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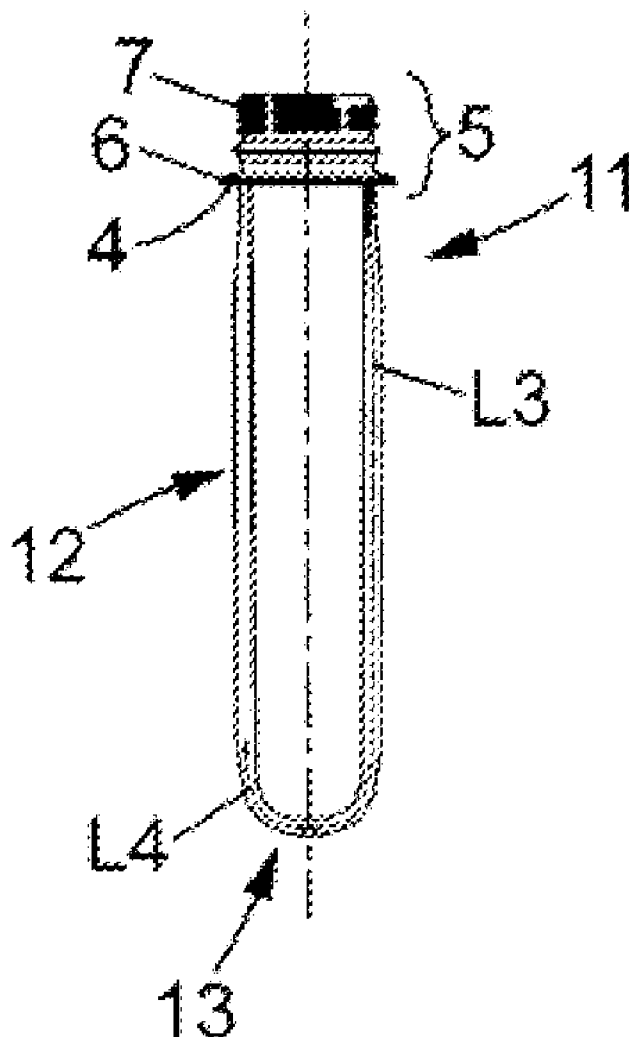
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Bunel et al.(10) **Pub. No.: US 2014/0030461 A1**(43) **Pub. Date: Jan. 30, 2014**(54) **BOTTOM OF PREFORMS****Publication Classification**(75) Inventors: **Christophe Bunel**, Octeville-sur-mer
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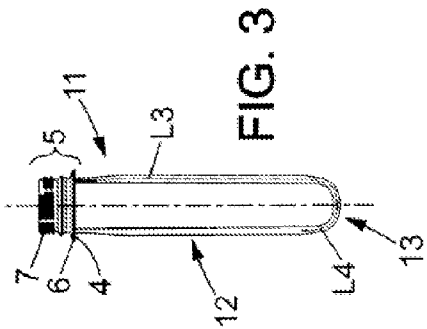
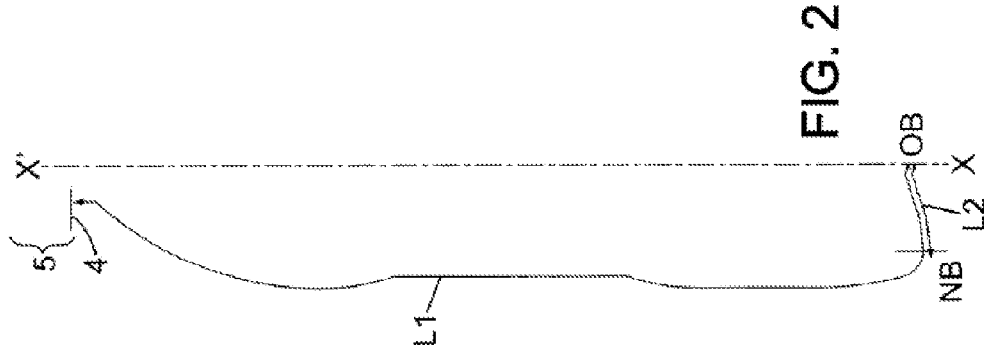
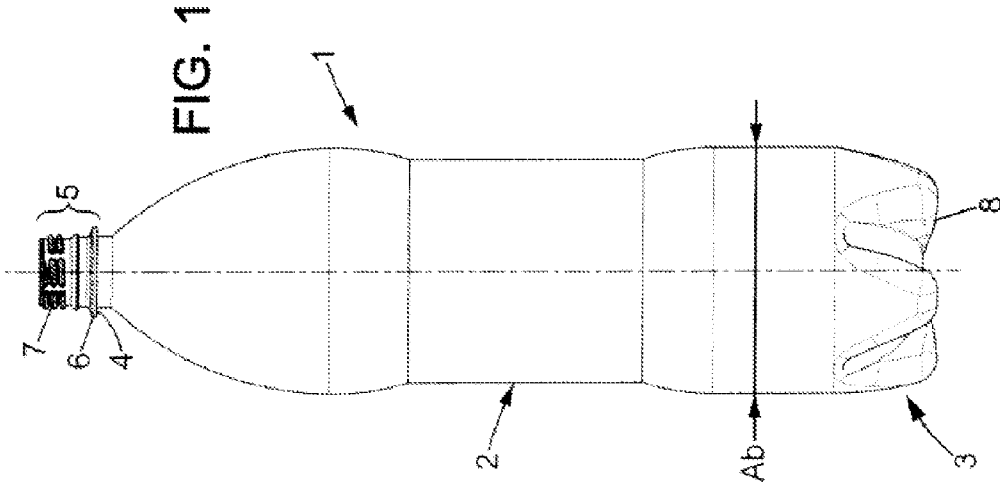
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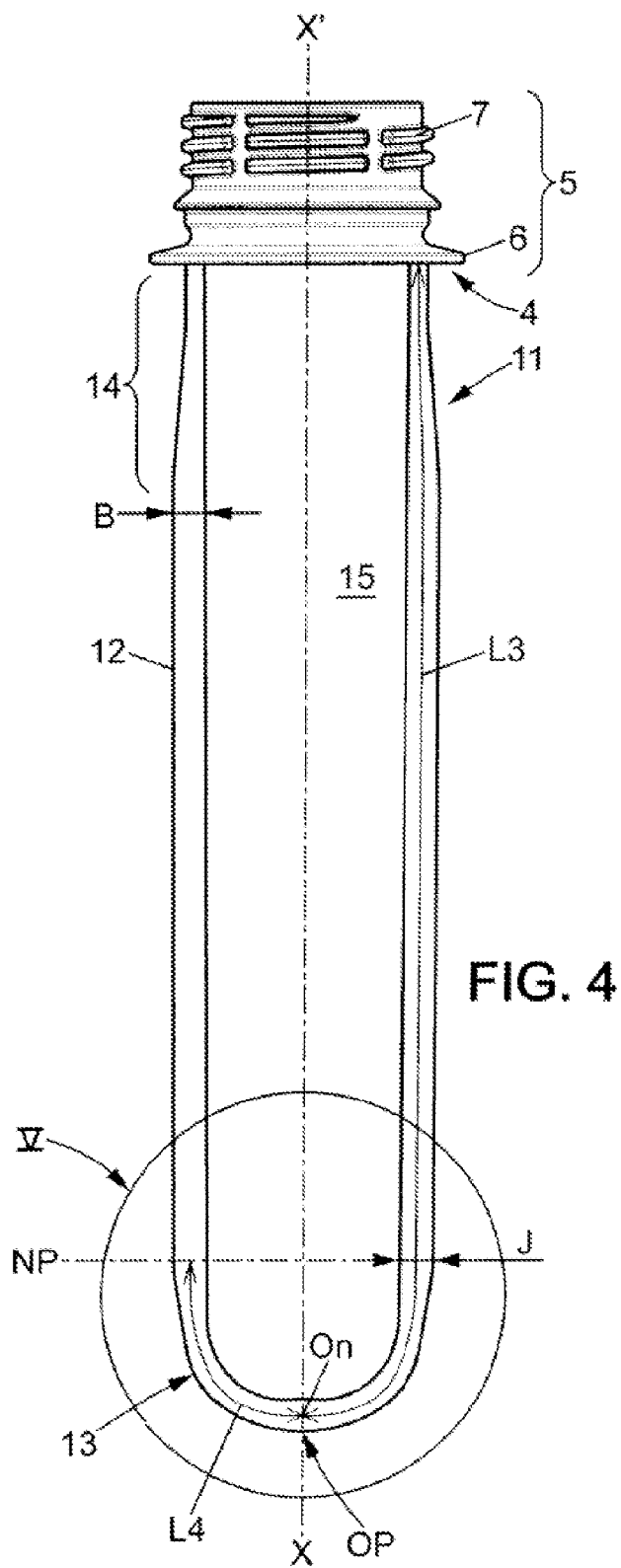
(2), (4) Date: **Oct. 9, 2013**(30) **Foreign Application Priority Data**

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The invention relates to a preform which includes, centred on a single axis xx': a neck (5), a cylindrical body (12), and a sealed spheroidal bottom (13), and is defined relative to the dimensions of a predefined bottle model (1) which includes: a bottom (3), a body (2) and a neck (5), said neck (5) of said bottle model (1) being identical to the neck of said preform (11).







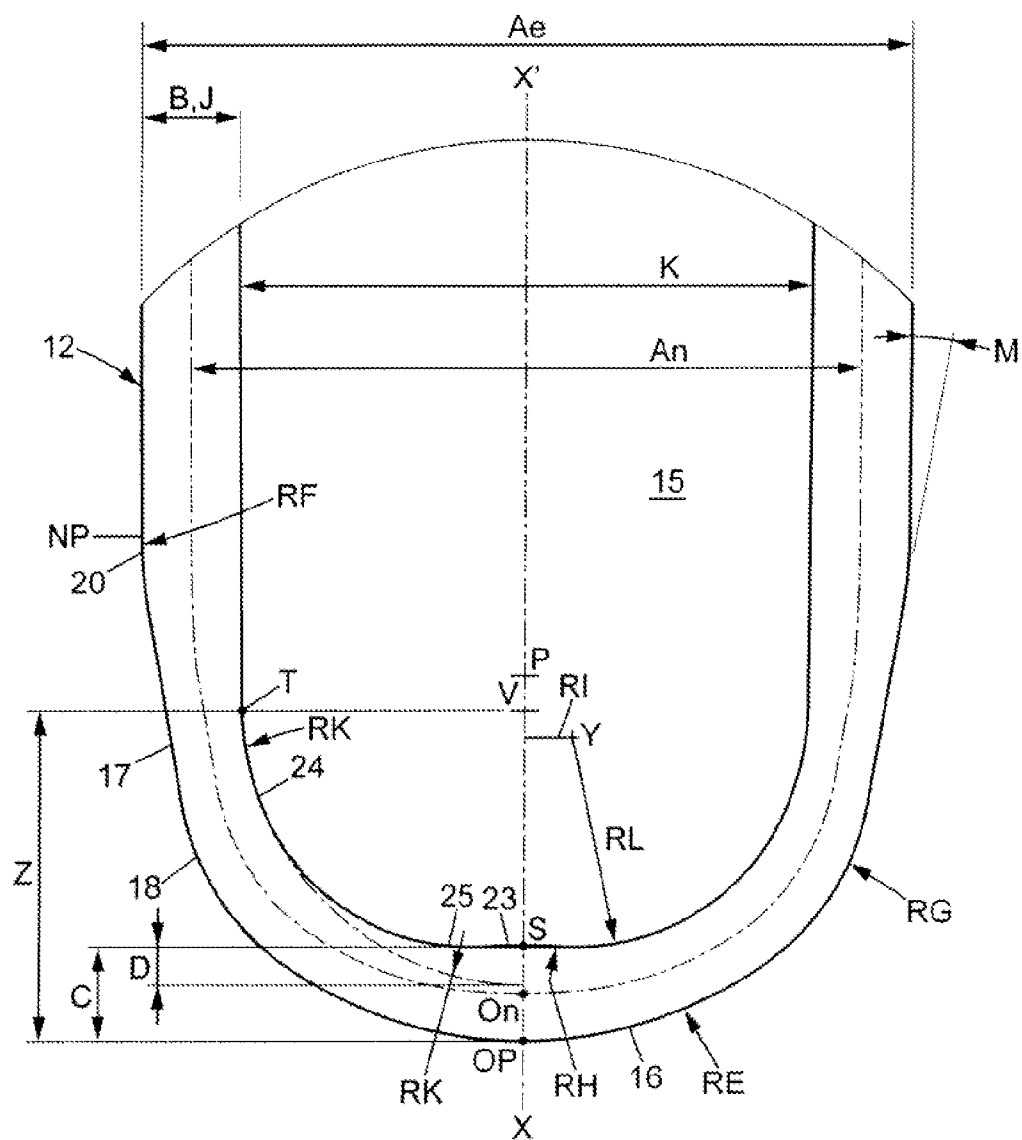


FIG.5

BOTTOM OF PREFORMS

[0001] The invention relates to preforms made of thermoplastic and used for the production of bottles; it more particularly relates to an improvement to the bottom of these preforms.

[0002] Conventionally, the bottom of a preform is hemispherical in appearance and the external central portion of this hemisphere corresponds to the point where material is injected during the manufacture of said preform.

[0003] As for the internal central portion of the hemisphere, this is the location which accepts the end of the stretch rod used to stretch the preform in the mold during the stretch-blow molding operation, and it is around this central portion that the biaxial expansion of the thermoplastic material occurs, such that the center of the central hemispherical portion of the preform corresponds to the center of the central portion of the bottom of the molded bottle.

[0004] There is a fragile area around this central portion of the bottom of the molded bottle which is a source of defects, particularly in bottles of moderate and high capacity (typically 1 to 5 liters). The bottom of the bottle is the site of fissuring phenomena and the bottle may rupture between the central portion where the material is amorphous and the periphery of this portion which corresponds to its base, where the material is expanded biaxially.

[0005] These defects are even more noticeable when bottles having a relatively complex bottom are concerned, such as bottles with a petaloid bottom.

[0006] The invention proposes an arrangement of the bottom of the preform which takes into account data related to both the definition of the bottle model that one wishes to obtain and to the definition of this preform, said arrangement providing, after the operation of stretch-blow molding said preform, a transition area on the bottom of the molded bottle which is less subject to fissuring phenomena between the central portion of said bottom of this bottle and the part which constitutes its base.

[0007] This preform comprises, centered on a single axis xx' :—a neck,—a cylindrical body, and—an enclosed bottom that is spheroidal in shape, said preform being defined relative to the dimensions of a pre-established bottle model which comprises: a bottom, a body, and a neck, said neck of said bottle model being identical to the neck of said preform,

[0008] said cylindrical body of this preform is determined by:—its outside diameter A_e ,—its mean diameter A_m measured at the neutral axis of the wall of said cylindrical body, and—its inside diameter K , and

[0009] said cylindrical body as well as said spheroidal bottom of said preform are determined by half-lengths which are measured along the neutral axis of their wall:—a half-length L_3 which extends from the connection between said neck and said cylindrical body to the center of said bottom of said preform and in particular to point O_n of said bottom which is located at the intersection of said neutral axis and of said axis xx' , and—a half-length L_4 which extends from said center O_n to a point N_P which is located at the connection between said cylindrical body and said bottom of said preform,

[0010] said diameter A_m is determined by applying, to the value of the maximum diameter A_b of the body of said pre-established bottle model, a reduction ratio chosen from among values which range from 3.7 to 4.5, due to the biaxial orientation;

[0011] said half-length L_3 is determined from half-length L_1 of said bottle model by applying to the value of this half-length L_1 a reduction ratio that is also related to the biaxial orientation and which is chosen from among values ranging from 2.8 to 3.5, and

[0012] said half-length L_4 corresponds to half-length L_3 multiplied by twice the value of the ratio between half-length L_2 of said bottle model and half-length L_1 of its base, in other words the value of $L_4 = 2 \times (L_3) \times (L_2/L_1)$, and said half-length L_2 of the base corresponds to the mean radius of the base of the bottom of said bottle,

[0013] and, starting from the position of point N_P , which is determined from L_4 :

[0014] the external contour of said preform between point N_P and the external central point O_P of the bottom of said preform, located on axis xx' , is defined starting from this point O_P , said point O_P being located at a distance from point O_n which corresponds to half the thickness C of said bottom of the preform and its value, described below, being in relation to the thickness B of the wall of the cylindrical body, measured near its neck,

[0015] said external contour of said preform is defined as follows:

[0016] starting from said central point O_P , said external contour is in the form of the spherical cap which is generated by an arc of a circle having its center P located on axis xx' , at a distance from said central point O_P which corresponds to a radius RE of which the value, described below, is in relation to the outside diameter A_e of said preform, and

[0017] starting from point N_P , said external contour is delimited by a tapered surface which starts at said point N_P and which extends towards said spherical cap, and which has its tip on said axis xx' , beyond said central point O_P and external to said bottom of said preform, said tapered surface forming a half-angle M at the top which is chosen to allow said tapered surface to be secant to said spherical cap generated by the arc of a circle of radius RE , and

[0018] still for this external contour of said preform, the connection between said spherical cap of radius RE and said tapered surface consists of a toroidal ring generated by an arc of a circle of radius RG , and the surface of said toroidal ring is tangent to said spherical cap and to said tapered surface, and said radius RG , described below, is in relation to the outside diameter A_e of said preform, and

[0019] the internal contour of said bottom of said preform extends from the end of the envelope of the pseudo-cylindrical inner cavity of the body of said preform to the central point S located on axis xx' , said central point S being positioned at a distance C from said central point O_P , measured on said axis xx' , of which the value, described below, is in relation to the thickness B of the wall of said body of said preform, said internal contour of said bottom being defined as follows:

[0020] starting from said point S , said internal contour is generated by an arc of a circle of radius RH of which the center, positioned on said axis xx' , is located beyond the bottom, externally to said preform, so as to form a central rounded portion in the shape of a spherical dome, said radius RH , described below, being in relation to the outside diameter A_e of the preform, and

[0021] starting from a point T which is located at the end of the envelope of said pseudo-cylindrical inner cavity of the body of said preform, for which the position is defined below, said internal contour comprising a spherical surface generated by an arc of a circle of radius RK of which the length is equal to half the inside diameter K of said preform and the center V of this arc of a circle of radius RK is located on axis xx'; said point T is located at the same level as said center V, meaning that its projection onto axis xx' coincides with the center V, and the distance Z between this center V and point OP of the bottom of said preform corresponds to $\frac{1}{2}K + (C - D)$, meaning to half the inside diameter K of said preform, plus the thickness C of said bottom of said preform, measured along axis xx', and minus a thickness D which corresponds to the difference between radius RK and the distance separating the center V of the arc of this radius RK relative to central point S, said value of D being defined below as a function of the thickness B of the wall of the cylindrical body of said preform, and

[0022] still for this internal contour of said bottom of said preform, the connection between said spherical dome of radius RH and said spherical surface created by the arc of a circle of radius RK, consists of a toroidal annular surface created by an arc of a circle of radius RL which is located in a generating plane passing through axis xx' and having its center Y located between said central point S and said point V, in a plane perpendicular to said axis xx', said center Y being positioned on a circle centered on said axis xx' and having a radius RI for which the value, described below, is established as a function of the outside diameter Ae of said preform, and

[0023] both for the internal contour and for the external contour of said bottom of said preform, the values of RE, M, RG, RH, RK, RL, D, RI, and C are determined in the following manner:

- [0024] for RE: $0.5 \times Ae < RE < 0.7 \times Ae$,
- [0025] for M: $5^\circ < M < 20^\circ$,
- [0026] for RG: $0.25 \times Ae < RG < 0.5 \times Ae$,
- [0027] for RH: $0.7 \times Ae < RH < 1.3 \times Ae$,
- [0028] for RK: $RK = \frac{1}{2}K$,
- [0029] for RL: $0.6 \times RK < RL < RK$,
- [0030] for D: $0.2 \times C < D < 0.6 \times C$,
- [0031] and for RI: $0.05 \times Ae < RI < 0.1 \times Ae$,

where:

- [0032] Ae is the outside diameter of the body of said preform;
- [0033] B corresponds to the thickness of the wall of the body of said preform at the start of its cylindrical portion;
- [0034] C corresponds to the thickness of the wall of said preform at its bottom, along its axis xx', with, for C: $B < C < 1.1 \times (B)$;
- [0035] K is the inside diameter of the pseudo-cylindrical cavity of the cylindrical body, at the bottom of said preform.

[0036] Still according to the invention, for the external contour of the bottom of the preform, the connection between the envelope of the outside cylindrical body and the envelope of the tapered surface, at point N, is in the form of a curved surface of which the radius RF corresponds to $\frac{1}{2} \times (Ae)$ and may be of the same order as the radius RE of the spherical cap

which forms the external contour of said bottom, said circular curved surface being such that it is tangent to said outside cylindrical envelope and said tapered section and acts to soften the edge at said connection point N.

[0037] In a preferred arrangement of the invention, the radius RE of the spherical cap of the external contour of the preform is on the order of $0.53 \times (Ae)$.

[0038] In another preferred arrangement of the invention, the half-angle M of the tapered portion of the external contour is on the order of 10° .

[0039] In another preferred arrangement of the invention, the radius RG of the toroidal area of the external contour of the preform, which extends between the spherical surface and the tapered envelope, is on the order of $0.32 \times (Ae)$.

[0040] In another preferred arrangement of the invention, the radius RH of the small central spherical cap of the internal contour of the preform is substantially equal to $\frac{1}{2} \times (Ae)$, meaning to half the outside diameter Ae of its cylindrical body.

[0041] In another preferred arrangement of the invention, the radius RL of the toroidal area of the internal contour of the preform, which acts as the connection between the spherical area, which begins at the lower end of the inside cylindrical envelope, and the small central spherical cap, is on the order of $0.8 \times (K/2)$.

[0042] In another preferred arrangement of the invention, for the radius RI of the circle which is traced by the center Y of the arc of the circle generating the toroidal area acting as the connection between the spherical area, which begins at the lower end of the inside cylindrical envelope, and the central spherical cap, said radius RI has a value on the order of $0.07 \times (Ae)$.

[0043] In another preferred arrangement of the invention, the construction thickness D of the wall of the bottom of the preform, along its axis xx', is on the order of $0.41 \times (C)$.

[0044] In another preferred arrangement of the invention, the thickness C of the preform along its axis xx' is on the order of $1.02 \times (B)$.

[0045] The invention is detailed in a sufficiently clear and complete manner in the following description to allow its execution, accompanied by drawings in which:

[0046] FIG. 1 represents a bottle model which can be obtained from a preform according to the invention by a stretch-blow molding operation;

[0047] FIG. 2 represents what is referred to as the half-length L1 of the bottle and half-length L2 of the base of said bottle;

[0048] FIG. 3 represents a preform which is proportioned relative to the bottle model represented in FIG. 1;

[0049] FIG. 4 is a preform enlarged to show what is referred to as the half-length L3 of the preform and half-length L4 of the bottom of said preform;

[0050] FIG. 5 is an enlargement of the bottom of the preform to show the details of its internal contour and external contour as well as the details of the curve construction that generates these contours.

[0051] The bottle model 1, represented in FIG. 1, comprises an elongated body 2 which extends between a bottom 3 and its connection 4 with a neck 5. The bottom 3 which is represented is a relatively complex petaloid bottom. The neck 5 of the bottle, which corresponds to that of the preform used to produce it, conventionally and in the example illustrated comprises a collar 6 immediately above its connection 4 with the body 2; said neck 5 is arranged to have means 7, threading in

this case, for accepting closure means (not represented) of the screw cap type. The collar 6 serves for the transport and/or retention of the container 1, or of the preform which is used to produce it, during certain steps in the production or packaging. However, for certain applications, collarless containers and therefore collarless preforms are possible and their transport and/or retention are achieved in other ways, the neck then having the primary function of accommodating the closure means. The bottom 3 comprises a base 8 consisting of several support points or areas.

[0052] During the design of the bottle 1 model, several dimensions are defined: its maximum diameter Ab in the body 2, said maximum diameter Ab being generally located in the lower portion of the body 2, above the bottom 3; also defined for this bottle 1 is a dimension referred to as half-length $L1$, represented in FIG. 2, and a dimension referred to as half-length $L2$, measured at the base 8. These half-lengths $L1$ and $L2$ are taken (measured) along the neutral axis of the wall of the bottle 1 model.

[0053] Half-length $L1$ extends between the center OB of the bottom and the connection 4 between the neck 5 and the body 2 of the bottle model 1. Dimension $L2$ at the base 8 extends between the center OB of the bottom of the bottle model 1 and point NB which corresponds to the centroid of the area of the base 8 of said bottle 1; in other words, half-length $L2$ corresponds to the mean radius of the supporting area of the petaloid bottom 3.

[0054] These half-lengths $L1$ and $L2$ of the bottle model 1 are used to delimit the contour of the preform 11, FIG. 3, from which said bottle 1 will be created by a conventional stretch-blow molding operation.

[0055] This preform 11 is represented in FIG. 3 in proportions relative to the bottle model 1 of FIG. 1, and it is additionally represented in FIGS. 4 and 5 at a larger scale to show the details of its internal and external contours.

[0056] As represented in FIG. 3, the preform 11 consists of:—a body 12 that is cylindrical in shape,—a bottom 13 that is generally spheroidal in appearance,—a neck 5, equipped in this example with a collar 6 just above its connection 4 with the body 12, said neck 5 being identical to that of the bottle model 1 represented in FIG. 1. In fact the neck 5, meaning the portion consisting of means 7 provided for receiving a cap and the collar 6 when it is present, is not modified during the container shaping steps. It is only the portions of the preform 11 located below the connection 4 of the neck 5 with the body 12 which are modified.

[0057] Depending on the capacities and shapes of the resulting bottle 1, one may also find a tapering area 14 between the cylindrical body 12 and the connection 4 with the neck 5; in this tapering area 14, the thickness of the wall of the preform 11 varies between said connection 4 and said cylindrical body 12; for the embodiment represented in FIG. 4 it increases in thickness from the connection 4 towards the body 12.

[0058] Considering the undercut necessary for unmolding the preform 11, the inside cavity 15 of this preform 11 is more pseudo-cylindrical; the thickness of the wall of the body 12 varies, and for the dimensional definition of the preform relative to the bottle model 1, two values of this thickness are used:—the thickness B of the wall at the start of the cylindrical portion of the body 12, and—the thickness J at the start of the internal contour of the bottom 13 of the preform 11. This thickness J is defined in the following manner, relative to B : $0.9 \times (B) < J < 1.2 \times (B)$, preferably with $J = 1.05 \times (B)$. As for the

thickness B , it is defined by taking into account the desired dimensions and weight of the bottle 1, said weight corresponding to that of the preform 11.

[0059] Similarly to the bottle 1 model, the preform 11 is also defined with dimensions measured at the neutral axis of its wall. Thus we find, as represented in FIG. 4, half-length $L3$ and half-length $L4$; half-length $L3$ extends from the connection 4 between the neck 5 and the body 2 to the center On of the bottom 13, said center On being located at the intersection of axis xx' and the neutral axis of the wall of the preform 11, at the bottom 13. Half-length $L4$ corresponds to the neutral axis which extends from On to a point NP . This point NP is located at the end of the cylindrical wall of the body 12 of this preform 11; it is in fact located within an area which, after the stretch-blow-molding operation that yields the bottle, will correspond to the base 8 area of said bottle 1 and in particular to the area which is denoted NB in FIG. 2.

[0060] The dimensions of the preform 11 are related to the dimensions of the bottle 1 model. To obtain the preform 11, a reduction ratio is applied to the dimensions of the bottle 1 model, this ratio being chosen from among a range of values which takes into account the capacity (volume) of the bottle 1 and also takes into account the shape of the preform 11 that will allow obtaining said bottle 1.

[0061] In effect, the design of a preform 11 must take into account certain constraints related to handling the preforms between the moment they are produced and the moment they are placed on a conveyor for entry into the heating facility and then into the stretch-blow molding machine.

[0062] The design of the preforms 11 must allow limiting, and better yet preventing, incidents such as preforms becoming nested inside one another, said incidents arising for example during storage and especially during handling when they are being sorted and transferred from storage to the conveyor for introduction into the heating facility.

[0063] Thus the outside diameter Ae of the preform 11, measured at the cylindrical body 12, is proportional to the diameter Ab of the body 2 of the bottle model 1, said diameter Ae being determined by applying a reduction ratio chosen from among values from 3.7 to 4.5, meaning that: $3.7 \times (Ae) < Ab < 4.5 \times (Ae)$.

[0064] The values of half-lengths $L3$ and $L4$ of the preform 11 are related to those of half-lengths $L1$ and $L2$ of the bottle model 1. Thus half-length $L3$ of the preform 11 is determined by applying a reduction ratio which is chosen from among values ranging from 2.8 to 3.5. The value of this half-length $L1$ is defined in the following manner: $2.8 \times (L3) < L1 < 3.5 \times (L3)$.

[0065] In addition, to obtain a good definition of the preform 11, the ratio LP of the half-lengths of said preform is preferably equal to twice the ratio LB of the half-lengths of the bottle 1 model. Thus $LP = L4/L3 = 2 \times (LB)$, where $LB = L2/L1$.

[0066] The bottom 13 of the preform 11 is drawn, FIG. 4, with half-length $L4$ extending from point On to point NP . This point NP corresponds, as indicated above, to point NB of the base 8 of the bottle 1, FIG. 2. Half-length $L4$ therefore allows plotting the position of point NP on the preform 11; this point NP on the preform 11 is located in the connection area between the cylindrical body 12 and the bottom 13 of said preform 11.

[0067] The value of this half-length $L4$ is determined, as indicated above, from half-lengths $L1$ and $L2$ of the bottle 1 model and from the previously determined half-length $L3$ of

the preform 11: $L_4 = (L_3) \times 2(L_2/L_1)$. This half-length L_4 , along the neutral axis of the wall of this bottom 13 of the preform, corresponds to half-length L_3 multiplied by two times the ratio between half-length L_2 and half-length L_1 of the bottle 1 model.

[0068] The external geometric contour of the bottom 13 of the preform 11, enlarged in FIG. 5 to show the detail, extends between point OP which is located outside the preform 11, at the center of the bottom 13, on axis xx' of said preform 11, and point NP. This external geometric contour of said bottom 13 comprises an external toroidal cap 16 and a tapered surface 17.

[0069] The external spherical cap 16 is generated by an arc of a circle having its center P located on axis xx' of the preform, at a distance from point OP which is equal to radius RE, said radius RE being determined based on the outside diameter Ae of the preform 11; it is defined as follows: $0.5 \times (Ae) < RE < 0.7 \times (Ae)$, and preferably this radius RE is on the order of $0.53 \times (Ae)$.

[0070] Still for this outside envelope of the bottom 13, starting from point N, the external contour comprises the tapered surface 17 extending towards the external spherical cap 16, said tapered surface 17 having a top which is located on axis xx' of the preform 11, beyond point OP, meaning externally to said preform 11. This tapered surface 17 forms a half-angle M at the top which is chosen so that the envelope of said tapered surface 17 is secant to the envelope of the external spherical cap 16 generated by the arc of a circle of radius RE.

[0071] The connection between the external spherical cap 16 and the tapered surface 17 consists of a toroidal ring 18 which is generated by an arc of a circle of radius RG; said arc of a circle of radius RG is such that this toroidal ring 18 is tangent to the radius generating said spherical cap 16 and to the generator of said tapered surface 17 such that the surface of this toroidal ring 18 is tangent to said external spherical surface 16 and to said tapered surface 17.

[0072] This radius RG is itself also delimited relative to the outside diameter Ae of the preform 11, according to the following relation: $0.25 \times (Ae) < RG < 0.5 \times (Ae)$. Preferably, this radius RG of the toroidal ring 18 of the external contour is on the order of $0.32 \times (Ae)$.

[0073] The half-angle M at the top of the tapered envelope 17 of the external contour is, for example, between 5° and 20° ; preferably, this half-angle M at the top is on the order of 10° .

[0074] Still for this external contour of the bottom 13 of the preform 11, the connection between the outside envelope of the cylindrical body 12 and the envelope of the tapered surface 17, at point NP, is in the form of a rounded surface 20 of which the radius RF corresponds to the radius of said cylindrical body 12, meaning to half the diameter Ae of said preform 11, said radius RF possibly also corresponding to the radius RE of the spherical cap 16 which constitutes the extreme external contour of the bottom 13 of the preform 11.

[0075] In fact, this circular rounded surface 20 acts as a simple softening of any edge located in the area marked by the point NP where the connection occurs between the outside envelope of the cylindrical body 12 of the preform 11 and the envelope of the tapered surface 17 of the bottom 13.

[0076] The definition of the internal contour of the bottom 13 of the preform 11 starts from the end of the pseudo-cylindrical cavity 15, near said bottom 13, to a central point S

which is located on axis xx' , at a distance C from point OP, said distance, measured along axis xx' , being further detailed below.

[0077] Starting from this point S, the internal contour of the bottom 13 of the preform 11 has a central portion which curves in the shape of a spherical dome 23 centered on axis xx' ; this internal spherical dome 23 has a radius RH which is centered on axis xx' at a point which is on the external side of the preform 11. This radius RH is defined relative to the outside diameter Ae of the preform 11 according to the relation $0.7 \times (Ae) < RH < 1.3 \times (Ae)$. Preferably, the radius RH of the spherical dome 23 is about the same as half the outside diameter Ae of the body 12 of the preform 11.

[0078] This internal contour of the bottom 13 of the preform 11 comprises, between the envelope of the inside cavity 15 and the dome 23, a spherical surface portion 24 which is generated by an arc of a circle of radius RK, said radius RK being equal to half the inside diameter K of said preform 11. The center V of this arc of a circle of radius RK is located on axis xx' of the preform 11, and the connection between the spherical surface portion 24 and the envelope of the inside cavity 15 is marked by a point T, the projection of point T onto axis xx' coinciding with the center V, and the distance Z between this center V and point OP of the bottom 13 of said preform 11 is determined as a function of K, of the thickness C of this bottom 13, and of a dimension D having a value as detailed below.

[0079] Thus $Z = K/2 - C + D$, meaning that distance Z corresponds to half the inside diameter K of the preform 11, measured at point T, plus the thickness C of the bottom of this preform, measured on axis xx' , and minus a dimension D which is referred to as the construction thickness, said dimension D being measured on axis xx' starting from the central point S.

[0080] The value of this dimension D is established from the thickness C of the bottom 13 of the preform 11. This dimension D has a value which is determined by the following relation: $0.2 \times (C) < D < 0.6 \times (C)$; preferably, this dimension D is on the order of $0.41 \times (C)$.

[0081] The thickness C of the bottom 13 of the preform 11, measured on axis xx' , is established from the thickness B of the preform 11 measured at the start of the cylindrical portion of the body 12. This thickness C is determined by the relation $B < C < 1.1 \times (B)$; preferably, this thickness C is on the order of $1.02 \times (B)$.

[0082] As for the thickness B, it is defined by taking into account the desired dimensions and weight of the bottle 1, said weight corresponding to that of the preform 11.

[0083] The connection between the spherical dome 23 of radius RH and the spherical surface portion 24 created by the arc of a circle of radius RK, consists of a toroidal annular surface 25, said annular surface 25 being created by an arc of a circle of radius RL which is located within a generating plane rotating about axis xx' , said arc of a circle of radius RL comprising a center Y which is located in said generator plane and on a circle of radius RI, said circle of radius RI being centered on said axis xx' and being positioned in a plane perpendicular to said axis xx' .

[0084] The radius RI has a value which is established from the outside diameter Ae of the preform 11; this value is given by the relation $0.05 \times (Ae) < RI < 0.1 \times (Ae)$, and preferably said radius RI, of the circle traced by the center Y of the arc of the circle of radius RL, has a value which is on the order of $0.07 \times (Ae)$.

1.-10. (canceled)

11. A preform comprising, centered on a single axis xx' : a neck, a cylindrical body, and an enclosed bottom that is spheroidal in shape, said preform being defined relative to the dimensions of a pre-established bottle model which comprises: a bottom, a body, and a neck, said neck of said bottle model being identical to said neck of said preform,

said cylindrical body of said preform comprises an outside diameter A_e , a mean diameter A_m measured at the neutral axis of the wall of said cylindrical body and of said bottom, and an inside diameter K , and

said cylindrical body as well as said spherical bottom of said preform comprise half-lengths L_3 and L_4 which are measured along the neutral axis of their wall: a half-length L_3 which extends from a connection between said neck and said cylindrical body to a center of said bottom and in particular to a point O_n of said bottom which is located at an intersection of said neutral axis and of said axis xx' , and a half-length L_4 which extends from said center O_n to a point NP which is located at a connection between said cylindrical body and said bottom of said preform,

said diameter A_m of said preform is determined by applying, to the value of the maximum diameter A_b of the body of said pre-established bottle model, a reduction ratio chosen from among values which range from 3.7 to 4.5, due to the biaxial orientation;

said half-length L_3 is determined from half-length L_1 of said bottle model by applying to the value of half-length L_1 a reduction ratio that is also related to the biaxial orientation and which is chosen from among values ranging from 2.8 to 3.5, and

said half-length L_4 corresponds to said half-length L_3 multiplied by twice the value of the ratio between half-length L_2 of said bottle model and half-length L_1 of its base, in other words: $L_4 = 2 \times (L_3) \times (L_2/L_1)$, and said half-length L_2 of said base corresponds to the mean radius of said base of said bottom of said bottle,

and, starting from the position of said point NP , which is determined from L_4 :

an external contour of said preform between said point NP and an external central point OP of said bottom, which is located on said axis xx' , is defined starting from said point OP , said point OP being located at a distance from said point O_n which corresponds to half a thickness C of said bottom of said preform and its value being in relation to a thickness B of the wall of said cylindrical body of said preform, measured near said neck,

said external contour of said preform comprising:

starting from said central point OP , a spherical cap which is generated by an arc of a circle having a center P located on said axis xx' , at a distance from said central point OP which corresponds to a radius RE for which the value is in relation to said outside diameter A_e of said preform, and

starting from said point NP , a tapered surface which starts at said point NP and which extends towards said spherical cap, and which has a tip on said axis xx' , beyond said central point OP and external to said bottom of said preform, said tapered surface forming a half-angle M at the top which is chosen to allow said tapered surface to be secant with said spherical cap generated by an arc of a circle of radius RE , and

still for said external contour of said preform, a connection between said spherical cap of radius RE and said tapered surface consists of a toroidal ring generated by an arc of a circle of radius RG , and the surface of said toroidal ring is tangent to said spherical cap and to said tapered surface, and said radius RG is in relation to said outside diameter A_e of said preform, and an internal contour of said bottom of said preform extends from the end of the envelope of a pseudo-cylindrical inner cavity of said body of said preform to a central point S located on said axis xx' , said central point S being positioned at a distance C from said central point OP , measured on said axis xx' , of which the value is in relation to a thickness B of the wall of said body of said preform, said internal contour of said bottom being defined in the following manner:

starting from said point S , said internal contour is generated by an arc of a circle of radius RH of which the center, positioned on said axis xx' , is located beyond said bottom, externally to said preform, so as to form a central rounded portion in the shape of a spherical dome, said radius RH being in relation to said outside diameter A_e of said preform, and

starting from a point T which is located at the end of the envelope of said pseudo-cylindrical inner cavity of said body of said preform, said internal contour comprising a spherical surface generated by an arc of a circle of radius RK of which the length is equal to half the inside diameter K of said preform and a center V of said arc of a circle of radius RK is located on said axis xx' ; said point T is located at the same level as said center V , meaning that projection of said point T onto said axis xx' coincides with said center V , and a distance Z between said center V and said point OP of said bottom of said preform corresponds to $\frac{1}{2}K + (C - D)$, meaning to half the inside diameter K of said preform, plus the thickness C of said bottom of said preform, measured along said axis xx' , and minus a thickness D which corresponds to a difference between said radius RK and a distance separating said center V of said arc of this radius RK relative to said central point S , said value of D being defined as a function of said thickness B of the wall of said cylindrical body of said preform, and

still for said internal contour of said bottom of said preform, a connection between said spherical dome of radius RH and said spherical surface created by said arc of a circle of radius RK , consists of a toroidal annular surface created by an arc of a circle of radius RL which is located in a generating plane passing through said axis xx' and having a center Y located between said central point S and said point V , in a plane perpendicular to said axis xx' , said center Y being positioned on a circle centered on said axis xx' and having a radius RI for which the value is established as a function of said outside diameter A_e of said preform, and

both for said internal contour and for said external contour of said bottom of said preform, the values of RE , M , RG , RH , RK , RL , D , RI , and C are determined in the following manner:

for RE : $0.5 \times A_e < RE < 0.7 \times A_e$,

for M : $5^\circ < M < 20^\circ$,

for RG : $0.25 \times A_e < RG < 0.5 \times A_e$,

for RH : $0.7 \times A_e < RH < 1.3 \times A_e$,

for RK: $RK = \frac{1}{2}K$,
 for RL: $0.6 \times RK < RL < RK$,
 for D: $0.2 \times C < D < 0.6 \times C$,
 and for RI: $0.05 \times Ae < RI < 0.1 \times Ae$,
 where:

Ae is an outside diameter of said body of said preform;
 B corresponds to a thickness of the wall of said body of said preform at the start of said cylindrical portion of said preform;

C corresponds to the thickness of the wall of said preform at said bottom of said preform, along said axis xx', with, for C: $B < C < 1.1 \times (B)$;

K is the inside diameter of said pseudo-cylindrical cavity of said cylindrical body, at said bottom of said preform.

12. The preform according to claim 11, wherein, for said external contour of said bottom, said connection between said outside envelope of said cylindrical body and said tapered envelope, at a point N, is in the form of a rounded surface of a radius RF that is on the same order as radius RE and, preferably, is equal to $\frac{1}{2} \times (Ae)$.

13. The preform according to claim 11, wherein said radius RE of said spherical cap of said external contour is on the order of $0.53 \times (Ae)$.

14. The preform according to claim 11, wherein said half-angle M at said top of said tapered surface of said external contour is on the order of 10° .

15. The preform according to claim 11, wherein said radius RG of said toroidal ring of said external contour, which extends between said spherical surface and said tapered envelope, is on the order of $0.32 \times (Ae)$.

16. The preform according to claim 11, wherein said radius RH of said central spherical dome of said internal contour is substantially equal to $\frac{1}{2}(Ae)$, meaning to half said outside diameter Ae of said cylindrical body.

17. The preform according to claim 11, wherein said radius RL of said toroidal annular surface of said internal contour, which acts as said connection between said spherical surface and said central spherical dome, is on the order of $0.8 \times (K/2)$.

18. The preform according to claim 11, wherein said radius RI of a circle which is traced by a center of the toroidal annular surface has a value which is on the order of $0.07 \times (Ae)$.

19. The preform according to claim 11, wherein said construction thickness D of the wall of said bottom, along said axis xx', is on the order of $0.41 \times (C)$.

20. The preform according to claim 11, wherein said thickness C of the wall of said bottom, along said axis xx', is on the order of $1.02 \times (B)$.

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