



- (51) International Patent Classification:
B65D 85/804 (2006.01)
- (21) International Application Number:
PCT/EP2014/057290
- (22) International Filing Date:
10 April 2014 (10.04.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
13163334.9 11 April 2013 (11.04.2013) EP
- (71) Applicant: NESTEC S.A. [CH/CH]; Av. Nestlé 55, CH-1800 Vevey (CH).
- (72) Inventors: TALON, Christian; Chemin des Vignes 22C, CH-1134 Vufflens-le-Château (CH). HEYDEL, Christophe Sébastien Paul; Rue Foulaz 26, CH-2025 Chez Le Bart (CH). BEZET, Nicolas, Jean-Guy; 73 rue de la Liberté, F-7100 Macon (FR).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,

KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
- of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))

(54) Title: A FOOD PREPARATION CAPSULE

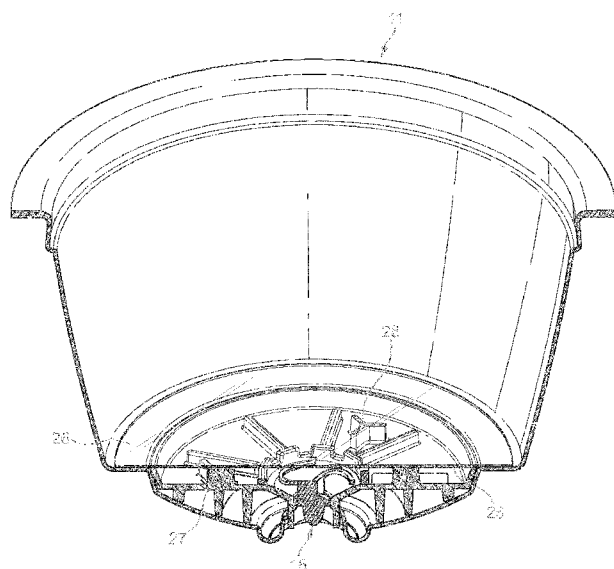


FIG. 10

(57) Abstract: The present invention concerns a capsule (11) containing a beverage ingredient, adapted to be functionally inserted in a food preparation machine (1), said capsule comprising walls (12) that define a cavity wherein said beverage is prepared by mixing said ingredient with a fluid injected therein under pressure by said machine, said capsule further comprising a dispensing opening (13), and opening means that open upon effect of the rise of pressure within said cavity, characterized in that said opening means comprise a flow-conducting channel (14) able to connect the capsule cavity to the dispensing opening (13) and a spring-mounted piston plug (15) that is movable in said channel between: (i) a closed position where said cavity pressure is below a first predetermined pressure P_c , the piston spring (16) is at rest, and the piston plug (15) seals against a sealing portion (19) of the channel walls, (ii) a dispensing position where said cavity pressure is equal or superior to P_c , the piston spring (16) is elastically deformed and the piston plug (15) is moved away from the channel walls so that beverage can flow outside of said capsule through said channel (14).



5

A FOOD PREPARATION CAPSULE

10

15

Field of the invention

20 The present invention concerns a capsule for use in a food or beverage preparation machine, more precisely, a capsule with anti-dripping properties.

Background of the invention

25 Beverage preparation machines are well known in the food science and consumer goods area. Such machines allow a consumer to prepare at home a given type of beverage, for instance a coffee-based beverage, e.g. an espresso or a brew-like coffee cup.

30 Today, most beverage preparation machines for in-home beverage preparation comprise a system made of a machine which can accommodate portioned

ingredients for the preparation of the beverage. Such portions can be soft pods or pads, or sachets, but more and more systems use semi-rigid or rigid portions such as rigid pods or capsules. In the following, it will be considered that the beverage machine of the invention is a beverage preparation machine working with a rigid or semi-rigid capsule, such as for instance capsules, sachets, pods, pads.

The machine comprises a receptacle or cavity for accommodating said capsule and a fluid injection system for injecting a fluid, preferably water, under pressure into the capsule. Water injected under pressure in the capsule, for the preparation of a coffee beverage according to the present invention, is preferably hot, that is to say at a temperature above 70°C. However, in some particular instances, it might also be at ambient temperature, or even chilled. The pressure (relative to atmospheric pressure) inside the capsule chamber during extraction and/or dissolution of the capsule contents, until the capsule opens, increases up to typically about 1 to about 8 bar for dissolution products and about 2 to about 12 bar for extraction of roast and ground coffee. Such a preparation process differs a lot from the so-called "brewing" process of beverage preparation – particularly for tea and coffee, in that brewing involves a long time of infusion of the ingredient by a fluid (e.g. hot water), whereas the beverage preparation process allows a consumer to prepare a beverage, for instance coffee, within a few seconds.

The principle of extracting and/or dissolving the contents of a closed capsule under pressure is known, and consists typically of inserting the capsule in a receptacle or cavity of a machine, injecting a quantity of pressurized water into the capsule, generally after piercing a face of the capsule with a piercing injection element such as a fluid injection needle mounted on the machine, so as to create a pressurized environment inside the capsule either to extract the substance or dissolve it, and then release the extracted substance or the dissolved substance through the capsule. Capsules allowing the application of this principle have already been described for example in applicant's European patents n° **EP 1472156 B1**, and **EP 1784344 B1**.

Machines allowing the application of this principle have already been described for example in patents **CH 605 293** and **EP 242 556**. According to these

documents, the machine comprises a receptacle or cavity for the capsule and a perforation and injection element made in the form of a hollow needle comprising in its distal region one or more liquid injection orifices. The needle has a dual function in that it opens the top portion of the capsule on the one hand, and that it forms the water inlet channel into the capsule on the other hand.

The machine further comprises a fluid tank – in most cases this fluid is water – for storing the fluid that is used to dissolve and/or infuse and/or extract under pressure the ingredient(s) contained in the capsule. The machine comprises a heating element such as a boiler or a heat exchanger, which is able to warm up the water used therein to working temperatures (classically temperatures up to 80-90°C). Finally, the machine comprises a pump element for circulating the water from the tank to the capsule, optionally through the heating element. The way the water circulates within the machine is e.g. selected via a selecting valve means, such as for instance a peristaltic valve of the type described in applicant's European patent **EP 2162653 B1**.

When the beverage to be prepared is coffee, one interesting way to prepare the coffee is to provide the consumer with a capsule containing roast and ground coffee powder, which is to be extracted with hot water injected therein.

In many instances, the machine comprises a capsule holder for holding a capsule, which is intended to be inserted in and removed from a corresponding cavity or receptacle of the machine. When a capsule holder is loaded with a capsule and inserted within the machine in a functional manner, the water injection means of the machine can fluidly connect to the capsule to inject water therein for a food preparation, as described above. A capsule holder was described for example in applicant's European patent **EP 1967100 B1**.

Capsules have been developed for such an application of food preparation, and in particular for beverage preparation, which are described and claimed in applicant's European patent **EP 1784344 B1**, or in European patent application **EP 2062831**.

In short, such capsules comprise typically:

- a hollow body and an injection wall which is impermeable to liquids and to air and which is attached to the body and adapted to be punctured by e.g. an injection needle of the machine,

5 - a chamber containing a bed of roast and ground coffee to be extracted, or a soluble ingredient or mix of soluble ingredients,

- an aluminium membrane disposed at the bottom end of the capsule, closing the capsule, for retaining the internal pressure in the chamber.

The aluminium membrane is designed for being pierced with piercing means that are either integral with the capsule, or located outside of said capsule, for
10 example within a capsule holder of the machine.

The piercing means are adapted for piercing dispensing holes in the aluminium membrane when the internal pressure inside the chamber reaches a certain pre-determined value.

Also, optionally, the capsule can further comprise means configured
15 to break the jet of fluid so as to reduce the speed of the jet of fluid injected into the capsule and distribute the fluid across the bed of substance at a reduced speed.

In some instances when the product to be prepared and dispensed is a beverage, and depending on several parameters like the viscosity of said beverage, its
20 serving temperature, and the preparation pressure, some dripping can occur at the end of the dispensing phase. In such cases, after the machine pump has stopped, and after the beverage is dispensed from the capsule into the cup, some liquid remaining into the capsule can drip through the bottom opening of said capsule.

This is undesirable because it is messy and unclean if the consumer
25 has already withdrawn the cup from under the machine, or when the consumer moves the used capsule to the dustbin, and also because, in case the cup is still placed under the machine, an additional volume of beverage is dispensed into the cup, which does not correspond to the serving size.

It is therefore an objective of the present invention to provide a capsule that obviates the drawbacks of the known capsules, and comprises a system to guarantee that no dripping occurs, whatever the conditions of preparation of dispensing of the beverage. More than that, it is an objective to provide a system that is not sensitive to the temperature and pressure difference between inside and outside of the capsule. The solution should also be food safe, and cheap to produce.

Summary of the invention

The invention concerns a capsule containing a beverage ingredient, adapted to be functionally inserted in a food preparation machine, said capsule comprising walls that define a cavity wherein said beverage is prepared by mixing said ingredient with a fluid injected therein under pressure by said machine, said capsule further comprising a dispensing opening, and opening means that open upon effect of the rise of pressure within said cavity, characterized in that said opening means comprise a rigid flow-conducting channel able to connect the capsule cavity to the dispensing opening and a spring-mounted rigid piston plug that is movable in said channel between:

(i) a closed position where said cavity pressure is below a first predetermined pressure P_c , the piston spring is at rest, and the piston plug seals against a sealing portion of the channel walls,

(ii) a dispensing position where said cavity pressure is equal or superior to P_c , the piston spring is elastically deformed and the piston plug is moved away from the channel walls so that beverage can flow outside of said capsule through said channel.

As can be understood, P_c is the limit pressure after which the capsule self opens to let the beverage flow out. P_c is preferably comprised between 0.003 and 5 bar, more preferably between 0.1 and 3 bar and most preferably between 0.5 and 2 bar.

Interestingly, a spring-mounted piston has the advantage of being a purely mechanical element that is not sensitive to the beverage preparation conditions,

such as for instance temperature and pressure. This is particularly important that even in the case of a high temperature of the beverage dispensed through the channel, the spring is reliable and its deformability is not impacted, unlike other valve solutions known in the art like rubber slit valves for instance. With such slit valves, temperature and pressure can impact on the geometry and deformation properties of the valve lips, and reclosability is not guaranteed for instance when dispensing pressure is high (between 3 and 15 bar) and temperature is above 60 to 70°C. Moreover known solutions such as flexible rubber or silicone slit valves are expensive, unlike the mechanical piston plug according to the present invention. Moreover, another advantage of the invention is that the more pressure, the wider the dispensing opening opens.

Importantly, by “spring-mounted piston plug”, it is meant that the spring that actuates the piston plug can be an integral part of the whole piston, but it can also be an independent part by itself, or it can also be integrally formed with the capsule walls. Preferably however, the spring part is integrally made together with the piston plug, and then the whole piston (plug plus spring) is assembled to the capsule walls.

Said piston plug is preferably movable in translation along a vertical symmetry axis of said channel.

In a first embodiment of the invention, the spring comprises a plurality of deformable wave-shaped arms integrally formed with said plug, each arm having a longitudinal axis that is substantially parallel to the longitudinal axis of said plug.

In a second embodiment of the invention, the spring comprises a plurality of deformable curved arms extending outwardly from the piston plug.

Preferably in the latter embodiment of the invention, the spring further comprises a ring connected to the distal ends of said curved arms, said ring for connecting said piston plug and spring to the rest of the capsule in such a way that said plug and spring are movable relative to the capsule.

In any case, said spring can be elastically compressible, or extendible. In both possibilities, the spring is deformed elastically and resiliently when pressure inside the capsule cavity increases.

In a preferred embodiment of the invention, the capsule further
5 comprises a pierceable wall sealed between said capsule cavity and said dispensing channel, and piercing means located within the cavity or outside said cavity, and adapted to pierce said pierceable wall upon effect of the rise of pressure within said cavity.

With such a pierceable wall and piercing means, the capsule opening
10 is therefore structured in two separate steps. When the pressure inside the capsule cavity increases, the pierceable wall and the piercing means come into contact with one another so that the pierceable wall is pierced. Beverage prepared inside the capsule cavity flows under pressure towards the capsule dispensing channel which is closed by the piston plug. Once the fluid pressure applies onto the piston, the spring deforms and
15 the piston plug is moved relative to the channel, so that a passage is created between the two, through which beverage can flow, outside of the capsule, through the dispensing channel and into a cup placed under the capsule.

In a first possible embodiment, the piercing means can be a plate having a surface covered with at least one piercing protrusion, said plate being an
20 independent element from the rest of the capsule, and arranged therein. In this case, the spring-mounted piston plug can be functionally assembled within a flow-conducting channel of said piercing plate.

In a second alternative embodiment, the piercing means can be a plate having a surface covered with at least one piercing protrusion, said plate being an
25 integrally formed with the rest of the capsule walls.

Advantageously, said piston plug and spring can be integrally moulded from a thermoplastic material such as, but not limited to polyethylene, polypropylene, polystyrene, polycarbonate, polyoxymethylene (POM), polyetherethercetone (PEEK), polybutyleneterephthalate (PBT), a polyamide with or without glass fibre reinforcement,
30 polyethylene terephthalate (PET), or a combination thereof.

Brief description of the drawings

Additional features and advantages of the present invention are described in, and will be apparent from, the description of the presently preferred embodiments which are set out below with reference to the drawings in which:

Figure 1 is a schematic perspective view of a beverage preparation system;

Figure 2 is a schematic enlarged cut side view of the bottom part of a capsule according to the invention;

Figure 3 is a top view similar to figure 2;

Figure 4 is a schematic perspective bottom view of a piston valve according to the present invention;

Figures 5, 6 and 7 are enlarged schematic cut views of a capsule dispensing opening with a piston valve according to the invention, in closed (fig. 5) and open (figs. 6, 7) configurations;

Figures 8 and 9 are schematic perspective top, respectively bottom, views of an alternative embodiment of a piston according to the invention;

Figure 10 is a schematic cut side view of a capsule featuring a piston valve according to the alternative embodiment illustrated in figures 8 and 9;

Figure 11 and 12 are enlarged schematic cut views of a capsule dispensing opening with a piston valve according to the alternative embodiment illustrated in figures 8, 9, and 10, in closed, respectively open, configurations;

Figures 13 and 14 are partial schematic cut views of yet another embodiment of the invention where the piston valve is assembled with an additional opening means of the capsule.

Detailed description of the invention

The capsule according to the present invention is meant to be used with a beverage preparation machine illustrated in **figure 1**, thus forming a beverage preparation system.

As shown in **figure 1**, the machine 1 comprises a machine body 2, a water reservoir 3 that can be removed from the machine body 2 for refill. The body 2 comprises an on/off push button 4. The machine 1 further comprises an extraction head 5. The head 5 comprises a water temperature selector for hot or cold water taking the form of two buttons 6 (one for selecting a hot beverage, the other for cold), a locking lever 7, and an opening for insertion of a capsule holder 8. The machine 1 further comprises a cup tray 9, for holding a cup under the extraction head. The machine further comprises a control panel 10 comprising a selector wheel for selecting for instance the volume of beverage to be dispensed, as well as a screen, wherein data about the beverage preparation settings are represented. The capsule holder 8 is adapted to receive a capsule 11.

As illustrated in **figure 2** and **figure 3**, the capsule 11 according to the present invention comprises capsule walls 12 that define a capsule cavity, into which a beverage ingredient is contained. This ingredient is in a form suitable for being mixed with water injected inside the capsule by the machine, under pressure. Typically, the ingredient is a powder; however, it can also be a liquid concentrate, a gel, a compacted powder (e.g. a tablet), or a mass of discrete elements such as small ingredient masses having a diameter less than 1mm, that are either agglomerated or compacted.

The capsule further comprises a dispensing opening 13 with opening means that open upon effect of the rise of pressure within said cavity.

According to the essential principle of the invention, the opening means comprise a dispensing channel 14 and a spring-mounted piston plug 15 that is movable in said channel between:

(i) a closed position where said cavity pressure is below 1.2 bar, the piston spring is at rest, and the piston plug seals against the channel walls, as illustrated in **figures 2** and **5**,

(ii) a dispensing position where said cavity pressure is equal or above 1.2 bar, the piston spring is elastically deformed and the piston plug is moved away from the channel walls so that beverage can flow outside of said capsule through said dispensing channel, as illustrated in **figures 6** and **7**.

5 The piston plug 15 is movable in translation within the channel 14, along the symmetry axis of said channel. The symmetry axis of said channel is not necessarily, although preferably vertical. The opening direction of the piston can be oriented downwardly as illustrated in the drawing, but can also be oriented in another direction, e.g. upside down.

10 In a first embodiment of the invention illustrated in **figures 2** to **7**, the spring 16 comprises a pair of deformable wave-shaped spring arms 17. Said spring arms 17 are integrally formed by injection moulding together with the rest of the piston plug, and each of these arms 17 has a longitudinal axis that is substantially parallel to the
15 longitudinal axis of said plug 15.

As shown in greater detail in **figure 4**, the plug 15 comprises a sealing portion 18 which serves to seal against the inner surface of a corresponding sealing portion 19 of the dispensing channel 14, as illustrated in **figure 5**. The piston plug further comprises a flow-directing portion 20 which serves to direct the flow of
20 beverage out of the capsule, towards the consumer cup, reducing spillage to a great extent. Preferably, the flow-directing portion 20 of the piston plug has a cross-shaped cross section, as illustrated in **figure 4**.

The distal free ends 21 of the arms 17 are meant to rest upon bearing edges 22 of the dispensing channel 14, as shown in **figures 5** to **7**.

25 Once the capsule 11 is inserted within the machine and the consumer starts a beverage preparation cycle, water is injected within the capsule under pressure, to mix with the beverage ingredient contained therein. Fluid pressure inside the capsule cavity increases. As pressure builds-up, a force is exerted onto the upper surface of the
30 piston sealing portion 18, which is forced downwards into the dispensing channel 14,

while the spring arms 17 are squeezed, as illustrated in **figures 6** and **7**. When the sliding movement of the piston 15 is sufficient, the sealing portion 18 escapes the sealing portion 19 of the dispensing channel as illustrated in **figures 6** and **7**, thus creating a passage for the flow of beverage that is directed towards a cup placed below (not shown in the drawing).

Once, the beverage preparation is complete, the machine stops injecting water within the capsule, and as beverage is dispensed, in-capsule pressure decreases until it has reached a limit pressure below which the spring 16 moves back the piston plug 15 back into its initial rest position. In this rest position, the piston sealing portion 18 is adjacent to the sealing portion 19 of the dispensing channel as shown in **figure 5**, and the latter is closed. In case some liquid remains within the capsule, it is retained within the capsule, and no dripping occurs.

In addition, the applicant surprisingly observed that when the piston has returned to its closed position after the capsule has been used, no spillage can occur through the opening pierced by the water injection needle of the machine through the top wall of the capsule.

In a second embodiment of the invention illustrated in **figures 8 to 12**, the spring 16 comprises three deformable curved arms 23 extending outwardly from the piston plug 15. The spring further comprises a ring 24 connected to the distal ends 25 of said curved arms 23. The ring 24 serves for connecting said piston plug 15 and spring 16 to the rest of the capsule in such a way that said plug and spring are movable relative to the capsule.

The function of this spring embodiment is similar to that of the first embodiment described above. Again, once the capsule 11 is inserted within the machine and the consumer starts a beverage preparation cycle, water is injected within the capsule under pressure, to mix with the beverage ingredient contained therein. Fluid pressure inside the capsule cavity increases. As pressure builds-up, a force is exerted onto the upper surface of the piston sealing portion 18, which is forced downwards into the dispensing channel 14, while the spring arms 17 are deformed, as

illustrated in **figure 12**. When the sliding movement of the piston 15 is sufficient, the sealing portion 18 escapes the sealing portion 19 of the dispensing channel as illustrated in **figure 12**, thus creating a passage for the flow of beverage that is directed towards a cup placed below (not shown in the drawing).

5 Once, the beverage preparation is complete, the machine stops injecting water within the capsule, and as beverage is dispensed, in-capsule pressure decreases until it has reached a limit pressure below which the spring 16 moves back the piston plug 15 back into its initial rest position illustrated in **figure 11**. In this rest position, the piston sealing portion 18 is adjacent to the sealing portion 19 of the
10 dispensing channel as shown in **figure 11**, and the latter is closed. In case some liquid remains within the capsule, it is retained within the capsule, and no dripping occurs.

As represented in **figures 2 and 10**, the capsule can further comprise a pierceable wall 26 sealed between said capsule cavity and said dispensing channel, and
15 piercing means 27 located within the cavity or outside said cavity, and adapted to pierce said pierceable wall upon effect of the rise of pressure within said cavity. Said piercing means is a plate having a surface covered with at least one piercing protrusion 28.

In a first embodiment of the invention, as illustrated in **figure 2**, said plate is integrally moulded together with the rest of the capsule.

20 In a second alternative embodiment of the invention, the piercing plate is a separate element from the rest of the capsule, and is assembled therein, as illustrated in **figures 10**.

Importantly though, the fact that the piercing plate is integral or separate from the rest of the capsule is independent from the type of spring that is used
25 with the piston plug. All combinations of these elements can be produced, with somehow equivalent technical effects.

In case the piercing plate is a separate element of the capsule as described above and shown in **figure 10**, the piston plug and spring can be assembled directly to the piercing plate, as shown in **figure 13**. In this case, the spring-mounted
30 piston plug 15 is functionally assembled within a flow-conducting channel 29 of said

piercing plate 27. As described above, when pressure builds-up inside the capsule, the piston plug 15 is pressed downwards and a flow path opens as illustrated with an arrow in **figure 14**. When the pressure inside the capsule decreases, the piston plug comes back into its closed position shown in **figure 13**. As can be understood, in this case, two different opening systems are combined. The first one is made of the pierceable membrane and piercing plate, which is a permanent opening system: once opened, the pierced membrane cannot reseal, however, the membrane guarantees a perfect seal during storage and shelf life of the capsule. The second one is the reclosable spring-mounted piston plug system according to the present invention.

The fact that the present invention solves the technical problem of dripping, is due to the sealing effect of the piston plug with the capsule wall surface onto which it rests when said piston is in the closed position. The sealing effect of the piston plug on the capsule walls (or dispensing channel walls) can be achieved either with:

- capillarity effect: in this case, a functional play exists between the piston plug and the capsule walls in the closed position of the piston (which is typically about 10 to 300 microns), so that the plug can move relatively to the capsule, the distance between the two being sufficient small to allow the creation of a capillarity effect to prevent liquids to flow there between, or
- active sealing which is achieved by direct contact of the plug and the capsule through a surface made of a sealing material, for instance rubber, on the capsule and/or on the piston plug.

It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present invention and without diminishing its attendant advantages. It is therefore intended that such changes and modifications be covered by the appended claims.

Claims

5 1. A capsule (11) containing a beverage ingredient, adapted to be functionally inserted in a food preparation machine (1), said capsule comprising walls (12) that define a cavity wherein said beverage is prepared by mixing said ingredient with a fluid injected therein under pressure by said machine, said capsule further comprising a dispensing opening (13), and opening means that open upon effect of the rise of pressure within said cavity, **characterized in that** said opening means
10 comprise a flow-conducting channel (14) able to connect the capsule cavity to the dispensing opening (13) and a spring-mounted piston plug (15) that is movable in said channel between:

- 15 (i) a closed position where said cavity pressure is below a first predetermined pressure P_c , the piston spring (16) is at rest, and the piston plug (15) seals against a sealing portion (19) of the channel walls,
- 20 (ii) a dispensing position where said cavity pressure is equal or superior to P_c , the piston spring (16) is elastically deformed and the piston plug (15) is moved away from the channel walls so that beverage can flow outside of said capsule through said channel (14).

25 2. A capsule (11) according to claim 1, wherein said pressure P_c is comprised between 0.003 and 5 bar, more preferably between 0.1 and 3 bar and most preferably between 0.5 and 2 bar.

 3. A capsule (11) according to claims 1 or 2, wherein said piston plug (15) is movable in translation along a vertical symmetry axis of said channel (14).

5 **4.** A capsule (11) according to any one of the preceding claims 1 to 3, wherein said spring (16) comprises a plurality of deformable wave-shaped arms (17) integrally formed with said plug, each arm (17) having a longitudinal axis that is substantially parallel to the longitudinal axis of said plug.

10 **5.** A capsule (11) according to any one of the preceding claims 1 to 3, wherein said spring (16) comprises a plurality of deformable curved arms (23) extending outwardly from the piston plug.

15 **6.** A capsule (11) according to claim 5, wherein said spring (16) further comprises a ring (24) connected to the distal ends (25) of said curved arms (23), said ring for connecting said piston plug and spring to the rest of the capsule.

7. A capsule (11) according to any one of the preceding claims 1 to 6, wherein said spring (16) is elastically compressible.

20 **8.** A capsule (11) according to any one of the preceding claims 1 to 6, wherein said spring (16) is elastically extendible.

25 **9.** A capsule (11) according to any one of the preceding claims 1 to 8, which further comprises a pierceable wall (26) sealed between said capsule cavity and said dispensing opening (13), and piercing means (27) located within the cavity or outside said cavity, and adapted to pierce said pierceable wall upon effect of the rise of pressure within said cavity.

10. A capsule (11) according to claim 9, wherein said piercing means is a plate (27) having a surface covered with at least one piercing protrusion (28), said plate being an independent element from the rest of the capsule, and arranged therein.

5

11. A capsule (11) according to claim 10, wherein the spring-mounted piston plug (15, 16) is functionally assembled within a flow-conducting channel of said piercing plate (27).

10

12. A capsule (11) according to claim 9, wherein said piercing means is a plate (27) having a surface covered with at least one piercing protrusion (28), said plate being an integrally formed with the rest of the capsule walls.

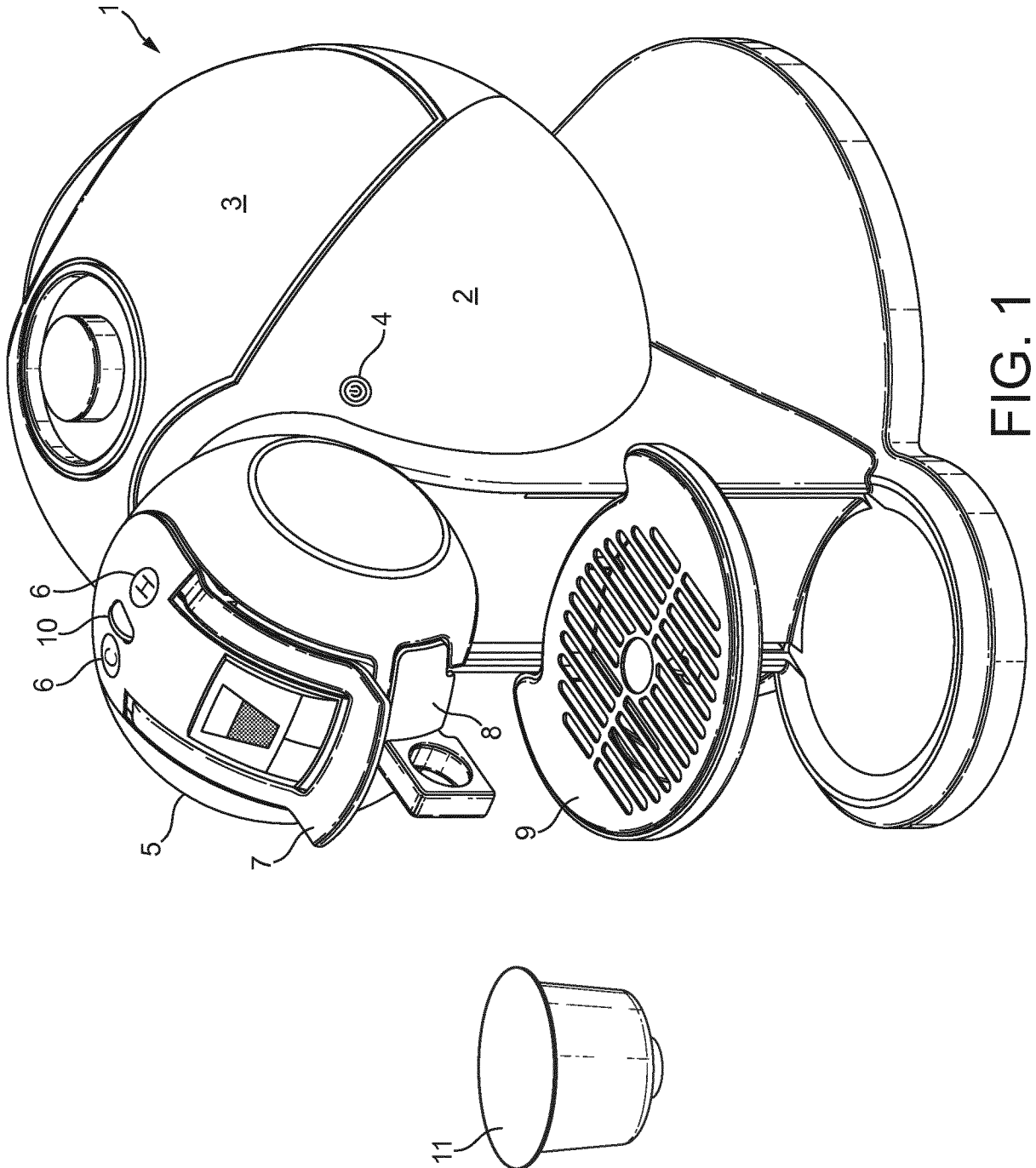
15

13. A capsule (11) according to any one of the preceding claims, wherein said piston plug (15) comprises a sealing portion (18) and a flow-directing portion (19).

20

14. A capsule (11) according to any one of the preceding claims, wherein said piston plug (15) and spring (16) are integrally moulded from a thermoplastic material such as, but not limited to polyethylene, polypropylene, polystyrene, polycarbonate, polyoxymethylene (POM), polyetherethercetone (PEEK), polybutyleneterephthalate (PBT), a polyamide with or without glass fibre reinforcement, polyethylene terephthalate (PET), or a combination thereof.

25



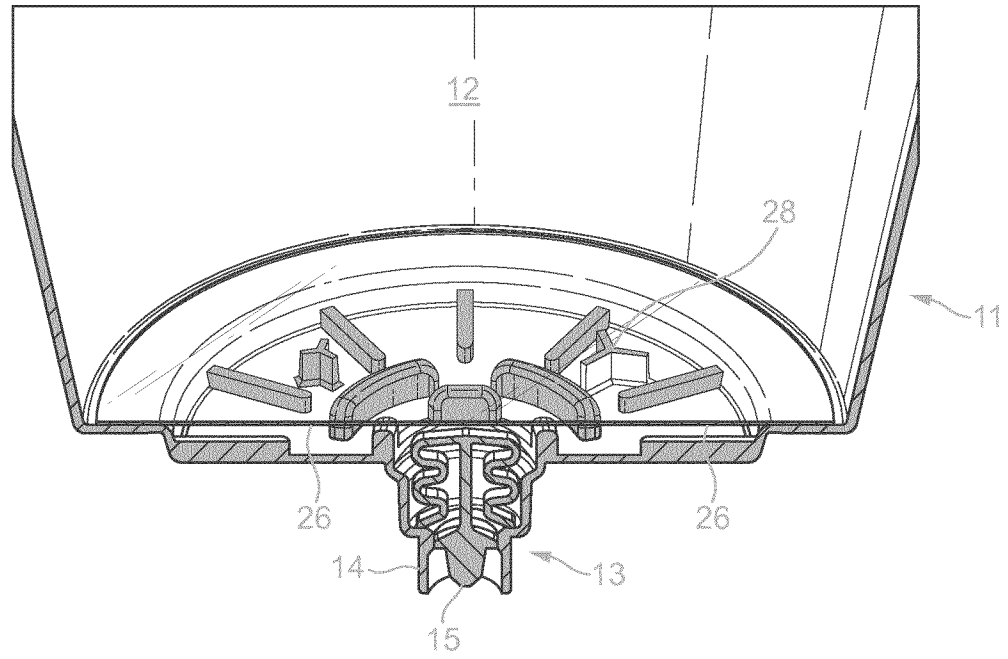


FIG. 2

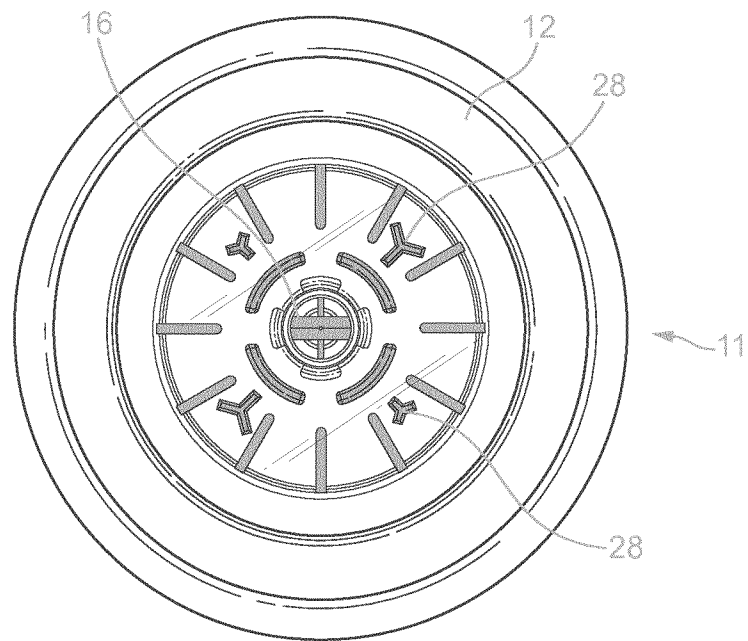


FIG. 3

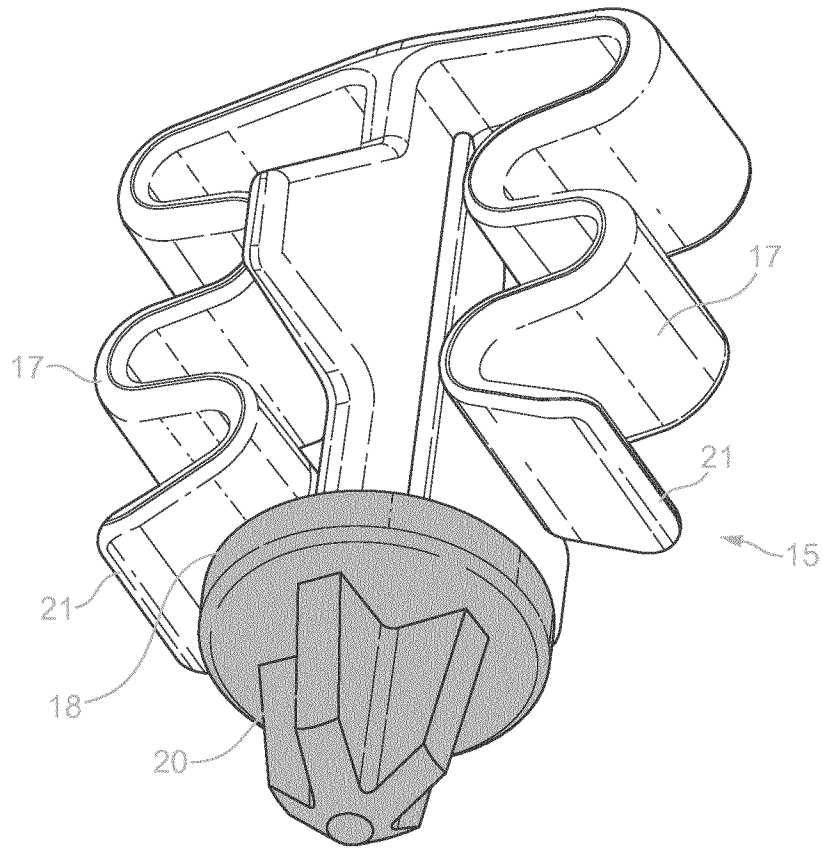


FIG. 4

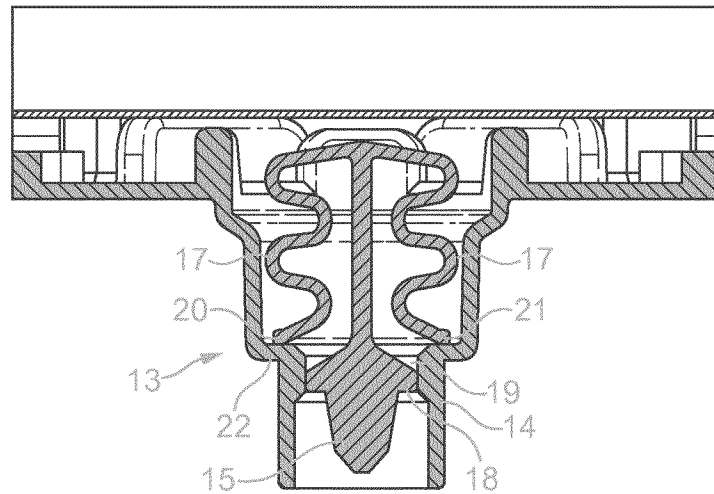


FIG. 5

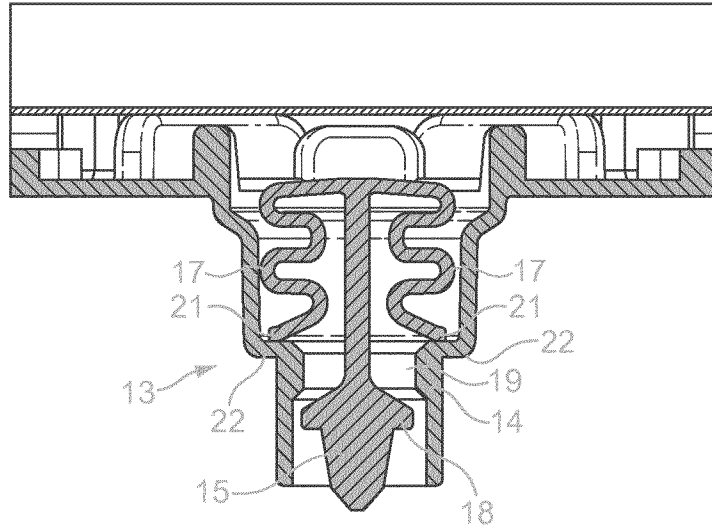


FIG. 6

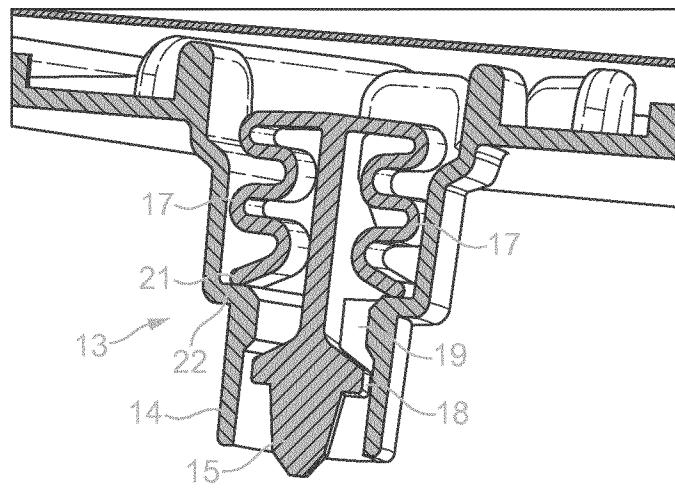


FIG. 7

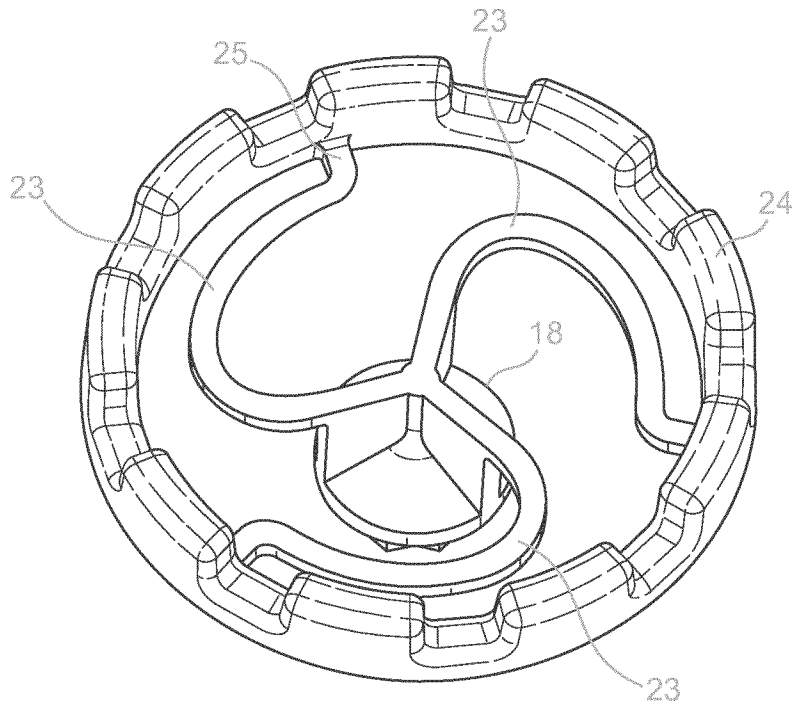


FIG. 8

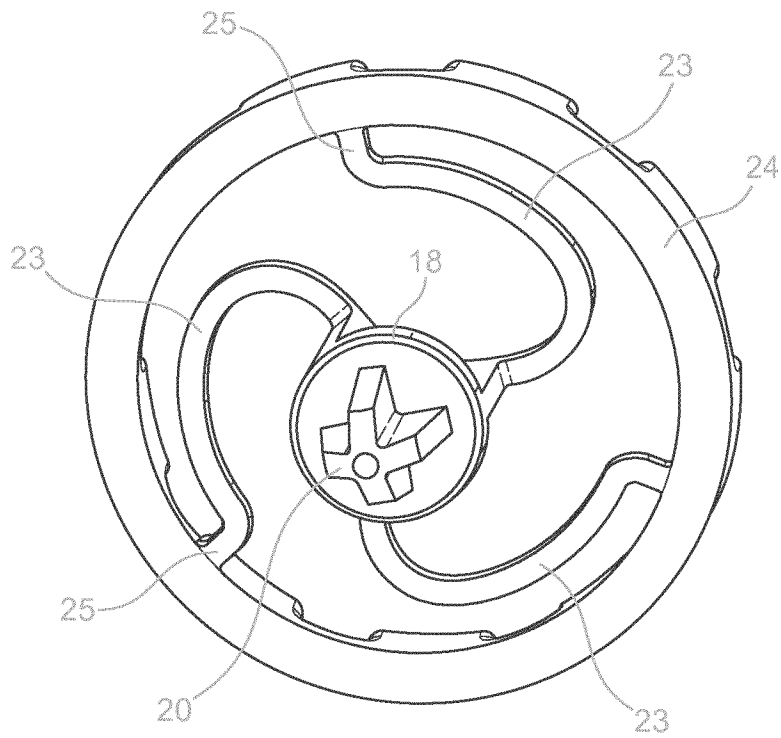


FIG. 9

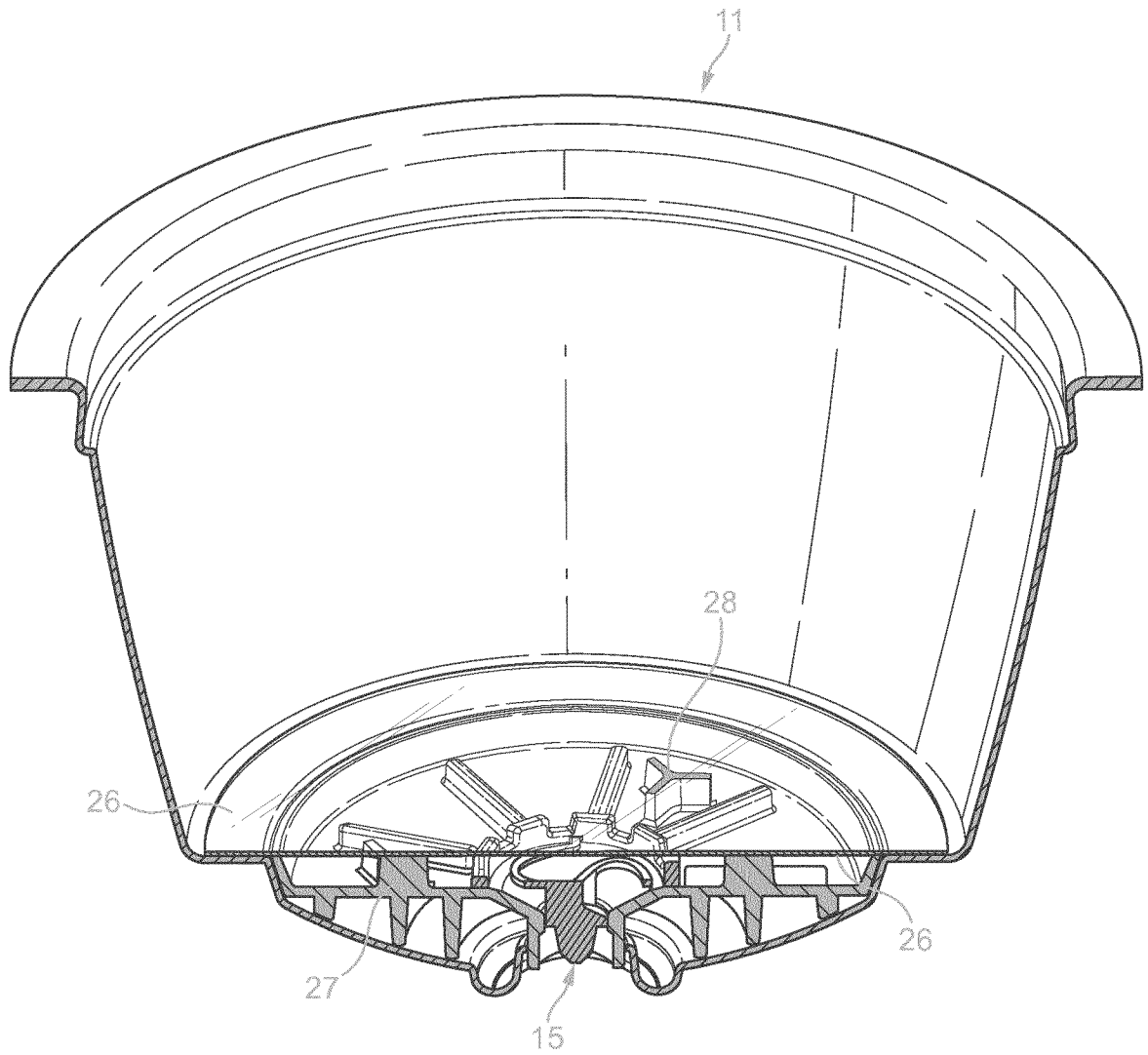


FIG. 10

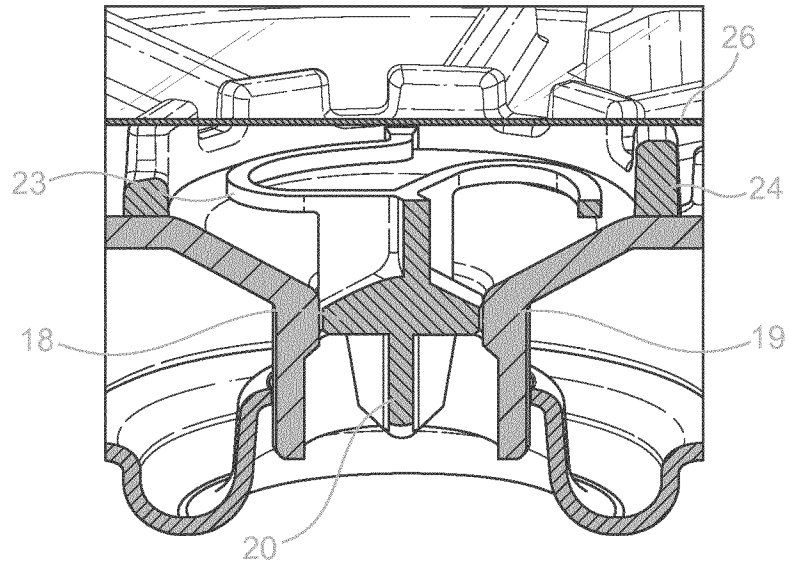


FIG. 11

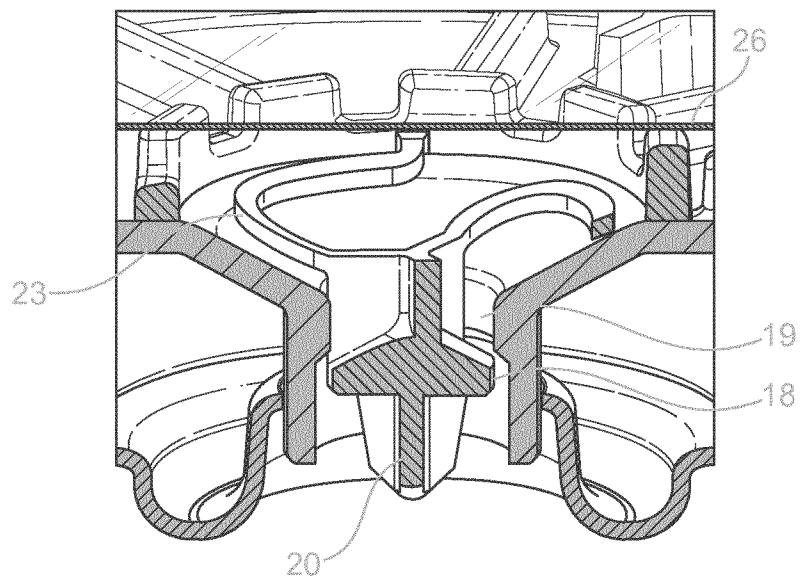


FIG. 12

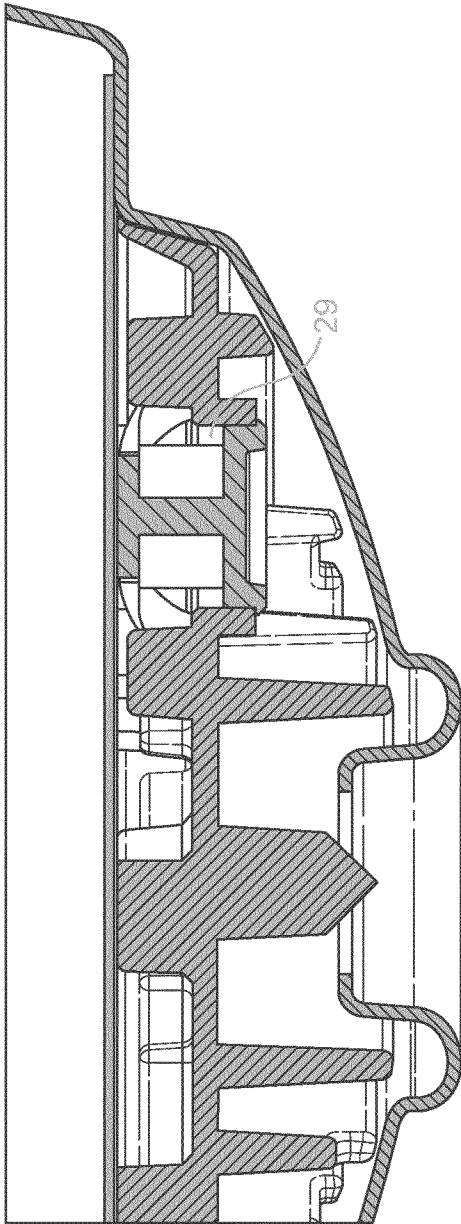


FIG. 13

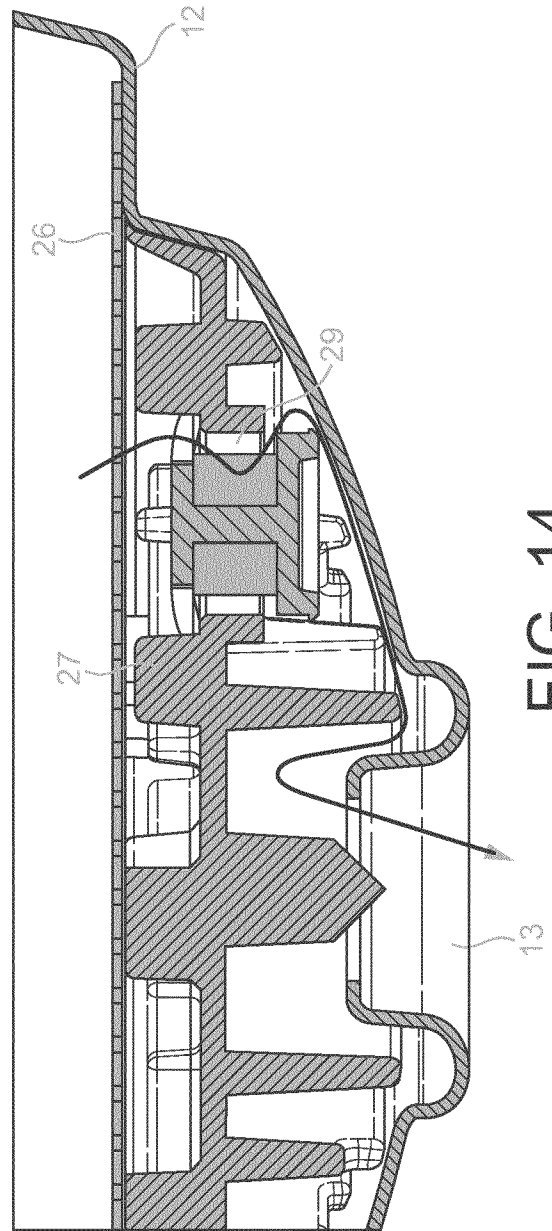


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/057290

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.
A	US 2008/028946 A1 (KIRSCHNER JONATHAN [US] ET AL) 7 February 2008 (2008-02-07) paragraph [0022] - paragraph [0031]; figures 1-5	1
A	WO 2008/011913 A1 (ILLYCAFFE SPA [IT]; MASTROPASQUA LUCA [IT]; DELLAPIETRA BRUNO [IT]; VA) 31 January 2008 (2008-01-31) page 5, line 1 - page 6, line 18; figures 1-3	1
A	WO 2012/034819 A1 (NESTEC SA [CH]; DOGAN NIHAN [CH]; ABRAHAM SOPHIE [FR]; WYSS HEINZ [CH]) 22 March 2012 (2012-03-22) claim 1; figures 3-5	1,9

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "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
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search 4 June 2014	Date of mailing of the international search report 13/06/2014
---	---

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 Newell, Philip
--	---

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/EP2014/057290

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 2008028946	A1	07-02-2008	AR 066644 A1	02-09-2009
			AT 515459 T	15-07-2011
			CA 2686347 A1	11-12-2008
			CN 101678952 A	24-03-2010
			DK 2155586 T3	24-10-2011
			EP 2155586 A1	24-02-2010
			JP 2010532296 A	07-10-2010
			RU 2009145628 A	10-07-2011
			US 2008028946 A1	07-02-2008
			US 2011262597 A1	27-10-2011
			WO 2008150627 A1	11-12-2008

WO 2008011913	A1	31-01-2008	AR 059199 A1	19-03-2008
			AT 466791 T	15-05-2010
			AT 533705 T	15-12-2011
			AU 2006346692 A1	31-01-2008
			BR PI0621893 A2	20-12-2011
			CA 2657846 A1	31-01-2008
			CN 101500907 A	05-08-2009
			DK 2049416 T3	26-07-2010
			DK 2177460 T3	05-03-2012
			EP 2049416 A1	22-04-2009
			EP 2177460 A1	21-04-2010
			ES 2341890 T3	29-06-2010
			ES 2373774 T3	08-02-2012
			HK 1128669 A1	05-11-2010
			HK 1142577 A1	24-02-2012
			JP 5275986 B2	28-08-2013
			JP 2009544439 A	17-12-2009
			JP 2013090958 A	16-05-2013
			RU 2009107061 A	10-09-2010
TW 200806231 A	01-02-2008			
US 2008026121 A1	31-01-2008			
WO 2008011913 A1	31-01-2008			

WO 2012034819	A1	22-03-2012	AU 2011301237 A1	28-03-2013
			CA 2811153 A1	22-03-2012
			CN 103209908 A	17-07-2013
			EP 2616364 A1	24-07-2013
			US 2013180409 A1	18-07-2013
			WO 2012034819 A1	22-03-2012
