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(54) **CONTAINER WITH REMOVABLE PORTION**

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Description

FIELD

[0001] This specification relates to containers and in particular to a container, such as a single serve capsule, having a portion that is removable from the remainder of the container.

BACKGROUND

[0002] The following background discussion is not an admission that anything discussed below is citable as prior art or common general knowledge.

[0003] Single serve capsules for use in machines for preparing beverages or other products are becoming increasingly popular. Such capsules come in a variety of formats for producing products such as espresso coffee, drip coffee, tea or hot chocolate.

[0004] Multi chamber capsules, such as drip coffee capsules, have a first chamber defined by a filter (typically a paper filter) that is loosely packed with ingredients (such as ground coffee) and a second chamber downstream of the first chamber that defines an empty space for receiving a prepared product that flows through the filter prior to dispensing into a cup. One example of a multi chamber capsule is the Keurig K-Cup™ capsule. This capsule includes a paper filter having a side wall that is sealed to an inside peripheral edge of the capsule.

[0005] A problem with conventional multi chamber capsules, such as the Keurig K-cup™ capsule, is that the capsules are not adapted for recycling. The portion containing the precursor ingredients (such as coffee grounds) cannot be easily separated from the plastic outer shell. As a result, the used capsules must be disposed into garbage destined for landfill.

[0006] One approach to addressing this problem is provided with the Keurig Vue™ capsule, as described in US patent application 2012/0058226. The Vue™ capsule includes a filter that is secured to the capsule cover inwardly from the sidewall of the outer shell. The capsule cover with attached filter may be peeled from the outer shell to allow the shell to be disposed into plastics recycling while the cover and filter (with ingredients) is disposed into garbage destined for landfill. As a result, the Vue™ capsule provides a partially recyclable solution.

[0007] There are a number of problems with the Keurig Vue™ capsule solution however. The process for filling and sealing the capsule is more complicated than for conventional capsules and the capsule is more costly to produce as a result. Also, the used paper filter is weak, in particular when it is wet, and prone to tearing and spilling of ingredients when the filter and cover are being removed from the capsule following use.

[0008] Other forms of containers having a removable portion are also well known. Such containers typically include a component that is adapted to be manipulated by a user to facilitate removal of the desired portion of

the container. A problem with such containers is that the component tends to add complexity and cost to the manufacturing and packaging of the container. Another problem with such containers is that they are not adapted to include a filter element that is removable. EP1905 699, discloses a package for a food product comprising a sack-shaped sealed casing that can be separated from a rigid or semi-rigid support e.g. for storage in a refrigerator. Further documents US4,944,427 and US 6,391,402 B1, disclose containers that can be easily recycled.

[0009] There is a need for an improved container having one or more removable portions that address one or more problems with conventional containers such as the problems noted above.

SUMMARY

[0010] The invention provides a container having the features according to claim 1.

[0011] Other aspects of the invention are as provided in the dependent claims.

[0012] 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

[0013] 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.

Figure 1 is a perspective view of a container in accordance with the present invention;

Figure 2 is a perspective view of the container of Figure 1 following its use in a machine for preparing products from containers, the cover and filter being partially removed from the body;

Figure 3 is a sectional view of the container of Figure 1 as viewed along lines 3-3, the container being disposed in a chamber for a machine for preparing a product from the container;

Figure 4 is an enlarged sectional view of the container shown in Figure 3 as viewed within circle 4;

Figure 5 is an exploded sectional view of a container in accordance with another embodiment of the present invention, the container having a body and cover made from multilayered materials;

Figures 6 (a) to 6 (d) are enlarged sectional views of a container in accordance with another embodiment of the present invention showing different examples of a peelable bond between filter and body;

Figure 7 is a perspective view of another embodiment of a container in accordance with the present invention, showing the filter being peeled from the body and the cover being peeled from the filter;

Figure 8 is a perspective view of another embodiment of a container in accordance with the present invention, showing the filter attached to the sidewall of the body with a tab for peeling filter from body and the cover attached to the flange with a tab for peeling cover from body;

Figure 9 is a side view of a container in accordance with another embodiment of the present invention with a portion of the container being separated from the remainder of the container;

Figure 10 is a top view of the body for the container of Figure 9 showing one variant for the separation point;

Figure 11 is a top view of the body for the container of Figure 9 showing another variant for the separation point;

Figure 12 is a side view of a container in accordance with another embodiment of the present invention showing the tab, cover and filter with ingredients being separated from the remainder of the body;

Figure 13 is a bottom view of the container shown in Figure 12 with the separation point defined in the bottom surface of flange to define tab;

Figure 14 is a schematic top view of a mold and material for forming a plurality of bodies with a plurality of tab indicators in accordance with the present invention

Figure 14 is a schematic top view of a mold and material for forming a plurality of bodies with a plurality of tab indicators in accordance with the present invention

Figure 15 is a perspective view of another embodiment of a container in accordance with the present invention, showing the cover and filter being peeled from the body;

Figure 16 is an enlarged sectional view of the flange for the container of Figure 15 as viewed along lines 16-16, showing the separation point defining the tab prior to it being separated from the remainder of the

flange (the cover is not shown);

Figure 17 is a perspective view of another embodiment of a container in accordance with the present invention; [0033] Figure 18 is a perspective view of another embodiment of a container in accordance with the present invention;

Figure 19 is a perspective view of another embodiment of a container in accordance with the present invention;

Figure 20 is a perspective view of another embodiment of a container in accordance with the present invention.

DESCRIPTION OF VARIOUS EMBODIMENTS

[0014] 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.

[0015] A container in accordance with one embodiment of the present invention is shown generally at 10 in Figures 1-4. Container 10 includes a body 12, filter 14, ingredients 16 and cover 18.

[0016] Body 12 includes a side wall 20 and an end wall 22 together defining an enclosed interior space 24. An opening 26 is defined at one end of body 12. Body 12 further includes a flange 28 that extends around the perimeter of opening 26. Preferably, side wall 20, end wall 22 and flange 26 are all integrally formed, such as by thermoforming, from one sheet of material. Container 10 preferably is symmetrical with an annular flange 28 having a uniform width. Most preferably, container 10 has a circular cross section in order that it does not require orientation during manufacture or during use (in cases where container is used in a machine for preparing beverages or other products).

[0017] Cover 18 includes at least one tab 30 that is adapted to provide a grip for cover 18 to be peeled from body 12 following use of container 10 in a machine for preparing products, such as beverages, from containers 10. Tab 30 may extend from flange 28 and fold over or, more preferably, tab 30 is integrally formed with flange 28 as shown for example with the embodiment depicted in Figures 12 and 13.

[0018] Cover 18 is preferably formed of a material that is resistant to tearing upon the application of a peel force. Most preferably, cover 18 is formed of a multi-layered material that includes at least one layer that is resistant

to tearing upon the application of a peel force. Cover 18, or a tear resistant layer of cover 18, preferably has a minimum tensile strength of 20.7 Mpa (3000 psi) and a minimum elongation of 50%. Examples of materials that are resistant to tearing include

polyethylene (PE), polyethylene terephthalate (PET) and polyamide PA6. A multi-layered material for cover 18 may include at least one layer formed of a continuous film of tear resistant material (laminated or extrusion coated) or a non-continuous film such as a non-woven polymer, mesh or perforated film. Examples of a multi-layered material for cover 18 include (from outside layer to inside layer): PET/aluminum foil/PE, PET/EVOH/PE, PET/metalized PET/PE or PET/PE. End wall 22 includes at least one extraction region 32 adapted for being pierced by at least one extraction needle 34 of a machine 36 for dispensing product, such as a beverage, from the container 10 to a user's cup.

[0019] Filter 14 is adapted to be disposed within body 12 to define at least one ingredients chamber 46 in an upper region of the interior space 24 for receiving one or more ingredients 16 and, for filtering applications, at least one extraction chamber 48 exterior to the ingredients chamber 46 in the interior space 24 for receiving product, such as a beverage, from the at least one ingredients chamber 46 prior to extraction using the extraction needle 34.

[0020] "Filter" is defined herein to mean any material that is suitable for holding and filtering ingredients for preparing a beverage.

[0021] "Ingredients" is defined herein to mean any material that is desired for use within container for a desired purpose. Ingredients may include food or beverage ingredients or other natural or synthetic material (for example packaging preservatives) desired for use within container.

[0022] In the case of a container 10 for preparing a beverage as intended for the present embodiment, ingredients 16 may be coffee grounds, tea leaves, chocolate powder, milk powder, instant coffee or any other soluble or insoluble ingredients or combinations of ingredients that may be used to prepare a beverage in a beverage preparing machine 36 as described herein.

[0023] Filter 14 includes a gasket portion 50 that is adapted for securing filter 14 to body 12 as described further below. Gasket portion 50 includes a plurality of pores, openings or channels 62 (collectively referred to as channels 62 hereafter) suitable for securing filter 14 between cover 18 and flange 28 as described herein. Filter 14 also includes a filter portion 52 that is disposed within interior space 24 to define ingredients chamber 46. In a preferred embodiment, as described further below, filter portion 52 is molded to a desired shape within interior space 24 once gasket portion 50 has been secured to body 12 and prior to filling with ingredients 16.

[0024] Filter 14 may be formed of any material suitable for holding and filtering the specific ingredients 16 that are intended to be disposed within ingredients chamber

46.

[0025] Preferably, for beverage filtering applications, filter 14 is formed of a moldable non-woven filtration material that includes a plurality of multi-component filaments that are bound or interlocked by non-woven manufacturing techniques (such as spunbond techniques) to form a web having channels 62 extending from one side of filter 14 to the other. The basis weight for filter 14 adapted for filtering ingredients for preparing a single serving of beverage is in the range of 8 to 400 grams per square meter (gsm), preferably in the range of 40 to 150 gsm and more preferably in the range of 60 to 120 gsm. More details of the preferred moldable nonwoven filtration material for filter 14 are provided in co-pending US provisional patent application No. 61/723,644 and regular US patent application 14/074,024.

[0026] Gasket portion 50 of filter 14 is adapted to be secured by way of a first bond 64 to the periphery of opening 16 of body 12 (and most preferably to the top surface of flange 28). First bond 64 may be formed by disposing a separate bonding material between filter 14 and body 12 or it may be integrally formed from the material of one or both of filter 14 and body 12 (as shown for example in Figure 5).

[0027] First bond 64 preferably comprises a peelable bond between second surface 14b of filter 14 and first surface 12a of body 12 (top surface of flange 28) in order that filter 14 may be peeled away from body 12.

[0028] "Peelable bond" is defined herein to mean a bond between two materials that is sufficiently strong to allow both materials to remain bonded together during normal conditions for manufacture, shipment and use while being sufficiently weak to allow one material to be peeled away from the other material by hand following use.

[0029] First bond 64 is formed from a first bonding material 66 that is adapted for securing filter 14 to body 12. As noted above, first bonding material 66 may be a separate material from filter 14 and body 12 or it may be an integral part of the material (either a monolayer material or a layer of a multi-layered material) for one or both of filter 14 and body 12.

[0030] One example of a preferred first bonding material 66 is a heat sealable polymer such as polyethylene (PE) including low density PE, linear low density PE and high density PE. This material may be provided as a sealing layer for a multi-layered material for body 12 or it may be provided as a separate first bonding material 66.

[0031] Other suitable first bonding materials 66 include other heat sealable materials such as polypropylene, lacquer, ethylene vinyl acetate (EVA), ethylene acrylates, polystyrene or combinations of the above. Adhesive materials (having comparable adhesion properties as described above to form a peelable bond) may be utilized for applications where a heat sealer is not desired or feasible.

[0032] Suitable first bonding materials that may be integral with filter 14 include homocomponent materials

(such as polyolefin, polyester, and polyamide) and multicomponent materials (such as polyester-polyolefin, polyamide-polyolefin and polyester-polyamide).

[0033] Cover 18 is adapted to be secured by way of a second bond 68 to gasket portion 50 of filter 14. In the embodiments depicted in Figures 1-6, second bond 68 preferably is at least as strong and more preferably is stronger than first bond 64 in order that filter 14 will remain secured to cover 18 when cover 18 is peeled from body 12.

[0034] Second bond 68 is preferably formed from a second bonding material 70 that is adapted for securing a first surface 18a of cover 18 to second surface 14b of filter 14. One example of a preferred second bonding material is a heat sealable polymer such as polyolefin. Other suitable second bonding materials 70 may include other heat sealable materials such as lacquer, ethylene vinyl acetate (EVA), and ethylene acrylates or adhesive materials for applications where a heat sealer is not desired or feasible.

[0035] The selection of the first bonding material 66 and second bonding material 70 are interdependent and also depend on the selection of other components within container 10 including filter 14. The strength or weakness of the bonds is related to the compatibility of the respective materials being bonded together. Less compatible bonds are adapted to separate prior to more compatible bonds. More details concerning the preferred choice of bonding materials are provided below with reference to Figures 6(a)-(d).

[0036] For the embodiments depicted in Figures 1-6, the bond strength of second bond 68 is preferably at least as strong as the first bond 64 and more preferably 50% higher than that of first bond 64 and even more preferably 100% higher or more. For example, using the ASTM F88 protocol, the bond strength of first bond 64 is preferably no more than 20 N/15 mm and more preferably no more than 10 N/15 mm. The bond strength of second bond 68 is preferably no less than 15 N/15 mm and more preferably no less than 25 N/15 mm.

[0037] First and second bonding materials 66, 70 are preferably adapted to become at least partially embedded within channels 62 of gasket portion 50 of filter 14. Heat sealable polymers for example will flow into channels 62 when melted during a heat sealing process and then form a bond within channels 62 upon cooling. In the case of filter 14 being formed of filtration material having multi-component fibers, one or more portions of the multi-component fibers may melt during the heat sealing process and combine with the first or second bonding materials while other portions of the multi-component fibers remain intact (do not melt) during the heat sealing process to maintain a web defining channels 62. Preferably, second bonding material 70 is chemically compatible in order that it may be sealed to all the components of filter material 14 to give a sufficiently strong seal strength. More details of filter 14 and the manner for securing filter 14 and cover 18 to flange 28 of body 12 are provided in

co-pending patent application No 13/600,582.

[0038] Referring to Figure 5, an exploded sectional view of a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0039] Container 10 includes body 12, filter 14, ingredients 16 and cover 18. While the body 12 and cover 18 of container 10 shown in Figures 1-4 could be formed of a monolayered material, body 12 and cover 18 for the embodiment shown in Figure 5 are each formed of multilayered materials that include one or more barrier layers providing barriers against one or more environmental factors such as light, oxygen, and moisture as described further below.

[0040] Body 12 is formed of a conventional multilayered material MM1 that includes a barrier layer B1 preferably formed of ethylene vinyl alcohol (EVOH) and a sealing layer S1 preferably formed of polyethylene (PE). As well, body 12 may include outer base layer O1 preferably formed of polyolefin or polystyrene or other materials adapted to cover and protect barrier layer B1.

[0041] Cover 18 is formed of a conventional multilayered material MM2 that includes a barrier layer B2 preferably formed of aluminum foil or metalized polyester or Ethylene Vinyl Alcohol (EVOH) and a sealing layer S2 preferably formed of polyethylene or modified polyethylene or polyethylene copolymer. Sealing layer S2 may be formed from a lamination process, extrusion coating or lacquer coating process. As well, cover 18 may include an outer base layer O2 preferably formed of polyester and a graphics layer G2 preferably formed of ink. Depending upon the type of packing machinery, cover 18 could be provided as roll stock or in die-cut format.

[0042] It is preferred that cover 18 is formed of multilayered material MM2 (such as described above) that is resistant to tearing as described above and that shrinks when exposed to heat. This allows cover to be peeled away from body 12 and also reduces the likelihood of cover 18 being torn during the process of puncturing with injection nozzle and injecting fluid into ingredients chamber 46. Multilayered material MM2 of cover 18 will also preferably shrink around the opening formed by injection nozzle when exposed to injection of hot fluid to reduce the size of opening. These characteristics can be achieved by choosing a proper outer base layer O2 such as polyester for providing rigidity to the cover 18.

[0043] Filter 14 is formed by disposing filtration material over opening 26 of body 12. Gasket portion 50 of filter 14 engages sealing layer S1 disposed on the top surface of flange 28 and filter portion 52 extends across opening 26. Gasket portion 50 is then sealed with a heat sealer to sealing layer S1 disposed on the top surface of flange 28. A portion of sealing layer S1 on top surface of flange 28 (also referred to herein as first bonding material 66) is melted by heat sealer and flows into channels 62 within gasket portion 50. The gasket portion 50 of filter 14 may be partially melted during this process if it contains mul-

multiple component fibres while other portions of the multi-component fibers remain intact (do not melt) during the heat sealing process to maintain a web defining channels 62.

[0044] In addition to choosing desired first and second bonding materials 66, 70, the temperature, pressure and time parameters for the heat sealing process are optimized to ensure the desired bonding strength is achieved for both first bond 64 and second bond 68. For example, with respect to both first bond 64 and second bond 68, the sealing temperature is preferably in the range of 100-250 C and more preferably in the range of 160-220 C. The sealing pressure is preferably in the range of 0.5-4 bar and more preferably in the range of 1-3 bar. The sealing time is preferably in the range of 50-5000 milliseconds and more preferably in the range of 500-3000 milliseconds.

[0045] Once the melted first bonding material 66 sufficiently cools to form first bond 64 to secure gasket portion 50 to flange 28, then filter 14 may be molded for instance by engaging filter portion 52 using a heated mandrel to mold filter portion 52 to a desired shape within interior space of body 12 to form the ingredients chamber 46. Then ingredients 16 are disposed within ingredients chamber 46 of filter 14 and cover 18 is positioned over gasket portion 50 to cover opening 26.

[0046] Cover 18 may then be partially sealed to gasket portion 50 using a heat sealer. A portion of the sealing layer S2 (also referred to herein as second bonding material 70) on bottom surface of cover 18 is melted by a heat sealer and flows into channels 62 of gasket portion 50. The air within interior space 16 of container 10 may then be evacuated and replaced with an inert gas such as nitrogen in accordance with a modified atmosphere packaging process. The remainder of cover 18 may then be fully sealed to body 12 over gasket portion 50 as described above to form second bond 68 and seal interior space 16 of container 10.

[0047] Body 12 preferably includes a notch 72 cut into at least sealing layer S1 (first bonding layer 66) below the periphery of opening 16. Notch 72 may, in certain applications where barrier properties are not excessively compromised, also extend into barrier layer B1 if necessary to provide a sufficient area weakness as discussed below. Notch 72 provides an area of weakness for ingredients chamber and first bonding material 66 (in this instance sealing layer S1 at gasket 50) to be separated from body 12 when tab 30 is pulled to peel cover 18 from body 12 following use of container 10.

[0048] Adhesion or tie layers T may be disposed in known manner between the respective layers B1, S1, O1 and G1 as described above to adhere or tie the respective layers together. Adhesion or tie layers T in body 12 may provide a relatively weak connection between adjoining surfaces to allow for separating layers when peeling cover 18 and ingredients chamber 46 from body 12.

[0049] Referring to Figures 6 (a)-(d), a number of examples of a peelable bond between filter 14 and body 12

are shown.

[0050] Figures 6(a) and 6(b) show first bond 64 being formed using a separate material (first bonding material 66) disposed between first surface 14a of filter 14 and first surface 12a of body 12.

[0051] In Figure 6(a) the peel strength of the first bond 64 between first surface 14a of filter 14 and first bonding material 66 is greater than the peel strength of the first bond 64 between first bonding material 66 and first surface 12a of body 12. As a result, filter 14 and first bonding material 66 are peeled away from first surface 12a of body 12 upon the application of a sufficient peeling force to filter 14.

[0052] The choice of materials for the example shown in Figure 6(a) include the following. Filter 14 may be formed of $\geq 20\%$ LDPE or LLDPE and cover 18 may be formed of PE, EVA, EAA or a combination of two or more of these materials. In this case, first bonding material 66 and second bonding material 70 may be formed from LDPE, EVA (Dupont Bynel™) or modified PE (Dow Sealution™). It will be understood that other choices of materials may be selected as well.

[0053] In Figure 6(b) the peel strength of the first bond 64 between first surface 14a of filter 14 and first bonding material 66 is less than the peel strength of the first bond 64 between first bonding material 66 and first surface 12a of body 12. As a result, filter 14 is peeled away from first bonding material 66 upon the application of a sufficient peeling force to filter 14.

[0054] The choice of materials for the example shown in Figure 6(b) include the following. Filter 14 may be formed of $\leq 20\%$ LDPE or LLDPE, PP, PA or Polyester and cover 18 may be formed of a PE, EVA, EAA or a combination of two or more of these materials. In this case, first bonding material 66 may be formed from LDPE, EVA (Dupont Bynel™) or modified PE (Dow Sealution™). Second bonding material 70 may be formed from polyester or other suitable materials provided that the second bond 68 is stronger than first bond 64. It will be understood that other choices of materials may be selected as well.

[0055] Figures 6(c) and 6(d) show first bond 64 being integrally formed from a layer of a multilayered material MM1 forming body 12.

[0056] In Figures 6(c) the peel strength of the first bond 64 between first surface 14a of filter 14 and first bonding material 66 (which is the sealing layer S1 of the multilayered material MM1 forming body 12) is greater than the peel strength of the first bond 64 between first bonding material 66 and the adjacent layer of the multilayered material MM1. The adjacent layer may be a tie layer formed of a low compatibility material such as Surlyn™ or Bynel™ or adjacent layer may be barrier layer B1. As a result, filter 14 and first bonding material 66 (ie a portion of the sealing layer S1 of multilayered material MM1) are peeled away upon the application of a sufficient peeling force to filter 14. This example is described in more detail above with reference to Figure 5. Notch 72 defines a

break point to allow a portion of sealing layer S1 to be removed with filter 14 while the remainder of sealing layer S1 stays within body 12.

[0057] The choice of materials for the example shown in Figures 6(c) include the following. Filter 14 may be formed of $\geq 20\%$ LDPE or LLDPE, PP, PA or Polyester and cover 18 may be formed from PE, EVA, EAA or a combination of two or more of these materials. In this case, first bonding material 66 may be formed from LDPE, LLDPE, HDPE, EVA or a combination of two or more of these materials. Second bonding material 70 may be formed from PE, EVA, EAA or a combination of two or more of these materials. It will be understood that other choices of materials may be selected as well.

[0058] In Figure 6(d) the peel strength of the first bond 64 between first surface 14a of filter 14 and first bonding material 66 is less than the peel strength of the first bond 64 between first bonding material 66 and the adjacent layer of the multilayered material MM1. As a result, filter 14 is peeled away from first bonding material 66 (ie away from first surface 12a of body 12 or, in other words, away from sealing layer S1 of multilayered material MM1 that forms body 12) upon the application of a sufficient peeling force to filter 14.

[0059] The choice of materials for the example shown in Figure 6(d) include the following. Filter 14 may be formed of $\geq 20\%$ LDPE or LLDPE and cover 18 may be formed of PE, EVA, EAA or a combination of two or more of these materials. In this case, first bonding material 66 (sealing layer S1) may be formed from HDPE, PP or PS. Second bonding material 70 may be formed from PE, EVA, EAA or a combination of two or more of these materials. It will be understood that other choices of materials may be selected as well.

[0060] Referring to Figure 7, a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0061] Container 10 includes body 12, filter 14, ingredients 16 and cover 18. If desired, body 12 and cover 18 may each be formed of multilayered materials that include one or more barrier layers providing barriers against one or more environmental factors such as light, oxygen, and moisture as described further below.

[0062] In this embodiment, second bond 68 between filter 14 and cover 18 comprises a peelable bond similar to first bond 64 as described for the embodiments above. For example, the peel strength of the second bond 68 between second surface 14b of filter 14 and second bonding material 70 may be less than the peel strength of the second bond 68 between second bonding material 70 and the first surface 18a of cover 18. As a result, filter 14 may be peeled away from second bonding material 70 (ie away from first surface 18a of body 12) upon the application of a sufficient peeling force to filter 14.

[0063] Filter 14 and cover 18 also preferably each include tabs 30a and 30b that are preferably aligned to

provide a common grip for peeling filter 14, ingredients 16 and cover 18 from body 12. Tabs 30a and 30b may then be separately gripped to peel cover 18 away from filter 14 and ingredients 16. This allows the user to dispose of body 12, filter 14, ingredients 16 and cover 18 in one of multiple desired locations.

[0064] The choice of materials for the example shown in Figure 7 include the following. Filter 14 may be formed of $\geq 20\%$ LDPE or LLDPE and cover 18 may be formed of HDPE, PP or PS. In this case, first bonding material 66 (sealing layer S1) and second bonding material 70 (sealing layer S2) may be formed from HDPE, PP or PS. Alternatively, filter 14 may be formed of $\geq 20\%$ LDPE or LLDPE, PP, PA or Polyester and cover 18 may be formed from LDPE, LLDPE, HDPE, EVA or a combination of these materials. In this case, first bonding material 66 (sealing layer S1) and second bonding material 70 (sealing layer S2) may be formed from LDPE, LLDPE, HDPE, EVA or a combination of these materials. It will be understood that other choices of materials may be selected as well.

[0065] Referring to Figure 8, a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0066] Container 10 includes body 12, filter 14, ingredients 16 and cover 18. If desired, body 12 and cover 18 may each be formed of multilayered materials that include one or more barrier layers providing barriers against one or more environmental factors such as light, oxygen, and moisture as described further below.

[0067] In this embodiment, filter 14 is secured to side-wall 20 of body 12 by way of first bond 64 using first bonding material 66. First bond 64 is a peelable bond as described above. Filter 14 includes tab 30a that provides a grip for peeling filter 14 from body 12. Tab 30a is preferably folded away from flange 28.

[0068] Cover 18 is secured to flange 28 of body 12 by way of second bond 68 using second bonding material 70. Second bond 68 is also a peelable bond as described above. Cover 18 includes tab 30b that provides a grip for peeling cover 18 from body 12.

[0069] As a result, once container 10 has been used for its intended purpose, a user will grip tab 30b to peel cover away from body 12. The user will then grip tab 30a to peel filter 14 together with ingredients 16 away from body 12. This allows the user to dispose of body 12, filter 14, ingredients 16 and cover 18 in one of multiple desired locations.

[0070] The choice of materials for the example shown in Figure 8 include the following. Filter 14 may be formed of $\geq 20\%$ LDPE or LLDPE and cover 18 may be formed of LDPE, LLDPE, HDPE, EVA, modified PE or a combination of these materials. In this case, first bonding material 66 (sealing layer S1) and second bonding material 70 (sealing layer S2) may be formed from HDPE, PP or PS. Alternatively, filter 14 may be formed of $\leq 20\%$ LDPE

or LLDPE, PP, PA or Polyester and cover 18 may be formed from LDPE, LLDPE, HDPE, EVA or a combination of these materials. In this case, first bonding material 66 (sealing layer S1) and second bonding material 70 (sealing layer S2) may be formed from LDPE, LLDPE, HDPE, EVA or a combination of these materials. It will be understood that other choices of materials may be selected as well.

[0071] Referring to Figures 9-11, a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0072] Container 10 includes body 12, filter 14, ingredients 16 and cover 18. If desired, body 12 and cover 18 may each be formed of multilayered materials that include one or more barrier layers providing barriers against one or more environmental factors such as light, oxygen, and moisture as described further below.

[0073] Instead of having a separation of cover 18 and ingredients chamber 46 from body 12, this embodiment provides a separation of one portion of body 12, such as flange 28, from the rest of body 12. Cover 18 with filter 14 defining ingredients chamber 46 containing ingredients 16 remains connected to the removed portion of body 12, such as flange 28, following such separation.

[0074] Continuing with the example where flange 28 is being removed from the remainder of body 12, a separation point 80 is defined in body 12 preferably proximate to the interface between flange 28 and side wall 20. Separation point 80 may be a score line (a continuous indentation) or perforation line (a line of discrete indentations) that is adapted to break or separate upon the application of force. Separation point 80 may be defined in body 12 either during or following the process for forming body 12 for instance by thermoforming. The separation point 80 may be defined only in the outer surface (second surface 12b) of body 12 or it may be defined in both the outer surface and inner surfaces (second surface 12b and first surface 12a) of body 12. Preferably, separation point 80 is formed through an in-mold cutting process during thermoforming of body 12 or at a separate station following formation of body 12.

[0075] In one variant as shown in Figure 10, separation point 80 may extend about circumference of body 12 and be adapted to separate upon application of opposing twisting forces to flange 28 and side wall 20 (as shown in figure 6) similar to twisting a cap from a bottle. Separation point 80 is shown defined in flange 28 adjacent to the interface with side wall 20. It will be understood that separation point 80 could alternatively be defined in side wall 20 proximate to interface with flange 28. Filter 14 may be bonded to side wall 20 between separation point 22 and flange 28. Filter 14 is preferably formed of a non-woven material as described above but may alternatively be formed from a conventional paper filter material if desired since it is not subjected to significant tear forces.

[0076] In another variant as shown in Figure 11, sep-

aration point 80 may be defined in flange 28 about circumference of body 12 and include a portion extending to peripheral wall of flange 28 to define tab 30 for peeling flange 28 with cover 18 and filter 14 with ingredients chamber 46 from the remainder of body 12.

[0077] Referring to Figures 12-13, a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0078] Container 10 includes body 12, filter 14, ingredients 16 and cover 18. If desired, body 12 and cover 18 may each be formed of multilayered materials that include one or more barrier layers providing barriers against one or more environmental factors such as light, oxygen, and moisture as described further below.

[0079] In this embodiment, cover 18 is bonded with second bonding material 68 to the first surface 12a of body 12 (top surface of flange 28) in the same manner as described for the embodiments shown in Figures 1-6.

[0080] A separation point 80 is defined along at least one portion of body 12, such as flange 28, to form at least one tab 30 (and preferably two tabs 30 as shown). Separation point 80 may be formed for example by a score line or perforation line that is adapted to break or separate from flange 28 upon the application of sufficient force. The force for instance may be applied by upward pressure, for instance by a person's thumb, along the bottom side of tab 30 until tab 30 snaps and separates from flange 28.

[0081] Separation point 80 is preferably made through scoring or perforating during the same operation that is utilized for thermoforming body 12 or at a subsequent station. Separation point 80 may be defined along the second surface 12b of body 12 (bottom surface of flange 28) without significantly disrupting or negatively impacting the ability of cover 18 to be peelably sealed to the top surface of flange 28 such as described for the embodiments shown in Figures 1-6. Separation point 80 may for instance extend a desired distance into the bottom surface of flange 28 without breaking the top surface. Preferably, separation point 80 is defined in both the outer surface and inner surfaces (second surface 12b and first surface 12a) of body 12. Preferably, for containers 10 formed of multilayered materials MM, separation point 80 does not break or significantly disrupt the barrier layer B.

[0082] Preferably, a tab indicator 82 is disposed on body 12 to indicate the location of tab 30. Tab indicator may be embossed onto the outer surface of sidewall 20 of body 12 in the same operation utilized for thermoforming body 12. Tab indicator 82 may alternatively be printed or adhered onto the material for forming body 12 at locations that align with the molds 84 that are adapted for formation of body 12 and separation point 80 as shown in Figure 14.

[0083] Following use of container 10, allowing sufficient time for the container 10 to cool if necessary, a user

will apply force to tab 30 along the bottom portion of tab 30 until the tab 30 snaps free from the remainder of flange 28 along separation point 80. The user may hear a snap sound to indicate that tab 30 has separated from flange 28. The user then applies a peeling force to tab 30 in order to peel cover 18 and filter 14 with ingredients chamber containing ingredients 16 from body 12. Body 12 may be disposed into plastics recycling and cover 18 and filter 14 with ingredients chamber and ingredients 16 may be disposed into garbage destined for landfill or further processed or separated for disposal or recycling purposes.

[0084] As noted earlier, container 10 preferably is symmetrical with an annular flange 28 having a uniform width W with separation point 80 defining tab 30 within the uniform width W of flange 28. This is preferable to having a portion of flange 28 with tab 30 extend beyond the uniform width W of the remainder of flange 28 which could complicate the manufacture and packaging of container 10 and which may prevent container from being utilized in a machine 36.

[0085] Referring to Figures 15 and 16, a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0086] Container 10 includes body 12, ingredients 16 and cover 18. If desired, body 12 and cover 18 may each be formed of multilayered materials that include one or more barrier layers providing barriers against one or more environmental factors such as light, oxygen, and moisture as described further below.

[0087] This embodiment of container 10 is similar to the embodiment shown in Figure 12 and 13 but does not include filter 14. A tab 30 is defined in body 12 (preferably in flange 28) by separation point 80. Cover 18 is bonded by second bond 68 to the portion of body 12 (preferably to flange 28) that includes tab 30 defined by separation point 80. Second bond 68 is a peelable bond as described above to allow cover 18 to be peeled away with tab 30 from the remainder of body 12. Tab indicator 82 is provided, as described above, to assist the user in locating tab 30.

[0088] This embodiment may be applied to a wide variety of containers 10. The separation point 80 defining tab 30 may be integrally formed within the body 12 of container 10 without adding significant costs or adding significant complexity to the overall structure of the container.

[0089] Referring to Figure 17, a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0090] Container 10 includes body 12, filter 14, ingredients 16 and cover 18. In this embodiment, body 12 comprises flange 28 and a partial side wall 20 adapted to support filter 14. Body 12 does not include a full side wall 20 and end wall 22 for defining a fully enclosed in-

terior space.

[0091] In all other respects, container 10 is similar to the embodiments described above with a portion of container 10 being removable from the remainder of container 10. For example, filter 14 may be bonded to body 12 (either to flange 28 or side wall 20) with a first bond 64 that is a peelable bond. Cover 18 may be bonded to filter 14 or to body 12 (such as to flange 28) with a second bond that may also be a peelable bond if desired.

[0092] Referring to Figure 18, a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0093] Container 10 includes body 12, filter 14, ingredients 16 and cover 18. If desired, body 12 and cover 18 may each be formed of multilayered materials that include one or more barrier layers providing barriers against one or more environmental factors such as light, oxygen, and moisture as described further below.

[0094] In this embodiment, body 12 further comprises a shoulder 90 disposed inwardly from flange 28 to support filter 14. Filter 14 may be bonded to a support ring 92 that is adapted to either rest loosely upon shoulder 90 as shown or be bonded to shoulder with a first bond 64 that is preferably a peelable bond (not shown). Cover 18 is bonded to flange 28 with second bond 68 that is a peelable bond as described for the embodiments above.

[0095] This embodiment of container allows filter 14 to be disposed within container 10 without bonding to the same flange surface as cover 18. Upon peeling away cover 18 following the use of container 10, filter 14 and ingredients 16 may be removed from container either by tipping container upside down (if ring rests loosely upon shoulder 90) or by peeling away ring and filter 14 preferably with the aid of a tab (not shown).

[0096] Referring to Figure 19, a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0097] Container 10 includes body 12, filter 14, ingredients 16 and cover 18. If desired, body 12 and cover 18 may each be formed of multilayered materials that include one or more barrier layers providing barriers against one or more environmental factors such as light, oxygen, and moisture as described further below.

[0098] In this embodiment, container 10 is similar to the container shown in Figure 18. Shoulder 90 includes a slot 94 that is adapted to receive a portion of filter 14 and support ring 92. Support ring 92 is preferably configured to support filter 14 within slot 94 by way of a friction fit.

[0099] This embodiment of container also allows filter 14 to be disposed within container 10 without bonding to the same flange surface as cover 18. Upon peeling away cover 18 following the use of container 10, filter 14 and ingredients 16 may be removed from container by peeling

away ring and filter 14 preferably with the aid of a tab 30.

[0100] Referring to Figure 20, a container 10 in accordance with another embodiment of the present invention is shown. The same reference numerals are provided for elements that are similar to the elements described above.

[0101] Container 10 includes body 12, filter 14, ingredients 16 and cover 18. If desired, body 12 and cover 18 may each be formed of multilayered materials that include one or more barrier layers providing barriers against one or more environmental factors such as light, oxygen, and moisture as described further below.

[0102] In this embodiment, container 10 is similar to the container shown in Figure 19 however no shoulder 90 is provided. Instead, slot 94 is defined in flange 28. Slot 94 is adapted to receive a portion of filter 14 and support ring 92.

[0103] Cover 18 is bonded to support ring 92 as well as to flange 28 by a peelable bond. Upon peeling away cover 18 following the use of container 10, filter 14 and ingredients 16 may be removed from container.

[0104] 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.

Claims

1. A container (10) comprising:

a body (12) defining an interior space (24) having an opening (26), said body having a flange (28) surrounding said opening;
a filter (14) disposed in said body to define an ingredients chamber (46), said filter being bonded to a first surface (12a) of said flange with a first bond (64), said first bond being a peelable bond;
a separation point (80) defined in said flange, said separation point defining a tab (30) that is adapted to be separated from the remainder of said flange upon the application of sufficient force by hand;
ingredients (16) disposed in said ingredients chamber; and
a cover (18) disposed over said opening for covering said interior space, said cover being bonded to said filter with a second bond (68),

wherein said tab and said cover are adapted to be removed together with said filter and said ingredients chamber containing said ingredients following use of the container by the application of force by hand, wherein said filter is formed of a material suitable for holding and filtering said ingredients for preparing a beverage.

2. A container as claimed in claim 1, wherein said filter is formed of a moldable non-woven filtration material.

3. A container as claimed in claim 1 or 2, wherein said filter further defines an extraction chamber (48) exterior to said ingredients chamber.

4. A container as claimed in any one of claims 1-3, wherein a notch (72) is defined in the interior surface of said body, said notch providing a predicted point of weakness in said body.

5. A container as claimed in claim 4 wherein said notch extends substantially about the periphery of said opening.

6. A container as claimed in claim 4 wherein said body is formed of a multilayered material (MM1) that includes a barrier layer (B1) disposed between a sealing layer (S1) and an outer layer (O1), and wherein said notch is defined in said sealing layer.

7. A container as claimed in any one of the preceding claims, wherein said body is formed of a multilayered material that includes a barrier layer disposed between a sealing layer and an outer layer, and wherein said first bond between said filter and said body is formed with said sealing layer.

8. A container as claimed in any one of the preceding claims, wherein said filter has a gasket portion (50) with a plurality of channels (62), and wherein a first bonding material (66) is disposed in at least some of said channels for forming said first bond between said filter and said flange.

9. A container as claimed in claim 8, wherein a second bonding material (70) is disposed in at least some of said channels for forming said second bond between said filter and said cover.

10. A container as claimed in claim 9, wherein at least one of said first bonding material and said second bonding material is a heat sealable polymer.

11. A container as claimed in any one of the preceding claims, wherein said second bond has a bond strength that is greater than the bond strength of the first bond.

12. A container as claimed in claim 11, wherein said first bond has a bond strength of no more than 20 N/15mm.

13. A container as claimed in claim 11, wherein said second bond has a bond strength of no less than 15 N/15mm.

14. A single serve beverage capsule comprising a container according to any preceding claim and a quantity of a beverage ingredient provided within said ingredients chamber.
15. The single serve beverage capsule as claimed in claim 14, wherein the beverage ingredient is ground coffee.

Patentansprüche

1. Behälter (10), umfassend:

einen Körper (12), der einen Innenraum (24) mit einer Öffnung (26) definiert, wobei der Körper einen Bund (28) aufweist, der die Öffnung umgibt;
 einen Filter (14), der in dem Körper angeordnet ist, um eine Inhaltsstoffkammer (46) zu definieren, wobei der Filter an eine erste Oberfläche (12a) des Bundes mit einer ersten Bindung (64) angebunden ist, wobei die erste Bindung eine abziehbare Bindung ist;
 einen Trennpunkt (80), der in dem Bund definiert ist, wobei der Trennpunkt einen Anhänger (30) definiert, der angepasst ist, um von dem Rest des Bundes bei der Beaufschlagung einer ausreichenden Kraft per Hand abgetrennt zu werden;
 Inhaltstoffe (16), die in der Inhaltsstoffkammer angeordnet sind;
 eine Abdeckung (18), die über der Öffnung zum Abdecken des Innenraums angeordnet ist, wobei die Abdeckung an den Filter mit einer zweiten Bindung (68) angebunden ist, wobei der Anhänger und die Abdeckung angepasst sind, um zusammen mit dem Filter und der Inhaltsstoffkammer enthaltend die Inhaltstoffe folgend einer Verwendung des Behälters durch die Beaufschlagung einer Kraft per Hand entfernt zu werden, **dadurch gekennzeichnet, dass** der Filter aus einem Material gebildet ist, das zum Halten und Filtern der Inhaltstoffe zum Herstellen eines Getränks geeignet ist.

2. Behälter nach Anspruch 1, wobei der Filter aus einem formbaren Vliesfiltrationsmaterial gebildet ist.
3. Behälter nach Anspruch 1 oder 2, wobei der Filter ferner eine Extraktionskammer (48) außerhalb der Inhaltsstoffkammer definiert.
4. Behälter nach einem der Ansprüche 1-3, wobei eine Kerbe (72) in der Innenoberfläche des Körpers definiert ist, wobei die Kerbe einen vorhergesagten Schwächungspunkt in dem Körper bereitstellt.

5. Behälter nach Anspruch 4, wobei die Kerbe im Wesentlichen sich um die Peripherie der Öffnung erstreckt.
6. Behälter nach Anspruch 4, wobei der Körper aus einem mehrschichtigen Material (MM1) gebildet ist, das eine Barrierschicht (B1) einschließt, die zwischen einer Versiegelungsschicht (S1) und einer äußeren Schicht (O1) angeordnet ist, und wobei die Kerbe in der Versiegelungsschicht definiert ist,
7. Behälter nach einem der vorangehenden Ansprüche, wobei der Körper aus einem mehrschichtigen Material gebildet, das eine Barrierschicht einschließt, die zwischen einer Versiegelungsschicht und einer äußeren Schicht angeordnet ist, und wobei die erste Bindung zwischen dem Filter und dem Körper mit der Versiegelungsschicht gebildet ist.
8. Behälter nach einem der vorangehenden Ansprüche, wobei der Filter einen Dichtungsbereich (50) mit einer Vielzahl von Kanälen (62) aufweist, und wobei ein erstes Bindungsmaterial (66) in wenigstens einigen der Kanäle zum Bilden der ersten Bindung zwischen dem Filter und dem Bund angeordnet ist.
9. Behälter nach Anspruch 8, wobei ein zweites Bindungsmaterial (70) in wenigstens einigen der Kanäle zum Bilden der zweiten Bindung zwischen dem Filter und der Abdeckung angeordnet ist.
10. Behälter nach Anspruch 9, wobei wenigstens eines des ersten Bindungsmaterials und des zweiten Bindungsmaterials wärmesiegelbares Polymer ist.
11. Behälter nach einem der vorangehenden Ansprüche, wobei die zweite Bindung eine Bindungsstärke aufweist, die größer ist als die Bindungsstärke der ersten Bindung.
12. Behälter nach Anspruch 11, wobei die erste Bindung eine Bindungsstärke von nicht mehr als 20N/15mm aufweist.
13. Behälter nach Anspruch 11, wobei die zweite Bindung eine Bindungsstärke von nicht weniger als 15N/15mm aufweist.
14. Einzelserviergetränkapsel umfassend einen Behälter nach einem vorangehenden Ansprüche und eine Menge eines Getränkeinhaltsstoffs, der innerhalb der Inhaltsstoffkammer bereitgestellt ist.
15. Einzelserviergetränkapsel nach Anspruch 14, wobei der Getränkeinhaltsstoff gemahlener Kaffee ist.

Revendications

1. Récipient (10) comprenant :

un corps (12) définissant un espace intérieur (24) ayant une ouverture (26), ledit corps ayant une bride (28) entourant ladite ouverture ;
 un filtre (14) disposé dans ledit corps afin de définir une chambre d'ingrédients (46), ledit filtre étant adhérisé à une première surface (12a) de ladite bride au moyen d'une première liaison (64), ladite première liaison étant une liaison détachable ;
 un point de séparation (80) défini dans ladite bride, ledit point de séparation définissant une languette (30) qui est adaptée pour être séparée du reste de ladite bride suite à l'application de la force suffisante à la main ;
 des ingrédients (16) disposés dans ladite chambre d'ingrédients ; et
 un couvercle (18) disposé sur ladite ouverture pour recouvrir ledit espace intérieur, le couvercle étant adhérisé audit filtre au moyen d'une seconde liaison (68),

dans lequel ladite languette et ledit couvercle sont adaptés pour être retirés conjointement avec ledit filtre et ladite chambre d'ingrédients contenant lesdits ingrédients, suite à l'utilisation du récipient par l'application d'une force à la main, **caractérisé en ce que** ledit filtre est formé avec un matériau approprié pour contenir et filtrer lesdits ingrédients pour la préparation d'une boisson.

2. Récipient selon la revendication 1, dans lequel ledit filtre est formé avec un matériau de filtration non tissé moulable.
3. Récipient selon la revendication 1 ou 2, dans lequel ledit filtre définit en outre une chambre d'extraction (48) à l'extérieur de ladite chambre d'ingrédients.
4. Récipient selon l'une quelconque des revendications 1 à 3, dans lequel une encoche (72) est définie dans la surface intérieure dudit corps, ladite encoche fournissant un point prédéterminé de faiblesse dans ledit corps.
5. Récipient selon la revendication 4, dans lequel ladite encoche s'étend sensiblement autour de la périphérie de ladite ouverture.
6. Récipient selon la revendication 4, dans lequel ledit corps est formé avec un matériau multicouche (MM1) qui comprend une couche de barrière (B1) disposée entre une couche d'étanchéité (S1) et une couche externe (O1), et dans lequel ladite encoche est définie dans ladite couche d'étanchéité.

7. Récipient selon l'une quelconque des revendications précédentes, dans lequel ledit corps est formé avec un matériau multicouche qui comprend une couche de barrière disposée entre une couche d'étanchéité et une couche externe, et dans lequel ladite première liaison entre ledit filtre et ledit corps est formée avec ladite couche d'étanchéité.
8. Récipient selon l'une quelconque des revendications précédentes, dans lequel ledit filtre a une partie de joint (50) avec une pluralité de canaux (62), et dans lequel un premier matériau de liaison (66) est disposé dans au moins certains desdits canaux pour former ladite première liaison entre ledit filtre et ladite bride.
9. Récipient selon la revendication 8, dans lequel un second matériau de liaison (70) est disposé dans au moins certains desdits canaux pour former ladite seconde liaison entre ledit filtre et ledit couvercle.
10. Récipient selon la revendication 9, dans lequel au moins l'un parmi ledit premier matériau de liaison et ledit second matériau de liaison est un polymère thermosoudable.
11. Récipient selon l'une quelconque des revendications précédentes, dans lequel ladite première liaison a une résistance de liaison qui est supérieure à la résistance de liaison de la première liaison.
12. Récipient selon la revendication 11, dans lequel ladite première liaison a une résistance de liaison non supérieure à 20 N/15 mm.
13. Récipient selon la revendication 11, dans lequel ladite seconde liaison a une résistance de liaison non inférieure à 15 N/15 mm.
14. Capsule de boisson à dose unique comprenant un récipient selon l'une quelconque des revendications précédentes et une quantité d'un ingrédient de boisson prévu à l'intérieur de ladite chambre d'ingrédients.
15. Capsule de boisson à dose unique selon la revendication 14, dans laquelle l'ingrédient de boisson est du café moulu.

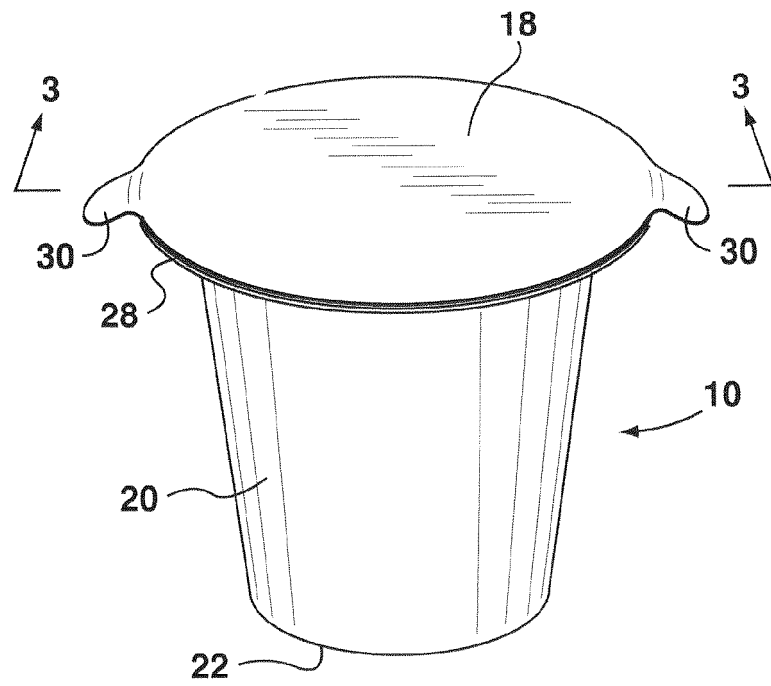


FIG. 1

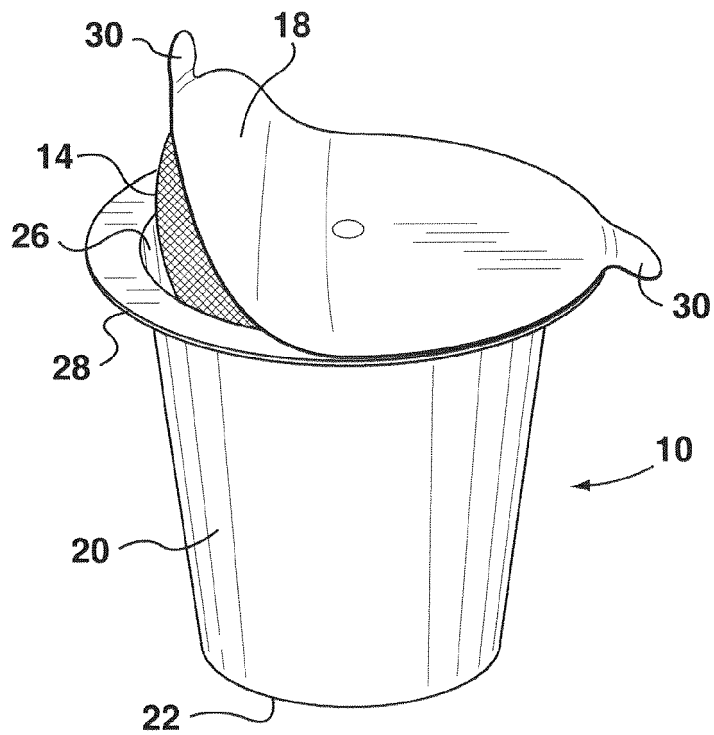


FIG. 2

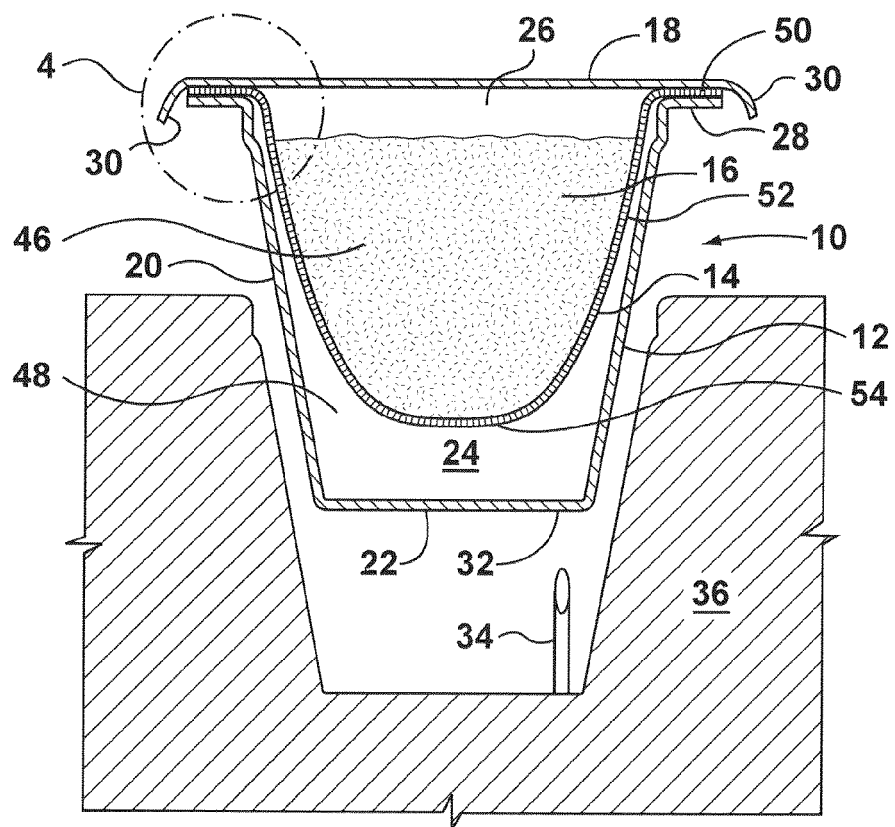


FIG. 3

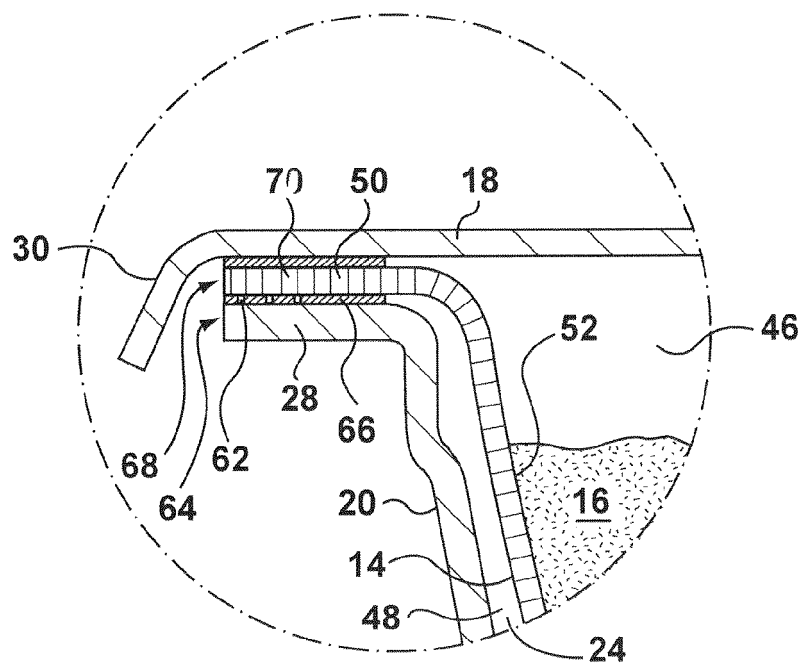


FIG. 4

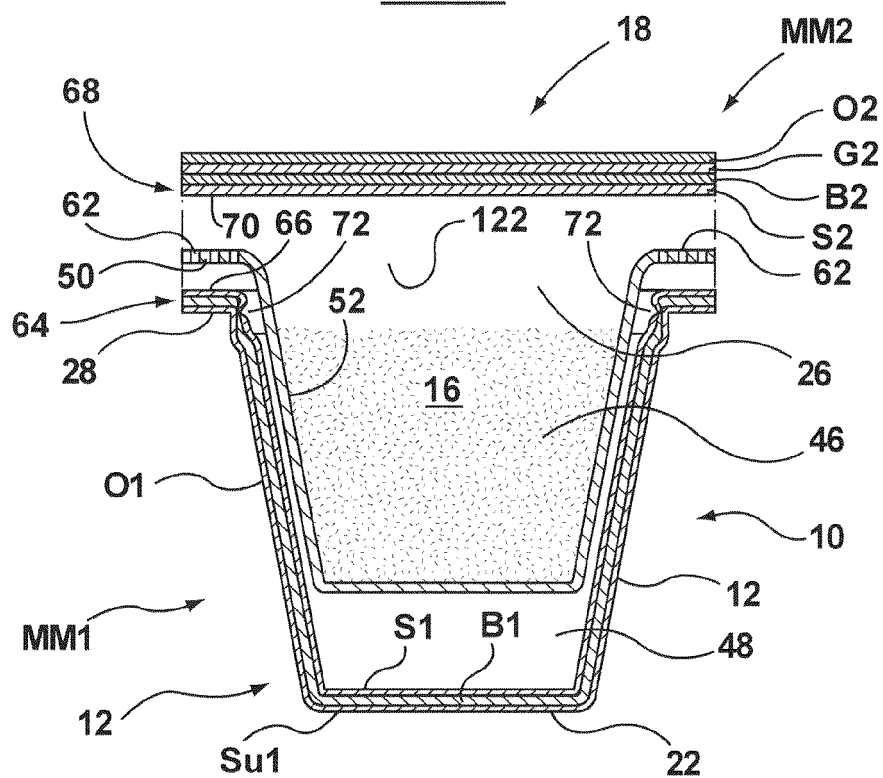


FIG. 5

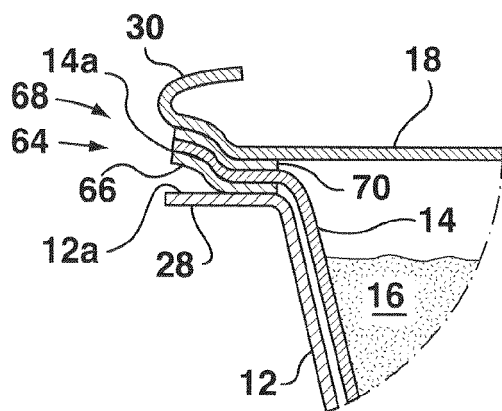


FIG. 6(a)

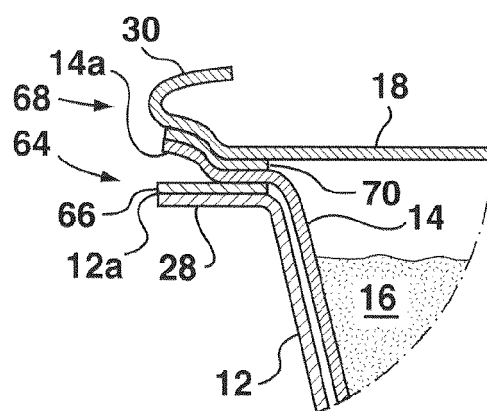


FIG. 6(b)

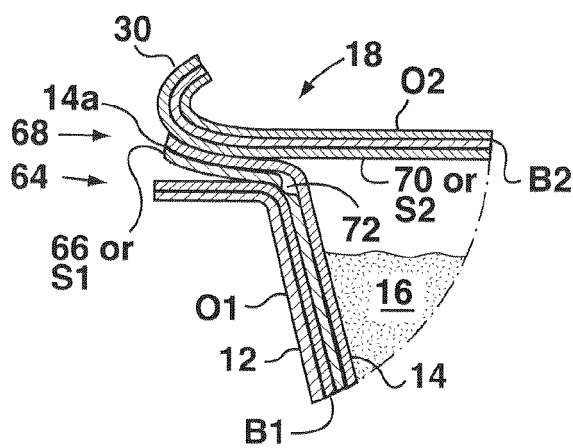


FIG. 6(c)

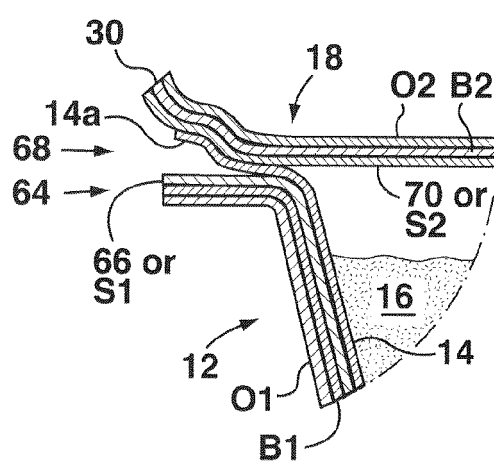


FIG. 6(d)

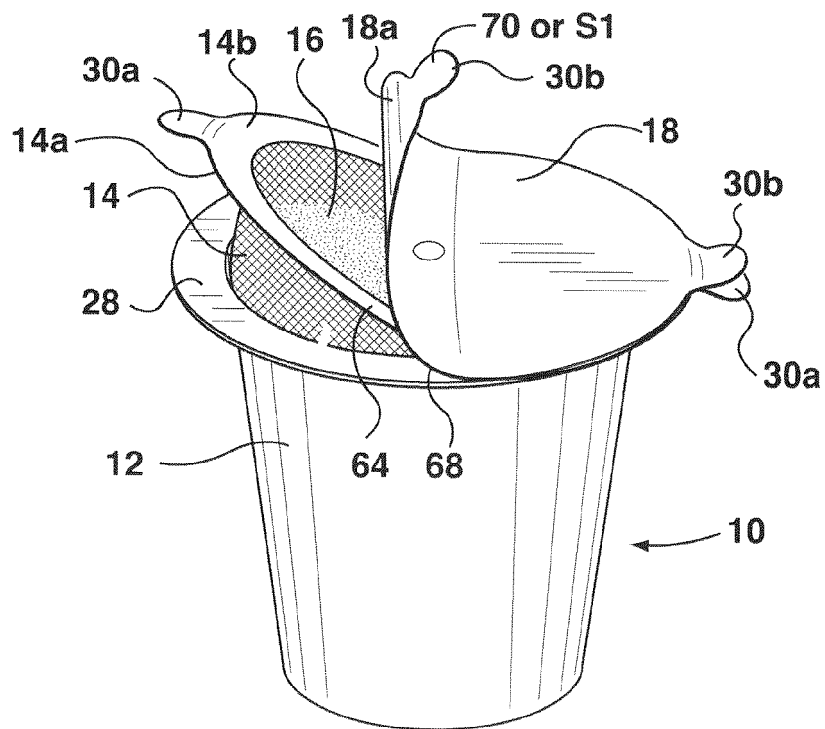


FIG. 7

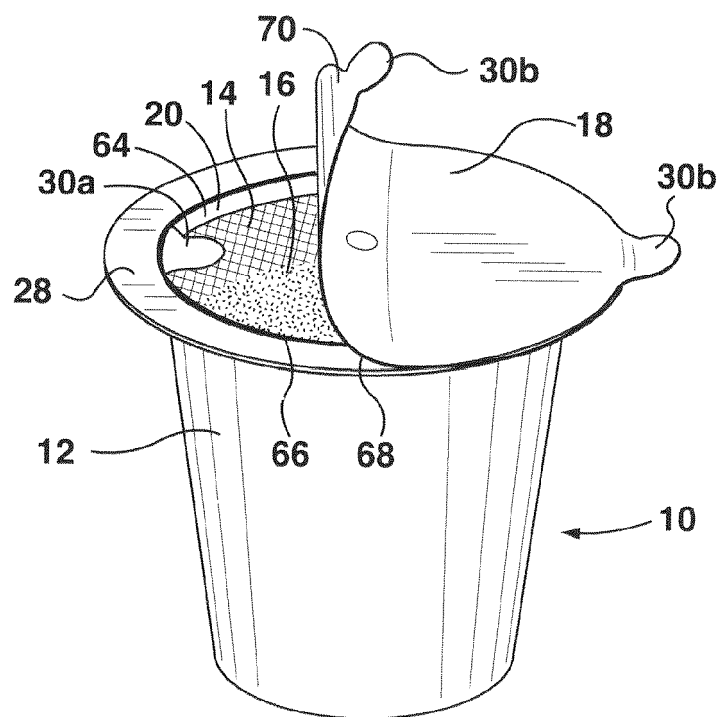


FIG. 8

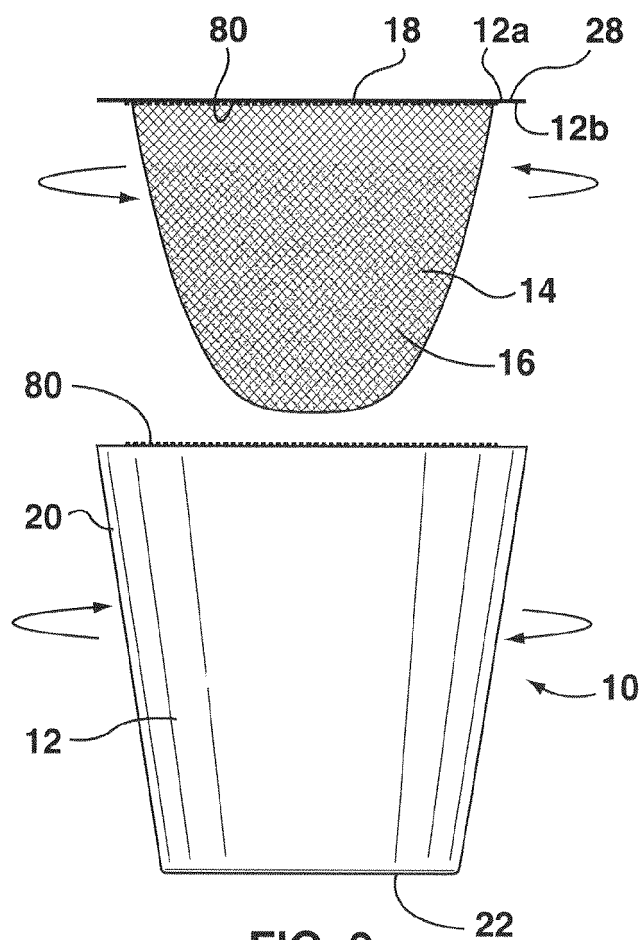


FIG. 9

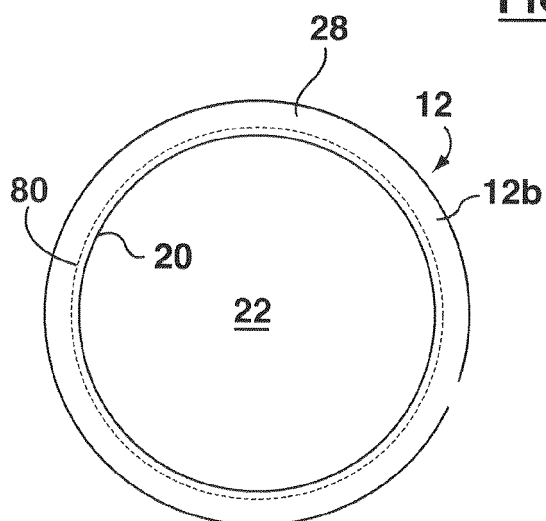


FIG. 10

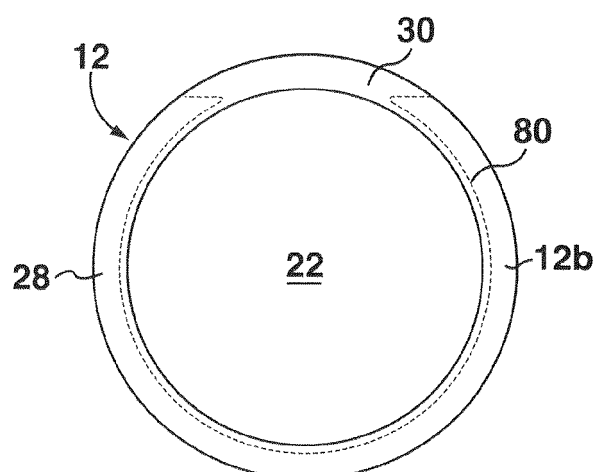


FIG. 11

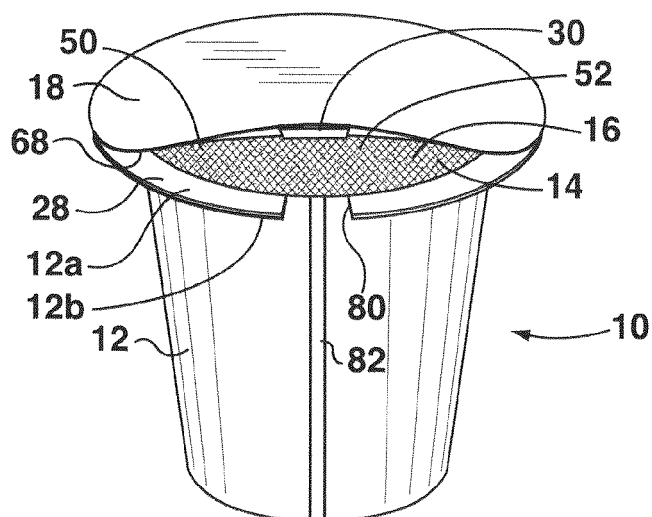


FIG. 12

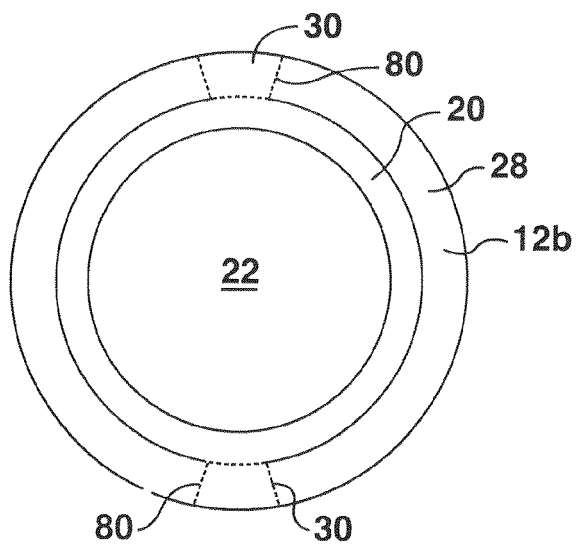


FIG. 13

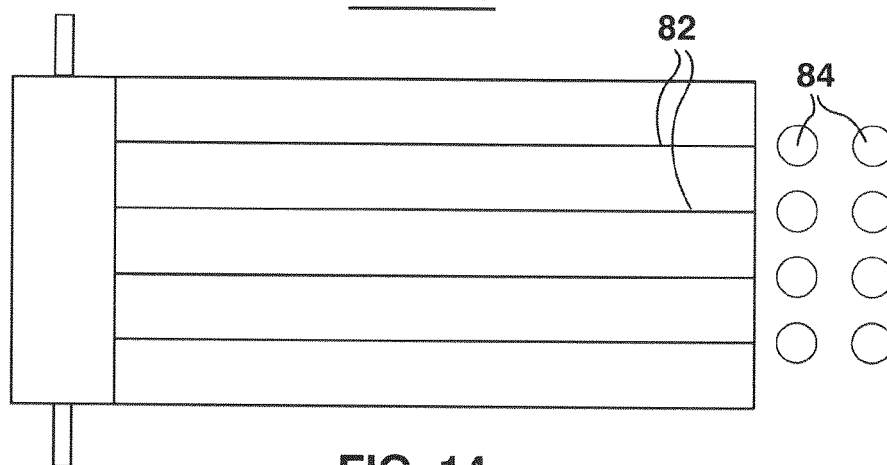


FIG. 14

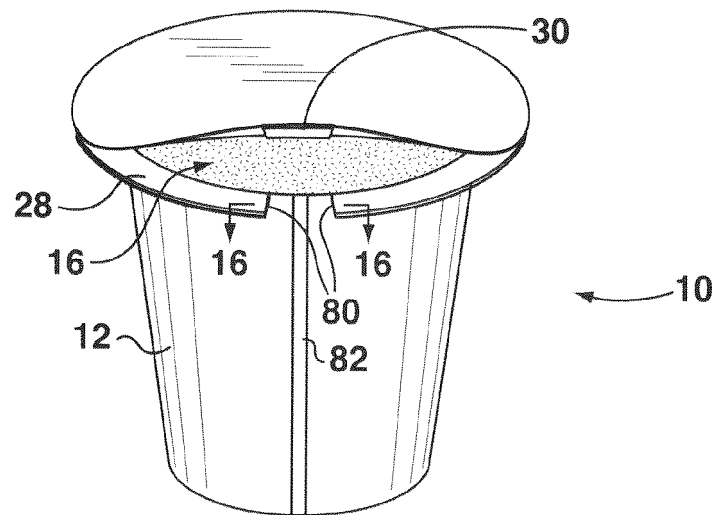


FIG. 15

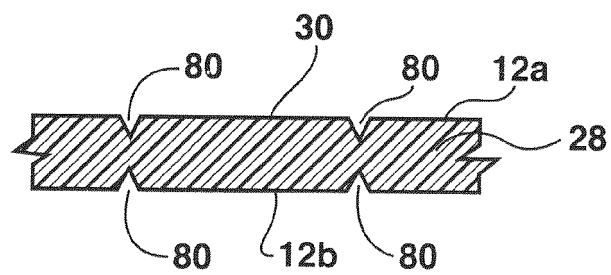


FIG. 16

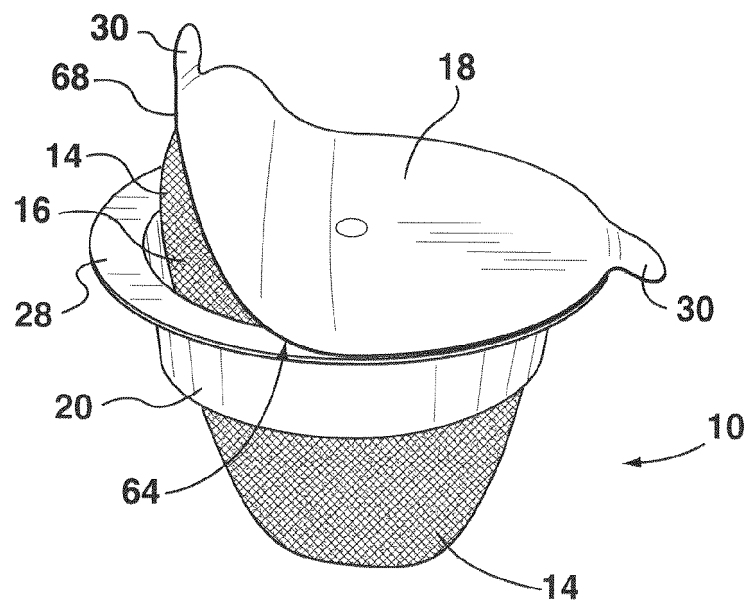


FIG. 17

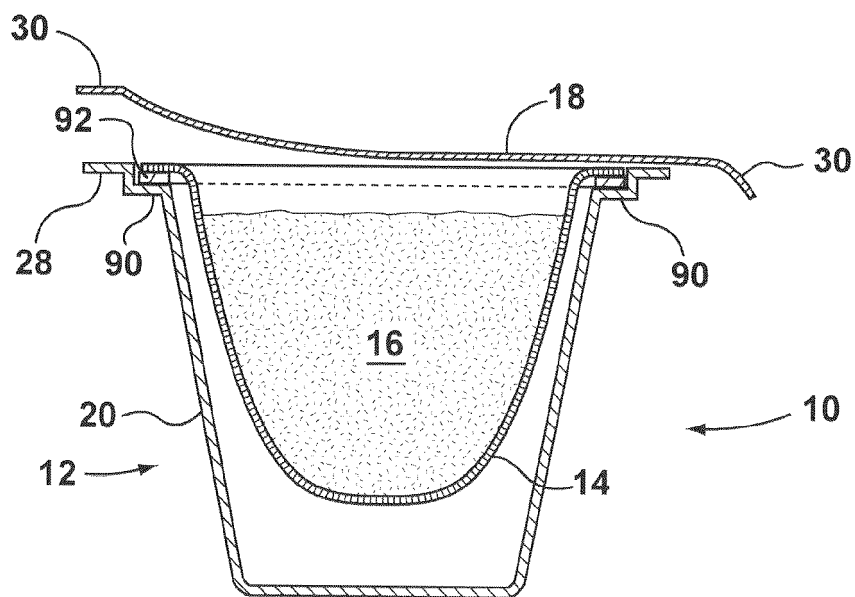


FIG. 18

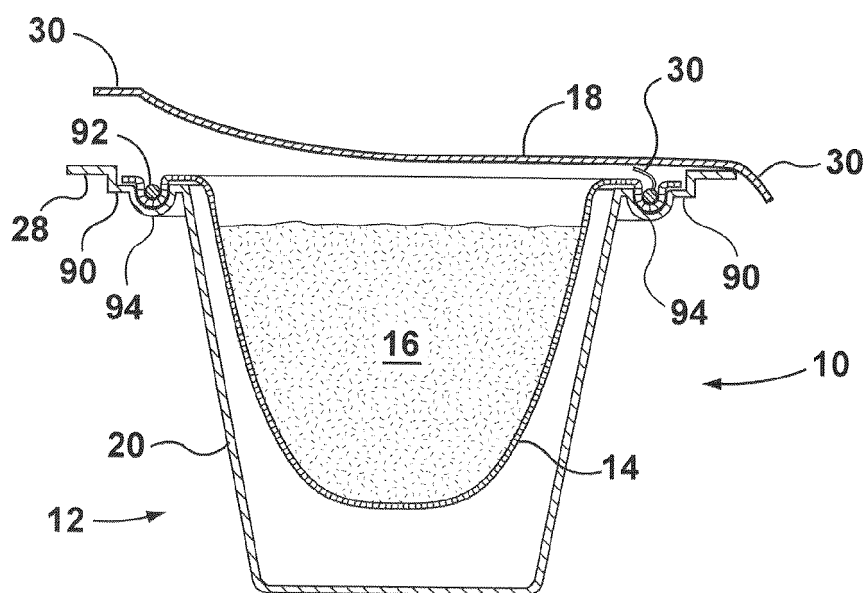


FIG. 19

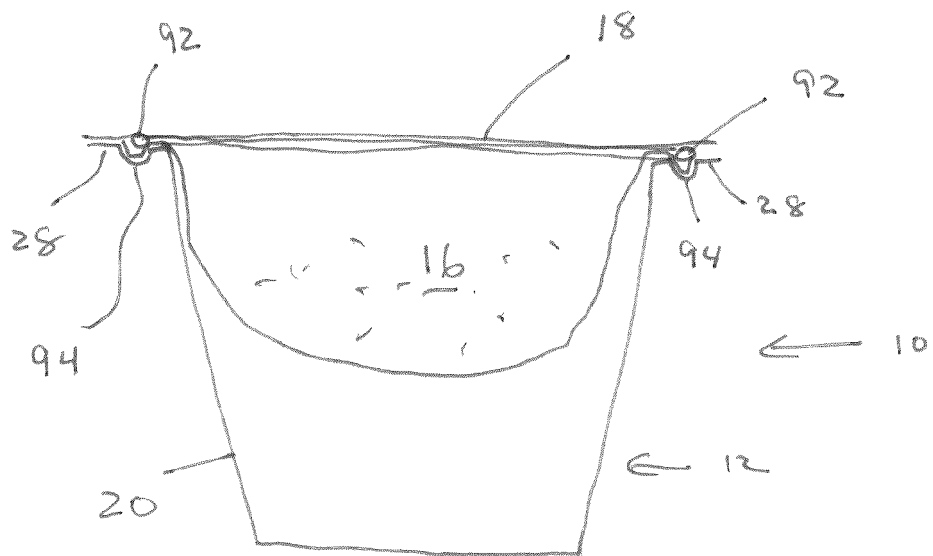


Fig. 20

REFERENCES CITED IN THE DESCRIPTION

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