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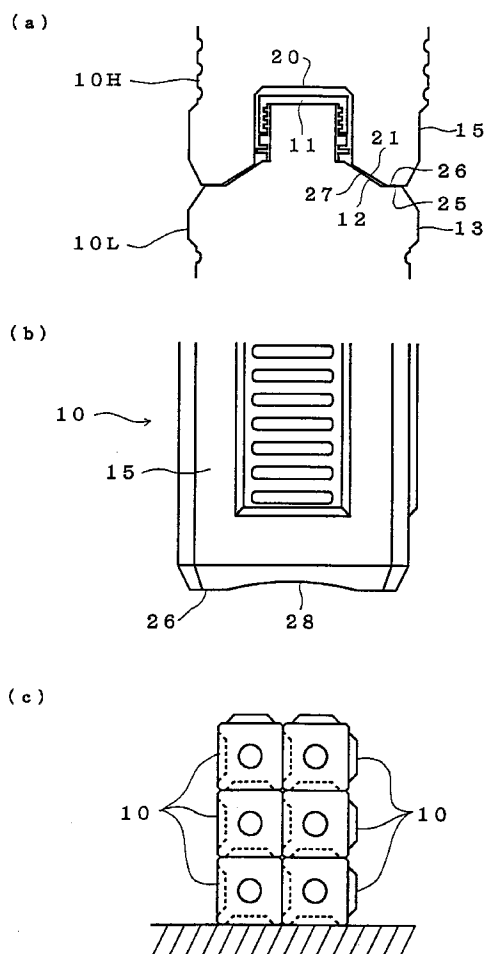
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(54) PLASTIC CONTAINER FOR LIQUIDS

(57) Horizontal surfaces (25) are provided around at least four apexes of an upper rectangular portion of a substantially rectangular prismatic container body. A lower portion of the container body is provided with flat contact surfaces (26), which contact such horizontal surfaces around at least four apexes mentioned above, when plastic containers (10) are piled up, and also a recess (20) capable of holding an pouring port (11), which is provided at a top portion of a lower container, and a cap fitted herearound with the pouring port and cap not contacting the inner surface of the recess (20). Since a load of an upper container (10H) (and a liquid held therein) is applied onto corner portions only of the rectangular upper portion of a lower container (10L), the lower container (10L) can bear loads of a plurality of containers without being deformed and buckled.

Fig. 6



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Description

[TECHNICAL FIELD]

The present invention relates to a plastic bottle for containing mineral water, juice, etc.

[BACKGROUND ART]

Taking account of the efficiency in transporting and storing, it is desirable that bottles can be stored in a vertical pile. On the other hand, a plastic bottle itself is not usually allowed to have sufficient strength because it is desired to be as light as possible. Herein exists a problem that, when a number of conventional bottles are piled up, the lower bottles may be deformed. For example, Japanese Unexamined Utility Model Application No.S58-59716 shows an example of a bottle that can be piled up vertically, where "rigid or quasi-rigid bottles" must be used regarding the deformation of the lower bottles.

Besides being piled up vertically, these bottles are often aligned laterally on the shop shelves. Nothing has been considered to conventional bottles in this respect, that is, conventional bottles are independent of each other in the lateral direction, so that they are unstable in that direction because they are hard to be banded or combined together (the characteristic of being banded and combined well is called "bandability and combinability" hereinafter in this description). The same problem also arises when the bottles are laid down and piled up.

The present invention is accomplished for solving the above described problems, the first object of which is to provide, based on the knowledge of structural mechanics, a bottle that is designed to prevent the lower bottle from buckling or deforming even under the weight of several filled bottles put thereon when they are piled up vertically. The second object of the present invention is to make a bottle capable of being aligned or built up in a stable state by improving the bandability and combinability of the bottles contacting at the side faces.

[DISCLOSURE OF THE INVENTION]

The above described first object can be accomplished by a plastic bottle for containing liquid comprising:

- a) a body portion shaped a substantially rectangular prism;
- b) a top portion formed at the top of the body portion, having a horizontal plane at least around each of the four upper vertexes of the substantially rectangular prism and having a mouth for pouring liquid into and out of the bottle; and
- c) a bottom portion formed at the bottom of the body portion, having a contact plane for contacting, when the plastic bottles are piled up vertically, the horizontal plane at around each of the four vertexes and

having a cavity for admitting the mouth and a cap put thereon without contacting them.

By shaping cross section of the body portion substantially square, it will be more convenient because higher degree of freedom is obtained in aligning the bottles horizontally.

When the plastic bottles of the present invention are piled up vertically, the mouth and the cap of the lower bottle are wholly admitted in the cavity formed at the bottom of the upper bottle, so that the storage efficiency is very high in case a number of the present bottles are contained in a large transport box. Furthermore, in that case, the weight of the upper bottle is sustained by the lower bottle solely at the four vertexes of the substantially rectangular prism because the cavity and the cap do not contact with each other, so that a number of bottles can be piled up vertically in a stable state without causing deformation or buckling of lower bottles. The reason is explained as follows.

As shown in Fig. 7(a), one of the possible ideas to prevent a displacement between the two piled-up plastic bottles B_h and B_l is to make the two bottles contact at the top of the cap P_a , at the side of the cap P_b and at the shoulder of the body portion P_c , where the weight of the upper bottle B_h (and the liquid contained therein) is sustained mainly by the top of the cap P_a which is normally strong. Since, however, the sustaining base area is very small in this case, the center of gravity of the upper bottle B_h easily comes out of the base area and the upper bottle B_h falls down even with a slight displacement thereof. Furthermore, when the bottles are piled up vertically in multitude, the shoulder S_{ld} (including the part of the shoulder that is not contacting) of the lowest bottle may buckle and the upper bottle also falls down. When the plastic bottles of the present invention are piled up, on the other hand, the contact planes formed at the bottom of the upper plastic bottle contact the horizontal planes formed in the upper portion of the lower plastic bottle. The cavity formed at the bottom of the upper plastic bottle does not contact the mouth and the cap put thereon of the lower plastic bottle, therefore the weight of the upper plastic bottle (and the liquid contained therein) is not exerted on the mouth of the lower plastic bottle, but is mainly exerted on the upper four corners of the lower plastic bottle. Fig. 7(b) illustrates that the diagonal D_R of the rectangle R and the diagonal D_S of the square S are longer than the diameter D_C of the circle C when the rectangle R , the square S and the circle C have the same area. This means that the plastic bottle of the present invention has a longer legspan for sustaining the weight of the plastic bottle (and the liquid contained therein) than that of a circular cylindrical plastic bottle with the same height and the same cross-sectional area (i.e. with the same volume). Therefore, when being piled up, the plastic bottles do not buckle and can be piled up in multitude in a stable state, as shown in the frame diagram of Fig. 7(d).

The periphery of the mouth of a plastic bottle needs to be inclined to let out all the liquid contained therein completely. When two bottles are piled up contacting at this inclined surface, the weight W of the upper bottle B_u (and the liquid contained therein) exerts a horizontal component force C_m and a vertical component force S_h on the wall of the lower plastic bottle B_l , as shown in Fig. 7(c). The wall members of a bottle made of plastic, such as PET (PolyEthylene Terephthalate), generally have sufficient strength against compression and tension due to horizontal force, while they are weak against bending moment or shear due to vertical force, and even a comparatively small load (i.e. when a small number of bottles are piled up) can cause a deformation of the wall of the bottle B_l under the loading state as shown in Fig. 7(c), so that the upper plastic bottle B_u leans. Even though the leaning angle of one bottle may be small, the deformation can be magnified when the bottles are piled up in multitude. Since, on the contrary, the contact part of the upper and the lower plastic bottles of the present invention is flatly formed, the weight of the upper plastic bottle (and the liquid contained therein) is not concentrated on only a small part of the lower bottle. Thus the lower plastic bottle hardly deforms. Furthermore, since the loading points on the lower bottle are located at the vertexes of the rectangle (or the square) which are the most advantageous points in respect of the strength and stability, the weight of the upper bottle is sustained by the beams (edges) in the beam structure of the substantially rectangular prism of the lower bottle, as shown in Fig. 7(d). Therefore, the lower bottle can sustain the weight without deforming even when a number of filled bottles are piled up thereon. In the above description, maximum effect is obtained in case that the cross section is square, but sufficient effect can also be obtained with rectangular cross section if the rectangle is not far from a square.

The following is the explanation of the present invention with respect to the second object, i.e., the bandability and the combinability of the bottles contacting at the side faces. The object can be accomplished by forming elevations on adjoining two side faces and depressions corresponding to the elevations on the other adjoining two side faces of the four side faces of the body portion. In this case, the horizontal cross section needs to be substantially square.

When a plurality of plastic bottles are placed on a shop shelf, the shop clerk can align the bottles neatly without difficulty because the mutual position of the neighboring bottles are fixed by fitting the elevation and the depression of the neighboring bottles. Since the elevations are formed on adjoining two side faces, all the bottles are aligned with their direction being the same when they are aligned two-dimensionally, which facilitates automatic aligning. If the elevations are formed on opposing two side faces and the depressions are formed on the other opposing two side faces, on the contrary, directions of the bottles must differ alternately by 90° .

In one of the preferable cases, a constriction is formed in the body portion dividing the body portion into

the upper body portion and the lower body portion, and the elevations and the depressions on the adjoining faces are formed at least in one of the upper body portion and the lower body portion.

By forming a constriction, two plastic bottles can be bundled into a unit by fitting a band in the constriction. Since the cross section of the unit is a rectangle with the side ratio of 2:1, the units can be used to build a variety of structures just like dominos or toy blocks.

The plastic bottles of the present invention can be used for toy blocks, as well as for liquid transportation, because they are easily combined together. It is further possible to use them as gardening blocks or weight blocks by filling them with sand or water.

[BEST MODE FOR CARRYING OUT THE INVENTION]

The first embodiment of the present invention is shown from Fig. 1 to Fig. 3. Fig. 1(a) is a front view of a bottle of the present embodiment (a rear view is the mirror image thereof), and (b) is a right side view (a left side view is the mirror image thereof). Fig. 2(a) is a top view, (b) is a cross-sectional view as seen on the line A-A' of Fig. 1, and (c) is a bottom view. Fig. 3(a) is a cut end view on the line B-B' of Fig. 2(a), (b) is a cut end view on the line C-C' of Fig. 3(a), and (c) is a cut end view on the line D-D' of Fig. 3(a). As shown in these drawings, the bottle 10 of the present embodiment has a substantially square cross section. Separated by a constriction 14 at the center, the upper portion 13 has depressions 16 on all of its four side faces, and the lower portion 15 has elevations 17 on adjoining two side faces and depressions 18 on the other adjoining two side faces.

Synthetic resin with a good workability (such as PET) is preferred as the material of the bottle 10. Further, transparency is preferred when the bottle is used to contain mineral water, juice, etc.

Fig. 4 shows a cut end view of four bottles piled up laterally and vertically cut by a vertical center plane. As shown by the drawing, the bottles 10 of the present embodiment have a very high storage efficiency. When the bottles 10 of the present embodiment are contained in a large transport box, the storage efficiency is improved by 30% compared to conventional cylindrical bottles having no cavity at the bottom.

Fig. 6(a) illustrates the detail loading condition of two bottles 10 of the present embodiment piled up vertically. As shown in this diagram, the upper bottle 10H and the lower bottle 10L of the present embodiment contact neither at the cap 11 nor at the inclined surface 12, and a small gap 27 exists between the two bottles. Therefore, the weight of the upper bottle 10H is sustained by the four sides of the cross-sectional square of the upper portion 13 and the four sides of the lower portion 15, where the two bottles 10H and 10L contact. Since, however, each side is relatively weaker at the center than near the corners, it is the corners of the square that mainly sustain the weight of the upper bottle 10H. In the present embodiment, both the upper portion 13 and the lower portion

15 have chamfers 22 at their corners, from which it results that they have a sufficient strength against vertical loading, and the lower bottle 10 can sustain weight without deforming even when a number of bottles 10 are piled up thereon. In Fig. 6(a), the numeral 25 denotes a loading plane formed at a corner of the lower bottle 10L, and the numeral 26 denotes a contact plane of the upper bottle 10H. A conventional bottle as shown in Fig. 7(a) which contacts the upper bottle at its shoulder can sustain a weight of about 1.5 to 10kgf at most, while the bottle 10 of the present embodiment can sustain a weight up to 30kgf.

By designing the gap 27 very small, displacement of upper and lower bottles 10H and 10L can be minimized when they are piled up. It is also advantageous of course because the vertical storage efficiency is maximized.

In one of preferable features, the bottom square of the lower portion 15 have their sides slightly arched at the center 28 to prevent the upper and lower bottles from contacting there, whereby the corner loading is assured.

Though the above description is concentrated on the bottle with a square cross section, the effects of the present invention can be obtained analogously in case of one having a rectangular cross section.

Other features of the present invention can be summarized as follows. In a plastic bottle including:

- a) an upper slope portion formed in the upper part of the body portion and tapering off upwards; and
- b) a cap portion provided at the top of the upper slope portion, the bottle is characterized by that:
- c) a cavity is formed at the bottom of the body portion for admitting the cap portion and the upper slope portion without contacting them;
- d) elevations are formed on adjoining two side faces of the body portion; and
- e) depressions are formed on the other adjoining two side faces of the body portion corresponding to the elevations.

The effects are as follows. The high vertical storage efficiency is already described. Horizontal storage efficiency is also maximized because the elevations 17 formed on two side faces of the body portion fit into the depressions 18 formed on the other two side faces. In aligning several bottles (filled with liquid in trade such as mineral water or juice) on a shop shelf, the elevation 17 and the depression 18 fit and does not allow displacement between neighboring bottles, so that they can be aligned neatly without effort of the shop clerk. Conventional orthorhombic bottles have almost flat side faces, so that it is troublesome to align them neatly. When, furthermore, as shown in Fig. 6(c), the bottles 10 are laid down and piled up laterally and vertically, the piled bottles are more firmly fixed by the fitting of the elevation 17 and the depression 18, and no fall down is expected.

In the bottle of the present embodiment, the body portion is divided by a constriction 14 into the upper portion 13 and the lower portion 15, and the upper portion

13 has depressions 16 on all of its four side faces, which helps easy holding of the bottle 10. Another design is of course possible in which the lower portion 15 has depressions on all of its four side faces while the upper portion 13 has elevations on two side faces and depressions on two side faces. The constriction 14 itself can be used for bundling the bottles 10 with a band or the like after the bottles are aligned laterally.

Two bottles of the present embodiment can be handled as a unit 80 by bundling them with a plastic band 81 or the like fit in the constriction 14 and with the elevation 17 and the depression 18 fitting together, as shown in Fig. 8. Since the horizontal cross section of this unit 80 is shaped rectangle with the ratio of [long side]:[short side] = 2:1, the units can be used to build up any three dimensional structures freely just like dominos or toy blocks. Fig. 9 and Fig. 10 show two examples.

The bottle can be held securely because a number of horizontal ridges or ditches 19 are formed on the surface of the elevation 17 and the depression 16 and 18 so that it is prevented from slipping off the hand when held. These ridges or ditches 19 also help preventing the bottles from displacing from each other when the bottles 10 are laterally packed or when the bottles 10 are laid down and piled up. In the present bottle 10, in detail description, ridges 19 are formed on the depressions 16 and 18, and ditches 19 are formed on the elevations 17 (Fig. 3).

The cross section of the present bottle is made substantially square, so that the storage efficiency when contained in a large transport box generally increases, and an automatic packing is facilitated.

Since the elevations are formed on adjoining two side faces, all the bottles are aligned with their direction being the same when they are aligned two-dimensionally, which facilitates automatic packing of the bottles in large transport boxes. If the elevations are formed on opposing two side faces and the depressions are formed on the other opposing two side faces, directions of the bottles must differ alternately by 90°. Furthermore, as described above, piling up of the laid bottles (Fig. 6(c)) is also facilitated.

It is possible to design the bottle to have elevations on two opposing side faces and depressions on the other two opposing side faces, as shown in Fig. 5, if a special display effect is aimed where the labels appear alternately, or if easy bottle holding is regarded most. However, the above described facilities in displaying and piling work may be sacrificed a little thereby.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 (a) A front view, and (b) a right side view, of the bottle in one of the embodiments of the present invention.

Fig. 2 (a) A top view, (b) a cross-sectional view seen on the line A-A' of Fig. 1 and (c) a bottom view, of the bottle of the embodiment.

Fig. 3 (a) A cut end view on the line B-B' of Fig. 2(a), (b) a cut end view on the line C-C' of Fig. 3(a) and (c) a cut end view on the line D-D' of Fig. 3(a).

Fig. 4 A cut end view on the vertical center plane of the bottles of the embodiment in a laterally and vertically piled-up state. 5

Fig. 5 (a) A cut end view on the vertical center plane, (b) a cut end view of the upper portion and (c) a cut end view of the lower portion, in another embodiment of the present invention. 10

Fig. 6 (a) A detail view of a vertical cross section of the bottles according to the present invention being piled up, (b) a side view showing a modification of the bottom, and (c) a front view of the bottles in the state of being laid down and piled up. 15

Fig. 7 Figures illustrating the effects of the present invention.

Fig. 8 A side view of a unit composed of two plastic bottles of the embodiment.

Fig. 9 A plan view of a first example of a build-up structure of the above unit. 20

Fig. 10 A plan view of a second example of a build-up structure of the above unit.

[NUMERALS OF THE DRAWINGS] 25

10 Bottle	
11 Cap	
12 Upper slope portion	
13 Upper body portion	30
14 Constriction	
15 Lower body portion	
16 Depression of the upper body portion	
17 Elevation of the lower body portion	
18 Cavity of the lower body portion	35
19 Ridges and ditches for preventing slip	
20 Cap admitting part	
21 Inclined plane at the bottom	
22 Chamfer at the corner	
25 Plane on top of the corner	40
26 Plane at the bottom	
27 Gap between the upper and lower bottles	
28 Arch at the center of a bottom side	
80 Unit of two bottles fixed together	
81 Plastic band	45

Claims

1. A plastic bottle for containing liquid comprising: 50

- a) a body portion having a shape of a substantially rectangular prism;
- b) a top portion formed at the top of the body portion comprising: a horizontal plane formed at least around each of four upper vertexes of the substantially rectangular prism, and a mouth for pouring liquid into and out of the bottle; and 55
- c) a bottom portion formed at the bottom of the body portion comprising: a contact plane for

contacting the horizontal plane at least around each of the four upper vertexes when a plurality of the plastic bottles are piled up vertically, and a cavity that can admit the mouth and a cap put thereon without contacting them.

- 2. A plastic bottle according to claim 1, wherein the horizontal cross section of the body portion is shaped square.
- 3. A plastic bottle according to claim 2, wherein the bottle has elevations on adjoining two side faces and depressions corresponding to the elevations on other adjoining two side faces of four side faces of the body portion.
- 4. A plastic bottle according to claim 3, wherein the body portion is divided by a constriction into an upper body portion and a lower body portion, and the elevations are formed on adjoining two side faces and the depressions are formed on the other adjoining two side faces of at least one of the upper body portion and the lower body portion.

Fig. 1

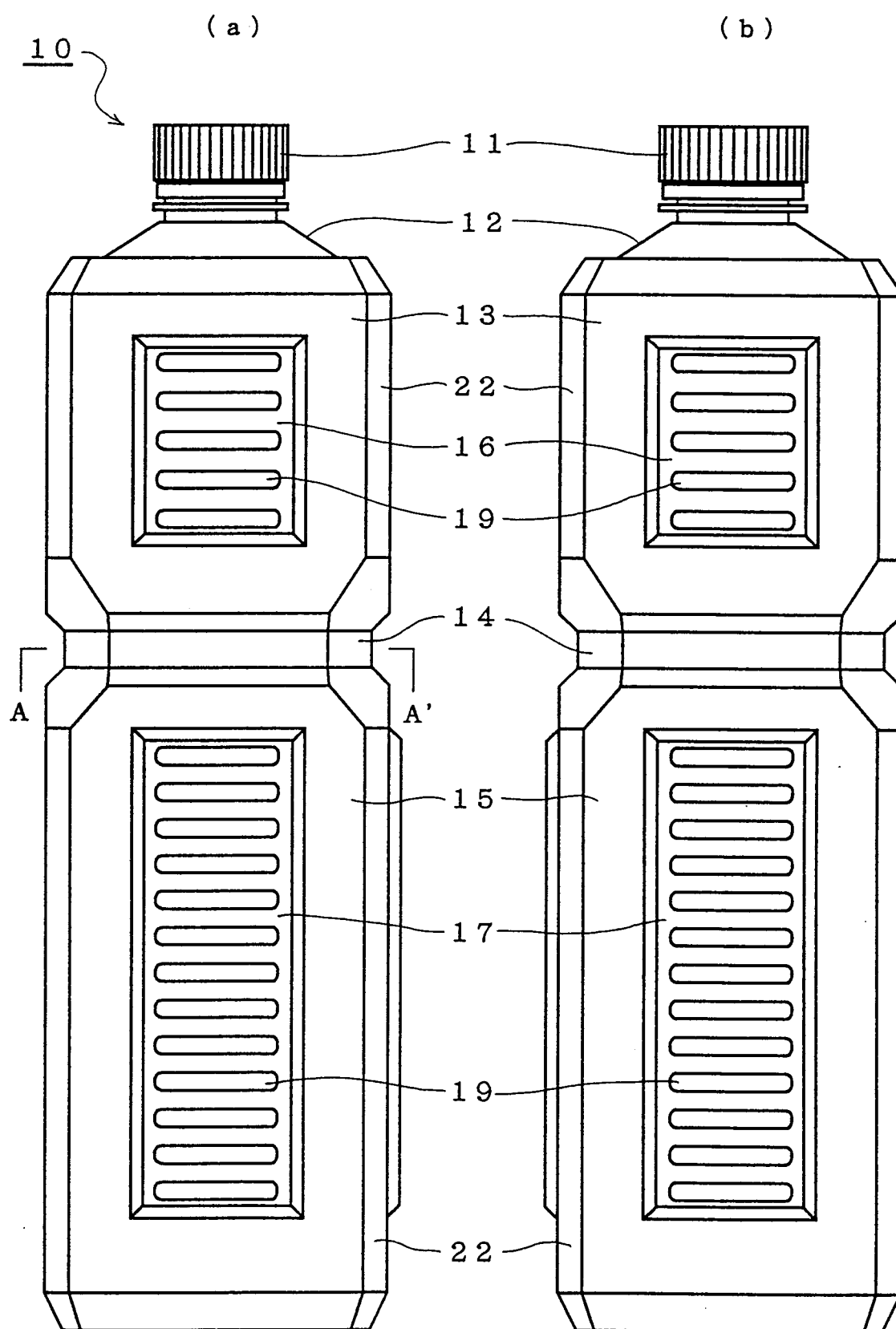


Fig. 2

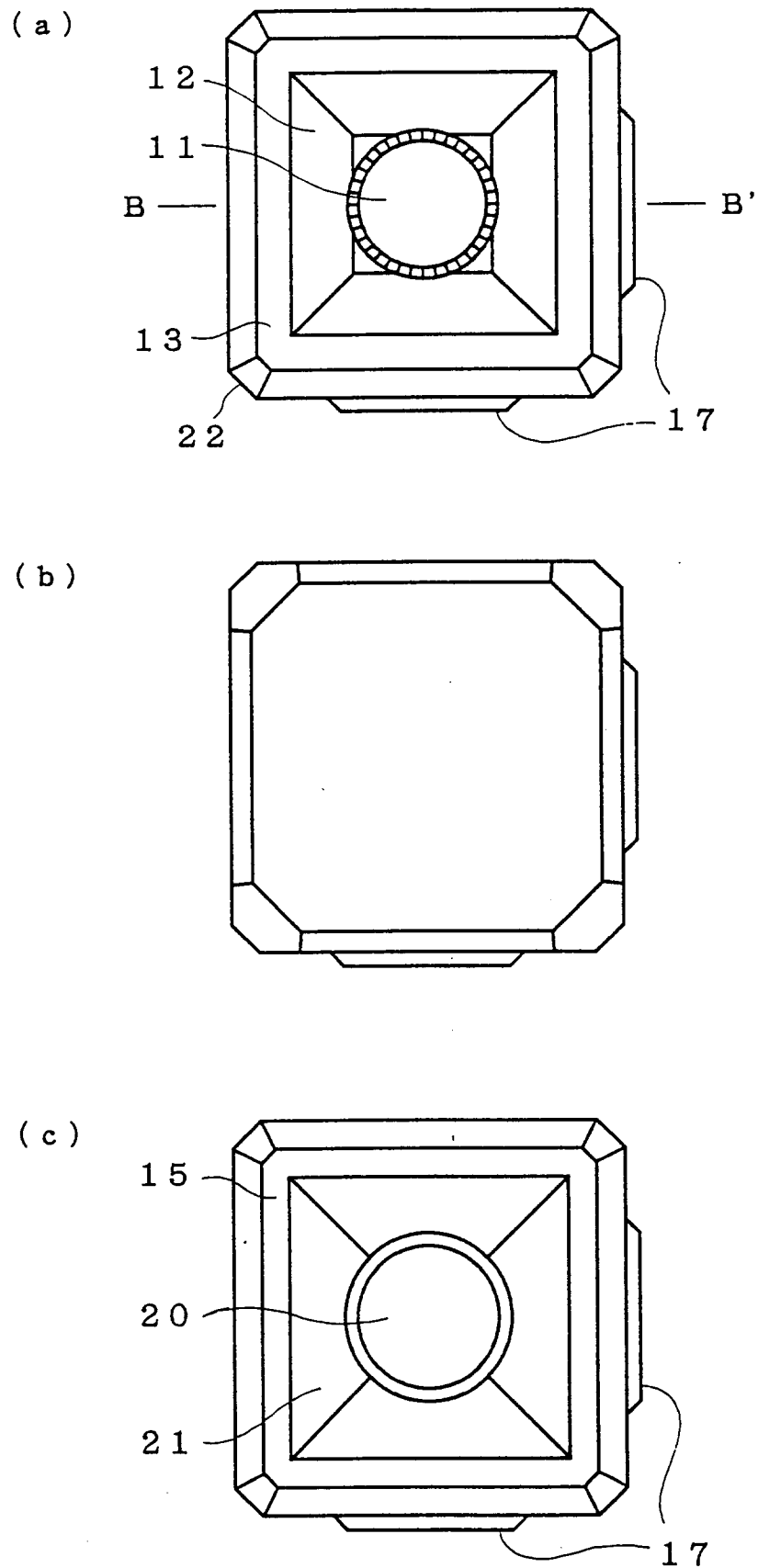


Fig. 3

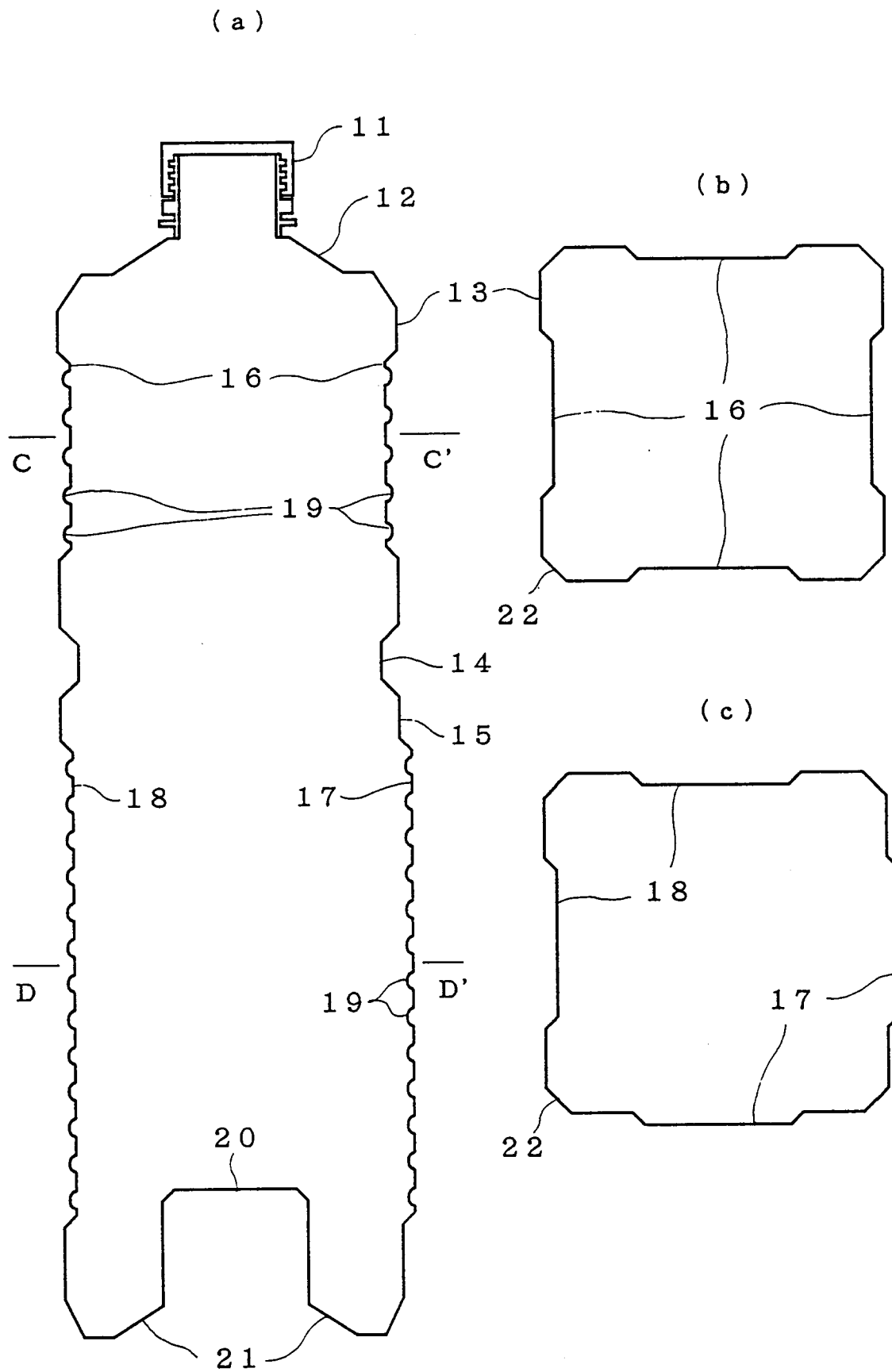


Fig. 4

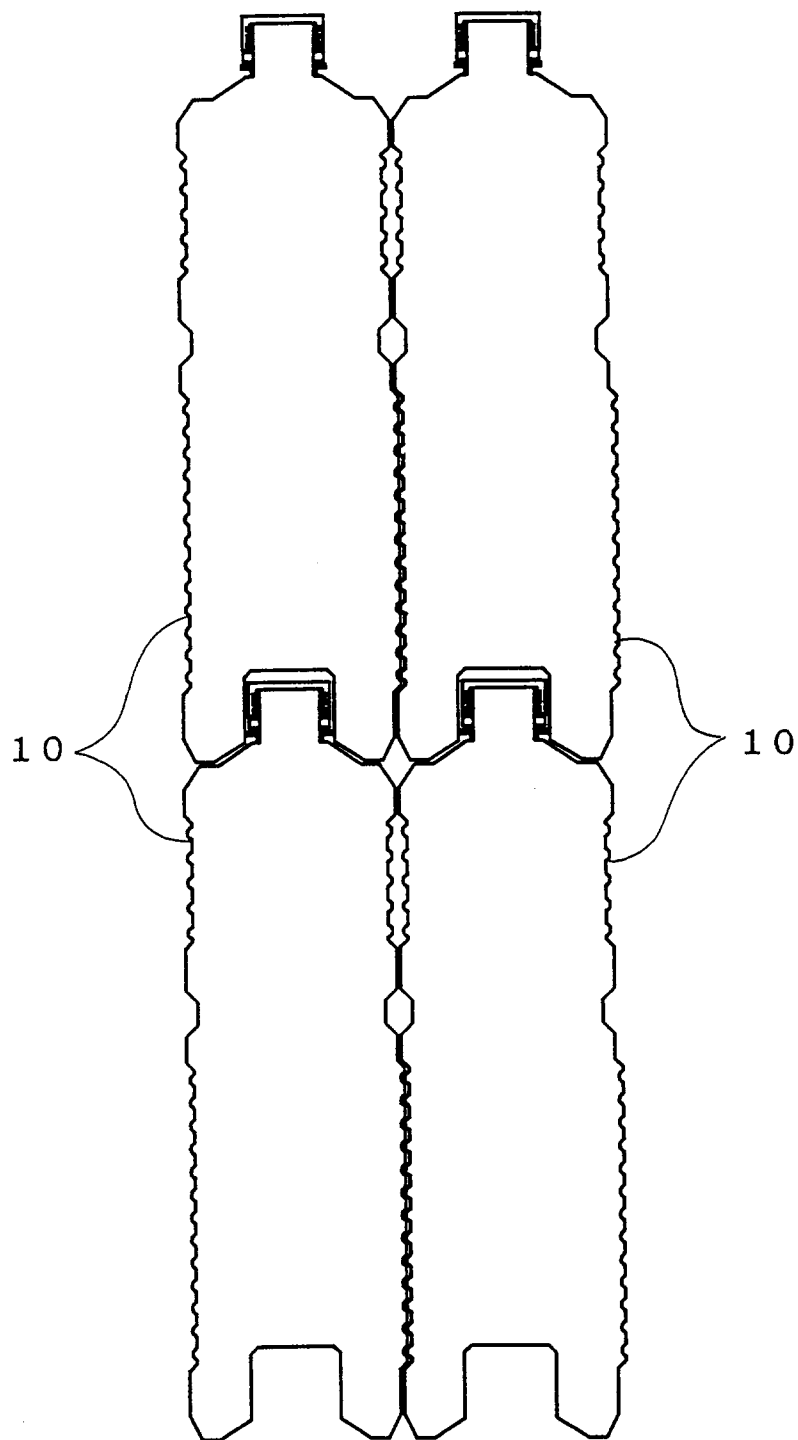


Fig. 5

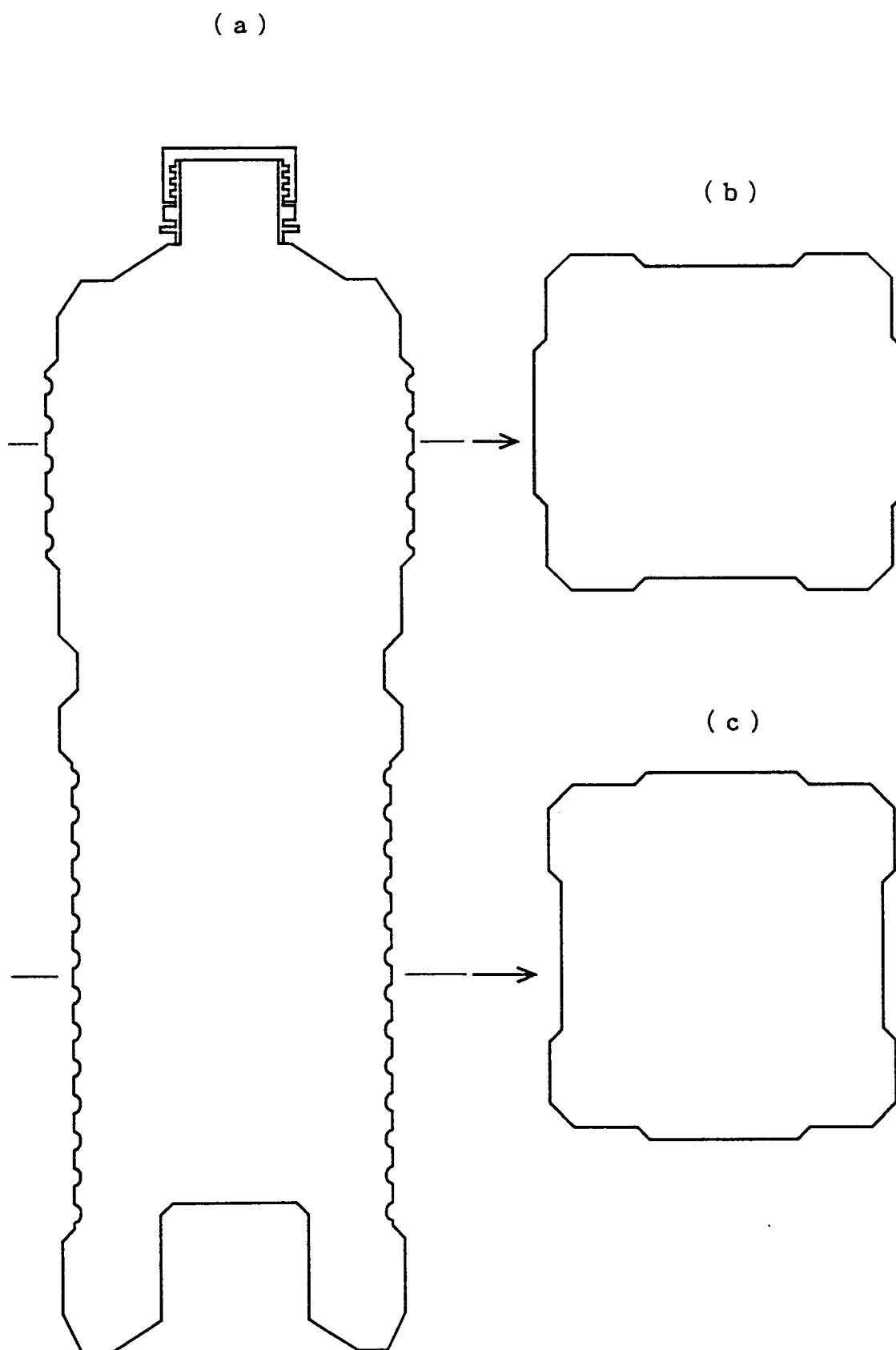


Fig. 6

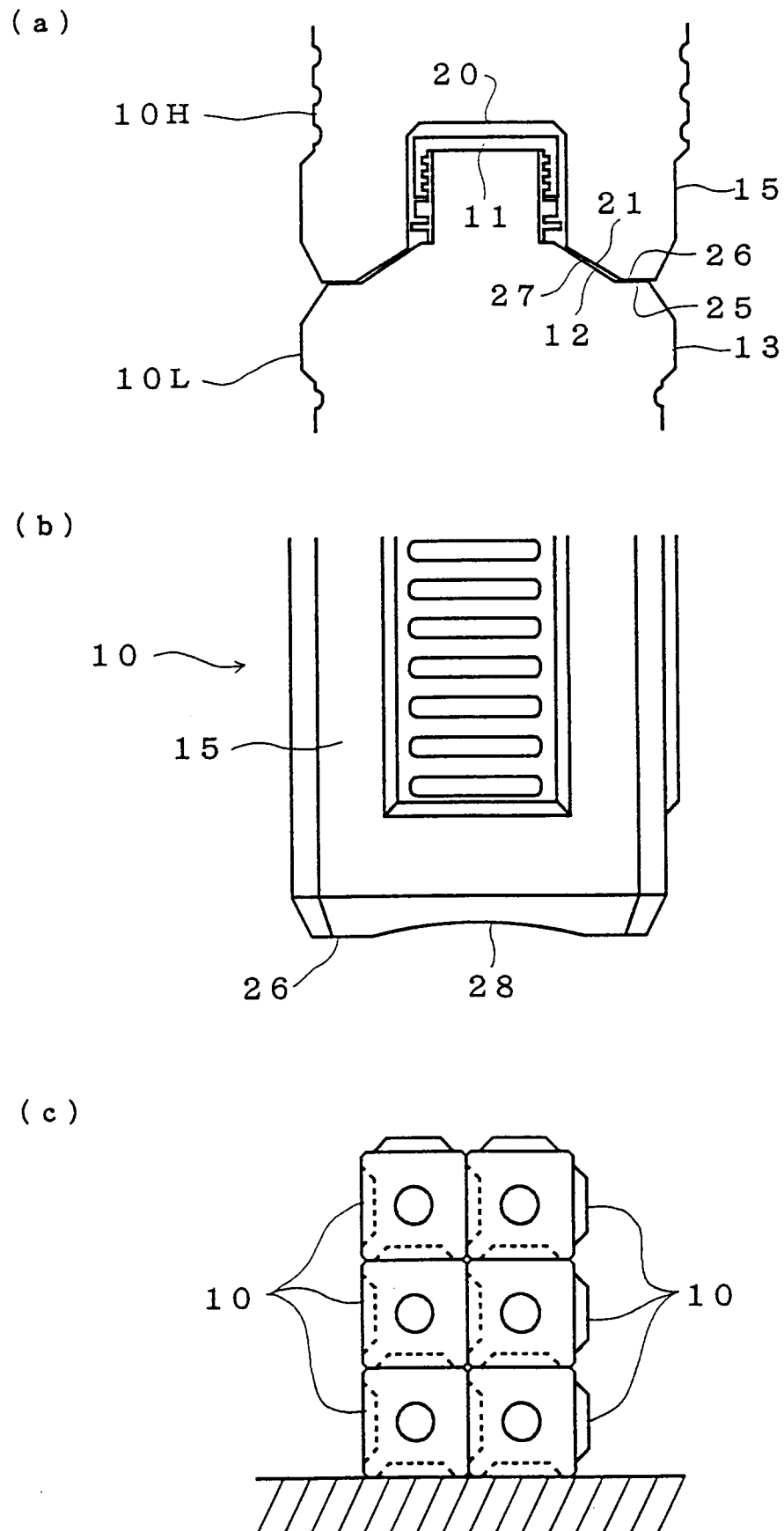


Fig. 7

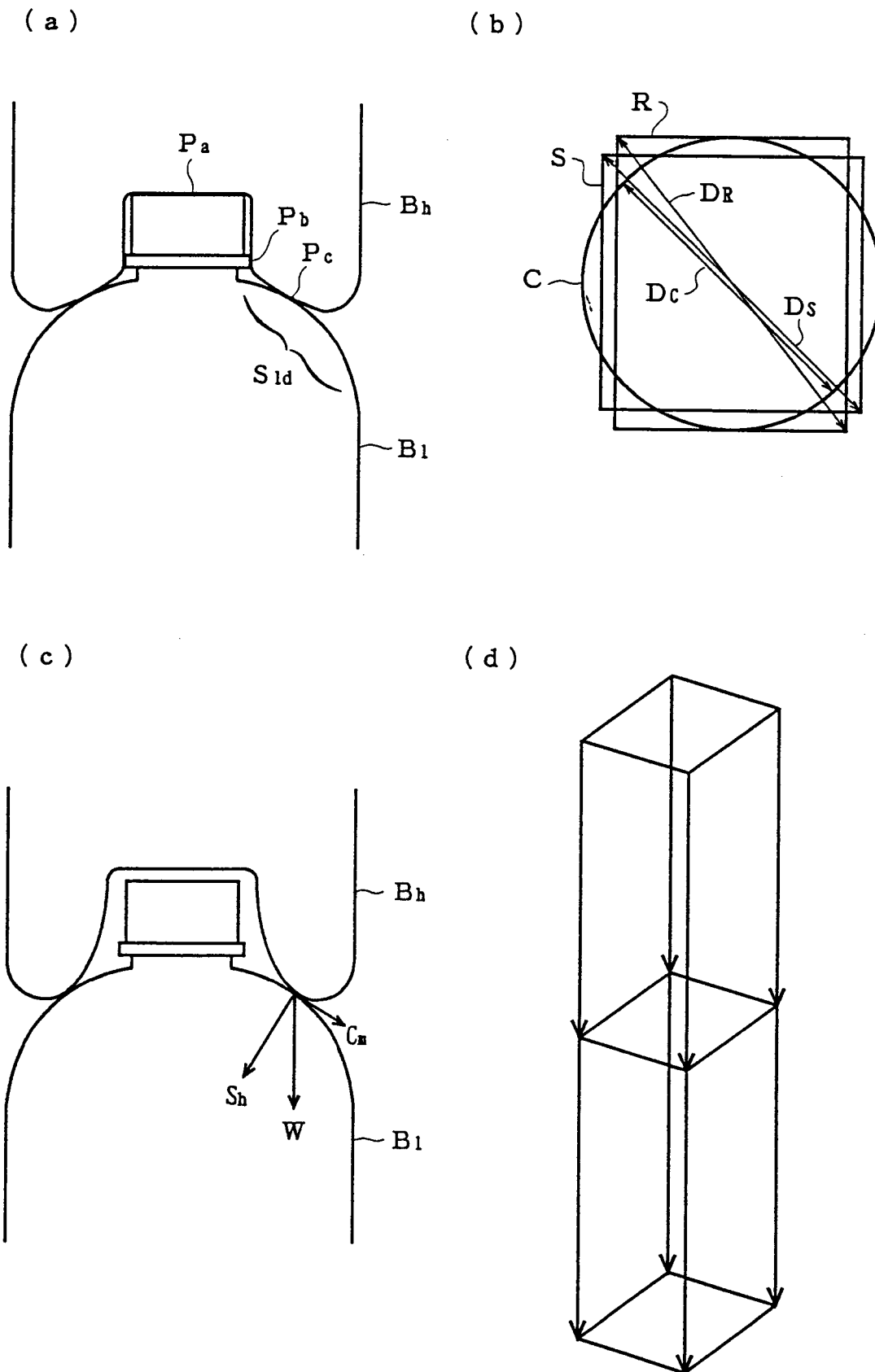


Fig. 8

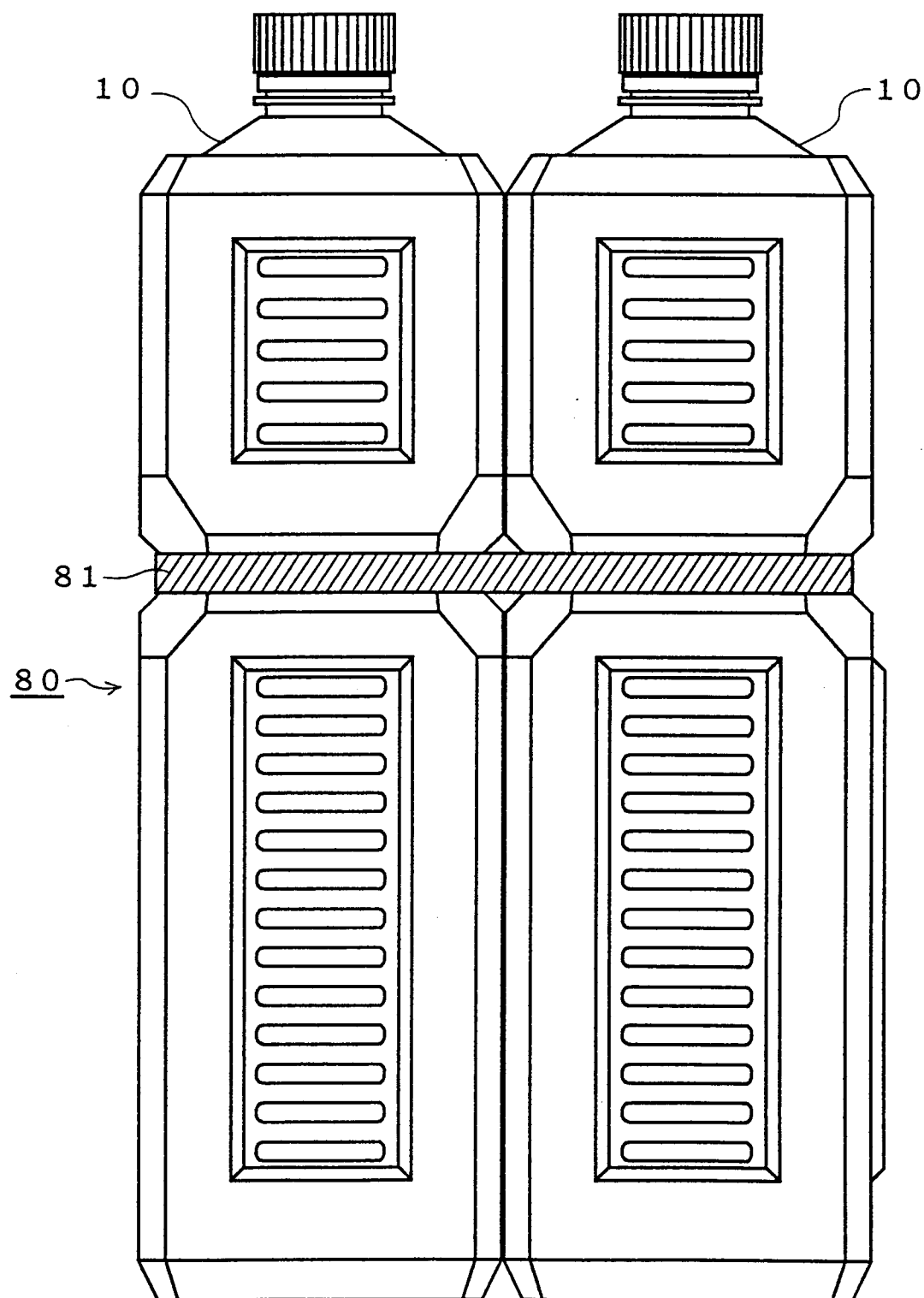


Fig. 9

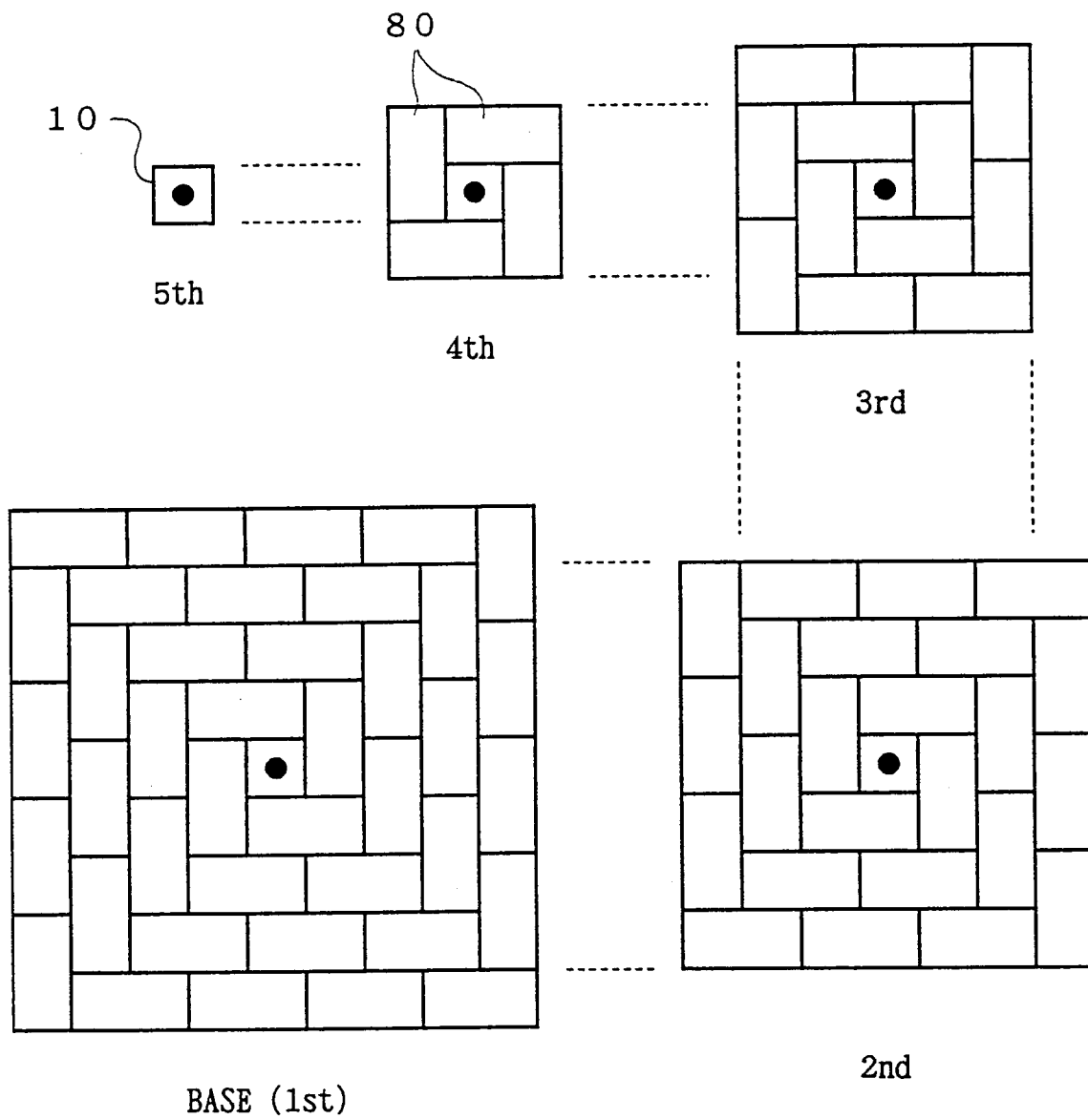
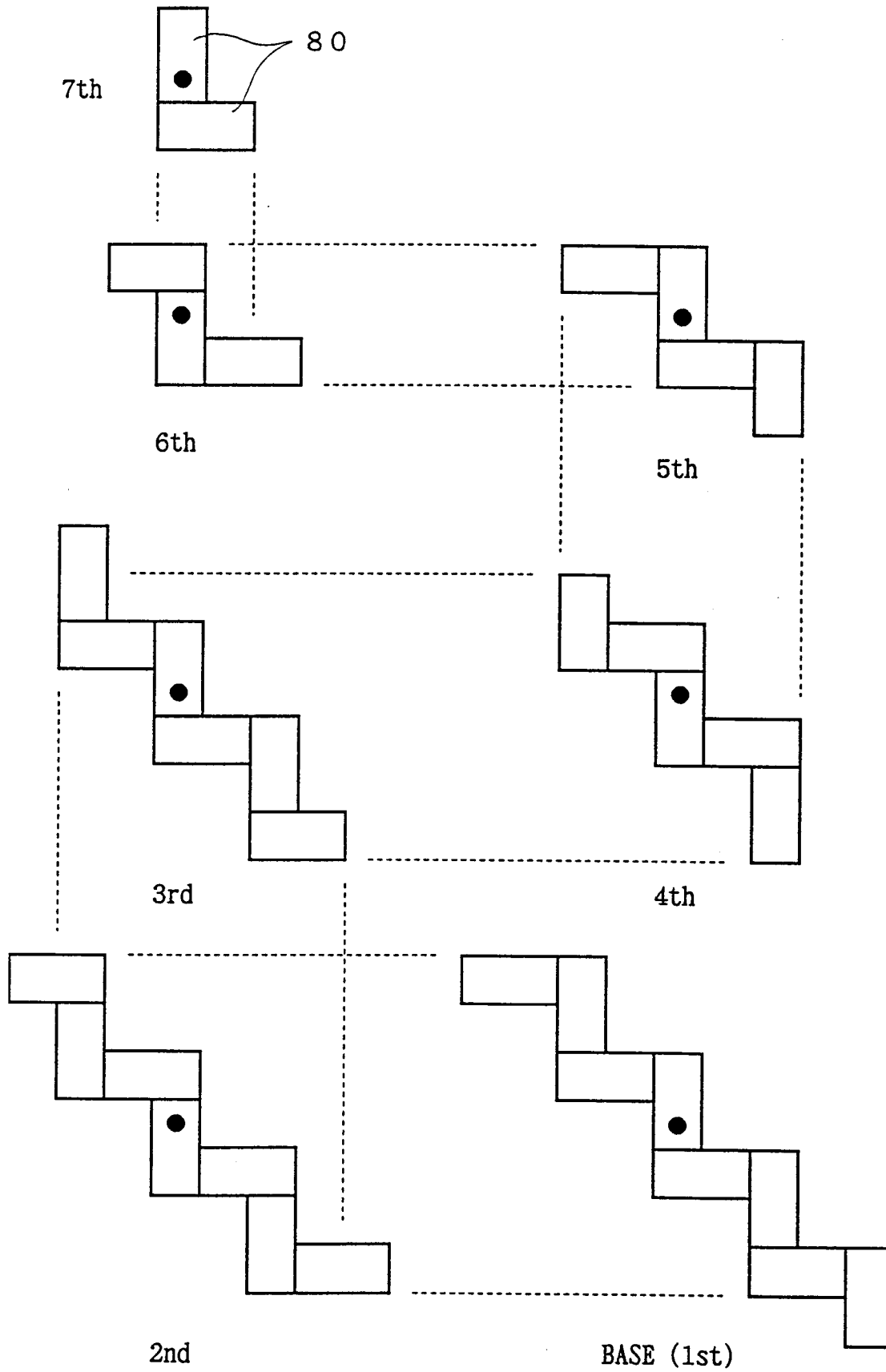


Fig. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP95/00448

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl ⁶ B65D1/02		
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 ⁶ B65D1/00, B65D1/02, B65D21/02, B65D81/32		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Jitsuyo Shinan Koho 1926 - 1995		
Kokai Jitsuyo Shinan Koho 1971 - 1995		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 38-9711, Y1 (Yamamura Glass K.K.), May 22, 1963 (22. 05. 63) (Family: none)	1, 2
X	JP, 58-59716, U (Microfilm) (Kazuhiro Yokomizo), April 22, 1983 (22. 04. 83) (Family: none)	1, 2
Y	JP, 59-22730, U (Microfilm) (Dainippon Printing Co., Ltd.), February 13, 1984 (13. 02. 84) (Family: none)	3
Y	JP, 61-97122, U (Microfilm) (Taisei Kogyosho K.K.), June 21, 1986 (21. 06. 86) (Family: none)	4
Y	JP, 1-161428, U (Microfilm) (Yoshino Kogyosho K.K.), November 9, 1989 (09. 11. 89) (Family: none)	4
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
May 9, 1995 (09. 05. 95)		May 30, 1995 (30. 05. 95)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.		Authorized officer Telephone No.

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