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(11) **EP 1 705 124 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**27.09.2006 Bulletin 2006/39**

(51) Int Cl.:  
**B65D 1/02 (2006.01)**

(21) Application number: **06111001.1**

(22) Date of filing: **13.03.2006**

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR  
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI  
SK TR**  
Designated Extension States:  
**AL BA HR MK YU**

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(30) Priority: **15.03.2005 IT BO20050012**  
**14.06.2005 IT BO20050036**

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(54) **Bottle made of plastic material with reinforced bottom**

(57) During the forming stage of the bottle in the special mould parts, first linear ribs (2), in relief outwards, parallel with each other, symmetrically arranged and with a curved external profile (102), are obtained on the bottom (301), raised and with the form of a spherical cap of the bottle itself, these ribs being, for example, five in number, or in another preferably odd number, in such a way that one of these is located on the centreline of the bottom of the bottle and these ribs are oriented perpendicularly compared with the ideal vertical plane on which the crushed part (101') of the top sprue (101) of the bottle lies. During the same forming stage as that of said first ribs (2), perpendicularly to these and at least on the centreline of the bottle's bottom, at least one second rib (3) is obtained, adjacent to and aligned with the bottom sprue of the bottle itself and which is composed of a bottom part (103) in contact with the bottom of the bottle, which intersects with and is fixed to said first ribs (2) and which protrudes with short sections (103') from the outer ones of the first ribs (2) themselves, and this second rib (3) comprises on said bottom part (103) and along the entire length, a median ridge (203) with limited thickness, with stiffening and heat dispersion functions. The bottom support edge (401', 401'') of the bottle itself, which is connected externally with appropriate rounding to the contiguous side wall (701', 701''), is connected internally with the raised and arched bottom (301', 301'') of the bottle itself, with an inclined edge (901', 901'') whose generatrix forms an angle ( $\alpha$ ,  $\alpha'$ ,  $\alpha''$ ) between 90° and 40°, and between about 53° and 48° in particular, with the horizontal.

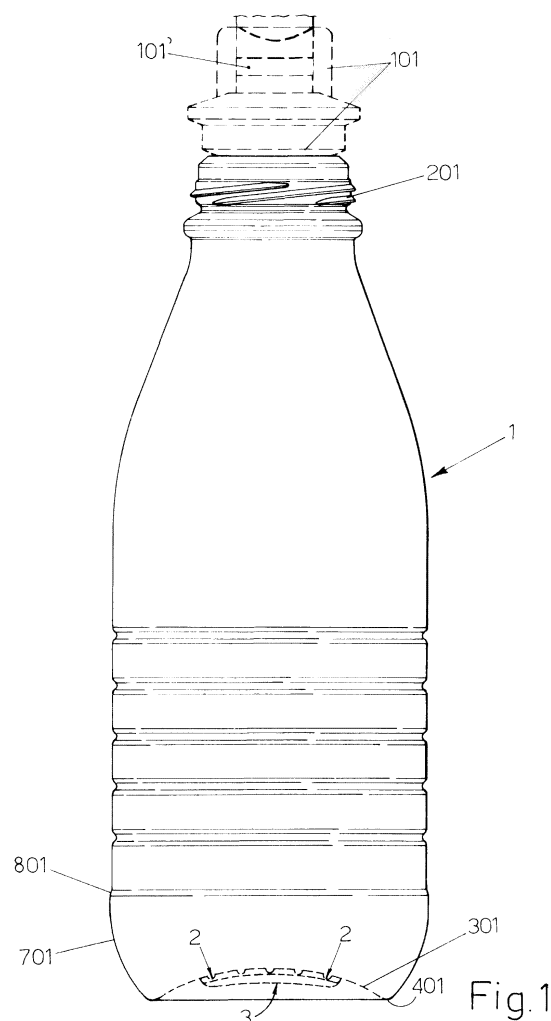


Fig.1

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## Description

**[0001]** The invention concerns a bottle made of a plastic material with a reinforced bottom, produced using the technique of blowing an extruded or coextruded parison of high-density polyethylene (HDPE) or other suitable material and particularly suitable for the sterile packaging of liquids for foodstuff use or for other uses for which sterile packaging conditions are required, for example for packaging liquids for cosmetic, pharmaceutical or similar uses.

**[0002]** When making these bottles, giving their bottom a recessed and appropriately concave form with reinforcing ribs in order to guarantee the non-deformability of the bottom itself of the bottle, both during the production stage and the stage of use, when the bottle itself is loaded by the weight of the packaged product and will be subjected to the vibrations and mechanical stresses which are generated during the various transport stages, is known. Problems have been noted in the known technology with the tightness of the bottom of the bottles, because of the long-term onset of little cracks in the area where said reinforcing ribs and the bottom the bottle meet, and problems of deformation of the lateral bottom part of the bottle itself have also been found during the final stages of the process of thermoforming the bottle itself by blowing, as better specified here below. The intention of the invention is to overcome these shortcomings of the known technology with the solutions indicated in the annexed claims whose characteristics and whose advantages will appear evident from the following description made with reference to the figures of the five pages of drawings attached, in which:

- Fig. 1 is a side elevation view of a bottle according to the invention;
- Fig. 2 is a plan view from the bottom of the bottle in question;
- Fig. 3 illustrates the details of the bottom of the bottle, viewed in accordance with the section III-III in figure 2;
- Fig. 3a shows an enlargement of one of the transverse ribs of the bottom of the bottle, enclosed in the circle indicated by K1 in figure 3;
- Fig. 4 illustrates other details of the bottom of the bottle, viewed in accordance with the section IV-IV in figure 2;
- Fig. 4a shows an enlargement of one of the transverse ribs of the bottom of the bottle, enclosed in the circle indicated by K2 in figure 4;
- Fig. 5 shows a lateral elevation of the bottom part of a bottle of the known type;
- Fig. 6 shows the improved bottom, and with a round plan, of a container with a body with a round section as in the solution in figure 2 or with a polygonal and rounded section as in the example in question;
- Figs. 7 and 8 show further details of the bottom of the container as in figure 6, viewed in accordance

with the respective sections, VII-VII and VIII-VIII;

- Fig. 9 shows the improved bottom, and with an oval plan, of a container with a body which also has an oval section;
- Figs. 10 and 11 show further details of the bottom of the container as in figure 9, viewed in accordance with the respective sections, X-X and XI-XI.

**[0003]** Bottle 1, illustrated in figure 1, is produced using the known technology of thermoforming by blowing, starting from a HDPE parison formed, for example, from several coextruded layers, arranged vertically with its own longitudinal axis, which at the right stage is enclosed between two specular and complementary parts of a mould which define the negative of the form of the future bottle with their internal cavities and which with their own means close the opposite ends of the parison, with complete closure of the bottom end destined to form the bottom of the bottle and with partial closure of the top end, to permit the passage of a needle connected to a circuit which at the right stage blows air into the parison under pressure, obliging the parison itself to inflate and to adhere to the internal walls of the two parts of mould, to assume the established form of bottle 1. When, as in the case in question, the bottle is destined for the sterile packaging of products of the food, cosmetic or other type, said blowing operation employs sterile air. Following the forming stage, the two parts of the mould are opened, the bottle still connected to the blowing needle, is usually tested with regard to its tightness and to any other quality characteristics and is then removed from the needle and transferred to the bottom spruing process. If the bottles have been blown using sterile air, the same are removed from the blowing needle only when their top sprue 101 has been crushed and closed tight in the intermediate zone 101' and after a vacuum has been created in the bottles themselves capable of balancing the future increase of the internal pressure caused by the residual heat in the plastic material which makes up the bottles themselves. The top mouth of the bottles will be opened during the subsequent product filling stage, carried out in an environment with a controlled atmosphere. In this stage, the entire top part of the bottle indicated in figure 1 by the broken line and by 101 is removed and, after filling, the bottle is closed tight with a screw cap, not shown in the drawings, screwed onto the externally threaded mouth 201 of the bottle itself. It remains understood that the form and dimensions of the bottle can be different from those illustrated in figure 1.

**[0004]** The bottles 1 in question have a bottom 301 with a slight recess and with the form of a spherical cap, and said two parts of a mould which form the bottle have bottom parts which each define half of the form of the bottom 301, and which are vertically mobile compared with every upper part of the mould, with the logic that these mobile parts are usually raised in the initial closing stage of the two parts of mould. When the forming of the bottle is complete, the two parts of mould are opened

with a slight horizontal, reciprocally distancing movement, so that their bottom mobile parts are released from contact with the bottom sprue and can be lowered to come out of the undercut formed by the bottom of the bottle, after which said two parts of mould complete the opening stage to permit the release of the bottle.

**[0005]** During the bottle forming stage in said parts of mould, linear ribs 2 are obtained on the bottom 301 of the bottle itself, in relief outwards (figs. 2 and 3), parallel with one another and arranged symmetrically, and being five in number, for example, or in another preferably odd number, in such a way that one of these ribs is located on the centreline of the bottle's bottom and these ribs are oriented perpendicularly compared with the ideal vertical plane on which the crushed part 101' of the top sprue 101 of the bottle lies and are therefore oriented with their longitudinal axis in the same direction as the relative horizontal movement of approach and withdrawal of the two main parts of mould between which the bottle is formed. The ribs 2 have a curved transverse and external profile 102, with an appropriate radius of curvature and the ribs themselves are connected to the bottom face of the bottom 301 with an appropriately radiused line 202, as illustrated in the detail in figure 3a, in order to prevent said cracking phenomena during the cooling stage of the material of which they are composed. The ribs 2 have an intermediate section with substantially parallel sides and substantially constant depth and end with progressively tapered ends and decreasing depth, therefore with a pointed form, placed at the right distance from the perimetric part 401 with which the bottom of the bottle is destined to touch a support surface.

**[0006]** During the same forming stage of the ribs 2, a rib 3 is obtained perpendicularly to them and on the centreline of the bottom of the bottle, which is adjacent to and aligned with the bottom sprue of the bottle itself, and which is composed of a bottom part 103 which is in contact with the bottom of the bottle, and has a depth and external width which are constant for the entire length and with values which are equal to or slightly greater than those of the intermediate sections of said ribs 2, and intersects with and is fixed to these ribs and protudes with short sections 103' from the outer ones of the ribs 2 themselves, as can be seen from figures 2 and 3. On said bottom part 103 and along the entire length, the median rib 3 comprises a median ridge 203 of thickness A limited, for example, to a value of about 1/3 of the width B of the bottom part 103 itself of the rib itself which, seen laterally as in figure 3, has a slightly arched profile which terminates with an appropriate rounded shape at the ends, also rounded, of the bottom part 103 itself of the median rib. One of the functions of the ridge 203 is to further stiffen the median rib 3 while another important function is to disperse heat to guarantee fast and balanced cooling both of the median rib 3 and of the ribs 2 perpendicular to it and structurally linked together.

**[0007]** It can be seen from the detail of figure 4a that the median rib 3 overall has a substantially Y-shaped

cross section and that this is also connected to the bottom 301 of the bottle by its own bottom part 103, with an appropriately radiused external line 303, which prevents all formation of cracks during the cooling stage of the rib 3 itself. The connection zones 403 between the part 103 and that 203 of the rib 3 are also appropriately radiused, while the longitudinal edge 503 of the ridge 203 is also appropriately rounded.

**[0008]** The number 4 in figures 2, 3 and 4 indicates two small recessed impressions on the perimetric support edge of the bottom of the bottle, aligned with the above-mentioned median rib 3 and destined to cooperate with means which are suitable for preventing the rotation of the bottle itself during the stage in which it is being closed at the top by the screw cap.

**[0009]** Figure 5 illustrates the bottom part of a bottle in which, in accordance with a known construction technique, the perimetric support edge 401' of the bottom of the bottle itself has a considerable width in the radial direction. This edge with considerable width can bend downwards and lengthen the bottle in an anomalous and permanent manner during the stage in which it is being closed and the vacuum is being created in it so as to balance the increase of the internal pressure itself caused by the residual heat of the process of thermoforming by blowing. This deformation is indicated by the broken line and also involves the side wall 501 of the bottle which is characterized by a large radius of curvature and by considerable height in the section included between said edge 401' and the first ribbed part 601 of the lateral wall itself of the bottle. The invention is intended to overcome this shortcoming by means of the solution illustrated in figures 1 to 4, according to which the curvature of the bottom 301 is increased compared with the known technology in such a way as to reduce the width of the support edge 401 to a small part with a rounded profile and tangential to the side wall 701 which has a lower radius of curvature R than that of the known technology, which has a height which is also lower than that of the known technology illustrated in figure 5 and which terminates in correspondence with a part 801 of the side wall itself, which is ribbed by a corresponding downward broadening step, all of this in such a way that the wall 701 so realized and linked to parts 401 and 801 has considerable resistance to bending both towards the inside and towards the outside of the bottle, completely overcoming said shortcomings in the known technology.

**[0010]** In the bottle as described, in some particularly extreme conditions of use, it can happen that the zone between the edge 401 and the ends of the ribs 2 and 3 can bend outwards, while the bottom wall 301 drops proportionally. It is possible to overcome this problem with an improved bottle as will now be described with reference to figures 6 to 11. In the bottles 1' with bottoms with a round plan, as in the example in figures 6, 7 and 8, the width of the support edge 401' is greater compared with that 401 of the previous solution as in figures 1 to 3, and this to the detriment of the width of the recessed part of

the bottom 301', which is interested by the reinforcing ribs 2 and 3, which can be lower than that 301 given by the previous solution. The edge 401' is now radiused, with a broad radius of curvature, with the profile of the bottom side wall 701' of the bottle while the internal end of the same edge 401' is connected disjointedly to the spherical cap 301' in the bottom of the bottle, with an edge in truncated cone form 901' the generatrix of which forms an angle  $\alpha$  measuring less than  $90^\circ$  with the horizontal and which preferably falls between  $40^\circ$ - $60^\circ$ , for example about  $48^\circ$ C.

**[0011]** The number 5 indicates the closed boundary line between said truncated cone-shaped edge 901' and the cap 301' in the bottom of the bottle, which consists of a circumference in this example. The reinforcing ribs 2 are placed with their ends almost touching said circumference 5 and are distributed with a reciprocal distance greater than that of the previous solution shown in figures 1-3, in such a way that their ends 103' protruding from the diametric rib 3 are also at a short distance from said circumference 5. In the new solution discussed here, the distancing pitch between the ribs 2 is substantially equal to the value which one obtains by dividing the diameter of the circumference 5 by the number of ribs themselves, so that the distance between the outermost ribs 2 compared with the zones of the circumference 5 which are near the recesses 4 is substantially equal to the pitch between the ribs 2 themselves.

**[0012]** The improvements described with reference to figures 6-8 are valid for all the bottles with bodies with a round section or with a regular polygonal section tending towards a round section. In the case in which the section of the bottle 1' is substantially square, with rounded sides and corners, as in the example in figure 6, this same section is connected to the part of bottom which comprises the edge 401', with a corresponding part 10 with a square plan, with appropriately rounded corners and sides, which is inscribed in the section of the body of the bottle 1' and which is rotated  $90^\circ$  compared to it.

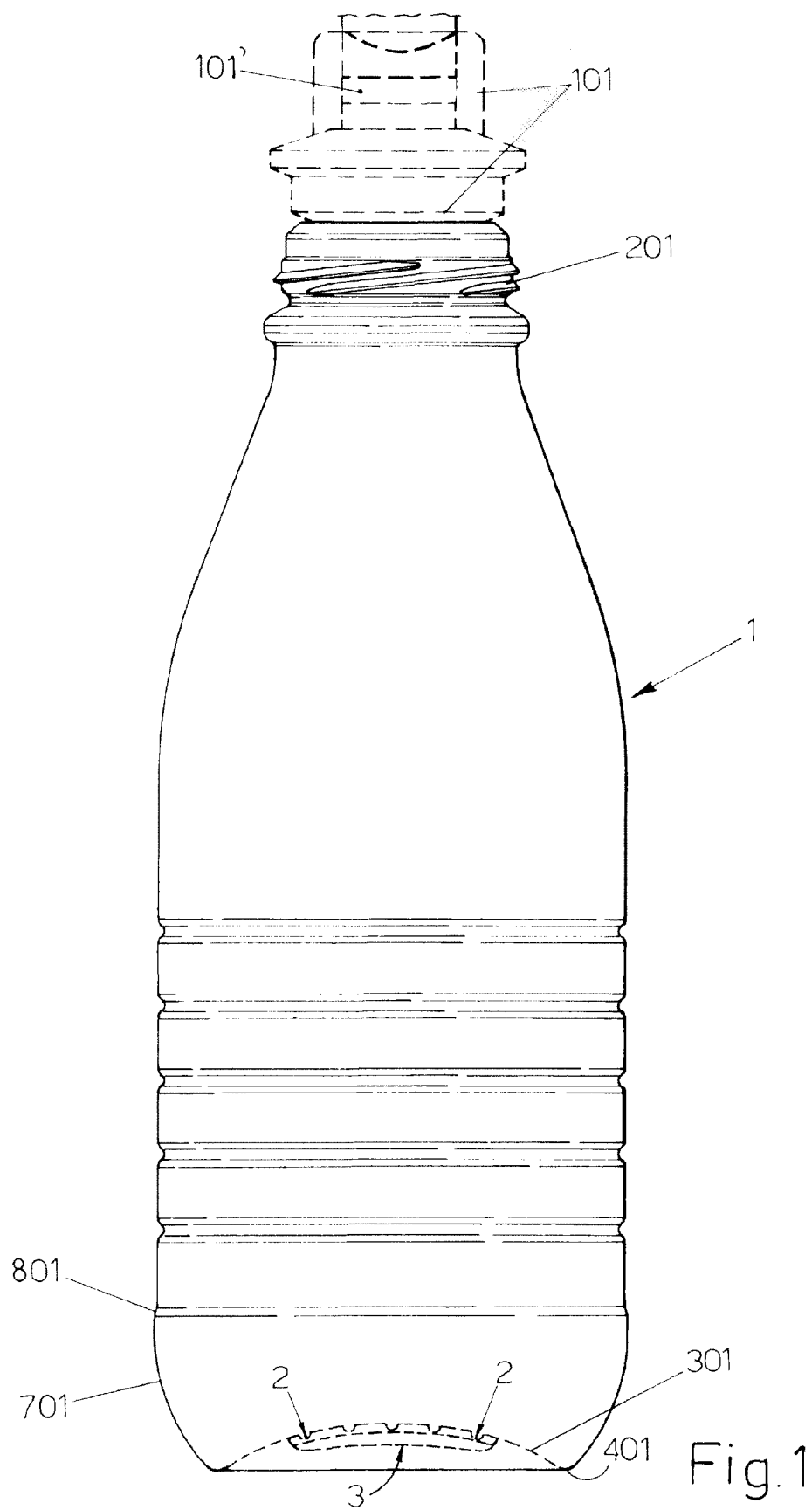
**[0013]** When the bottom of the bottle 1" has an oval plan, as in the example in figures 9-11, the bottom support edge 401" of the bottle itself has a profile and an external connection to the bottom side wall 701" which are very similar to those of the previous solution referred to in figures 1-3, but in this case also the support edge 401" is connected internally to the arched bottom wall 301", now with an oval plan, with an inclined edge 901" whose generatrix, in correspondence with the recesses 4, forms an angle  $\alpha'$  of about  $45^\circ$ - $50^\circ$ , of about  $48^\circ$  for example (fig. 10), with the horizontal, while in correspondence with the ends of the equatorial rib 2, the generatrix of the same edge 901" forms an angle  $\alpha''$  of about  $50^\circ$ - $55^\circ$ , of about  $53^\circ$  for example (fig. 11), with the horizontal.

**[0014]** As far as the positioning of the ribs 2 and 3 compared with the boundary line 5 of the inclined edge 901" is concerned, what has already been said for the solution referred to in figures 6-8 is valid.

## Claims

1. Bottle made of plastic material with reinforced bottom, produced by blowing and particularly suitable for the sterile packaging of liquid foodstuffs, cosmetics or for other uses, **characterized in that** in the bottle-forming stage in the special mould parts, first linear ribs (2), in relief outwards, parallel with one another, arranged symmetrically with a curved external profile (102), and oriented perpendicularly compared with the ideal vertical plane on which the crushed part (101') of the top sprue (101) of the bottle lies, are obtained on the bottom (301), raised and with the form of a spherical cap of the bottle itself, while at least one second rib (3) is obtained during the same forming stage as said first ribs (2), perpendicularly to them and at least on the centreline of the bottom of the bottle, this second rib being adjacent to and aligned with the bottom sprue of the bottle itself and being composed of a bottom part (103) in contact with the bottom of the bottle, and intersecting and being fixed to said first ribs (2) and protruding with short end sections (103') from the outer ones of the first ribs themselves (2), and this second rib (3) comprising bottom part (103) on said and along the entire length, a median ridge (203) with limited thickness, with stiffening and heat dispersion functions.
2. Bottle according to Claim 1), in which said ridge (203) of said second median rib (3) has a thickness with a value of about  $1/3$  of the width of the bottom part (103) of the rib itself (3).
3. Bottle according to Claim 1), in which said ridge (203) of the second median rib (3) has a slightly curved and outwardly concave profile laterally, with an appropriately rounded shape on its ends, these also being rounded at the bottom part (103) of the rib (3) itself.
4. Bottle according to Claim 1), in which said first parallel ribs (2) are, for example, five in number or another preferably odd number, in such a way that one of these is located on the centreline of the bottom of the bottle.
5. Bottle according to Claim 1), in which said first parallel ribs (2) have an intermediate section with sides which are substantially parallel and with a substantially constant depth and terminate with progressively tapered ends with decreasing depth, therefore with a pointed form, located at the right distance from the perimetric part (401) with which the bottom of the bottle is destined to touch a support surface, while said second median rib (3) has a bottom part (103) with a depth and external width with constant values, equal to or slightly greater than those of the intermediate sections of said first parallel ribs (2).

6. Bottle according to Claim 1), in which said first parallel ribs (2) have a curved profile which is connected to the bottom face of the bottom (301) of the bottle with an appropriately radiused line (202), and the bottom part (103) of said second median rib (3) also has an appropriately curved external profile connected to the bottom of the bottle with an appropriately radiused line (303), all for the purpose of preventing the formation of cracks during the cooling stage of the ribs in question.
7. Bottle in accordance with Claim 1), in which the connection zones (403) between the bottom part (103) and the ridge (203) of said second median rib (3) are also appropriately radiused, while the longitudinal edge (503) of the ridge (203) itself is also appropriately rounded.
8. Bottle in accordance with Claim 1), **characterized by** having a bottom (301) with a broad radius of curvature in such a way as to reduce the width of the perimetric support edge (401) of the bottom itself to a small part with a rounded profile and tangential to the side wall (701) of the bottle, which has a curvature radius (R) of limited value, which also has a height of limited value and which terminates in correspondence with a part (801) of the side wall itself, which is ribbed by a corresponding downward broadening step, all of this in such a way that said wall (701) so realized and linked to said parts (401, 801) has considerable resistance to bending, both towards the inside and towards the outside of the bottle.
9. Bottle in accordance with one or more of the preceding claims, **characterized in that** the bottom support edge (401', 401'') of the bottle itself which is connected externally with appropriate rounding to the contiguous side wall (701', 701''), is connected internally to the raised and arched bottom (301', 301'') of the bottle itself, with an inclined edge (901', 901'') whose generatrix forms an angle ( $\alpha$ ,  $\alpha'$ ,  $\alpha''$ ) between 90° and 40° with the horizontal.
10. Bottle in accordance with Claim 9), **characterized in that** in bottles with bottoms (301, 301') with a round plan and with bodies with a section which is round or regular polygonal tending to round, the generatrix of said inclined edge (901') forms an angle ( $\alpha$ ) between 40-60° with the horizontal, of about 48° for example.
11. Bottle in accordance with Claim 10), **characterized in that** in bottles with bottoms (301, 301') with a round plan, the width of the bottom support edge (401') is greater compared with that (401) of the previous solution referred to in Claims 1) to 8), and this to the detriment of the width of the recessed part of the bottom (301') which is interested by the reinforcing ribs (2, 3), which can be lower than that given by said previous solution.
12. Bottle in accordance with Claim 10), **characterized in that** in bottles with bottoms (301, 301') with a round plan, the bottom support edge (401') is radiused with a broad radius of curvature with the profile of the bottom side wall (701') of the bottle itself.
13. Bottle in accordance with Claim 12), **characterized in that** if the section of the bottle itself 1' is substantially square, with rounded sides and corners, this same section is connected to the part of bottom which comprises the support edge (401'), with a corresponding part (10) with a square plan, with appropriately rounded corners and sides, which is inscribed in the section of the body of the bottle (1') and which is rotated 90° compared to it.
14. Bottle in accordance with Claim 9), **characterized in that** in bottles with bottoms (301 ") with an oval plan, the bottom support edge (401 ") is connected to said arched bottom wall (301''), with an inclined edge (901'') whose generatrix, in correspondence with the recesses (4), forms an angle ( $\alpha'$ ) of about 45°-50°, of about 48° for example with the horizontal, while in correspondence with the ends of the equatorial rib (2), the generatrix of the same edge 901'' forms an angle ( $\alpha''$ ) of about 50°-55°, of about 53° for example, with the horizontal.
15. Bottle in accordance with one or more of Claims 9) to 14), in which the closed boundary line (5) between said inclined edge (901', 901'') and the arched recessed bottom (301', 301'') of the bottle itself, substantially touches the ends of the multiple reinforcing ribs (2) which are distributed with a pitch which is substantially equal to the value obtained by dividing the width of the space circumscribed by said closed line (5) in the direction perpendicular to said ribs, by the number of the ribs (2) themselves, all in such a way that the ends (103') of them protruding from the diametric rib (3) are also at a short distance from said closed boundary line (5).



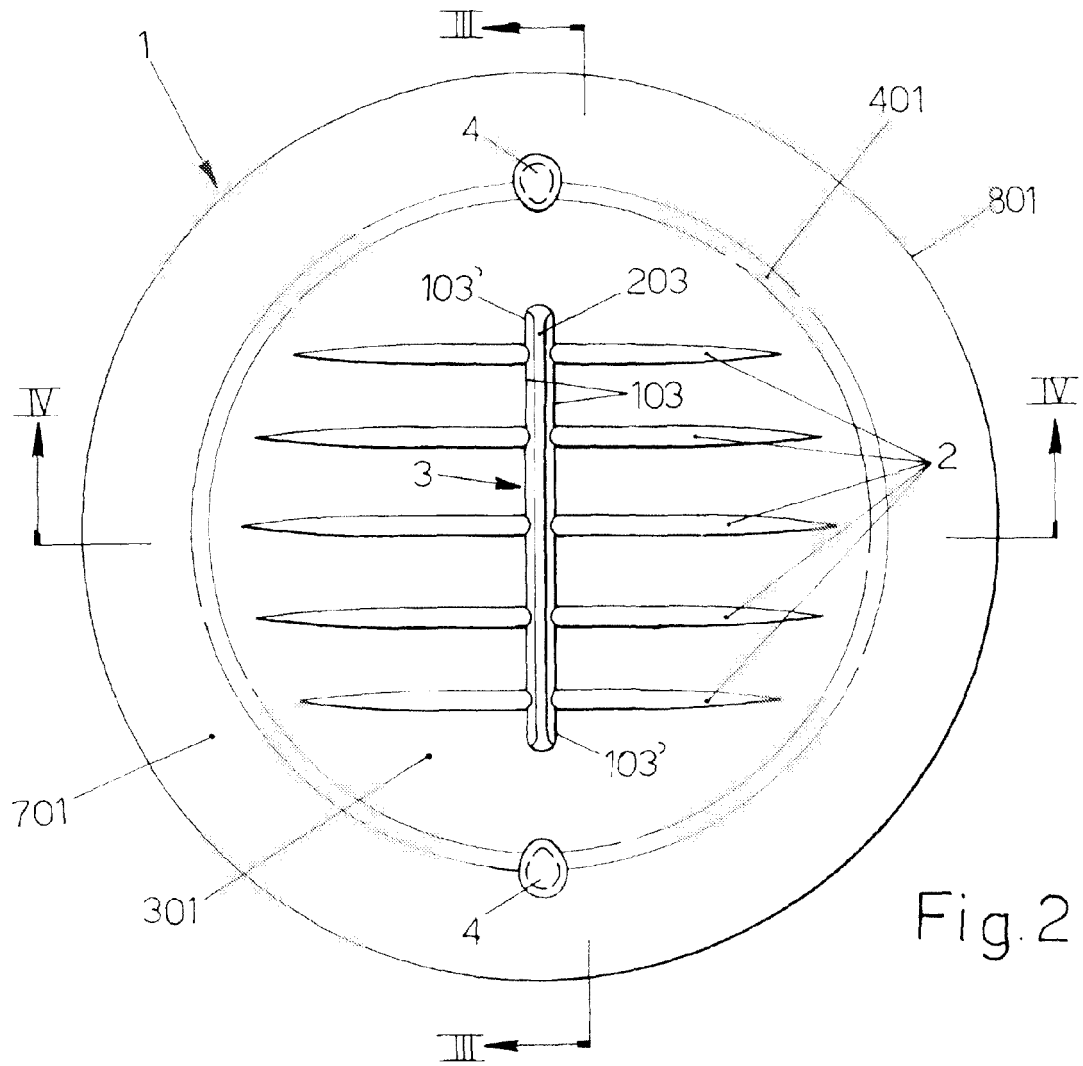


Fig. 2

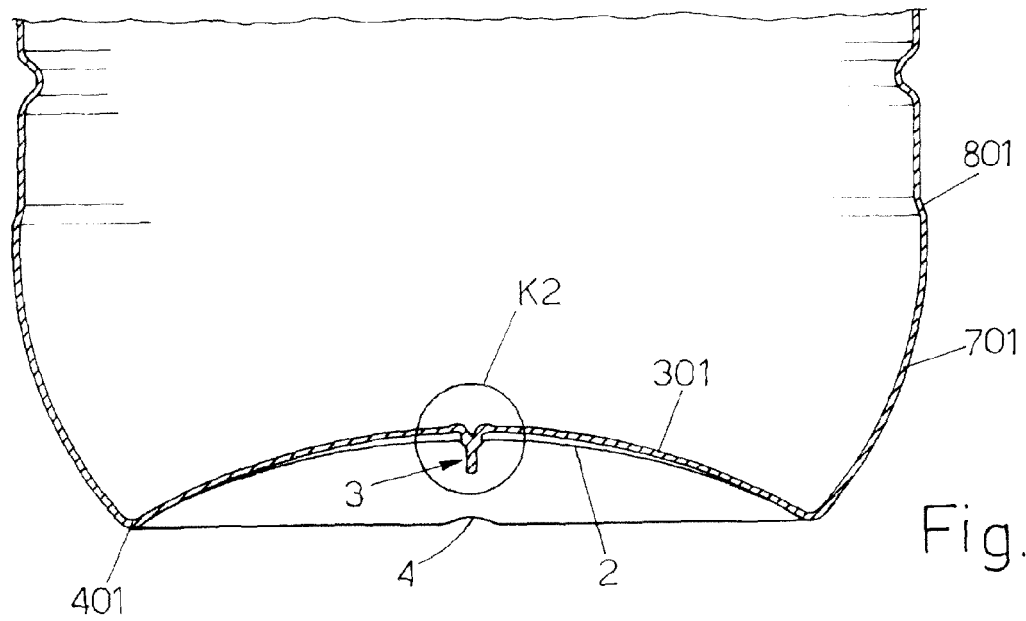
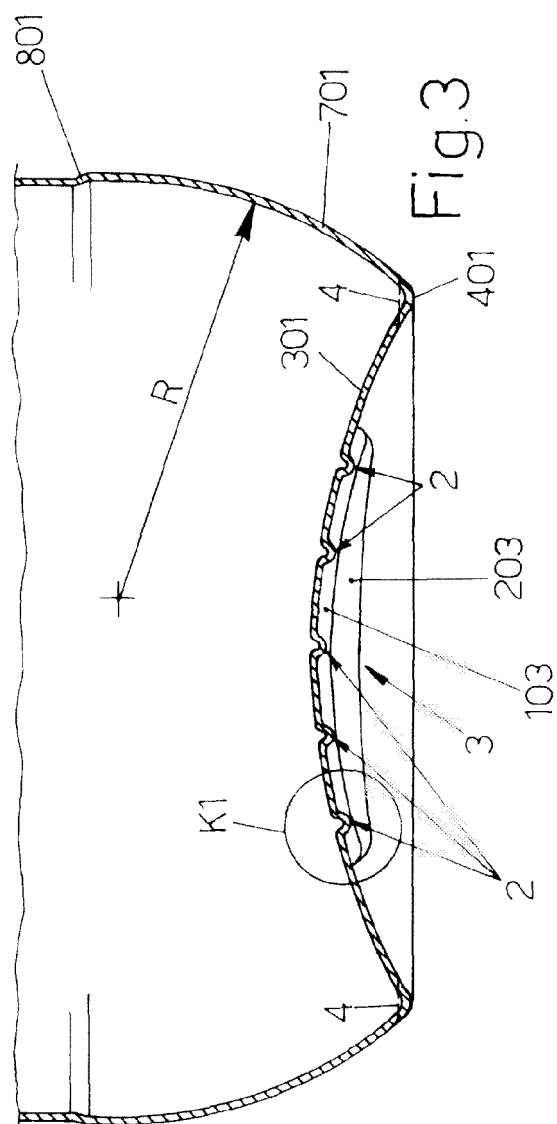
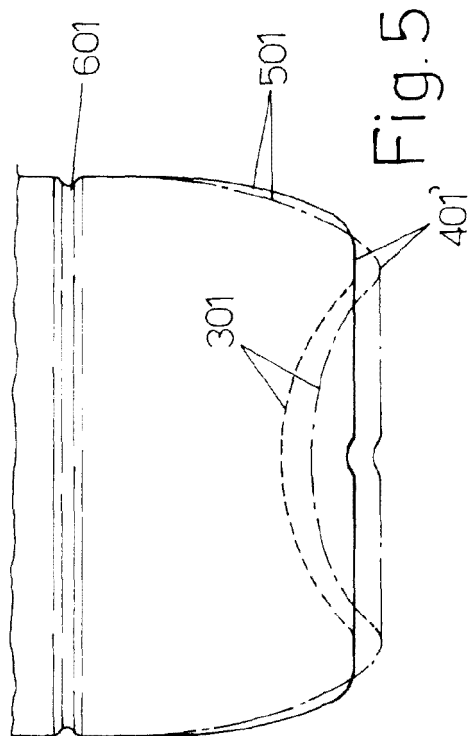
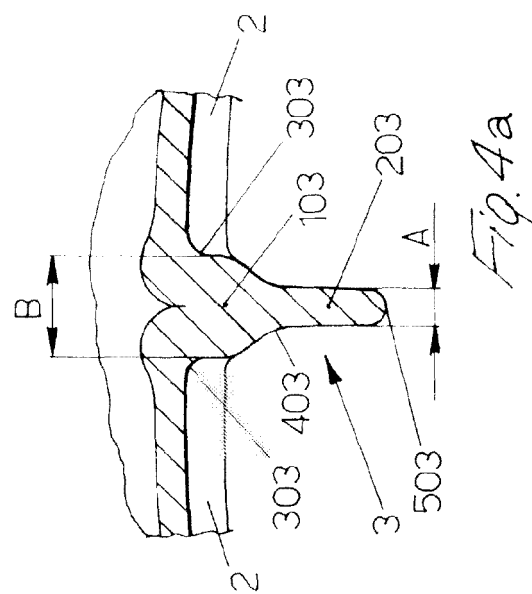
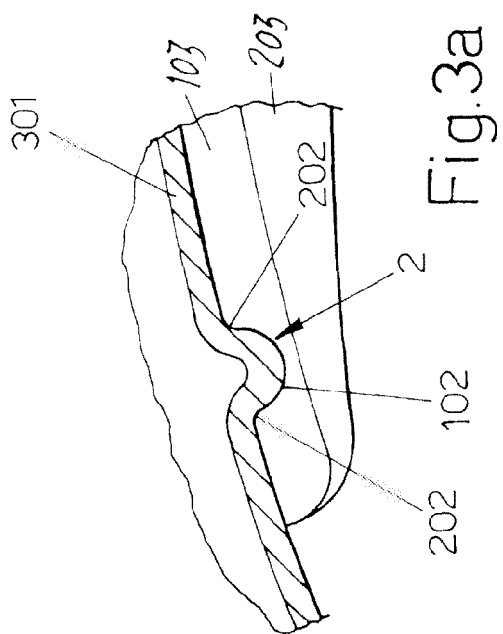
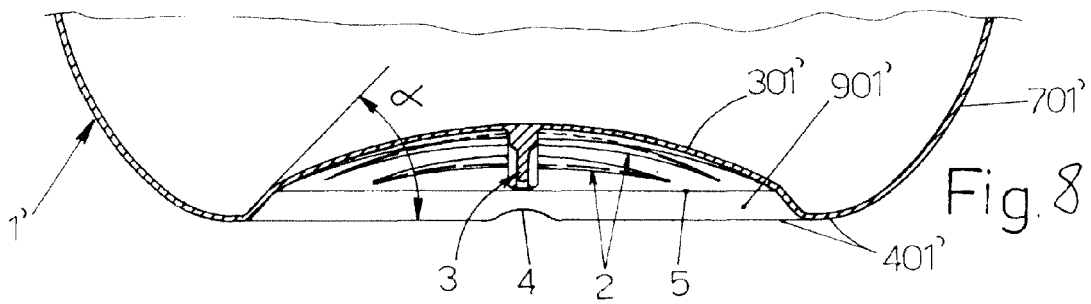
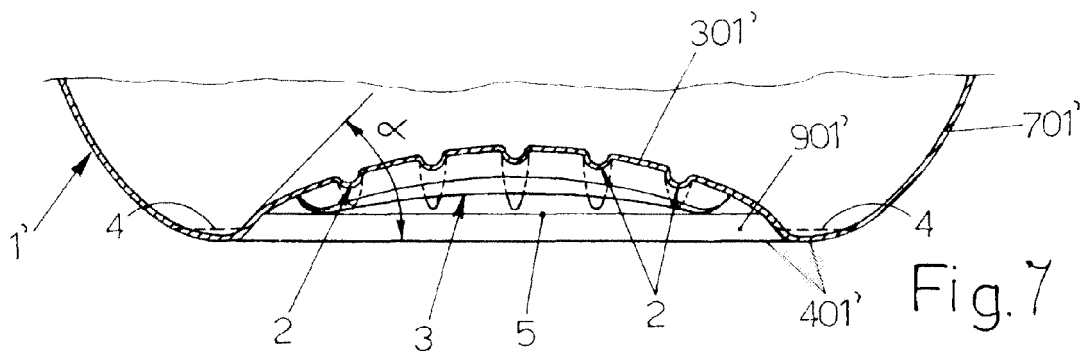
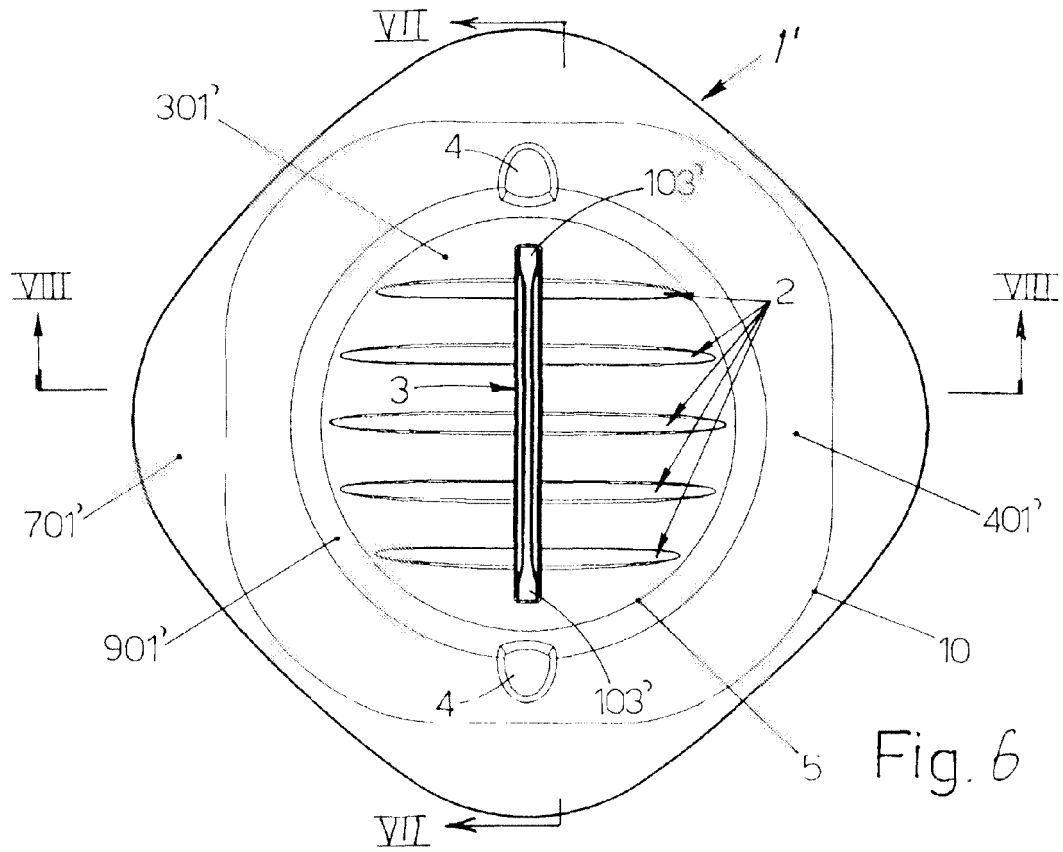
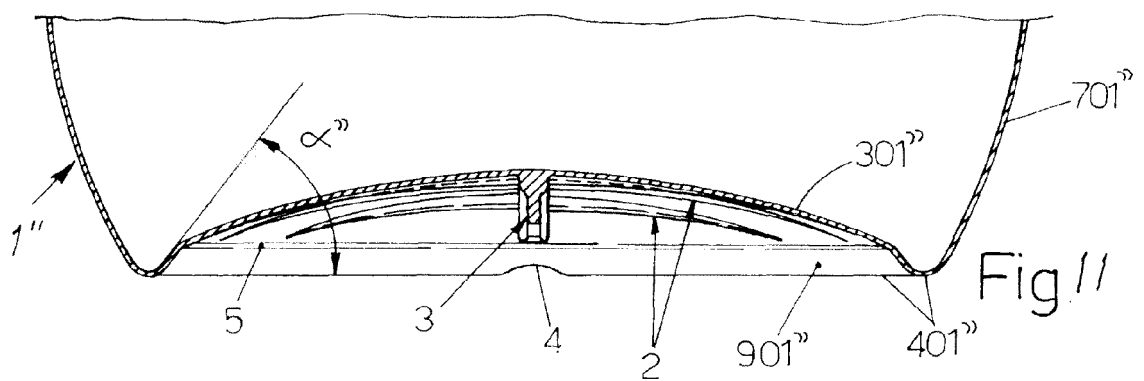
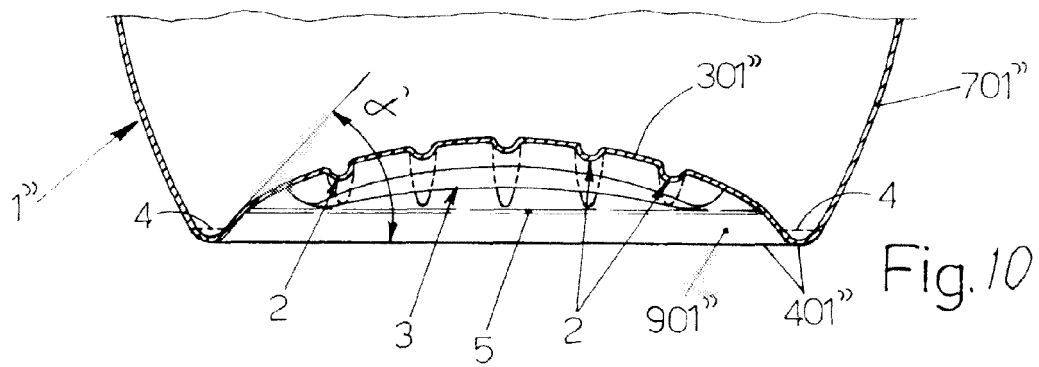
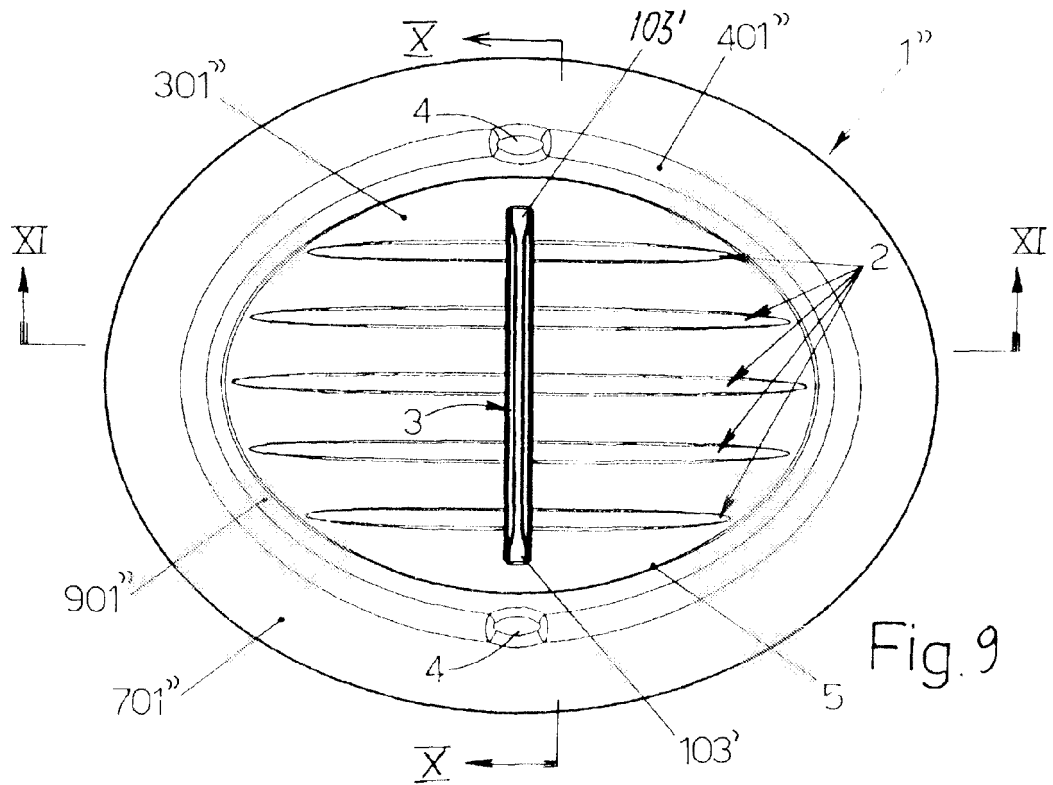


Fig. 4











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# EUROPEAN SEARCH REPORT

Application Number  
EP 06 11 1001

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 3 403 804 A (COLOMBO ROBERTO) 1 October 1968 (1968-10-01) * column 3, line 43 - line 51; figures 1-6 *	1-15	INV. B65D1/02
A	----- EP 0 422 436 A (GENERAL ELECTRIC COMPANY) 17 April 1991 (1991-04-17) * column 3, line 6 - line 18; figures 1-4 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 June 2006	Examiner Derrien, Y
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... &amp; : member of the same patent family, corresponding document</p>			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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