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(54) **Cap and process for forming the same**

(57) The present invention relates to a cap and a process for forming the same, which includes the step a) of providing a metal body (110) having a bottom (111) and a tubular wall (120) extending therefrom in a longitudinal direction (Y-Y) between an upper end (120a) and a lower end (120b). Particularly, the free end of the tubular wall (120) has a circular rim (121), substantially defining the lower end (120b) of said tubular wall (120). The step a) of providing a metal body (110) is followed by the step b) of curling the circular rim (121) to form a substantially spiral-shaped rib (122) curved inwards from the cap (100). Finally, the process includes the step c) of tapping the tubular wall (120) substantially at the rib (122) to form the threads (130) of the cap (100) so that the outer surface of the tubular wall (120) is substantially smooth.

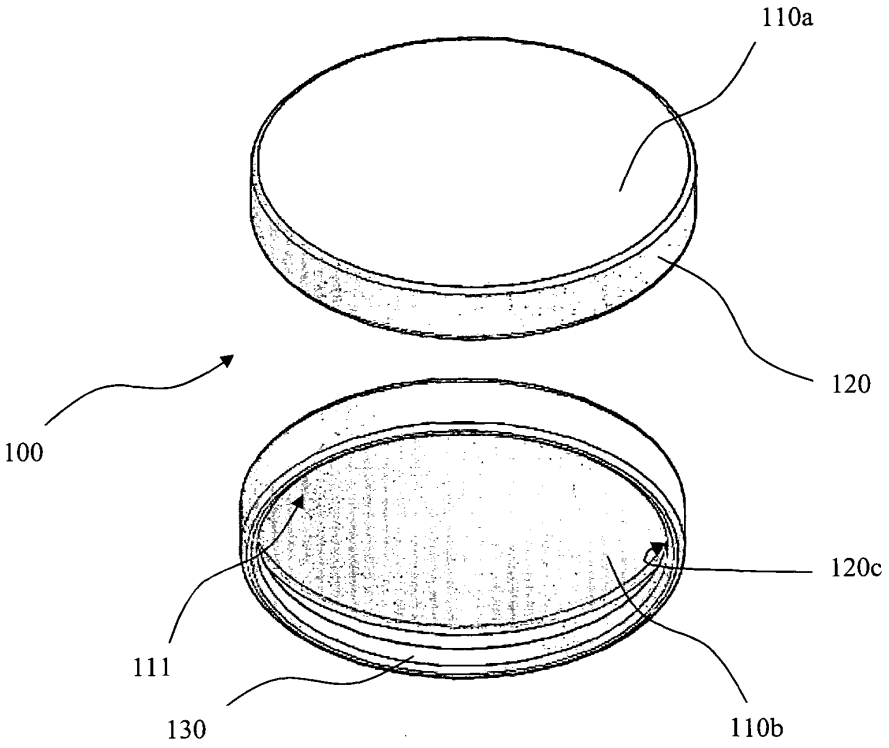

FIG. 1

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Description

[0001] The present invention relates to a cap and a process for forming the same, and more particularly to a threaded metal cap.

[0002] As used in the present disclosure and annexed claims, the term threaded metal cap is generally intended to indicate a cap having threads for screwing such cap onto the externally threaded mouth of a container.

[0003] A typical threaded metal cap is defined, for instance, by a tubular wall that extends transversely from the bottom of the cap in which the threads are formed on the interior of the tubular wall.

[0004] A number of processes are known to be used to form the above threaded metal cap. In one of these a metal sheet is deep-drawn to form the tubular wall that transversely extends from the bottom of the cap and the interior of the tubular wall is tapped to form the cap threads. Particularly, tapping is performed by dedicated machines (known as curling machines) which force a tap screwed onto the inner surface of the tubular cap wall. Thus, the tap is designed to alter the surface of the inner tubular wall of the surface to form its threads.

[0005] While the above process is effective in forming threaded metal caps, such caps still have some defects.

[0006] For instance, if the tubular wall of the cap is formed from a metal sheet, tapping of the inner surface of the wall also causes alteration of the outer surface thereof, thereby causing undesired wrinkling. As a result, the cap formed with the above process cannot be used if special predetermined aesthetic specifications require a wrinkleless outer surface of the tubular wall.

[0007] Therefore, the need arises for a cap that can comply with predetermined aesthetic specifications and has no wrinkle and/or folds on the outer surface of the tubular wall, even when the cap is formed from a metal sheet.

[0008] In view of the above described prior art, there is the need of providing a process for forming a threaded metal cap that fulfills the above mentioned needs, while obviating the above prior art drawbacks.

[0009] This object is fulfilled by a process for making a threaded metal cap as defined in claim 1 and a threaded metal cap as defined in claim 10.

[0010] Further features and advantages of the process for forming a threaded metal cap and the threaded metal cap of the present invention will appear from the following description of one preferred embodiment thereof, which is given by way of illustration and without limitation with reference to the accompanying figures, in which:

- Figure 1 shows a top perspective view and a bottom perspective view of the threaded metal cap of the present invention,
- Figure 2 shows a top view and a cross sectional side view of a metal sheet designed for forming the cap of Figure 1,
- Figures 3 to 7 are cross sectional side views of semifinished products, during the process of forming the cap of Figure 1,
- Figures 8a to 8e are cross sectional side views of different embodiments of the first face of the cap of Figure 1.

[0011] Referring to the annexed figures, numeral 100 generally designates a cap of the present invention.

[0012] The cap 100 is formed from a metal sheet (or foil) preferably of rectangular shape, by a process that will be explained in detail hereinafter. Preferably, the metal sheet is made of steel or aluminum, possibly tinned or chromate.

[0013] As shown in Figure 1, the cap 100 has a metal body 110 which defines a first face 110a and a second face 110b. Particularly, a portion of the second face 110b is designed to define the bottom of the cap 100. Therefore, the cap 100 has a substantially circular bottom 111 with a tubular wall 120 extending therefrom.

[0014] The tubular wall 120 extends transversely from the bottom 111 of the cap 100 in a longitudinal direction Y-Y to a predetermined length 1_1. Thus, an upper end 120a and a lower end 120b can be defined, with the tubular wall 120 therebetween.

[0015] As shown in Figure 7, the tubular wall 120 has an inner portion 120c and an outer portion 120d opposite thereto.

[0016] In the preferred embodiment as shown herein, the tubular wall 120 has a substantially U-shaped portion which connects together the inner portion 120c and the outer portion 120d. Particularly, the transverse section of the U-shaped portion is designed to define the edge 123 of the cap. Thus, the edge 123 forms the portion of the cap 100 that corresponds to the free end of the tubular wall 120.

[0017] It shall be noted that the inner portion 120c is an extension of the above defined U-shaped portion, which extends substantially parallel to the outer portion 120d of the tubular wall 120.

[0018] As shown in Figure 7, the tubular wall 120 has threads 130 projecting inwards from the cap 100 for screwing the cap 100 onto the externally threaded portion (e.g. the neck) of a container (not shown). Preferably the threads 130 project out from the inner portion 120c of the tubular wall 120.

[0019] As shown in the figures, a spacer portion may be provided between the U-shaped portion and the threads 130, which has a constant-diameter cylindrical profile.

[0020] It shall be noted that the threads 130 define the helical element that projects out from the inner portion 120c of the tubular wall 120 with a profile including alternating crests and grooves.

[0021] In the preferred embodiment, the threads 130 have a substantially spiral-shaped section. In one alternative embodiment, the threads 130 e a substantially circular section.

[0022] Preferably, the threads 130 include at least one

thread and have at least one pitch. The thread pitch may be as required by the user.

[0023] As shown in the embodiment of Figure 7, the bottom 111 and the tubular wall 120 are joined together by a connecting portion 125 with a substantially semicircular profile. It will be appreciated in this respect that the connecting portion 125 may have various shapes or profiles such as those as shown in Figures 8a to 8e.

[0024] As shown in the embodiment of Figure 7, an interspace of predetermined size 1_2 is provided between the inner portion 120c and the outer portion 120d of the tubular wall 120. Particularly, the inner portion 120c is separated from the outer portion 120d by a distance 1_2.

[0025] The presence of an interspace between the inner portion 120c and the outer portion 120d of the tubular wall 120 advantageously provides a tubular wall 120 having high elasticity, particularly at the inner portion 120c of the tubular wall 120. This is because the inner portion 120c can slightly bend in a direction transverse to the bottom 111 thereby allowing the cap 100 to at least partially deform at the side wall 120, e.g. when the cap 100 is screwed onto a container, while preventing any deformation in other parts, such as at the metal body 110. By this configuration, the cap 100 may be exposed to minor deformations even for long periods of time without any creep buckling.

[0026] Preferably, the distance 1_2 between the inner portion 120c and the outer portion 120d of the tubular wall 120 is of about 0.5 mm to about 2 mm.

[0027] In the preferred embodiment as shown in figure 8a, the first face 110a of the metal body 110 has a flat profile.

[0028] In the alternative embodiments as shown in Figures 8a to 8e the first face 110a of the metal body 110 may have different profiles. For instance, Figure 8b shows an example in which the first face 110a has a substantially corrugated profile with outward concavities to create a depression in the first face 110a of the metal body 11a substantially at a central area thereof. As used hereinafter and in the claims, the term diameter d_1 of the tubular wall 120 is intended to indicate the exterior diameter of the exterior portion 120d.

[0029] In one embodiment, the cap 100 has a diameter d_1 from 25 mm to 120 mm.

[0030] As used hereinafter and in the claims, the term diameter d_2 of the tubular wall 100 is intended to indicate the interior diameter of the spacing portion.

[0031] The interior diameter d_2 of the cap 100 may be selected according to the diameter of the container.

[0032] As used hereinafter and in the claims, the term crest diameter d_3 of the tubular wall 120 is intended to indicate the distance between two opposite crests of the threads 130.

[0033] The crest diameter d_3 of the tubular wall 120 may be also selected according to the diameter of the container threads.

[0034] As shown in Figure 7, the section 1_1 of the tubular wall 120 has a length from 5 to 20 mm, preferably from 8 mm to 17 mm.

[0035] Referring to Figure 2, the integrity of the product in the containing member is ensured by providing the cap 100 with a seal 115, advantageously of substantially circular shape, which is attached to the bottom 111 of the metal body 110.

[0036] Preferably, the seal 115 is made of polymeric material and may be integrally joined to the bottom 111 of the cap, preferably by press fitting the edge of the seal 115 against the surface of the inner portion 120c of the tubular wall 120. In one alternative embodiment, the seal 115 is formed by pouring a liquid polymeric material 111 onto the bottom 111 of the cap 100. Preferably, the polymeric material is poured at the end of the process for forming the cap 100, after threading, as described hereafter.

[0037] The diameter of the seal 115 is substantially equal or slightly smaller than the diameter d_1 of the cap 100.

[0038] The process for forming a cap 100 according to a preferred embodiment of the present invention will be now described.

[0039] Namely, the process of the invention includes the step of:

a) providing a metal body 110 having a bottom 111 and a tubular wall 120 extending therefrom in a longitudinal direction Y-Y between an upper end 120a and a lower end 120b. Particularly, the free end of the tubular wall 120 has a rim 121, advantageously of circular shape.

Referring to Figures 2 to 7, it shall be noted that the step a) of providing a metal body 110 may include the steps of:

a1) providing a metal sheet having a first face 110a and a second face 110b opposite thereto, wherein a portion of the second face 110b is designed to become the bottom 111 of the cap 100 (see Figure 3),

a2) deep-drawing the metal sheet to obtain the tubular wall 120 (see Figure 2).

The step a2) of deep-drawing the metal sheet may be followed by the step of:

a2.2) placing the seal 115 against the bottom 111 of the cap 100, and/or

a2.3) integrally connecting the/a seal 115 to the bottom 111 of the cap 100.

Still referring to Figures 2 to 7, the step a) of providing a metal body 110 may further include the steps of:

a3) trimming the free end of the tubular wall 120 to form the rim 121.

It shall be noted that, by trimming the free end of the tubular wall 120 the superfluous part of the metal sheet is removed.

In one embodiment of the inventive process, the steps a1), a2), a2.2), a2.3) and a3) are carried out in this sequence.

If the cap 100 is required to be coated with a decorated layer, comprising graphics and/or information for a user, the step a1) of providing a metal sheet may be followed by the step of:

a1.1) decorating, e.g. printing, at least one portion of the first face 110a, e.g. by lithography.

In one embodiment, the step a1.1) of decorating at least one portion of the first face 110a is carried out before the step a2) of deep drawing the metal sheet 110.

Referring to Figures 4 and 5, the process of the invention may include the step of:

b) curling the circular rim 121 to form a rib 122; the rib 122 may have, for example, a substantially spiral-shaped inwardly curved section or, for example a substantially circular or partially circular section.

Referring to the example of Figures 4 and 5, curling is performed by dedicated apparatus which use specially shaped rolls to form a so-called curl at the free end of the tubular wall. Particularly, the step b) of curling the circular rim 121 may include the step of:

b1) rotating the rim 121 of the cap 100 at least one turn around the pole of the rib 122.

Preferably, the step b) of curling the circular rim 121 follows the step a).

Referring to the example of Figure 6, the step b2) of rotating the rim 121 may be followed by the step of:

b2) forming the rib 122 at the lower end 120b of the cap 100 to form an edge 123; the edge 123 may extend transverse to the tubular wall 120 to a predetermined length 1_2.

In one embodiment of the inventive process, the steps b1) and b2) are carried out in this sequence.

Referring to the example of figure 7, in order to form the threads 130, the proces of the invention may include the step of:

c) tapping the tubular wall 120 substantially at the rib 122 to form the threads 130 of the cap 100 so that the outer surface of the tubular wall 120 is substantially smooth.

Preferably, the step c) of tapping the tubular wall 120 follows the step b).

Particularly, the step c) of tapping the tubular wall 120 may include the step of:

c1) helically forming the portion of the rib 122 facing inwards from the cap 100 to obtain the threads 130 of the cap 100.

Also, the step c1) of helically forming the portion of the rib 122 may include the step of:

c2) forming the threads 130 which have at least one pitch.

By tapping the tubular wall 120 after curling the rim 121 of the tubular wall 120 at the rib 122, a cap 100 is obtained in which the outer surface of the tubular wall 120 has no wrinkle and/or fold caused by cap threading. Therefore, the process of the present invention provides a cap in which the outer surface of the tubular wall 120 is substantially smooth.

In the process for forming a cap 100 according to the invention, said step c) of tapping the tubular wall 120 may be followed by the steps of:

d) forming a layer of polymeric material, and/or

e) integrally connecting the layer of polymeric material to the bottom 111 of the cap 100.

[0040] In one embodiment, the steps d) and e) are carried out after the step a2) of deep-drawing the metal sheet 110 to obtain the tubular wall 120.

[0041] As clearly shown in the above description, the cap and process for forming the same of the present invention fulfills the needs and obviates the prior art drawbacks as set out in the introduction of this disclosure.

[0042] Those skilled in the art will obviously appreciate that a number of changes and variants may be made to the cap and process for forming the same of the invention as described hereinbefore to meet specific needs, without departure from the scope of the invention, as defined in the following claims.

Claims

1. A process for forming a cap (100) comprising the steps of:

   a) providing a metal body (110) having a bottom (111) and a tubular wall (120) extending therefrom in a longitudinal direction (Y-Y) between an upper end (120a) and a lower end (120b), wherein the free end of said tubular wall (120) defines a circular rim (121),

   b) curling said circular rim (121) to form a rib (122) curved inwards from said cap (100) and preferably having a substantially spiral-shaped profile;

   c) tapping the tubular wall (120) substantially at said rib (122) to form the threads (130) of said cap (100) so that the outer surface of said tubular wall (120) is substantially smooth.

2. A process as claimed in claim 1, wherein said step a) of providing a metal body (110) comprises the steps of:

   a1) providing a metal sheet (110) having a first

face (110a) and a second face (110b) opposite thereto, wherein a portion of said second face (110b) is designed to become the bottom (111) of said cap (100),
a2) deep drawing said metal sheet (110) to obtain sais tubular wall (120), said tubular wall (120) extending transversely with respect to said bottom (111) to a predetermined length (1_1),
a3) trimming the free end of said tubular wall (120) to form said circular rim (121).

3. A process as claimed in claim 2, wherein said step a1) of providing a metal sheet (110) comprises the steps of:

a1.1) printing at least one portion of said first face (110a) by lithography.

4. A process for forming a cap (100) as claimed in claim 2 or 3, wherein said step **a2)** of deep drawing said metal sheet (110) is followed by the step of:

a2.2) placing a seal (115) against the bottom (111) of said cap (100),
a2.3) integrally connecting said seal (115) to the bottom (111) of said cap (100).

5. A process for forming a cap (100) as claimed in any claim from 1 to 4, wherein said step **b)** of curling said rim (121) said includes the step of:

b1) rotating the rim (121) of said cap (100) at least one turn around the pole of said rib (122).

6. A process for forming a cap (100) as claimed in any claim from 1 to 5, wherein said step **b2)** of rotating said rim (121) is followed by the step of:

b2) forming said rib (122) at the lower end (120b) of said cap (100) to form an edge (123) extending transverse to said tubular wall (120) to a predetermined length (1_2), said edge (123) substantially having a U-shape that forms a connecting portion between said tubular wall (120) and said rim (121).

7. A process for forming a cap (100) as claimed in any claim from 1 to 6, wherein said step c) of tapping said tubular wall (120) comprising the step of:

c1) helically forming the portion of said rib (122) facing inwards from said cap (100) to obtain the threads (130) of said cap (100).

8. A process for forming a cap (100) as claimed in claim 6, wherein said step **c1)** of helically forming the portion of said rib (122) includes the step of:

c2) forming said threads (130) which have at least one pitch.

9. A process for forming a cap (100) as claimed in any claim from 1 to 7, wherein said step c) of tapping said tubular wall (120) follows the step of:

d) forming a layer of polymeric material,
e) integrally connecting said layer of polymeric material to the bottom (111) of said cap (100).

10. A cap (100) formed by the process as claimed in any claim from 1 to 9, said cap (100) comprising:

- a metal body (110) having a first face (110a) and a second face (110b), wherein a portion of said second face (110b) is designed to be the bottom (111) of said cap (100),
- a tubular wall (120) extending from said bottom (111) between an upper end (120a) and a lower end (120b) in a longitudinal direction (Y-Y), said tubular wall (120) comprising an inner portion (120c) and an opposite outer portion (120d), and extending transverse to said bottom (111) to a predetermined length (1_1),

characterized in that said tubular wall (120) has threads (130) inwardly projecting from said cap (100) and that the surface of the outer portion (120d) of said side wall (120) is substantially smooth.

11. A cap (100) as claimed in claim 10, wherein said tubular wall (120) has a substantially U-shaped portion connecting together said inner portion (120c) and said outer portion (120d) of said tubular wall (120), said U-shaped portion substantially defining the edge (123) of said cap (100) at the free end of said tubular wall (120).

12. A cap (100) as claimed in claim 10 or 11, wherein said threads (130) project out from said inner portion (120c) of said tubular wall (120).

13. A cap (100) as claimed in claim 12, wherein said threads (130) have a substantially spiral section.

14. A cap (100) as claimed in claim 12, wherein said threads (130) have a substantially spiral-shaped section.

15. A cap (100) as claimed in any claim from 10 to 14, wherein an interspace of predetermined length (1_2) is provided between said inner portion (120c) and said outer portion (120d).

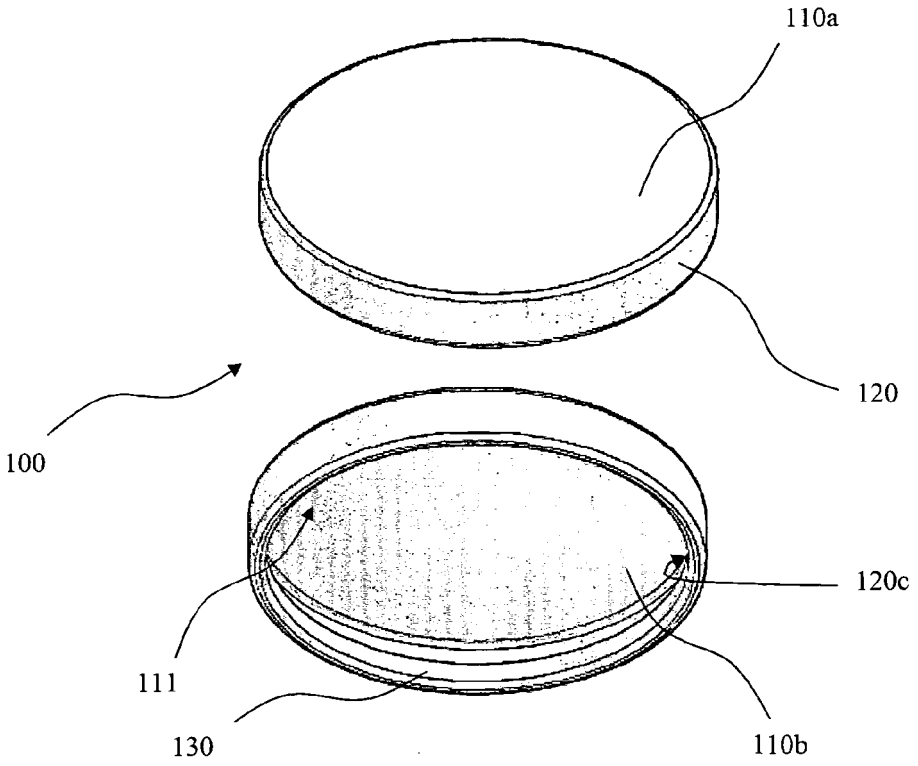

FIG. 1

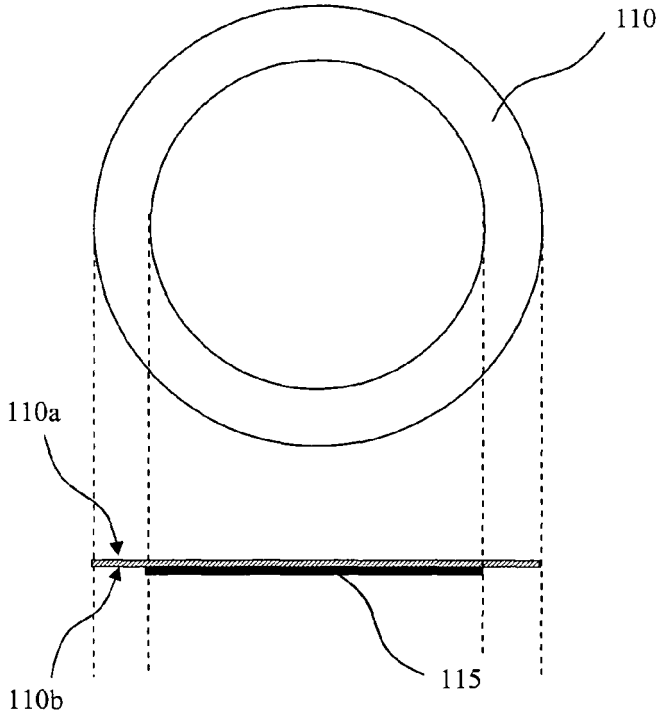

FIG. 2

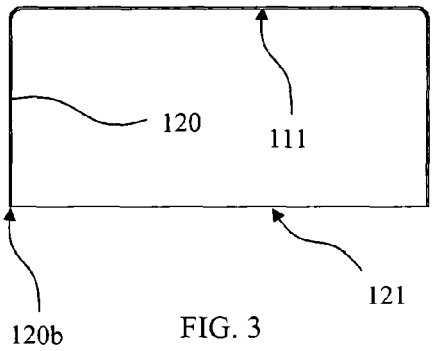

FIG. 3

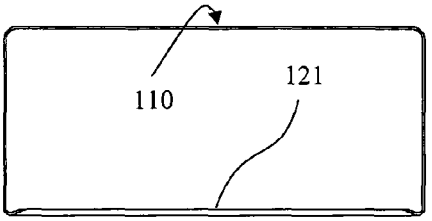

FIG. 4

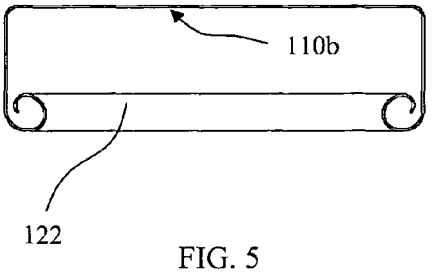

FIG. 5

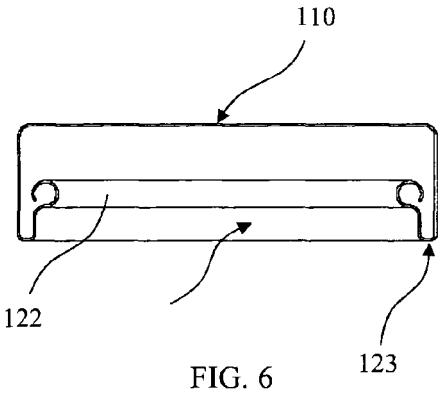

FIG. 6

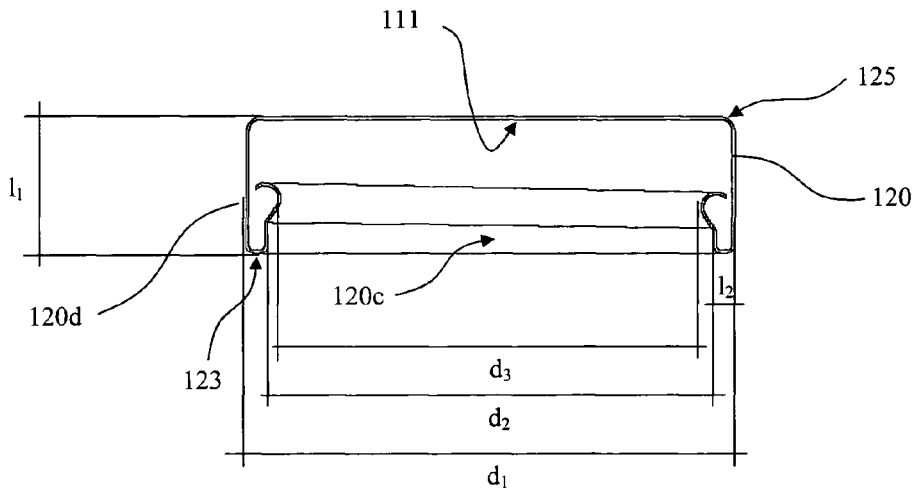

FIG. 7

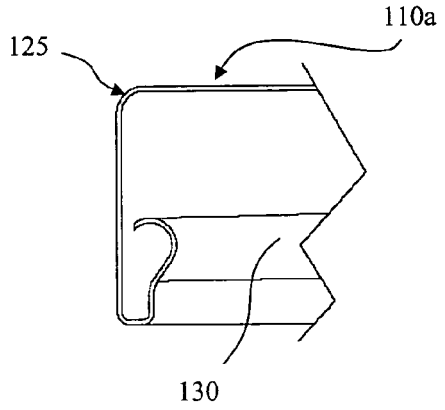

FIG. 8a

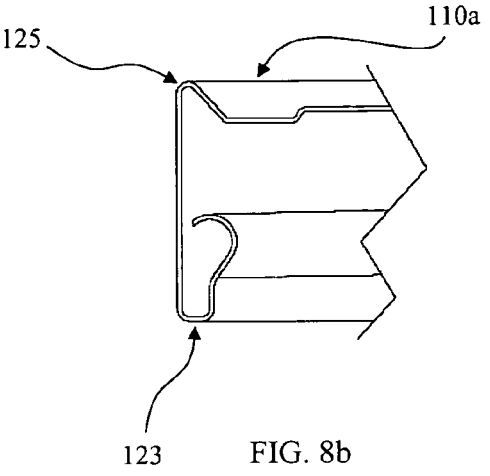

FIG. 8b

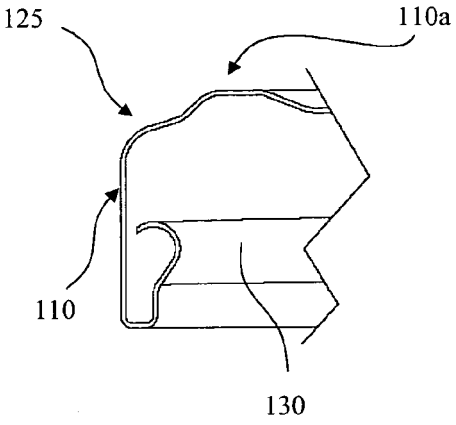

FIG. 8c

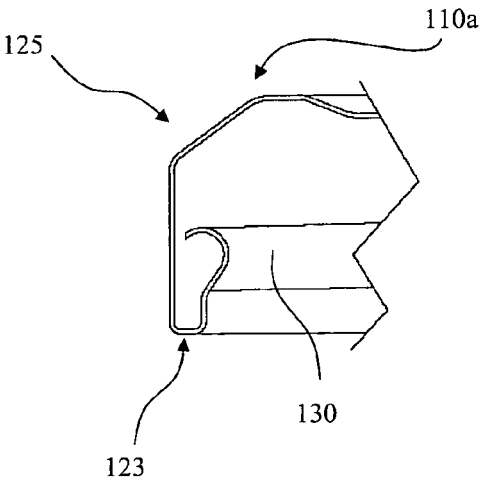

FIG. 8d

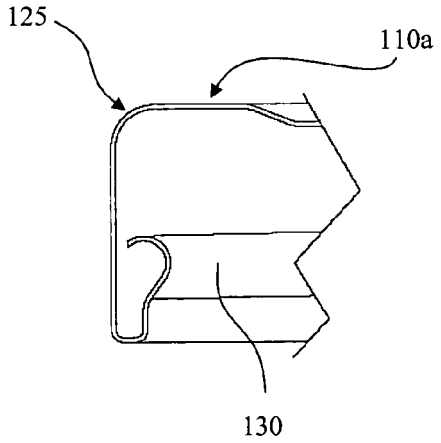

FIG. 8e

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EUROPEAN SEARCH REPORT

Application Number
EP 09 42 5310

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC) B21D B65D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 January 2010	Pieracci, Andrea

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 42 5310

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