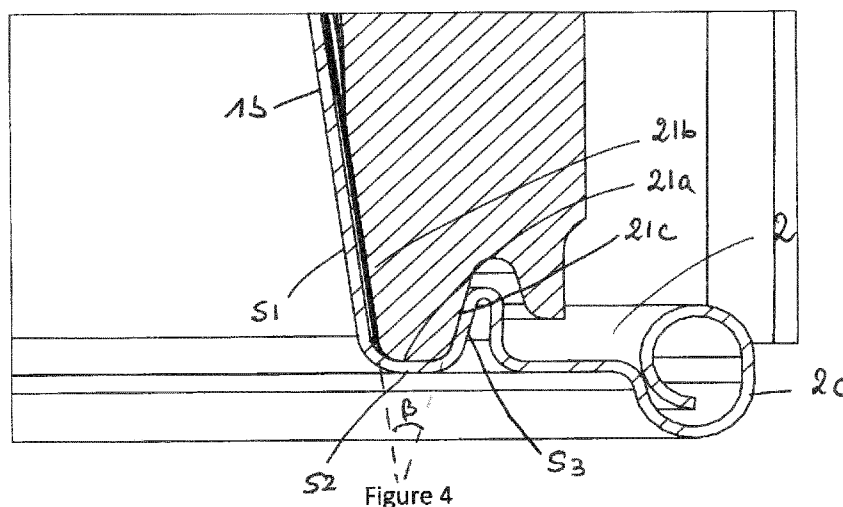




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(54) **Title:** CAPSULE FOR BEVERAGE PREPARATION WITH INTEGRALLY FORMED SEALING MEMBER



(57) **Abstract:** The invention relates to a capsule (10) designed for preparing a beverage upon injection of liquid into the capsule by means of a beverage preparation machine (20), the capsule (10) having a longitudinal axis (y) and comprising a cup-shaped base body (1) being provided with a closed end (1a) and lateral sidewalls (1b) for holding beverage preparation ingredients and a flange-like rim (2) arranged at an open end (1c) of the base body (1) and radially ending with a curled outer edge (2c); in which - the capsule (10) is in a first state before being used in the beverage preparation machine, wherein the capsule further comprises a sealing member (3) for providing a fluid sealing engagement with a sealing profile of a capsule engagement member (21) of the beverage preparation machine (20), said sealing profile having at least one sealing surface (21a, 21b, 21c), wherein the base-body (1), the flange-like rim (2) and the sealing member (3) are made integrally from metallic material such as aluminum as a one piece element, and wherein the sealing member (3) comprises at least one dedicated surface (4) located at the junction between the sidewalls (1b) of the base body (1) and the flange-like rim (2), said dedicated surface (4) being in the form of at least one step extending over the flange-like rim (2), and in which - the capsule (10) is in a second state after being used in the beverage preparation machine. The capsule is characterized in that, in the second state, after engagement between the sealing profile of the capsule engagement member (21) and the at least one step of the dedicated surface (4), the at least one step is plastically deformed and the capsule (10) comprises, at the location of the at least one

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step (4), a flange-like rim (2) having a profile corresponding to the shape of at least one of the sealing surface (21a, 21b, 21c), said profile presenting at least three contiguous surfaces (S1, S2, S3) having each a different orientation.

Capsule for beverage preparation with integrally formed sealing member

5 **Field of the invention**

The present invention relates to a capsule designed for preparation of a food product such as a beverage with enhanced sealing means. In particular, the invention relates to a capsule having a body with an integrally formed sealing member made from metallic material such as aluminum.

Background and object of the invention

15 Capsules for preparation of a food product such as a beverage are widely known in the market. An example of such capsule that is intended for being used with a beverage preparation machine is described in EP 0 512 468 A1. For beverage preparation in a dedicated beverage preparation machine, the capsule is inserted into the machine and ingredients contained in the capsule are made to interact with liquid provided to the capsule in order to form a desired beverage that is then made to leave the capsule. Thereby, the capsule is opened under the effect of rising pressure within the capsule, which urges an outlet face of the membrane against opening means such as raised elements provided on a supporting part of the beverage preparation machine. Sealing of the capsule with the beverage preparation machine during the beverage preparation process is obtained by an outer portion of a flange-like rim of the capsule which is contacted along a circumferential contact line by a suitably shaped engagement member of the beverage preparation machine.

In order to enhance sealing between the capsule and an engagement member of the beverage preparation machine, capsules have been developed in which a dedicated sealing member is applied and wherein the sealing member is of different material than the capsule body. EP 1 654 966 A1, EP 1 849 715 A1 and EP 2 151 313 A1 for example

relate to such a capsule in which a sealing member of rubber elastic material is applied to the capsule. The sealing member may be applied onto the capsule body by means of liquid depositing and hardening, gluing or by crimping a portion of the capsule body and/or the flange-like rim of the capsule onto the sealing member.

5

A disadvantage of these capsules is a more complex manufacturing process in which the capsule and the sealing member are manufactured in individual manufacturing steps and then assembled. The solution is more costly to produce both in terms of material cost and production cost and has also an environmental impact due to the use of two different materials. Therefore, a solution is sought-after which enables a facilitated manufacturing process while at the same time providing enhanced sealing properties of the flange-like rim of the capsule.

Capsules are also known, which comprise an integrally formed sealing member, i.e. a sealing member made from the same material as the capsule body respectively the flange-like rim of the capsule. EP 1 654 966 A1, EP 2 303 077 B1, EP 2 387 922 B1 and EP 2 814 328 B1 for example relate to a capsule comprising a sealing member formed of a plurality of concentric annular protrusions integrally formed with the flange-like rim.

EP 1 654 966 A1 discloses, in its third embodiment, to have the resilient nature of the sealing member made by the geometrical shape of the capsule itself. It proposes to have the sealing member in the shape of a step that increase the diameter of the side wall of the capsule . When the capsule is engaged with the inclined sealing surface of the beverage preparation machine, a deflection of the sealing member occurs on the capsule.

25

WO2014/012783 A1, WO2014/184652 A1, WO2016/186489 A1, WO2016/186495 A1 and WO2016/186496 A1 also disclose capsules for beverage preparation and which comprise a flange-like rim portion with an integrally formed annular sealing member.

WO2016/186495 A1 relates to a plastic capsule comprising a flange-like rim with two spaced projections projecting axially from the flange-like rim and a plateau between the two projections. During extraction of the capsules, a specific part of the beverage

preparation machine is configured to interact with the projections and the plateau to provide sealing engagement.

5 These known capsules however suffer the disadvantage that due the manufacturing tolerances in the dimensions of the capsules and in those of the enclosing member of the beverage preparation machine, the two parts are not properly matching and engaging, thus reducing the tightness between capsule and engagement member with risk of leaks and beverage dilution with water.

10 Furthermore, due to the circumferentially arranged projections of the flange-like rim, tensions may occur during forming of the projections in the manufacturing process, which in turn lead to defects in the sealing member and/or the flange-like rim and which negatively affect the sealing properties of the sealing member.

This particularly applies for metal capsules, e.g. made from aluminum or aluminum alloy. Thereby, defects such as stress cracking, wrinkling and other surface defects may occur 15 during the deep drawing process of aluminum when forming the capsule.

It is therefore an object of the present invention to provide an improved capsule which overcomes the disadvantages of the prior art solutions. This object is solved by the independent claims. The dependent claims define further preferred embodiments of the 20 invention.

Summary of the invention

25 The invention relates to a capsule designed for preparing a beverage upon injection of liquid into the capsule by means of a beverage preparation machine.

The proposed capsule has a longitudinal axis and comprises a cup-shaped base body being provided with a closed end and lateral sidewalls for holding beverage preparation ingredients, and a flange-like rim arranged at an open end of the base body and radially 30 ending with a curled outer edge.

The proposed capsule is in a first state before being used in the beverage preparation machine wherein the capsule further comprises a sealing member for providing a fluid

sealing engagement with a sealing profile of a capsule engagement member of the beverage preparation machine, said sealing profile having at least one sealing surface, wherein the base-body, the flange-like rim and the sealing member are made integrally from metallic material such as aluminum as a one piece element, and wherein the sealing
5 member comprises at least one dedicated surface located at the junction between the sidewalls of the base body and the flange-like rim, said dedicated surface being in the form of at least one step extending over the flange-like rim.

The proposed capsule presents a second state after being used in the beverage preparation machine.

10 According to the invention, in the second state, after engagement between the the capsule engagement member and the at least one step of the dedicated surface of the sealing member, the at least one step is plastically deformed and the capsule comprises, at the location of the at least one step, a flange-like rim having a profile corresponding to the shape of the sealing profile of the capsule engagement member, said profile
15 presenting at least three contiguous surfaces (S1, S2, S3) having each a different orientation.

In the second state of the capsule, the newly created profile, comprising the three surfaces having each a different orientation, generates axial and radial forces around the
20 engagement member producing an effective tightness between the flange-like rim and the sealing member of the engagement member.

The contiguous surfaces created by the plastic deformation of the at least one step, present the following orientation:

- The first surface is substantially parallel to a surface of the engagement member
25 facing the sidewalls of the base body of the capsule;
- The second surface is substantially parallel to flange-like rim; and
- The third surface forms an angle β with the base body sidewall, said angle being comprised between 1 and 50°.

30 The capsule according to the invention enables an efficient, reliable and tolerant sealing structure made from a single integral piece and thus by omitting any additional material

such as rubber.

Additionally, the capsule may be formed in a facilitated manufacturing process at reduced costs, while at the same time providing an enhanced sealing member without any
5 material defects such as cracks, wrinkling and surface defects that could affect the capsule quality and tightness and as well the extraction process.

The flange-like rim is preferably an essentially planar collar that extends from an open
10 end of the cup-shaped base body essentially perpendicular to outer lateral sidewalls of the base body and/or to a rotational axis of the capsule.

The dedicated surface is arranged at the junction between the cup-shaped base body and the flange-like rim and extends over a length D that is larger than the sealing profile of the engagement member.

Particularly, the dedicated surface extends over a length D comprised between 0.5 and 4
15 mm.

The dedicated surface of the sealing member, comprising at least one step, is preferably integrally formed in the otherwise essentially planar flange-like rim. The step formed in the flange-like rim preferably comprises a material thickness essentially corresponding to
20 the rest of the flange-like rim.

The step(s) in the flange-like rim are preferably made by a deep-drawing process. In a preferred embodiment, the capsule body, the flange-like rim and the sealing member are manufactured in a single deep-drawing process. The capsule may e.g. be produced by
25 deep-drawing an initially flat metal sheet.

The capsule is preferably made from a single sheet of metal such as aluminum.

The sealing member is considered as part of the flange-like rim and forms a continuous surface with it. The surface is directed towards the cup-shaped base body of the capsule.
30 On a surface of the flange-like rim opposite thereto, a closing membrane may be connected to the capsule base body.

The dedicated surface is designed for receiving and engaging a preferably annular sealing profile of a capsule engagement member of the beverage preparation machine. The sealing profile of the capsule engagement member comprising at least one sealing surface. The engagement member is preferably an essentially bell-shaped engagement member respectively a so-called capsule cage designed to house the cup-shaped base body of the capsule. The sealing profile of the engagement member may be a flat or rounded end surface of the engagement member.

In a preferred mode, the sealing profile of the engagement member is arranged for engaging the at least one step of the sealing member. The engagement of the sealing profile of the engagement member is designed such that it deforms the dedicated surface of the sealing member when engaging with it. The engagement of the sealing profile of the engagement member may be such that it provides at least substantially radially and axially oriented sealing forces with the sealing member.

In a first embodiment, the dedicated surface comprises one step, said one step is substantially parallel to the flange-like rim. It comprises a length d between 0.5 and 3 mm and a height H between 1 and 3 mm.

In a second embodiment, the dedicated surface comprises two steps: a first step adjacent the remaining flange-like rim portion and parallel to the flange-like rim and a second step located between the first step and the sidewalls. The second step forms an angle α with the longitudinal axis of the capsule and has a height h comprised between 0.2 and 2 mm.

The capsule preferably further comprises a closing membrane connected to the base body and/or the flange-like rim of the capsule. The closing membrane is preferably connected to a surface of the flange-like rim opposite to the surface at which dedicated surface of the sealing member is arranged. The closing membrane may be connected to the flange-like rim by means of an adhesive and/or welding technique. The closing membrane is preferably a closed membrane, i.e. void of any perforations. The closing membrane may however as well comprise pre-formed perforations therein. The closing membrane is preferably an aluminum foil. The foil is preferably sealed to the flange-like

rim such as to form a seal hermetical to gas with the capsule base body for preserving freshness of the ingredients contained in the cartridge.

5 The thickness of the closing membrane preferably lies between 60 and 100 microns (including the embossed structure and lacquer(s) on surface).

10 In a further aspect, the invention relates to a system comprising a capsule as described above and a beverage preparation machine designed to provide heated and/or pressurized liquid into the capsule for preparing a beverage upon interaction of the liquid with ingredients held within the capsule.

15 The beverage preparation machine preferably comprises a pump, heating and/or cooling means, a liquid supply such as a water tank and/or a beverage brewing chamber for selectively receiving a capsule in order to prepare a beverage therefrom.

20 The beverage preparation machine preferably comprises a capsule engagement member, e.g. as part of the brewing chamber, which is designed to house a capsule and in particular the capsule base body when the capsule is provided into the machine. The engagement member comprises an annular sealing profile designed to interact with the sealing member of the capsule in order to enable an effective sealing of the capsule during the beverage preparation process. As mentioned earlier, the sealing profile of the engagement member may be arranged for engaging the dedicated surface comprising at least one step. The engagement of the sealing profile of the engagement member may be such that it deforms the dedicated surface. The engagement of the sealing profile of the engagement member may be such that it provides at least substantially radially and axially oriented sealing forces with the dedicated surface

25 The beverage preparation machine preferably further comprises perforation means such as injection blades or the like, which are designed to perforate an inlet face of the capsule, in particular situated at a closed end of the capsule base body, and to inject liquid into the capsule interior.

The beverage preparation machine preferably further comprises a capsule support designed to hold the flange-like rim of the capsule at a side opposite to a side at which the engagement member of the machine engages the sealing member of the capsule. The capsule support preferably comprises opening means such as e.g. truncated pyramid-like elements against which a closing membrane of the capsule may be urged during
5 pressure rise within the capsule such as to open the closing member e.g. by of tearing or rupturing.

The capsule according to the present invention is preferably rotational symmetric, i.e.
10 symmetric along its vertical axis.

The beverage preparation ingredients provided in the capsule are preferably chosen from the group consisting of roasted ground coffee, tea, instant coffee, a mixture of roasted ground coffee and instant coffee, a syrup concentrate, a fruit extract concentrate, a
15 chocolate product, a milk-based product or any other dehydrated edible substance, such as dehydrated stock. The liquid to be used for beverage preparation is preferably water of any temperature.

The invention further relates to a cup-shaped base body of a capsule for preparation of a
20 food product with an enhanced integrally formed sealing member.

According to the invention, it is proposed a cup-shaped base body of a capsule for holding beverage preparation ingredients and a flange-like rim and a sealing member comprising a dedicated surface with at least one step at the junction between the cup-shaped base body and the flange-like rim and extending over the flange-like rim, the at
25 least one step being conformed for engaging with at least one sealing surface of a capsule engagement member of the beverage preparation machine, wherein the base-body, the flange-like rim and the sealing member are made integrally from metallic material such as aluminum.

30 The proposed flange-like rim is in a first state before being used in a beverage preparation machine; and is in a second state after being used in the beverage preparation machine.

In the second state of the flange-like rim, at the location of the at least one step, the flange-like rim is plastically deformed and presents a profile corresponding to the shape of at least one of the sealing surface, said profile comprising at least three contiguous surfaces (S1, S2, S3) having each a different orientation and generating axial and radial
5 forces around the engagement member producing an effective tightness between the flange-like rim and the sealing member of the engagement member.

The solution as proposed, allows producing an effective tightness between the flange-like rim and the sealing member of the engagement member thereby improving the
10 current state of the art.

Brief description of the figures

15 Further features, advantages and objects of the present invention will become apparent for a skilled person when reading the following detailed description of embodiments of the present invention, when taken in conjunction with the figures of the enclosed drawings.

20 These drawings depict only some embodiments in accordance with the disclosure and are, therefore, not to be considered limiting of its scope, the disclosure will be described with additional specificity and detail through use of the accompanying drawings. Hence, it will be appreciated that the invention as claimed is not intended to be limited in any way by these examples.

25

- Fig. 1a is a perspective side view of a first embodiment of a capsule according to the invention;
- Fig. 1b is a top view of the capsule according to Fig. 1a;
- Fig. 1c is cross sectional side view of the capsule according to Fig. 1a;
- 30 - Fig. 2 is sectional side view of the capsule of Fig. 1a integrating the first embodiment of the sealing member according to the invention and an engagement member of a beverage preparation machine before engaging

- with each other;
- Fig. 3 is a partial enlarged sectional side view of a first embodiment of the sealing member according to the invention and an engagement member of a beverage preparation machine before engaging with each other;
 - 5 - Fig. 4 is a partial enlarged sectional side view of a first embodiment of the sealing member according to the invention and an engagement member of a beverage preparation machine engaged with each other;
 - Fig. 5a is a perspective side view of a second embodiment of a capsule according to the invention;
 - 10 - Fig. 5b is a top view of the capsule according to Fig. 5a;
 - Fig. 5c is cross sectional side view of the capsule according to Fig. 5a;
 - Fig. 6 is sectional side view of the capsule of Fig. 5a according to the second embodiment of the invention and an engagement member of a beverage preparation machine before engaging with each other;
 - 15 - Fig. 7 is a partial enlarged sectional side view of the second embodiment of the sealing member according to the invention and an engagement member of a beverage preparation machine before engaging with each other; and
 - Fig. 8 is a partial enlarged sectional side view of the second embodiment
20 of the sealing member according to the invention and an engagement member of a beverage preparation machine engaged with each other.

Detailed description of the figures

25

In the following detailed description, reference is made to the accompanying drawings, which form a part hereof.

In the drawings, similar symbols and references typically identify similar components, unless context dictates otherwise.

30

The illustrative embodiments described in the detailed description and drawings are not meant to be limiting. Other embodiments may be utilized, and other changes may be

made, without departing from the scope of the claimed subject matter presented here. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the figures, may be arranged, substituted, combined, and designed in a wide variety of different configurations, all of which are
5 explicitly contemplated and make part of this disclosure.

As used in this specification, the words “comprises”, “comprising”, and similar words, are not to be interpreted in an exclusive or exhaustive sense. In other words, they are intended to mean including, but not limited to.

10

Any reference to prior art documents in this specification is not to be considered as an admission that such prior art is widely known or forms part of the common general knowledge in the field.

15 **Figure 1a** to **figure 4** relate to a first embodiment of a capsule 10 according to the invention.

As presented in the figures where **figure 1a** presents a perspective side view of a first embodiment of a capsule, **figure 1b** a top view of said capsule, **figure 1c** a cross sectional side view of said capsule and **figure 2** a sectional side view of said capsule, the capsule 10
20 comprises a cup-shaped base body 1. The base body 1 comprises a closed end 1a (whole area of the top portion of the capsule and not only the central one), lateral sidewalls 1b and an open end 1c. The closed end 1a may serve as an injection face during a beverage preparation process, which may be opened by a dedicated injection member of a
beverage preparation machine 20.

25

During the extraction process, an engagement member 21 of the dedicated beverage preparation machine 20, as presented in **figure 3**, is engaged with the capsule 10. The engagement member 21 preferably comprises an essentially hollow bell-shaped engagement member for receiving the capsule base body 1 therein. When the capsule
30 10 is placed into the beverage preparation machine 20, the engagement member 21 will be lowered onto the capsule 10 by means of a dedicated closing force F.

The engagement member 21 comprises a sealing profile presenting several sealing surfaces 21a, 21b and 21c. The sealing surfaces are located on an inner part of the engagement member 21, on a portion of the engagement member 21 that comes into contact with the capsule 10. The sealing surfaces, for example, may be in the form of an annular lower surface with rounded inner and outer circumferential edges, a flat surface that in use is parallel to the sidewalls of the capsule. The sealing surface 21a facing the peripheral portion of the capsule comprises a radial thickness which preferably lies between 0.1 and 0.6 mm, more preferably between 0.2 and 0.5 mm.

10 As shown on **figure 1a**, the capsule 10 further comprises a flange-like rim 2, which is preferably arranged at the open end 1c of the capsule 10. The flange-like rim 2 extends radially outwardly from lateral sidewalls of the cup-shaped base body 1. The flange-like rim 2 is preferably arranged transversally to a rotational axis Y of the capsule 10 and presents a curled outer edge 2c at its extremity opposite the base body 1.

15 In the shown embodiment, the capsule is preferably made of aluminum. In terms of dimension, the base body 1 has a diameter comprised between 8 and 30 mm, a height of about 24 to 30 mm, the thickness of the base body sidewalls is between 0.08 and 0.12 mm.

The flange-like rim 2 extending from the body base 1 has a length L measured from the body base sidewalls 1b to the curled out edge 2c that is between 2 and 4 mm.

20 At the open end 1c (shown in figure 1c) of the capsule base body 1, a closing membrane 9 may be arranged. The closing membrane 9 is preferably connected to the flange-like rim 2, as presented in **figure 1c** and in **figure 2**. The closing membrane 9 is preferably connected to at least one lower annular surface 2b of the flange-like rim 2, which surface 2b is directed away from the capsule base body 1.

25 Alternatively, the closing membrane 9 may be connected to the base body 1 or to both the base body 1 and the flange-like rim 2.

30 The closing membrane 9 is preferably an aluminum foil sealed to the flange-like rim 2.

The cup-shaped base body 1 preferably encloses beverage ingredients suitably for preparing a liquid comestible upon interaction with liquid injected into the capsule 10. The ingredients are preferably enclosed by the cup-shaped base body 1 and the closing membrane 9. The beverage ingredients may be roasted ground coffee or other kinds of ingredients as previously described.

The flange-like rim 2 comprises an integrally formed sealing member 3 which is arranged at an upper annular surface 2a of the flange-like rim. The annular surface 2a is arranged opposite to the surface 2b to which the closing membrane 9 is preferably connected. The annular surface 2a is thus facing away from the open end 1c of the capsule.

The sealing member 3 is positioned between the capsule body base 1 and the flange-like rim 2. It comprises a dedicated surface 4 located at the junction between the lateral sidewalls 1b of the body base 1 and the flange-like rim 2.

Said dedicated surface 4 extends over a length D that is larger than the inner part (where the sealing surfaces are located) of the engagement member 21.

More precisely, the dedicated surface 4 extends over a length D (measured from the sidewalls 1b) comprised in the range from 0.5 to 4 mm.

in the present embodiment, length D is about 2.5 mm.

The dedicated surface 4 comprise a step 4a extending from the lateral sidewalls 1b over the flange-like rim 2, the step 4a being substantially parallel to the flange-like rim direction. The step 4a is integrally formed with the flange-like rim 2 and the base body 1. This means that it is formed of same material as the flange-like rim and as the body base and is formed from the flange-like rim such as (and are not add-on parts) to extend from the surface 2a.

As can be seen in **figure 1b**, the step 4a extends continuously and annularly around the lateral sidewalls 1b and is arranged to engage with a sealing surface 21a of a capsule engagement member 21 of the beverage preparation machine 20. This is visible in **figure 2** showing the capsule 10 interacting with the engagement member of the beverage machine 20.

In order to have an efficient engagement, the length d of the step 4a (extending from the lateral sidewalls 1b) is preferably chosen such that it suitably and fully interacts in sealing engagement with the dedicated sealing surface 21a of the engagement member 21.

- 5 The length d of step 4a, is preferably between 0.5 and 3 mm, more preferably between 1 and 2.5 mm. The height H of step 4a preferably lies between 1 and 3 mm, more preferably between 1.5 to 2.5 mm.

10 The step 4a then extends over a length d that is larger than the inner part (where the sealing surfaces are located) of the engagement member 21 and the remaining portion of the flange-like rim 2 is then preferably between 0.5 to 1 mm.

The system to which the capsule and the beverage preparation machine are integrated in, is operated as follows for the preparation of a cup of a beverage, for example, a coffee.

- 15 The capsule 10 is placed in the beverage preparation machine and the capsule engaging member 21 is brought into contact with the capsule 10 when the beverage preparation machine is closed. The capsule is pierced on its closed end 1a by piercing means (not represented) for creating the entrance of a fluid (hot or cold) under pressure into the capsule 10. The water wets the coffee stored inside the capsule and extracts the desired
20 substance to form the coffee beverage.

During the supply of the water under pressure to the capsule, the rise in pressure causes the closing membrane 9 to rupture (through pressing of the closing membrane 9 on some cover piercing means, for example) and the coffee beverage is delivered by drainage of the coffee beverage from the capsule to a cup.

25

Reference is now made to **figures 3 and 4** presenting partial enlarged sectional side views of the embodiment of the sealing member of figures 1a to 2 and an engagement member of a beverage preparation machine before and during engagement with each other.

- 30 Particularly, when the engagement member 21 is lowered from the position shown in **figure 3** onto the sealing member 3 by closing force F , the annular sealing surface 21a engages with step 4a.

As a results of the force applied on the sealing member 3 in the overlap region between the engagement member 21 and the sealing member 3, the step 4a of the sealing member 3 undergoes a plastically deformation during said engagement. Indeed, step 4a extends over a length d that is larger than the inner part of the engagement member 21 where the sealing surfaces are located.

In the present case, the length d of step 4a is larger than the radial extension of sealing surface 21a.

As explained, the plastic deformation is due to the force that is applied:

- 10 - by the clamping system when the coffee machine is closed through the engagement member 21; and
- during the extraction process by the water pressure through the engagement member 21 on the capsule.

The step 4a then closely conforms with the sealing surfaces 21a, 21b, 21c of the engagement member 21 so that during the extraction process, the surface of the flange-like rim 2 conforms with the shape of the sealing profile (with sealing surfaces 21a, 21b and 21c) on the overlap portion.

Figure 4 shows this close conformation between the sealing surfaces 21a, 21b, 21c and the flange-like rim 2 occurred during use (and visible after use), where the step 4a and the flange-like rim 2 are deformed leading to a structure conforming the grooves of the sealing member. The resulting structure presents at least three new contiguous (or adjacent) surfaces S1, S2, S3 formed during the plastic deformation, said surfaces following the shape of the sealing surfaces 21a, 21b, 21c of the capsule engagement member 21.

Hence, the new shape of the flange-like rim 2 presents at least three new surfaces S1, S2; S3 having each a different orientation.

As can be seen on **figure 4**, the first surface S1 of the flange-like rim deformed capsule is substantially parallel to the base body sidewall 1b and to sealing surface 21b.

The second surface S2 of the flange-like rim deformed capsule is substantially parallel to flange-like rim 2 and to sealing surface 21a.

The third surface S3 of the flange-like rim deformed capsule forms an angle β with the base body sidewall 1b, comprised between 1 and 50°. In the present case, surface S3 is
5 substantially parallel to sealing surface 21c of the engagement member 21 and angle β is about 22°.

These three surfaces S1, S2 and S3, presenting each a different orientation, allow to perfectly conform with the sealing profile of the capsule engagement member 21, thus
10 generating axial and radial forces around the engagement member and producing an effective fluid tightness between the capsule 10 and the beverage preparation machine 20.

Because of the deformed flange-like rim conforming with the shape corresponding to the
15 sealing surfaces 21a, 21b, 21c the sealing between the capsule flange-like rim 2 and the engagement member is increased.

In the proposed embodiment, the cup-shaped base body 1, the flange-like rim 2 and the sealing member 3 are integrally formed, i.e. by one single piece made from the same
20 material. Accordingly, the cup-shaped base body 1, the flange-like rim 2 and the sealing member 3 can be manufactured from the same material by a conventional forming process. In particular, the base body 1, the flange-like rim 2 and the integrally formed sealing member 3 can be formed in a deep-drawing process. The deep drawing process may require more than one deep drawing step to properly form from a flat piece of
25 material, preferably a metal sheet, the body of the capsule and the sealing member.

The base body 1, the flange-like rim 2 and the sealing member 3 are formed of one piece made of metal, preferably of aluminum, most preferably an aluminum alloy.

30 **Figure 5a** to **figure 8** relate to a second embodiment of a capsule 10 according to the invention.

In the figures where **figure 5a** presents a perspective side view of a first embodiment of

a capsule, **figure 5b** a top view of said capsule, **figure 5c** a cross sectional side view of said capsule and **figure 6** a sectional side view of said capsule, a capsule 10 is shown.

As indicated previously, similar symbols and references typically identify similar components, unless context dictates otherwise and only additional elements will be described in detail, the previously described elements applying also on this second embodiment.

In the second embodiment, the dedicated surface 4 of the sealing member 3 comprises two steps:

- a first step 4a adjacent the remaining flange-like rim 2 portion and parallel to the flange-like rim. Said first step has a length d in the range of 0.5 to 3 mm; and
- a second step 4b located between the first step 4a and the sidewalls 1b of the base body 1. The second step 4b is shorter than the first step 4a. It forms an angle α with the longitudinal axis of the capsule. Angle α is in the range of 10 to 80°. The second step 4b has a height h comprised between 0.2 and 2 mm.

Reference is now made to figures 7 and 8 presenting partial enlarged sectional side views of the embodiment of the sealing member of figures 5a to 6 and an engagement member of a beverage preparation machine before and during engagement with each other.

Particularly, when the engagement member 21 is lowered from the position shown in **figure 7** onto the sealing member 3 by closing force F , the annular sealing profile of the engagement member 21 first engages with step 4b. In the present case, the edge between sealing surfaces 21a and 21b engages with step 4b. In this overlap region between sealing surface 21a, 21b and step 4b, step 4b initiates to undergo a plastic deformation.

While going in further engagement, the sealing surfaces 21a, 21b, 21c of the sealing profile further engage with the sealing member and enters in engagement with the first step 4a.

In turn, first step 4a undergoes a plastically deformation during said engagement.

The two steps 4b, 4a, one after the other closely conform with at least one of the sealing surfaces 21a, 21b, 21c of the engagement member 21.

At the end of the closure of the machine and of the extraction process, when the engagement member and the dedicated surface are fully engaged, the plastic deformation is finished and the surface of the flange-like rim 2 conforms with the shape of the sealing profile (sealing surfaces 21a, 21b, 21c) of the engagement member on the overlap portion.

Figure 8 shows this close conformation between the sealing surface 21a, 21b, 21c and the flange-like rim 2 after use of the capsule. The steps 4a and 4b have been deformed leading to a structure of the flange-like rim 2 conforming the grooves of the sealing surface 21. The resulting structure presents at least three new contiguous (or adjacent) surfaces S1, S2, S3 coming from the deformation, said surfaces following the shape of the sealing profile of the capsule engagement member 21.

15

Hence, the new shape of the flange-like rim 2 presents at least three new surfaces S1, S2; S3 having each a different orientation.

Similarly as in the first embodiment:

- 20
- first surface S1 of the flange-like rim in its second state is substantially parallel to the surface (21b) of the capsule engaging member (21).
 - second surface S2 of the flange-like rim in its second state is substantially parallel to flange-like rim 2 and to sealing surface 21a.
 - third surface S3 of the flange-like rim in its second state forms an angle β with the
- 25
- base body sidewall 1b, comprised between 1 and 50°. In the present case, surface S3 is substantially parallel to sealing surface 21c of the engagement member 21 and angle β is about 22°

The dedicated surface 4 of this second embodiment, with steps 4a and 4b, is larger than the dedicated surface 4 of the first embodiment. This leads to having a sealing surface 21a larger thus providing an improved fluid tightness between the engagement member

30

and the capsule.

In this second embodiment, step 4b also contributes to the centering between the capsule and the engagement member. Indeed, step 4b is extending from the sidewalls 1b
5 of the body base and also presents a certain angle (angle α with longitudinal axis) allowing a self-centering effect.

Hence, similarly as in the first embodiment, as the engagement member 21 is moved towards the flange-like rim 2, during closing (mechanical force applies) and/or extraction
10 (pressure force applies), the sealing surfaces 21a, 21b, 21c of the sealing profile deform the dedicated surface (first and second steps) and the flange-like rim 2 conforms to the sealing profile of the engagement member 21.

The conformation has the effect to increase the contact surface area between the engagement member 21 and the capsule flange-like rim 2 and therefore to increase the
15 fluid tightness between the capsule 10 and the beverage machine 20.

The proposed embodiments show a capsule engagement member 21 with a given geometry however other geometries of the capsule engagement member may be envisaged.
20

Thanks to the proposed structure comprising at least one step, the proposed capsule has the specificity to adapt to the capsule engagement member.

In any case, during the extraction process, the sealing member 3 which comprises at least
25 one step 4a, 4b conforms with the shape of the sealing profile of the capsule engagement member 21 over at least three surfaces having different orientation thereby leading to an increase sealing between the capsule and the beverage machine.

30

Claims

1. A capsule (10) designed for preparing a beverage upon injection of liquid into the capsule by means of a beverage preparation machine (20), the capsule (10) having a longitudinal axis (y) and comprising a cup-shaped base body (1) being provided with a closed end (1a) and lateral sidewalls (1b) for holding beverage preparation ingredients and a flange-like rim (2) arranged at an open end (1c) of the base body (1) and radially ending with a curled outer edge (2c); in which
- 5
- 10 - the capsule (10) is in a first state before being used in the beverage preparation machine,
- wherein the capsule further comprises a sealing member (3) for providing a fluid sealing engagement with a sealing profile of a capsule engagement member (21) of the beverage preparation machine (20),
- 15 said sealing profile having at least one sealing surface (21a, 21b, 21c), wherein the base-body (1), the flange-like rim (2) and the sealing member (3) are made integrally from metallic material such as aluminum as a one piece element, and
- wherein the sealing member (3) comprises at least one dedicated surface (4) located at the junction between the sidewalls (1b) of the base body (1) and the flange-like rim (2), said dedicated surface (4) being in the form of at least one step extending over the flange-like rim (2), and in which
- 20
- the capsule (10) is in a second state after being used in the beverage preparation machine;
- 25
- characterized in that;** in the second state, after engagement between the sealing profile of the capsule engagement member (21) and the at least one step of the dedicated surface (4), the at least one step is plastically deformed and the capsule (10) comprises, at the location of the at least one step (4), a flange-like rim (2) having a profile corresponding to the shape of at least one of the sealing surface (21a, 21b, 21c), said profile presenting at least three contiguous surfaces (S1, S2, S3) having each a different orientation.
- 30

2. The capsule of claim 1,
wherein the dedicated surface (4) extends over a length D that is larger than the sealing profile of the engagement member (21).
- 5 3. The capsule of claim 1 or 2,
wherein the dedicated surface (4) extends over a length D comprised between 0.5 and 4 mm, preferably between 0.7 and 3 mm.
4. The capsule of any of the preceding claims,
10 wherein the dedicated surface (4) comprises at least a first (4a) and a second step (4b).
5. The capsule of claim 4,
wherein the first step (4a) is substantially parallel to the flange-like rim (2).
- 15 6. The capsule of any of claims 4 or 5,
wherein the first step (4a) has a height H comprised between 1 and 3 mm and a length d comprised between 0.5 and 3 mm.
- 20 7. The capsule of any of claims 4 to 6,
wherein the second step (4b) forms an angle α with the longitudinal axis (y) of the capsule (10) comprised between 10 and 80°.
8. The capsule of any of claims 4 to 7,
25 wherein the second step (4b) has a height h comprised between 0.2 and 2 mm, preferably between 0.5 and 1.5 mm.
9. The capsule of any of the preceding claims,
30 wherein, after engagement with at least on the sealing surfaces (21a, 21b, 21c) of the capsule engagement member (21), one of the surface (S1) of the flange-like rim in its second state is substantially parallel to one of the sealing surface (21b) of the capsule engaging member (21).

10. The capsule of any of the preceding claims,
wherein, after engagement with the at least one of the sealing surfaces (21a, 21b, 21c) of the capsule engagement member (21), one of the surface (S2) of the flange-like rim in its second state is substantially parallel to flange-like rim (2).
- 5
11. The capsule of any of the preceding claims,
wherein, after engagement with at least one of the sealing surfaces (21a, 21b, 21c) of the capsule engagement member (21), one of the surface (S3) of the flange-like rim in its second state forms an angle β with the base body sidewall (1b) comprised between 1 and 50°.
- 10
12. The capsule of any of the preceding claims,
wherein the capsule body (1), the flange-like rim (2) and the sealing member (3) are produced by deep drawing an initially flat metal sheet.
- 15
13. The capsule of any of the preceding claims,
wherein the capsule (10) is made from aluminum.
- 20
14. The capsule of any of the preceding claims,
wherein the capsule further comprises a closing membrane (9) connected to the base body (1) and/or the flange-like rim (2) of the capsule.
15. The capsule according to claim 14,
wherein the closing membrane (9) is connected to a surface (2b) of the flange-like rim (2) opposite to the surface (2a) at which the sealing member (3) is arranged.
- 25
16. The capsule according to claim 14 or 15,
wherein the closing membrane (9) is an aluminum foil sealed to the flange-like rim (2) on the surface (2b) opposite to the surface (2a).
- 30
17. A system comprising a capsule (10) of any of claims 1 to 16 and a beverage

preparation machine (20) designed to provide heated and/or pressurized liquid into the capsule for preparing a beverage upon interaction of the liquid with ingredients held within the capsule.

- 5 18. A cup-shaped base body (1) of a capsule for holding beverage preparation ingredients and a flange-like rim (2) and a sealing member (3) comprising a dedicated surface (4) with at least one step at the junction between the cup-shaped base body (1) and the flange-like rim (2) and extending over the flange-like rim (2), the at least one step being conformed for engaging with at least one of the sealing surfaces (21a, 21b, 21c) of a capsule engagement member (21) of the beverage preparation machine (20),
- 10 wherein the base-body (1), the flange-like rim (2) and the sealing member (3) are made integrally from metallic material such as aluminum,
- wherein the flange-like rim (2) is a first state before being used in a beverage preparation machine; and
- 15 wherein the flange-like rim (2) is in a second state after being used in the beverage preparation machine in which, at the location of the at least one step, the flange-like rim (2) is plastically deformed and presents a profile corresponding to the shape of at least one of the sealing surfaces (21a, 21b, 21c), said profile comprising at least
- 20 three contiguous surfaces (S1, S2, S3) having each a different orientation and generating axial and radial forces around the engagement member producing an effective tightness between the flange-like rim (2) and the sealing member (21a) of the engagement member (21).

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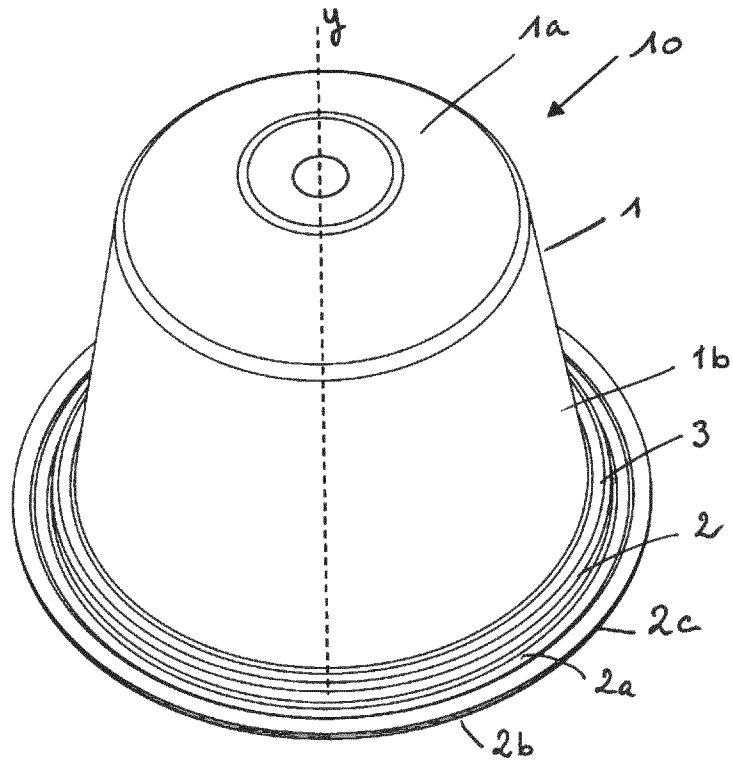


Figure 1a

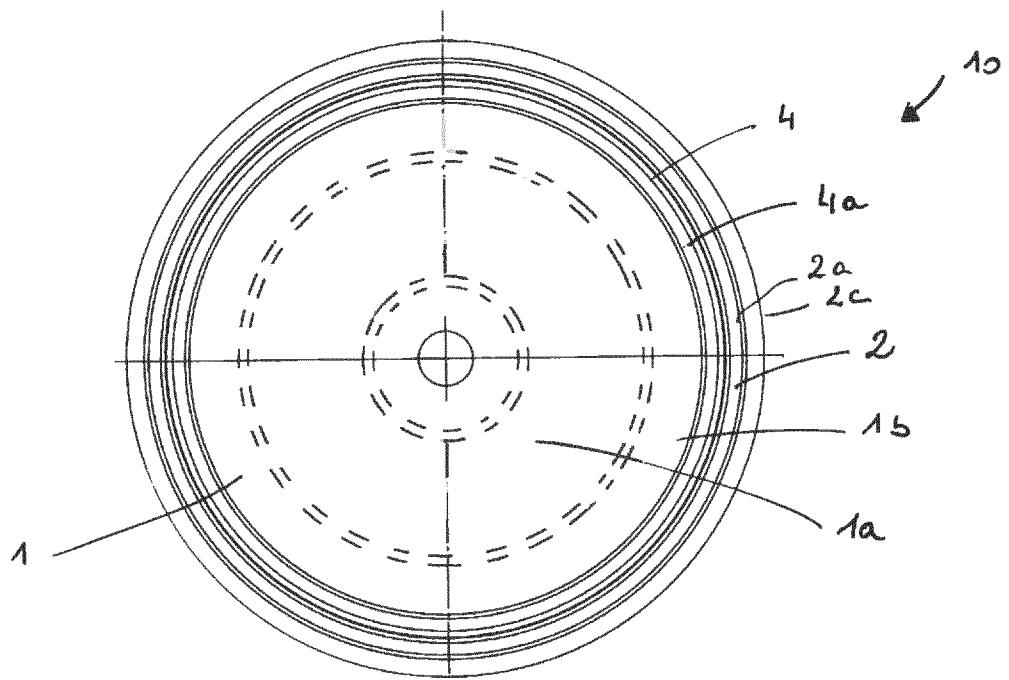


Figure 1b

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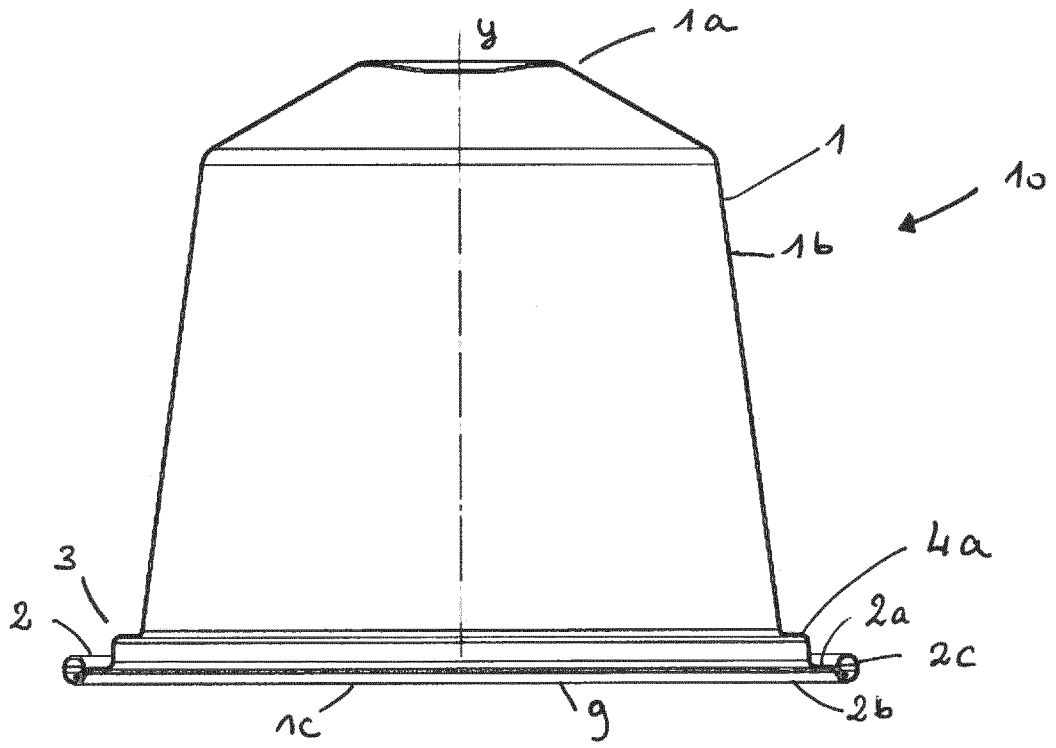


Figure 1c

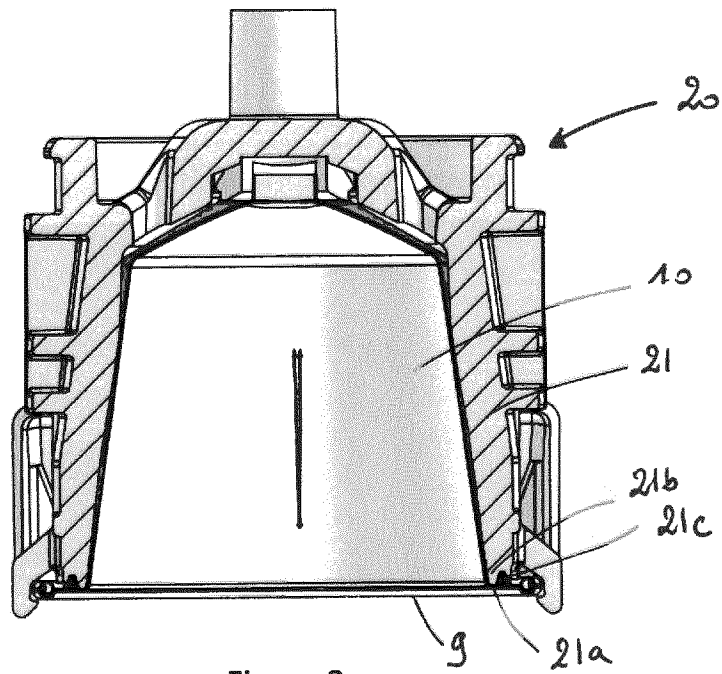


Figure 2

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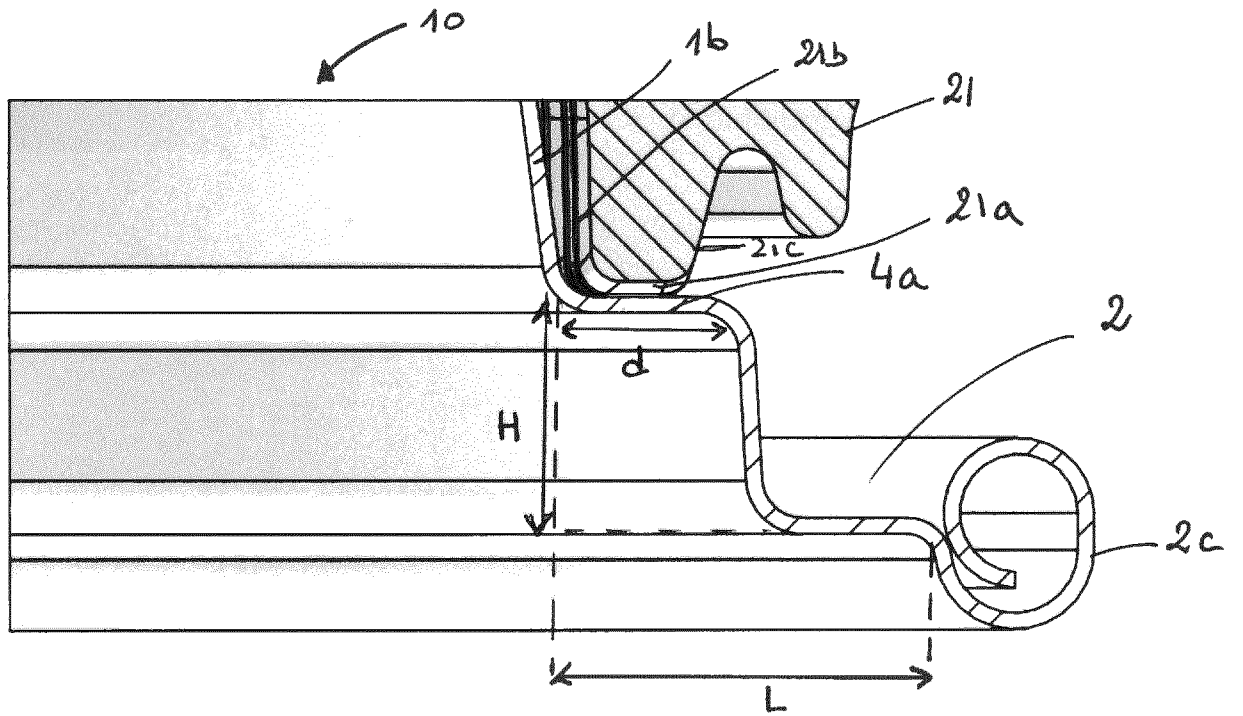


Figure 3

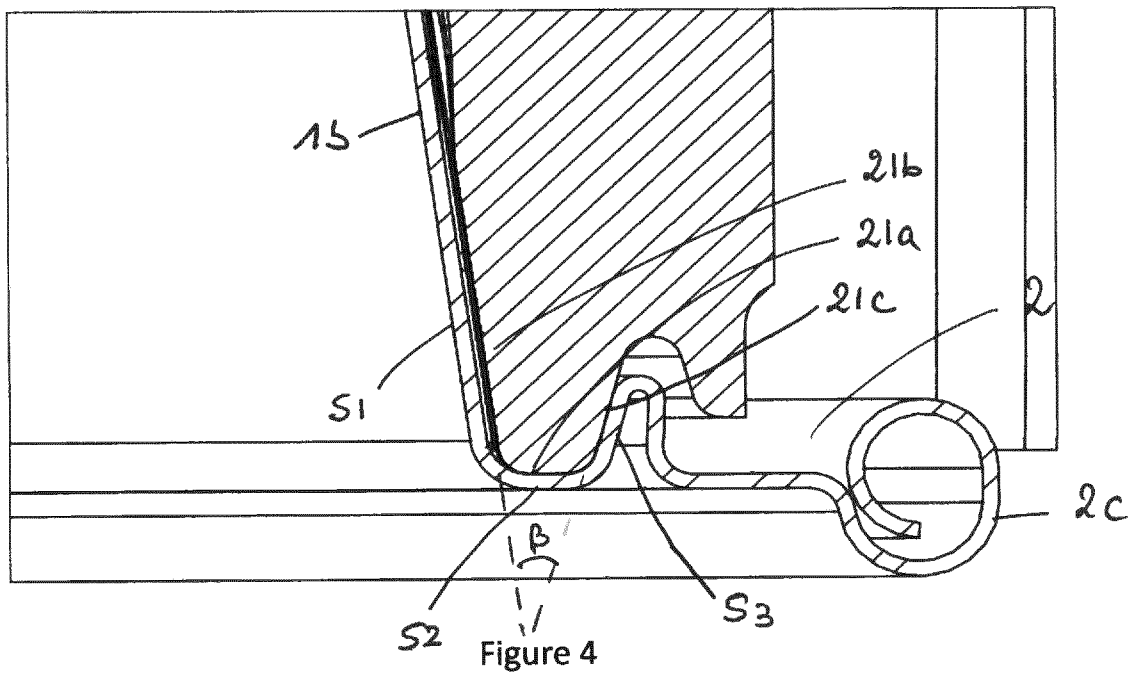


Figure 4

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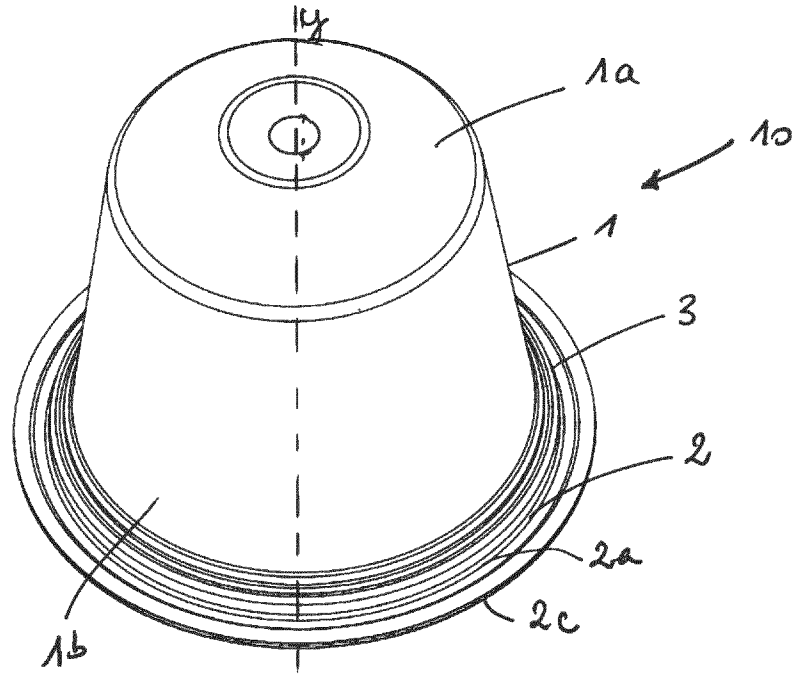


Figure 5a

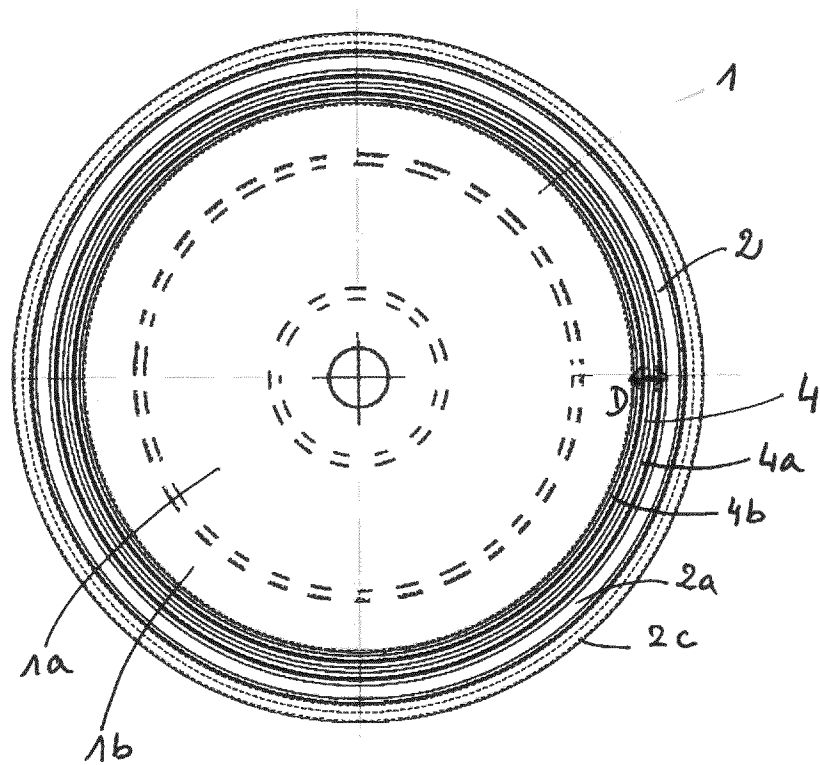


Figure 5b

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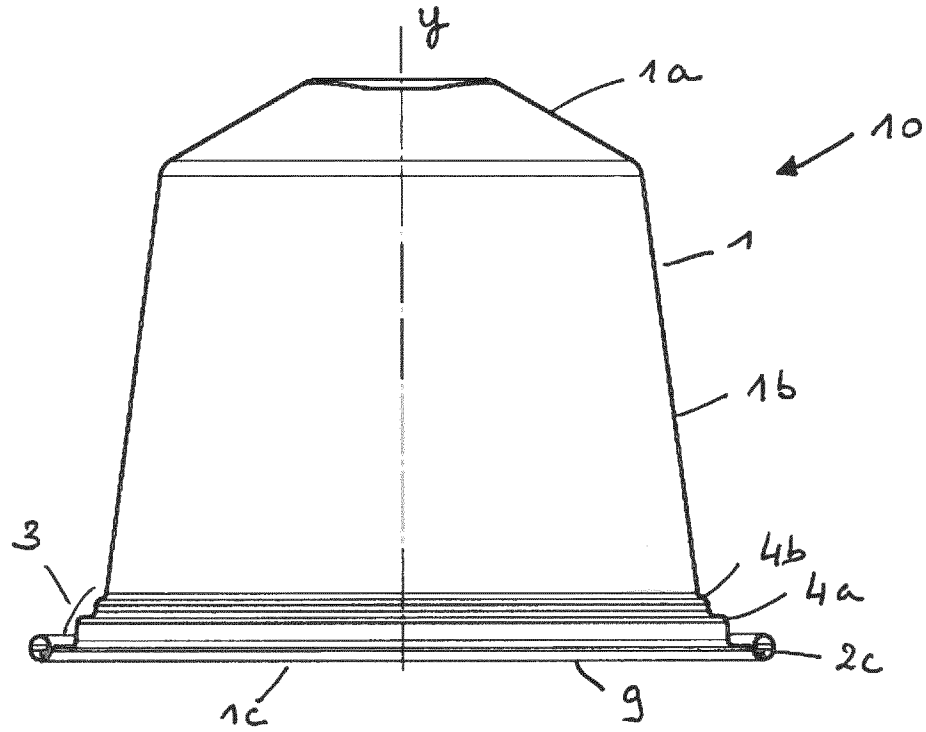


Figure 5c

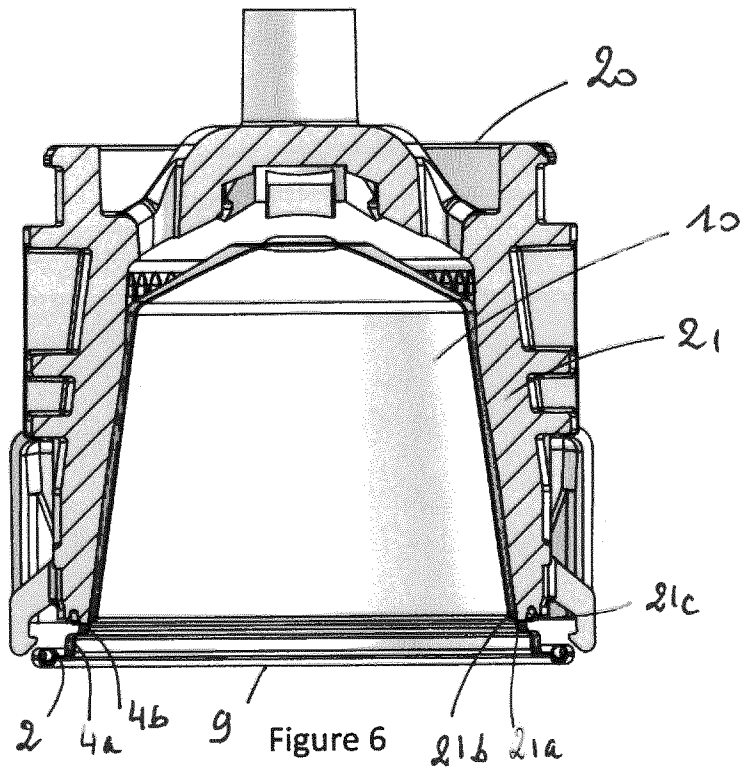


Figure 6

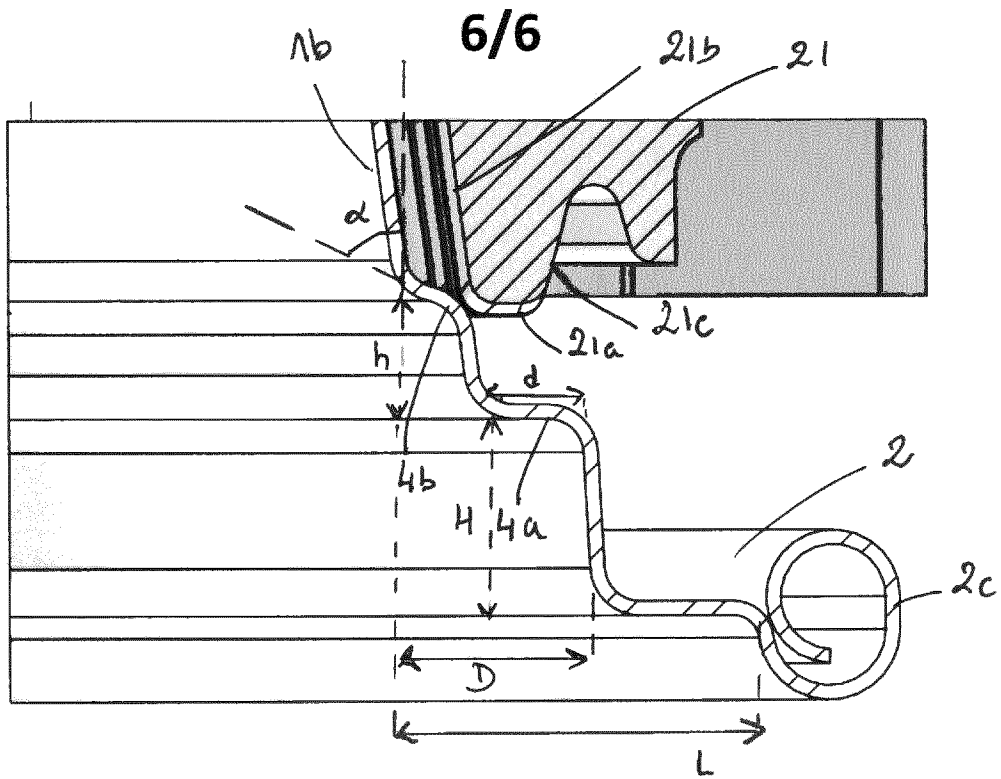


Figure 7

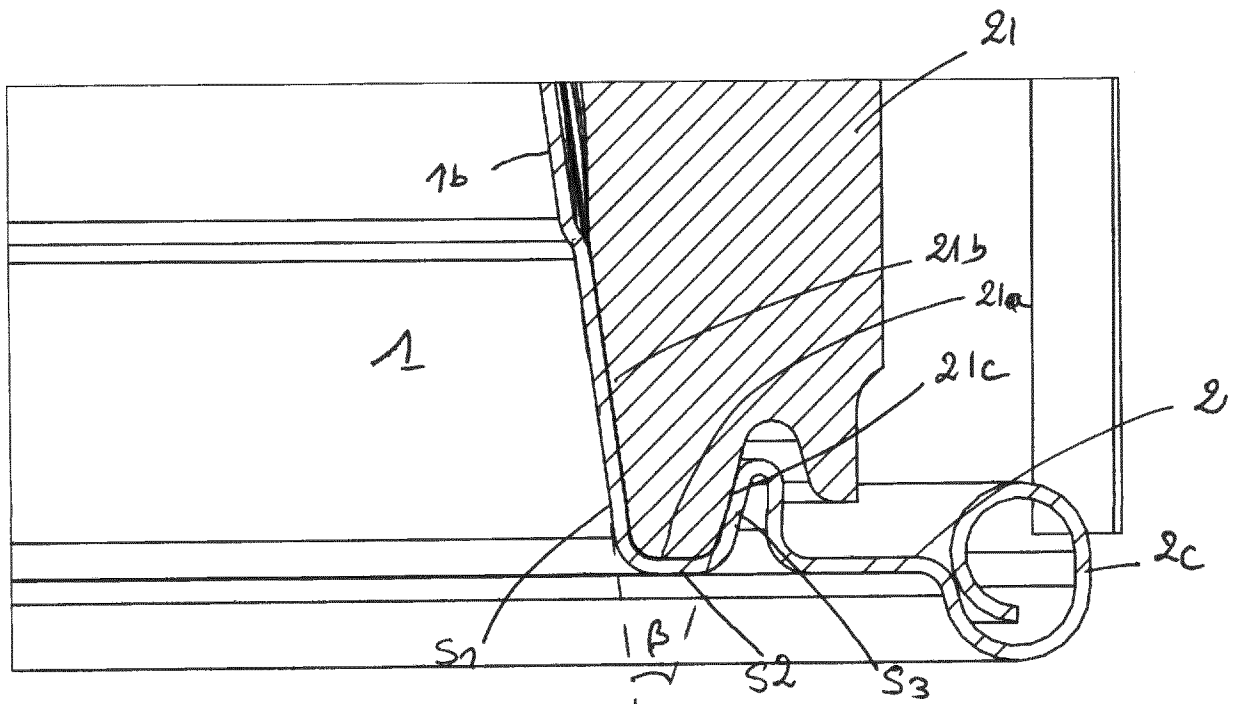


Figure 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/073781

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65D85/804
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2016/186493 A1 (DOUWE EGBERTS BV [NL]) 24 November 2016 (2016-11-24) page 8 - page 19; claims 1-33; figures 4-6 -----	1-18
X	WO 2017/196177 A1 (DOUWE EGBERTS BV [NL]) 16 November 2017 (2017-11-16) claims 1-24; figures 4c,4d -----	1-18
X	WO 2018/067013 A1 (DOUWE EGBERTS BV [NL]) 12 April 2018 (2018-04-12) claims 1,9; figures 4a,4b,5 -----	1-18
X	WO 2016/186488 A1 (DOUWE EGBERTS BV [NL]) 24 November 2016 (2016-11-24) claims 1,34; figures 4a-4d -----	1-18

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- "&" document member of the same patent family

Date of the actual completion of the international search 25 September 2019	Date of mailing of the international search report 09/10/2019
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Brochado Garganta, M
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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