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(54) CAPSULE FOR THE PREPARATION OF BEVERAGES

KAPSEL ZUR ZUBEREITUNG EINES GETRÄNKS

CAPSULE POUR LA PRÉPARATION DE BOISSONS

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EP 2 962 958 B1

Description

TECHNICAL FIELD

[0001] The present invention relates to a single-use capsule for preparation of beverages, typically coffee, tea or other beverages obtainable by infusion/extraction or by solution of a granular or powdered comestible substance.

PRIOR ART

[0002] As is known, for preparation of beverages, typically coffee, tea or other beverages obtainable by infusion/extraction or by solution of a granular or powdered comestible substance, single-use capsules are used, generally comprising a beaker-shaped container, defined by a lateral wall, a bottom wall and an opposite opening, a dose of the comestible substance contained in the beaker body, and a covering element able to close the opening of the beaker body, so as to retain the dose of comestible substance internally of the capsule.

[0003] In some embodiments, the beaker body (or container) and the covering element are perforated, with sufficiently small holes to retain the comestible substance internally of the capsule, but large enough to enable passage of the water and/or the steam necessary for preparing the beverage.

[0004] In other embodiments, the container and/or the covering element are made of a continuous and impermeable material, so as to completely isolate the comestible substance from the external environment.

[0005] In both above-mentioned cases, the covering element can be a slim film which is fixed, for example by heat-welding or gluing, on a flange of the container which delimits the opening.

[0006] Starting from a single-use capsule of this type, the preparation of the beverage is carried out with the aid of a special dispensing machine which enables introducing hot water and/or steam internally of the capsule, and then to extract the beverage obtained, leaving the remains of the comestible substance internally of the capsule.

[0007] The dispensing machine is generally further predisposed to perforate both the covering element and the container body, so as to enable introduction of the hot water and/or steam, and then enable exit of the beverage obtained. The complete exploitation of the product contained internally of the container, and consequently the quality of the beverage obtained, requires a perfect saturation of water/steam in the product.

[0008] In particular, in the case of preparation of coffee, to obtain a high-quality product high-pressure hot water or steam must be used in order to obtain a beverage having the correct consistency and creamy quality.

[0009] However, in known-type capsules, the presence of holes for dispensing the beverage does not allow the fluid to reach the pressure required for obtaining a good quality of infusion.

[0010] In fact the high-pressure fluid which comes into contact with the product internally of the capsule creates preferential flow channels which connect the inlet holes with the dispensing holes. Therefore the fluid, flowing mainly internally of the channels, extracts the aromatic components or solubilizes only those parts of product situated close to the channels. It follows that the aromatic components of the majority of the product internal of the capsule are not extracted completely, or a part of the product remains insolubilized. WO 2008/017608 and WO 2007/063411 disclose capsules for preparation of beverages in accordance with the preamble of independent claim 1.

[0011] An aim of the present invention is to provide a capsule which enables obviating the above-mentioned drawbacks of the prior art, with a solution that is simple, rational and relatively inexpensive.

[0012] In particular an aim of the present invention is to provide a capsule that enables excellent extraction of the aromatic components of practically all of the product contained therein, or an almost-total solubilisation thereof.

[0013] The aims are attained by the characteristics of the invention reported in the independent claim. The dependent claims delineate preferred and/or particularly advantageous aspects of the invention.

[0014] An embodiment of the invention discloses a capsule for preparation of beverages, comprising a beaker body provided with an external wall and a bottom wall, the external wall defining an opening closed by a covering element, the external wall, the bottom wall and the covering element defining a containing chamber of a substance for preparation of the beverage; at least a groove is realized on the covering element, which groove is defined by a first and a second lateral wall, mutually facing and connected by a breakable portion, the breakable portion being dimensioned such as to break following flexion of at least one between the first and the second lateral wall towards an outside of the capsule when the pressure internally of the compartment exceeds a predetermined threshold, thus creating a dispensing opening of the beverage.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Further characteristics and advantages of the invention will emerge from a reading of the description that follows, provided by way of non-limiting example, with the aid of the figures of the accompanying tables, in which:

figure 1 is a lateral elevation of a capsule according to the present invention;

figure 2 is a perspective view of the capsule of figure 1, without the covering element;

figure 3 is a perspective view from below of a covering element of the capsule of figure 1;

figure 4 is a plan view from below of the covering element of the preceding figure;
figure 5 is a section made along plane V-V of figure 4;
figure 6 is a simplified and schematic section of the capsule of figure 1 located in a dispensing machine; and
figure 7 is a simplified sectioned view taken along line 7-7 of figure 4.

DESCRIPTION OF THE INVENTION

[0016] With particular reference to the figures, reference numeral 1 denotes in its entirety a single-use capsule for preparation of beverages, typically coffee, tea or other beverages obtainable by infusion/extraction or by solution of a granular or powdered comestible substance.

[0017] The capsule 1 comprises a beaker body 11 defined by an external wall 12, having a preferably circular section, and a bottom wall 13; the external wall defines an opening 15, destined to be closed by a covering element 14. The covering element is not visible in figure 2, but is clearly visible in figures 3 and 4, where it is separated from the capsule.

[0018] The beaker body 11 is able to contain a dose of granular or powdered comestible substance (product) which, by infusion/extraction or solution in water, enables production of a beverage. The product is advantageously coffee in powder form.

[0019] The bottom wall 13 is made in a single piece with the external wall 12.

[0020] The beaker body is advantageously made by moulding a plastic material, for example polypropylene (PP) for food use or PLA-type bioplastics.

[0021] The shape of the beaker body 11, and in particular of the external wall 12, can be any, for example truncoconical as in the figures, or cylindrical, hemispherical, polygonal or another shape.

[0022] As already mentioned, the capsule 1 further comprises a covering element 14 which closes the opening 15, and together with the external wall and the bottom wall defines a compartment 51 destined to contain the product.

[0023] The covering element 14 is applied after the filling of the beaker body 11 with the comestible substance. In the illustrated embodiment, the covering element 14 advantageously cooperates in a snap-fit with the part of the external wall that delimits the opening 15.

[0024] In other embodiments of the invention the covering element can be welded or glued at the opening.

[0025] Further, the covering element is without openings, and is configured so as to be sealedly associated with the beaker body in such a way as to hermetically seal the comestible substance internally of the compartment 51 with respect to the external environment.

[0026] The covering element 14 is well illustrated in figures from 3 to 5 and preferably comprises a plurality of grooves 131, each defined by at least a first 131A and a second lateral wall 131B mutually facing and connected by a breakable portion 130.

[0027] The grooves are realised on both the external face "O" and the internal face "I" of the covering element 14.

[0028] By internal face I of the covering element is meant the face destined to be facing towards the compartment 51 when the covering element is positioned on the beaker body 11.

[0029] For the sake of simplicity, in the drawings the grooves are denoted by reference numeral 131 followed by an I or an O according to whether they are on the internal face I or the external face O of the covering element 14, but in the present text, when describing the grooves in a general sense, in relation for example to the configuration thereof, only reference numeral 131 will be used.

[0030] In the illustrated case the grooves 131 realised on the side of the covering element 14 facing towards the inside of the compartment are superposed on the grooves 131 realised on the side of the covering element facing towards the outside of the compartment. The configuration of the grooves is clearly visible in the section of figure 7.

[0031] Note, with particular reference to figure 7, that the grooves of both the faces exhibit a V-shaped section with coinciding vertices. Therefore the breakable portion 130 is positioned/realised at the vertex of the V.

[0032] Obviously in alternative embodiments the grooves 131 can be realised only on the internal face I, only on the external face O or on both faces of the closing element 14, but offset.

[0033] In any case the grooves, singly (or in couples when superposed) always define a breakable portion 130 configured such as to break when at least one of the two lateral walls 131A, 131B flexes towards the outside of the capsule consequently to exceeding a predetermined pressure internally of the compartment 51.

[0034] In fact the thickness of the breakable portion determines the predetermined pressure at which the breakage occurs.

[0035] This detail will be the subject of further description in the following.

[0036] Once the breakable portion 131 of each groove has been broken, openings form on the covering element 14 body which enable dispensing of the beverage.

[0037] The presence of the breakable portions and the possibility of regulating, by means of the thickness of the breakable portions, the predetermined pressure at which the opening occurs, is particularly advantageous as the pressurized water entering the compartment "wets" all the product contained in the compartment before "breaking" the breakable portions.

[0038] This leads to an excellent extraction of the product, preventing formation of "preferential" channels in which the pressurized water is constrained to flow. Specifically, this predetermined threshold is comprised between 4 and 20 bar, and is preferably 9 bar.

[0039] The thickness of the breakable portions is in-

stead comprised between 0.05 mm and 0.5 mm, preferably 0.2 mm.

[0040] The capsule described in the present embodiment of the invention is made of polypropylene and exhibits the breakable portions having a thickness of 0.2 mm.

[0041] In fact the air (nitrogen or another conserving gas of the comestible substance) present in the capsule yields its place to the water which cannot create preferential flowing channels given that the bottom of the capsule is lacking in perforations.

[0042] The extraction occurs very homogeneously and directly involves the near-totality of the product contained internally of the capsule.

[0043] In particular each breakable portion 130 is able to open following reaching of a critical predetermined pressure internally of the capsule 1.

[0044] In the embodiment illustrated in the figures, the covering element 14 is configured so as to be a dispensing wall of the beverage, while the bottom wall 13 is configured so as to be an inlet wall of the fluid for the infusion, for example water or steam.

[0045] Returning to the description of the covering element, it can be noted that a plurality of grooves 131l realised on the internal face of the covering element 14 exhibit a concavity facing towards the inside of the compartment 51. At least these grooves are interconnected by at least a channel 132A, 132B open towards the inside of the compartment 51. Note that the channel includes a bottom wall which, on the contrary to the breakable portions 130, is able to withstand a pressure internally of the compartment that is higher than that which the breakable portions can withstand.

[0046] Further, a first 132A and a second 132B channel are advantageously provided, having a circular conformation (in plan view). The first channel 132B is internal (inscribed) in the second channel 132B which has a larger radius. The outflow channels 132A, 132B intersect the grooves 131 in such a way that the beverage can be distributed efficiently internally of all the grooves, so as to facilitate the dispensing of the beverage.

[0047] Note that the outflow channels 132A, 132B are preferably uniformly distributed on the internal face of the covering element 14 and are sufficiently distanced from one another so as not to constitute weakenings of the bottom wall.

[0048] In the embodiment described two outflow channels 132C and 132D are also included, also on the external face of the covering element 14. These are entirely similar to the ones described in the foregoing. The channels however are offset with respect to the channels realized on the internal face of the covering element, so as not to weaken the structure thereof by making it yieldable also in zones not designated to break.

[0049] Note that the outflow channels 132C and 132D realised on the external surface of the covering element do not have a particular function when they are on the outside of the compartment 51. However the presence thereof is justified by the need to realize a covering element which facilitates the mounting operations, not requiring being orientated.

[0050] In fact, in the embodiment described herein, the covering element is mounted with the channels 132C and 132D arranged externally, but given the configuration thereof, they would function well even should they be mounted oppositely.

[0051] The peculiarity of this embodiment lies in the fact that it "does not require" orientating the covering element, during the mounting operations. This constitutes a significant simplification for automatic machines for packing the capsules.

[0052] It is however specified that other embodiments of the invention do not include the outflow channels even on the outside face of the covering element 14, i.e. on the face of the covering element facing on the opposite side of the compartment 15, but only on the internal face of the covering element 14, i.e. the face turned towards the compartment 15.

[0053] As can be noted from the drawings, the grooves 131 are arranged radially on the covering element and depart from a central portion C thereof, which is lacking in grooves.

[0054] When the capsule is in the use configuration, on the covering element 14, and precisely on the face turned internally of the compartment 51, a filtering element might be arranged. The filtering element, if present, would retain the powder substance internally of the capsule 1 during the dispensing of the beverage.

[0055] The container 11 is made of an elastically yielding and water-repellent material.

[0056] As already mentioned, the beaker body 11 is made in a single piece, for example by means of an injection moulding process of a plastic material, without excluding the possibility of its being made using other materials, among which for example aluminium, or a multi-layer material comprising aluminium.

[0057] The capsule 1 can be used by a machine M for production of a beverage, which generally comprises a boiler CD for heating the water, an infusion group 30 (see figure 6) able to accommodate the capsule 1, and a pump P for pumping the hot water from the boiler and supplying the water internally of the infusion group 30.

[0058] The pump and the boiler, like the body of the machine, and the hydraulic circuits are illustrated only schematically, as they are well known to the expert in the sector.

[0059] The infusion group 30 illustrated is of the laterally-open type and comprises a beaker body 31 able to accommodate the capsule 1. It exhibits, on the bottom thereof, a dispensing spout 310 of the beverage, and, opposite the spout, a mouth for introduction and extraction (after use) of the capsule 1. The infusion group 30 further comprises a cylindrical closing plate 32, which can close in abutment on the beaker body 11 (of the capsule), so as to define a closed infusion chamber, coinciding with the internal chamber of the beaker body 11,

which completely closes the comestible substance (or product). The closing plate 32 advantageously includes one or more needles 35 (preferably having a conical point), which project towards the beaker body 31.

[0060] Each of the needles 35 exhibits a central hole 350 which is located hydraulically in communication with the water supply pump P.

[0061] The plate 32 and the beaker body 31 are reciprocally mobile so as to enable insertion of the capsule 1, and once neared the infusion chamber is hermetically closed, by means of appropriate seals G interposed between the beaker body 31 and the capsule 1 and the closing plate 32 and the capsule. The hot water is supplied from the boiler to the infusion chamber through the holes 350 and the needles 35 which penetrate the covering element 14. The water mixes with or extracts the aromas of the comestible substance contained in the capsule 1, realizing a beverage by infusion or solution.

[0062] An inlet way is created for the fluid via the central holes 350, made by penetration in the capsule 1 through the bottom wall; however, in an initial step, the absence of an exit way means that by continuing supply of the fluid an increase of pressure is caused internally of the capsule 1.

[0063] In particular, in the non-limiting illustrated example shown in the figures, the beverage formed, when crossing the filter (if present), accumulates in the channels 132A and 132B of the covering element, and at the yielding portions 131, pressing against the covering element, in particular against the breakable portions 130.

[0064] Thanks to the channels 132 in which the beverage flows freely, the beverage is distributed uniformly on the covering element 14 and in the grooves, completely wetting the product before the opening of the breakable portions, so as to obtain an infusion of greater quality and avoiding or minimising the formation of preferential flow channels.

[0065] When the pressure reaches a critical preset value, the breakable portions 130 break; the breakable portions represent a preferential fracture zone due to the smaller thickness of the bottom of the breakable portions.

[0066] The breaking of these portions is done at the same time and consequently to the flexion towards the outside of the capsule (in the dispensing direction of the beverage) of the first and the second lateral wall which define each groove. In this way the dispensing of the beverage is achieved through the closing element 14 of the beaker body 11, in the direction of the dispensing spout 310.

[0067] Note that following the opening and during the dispensing, the first and the second lateral wall remain fixed to the capsule 1, at most slightly flexing towards the outside of the compartment.

[0068] This is particularly advantageous in a case in which the beverage under preparation is espresso coffee, as the high pressure obtained internally of the capsule enables obtaining a correct extraction of the aromatic components of the powder, and especially the generation of a more persistent cream.

Claims

1. A capsule (1) for preparation of beverages, comprising a beaker body (11) provided with an external wall (12) and a bottom wall (13), the external wall defining an opening (15) closed by a covering element (14), the external wall, the bottom wall and the covering element defining a containing chamber (51) of a substance for preparation of the beverage, at least a groove (131) is realized on the covering element (14), which groove (131) is defined by a first (131A) and a second (131B) lateral wall, mutually facing and connected by a breakable portion (130), the breakable portion being dimensioned such as to break following flexion of at least one between the first and the second lateral wall (131A, 131B) towards an outside of the capsule when the pressure internally of the compartment (51) exceeds a predetermined threshold, thus creating a dispensing opening of the beverage, **characterized in that** the grooves (131) are arranged with a radial extension on the covering element (14) and depart from a central portion (C) of the covering element lacking in grooves.

2. The capsule of the preceding claim, wherein a plurality of grooves is made on the covering element (14), which grooves exhibit a concavity facing towards an inside of the compartment (51) and/or towards an outside of the compartment.

3. The capsule of the preceding claim, wherein at least some of the grooves (131) made on the side of the covering element (14) facing towards the inside of the compartment are superposed on the grooves (131) made on the side of the covering element facing towards outside the compartment.

4. The capsule of one or more of the preceding claims, wherein the covering element (14) includes at least a channel (132A, 132B) open towards the inside of the compartment which interconnects the grooves (131) arranged on the face of the covering element facing towards the inside of the compartment.

5. The capsule of one or more of the preceding claims, **characterised in that** it includes at least a channel open towards an outside of the compartment (132C, 132D), which channel interconnects the grooves (131) arranged on the face of the covering element facing on the opposite side with respect to the compartment.

6. The capsule of claim 4, wherein the at least a channel (132A, 132B) exhibits a circular progression.

7. The capsule of one or more of the preceding claims, wherein the channels (132) realised on the side of the covering element (14) facing towards the inside of the compartment are offset with respect to the channels (132) realised on the side of the covering element facing towards the outside of the compartment.

8. The capsule of one or more of the preceding claims, wherein the thickness of the breakable portions is comprised between 0.05 mm and 0.5 mm, preferably 0.2 mm.

9. The capsule of one or more of the preceding claims, wherein a filtering element is rested on the covering element (14).

10. The capsule of one or more of the preceding claims, wherein the at least a groove (131) exhibits a V-shaped section, the breakable portion being positioned at the vertex of the V-shape.

Patentansprüche

1. Kapsel (1) zur Zubereitung von Getränken, einen Becherkörper (11) umfassend, der mit einer Außenwand (12) und einer Bodenwand (13) versehen ist, wobei die Außenwand eine Öffnung (15) definiert, die durch ein Abdeckelement (14) verschlossen ist, wobei die Außenwand, die Bodenwand und das Abdeckelement eine Inhaltskammer (51) für eine Substanz zur Zubereitung des Getränks definieren, wobei an dem Abdeckelement (14) mindestens eine Rille (131) umgesetzt ist, wobei die Rille (131) durch eine erste (131A) und eine zweite (131B) Seitenwand definiert ist, die sich gegenseitig gegenüberliegen und durch einen zerbrechlichen Abschnitt (130) verbunden sind, wobei der zerbrechliche Abschnitt derart bemessen ist, dass er infolge eines Biegens der ersten und/oder der zweiten Seitenwand (131A, 131B) hin zu einer Außenseite der Kapsel bricht, wenn der Druck im Innern der Kammer (51) einen festgelegten Grenzwert übersteigt, was eine Ausgabeöffnung für das Getränk erzeugt, **dadurch gekennzeichnet, dass** die Rillen (131) in einer radialen Erstreckung an dem Abdeckelement (14) angeordnet sind und von einem mittleren Abschnitt (C) des Abdeckelements ausgehen, der keine Rillen aufweist.

2. Kapsel nach dem vorhergehenden Anspruch, wobei an dem Abdeckelement (14) mehrere Rillen gefertigt sind, wobei die Rillen eine Konkavität aufweisen, die zu einem Inneren der Kammer (51) und/oder zu einer Außenseite der Kammer weist.

3. Kapsel nach dem vorhergehenden Anspruch, wobei mindestens einige der Rillen (131), die auf der Seite des Abdeckelements (14) gefertigt sind, die zum Inneren der Kammer weist, die Rillen (131) überlagern, die auf der Seite des Abdeckelements gefertigt sind, die zur Außenseite der Kammer weist.

4. Kapsel nach einem oder mehreren der vorhergehenden Ansprüche, wobei das Abdeckelement (14) mindestens einen Kanal (132A, 132B) enthält, der zum Inneren der Kammer hin offen ist und die Rillen (131) verbindet, die auf der Fläche des Abdeckelements angeordnet sind, die zum Inneren der Kammer weist.

5. Kapsel nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** sie mindestens einen Kanal enthält, der zu einer Außenseite der Kammer (132C, 132D) hin offen ist, wobei der Kanal die Rillen (131) miteinander verbindet, die auf der Fläche des Abdeckelements angeordnet sind, die zur im Verhältnis zur Kammer entgegengesetzten Seite weist.

6. Kapsel nach Anspruch 4, wobei der mindestens eine Kanal (132A, 132B) einen kreisrunden Verlauf aufweist.

7. Kapsel nach einem oder mehreren der vorhergehenden Ansprüche, wobei die Kanäle (132), die auf der Seite des Abdeckelements (14) umgesetzt sind, die zur Innenseite der Kammer weist, im Verhältnis zu den Kanälen (132) versetzt sind, die auf der Seite des Abdeckelements realisiert sind, die zur Außenseite der Kammer weist.

8. Kapsel nach einem oder mehreren der vorhergehenden Ansprüche, wobei die Dicke der zerbrechlichen Abschnitte zwischen 0,05 und 0,5 mm liegt, vorzugsweise bei 0,2 mm.

9. Kapsel nach einem oder mehreren der vorhergehenden Ansprüche, wobei auf dem Abdeckelements (14) ein Filterelement ruht.

10. Kapsel nach einem oder mehreren der vorhergehenden Ansprüche, wobei die mindestens eine Rille (131) einen V-förmigen Querschnitt aufweist, wobei der zerbrechliche Abschnitt am Scheitelpunkt der V-Form positioniert ist.

Revendications

1. Capsule (1) pour la préparation de boissons, comprenant un corps de gobelet (11) pourvu d'une paroi extérieure (12) et d'une paroi inférieure (13), la paroi extérieure délimitant une ouverture (15) fermée par un élément couvrant (14), la paroi extérieure, la paroi inférieure et l'élément couvrant délimitant un réser-

voir (51) contenant une substance pour la préparation de la boisson, au moins une rainure (131) est réalisée sur l'élément couvrant (14), ladite rainure (131) est délimitée par une première (131 A) et une seconde (131 B) paroi latérale, se faisant mutuellement face et reliés par une partie cassable (130), la partie cassable étant conçue de sorte à se casser suite à la flexion d'au moins une des deux parois latérales (131 A, 131 B) vers l'extérieure de la capsule lorsque la pression interne du compartiment (51) dépasse un seuil prédéterminé, créant ainsi une ouverture de distribution de la boisson, **caractérisée en ce que** les rainures (131) sont disposées avec une extension radiale sur l'élément couvrant (14) et s'écartent d'une partie centrale (C) de l'élément couvrant ne disposant pas de rainures.

2. Capsule selon la revendication précédente, dans laquelle une pluralité de rainures est réalisée sur l'élément couvrant (14), lesdites rainures présentent une concavité orientée vers une partie intérieure du compartiment (51) et/ou vers une partie extérieure du compartiment.

3. Capsule selon la revendication précédente, dans laquelle au moins certaines rainures (131) réalisées sur le côté de l'élément couvrant (14) orienté vers l'intérieur du compartiment sont superposées sur les rainures (131) réalisées sur le côté de l'élément couvrant orienté vers l'extérieur du compartiment.

4. Capsule selon l'une ou plusieurs des revendications précédentes, dans laquelle l'élément couvrant (14) comprend au moins un canal (132A, 132B) ouvert vers l'intérieur du compartiment qui relie les rainures (131) disposées sur la face de l'élément couvrant orienté vers l'intérieur du compartiment.

5. Capsule selon l'une ou plusieurs des revendications précédentes, **caractérisée en ce qu'**elle comprend au moins un canal ouvert vers une partie extérieure du compartiment (132C, 132D), ledit canal reliant les rainures (131) disposées sur la face de l'élément couvrant orienté vers le côté opposé par rapport au compartiment.

6. Capsule selon la revendication 4, dans laquelle au moins un canal (132A, 132B) présente une progression circulaire.

7. Capsule selon l'une ou plusieurs des revendications précédentes, dans laquelle les canaux (132) réalisés sur le côté de l'élément couvrant (14) orienté vers l'intérieur du compartiment sont décalés par rapport aux canaux (132) réalisés sur le côté de l'élément couvrant orienté vers l'extérieur du compartiment.

8. Capsule selon l'une ou plusieurs des revendications précédentes, dans laquelle l'épaisseur des parties cassables est comprise entre 0,05 mm et 0,5 mm, de préférence de 0,2 mm.

9. Capsule selon l'une ou plusieurs des revendications précédentes, dans laquelle un élément filtrant repose sur l'élément couvrant (14).

10. Capsule selon l'une ou plusieurs des revendications précédentes, dans laquelle au moins une rainure (131) présente une section en forme de V, la partie cassable étant positionnée sur le sommet de la forme de V.

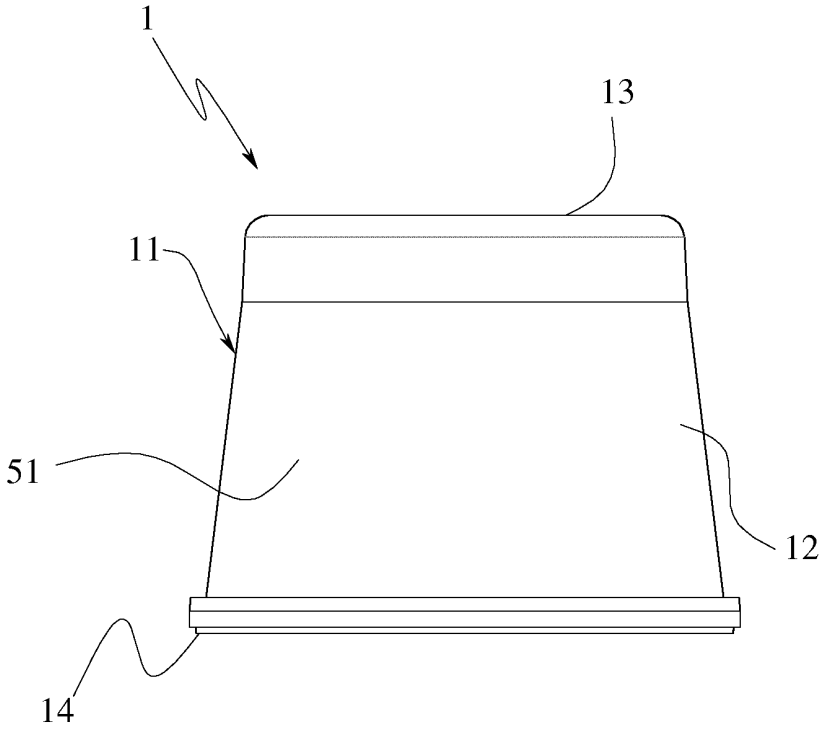


FIG.1

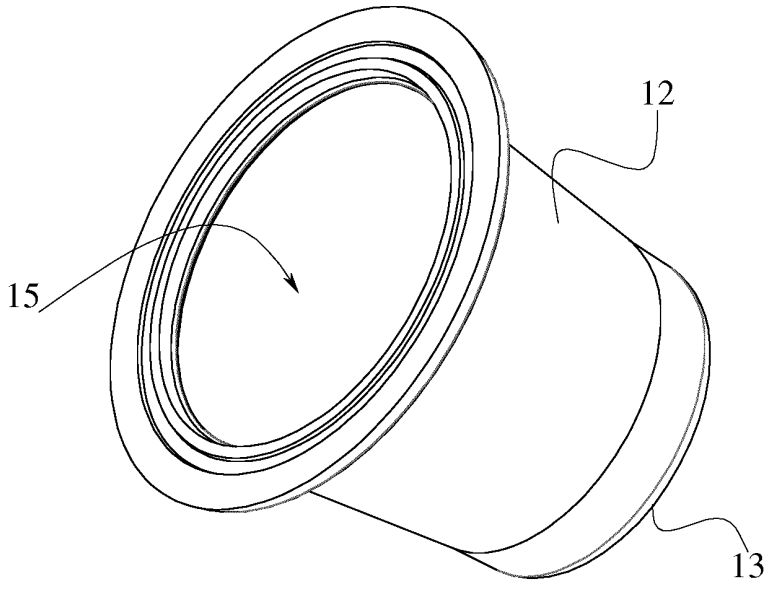


FIG.2

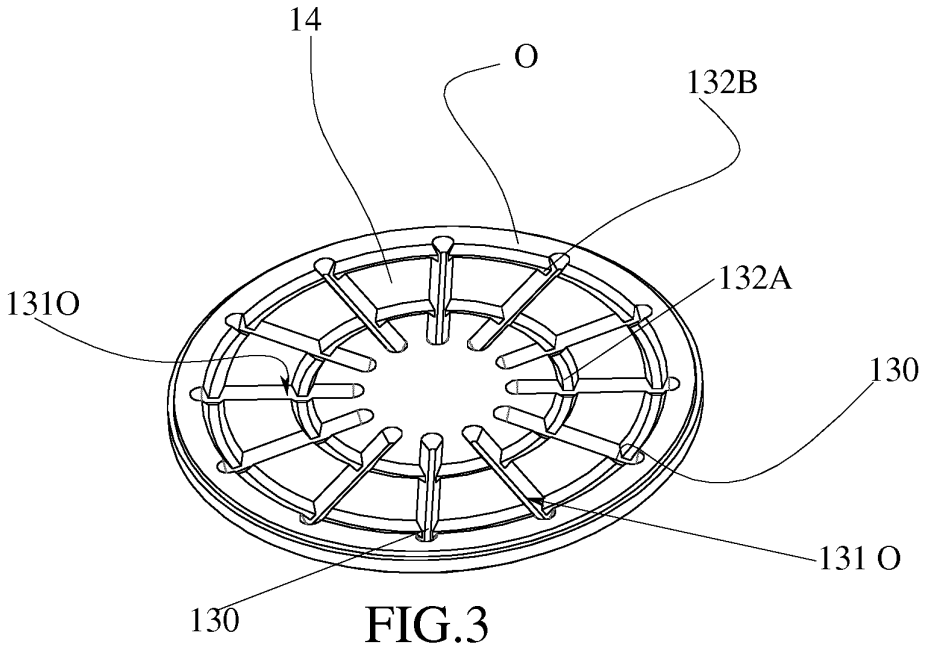


FIG.3

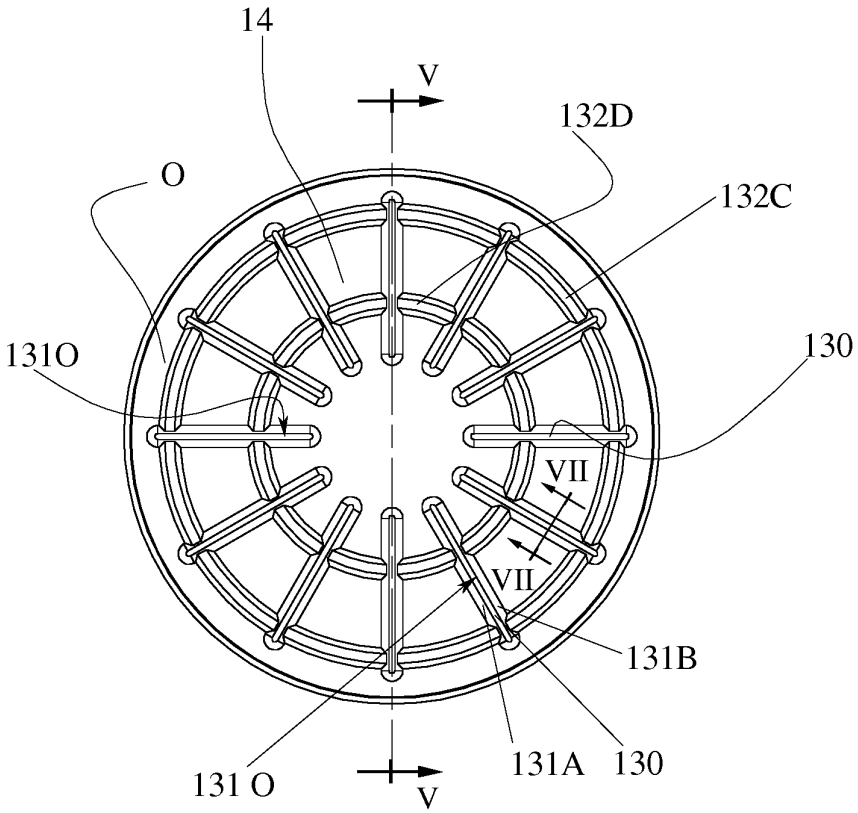


FIG.4

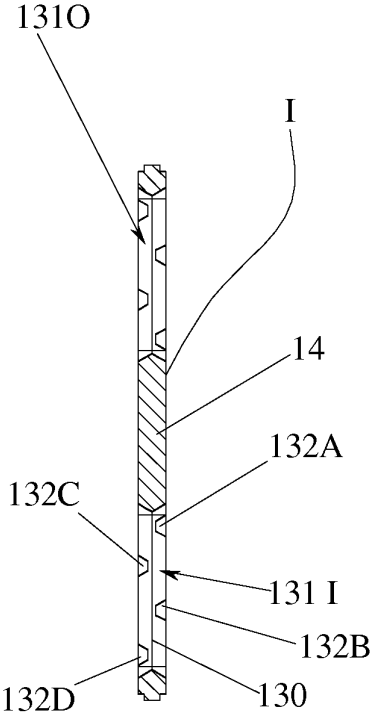


FIG.5

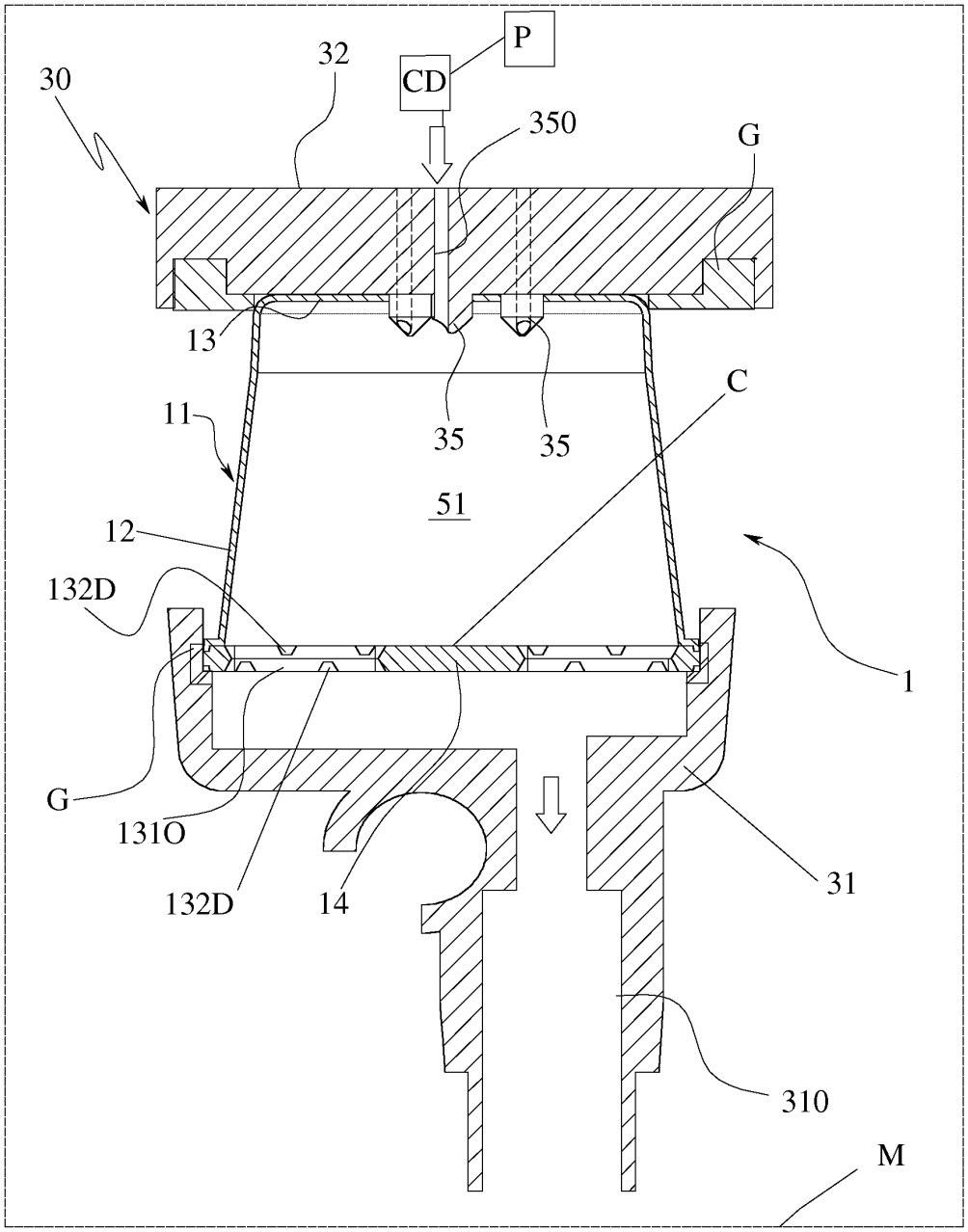

30
32
P
CD
350
G
13
11
35
35
C
51
12
132D
1
G
131O
132D
14
31
310
M

FIG.6

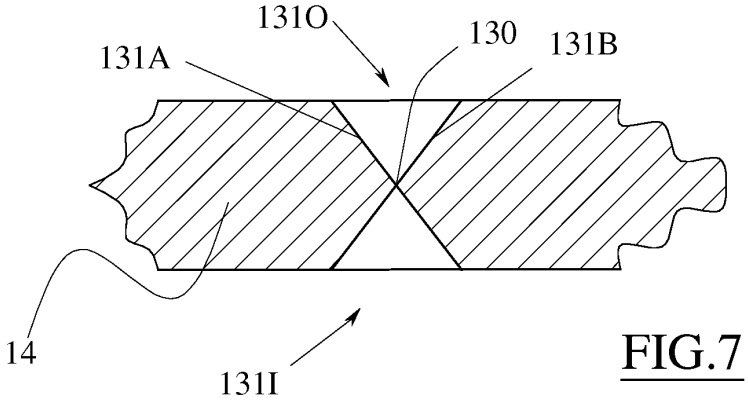

131O
130
131B
131A
14
131I

FIG.7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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