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(54) **Plastic bottle having crimp-on, pry-off crown finish**

(57) A plastic bottle mouth has a finish (22) generally symmetric about a vertical axis of the bottle (10), suitable to receive a metal crown cap (32). The finish (22) has a top planar surface (44) lying in a plane normal to the vertical axis. A downwardly curved portion (48) extends outward from the planar ring (46) and terminates at an outermost edge (50) located at a radius R_1 bottle axis. An undercutting surface (52) begins adjacent to the outer edge (50) and extends axially inwardly and downwardly

as a concave partial toroid. The undercutting surface (52) can be defined in substantial part by a locus of points generated by a radius R having its origin on a circle of radius R_2 lying in a plane normal to the vertical axis, particularly where $R \ll R_2 < R_1$. The radius R defining the undercutting surface (52) is generally less than about 7% of radius R_1 , and can be only about 4% of radius R_1 . The planar ring (46) on the top surface of the finish can have a width that is greater than about 2% of radius R_1 .

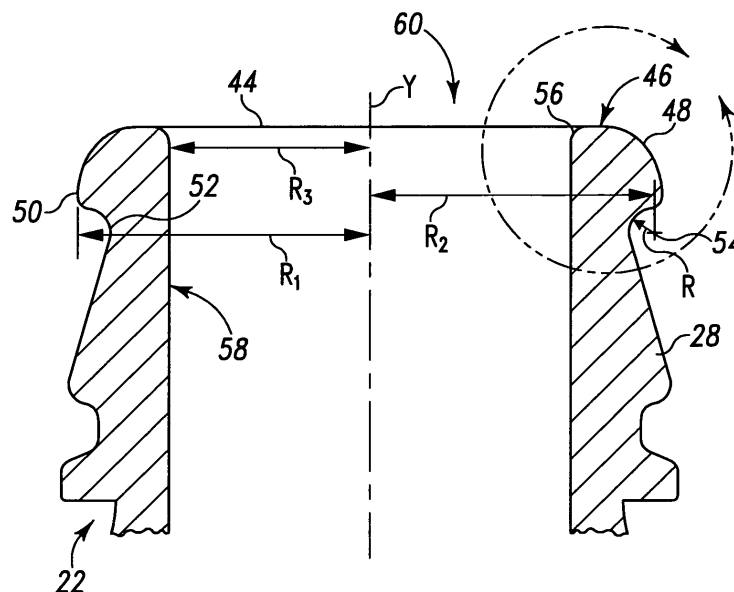


Fig. 3

Description

BACKGROUND

[0001] 1. Technical Field — The present invention relates generally to molded plastic containers, and particularly to injection-blow molded bottles for containing carbonated beverages.

[0002] 2. General Background — For many years, glass bottles have been formed with crown finishes; that is, with finishes specifically designed to receive crimp-on, pry-off crown closures. Such closures are low cost, easy to remove using a conventional bottle opener, and easy to apply with the use of specially designed capping equipment. Over the years, much capital has been invested by bottlers of soft drinks and beer in equipment for applying such crown closures to glass bottles that contain their products. The character of glass contributes desirable properties that help ensure that such closures are retained on the finish of the bottles even in the presence of significant internal pressure presented by the carbonation in the contained beverage. However, safety concerns based on the fragility of the glass have motivated some bottlers to consider the use of plastic bottles instead of glass.

[0003] With the substitution of plastic for glass, there has also been a commensurate substitution of a threaded closure for the crimp-on, pry-off crown closure. Threaded closures provide a simple means for resealing an opened bottle, which is particularly desirable for bottles containing volumes of one liter or more. Threaded closures on single serving size bottles are rarely used to reseal the contents. Threaded closures require the use of different capping equipment than do the crown closures. In commercial settings such as bars and restaurants, threaded closures are viewed as undesirable on single serving containers. Thus, there is some motivation to incorporate a finish suitable to receive a crimp-on, pry-off crown closure onto plastic bottles. However, the more flexible characteristics of plastic do not permit a mere substitution of a conventional crown finish as used in glass. Under testing, it has been determined that the mere substitution of a conventional crown finish as used in glass results in insufficient retention of the crown cap. As a result, there is a need for a modified finish suitable to receive a crimp-on, pry-off crown closure onto plastic bottles that will retain the crown closure satisfactorily even in the presence of significant internal pressure generated by the carbonation in the contained beverage.

BRIEF SUMMARY

[0004] A plastic bottle of the present invention has a finish at the bottle mouth that is generally symmetric about a vertical axis of the bottle, which is suitable to receive a metal crown cap. The finish has a top surface that includes a planar ring lying in a plane normal to the vertical axis. A downwardly curved portion extends out-

ward from the planar ring. The downwardly curved outer portion terminates at an outermost edge located at a radius R_1 from the vertical axis of the bottle. The finish also has an undercutting surface beginning adjacent to the outer edge and extending axially inwardly and downwardly from the outer edge. The undercutting surface can be considered as a concave partial toroidal surface. The concave partial toroidal surface can be defined in substantial part by a locus of points generated by a radius R having its origin on a circle of radius R_2 lying in a plane normal to the vertical axis, particularly where $R < R_2 < R_1$. The concave partial toroidal surface interacts with a conventionally applied metal crown cap in such a way as to retain the cap under pressures that would cause cap leaking or expulsion with conventional crown finishes.

[0005] The radius R defining the concave partial toroidal surface must be less than about 15% of the radius R_1 , and is generally less than 10% of the radius R_1 . The length of radius R can even be less than about 7% of radius R_1 , and may be only about 4% of radius R_1 . The planar ring on the top surface of the finish can have a width that is greater than about 2% of radius R_1 . The top surface can include a downwardly curved inner edge. The downwardly curved inner edge can be defined by a radius having a length that is about equal to the width of the planar ring. The downwardly curved inner edge generally terminates in a substantially cylindrical inner surface of the bottle mouth defined by a radius R_3 . The distance between the cylindrical inner surface of the bottle mouth and the undercutting surface can be less than 25% R_1 , yet still retain sufficient strength to permit the necessary pry-off function of a conventional metal crown cap using a conventional bottle opener.

[0006] The various features and advantages of a bottle having a crown finish of the present invention will become apparent to those skilled in the art from a consideration of an illustrative embodiment shown in the attached drawings and described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Figure 1 is a perspective view of a bottle of the present invention including a crown closure.

[0008] Figure 2 is a side elevation view of the neck and finish portion of the bottle shown in Figure 1 including the crown closure in greater detail.

[0009] Figure 3 is a sectional view of the finish portion of the bottle shown in Figure 1 with the crown closure removed.

[0010] Figure 4 is a sectional detail view of the upper portion of the finish showing the details of radii defining the surfaces of an example finish of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] A bottle 10 of the present invention is shown in Figure 1 to include a base 12 that supports the bottle on any underlying surface. A side wall 14 extends upward

from the base 12. The side wall 14 typically includes a label panel 16 adapted to receive a label, not shown, disclosing the contents of the bottle 10. A shoulder 18 is located at the upper margin of the label panel 16 the leads into a neck 20. The side wall 14, label panel 16, shoulder 18 and neck 20 are generally rotationally symmetric about a vertical axis Y projecting upward from base 12.

[0012] A finish 22 is located at the upper end of the neck 20 as shown in Figures 1 and 2. The finish 22 is also generally symmetric about the vertical axis Y and includes a support ring 24 extending outward from the neck 20 to support the bottle 10, and the preform from which the bottle is manufactured, not shown, during the manufacturing process, which is typically a conventional one- or two-stage injection blow molding process. A channel 26 separates the support ring 24 from a bell portion 28, which has a bulbous lower portion 30 tapering inward as the bell portion 28 leads upward toward a cap 32 that seals the bottle mouth.

[0013] The cap 32 is a conventional crown closure typically manufactured of 0.235 mm single reduced, tin free steel. The cap 32 includes a central panel 34 surrounded by a depending skirt 36. The skirt 36 is typically about 6mm in height and has an exposed lower edge 38 that is formed during the capping process to include a series of alternating ribs 40 interspaced by flutes 42 extending around the entire lower edge 38. A soft polymeric sealing material, not shown, is typically located on an inner surface of the central panel 34 for sealing against a top surface of the bottle 10, discussed below. The sealing material can be, for example, made of PVC or other suitable flavor neutral polymer. The sealing material, which is located on the inner surface of the central panel 34, is maintained in contact with the top 44 surface of the bottle 10 by means of strength of the inward projecting flutes 42 in cooperation with the structure of the finish 22 described below.

[0014] The top surface 44 of the finish 22 is shown in Figures 3 and 4 to include a planar ring 46 lying in a plane normal to the bottle vertical axis Y. A downwardly curved portion 48 extends outward from the planar ring 46 to an outermost edge 50 located at a radius R_1 from the bottle vertical axis Y. An undercutting surface 52 begins adjacent to the outer edge 50 and extends radially inward and axially downward from the outer edge 50. The undercutting surface 52 is a concave partial toroidal surface defined in substantial part by a locus of points generated by a radius R having its origin on a circle 54 of radius R_2 lying in a plane normal to the bottle vertical axis Y, where R_2 is less than R_1 . The radius R generating the undercutting surface 52 is very small as compared to either radius R_1 or R_2 . The length of radius R must be less than about 15% of the radius R_1 , and is generally less than 10% of the radius R_1 . The length of radius R can even be less than about 7% of radius R_1 , and may be only about 4% of radius R_1 . The radius R_2 of the circle 54 is smaller than the outer radius R_1 , but can be nearly as big

as radius R_1 . The radius R_2 can be as large as 97% of radius R_1 . A lower edge of the concave partial toroidal undercutting surface 52 blends smoothly and generally tangentially into the bell portion 28, which can be variously dimensioned both in height and angle.

[0015] A downwardly curved inner edge 56 can be situated on the inside of the planar ring 46. The downwardly curved inner edge 56 extends between the planar ring 46 and a cylindrical inner surface 58 of the bottle mouth 60 defined by a radius R_3 . The radius R_3 can be about 70% to 80% of radius R_1 . The distance between the cylindrical inner surface 58 of the bottle mouth 60 and the undercutting surface 52 at the point of closest approach can be less than 25% R_1 , but is generally greater than about 15% R_1 . The distance between the inner edge 56 and the downwardly curved outer portion 48 defines the width W of the planar ring 46 as shown in Figure 4. The width of the planar ring 46 is preferably greater than about 2% of radius R_1 .

[0016] The downwardly curved outer portion 48 can include a plurality of blended radii R_{4i} , R_{4ii} , ..., that generally increase in size as the curved outer portion 48 proceeds from the planar ring 46 to the outermost edge 50. The size of the radii R_{4i} , R_{4ii} , can vary between about 5% and 15% of radius R_1 . A lower outside surface 62 of radius R_5 can connect the outermost edge 50 to the undercutting surface 52. The radius R_5 is preferably less than about 2% of radius R_1 .

[0017] The flutes 42 of the cap 32 engage the undercutting surface 52 to retain the cap 32 in sealing engagement with the bottle mouth 60 satisfactorily even in the presence of significant internal pressure generated by the carbonation in the contained beverage. Further, the strength provided by the material in the finish 22 permits the cap 32 to be easily removed using a conventional bottle opener.

[0018] The foregoing detailed description should be regarded as illustrative rather than limiting, and the following claims, including all equivalents, are intended to define the spirit and scope of this invention.

Claims

1. A plastic bottle having a finish at the bottle mouth that is generally symmetric about a vertical axis of the bottle and suitable to receive a metal crown cap, the finish comprising:

a top surface including a planar ring lying in a plane normal to the vertical axis and a downwardly curved outer portion terminating at an outermost edge located at a radius R_1 from the vertical axis of the bottle, and
an undercutting surface beginning adjacent to the outer edge and extending axially inwardly and downwardly from the outer edge, the undercutting surface being defined in substantial part

by a locus of points generated by a radius R having its origin on a circle of radius R_2 lying in a plane normal to the vertical axis, where $R_2 < R_1$.

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2. The plastic bottle of claim 1 wherein the length of radius R is less than about 10% of radius R_1 .

3. The plastic bottle of claim 2 wherein the length of radius r is equal to about 8% of radius R_1 .

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4. The plastic bottle of claim 1 or 2 or 3 wherein the planar ring of the top surface has a width that is greater than about 2% of radius R_1 .

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5. The plastic bottle of claim 4 wherein the top surface includes a downwardly curved inner edge defined by a radius having a length that is about equal to the width of the planar ring, the downwardly curved inner edge terminating in a cylindrical inner surface of the bottle mouth defined by a radius R_3 .

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6. The plastic bottle of claim 5 wherein the distance between the cylindrical inner surface of the bottle mouth and the undercutting surface is less than 25% R_1 .

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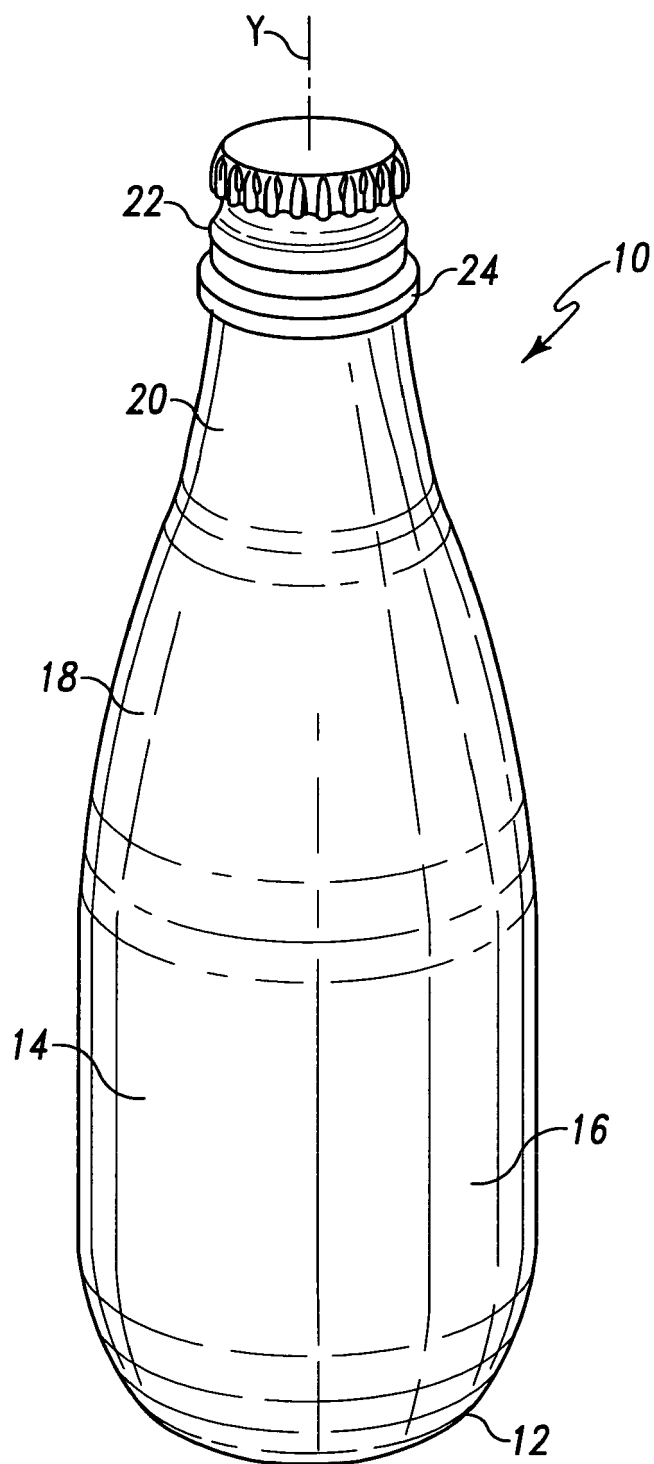


Fig. 1

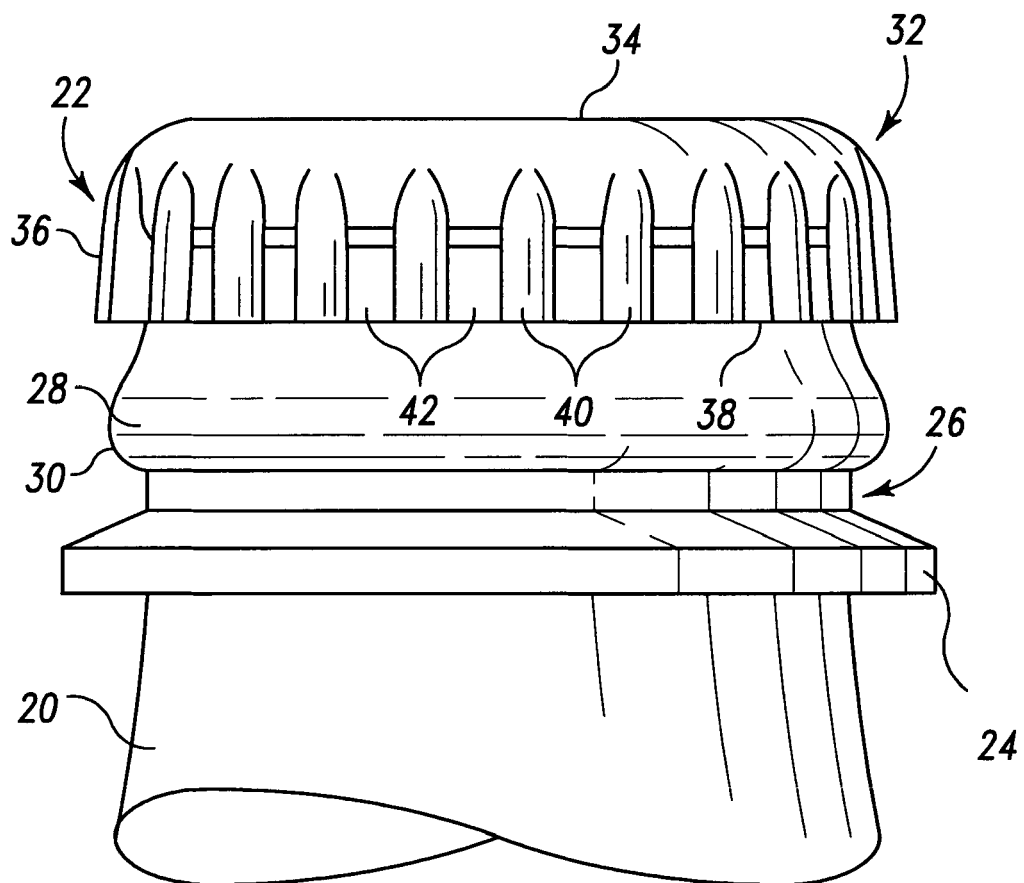


Fig. 2

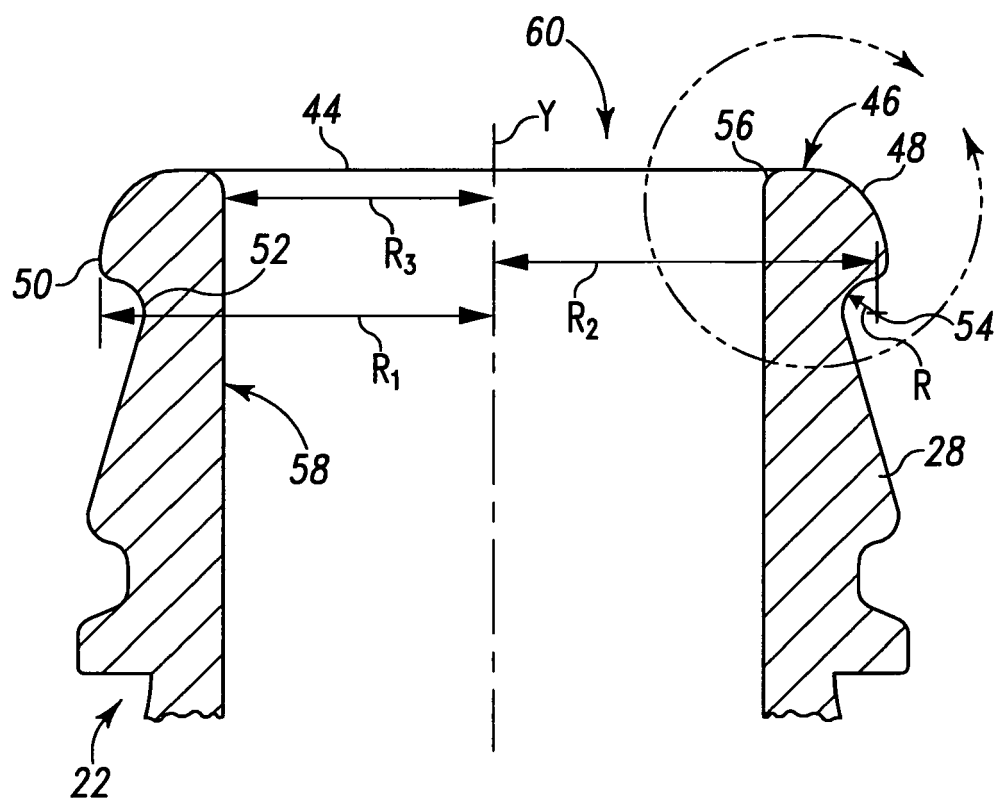


Fig. 3

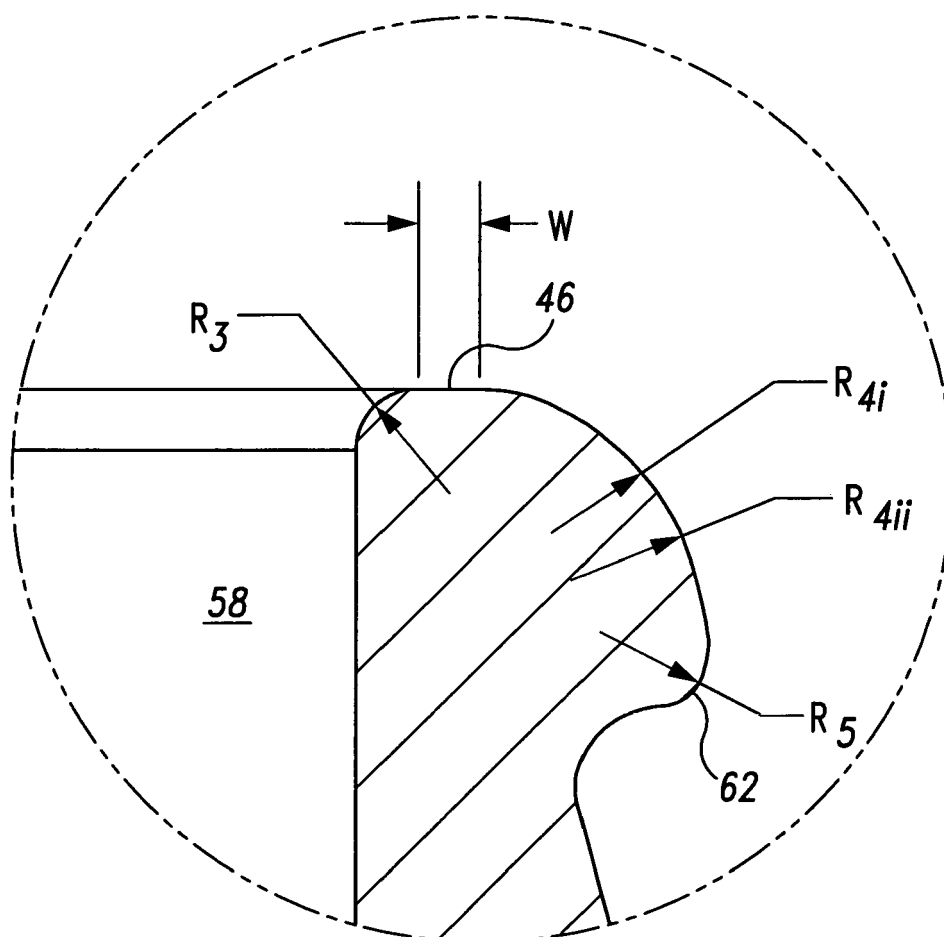


Fig. 4



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 09 0246

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			B65D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 January 2006	Examiner Vesterholm, M
CATEGORY OF CITED DOCUMENTS 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		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 & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 09 0246

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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20-01-2006

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