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(54) **A METHOD FOR MANUFACTURING A PUNCTURED FILTER PLATE FOR USE IN A BEVERAGE CAPSULE**

(57) A method (100) for manufacturing a punctured filter plate (20) for use in a beverage capsule (10), the method comprising:
a) providing (110) a metal foil (30) having a thickness (T_o) between 100 μm and 400 pm;
b1) piercing (120) the metal foil to obtain a plurality of openings (24) each having a smallest dimension (D_{hi}) between 300 μm and 1,5 mm and stamping (135; 140) at least an area around each opening to reduce the smallest dimension thereof to between 25 μm and 300 pm; and
c) cutting (130; 145) the metal foil along a predetermined two-dimensional contour to obtain the punctured filter plate.

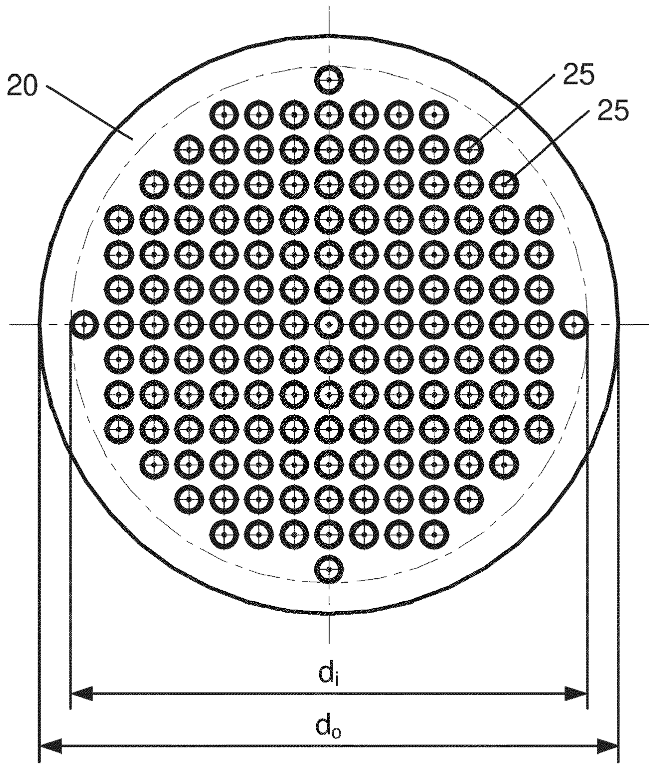

Fig. 6

Description

Technical field

[0001] The present invention relates to a method for manufacturing a punctured filter plate for use in a beverage capsule which is intended to be used in a beverage preparation system to prepare a beverage by passing a fluid through the beverage capsule. The present invention further relates to a method for manufacturing a beverage capsule for use in a beverage preparation machine.

Background art

[0002] A known beverage capsule comprises: a cup-shaped body comprising a base and a sidewall contiguous with the base, wherein the base is configured to be pierced by a draining member of the beverage preparation machine to allow draining a beverage from the beverage capsule; a lid which is typically sealed to the cup-shaped body, the lid and cup-shaped body enclosing an interior volume, wherein the lid is configured to be pierced by an injection member of the beverage preparation machine to inject a fluid into the beverage capsule; and a punctured filter plate positioned inside the cup-shaped body and dividing the interior volume into a first compartment delimited in part by the lid and configured for holding one or more beverage ingredients and a second compartment delimited in part by the base, wherein the punctured filter plate is located at a distance from said base which is equal or larger than a piercing height of the draining member of the beverage preparation machine and wherein said beverage is able to pass through the punctured filter plate.

[0003] Such a beverage capsule is known from WO 2013/39585 A1 where a filter paper is attached to the plastic punctured filter plate. The paper filter in the capsule disclosed in WO 2013/39585 A1 is configured to filter the beverage made by passing the water through the beverage ingredients contained in the capsule. In other words, the filter paper retains at least most of the beverage ingredients inside the capsule which, if these were to come out together with the beverage, would reduce the quality of the latter. The role of the punctured filter plate is avoiding that the filter paper gets damaged by the ingredients and/or the piercing member of the beverage preparation machine.

[0004] In the prior art various beverage ingredients are known. These may be divided roughly into two classes, namely extraction or infusion ingredients and dissolving ingredients. The beverage capsule according to the present invention may be applied in both cases, i.e. either in the case in which the capsule is of the type which contains beverage ingredients intended to allow the beverage to be made by extraction or infusion (such as roasted ground coffee or tea leaves as with the capsule disclosed in WO 2013/39585 A1) and in the case in which the capsule is of the type which contains beverage ingredients intended to allow the beverage to be made following complete or partial dissolving of the beverage ingredients when the water passes through it (for example milk, chocolate, powdered tea, instant drink, etc.).

[0005] The known beverage capsules are used in a beverage preparation system where fluid (usually water) is supplied directly into the capsule. More specifically, the capsule is inserted in an openable and closable chamber, defined inside the beverage preparation system. When the capsule is inside the closed chamber, an injection member of the beverage preparation machine pierces the lid and water (usually hot and pressurised as required) is injected into the capsule, in order to obtain the beverage following the interaction of the water with the beverage ingredients (e.g. extraction, infusion, or partial or whole dissolution). Finally, the beverage is released from the capsule by a draining member which pierces the base allowing the beverage to flow along an outflow path of the beverage preparation system.

[0006] A known issue with the beverage capsules is their recyclability after having been used. The capsules are often formed from a mix of materials that are not easily distributed to specific recycling streams. For example, Keurig K-Cup™ capsules have: a body that is formed from a multilayered material that includes a polyethylene, polypropylene, or polystyrene outer layer, an ethylene vinyl alcohol copolymer (EVOH) barrier layer and a polyethylene, polypropylene, or polystyrene sealing layer; a filter that is formed primarily out of paper or a non-woven material; and a cover that is formed from a multilayered material that includes an aluminium foil outer layer, an EVOH barrier layer and a polyethylene sealing layer. Moreover, the filter and the lid are usually attached to and irremovable from the capsule body. As such, even if the lid is removed, which in itself is already difficult since it is often welded to the cup-shaped body, it is difficult to remove the filter. Also, because the filter is not necessarily closed around the beverage ingredients, once the lid is removed the beverage ingredients can spill out of the capsule and onto the floor.

[0007] The issue of recyclability has already been addressed in the prior art, e.g. US 2017/283163 A1 and WO 2019/204916 A1. WO 2019/204916 A1 proposes forming the entire capsule (i.e. body, filter and cover) from a single polymeric material thus allowing recycling in a single material stream. US 2017/283163 A1 proposes an aluminium capsule with a base having an elevated part to support the paper filter to avoid the use of a plastic punctured filter plate.

[0008] In the context of these problems, the current applicant has already filed a European patent application under no. 23186712.8 which is not yet published. This patent application discloses a beverage capsule in which the cup-shaped body, the lid and the punctured filter plate are all made of a material comprising metal. The use of metal aids in preserving the beverage ingredients which are present within the interior volume. More specifically, a known downside of polymeric materials (as in the capsule disclosed in WO 2019/204916 A1) is a low preservation of food ingredients inside the capsule, this is particularly caused by an insufficient oxygen tightness. The use of metal overcomes this issue.

[0009] Unpublished European patent application no. 23186712.8 further discloses that the punctured filter plate can perform the role of a conventional filter paper. As such, there is no longer any need to include a filter paper inside the capsule. This improves the recyclability of the capsule since there is no longer any need to separate the filter paper from the remainder of the capsule as with the capsuled disclosed in US 2017/283163 A1.

Disclosure of the invention

[0010] The present inventors realized that the punctured filter plate disclosed European patent application no. 23186712.8 has to have small openings in order to perform its desired filter function. In particular, the punctured filter plate should comprise openings having a smallest dimension which is at most 500 μm, in particular at most 300 μm, more in particular at most 200 μm, and most in particular at most 150 μm. Advantageously, the smallest dimension is comprised between 50 μm and 150 μm, such as 55 μm, 60 μm, 65 μm, 70 μm, 75 μm, 80 μm, 85 μm, 90 μm, 95 μm, 100 μm, 105 μm, 110 μm, 115 μm, 120 μm, 125 μm, 130 μm, 135 μm, 140 μm or 145 μm. Manufacturing such small openings is not straightforward as conventional puncturing or laser cutting techniques are not accurate at such small dimensions.

[0011] It is an object of the present invention to provide a method for manufacturing a punctured filter plate for use in a beverage capsule.

[0012] This object is achieved according to the present invention with a first method comprising: a) providing a metal foil having a thickness between 100 μm and 400 μm; b1) piercing the metal foil to obtain a plurality of openings each having a smallest dimension between 300 μm and 1,5 mm and stamping at least an area around each opening to reduce the smallest dimension thereof to between 25 μm and 300 μm; and c) cutting the metal foil along a predetermined two-dimensional contour to obtain the punctured filter plate.

[0013] The first method according to the present invention is based on the realization that relative large openings (i.e. having a smallest dimension between 300 μm and 1,5 mm) are much easier to pierce in a metal foil when compared to attempting to pierce the desired small openings (i.e. having a smallest dimension between 25 μm and 300 μm). The larger openings are then reduced in size by stamping the area around each opening. This causes a thinning of the metal foil with foil material moving inwards thereby narrowing the large openings to obtain the small openings.

[0014] This object is also achieved according to the present invention with a second method comprising: a) providing a metal foil having a thickness between 100 μm and 400 μm; b2) locally pushing on a plurality of locations on the metal foil thereby creating one or more tears on each of the plurality of locations; and c) cutting the metal foil along a predetermined two-dimensional contour to obtain the punctured filter plate.

[0015] The second method according to the present invention is based on the principle of creating opening by tearing the foil. Such tears may be achieved by locally pushing on the foil thus causing a local depression and corresponding bulge on the opposing foil side. By continuing to locally push, the bulge is increased causing an elongation of the foil material which eventually causes a tear when the material's elongation at break value is reached. Furthermore, as the tear distance cannot be larger than the depth of the depression, the pushing distance can be used to control the smallest distance of the obtained tears.

[0016] Both methods achieve the same end result, namely a punctured filter plate with small openings, and each has their advantage.

[0017] The first method allows for a very accurate control of the openings shape. In particular, the shape is determined by the shape of the piercing tool and the smallest dimension is determined by the amount of compression and the initial smallest dimension. The second method obtains less accurate and more variable openings as tearing inherently involves some randomness.

[0018] The main advantage of the second method is that tearing does not lead to waste material as no material is actually detached from the foil. Contrary thereto, in the first method, waste material may be a side-effect in the piercing step (depending on how the piercing was obtained). Such waste comprises metal flakes having a size in the range of 300 μm and 1,5 mm. These metal flakes may be inhaled by workers present in the manufacturing premises thus posing significant health risks. It may also be difficult to gather all these flakes so that material is lost.

[0019] In an embodiment of the present invention step b1) comprises piercing the metal foil to obtain substantially identical openings. Firstly, this allows using a same tool sequentially to make the openings in sequential steps, thus requiring less different tools. Secondly, substantially identical openings decrease design complexity as no account has to be taken of different sized openings and the effect this could have on the punctured filter plate capabilities of retaining the beverage ingredients, nor on the potential flow behavior effects.

[0020] In an embodiment of the present invention step b1) comprises: piercing the metal foil to obtain substantially circular openings each having a diameter as the smallest dimension; or piercing the metal foil to obtain substantially oblong slits each having a width as the smallest dimension. This provides flexibility in choosing which opening shapes are used as some shapes may be better suited for retaining specific beverage ingredients. Moreover, the second method is better suited to obtain oblong slits as openings due to the tearing behavior which tends to create a slit rather than a circular opening.

[0021] In an embodiment of the present invention step b1) comprises: using a needle punch to obtain the openings; or using a laser to obtain the openings. Both options have their own (dis)advantages. While a needle punch is often cheaper in acquisition and faster in use than a laser cutter, the laser tends to be more accurate and avoids the mechanical stress and deformations that may occur during punching.

[0022] In an embodiment of the present invention step b1) comprises stamping only the area around each opening to reduce the smallest dimension, and step c) is particularly performed prior to stamping only the area around each opening. In this method only the area surrounding each opening is stamped so that mechanical stress is avoided in the other regions of the punctured filter plate. This operation is preferably carried out after the desired outer contour shape of the punctured filter plate has been extracted from the metal foil.

[0023] In an alternative embodiment of the present invention step b1) comprises stamping at least the entire area within the predetermined two-dimensional contour and preferably stamping the substantially the entire metal sheet, and step c) is particularly performed after stamping at least the entire area within the predetermined two-dimensional contour. In this alternative method the entire punctured filter plate, preferably the entire sheet, is stamped. This avoids a punctured filter plate with varying thickness and reduces the risk of errors in the sense that one of the openings would not be stamped. The final extraction of the punctured filter plate from the metal foil is then done after the stamping operation.

[0024] In an embodiment of the present invention step b1) comprises stamping to at least locally reduce the thickness of the metal foil to a reduced thickness comprised between 50 μm and 350 μm, the reduced thickness particularly being at least 75 μm and more particularly at least 100 μm, the reduced thickness particularly being at most 250 μm and more particularly at most 200 μm. The desired thickness reduction is a consequence of the initial thickness and the initial size of the openings. A initially relatively thin foil (e.g. 150 μm) with relatively small initial openings (e.g. 400 μm) has to be compressed little to obtain the desired opening size of, for example, 100 μm. Whereas the same relatively thin foil (e.g. 150 μm) with relatively large initial openings (e.g. 1000 μm) has to be compressed more to obtain the desired size openings.

[0025] In an embodiment of the present invention step b1) comprises piercing the metal foil to obtain openings having a smallest dimension between 400 μm and 1 mm, the smallest dimension being particularly at least 500 μm and more particularly at least 600 μm, the smallest dimension being particularly at most 900 μm and more particularly at most 800 μm. Openings of between 600 μm and 800 μm are relatively easy to manufacture using piercing. Moreover, the stamping involved of reducing these openings to the desired size (e.g. 100 μm) involves acceptable stamping pressures.

[0026] In an embodiment of the present invention step b1) comprises stamping the area around each opening to reduce the smallest dimension thereof to between 50 μm and 200 μm, the smallest dimension being particularly at least 70 μm, the smallest dimension being particularly at most 170 μm and more particularly at most 150 μm. Such a smallest dimension has been found to retain conventional roasted ground coffee ingredients to a sufficient extent so as to avoid these from lowering the beverage quality.

[0027] In an embodiment of the present invention step b1) comprises coining to reduce the smallest dimension. Coining is a form of (precision) stamping in which the metal foil is subjected to a sufficiently high stress to induce plastic flow on the surface of the material. An advantageous feature is that in some metals, the plastic flow reduces surface grain size, and work hardens the surface.

[0028] In an embodiment of the present invention step b2) comprises creating teared openings having a smallest dimension between 25 μm and 300 μm, the smallest dimension being particularly at least 50 μm and more particularly at least 70 μm, the smallest dimension being particularly at most 200 μm, more particularly at most 170 μm and most particularly at most 150 μm. Such a smallest dimension has been found to retain conventional roasted ground coffee ingredients to a sufficient extent so as to avoid these from lowering the beverage quality.

[0029] In an embodiment of the present invention step b2) comprises locally (deep) drawing to create the one or more tears. Drawing, and in particular deep drawing, is technique which is known to the skilled person. The metal sheet deformation using (deep) drawing is therefore understood and can be controlled to achieve the desired tear dimensions.

[0030] In an embodiment of the present invention step b2) comprises using one or more tools to locally push on the plurality of locations, each tool comprising a head extending in a length direction between opposing ends, thereby creating two tears nearby the opposing ends. It has been found that the use of locally extended head for pushing is advantageous compared to other shape (such as a point head). The locally extended head causes a pushing along a line on the metal foil thereby achieving a triangular (in cross-section) deformation. In other words, a V-shape valley is created. The stretching is thereby maximized at the opposing ends of the V-shape valley which results in the formation of two tearing regions. Advantageously, the size of these tears is maximally determined by the depth of the valley and the width of its base which are both directly controllable by the shape of the head and the depth by which the head is pushed into the metal foil.

[0031] In an embodiment of the present invention step b2) comprises using one or more tools to locally push on a first subset of the plurality of locations and subsequently to locally push on a second subset of the plurality of locations, the first and second subset particularly being non-overlapping. As such, various locations are pushed at different stages of the manufacturing process. This makes it easier to have the plurality of location closer to one another when compared to a single tool that has to push on all locations at the same time, which single tool with a plurality of heads would be difficult to manufacture.

[0032] In an embodiment of the present invention the punctured filter plate is designed to be used in a beverage capsule to be filled with extraction/infusion based ingredients (e.g. roasted ground coffee, tea leaves, etc.). Preferably, when the ingredients are extraction/infusion based ingredients, the beverage ingredients have a particle size distribution determined using optical microscopy according to ISO 13320:2020, wherein at least 90 volume%, and in particular at least 95 volume%, of the one or more beverage ingredients have a particle size of at least 30 μm, in particular at least 40 μm and more particularly at least 50 μm.

[0033] In an embodiment of the present invention, when the ingredients are extraction/infusion based ingredients, the punctured filter plate comprises openings having a size (i.e. a smallest dimension) so as to prevent at least 90 volume%, in particular at least 95 volume%, and specifically at least 99 volume%, of the one or more beverage ingredients from passing therethrough. This avoids that too much of the ingredients would pass into the beverage which could otherwise negatively affect beverage quality.

[0034] Alternatively, the punctured filter plate is designed to be used in a beverage capsule to be filled with dissolution based ingredients (e.g. powder materials such as milk powder, chocolate powder, powdered tea, powdered soup, instant drink, etc.).

[0035] In an embodiment of the present invention step a) comprises: providing the metal foil comprising a food-grade metal, such as aluminium or an aluminium alloy. Aluminium is a material well known for use in beverage capsules and its material properties are known to the skilled person. Aluminium has an excellent ductility allowing it to be readily deformed from a foil into the punctured filter plate.

[0036] The aluminium or aluminium alloy is preferably annealed aluminium or aluminium alloy and particularly being a soft annealed aluminium or aluminium alloy. The aluminium alloy may, for example, be of grade 3005, 3104, 3105, 3175, 8011 or 8079. The skilled person is familiar with these materials and their various advantages, in particular in the context of food-grade materials.

[0037] In an embodiment of the present invention step a) comprises: providing the metal foil having a thickness between 125 μm and 350 μm, the thickness particularly being at least 150 μm, more particularly at least 175 μm and most particularly at least 200 μm, the thickness particularly being at most 300 μm, more particularly at most 275 μm and most particularly at most 250 μm. Such a thickness firstly allows sufficient stamping to reduce the size of the pierced openings. Furthermore, the thickness leads to a sufficiently rigid punctured filter plate.

[0038] In an embodiment of the present invention step b1) and/or step b2) comprises piercing the metal foil according to a uniform pattern to obtain uniformly distributed openings. However, alternative distributions with a concentration in the center or on the outer part are also possible. The distribution is mainly determined to achieve a desired contact time between the water and the beverage ingredients, which desired contact time is dependent on the type of beverage to prepare.

[0039] In an embodiment of the present invention step c) comprises: cutting the metal foil along a circle as the predetermined two-dimensional contour; or using a punch having a contour corresponding to the predetermined two-dimensional contour to punch the punctured filter plate from the metal foil; or removing metal foil material outside the predetermined two-dimensional contour, for example by trimming. These various techniques enable the skilled person flexibility when extracting the final punctured filter plate from the metal foil. Each technique has its own (dis)advantages. While any two-dimensional contour is theoretically possible to obtain the punctured filter plate, the contour is ideally complementary to the beverage capsule in which the punctured filter plate is intended to be used. As most beverage capsules have circular cross-sections, using a circle as the outer contour for the punctured filter plate is advantageous.

[0040] The object according to the present invention is also achieved by a method for manufacturing a beverage capsule for use in a beverage preparation machine, the method comprising: providing a cup-shaped body comprising a base and a sidewall contiguous with the base, wherein the base is configured to be pierced by a draining member of the beverage preparation machine to allow draining a beverage from the beverage capsule; manufacturing a punctured filter plate as described above; placing the punctured filter plate in the cup-shaped body thereby dividing an interior volume of the cup-shaped body into a first compartment configured for holding one or more beverage ingredients and a second compartment delimited in part by the base; positioning the one or more beverage ingredients in the first compartment; and sealing a lid to the cup-shaped body thereby closing the first compartment, the lid being configured to be pierced by an injection member of the beverage preparation machine to inject a fluid into the beverage capsule.

[0041] As the method for manufacturing the beverage capsule involves the method of manufacturing the punctured filter plate, the same advantages described above are inherently also achieved.

[0042] In an embodiment of the present invention the cup-shaped body the lid and the punctured filter plate are all made of a metal, preferably a food-grade metal, such as aluminium or an aluminium alloy. Ideally, all parts are made of the same metal to optimize recyclability of the capsule.

[0043] In an embodiment of the present invention the cup-shaped body and the lid are both made of a metal-based laminate material comprising at least one layer of metal, the metal layer preferably comprising a food-grade metal, such as an aluminium or an aluminium alloy, wherein the punctured filter plate is made of a metal, preferably a food-grade metal, such as aluminium or an aluminium alloy. Ideally, the metal used for the punctured filter plate is the same as that used in the metal layer of the metal-based laminate. The use of the same metal in all parts optimizes recyclability of the capsule.

[0044] The metal-based laminate may comprises one or more lacquer layers (i.e. a lacquer-metal laminate). For example, a heat seal lacquer, in particular a vinyl heat seal lacquer, or an epoxy stove lacquer, in particular a colored or transparent epoxy stove lacquer. These lacquers can influence the visual look of the cup-shaped body exterior and may also be beneficial for, in a later stage of production, applying a lid to the cup-shaped body to seal the capsule. Moreover, the presence of one or two lacquer layers has no negative impact on the capsule recyclability as the capsule is mainly formed from a metal material.

[0045] The metal-based laminate may comprise one or more polymer layers (i.e. a polymer-metal laminate). The one or more polymer layers may comprise a single layer of a single polymer material or multiple layers of different polymer materials. Where multiple layers of different polymer materials are used, each layer may be applied separately when forming the sheet of material that is usually the basis for forming the cup-shaped body. However, it is preferred that the multiple layers of different polymer materials are first made up into a multilayer laminated polymer film which can then be laminated onto the metal layer (e.g. the aluminium or aluminium alloy layer) by a suitable process, for example adhesive lamination. The polymer materials of the one or more polymer layers may comprise materials selected from the group consisting of homopolymers, copolymers and mixtures thereof. A homopolymer refers to a polymer produced by the polymerization of a single monomer. A copolymer refers to a polymer produced by the polymerization of two or more monomers. Suitable homopolymers include polyvinyl chloride (PVC), polypropylene (PP), low density polyethylene (LDPE), medium density polyethylene (MDPE), high density polyethylene (HDPE), polytetrafluoroethylene (PTFE), polyethylene terephthalate (PET), polychloroprene, polyisobutylene, and polyamides. Suitable copolymers include fluorinated ethylene propylene (FEP), ethylene propylene diene monomer (EPDM), polyamides, thermoplastic copolyesters (TPC) and olefin block copolymers (OBC). These copolymers are preferably alternating copolymers or block copolymers. An alternating copolymer refers to a copolymer with regular alternating monomer units. A block copolymer refers to a copolymer comprising two or more homopolymer subunits linked by covalent bonds.

[0046] The use of an all-metal capsule or a lacquer-metal based laminate is preferred for recycling purposes as opposed to a polymer-metal based laminate.

[0047] In an embodiment of the present invention the cup-shaped body is integrally formed (e.g. by drawing or deep drawing operations) from a sheet of material. The sheet may have a thickness between 50 and 500 microns. The thickness preferably being at least 60 microns, more preferably at least 70 microns and most preferably at least 80 microns. The thickness preferably being at most 400 microns, more preferably at most 300 microns, even more preferably at most 200 microns, still more preferably at most 150 microns, and most preferably at most 120 microns. The sheet advantageously has a thickness of about 80 to 100 microns.

[0048] In an embodiment of the present invention the sidewall comprises a stepped region, the punctured filter plate engaging the stepped region.

[0049] In an alternative embodiment of the present invention the sidewall comprises a first region and a second region having a different inclination with respect to a central axis of the beverage capsule, the punctured filter plate engaging the sidewall where the first region and a second region are contiguous.

[0050] Both embodiments rely on a change in shape of the sidewall to create an abutment surface for the punctured filter plate. This allows the punctured filter plate to, during assembly of the capsule, rest against the abutment surface by the influence of gravity. Once the capsule is filled, i.e. after the beverage ingredients are placed in the capsule, the lid is sealed to the cup-shaped body. In this way, the lid traps the beverage ingredients which therefore maintain the placement of the punctured filter plate, e.g. by pushing lightly against this.

[0051] For a more secure placement, the punctured filter plate may be welded to the abutment surface (i.e. the stepped region or the region where the sidewall inclination changes). It should be appreciated that the punctured filter plate may generally be welded to the sidewall without requiring an abutment surface.

[0052] Another way to achieve a more secure placement of the punctured filter plate is to provide one or more inwardly extending protrusions facing the abutment surface (i.e. the stepped region or the region where the sidewall inclination changes). For example, during assembly of the capsule, once the punctured filter plate has been placed, the sidewall of the capsule is indented in the region above the punctured filter plate. In this way, the punctured filter plate is trapped between the abutment surface and the protrusions.

[0053] In an embodiment of the present invention said distance between the punctured filter plate and the base is at least 5 mm and preferably at least 8 mm or more. Such a distance has been found to be sufficiently far away to allow the draining member of the beverage preparation machine to sufficiently pierce the base to allow a satisfactory draining of the beverage from the capsule without contacting and/or damaging the punctured filter plate.

[0054] In an embodiment of the present invention the beverage capsule does not contain a filter paper.

[0055] In an embodiment of the present invention the beverage capsule comprises an annular rim contiguous with the sidewall, the lid being sealed to the annular rim. The provision of an annular rim provides a surface on which the lid can be easily sealed.

[0056] In an embodiment of the present invention, the capsule is a single-use, disposable element.

[0057] The object according to the present invention is also achieved with a method for preparing a beverage, the method comprising: providing the beverage capsule as described above; placing the beverage capsule in a beverage preparation machine; and activating the beverage preparation machine to pass a fluid through the beverage capsule thereby preparing the beverage.

Brief description of the drawings

[0058] The invention will be further explained by means of the following description and the appended figures.

Figure 1 shows an exploded view of a beverage capsule according to the present invention.
Figure 2 shows a perspective view of a beverage capsule according to the present invention.
Figure 3 shows a cross-sectional view of the beverage capsule of figure 2.
Figures 4 and 5 show details of figure 3.
Figure 6 shows a top view of the punctured filter plate used in the beverage capsule of figures 1 and 2.
Figure 7A shows a detail of a cross-section through a pierced metal foil used in manufacturing the punctured filter plate of figure 6.
Figure 7B shows a detail of a cross-section through the punctured filter plate of figure 6.
Figure 8 shows an alternative punctured filter plate for use in a beverage capsule according to the present invention.
Figure 9A shows a detail of a cross-section through a metal foil used in manufacturing the punctured filter plate of figure 8.
Figure 9B shows a detail of a cross-section through the punctured filter plate of figure 8.
Figure 10 shows a flow-chart of a method for manufacturing the punctured filter plate of figure 6.
Figure 11 shows a flow-chart of a method for manufacturing the punctured filter plate of figure 8.

Description of the invention

[0059] The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. The dimensions and the relative dimensions do not necessarily correspond to actual reductions to practice of the invention.

[0060] Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. The terms are interchangeable under appropriate circumstances and the embodiments of the invention can operate in other sequences than described or illustrated herein.

[0061] Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes. The terms so used are interchangeable under appropriate circumstances and the embodiments of the invention described herein can operate in other orientations than described or illustrated herein.

[0062] Furthermore, the various embodiments, although referred to as "preferred" are to be construed as exemplary manners in which the invention may be implemented rather than as limiting the scope of the invention.

[0063] The term "substantially" includes variations of +/- 10% or less, preferably +/-5% or less, more preferably +/-1% or less, and more preferably +/-0.1 % or less, of the specified condition, in as far as the variations are applicable to function in the disclosed invention. It is to be understood that the term "substantially A" is intended to also include "A".

[0064] Figure 1 shows an exploded view of a beverage capsule 10 according to the present invention. The capsule 10 comprises a cup-shaped body 12 having a base 14, a sidewall 16 which is contiguous with the base 14 and an annular rim 18 which is contiguous with the sidewall 16. The capsule 10 further comprises a punctured filter plate 20 and a lid 22 sealed to the sidewall 16, in particular to the annular rim 18. Beverage ingredients 24 are also schematically shown in figure 1.

[0065] As indicated in figure 3, the cup-shaped body 12 generally has a height H comprised between 25 and 65 mm. The height H is preferably at least 35 mm, more preferably at least 40 mm, and most preferably at least 43 mm. The height H is preferably at most 55 mm, more preferably at most 50 mm, and most preferably at most 47 mm. In the illustrated embodiment, the height H is about 45 mm.

[0066] The cup-shaped body 12 generally has an outer diameter D comprised between 30 and 70 mm. The outer diameter D is preferably at least 40 mm, more preferably at least 45 mm, and most preferably at least 49 mm. The outer diameter D is preferably at most 60 mm, more preferably at most 55 mm, and most preferably at most 53 mm. In the illustrated embodiment, the outer diameter D is about 51 mm.

[0067] The sidewall 16 has an inner diameter D_i measured at the end 16a contiguous with the base 14 comprised between 15 and 55 mm. The inner diameter D_i is preferably at least 25 mm, more preferably at least 30 mm, and most preferably at least 33 mm. The inner diameter D_i is preferably at most 45 mm, more preferably at most 40 mm, and most preferably at most 37 mm. In the illustrated embodiment, the outer diameter D_i is about 35 mm.

[0068] The sidewall 16 has an outer diameter D_o measured at the end 16b contiguous with the annular rim 18 comprised between 25 and 65 mm. The outer diameter D_o is preferably at least 35 mm, more preferably at least 40 mm, and most preferably at least 43 mm. The outer diameter D_o is preferably at most 55 mm, more preferably at most 50 mm, and most preferably at most 47 mm. In the illustrated embodiment, the outer diameter D_o is about 45 mm.

[0069] The dimensions H, D, D_i and D_o are mainly determined in function of the beverage preparation machine, in particular of the closed chamber inside the beverage preparation machine.

[0070] In the illustrated embodiment, the sidewall 16 is provided with a stepped region 16c, i.e. a region in which the diameter of the sidewall rapidly increases. The punctured filter plate 20 engages this stepped region 16c as best shown in figure 4 and may be sealed thereto. The stepped region 14c divides the sidewall 14 into a first section 16_1 extending between the base 14 and the stepped region 16c and a second section 16_2 extending between the stepped region 16c and the annular rim 18.

[0071] In other embodiments, the stepped region can be replaced by a change in inclination angles of the sidewall sections, e.g. the first sidewall section having an inclination angle of 30° or more (e.g. 45°) with the second sidewall section having an inclination angle of 20° or less (e.g. 8°). Furthermore, in yet other embodiments, both a stepped region and/or inclination change may be absent in which case the punctured filter plate 20 is welded to the sidewall 16 at the desired location.

[0072] The first sidewall section 16_1 has a height H_1 comprised between 3 and 20 mm. The height H_1 is preferably at least 5 mm, more preferably at least 8 mm, and most preferably at least 9 mm. The height H_1 is preferably at most 15 mm, more preferably at most 12 mm, and most preferably at most 11 mm. In the illustrated embodiment, the height H_1 is about 10 mm.

[0073] The second sidewall section 16_2 has a height H_2 comprised between 20 and 50 mm. The height H_2 is preferably at least 25 mm, more preferably at least 30 mm, and most preferably at least 33 mm. The height H_2 is preferably at most 45 mm, more preferably at most 40 mm, and most preferably at most 37 mm. In the illustrated embodiment, the height H_2 is about 35 mm.

[0074] The first sidewall section 16_1 has an inclination angle α_1 with respect to the central axis 30 of the capsule 10 comprised between 0° and 10°. The inclination angle α_1 is preferably at least 1° and more preferably at least 2°. The inclination angle α_1 is preferably at most 8°, more preferably at most 6°, and most preferably at most 4° mm. In the illustrated embodiment, the inclination angle α_1 is about 3°.

[0075] The second sidewall section 16_2 has an inclination angle α_2 with respect to the central axis 30 of the capsule 10 comprised between 0° and 20°. The inclination angle α_2 is preferably at least 2°, more preferably at least 4°, and most preferably at least 5°. The inclination angle α_2 is preferably at most 15°, more preferably at most 10°, and most preferably at most 8° mm. In the illustrated embodiment, the inclination angle α_2 is about 6°.

[0076] The inclination angles α_1 and α_2 are determined in order to maximize the volume inside the cup-shaped body whilst allowing the cup-shaped bodies to be stackable before assembly.

[0077] The punctured filter plate 20 divides the internal capsule volume into a first compartment C1 and a second compartment C2. The first compartment C1 is normally empty and the second compartment C2 is filled with beverage ingredients 24. The first compartment C1 is delimited by the base 14, the first sidewall section 16, and the punctured filter plate 20. The second compartment C2 is delimited by the lid 22, the second sidewall section 16_2 and the punctured filter plate 20.

[0078] As described above, the beverage ingredients 24 are either extraction/infusion based ingredients (e.g. roasted ground coffee, tea leaves, etc.) or dissolution based (e.g. powder materials such as milk powder, chocolate powder, powdered tea, powdered soup, instant drink, etc.). Preferably, when the ingredients are extraction/infusion based ingredients, the beverage ingredients have a particle size distribution determined using optical microscopy according to ISO 13320:2020, wherein at least 90 volume%, and in particular at least 95 volume%, of the one or more beverage ingredients have a particle size of at least 30 μm, in particular at least 40 μm and more particularly at least 50 μm.

[0079] The second compartment C2 has a volume comprised between 30 and 70 mml. The second compartment volume is preferably at least 35 ml, more preferably at least 40 ml, and most preferably at least 45 ml. The second compartment volume is preferably at most 60 ml, more preferably at most 55 ml, and most preferably at most 52 ml. In the illustrated embodiment, the second compartment volume is about 48 or 49 ml.

[0080] As shown in figure 5, the annular rim 18 has a flat section 18_2 and a rolled-over rim potion 18_1. The lid 22 is normally sealed to the flat section 18_2. The use of a rolled-over rim portion 18_1 is a well-known technique for forming the free end of the annular rim when using a metal or metal-based laminate material to form the cup-shaped body 12. The rolled-over rim 18_1 has a height h comprised between 0,8 and 2,0 mm. The height h is preferably at least 1,0 mm, more preferably at least 1,2 mm, and most preferably at least 1,25 mm. The height h is preferably at most 1,6 mm, more preferably at most 1,4 mm, and most preferably at most 1,35 mm. In the illustrated embodiment, the height h is about 1,25 mm.

[0081] Naturally, other shapes are possible for the rolled-over rim portion, e.g. an elliptic shape which increases the surface area of the flat section 18_2 useable for sealing the lid 22. Furthermore, the orientation of the roll-over rim portion may also be clockwise instead of counter-clockwise in the illustrated embodiment.

[0082] Figure 2 further illustrates that the base 14 is provided with a ridged contour 14_C which divides the base 14 into an inner region 14_i and an outer region 14_o. Typically, the outer region 14_o is punctured by a piercing member of the beverage preparation machine to drain a beverage from the capsule 10. The lid 22 is normally pierced by a piercing member of the beverage preparation machine to inject a fluid (typically water) into the capsule to create a beverage through interaction with the beverage ingredients. The operation of the beverage capsule 10 in a beverage preparation machine will not be described further and is considered known to the skilled person.

[0083] The punctured filter plate 20 is provided with openings (schematically illustrated in figure 1) to allow the prepared beverage to pass therethrough. As described above, when the ingredients are extraction/infusion based ingredients, the openings in the punctured filter plate 20 have a size so as to prevent at least 90 volume%, in particular at least 95 volume%, and specifically at least 99 volume%, of the beverage ingredients 24 from passing therethrough.

[0084] Depending on the type of beverage ingredients 24 (e.g. roasted ground coffee), the openings in the punctured filter plate 20 have a smallest dimension which is at most 500 μm, in particular at most 300 μm, more in particular at most 200 μm, and most in particular at most 100 μm. The smallest dimension may be the diameter in case the openings are substantially circular (as in the illustrated embodiment) or the width in case the openings are formed as oblong slits as in the embodiment of the punctured filter plated 20' illustrated in figure 6.

[0085] In the illustrated embodiment, the openings are substantially uniformly distributed across the punctured filter plate 20 and are substantially the same. However, this is not necessary. The distribution of the openings may vary as described above. Moreover, the openings may have varying shapes and/or size.

[0086] The cup-shaped body 12 is usually obtained by deforming a flat sheet of material into the cup-shape. This may be done by deep drawing in a one-stage or multiple-stage process. Due to the presence of the stepped region 16c, the cup-shaped body 12 is usually manufactured in a multiple-stage process using differently sized punches sequentially. However, a multiple-element punch may also be used to manufacture the cup 12 in a single step.

[0087] According to the present invention, the cup 12, the punctured filter plate 20 and the lid 22 all comprise metal and ideally a same metal for improving recyclability.

[0088] In the illustrated embodiment, the cup 12 and the lid 22 are both made either solely from a metal or a metal-based laminate having a metal layer with a lacquer layer on one or both sides. Possible and preferred metals have been described above and will not be repeated. The punctured filter plate 20 in the illustrated embodiment is made solely from a metal and ideally the same metal as used for the cup 12 and the lid 22.

[0089] In another embodiment, the cup 12 and the lid 22 are both made from a same metal-based polymer laminate. In this embodiment, the punctured filter plate 20 is preferably made solely from a metal and ideally the same metal as used for the metal layer in the cup 12 and the lid 22. Possible and preferred metals and polymers have been described above and will not be repeated.

[0090] In yet another embodiment, the cup 12 is made from a metal or a metal-based laminate having a metal layer with a lacquer layer on one or both sides; the lid 22 is made from a metal-based polymer laminate and the punctured filter plate 20 is preferably made solely from a metal. Ideally the metal is the same for each component. Possible and preferred metals and polymers have been described above and will not be repeated.

[0091] A first method 100 for manufacturing a punctured filter plate according to the present invention and the resulting punctured filter plate 20 will be described with respect to figures 6 to 7B and 10.

[0092] The method 100 comprises providing 110 a metal foil 30 having a thickness T_o between 100 μm and 400 μm. The metal used is preferably aluminium or an alloy thereof. In some embodiments, the metal foil 30 may have a thickness between 125 μm and 350 μm, the thickness particularly being at least 150 μm, more particularly at least 175 μm and most particularly at least 200 μm, the thickness particularly being at most 300 μm, more particularly at most 275 μm and most particularly at most 250 μm.

[0093] The method 100 further comprises piercing 120 the metal foil 30 to obtain a plurality of openings 24 each having a smallest dimension D_{hi} between 300 μm and 1,5 mm. In some embodiments, the pierced openings may have a smallest dimension between 400 μm and 1 mm, the smallest dimension being particularly at least 500 μm and more particularly at least 600 μm, the smallest dimension being particularly at most 900 μm and more particularly at most 800 μm. As described above, the piercing may be obtained by various known techniques, such as punching, laser cutting, etc.

[0094] A detail of such a pierced foil is shown in figure 7A. In this detail, the pierced opening 24 is circular with a diameter D_{hi} (i.e. a smallest dimension) of about 750 μm. In figure 7A, the metal foil 30 has a thickness T_o of about 250 μm.

[0095] As illustrated in figure 10, the method 100 further comprises either step 130 or step 135. Both of which are described below.

[0096] In step 130, the method 100 comprises cutting the metal foil 30 along a predetermined two-dimensional contour to obtain a precursor of the punctured filter plate 20. In the illustrated embodiments, this two-dimensional contour is a circle as shown in figure 6. As described above, this cutting may involve various known techniques, such as removing excess material (e.g. trimming), punching the disk from the foil, etc. The result of this step is a flat disk with large openings 24.

[0097] In step 140, the area around each opening 24 is stamped, preferably coined, to reduce the foil thickness to obtain small openings 25 having a smallest dimension D_{he} comprised between 25 μm and 300 μm. In some embodiments, the foil thickness is reduced to a reduced thickness T_c comprised between 50 μm and 350 μm, the reduced thickness particularly being at least 75 μm and more particularly at least 100 μm, the reduced thickness particularly being at most 250 μm and more particularly at most 200 μm. In some embodiments, the smallest dimension D_{he} is comprised between 50 μm and 200 μm, the smallest dimension being particularly at least 70 μm, the smallest dimension being particularly at most 170 μm and more particularly at most 150 μm.

[0098] A detail of such a stamped metal foil is shown in figure 7B. In this illustration, the foil thickness T_o is about 300 μm, the reduced foil thickness T_c is about 50 μm and the opening 25 has a smallest dimension D_{he} of about 100 μm. Figure 7B also illustrates that the stamping causes a depressed area 26 having a diameter D_c of about 1,5 mm in the illustrated embodiment. This depression is a side-effect of the stamping tool and counter mold used and would be absent (or at least less outspoken) if a flat surface counter mold was used. This depression results in a total foil thickness T of about 400 μm in the illustrated embodiment.

[0099] The final punctured filter plate 20 obtained with the method 100 with steps 130 and 140 is shown in top view in figure 6. In that figure, the openings 25 are uniformly distributed within an inner circular surface with diameter d_i which is about 34 mm in the illustrated embodiment. The larger circles surrounding each opening 25 are the depressed areas 26 caused by the coining operation. The outer ring is free of openings which provides a larger surface area to contact with the stepped region 16_c. The outer diameter d_o of the punctured filter plate 20 is about 38 mm in the illustrated embodiment. The values of d_o, d_i are naturally dependent on the dimensions of the cup-shaped body 12 and on the desired fluid flow rate.

[0100] In other embodiments, the openings 25 in punctured filter plate 20 could also be oblong slits as described above.

[0101] Returning to the method 100 illustrated in figure 10. Whereas, in the variant described above, step 120 was followed by steps 130 and 140, in another variant, step 120 is followed by steps 135 and 145.

[0102] In step 135 the entire metal foil 30 is stamped, in particular coined, in a single step to reduce the smallest dimension of the openings 24. Step 135 may also involve stamping at least the area of the foil within the predetermined two-dimensional contour which delimits the punctured filter plate. The stamping is similar as in step 140 with the difference that a much larger area is stamped. There are thus also no local depressions 26 as the entire foil is thinned.

[0103] Step 145 is similar to step 130 in that this involves cutting the stamped metal foil 30 along a predetermined two-dimensional contour to obtain the punctured filter plate 20. In the illustrated embodiments, this two-dimensional contour is a circle as shown in figure 6. As described above, this cutting may involve various known techniques, such as removing excess material (e.g. trimming), punching the disk from the foil, etc. As the stamping has already occurred, the result of this step is the punctured filter plate 20 as illustrated in figure 1.

[0104] A second method 200 for manufacturing a punctured filter plate according to the present invention and the resulting punctured filter plate 20' will be described with respect to figures 8 to 9B and 11.

[0105] The method 200 comprises providing 210 a metal foil 30 having a thickness T_o between 100 μm and 400 μm. The metal used is preferably aluminium or an alloy thereof. In some embodiments, the metal foil 30 may have a thickness between 125 μm and 350 μm, the thickness particularly being at least 150 μm, more particularly at least 175 μm and most particularly at least 200 μm, the thickness particularly being at most 300 μm, more particularly at most 275 μm and most particularly at most 250 μm.

[0106] In step 220 one or more tools 50 are used to locally on a plurality of locations on the metal foil. A tool 50 is schematically shown in figure 9A with a metal foil 30. By locally pushing onto the foil 30, a depression 27 is created as shown in figure 9B. If the tool 50 is pushed deep enough into the foil 30 (e.g. by deep drawing), the elongation of the foil 30 will exceed the elongation at break properties of the material (e.g. aluminium) thus causing a tear 28 to appear. As shown in figure 8, the tool 50 used has an elongated head. This causes a valley like depression 27 to be formed with eventual tearing 28 at the opposing ends of the valley.

[0107] Step 230 is similar to steps 130, 145 in that this involves cutting the metal foil 30 along a predetermined two-dimensional contour to obtain the punctured filter plate 20'. In the illustrated embodiments, this two-dimensional contour is a circle as shown in figure 8. As described above, this cutting may involve various known techniques, such as removing excess material (e.g. trimming), punching the disk from the foil, etc. The result of this step is the punctured filter plate 20' as illustrated in figure 8.

[0108] Although aspects of the present disclosure have been described with respect to specific embodiments, it will be readily appreciated that these aspects may be implemented in other forms within the scope of the invention as defined by the claims.

Claims

1. A method (100) for manufacturing a punctured filter plate (20) for use in a beverage capsule (10), the method comprising:

   a) providing (110) a metal foil (30) having a

thickness (T_o) between 100 μm and 400 μm;
b1) piercing (120) the metal foil to obtain a plurality of openings (24) each having a smallest dimension (D_{hi}) between 300 μm and 1,5 mm and stamping (135; 140) at least an area around each opening to reduce the smallest dimension thereof to between 25 μm and 300 μm; and
c) cutting (130; 145) the metal foil along a predetermined two-dimensional contour to obtain the punctured filter plate.

2. The method according to claim 1, wherein step b1) comprises piercing the metal foil to obtain substantially identical openings.

3. The method according to claim 1 or 2, wherein step b1) comprises:

- piercing the metal foil to obtain substantially circular openings each having a diameter as the smallest dimension; or
- piercing the metal foil to obtain substantially oblong slits each having a width as the smallest dimension.

4. The method according to any one of the preceding claims, wherein step b1) comprises:

- using a needle punch to obtain the openings; or
- using a laser to obtain the openings.

5. The method according to any one of the preceding claims, wherein step b1) comprises stamping only the area around each opening to reduce the smallest dimension, and
wherein step c) is particularly performed prior to stamping only the area around each opening.

6. The method according to any one of claims 1 to 4, wherein step b1) comprises stamping at least the entire area within the predetermined two-dimensional contour and preferably stamping the substantially the entire metal sheet, and
wherein step c) is particularly performed after stamping at least the entire area within the predetermined two-dimensional contour.

7. The method according to any one of the preceding claims, wherein step b1) comprises stamping to at least locally reduce the thickness of the metal foil to a reduced thickness (T_c) comprised between 50 μm and 350 μm, the reduced thickness particularly being at least 75 μm and more particularly at least 100 μm, the reduced thickness particularly being at most 250 μm and more particularly at most 200 μm.

8. The method according to any one of the preceding claims, wherein step b1) comprises piercing the metal foil to obtain openings having a smallest dimension between 400 μm and 1 mm, the smallest dimension being particularly at least 500 μm and more particularly at least 600 μm, the smallest dimension being particularly at most 900 μm and more particularly at most 800 μm.

9. The method according to any one of the preceding claims, wherein step b1) comprises stamping the area around each opening to reduce the smallest dimension thereof to between 50 μm and 200 μm, the smallest dimension being particularly at least 70 μm, the smallest dimension being particularly at most 170 μm and more particularly at most 150 μm.

10. The method according to any one of the preceding claims, wherein step b1) comprises coining to reduce the smallest dimension.

11. A method (200) for manufacturing a punctured filter plate (20') for use in a beverage capsule (10), the method comprising:

a) providing (210) a metal foil (30) having a thickness (T_o) between 100 μm and 400 μm;
b2) locally pushing (220) on a plurality of locations on the metal foil thereby creating one or more tears (28) on each of the plurality of locations; and
c) cutting (230) the metal foil along a predetermined two-dimensional contour to obtain the punctured filter plate.

12. The method according to claim 11, wherein step b2) comprises creating teared openings having a smallest dimension between 25 μm and 300 μm, the smallest dimension being particularly at least 50 μm and more particularly at least 70 μm, the smallest dimension being particularly at most 200 μm, more particularly at most 170 μm and most particularly at most 150 μm.

13. The method according to claim 11 or 12, wherein step b2) comprises locally deep drawing to create the one or more tears.

14. The method according to any one of claims 11 to 13, wherein step b2) comprises using one or more tools (50) to locally push on the plurality of locations, each tool comprising a head extending in a length direction between opposing ends, thereby creating two tears nearby the opposing ends.

15. The method according to any one of claims 11 to 14, wherein step b2) comprises using one or more tools (50) to locally push on a first subset of the plurality of locations and subsequently to locally push on a second subset of the plurality of locations, the first and second subset particularly being non-overlapping.

16. The method according to any one of the preceding claims, wherein step a) comprises: providing the metal foil comprising a food-grade metal, such as aluminium or an aluminium alloy.

17. The method according to any one of the preceding claims, wherein step a) comprises: providing the metal foil having a thickness between 125 μm and 350 μm, the thickness particularly being at least 150 μm, more particularly at least 175 μm and most particularly at least 200 μm, the thickness particularly being at most 300 μm, more particularly at most 275 μm and most particularly at most 250 μm.

18. The method according to any one of the preceding claims, wherein step b1) and/or step b2) comprises piercing the metal foil according to a uniform pattern to obtain uniformly distributed openings.

19. The method according to any one of the preceding claims, wherein step c) comprises:

- cutting the metal foil along a circle as the predetermined two-dimensional contour; or
- using a punch having a contour corresponding to the predetermined two-dimensional contour to punch the punctured filter plate from the metal foil; or
- removing metal foil material outside the predetermined two-dimensional contour, for example by trimming.

20. A method for manufacturing a beverage capsule (10) for use in a beverage preparation machine, the method comprising:

- providing a cup-shaped body (12) comprising a base (14) and a sidewall (16) contiguous with the base, wherein the base is configured to be pierced by a draining member of the beverage preparation machine to allow draining a beverage from the beverage capsule;
- manufacturing a punctured filter plate (20; 20') according to any one of the preceding claims;
- placing the punctured filter plate in the cup-shaped body thereby dividing an interior volume of the cup-shaped body into a first compartment (C2) configured for holding one or more beverage ingredients (24) and a second compartment (C1) delimited in part by the base;
- positioning the one or more beverage ingredients in the first compartment; and
- sealing a lid (22) to the cup-shaped body thereby closing the first compartment, the lid being configured to be pierced by an injection member of the beverage preparation machine to inject a fluid into the beverage capsule.

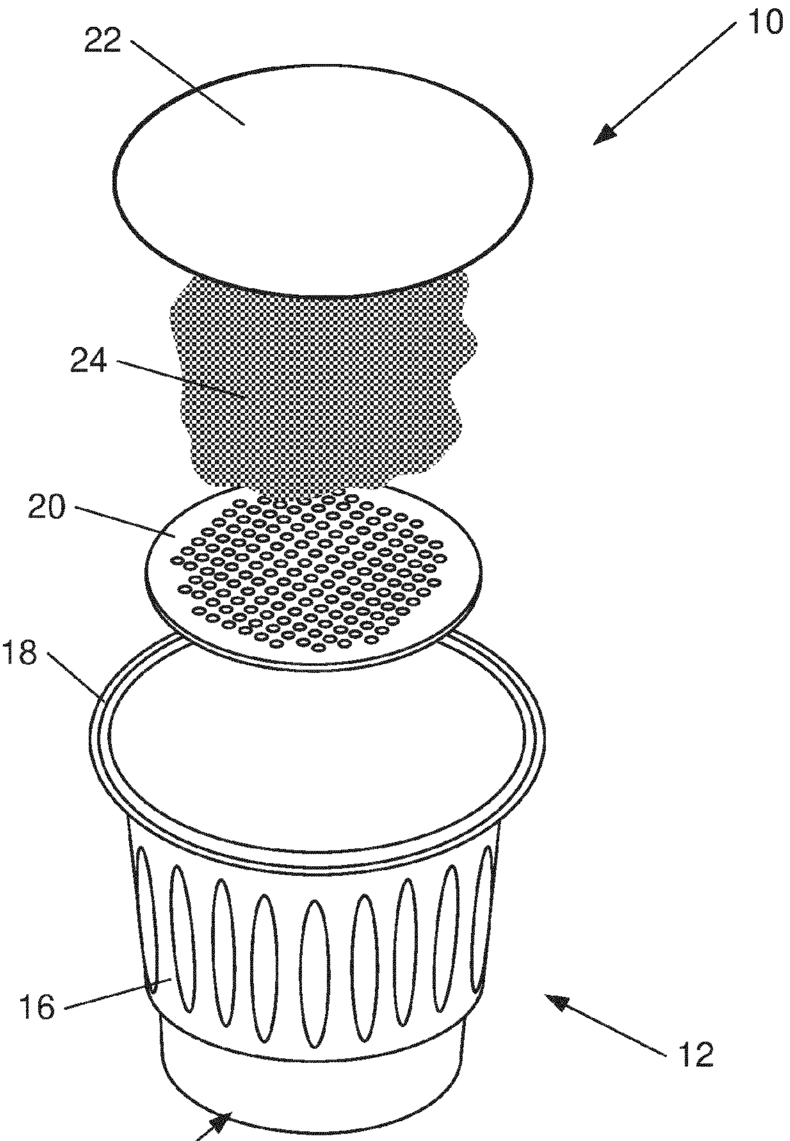

Fig.1

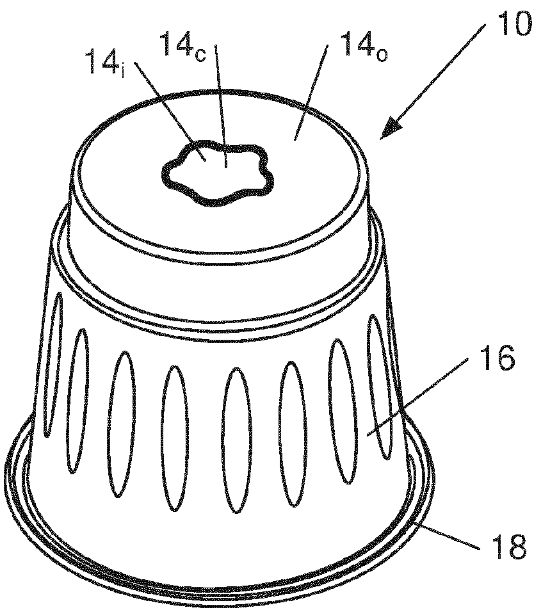

Fig.2

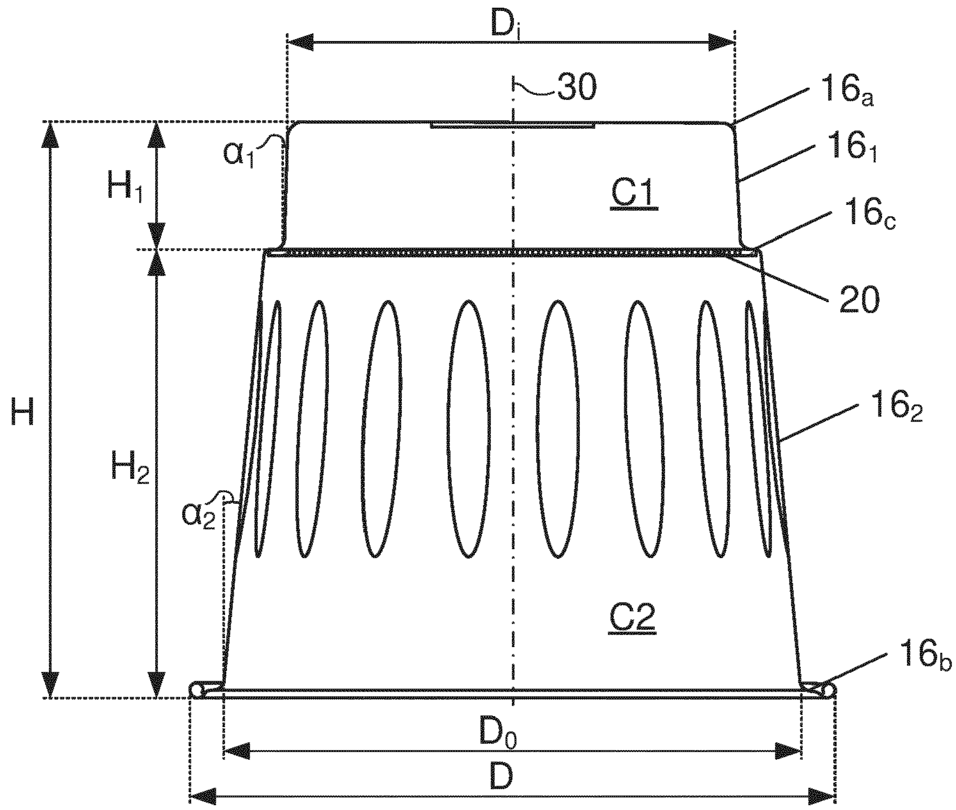

Fig. 3

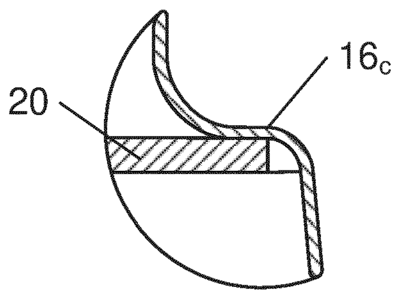

Fig. 4

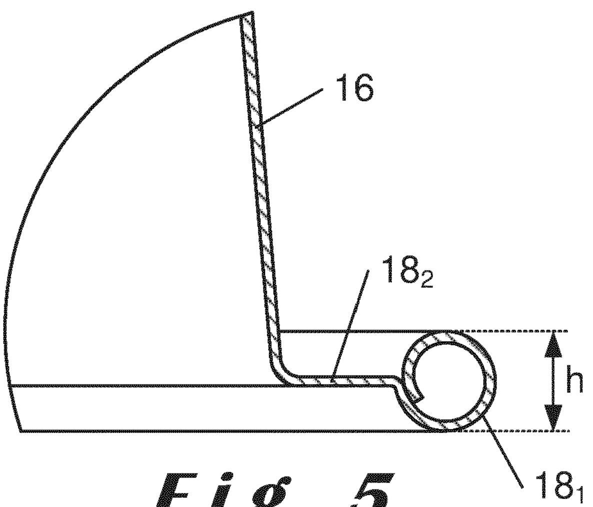

Fig. 5

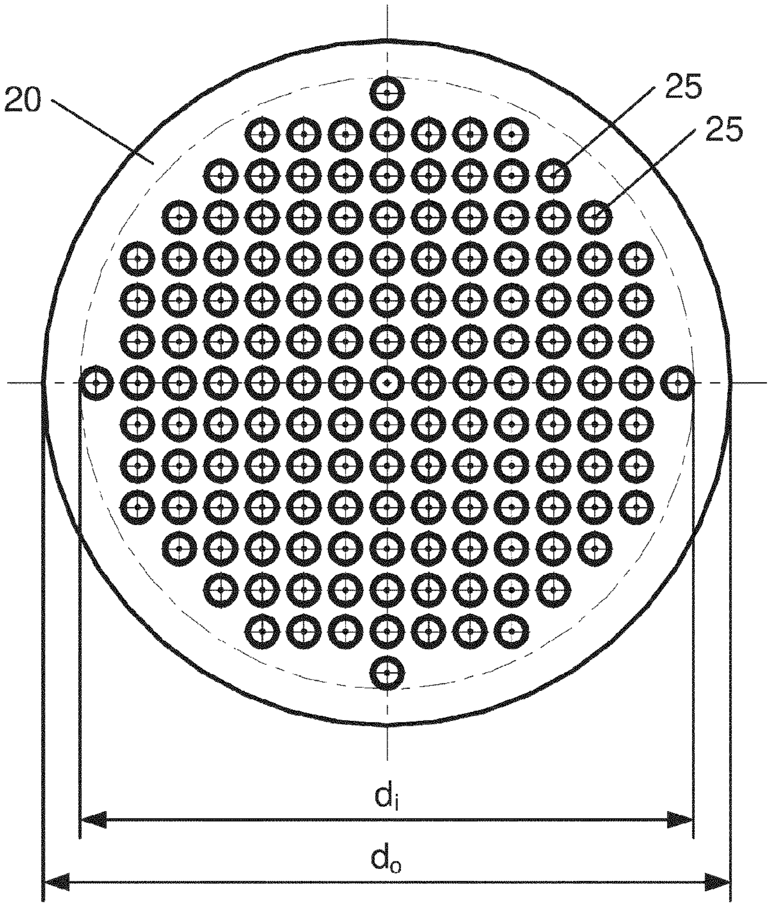

Fig. 6

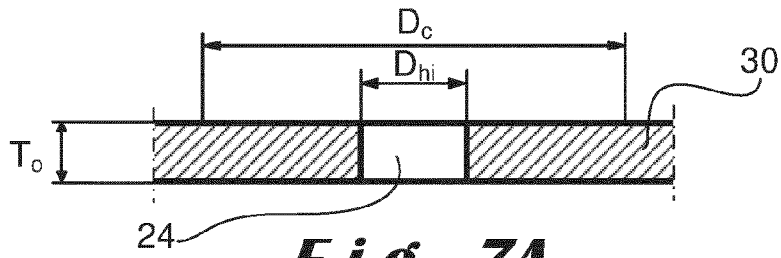

Fig. 7A

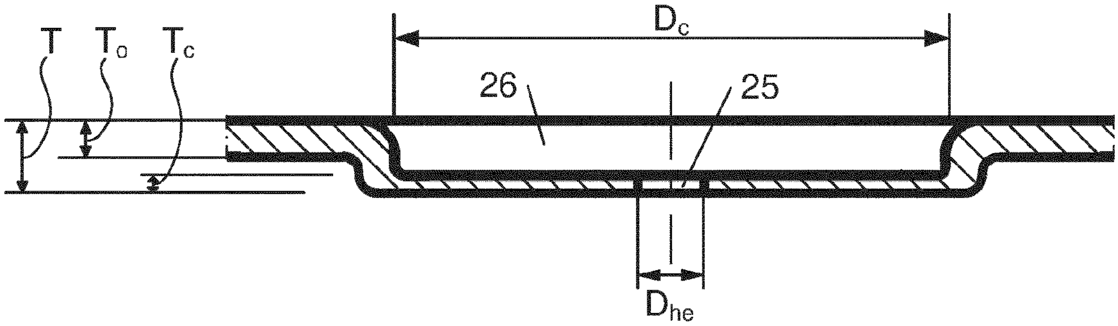

Fig. 7B

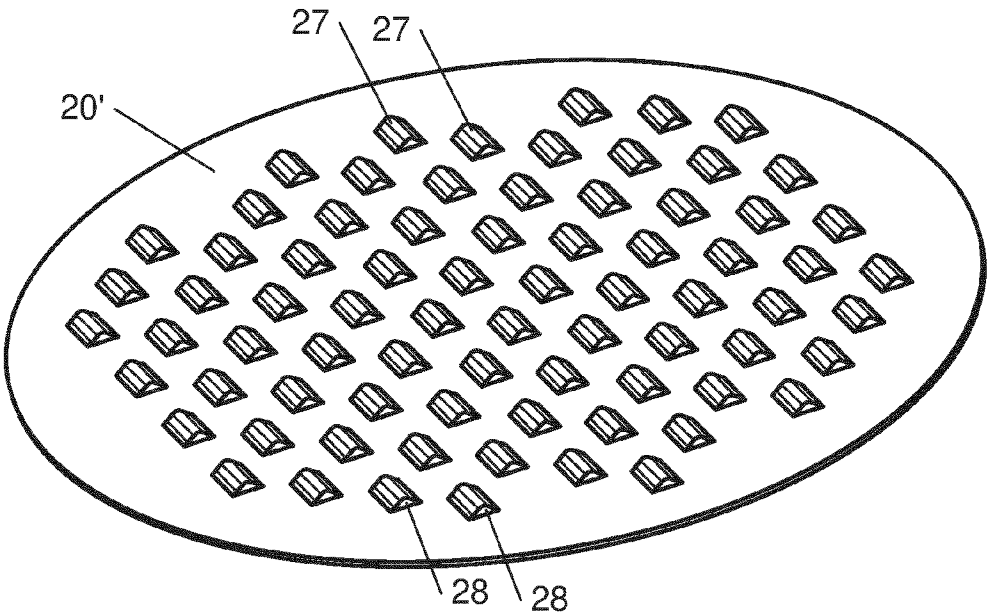

Fig. 8

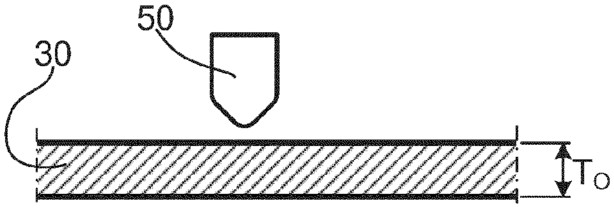

Fig. 9A

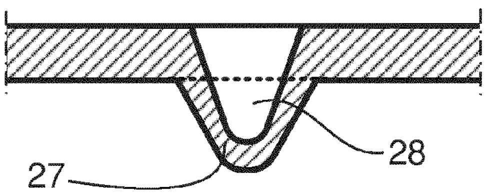

Fig. 9B

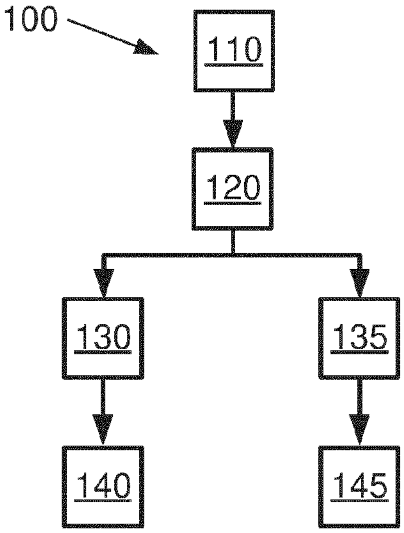

Fig. 10

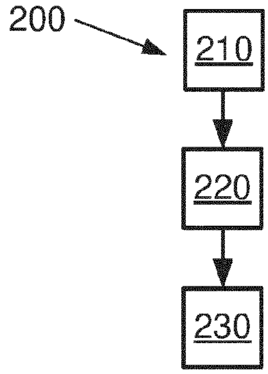

Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 8128

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	EP 0 742 691 B1 (MAXS AG [CH]) 23 September 1998 (1998-09-23) * column 9, line 10 - line 55; figure 2 * -----	11,12, 15-20 1-10,13	INV. B21D31/02 B65D85/80
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			TECHNICAL FIELDS SEARCHED (IPC)
			B21D B65B B65D

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
Munich	23 April 2024	Vesterholm, Mika

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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23-04-2024

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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