical sense, but also such shapes with additional deformation imparted for industrial application, as noted above about the expression "substantially rectangular". Further, the plastic bottle may have a transverse cross-sectional shape that varies according to the position in the up-down direction; for instance, the plastic bottle may have a circular transverse cross-sectional shape at an upper portion and a polygonal transverse cross-sectional shape at a lower portion. The portion of the body in which the cushion is disposed may also have any transverse cross-sectional shape, but should preferably have a substantially rectangular transverse cross-sectional shape.

[0043] The embodiment described above is an example including a cushion 43 having a position in the up-down direction which position varies continuously such that the portions on the respective faces 4a and 4b are above the portions at the respective corners 4c. The plastic bottle according to the present invention is, however, configured such that the cushion has any position in the up-down direction as long as the position varies continuously around the body. If the cushion is in the shape of a wave, that is, it includes alternating upper and lower portions in the up-down direction, the wave should preferably have vertices at the respective corners of the body to facilitate load absorption. The vertices may, in that case, be convex downward (as in the embodiment described above) or upward.

[0044] The embodiment described above is an example including a cushion 43 at a lower portion of the body 4. The plastic bottle according to the present invention is, however, configured such that the cushion may be at any position in the up-down direction. The cushion may thus be positioned in view of a factor only distantly related to the main function of the cushion (such as the appearance of the plastic bottle or how the linear ribs should be positioned for the plastic bottle as a whole to have a higher strength).

[0045] The embodiment described above is an example in which the groove 43a and the small recesses 43b are separated from each other by a boundary portion that recedes inward from the outer surface of the body 4. The plastic bottle according to the present invention may, however, be configured such that the groove 43a and the small recesses 43b are separated from each other by a boundary portion that is flush with the outer surface of the body 4. Further, the groove 43a, the small recesses 43b, and the boundary portion are not necessarily sized relative to one another as in the example above.

[0046] The plastic bottle according to the present invention is configured such that the groove and the small recesses may each have a constant or varying depth and width. The groove and the small recesses may each, in the case of having a varying depth, have a depth that varies in the form of a wave, for example. This applies to the width as well. Further, the groove and the small recesses may each have a depth and a width both of which vary in the shape of a wave.

[0047] It should be understood that with respect to other arrangements as well, the embodiments disclosed herein are illustrative in all respects and do not limit the scope of the present invention. Persons skilled in the art will readily understand that the present invention can be modified as appropriate without departing from the scope of the present invention. The present invention thus naturally covers in its scope any embodiment as modified without departing from the scope of the present invention.

Examples

[0048] The description below deals with the present invention in greater detail on the basis of Examples. The present invention is, however, not limited by the Examples below.

[Example]

[0049] The bottle 1 as the embodiment described above was used as an Example. The bottle 1 had a capacity of 2 L as mentioned above.

[Comparative Example 1]

[0050] Comparative Example 1 was a bottle 1A with a linear cushion 45 instead of the cushion 43 for the embodiment described above (see Fig. 4). The cushion 45 for Comparative Example 1 included a groove 45a and small recesses

45b each extending horizontally and entirely around the body 4. Comparative Example 1 thus differed from the Example on whether the position of the cushion in the up-down direction varied around the body. The bottle 1A as Comparative Example 1 also had a capacity of 2 L.

[Comparative Example 2]

[0051] Comparative Example 2 was a bottle 1B with an additional wavy rib 44 instead of the cushion 43 for the embodiment described above (see Fig. 5). The additional wavy rib 44 for Comparative Example 2 was configured similarly to the wavy rib 44 for the embodiment described above. The bottle 1B as Comparative Example 2, in other words, had two wavy ribs 44. Comparative Example 2 differed from the Example in that the former did not include a cushion. The bottle 1B as Comparative Example 2 also had a capacity of 2 L.

[Buckling Load Test]

[0052] The respective bottles of the Example and Comparative Examples were each filled with 2 L of water, placed to stand with the bottom 5 on the ground and subjected to a load in the up-down direction for a load-displacement measurement. The resulting load-displacement curve had a point at which the displacement stopped being proportional to the load (the point corresponding to the yield point in a load-displacement measurement for material evaluation). The bottles were each regarded as starting to buckle at the point, so that the load at the point was regarded as a buckling load. This test was conducted three times for each of the Example and Comparative Examples. The average of the respective measurements in the individual instances of the test was used as the test result. The results of the Example and Comparative Examples are shown in Table 1.

Table 1: Buckling Load Test

[0053]

[Table 1]

	Example	Comparative Example 1	Comparative Example 2
Buckling load [N]	641	644	481

[0054] Table 1 shows that Comparative Example 2, which did not include a cushion, had a low buckling load (that is, it easily buckled) as compared to the Example and Comparative Example 1, each of which did include a cushion. The results indicate that the respective bottles of the Example and Comparative Example 1, each of which included a cushion, did not easily buckle.

[Lateral Load Test]

[0055] The respective bottles of the Example and Comparative Example 1 were each filled with 2 L of water, laid with the upper and lower ends of the body 4 (specifically, a face 4a thereof) supported, and subjected to a downward load at a vertically central portion of the body 4 (see Fig. 6). The test used the device illustrated in Fig. 6, which included a push-pull gauge P movable in the up-down direction and a vernier caliper N with a jaw N1 movable in the up-down direction to follow the push-pull gauge P for determination of the amount of movement of the push-pull gauge P. The amount by which the push-pull gauge P moved (that is, the measurement of the vernier caliper N) by the time the load (that is, the measurement of the push-pull gauge P) reached 50 N was regarded as the amount of deformation of the bottle. This test was conducted five times for each of the Example and Comparative Example 1. The average of the respective measurements in the individual instances of the test was used as the test result. The results of the Example and Comparative Example 1 are shown in Table 2.

Table 2: Lateral Load Test

[0056]

[Table 2]

		Example	Comparative Example 1
Deformation amount	[mm]	6.92	7.68

[0057] Table 2 shows that Comparative Example 1, which included a horizontal cushion, was easily deformed by a lateral load as compared to the Example, which included a wavy cushion. The results indicate that a cushion whose position in the up-down direction varies around the body as of the Example reinforces a bottle against both a vertical load and a lateral load.

INDUSTRIAL APPLICABILITY

[0058] The present invention is applicable to, for example, a container configured to be filled with a liquid product such as a beverage.

REFERENCE SIGNS LIST

[0059]

- 1 Plastic bottle
- 2 Mouth
- 3 Shoulder
- 4 Body
- 4a Face (long side)
- 4b Face (short side)
- 4c Corner
- 41 Depression
- 41a First-stage section
- 41b Second-stage section
- 42 Linear rib
- 43 Cushion
- 43a Groove
- 43b Small recess
- 44 Wavy rib
- 45 Cushion (Comparative Example 1)
- 45a Groove (Comparative Example 1)
- 45b Small recess (Comparative Example 1)
- 5 Bottom
- N Vernier caliper
- P Push-pull gauge

Claims

1. A plastic bottle, comprising:

a body including a cushion,
the cushion having a groove extending entirely around the body, a first small recess disposed above the groove and extending entirely around the body, and a second small recess disposed below the groove and extending entirely around the body, the first and second small recesses being shallower than the groove,
the cushion being shaped to have a position in an up-down direction which position varies continuously.

2. The plastic bottle according to claim 1, wherein

the groove and each of the first and second small recesses are separated from each other by a boundary portion having a dimension in the up-down direction which dimension is smaller than a dimension of the groove in the up-down direction.

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3. The plastic bottle according to claim 1 or 2, wherein the cushion is disposed at a portion of the body which portion has a substantially rectangular transverse cross-sectional shape.
- 5 4. The plastic bottle according to claim 3, wherein the cushion is in a shape of a wave including alternating upper and lower portions in the up-down direction and having vertices at respective corners of the body.
- 10 5. The plastic bottle according to any one of claims 1 to 4, wherein the groove has a depth of 3 mm to 10 mm.
6. The plastic bottle according to any one of claims 1 to 5, wherein the groove has a dimension of 3 mm to 10 mm in the up-down direction.

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Fig.1

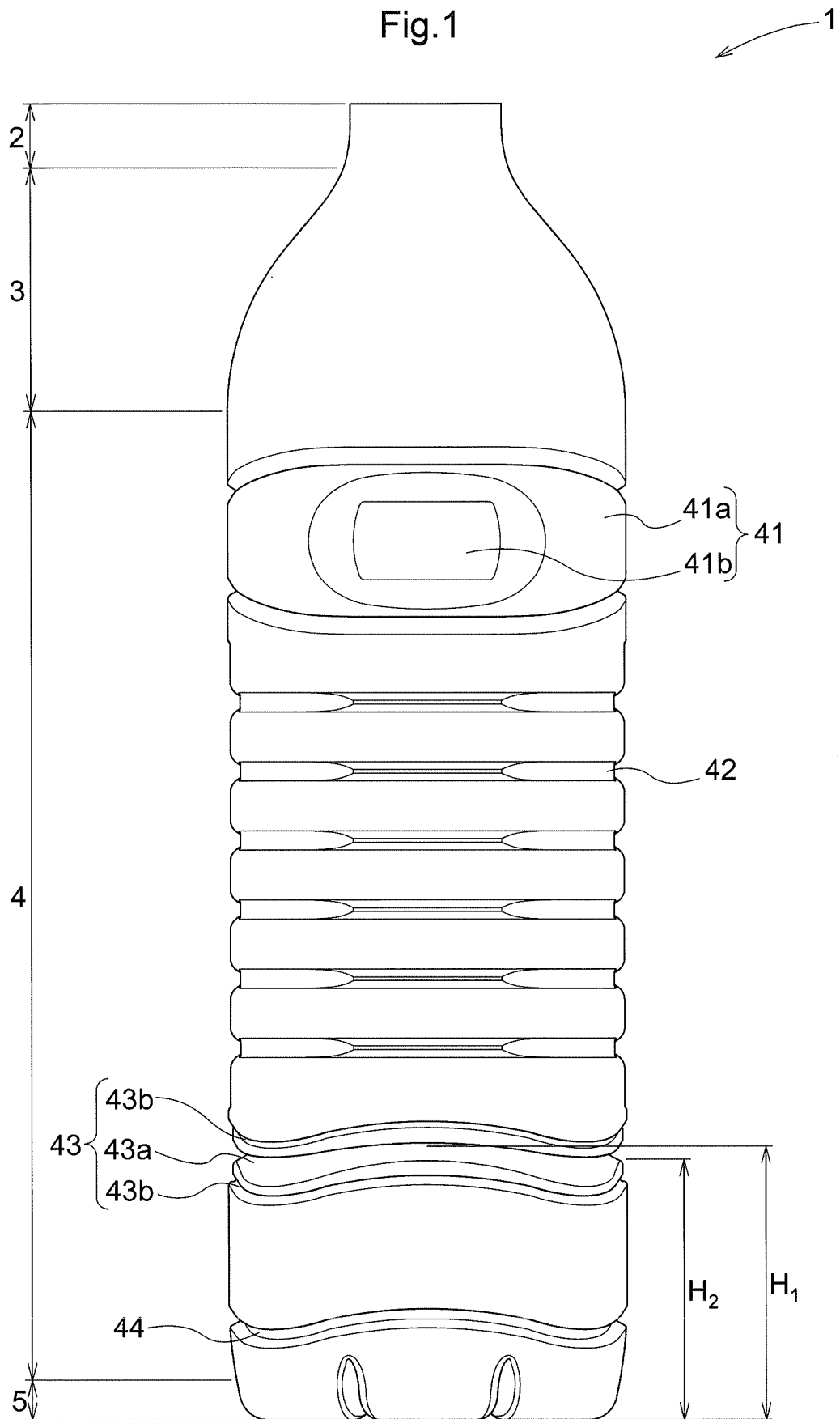


Fig.2

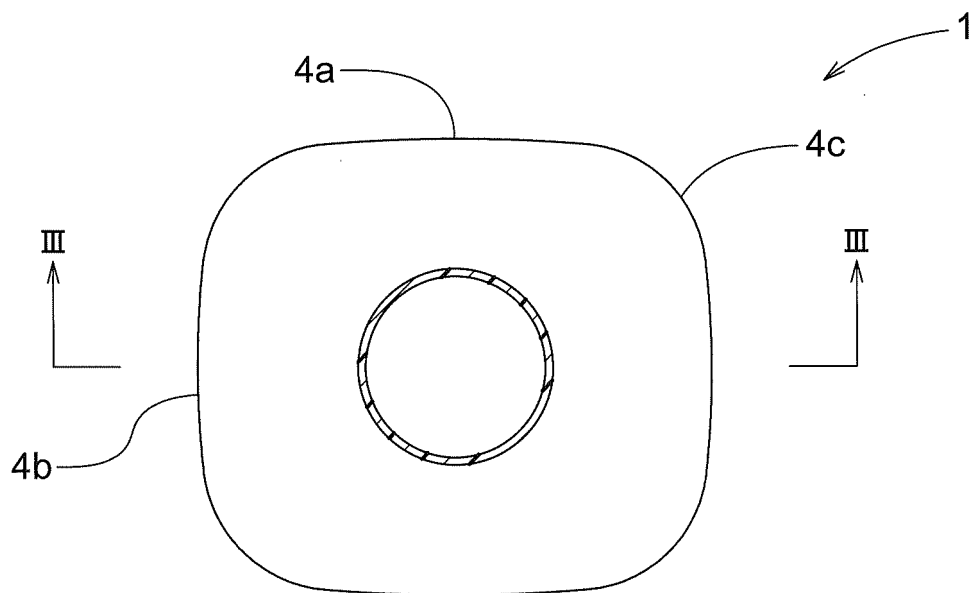


Fig.3

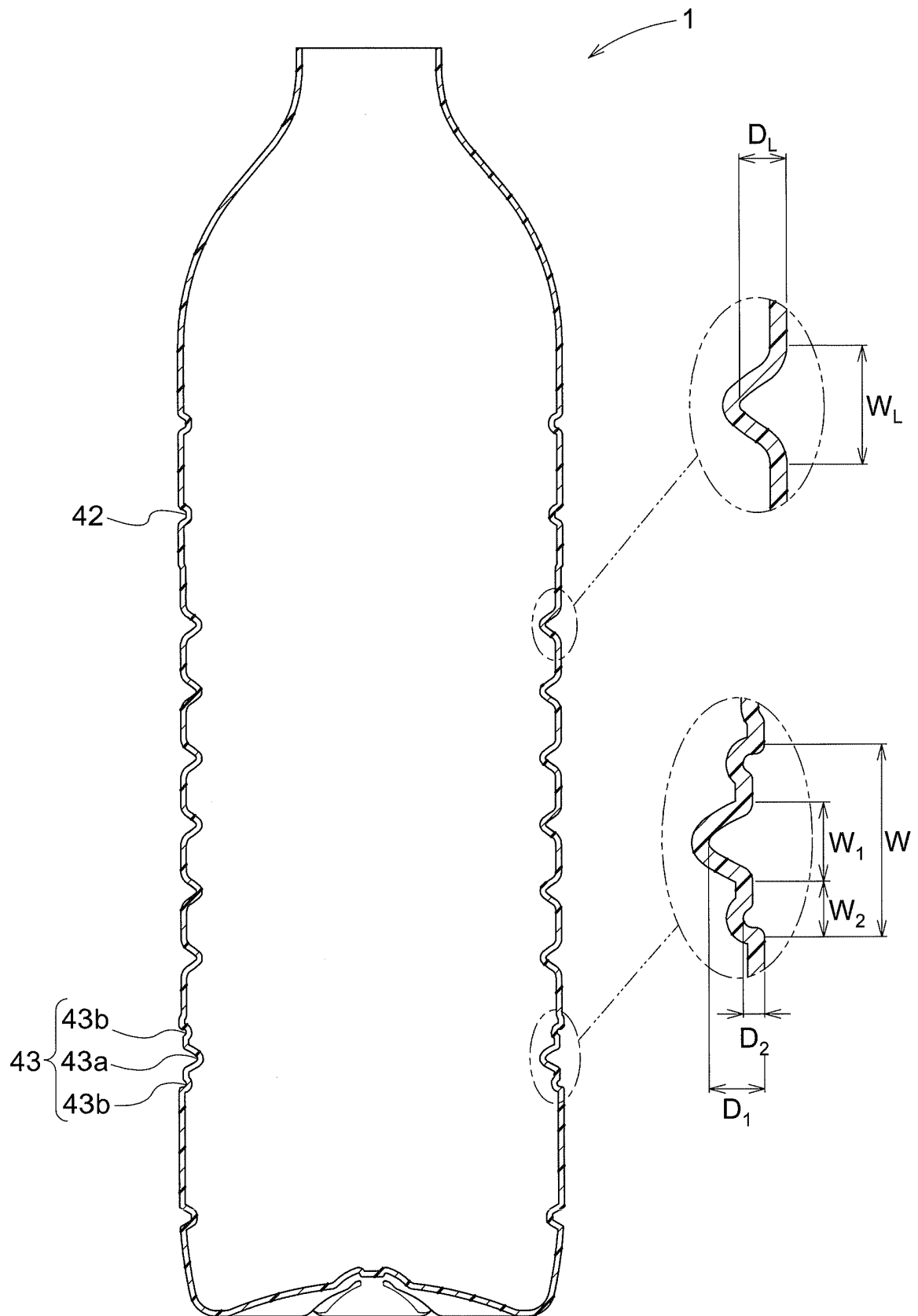


Fig.4

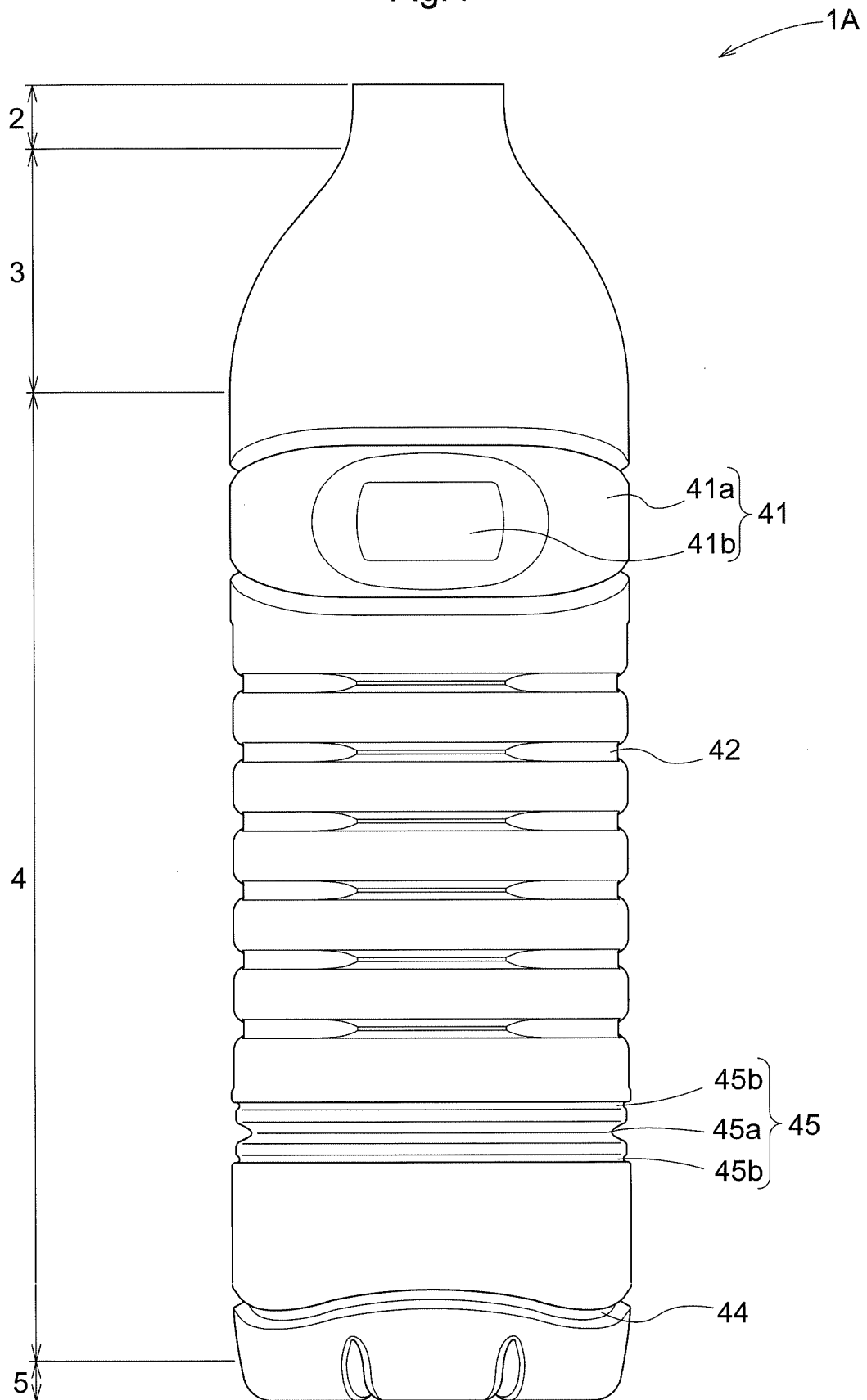


Fig.5

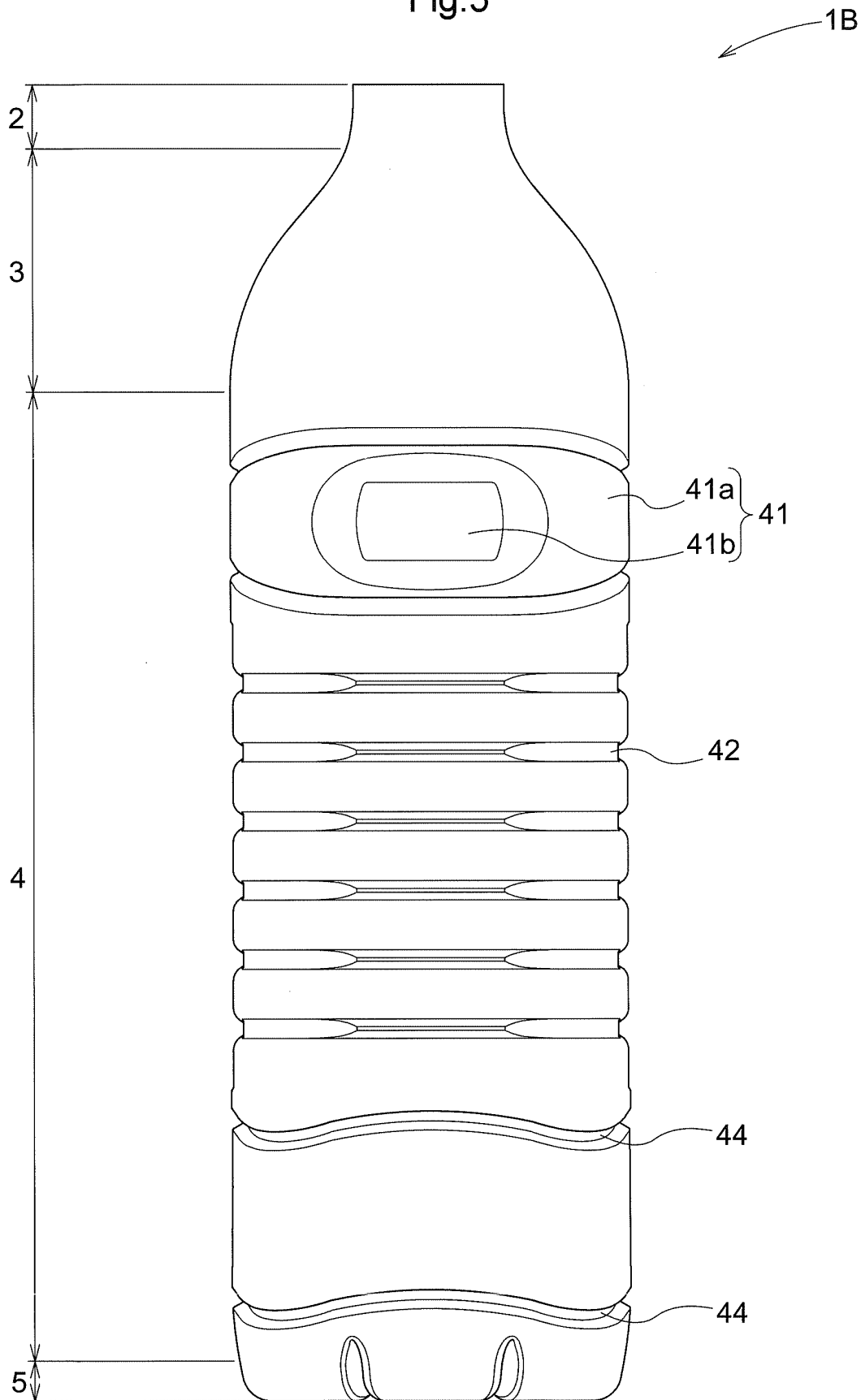
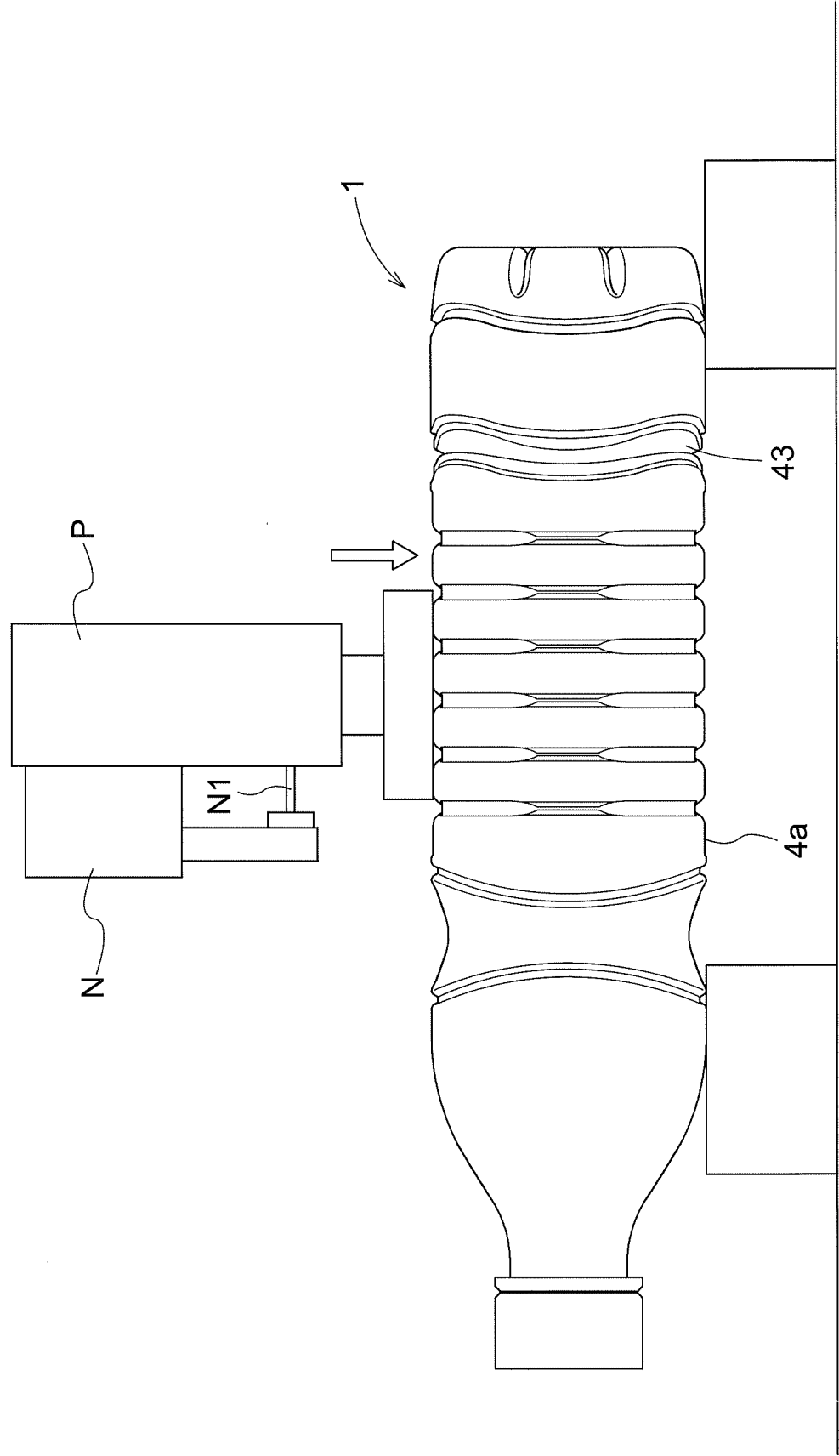


Fig.6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/007946

A. CLASSIFICATION OF SUBJECT MATTER

B65D 1/44(2006.01)i; **B65D 1/02**(2006.01)i
FI: B65D1/44; B65D1/02 221

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)

B65D1/44; 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 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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 2017-105546 A (SUNTORY BEVERAGE & FOOD LTD.) 15 June 2017 (2017-06-15) claims 1, 4, paragraphs [0042]-[0047], fig. 1-4, 8	1-6
Y	JP 2011-116428 A (KIRIN BREWERY CO., LTD.) 16 June 2011 (2011-06-16) claims, paragraphs [0014], [0032]-[0042], fig. 1-13	1-6
Y	JP 2015-127211 A (SUNTORY BEVERAGE & FOOD LTD.) 09 July 2015 (2015-07-09) claim 3, paragraphs [0013], [0038], [0042], fig. 4	1-6
A	JP 2010-76772 A (THE COCA-COLA CO.) 08 April 2010 (2010-04-08)	1-6
A	US 2009/0166314 A1 (THE COCA-COLA CO.) 02 July 2009 (2009-07-02)	1-6

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

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"A" document defining the general state of the art which is not considered to be of particular relevance	"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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Date of the actual completion of the international search

14 March 2022

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Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2022/007946

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JP	2011-116428	A	16 June 2011	(Family: none)	
JP	2015-127211	A	09 July 2015	(Family: none)	
JP	2010-76772	A	08 April 2010	(Family: none)	
US	2009/0166314	A1	02 July 2009	(Family: none)	

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REFERENCES CITED IN THE DESCRIPTION

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