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(54) **SEALED CAPSULE FOR THE PREPARATION OF A BEVERAGE, IN PARTICULAR COFFEE**

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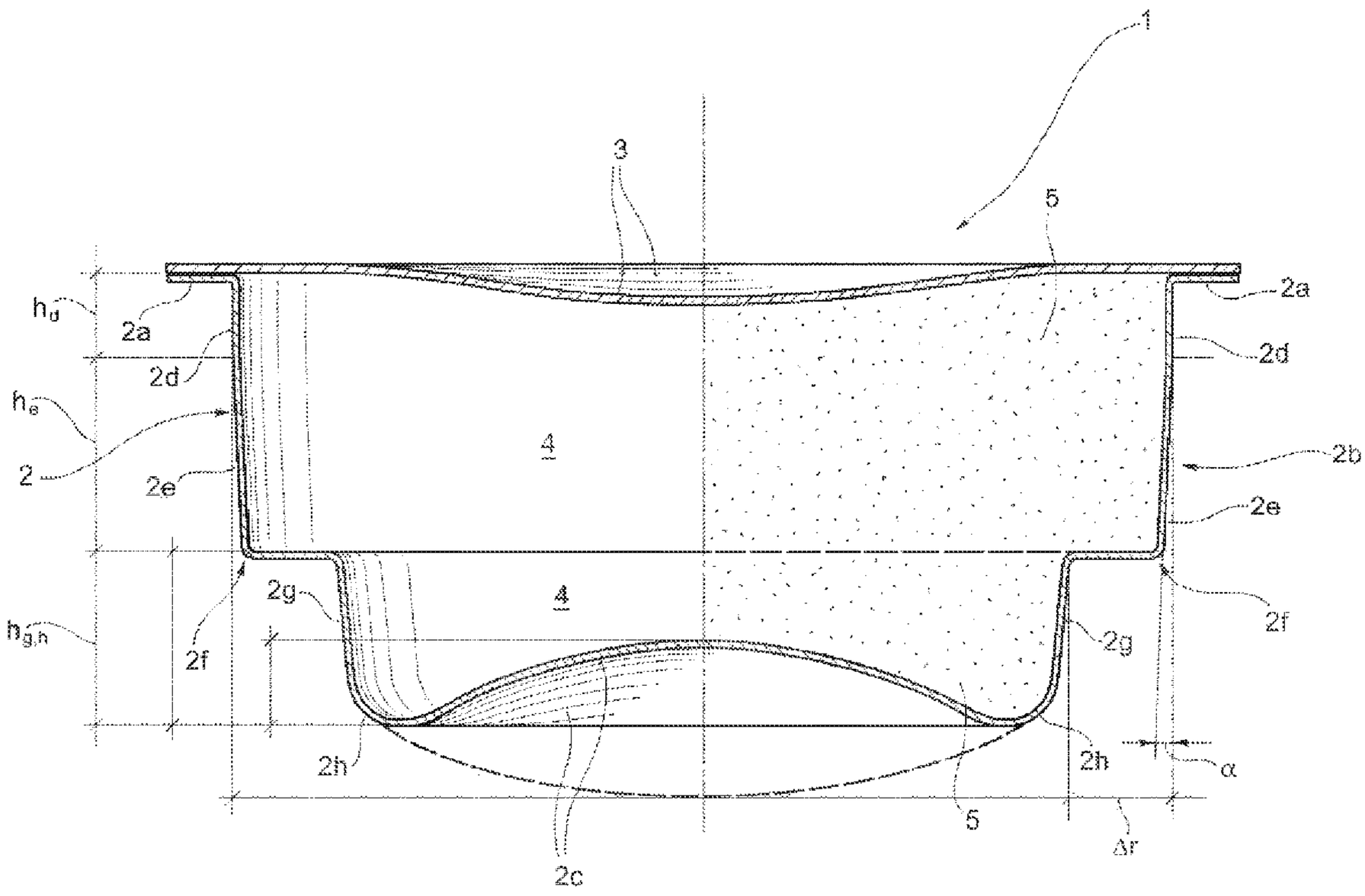
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(57) **ABSTRACT**

A capsule including a cup-shaped body with a protruding top flange, a lateral wall, a flexible bottom wall, and a flexible cover welded to the flange to define a sealed chamber containing ground roasted coffee. The coffee is compressed within the chamber to form a compact panel, and a vacuum is provided such that the cover moves towards the upper surface of the panel. Between the flange and the bottom wall, the lateral wall of the body has an annular step formation providing a local reduction in the cross-section of the chamber towards the bottom wall. This step formation is closer to the bottom wall than to the flange and provides a local reduction in the cross-section of the chamber of at least about 25%. The bottom wall of the body is deformable under the effect of the fluid introduced into the capsule, being displaced away from the cover.



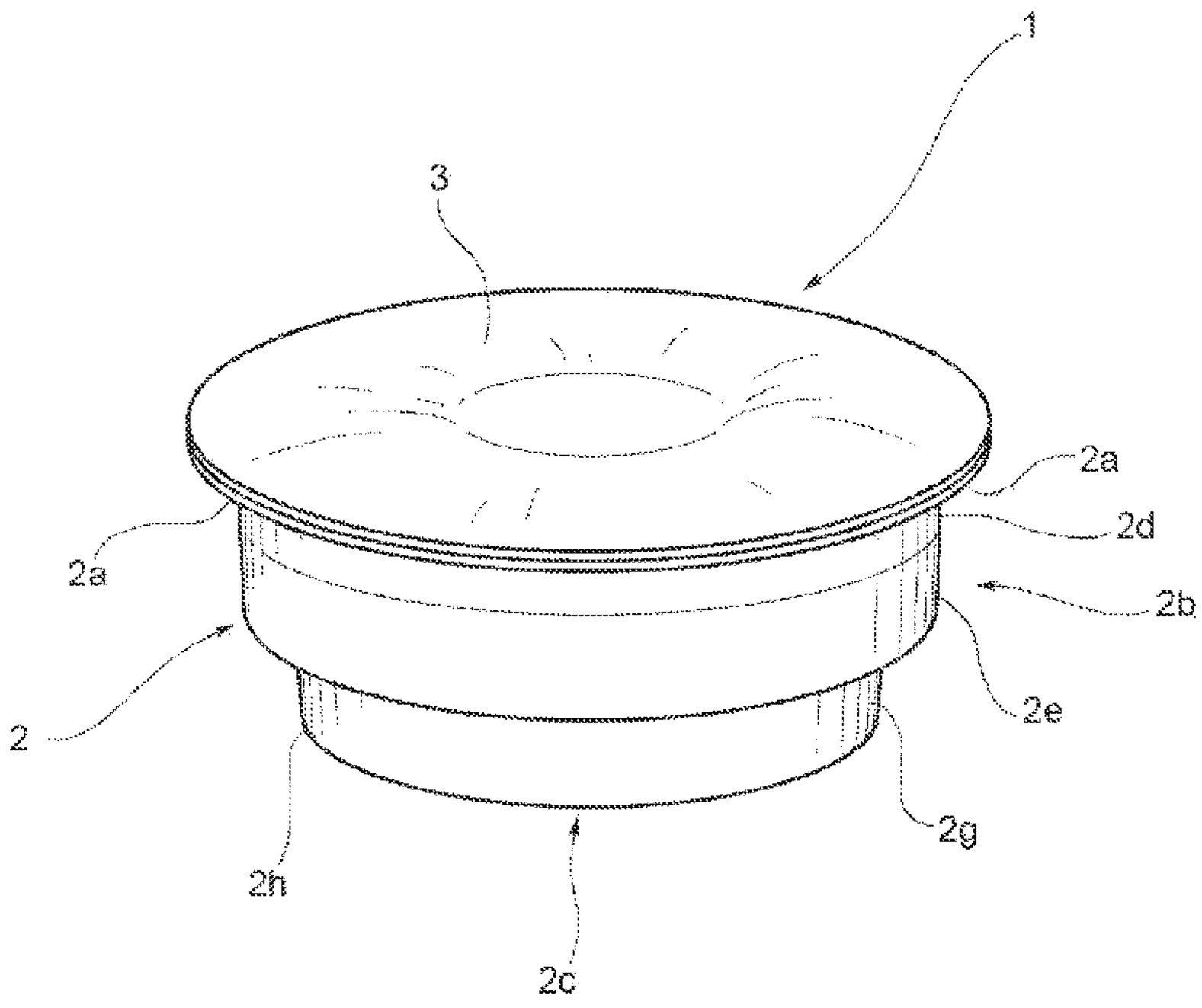


FIG. 1

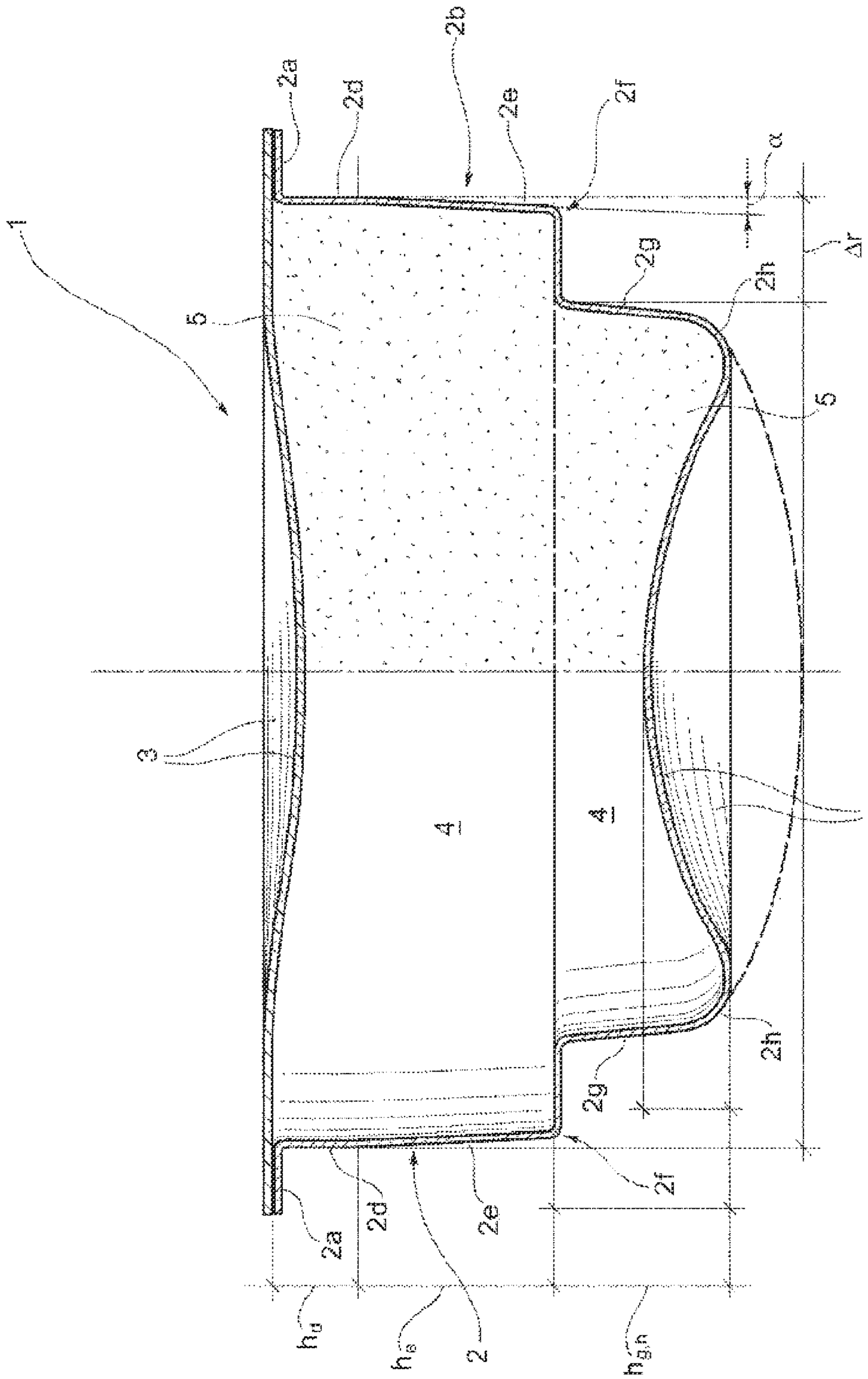


FIG. 2

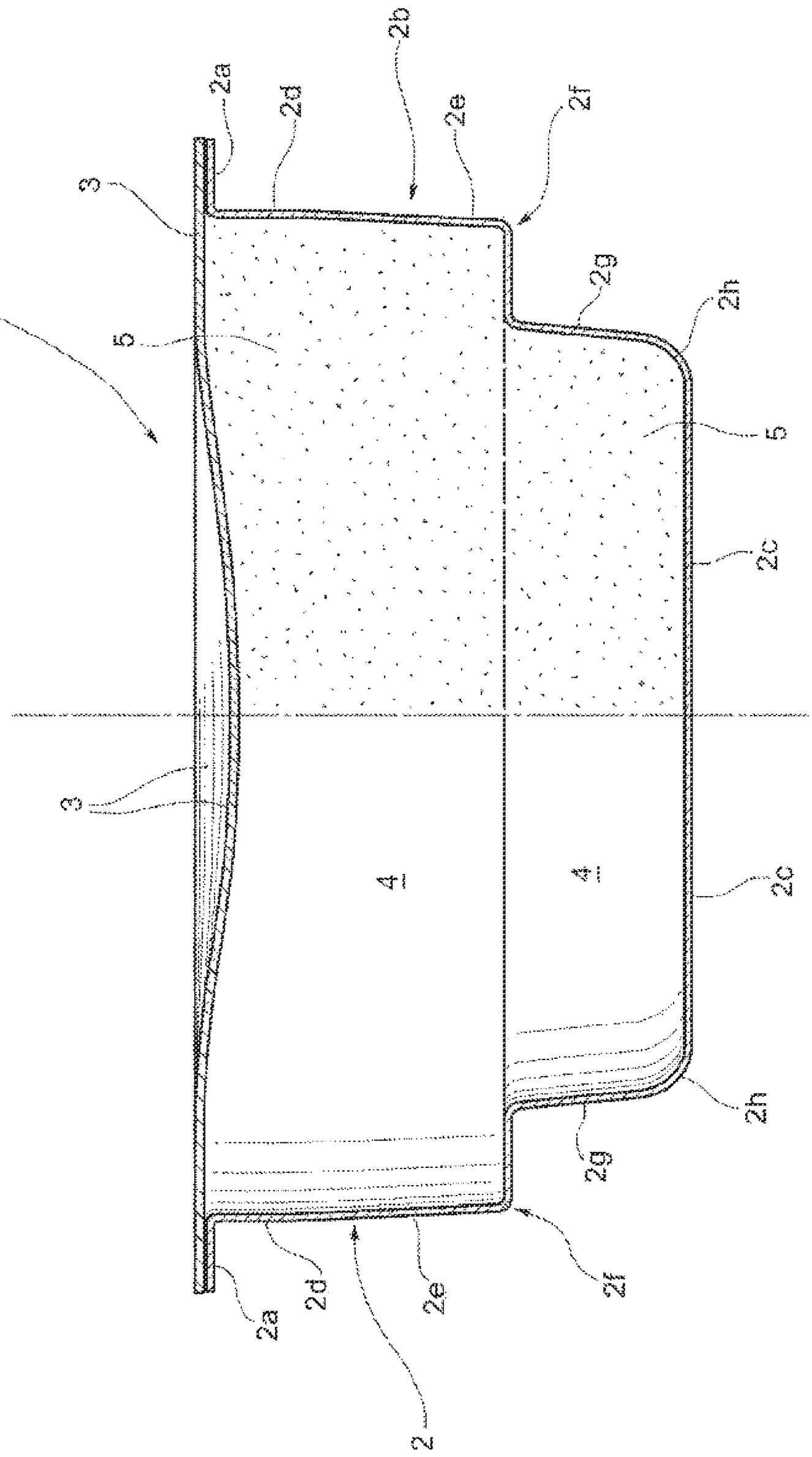


FIG. 3

SEALED CAPSULE FOR THE PREPARATION OF A BEVERAGE, IN PARTICULAR COFFEE

[0001] The present invention relates to a sealed capsule, preferably without an internal filter, for the preparation of a beverage, in particular espresso coffee, by means of introduction of a fluid under pressure, such as hot water and/or steam.

[0002] More specifically the invention relates to a sealed capsule of the type comprising:

[0003] a cup-shaped body having an essentially planar top flange, radially protruding towards the outside, a lateral wall and a flexible bottom wall, and

[0004] a flexible cover welded to the flange of the cup-shaped body so as to define therewith a sealed chamber containing a dose of a granular material, in particular ground roasted coffee, for the preparation of the beverage, in particular espresso coffee;

[0005] wherein the granular material is preliminarily compressed within said chamber in a direction perpendicular to the plane containing said flange, such as to form a compact panel of said material, and in said chamber a vacuum is then provided to a degree such that the cover substantially adheres to the upper surface of said panel; and

[0006] wherein between the flange and the bottom wall the lateral wall of the cup-shaped body has an annular step formation which provides a local reduction in the cross-section of said chamber towards the bottom wall.

[0007] A sealed capsule of this type is known from the document EP 1 886 942 A in the name of the same Applicant. In such a capsule according to the prior art the lateral wall of the cup-shaped body forms an essentially cylindrical upper portion which is connected to an essentially frusto-conical lower portion by means of an annular step formation. The latter forms a reduction in the diameter of the section of said body. This annular step formation is however much closer to the cover and to the corresponding flange than to the bottom wall of the cup-shaped body. Moreover, the radial extension of this step formation is decidedly small, so that it exerts an absolutely negligible effect on the flow of the fluid introduced under pressure into the capsule during the course of preparation of the beverage.

[0008] The documents WO 92/07775 and EP 1 783 066 A2 disclose a sealed capsule for the preparation of a beverage, in particular coffee, comprising a cup-shaped body, the bottom wall of which is able to be deformed, without tearing, under the effect of the fluid introduced into the capsule, moving away from the cover so as to come into contact with a perforation device. The capsule described in these documents has an annular lateral wall which is uniformly frusto-conical, without any step formation able to provide a local reduction in the cross-section.

[0009] An object of the present invention is to provide a sealed capsule for the preparation of a beverage, in particular coffee, which has improved characteristics.

[0010] This object, together with other objects, is achieved according to the invention with a sealed capsule of the type initially defined, characterized primarily in that:

[0011] the bottom wall of the cup-shaped body is able to be deformed under the effect of the fluid introduced into the capsule, being displaced away from the cover, and in that

[0012] said step-like formation is provided closer to the bottom wall of the cup-shaped body than to the aforementioned flange and provides a local reduction in the cross-section of the chamber of at least 25%.

[0013] In a sealed capsule according to the present invention, the step formation, as a result of the sudden and significant local reduction in the cross-section, produces a corresponding appreciable increase in the speed of the fluid through the capsule, in particular in the vicinity of the bottom wall, this being able to facilitate the deformation of this wall towards the associated perforation device. As a result of the solution according to the invention it is therefore possible to perform effective extraction of the beverage, despite the fact that, owing to pre-compaction of the granular material in the capsule, this material offers a certain resistance to the flow of the fluid under pressure and results in a corresponding loss of head.

[0014] Further characteristic features and advantages of the invention will become clear from the following detailed description provided purely by way of a non-limiting example, with reference to the accompanying drawings in which:

[0015] FIG. **1** is a perspective view of a sealed capsule according to the present invention;

[0016] FIG. **2** is a cross-sectional view along the line II-II of FIG. **1**; and

[0017] FIG. **3** is a cross-sectional view similar to that shown in FIG. **2** and shows a variation of embodiment.

[0018] In the drawings, **1** denotes overall a sealed capsule according to the present invention for the preparation of a beverage, in particular espresso coffee, by means of introduction of a fluid, typically hot water and/or steam, under pressure.

[0019] The capsule **1** comprises a cup-shaped body **2** which has at the top an essentially planar flange formation **2***a* radially protruding towards the outside.

[0020] The body **2** may be conveniently made for example with a multilayer laminated structure, with an internal layer of polypropylene, an intermediate layer of EVOH (ethylene vinyl alcohol copolymer) and an external layer of polypropylene.

[0021] The cup-shaped body **2** has a lateral wall, denoted overall by **2***b*, and a flexible bottom wall **2***c*.

[0022] With reference in particular to FIG. **2**, in the embodiment shown, the lateral wall **2***b* of the cup-shaped body **2** has an essentially cylindrical upper portion **2***d*, followed by an essentially frusto-conical portion **2***d*, which tapers gradually towards the bottom wall **2***c*.

[0023] The cylindrical portion **2***d* has a height which is substantially smaller than the frusto-conical portion **2***e*. The latter has a tapering angle, indicated by α in FIG. **2**, conveniently comprised between 0° and 8° and preferably comprised between 2° and 4° .

[0024] At the bottom end of the frusto-conical wall portion **2***e*, the lateral wall **2***b* of the cup-shaped body **2** has an annular step formation **2***f* which provides a sudden local reduction in the cross-section of this body, towards the bottom wall **2***c*. The radial extension Δr of the step-like formation **2***f* is conveniently such as to provide a local reduction in the internal cross-section of the body **2** of at least 25% and preferably of about 35%.

[0025] Under the formation **2***f*the lateral wall **2***b* of the cup-shaped body **2** has a lower wall portion **2***g* which is essentially frusto-conical and is connected to the bottom wall **2***c* by means of curved and convex profiles **2***h*.

[0026] The height h_e of the frusto-conical wall portion **2***e* is preferably approximately equal to or greater than the overall height $h_{g,h}$ of the wall portion **2***g* and **2***h*.

[0027] The step-like formation **2***f* is therefore provided closer to the bottom wall **2***c* than to the flange **2***a*.

[0028] A flexible cover **3** is welded to the flange **2***a* of the cup-shaped body **2**. This cover is for example formed with a multilayer structure, for example an internal layer of polypropylene and an external layer of aluminium.

[0029] Welding between the edge of the flexible cover **3** and the flange **2***a* of the cup-shaped body **2** may be performed by means of heat or ultrasound.

[0030] The cover **3** may have for example a thickness of between 30 μm and 90 μm and preferably equal to about 70 μm.

[0031] Overall, the flexible cover **3** and the cup-shaped body **2** define a sealed chamber—indicated by **4** in FIG. **3**—which is conveniently impermeable to oxygen (O_2) and to moisture.

[0032] The chamber **4** of the capsule **1** contains a quantity of granular material **5** for the preparation of a beverage, for example ground toasted coffee for the preparation of espresso coffee.

[0033] Preparation of the beverage is performed by means of extraction by introducing a fluid under pressure, in particular hot water and/or steam, using machines which are generally known per se.

[0034] Conveniently, according to the invention, the chamber **4** is filled with the granular material **5** which is preliminarily compressed inside this chamber in a direction perpendicular to the plane containing the flange **2***a*.

[0035] The compressive load of the granular material **5** may be for example between 2 and 50 kg per cm^2 of the average cross-sectional area of the chamber **4**.

[0036] The compression of the material **5** is performed so as to form a compact panel of said material, namely possessing a certain form stability.

[0037] Inside the chamber **4** a vacuum is then provided to a degree such that the flexible cover **3** tends to move towards and tends to adhere to the upper surface of said panel, as illustrated specifically in the right-hand part of FIG. **2**.

[0038] Viewed from the outside, the flexible cover **3** therefore has a concave configuration, with a main deformation or camber which is greater along the axis of the capsule. This deformation or camber may reach values in the region of 3-4 mm.

[0039] In the embodiment shown in FIG. **2**, the bottom wall **2***c* of the cup-shaped body **2** is curved towards the inside of the capsule and is therefore internally convex and externally concave.

[0040] This wall **2***c* is formed so that it is able to be deformed, under the effect of the fluid introduced under pressure into the capsule, moving away from the cover **3**, without however tearing.

[0041] In principle, the capsule **1** according to the invention may moreover be used in a machine for extracting the beverage, which is able to perforate the bottom wall **2***c* of the cup-shaped body **2** before the extraction fluid is injected through the cover **3**.

[0042] However, the capsule **1** may be advantageously used also in extraction machines known per se, where firstly the cover **3** is perforated for injection of the extraction fluid under pressure. The pressure of this fluid is therefore able to cause a deformation of the bottom wall **2***c* which comes into contact with perforation devices—known per se—which cause tearing thereof.

[0043] In the solution according to FIG. **2**, the deformation of the bottom wall **2***c* is such that it passes from the externally concave configuration shown in this figure to an externally convex configuration such as that illustrated specifically in broken lines in the same figure. When extraction of the beverage is performed in this way, the step-like formation **2***f* of the lateral wall **2***b* of the capsule body produces, as a result of the sudden and significant local reduction in the cross-section, a corresponding considerable increase in the speed of the fluid through the capsule, in particular in the vicinity of the bottom wall **2***c*, this being able to facilitate deformation of this wall towards the associated perforation device.

[0044] As already mentioned above, this results in effective extraction of the beverage despite the considerable pre-compression of the granular material **5** which offers a certain resistance to the flow of the extraction fluid and results in a corresponding loss of head.

[0045] FIG. **3** shows a variation of embodiment. In this figure, parts and elements already described have again been assigned the same reference numbers and letters used previously.

[0046] The variant shown in FIG. **3** differs from that shown in FIG. **2** essentially owing to the fact the bottom wall **2***c* of the cup-shaped body **2** of the capsule is essentially flat, rather than recessed towards the inside of the capsule.

[0047] Moreover the variant shown in FIG. **3** also has the advantageous characteristic features specifically described above with reference to the capsule shown in FIG. **2**.

[0048] Obviously, without affecting the principle of the invention, the embodiments and the constructional details may be significantly varied with respect to that described and illustrated purely by way of a non-limiting example, without thereby departing from the scope of the invention as defined in the accompanying claims.

1. A sealed capsule for the preparation of a beverage including coffee, by introduction of fluid under pressure, comprising:

a cup-shaped body having a substantially planar top flange, radially protruding towards the outside, a lateral wall and a flexible bottom wall, and

a flexible cover welded to the flange of the cup-shaped body so as to define therewith a sealed chamber containing a dose of a granular material, including ground roasted coffee, for the preparation of the beverage;

wherein the granular material is preliminarily compressed within said chamber in a direction perpendicular to the plane containing said flange, such as to form a compact panel of said material, and in said chamber a vacuum is provided to a degree such that the cover moves towards and at least tends to adhere to the upper surface of said panel;

wherein between the flange and the bottom wall the lateral wall of the cup-shaped body has an annular step formation which provides a local reduction in the cross-section of said chamber towards the bottom wall;

wherein the bottom wall of the cup-shaped body is deformable under the effect of the fluid introduced into the capsule, being displaced away from the cover; and

wherein said step-like formation is provided closer to the bottom wall of the cup-shaped body than to the flange

and provides a local reduction in the cross-section of said chamber of at least about 25%.

2. The sealed capsule according to claim **1**, wherein said step-like formation provides a local reduction in the cross-section of said chamber of about 35%.

3. The sealed capsule according to claim **1**, wherein the step-like formation the cup-shaped body has a frusto-conical lateral wall portion which tapers toward said step-like formation.

4. The sealed capsule according to claim **3**, wherein said lateral wall portion has a tapering angle (α) between 0° and 8°.

5. The sealed capsule according to claim **3**, wherein between the frusto-conical lateral wall portion and said top flange the cup-shaped body has a cylindrical wall portion.

6. The sealed capsule according to claim **5**, wherein the cylindrical lateral wall portion has a height (h_d) smaller than the height (h_e) of said frusto-conical lateral wall portion.

7. The sealed capsule according claim **1**, wherein under the step-like formation the cup-shaped body has a lower lateral wall portion which tapers, in a frusto-conical manner, towards the bottom wall of said body.

8. The sealed capsule according to claim **3**, wherein said lower lateral wall portion has a height ($h_{g,h}$) at least approximately equal to or smaller than the height (h_e) of said lateral frusto-conical wall portion.

9. The sealed capsule according to claim **1**, wherein the bottom wall of the cup-shaped body is curved towards the inside of the capsule.

10. The sealed capsule according to claim **1**, wherein the bottom wall of the cup-shaped body is essentially flat.

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