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(73) Patenthaver: **K-fee System GmbH, Senefelder Strasse 44, 51469 Bergisch Gladbach, Tyskland**

(72) Opfinder: **EMPL, Günter, Falltorstraße 12, 51429 Bergisch Gladbach, Tyskland**

(74) Fuldmægtig i Danmark: **RWS Group, Europa House, Chiltern Park, Chiltern Hill, Chalfont St Peter, Bucks SL9 9FG, Storbritannien**

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**Description**

The present invention relates to a portion capsule for producing a beverage, having a capsule body with a capsule base and a lid, wherein a cavity for receiving a granulated, pulverulent or liquid beverage substrate is configured between the capsule base and the lid and wherein a filter element is disposed in the cavity. Furthermore, the present invention relates to a method for producing a portion capsule as well as the use of the portion capsule for producing a beverage.

Suchlike portion capsules are generally familiar from the prior art. For example, generic portion capsules for making coffee and espresso are disclosed in publications EP 1792850 B1, EP 1344722 A1, WO 2012/038063 A1 and US 2003/0172813 A1.

Suchlike portion capsules for producing a beverage or a foodstuff are preferably moulded in the form of a truncated cone or cylindrically and are produced, for example, from a thermoformed plastic film or by the plastic injection moulding process. They usually have a closed capsule base and an open filling side with a peripheral collar, onto which, after the cavity of the portion capsule has been provided with a filter element and has been filled with a granulated, pulverulent or liquid beverage substrate, a lid film is sealed or glued in place. The filter element is preferably disposed between the beverage substrate and the capsule base and is supported thereon. These filter elements are either injection moulded from a thermoplastic plastic or are thermoformed or punched from a plastic film or are produced from a woven or non-woven material and prevent particles of the beverage substrate from finding their way into the beverage to be produced.

For the preparation of a beverage, for example a coffee beverage, the portion capsule is introduced into a brewing chamber of a preparation device. After or during the closing operation of the brewing chamber, the capsule is preferably opened on its closed bottom side by means of an opening spike

disposed in the brewing chamber, and, after sealing of the brewing chamber, preferably the filling side of the portion capsule that is closed with a lid film is preferably penetrated by means of at least one piercing means. There are also portion capsules, however, which is already open on at least one side before it is introduced into the preparation device. A preparation liquid, preferably hot water, is then supplied under pressure into the portion capsule. The preparation liquid flows through the beverage substrate and extracts and/or dissolves the substances required for the production of the beverage from the beverage substrate. For the preparation of an espresso, a brewing water pressure of up to 20 bar, for example, acts on the coffee powder for the extraction of the essential oils. This pressure also acts on the particle sieve situated between the coffee powder and the capsule base and ahead of the pierced outlet from the capsule.

A disadvantage associated with the filter elements produced by the plastic injection moulding process or by the thermoforming or punching process, however, is that for the retention of the coffee particles the opening of the sieve holes must be smaller than the smallest coffee particles. For example, since a certain level of dust inevitably also occurs in the coffee grinding process, the passage of coffee particles occurs in the case of excessively large sieve holes, or blocking of the sieves takes place in the case of excessively small sieve holes, in particular at high pressures. Appropriate supporting elements acting against the capsule base are required in addition underneath the sieves, in order to absorb the brewing water pressures of up to 20 bar and to prevent deformation of the sieves as a consequence of the high brewing water pressure (together with a high brewing water temperature) and in order to prevent the piercing means from penetrating into the filter element and/or passing through the latter. In a disadvantageous manner, in particular in the case of sieve arrangements produced by the injection moulding process, this supporting element require the use of additional materials, resulting in an increase in the production costs.

Portion capsules with sieve arrangements, which are intended to avoid these disadvantages, are thus familiar in the prior art. Portion capsules with sieve arrangements, which consist of a sieve carrier with relatively large passage openings, are disclosed in US 2778739, EP 1710173 A1 and US 5352765, wherein these openings are covered with a filter material. A disadvantage associated with these arrangements is that additional material and production costs are incurred for the production of suchlike sieve arrangements, since they consist of a stable sieve carrier and the filter material disposed on the sieve carrier, and/or that the available filter area is too small, so that the extraction or dissolving process takes a comparatively long time.

The object of the present invention was thus to make available a portion capsule having a filter element which can be produced more cost-effectively in comparison with the prior art and/or in which the disadvantages outlined in connection with the prior art can be avoided.

This object is accomplished with a portion capsule according to claim 1.

The expression thermoformed is used in the sense of the invention to denote that a previously flat filter element adopts a 3-D form with at least one indentation or salient.

The statements that have already been made in relation to this object of the present invention are likewise applicable to the other objects of the present invention, and vice versa.

In comparison with the prior art, the inventive portion capsule has the advantage that a simple and cost-effective non-woven fibrous material finds an application as a sieve element. This material is plastically formed, preferably thermoformed, as a result of which it is not flat and consequently possesses a large filter area in comparison with

a flat filter element, which in particular is larger than the cross-sectional area of the capsule body to which it is attached. In comparison with the plastic filters that are familiar from the prior art, a filter element made from a non-woven fibrous material has the additional advantage that it possesses a significantly larger liquid entry surface. A liquid cross-flow (parallel to the principal plane of extension of the filter plane) is also made possible, as a result of which a better mixing and flow behaviour is achieved. In addition, it has become clear that, by using a suchlike filter material, the risk of sieve blockages is significantly reduced or almost eliminated. The non-woven filter material has surprisingly been found to be resistant to blockages, both in the case of beverage preparation with a preparation liquid under comparatively low pressure, and also in the case of beverage preparation with a preparation liquid under comparatively high pressure. In addition, a liquid cross-flow is reliably maintained at all times in the filter element, and an outflow of the liquid entering into the filter element to a discharge outlet is assured.

The portion capsule in the sense of the present invention comprises a preferably hermetically sealed portion capsule. This means that the beverage or foodstuff substrate, for example coffee powder, soup powder or tea, that is present in the portion capsule is sealed from the environment in a substantially aroma-tight manner ahead of the extraction process. The portion capsule does not need to be hermetically sealed, however, but can also be supplied before use in hermetically sealed packaging, which is then opened manually, for example. Suchlike portion capsules are opened on at least one side, and preferably two sides, i.e. the preparation liquid is able to flow through them, without their being penetrated.

The non-woven fibrous material is preferably a non-woven fabric. A non-woven fabric in the sense of the invention is a disordered, non-woven structure of fibres, in particular

plastic fibres. A non-woven fabric in the sense of the invention preferably contains no paper or paper-like substances, but is made completely from plastic.

According to a further preferred embodiment of the present invention, it is proposed that the non-woven fabric comprises a non-woven material produced from plastic fine fibres, for example polyester fine fibres, which in particular is a random-laid fibre and/or a fibre-oriented non-woven material. The non-woven fabric preferably has a population of mass (also referred to as grammage or weight per unit area) of between 20 and 140 grams per square metre, particularly preferably of between 60 and 80 grams per square metre, and most preferably of substantially 70 grams per square metre. The filter element or the non-woven fabric preferably has a thickness of between 0.2 and 0.8 millimetre, particularly preferably between 0.3 and 0.35 millimetre, and most preferably of substantially 0.32 millimetre. The non-woven fabric is configured such that the air permeability of the non-woven fabric at 100 Pascal is preferably between 1000 and 3000 $l/(m^2s)$, particularly preferably between 1500 and 2500 $(l/m^2s)$ and most preferably of substantially 2000 $l/(m^2s)$. It has emerged in a surprising and unforeseeable way that optimal results in respect of extraction efficiency, mixing behaviour and flow behaviour, as well as resistance to blockages, can be achieved with suchlike non-woven materials and that the "crema" nevertheless still forms.

According to a preferred embodiment of the present invention, the non-woven fibrous material has a felt structure. In particular, the structure in this case is a needlefelt structure. The fibrous material preferably consists of at least one felt structure and one carrier structure, in particular a woven fabric structure, wherein, particularly preferably the felt structure, at least a portion of the volume, comprises the carrier structure. The felt structure preferably extends over the entire cross section of the carrier structure, although particularly preferably over only

over only a part of the height. The felt structure is preferably connected with a form fit, with a force fit and/or positively bonded to the carrier structure. The fibrous material preferably has two or more felt structures, which are separated from one another preferably by the carrier structure. The thickness of the two felt structures can be the same or different. A felt structure facing towards the powder or tea is preferably thinner than the felt structure facing towards the capsule base, or vice versa. The surface of the felt structure is preferably treated, for example heat treated, for example in order to secure any loose fibres. The filter element having a felt structure is preferably simply laid into the capsule, in particular on it base. However, the filter element can also be connected, in particular positively bonded, to the capsule, in particular to its base. The perforation means can penetrate into this filter element at the time of perforation. A plurality of filter elements, which have one or a plurality of felt structures and a carrier structure, are preferably disposed one above the other in the capsule, or if necessary are connected to one another.

A fibrous material having a carrier structure, in particular a woven fabric structure, and a having a felt structure is produced, for example, by making available a woven fabric structure consisting of longitudinal and transverse threads. Preferably fibre units of 0.8 - 7 dtex are selected for the construction of a felt, in particular a needlefelt. The connection of the individual fibres to one another to produce a felt and/or their anchoring in the carrier structure preferably takes place in the production process for needling. In the process, needles with reversed barbs are pierced at high speed into the presented fibre set and are pulled out again. The fibres are intertwined with one another and/or with the carrier fabric by the barbs via a multiplicity of resulting loops.

The carrier element having one or a plurality of felt structures preferably has a population of mass (also referred

to as grammage or weight per unit area) of between 100 and 1200 grams per square metre, particularly preferably between 200 and 1150 grams per square metre, and most preferably of substantially 150 - 250 grams per square metre for producing tea and 600 - 1200 grams per square metre for producing coffee, espresso or the like. The filter element or the non-woven fabric preferably has a thickness of between 0.8 and 3.3 millimetres, particularly preferably between 1.1 and 3.0 millimetres, and most preferably 1.2 - 1.4 millimetres for producing tea and 2.6 - 3.0 for producing coffee.

According to the invention, the fibrous material is plastically formed, in particular thermoformed, for producing the filter element. In the process, the flat fibrous material, which is made available as a web material or a sheet, leaf or panel, for example, is brought into a three-dimensional form. The plastic deformation, in particular thermoforming, of the non-woven fibrous material preferably takes place under the influence of pressure and/or temperature. A punch is preferably pressed into a die for this purpose. The fibrous material is then present between the punch and the die and is formed, for example thermoformed, as a result. After the plastic deformation, the filter element retains its three-dimensional form (3-D form). Plastic forming, in particular thermoforming, causes the fibrous material to form a space, which can be filled with the beverage or foodstuff substrate. It was surprising for a person skilled in the art to find that the fibrous material can be plastically formed, in particular thermoformed, without losing its filter properties. The flat fibrous material is punched according to a further preferred embodiment of the present invention. The plastic deformation can also take place, however, through any other forming process that is familiar to a person skilled in the art.

The filter element, i.e. the non-woven fabric material or the felt material, for example, is connected according to a preferred object or a further object of the present invention to the side wall of the portion capsule or to the peripheral

collar, in particular by welding, for example with ultrasound, or by gluing, before the beverage substrate is filled into the capsule body.

The statements that have already been made in relation to this object of the present invention are likewise applicable to the other objects of the present invention, and vice versa.

According to yet a further object or a preferred object of the present invention, the filter element is connected to the peripheral collar of the portion capsule, i.e. to the flange of the portion capsule protruding in particular horizontally from the side wall, in particular by welding, for example with ultrasound, or by gluing, preferably before the beverage substrate is filled into the capsule body. The outer edge of the filter element is preferably likewise configured for this purpose as a flange, which rests on the peripheral collar of the portion capsule. The diameter of the filter element is preferably the same as or smaller, in particular slightly smaller, than the outer diameter of the peripheral collar. In this embodiment, the lid film is preferably connected to the filter element, in particular to its peripheral area, for example by gluing or welding. The connection of the lid film to the filter element can take place simultaneously with or staggered with the connection between the filter element and the portion capsule, wherein preferably the filter element is initially connected to the portion capsule and the lid film is then attached to the filter element. It was extremely surprising, and also unexpected, for a person skilled in the art to find that this embodiment can also be hermetically sealed.

The statements that have already been made in relation to this object of the present invention are likewise applicable to the other objects of the present invention, and vice versa.

The filter element is preferably configured at a distance from the capsule base, i.e. it is not in contact with the capsule

base at least before the substrate is supplied with the liquid. Particularly preferably the filter element is never in contact with the capsule base. This embodiment has the advantage that the filter element cannot be damaged at the time of puncturing the portion capsule.

Preferably shows the side wall of the filter element is configured substantially cylindrically or in the form of a truncated cone and, for example, has a substantially flat, elliptical or hemispherical base. The side wall in particular preferably has embossing, which increases the size of its surface. For example, the side wall is of corrugated or zig-zag configuration. The side wall of the filter element preferably bears at least not completely against the side wall of the portion capsule before the portion capsule is supplied with the liquid, wherein, particularly preferably, the pressure of the liquid increases the size of the bearing surface of the side wall of the filter element on the side wall of the portion capsule. The base of the filter element is preferably raised in the process.

The capsule body is preferably moulded in the form of a truncated cone or cylindrically and is produced from a thermoformed plastic film or by the plastic injection moulding process, for example from plastic, a natural substance and/or a biodegradable material and/or a metallic material. The material from which the capsule body is produced can be configured in multiple layers. The capsule body preferably or according to the invention has a peripheral collar on the filling side, onto which a lid film is sealed or glued directly or indirectly. Alternatively, it is conceivable for the capsule body and a capsule cover to be connected to one another by means of a mechanical process. The base of the portion capsule is preferably closed and is preferably only perforated in the brewing chamber by means of a perforation means acting from the outside on the portion capsule base in order to produce an outlet opening. Alternatively, it would also be conceivable for the base of the portion capsule

already to be provided in the factory with an outlet opening, which is preferably closed by means of a sealing film. The sealing film is then capable of being perforated, for example, by means of the perforation means or is detachable by hand from the capsule base. The filter element is preferably of tear-proof configuration. The sealing film is preferably a plastic film, which possesses at least one barrier layer, for example a metal layer, in particular an aluminium layer or an aluminium oxide layer. Alternatively, a pure plastic film having a single barrier layer for the flavouring agent of the beverage to be produced can be used as a sealing film. The plastic film preferably has a "peel layer" on its side facing towards the capsule, in order for the plastic film to be capable of being removed comparatively easily from the capsule base.

The outlet opening is preferably of sufficiently large configuration for it to be capable of accommodating any perforation means that may be present without contact. Particularly preferably, the outlet opening is of sufficiently large configuration that no significant pressure loss arises thereon, as the finished beverage flows out, and in particular that no significant turbulence of the finished beverage occurs, which could lead to the entry of gas into the beverage and, as a result, to foaming.

Alternatively, the material of the capsule base bears against the puncturing means after puncturing. The finished beverage runs between the puncturing means and the material into the capsule. A specific pressure loss and/or a specific turbulence occurs in the process, which produces a "crema" in the coffee.

According to a further preferred object of the present invention, it is proposed that the filter element is configured so as to be elastic. When the capsule base is perforated by an external perforation means, the filter element is able because of its elasticity, upon making contact with the perforation means, to yield or stretch in such a way

that a perforation of the filter element is prevented. The risk is thus eliminated of the filter element being perforated by the perforation means and of beverage substance being flushed unfiltered from the portion capsule.

A fixed gap between the filter element and the capsule base is preferred.

According to a further preferred embodiment of the present invention, it is proposed that the filter element is tensioned, penetrated and/or perforated by the perforation means.

According to a further inventive or preferred embodiment of the present invention, it is proposed that the filter element is attached to the capsule body or to the peripheral collar, wherein the filter element is attached in particular by sealing or gluing. Slipping of the filter element in the portion capsule is prevented advantageously in this way. Furthermore, the liquid is prevented from flowing around the filter element unintentionally in this way. This attachment preferably takes place by ultrasonic welding.

It is proposed according to the invention that the capsule base has a salient in a direction that is counter to the filling side. Advantageously, the salient serves for receiving the perforation means, so that, in the event of piercing of the perforation means into the capsule base, the capsule base is itself perforated in the area of the salient, although the perforation means subsequently remains in the cavity of the salient. Perforation of the filter element is thus prevented. In particular, any raising of the filter element by the perforation means is not required in this embodiment.

According to a further preferred embodiment of the present invention, it is proposed that the filter element is configured in such a way that, in the event of the perforation of the capsule base by an external perforation means, raising

of the filter element from the capsule base takes place, at least in part. Perforation of the filter element by the perforation means is effectively prevented in this way.

According to a further preferred embodiment of the present invention, it is proposed that the capsule base has a predetermined breaking point, which is intended to tear open as the result of a mechanical contact with an external perforation means, wherein the predetermined breaking point preferably comprises a plurality of lines of weakness disposed in the shape of a star around a central point of the capsule base. The capsule base preferably has a reduced material strength along the lines of weakness and/or is perforated along the lines of weakness. In an advantageous manner, the perforation of the capsule base is favoured by the provision of the predetermined breaking point. This also has the advantage that a less sharp perforation point can be used for the perforation of the capsule base, so that the risk of damage to the filter element by the perforation point is reduced when raising the filter element. In particular, a blunt perforation means is now sufficient for the perforation of the capsule base.

According to a further preferred embodiment, the capsule base permanently has an outlet opening, which is preferably sealed with a film, wherein the film particularly preferably has a peel-off tab for peeling off the film by hand. A perforation of the capsule base by means of an external perforation means is advantageously not required in this case. Before placing the portion capsule into the brewing chamber, the film is simply peeled from the capsule base by means of the peel-off tab, and the brewing process can start. The combination of a prefabricated and thus comparatively large outlet opening with a filter element made from a non-woven fibrous material, in particular a non-woven fabric, a felt, in particular needlefelt, has the advantage that the beverage liquid does not flow out of the outlet opening under high pressure and foaming ("crema") is thus prevented, in particular in the

production of coffee or tea.

A further preferred or inventive object of the present invention is a portion capsule, in which the filter element has a filter region and a connection region, wherein the connection region is configured so as to be angled in relation to the filter region.

The statements that have already been made in relation to this object of the present invention are likewise applicable to the other objects of the present invention, and vice versa.

According to the invention, the filter element has a filter region and a connection region. In the connection region, the filter element is connected to the capsule body or to the capsule base, in particular by sealing. The filter region is flowed through the finished beverage. According to the invention, the connection region and the filter region are now configured at an angle to one another. For example, the connection region of the filter element bears against the conical inner surface of the capsule body, and the filter region is configured parallel to the base of the portion capsule or is configured so as to be curved.

This embodiment is particularly suitable for producing tea.

Preferably a paper material or a paper-like material is used as a filter material, which in each case, at least in sections, is preferably coated with a plastic, in order for it to be sealable.

A further preferred or inventive object of the present invention is a portion capsule, in which the filter element has a filter region which is configured so as to be curved.

The statements that have already been made in relation to this object of the present invention are likewise applicable to the other objects of the present invention, and vice versa.

The filter region is preferably configured at a distance from the capsule base, in particular sufficiently far from the capsule base to ensure that the filter region is not penetrated or perforated by a puncturing spike that may possibly be present, and/or that the filter region touches an outlet opening in the capsule base.

This embodiment is particularly suitable for producing tea.

Preferably a paper material or a paper-like material is used as a filter material, which in each case, at least in sections, is preferably coated with a plastic in order for it to be sealable.

Yet a further inventive or preferred object of the present invention is a portion capsule, in which the filter element has at least one pleat in its connection region.

The statements that have already been made in relation to this object of the present invention are likewise applicable to the other objects of the present invention, and vice versa.

According to this object of the present invention, the filter element has at least one, and preferably a multiplicity of pleats in its connection region, i.e. in the area in which the filter element is connected to the capsule body or capsule base, preferably by sealing. The pleats are preferably different in respect of their form and/or size and/or are configured at irregular distances around the periphery of the filter element. The overlapping areas of the pleat are preferably connected to one another during sealing. The pleat preferably bears against the connection area of the filter element.

The pleats are preferably formed by the fact that a flat filter element is introduced into the capsule body, but without causing it to deform plastically in the process. In

spite of the pleats and the overlaps associated therewith, the filter element in the connection region is capable of being connected securely to the capsule body, without causing damage to the filter element.

This embodiment is particularly suitable for producing tea.

Preferably a paper material or a paper-like material is used as a filter material, which in each case, at least in sections, is preferably coated with a plastic, in order for it to be sealable.

Yet a further inventive or preferred object of the present invention is a portion capsule, in which the filter element in its connection region has at least one multilayer area.

The statements that have already been made in relation to this object of the present invention are likewise applicable to the other objects of the present invention, and vice versa.

According to this object of the present invention, the filter element has at least one, and preferably a multiplicity of multilayer areas in its connection region, i.e. in the area in which the filter element is connected to the capsule body or capsule base, preferably by sealing. The multilayer area preferably has three layers of the filter material. The multilayer areas are preferably different in respect of their form and/or size and/or are configured at irregular distances around the periphery of the filter element. The layers of the multilayer areas are preferably connected to one another during sealing.

The multilayer areas are preferably formed by the fact that a flat filter element is introduced into the capsule body, but without causing it to deform plastically in the process. In spite of the multilayer areas and the overlaps associated therewith, the filter element in the connection region is capable of being connected securely to the capsule body,

without causing damage to the filter element.

This embodiment is particularly suitable for producing tea.

Preferably a paper material or a paper-like material is used as a filter material, which in each case, at least in sections, is preferably coated with a plastic, in order for it to be sealable.

Paper is preferably a component part of the filter element.

Another object of the present invention is a portion capsule, in which the filter element has a polygonal circumference, preferably being hexagonal.

The filter element is preferably sealed to the capsule base, wherein the sealed seam is particularly preferably of circular ring shape. The mean diameter of the circular ring is preferably 22 - 25 mm.

A further object of the present invention is a method for producing a portion capsule having a filter element made from a non-woven fibrous material, in which the filter element is plastically formed, in particular thermoformed, from a flat material, preferably a product web or a sheet, a panel or the like.

The disclosure that has already been made in relation to this object of the present invention is likewise applicable to the other objects of the present invention, and vice versa.

The filter element is preferably cut out or punched out before or after forming and, particularly preferably, is introduced by the knife into the capsule and is connected there, preferably at a distance from the capsule base, to the capsule body or the peripheral collar, and the beverage or foodstuff substrate is then filled into the portion capsule and the capsule is then closed with a lid film.

The lid film is particularly preferably attached to the filter element. This is done after the beverage or foodstuff substrate has been filled into the portion capsule.

The cut-out filter element is preferably transported at least for a certain distance by the knife that cuts it out, in particular a hollow knife. The cut-out filter element is preferably transported onwards by a sonotrode, which is required for the ultrasonic welding and/or is pressed onto the capsule, in particular its side wall or peripheral collar.

A further object of the present invention is a method for producing a portion capsule having a filter element made from a non-woven fibrous material, in which a flat filter element is introduced into a portion capsule with a punch and is formed in the process and is then connected to the capsule body, in particular by sealing.

The disclosure that has already been made in relation to this object of the present invention is likewise applicable to the other objects of the present invention, and vice versa.

According to the inventive method, for example, a circular disc-shaped filter element is pressed into the capsule body by a punch. The filter element is deformed in the process so that a part of the filter element bears against the capsule body. The filter element in its entirety is preferably pushed the portion capsule, but only so far that a free space remains between the filter element and the capsule base. After the filter element has been pushed into the capsule, it is connected to the capsule body or the peripheral collar, preferably by sealing. The filter element is preferably relaxed before sealing. In particular the area, which is subsequently the filter region, is relaxed. This can take place, for example, by reducing the pressure which is exerted on this area by the punch.

A further object of the present invention is the use of a portion capsule for producing a beverage, preferably for producing a coffee, cocoa, tea and/or milk beverage or a foodstuff, in particular a soup.

The statements that have already been made in relation to one object of the present invention are likewise applicable to the other objects of the present invention, and vice versa.

Illustrative embodiments of the invention are represented in the figures and are explained in more detail in the following description. The figures are described only by way of example and do not restrict the general idea of invention. The description is likewise applicable to all the objects of the present invention.

**Figure 1** depicts a longitudinal section through a portion capsule according to a first embodiment of the present invention, which is arranged for the preparation of espresso.

**Figure 2** depicts a longitudinal section through a portion capsule according to the first embodiment of the present invention situated inside a closed brewing chamber.

**Figure 3** depicts a longitudinal section through a portion capsule according to a second embodiment of the present invention situated inside a closed brewing chamber.

**Figures 4a, 4b** depict schematic sectional views of a portion capsule according to a third embodiment of the present invention.

**Figures 5a, 5b** depict schematic sectional views of a portion capsule according to a fourth embodiment of the present invention.

**Figures 6a, 6b** depict schematic top views of a capsule base of a portion capsule according to a seventh embodiment of the

present invention.

**Figure 7** depicts a sectional view of a portion capsule according to an eighth embodiment of the present invention.

**Figures 8a -c** depict different embodiments of the filter element having a felt, in particular a needlefelt.

**Figures 9a, b** depict an embodiment of a thermoformed filter element.

**Figure 10** depicts a further embodiment of a thermoformed filter element.

**Figure 11** depicts a further embodiment of the inventive filter element.

In the various figures, identical parts are always provided with identical reference designations and are thus also designated or mentioned only once as a rule.

Represented in **Figure 1** is a first embodiment of the inventive portion capsule 1. The portion capsule 1 comprises a capsule body 2 in the form of a truncated cone having a closed capsule base 3 and having a peripheral collar 5 disposed on its filling side 4, to which a lid film 6 is welded or glued. A preferably air-tight and aroma-tight closed cavity 100 is thus configured between the capsule base 3 and the lid film 6, which cavity is filled with a pulverulent and granulated beverage substance 101. The beverage substance 101 in this case comprises, for example, a coffee, cocoa, tea and/or milk powder (or milk granulate). A filter element 7 consisting of a non-woven fibrous material is disposed on the inside 3a of the closed capsule body base 3, i.e. within the cavity 100. The filter element is thermoformed, i.e. it is not flat. The filter element 7 either rests loosely on the inside 3a of the capsule base 3, or it is securely connected, i.e. preferably positively bonded, to the inside 3a of the capsule body base

3. In the second variant, the filter element 7 in particular is attached in a positively bonded manner to the capsule base 3 only in a peripheral area 3' of the capsule base 3. The filter element preferably comprises a non-woven material produced from polyester fine fibres. The fibres are thermally connected to one another particularly preferably by means of a calender, for example a multiplicity of extruded polyester fibres are disposed on top of one another and next to one another and are then consolidated by means of heated rollers (flat calendered). The non-woven material consists of a random-laid fibre and/or fibre-oriented non-woven material. The non-woven fabric preferably has a population of mass (also referred to as grammage or weight per unit area) of between 40 and 100 grams per square metre, particularly preferably between 60 and 80 grams per square metre, and most preferably of substantially 70 grams per square metre. The filter element or the non-woven fabric preferably has a thickness of between 0.20 and 0.8 millimetre, particularly preferably between 0.25 and 0.39 millimetre, and most preferably of substantially 0.32 millimetre. The non-woven fabric is configured such that the air permeability of the non-woven fabric at 100 Pascal lies preferably between 1000 and 3000 l/($m^2$s), particularly preferably between 1500 and 2500 (l/$m^2$s) and most preferably substantially 2000 l/($m^2$s). The non-woven fabric is also preferably configured such that the ultimate tensile strength is substantially 110 Newton per 5 centimetres in the longitudinal direction and is substantially 67 Newton per 5 centimetres in the transverse direction, wherein the elongation at break in the longitudinal direction is substantially 30 per cent and in the transverse direction is substantially 38 per cent.

Represented in **Figure 2** is a portion capsule 1 according to the first embodiment of the present invention illustrated in Figure 1, wherein the portion capsule 1 in Figure 2 is disposed in a closed brewing chamber 8. The brewing chamber 8 consists of a first brewing chamber element 9 and a second brewing chamber element 10, wherein the first brewing chamber

element 9, in order to permit the introduction of the portion capsule 1, is movably configured relative to the second brewing chamber element 10, or vice versa. A seal 11 is disposed between the two brewing chamber elements 9, 10. The first brewing chamber element 9 consists substantially of a closing piston 12 having piercing elements 13a, 13b for opening the lid film 6 of the portion capsule 1, a supply of preparation liquid 14 and the seal 11. The second brewing chamber element 10 consists substantially of a brewing chamber head 15 partially enclosing the portion capsule 1 having an opening spike 16 disposed on the base of the brewing chamber head 15, which spike is provided with drainage grooves 17, and a beverage outlet 18. In order to receive the portion capsule 1, the brewing chamber 8 is in an opened state, not represented here, in which the first and the second brewing chamber elements 9, 10 are spaced apart from one another, in order to ensure feeding of the portion capsule 1, and the represented closed state, in which a preparation process for producing a beverage by means of the portion capsule 1 can take place. In the closed state, the brewing chamber 8 is closed in a pressure-tight manner. When transferring the brewing chamber 8 from the opened state into the illustrated closed state, the lid film 6 is perforated by the piercing elements 13a, 13b, so that preparation liquid, in particular hot brewing water, makes its way through the supply of preparation liquid 14 under pressure into the cavity 100 of the portion capsule 1. When closing the brewing chamber 8, the capsule base 3 is also perforated by the perforation means configured as an opening spike 16, so that an outlet opening 107 is produced in the portion capsule 1, through which the produced beverage liquid is able to emerge from the portion capsule 1 in the direction of the beverage outlet 18. To facilitate the discharge of the beverage liquid, the opening spike 16 has the drainage grooves 17 on its outer surface. In the representation, the base 3 of the portion capsule 1 that is present in the brewing chamber 9, 10 is perforated by the opening spike 16 of the second brewing chamber element, but the filter element 7 situated above the piercing site is

raised slightly by the piercing tip 19 of the opening spike 16, albeit not perforated. This is achieved in particular in that the central area 7" is connected to the capsule base 3 in a non-positively bonded manner, but the filter element 7 is connected to the capsule base 3 in a positively bonded manner only in the peripheral area 3' of the capsule base 3, so that, as a consequence of the mechanical contact with the tip of the opening spike 16, it is only raised from the capsule base 3 and thus remains unperforated (i.e. it is not perforated by the opening spike 16). As an alternative or in addition, the filter element is formed by thermoforming, in such a way that is raised from the capsule base at the piercing site. In the peripheral area 3' of the capsule base 3 or in the peripheral area 7' of the filter element 7, the capsule base 3 and the filter element 7 remain in contact with one another and, in particular, remain connected to one another in a positively bonded manner, so that no beverage substance 101 makes its way around the filter element 7 into the beverage outlet 18. The capsule base 3 optionally has a predetermined breaking point 104 at its central point 106, in which the capsule base 3 is perforated by the opening spike 16, such that a comparatively blunt opening spike 16 is sufficient for perforation of the capsule base 3 and the risk of the unintentional perforation of the filter element 7 by the opening spike 16 is also eliminated.

Represented in Figure 3 is a portion capsule 1 according to a second embodiment of the present invention, wherein the second embodiment substantially corresponds to the first embodiment illustrated in Figure 2, and the portion capsule 1 is likewise represented in a closed brewing chamber 8. Unlike the first embodiment, however, the portion capsule base 3 in the piercing area of the opening spike 16 has a salient 21 oriented towards an indentation 20 in the brewing chamber base 3a (the salient 21 is thus oriented in a direction opposite the filling side 4), into which the opening spike 16 penetrates, albeit without perforating the filter element 7 in the process. In particular, raising of the filter element 7

from the capsule base 3 is thus not required. Following the introduction of the portion capsule 1 into the brewing chamber 8, the brewing chamber 8 is closed once more in order to produce the beverage. During the closing operation, the lid film 6 of the portion capsule 1 is perforated by means of the piercing means 13a, 13b and, on completion of the combination and sealing of the first and the second brewing chamber element 9, 10 (by means of the seal 11), brewing water is made available via the liquid inlet 6. During the closing operation of the brewing chamber, the opening spike 16 also pierces an opening into the base 3 of the portion capsule 1. The filter element 7 situated above the piercing site is adapted, in respect of the thickness and the resistance to tearing of a form obtained by thermoforming, to the depth of penetration of the piercing tip 19 of the opening spike 16, so that the filter element 7 is not perforated. Alternatively, the filter element 7 is situated above the salient 21 of the capsule base 3, which lies in the indentation of the brew head base 23, and the opening spike 16 only penetrates into the salient 21 of the capsule base 3 and does not reach as far as the filter element 7. The liquid, for example hot water in the production of coffee, then flows into the capsule 1. In the capsule, this liquid flows through the beverage substrate 101 and extracts and/or dissolves the substances required for the production of the beverage from the beverage substrate 101. The flow of the liquid in the beverage substrate 101 is illustrated by the reference designation 22. The resulting beverage then flows through the filter element 7 disposed between the beverage substrate 101 and the capsule base 3, which prevents component parts of the beverage substrate 101 from finding their way in the form of particles into the resulting beverage and via the opening pierced by the opening spike 16 into the capsule base 3 and further via the drainage grooves 17 of the opening spike 16 into a collecting vessel, for example a cup or a pot.

Represented in **Figures 4a and 4b** are schematic sectional views of a portion capsule 1 according to a third embodiment of the present invention. In the present case, the filter element is

preferably produced from a non-woven fibrous material and particularly preferred is thermoformed, i.e. the originally flat fibrous material of the filter element has been brought into a three-dimensional form. In its peripheral area 7', the filter element in the present case is connected to the peripheral collar 5 of the capsule body. This connection can take place, for example, by sealing or gluing. The attachment of the filter element 7 to the peripheral collar of the capsule body provides a space between the central area 7" of the filter element and the filter base 3, into which space a piercing spike 16 is able to penetrate during puncturing of the portion capsule, but without the filter element being perforated. At any event, the central area 7" of the filter element is deformed by the piercing spike on account of its elasticity. The portion capsule is preferably closed with a lid film 6, which, particularly preferably, is connected to the peripheral area of the filter element, for example by sealing or gluing.

Represented in **Figures 5a and 5b** are schematic sectional views of a portion capsule 1 according to a fourth embodiment of the present invention, wherein reference is made to the statements that have been made in relation to the third embodiment (see Figures 4a, b). In the present case, the peripheral area 7' of the filter element is connected to the side wall of the capsule body, for example by sealing or gluing. The lid film 6 in the present case is connected directly to the peripheral collar of the capsule body. Reference is otherwise made to the statements that have been made in relation to Figures 4a, b. The filter element in the present case is likewise preferably thermoformed.

In **Figures 6a and 6b** is a view of a capsule base 3 of a portion capsule 1 according to a sixth embodiment, wherein reference is made to each of the preceding embodiments. The portion capsule 1 is represented from "below" in Figure 6. The optional predetermined breaking point 104 can be seen in this view, which here comprises three lines of weakness 105, which

are disposed in the shape of a star and in a radial direction around the central point 106 on the capsule base 3. The capsule base 3 has a reduced material strength along the lines of weakness 105, and/or the capsule base 3 is pre-perforated, in order to facilitate a perforation in the brewing chamber 8. In order to ensure that the aroma of the beverage substance 101 also continues to be maintained over longer storage times in the case of a pre-perforated capsule base 3, the capsule base 3 is preferably sealed with a film 108 which can be perforated or can be peeled away by hand at least in the area of the predetermined breaking point 104. The film 108 adheres for this purpose, for example, to the outside of the capsule base 3 and is provided with a peel-off tab 109, which does not adhere to the capsule base 3 and on which the film 108 can be peeled away by hand. An illustrative embodiment having lines of weakness 105 in the form of perforations in the capsule base 3, and having a film 108, is illustrated in Figure 6b.

Represented in **Figure 7** is a sectional view of a portion capsule 1 according to an eighth embodiment of the present invention. The eighth embodiment is essentially similar to the first embodiment represented in Figure 1, although it can also be combined with any other represented embodiment. The portion capsules 1 of the eighth embodiment is equipped with a permanent outlet opening 107 in the capsule base 3, which in the starting position is sealed with the film 108. The portion capsule 1 thus does not have any predetermined breaking points. The film 108 in this case likewise has the peel-off tab 109 for peeling off the film 108 by hand. A perforation of the capsule base 3 by means of an external perforation means 16 is not proposed. In point of fact, for the purpose of placing the portion capsule 1 into the brewing chamber 8, the film 108 is simply peeled from the capsule base 3 by means of the peel-off tab 109, and the brewing process can then be started directly and without perforation of the capsule base 3.

**Figures 8 a - c** depict different embodiments of a filter

element 7 having a felt structure 7.1, in particular a needlefelt structure. This filter element 7 preferably has a carrier structure 7.2, for example a woven fabric structure. A felt structure 7.1 is disposed on this and/or into this woven fabric structure 7.2 on the entire surface facing towards the coffee powder or tea and is connected thereto, for example by needlefelts, as represented in Figure 8a.

The embodiment according to Figure 8b has two felt structures 7.1 and 7.3, which in each case are disposed on and/or in the carrier structure. Both structures extend preferably over the entire cross section, i.e. here the entire circular surface, of the filter element. The felt structures 7.1 and 7.3 can be of the same or different thickness. The felt structure 7.1 is preferably of thinner execution than the layer 7.3, or vice versa. The carrier layer is then of staggered configuration in relation to the middle, relative to the thickness, of the filter element. The structures 7.1 and 7.3 can be produced from different material(s) or the same material(s). These concern not only the substance from which they are produced, but also the thread diameter and/or the length of the threads from which the felt structures are produced. Provided between the two structures 7.1 and 7.3 is a carrier structure 7.2, in which no or only little felt structure is present and which preferably permits transverse flows.

Figure 8c depicts yet a further embodiment of a filter element having a felt structure. In the present case, two filter elements 7 having a felt structure, as have already been described, for example according to Figures 8a and b, are disposed one above the other. The filter elements 7 can only rest one on top of the other or be connected to one another. However, the filter elements 7 can also have only felt without a carrier structure.

All filter elements with a felt structure have the advantage that they have a low pressure loss, or that the reduction in pressure along the filter element takes place with a small

gradient. Coffee without crema, i.e. foam, or tea without foam, for example, can be produced as a result. The filter elements with a felt structure are preferably simply laid into the capsule. The filter element with the felt structure preferably has a larger diameter than the base of the capsule, so that it presses against the wall of the capsule in the peripheral area.

The filter element is preferably produced with a felt structure made from PET, in particular in its entirety.

A person skilled in the art will be aware that the filter element 7 is not restricted to the form represented here, but can have any desired form, in particular 3-D form. In particular, the filter element according to Figures 8 a - c can also be thermoformed.

A thermoformed filter element represented in Figures 9a, b. In the present case, this has a conical side wall and in its peripheral area 7' a flange-like collar, which can be connected to the peripheral collar 5 of the portion capsule body. The lid film 6 of the portion capsule can also be applied to the peripheral area 7'. In the present case, indentations 103' in the form of channels are embossed in the side wall of the filter element. In the production of the beverage, the filter element is pushed in the direction of the side wall of the portion capsule and touches this at least in sections, or the side wall of the filter element, at least in sections, bears against the side wall of the capsule body from the outset. The side wall of the capsule body and the indentation 103' form a channel, through which the finished beverage flows out. A person skilled in the art will appreciate that the indentations preferably extend around the periphery of the side wall of the filter element and particularly preferably are configured equidistant. This results in a corrugated or folded section 103'. As can be appreciated in Figure 9b in particular, the channel 103' can have a triangular or partially circular cross section.

Figure 10 depicts a further embodiment of a thermoformed filter element. Reference can be made essentially to the statements according to Figure 9, wherein in the present case the base is configured as a spherical bottom and the side wall is of conical configuration, wherein the degree of conicity of the side wall preferably changes, preferably increasing towards the opening of the filter element. The side wall can have indentations 103', if required.

**Figure 11** depicts a further embodiment of the inventive portion capsule in a side view and in a view from above. The portion capsule 1 in turn comprises a capsule body 2 in the form of a truncated cone having a closed capsule base 3 and having a peripheral collar 5 disposed on its filling side 4, onto which a lid film 6 is welded or glued. The capsule base can be provided with a comparatively large opening, in particular a circular opening, which is closed by means of a peelable film, for example. Present in the interior of the portion capsule is a filter element 7, which has a connection region 27 and a filter region 28. In the connection region 27, the filter element is connected to the capsule body 2, in particular by sealing, i.e. under the influence of heat and/or pressure. The filter region is flowed through by the liquid finished beverage. It can be seen clearly that a distance is provided between the capsule base and the filter element, which distance is preferably so large that the filter element does not touch the capsule base under the influence of pressure and/or liquid. Furthermore, the distance provided here is preferably so large that a possible opening spike, which is provided in the brewing chamber (see, for example Figures 4b, 5b), does not touch the filter element. In the present case, the filter region has a curvature which is symbolized by the radius r. A person skilled in the art will appreciate that the curvature need not be a curvature in the form of a segment of a circle. The filter element is preferably produced from a material which consists substantially of paper or a paper-like material. This material

is coated, at least in sections, preferably with a sealable plastic material, in order that the filter element can be connected to the capsule body by sealing. The portion capsule is preferably produced in such a way that the filter element is configured as a flat, for example circular, disc, which is pushed into the portion capsule by means of a punch until the connection region 27 of the filter element 7 bears against the capsule body. The filter element is only pushed so far into the portion capsule that a distance remains between the under side of the filter element and the capsule base. The filter element is then sealed on the capsule body by the influence of heat and pressure, for example by heating the punch. Before sealing, the load on the filter region 28 of the filter element is preferably relieved. This can take place, for example, by the punch being of two-part configuration and the bottom part of the punch being drawn upwards against the direction of introduction of the punch. The load on the filter region 28 is relieved in this way, without the pressure on the connection region being reduced.

The lower part of Figure 11 depicts the inventive portion capsule after the filter element has been connected to the capsule body. It can be clearly appreciated that a plurality of pleats 24 and/or multilayer areas 25 are provided in the connection region 27, the pleats 24 or multilayer areas 25 preferably differing in respect of their form and/or size and their distance to one another preferably being different, wherein their form is substantially triangular It can be appreciated, furthermore, that the pleats 24 or multilayer areas 25 bear against the connection region, and the layers of the pleats are connected to one another by sealing.

**List of Reference Designations**

| | |
|---|---|
| 1 | portion capsule |
| 2 | capsule body |
| 3 | capsule base |
| 3a | capsule base - inside |
| 3' | peripheral area of the capsule base |
| 4 | filling side |
| 5 | peripheral collar |
| 6 | lid, lid film |
| 7 | filter element |
| 7' | peripheral area of the filter element |
| 7" | central area of the filter element |
| 7.1 | felt structure, needlefelt structure |
| 7.2 | carrier structure |
| 7.3 | felt structure, needlefelt structure |
| 8 | brewing chamber |
| 9 | first brewing chamber element |
| 10 | second brewing chamber element |
| 11 | seal |

12 closing piston

13a piercing element

13b piercing element

14 supply of preparation liquid

15 brew head

16 opening spike

17 drainage grooves

18 outlet

19 piercing tip

20 indentation

21 indentation/salient

22 preparation liquid flow

23 brew head base

24 pleat

25 multilayer area

27 connection region

28 filter region

100 cavity

101 beverage substrate

102 side wall region

103' indentation, corrugated or folded area

104 predetermined breaking point

105 lines of weakness

106 central point

107 opening, outlet opening

108 film

109 peel-off tab

R radius of curvature of the filter area

Patentkrav

1. Portionskapsel (1) til fremstilling af en drik bestående af et kapsellegeme (2) med en kapselbund (3) og et låg (6), idet der mellem kapselbunden (3) og låget (6) er udformet et hulrum (100) til optagelse af et pulverformet eller flydende drikkesubstrat (101), og idet der i hulrummet er placeret et filterelement (7), og filterelementet er fremstillet af ikke vævet fibermateriale, idet fibermateriale er formet plastisk, fortrinsvis dybtrukket, idet kapselbunden har en udbuling i en retning modsat påfyldningssiden.

2. Portionskapsel (1) ifølge krav 1, kendetegnet ved, at filterelementet er forbundet med kapsellegemet (2).

3. Portionskapsel (1) ifølge krav 1 kendetegnet ved, at filterelementet er forbundet med en kravekant (5).

4. Portionskapsel (1) ifølge et af de foregående krav, kendetegnet ved, at filterelementet har et filterområde (28) og et forbindelsesområde (27), og at forbindelsesområdet er indrettet således, at det er bøjet væk fra filterområdet.

5. Portionskapsel (1) ifølge et af de foregående krav, kendetegnet ved, at filterelementet har et filterområde (28), som er indrettet således, at det er krumt.

6. Portionskapsel ifølge et af de foregående krav, kendetegnet ved, at filterelementet i sit forbindelsesområde har i det mindste en fold (24).

7. Portionskapsel ifølge krav 6, kendetegnet ved, at den har flere folder (24), som fortrinsvis er indrettet således, at de er uregelmæssige.

8. Portionskapsel ifølge et af de foregående krav, kendetegnet ved, at en bestanddel af filterelementet er papir.

9. Portionskapsel ifølge et af de foregående krav, kendetegnet ved, at filterelementet er en fiberdug og/eller har en filtstruktur.

10. Portionskapsel (1) ifølge krav 9, kendetegnet ved, at fiberdugen omfatter et af fine polyesterfibre fremstillet fiberdugsstof, og/eller at fiberdugen har en massebelægning mellem 40 og 100 gram pr. kvadratmeter, fortrinsvis mellem 60 og 80 gram pr. kvadratmeter og særligt foretrukket i det væsentlige 70 gram pr. kvadratmeter, og/eller at fiberdugen har en tykkelse på mellem 0,20 og 0,8 millimeter, fortrinsvis mellem 0,25 og 0,39 millimeter og særligt foretrukket i det væsentlige 0,32 millimeter, og/eller at fiberdugen har en luftgennemtrængelighed ved et tryk på 100 Pascal mellem 1.000 og 3.000 l/($m^2$s), fortrinsvis mellem 1.500 og 2.500 (l/$m^2$s) og særligt foretrukket i det væsentlige ved 2.000 l/($m^2$s).

11. Portionskapsel ifølge krav 9, kendetegnet ved, at filterelementet (7) har to filtstrukturer (7.1., 7.3), fortrinsvis nålefiltstukturer, som fortrinsvis er skilt fra hinanden ved hjælp af en bærestruktur (7.2).

12. Portionskapsel (1) ifølge et af de foregående krav, kendetegnet ved, at filterelementet (7) er udformet elastisk.

13. Portionskapsel (1) ifølge et af de foregående krav, kendetegnet ved, at filterelementet (7) er forseglet, fortrinsvis ultralydsforseglet, til kapsellegemet (2) eller til kravekanten (5) på kapslen.

14. Portionskapsel (1) ifølge et af de foregående krav, kendetegnet ved, at der til filterelementet (7) er forseglet en dækfolie (6).

15. Portionskapsel (1) ifølge et af de foregående krav, kendetegnet ved, at diameteren på filterelementet (7) er større end diameteren på kapselbunden (3).

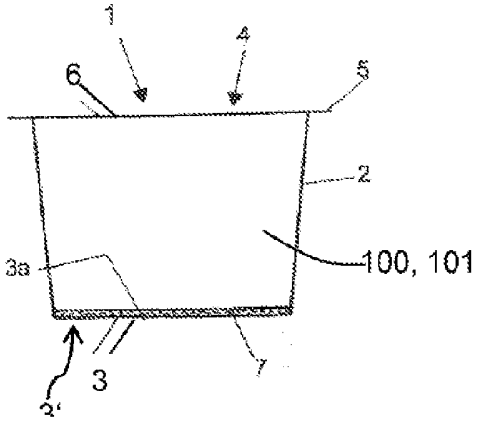



Fig. 1

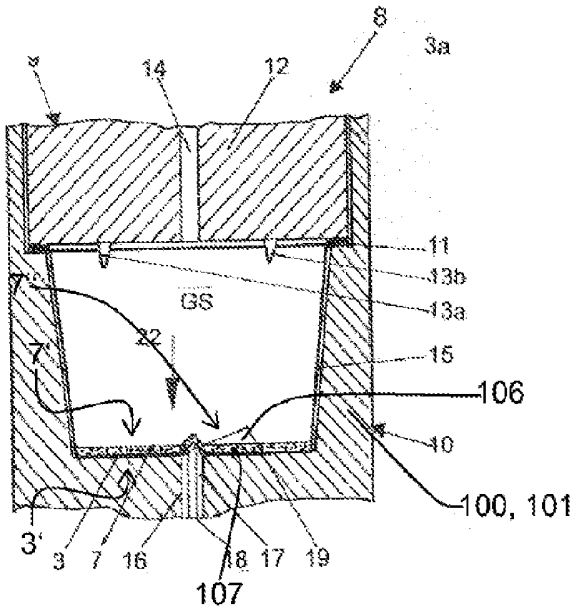



Fig. 2

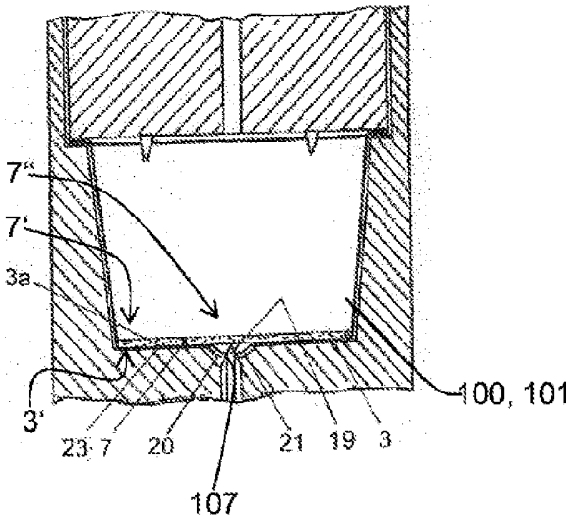



Fig. 3

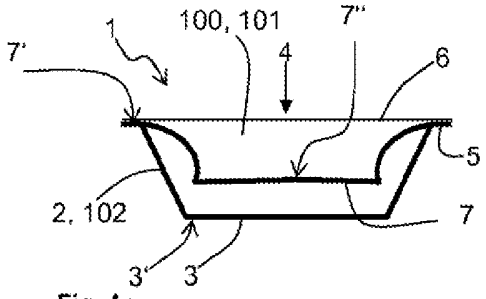


Fig. 4a

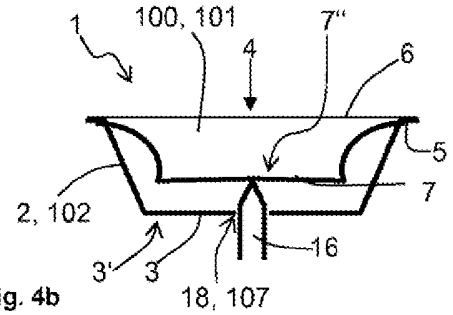


Fig. 4b

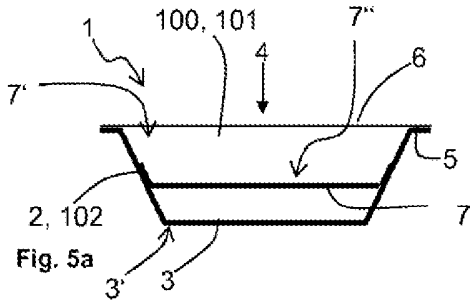


Fig. 5a

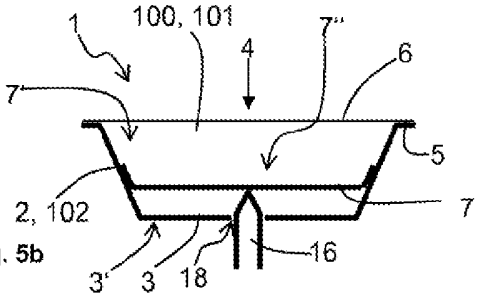


Fig. 5b

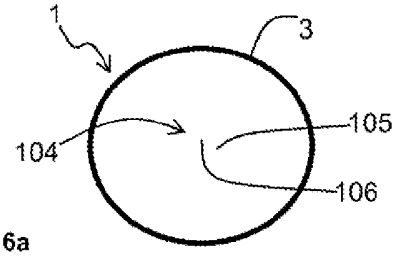


Fig. 6a

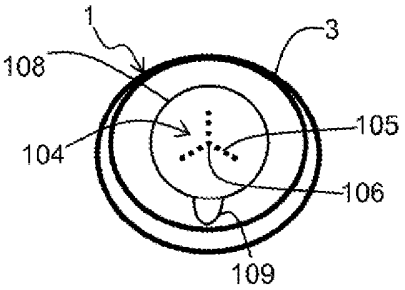


Fig. 6b

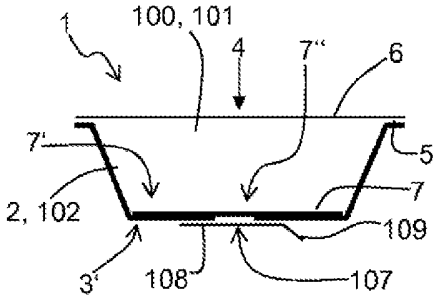


Fig. 7

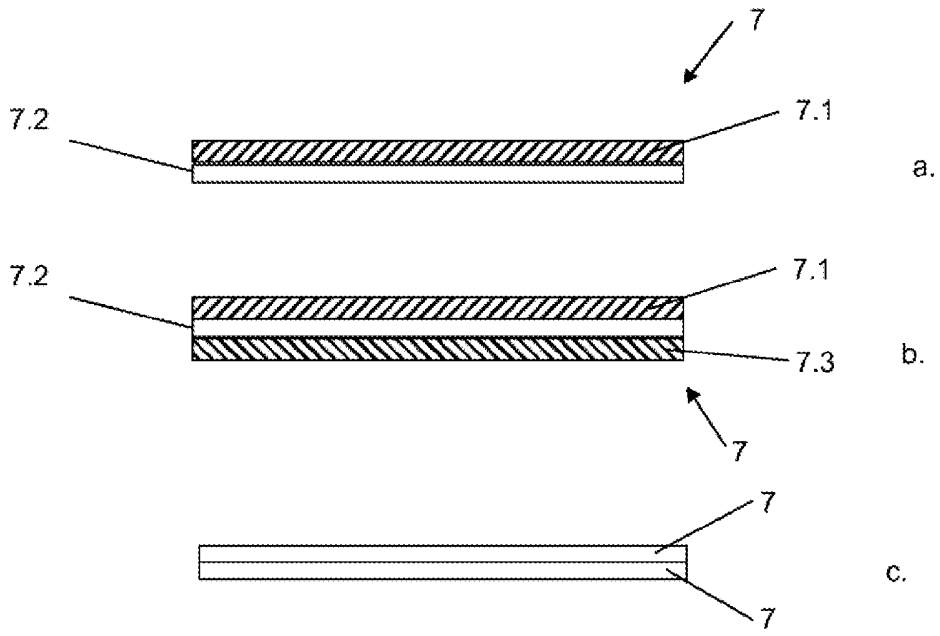



Fig. 8

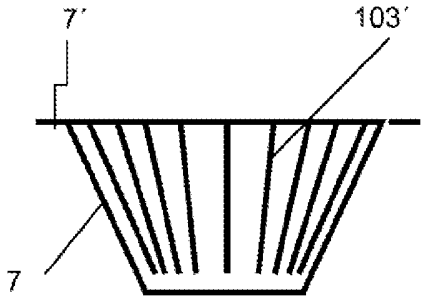



Fig. 9a

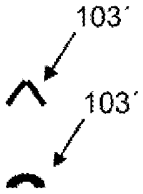



Fig. 9b

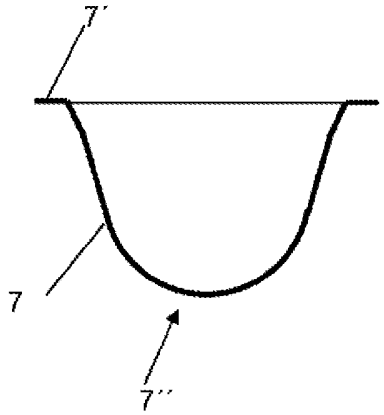



Fig. 10

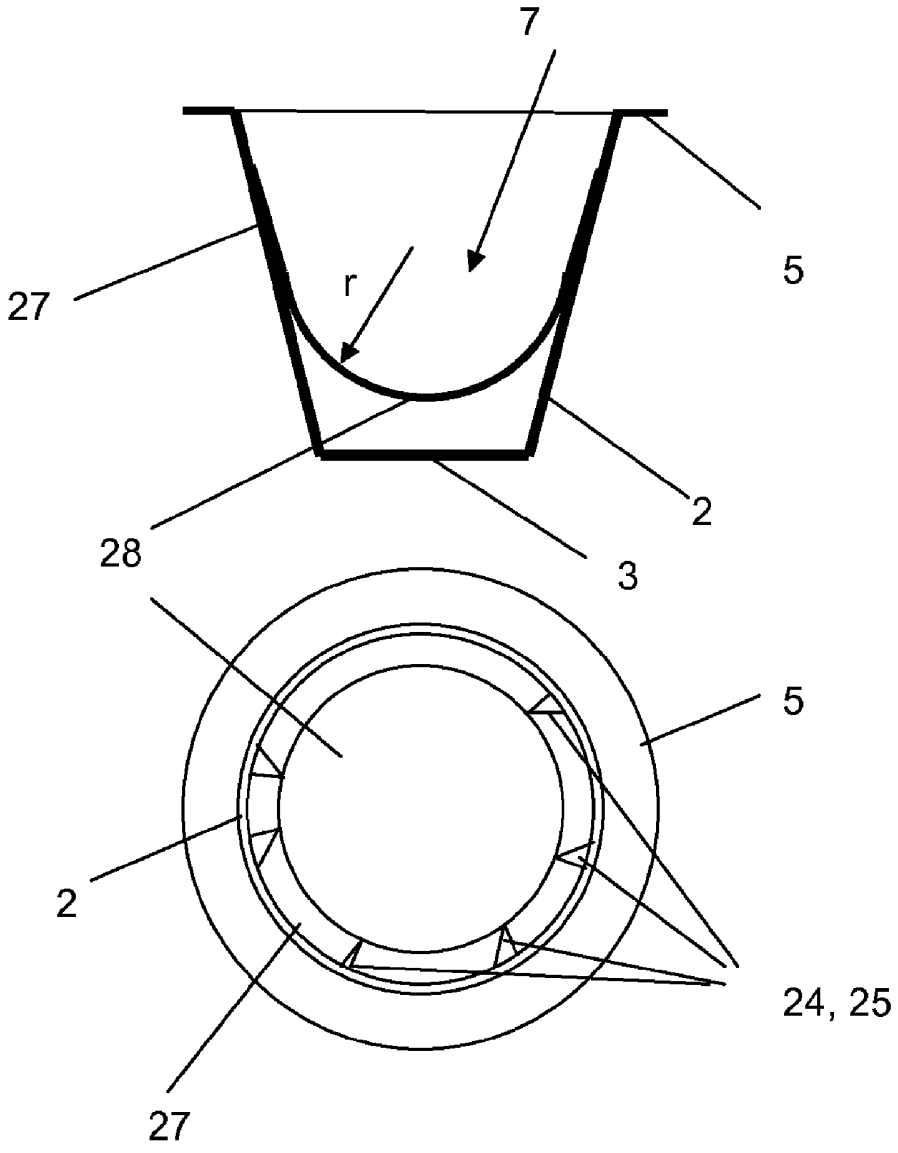



Fig. 11