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(54) Screw cap for a container

(57) A screw cap (1) for a container (12) is made of a plastics material and comprises an inner circular skirt (9) provided on an inner top face of the cap (1), for sealing against an inner face of a mouth (14) of the container (12) when the cap (1) is applied to the container (12), a support structure (10, 11) provided on the inner top face of the cap (1), associated with the inner skirt (9) and an outer skirt (7) provided on the inner top face (2a) of the cap (1), arranged coaxially around the inner skirt (9) and distant from a side wall (3) of the cap (1), for sealing against an outer face of the mouth (14) of the container (12). Preferably, the support structure (10, 11) comprises a plurality of elements (10) arranged distant from one another, where each of the plurality of elements (10) is formed and arranged such as to be contacted by an associated segment of the inner skirt (9) when the cap (1) is applied to the container (12). The inventive cap (1) ensures easy closing and reclosing and reliable sealing of the container (12).

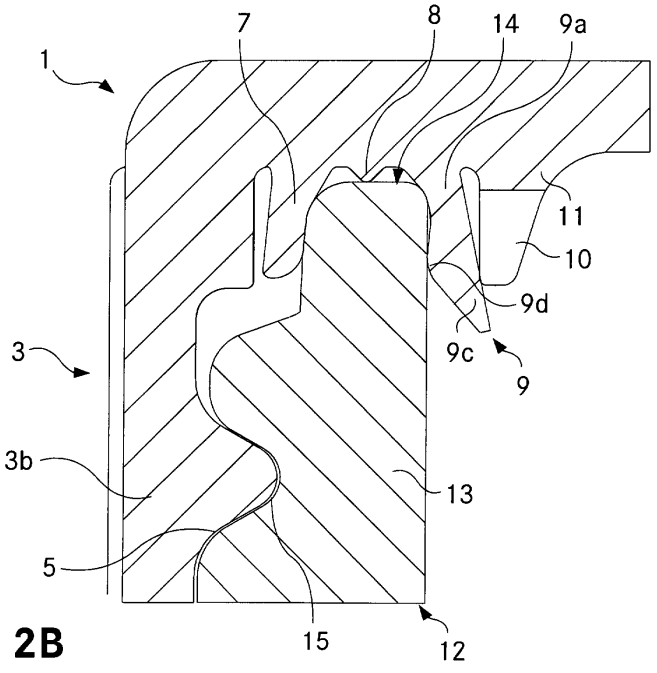

Fig. 2B

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Description

Technical Field

[0001] The invention relates to a screw cap for a container, the cap being made of a plastics material and comprising an inner circular skirt provided on an inner top face of the cap, for sealing against an inner face of a mouth of the container when the cap is applied to the container; and a support structure provided on the inner top face of the cap, associated with the inner skirt.

Background Art

[0002] Screw caps are widely used for a variety of different containers such as bottles or jars. Traditionally, the content of the container has been sealed off by a sealing liner inserted inside the screw cap. However, linerless caps are favourable regarding cost efficiency, durability and effective recycling. With linerless caps, special means are required for sealing the closure against the mouth of the container, in particular if the caps are to be manufactured of a single plastics material, in a single forming (in particular molding) step.

[0003] For this purpose, usual linerless caps feature an inner circular skirt provided on an inner top face of the cap. The skirt is dimensioned such that it seals against an inner face of the container's mouth, i. e. against the cylindrical portion of the container's neck and/or the rounded portion at the top end of the mouth. During application of the cap to the container, i. e. during screwing the cap on the container, the inner skirt contacts the inner face of the container's mouth and is introduced into the mouth along a certain distance. During introduction the skirt is slightly deformed, such that it exerts a certain force against the container's mouth.

[0004] In order to reliably seal, the skirt is rigid which is achieved by choosing a rigid material or by dimensioning the skirt accordingly. This may lead to problems concerning closing and reclosing the container because of a high counterpressure exerted by the mouth of the container against the inner skirt of the cap.

[0005] The international patent application WO 97/10154 (Vesag Verpackungssystem AG) discloses a screw cap for a container featuring an inner skirt that has a predetermined flexural strength, whereby a support structure in the form of an annular rib is associated with the skirt. When the cap is applied to the container, the end of the container's neck is introduced in a clearance between a side wall of the cap and the inner skirt. Thereby, the inner skirt is deformed and eventually contacts the support structure. Combining a rather weak and therefore flexible inner skirt with the support structure enables the use of hard plastic materials for cap manufacturing. Screw caps featuring similar support structures are further disclosed in FR 1 378 226 (Gaston Vignon), GB 2 099 800 (René E. L. Barre) and FR 2 205 451 (Saint-Gobain).

[0006] However, even with such caps the closing and reclosing behaviour of the container is still not completely satisfactory, in particular due to hardly avoidable manufacturing tolerances of the cap and/or container. In other cases, when the design of the inner skirt/annular rib combination was optimised for easy opening and reclosing, the tightness of the seal was compromised.

Summary of the invention

[0007] It is the object of the invention to create a screw cap pertaining to the technical field initially mentioned, that ensures easy closing and reclosing and reliable sealing of the container.

[0008] The solution of the invention is specified by the features of claim 1. According to the invention, an outer skirt is provided on the inner top face of the cap. The outer skirt is arranged coaxially around the inner skirt in a certain radial distance from a side wall of the cap and serves for sealing against an outer face of the mouth of the container.

[0009] Firstly, the additional sealing improves the overall tightness of the closure. However, the independent outer skirt is particularly advantageous in connection with the support structure provided for the inner skirt, in that the mouth of the container is reliably guided and held in between two rather rigid elements, namely the outer skirt and the support structure, whereas the inner, more flexible skirt ensures a tight sealing of the container and at the same time facilitates opening and reclosing the container. Furthermore, it is not required that the side wall of the cap, which features the screw thread for fastening the cap to the container's neck, additionally seals against the outer face of the container's mouth, i. e. against the cylindrical portion of the neck and/or the rounded portion at the top end of the mouth. Thereby, there are no additional forces exerted on the side wall of the cap and steady engagement of the screw threads of the cap and of the container's neck is ensured.

[0010] Preferably, the support structure comprises a plurality of elements arranged distant from one another, where each of the plurality of elements is formed and arranged such as to be contacted by an associated segment of the inner skirt when the cap is applied to the container. Therefore, instead of the known combination of two coaxial skirts (inner skirt/annular rib) arranged inside the container's mouth the inventive cap features a single coaxial skirt (the inner skirt) and a plurality of associated support elements inside the mouth and a further coaxial skirt (the outer skirt) outside of the mouth.

[0011] The plurality of elements contacting the inner skirt at distant locations ensure a high circumferential flexibility of the inner skirt. This is because the skirt has more freedom to deform compared to the known solution where the support structure is a coaxial skirt. The improved flexibility and the locally independent support of the inner skirt are particularly important if the radial forces exerted on the inner skirt are not constant along the skirt's

circumference as may be the case e. g. due to manufacturing tolerances of the cap and/or the container or due to slight canting of the cap during application. In these cases, opening and reclosing of the container is eased by the interplay of the more rigid outer skirt and the support structure with the more flexible inner skirt.

[0012] Alternatively, the support structure is constituted by a further continuous skirt or by a central circular or annular section of the inner top face of the cap, having an increased thickness.

[0013] Preferably, the plurality of elements are arranged equally spaced along a circle that is coaxial with and interior of the inner skirt. The equal spacing of the elements as well as their equal radial distance with respect to the inner skirt ensures even support for the inner skirt. Advantageously, all of the elements are uniform, by preference they are segment-shaped projections having a wedge-shaped radial cross-section. The tangential width of the elements and therefore the potential contact area with the inner skirt, and correspondingly the width of the spacings in between the elements may be adjusted in order to optimise the flexibility of the inner skirt/support structure combination. If a high flexibility is required, the tangential width of the elements may be reduced. In an extreme case, for achieving maximum flexibility the elements may be radially oriented noses that are to contact the inner skirt only in a very small, almost point-like area.

[0014] Preferentially, the number of equally spaced elements is at least 8, preferably 12 or more. Thereby, a segment of the inner skirt associated to one of the elements is rather short and therefore the supporting effect of a single element is constricted to a confined region of the skirt, ensuring good support and at the same time high flexibility concerning the deformation of the inner skirt.

[0015] Advantageously, the plurality of elements are arranged on an annular bank that is provided on the inner top face of the cap. The bank serves to bear the individual elements and is never directly contacted by the inner skirt. By providing an annular bank, the flexibility of the elements of the support structure is reduced. Therefore, a desired rigidity of the elements may be achieved by tuning the proportions of the annular bank and the individual elements.

[0016] Alternatively, the elements of the support structure are directly borne on the inner top face of the cap, or the elements are formed on the outer face of a structure or a plurality of structures that are arranged in a larger radial distance to the inner skirt than the elements themselves.

[0017] Preferably, each of the plurality of elements has an inner conical face such that a radial thickness of the element decreases from the inner top face of the cap. This ensures good support for the inner skirt and at the same time minimised use of material. Furthermore, forces applied onto the elements of the support structure are smoothly transferred to the top face of the cap. The outer face of the elements, i. e. the face that is contacted by the inner skirt, may be perpendicular with respect to the inner top face of the cap or featuring a dedicated seat for the inner skirt.

[0018] Preferentially, a height of each of the plurality of elements is between half a height of the inner skirt and the full height of the inner skirt, preferably about 3/4 of the height of the inner skirt. Thereby, even if the inner skirt is rather flexible it is able to deform in a controlled way after its lower half has contacted the inner face of the container's mouth. Contrary to this preferred situation, if the elements' height exceeds the height of the inner skirt, the top end of the skirt will first contact the support structure. Following this, the deformation of the skirt may go on unevenly, the inner skirt being crushed in an uncontrolled way in between the mouth and the support structure. On the other hand, if the height of the elements is much smaller than the height of the inner skirt, the effect of the elements on the skirt will be negligible, unless the deformation of the skirt becomes very large.

[0019] Preferentially, an outer face of the inner skirt features an annular radial bulge for contacting the inner face of the mouth of the container, i. e. the outer face of the inner skirt features two substantially conical sections meeting with their maximum cross-section at a central level of the skirt. The lower conical section close to the lower end of the skirt ensures that the inner skirt is smoothly contacted by the mouth of the container and that its deformation and thus the tightening force increase gradually. Due to its reduced cross-section, it is the upper conical section which is closer to the inner top face of the cap that is primarily deformed when the cap is applied to the container. Therefore, the inner skirt is bent instead of compressed which facilitates the use of hard plastics materials (such as polypropylene) and reduces radial forces transmitted to the top face of the cap. Compression only takes place at a final stage when the inner skirt contacts the support structure. The resulting forces are mainly transferred to the elements of the support structure.

[0020] If the inner skirt features an annular radial bulge, each of the plurality of elements of the support structure ends preferably at about a height that corresponds to the lower conical section of the radial bulge of the inner skirt. This allows for a controlled and flexible deformation of the inner skirt. By preference, the bulge is at about half the height of the inner skirt such that the height of the elements is between half the height of the skirt and the full height of the skirt.

[0021] Advantageously, the outer skirt ends at about a height corresponding to the maximum wall thickness of the radial bulge. Thereby, during application of the cap to the container the outer skirt as well as the inner skirt are concurrently contacted. This ensures that the neck of the container is reliably guided in between the inner skirt/support structure combination and the outer skirt.

[0022] If an inventive screw cap is to be used for hot fill applications, a height of the inner skirt is preferably about 2-4 times a height of the outer skirt. When the con-

tainer is opened by unscrewing the cap, the long inner skirt ensures reliable sealing of the container at least until a tamper evident ring of the cap is broken. Only after this has happened, the inner skirt loses contact with the mouth of the container and outside air may flow into the container, thereby destroying the vacuum generated by the hot fill process. In order to ensure that the inner skirt deforms in a controlled way the length of the support structure is preferably increased accordingly, e. g. until it corresponds to half the height of inner skirt to the full height of the inner skirt.

[0023] All this is in contrast with the situation of caps for carbonated soft drink (CSD) containers, where the carbon dioxide gas present in the container shall escape before the tamper evident ring is broken. Therefore inventive screw caps to be used for CSD containers generally feature inner skirts having a height of less than 2 times, preferably about 1.5 times, the height of the outer skirt.

[0024] Preferentially, a radial cross-section of the outer skirt is substantially constant, whereby an inner face as well as an outer face of the outer skirt are substantially perpendicular to the inner top face of the cap. This results in a spring force that is increasing the more the neck is introduced in between the inner and outer skirt. Thereby, the mouth of the container is gradually driven to a desired end position, where the outer face of the neck including the rounded portion near the neck's mouth is firmly supported by the inner face of the outer skirt.

[0025] Alternatively, the spring characteristic of the outer skirt may be tuned by choosing a non-constant radial profile; e. g. the increase of the spring force may be increased if the outer skirt has a wedge-shaped radial cross-section with a conical outer face.

[0026] Advantageously, an annular bead is provided on the inner top face of the cap, arranged coaxially between the inner skirt and the outer skirt. The annular bead contacts the top side of the mouth of the container and thereby constitutes another sealing in between the sealings provided by the inner and the outer skirt, further improving the tightness of the closure.

[0027] Preferably, the plastics material is polypropylene (PP). Polypropylene is tough, lightweight and easily processed via injection or compression molding (jars and closures). Furthermore it has excellent chemical resistance and is stable up to high temperatures and therefore compatible with high filling temperatures as used e. g. with hot fill products such as orange juice, syrups etc.

[0028] Alternatively, the invention is applicable with other plastics materials such as polyethylene (PE), polyethylene terephthalate (PET), polystyrene (PS) or polyvinyl chloride (PVC).

[0029] Preferably, a first thickness of a top wall of the cap, in an annular region featuring the inner circular skirt as well as the support structure, is larger than a second thickness of the top wall in a central region of the cap. Thereby, the sealing structures of the cap are stable, while at the same time the material requirements and weight of the cap may be kept low.

[0030] Other advantageous embodiments and combinations of features come out from the detailed description below and the totality of the claims.

Brief description of the drawings

[0031] The drawings used to explain the embodiments show:

- Fig. 1 A vertical cross-section of an inventive screw cap appropriate for carbonated soft drink containers;
- Fig. 2A a detailed view of Fig. 1, showing the inner and outer skirts and the support structure for the inner skirt before applying the cap to a bottle;
- Fig. 2B a detailed view of Fig. 1, showing the inner and outer skirts and the support structure for the inner skirt when the cap is applied to a bottle;
- Fig. 3 a horizontal cross-section of the inventive screw cap;
- Fig. 4A a detailed view of a vertical cross-section of a further embodiment of an inventive screw cap appropriate for hot fill containers;
- Fig. 4B the detailed view of Fig. 4A when the cap is applied to a bottle.

[0032] In the Figures, the same components are given the same reference symbols. All the Figures are schematic and not to scale.

Preferred embodiments

[0033] The Figure 1 shows a vertical cross-section along a diameter of an inventive screw cap appropriate for carbonated soft drink (CSD) containers. The cap 1 is molded in a single step and manufactured from polypropylene (PP). It is substantially constituted by a circular head section 2 and a cylindrical side wall 3. The outer face of the side wall 3 features knurls 4 for improving the handling of the cap 1 by a user and by closing heads employed for initially screwing down the cap 1 applied to the neck of a bottle. A first section 3a of the side wall 3, adjacent to the head section 2, has a first constant wall thickness. The inner face of a second section 3b of the side wall 3 features a screw thread 5 for screwing the cap 1 onto the neck of a container, the neck featuring a corresponding threading. The first section 3a and the second section 3b make up about half of the height of the side wall 3.

[0034] A third section 3c of the side wall 3 has again

a constant wall thickness which is however less than the thickness of the first section 3a. The lowermost fourth section 3d of the side wall 3 has again an even smaller constant wall thickness. A tamper evident band 6 is joined to the fourth section 3d. All types of tamper evident bands 6 may be employed with the invention. In general, the band 6 is folded up inside prior to applying the cap 1 to the container. After application, its free ending co-operates with an annular collar provided on the neck of the container. When the container is first opened the band is ripped off from the side wall 3 of the cap 1 along a dedicated breaking line. Therefore, an intact band 6 assures the customer that there has been no tampering after the cap 1 was applied to the container.

[0035] The inner face 2a of the head section 2 of the cap 1 features a plurality of structures that are displayed in greater detail in Figures 2A, B.

[0036] The Figure 2A is a detailed view of Figure 1, showing the outer region of the head section 2 of the cap 1 as well as the adjacent first and second sections 3a, b of the side wall 3. Four kinds of projections are featured on the inner face 2a of the head section 2, which are (from the periphery to the centre of the cap) an outer skirt 7, a bead 8, an inner skirt 9 and a support segment 10. The main axes of the projections are perpendicular to the inner face 2a of the head section 2.

[0037] The annular outer skirt 7 is arranged in a radial distance inside the first section 3a of the side wall 3. Its cross-section is generally constant, except that its inner face is rounded close to the bottom end. By way of example, for a 28 mm screw cap the radial cross-section of the outer skirt 7 is about 0.5 mm and its height is about 1.5 mm. The annular bead 8 has a roughly triangular radial cross-section with a rounded ridge. The height of the bead 8 is only about one eighth of the height of the outer skirt 7.

[0038] Adjacent to the head section 2, the annular inner skirt 9 shows a first section 9a having a constant radial cross-section. Two substantially conical sections 9b, 9c further make up the inner skirt 9, meeting with their maximum cross-sections at a central level of the skirt 9, forming a bulge 9d. The outer face of the upper conical section 9b includes an angle α of about 20° with the main axis of the inner skirt 9. The outer face of the lower section 9b includes an angle β of about 30° with the main axis. The inner face of all the sections 9a-c of the inner skirt 9 is straight and parallel to the main axis of the inner skirt 9.

[0039] The cross-section of the first section 9a of the inner skirt 9 corresponds to about the cross-section of the outer skirt 7. At the level of the bulge 9d the cross-section is about 1.5 times larger. At the bottom end of the lowermost section 9c, the cross-section of the inner skirt 9 is only about one third compared to the upper end. The total height of the inner skirt 9 amounts to about 1.5 times the height of the outer skirt 7.

[0040] The radial distance between the outer skirt 7 and the first section 9a of the inner skirt 9 is slightly less than the wall thickness of the neck of a container the cap 1 is to be applied to. In the free position shown in Figure 2A, the bulge 9d formed on the outer face of the inner skirt 9 radially protrudes into the clearance between the two skirts 7, 9.

[0041] The support segment 10 is arranged with a radial distance inside the inner skirt 9. It is provided on an annular bank 11 which is formed on the inner face 2a of the head section 2.

[0042] The segment 10 is substantially wedge-shaped whereby the outer face 10a adjacent to the inner skirt 9 is straight and perpendicular to the inner face 2a of the head section 2. The inner face 10b is conical in such a way that the radial cross-section of the segment 10 decreases from the annular bank 11 to the bottom ending of the segment 10 to about half of the initial cross-section. The wedge angle γ amounts to about 20°. The bottom edges of the segment 10 are rounded. The total height of the support segment 10 (including the annular bank 11) corresponds to about 0.7 times the height of the inner skirt 9. Therefore, the bottom ending of the support segment 10 is at a height that corresponds to the lower conical section 9c of the inner skirt 9.

[0043] The wall thickness of the central region 2b of the head section 2 of the cap 1, i. e. of the region inside the annular bank 11 featuring the segment 10, is about 0.85 times the wall thickness of the annular region 2c in which the described projections are provided.

[0044] The Figure 2B is again a detailed view of Figure 1, now showing the inner and outer skirts 7, 9 and the support structure 10, 11 for the inner skirt 9 when the cap 1 is applied to a bottle 12. The bottle 12 comprises a neck 13 forming a circular mouth 14 for filling and pouring out. On its outer face, the neck 13 features a screw thread 15 for co-operating with the corresponding screw thread 5 in section 3b of the side wall 3 of the cap 1.

[0045] During application of the cap 1 to the bottle 12, the mouth 14 contacts the inner face of the outer skirt 7 and the outer face of the inner skirt 9. Because of the rounded bottom end of the outer skirt 7 and the conical section 9c of the inner skirt 9 the mouth 14 is carefully guided along the adjacent faces of the two skirts 7, 9. At first, both the outer skirt 7 as well as the inner skirt 9 are about equally deformable. The more the mouth 14 is introduced into the cap the counterpressure from the outer skirt 7 increases. However, the spring force of the inner skirt 9 only slightly changes because the deformation mainly takes place in the top section 9a adjacent to the head section 2. Thereby, the mouth 14 is guided into its desired end position, where the outer face of the mouth 14 is firmly supported by the inner face of the outer skirt 7. The inner face of the mouth 14 is supported by the bulge 9d as well as the inner face of the top region 9a of the inner skirt 9.

[0046] Near completion of the application of the cap 1 to the bottle 12, i. e. soon before the front face of the mouth 14 contacts the annular bead 8, the inner face of the inner skirt 9 contacts the support segment 10. This leads to a sudden increase of counterpressure of the

inner skirt/support segment combination 9, 10 against the inner face of the mouth 14. The resulting radial force is distributed to the contact forces between the outer skirt 7 and the mouth 14 and between the inner skirt 9 and the mouth 14. At first, this causes a certain deformation of the outer skirt 7 which is more flexible than the inner skirt 9 after the inner skirt 9 has contacted the support structure 10, 11. Finally, this results in two reliable independent sealings against the inner skirt 9 and the outer skirt 7, complemented by the third sealing between the annular bead 8 and the front face of the mouth 14. The fact that the radial cross-section of the neck 13 is slightly larger than the radial distance between the outer skirt 7 and the first section 9a of the inner skirt 9 ensures that both the outer skirt 7 and the inner skirt 9 are deformed in the end position of the mouth 14 and therefore both elements exert a counterpressure against the outer and the inner face of the neck 13 respectively.

[0047] The Figure 3 shows a horizontal cross-section (along line A-A in Figure 1) of the inventive screw cap 1, illustrating the arrangement of the support segments 10. 24 uniform segments 10 are arranged along a circle that is coaxial with and inside the inner skirt 9. The segments 10 are provided on the unsegmented annular bank 11 and separated by clearances 16, whereby in the displayed example a segmental angle of a segment 10 is about six times the segmental angle of a clearance 16, i. e. the segmental angle of a segment is about 13° and the segmental angle of a clearance is about 2°. Further visible on Figure 3 are the annular bead 8 as well as the outer skirt 7.

[0048] The Figure 4A shows a detailed view of a vertical cross-section of a further embodiment of an inventive screw cap appropriate for hot fill containers. For most of the aspects, the cap 101 corresponds to the cap for CSD containers described in connection with the Figures 1-3. Therefore, in the following we concentrate on the differences with respect to the first embodiment and do not address all the common features. The reference numbers concerning the second embodiment are offset by 100 compared to the reference numbers concerning the first embodiment. The main difference concerns the inner skirt 109 and the support segments 110. The length of the first section 1 09a of the inner skirt 109, adjacent to the inner face 102a of the top section 102 of the cap 101, is increased such that the total height of the inner skirt 109 is about 2.5 times the height of the outer skirt 107. The other sections of the inner skirt 109, namely the conical sections 109b, 109c forming the bulge 109d generally correspond to their counterparts of the first embodiment.

[0049] The height of the support segment 110 is correspondingly increased such that it ends at a height that corresponds to the lower conical section 109c of the inner skirt 109. The height of the support segment 110 (including the height of the annular bank 111) is about 0.85 times the length of the inner skirt 109.

[0050] The Figure 4B shows the inner and outer skirts 107, 109 and the support structure 110, 111 for the inner skirt 109 when the cap 101 is applied to a bottle 112. Again, the bottle 112 comprises a neck 113 forming a circular mouth 114 for filling and pouring out. On its outer face, the neck 113 features a screw thread 115 for co-operating with the corresponding screw thread 105 in the side wall 103 of the cap 101.

[0051] During application of the cap 101 to the bottle 112, the mouth 114 first contacts the outer face of the inner skirt 109. During introduction of the mouth 114 into the cap the counterpressure from the inner skirt 109 only slightly changes because the deformation mainly takes place in the top section 109a adjacent to the head section 102. After the mouth 114 has as well contacted the inner face of the outer skirt 107 it is carefully guided along the adjacent faces of the two skirts 107, 109 towards its desired end position, where the outer face of the mouth 114 is firmly supported by the inner face of the outer skirt 107. The inner face of the mouth 114 is supported by the bulge 109d as well as the inner face of the top region 109a of the inner skirt 109.

[0052] Again it is only near completion of the application of the cap 101 to the bottle 112 when the inner face of the inner skirt 109 contacts the support segment 110, leading to deformation of the outer skirt 107. Finally, this results again in two reliable independent sealings against the inner skirt 109 and the outer skirt 107, complemented by the third sealing between the annular bead 108 and the front face of the mouth 114.

[0053] When the container is opened by unscrewing the cap it remains sealed in a first phase of the opening process, due to the large vertical distance of the bulge 109d of the inner skirt 109, sealing against the outer face of the mouth 114, from the inner face 102a of the head section 102 of the cap 101. Thereby, it is ensured that the tamper evident band of the cap is broken before the outside air flows into the bottle 112.

[0054] The invention is not constrained to the described embodiment. The shape of the different elements of the screw cap may be modified, in particular for adaptation to a different kind of container or if another plastics material is used. For a given application, the sealing properties as well as the ease of use may be both optimised at the same time by modifying the dimensions and shapes of the projections featured on the inner face of the head section, particularly of the inner and outer skirts and of the support structure for the inner skirt. For example, the flexibility of the inner skirt is enhanced if the radial cross-section of the inner skirt is reduced, if the segment angle of the support elements is reduced and/or if the height of the support elements is decreased.

[0055] Furthermore, it is possible to provide another support structure for the outer skirt which is similar to the support structure for the inner skirt. In certain applications, the annular bead arranged in between the inner and the outer circular skirt may be dispensed with, or the support structure may just be constituted by a further coaxial skirt (i. e. by a single angular element).

[0056] In summary, it is to be noted that the invention

creates a screw cap that ensures easy closing and reclosing and reliable sealing of the container.

Claims

1. Screw cap for a container (12; 112), the cap (1; 101) being made of a plastics material and comprising

   a) an inner circular skirt (9; 109) provided on an inner top face (2a; 102a) of the cap (1; 101), for sealing against an inner face of a mouth (14; 114) of the container (12; 112) when the cap (1; 101) is applied to the container (12; 112); and
   b) a support structure (10, 11; 110, 111) provided on the inner top face (2a; 102a) of the cap (1; 101), associated with the inner skirt (9; 109);
   characterised by
   c) an outer skirt (7; 107) provided on the inner top face (2a; 102a) of the cap (1; 101), arranged coaxially around the inner skirt (9; 109) and distant from a side wall (3; 103) of the cap (1; 101), for sealing against an outer face of the mouth (14; 114) of the container (12; 112).

2. Screw cap as recited in claim 1, **characterised in that** the support structure (10, 11; 110, 111) comprises a plurality of elements (10; 110) arranged distant from one another, where each of the plurality of elements (10; 110) is formed and arranged such as to be contacted by an associated segment of the inner skirt (9; 109) when the cap (1; 101) is applied to the container (12; 112).

3. Screw cap as recited in claim 2, **characterised in that** the plurality of elements (10; 110) are arranged equally spaced along a circle that is coaxial with and interior of the inner skirt (9; 109).

4. Screw cap as recited in claim 3, **characterised in that** the number of elements (10; 110) is at least 8, preferably 12 or more.

5. Screw cap as recited in one of claims 2 to 4, **characterised in that** the support structure (10, 11; 110, 111) comprises an annular bank (10; 110) provided on the inner top face (2a; 102a) of the cap (1; 101), on which the plurality of elements (10; 110) are arranged.

6. Screw cap as recited in one of claims 2 to 5, **characterised in that** each of the plurality of elements (10; 110) has an inner conical face (10b) such that a radial thickness of the element (10; 110) decreases from the inner top face (2a; 102a) of the cap (1; 101).

7. Screw cap as recited in one of claims 2 to 6, **characterised in that** a height of each of the plurality of elements (10; 110) is between half a height of the inner skirt (9; 109) and the full height of the inner skirt (9; 109), preferably about 3/4 of the height of the inner skirt (9; 109).

8. Screw cap as recited in one of claims 1 to 7, **characterised in that** an outer face of the inner skirt (9; 109) features an annular radial bulge (9d; 109d) for contacting the inner face of the mouth (14; 114) of the container (12; 112).

9. Screw cap as recited in claim 8, **characterised in that** each of the plurality of elements (10; 110) ends at a height corresponding to a lower conical section (9c; 109c) of the radial bulge (9d; 109d) of the inner skirt (9; 109).

10. Screw cap as recited in claim 8 or 9, **characterised in that** the outer skirt (7) ends at about a height corresponding to the maximum wall thickness of the radial bulge (9d) of the inner skirt (9).

11. Screw cap as recited in one of claims 1 to 9, **characterised in that** a height of the inner skirt (109) is about 2-4 times a height of the outer skirt (107).

12. Screw cap as recited in one of claims 1 to 11, **characterised in that** a radial cross-section of the outer skirt (7; 107) is substantially constant, whereby an inner face as well as an outer face of the outer skirt (7; 107) are substantially perpendicular to the inner top face (2a; 102a) of the cap (1; 101).

13. Screw cap as recited in one of claims 1 to 12, **characterised by** an annular bead (8; 108) provided on the inner top face (2a; 102a) of the cap (1; 101), arranged coaxially between the inner skirt (9; 109) and the outer skirt (7; 107), for contacting and sealing against a top side of the mouth (14; 114) of the container (12; 112).

14. Screw cap as recited in one of claims 1 to 13, **characterised in that** the plastics material is polypropylene (PP).

15. Screw cap as recited in one of claims 1 to 14, **characterised in that** a first thickness of a top wall (2; 102) of the cap (1; 101), in an annular region (2c) featuring the inner circular skirt (9; 109) as well as the support structure (10, 11; 110, 111), is larger than a second thickness of the top wall (2; 102) in a central region (2b) of the cap.

16. Container, in particular a bottle or jar, comprising a screw cap (1; 101) as recited in one of claims 1 to 15.

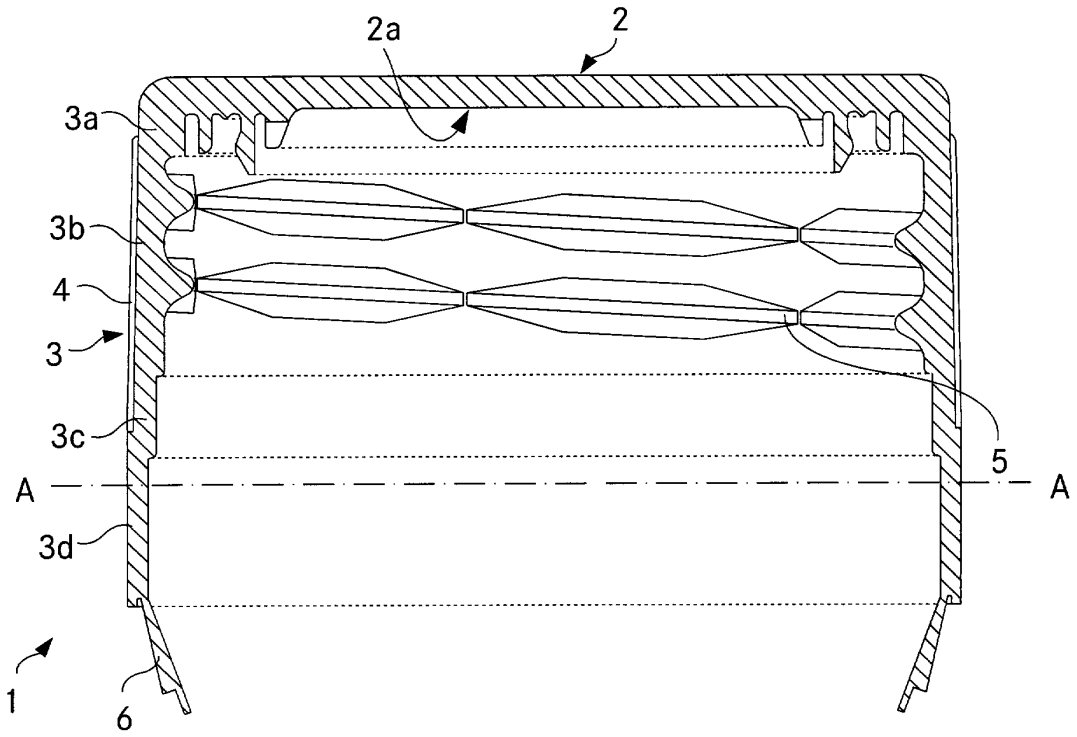

Fig. 1

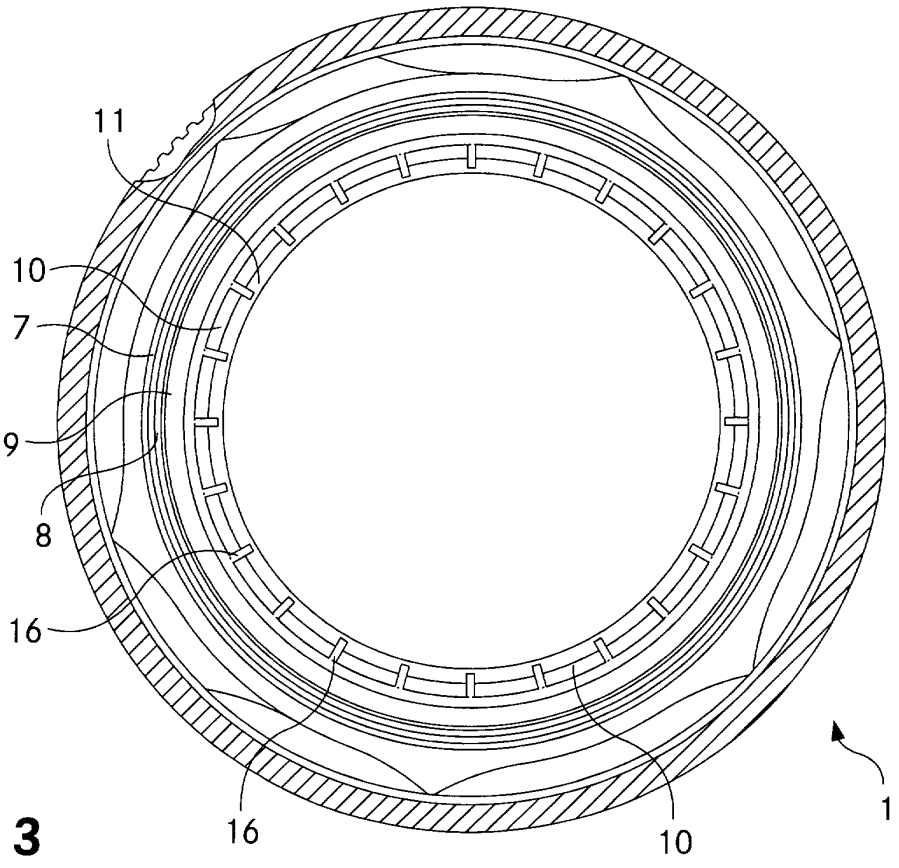

Fig. 3

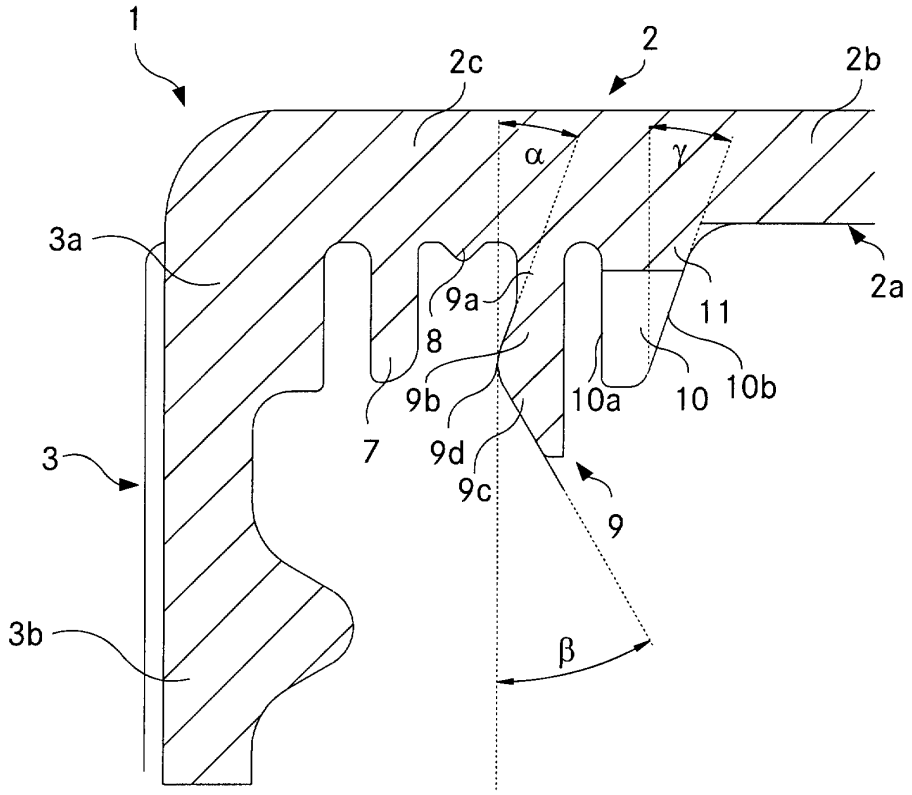
1
2
2c
2b
α
γ
3a
2a
9a
11
8
9b
10a
10
10b
7
9d
9c
3
9
3b
β

Fig. 2A

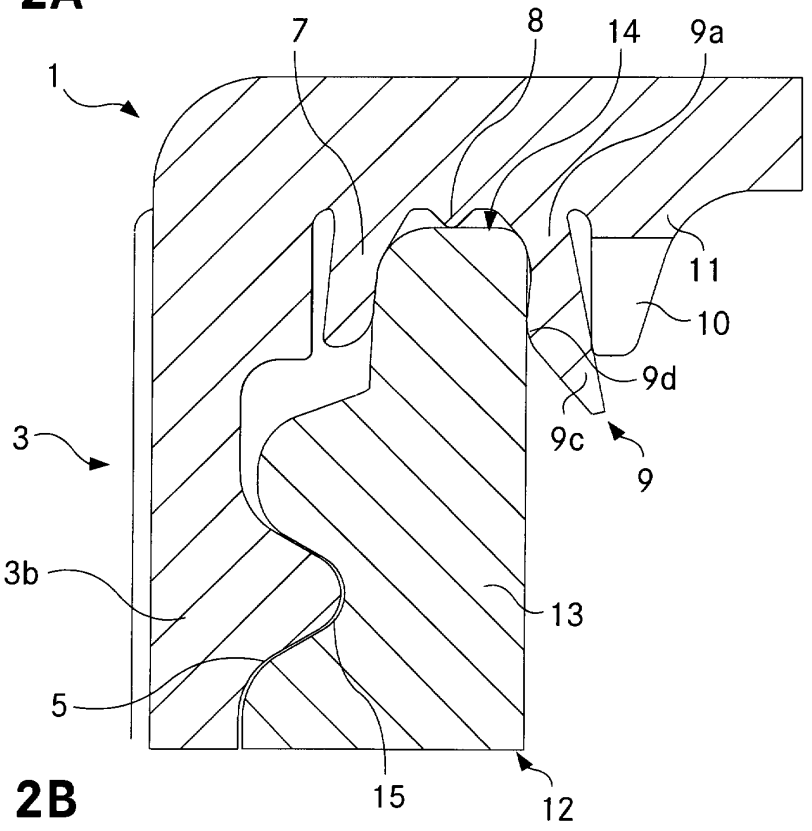
7
8
14
9a
1
11
10
9d
3
9c
9
3b
13
5
15
12

Fig. 2B

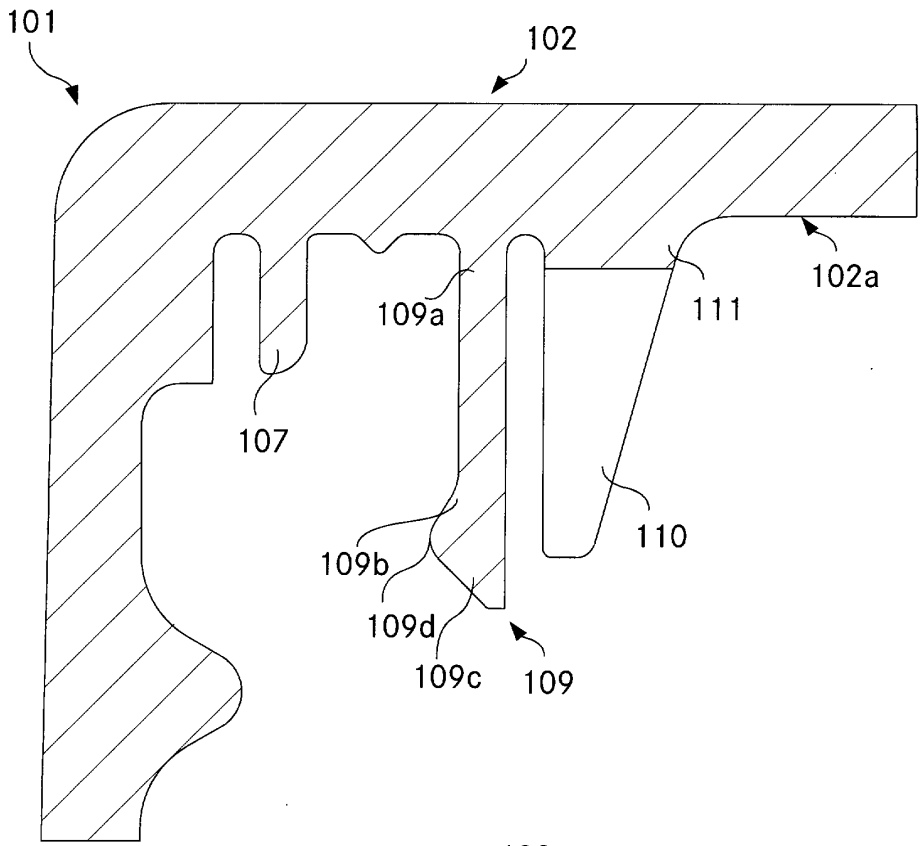
101
102
102a
111
109a
107
110
109b
109d
109c
109

Fig. 4A

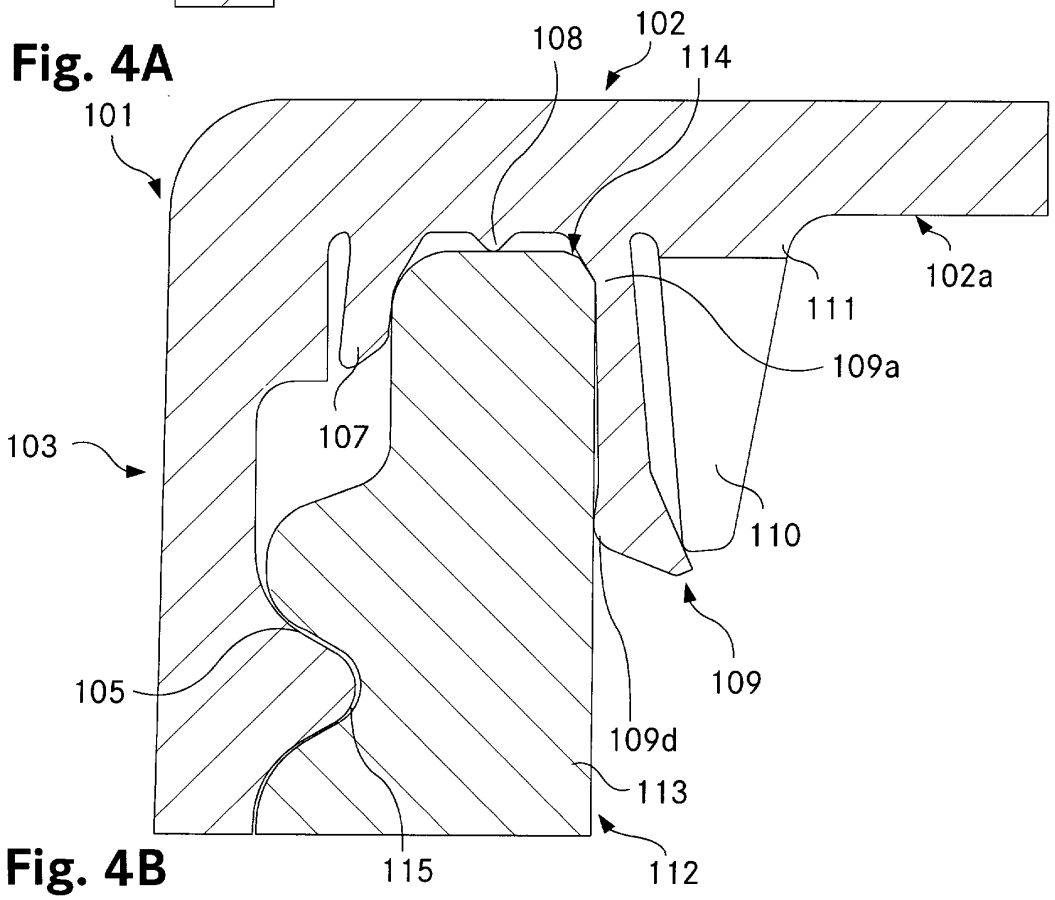
108
102
114
101
102a
111
109a
107
103
110
109
105
109d
113
115
112

Fig. 4B

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 40 5512

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X A	US 4 560 077 A (DUTT HERBERT V) 24 December 1985 (1985-12-24) * column 2, line 46 - column 7, line 56; figure 1 *	1 2	B65D41/04
X	US 4 442 947 A (BANICH SR JOHN N) 17 April 1984 (1984-04-17) * column 1, line 63 - column 3, line 47; figure 2 *	1	
X	US 2004/035818 A1 (KING ROGER MILNER) 26 February 2004 (2004-02-26) * paragraphs [0036] - [0041]; claim 1; figures 2,3 *	1	
X	US 6 581 792 B1 (LIMANJAYA TJANDRA) 24 June 2003 (2003-06-24) * column 3, line 44 - column 4, line 58; figures 2A,4 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) B65D

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
Munich	19 January 2005	Cazacu, C

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

EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 04 40 5512

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-7, 16

European Patent Office

LACK OF UNITY OF INVENTION SHEET B

Application Number
EP 04 40 5512

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-7, 16

   a support structure comprising a plurality of elements

   ---

2. claims: 8-10

   the outer face of the inner skirt comprising an annular radial bulge

   ---

3. claims: 11, 13

   the height of the inner skirt being about 2-4 times a height of the outer skirt; an annular bead

   ---

4. claim: 12

   radial cross-section of the outer skirt being constant

   ---

5. claim: 14

   plastics material being polypropylene

   ---

6. claim: 15

   thickness ratio of two top wall regions of the cap

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 40 5512

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-01-2005

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82