



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

(21) International Application Number:

PCT/US2014/011021

(22) International Filing Date:

10 January 2014 (10.01.2014)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/751,484	11 January 2013 (11.01.2013)	US
61/825,179	20 May 2013 (20.05.2013)	US
61/898,603	1 November 2013 (01.11.2013)	US

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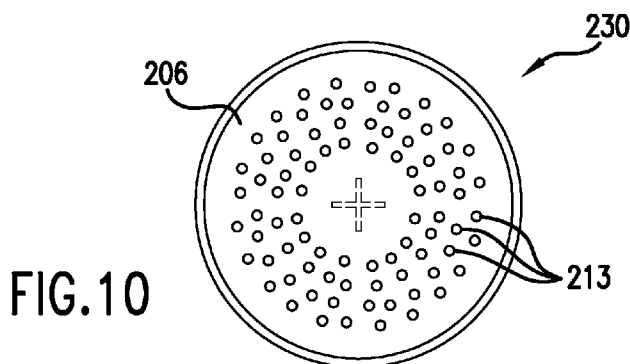
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

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(54) Title: A BEVERAGE CARTRIDGE



(57) Abstract: A beverage cartridge having a rigid filter positioned between the base of the cup and the access opening, and a second filter positioned between the rigid filter and the base of the cup where the rigid filter and second filter have a spacer between them. A powdered beverage material is positioned between the access opening and the rigid filter.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, **Published:**
KM, ML, MR, NE, SN, TD, TG).

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A BEVERAGE CARTRIDGE

FIELD OF INVENTION

5 This invention relates to a beverage cartridge to be used in an automatic brewing machine.

 The entire disclosures of all applications, patents and publications, cited herein and U.S. Provisional Application No. 61/751,484, filed on January 11, 2013, U.S. Provisional Application No. 61/825,179, filed May 20 2013, and U.S. Provisional Application No.
10 61/898,603, filed November 1, 2013, are incorporated by reference herein.

BACKGROUND OF INVENTION

 There are a number of schemes and devices for making a single beverage serving, such as a cup of coffee or tea. In one approach a disposable container fits on top of a cup
15 and has a compartment for receiving a beverage medium such as coffee with a large reservoir on top into which a person must pour boiling water. These devices are disposable but are not generally suitable for automatic coffee making or other beverage machines. Since the flow rate of beverage is generally slow, these devices are typically large relative to the volume of beverage dispensed. In addition, only the bottom area is available for
20 filtration flow and this contributes to the slowness of the filtration process. Attempts to overcome these shortcomings have met with indifferent success. In one scheme, a filter is provided in a sealed receptacle which includes a support member between the receptacle and filter to support the filter. When the filter is wetted it sags and conforms to the support member which has a hole in it to release the filtered beverage. Examples of other schemes
25 are described in the following patents: US 6,607,762; US 6,645,537; US 6,740,345; US 6,810,788; US 6,948,420; US 7,543,527; US 7,552,672; US 7,846,917; US 8,263,148 and US 8,443,717.

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SUMMARY OF INVENTION

A general objective of the present invention is to provide an improved beverage cartridge using an improved beverage filter device which is small and compact yet has a high flow rate. Another objective of the present invention is to provide an improved
5 beverage filter device.

An embodiment of the beverage filter device is comprised of two filters with distinct pore sizes and/or mesh sizes. One filter has larger pores and/or a larger mesh size than the other to retain large/course particles. The filter with the larger pore size and/or
10 mesh size is typically rigid and is referred to herein as the "rigid filter". The other filter has smaller pores or a smaller mesh size than the rigid filter to retain small/fine particles. This other filter need not be rigid and is typically soft and flexible. This other filter is referred to herein as the "second filter."

15 The beverage filter device of the invention is typically circular in shape and of a size which fits within a beverage cartridge suitable for a conventional single serve brewing machine such as a KEURIG® brewing machine. However, it is contemplated that the beverage filter device can vary widely in shape and size to conform to the interior shape of the beverage cartridge it is intended to fit into and furthermore, the beverage cartridge can
20 vary widely in shape and size as necessary for use in the particular coffee brewing machine desired.

The rigid filter is capable of filtering out course solids or sediment and establishing the water flow rate for ideal extraction and/or dissolution. To accomplish this, the rigid
25 filter has a plurality of holes/voids with their longest dimension, typically a diameter, measured at the top surface of the filter, ranging from 1/128" (0.198 mm or about 0.1 mm) to 1/8" (3.175 mm or about 3.0 mm), typically about 1/64" to 1/16" or alternatively about 0.25 mm to 1 mm, and often about 1/32" or alternatively about 0.8 mm. The holes/voids are typically circular in shape, however, they can also be other shapes, for example, square
30 shaped, "x" shaped, "star" shaped, triangular, oblong, oval or rectangular. In such cases the area of the holes/voids at the top surface of the filter is similar to that provided by the circular holes discussed above, with their widest point ranging from 1/128" (0.198 mm or

about 0.1 mm) to 1/8" (3.175 mm or about 3.0 mm), typically about 1/64" to 1/16" or alternatively about 0.25 mm to 1 mm and often about 1/32" or alternatively about 0.8 mm. In embodiments where the holes/voids are generally rectangular, oblong or oval, they preferably have a length which is at least 150% of the width.

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The holes/voids can taper from the top surface of the rigid filter to the bottom surface of the rigid filter so as to provide an increase in the area of the hole/void. An example of a typical taper is one which provides an increase in area of the hole/void within the range of 50% to 500%, more typically about 100% to about 300%.

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In some embodiments at least 4% of the top surface area of the rigid filter comprises holes or voids. More typically, 5-10% of the top surface area of the rigid filter comprises holes or voids. However, it is contemplated that up to about 75% of the top surface area of the rigid filter can comprise holes/voids, including 4% , 5%, 6% , 7%, 8% ,
15 9% ,10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65% and 70%. The more porous filters can be used where the size and shape of the filter compensates for the high flow rate.

As mentioned above, the holes can be of any shape or any pattern including
20 random shapes and/or random distributions. Where the filter has voids, they are typically of an indefinite shape.

The rigid filter may be made of any material which is solid (Tg) at 125°C and is safe to store and contact food items meant for human consumption, for example,
25 aluminum, copper, food grade polymers, rigid plastic, metal, glass, fiberglass, or wood. In most embodiments, the rigid filter is made of food grade polymers or plastics, such as PET (polyethylene terephthalate), HDPE (high density polyethylene), LDPE (low density polyethylene), LLDPE (linear low density polyethylene), PVC (polyvinyl chloride) and PP (polypropylene).

30 In some embodiments made of food grade polymers or plastics, the rigid filter may include additives or a stiffening agent to increase rigidity. The stiffening agents can be mineral or fiber fillers introduced to the polymers or plastics directly or through a heavily

loaded (mineral or fiber) food grade thermoplastic polymer. An example of such a stiffening agent is LLDPE loaded with about 75 wt.% food grade minerals such as talc or diatomaceous earth.

5 In some embodiments, the rigid filter has at least one optional reinforcing member. When used, the optional reinforcing member is typically positioned on the bottom surface of the rigid filter, i.e., the surface facing toward the second filter, so as not to interfere with the flow of liquid through the filter. In some embodiments, the optional reinforcing members have a width of between 0.1-2 millimeters, a thickness of from 0.1-2 millimeters,
10 and a height of from 0.1-2 millimeters. In some embodiments, the optional reinforcing members extend across the entire diameter of the rigid filter. In some embodiments, the reinforcing members do not extend through the middle of the rigid filter and therefore do not extend across the entire diameter of the rigid filter. In some embodiments with more than one reinforcing member, the reinforcing members intersect in the center of the rigid
15 filter.

In some embodiments, the rigid filter is dome shaped, i.e., the center portion is convex and therefore elevated relative to the perimeter. In some embodiments, the transition from the perimeter to the center of the rigid filter is smooth. In alternative
20 embodiments, the rigid filter can have various pyramid shapes, for example, a regular four sided pyramid, a truncated four sided pyramid, a five sided pyramid, or a star pyramid. In other alternative embodiments, the rigid filter is flat.

The second filter is capable of further filtering the liquid by removing smaller
25 solids from the liquid. The second filter can be made from any food grade material capable of accepting many small holes and/or voids without losing its structural integrity in resisting tears. The second filter can be soft and flexible. The holes and/or voids of the second filter must be able to maintain a flow rate sufficient to allow 8 ounces of fluid to pass through a beverage material in under two minutes, typically under 90 seconds, more
30 typically under 60 seconds (about 45 seconds) at ambient pressure. It is contemplated that flow rates below 45 seconds, such as 30 seconds or 15 seconds, can be achieved where desired.

The second filter must provide sufficient surface area and porosity to achieve these flow rates. In some embodiments, the entire surface of the second filter is covered in holes and/or voids. In typical embodiments, the size of the holes and/or voids, at their widest point, is from about 1-200 micrometers wide. This includes embodiments where the size of the holes and/or voids, at their widest point, is less than 50 micrometers. This also includes embodiments where the size of the holes and/or voids, at their widest point, is less than 20 micrometers wide.

The surface area of the second filter can vary over a wide range and suitable values are dependent on a number of variables including the number of holes in the surface in the second filter, the beverage medium to be extracted, the area defined by the perimeter of the rigid filter and the volume of space defined by the bottom surface of the rigid filter and the perimeter of the rigid filter. This space provides for positioning of the second filter prior to filtration of the extract from the beverage medium.

A second filter where the entire surface is covered in holes and/or voids that are less than 50 micrometers at their widest point, which is intended to filter the extract from coffee, which is paired with a rigid filter as shown in Fig. 1 or Fig. 10, will have a minimum surface area of about 600 mm² and a maximum surface area of about 1,500 mm². Values for the surface area of 600, 625, 650, 675, 700, 725, 750, 775, 800, 825, 850, 875, 900, 925, 950, 975, 1000, 1050, 1100, 1150, 1200, 1250, 1300, 1350, 1400, 1450 and 1500 mm² are typically selected to achieve the desired flow rate/extraction. It should be recognized that smaller surface areas and larger surface areas may be appropriate for certain beverage media where adjustments are made to the number of holes in the secondary filter, the size of the holes in the secondary filter, the area of the perimeter for the rigid filter and the volume of space under the rigid filter.

In addition to the two filters, a rigid filter and a second filter, the beverage filter device of some embodiments of the present invention comprises a spacer positioned between the rigid filter and second filter.

In some embodiments, the shape of the spacer is complementary to the shape of both the rigid filter and second filter and each filter is bonded/fused to the spacer.

The spacer can be a continuous ring positioned between the two filters connected
5 to or integrated with the perimeters of each filter, i.e. the perimeter of rigid filter is connected to or integrated with the top side of the ring and the perimeter of the second filter is connected to or integrated with the bottom side of the ring. The continuous ring assures that liquid passing through the rigid filter will not overflow the second filter. The spacer need not be a continuous ring if other measures are taken to assure the brewed
10 liquid does not overflow the second filter, such as by bonding the filters to the container wall. This will allow the circular spacer to be vented or replaced by tabs as the spacer.

The spacer prevents filtered liquid from back-flowing through the rigid filter. Where the spacer is a ring, the ring has a thickness which provides a distance of at least
15 0.5 mm between the filters, typically at least 1 mm between the filters and more typically about 3 mm. To conserve space in the beverage cartridge, the thickness of the ring is less than the radius of the ring. Typically, the ring has a thickness from 0.5 to 10 mm, for example about 0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0 or 10.0 mm.

20 It is contemplated the beverage filter device of this invention can include an optional third filter, which can be connected to the second filter by a similar spacer such as a ring.

The beverage filter device of the present invention may include an optional
25 separator which reduces the contact between the rigid filter and the second filter, i.e., separates the filters, by being positioned there-between. The shape of the separator can vary widely. The separator can be any three dimensional shape, for example, a cylinder or a polyhedron. In the embodiments illustrated in the figures, the separator is in the shape of a three dimensional cross (plus sign).

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The most important dimension of the separator is its height. It is contemplated that the width, length and thickness of the separator can vary widely with the only limitation being interference with the flow of filtered liquid.

5 In some embodiments, the separator occupies less than 50% of the total volume of space between filters, for example, less than 45%, 41%, 37%, 33%, 29%, 23%, 16%, 11%, 8%, 6%, 5%, or 2.5%. In some embodiments the separator occupies from 1%-10% of the total volume of space between filters. In some embodiments, the separator can additionally be attached to the spacer. In some embodiments, the separator is not
10 connected to the spacer and no part of the separator is within a distance to the spacer of $\frac{1}{2}$ the radius of the spacer.

The separator typically has a height equal to or greater than the thickness of the spacer. In some embodiments, the height of the separator is greater than the height of the
15 spacer plus the height of the rigid filter dome, the result of which is that the separator extends vertically beyond the spacer. This causes the center of the second filter to be extended relative to its perimeter.

In some embodiments, the separator is positioned in the center of each filter and is
20 permanently attached to at least one of the filters. In some embodiments, the separator is permanently attached or integrated into the rigid filter, typically at the center of the rigid filter. It is contemplated that the separator can be integrated into the second filter as alternative embodiment or remain loose between the filters. It is also contemplated that the separator can be integrated or permanently attached to the center of both filters.

25 When integrated into the rigid filter, the separator can optionally be integrated into the reinforcing members, where used. In some embodiments, the separator has a greater height than the reinforcing members. In some embodiments, the separator is optionally integrated into the reinforcing members with a reinforcing ring which surrounds the
30 separator. The thickness, width, and height of this reinforcing ring can vary widely.

In some embodiments, the reinforcing ring optionally has the same thickness, width, and height as the other reinforcing members. In other embodiments, the reinforcing ring optionally has the same thickness, width, and height as the separator.

5 In some embodiments, the rigid filter has hole-containing regions and regions without holes (solid or hole-less). A hole-containing region is an area of the rigid filter with regularly occurring holes. The holes in these regions typically share a common spacing between them and optionally are arranged in a repeating pattern. The holes within a particular hole-containing region are optionally the same size.

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A "hole-less" region is a space without holes (solid) that interrupts the common spacing of holes in a hole-containing region. Therefore, the space between holes in a hole-containing region is not a "hole-less region" for the purposes of this application. In some embodiments, there are multiple hole-less regions. In some embodiments the hole-less
15 region or regions define multiple hole-containing regions by completely separating at least two hole-containing regions.

In some embodiments, a circular hole-less region (solid) is positioned around the center of the rigid filter, specifically the portion of the rigid filter where its bottom surface
20 contacts the separator and/or the ring support member. In some embodiments, the center hole-less region radiates outward from the center creating a circular hole-less region with a radius of 1 to 10 millimeters. In some embodiments, at least two rectangular hole-less regions extend from the circular hole-less region outward to the perimeter of the rigid filter. In some embodiments, the hole-less regions conform to those regions with the
25 separator and/or with any of the reinforcing members, including a reinforcing ring beneath the surface of the rigid filter. In some embodiments the hole-less region also occurs in close proximity to the separator or any region with reinforcing members, including the reinforcing ring, for example from 0.1-2 millimeters away from the separator or any region with reinforcing members.

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In some embodiments, the rigid filter has a plurality of holes of an average diameter less than or equal to the average particle size of the beverage medium but large

enough to allow the flow of liquid through them at a rate greater than 8 fluid ounces/for 2 minutes at ambient pressure. In some embodiments, the holes are located only in a region of the rigid filter beginning 1mm - 5mm from the center of the filter and ending 1mm-5mm from the edge of the filter.

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In some embodiments the holes are sized and patterned with the following considerations:

1. The total available open area (size of the holes and number of holes) - to maintain a desired flow rate for the extract formed.
- 10 2. The spacing of the holes relative to themselves -- which is designed to minimize blockage and regulate flow to the second filter.
3. The spacing of the holes relative to the low point of the rigid filter (the perimeter for a rigid filter with a convex shape), which is designed to create a particulate trap area.
- 15 4. The spacing of the holes relative to the high point of the rigid filter (the center for a rigid filter with a convex shape), which is designed to provide the desired extraction from the beverage medium. An example of a suitable hole pattern is illustrated in Figure 2.

20 For example, in some embodiments, the size of the holes in the rigid filter are from 0.1 mm – 3 mm in diameter. In other embodiments the size of the holes can be 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.5, 2, and 2.5 mm (all measurements are in millimeters).

In some embodiments, the minimum and maximum number of holes is limited by
25 the following:

1. Geometry: too few holes inhibits flow through the capsule and too many limits the extraction and particulate capture and also floods the second filter,
2. Residency Time: too few holes increases extraction time and over extracts the beverage medium. Too few holes decreases the extraction time and under
30 extracts the beverage medium. In some embodiments, the extraction time is typically from 20-80 seconds (8 ounces), more typically 45-60 seconds (8 ounces), in conventional beverage brewing machines.

The second filter is typically a soft, flexible liquid permeable filter. Preferably, the second filter is made of a food grade material. More preferably, the second filter is made of a food grade material that when used as a filter results in a liquid that is safe for human consumption. Examples include conventional materials approved by the FDA for use as filters such as polyester and nylons which can be bonded to other components by heat sealing or ultrasonic bonding/welding. In some embodiments the second filter is elastic or semi-elastic.

Typically, the second filter is capable of further filtering the liquid from the rigid filter to a state where the number and size of the unsolubilized particles in the liquid are minimized to a desired level, which is typically at a level that they are undetectable as solids or minimally detectable as solids.

In some embodiments, the second filter is 12 oz. needled; self-supported polyester felt with a thickness of about 0.055" $\pm$ 0.005", 1.50" OD.

In some embodiments, the second filter is a polymer screen or mesh, which can comprise a food grade woven polyester or nylon with a mesh size of 60 mesh/ inch, 80 mesh/ inch, 100 mesh/ inch, 110 mesh/ inch, 120 mesh/ inch, 135 mesh/ inch, 160 mesh/ inch, 180 mesh/ inch, 200 mesh/ inch, 230 mesh/ inch, 250 mesh/ inch, 280 mesh/ inch, 305 mesh/ inch, 355 mesh/ inch, 380 mesh/ inch, 420 mesh/ inch or 460 mesh/ inch.

In some embodiments, the second filter is capable of filtering particles less than 0.5, 0.4, 0.3, 0.2, 0.1, 0.09, 0.08, 0.07, 0.06, 0.05, 0.04, 0.03, 0.02, 0.03, 0.02, 0.01, or 0.005 mm in diameter (all measurements are in millimeters).

In some embodiments the holes and/or voids in the second filter are of a size to prevent particles larger than approximately 60-80 micrometers from passing through.

In some embodiments the second filter is positioned between 1mm – 10mm from the base of the cartridge.

The beverage filter device is designed to fit into a single serve beverage cartridge of this invention. In typical embodiments, the beverage cartridge is generally frustoconically shaped and comprises a pierceable lid, and a cup with a liquid impermeable base and side walls which are pierceable. The base has a predetermined
5 shape which can be flat, substantially flat, concave, or convex, but is typically substantially flat.

The cup has an access opening at the end opposite to the base that is covered by the pierceable lid. The lid is pierceable to accommodate the injection of liquid to combine
10 with a beverage medium within the cup to form an extract (brewed beverage). Suitable materials for the lid include metallic/polymer laminates well known in the art.

A beverage filter device of this invention is secured inside the cartridge to the side walls. A beverage medium is located in the cup between the beverage filter device and the
15 lid.

The cartridge is capable of allowing a standard single serve beverage machine such as one manufactured under the trademark "KEURIG®" to pierce the lid and base of the cartridge and inject liquid through the lid on the access opening to the beverage medium
20 and allow the outflow of an extract (brewed beverage) at the base. The beverage filter device is capable of filtering out coarse sediment and establishing the water flow rate for ideal extraction and/or dissolution. After the liquid passes through the rigid filter and second filter, it exits through the hole in the base of the cup.

25 For the purposes of this application, a beverage medium refers to any solid or semi-solid substance with components that are soluble or dispersed in water or other aqueous solutions and when combined with water or other aqueous solution forms an extract (brewed beverage) fit for human consumption. For the purposes of this application, a beverage medium can include ground coffee beans, ground cocoa beans, tea
30 leaves or other plant matter that when combined with water or other aqueous solution forms an extract or mixture (brewed beverage) fit for human consumption. The beverage medium can also include flavorings and vitamins, both natural and artificial.

In some embodiments, the cup of the cartridge has a frustoconical shape. The cup is fully enclosed and sealed by a lid with the beverage filter device of this invention inside. The cup may be made of any liquid impermeable materials that are safe to store items
5 meant for human consumption. In some embodiments, the cup is made of a rigid material, for example, plastic used in conventional single serve beverage machines. In other embodiments, the cup and lid may be fabricated from any commercially available liquid impermeable materials, including plastics, papers, metals such as aluminum, etc. An example of a suitable material is polyethylene/ethyl vinyl alcohol/polystyrene. Similar
10 materials are also suitable. The cup and lid may optionally include an oxygen barrier layer.

In some embodiments, the cup has at least one inset, indentation or protrusion in its side walls to secure the beverage filter device of this invention. The insets, indentations or
15 protrusions form features referred to herein as a lip or a seat.

The seat in the cup is an inset, indentation, or protrusion in the side walls of the cup positioned below the beverage filter device. The beverage filter device can optionally rest on top of the seat inside the cup or in some embodiments, optionally be secured to the
20 seat inside the cup. In some embodiments, this relationship ensures that the filter is correctly oriented in a straight linear trajectory between the base and the access opening of the cup. In some embodiments, the seat is an indentation in the side walls that functions as an optional resting surface for the beverage filter device by allowing the ring of the
beverage filter device to optionally rest on top of it.

25 In some embodiments, the bottom edge of the base of the ring of the beverage filter device comes to a point referred to herein as a spike. The spike serves to aid assembly of beverage filter device by providing a bonding site for the second filter. Where present, the spike optionally rests on the top of the seat. In some embodiments the spike does not
30 touch the seat.

In some embodiments, an optional protrusion of the cup wall forms a cavity on the inner surface of the cup wall that is referred to herein as a lip. The optional lip is positioned to align with an optional rim on the beverage filter device when the beverage filter device is positioned in the cup. In some embodiments, the lip receives the rim of the filter device in a male/female style connection where the lip is the female component and the rim is the male component and functions to ensure the correct alignment of the filter within the cup. Additionally, in some embodiments, this interaction acts to prevent the beverage filter device from moving upward in the cup. In some embodiments, this interaction acts as the primary locking mechanism which secures the filter into the cup. In some embodiments the beverage filter device can be bonded to one or both of the indentations. The cooperation of the lip and seat effectively prevent the beverage filter device from moving out of position within the cartridge and optionally prevent either or both its upward or downward movement.

In some embodiments the seat/lip is positioned near the bottom of the capsule, i.e., in the bottom 10% of the capsule. In some other embodiments the seat/lip can occur anywhere along the side walls where positioning will form a chamber of a volume that will allow the storage of the beverage medium above the rigid filter and where the second filter will not directly contact the base of the cartridge before or during a filtration step.

In some embodiments, the seat is a protrusion that forms a cavity that secures the filter device. In some embodiments, beverage filter device is held in the seat and/or lip by friction fit. In some other embodiments, the beverage filter device is secured to the seat with adhesive or bonded to the seat, for example, by sonic welding or heat melt. In some alternative embodiments, a conventional adhesive is used instead of a seat and/or lip to secure the filters to the sidewall without insets, indentations or protrusions or they are heat-fused or otherwise bonded to the sidewalls. In some embodiments the spacer functions to help lock the beverage filter device in place to the side wall. This locking can be achieved by a friction fit between the spacer and the side-walls or lip or by adhesion or heat-fusion of the spacer to the sidewall.

In some embodiments, the bottom of the spacer contacts and is supported by the seat in the cup. Specifically, the bottom surface of the spacer is bonded to the second filter and therefore the second filter surface contacts the surface of the seat. However, the spacer provides the structural support of the beverage filter device on the seat.

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The beverage filter device is arranged so that the rigid filter is the top filter. The rigid filter faces the beverage medium and the lid. The spacer helps secure the beverage filter device to the side walls. The second filter is the bottom filter and faces the bottom/base of the cartridge.

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In some embodiments, the rigid filter is convex with the convex side facing towards the access opening. This design aids the filtering process and optimizes the available volume of water passing through the beverage medium.

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The beverage filter device functions as a complete filtration solution inside the cartridge. The beverage filter device will primarily be used to filter the extract (brewed beverage) formed from the beverage medium. In a typical embodiment, the capsules are compatible with standard single serving brewers, for example, KEURIG® Brewer, which is designed to accept individual single-serve capsules of a particular size and shape.

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Other objects, features and advantages will occur to those skilled in the art from the description herein.

Brief Description of the Drawings

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FIG. 1 is a top perspective view of a beverage filter device.

FIG. 2 is a top view of a beverage filter device.

FIG. 3 is a side view of a beverage filter device.

FIG. 4 is a bottom view of a beverage filter device.

FIG. 5 is a bottom perspective view of a beverage filter device.

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FIG. 6 is a bottom perspective view of another beverage filter device.

FIG. 7 is a top view of a beverage filter device inside of the cartridge.

FIG. 8 is a side sectional view of a beverage filter device inside of the cartridge.

FIG. 9 is a bottom view of another beverage filter device.

FIG. 10 is a top view of another rigid filter.

FIG. 11 is a side view of a rigid filter of Fig. 10.

FIG. 12 shows another beverage cartridge (211) of the current invention.

5 FIG. 13 is a top view of another beverage filter device.

FIG. 14 is a side view of the beverage filter device of FIG 13.

FIG. 15 is a side sectional view of another cartridge with a beverage filter device.

FIG. 16 is an expanded view of an area of a cartridge designated in FIG 15.

10 Detailed Description of the Drawings

Figure 1 shows a top perspective view of a beverage filter device 1. Beverage filter device 1 is made up of a rigid filter 2 positioned on top of a spacer 4 which is positioned on top of a second filter 3. In the embodiment shown, the spacer 4 is a ring that
15 extends around the perimeters of the rigid filter 2 and second filter 3 and is connected or bonded to both filters (2 and 3). On the outside edge portion of rigid filter 2 is rim 9, which is optional. The rigid filter 2 has holes 5 in its surface. Rigid filter 2 also includes optional reinforcing members 6, optional reinforcing ring 7, and optional separator 8 below the top surface 101.

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Figure 2 shows a top view of the beverage filter device 1. The top surface 101 of the rigid filter 2 without holes is optional region 19. Region 19 includes the center of rigid filter 2 and areas that correspond to the location of structures on the bottom surface of the rigid filter 2. These structures are for example, the reinforcing members 6, reinforcing
25 ring 7, and separator 8.

Figure 3 shows a side view of the beverage filter device 1. In the embodiment shown in figure 3, the top surface 101 of rigid filter 2 has an optional dome shape. Figure 3 also shows second filter 3 which is connected or bonded to the perimeter of spacer 4. Spacer 4 is also connected or bonded to the perimeter of the rigid filter 2; however, the rim
30 9 of rigid filter 2 extends slightly beyond the surface of spacer 4. In the embodiment

shown in Figure 3, the separator 8 has sides 102 that optionally taper toward the center as they extend away from the bottom of rigid filter 2.

Figure 4 shows a bottom view of beverage filter device 1. In the embodiment shown, the separator 8 is aligned with the reinforcing members 6. Additionally, the diameter of the reinforcing ring 7 is defined by the length of the separator 8. In the embodiment shown the second filter 3 is optionally loose, i.e. there is more filter material than is need to cover the area whose perimeter is defined by the spacer 4. This excess material provides more surface area for filtration than if the second filter were stretched taught across the area whose perimeter is defined by the spacer 4. In some embodiments, the second filter 3 is connected or bonded to the separator 8, in other embodiments the second filter 3 is not connected or bonded to the separator 8.

Figure 5 shows a bottom perspective view of the beverage filter device 1. In each embodiment shown, the reinforcing members 6 and the reinforcing ring 7 have heights that are optionally less than the height of the spacer 4. In embodiments shown, the separator 8 has a height optionally greater than the height of spacer 4. In some embodiments, the reinforcing members 6 and the reinforcing ring 7 have the same height.

Figure 6 shows a bottom perspective view of the alternative beverage filter device 10. In the alternative embodiment, the second filter 3 is stretched taught. In these embodiments, the second filter 3 contacts the separator 8 and is optionally bonded or connected to it.

Figure 7 shows a top view of the beverage filter device inside of cartridge 11 with cup 15 and beverage filter device 1. The top surface 101 of rigid filter 2 of beverage filter device 1 is flush with the side walls 14 of the cup 15.

Figure 8 shows a sectional view of beverage filter device 1 inside of the cartridge 11. In some embodiments, cartridge 11 is generally frustoconically shaped and comprises a cup 15 with a liquid impermeable pierceable base 16 and side walls 14. The base has a predetermined shape which can be flat, substantially flat, concave, or convex, but is

typically substantially flat. The cartridge has an access opening 17 at the end opposite to the base 16 that is covered by a pierceable lid 18. The cup 15 of cartridge 11 has an optional seat 12 which, in the embodiment shown, is an indentation in the side walls 14 of the cup 15 positioned below the beverage filter device 1. The seat 12 functions as a support for the beverage filter device 1 by allowing the spacer 4 of the beverage filter device 1 to rest on top of it. In the embodiment shown, an optional protrusion of the cup wall forms a cavity on the inner surface of the cup wall which is lip 13. The lip 13 is positioned to align with the rim 9 of the beverage filter device when the beverage filter device 1 is positioned on seat 12 of cup 15. The lip 13 receives the rim 9 of the beverage filter device in a male/female style connect where the lip 13 is the female component and the rim 9 is the male component.

Figure 9 shows a bottom view of an alternative embodiment of beverage filter device 1. In the embodiment shown optional reinforcing members 6 and the reinforcing ring 7 have been removed however, separator 8 remains. Additionally, the only hole-less region, region 19 is in the center of the rigid filter corresponding to the region occupied by the separator on the underside.

Figure 10 shows an alternative embodiment of a filter device 230 with the holes 213 of the ridge filter 206 in a desired pattern.

Figure 11 shows an alternative embodiment of a beverage filter device 230 having a rigid filter 206 of figure 10 and a second filter 207. Figure 11 also shows rim 209.

Figure 12 shows an alternative embodiment of a beverage cartridge 201 of the current invention comprising a cup 202 with side walls 203 and a pierceable base 204, and an access opening 205. A rigid filter 206 and a second filter 207 of a beverage filter device are positioned between the base 204 of the cup and the access opening 205. A pierceable lid 221 is positioned over access opening 205. A beverage medium 210 is positioned between the access opening 205 the rigid filter 206.

The rigid filter 206 and second filter 207 have a space 208 between them provided by a spacer 214. The spacer 214 also secures the rigid filter 206 and second filter 207 to each other. Rigid filter 206 is secured in position by a lip 211 that is inset in sidewalls 203 and an optional seat 212 which is an inset in side walls 203. The lip 211 protrudes
5 inwardly from the side wall 203 and traps the rim 209 under it, preventing the upward movement of rigid filter 206 and second filter 207. During assembly, the rim 209 of the spacer 214 is pushed under the lip 211. The seat 212 prevents the downward movement of the rigid filter 206 and second filter 207. In some embodiments, the bottom surface of the spacer 214 rest against the seat 212. In some embodiments they only contact, for
10 example, during manufacturing.

The beverage cartridge 201 also has an optional valve 215 in lid 221 that is capable of releasing pressure from inside of beverage cartridge 201.

15 Figure 13 illustrates a top view of another embodiment of the filter device 330. Figure 13 show the rigid filter 306. The holes 313 of the filter are round and arranged in quadrants comprising four rows of holes around the center of the filter.

Figure 14 illustrates a side view of filter device 330 showing the rigid filter 306
20 second filter 307 and optional spike 320.

Figure 15 illustrates a cutaway view of a beverage cartridge 301 which includes a filter device and a cup 302 with side walls 303 and a pierceable base 304, and an access opening 305. A pierceable lid 321 is positioned over access opening 305 shown with
25 optional valve 315. A beverage medium 310 is positioned between the access opening 305 and the rigid filter 306.

A rigid filter 306 and a second filter 307 are positioned between the base 304 of the cup and the access opening 305. The rigid filter 306 and second filter 307 have a
30 space 308 between them provided by spacer 314. The spacer 314 also secures the rigid filter 306 to the second filter 307. Additionally, the rim 309 of the spacer 314 acts as a male member and interlocks with the lip 311 which acts as a female member and this

interlocking secures rigid filter 306 and second filter 307 to the side walls 303. The seat 312 is an indentation in the side walls 303 which provides a stop for the downward movement of the filters, for example, during manufacturing. The spike 320 is positioned along the bottom edge of the spacer 314. The spike 320 may temporary contact the seat 312 in some instances, for example, during manufacturing; however, generally, the spike 320 does not contact the seat 312.

Figure 16 is a zoomed in view of the area designated in figure 15. Figure 16 better shows the interaction between the lip 311 and the rim 309. Figure 16 also better shows the positioning of spike 320 and seat 312 with space 322 between the spike 320 and the seat 312.

The following are aspects of the present invention

- Aspect 1. A beverage cartridge comprising:
- A. a cup having a pierceable base with side walls that extend from said pierceable base to form an enclosure with an access opening opposite the pierceable base,
 - B. a beverage filter device positioned between the pierceable base of the cup and the access opening comprising a rigid filter, a second filter and a spacer between the rigid filter and the second filter connected to both the rigid filter and second filter, wherein the rigid filter is positioned closer to the access opening than said second filter,
 - C. a pierceable lid covering the access opening, and
 - D. a beverage medium positioned in the cup between the access opening and the beverage filter device.
- Aspect 2. The beverage cartridge of Aspect 1, wherein the rigid filter additionally includes a rim at its periphery and the beverage filter device is secured in position by a lip and a seat in the side walls of the cup wherein the lip is positioned to align with the rim at the periphery of the rigid filter and the seat is positioned below the beverage filter device.
- Aspect 3. The beverage cartridge of Aspect 1, wherein the rigid filter is convex towards the access opening.

Aspect 4. The beverage cartridge of Aspect 1, wherein the rigid filter has holes positioned in an area beginning 1mm - 5mm from the center of the rigid filter and ending 1mm-5mm from the edge of the rigid filter.

5

Aspect 5. The beverage cartridge of Aspect 4, wherein size of the holes and/or voids in the rigid filter are from 1/64" to 1/16" in diameter and the size of the holes and/or voids in the second filter are from about 1-200 micrometers.

10 Aspect 6. The beverage cartridge of Aspect 1, wherein the beverage medium is coffee or tea.

Aspect 7. The beverage cartridge of Aspect 1, wherein the second filter is positioned between 1mm -- 10mm from the base of the cup.

15

Aspect 8. The beverage cartridge of Aspect 1, wherein the spacer has a thickness of from 1 mm to 10 mm and provides a distance of at least 1 mm between said rigid filter and said second filter.

20 Aspect 9. A beverage filter device comprising:

A. a rigid filter with a plurality of holes and/or voids that are from 0.1mm -- 3mm at their widest point,

B. a second filter with a plurality of holes that are from 1-200 micrometers wide at their widest point, and

25 C. a spacer which has a thickness of from 1 mm to 10 mm that separates said rigid filter from said second filter by a distance of at least 1 mm, while providing a connection between said rigid filter for said second filter to form a unitary piece, wherein said beverage filter device is adapted for use in a single serve beverage cartridge.

30 Aspect 10. The beverage filter device of Aspect 9 which additionally comprises a separator positioned between the rigid filter and second filter that is bonded to

at least one of the rigid filter or the second filter to separate the rigid filter and second filter.

Aspect 11. The beverage filter device of Aspect 9 wherein the rigid filter is
5 convex in the direction away from the second filter.

Aspect 12. The beverage filter device of Aspect 9 wherein the bottom surface of the rigid filter has reinforcing members.

10 Aspect 13. The beverage filter device of Aspect 9 wherein the bottom surface of the rigid filter has a circular reinforcing member.

Aspect 14. The beverage filter device of Aspect 12 wherein the rigid filter has a plurality of holes in a pattern that forms at least one hole-less region on the surface.

15 Aspect 15. The beverage filter device of Aspect 14 wherein the center of said rigid filter is a hole-less region.

Aspect 16. The beverage filter device of Aspect 14 wherein the hole-less region
20 conforms to regions of the rigid filter where the bottom surface of the rigid filter has a reinforcing member, a reinforcing ring, or a separator.

Aspect 17. The beverage filter device of claim 9 wherein the second filter is a polymer mesh with uniform pores.

25 Aspect 18. The beverage filter device of Aspect 9 wherein the second filter is a polymer mesh with non- uniform pores.

Aspect 19. The beverage filter device of Aspect 10 wherein the length of the
30 separator is greater than the thickness of the spacer.

Aspect 20. The beverage filter device of Aspect 9 wherein the bottom edge of the spacer comprises a spike.

Aspect 21. The beverage filter device of Aspect 10 wherein the center of the
5 second filter is attached to said separator.

Aspect 22. A beverage cartridge which has a beverage filter device of Aspect 9.

Aspect 23. The beverage cartridge of Aspect 1 wherein the lid has a valve that
10 is capable of releasing pressure from the inside of said cartridge.

Aspect 24. The beverage cartridge of Aspect 9, wherein a bottom edge of the spacer of the filter device does not contact said seat in the side walls of the cup.

Aspect 25. A rigid filter having which has a domed shape and a plurality of
15 holes and /or voids that are from 0.1mm – 3mm at their widest point, wherein said rigid filter is adapted for mounting in a single serve beverage cartridge having an access opening, wherein said rigid filter is convex in the direction toward said access opening when mounted in said single serve beverage cartridge.

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Aspect 26. A rigid filter of Aspect 25 having a plurality of holes in a pattern that forms a hole-less region in the center of said rigid filter and at the periphery of said rigid filter.

Aspect 27. The rigid filter of Aspect 25 having a plurality of holes positioned
25 in an area beginning 1mm - 5mm from the center of the rigid filter and ending 1mm-5mm from the edge of the rigid filter.

Aspect 28. The rigid filter of Aspect 27 having a plurality of holes of from
30 1/64" to 1/16" in diameter.

WHAT IS CLAIMED:

1. A beverage cartridge comprising:
 - A. a cup having a pierceable base with side walls that extend from said pierceable base to form an enclosure with an access opening opposite the pierceable base,
 - B. a beverage filter device positioned between the pierceable base of the cup and the access opening comprising a rigid filter, a second filter and a spacer between the rigid filter and the second filter connected to both the rigid filter and second filter, wherein the rigid filter is positioned closer to the access opening than said second filter,
 - C. a pierceable lid covering the access opening, and
 - D. a beverage medium positioned in the cup between the access opening and the beverage filter device.
2. The beverage cartridge of claim 1, wherein the rigid filter is convex towards the access opening.
3. The beverage cartridge of claim 1, wherein the rigid filter has holes positioned in an area beginning 1mm - 5mm from the center of the rigid filter and ending 1mm-5mm from the edge of the rigid filter.
4. The beverage cartridge of claim 3, wherein size of the holes and /or voids in the rigid filter are from 1/64" to 1/16" in diameter and the size of the holes and/or voids in the second filter are from about 1-200 micrometers.
5. The beverage cartridge of claim 1, wherein the beverage medium is coffee or tea.
6. The beverage cartridge of claim 1, wherein the second filter is positioned between 1mm – 10mm from the base of the cup.
7. The beverage cartridge of claim 1, wherein the spacer has a thickness of from 1 mm to 10 mm and provides a distance of at least 1 mm between said rigid filter and said second filter.

8. A beverage filter device comprising:
 - A. a rigid filter with a plurality of holes and /or voids that are from 0.1mm – 3mm at their widest point,
 - B. a second filter with a plurality of holes that are from 1-200 micrometers wide at their widest point, and
 - C. a spacer which has a thickness of from 1 mm to 10 mm that separates said rigid filter from said second filter by a distance of at least 1 mm, while providing a connection between said rigid filter for said second filter to form a unitary piece, wherein said beverage filter device is adapted for use in a single serve beverage cartridge.
9. The beverage filter device of claim 8 wherein the rigid filter is convex in the direction away from the second filter.
10. The beverage filter device of claim 9 wherein the rigid filter has a plurality of holes in a pattern that forms at least one hole-less region on the surface.
11. The beverage filter device of claim 10 wherein the center of said rigid filter is a hole-less region.
12. The beverage filter device of claim 8 wherein the second filter is a polymer mesh with uniform pores.
13. The beverage filter device of claim 8 wherein the second filter is a polymer mesh with non- uniform pores.
14. The beverage filter device of claim 8 wherein the bottom edge of the spacer is a spike.
15. A beverage cartridge which has a beverage filter device of claim 8.

16. The beverage cartridge of claim 1 wherein the lid has a valve that is capable of releasing pressure from the inside of said cartridge.
17. The beverage cartridge of claim 8, wherein a bottom edge of the spacer of the filter device does not contact said seat in the side walls of the cup.
18. A rigid filter having which has a domed shape and a plurality of holes and/or voids that are from 0.1mm – 3mm at their widest point, wherein said rigid filter is adapted for mounting in a single serve beverage cartridge having an access opening, wherein said rigid filter is convex in the direction toward said access opening when mounted in said single serve beverage cartridge.
19. A rigid filter of claim 18 having a plurality of holes in a pattern that forms a hole-less region in the center of said rigid filter and at the periphery of said rigid filter.
20. The rigid filter of claim 18 having a plurality of holes positioned in an area beginning 1mm - 5mm from the center of the rigid filter and ending 1mm-5mm from the edge of the rigid filter.
21. The rigid filter of claim 18 having a plurality of holes and/or voids of a size from 1/64" to 1/16" in diameter.

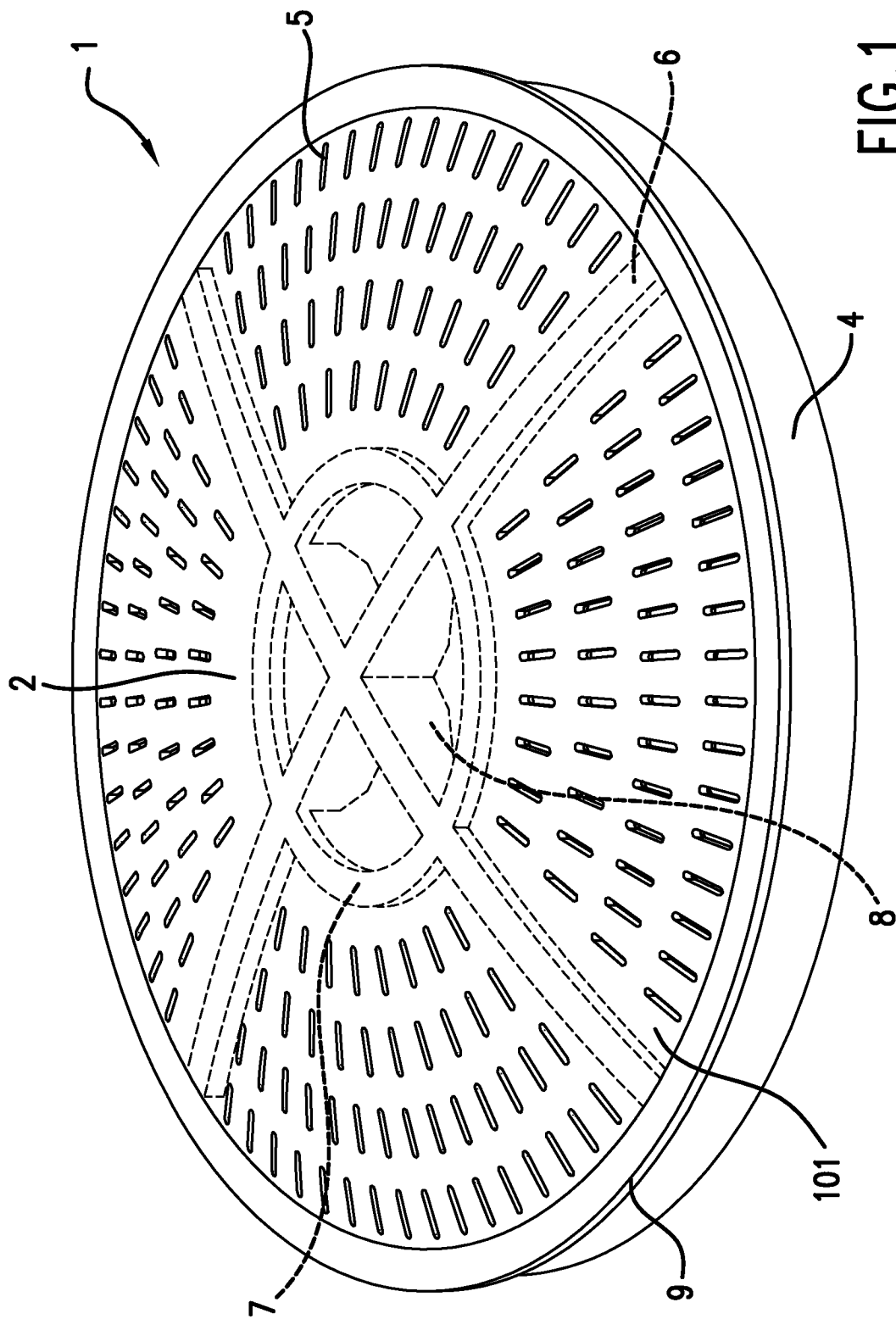
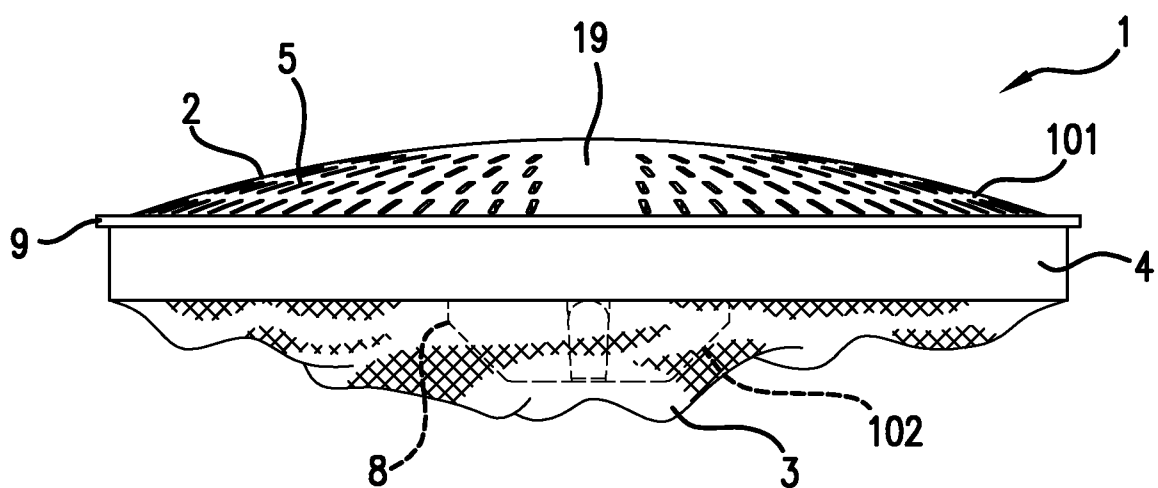
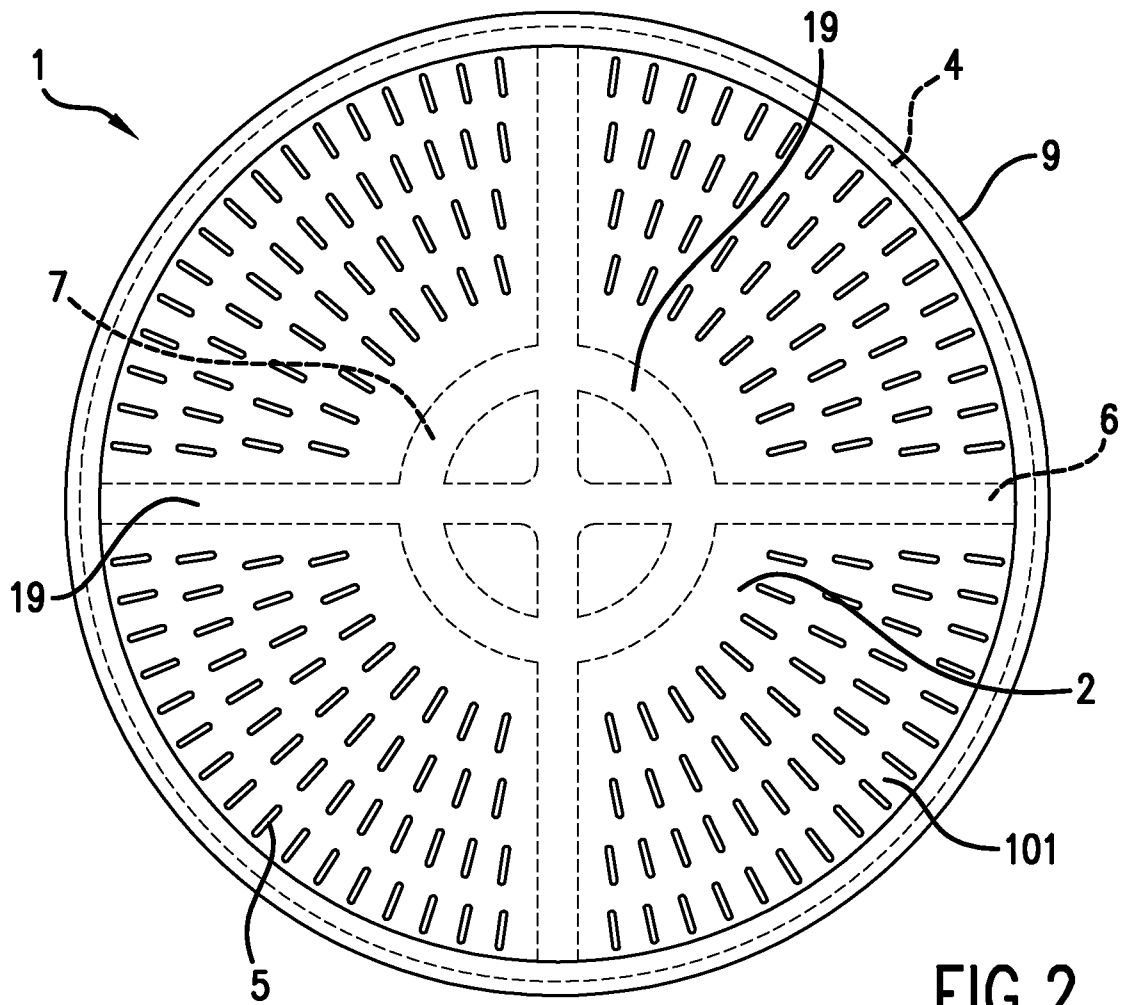


FIG. 1



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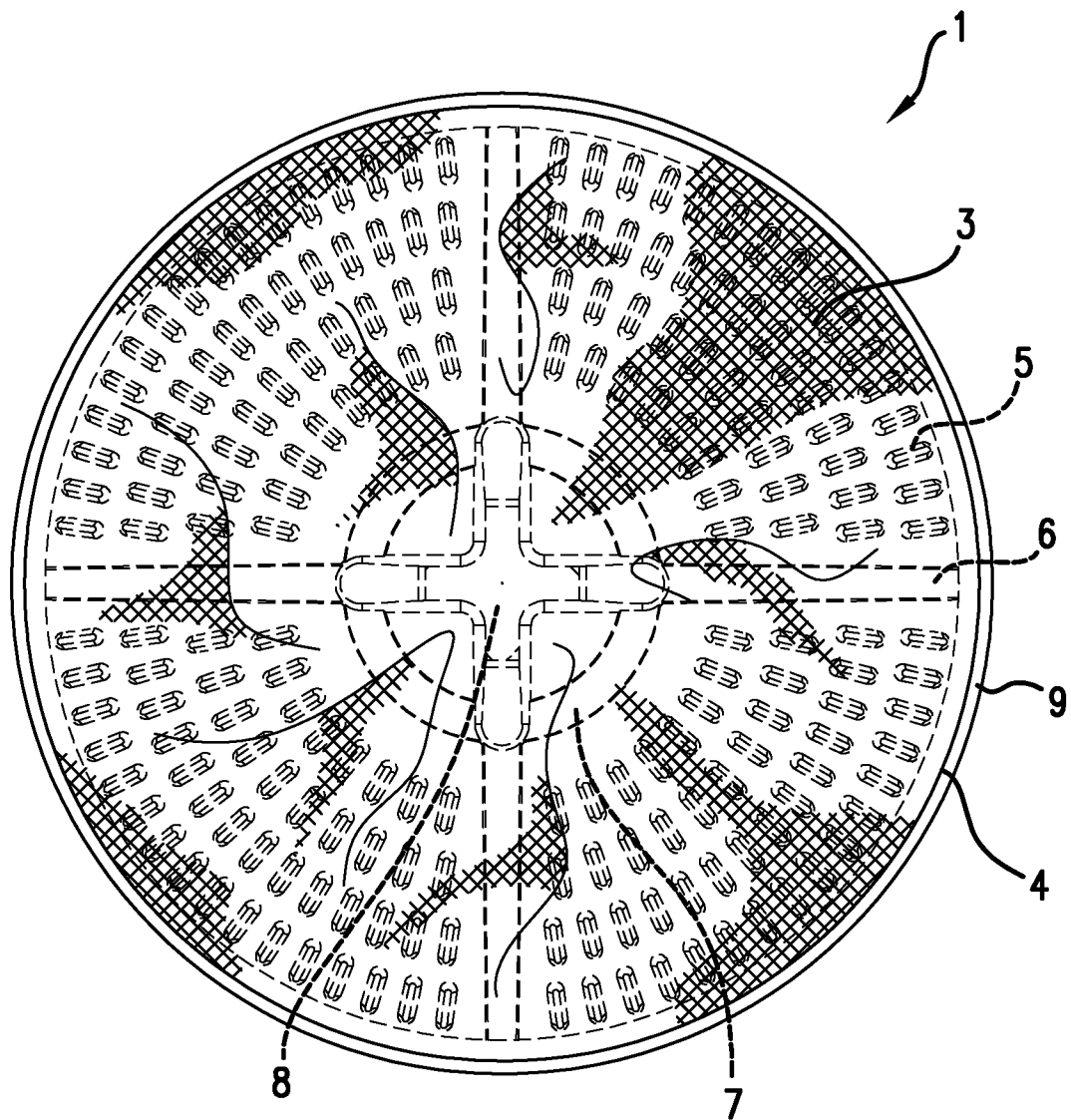


FIG. 4

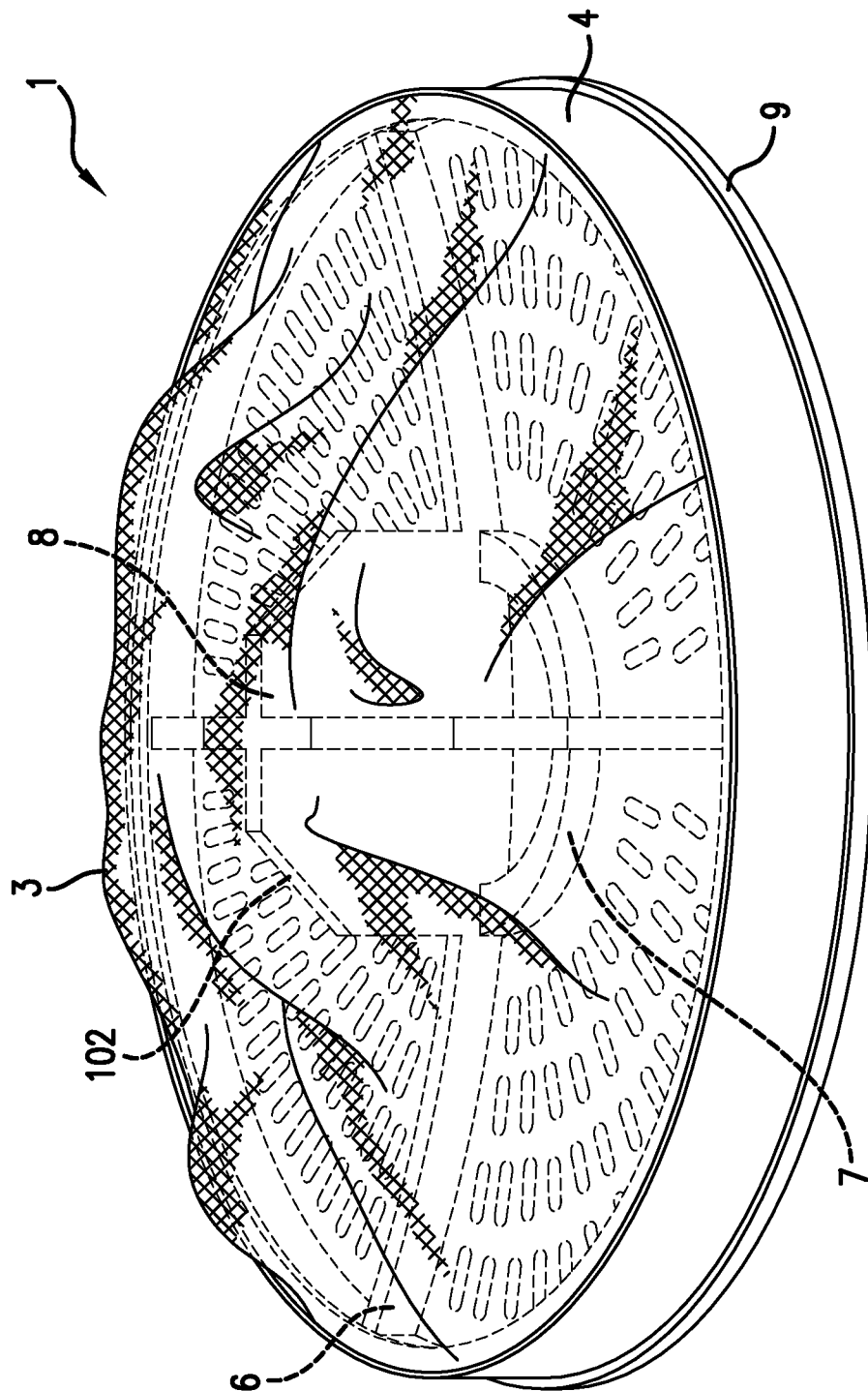


FIG. 5

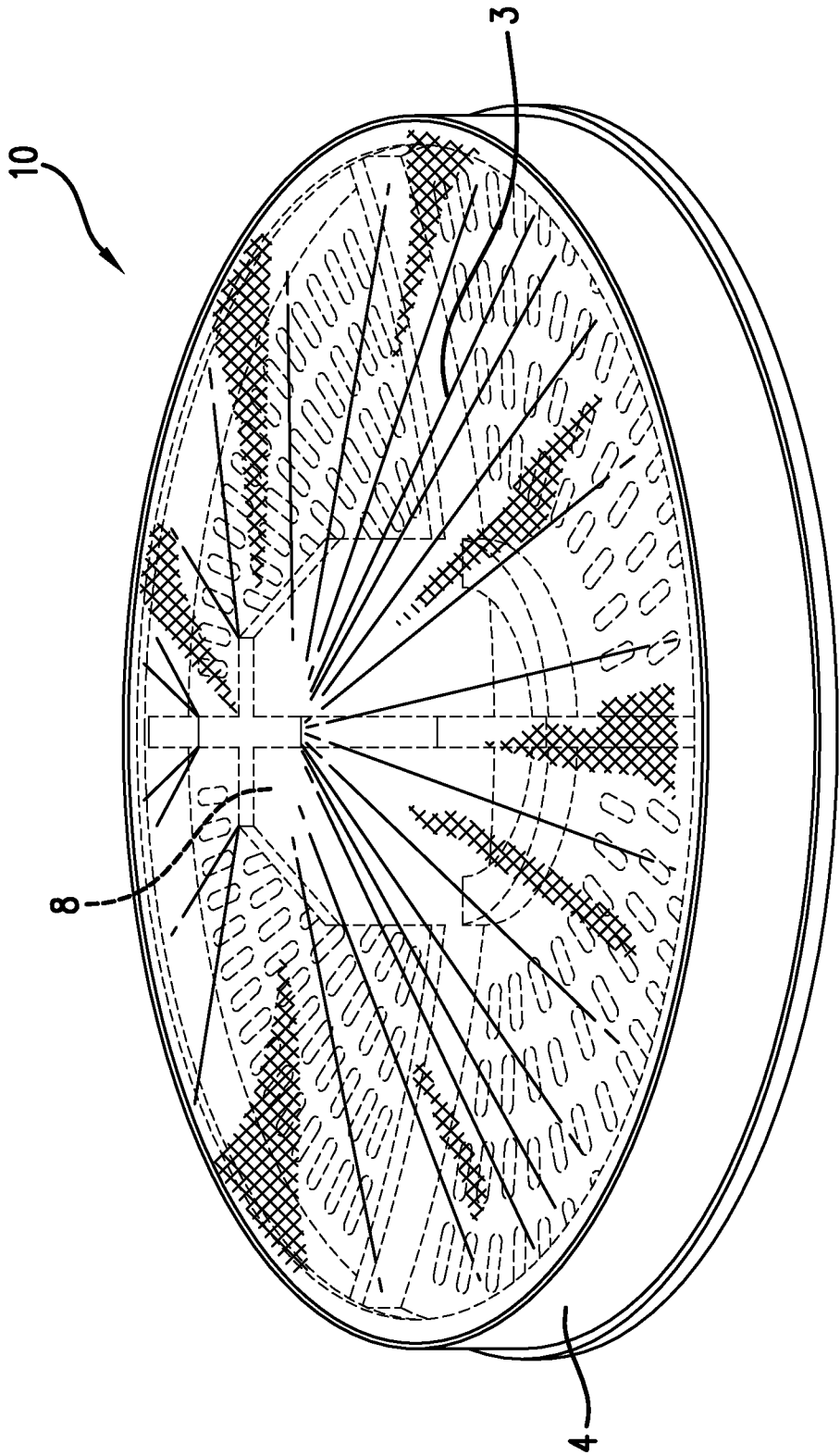


FIG. 6

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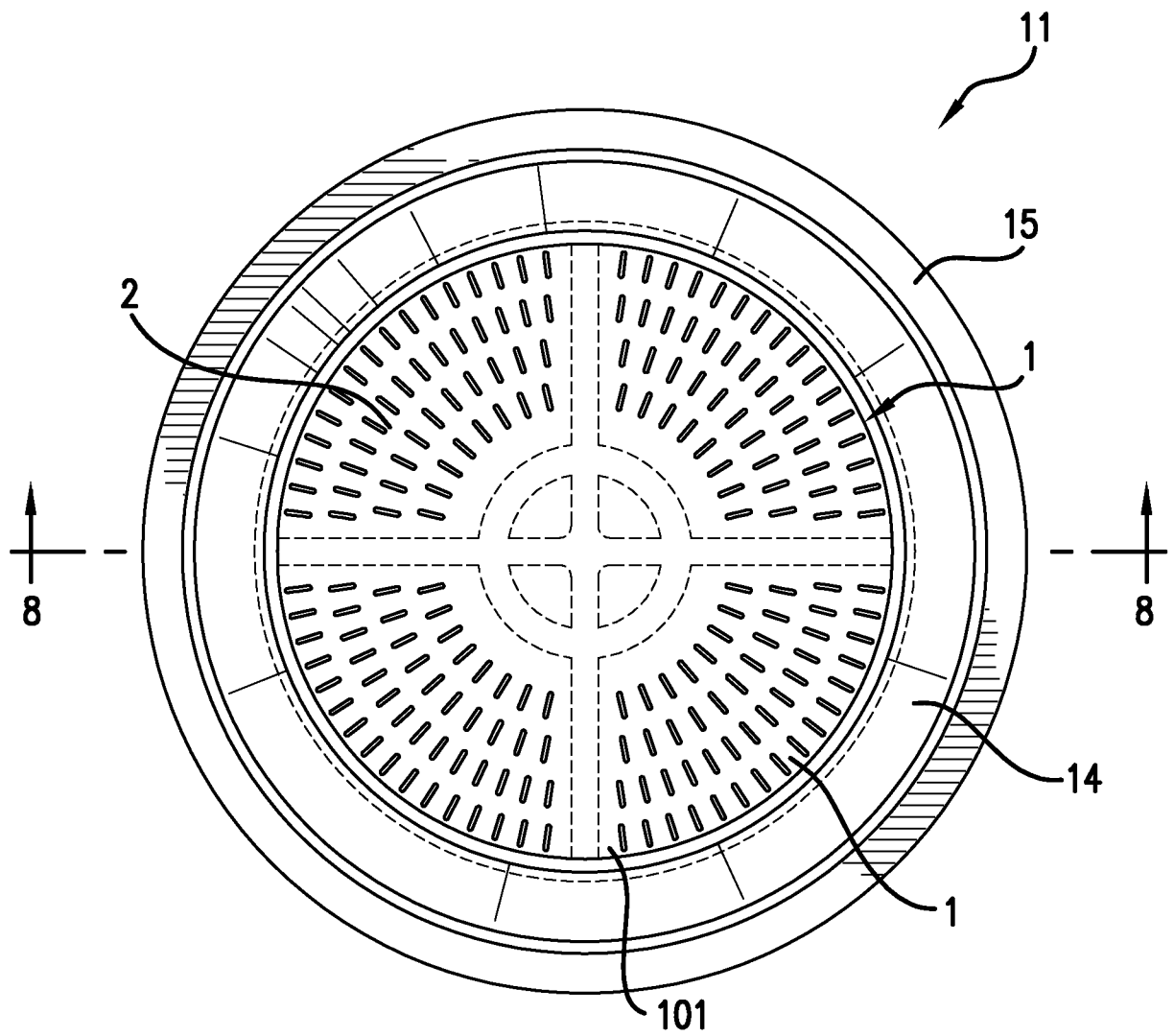


FIG. 7

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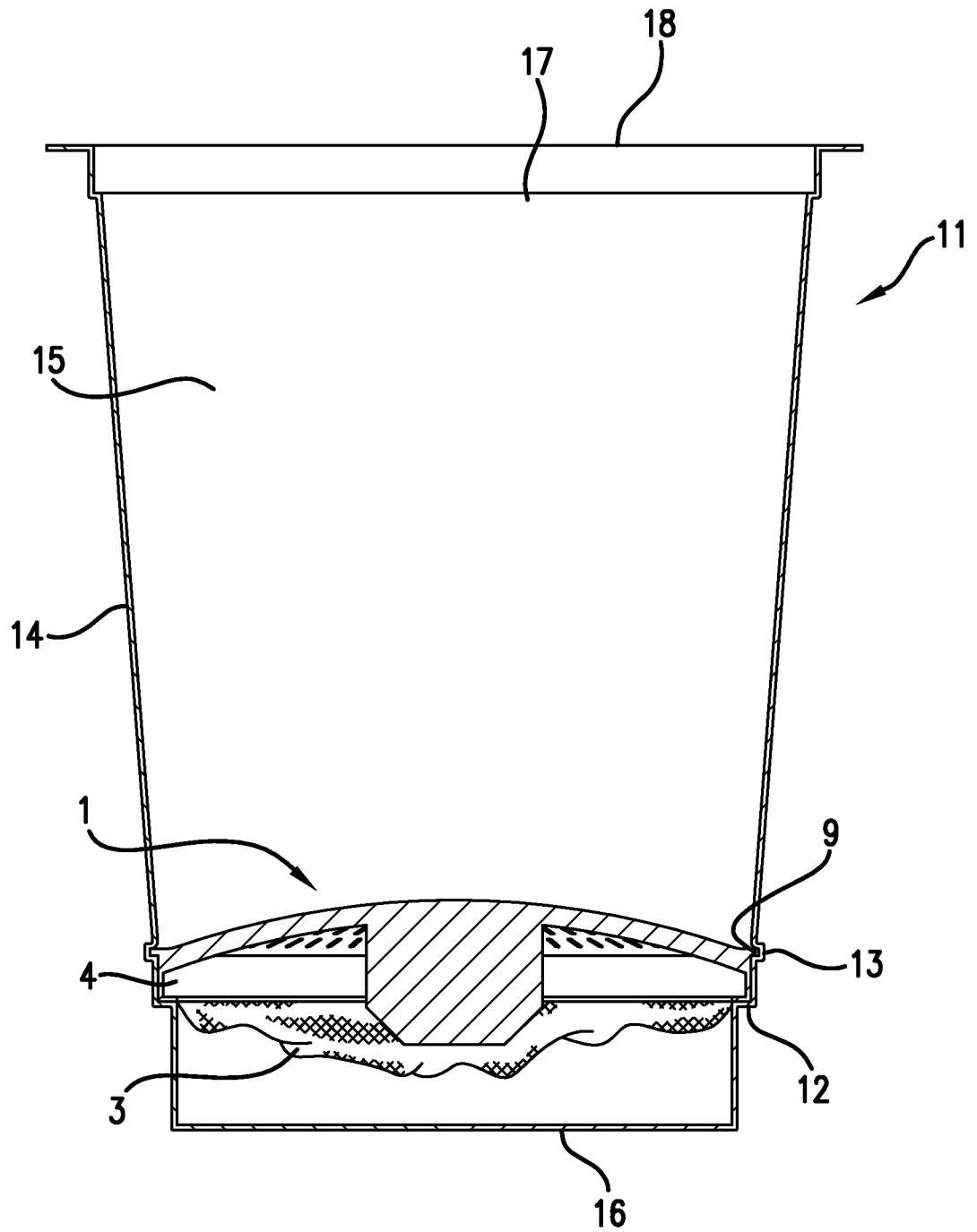


FIG. 8

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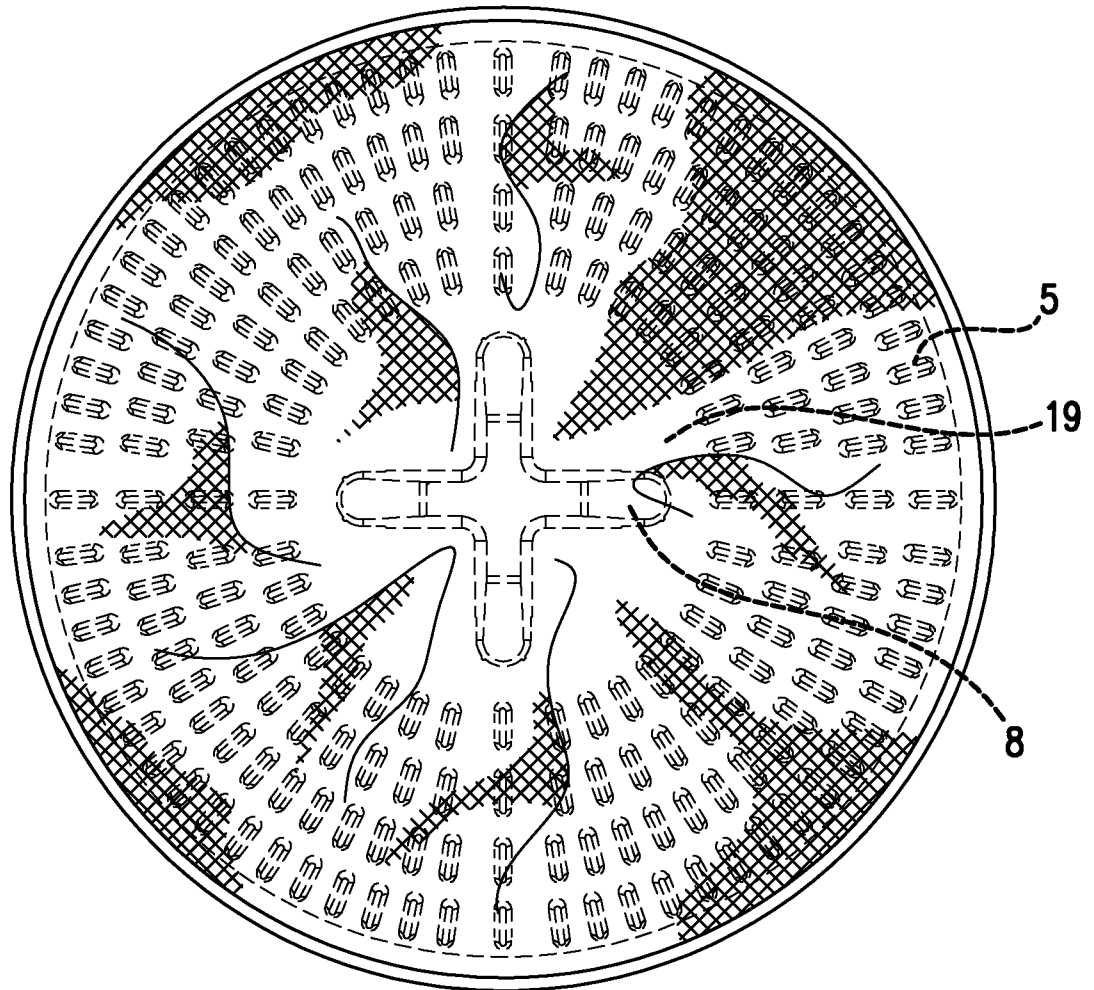


FIG. 9

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FIG.10

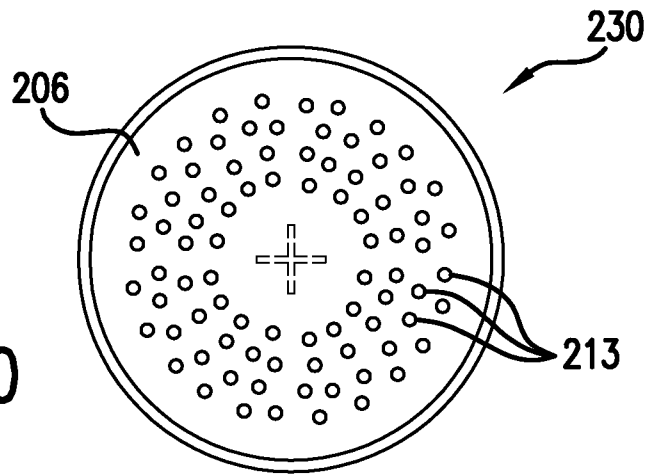


FIG.11

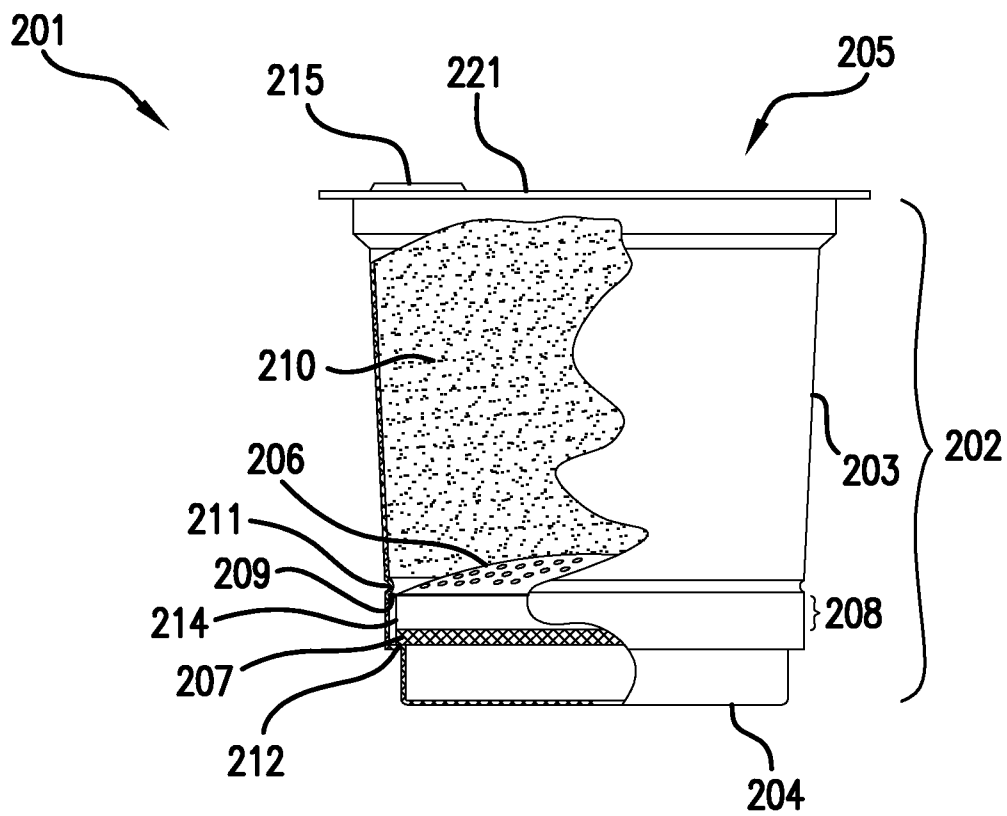
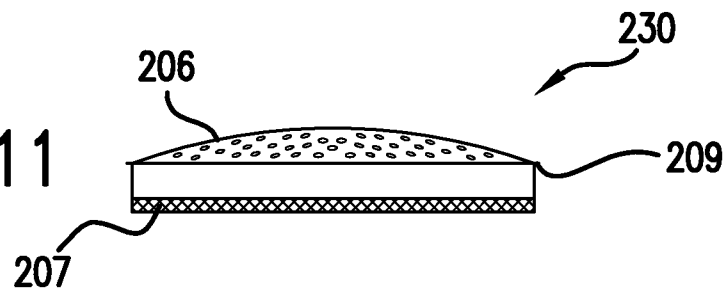


FIG.12

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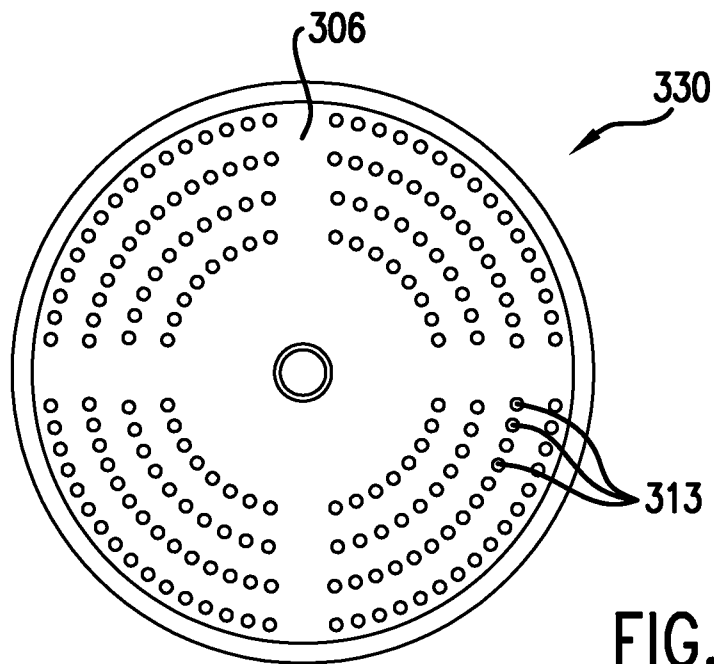


FIG. 13

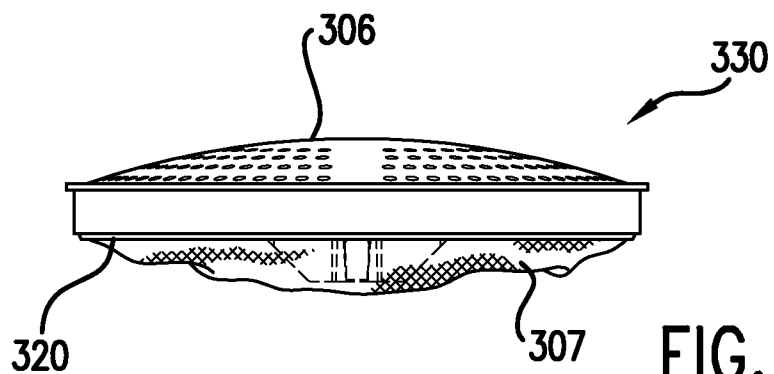


FIG. 14

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