

(19)



(11)

EP 4 530 218 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.04.2025 Bulletin 2025/14

(51) International Patent Classification (IPC):
B65D 85/804^(2006.01)

(21) Application number: **23199603.4**

(52) Cooperative Patent Classification (CPC):
B65D 85/8043

(22) Date of filing: **26.09.2023**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

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(54) **A BEVERAGE CAPSULE**

(57) A beverage capsule (10) for use in a beverage preparation machine to prepare a beverage by passing a fluid under pressure therethrough. The beverage capsule comprises: a cup-shaped body (12) having a base (14) and a sidewall (16); and a lid sealed to the sidewall. The cup-shaped body consists of: a base member made

from a compostable material; and an inner barrier layer and/or an outer barrier layer which covers an inner, respectively outer, side of the base member, wherein each barrier layer is made from a metal and has a thickness between 0,5 μm and 30 μm .

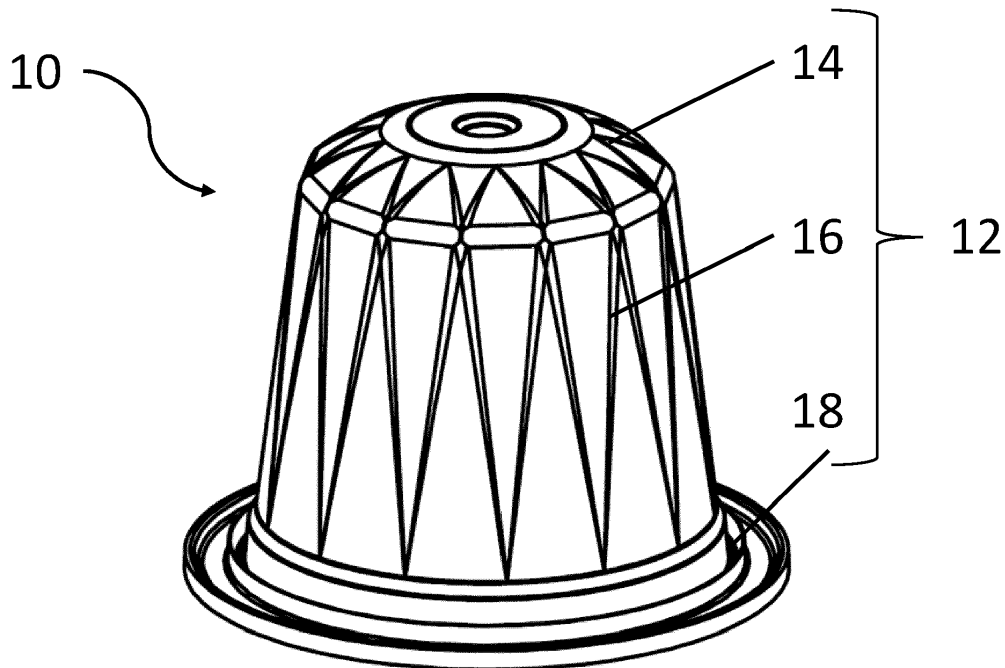


Fig. 1

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Description

Technical field

[0001] The present invention relates to a beverage capsule for use in a beverage preparation system to prepare a beverage by passing a fluid under pressure through the beverage capsule. The present invention further relates to a use of the beverage capsule in a beverage preparation system to prepare a beverage. The present invention also relates to a method for manufacturing a cup-shaped body of the beverage capsule.

Background art

[0002] A known beverage capsule comprises: a cup-shaped body comprising a base and a sidewall contiguous with the base; and a lid sealed to the sidewall, the lid and cup-shaped body enclosing an interior volume configured for holding one or more beverage ingredients. The base is typically configured to be pierced by an injection member of the beverage preparation machine to inject a fluid under pressure into the beverage capsule. The lid is configured to tear due to an increase in pressure inside the capsule, optionally due to contact with one or more piercing elements provided in the beverage preparation machine.

[0003] Such beverage capsules and the beverage preparation machines in which they are used are well-known to the person skilled in the art. Examples are disclosed in EP 1 839 543 and EP 2 996 521. The known beverage capsules are used in a beverage preparation system where a heated fluid (usually water) is supplied under pressure directly into the capsule. More specifically, the capsule is inserted in an openable and closable chamber, defined inside the beverage preparation machine. When the capsule is inside the closed chamber, an injection member of the beverage preparation machine pierces the base of the cup-shaped body and water (usually hot and pressurised) is injected into the capsule, in order to obtain the beverage following the interaction of the water with the beverage ingredients (e.g. extraction, infusion, or partial or whole dissolution). Finally, the beverage is released from the capsule since a build-up of pressure inside the capsule forces the lid of the capsule outwards causing a rupture (possibly due to contact with tearing elements present in the beverage preparation machine). This allows the beverage to flow along an outflow path of the beverage preparation system.

[0004] In the prior art various beverage ingredients are known. These may be divided roughly into two classes, namely extraction or infusion ingredients and dissolving ingredients. The beverage capsule according to the present invention may be applied in both cases, i.e. either in the case in which the capsule is of the type which contains beverage ingredients intended to allow the beverage to be made by extraction or infusion (such as roasted ground coffee or tea leaves as with the capsule disclosed

in EP 1 839 543) and in the case in which the capsule is of the type which contains beverage ingredients intended to allow the beverage to be made following complete or partial dissolving of the beverage ingredients when the water which passes through it (for example milk, chocolate, powdered tea, instant drink, etc.).

[0005] At present, many capsules (e.g. as disclosed in) are made solely or mostly from aluminium or an alloy thereof. Aluminium has many advantages for use in this application. It is able to withstand the pressures and temperatures reached in a beverage preparation machine. The capsule is also moisture and oxygen tight thus achieving a high shelf life without quality loss of the beverage ingredients (e.g. a loss of aroma or flavour).

[0006] There is an increasing concern regarding the environmental impact of such capsule. Each capsule specifically contains metal components and organic components (i.e. the beverage ingredients) and often also plastic materials are used. This means that these capsules are difficult to recycle and are often disposed in a landfill instead of being recycled.

[0007] This problem is known in the prior art and has been addressed by proposing to manufacture the capsules from biodegradable materials, e.g. cellulose, polylactic acid (PLA), etc. The downside of such capsules, as disclosed in WO 2018/203184 and WO 2022/170276, is related to a reduced moisture and oxygen tightness negatively impacting the quality of the beverage.

[0008] WO 2018/203184 proposes to overcome this issue by the provision of a compostable multilayer membrane having 7 or 8 different layers. The multilayer membrane comprises various layers one of which is a metallization layer. The metallization layer increases the oxygen barrier properties of the first barrier layer and creates a moisture barrier and may be applied by spraying. A thickness in the range of 200-500 Å is disclosed. The metal may be aluminium. WO 2022/170276 likewise proposes to overcome this issue by the use of a 6-layered film with one layer being an oxidizing barrier comprising steel.

Disclosure of the invention

[0009] It is an object of the present invention to provide a beverage capsule which alleviates one or more of the above-mentioned problems.

[0010] This object is achieved according to the present invention with a beverage capsule in which the cup-shaped body consists of: a base member made from a compostable material; and a barrier layer which covers a side of the base member, wherein the barrier layer is made from a metal and has a thickness between 0,5 µm and 30 µm.

[0011] This object is also achieved according to the present invention with a beverage capsule in which the cup-shaped body consists of: a base member made from a compostable material; an inner barrier layer which covers an inner side of the base member; and an outer

barrier layer which covers an outer side of the base member, wherein each barrier layer is made from a metal and has a thickness between 0,5 μm and 30 μm .

[0012] In other words, according to the present invention, the cup-shaped body consists only of two or three layers. More specifically, according to the present invention, the cup-shaped body consists of a base member which is compostable. The base member is provided on one or both sides with a metal barrier layer. This metal (or metal alloy) may be a natural element, e.g. aluminium. The cup-shaped body thus maintains the advantages of being manufactured mostly from a compostable material together with the advantages offered from a metal barrier layer. Any barrier layer (i.e. inner or outer) ensures the desired moisture and oxygen tightness. An outer barrier layer further provides the capsule with the look and texture that consumers desire and are used too.

[0013] As used herein, the term "compostable" in relation to waste materials is defined in European standard EN 13421.

[0014] The present invention is based on the realization that, although the metal barrier layer(s) is not compostable, the cup-shaped body itself satisfies the compostability requirements due to the very low fraction of metal material to the overall dimension of the cup-shaped body.

[0015] Furthermore, the present invention does not involve the complexities and costs caused by reliance on a 6 or more layer material as in the prior art capsules.

[0016] It may be advantageous, especially if the cup-shaped body comprises both an inner and an outer barrier layer, to cut, grind, or otherwise divide the cup-shaped body in smaller pieces prior to composting. This increases the contact surface area with the base member.

[0017] In an embodiment of the present invention the cup-shaped body is home-compostable. This is advantageous as it avoids a user having to dispose of the capsule with an external provider. In this context, it may be advantageous that a user cuts the capsule in half prior to tossing the capsule on the compost heap. This is especially the case if the cup-shaped body comprises both an inner and an outer barrier layer as this cutting allows easier access to the base member for microorganisms in the compost heap.

[0018] As used herein, the term "home-compostable" in relation to waste materials means that the cup-shaped body biodegrades at least 90% in a non-industrial composting process.

[0019] In an embodiment of the present invention a ratio of a total volume of the barrier layer(s) and a volume of the base member is at most 10%, preferably at most 5%, more preferably at most 2% and most preferably at most 1%.

[0020] The volume of the barrier layer(s) is preferably as small as possible when compared to the volume of the base member since, as described above, the barrier layer(s) do not biodegrade. However, a minimum volume

of barrier layer(s) is needed to obtain the desired moisture and oxygen tightness. The volume may be determined, e.g. by submerging the base member and the cup-shaped body in a liquid.

[0021] In an embodiment of the present invention the base member has an average thickness between 100 μm and 1000 μm , wherein the average thickness particularly is at least 200 μm and more particularly at least 250 μm , and wherein the average thickness particularly is at most 800 μm and more particularly at most 700 μm .

[0022] This aids in achieving that the base member has a sufficient rigidity for use in a beverage preparation machine injecting heated and pressurized water.

[0023] In an embodiment of the present invention each barrier layer has a thickness of at most 10 μm , preferably at most 5 μm , more preferably at most 3 μm and most preferably at most 2 μm and/or each barrier layer has a thickness of at least 0,8 μm and preferably at least 1 μm .

[0024] As such, each barrier layer has a most preferred thickness in the range of 1-2 μm . This has been found to provide a sufficient moisture and oxygen tightness, in particular to have a shelf life of preferably at least 6 months, while at the same time involving as little metal (i.e. non-biodegradable, but natural) material as possible.

[0025] In an embodiment of the present invention the base member comprises at least one of the following materials or a derivative thereof: a polybutylene succinate (PBS), a poly-3-hydroxybutyrate-co-3-hydroxyhexanoate (PHBH), a polyhydroxyalkanoate (PHA), and a cellulose.

[0026] Such materials are all biodegradable and offer a flexible choice depending on the intended use. For example, a capsule for use with coffee ingredients may require a more rigid capsule than a capsule for use with instant drinks.

[0027] In an embodiment of the present invention at least one barrier layer comprises a lacquer layer disposed on the side facing away from the base member.

[0028] For example, a heat seal lacquer, in particular a vinyl heat seal lacquer, or an epoxy stove lacquer, in particular a colored or transparent epoxy stove lacquer. These lacquers can influence the visual look of the cup-shaped body exterior and may also be beneficial for, in a later stage of production, applying a lid to the cup-shaped body to seal the capsule. In other words, the lacquer layer is usually part of the external base layer.

[0029] In an embodiment of the present invention the metal is a food-grade metal, such as aluminium or an aluminium alloy. The aluminium or aluminium alloy is preferably annealed aluminium or aluminium alloy and particularly being a soft annealed aluminium or aluminium alloy. The aluminium alloy may, for example, be of grade 3005, 3105, 3175, 8011 or 8079. The skilled person is familiar with these materials and their various advantages, in particular in the context of food-grade materials.

[0030] In an embodiment of the present invention the

beverage capsule further comprises the one or more beverage ingredients, which ingredients are either extraction/infusion based ingredients (e.g. roasted ground coffee, tea leaves, etc.) or dissolution based (e.g. powder materials such as milk powder, chocolate powder, powdered tea, powdered soup, instant drink, etc.). The beverage capsule according to the present invention is thus usable for preparing a variety of beverages.

[0031] In an embodiment of the present invention the beverage capsule comprises an annular rim contiguous with the sidewall, the lid being sealed to the annular rim. The provision of an annular rim provides a surface on which the lid can be easily sealed.

[0032] In an embodiment of the present invention the capsule is a single-use, disposable element.

[0033] The object according to the present invention is also achieved with a use of a beverage capsule as described above in a beverage preparation machine to prepare a beverage by passing a fluid under pressure through the beverage capsule.

[0034] The object according to the present invention is also achieved with a method for manufacturing the cup-shaped body of the beverage capsule described above, the method comprising: providing the base member; and applying a barrier layer to the inner side and/or the outer side of the base member.

[0035] In an embodiment of the present invention the step of applying the barrier layer comprises: micronized spray coating a metal composition onto the inner and/or outer side of the base member.

[0036] This has been found to be a reliable technique to apply a thin barrier layer (e.g. having a thickness in the range of few micrometer, e.g. 1-2 μm) to a base member.

Brief description of the drawings

[0037] The invention will be further explained by means of the following description and the appended figures.

Figure 1 shows a perspective view of a beverage capsule according to the present invention.

Figure 2 shows a cross-sectional view of the beverage capsule of figure 1.

Figure 3A shows an enlarged schematic view of a layer assembly representing a cross-section of a cup-shaped body of a beverage capsule according to the present invention.

Figure 3B shows an enlarged schematic view of a different layer assembly representing a cross-section of a cup-shaped body of a beverage capsule according to the present invention.

Description of the invention

[0038] The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto

but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. The dimensions and the relative dimensions do not necessarily correspond to actual reductions to practice of the invention.

[0039] Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. The terms are interchangeable under appropriate circumstances and the embodiments of the invention can operate in other sequences than described or illustrated herein.

[0040] Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes. The terms so used are interchangeable under appropriate circumstances and the embodiments of the invention described herein can operate in other orientations than described or illustrated herein.

[0041] Furthermore, the various embodiments, although referred to as "preferred" are to be construed as exemplary manners in which the invention may be implemented rather than as limiting the scope of the invention.

[0042] Figure 1 shows a perspective view of a beverage capsule 10 according to the present invention. The capsule 10 comprises a cup-shaped body 12 having a base 14, a sidewall 16 which is contiguous with the base 14 and an annular rim 18 which is contiguous with the sidewall 16. The capsule 10 further comprises a lid (not shown) sealed to the sidewall 16, in particular to a bottom surface of the annular rim 18.

[0043] As indicated in figure 2, the cup-shaped body 12 generally has a height H comprised between 25 and 32 mm. The height H is preferably at least 27 mm, more preferably at least 28 mm, and most preferably at least 28,5 mm. The height H is preferably at most 31 mm, more preferably at most 30 mm, and most preferably at most 29 mm.

[0044] The cup-shaped body 12 generally has an outer diameter D comprised between 33 and 41 mm. The outer diameter D is preferably at least 35 mm, more preferably at least 36 mm, and most preferably at least 36,5 mm. The outer diameter D is preferably at most 39 mm, more preferably at most 38 mm, and most preferably at most 37,5 mm.

[0045] The sidewall 16 has an outer diameter D_o measured at division line 125 comprised between 25 and 34 mm. The outer diameter D_o is preferably at least 27 mm, more preferably at least 28 mm, and most preferably at least 29,0 mm. The outer diameter D_o is preferably at most 32 mm, more preferably at most 31 mm, and most preferably at most 30,0 mm.

[0046] The sidewall 16 has an inclination angle α with respect to the central cup-shaped body axis comprised between 4 and 11 degrees. The inclination angle α is

preferably at least 5 degrees, more preferably at least 6 degrees, and most preferably at least 7 degrees. The inclination angle α is preferably at most 10 degrees, more preferably at most 9 degrees, and most preferably at most 8 degrees.

[0047] The dimensions H, D and D_0 and inclination angle α are mainly determined in function of the beverage preparation machine, in particular of the closed chamber inside the beverage preparation machine.

[0048] Figure 2 further illustrates that the annular rim 18 is provided with a sealing member 20 formed by a protrusion on the upper surface of the annular rim 18. The sealing member 20 acts so as to provide an adequate sealing between the annular rim 18 and an enclosing member in the beverage preparation machine thereby avoiding or reducing leakage of the injected water. Such sealing members 20 are known in the art and the various possibilities in shape, size, position, material, etc. will not be described further.

[0049] The present invention is mainly focused on the material composition of the cup-shaped body 12. Two alternatives are schematically shown in figures 3A and 3B.

[0050] In a first alternative shown in figure 3A, the cup-shaped body 12 consists of a base member 30 and one barrier layer 32. This barrier layer 32 may be on the inner side of the base member 30 or on the outer side of the base member 32. Albeit the inner side is preferred for avoiding interaction of the beverage ingredients with the base member 30.

[0051] In a second alternative shown in figure 3B, the cup-shaped body 12 consists of a base member 30, an inner barrier layer 32 and an outer barrier layer 34.

[0052] According to the present invention, the base member 30 is made of a compostable, preferably home-compostable, material, whereas the barrier layer(s) 32, 34 are made of a metal. As described above, the base member 30 comprises at least one of the following materials or a derivative thereof: a polybutylene succinate (PBS), a poly-3-hydroxybutyrate-co-3-hydroxyhexanoate (PHBH), a polyhydroxyalkanoate (PHA), and a cellulose. As described above, the metal is preferably a food-grade metal, such as aluminium or an aluminium alloy. The aluminium or aluminium alloy is preferably annealed aluminium or aluminium alloy and particularly being a soft annealed aluminium or aluminium alloy. The aluminium alloy may, for example, be of grade 3005, 3105, 3175, 8011 or 8079. Naturally, other metals, e.g. steel, may also be suitable to provide the oxygen and moisture tightness.

[0053] The barrier layer(s) 32, 34, in particular the outer barrier layer, may comprise a lacquer (e.g. a heat seal lacquer, in particular a vinyl heat seal lacquer, or an epoxy stove lacquer, in particular a colored or transparent epoxy stove lacquer).

[0054] The base member 30 has an average thickness between 100 μm and 1000 μm , wherein the average thickness particularly is at least 200 μm and more parti-

cularly at least 250 μm , and wherein the average thickness particularly is at most 800 μm and more particularly at most 700 μm . As is evidenced from the cross-sectional view in figure 2, the thickness of the cup-shaped body 12 is not constant. Each barrier layer 32, 34 has an average thickness preferred between 1 μm and 2 μm . However, broader ranges have been disclosed above, i.e. with an average thickness between 0,5 μm and 30 μm . Such widely different thicknesses cause that a ratio of the total volume of the barrier layer(s) 32, 34 and the volume of the base member is at most 10%, preferably at most 5%, more preferably at most 2% and most preferably at most 1%. This thus effectively limits the amount of non-biodegradable (but natural) material (i.e. metal) to the total volume of waste (i.e. the cup-shaped body 12).

[0055] The cup-shaped body 12 may be manufactured according to different techniques. The manufacturing method comprises the provision of the base member 30. Various techniques to produce a compostable base member are known to the person skilled in the art and will not be described. One or two barrier layer(s) 32, 34 are then applied to the base member 30. Various application techniques are possible, e.g. submersion, lamination, coating, etc. The preferred technique is application by micronized spraying as this allows a more accurate control of the thickness and achieves a more uniform barrier layer.

[0056] Various material compositions for the lid of the capsule 10 are known. Ideally, the lid is also compostable. However, this is not essential as the lid may also be removed prior to composting.

[0057] Although aspects of the present disclosure have been described with respect to specific embodiments, it will be readily appreciated that these aspects may be implemented in other forms within the scope of the invention as defined by the claims.

Claims

1. A beverage capsule (10) for use in a beverage preparation machine to prepare a beverage by passing a fluid under pressure through the beverage capsule, the beverage capsule comprising:

- a cup-shaped body (12) comprising a base (14) and a sidewall (16) contiguous with the base; and

- a lid sealed to the sidewall, the lid and cup-shaped body enclosing an interior volume configured for holding one or more beverage ingredients,

characterized in that the cup-shaped body consists of:

- a base member (30) made from a compostable material; and

- a barrier layer (32) which covers a side of

- the base member,
- wherein the barrier layer is made from a metal and has a thickness between 0,5 μm and 30 μm .
2. A beverage capsule (10) for use in a beverage preparation machine to prepare a beverage by passing a fluid under pressure through the beverage capsule, the beverage capsule comprising:
- a cup-shaped body (12) comprising a base (14) and a sidewall (16) contiguous with the base;
 - a lid sealed to the sidewall, the lid and cup-shaped body enclosing an interior volume configured for holding one or more beverage ingredients,
- characterized in that** the cup-shaped body consists of:
- a base member (30) made from a compostable material;
 - an inner barrier layer (32) which covers an inner side of the base member; and
 - an outer barrier layer (34) which covers an outer side of the base member,
- wherein each barrier layer is made from a metal and has a thickness between 0,5 μm and 30 μm .
3. The beverage capsule according to claim 1 or 2, **characterized in that** the cup-shaped body is home-compostable.
4. The beverage capsule according to any one of the preceding claims, **characterized in that** a ratio of a total volume of the barrier layers and a volume of the base member is at most 10%, preferably at most 5%, more preferably at most 2% and most preferably at most 1%.
5. The beverage capsule according to any one of the preceding claims, **characterized in that** the base member has an average thickness between 100 μm and 1000 μm , wherein the average thickness particularly is at least 200 μm and more particularly at least 250 μm , and wherein the average thickness particularly is at most 800 μm and more particularly at most 700 μm .
6. The beverage capsule according to any one of the preceding claims, **characterized in that** each barrier layer has a thickness of at most 10 μm , preferably at most 5 μm , more preferably at most 3 μm and most preferably at most 2 μm .
7. The beverage capsule according to any one of the preceding claims, **characterized in that** each barrier layer has a thickness of at least 0,8 μm and
- preferably at least 1 μm .
8. The beverage capsule according to any one of the preceding claims, **characterized in that** the base member comprises at least one of the following materials or a derivative thereof: a polybutylene succinate, a poly-3-hydroxybutyrate-co-3-hydroxyhexanoate, a polyhydroxyalkanoate, and a cellulose.
9. The beverage capsule according to any one of the preceding claims, **characterized in that** at least one barrier layer comprises a lacquer layer disposed on the side facing away from the base member.
10. The beverage capsule according to any one of the preceding claims, **characterized in that** the metal is a food-grade metal, such as aluminium or an aluminium alloy.
11. The beverage capsule according to any one of the preceding claims, **characterized in that** the beverage capsule further comprises the one or more beverage ingredients, the one or more beverage ingredients preferably being extraction ingredients, such as roasted ground coffee, tea leaves, etc.
12. The beverage capsule according to any one of the preceding claims, **characterized in that** the beverage capsule comprises an annular rim (18) contiguous with the sidewall, the lid being sealed to the annular rim.
13. Use of a beverage capsule (10) according to any one of the preceding claims in a beverage preparation machine to prepare a beverage by passing a fluid under pressure through the beverage capsule.
14. A method for manufacturing the cup-shaped body (12) of the beverage capsule (10) according to any one of the claims 1 to 12, the method comprising:
- providing the base member (30); and
 - applying a barrier layer (32, 34) to the inner side and/or the outer side of the base member.
15. The method according to claim 14, **characterized in that** the step of applying the barrier layer comprises: micronized spray coating a metal composition onto the inner and/or outer side of the base member.

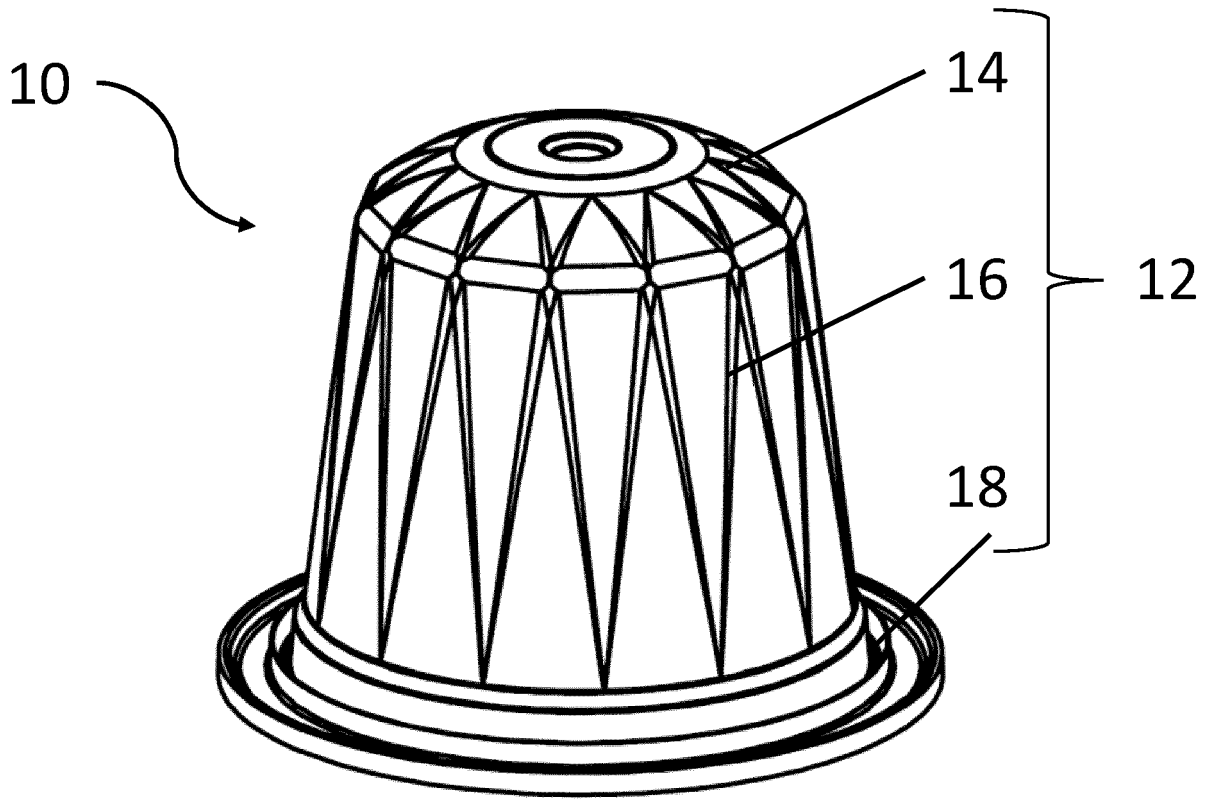


Fig. 1

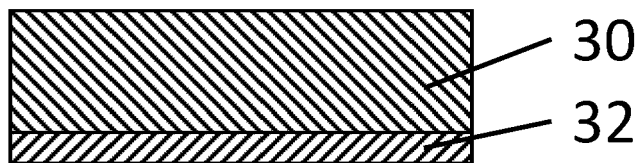


Fig. 3A

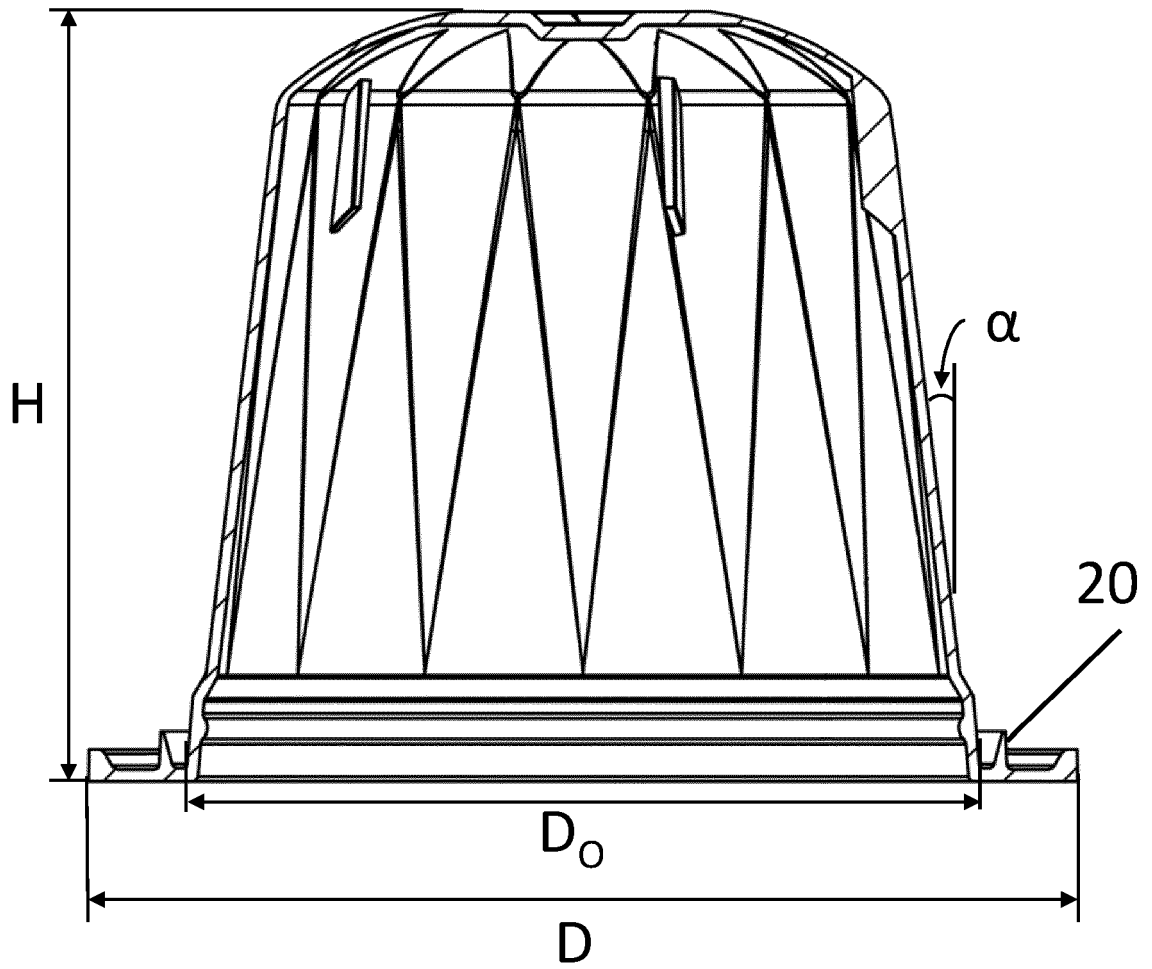


Fig. 2

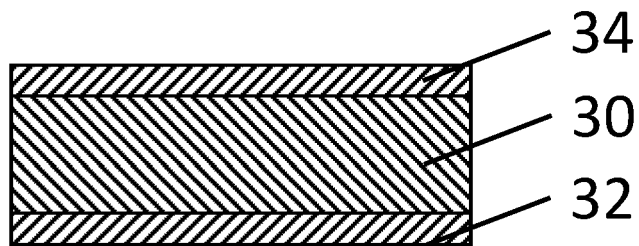


Fig. 3B

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

EP 23 19 9603

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2022170276 A1	11-08-2022	EP 4281388 A1	29-11-2023
		US 2022250819 A1	11-08-2022
		WO 2022170276 A1	11-08-2022

WO 2018203184 A1	08-11-2018	AU 2018262360 A1	21-11-2019
		BR 112019022768 A2	19-05-2020
		CA 3061454 A1	08-11-2018
		CN 110891778 A	17-03-2020
		EP 3619038 A1	11-03-2020
		JP 7169295 B2	10-11-2022
		JP 2020519533 A	02-07-2020
		RU 2019133575 A	22-04-2021
		US 2020087056 A1	19-03-2020
		WO 2018203184 A1	08-11-2018
ZA 201907140 B	28-04-2021		

US 2017107034 A1	20-04-2017	NONE	

WO 2018042339 A1	08-03-2018	AU 2017319586 A1	06-12-2018
		CA 3024822 A1	08-03-2018
		CN 109641696 A	16-04-2019
		EP 3507215 A1	10-07-2019
		US 2019225412 A1	25-07-2019
		WO 2018042339 A1	08-03-2018

EPO FORM P0459

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1839543 A [0003] [0004]
- EP 2996521 A [0003]
- WO 2018203184 A [0007] [0008]
- WO 2022170276 A [0007] [0008]