



- (51) International Patent Classification: **B65D 1/16** (2006.01)
- (21) International Application Number: PCT/EP2016/063213
- (22) International Filing Date: 9 June 2016 (09.06.2016)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 102015213204.8 14 July 2015 (14.07.2015) DE
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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(54) Title: ALUMINIUM BEVERAGE CAN

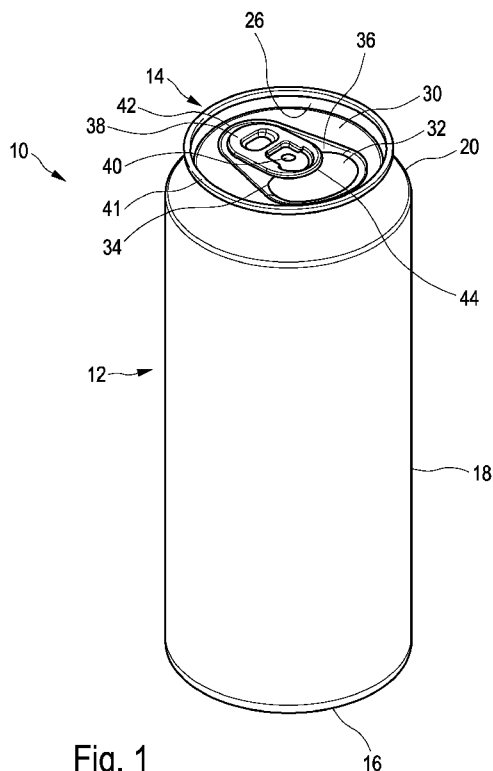


Fig. 1

(57) Abstract: The invention relates to an aluminum beverage can that comprises a unitary DWI can body and a can lid with a pull tab. The can body has a base, a cylindrical side wall and a neck. The aluminum beverage can has an internal nominal volume of between 330 ml and 355 ml. The can body has a maximum diameter of between 56 and 59 mm, a can body plug diameter of between 45 to 49 mm and a weight below 9.3 g for a 330 ml can and below 9.7 g for a 355 ml can. The necking ratio is between 0.75 and 0.95, and preferably between 0.78 and 0.8. The side wall has a mid wall thickness of less than 0.085 mm. The lid has lid plug diameter of between 45 to 49 mm, an outside diameter of between 52 to 55 mm, a central panel with a thickness of less than 0.19 mm and a weight of less than 1.9 g.



**Published:**

— *with international search report (Art. 21(3))*

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Aluminum beverage can

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The invention refers to two-piece aluminum beverage cans with a unitary DWI can body and can lid with a pull tab.

Two piece beverage cans comprise a can body made from one piece of aluminum sheet metal and a can lid with a pull tab affixed to the can lid. A score line in a panel of the can lid defines a tear panel that can be opened by means of the pull tab. The pull tab can be a stay-on-tab that opens a hinged tear panel. In prior art cans, the pull tab is affixed to the can end by a rivet that is formed from the sheet metal of the can lid. Can lids are also known as can ends.

The can body is a drawn and ironed (DWI: drawn and wall-ironed) can body that is produced by first drawing an aluminum blank into a cup and then ironing the walls of the cup to form the can body. The can body has an open end with a reduced diameter. The reduced diameter of the can body's open end is achieved by way of necking the can body in a necking machine in which the diameter of the open end is reduced in several stages.

Prior art cans often have a body that is cylindrical along the largest portion of its longitudinal extension. A typical diameter of prior art aluminum beverage cans is 66 mm. These cans are named 211 cans in the industry.

After filling of a can body e.g. with a carbonated beverage, a respective can lid is attached to the can body by way of a folded double seam. The can lid has a smaller diameter than the can body.

To match a respective can lid, the can body diameter at the can body's open end is reduced from 66 mm to the fitting diameter for the can lid, e.g. ~57 mm (206), 55 mm (204), 52 mm (202) or 50 mm (200) by way of necking

A typical can body has a base, a cylindrical side wall that extends upwardly from the base and that has a wall thickness in the order of 94 to 97  $\mu\text{m}$  for a can having a diameter of 66 mm. A can having a diameter of 58 mm typically has a wall thickness in the order of 90 to 94  $\mu\text{m}$ . The can body further has a tapering neck that extends upwardly from the cylindrical side wall and that defines the reduced diameter open end of the can body prior to seaming. The can body's open end has a smallest internal diameter called plug diameter, which approximately matches the metrical dimension of the can lid, e.g. 52 mm.

The ratio between the can maximum diameter and the plug diameter that is achieved by way of necking is called necking ratio. The base includes a standing ring and a dome arranged within the standing ring.

The can lid is made from sheet metal aluminum and has a central panel wherein the rivet and the tear panel are arranged. The central panel is circumferentially surrounded by a countersink that in turn is circumferentially surrounded by an upwardly extending leg, e.g. a chuck wall. At the outer end of the upwardly extending leg, a curl is arranged that eventually is folded to form the seam that connects can body and can lid and that defines the lid outside diameter. The chuck wall defines a plug diameter of the can lid.

It is an object of the invention to provide an improved two-piece aluminum beverage can.

According to the invention, this object is achieved by an aluminum beverage can comprising a unitary DWI can body and a can lid with a pull tab. The can body has a base, a cylindrical side wall and a neck. The aluminum beverage can has an internal nominal volume of between 330 ml and 355 ml. The can body has a maximum diameter of between 56 and 59 mm, a can body plug diameter of between 45 to 49 mm and a weight below 9.3 g for a 330 ml can, and below 9.7 g for a 355 ml can. The necking ratio is between 0.75 and 0.95 and preferably between 0.78 and 0.8. The side wall has a mid wall thickness of less than 0.095 mm. The lid has a can plug fitting diameter of between

45 to 49 mm, an outside diameter of between 52 to 55 mm, a central panel with a thickness of less than 0.19 mm and a weight of less than 1.9 g.

In a preferred embodiment, the neck has a wall thickness of between 0.13 and 0.15 mm, and even more preferred between 0.135 and 0.145 g.

- 5 The inventors have found that a 58 mm / 52 mm sleek can can be considerably further light-weighted by reducing the end diameter. For this invention, a traditional 14 neck stage 66 mm / 52 mm Necker set-up was transposed to a 58 mm can resulting in a plug diameter of about 46.4 mm. From there, a downscaled can end was designed to meet this plug diameter, and FEA analysis was carried out to clarify the shell design with the
- 10 highest light-weighting potential. Highest potential was achieved with 6 mm reduced diameter can shells, which allow to down-gauge the lid to 0.183 mm.

In a preferred embodiment, the neck of the can is inclined with respect to the side wall by an angle of between 25° and 35°, and the transition from the side wall to the neck has a radius greater 10 mm, for instance between 10 mm and 20 mm, e.g. 15 mm.

- 15 It is further preferred that the can lid is affixed to the can body by means of a folded double seam. This seam preferably has a diameter of between 46 mm and 49 mm.

The can lid preferably has a central panel, and a tear panel is arranged in the central panel. The tear panel defines an opening – for instance a drinking opening - having an area of between 300 mm<sup>2</sup> to 350 mm<sup>2</sup> after opening the beverage can.

- 20 A can with a nominal volume of 330 ml preferably has a height of between 145 mm and 147 mm.

A can with a nominal volume of 355 ml preferably has a height of between 156 mm and 159 mm.

The base preferably has a height of between 5 mm and 10 mm.

- 25 The base preferably has a stand ring with a diameter that is smaller than the diameter of the seam so that a can base of an upper can can be stacked into a seam of a lower can when the upper can is stacked upon the lower can. Alternatively, the stand ring may have a larger diameter than the seam.

The can body is preferably made from aluminum, in particular from series 3000 aluminum. The maximum wall thickness of the can in the middle of the dome of the base is between 235  $\mu\text{m}$  and 245  $\mu\text{m}$ , such as 240  $\mu\text{m}$  or 242  $\mu\text{m}$ .

5 The above and other aspects, features and advantages of the present invention will be more apparent from the following more particular description thereof presented in conjunction with the following drawings, wherein:

Figure 1 is a side-elevated perspective view of a seamed two-piece beverage can according to the invention;

10 Figure 2 is a cross-sectional view of a seamed two-piece beverage can along the can's longitudinal axis;

Figure 3 is a cross-sectional view of a can body prior to seaming;

Figure 4 is a detail from Figure 3 illustrating inter alia a radius of a transition from a side wall to a neck;

Figure 5 is a cross-sectional view of a can lid prior to seaming;

15 Figure 6 is a cross-sectional view of an alternative can with a body having a different base shape; and

Figures 7 to 12 illustrate alternative shapes of the can base.

20 The following description is of the best mode presently contemplated for carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of describing the general principles of the invention. The scope of the invention should be determined with reference to the claims.

Figure 1 shows a two piece aluminum beverage can 10 according to the invention. The can comprises a can body 12 and a can lid 14 seamed to the can body.

25 The can body 12 is formed from a single piece of sheet metal aluminum (blank) and has a base 16, a cylindrical side wall 18 and a neck 20. The base 16 has a standing ring 22 and a dome 24.

The can lid 14 has a chuck wall 26, a countersink 28 and a central panel 30. In the central panel, a tear panel 32 is provided, which is defined by a score line 34. Next to the tear panel, a material absorption bead 36 is arranged. A pull-tab 38 is affixed to the central panel 30 by means of a rivet 40. Pull-tab 38 has a handle part 42 to be gripped by a user's finger and an opening part 44 that is pressed against the tear panel 32 if the handle part 42 is lifted by a user. Thus, the pull tab 38 serves to rupture the score line 34 in order to open the beverage can 10 in a manner known per se. The tear panel 32 thus defines the dimensions of the opening created by lifting the handle part of the pull-tab 38.

Can lid 14 is fixed to can body 12 by means of a double seam 41.

10 Beverage can 10 has a nominal volume of 330 ml and a height E of approximately 146 mm. The diameter of the cylindrical side wall 18 is approximately 58 mm. The diameter L of the seam 41 is approximately 48 mm. The diameter J of the stand ring 22 is smaller than the diameter L of the seam 41. Therefore, beverage cans can be stacked upon another, so that the stand ring of the upper can protrudes into the space within seam 41.

15 Fig. 2 is a cross-sectional view of can 10 with can lid 14 seamed to can body 12. In the cross-sectional view, chuck wall 26 and countersink 28 of can lid 14 can be seen as well as cylindrical side wall 18, neck 20, stand ring 22 and dome 24 of the can body 12.

Fig. 3 is a cross-sectional view of can body 12 prior to seaming. Can diameter A is about 58 mm and corresponds to the diameter of cylindrical side wall 18. As further can be taken from Fig. 3, base 16 extends along a height F of about 5 to 10 mm. Cylindrical side wall 18 has a height G of about 120 mm. Neck 20 has a height H of about 17 mm. Can body 12 is symmetric about a longitudinal axis 46. Prior to sealing, can body 12 has an upper open end with an inner diameter B, which is called plug diameter, and which is about 46 mm.

25 Can body 12 is produced by a draw and wall ironing process (DWI), wherein first a cup is formed and then the side wall is formed by drawing and wall ironing. Thereafter, neck 20 is formed in a necking machine (necker) to achieve an upper can end that has a smaller diameter than the maximum can diameter. The ratio of plug diameter B to can diameter A  $B/A$  is called necking ratio. The necking ratio of can body 12 of the embodiment of Fig. 3 is a little less than 80 %.

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Can body 12 is drawn from a single piece of aluminum sheet metal, having a gauge of 242  $\mu\text{m}$ . Therefore, the wall thickness in the middle of dome 24 is approximately 240  $\mu\text{m}$ .

The aluminum for the can body preferably is a 3000 series aluminum alloy. The tool for drawing and wall ironing preferably is configured to create a transitional wall thickness from the base to the side wall in two steps. The tool preferably provides a first step with an angle of  $1^\circ$  and a second step with an angle of  $\sim 30^\circ$ . Thus, the wall thickness of the can body is reduced from about 240  $\mu\text{m}$  in the area of the base to about 79  $\mu\text{m}$  at the middle part of side wall 18; cf. mid-side wall thickness C in Fig. 4.

The wall thickness of the middle part of the neck is about 111  $\mu\text{m}$ ; cf. mid-neck thickness P in Figure 4. The neck has a flange (at its upper end) having a wall thickness N (cf. Fig. 4) in the range of between 130  $\mu\text{m}$  and 150  $\mu\text{m}$ , for instance 140  $\mu\text{m}$ .

The transition from side wall 18 to flange 20 is rounded. The radius M (cf. Fig. 4) in the transition from side wall 18 to neck 20 is between 10 mm and 20 mm, for instance 15 mm. Such a transition is also called "round shoulder".

The angle of the neck relative to the side wall 18 of a central longitudinal axis of can body 12 is between  $25^\circ$  and  $35^\circ$ , for instance  $30^\circ$ .

A can body according to the embodiments of the Figures has a weight below 9.3 g for a can with a nominal volume of 330 ml and below 9.7 g for a can having a nominal volume of 355 ml.

The total internal volume of the seamed can is the nominal volume plus a head space. The volume of the head space is little less than 20 ml, for instance 18 ml. Thus, a can with a nominal volume of 330 ml has a total internal volume of 348 ml, and a can with a nominal volume of 355 ml has a total internal volume of 373 ml.

Figure 5 is a cross-sectional view of can lid 14 prior to seaming illustrating the outside diameter (curl diameter) K.

While Figures 1 to 4 illustrate the preferred shape of can base 16, alternative shapes are applicable.

Figure 6 shows a can wherein the stand ring has a smaller diameter than the seam.

Alternatively, the outer wall of the base may be straight and can have the same diameter as the side wall; cf. Figure 7.

As another alternative, a non-stackable construction may be applied, wherein a can stands on top of the seam with 0 - 1 mm overlap; cf. Figure 8.

- 5 In another alternative embodiment, a convex base-profile from wall to wall added with a support means (e.g. a support ring) is provided, which allows both proper can handling and inner or outer or inner and outer or on top stacking; cf. Figure 9.

The support ring can be produced from any material. Preferred features of the support ring are:

- 10 - A hollow design to save weight.
- The material is a light degradable substrate.

Further weight reduction is possible by using only parts of the support ring over the surrounding of the base, e.g. a number of 1 to 16 pieces either separately or attached as one to the base ring.

- 15 In yet another embodiment, the base may have a food container-like base profile, which allows deflections under pressure but provides stack-ability, as illustrated in Figure 10.

Another possible embodiment is illustrated in Figure 11, wherein a convex base with integrated studs to support can handling and stack ability is provided.

- 20 It is also possible to provide a flexible bottom, which finds its final stackable dimension after filling/pressurizing; cf. Figure 12.

List of reference numerals

	10	Can
	12	Can body
	14	Can lid
5	16	Base
	18	Side wall
	20	Neck
	22	Stand ring
	24	Dome
10	26	Chuck wall
	28	Countersink
	30	Central panel
	32	Tear panel
	34	Score line
15	36	Absorption bead
	38	Pull-Tab
	40	Rivet
	41	Double Seam
	42	Handle part
20	44	Opening part
	46	Longitudinal axis of can body
	A	Maximum diameter
	B	Plug diameter
	A/B	Necking Ratio
25	C	Wall thickness
	D	Flange wall thickness
	E	Can height

	F	Base height
	G	Cylindrical sidewall height
	H	Neck height
	J	Stand ring diameter
5	K	Curl diameter
	L	Seam diameter
	M	Shoulder radius
	N	Flange thickness
	P	Neck thickness

## Claims

1. Aluminum beverage can (10) comprising a unitary DWI can body (12) and a can lid (14) with a pull tab (38), said can body (12) having a base (16), a cylindrical side wall (18) and a neck (20), wherein
  - 5 the aluminum beverage can (10) has an internal nominal volume of between 330 ml and 355 ml,  
  
the can body (12) has a maximum diameter (A) of between 56 and 59 mm, a can body plug diameter (B) of between 45 to 49 mm and a weight below 9.3 g for a can having a nominal volume of 330 ml and below 9.7 g for a can having a nominal  
10 volume of 355 ml,  
  
the necking ratio (B/A) is between 0.75 and 0.95,  
  
the mid-side wall has a wall thickness (C) of less than 0,085 mm,  
  
the neck has a flange wall thickness (D) in the range of between 0.13 mm and 0.15 mm, and
  - 15 the lid has lid plug diameter of between 45 mm to 49 mm, an outside diameter (K) of between 52 mm to 55 mm, a central panel (30) with a thickness of less than 0.19 mm and a weight of less than 1.9 g including the tab (38).
2. Beverage can according to claim 1, wherein the neck (20) is inclined with respect to the side wall (18) by an angle of at least 25°, and the transition from the side wall  
20 to the neck has a radius (M) between 10 mm and 20 mm.
3. Beverage can according to claim 1 or 2, wherein the can lid is affixed to the can body by means of a folded double seam (41), said seam (41) having a diameter (L) in the range between 46 mm and 49 mm.
4. Beverage can according to claim 3, wherein the base (16) comprises a stand ring  
25 (22) that has a diameter (J) that is smaller than the diameter (L) of the seam (41).

5. Beverage can according to at least one of claims 1 to 4, wherein the can lid (14) has a central panel (30) and a tear panel (32) that is arranged in the central panel, said tear panel (32) defining an opening having an area of between  $300 \text{ mm}^2$  to  $350 \text{ mm}^2$  after opening the beverage can (10).
- 5 6. Beverage can according to at least one of claims 1 to 5, wherein the can (10) has a nominal volume of 330 ml and a height (E) of between 145 mm and 147 mm.
7. Beverage can according to at least one of claims 1 to 5, wherein the can (10) has a nominal volume of 355 ml and a height (E) of between 156 mm and 159 mm.
8. Beverage can according to a least one of claims 1 to 7, wherein the base (16) has  
10 a height (F) of between 5 mm and 10 mm.
9. Beverage can according to a least one of claims 1 to 8, wherein the necking ratio (B/A) is between 0.78 and 0.8.
10. Beverage can according to a least one of claims 1 to 9, wherein the base (16) includes a dome (24) that has a maximum wall thickness of less than 0.242 mm.
- 15 11. Beverage can according to a least one of claims 1 to 10, wherein the wall thickness (C) of the side wall (18) is less than 0.08 mm.

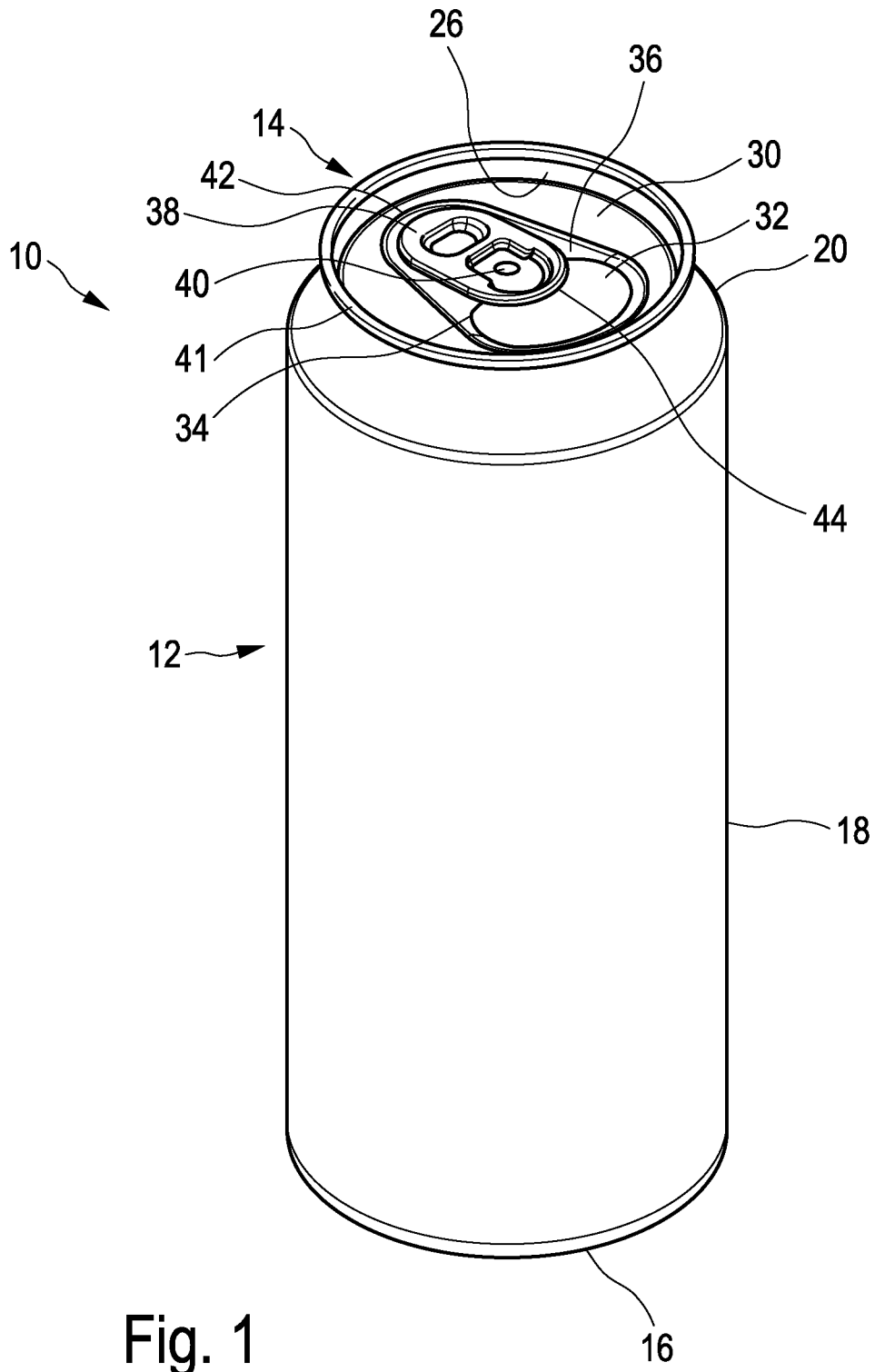


Fig. 1

2/12

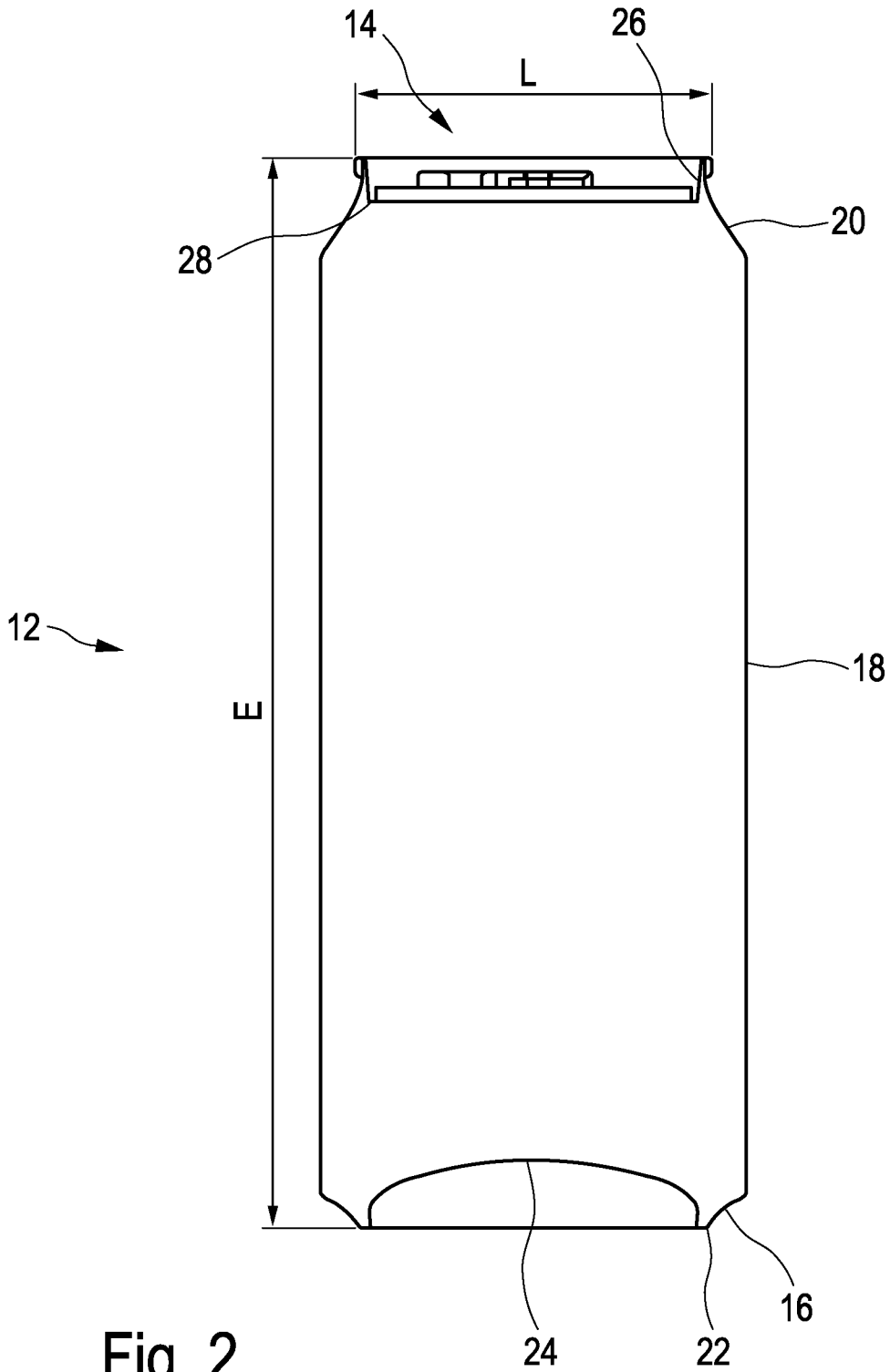


Fig. 2

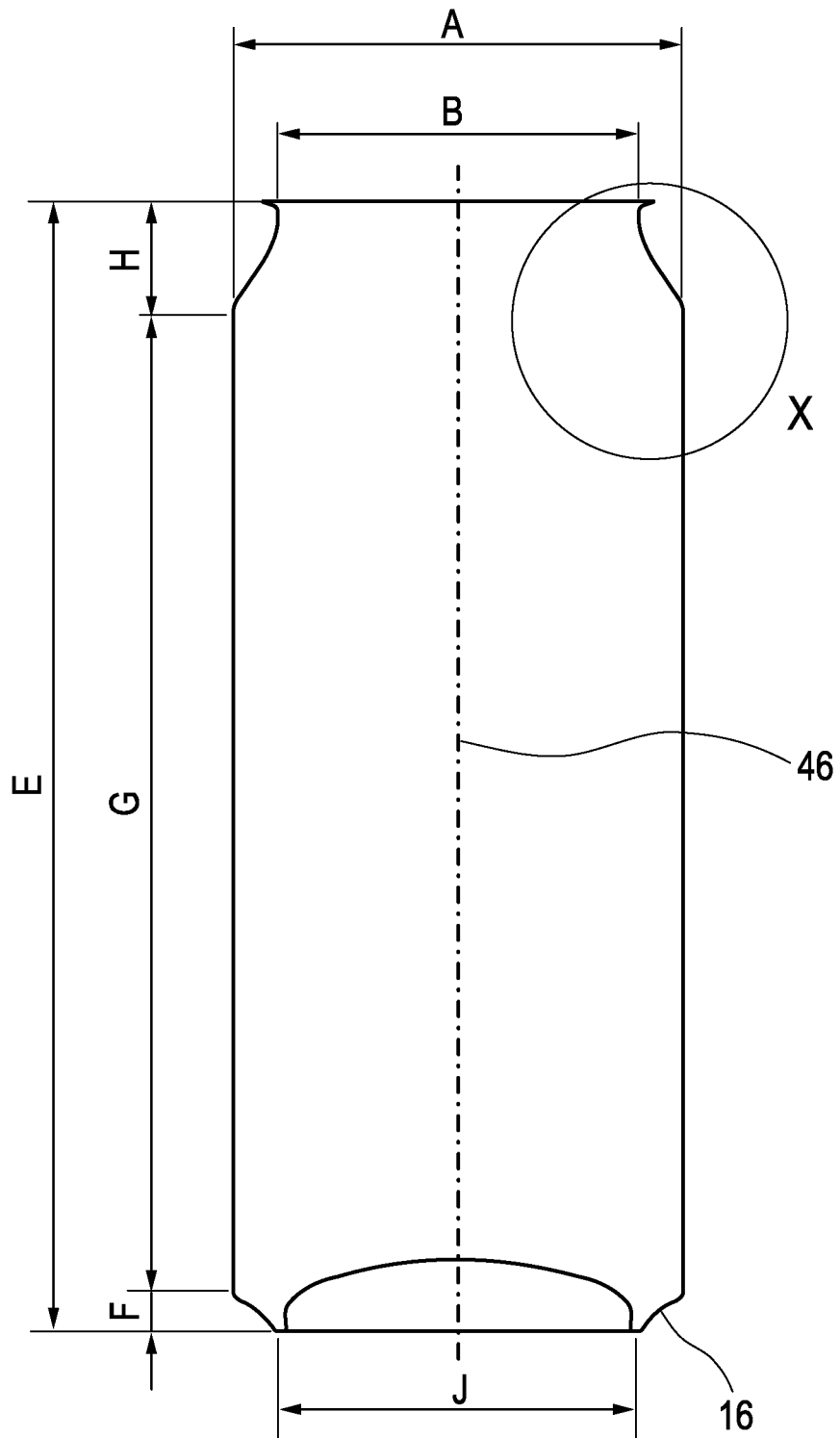


Fig. 3

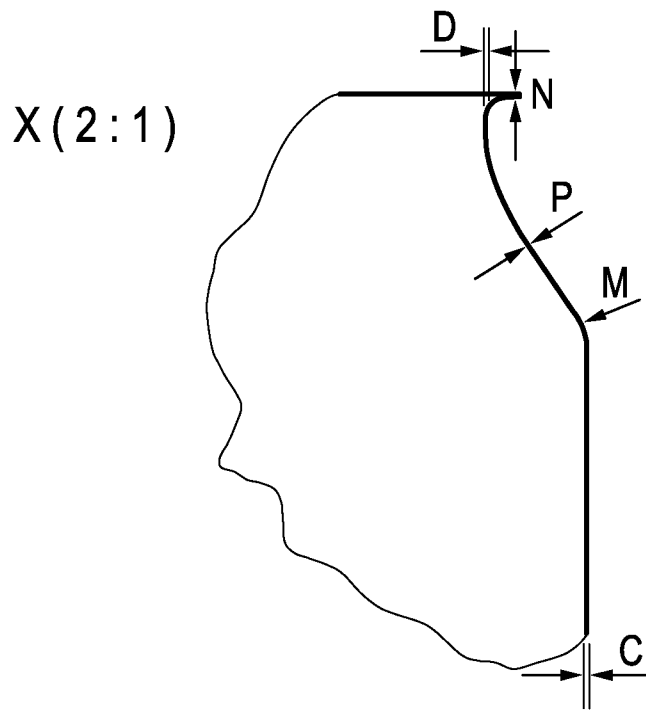


Fig. 4

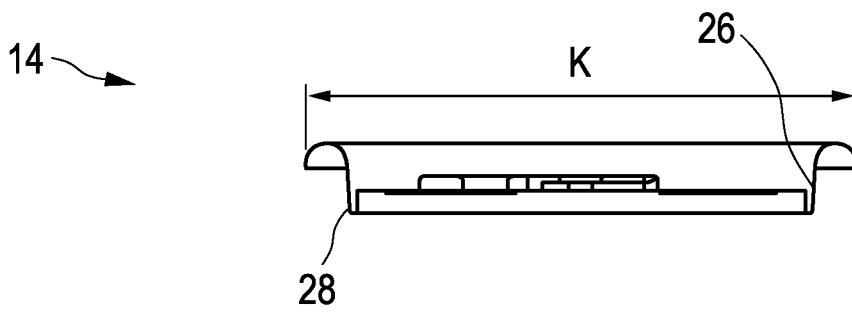


Fig. 5

6/12

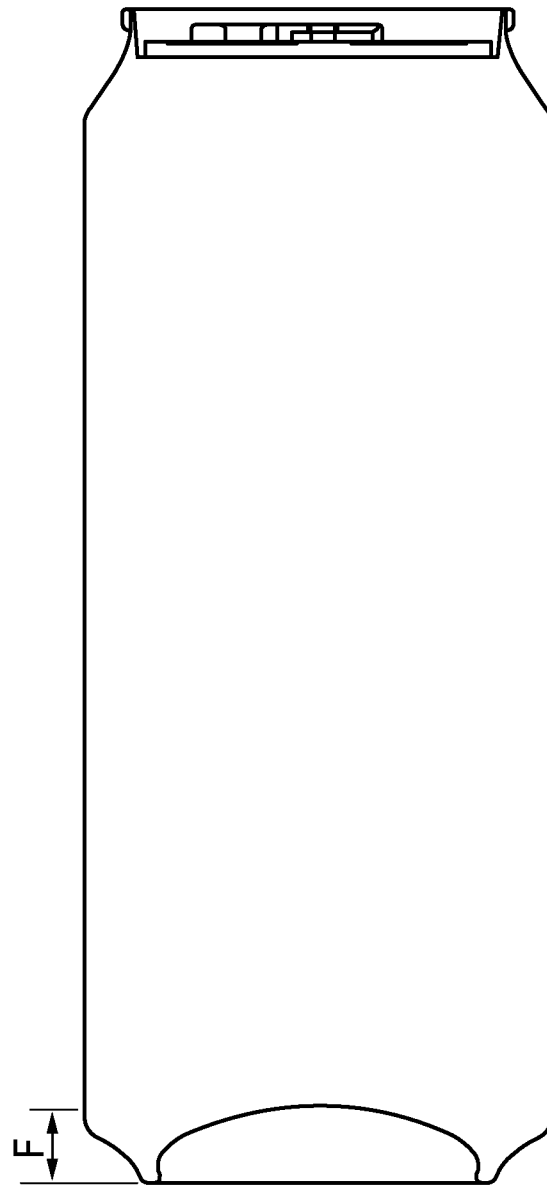


Fig. 6

7/12

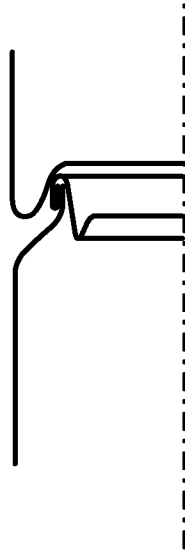


Fig. 7

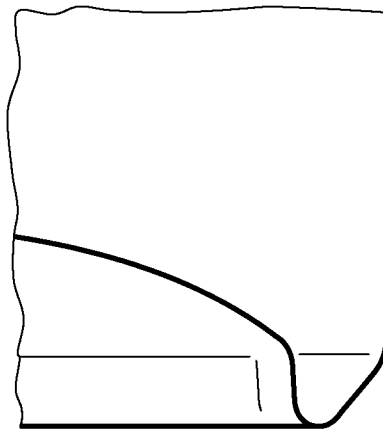


Fig. 8

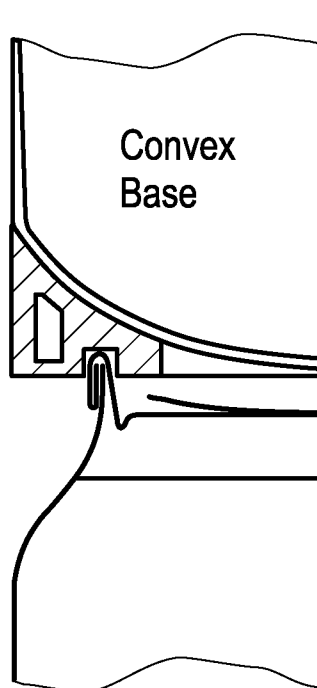


Fig. 9

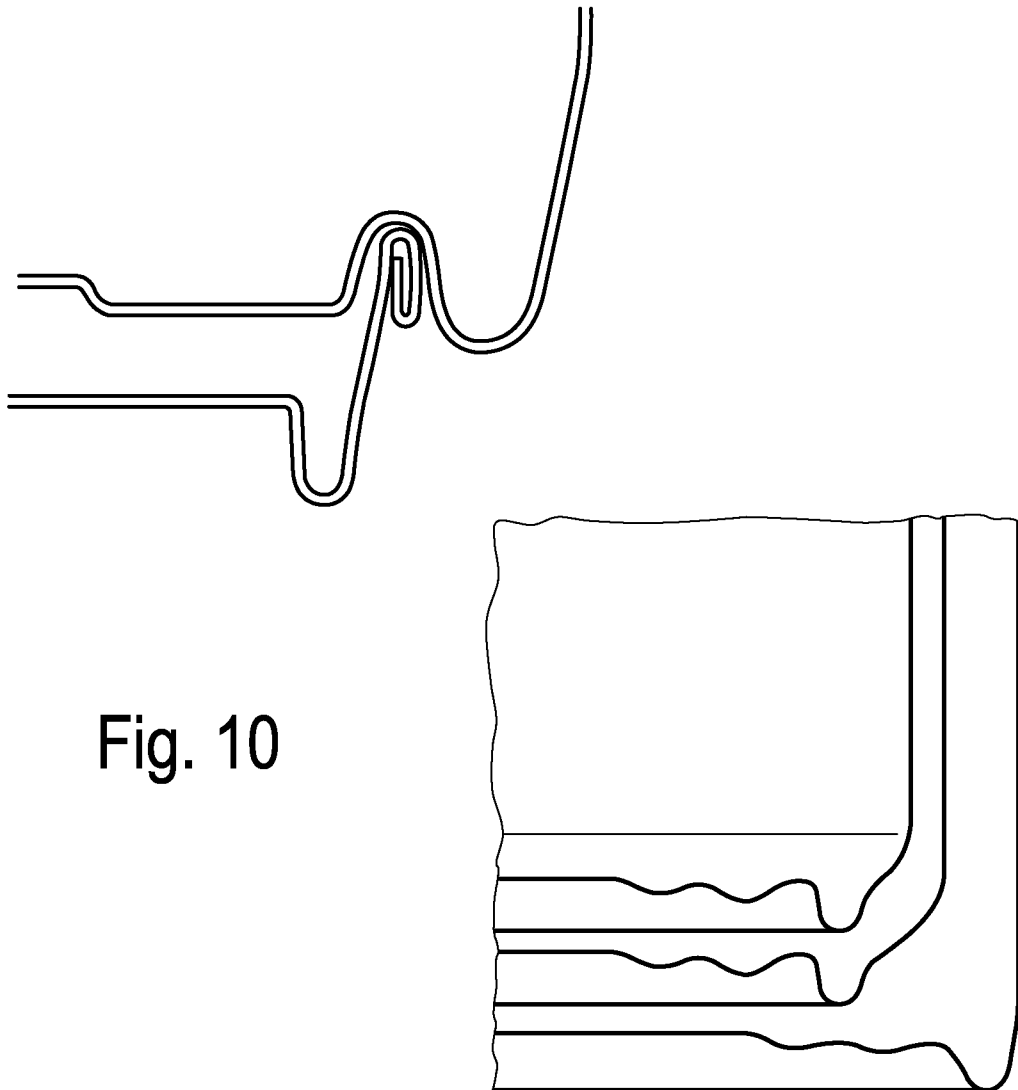


Fig. 10

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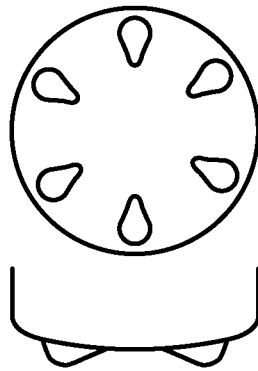


Fig. 11

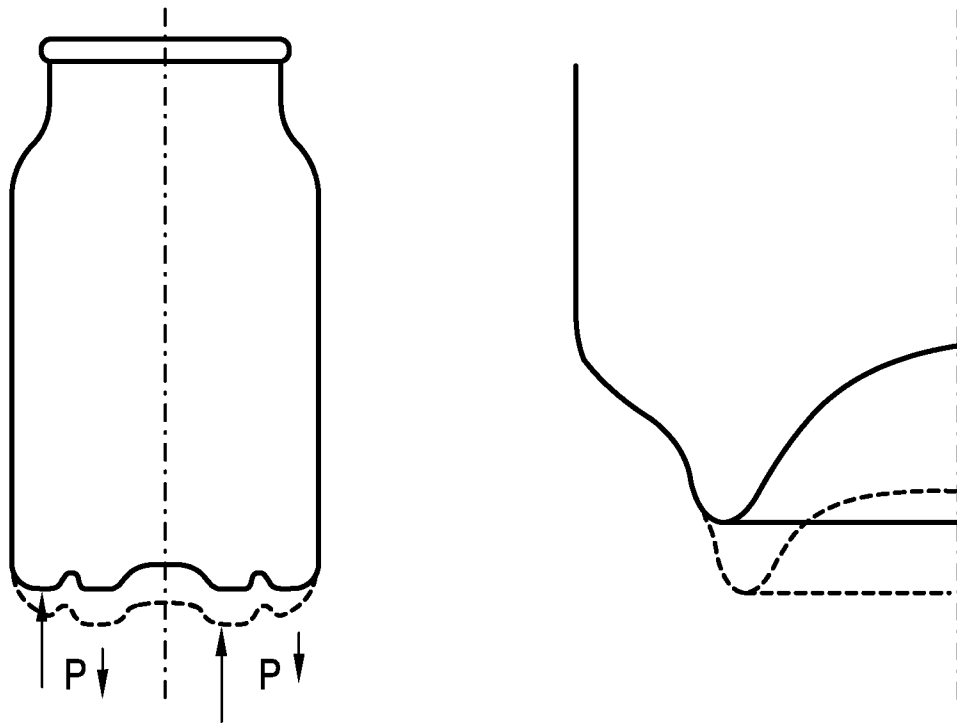


FIG. 12

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/EP2016/063213

**A. CLASSIFICATION OF SUBJECT MATTER**  
 INV. B65D1/16  
 ADD.  
 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)  
 B65D  
 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 315 478 A (METAL BOX PLC [GB]) 4 February 1998 (1998-02-04) page 6, line 8 - line 10 page 9, line 18 - line 32 -----	1
A	WO 2014/055399 A1 (CROWN PACKAGING TECHNOLOGY INC [US]) 10 April 2014 (2014-04-10) paragraph [0039] -----	1

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 application or patent 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
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- "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  27 June 2016	Date of mailing of the international search report  04/07/2016
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Bridault, Alain
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/063213

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2315478	A	04-02-1998	GB 2291610 A
			GB 2315478 A
			US 5911551 A
-----			
WO 2014055399	A1	10-04-2014	AU 2013327622 A1
			CA 2886643 A1
			CN 104837733 A
			CO 7350638 A2
			EP 2903899 A1
			EP 3009368 A1
			JP 2015534526 A
			SG 11201502481Y A
			US 2015239607 A1
			WO 2014055399 A1
-----			