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(54) **CAPSULES, BEVERAGE BREWING SYSTEMS AND FABRICS WITH OPTIMUM FILTRATION CHARACTERISTICS**

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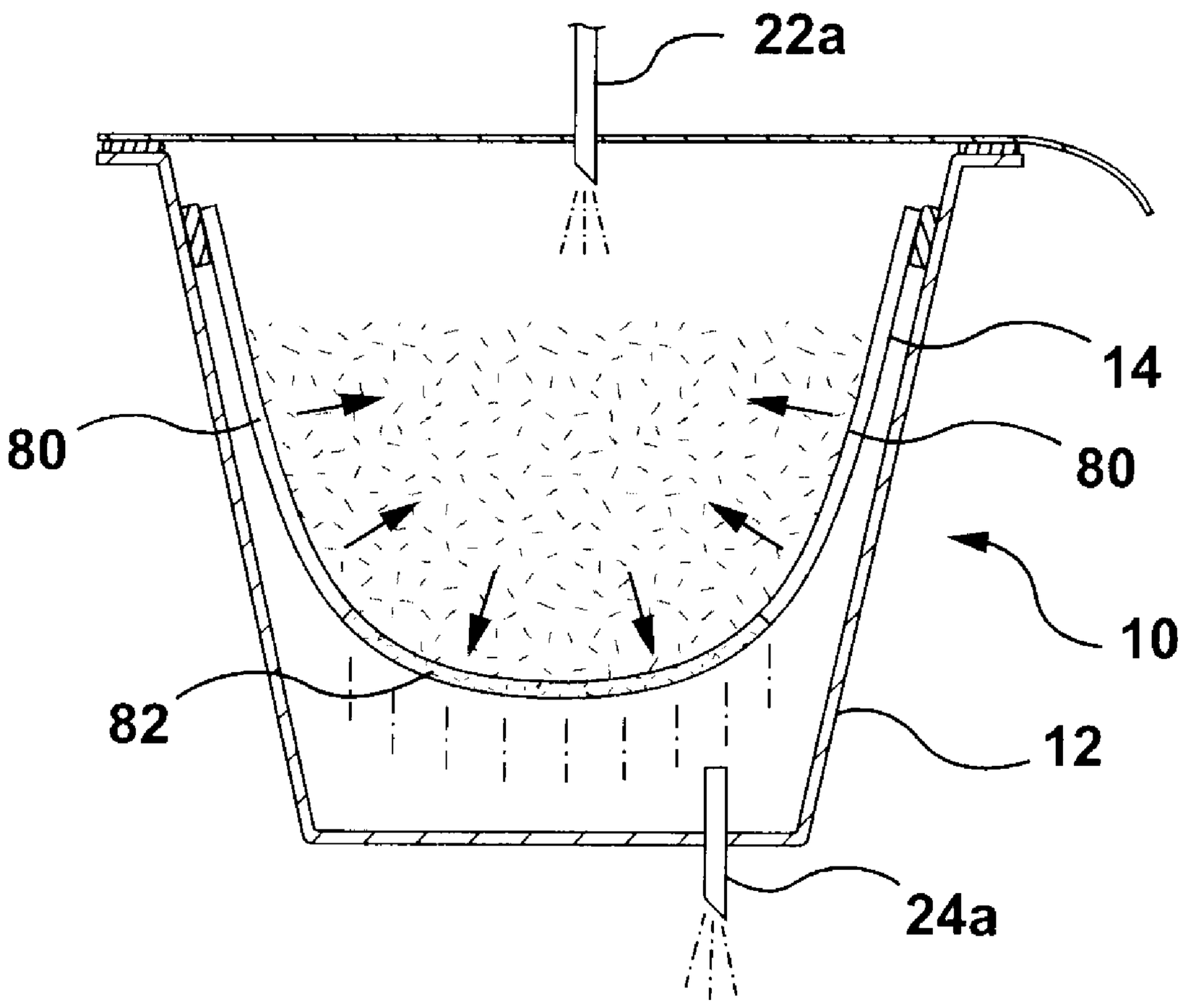
(57) **ABSTRACT**

A capsule or beverage brewing system or fabric is provided having optimized filtration characteristics. The capsule is provided for use in a machine for preparing a consumable product from capsules. The capsule includes a body that defines an interior space with an opening. A cover is disposed over the opening. A filter is disposed in the interior space to define a chamber between the filter and the cover. The filter has a basis weight of 40 gsm or less. Ingredients are disposed in the interior space for preparing a desired product. A portion of the ingredients have a grind size of less than 100 microns.



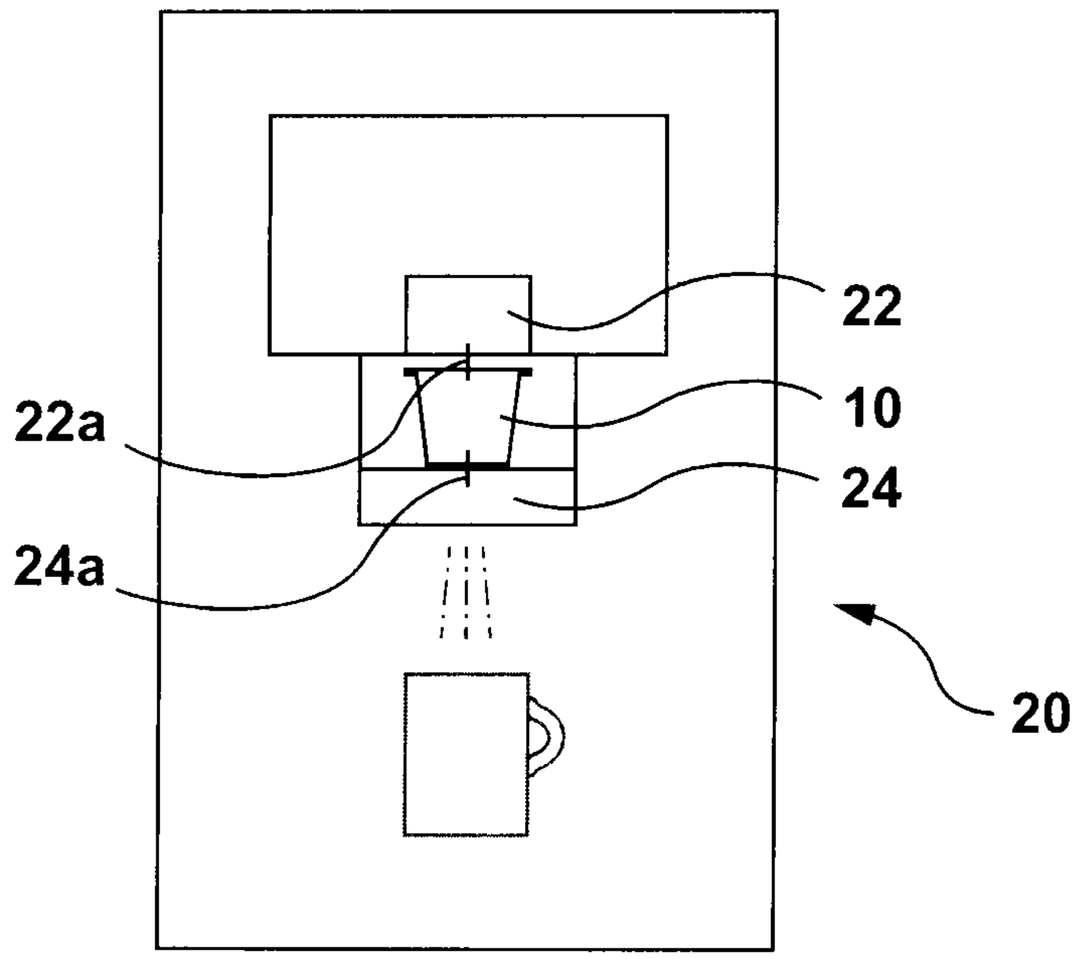


FIG. 1

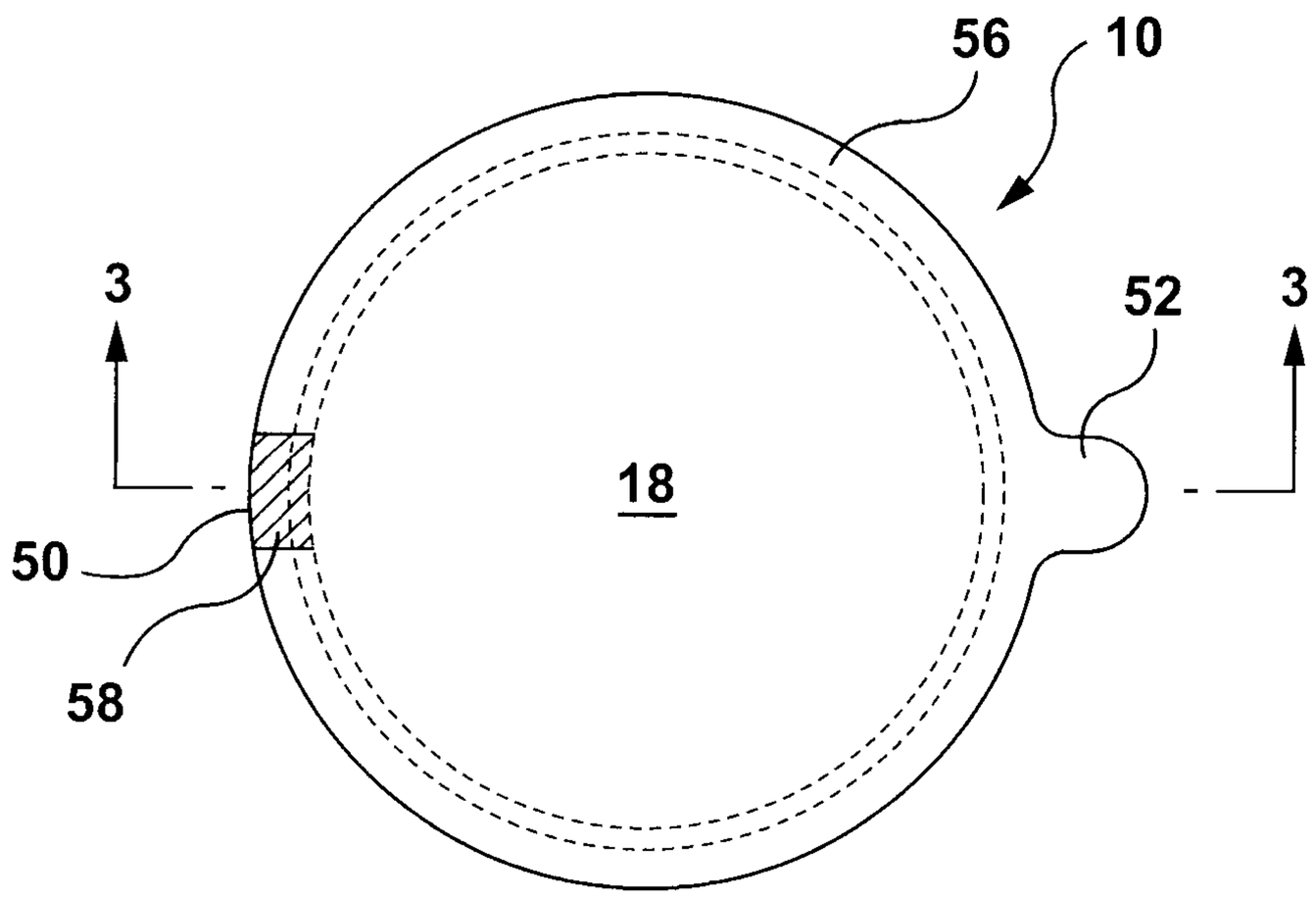


FIG. 2

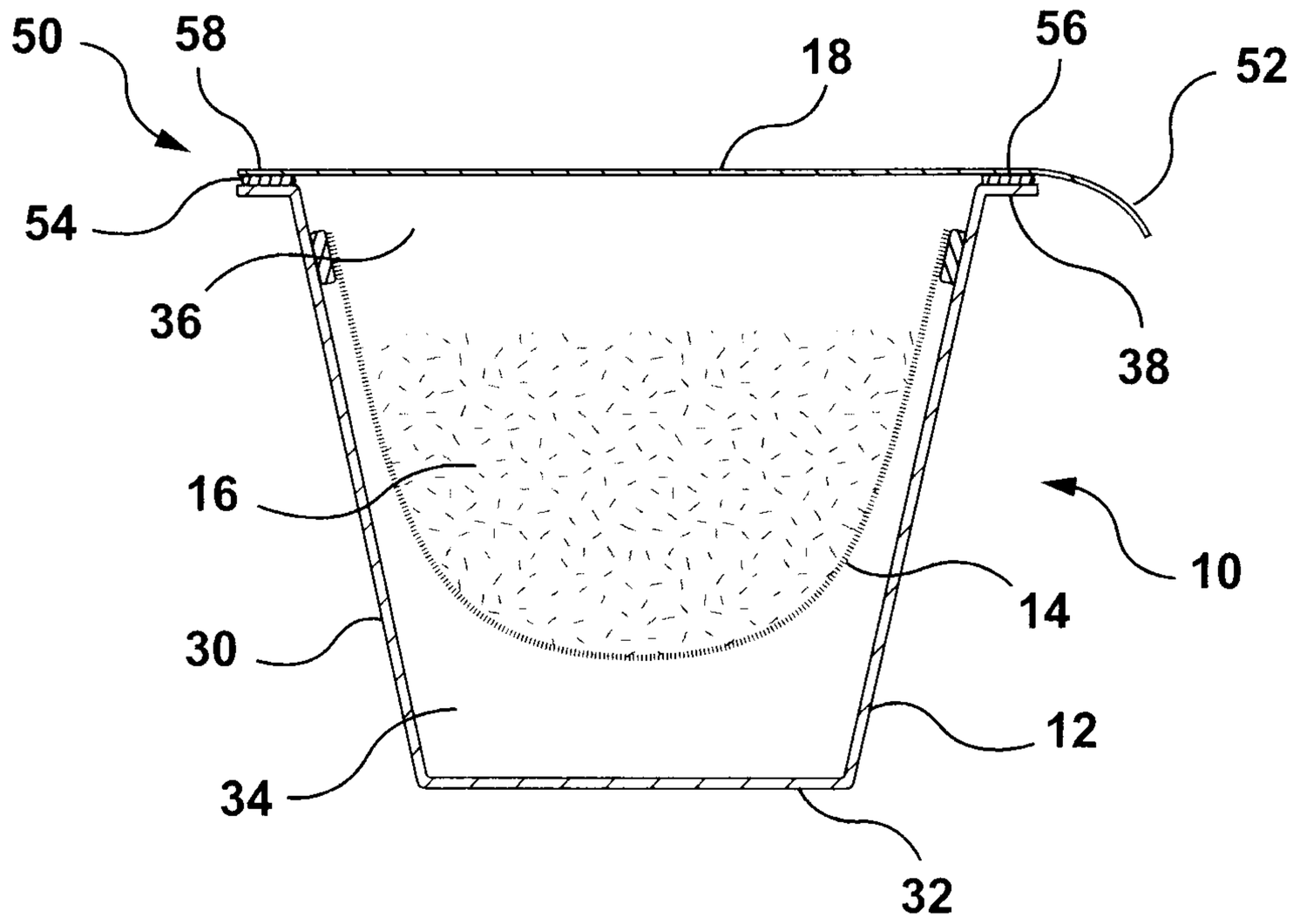


FIG. 3

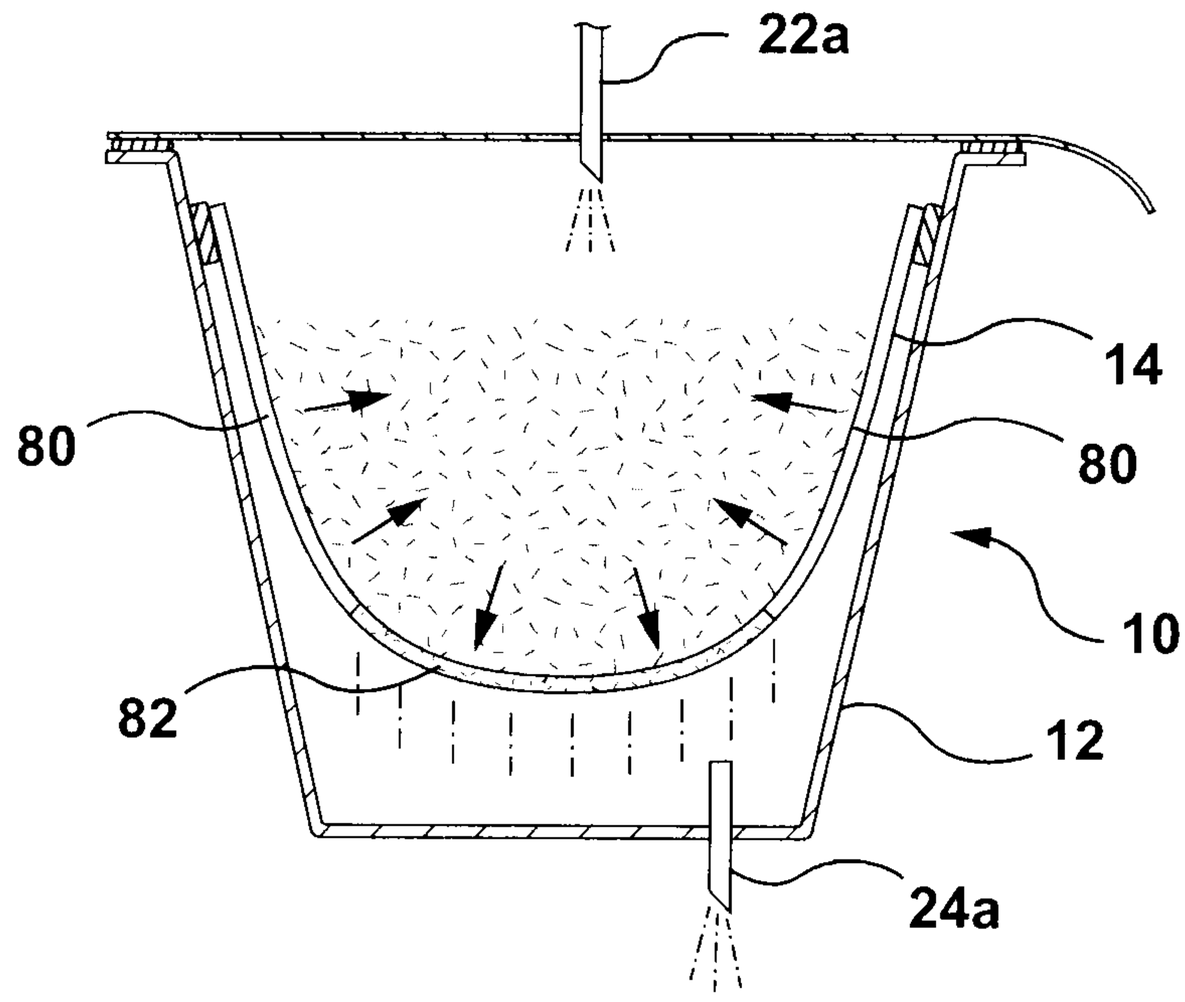


FIG. 4

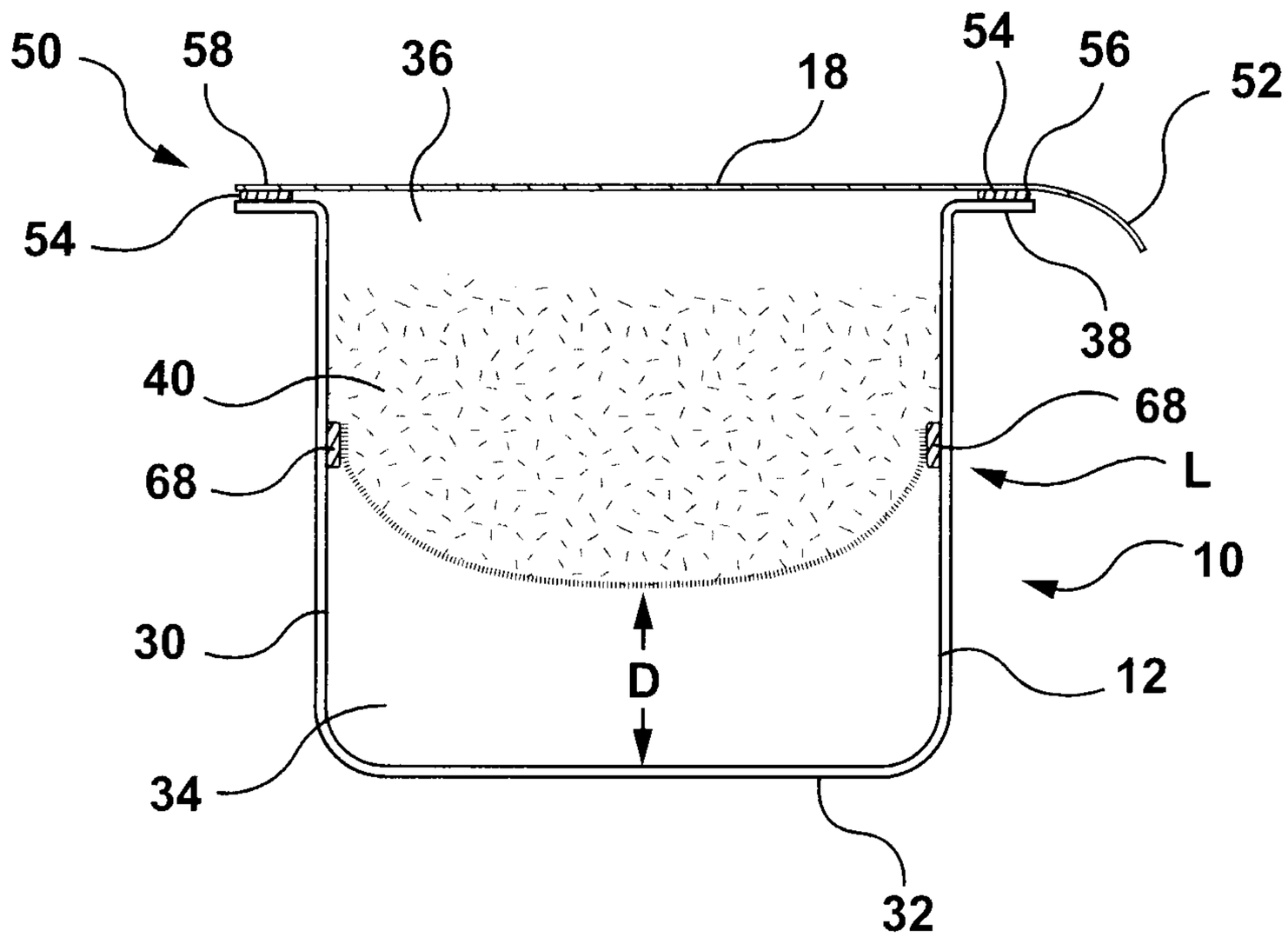


FIG. 5

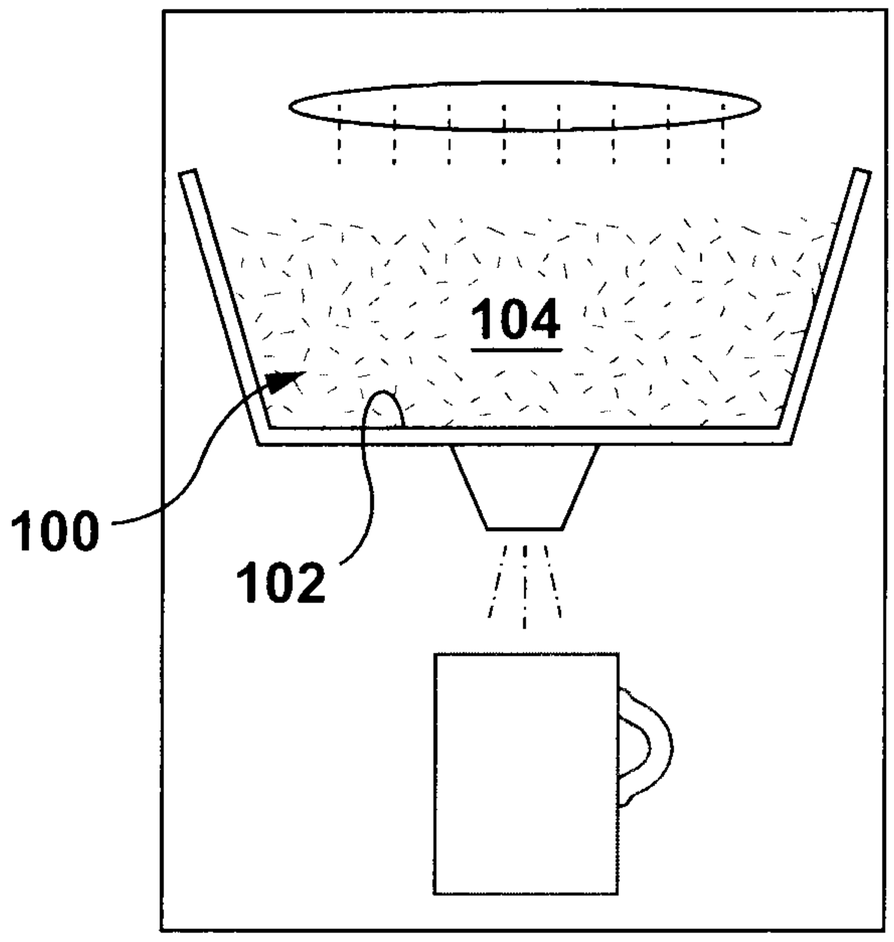


FIG. 6

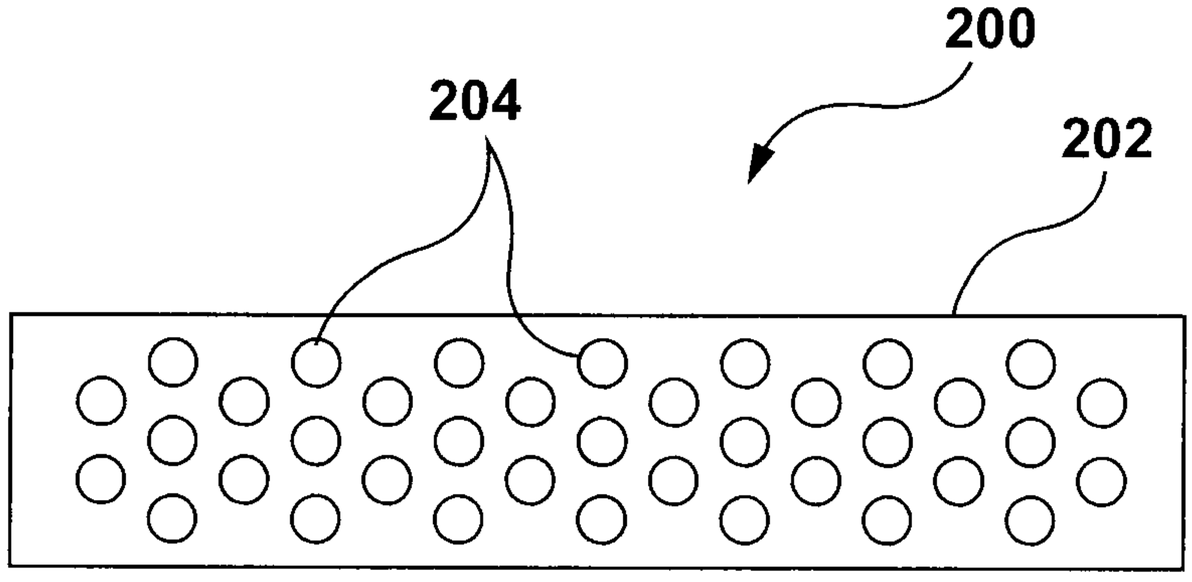


FIG. 7

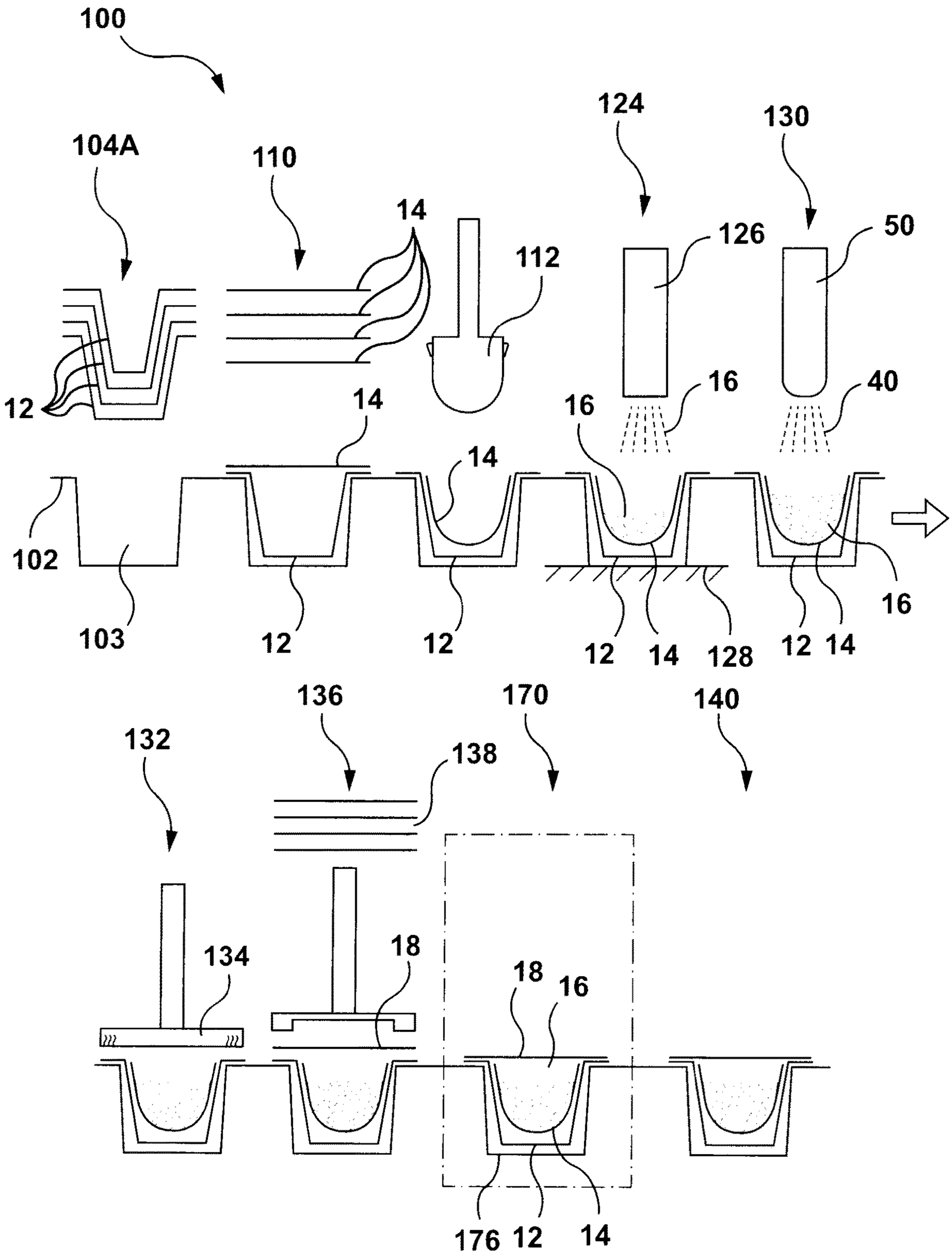

100
104A
110
14
112
124
130
126
50
12
16
40
14
16
14
102
103
12
12
12
14
128
12
14
16
136
170
140
132
138
134
18
18
16
176
12
14

FIG. 8

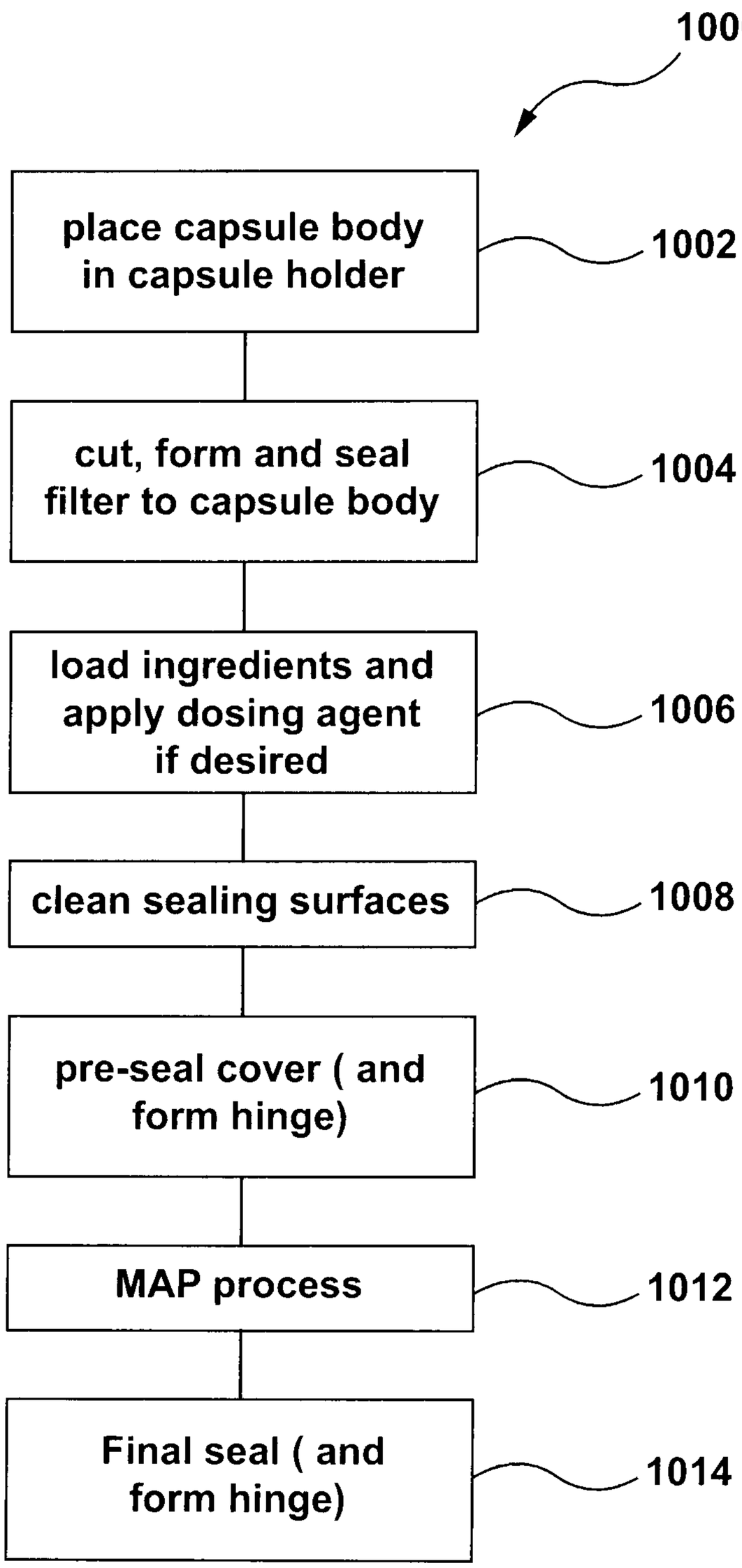

1000
place capsule body in capsule holder
1002
cut, form and seal filter to capsule body
1004
load ingredients and apply dosing agent if desired
1006
clean sealing surfaces
1008
pre-seal cover (and form hinge)
1010
MAP process
1012
Final seal (and form hinge)
1014

FIG. 9

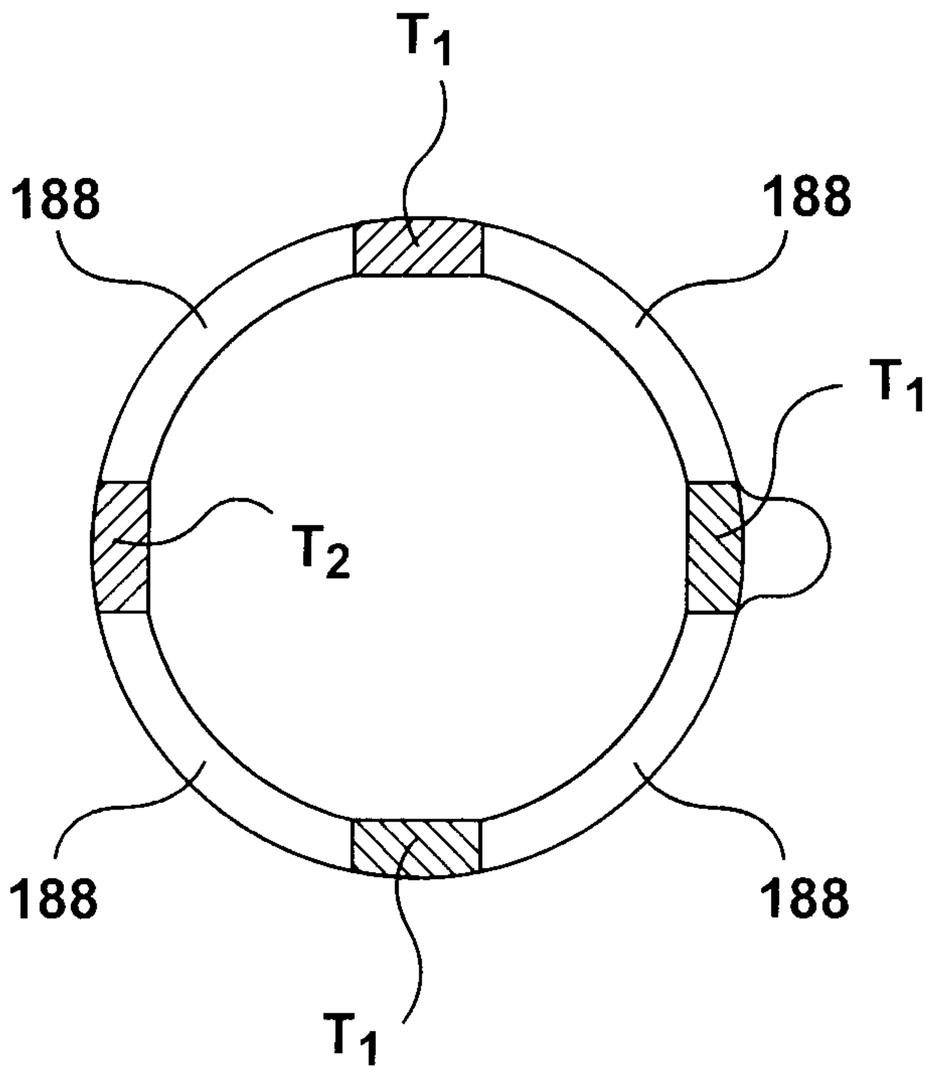


FIG. 10(a)

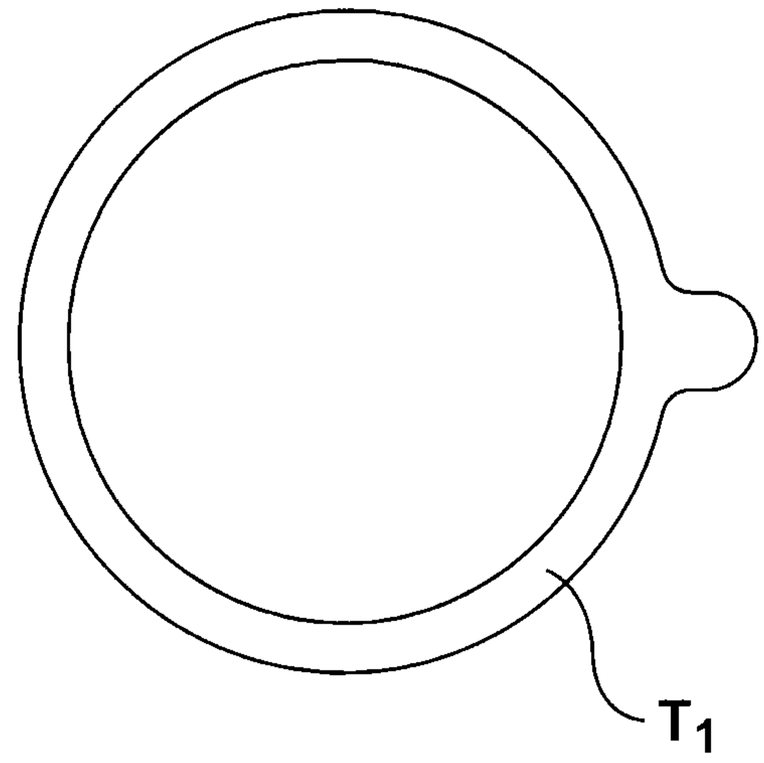


FIG. 10(b)

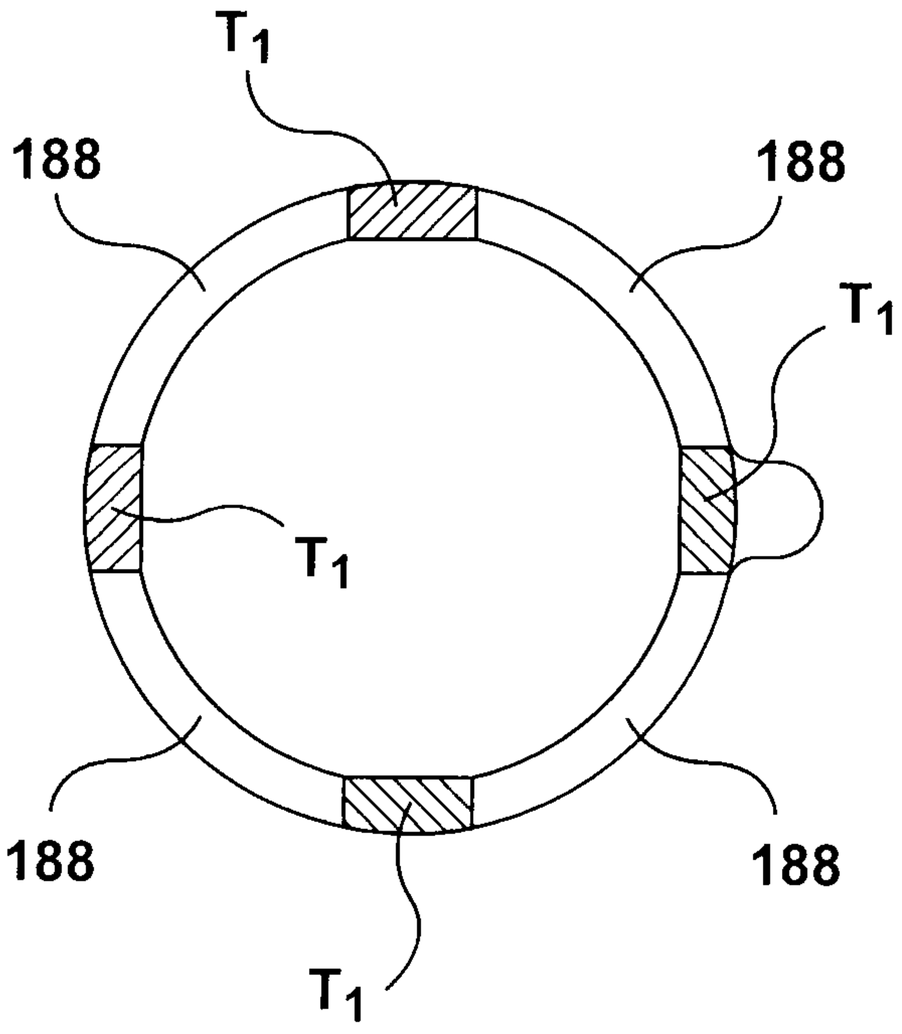


FIG. 11(a)

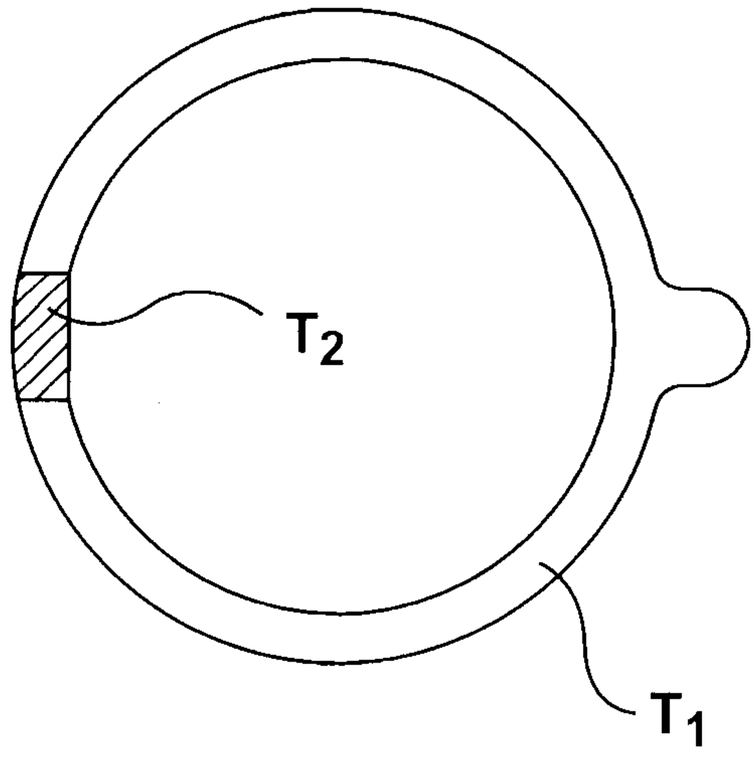


FIG. 11(b)

CAPSULES, BEVERAGE BREWING SYSTEMS AND FABRICS WITH OPTIMUM FILTRATION CHARACTERISTICS

FIELD

[0001] This specification relates to capsules, systems and processes for making capsules, beverage brewing systems and fabrics, and in particular to capsules, beverage brewing systems and fabrics with optimized filtration characteristics.

BACKGROUND

[0002] The following background discussion is not an admission that anything discussed below is citable as prior art or common general knowledge. The documents listed below are incorporated herein in their entirety by this reference to them.

[0003] Beverage capsules adapted for use in machines to prepare a desired consumable product from pre-cursor ingredients are becoming increasingly popular. Such capsules come in a variety of formats for producing consumable products such as coffee, tea or hot chocolate.

[0004] Beverage capsule machines inject a fluid (typically heated water) into a beverage capsule where it is intended to mix with the pre-cursor ingredients to prepare the desired consumable product prior to the consumable product being dispensed from the capsule. The beverage capsule includes a filter that defines a chamber for containing insoluble pre-cursor ingredients such as coffee grounds or tea leaves.

[0005] A problem with many conventional beverage capsules is that the filter, such as a paper filter, quickly becomes wetted by the introduction of fluid into the capsule. As a result, the fluid flows quickly through the capsule tunneling through the pre-cursor ingredients instead of mixing thoroughly with the ingredients. This produces an inferior tasting beverage and fails to optimize the use of the pre-cursor ingredients.

[0006] A similar problem can occur with conventional drip-style beverage brewing systems utilizing a filter, such as a paper filter, disposed in a filter basket for containing pre-cursor ingredients.

[0007] There is a need for a beverage capsule, beverage brewing system or fabric with optimized filtration characteristics to overcome one or more of the problems identified above.

SUMMARY

[0008] In one aspect the invention provides a beverage capsule for use in a beverage preparing machine to prepare a beverage product, said beverage capsule comprising:

a body defining an interior space having an opening;

a filter disposed in said interior space to define an ingredients chamber for containing and filtering at least some of the ingredients for preparing a desired beverage product, said filter being formed of a hydrophobic and non-absorbent material having a basis weight of 40 g/m2 or less;

ingredients disposed in said ingredients chamber, wherein a portion of said ingredients have a grind size of less than 100 microns; and

a cover sealed to said body to close said opening.

[0009] In another aspect, the invention provides a beverage brewing system for use in a beverage brewing machine, said beverage brewing system comprising:

a filter defining an ingredients chamber for containing and filtering at least some of the ingredients for preparing a desired beverage product, said filter being formed of a hydrophobic and non-absorbent material having a basis weight of 40 g/m2 or less;

ingredients disposed in said ingredients chamber, wherein a portion of said ingredients have a grind size of less than 100 microns.

[0010] In another aspect, the invention provides a fabric comprising:

a hydrophobic and non-absorbent material having a plurality of pores for filtering insoluble ingredients for preparing a desired beverage product and a basis weight of 40 g/m2 or less; and

ground coffee embedded in said plurality of pores of said material.

[0011] In another aspect, the invention provides a system for making a beverage capsule for use in a beverage preparing machine, the system comprising:

a filter station for sealing a filter to an interior space of a body for the beverage capsule to define an ingredients chamber, said filter being formed of a hydrophobic and non-absorbent material having a basis weight of 40 g/m2 or less;

an ingredients station for depositing a desired volume of desired ingredients into said ingredients chamber, wherein a portion of said ingredients have a grind size of less than 100 microns;

a cover sealing station for sealing a cover to said body.

[0012] In another aspect, the invention provides a process for making a beverage capsule for use in a beverage preparing machine, the process comprising the steps of:

sealing a filter to an interior surface of a body for the beverage capsule to define an ingredients chamber, said filter being formed of a hydrophobic and non-absorbent material having a basis weight of 40 g/m2 or less;

depositing a desired volume of desired ingredients into said ingredients chamber, wherein a portion of said ingredients have a grind size of less than 100 microns;

sealing a cover to said body to cover said opening.

[0013] Other aspects and features of the teachings disclosed herein will become apparent, to those ordinarily skilled in the art, upon review of the following description of the specific examples of the specification.

DRAWINGS

[0014] The drawings included herewith are for illustrating various examples of articles, methods, and apparatuses of the present specification and are not intended to limit the scope of what is taught in any way. For simplicity and clarity of illustration, where considered appropriate, reference numerals may be repeated among the drawings to indicate corresponding or analogous elements.

[0015] FIG. **1** is a schematic view of a capsule in accordance with one aspect of the present invention disposed in a machine for preparing a beverage;

[0016] FIG. **2** is a top view of the capsule of FIG. **1**;

[0017] FIG. **3** is a sectional view of the capsule of FIG. **1** as viewed along lines **3-3**;

[0018] FIG. **4** is a schematic cross-sectional view of the capsule of FIG. **1** during use in the machine.

[0019] FIG. **5** is a sectional view of the capsule in accordance with another embodiment of the present invention;

[0020] FIG. **6** is a schematic view of a beverage brewing system in accordance with another aspect of the present invention;

[0021] FIG. **7** is a schematic view of a fabric in accordance with another aspect of the present invention; and

[0022] FIG. **8** is a schematic view of a manufacturing system for manufacturing a capsule in accordance with the present invention;

[0023] FIG. **9** is a flow chart depicting a method for manufacturing a capsule in accordance with the present invention;

[0024] FIGS. **10**(*a*) and (*b*) are schematic views of the hinge sealing process in accordance with the present invention; and

[0025] FIGS. **11**(*a*) and (*b*) are schematic views of an alternate hinge sealing process in accordance with the present invention.

DESCRIPTION OF VARIOUS EMBODIMENTS

[0026] Various apparatuses or methods will be described below to provide examples of the claimed invention. The claimed invention is not limited to apparatuses or methods having all of the features of any one apparatus or method described below or to features common to multiple or all of the apparatuses described below. The claimed invention may reside in a combination or sub-combination of the apparatus elements or method steps described below. It is possible that an apparatus or method described below is not an example of the claimed invention. The applicant(s), inventor(s) and/or owner(s) reserve all rights in any invention disclosed in an apparatus or method described below that is not claimed in this document and do not abandon, disclaim or dedicate to the public any such invention by its disclosure in this document.

[0027] A capsule in accordance with the present invention is shown generally at **10** in the Figures. Capsule **10** includes a body **12**, filter **14** (when required), ingredients **16** and cover **18**.

[0028] Capsule **10** is sized and configured for use in a machine **20** that is adapted for preparing a product from capsule **10**.

[0029] Machine **20** includes an injection system **22** for injecting a fluid, typically heated water, into the capsule **10** for mixing with ingredients **16**. Injection system **22** may include at least one injection nozzle **22***a* disposed on machine **20** that is adapted to pierce cover **18** to inject fluid into capsule **10**.

[0030] Machine also includes a dispensing system **24** for dispensing product from capsule **10** into a desired receptacle such as a bowl or cup. Dispensing system **24** may include a hollow probe **24***a* that is adapted to pierce capsule **10** to dispense a prepared product from capsule **10**.

[0031] In an alternative embodiment, which is commonly used with high pressure espresso machines (not shown), dispensing system **22** may be provided within the capsule **10** instead of the machine **20**. Capsule **10** may for example have at least one component disposed within capsule **10** that is adapted to move under exposure to pressure to pierce a portion of capsule downstream of injection system **22** to dispense the prepared product. Alternatively, pressure within the capsule may cause a portion of the capsule to break upon contact with a portion of the machine to dispense the prepared product.

[0032] Body **12** of capsule **10** includes a sidewall **30** and an end wall **32** together defining an interior space **34**. Interior space **34** preferably has a volume in the range of 30 cc to 100 cc for preparing a single serving of beverage and more preferably a volume in the range of 40 cc to 80 cc.

[0033] An opening **36** is defined at one end of body **12** and a flange **38** extends around the perimeter of opening **36** to receive cover **18** and to support capsule **10** within machine **20**. Filter **14** may be secured to flange **38** or to an interior surface of capsule **10** (such as to sidewall **30** or the underside of cover **18**). Filter **14** is formed to define an ingredients chamber **40** within interior space **34** for receiving and filtering at least some of ingredients **16**. Filter **14** may optionally be peelably sealed to body **12** to allow filter **14** containing ingredients **16** to be removed from body **12** following use of capsule **10**.

[0034] In another embodiment (not shown), body **12** may be formed with no end wall **32** and no sidewall **30** or a partial sidewall **30**. Flange **38** may still extend around the perimeter of opening **36** to receive cover **18** and to support capsule **10** within machine **20**. Filter **14** may be secured to flange **38** or to partial sidewall **30** or underside of cover **18** to define ingredients chamber **40**.

[0035] Preferably, filter **14** is formed of a hydrophobic and non-absorbent polymer material having a basis weight that is 40 grams or less per square meter (gsm), preferably in the range of 5 to 40 gsm, more preferably between 10 to 30 gsm and even more preferably less than 20 gsm and most preferably in the range of 10-20 gsm. Most preferably, filter **14** is formed from a non-woven polymer fabric material having a plurality of pores **14***a* for filtering insoluble ingredients for preparing a desired beverage product.

[0036] Filter **14** preferably has the material properties specified below to facilitate optimum cutting of filter **14** during the manufacture of capsule **10**.

[0037] Filter **14** preferably has a tensile strength of less than 100 N/5 cm—in the Machine Direction (MD) and less than 70 N/5 cm in the Cross Direction (CD), preferably in the range of 20-70 MD and 10 to 40 CD, and more preferably in the range of 20-60 MD and 10 to 30 CD. The test method used to measure tensile strength test is described under ISO 9073.3.

[0038] Filter **14** preferably has a material tear strength of less than 15N MD and less than 20N CD, preferably in the range of 1-12 MD and 1-15 CD, and more preferably in the range of 3-10 MD and 3-10 CD. The test method used to determine material tear strength is described under ISO 13937.2.

[0039] Filter **14** preferably has an elongation to break value of less than 50% MD and less than 40% CD, and more preferably less than 40% MD and less than 30% CD. The test method used to determine elongation to break value is described under ISO 9073.3.

[0040] Ingredients **16** may include insoluble ingredients **16**, such as tea leaves, coffee grounds, herbs, spices or other ingredients, that are disposed in ingredients chamber **40** and adapted for forming a consumable product by extraction or infusion using machine **20**. Additional ingredients **16** may be disposed in ingredients chamber **40** or elsewhere in interior space **34**. Such additional ingredients **16** may include soluble ingredients **16** such as coffee, chocolate, soup stock, flavor additives or other ingredients in powdered, crystallized or other forms adapted for solubility or contained within a soluble film or pouch. Additional ingre-

dients **16** may also include active ingredients (eg foaming agents), natural health additives, regulated drugs, alcohol or other soluble or insoluble ingredients.

[0041] Insoluble ingredients **16**, such as ground coffee or tea leaves, preferably have an average grind size of less than 600 microns and more preferably in the range of 400-600 microns. Around 5% of such insoluble ingredients preferably have a grind size of less than 100 microns. It has been found that the ingredients, having a grind size of less than 100 microns and being hydrophilic, act as "hydrophilicity enhancers" that cause the hydrophobic filtration material to adopt hydrophilic characteristics in the location where the 100 micron or less size ingredients become embedded in the pores **14***a* of filter **14**. The ingredients having a grind size of less than 100 microns may be loaded into said ingredients chamber prior to loading the remainder of said insoluble ingredients in order for such ingredients to become embedded in pores **14***a* of filter **14**. Alternatively, ingredients having a grind size of less than 100 microns may be loaded at the same time as the remainder of said insoluble ingredients and subsequently become embedded in pores **14***a* of filter **14**.

[0042] Cover **18** is disposed over opening **36** and secured to body **12** such as by sealing cover **18** directly to flange **38** or by sealing cover **18** to filter **14** which in turn is sealed to flange **38**. Cover **18** may be formed of a polymer material that is resistant to tearing and adapted to shrink upon exposure to heat. Cover **18** may thus be adapted to shrink around the opening formed in cover **18** by injection system **22** to form a sufficient seal to withstand the buildup in pressure within capsule **10** under normal conditions during use in machine **20**. In other words, cover **18** may be adapted to shrink sufficiently around the at least one injection nozzle when the at least one injection nozzle pierces the cover and injects heated fluid into the capsule to create a seal and allow the buildup in pressure within capsule up to a maximum pressure. Alternatively, cover **18** may be formed of a metallic foil material such as aluminum foil.

[0043] In a preferred embodiment, components of capsule **10** (not including ingredients **16**) are formed from a single, substantially pure, type of material. This is also referred to herein as a mono-material capsule made with mono-material components. The type of material is selected based on factors including recyclability, ease of manufacturing, durability and desired shelf life.

[0044] Thus body **12**, filter **14** (if provided) and cover **18** each may be separate components that each are formed from the same, substantially pure, type of material. Alternatively, body **12** and filter **14** (if provided) each may be formed from the same, substantially pure, type of material and cover **18** may be formed of a different material. The term "substantially pure" is defined herein to mean at least 90% of the same type of material by weight (90%/wt), preferably at least 95%/wt, even more preferably at least 97%/wt and most preferably 100%/wt. The remaining different type of materials may include residual materials such as adhesives, barrier materials and print coatings. As noted above, the desired purity is determined in part by choice of material and shelf life considerations (for example, certain ingredients **16** may require little or no barrier protection or may have a shorter shelf life).

[0045] One preferable type of material for forming the components of the capsule **10** is polypropylene (PP) (which may include variants such as cast polypropylene (CPP)). Another preferable type of material is polyethylene terephthalate (PET) (which may include variants such as cast polyethylene terephthalate (CPET)). The PP and PET (and their variants) may be 100% fossil fuel based or it may be a mix of fossil fuels, post-recycled material and/or or bio-resins. Another preferable type of material is aluminum. Yet another preferred type of material is polylactic acid (PLA) for its biodegradable properties. The invention is not intended however to be restricted to any specific type of material provided that it is a single, substantially pure, type and that it meets the needs for operation of the capsule **10** in the machine **20**.

[0046] In some embodiments, cover **18** may be formed of a different type of material from body **12** and filter **14** provided that cover **18** may be easily separated from the remainder of the capsule **10** following use or is otherwise compatible from a recycling standpoint. For example, body **12** and filter **14** may be formed of PP and cover **18** may be formed of aluminum foil. Following use, the consumer may separate the cover **18** from the remainder of the capsule **10** so that the cover **18** may be placed into one stream of recycling and the remainder of the capsule **10** may be placed into another stream of recycling (with the consumer optionally also placing used ingredients **16** from capsule **10** into another stream for composting).

[0047] Preferably however, cover **18** is formed from the same type of material as the body **12** and filter **14** of capsule **10**. In such instances, it is desirable that cover **18** remain at least partially attached to the remainder of capsule **10** in order that capsule **10** with cover **18** attached may be disposed into the same recycling stream. This avoids placing small components (such as cover **18**) separately into the recycling stream where they may not be large enough to be mechanically collected for recycling. Preferably, a hinge **50** is formed on one or both of cover **18** and body **12** to allow cover **18** to be lifted or peeled partially away from the remainder of capsule **10** to allow ingredients **16** to be discarded (preferably to compost) while ensuring that cover **18** remains tethered to the remainder of capsule **10**. A tab **52** may also be provided to assist the user with lifting or peeling away cover **18**.

[0048] Referring to FIGS. **2** and **3**, a preferred structure for hinge **50** is shown. Capsule **10** includes a seal **54** between the underside of cover **18** and the top of flange **38** around the circumference of body **12**. Seal **54** includes a peel zone **56** and a hinge zone **58**. Seal **54** for peel zone **56** is a peelable seal between cover **18** and flange **38** that allows a consumer to peel cover **18** away from flange **38** by hand without excessive effort. Seal **54** for hinge zone **58** has a more secure seal between cover **18** and flange **38** that does not allow a consumer to peel cover **18** away from flange **38** by hand without excessive effort. In other words, hinge zone **58** has a higher seal or bond strength than peel zone **56**. Preferably, hinge zone **58** has a seal or bond strength that is at least 1.5 times as strong as the strength of peel zone **56** and even more preferably at least 2 times as strong. Seal or bond strength may be measured following the principals of ASTM F904.

[0049] Referring to FIG. **4**, an enlarged schematic view of capsule **10** during use in machine **20** is provided. Capsule **10** includes filter **14** having a hydrophobic region **80** and a hydrophilic region **82**. Hydrophilic region **82** is formed when the portion of ingredients **16** having a grind size of less

than 100 microns becomes deposited in the pores **14***a* of filter **14** downstream of where fluid is being injected through injection nozzle **22***a*.

[0050] Referring to FIG. **5**, another embodiment for capsule **10** is shown. Similar reference numerals are used to refer to similar elements for the embodiments described herein.

[0051] Capsule **10** includes filter **14** that is secured with a seal **68** to an interior surface of body **12** fully around the circumference of sidewall **30** at a location L between opening **36** and end wall **32**. Preferably, filter **14** is spaced away from opening **36** (ie not proximate to opening **36**). More preferably, filter **14** is secured to body **12** at a location that is in the middle ⅓ of the distance between opening **36** and end wall **32**. Filter **14**, at it's lowest point, is preferably spaced a distance D from end wall **32**. Distance D is selected to avoid filter **14** being contacted by hollow probe **24***a* of dispensing system **24** during use of capsule **10** in machine **20** (as shown in FIG. **1**).

[0052] Filter **14** forms a cup shaped area for containing and filtering ingredients **16**. Filter **14** includes a sufficient surface area A for allowing fluid to flow through filter **14** at a desired rate during the preparation of the beverage product. Preferably, for a capsule having a volume of 40-80 cc, filter **14** has a surface area of 10-70 cm2. More preferably, filter **14** has a surface area of 15-50 cm2. Filter **14** and body **12** are formed from the same substantially pure material and thus, filter **14** may be secured with seal **68** to body **12** using a heat seal that causes the materials to melt and securely bond together to form seal **68** that does not allow ingredients **16** to bypass filter around seal **68**.

[0053] Referring to FIG. **6**, a beverage brewing system in accordance with another embodiment of the invention is shown at **100**. Beverage brewing system is adapted for use in a machine **20'** such as a drip-style beverage machine.

[0054] Beverage brewing system **100** includes filter **102** that defines an ingredients chamber for containing ingredients **16**. Filter is adapted to fit in a brew basket **106** of the brewing machine. Filter **102** is formed of a hydrophobic and non-absorbent material having a basis weight that is 40 grams or less per square meter (gsm), preferably in the range of 5 to 40 gsm, more preferably between 10 to 30 gsm and even more preferably less than 20 gsm and most preferably in the range of 10-20 gsm. Most preferably, filter **102** is formed from a non-woven polymer fabric material having a plurality of pores **102***a* for filtering insoluble ingredients for preparing a desired beverage product.

[0055] Insoluble ingredients **104**, such as ground coffee or tea leaves, are disposed in filter **102**. Insoluble ingredients preferably have an average grind size of less than 600 microns and more preferably in the range of 400-600 microns. Around 5% of such insoluble ingredients preferably have a grind size of less than 100 microns. It has been found that the ingredients having a grind size of less than 100 microns act as "hydrophilicity enhancers" that cause the hydrophobic filtration material to adopt hydrophilic characteristics in the location where the 100 micron or less size ingredients become embedded in the pores of filter **102**. The ingredients having a grind size of less than 100 microns may be loaded into the ingredients chamber prior to loading the remainder of the insoluble ingredients in order for such ingredients to become embedded in pores **102***a* of filter **102**. Alternatively, ingredients having a grind size of less than 100 microns may be loaded at the same time as the remainder of the insoluble ingredients and subsequently become embedded in pores **102***a* of filter **102**.

[0056] Referring to FIG. **7**, a schematic view of a fabric **200** in accordance with another embodiment of the invention is shown.

[0057] Fabric **200** is formed of a hydrophobic and non-absorbent material **202** having a basis weight that is 40 grams or less per square meter (gsm), preferably in the range of 5 to 40 gsm, more preferably between 10 to 30 gsm and even more preferably less than 20 gsm and most preferably in the range of 10-20 gsm. Most preferably, fabric **202** is formed from a non-woven polymer fabric material having a plurality of pores **202***a* for filtering insoluble ingredients for preparing a desired beverage product.

[0058] Fabric **200** further includes ground coffee **204** embedded in the pores of material **202**. The ground coffee **204** preferably has a grind size of less than 100 microns. The ground coffee **204** may be fresh ground coffee of it may be used ground coffee that is repurposed for forming fabric **200**.

[0059] Referring to FIGS. **8-9**, schematic views of a system **100** and a process **1000** for making capsules **10** is shown.

[0060] System **100** comprises at least one transfer belt **102** having a plurality of capsule holders **103** adapted to cyclically and sequentially transfer capsules **10** from a working station to a following station as described further below. While only a single capsule holder **103** is shown at each station for system **100** it will be understood that transfer belt **102** has multiple capsule holders **103** disposed at each station in order that manufacturing operations may be performed simultaneously on multiple capsules at each station.

[0061] System **100** includes a body forming station **104** for engaging a sheet of moldable multilayered body material **106** with a heated mandrel **108** to form body **12** in accordance with body forming step **1002**. Alternatively, body forming station may be replaced with a body supply station **104**A having a body supplier, such as a denester, that denests previously formed bodies **12** from a body supply, and places each body **12** into a respective capsule holder **103**.

[0062] Capsule holder **103** with body **12** is then transferred to a filter station **110** for forming and sealing filter **14** to body **12** (in those instances where a filter **14** is required). Filter station **110** may include a supply of pre-cut filters **14** that are sized to be formed and sealed to body **12**. A pre-cut filter **14** may be picked from pre-cut filter supply and deposited over opening **36** of body **12**. A forming and sealing tool **112** may then engage pre-cut filter to form filter **14** and seal to body **12** (or seal to body **12** and subsequently form filter **14**). Alternatively, filter station **110** may include a roll of filter material that is subsequently cut to a desired size either before or after the filter is formed within body **12** and/or sealed to body **12**. It should be noted that filter **14** is preferably loosely formed within body **12** to define ingredients chamber **40**. Preferably filter **14** is not stretched in the process of forming filter **14**. Preferably, filter material is cut into a circular disc having a diameter that is larger than the diameter of opening **36**. Filter **14** will then be loosely formed within body **12** with portions of filter **14** overlapping each other or bunching together within body **12**.

[0063] Capsule holder **103** with body **12** and filter **14** (where filter is required) is then transferred to an ingredients station **124** having an ingredients supplier **126** for supplying a desired amount of ingredients **16** into ingredients chamber **46** in accordance with ingredients loading step **1010**. Ingre-

dients station may include a single portion for loading all ingredients into ingredients chamber at one time. Alternatively, ingredients chamber may have a first portion for loading a first desired set of ingredients (such as ingredients having a grind size of less than 100 microns) and a second portion for loading a second desired set of ingredients (such as the remainder of the ingredients). A scale **128** weighs beverage capsule **10** to ensure that the desired amount of ingredients **16** have been disposed into ingredients chamber **46**.

[0064] If a dosing agent is required, then capsule holder **103** transfers body **12** with filter **14** and ingredients **16** to dosing agent station **130** having a dispenser **50** for dispensing a desired amount of dosing agent **40** into ingredients **16** in accordance with dosing step **1012**.

[0065] Following dosing step **1012**, capsule holder **103** then transfers body **12** with filter **14** and ingredients **16** with dosing agent **40** to cleaning station **132** where a vacuum conduit **134** cleans the exposed surface of flange **28** or gasket portion **50** of filter **14** in preparation for sealing with cover **18** in accordance with cleaning step **1014**.

[0066] The system and process described above may either be performed in a non-modified atmospheric environment (such as a regular open-air manufacturing environment) or it may be performed in a modified atmospheric environment (such as an environment where air has been evacuated and replaced with an inert gas such as nitrogen). In a non-modified atmospheric environment, capsules **10** may need to be transferred to a modified atmospheric environment for the remaining steps of replacing the air within capsule with an inert gas and sealing cover **18** to body **12**. In a modified atmospheric environment, capsules **10** already contain an inert gas and simply require cover **18** to be sealed to body **12**.

[0067] Various options for forming hinge **50** on cover **18** are described below for both non-modified and modified atmospheric embodiments.

[0068] In a non-modified atmospheric environment, capsule holder **103** transfers body **12** with filter **14** and ingredients **16** with dosing agent **40** to a cover pre-sealing station **136** for receiving a supply of a cover material **138** and pre-sealing a portion of cover **18** to flange **38** of body **12** in accordance with pre-sealing step **1016**. Pre-sealing may be accomplished for example by thermal welding (heat sealing) or ultrasonic welding. Cover pre-sealing station **136** leaves openings **188** along edge of cover **18** for allowing air to be evacuated and inert gas to be flushed into capsule during the modified atmosphere packaging (MAP) process step **1018** as described in more detail below. Cover material **138** may be supplied in the form of pre-cut covers **12** that are picked and placed on body **12** for pre-sealing. Alternatively, a roll of cover material **138** may be provided and each cover **18** may be cut to a desired size prior to or following the step of pre-sealing cover **18** to body **12**.

[0069] Referring to FIGS. **10**(*a*) and (*b*), one approach to pre-sealing cover **18** to body **12** is shown. In FIG. **10**(*a*), cover **18** is pre-sealed at a first temperature T**1** in specific locations around flange **38** to form a peelable seal. Cover **18** is also sealed at hinge zone **58** to define hinge **50**. Hinge **50** is formed at a second temperature T**2** and/or using a different sealing technique (such as an ultrasonic weld instead of a thermal weld) to form a stronger seal than the seal in peel zone **56**. In FIG. **10**(*b*), cover **18** is subsequently sealed, following the MAP process described below, entirely around flange **38** to define a peelable seal in peel zone **56** and to fully seal capsule **10**.

[0070] Referring to FIGS. **11**(*a*) and (*b*), another approach to pre-sealing cover **18** to body **12** is shown. In FIG. **11**(*a*), cover **18** is pre-sealed at a first temperature T**1** in specific locations around flange **38** to form a peelable seal. In FIG. **11**(*b*), cover **18** is subsequently sealed, following the MAP process described below, around peel zone **56** at temperature T**1**. Hinge **50** is formed in hinge zone **58** at a second temperature T**2** and/or using a different sealing technique (such as an ultrasonic weld instead of a thermal weld) to form a stronger seal than the seal in peel zone **56**.

[0071] Hinge **50** may be formed in a two-stage process where the seal in hinge zone **58** is formed at one stage and the seal in peel zone is formed at another stage. Alternatively, hinge **50** may be formed in a single-stage process where a hinge applicator tool (not shown) having two different sealing heads is provided. One sealing head is adapted for forming a peelable seal in peel zone **56** of capsule **10** and the other sealing head is adapted for forming a relatively non-peelable seal in hinge zone **58** of capsule. The sealing heads of the hinge applicator tool may be adapted to operate at different sealing temperatures T**1** and T**2** and/or it may be adapted to perform different sealing operations (such as a thermal weld and an ultrasonic weld).

[0072] Partially sealed capsules **10** are then transferred from capsule holders **103** in transfer plate **102** to corresponding capsule holders **176** disposed within a transfer plate **178** using a pick-and-place device (not shown) or other suitable mechanism. Capsule holders **176** and transfer plate **178** are specially adapted for use during the MAP process step **1018**.

[0073] Transfer plate **178** with partially sealed beverage capsules **10** disposed in capsule holders **176** is then moved to a MAP station **170** for execution of the MAP process step **1018** as described in more detail in US patent publication 20140141128 which is incorporated herein in its entirety by reference. Once the MAP process is complete, openings **188** in cover **18** are sealed with sealer **192** in accordance with sealing step **1020** and the finished capsule **10** is transferred using a pick-and-place device (not shown) or other suitable mechanism to a collection station **140** for subsequent packaging into boxes (not shown).

[0074] In a modified atmospheric environment, capsule holder **103** transfers body **12** with filter **14** and ingredients **16** with dosing agent **40** to a final cover sealing station **136** for receiving a supply of a cover material **138** and sealing cover **18** to flange **28** of body **12** in accordance with sealing step. Sealing may be accomplished by thermal welding (heat sealing) or ultrasonic welding. Cover material **138** may be supplied in the form of pre-cut covers **12** that are picked and placed on body **12** for pre-sealing. Alternatively, a roll of cover material **138** may be provided and each cover **18** may be cut to a desired size prior to or following the step of pre-sealing cover **18** to body **12**.

[0075] In the modified atmospheric environment, hinge **50** may be formed prior to the final sealing step, after the final sealing step or during the final sealing step. Hinge **50** may be formed is a similar manner as discussed above with reference to FIGS. **16** and **17**. Thus, cover **18** may be sealed to hinge zone of flange **38** at temperature T**2** and/or by using a different sealing technique (such as an ultrasonic weld instead of a thermal weld) to define hinge **50** and the

remainder of cover may be sealed to peel zone of flange **38** at temperature T**1** and/or by using a different sealing technique (such as an thermal weld instead of an ultrasonic weld). Alternatively, cover **18** may first be sealed around flange **38** at temperature T**1** to define peel zone **56** and then cover **18** may be sealed at hinge zone **58** to define hinge **50**.

[0076] It will be understood that system **100** and process **1000** do not require all stations and steps to be provided. It will also be understood that the relative position of stations or the order of process steps may be changed depending on the desired structure and contents of the finished capsule **10**.

[0077] While the above description provides examples of one or more processes or apparatuses, it will be appreciated that other processes or apparatuses may be within the scope of the accompanying claims.

1. A beverage capsule for use in a beverage preparing machine to prepare a beverage product, said beverage capsule comprising:

a body defining an interior space having an opening;

a filter disposed in said interior space to define an ingredients chamber for containing and filtering at least some of the ingredients for preparing a desired beverage product, said filter being formed of a hydrophobic and non-absorbent material having a basis weight of less than 40 g/m2;

ingredients disposed in said ingredients chamber, wherein a portion of said ingredients have a grind size of less than 100 microns; and

a cover sealed to said body to close said opening.

2. A beverage capsule as claimed in claim **1**, wherein said ingredients have an average grind size of between 400-600 microns.

3. A beverage capsule as claimed in claim **2**, wherein 5% of said ingredients have a grind size of less than 100 microns.

4. (canceled)

5. The beverage capsule of claim **1** wherein said filter has a basis weight of no more than 25 g/m2.

6. The beverage capsule of claim **1** wherein said filter has a tensile strength of 100 N/5 cm or less in the Machine Direction (MD) and 70 N/5 cm or less in the Cross Direction (CD).

7. (canceled)

8. (canceled)

9. The beverage capsule of claim **1** wherein said filter has a material tear strength of 15 N or less in the Machine Direction (MD) and 20 N or less in the Cross Direction (CD).

10. (canceled)

11. The beverage capsule of claim **1** wherein said filter has an elongation to break value of 50% or less in the Machine Direction (MD) and 40% or less in the Cross Direction (CD).

12. (canceled)

13. (canceled)

14. The capsule of claim **1** wherein said body includes a sidewall and an end wall that define said interior space.

15. The capsule of claim **14** wherein said filter is sealed to said sidewall within said interior space at a location that is in the middle one-third of the distance between said opening and said end wall.

16.-**27**. (canceled)

28. The capsule of claim **1** wherein said cover includes a hinge, that is relatively permanently sealed at a hinge zone to said body, and a peelable portion that is peelably sealed at a peel zone to said body to enable said cover to be partially separated from said body following use of said capsule while remaining connected at said hinge.

29. A beverage brewing system for use in a beverage brewing machine, said beverage brewing system comprising:

a filter defining an ingredients chamber for containing and filtering at least some of the ingredients for preparing a desired beverage product, said filter being formed of a hydrophobic and non-absorbent material having a basis weight of less than 40 g/m2;

ingredients disposed in said ingredients chamber, wherein a portion of said ingredients have a grind size of less than 100 microns.

30. (canceled)

31. A beverage brewing system as claimed in claim **29**, wherein 5% of said ingredients have a grind size of less than 100 microns.

32. (canceled)

33. (canceled)

34. A fabric comprising:

a hydrophobic and non-absorbent material having a plurality of pores for filtering insoluble ingredients for preparing a desired beverage product and a basis weight of less than 40 g/m2; and

ground coffee embedded in said plurality of pores of said material.

35.-**38**. (canceled)

39. The fabric of claim **34** wherein said fabric is formed into a configuration to fit within a brew basket of a drip-style beverage machine.

40. (canceled)

41. A system for making a beverage capsule for use in a beverage preparing machine, the system comprising:

a filter station for sealing a filter to an interior space of a body for the beverage capsule to define an ingredients chamber, said filter being formed of a hydrophobic and non-absorbent material having a basis weight of less than 40 g/m2;

an ingredients station for depositing a desired volume of desired ingredients into said ingredients chamber, wherein a portion of said ingredients have a grind size of less than 100 microns;

a cover sealing station for sealing a cover to said body.

42. (canceled)

43. The system of claim **41** further comprising a cover pre-sealing station for sealing a portion of said cover to said body and a MAP station for replacing air in said capsule with an inert gas and sealing the remainder of said cover to said body.

44. The system of claim **43** wherein said cover is sealed to said body to define a hinge zone and a peel zone, wherein said hinge zone has a stronger seal than said peel zone

45. (canceled)

46. (canceled)

47. (canceled)

48. A process for making a beverage capsule for use in a beverage preparing machine, the process comprising the steps of:

sealing a filter to an interior surface of a body for the beverage capsule to define an ingredients chamber, said filter being formed of a hydrophobic and non-absorbent material having a basis weight of less than 40 g/m2;

depositing a desired volume of desired ingredients into said ingredients chamber, wherein a portion of said ingredients have a grind size of less than 100 microns;

sealing a cover to said body to cover said opening.

49. (canceled)

50. The process of claim **48** further comprising the steps of (i) sealing a portion of said cover to said body and (ii) replacing air in said capsule with an inert gas and (iii) sealing the remainder of said cover to said body.

51. The process of claim **50** wherein said cover is sealed to said body to define a hinge zone and a peel zone, wherein said hinge zone has a stronger seal than said peel zone

52.-**54**. (canceled)

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