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(71) Applicant: **Lavazza Professional UK Limited**
Basingstoke, Hampshire RG24 8NU (GB)

(72) Inventors:
- **Wicks, David**
  Chineham, Basingstoke Hampshire, RG24 8XQ (GB)
- **Nicholls, Darren**
  Hook Hampshire, RG27 9RQ (GB)
- **Fletcher, Paul**
  Camberley, GU15 3QG (GB)
- **Palmer, Jason**
  London, SW1E 5DN (GB)
- **Litten, Neil**
  London, SW1E 5DN (GB)
- **McCoy, Tony**
  Devon, TQ9 7RP (GB)

(74) Representative: **Thum, Bernhard**
Thum & Partner
Thum Mötsch Weickert
Patentanwälte PartG mbB
Siebertstr. 6
81675 München (DE)

(54) **CUP, STACK OF CUPS, AND METHOD OF FORMING THE SAME**

(57) A cup, a stack of cups, and a method of forming the same. Each of the cups includes a cup body and an insert. The cup body has a cavity defined by a sidewall and a floor. The insert is positioned within the cavity of the cup body and has a top edge that is spaced from the floor of the cup body. The cup body and the insert are formed from a paper-based material. A powder ingredient is located in the cavity of each of the cups. The plurality of cups are arranged in a stack so that a portion of each of the plurality of cups nests within the cavity of an immediate lower cup in the stack and a bottom end of each of the plurality of cups rests atop of the top edge of the insert positioned in the cavity of the immediate lower cup.

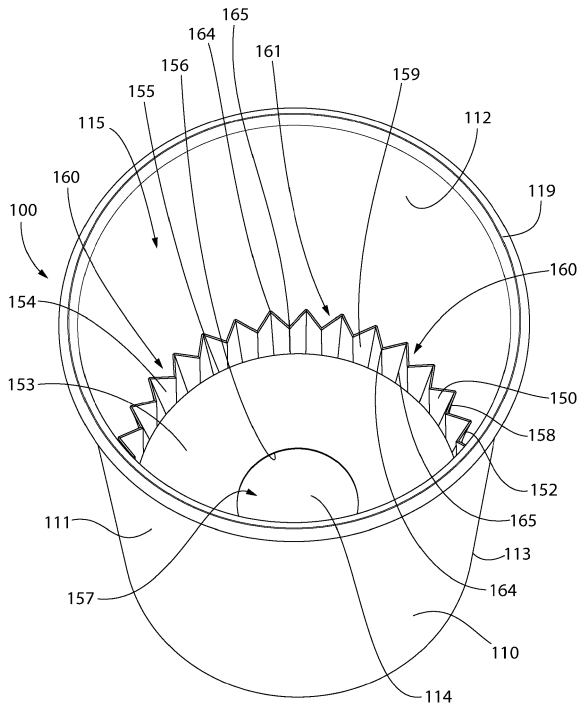

FIG. 2

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to United States Provisional Patent Application Serial No. 62/923,844, filed October 21, 2019, the entirety of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] Beverage vending machines create a beverage in a disposable cup and then present the disposable cup with the beverage therein to a consumer. Such beverage vending machines typically use cups that are pre-filled with powdered ingredients and inject a liquid such as water into the cups to form the desired beverage as the liquid mixes with the powdered ingredient. Both paper and plastic cups have their own environmental challenges and can be recycled. The introduction of paper cups enables users to make a choice based on local recycling schemes. One issue that occurs when using paper cups in beverage vending machines is that the cups can become locked together, making it difficult for the beverage vending machine to separate the bottommost cup from the stack consistently and/or without damaging the cup. Thus, a need exists for a paper cup that can be stacked without forming a taper lock with adjacent cups to reduce failures in dispensing of cups in beverage vending machines.

SUMMARY OF THE INVENTION

[0003] The present invention is directed to a cup, a stack of cups, and/or a method of forming a cup or stack of cups. The cups may be formed from paper and used in a beverage vending machine. As such, there is a need to prevent taper lock between adjacent cups in a stack so that the beverage vending machine can consistently vend the cups one at a time upon request by a consumer. This is done in the invention described herein by positioning an insert within each of the cups so that when the cups are stacked an upper cup in the stack rests atop the insert within a lower cup in the stack. This prevents the cups from being stacked too closely together, which may cause a taper lock situation.

[0004] In one aspect, the invention may be a stack of cups comprising: a plurality of cups formed from a paper-based material, each of the cups comprising: a cup body comprising a sidewall that surrounds a cavity having a floor and a cavity axis; and an insert positioned within the cavity of the cup body, the insert comprising a sidewall portion having an inner surface that faces the cavity axis of the cup body, an outer surface that faces the sidewall of the cup body, and a top edge, the sidewall portion of the insert being corrugated so that the inner and outer surfaces comprise alternating ridges and grooves; a powder ingredient located in the cavity of each of the plurality of cups, the powder ingredient at least partially surrounded by the sidewall portion of the insert; and wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the top edge of the sidewall portion of the insert of an immediate lower cup in the stack.

[0005] In another aspect, the invention may be a stack of cups comprising: a plurality of cups, each of the cups comprising: a cup body formed from a first paper-based material, the cup body comprising a cavity having a cavity axis, the cavity being defined by a sidewall and a floor; and an insert positioned within the cavity, the insert comprising a top edge that is spaced from the floor of the cup body, the insert being formed from a second paper-based material; a powder ingredient located in the cavity of each of the plurality of cups; and wherein the plurality of cups are arranged in a stack so that a portion of each of the plurality of cups nests within the cavity of an immediate lower cup in the stack and a bottom end of each of the plurality of cups rests atop of the top edge of the insert positioned in the cavity of the immediate lower cup in the stack.

[0006] In yet another aspect, the invention may be a method of forming a cup comprising: attaching a support member to a surface of a cup blank; rolling the cup blank into a cylindrical or conical shape to form a sidewall of a cup body so that the surface of the cup blank forms an inner surface of the sidewall of the cup body and the support member protrudes from the inner surface of the sidewall into an interior of the cup body; and attaching a bottom member to the sidewall of the cup body to form a floor of the cup body, the cup body and the support member collectively forming the cup.

[0007] In a further aspect, the invention may be a method of forming a stack of cups for a beverage vending machine, the method comprising: forming a cup body from a first paper-based material; forming an insert from a second paper-based material on a mandrel; sliding the cup body over the mandrel while the insert remains positioned on the mandrel and affixing the insert to the cup body using ultrasonic sealing technologies, thereby forming a cup; introducing a powder ingredient into a cavity of the cup so that the powder ingredient is at least partially surrounded by the insert; and stacking a plurality of the cups by nesting each cup within the cavity of an immediate lower cup, a bottom end of each cup resting atop of a top edge of the insert that is affixed to the immediate lower cup.

[0008] In a still further aspect, the invention may be a stack of cups comprising: a plurality of cups formed from a first paper-based material, each of the cups comprising an inner surface that defines a cavity, an outer surface opposite the inner surface, and a rim; a sleeve positioned around a portion of the outer surface of each of the cups so that a top edge of the sleeve is in contact with an underside of the rim of the cup, the sleeve being formed from a second paper-based material; and wherein the plurality of cups are arranged in a stack so that each of

the plurality of cups nests within the cavity of an immediate lower cup in the stack and a bottom edge of the sleeve positioned around each of the cups rests atop of the rim of the immediate lower cup in the stack.

[0009] In yet a further aspect, the invention may be a stack of cups comprising: a plurality of cups formed from a paper-based material, each of the cups comprising: a cup body comprising a sidewall that surrounds a cavity having a floor and a cavity axis; and an insert positioned within the cavity, each of the inserts comprising a floor portion that is affixed to the floor of the cup body and a sidewall portion extending upwardly from the floor portion and terminating in a top edge; a powder ingredient located in the cavity of each of the plurality of cups; and wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the top edge of the sidewall portion of the insert positioned in the cavity of an immediate lower cup in the stack.

[0010] In another aspect, the invention may be a stack of cups comprising: a plurality of cups formed from a paper-based material, each of the cups comprising: a cavity having a cavity axis; a sidewall comprising a rim; and a floor member comprising a top end, a floor, an inner annular flange extending from the floor to the top end, and an outer annular flange extending downwardly from the top end at a position that is radially outward of the inner annular flange so that the outer annular flange surrounds and is spaced apart from the inner annular flange and the floor, the outer annular flange coupled to a bottom end of the sidewall, the floor and the inner annular flange forming a bottom portion of the cavity that is recessed below the top end of the floor member; a powder ingredient located at least in the bottom portion of the cavity of each of the plurality of cups; and wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the top end of the floor member of an immediate lower cup in the stack.

[0011] In yet another aspect, the invention may be a stack of cups comprising: a plurality of cups formed from a paper-based material, each of the cups comprising: a sidewall extending from an open bottom end to an open top end; a floor member coupled to the sidewall to close the open bottom end of the sidewall and form a cavity of the cup, the floor member comprising: a top edge; a floor portion and a first sidewall portion that collectively define a powder ingredient portion of the cavity, the powder ingredient portion of the cavity being a bottom portion of the cavity; and an annular projection portion comprising a distal end that is located below the floor portion; a powder ingredient located at least in the powder ingredient cavity of the floor member of each of the plurality of cups; and wherein the plurality of cups are arranged in a stack so that the annular projection portion of the floor member of each of the plurality of cups rests atop of the top edge of the floor member of an immediate lower cup in the stack.

[0012] In still another aspect, the invention may be a stack of cups comprising: a plurality of cups, each of the cups comprising a sidewall and a floor that define a cavity having a cavity axis, the sidewall being curled to form a rim at a top end of the cup, the sidewall comprising an outer surface having a downward facing shoulder that faces away from the rim; wherein the plurality of cups are arranged in a stack so that at least a portion of each of the plurality of cups is disposed within the cavity of an immediate lower cup in the stack and the downward facing shoulder of an immediate upper cup in the stack rests atop of the rim of the immediate lower cup in the stack to maintain a cup-to-cup spacing distance between adjacent cups in the stack.

[0013] In a further aspect, the invention may be a stack of cups comprising: a plurality of cups formed from a paper-based material, each of the cups comprising: a cup body comprising a sidewall that surrounds a cavity having a floor and a cavity axis; and an insert positioned within the cavity of the cup body, each of the inserts comprising a bottom end which is adjacent to the floor of the cavity of the cup body and a top end opposite the bottom end, and wherein a distance measured between an outermost portion of the outer surface of the sidewall portion of the insert and an inner surface of the sidewall of the cup body decreases moving from the bottom end of the insert to the top end of the insert; a powder ingredient located in the cavity of each of the plurality of cups; and wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the top edge of the insert positioned in the cavity of an immediate lower cup in the stack.

[0014] In a still further aspect, the invention may be a stack of cups comprising: a plurality of cups formed from a paper-based material, each of the cups comprising: a cup body comprising a sidewall that surrounds a cavity having a floor and a cavity axis, the sidewall being oriented at a first angle relative to the cavity axis; and an insert positioned within the cavity of the cup body, each of the inserts comprising a sidewall portion, an outermost portion of the sidewall portion being oriented at a second angle relative to the cavity axis, the second angle being greater than the first angle; a powder ingredient located in the cavity of each of the plurality of cups; and wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of a top edge of the sidewall portion of the insert positioned in the cavity of an immediate lower cup in the stack.

[0015] In another aspect, the invention may be a paper cup comprising: a cup body formed from a paper-based material, the cup body comprising a sidewall and a floor that collectively define a cavity having a cavity axis; and an insert formed from a paper-based material, the insert positioned within the cavity of the cup body adjacent to the floor, the insert having a top edge that is spaced axially from the floor and that protrudes inwardly from an inner surface of the sidewall of the cup body towards the cavity axis.

[0016] Further areas of applicability of the present invention will become apparent from the detailed descrip-

tion provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

FIG. 1 is a front view of a cup in accordance with an embodiment of the present invention;
FIG. 2 is a perspective view of the cup of FIG. 1 illustrating a cup body and an insert positioned therein;
FIG. 3 is an exploded view of the cup of FIG. 1 illustrating the insert removed from the cup body;
FIG. 4 is a cross-sectional view taken along line IV-IV of FIG. 1;
FIG. 5 is a close-up view of area V of FIG. 4;
FIG. 6A is a perspective view of the insert of the cup of FIG. 1;
FIG. 6B is a front view of the insert of the cup of FIG. 1;
FIG. 7 is a front view of a plurality of the cups of FIG. 1 arranged in a stack;
FIG. 8 is a cross-sectional view taken along line VIII-VIII of FIG. 7;
FIG. 9 is a perspective view of the stack of cups of FIG. 7 with a package structure placed around the stack of cups;
FIG. 10A is a top view of the insert of FIG. 4A;
FIG. 10B is a top view of an insert in accordance with an alternative embodiment of the present invention;
FIGS. 11A-11F illustrate a method of forming the cup of FIG. 1 including forming the insert, bonding the insert to the cup, and filling the cup with a powder ingredient;
FIGS. 11G and 11H illustrate the process of stacking two of the cups formed by the method of FIGS. 11A-11F;
FIGS. 12A-12B illustrate a cross-sectional view of a cup in accordance with an alternative embodiment whereby the insert is supported above a floor of the cup body, and also illustrating an introduction of a liquid into the cup;
FIG. 13 is a top perspective view of a cup in accordance with another embodiment of the invention, whereby the insert has been flattened against an interior of the cup body;
FIG. 14 is a cross-sectional view taken along line XIV-XIV of FIG. 13;
FIG. 15 is a perspective view of an insert in accordance with another embodiment of the invention;
FIG. 16 is a perspective view of an insert in accordance with yet another embodiment of the invention;
FIG. 17 is a top view of an insert in accordance with still another embodiment of the invention;
FIG. 18 is a cross-sectional view illustrating two cups in a stack with the upper cup resting atop of a top edge of the insert of the lower cup;
FIG. 19 is a view of a cup blank with a support member bonded thereto;
FIG. 20 is a view of the cup blank and support member of FIG. 19 after rolling the cup blank into a cup body and attaching a floor member;
FIG. 21 is a cross-sectional view taken along line XXI-XXI of FIG. 20;
FIG. 22 is a perspective view illustrating the insertion of yet another embodiment of an insert into a cup body to form a cup;
FIG. 23 is a cross-sectional view illustrating two of the cups of FIG. 22 arranged in a stack;
FIG. 24 is a cross-sectional view taken along line XXIV-XXIV of FIG. 23;
FIG. 25 is a perspective view of an insert in accordance with yet another embodiment of the invention;
FIG. 26 is a perspective view illustrating the insertion of still another embodiment of an insert into a cup body to form a cup;
FIG. 27 is a cross-sectional view illustrating four of the cups of FIG. 26 arranged in a stack;
FIG. 28 is a close-up view of area XXVIII of FIG. 27;
FIG. 29 is a perspective view of an insert in accordance with another embodiment of the invention;
FIG. 30 is a perspective view illustrating the coupling of a sleeve to a cup;
FIG. 31 is a cross-sectional view illustrating four of the cups of FIG. 31 arranged in a stack;
FIG. 32 is a close-up view of area XXXII of FIG. 31;
FIG. 33 is a perspective view illustrating the insertion of another embodiment of an insert into a cup body to form a cup;
FIG. 34 is a cross-sectional view illustrating four of the cups of FIG. 33 arranged in a stack;
FIG. 35 is a close-up view of area XXXV of FIG. 34;
FIG. 36 is a cross-sectional view illustrating four cups in accordance with another embodiment arranged in a stack;
FIG. 37 is a close-up view of area XXXVII of FIG. 37;
FIG. 38 is a front view of a cup in accordance with another embodiment of the present invention;
FIG. 39 is a cross-sectional view taken along line XXXIX of FIG. 38;
FIG. 40 is a perspective view illustrating the formation of a cup that includes a sidewall and a floor member in accordance with one embodiment of the present invention;
FIG. 41 is a cross-sectional view illustrating four of the cups of FIG. 40 arranged in a stack;
FIG. 42 is a close-up view of area XLII of FIG. 41;
FIG. 43 is a perspective view illustrating the formation of a cup that includes a sidewall and a floor member in accordance with another embodiment of the present invention;

FIG. 44 is a cross-sectional view illustrating four of the cups of FIG. 43 arranged in a stack;
FIG. 45 is a close-up view of area XLV of FIG. 41;
FIG. 46 is a cross-sectional view of a stack of cups in accordance with still another embodiment of the present invention;
FIG. 47 is a close-up of area XLVII of FIG. 46;
FIG. 48 is a cross-sectional view of a stack of cups in accordance with yet another embodiment of the present invention;
FIG. 49 is a close-up view of area XLIX of FIG. 48;
FIG. 50 is a view of a cup blank having adhesive dots on a surface thereof;
FIG. 51 is a cross-sectional view of two of the cups formed from the cup blanks of FIG. 50 and arranged in a stack; and
FIG. 52 is a cross-sectional view taken along line LII-LII of FIG. 51.

DETAILED DESCRIPTION OF THE INVENTION

[0018] The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0019] The description of illustrative embodiments according to principles of the present invention is intended to be read in connection with the accompanying drawings, which are to be considered part of the entire written description. In the description of embodiments of the invention disclosed herein, any reference to direction or orientation is merely intended for convenience of description and is not intended in any way to limit the scope of the present invention. Relative terms such as "lower," "upper," "horizontal," "vertical," "above," "below," "up," "down," "top" and "bottom" as well as derivatives thereof (e.g., "horizontally," "downwardly," "upwardly," etc.) should be construed to refer to the orientation as then described or as shown in the drawing under discussion. These relative terms are for convenience of description only and do not require that the apparatus be constructed or operated in a particular orientation unless explicitly indicated as such. Terms such as "attached," "affixed," "connected," "coupled," "interconnected," and similar refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise. Moreover, the features and benefits of the invention are illustrated by reference to the exemplified embodiments. Accordingly, the invention expressly should not be limited to such exemplary embodiments illustrating some possible non-limiting combination of features that may exist alone or in other combinations of features; the scope of the invention being defined by the claims appended hereto.

[0020] Referring to FIGS. 1-4, a cup 100 will be described in accordance with an embodiment of the present invention. As described above, the cup 100 may be particularly suited for being stacked with other, identical cups and then used in a beverage vending machine. When used in a beverage vending machine, the cups 100 are stacked and placed within a cup dispensing mechanism. When a consumer makes a request for the beverage vending machine to vend a beverage, the cup dispensing mechanism operates to dispense a lowermost cup in the stack, and then the beverage vending machine introduces a liquid (i.e., water) into the cup 100 so that as the liquid mixes with a powder ingredient that is pre-filled in the cup 100 the beverage is formed. The lowermost cup in the stack may be dispensed by operation/rotation of one or more scrolls which drive the lowermost cup in a direction away from the remainder of the stack using a wedge-like protuberance, as is well known in the art. Although the above is one intended use for the cups 100 described herein, the invention is not to be so limited in all embodiments and the cups 100 may be used without being vended from a beverage vending machine.

[0021] The cup 100 generally comprises a cup body 110 and an insert 150 that is positioned within the cup body 110. As will be described in greater detail below, a plurality of the cups 100 are configured to be arranged in a stack so that each cup rests atop of the insert 150 positioned in the cup below. This prevents the cups 100 from being stacked too tightly together, which can cause a taper lock and make it difficult for the cups 100 to be separated particularly when they are used in a beverage vending machine which is configured to automatically dispense the cups 100 one at a time. More specifically, taper locking may occur as a result of powders interacting between the adjacent cups in the stack. That is, particles of ingredient powder that is pre-filled into the cups may become trapped between the sidewalls of adjacent cups in the stack, thereby making it more difficult to separate the cups during a conventional cup separation process using an automatic cup dispensing mechanism of a beverage vending machined.

[0022] In the exemplified embodiment, the cup 100, and each of the cups 100 described herein, is formed from a paper-based material. Specifically, the cup body 110 is formed from a paper-based material and the insert 150 is also formed from a paper-based material. As a result, the cup 100 in its entirety with the insert 150 remaining within the cup body 110 can be recycled as normal paper waste. As used herein, the term paper-based material includes all types of paper material including posterboard, cardboard, printing papers, or the like. Thus, paper-based material includes cellulose fibers derived from wood, rags, grasses, or other vegetable sources. Paper-based material, as used herein, also includes chemical pulp, wood-free paper, tree-free paper, wood fiber or wood pulp, flax, hemp, and cotton. In some embodiments, cups formed from paper-based materials are cups formed from cellulose fibers, which are fibers made with ethers or esters of cellulose which can be obtained from the bark, wood, or leaves of plants, or other plant-

based materials. Cellulose fibers are the most basic and important constituent of paper. In certain embodiments, the cup body 110 and the insert 150 may be formed from a paper-based material and may be free of plastic such as polyethylene because such materials often render the material incapable of being recycled as normal paper waste. That is, in the exemplified embodiment the paper-based materials used to form the various components of the cups described herein have no polyethylene content at all.

[0023] In some embodiments the cup body 110 and/or the insert 150 may be formed from a paper-based material that is lined with a water-based dispersion barrier that is either free of plastic or includes such a small percentage of plastic (i.e., less than 5wt%). Particularly, the barrier coating may include a polymeric material, but not as a distinct layer so when it goes to a recycling location the agitation with water that is part of separating the fibers also breaks down the barrier so it is not an impediment to recyclability. Even if not explicitly mentioned, each of the cups described in this application and including each cup body, insert, sleeve, etc., is preferably formed from a paper-based material so that the entirety of the cup can be recycled without having to separate components.

[0024] Thus, the cups 100 described herein and all components of the cups 100 may be formed from paper. Specifically, the cups 100 may be formed primarily from a paperboard made of virgin wood fiber. The cups 100 may also include a water-based dispersion barrier. Furthermore, the cups 100 may be devoid of a plastic liner, such as one that is conventionally made from polyethylene (PE), or contain a PE in a sufficiently low weight percentage (less than 5wt%) so that it does not affect the recyclability of the cups 100. A problem with paper cups formed with a PE liner is that they cannot be easily recycled because the plastic liner needs to be separated from the paper before each can be recycled using separate processes. However, during this process the plastic liner may break up into relatively large flakes that pass through coarse pulping screens but may clog fine screens. Thus, such paper cups with plastic liners often end up in the landfill rather than being recycled. In order to ensure that the cups 400 used herein are recycled, there is no PE liner used on the cups 400 (or any amount of PE in the liner is below the thresholds noted herein). Rather, the water-based dispersion barrier serves the same purpose as the previous PE liner, while still enabling the cups 400 to be completely recyclable in normal paper waste streams. The water-based dispersion barrier comprises polymers that are heat-sealable, block-resistant, and provide a liquid barrier. Thus, the cups 100 described herein are free of a plastic lining so that they are recyclable as paper waste in standard paper waste streams, the cups 100 are biodegradable, and in some embodiments the cups are formed entirely from paper and a water-based dispersion barrier. In some embodiments, the cups 100 may be free or devoid of a polyethylene lining or coating on the interior surface thereof or elsewhere.

[0025] In some embodiments, the insert 150 may be formed by manipulating a paper blank into the desired shape, which can be accomplished using a mandrel as described herein or using other techniques. In other embodiments, the insert 150 may be formed by a molding process. Specifically, pulp or cellulose may be injected into a mold cavity to form the desired shape, and then the shaped pulp or cellulose may be baked to ensure that it maintains its shape. Various processes of wet or dry forming of wood fiber to form a ring or dish could be used in various different embodiments to form the insert 150 (or any of the other inserts described herein. Such inserts may then be coated with a waterproof coating in some embodiments.

[0026] In the exemplified embodiment, the cup body 110 comprises a sidewall 111 having an inner surface 112 and an outer surface 113 and a floor 114 which is bonded to the sidewall 111. The sidewall 111 and the floor 114 collectively define a cavity 115 of the cup body 110 that is configured for holding powder ingredients and liquid food products such as beverages and soups. That is, the sidewall 111 and the floor 114 form the cavity 115 which is closed on its bottom end by the floor 114 and open at its top end. The cavity 115 of the cup body 110 extends along a cavity axis A-A from the floor 114 to an open top end 116. Thus, material such as beverage ingredients and liquids can be introduced into the cavity 115 through the open top end 116. The cup body 110 comprises a bottom end 117 and a top end 118 which also form the bottom and top ends of the cup 100.

[0027] A top portion of the sidewall 111 of the cup body 110 is curled to form a rim 119 of the cup 100 which is adjacent to the open top end 116 of the cavity 115. The rim 119 provides structural integrity to the cup body 110 so that it can maintain its conical shape, which is perhaps best shown in FIGS. 1 and 4. A top end of the rim 119 forms the top end 118 of the cup body 110 (which, as noted above, is also the top end of the cup 100). A bottom portion of the sidewall 111 is folded inwardly to form a pocket 120 along an inside of the sidewall 111 along the bottom portion of the sidewall 111. The bottom portion of the sidewall 111 is folded inwardly along an entirety thereof so that the pocket 120 is an annular pocket. In the exemplified embodiment, the outer surface 113 of the sidewall 111 is smooth and free of protuberances with the exception of the rim 119. Thus, from the bottom end 117 to the rim 119, the outer surface 113 of the sidewall 111 is completely smooth (no protuberances, projections, recesses, detents, indents, etc.).

[0028] In the exemplified embodiment the cup body 110 comprises a floor member 121 which comprises the floor 114 of the cup body 110. The floor member 121 and the insert 150 may be formed from the same paper-based material in some embodiments, but regardless the floor member 121, the sidewall 111 and the insert 150 are all formed from paper-based materials. The floor member 121 comprises a horizontal portion 122 which forms the

floor 114 of the cup body 110 and a flange portion 123 which extends from the horizontal portion 122. The flange portion 123 is an annular flange in the exemplified embodiment and it extends downwardly from the horizontal portion 122. The flange portion 123 of the floor member 121 is positioned within the pocket 120 formed by the bottom portion of the sidewall 111 which is folded inwardly, and then the flange portion 123 is bonded to the sidewall 111 (using ultrasonics, adhesive, or the like) to couple the floor member 121 to the sidewall 111. Due to the manner in which the floor member 121 is coupled to the sidewall 111, the horizontal portion 122 of the floor member 121 is recessed relative to the bottom end 117 of the cup body 117. That is, the horizontal portion 122 of the floor member 121 (and hence also the floor 114 of the cavity 115) is positioned axially in between the bottom and top ends 117, 118 of the cup body 110 (and also of the cup 100). Stated another way, a pocket region is formed between the bottom end 117 of the cup 100 and the lower surface of the floor 114.

[0029] Thus, in the exemplified embodiment the cup body 110 of the cup 100 comprises the sidewall 111 and the floor member 121, which collectively form and define the cavity 115. In other embodiments, the insert 150 may form the floor 114 of the cup 100, and in such embodiments the floor member 121 may be omitted, or the floor member 121 may serve a dual purpose in that it also functions as the ledge upon which an upper cup in a stack rests (which is the purpose of the insert 150 in the current embodiment, as explained in greater detail below).

[0030] As noted briefly above, in the exemplified embodiment the cup body 110 has a conical shape. Thus, in the exemplified embodiment the sidewall 111 is oriented at a first angle $\Theta 1$ relative to the cavity axis A-A. The first angle $\Theta 1$ is an acute angle, such as in a range of 1° to 10°, or more specifically 1° to 5°. Thus, the sidewall 111 is oriented at a slightly obtuse angle relative to the floor 114 (e.g., an angle of between 91° and 100°, and more specifically 91 ° and 95°). Due to this orientation of the sidewall 111, the cup body 110 has a generally conical shape. In other embodiments, the sidewall 111 may be oriented parallel to the cavity axis A-A (and hence perpendicular to the floor 114), and in such an embodiment the cup body 110 may have a generally cylindrical shape.

[0031] Referring to FIGS. 2-6B and 10A, the cup 100 will be further described, with a specific focus on the structural details of the insert 150 and its cooperation and/or relationship relative to the cup body 110. As discussed above, the cup 100 comprises the cup body 110 and the insert 150. The insert 150 is a structure that is also formed from a paper-based material and which is inserted into the cavity 115 of the cup body 110. When the insert 150 is positioned within the cavity 115 of the cup body 110, the entirety of the insert 150 is disposed within the cavity 115 such that no portion of the insert 150 protrudes beyond the open top end 116 of the cavity 115. That is, a height of the insert 150 is less than a height of the sidewall 111 of the cup body 110 measured from the floor 114 to the top end 118. It should be appreciated that the insert 150 is a separate component from the cup body 110 and that the insert 150 is positioned within the cavity 115 of the cup body 110. In some embodiments the insert 150 may be bonded or fixedly coupled to the cup body 110, and in other embodiments the insert 150 may remain unaffixed relative to the cup body 110 such that it is positioned in the cavity 115 of the cup body 110 but not directly attached or bonded to the cup body 110.

[0032] To reiterate, the cup body 110 is closed at its bottom end prior to positioning of the insert 150 within the cavity 115. Thus, the floor 114 of the cup body 110 closes the bottom end of the cavity 115. The floor 114 of the cup body 110 does not have any openings or apertures, but rather it spans across an entirety of the distance between the sidewall 111 of the cup body 110. In the exemplified embodiment, the insert 150 is positioned within the cavity 115 adjacent to the floor 114, and it may be in contact with the floor 114 in some embodiments. In some embodiments, an entirety of a floor portion of the insert 150 may be in contact with the floor 114 of the cup body 110. Thus, in the exemplified embodiment, no portion of the insert 150 is visible from a bottom end of the cup 100 because the insert 150 is blocked from view by the underside of the floor 114 of the cup body 110.

[0033] The insert 150 comprises a bottom end 151 and a top end 152. The insert 150 is positioned within the cavity 115 of the cup body 110 so that the bottom end 151 is adjacent to, or in contact with, the floor 114 of the cup body 110. In the exemplified embodiment, the insert 150 is coupled to the floor 114 of the cup body 110. The insert 150 may be coupled to the floor 114 of the cup body 110 by adhesive, ultrasonic bonding, or the like in various different embodiments. In the exemplified embodiment, the insert 150 is not coupled to the sidewall 111 of the cup body 110, although it may be possible to couple the insert 150 to the sidewall 111 of the cup body 110 in alternative embodiments and such coupling to the sidewall 111 may be as an alternative to or in addition to the coupling to the floor 114.

[0034] In the exemplified embodiment, the insert 150 comprises a floor portion 153 and a sidewall portion 154 extending upwardly from an outer edge 155 of the floor portion 153. However, in alternative embodiments, some of which will be described below with reference to, for example, FIGS. 22, 25, 26, and 29, the insert may include a sidewall but no floor. That is, the insert may be a ring-shaped component and this will be described below in accordance with alternative embodiments. In the exemplified embodiment, the floor portion 153 of the insert 150 is a flat, planar surface. Thus, when the insert 150 is positioned within the cavity 115 of the cup body 110, the floor portion 153 of the insert 150 rests directly atop of the floor 114 of the cup body 110, and the floor portion 153 of the insert 150 is coupled (i.e., bonded) to the floor 114 of the cup body 110. In the exemplified embodiment, the floor portion 153 is donut shaped such that it includes

a central hole 157. That is, in the exemplified embodiment the floor portion 153 comprises the outer edge 155 and an inner edge 156, with the inner edge 156 forming a boundary of the central hole 157. However, it should be appreciated that is may be possible to omit the central hole 157 in other embodiments. Stated another way, the insert 150, but itself, does not define an cavity which is closed on either end. Rather, a passageway exists from the top end 152 of the insert 150 to a bottom end of the insert 150 due, at least in part, to the existence of the central hole 157.

[0035] In the exemplified embodiment, the central hole 157 of the insert 150 has a diameter D1. Furthermore, the floor portion 153 of the insert 150 has a diameter D2 and a radius R1. In the exemplified embodiment, the diameter D1 of the central hole 157 is less than the radius R1 of the floor portion 155. Moreover, with the insert 150, a linear distance measured from the outer edge 155 to the inner edge 156 at any location and along any diameter of the floor portion 153 is constant. That is, the width of the donut shape of the floor portion 153 is constant. Thus, a value of a difference between the radius R1 of the floor and a radius of the central hole 157 is constant taken at any location along the floor portion 153 of the insert 150.

[0036] As noted above, the sidewall portion 154 of the insert 150 extends upwardly from the floor 153 of the insert 150 to the top end 152 of the insert 150. Thus, a distal end of the sidewall portion 154 forms the top end 152 of the insert 150. When the insert 150 is positioned within the cavity 115 of the cup body 110, the top end 152 is axially spaced from the floor 114 of the cup body 110, and is positioned between the floor 114 of the cup body 110 and the top end 118 of the cup body 110. The exact height of the sidewall portion 154 of the insert 150 may be determined based on various dimensions of the cup body 110 within which the insert 150 is to be positioned to ensure a proper cup-to-cup spacing distance when a plurality of the cups 100 are stacked. Thus, the height of the sidewall portion 154 may be modified as necessary based on dimensions of the cup body 110 within which the insert 150 is to be positioned.

[0037] The sidewall portion 154 of the insert 150 comprises an outer surface 158 that faces the inner surface 112 of the sidewall 111 of the cup body 110 and an inner surface 159 that faces the cavity axis A-A. Furthermore, the sidewall portion 154 of the insert 150 is corrugated in the exemplified embodiment. Due to the corrugated shape of the sidewall portion 154, both of the inner and outer surfaces 158, 159 of the sidewall portion 154 of the insert 150 comprise alternating ridges 164 and grooves 165. Stated another way, the inner and outer surfaces 158, 159 of the sidewall portion 154 of the insert 150 are wavy. In the exemplified embodiment, the corrugations are V-shaped, but the invention is not to be so limited in all embodiments. For example, FIG. 10B illustrates an alternative embodiment of an insert 150a which includes trapezoidal shaped corrugations (with the insert 150a being otherwise identical to the insert 150).

[0038] Due to the corrugations in the sidewall portion 154, when the insert 150 is positioned in the cavity 115 of the cup body 110, portions of the outer surface 158 of the sidewall portion 154 of the insert 150 may contact the sidewall 111 of the cup body 110 while other portions of the outer surface 158 of the sidewall portion 154 of the insert 150 are spaced from the sidewall 111 of the cup body 110. Thus, there exist gaps or spaces 160 between the outer surface 158 of the sidewall portion 154 of the insert 150 and the inner surface 112 of the sidewall 111 of the cup body 110, as best shown in FIG. 2. That is, the ridges 164 of the outer surface 158 of the sidewall portion 154 of the insert 150 are located closer to (and perhaps in contact with) the sidewall 111 of the cup body 110 than the grooves 165 of the outer surface 158 of the sidewall portion 154 of the insert 150. Due to the corrugated shape of the sidewall portion 154 of the insert 150, the top end 152 of the insert 150 has a zigzag shape along an entire circumference thereof. The inner and outer surfaces 158, 159 of the sidewall portion 154 of the insert 150 also have the aforementioned zigzag shape. The zigzag shape of the top end 152 of the insert 150 forms a ledge 161 for an immediate upper cup in a stack of the cups 100 to rest upon, as described in greater detail below. That is, portions of the top end 152 of the insert 150 protrude from the inner surface 112 of the sidewall 111 of the cup body 110 (without being attached directly thereto) towards the cavity axis A-A to form the ledge 161. Thus, if a second one of the cups 100 is placed inside of the cavity 115 of a first one of the cups 100, the bottom end 117 of the second one of the cups 100 will contact and rest atop of the top end 152 of the insert 150 to maintain a proper cup-to-cup spacing distance to prevent the two cups from becoming taper locked.

[0039] Referring to FIG. 10A, the insert 150 forms a ledge to support an upper cup in the stack despite the thickness of the material used to form the ledge 150 being rather small. In particular, the thickness T1 of the material that forms the insert 150 may be between 0.05mm and 0.5mm, more specifically between 0.2mm and 0.4mm, and still more particularly between 0.25mm and 0.35mm. However, because the sidewall portion 154 of the insert 150 is corrugated, the top edge thereof still forms a ledge. In particular, a thickness T2 of the ledge, which is measured as the distance between one of the ridges 164 on the outer surface 158 of the sidewall portion 154 and one of the ridges 164 on the inner surface 159 of the sidewall portion 154, may be between 3mm and 4mm, and more specifically between 3.3mm and 3.7mm, and still more specifically between 3.35mm and 3.5mm. In some embodiments, a ratio of the thickness T2 of the ledge to the thickness T1 of the material may be between 8:1 and 15:1, and more specifically between 10:1 and 13:1, and still more specifically between 11:1 and 12:1..

[0040] As best seen in FIGS. 4 and 5, the outside diameter of the insert 150 measured at the bottom end 151 of the insert 150 is less than a diameter of the cavity 115 of the cup body 110 measured along the floor 114 of the

cavity 115. As a result, the insert 150 is spaced from the sidewall 111 of the cup body 110 at the bottom end 151 of the insert 150. This ensures that the insert 150 can easily fit into the cavity 115 and be moved all the way to the floor 114 of the cavity 115. Moreover, the sidewall portion 154 of the insert 150 is oriented at a different angle than the sidewall 111 of the cup body 110. Specifically, while the sidewall 111 of the cup body 110 is oriented at the first angle Θ1 relative to the cavity axis A-A, the outermost portion of the sidewall portion 154 of the insert 150 is oriented at a second angle E)2 relative to the cavity axis A-A. In the exemplified embodiment, the second angle E)2 is greater than the first angle Θ1.

[0041] Due to the difference in the first and second angles Θ1, 82, the outer surface 158 of the sidewall portion 154 of the insert 150 is closer to the sidewall 111 of the cup body 110 moving in a direction from the floor 114 towards the top end 118 of the cup body 110. That is, the distance measured between the outermost portion of the outer surface 158 of the sidewall portion 154 of the insert 150 (which is formed by the ridges 164 along the outer surface 158) and the inner surface 112 of the sidewall 111 of the cup body 110 decreases moving from the bottom end 117 of the sidewall portion 154 of the insert 150 to the top end 152 of the sidewall portion 154 of the insert 150. It may be possible in other embodiments for the sidewall portion 154 of the insert 150 and the sidewall 111 of the cup body 110 to be oriented at the same angle relative to the cavity axis A-A.

[0042] As mentioned above, in the exemplified embodiment the floor portion 153 of the insert is bonded directly to the floor 114 of the cup body 110. This may be achieved using adhesives or more preferably using ultrasonic bonding techniques. Furthermore, in the exemplified embodiment the sidewall portion 154 of the insert 150 is not directly coupled or affixed to the sidewall 111 of the cup body 110. Thus, the sidewall portion 154 of the insert 150 is configured to freely flex and move relative to the cup body 110 in the exemplified embodiment. In other embodiments, the sidewall portion 154 may be coupled directly to the sidewall 111 of the cup body 110 using adhesive or ultrasonic bonding techniques.

[0043] In some embodiments, the sidewall portion 154 of the insert 150 may comprise one or more apertures 163 (shown in FIG. 4 only). Such apertures 163 may allow liquid introduced into the cavity 115 to flow through the apertures 163 so that the liquid can flow into the gaps 160 between the outer surface 158 of the sidewall portion 154 of the insert 150 and the inner surface 113 of the sidewall 111 of the cup body 110. The apertures 163 may be located adjacent to the floor portion 153 as shown, or they may be positioned at a higher elevation along the sidewall portion 154. The apertures 163 may be smaller than shown to minimize the amount of powder ingredient that is able to pass therethrough while allowing the liquid introduced into the cavity 115 during beverage formation to pass therethrough.

[0044] The inclusion of the apertures 163 may be helpful to flush out the gaps 160 which may contain particles of a powder or beverage ingredient which has previously been introduced into the cavity 115. Specifically, the cups 100 are generally pre-filled with a powder ingredient which may be ground coffee, ground coffee plus milk powder plus sugar, soup base, or other powders that contain a flavor for purposes of forming a beverage when mixed with a liquid such as water. The powder ingredient may find its way into the gaps 160 during transport and normal handling of the cups 100. Thus, apertures 163 will allow the liquid/water introduced into the cavity 115 to also mix with any powder ingredient particles that end up in the gaps 160. Of course, the apertures 163 may be omitted in some embodiments and are not shown in most of the figures.

[0045] Referring now to FIGS. 7 and 8, a plurality of the cups 100 are illustrated arranged in a stack 105. As mentioned above, after the cups 100 are formed by positioning the insert 150 within the cavity 115 of the cup body 110 (and possibly bonding or otherwise attaching the insert 150 to the cup body 110, although this is not required in all embodiments), a powder ingredient 190 (also referred to herein as a beverage ingredient) is introduced into the cavity 115 of the cup 100. The powder ingredient 190 may be, for example without limitation, coffee grounds, coffee grounds mixed with sugar, coffee grounds mixed with a whitener, coffee grounds mixed with sugar and a whitener, a tea ingredient, a soup base ingredient, a flavored beverage powder, a cocoa powder used for making hot chocolate, or any other type of ingredient that can be used to form a beverage, soup, or the like when water or some other liquid is introduced into the cavity 115 of the cup 100 and mixed with the powder ingredient 190. Of course, other ingredients may be used as the powder ingredient in other embodiments depending on the particular beverage or food/drink item to be made therein.

[0046] The cups 100 are arranged in a stack by inserting a portion of an immediate upper cup, bottom end 117 first, through the open top end 116 of the cavity 115 of an immediate lower cup. The immediate upper cup will move/slide within the cavity 115 via gravity or by a user until the bottom end 117 of the immediate upper cup contacts the top end 152 of the insert 150 in the immediate lower cup. If the inserts 150 were not present, the immediate upper cup would be able to move downwardly within the cavity 115 of the immediate lower cup until the bottom end 117 of the immediate upper cup was adjacent to or in contact with the floor 114 of the immediate lower cup. If the immediate upper cup was permitted to move downwardly within the cavity 115 of the immediate lower cup to this extent, it has the potential to create a taper lock whereby the beverage vending machine may have difficulty separating the cups during a cup dispensing operation. Therefore, in accordance with the present invention, the insert 150 prevents the immediate upper cup from moving downwardly that far. Specifically, the insert 150 stops movement of the immediate upper cup upon

the bottom end 117 of the immediate upper cup contacting the top end 152 of the insert 150 of the immediate lower cup. Of course, it is noted that the inserts 150 are formed from a paper-based material, and thus a user could potentially force an immediate upper cup past the insert 150 in the immediate lower cup by pressing downwardly on the immediate upper cup and causing the insert 150 to bend and/or break. However, using normal stacking and handling procedures, the insert 150 in the immediate lower cup will support the immediate upper cup.

[0047] As noted above, the top end 152 of the insert 150 (which forms a top edge of the insert 150) has a zigzag shape which causes parts of it to protrude from the inner surface 112 of the sidewall 111 of the cup body 110. This does not necessarily mean that the top edge of the insert 150 is in contact with the inner surface 112 of the sidewall 111 of the cup body 110. Rather, by stating that the top end 152 (or top edge) of the insert 150 protrudes from the inner surface 112 of the sidewall 111 of the cup body 110, this means that the top end 152 of the insert 150 extends in a direction away from the inner surface 112 of the sidewall 111 of the cup body 110 and towards the central axis A-A of the cavity 115. Stated another way, as used herein stating that the top edge 152 of the insert 150 (or the top edge of any other insert described herein) protrudes from the inner surface 112 of the sidewall 111 of the cup body 110 simply means that portions of an inner edge of the top edge 152 of the insert 150, which is formed at the intersection of the top edge 152 of the insert 150 and the sinner surface 159 of the sidewall portion 154 of the insert 150, is spaced radially inward of the sidewall 111 of the cup body 110 in a direction towards the cavity axis A-A.

[0048] In the exemplified embodiment, this forms the ledge 161 upon which the immediate upper cup rests. Parts of the top end 152 of the insert 150 must extend a certain distance from the sidewall 111 into the cavity 115 to ensure that the immediate upper cup cannot simply slide past the insert 150 when it is being inserted into the cavity 115 of the immediate lower cup. In some embodiments, the top end 152 of the insert 150, or portions thereof, may extend to a location that is between 0.5mm and 1.5mm, and more specifically between 0.6mm and 1.0mm, and more specifically approximately 0.8mm from the inner surface 112 of the sidewall 111 of the cup body 110.

[0049] Although in the exemplified embodiment, the top end 152 (or top edge) of the insert 150 forms the ledge upon which the immediate upper cup in the stack 105 rests, this is not required in all embodiments. Specifically, in alternative embodiments the ledge 161 may be positioned along the sidewall portion 154 at a location that is at an elevation below the top end 152 of the insert 150. The immediate upper cup in the stack 105 may rest atop of the ledge 161 regardless of whether it is formed by the top end 152 of the sidewall portion 154 or if it is positioned at a location below the top end 152 of the sidewall portion 154.

[0050] In FIG. 8, the powder ingredient 190 is illustrated in the cavity 115 of each of the cups 100. Furthermore, the powder ingredient 190 is positioned so that the sidewall portion 154 of the insert 150 surrounds the powder ingredient 190. In the exemplified embodiment, the powder ingredient 190 does not extend beyond the top end 152 of the insert 150. However, it may be possible for portions of the powder ingredient 190, specifically portions that are located closest to the cavity axis A-A, to pile higher than the top end 152 of the insert 150. However, because the floor 114 of the cup 100 is recessed relative to the bottom end 117, there is an added space for any such powder ingredient 190 which extends to a position that is above the top end 152 of the insert 150 in the cup below.

[0051] Because the inserts 150 prevent the cups 100 from becoming taper locked, if a user were to hold the stack 105 by gripping any of the cups 100 other than the lowermost cup, the cups below the one being gripped may separate from the stack 105. This is because the inserts 150 maintain the adjacent cups in the stack 105 at a sufficient spacing distance so that they are not frictionally coupled to one another, which may occur in a traditional stacking of cups without the inserts 150.

[0052] In that regard, referring to FIG. 9, the stack of cups 105 are preferably held together in the stacked arrangement with a package structure 130. The package structure 130 may be formed from a paper-based material in some embodiments, although the invention is not to be so limited and in other embodiments the package structure 130 may be formed from other materials such as plastics and the like. Of course, paper may be preferable due to recyclability and environmental factors as described herein. The package structure 130 is configured to wrap around the bottom end 117 of the bottommost cup in the stack 105 and around the top end 118 of the uppermost cup in the stack 105 in a snug fit to retain the cups 100 in the stacked arrangement. That is, the package structure 130 is configured to prevent any of the cups 100 in the stack 105 from moving axially relative to any of the other cups in the stack 105 while the package structure 130 is coupled to the stack 105. In the exemplified embodiment, a large portion of the cups 100 remain exposed and are not covered by the package structure 130. Of course, in other embodiments the package structure 130 may fully enclose the cups 100 and the stack 105 while still preventing relative axial movement of the cups 100.

[0053] When it is desired to add the stack 105 to a beverage machine, a user will remove the package structure 130 from the stack 105 while maintaining the cups 100 in the stacked arrangement and preventing any of the cups 100 from separating from the remainder of the stack 105. Then, the user will place the stack 105 into the beverage machine where the cups 100 can be dispensed one-by-one upon request by a consumer for the beverage machine to vend a particular beverage.

[0054] FIG. 9 illustrates one package structure 130 that

may be used to hold the stack 105 together for purposes of shipping, transport, or the like. In other embodiments, a shrink wrap film may be wrapped around the stack 105 for this purpose. In other embodiments, a vacuum pack may be placed around the stack 105 to hold the stack 105 together. In still other embodiments, the cups may include embossing, debossing, or mating protrusions/recesses on their inner and outer surfaces to resist relative axial movement of the cups when they are nested in a stack, such as shown in European Patent Number EP2195245B1.

[0055] Referring to FIGS. 11A-11H sequentially, a method of forming one of the cups 100 and then stacking two of the cups 100 will be described. First, referring to FIGS. 11A and 11B, an insert blank 10 is sandwiched between a mandrel 11 and a shaping member 12. The insert blank 10 is formed from a paper-based material as described herein. The mandrel 11 and/or the shaping member 12 may be heated during this process in some embodiments. Trapping the insert blank 10 between the mandrel 11 and the shaping member 12 as shown in FIG. 11B shapes the insert blank 10 into the insert 150. Next, referring to FIGS. 11C, the mandrel 11 and/or the shaping member 12 are moved relative away from one another (either one or both of the mandrel 11 and the shaping member 12 may be moved). During this process, the insert 150 may remain attached to the end of the mandrel 11.

[0056] Next, referring to FIG. 11D, one of the cup bodies 110 (which is formed in its own manufacturing process which is conventional and well-known in the art) is moved onto the mandrel 11 so that the mandrel 11 enters into the cavity 115 of the cup body 110 through the open top end 116 thereof. Next, as shown in FIG. 11E, the mandrel 11 is moved relative to the cup body 110 (or the cup body 110 is moved relative to the mandrel 11) until the insert 150 which was previously formed is in contact with the floor 114 of the cup body 110. Upon the insert 150 being in contact with the floor 114 of the cup body 110, the insert 150 is bonded to the floor 114 of the cup body 110. Such bonding may be achieved by ultrasonic bonding or sonic welding, whereby highfrequency ultrasonic sound waves are applied through the mandrel to fuse the insert 150 to the floor 114 of the cup body 110. Alternatively, one of the insert 150 or the floor 114 of the cup body 110 may have adhesive pre-applied thereon so that contacting the insert 150 with the floor 114 of the cup body 110 will automatically bond those two components together. Next, the mandrel 11 is removed from the cavity 115 of the cup body 110, leaving the insert 150 coupled to the cup body 110 and thereby forming the cup 100, which is shown in FIG. 11F.

[0057] Referring to FIG. 11F the cup 100 is illustrated in cross-section, including the cup body 110 and the insert 150 coupled thereto. Furthermore, the powder ingredient 190 is being introduced into the cavity 115 of the cup body 110. This step takes place when the cup 100 is being used in a beverage vending machine as has been described above.

[0058] Referring to FIGS. 11G and 11H, after a plurality of the cups 100 have been formed as described above with reference to FIGS. 11A-11E and then filled with the powder ingredient 190 as described above with reference to FIG. 11F, the cups 100 are arranged in a stack. To arrange the cups 100 in a stack, an immediate upper cup 100 is positioned, bottom end 117 first, through the open top end 116 of an immediate lower cup 100 until the bottom end 117 of the immediate upper cup 100 contacts the ledge 161 of the insert 150 of the immediate lower cup 100. In the exemplified embodiment, the ledge 161 is formed by the top end 152 of the insert 150, although this is not required in all embodiments and as explained above the ledge 161 could be positioned between the top end 152 of the insert 150 and the floor 114 of the cup 100 in other embodiments. Additional cups 100 can be added to the stack until the stack contains the desired number of cups (for example, each stack may contain 20 cups). The cups 100 are spaced a sufficient distance so that they will not taper lock. Finally, a package structure such as that which is shown and described in FIG. 9 may be placed around the stack 100 to prevent axial movement/separation of the various cups 100 in the stack.

[0059] Referring to FIGS. 12A and 12B, an alternative embodiment of one of the cups 100 is illustrated, whereby the cup 100 comprises the cup body 110 and the insert 150. The difference between FIGS. 12A and 12B and the figures previously described is that the bottom end 151 of the insert 150 is elevated above the floor 114 of the cup body 110. In the exemplified embodiment, one or more spacers 170 are positioned between the floor 114 of the cup body 110 and the bottom end 151 of the insert 150. In other embodiments, the floor portion 153 of the insert 150 may be pleated or corrugated (similar to the sidewall portion 154 of the insert 150) so that portions of the floor portion 153 which are the grooves of the corrugation are spaced from the floor 114 of the cup body 110. In either case, due to the spacing of the bottom end 151 (and floor portion 153) of the insert 150 relative to the floor 114 of the cup body 110, a space exists for the liquid (i.e., water) being introduced into the cavity 115 during beverage making to flow between the floor portion 153 of the insert 150 and the floor 114 of the cup body 110.

[0060] One reason that it may be desirable to elevate the bottom end 151 of the insert 150 above the floor 114 of the cup body 110 is to ensure that the water/liquid being introduced into the cavity 115 can flow into the space between the sidewall portion 154 of the insert 150 and the sidewall 111 of the cup body 110. More specifically, it is possible that during handling of the cup 100 and or stack of cups that some of the powder ingredient 190 may end up located in the space between the sidewall portion 154 of the insert 150 and the sidewall 111 of the cup body 110. Thus, to ensure that the liquid being introduced into the cavity 115 during beverage formation is able to mix with the powder ingredient 190 that is trapped between the sidewall portion 154 of the insert

150 and the sidewall 111 of the cup body 110, the insert 150 is elevated slightly above the floor 114 of the cup body 110. As seen in FIG. 12B, this allows the liquid to flow in the space between the floor portion 153 of the insert 150 and the floor 114 of the cup body 110 and then upwardly into the spaces between the sidewall portion 154 of the insert 150 and the sidewall 111 of the cup body 110.

[0061] Referring to FIGS. 13 and 14, a cup 200 comprising a cup body 210 and an insert 250 is illustrated in accordance with another embodiment of the present invention. The cup body 210 is identical to the cup body 110 and will therefore not be described here in any detail, it being understood that the description of the cup body 110 is applicable. The cup body 210 may include numerals which are identical to the numerals representative of features of the cup body 110, except that the 200-series of numbers will be used. The insert 250 is similar to the insert 150 which was previously described, except for the difFerences noted herein.

[0062] The insert 250 extends from a bottom end 251 to a top end 252. In the exemplified embodiment, the insert 250 comprises a sidewall portion 254, but it does not have a floor portion. However, it should be appreciated that the insert 250 may include a floor portion which is identical to the floor portion 153 of the insert 150 described above (with or without the central hole 157). The sidewall portion 254 of the insert 250 is corrugated like the sidewall portion 154 of the insert 150, except when the insert 250 is positioned within the cavity 215 of the cup body 210, the sidewall portion 254 is flattened against the sidewall 211 of the cup body 210. That is, the sidewall portion 254 of the insert 250 is pivoted so that the pleats formed by the corrugated sidewall portion 254 side against the sidewall 211 of the cup body 210. This decreases the size of (or eliminates) the gap between the outer surface of the sidewall portion 254 of the insert and the inner surface of the sidewall 211 of the cup body 210. As a result, it is less likely that powder ingredient particles will become trapped between the sidewall portion 254 of the insert 250 and the sidewall 211 of the cup body 210.

[0063] In this embodiment, the cups 200 can be stacked in much the same way as described above with reference to the cups 100. That is, each cup 200 is placed within the cavity 215 of an immediate lower cup until the bottom end 217 of the immediate upper cup rests atop of the top end 252 of the insert 250 of the immediate lower cup. This maintains a proper spacing between the adjacent cups in the stack to prevent a taper lock situation as described above. Moreover, although the top end 252 of the insert 250 forms the ledge upon which the immediate upper cup in the stack rests in this embodiment, the ledge could be formed at a lower elevation along the sidewall portion 254 of the insert 250 as mentioned above.

[0064] FIGS. 15-17 illustrate additional alternative embodiments for inserts. In FIGS. 15 and 16, there is a dashed line circle indicating the inner surface of the sidewall of the cup in which the insert is configured to be placed, for reference. Specifically, FIG. 15 illustrates an insert 260 that comprises a sidewall 261 that is divided into a plurality of sidewall segments 262. Each of the sidewall segments 262 overlaps with the two sidewall segments 262 that are adjacent thereto. That is, a first end of each sidewall segment 262 overlaps an inner surface of one adjacent sidewall segment 262 and an outer surface of another adjacent sidewall segment 262. This overlap of the sidewall segments 262 creates a certain thickness to the sidewall 261 particularly at the location of the overlap. This increased thickness at the location of the overlap between two adjacent sidewall segments 262 creates a ledge upon which an immediate upper cup in a stack can rest to maintain the desired cup-to-cup spacing within a stack of the cups which include the inserts 260.

[0065] FIG. 16 illustrates an insert 270 that comprises a sidewall 271 having a hexagonal shape. Thus, when the insert 270 is positioned within a cup body having a cavity with a circular cross-sectional shape, some portions of the sidewall 271 will be spaced from the sidewall of the cup body. The top edge of the portions of the sidewall 271 which are spaced from the sidewall of the cup body will form a ledge upon which an immediate upper cup in a stack of the cups can rest to maintain the desired cup-to-cup spacing. In FIG. 16, a circle is depicted around the insert 270 to represent the sidewall 111 of the cup body 110. Furthermore, an arrow is provided to show the increased ledge depth/thickness due to the spacing between portions of the sidewall 271 of the insert 270 and the sidewall 111 of the cup body 110, which provides a proper location for an upper cup in a stack to rest upon.

[0066] FIG. 17 illustrates an insert 280 that includes a floor portion 281 and a sidewall portion 282 extending from the floor portion 281. The sidewall portion 282 comprises a plurality of tabs 283 which are spaced apart from one another. When the insert 280 is positioned within a cup body 110 as shown in FIG. 18, the tabs 283 of the sidewall portion 282 fold and extend upwardly so that distal ends 284 of the tabs 283 form the ledge upon which an immediate upper cup in the stack rests (as shown in FIG. 18).

[0067] Referring to FIGS. 19-21, a method of forming a cup 300 comprising a cup body 310 and a support member 350 is illustrated in accordance with another embodiment of the present invention. In this embodiment, the component upon which an upper cup in a stack rests is referred to as the support member 350 rather than using the term insert. This is because in this embodiment the support member 350 attached to the blank that is used to form the cup body before the cup body is formed, as explained below.

[0068] Referring first to FIG. 19, a cup blank 320 having a surface 321 is illustrated. The cup blank 320 is flat during this point in the method. The cup blank 320 is preferably formed from a paper-based material. Furthermore, as also shown in FIG. 19, the support member 350

is being attached to the surface 321 of the cup blank 320. The support member 350 is attached to the surface 321 of the cup blank 320 before the cup blank 320 is rolled into a conical or cylindrical shape so as to form the cup 300. The support member 350 is also preferably formed from a paper-based material. The support member 350 may be coupled or attached to the surface 321 of the cup blank 320 using ultrasonic bonding, adhesives, or the like in various different embodiments.

[0069] In this embodiment, the support member 350 comprises a strip 351 of paper material having a first surface 352 and a second surface 353 opposite the first surface 352. The strip 351 is folded or bent or corrugated so as to form a plurality of projections 354 which protrude from the second surface 353. The projections 354 are distinct from one another and are spaced apart along a length of the strip 351. The support member 350 is coupled to the surface 321 of the cup blank 320 so that the first surface 352 of the strip 351 is in contact with the surface 321 of the cup blank 320 and the second surface 353 of the strip 351 faces away from the surface 321 of the cup blank 320. The projections 354 protrude from the surface 321 of the cup blank 320. Because the strip 351 is an integral structure, the projections 354 form recesses 355 in the first surface 352 of the strip 351, and a gap exists between the second surface 353 of the strip 351 and the surface 321 of the cup blank 320 at the locations of the projections 354.

[0070] In FIG. 19, the support member 350 extends across an entirety of the cup blank 320 from a first side thereof to a second side thereof in a continuous manner. Thus, the support member 350 is a continuous strip 351 of paper material. However, the invention is not to be so limited in all embodiments and the support member 350 may comprise a plurality of separate strips that are positioned on the cup blank 320 in a spaced apart, but adjacent, manner. Thus, there could be two or three or four or more separate strips that make up the support member 350, rather than a single strip, while still achieving the same end purpose of forming a ledge to support the next cup in the stack of cups. Stated simply, the support member 350 may be a continuous strip as shown in FIG. 19 or a discontinuous strip in various embodiments.

[0071] Referring to FIG. 20, after the support member 350 is coupled to the surface 321 of the cup blank 320, the cup blank 320 is rolled into a cylindrical or conical shape to form a sidewall 311 of the cup body 310. After the cup blank 320 has been rolled into the cylindrical or conical shape, a base member 330 is attached to the sidewall 311 of the cup body 310 to form the cup 300 as shown in FIG. 20. Specifically, FIG. 20 illustrates two of the cups positioned in a stacked arrangement.

[0072] Referring to FIGS. 20 and 21, upon rolling the cup blank 320 into the cylindrical or conical shape to form the sidewall 311 of the cup body 310, the support member 350 remains coupled to the surface 321 of the cup blank 320, and the surface 321 of the cup blank 320 ultimately forms an inner surface 312 of the sidewall 311 of the cup body 310. Thus, the support member 350 is coupled to the inner surface 312 of the sidewall 311 of the cup body 310 and the projections 354 of the strip 351 of the support member 350 protrude from the inner surface 312 of the sidewall 311 of the cup body 310 towards a cavity axis B-B of a cavity 315 of the cup body 310. When the cup 300 is fully formed as shown in FIGS. 20 and 21, the support member 350 comprises a bottom edge 356 that is adjacent to a floor 314 of the cup body 310 and a top edge 357 that is spaced from the floor 314 of the cup body 310. The top edge 357, and more particularly those portions of the top edge 357 which are formed by the projections 354, forms a ledge 360 of the support member 350 upon which an immediate upper cup in the stack can rest. As showing FIG. 20, the bottom end 317 of the immediate upper cup in the stack is resting atop of the ledge 360 of the support member 350 (which is formed by the top edge 357 of the support member 350) of the immediate lower cup in the stack.

[0073] As best seen in FIG. 21, there are gaps that exist between the recesses 355 of the first surface 352 of the support member 350 and the inner surface 312 of the sidewall 311 of the cup body 310. These gaps are formed as a result of the support member 350 having the projections 354 and being a unitary construction. Thus, there is a desire to minimize the size of the gaps between the recesses 355 and the sidewall 311 of the cup body 310, while also ensuring that the projections 354 extend a sufficient distance from the inner surface 312 of the sidewall 311 to form a proper ledge that can support the immediate upper cup in the stack as has been described in detail herein.

[0074] Thus, in the fully formed cup 300, the support member 350 is ring-shaped and comprises the first surface 352 (or outer surface) which faces the sidewall 311 of the cup body 310 and a second surface 353 (or inner surface) which is opposite the first surface 352 and faces the interior of the cup body 310. The second or inner surface 353 comprises the plurality of spaced apart projections (or protruding portions) 354 which extend inwardly towards the cavity axis B-B of the cup body 310. Each of the projections 354 forms a ledge, or a portion of a ledge, upon which the bottom end 317 of an immediate upper cup in the stack rests to maintain the bottom end 317 of the immediate upper cup in the stack spaced from the floor 314 of the immediate lower cup in the stack.

[0075] Referring to FIGS. 22-24, yet another embodiment of a cup 400 is illustrated and will be described. The cup 400 comprises a cup body 410 and an insert 450 positioned within a cavity 415 of the cup body 410. The cup body 410 is identical to the cup body 110 described above, and thus a detailed description of the cup body 410 will not be provided here in the interest of brevity. It should be appreciated that the description of the cup body 110 is applicable to the cup body 410. Reference numerals that are identical to those used to describe features of the cup body 110 will be used to describe the cup body 410, except that the 400-series of numbers will

be used. Thus, the cup body 410 comprises a floor 414 and sidewall 411 having an inner surface 412 extending from the floor 414. The floor 414 and an inner surface of the sidewall 411 collectively define a cavity 415. As discussed previously, a powder ingredient may be located in the cavity 415, although it is not shown in FIGS. 22-24 to avoid clutter.

[0076] In this embodiment, the insert 450 is a separate component from the cup body 410 and it is placed within the cavity 415 of the cup body 410 after the cup body 410 is formed (rather than during or before forming the cup body 410 as with the cup 300 described above with reference to FIGS. 19-21). The insert 450 comprises a ring-shaped backer member 460 and a ring-shaped support member 470 that are coupled together to collectively form the insert 450. Specifically, the ring-shaped backer member 460 comprises a smooth outer surface 461 and a smooth inner surface 462 opposite the smooth outer surface 461. The ring-shaped support member 470 comprises an inner surface 471 and an outer surface 472 and a plurality of spaced apart protruding portions 473 on the outer surface 472. The ring-shaped support member 470 is positioned within an interior of the ring-shaped backer member 460 so that the inner surface 471 of the ring-shaped support member 470 faces the outer surface 462 of the ring-shaped backer member 460, and then the ring-shaped support member 470 is attached or bonded to the ring-shaped backer member 460 to form the insert 450.

[0077] After the insert 450 is formed separately from the cup body 410, the insert 450 is placed into the cavity 415 of the cup body 410. In the exemplified embodiment, the insert 450 is positioned so that a bottom end 451 of the insert 450 is in contact with the floor 414 of the cup body. However, the invention is not to be so limited in all embodiments and the bottom end 451 of the insert 450 may be spaced from the floor 414 in other embodiments. Moreover, the smooth outer surface 471 of the ring-shaped backer member 460 forms the outer surface of the insert 450, and the smooth outer surface 471 of the ring-shaped backer member 460 is in contact with the inner surface 412 of the sidewall 411 of the cup body 410. The smooth outer surface 471 of the ring-shaped backer member 460 may be bonded (via adhesive, ultrasonics, or the like) to the inner surface 412 of the sidewall 411 of the cup body 410 in some embodiments, although this may not be required in all embodiments. That is, in alternative embodiments the insert 450 may not be physically bonded or coupled to the cup body 410, but may instead simply rest atop of the floor 414 of the cup body 410.

[0078] As best seen in FIG. 24, when the insert 450 is positioned within the cavity 415 of the cup body 410, the spaced apart protruding portions 473 of the insert 450 protrude in a direction away from the sidewall 411 of the cup body 410 and towards a cavity axis C-C of the cavity 415 of the cup body 410. As a result, the portions of the top end 452 of the insert 450 which are aligned with and formed by the protruding portions 473 of the insert 450 form a ledge upon which an immediate upper cup in a stack of the cups 400 can rest without allowing the upper cup in the stack of the cups 400 to move downwardly into the cavity 415 of the immediate lower cup beyond the top end 452 of the insert 450. This is shown in FIG. 23, whereby the immediate upper cup 400 has its bottom end 417 resting atop of the top end 452 of the insert 450 positioned in the cavity 415 of the immediate lower cup 400.

[0079] FIG. 25 illustrates another embodiment of an insert 480 formed from a paper-based material. The insert 480 is ring-shaped and has an inner surface 481 and an outer surface 482 opposite the inner surface 481. The insert 480 is folded or bent to form a plurality of protrusions 483 which extend inwardly from the inner surface 481 towards a central axis of the insert 480. However, in this embodiment, rather than the protrusions 483 forming recesses on the outer surface 482, the protrusions 483 are pinched together to close any gaps that would otherwise be formed. Thus, when the insert 480 is positioned within the cavity of a cup body, the gaps between the insert 480 and the sidewall of the cup body are minimized, if not eliminated entirely. Thus, this embodiment ensures that the ledge formed by the protrusions 483 is sufficiently deep to support a cup above while minimizing gaps through which powder ingredient may pass between the insert 480 and the sidewall of the cup within which the insert is positioned.

[0080] Thus, , in some embodiments the insert may comprise a ring-shaped member having protrusions that extend inwardly from an inner surface thereof to create a ledge for supporting a cup that above in a stack of the cups. Thus, the exact structure of the insert is not to be limited to the exemplary embodiments in all embodiments. Rather, the insert may be any ring-shaped member that is configured to fit within the cavity of a cup at a position that is adjacent to or in contact with the floor of the cup, and that includes protrusions that extend further into the cavity of the cup towards the cavity axis of the cup to ensure that a cup nesting therein will contact and rest atop of the insert rather than being pushed further down into the cup below, which could create a taper lock situation that will make it difficult for the beverage vending machine to consistently dispense the cups without failure. The outer surface of the insert which faces the sidewall of the cup body within which it is positioned may be smooth like shown in FIGS. 22, 25, and 26, or it may include recesses or the like as shown in FIG. 21.

[0081] Referring now to FIGS. 26-28, yet another embodiment of a cup 500 is illustrated. The cup 500 comprises a cup body 510 and an insert 550. The cup body 510 is identical to the cup body 110 described above and therefore will not be described in detail here in the interest of brevity. However, briefly, the cup body 510 comprises a floor 514 and a sidewall 511 having an inner surface 512 that collectively with the floor 514 defines a cavity 515. The cup body 510 also comprises a bottom end 517,

which forms a bottom end of the cup 500.

[0082] In this embodiment, the insert 550 is a ring-shaped component having a smooth inner surface 551 and a smooth outer surface 552. The insert 550 also comprises a bottom end or edge 553 and a top end or edge 554. The insert 550 in this embodiment does not have projections or protuberances extending from the inner surface 551. Rather, the insert 550 has a thickness, measured between the inner and outer surfaces 551, 552, which is sufficient to ensure that an upper cup in a stack will rest atop of the top end 554 of the insert 550 positioned in the immediate lower cup in the stack. In some embodiments, the thickness of the insert 550 may be at least 0.5mm, or more specifically at least 0.6mm, or more specifically at least 0.7mm, and still more specifically at least 0.8mm. The insert 550 may be formed from multiple layers of paper-based material or from a thicker type of paper-based material, such as paperboard or the like.

[0083] The insert 550 is positioned within the cavity 515 of the cup body 510 as shown in FIG. 27. The insert 550 may be positioned so that the bottom end 553 is in contact with the floor 514 of the cup body 510. Alternatively, the bottom end 553 of the insert 550 may be spaced from the floor 514 of the cup body 510. Moreover, the insert 550 may be physically attached to the floor 514 and/or sidewall 511 of the cup body 510, although this is not required in all embodiments. When the cups are stacked as shown in FIGS. 27 and 28, the bottom end 517 of an immediate upper cup 500 in the stack is in contact with and rests atop of the top end 554 of the insert 550 of the immediate lower cup 500 in the stack. This maintains a desired cup-to-cup spacing distance between adjacent cups in the stack to prevent a taper lock and ensure proper dispensing of the cups by a beverage vending machine as discussed herein. Although not shown in these figures, a powder ingredient may be disposed within the cavity 515 of each of the cups 500 as has been described above.

[0084] Referring now to FIG. 29, yet another embodiment of an insert 580 is illustrated. The insert 580 is very similar to the sidewall portion 154 of the insert 150 described above. Specifically, the insert 580 is the same as the insert 150 described above, with the floor portion 153 omitted. Thus, the insert 580 comprises a sidewall portion 581 that is corrugated to give it a wavy or zigzag shape. The insert 580 also has a bottom end 582 and a top end 583. Thus, when the insert 580 is positioned within the cavity of a cup body so that the bottom end 582 is adjacent to or in contact with the floor of the cup body, portions of the top end 583 of the insert 580 will protrude or extend inwardly from the sidewall of the cup body into the cavity of the cup body. Thus, the top end 583 of the insert 580 forms a ledge upon which an immediate upper cup in a stack of the cups can rest. As with all of the inserts described herein, the insert 580 may be formed from a paper-based material. The insert 580 may be held loosely within the cavity of the cup body and not physically coupled thereto, or the insert 580 may be physically attached or bonded to the cup body in various different embodiments.

[0085] Referring now to FIGS. 30-32, a cup 600 (and a stack 605 of the cups 600) is illustrated in accordance with yet another embodiment of the present invention. This embodiment is somewhat different than those previously described, in that there is no insert positioned within a cup body. Rather, in this embodiment a sleeve is provided around the outside of the cup, and the sleeve facilitates the maintaining of the proper and desired spacing between the cups in the stack 605.

[0086] FIG. 30 illustrates one of the cups 600, which comprises a cup body 610 having a sidewall 611 and a floor (not visible in FIG. 30). The sidewall 611 has an outer surface 613 and an inner surface 612 which, along with the floor, collectively defines a cavity 615. The cup 600 also comprises a rim 609 which is formed in the exemplified embodiment by curling a top portion of the sidewall 611. The rim 609 may be formed in the conventional manner which is well known to those of ordinary skill in the art. The cup 600 is preferably formed from a paper-based material. A top end of the rim 609 forms a top end 618 of the cup 600 and a bottom end of the rim 609 forms an underside 616 of the rim 609. The cup 600 is a traditional style of paper cup, which is one of the benefits of this embodiment (and many of the others described herein), that the cup 600 itself need not be modified.

[0087] Furthermore, in this embodiment there is a sleeve 650 positioned around a portion of the outer surface 613 of each of the cups 600. The sleeve 650 has a bottom end 651, a top end 652, an inner surface 653, and an outer surface 654. The sleeve 650 is a ring-shaped component so that the inner surface 653 thereof surrounds a passageway that extends from the bottom end 651 to the top end 652. The sleeve 650 is positioned around the cup 600 by inserting the cup 600, bottom end first, into the passageway defined by the sleeve 650 and sliding the sleeve 650 upwardly along the outer surface 613 of the sidewall 611 of the cup 600 until the top end 652 of the sleeve 650 abuts against the underside of the rim 609 of the cup 600. As seen in the figures, the sleeve 650 has a height which is much smaller than the height of the cup 600, and smaller than the height of sleeves which are used to prevent a user from burning their hand when holding the cup 600 with a hot beverage therein. Specifically, the sleeve 650 has a height measured from the bottom end 651 to the top end 652 which is between 10% and 20% of a height of the cup 600 measured from a bottom end 617 of the cup 600 to the underside 616 of the rim 609.

[0088] In the exemplified embodiment, the inner and outer surfaces 653, 654 of the sleeve 650 are smooth. However, the invention is not to be so limited in all embodiments. For example, the sleeve 650 may be corrugated in some embodiments, such that the inner and/or outer surfaces 653, 654 are wavy or include ridges and grooves as has been described above. In other embod-

iments, the sleeve 650 may have smooth inner and outer surfaces 653, 654 and may include protuberances extending from the outer surface 654 to perform the support function as described herein.

[0089] Referring to FIGS. 31 and 32, a plurality of the cups 600 are illustrated arranged in a stack 605 such that each cup is positioned within the cavity 615 of a cup immediately below. Due to the positioning of the sleeve 650, when an immediate upper cup is placed within the cavity of an immediate lower cup, the bottom end 651 of the sleeve 650 around the immediate upper cup 650 abuts against the top end 618 of the immediate lower cup, thereby trapping the sleeve 650 between the underside 616 of the rim 609 of the immediate upper cup and the top end 618 of the rim 609 of the immediate lower cup. Thus, the sleeve 650 ensures that the spacing between adjacent cups in the stack 605 remains at the desired height to ensure that the cups do not become taper locked together.

[0090] In the exemplified embodiment, the sleeve 650 has a varying thickness measured between the inner and outer surfaces 653, 654. More specifically, the thickness of the sleeve 650 measured between the inner and outer surfaces 653, 654 continuously increases moving from the top end (or top edge) 652 of the sleeve 650 to the bottom end (or bottom edge) 651 of the sleeve 650. As shown in FIG. 31, there is a powder ingredient 690 located in the cavity 615 of each of the cups 600 in the stack 605. Furthermore, the sleeve 650 has a height that is sufficient to ensure that the bottom end 617 of each cup 600 is spaced from the powder ingredient in the immediate lower cup in the stack 605.

[0091] It should be appreciated that the cups 600 and the sleeves 650 are configured so that when one cup 600 is being inserted into the cavity 615 of another cup 600 through the opening in the top end 618 of the cup 600, the sleeve 650 is prohibited from entering into the cavity 615. That is, when the sleeve 650 is positioned around the cup 600, an outer diameter of the sleeve 650 is greater than a diameter of the opening into the cavity 615 at the top end 618 of the cup 600. Thus, as an upper cup is nested within a lower cup, the bottom end 651 of the sleeve 650 forms a stopper in that it abuts against the top end 618 of the lower cup and cannot fit through the opening into the cavity 615 without distorting one or both of the cups 600.

[0092] Referring now to FIGS. 33-35, yet another embodiment of a cup 700 and a stack 705 of the cups 700 is illustrated and will be described. The cup 700 comprises a cup body 710 and an insert 750 positioned within a cavity 715 of the cup body 710. The cup body 710 comprises a sidewall 711 having an inner surface 712 and a floor 714. The floor 714 and the sidewall 711 collectively form the cavity 715 of the cup body 710. The cup 700 is formed from paper and has a similar structure to conventional paper cups.

[0093] The insert 750 comprises a floor portion 751 and a sidewall portion 752 extending upwardly from the floor portion 752. The insert 750 is preferably formed from a paper-based material, such as the materials mentioned above. The insert 750 may be formed by shaping a paper blank with a mandrel as described herein, or it may be formed via a pulp injection molding process. In fact, any of the inserts described herein may be formed by being shaped with a mandrel, being injection molded out of pulp or similar materials, or the like. In one embodiment, materials such as industrial starch, natural fibers, and water can be premixed and then placed within a mold cavity, baked/heated, and then removed to form the insert 750. In other embodiments, the inserts described herein may be formed from bagasse.

[0094] The insert 750 is positioned within the cavity 715 of the cup body 710 so that the floor portion 751 of the insert 750 is adjacent to the floor 714 of the cup body 710. The floor portion 751 of the insert 750 may be physically attached (via adhesive, ultrasonic bonding, or the like) to the floor 714 of the cup body 710 in some embodiments. The sidewall portion752 of the insert 750 may be coupled to the sidewall 711 of the cup body 710 in some embodiments. And in still other embodiments, the insert 750 may be free-standing within the cavity 715 of the cup body 710 such that the insert 750 is not physically coupled to the cup body 710. The difference between the insert 750 and the insert 150 is that the floor portion 751 of the insert 750 does not have a hole, and the sidewall portion 752 of the insert 750 is not corrugated, but instead it has smooth inner and outer surfaces.

[0095] Referring to FIGS. 34 and 35, when a plurality of the cups 700 are arranged in a stack 705, a bottom end 717 of each immediate upper cup rests atop of a top edge of the sidewall portion 752 of the insert 750 positioned within the cavity 715 of the immediate lower cup in the stack 705. Thus, the insert 750 prevents the cups from being stacked too tightly and therefore prevents taper lock situations so that a beverage vending machine can consistently vend the cups one at a time on demand.

[0096] FIGS. 36 and 37 illustrate a plurality of cups 800 arranged in a stack 805. Each of the cups 800 comprises a cup body 810 and an insert 850 as has been described in the previous embodiments. The cup body 810 comprises a floor 814 and a sidewall 811, with an inner surface 812 of the sidewall 811 and the floor 814 collectively defining a cavity 815 having a cavity axis D-D. In this embodiment, the insert 850 comprises a floor portion 851 and a sidewall portion 852. The insert 850 is positioned in the cavity 815 of one of the cup bodies 810 so that the floor portion 851 is adjacent to the floor 814 of the cup body 810.

[0097] The difference between this embodiment and the one previously described is that there is a minor structural modification to the insert 850 relative to the insert 750. Specifically, the sidewall portion 852 of the insert 850 is a double-walled structure. Specifically, the sidewall portion 852 comprises a first portion 853 which extends upwardly from the floor portion 851 and a second portion 854 that extends downwardly from the first portion

853. The first and second portions 853, 854 are spaced apart from one another, and there is a curved connection portion 855 formed at the intersection of the first and second portions 853, 854. Thus, the second portion 854 is essentially folded relative to the first portion 853. When a plurality of the cups 800 are arranged in the stack 805, a bottom end 817 of an immediate upper cup 800 rests atop of and in contact with the curved connection portion 855 of the sidewall portion 852 of the insert 850. Because the sidewall portion 852 is double-walled, there is an increased structural integrity and rigidity which better enables the inserts 850 to support the load of the cups above.

[0098] Also in this embodiment, the second portion 854 of the sidewall portion 852 of the insert 850 may be formed with a positive draft angle so that when the inert 850 is positioned within one of the cups 800 the second portion 854 of the sidewall portion 852 is forced to flex inwardly. In such a situation, the second portion 854 of the sidewall portion 852 will be biased outwardly against the inner surface 812 of the sidewall 811 of the cup body 810 so securely hold the insert 850 in place. Thus, the insert 850 may not need to be bonded to the cup body 810 in this embodiment, although the insert 850 may still be bonded to the cup body 810 if so desired using any of the techniques described above such as adhesives, ultrasonics, or the like.

[0099] Referring briefly to FIGS. 38 and 39, a cup 860 comprising a cup body 861 and an insert 862 will be described. The insert 862 may take on any of the structures of the inserts described herein above. Specifically, FIGS. 38 and 39 is merely intended to illustrate another alternative mechanism for securing the insert 862 within the cup body 861, and although a particular insert 862 is shown, the exact configuration, structure, shape, or the like of the insert 862 is not to be limited by that which is shown in the drawings. In particular, in this embodiment the insert 862 is positioned within a cavity 863 of the cup body 861 adjacent to a floor 864 of the cup body 861. Furthermore, a sidewall 865 of the cup body 861 includes a projection 866 extending inwardly in the direction of the cavity 863. When the insert 862 is positioned within the cavity 863, the projection 866 is positioned immediately above a top end of the insert 862 to axially retain the insert 862 within the cavity 863. The insert 862 can still readily be inserted into the cavity 863 because the sidewall 865 will flex outwardly as the insert 862 passes over the projection 866, and then flex back inwardly as the insert 862 becomes entirely positioned below the projection 866 and the floor 864. Thus, the insert 862 becomes axially retained and held in place between the projection 866 and the floor 864.

[0100] The projection 866 may be formed by forming an indent on the outer surface of the sidewall 865, which causes a portion of the sidewall 865 to project inwardly and form the projection 866. In the exemplified embodiment the projection 866 is annular and extends along an entire circumference of the cup body 861. However, the invention is not to be so limited in all embodiments and the projection 866 may be intermittent or discontinuous such that it may include a plurality of projection segments that are circumferentially spaced apart from one another. In either case the projection 866 can serve to hold the insert 862 in place within the cavity 863 as shown and described.

[0101] Referring to FIGS. 40-42, yet another embodiment of a cup 900 is illustrated and will be described. As shown in FIGS. 41 and 42, a plurality of the cups 900 (the details of which will be provided below) can be arranged in a stack 905 whereby a bottom end of each cup 900 is maintained at a distance from a floor of the cup below to prevent the cups from becoming locked together, as has been described in detail throughout this application. The cup 900 may be formed entirely from a paper-based material, including any of the materials that have been described herein.

[0102] On major difference between this embodiment and those previously described is that there is no true insert. Rather, the function provided by the inserts in the previous embodiments is provided by the base member in this embodiment. In particular, each of the cups 900 comprises a sidewall 910 having an inner surface 911 and an outer surface 912, with the inner surface 911 surrounding a cavity 915 having a cavity axis E-E. The sidewall 910 is open at both of its top and bottom ends. The sidewall 910 comprises a rim 913 along an upper portion thereof.

[0103] The cup 900 also comprises a base member 920 that is coupled to the sidewall 910 to close the open bottom end of the sidewall 910. Thus, the base member 920 forms a floor of the cavity 915 of the cup 900. The base member 920 comprises a floor portion 921 and a sidewall portion 922 extending upwardly from the floor portion 921 to a distal end 923. The distal end 923 of the sidewall portion 922 forms a top end of the base member 920 upon which an upper cup in the stack 905 will rest. In this embodiment, the sidewall portion 922 comprises an inner surface 924 and an outer surface 925, with the outer surface 925 comprising a recessed portion 926 that extends from the distal end 923 to a shoulder 927. When the base member 920 is coupled to the sidewall 910, a lower portion of the sidewall 910 nests within the recessed portion 926 of the sidewall portion 922 of the base member 920 and a bottom end of the sidewall 910 abuts against the shoulder 927. The lower portion of the sidewall 910 can then be bonded to the sidewall portion 922 of the base member 920 to couple the base member 920 to the sidewall 910 and form the cup 900.

[0104] Furthermore, the base member 920 comprises a protrusion 930 extending downwardly from the floor 921 in a direction away from the distal end 923 of the sidewall portion 922. In the exemplified embodiment, the protrusion 930 is positioned immediately adjacent to the sidewall portion 922. Furthermore, in the exemplified embodiment the protrusion 930 is an annular protrusion, but the invention is not to be so limited in all embodiments

and the protrusion 930 could be discontinuous in other embodiments. In the exemplified embodiment, the protrusion 930 creates a recess region in the cavity 915 of the cup 900 as seen in FIGS. 41 and 42. In other embodiments, the recess region in the cavity 915 of the cup 900 may be filled in by additional amounts of the paper-based material without affecting the function of the base member 920 as described herein.

[0105] A powder ingredient 931 is disposed within the cavity 915 of the cup 900 and rests atop of the floor portion 921 of the base member 920. The powder ingredient 931 may be any one or a combination of the powder ingredient types mentioned above.

[0106] When the cups 900 are stacked as shown in FIGS. 41 and 42, the protrusion 930 of the base member 920 of an immediate upper cup in the stack 905 rests atop of the distal end 923 of the sidewall portion 922 of the base member 920 in an immediate lower cup in the stack 905. Thus, this arrangement prevents the immediate upper cup from being inserted into the cavity 915 of the immediate lower cup too far which can create a taper lock. Specifically, the structure, shape, and configuration of the base member 920 ensures that a proper cup-to-cup spacing distance is maintained to prevent such a taper lock situation and allow for proper and consistent dispensing of the cups 900 when they are stacked and used in a beverage vending machine as has been described herein.

[0107] Referring to FIGS. 43-45, another embodiment of a cup 1000 is illustrated in accordance with an embodiment of the present invention, and a plurality of the cups 1000 are illustrated in a stack 1005 in FIGS. 44 and 45. Similar to the previous embodiment, in this embodiment the cup 1000 comprises a cup body 1010 and a base member 1050. The cup body 1010 comprises a sidewall 1011 that extends from an open bottom end to an open top end such that the sidewall 1011 defines and surrounds a cavity 1015. A lower portion of the sidewall 1011 is folded to form a pocket for purposes of coupling the sidewall 1011 to the base member 1050 as described further below.

[0108] The base member 1050 comprises a floor 1051, a first sidewall portion 1052 extending upwardly from the floor 1051 to a support portion 1053, and a second sidewall portion 1054 extending downwardly from the support portion 1053 to a distal end 1055. The support portion 1053 of the base member is rounded in the exemplified embodiment and forms the top end of the base member 1050, which forms a ledge for an upper cup in the stack 1005 to rest. The second sidewall portion 1054 is spaced radially from the first sidewall portion 1052. The floor 1051 and the first sidewall portion 1052 collectively form a lower portion of the cavity 1015 of the cup 1000 within which a powder ingredient 1090 is disposed. The second sidewall portion 1054 extends to a position that is below a lower surface of the floor 1051 of the base member 1050. That is, the floor 1051 of the base member 1050 is positioned axially in between the distal end 1055 of the second sidewall portion 1054 and the support portion 1053.

[0109] To attach the base member 1050 to the sidewall 1010, the base member 1050 is inserted into the cavity 1015 until a lower portion of the second sidewall portion 1054 of the base member 1050 enters the pocket formed by the folded lower portion of the sidewall 1011. The lower portion of the second sidewall portion 1054 of the base member 1050 is then bonded to the lower portion of the sidewall 1011 of the cup body 1010 using adhesives, ultrasonics, or the like. Due to this positioning of the components, the distal end 1055 of the second sidewall portion 1054 as well as the lower portion of the sidewall 1011 of the cup body 1010 which surrounds the distal end 1055 of the second sidewall portion 1054 of the base member 1050 form an annular projection portion of the cup.

[0110] When a plurality of the cups 1000 are arranged in the stack 1005 as shown in FIGS. 44 and 45, a bottom end of the cups 900 which is formed by the distal end 1055 of the second sidewall portion 1054 of the base member 1050 and the lower portion of the sidewall 1011 of the cup body 1010, rests atop of the rounded support portion 1053 of the base member 1050 of the immediate lower cup in the stack 1005. That is, the support portion 1053 of the base member 1050 forms the ledge upon which an immediate upper cup in the stack 1050 rests to prevent the adjacent cups from becoming taper locked. In total, the base member 1050 forms both the floor of the cavity 1015 and the ledge for supporting an upper cup in the stack 1050 to maintain an acceptable cup-to-cup spacing distance.

[0111] Referring now to FIGS. 46 and 47, another embodiment of a cup 1100 will be described. In this embodiment, the cup 1100 comprises a bottom end 1101 and a top end 1102. Furthermore, the cup 1100 comprises a sidewall 1110 having an inner surface 1111 and an outer surface 1112 and a floor 1113. The floor 1113 and the inner surface 1111 of the sidewall 1110 collectively define a cavity 1115 of the cup 1100 which extends along a cavity axis F-F. A powder ingredient 1190 is disposed within the cavity 1115 of the cup 1100 and is supported by the floor 1113.

[0112] In this embodiment, the inner surface 1111 of the sidewall 1110 of the cup 1110 comprises an upward facing shoulder 1120 positioned near, but above, the floor 1113. The upward facing shoulder 1120 forms a ledge upon which a bottom end 1101 of an immediate upper cup in a stack 1105 of the cups 1100 can rest. Specifically, in this embodiment the sidewall 1110 of the cup 1100 comprises an upper portion 1116 that extends from the top end 1102 of the cup 1100 to the shoulder 1120 and a lower portion 1117 that extends from the shoulder 1120 to the bottom end 1101 of the cup 1100. The upper portion 1116 of the sidewall 1110 is oriented so as to diverge from the cavity axis F-F as it extends from the shoulder 1120 towards the top end 1102 of the cup 1100. The lower portion 1117 of the sidewall 1110 is oriented so as to diverge from the cavity axis F-F as it extends from the shoulder 1120 towards the bottom end 1102 of the cup

1100. The shoulder 1120 is formed by a horizontally oriented portion of the sidewall 1110 which extends between a bottom end of the upper portion 1116 of the sidewall 1110 and an upper end of the lower portion 1117 of the sidewall 1110.

[0113] Thus, the upper and lower portions 1116, 1117 of the sidewall 1110 are angled in opposite directions. Specifically, moving from the bottom end 1101 of the cup 1100 to the top end 1102 of the cup 1100, the lower portion 1117 of the sidewall 1110 is angled towards the cavity axis F-F and the upper portion 1116 of the sidewall 1110 is angled away from the cavity axis F-F. This helps to make sure that the bottom end 1101 of an immediate upper cup in the stack 1105 will rest atop of the upwardly facing shoulder 1120 of an immediate lower cup in the stack 1105. This arrangement prevents the cups 1100 from becoming taper locked and also prevents powder ingredient 1190 from becoming trapped in the spaces between adjacent cups.

[0114] Referring now to FIGS. 48 and 49, yet another embodiment of a cup 1200 and a stack 1205 of the cups 1200 will be described. The cup 1200 comprises a bottom end 1201 and a top end 1202. The cup 1200 comprises a sidewall 1210 having an inner surface 1211 and an outer surface 1212. The sidewall 1210 is curled to form a rim 1214 at the top end 1202 of the cup 1200. The cup 1200 also comprises a floor 1213. The floor 1213 and the inner surface 1211 of the sidewall 1210 collectively define a cavity 1215 having a cavity axis G-G. A powder ingredient 1290 is disposed within the cavity 1215 and rests atop of the floor 1213 of the cavity 1215.

[0115] In this embodiment, the outer surface 1212 of the sidewall 1210 comprises a downward facing shoulder 1220 located near, but spaced from, the rim 1214 of the cup 1200. Specifically, in the exemplified embodiment the downward facing shoulder 1220 is located along an upper 20% of a length of the sidewall 1210 of the cup 1200 (with the length of the sidewall 1210 being measured from the bottom end 1201 to the top end 1202 of the cup 1200. In other embodiments, the downward facing shoulder 1220 may be located along an upper 15% of the length of the sidewall 1210 of the cup 1200, or along an upper 10% of the length of the sidewall 1210 of the cup 1200. The sidewall 1210 of the cup 1200 comprises a first portion 1216 extending from the floor 1213 to the downward facing shoulder 1220 and a second portion 1217 extending from the downward facing shoulder 1220 to the rim 1214. The first portion 1216 of the sidewall 1210 diverges from the cavity axis G-G as it moves from the floor 1213 to the downward facing shoulder 1220. Stated another way, the first portion 1216 of the sidewall 1210 is oriented at an acute angle relative to the cavity axis G-G. The second portion 1217 of the sidewall 1210 is oriented parallel to the cavity axis G-G. Thus, the second portion 1217 of the sidewall 1210 extends vertically from the downward facing shoulder 1220 to the rim 1214. The second portion 1217 of the sidewall 1210 should be oriented vertically to ensure that the rim 1214 is in alignment with the downward facing shoulder 1220. This ensures that when the cups 1200 are stacked, the downward facing shoulder 1220 of an upper cup in the stack 1205 rests atop of the rim 1214 of a lower cup in the stack 1205.

[0116] As shown in the figures, when the cups 1200 are stacked, the downward facing shoulder 1220 of an immediate upper cup in the stack 1205 rests atop of the top end 1202 of an immediate lower cup in the stack 1205. Stated another way, the downward facing shoulder 1220 of an immediate upper cup in the stack 1205 rests atop of the rim 1214 of an immediate lower cup in the stack 1205. This arrangement is configured to maintain a cup-to-cup spacing distance between adjacent cups in the stack 1205 and to prevent a taper lock situation. Each cup may be maintained so that the bottom end 1201 of an immediate upper cup in the stack 1205 does not contact the powder ingredient 1290 in an immediate lower cup in the stack 1205, in some embodiments.

[0117] Referring now to FIGS. 50-52, one final embodiment of a cup 1300 is illustrated and will be described. FIG. 50 illustrates a cup blank 1380 which is used to form the cup 1300. Prior to rolling the cup blank 1380 into a conical or cylindrical shape to form the cup 1300, one or more protruding elements 1350 are positioned on a surface 1381 of the cup blank 1380 in an aligned manner. In the exemplified embodiment, there are a plurality of the protruding elements 1350, although in other embodiment a single, continuous protruding element may be used. In the exemplified embodiment, the protruding elements 1350 are beads of adhesive (e.g., hot melt adhesive) that are disposed on the surface 1381 of the cup blank 1380. However, the invention is not to be so limited and other materials can be used as the protruding elements 1350. In some embodiments, the protruding elements 1350 may be formed from a paper-based material and may be bonded to the surface 1381 of the cup blank 1380 using adhesives, ultrasonics, or the like.

[0118] After the protruding elements 1350 are bonded to the surface 1381 of the cup blank 1380, the cup blank 1380 is rolled into the cup shape, particularly a conical shape in the exemplified embodiment although it could be cylindrical in other embodiments, to form a sidewall 1311 of a cup body 1310 of the cup 1300. Next, a base member 1320 is attached to the sidewall 1311 in the conventional manner. When the cup body 1310 is so formed, the protruding elements 1350 protrude from an inner surface 1312 of the sidewall 1311 into a cavity 1315 of the cup body 1310. Thus, the protruding elements 1350 form a ledge upon which an upper cup in a stack 1305 of the cups may rest, as shown in FIG. 51. That is, a bottom end 1301 of an immediate upper cup in the stack 1305 will rest atop of the protruding elements 1350 to ensure that a proper cup-to-cup spacing distance is maintained among the cups 1300 in the stack 1305. As shown, each of the cups 1300 may contain a powder ingredient 1390 therein as has been described above.

[0119] As used throughout, ranges are used as short-

hand for describing each and every value that is within the range. Any value within the range can be selected as the terminus of the range. In addition, all references cited herein are hereby incorporated by referenced in their entireties. In the event of a conflict in a definition in the present disclosure and that of a cited reference, the present disclosure controls.

[0120] While the invention has been described with respect to specific examples including presently preferred modes of carrying out the invention, those skilled in the art will appreciate that there are numerous variations and permutations of the above described systems and techniques. It is to be understood that other embodiments may be utilized and structural and functional modifications may be made without departing from the scope of the present invention. Thus, the spirit and scope of the invention should be construed broadly as set forth in the appended claims.

ASPECTS OF THE INVENTION

[0121] Aspect 1. A stack of cups comprising:
a plurality of cups formed from a paper-based material, each of the cups comprising:

a cup body comprising a sidewall that surrounds a cavity having a floor and a cavity axis; and
an insert positioned within the cavity of the cup body, the insert comprising a sidewall portion having an inner surface that faces the cavity axis of the cup body, an outer surface that faces the sidewall of the cup body, and a top edge, the sidewall portion of the insert being corrugated so that the inner and outer surfaces comprise alternating ridges and grooves;
a powder ingredient located in the cavity of each of the plurality of cups, the powder ingredient at least partially surrounded by the sidewall portion of the insert; and
wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the top edge of the sidewall portion of the insert of an immediate lower cup in the stack.

[0122] Aspect 2. The stack of cups according to aspect 1 wherein for each of the plurality of cups, the sidewall portion of the insert comprises a bottom end which is adjacent to the floor of the cavity of the cup body, and wherein a distance measured between an outermost portion of the outer surface of the sidewall portion of the insert and an inner surface of the sidewall of the cup body decreases moving from the bottom end of the sidewall portion of the insert to the top end of the sidewall portion of the insert.

[0123] Aspect 3. The stack of cups according to aspect 2 wherein an outside diameter of the insert measured at the bottom end of the sidewall portion of the insert is less than a diameter of the cavity of the cup body within which the insert is positioned measured at the floor of the cavity.

[0124] Aspect 4. The stack of cups according to any one of aspects 1 to 3 wherein for each of the plurality of cups, the sidewall of the cup body is oriented at a first angle relative to the cavity axis and at least a portion of the sidewall portion of the insert is oriented at a second angle relative to the cavity axis, the second angle being greater than the first angle.

[0125] Aspect 5. The stack of cups according to any one of aspects 1 to 4 where each of the inserts and each of the cup bodies is formed from a paper-based material so that each of the plurality of cups is configured to be recycled as paper.

[0126] Aspect 6. The stack of cups according to any one of aspects 1 to 5 wherein each of the inserts further comprises a floor portion having an outer edge from which the sidewall portion extends, and wherein for each of the plurality of cups, the floor portion of the insert is adjacent to the floor of the cavity of the cup body.

[0127] Aspect 7. The stack of cups according to aspect 6 further comprising a hole in the floor portion of each of the inserts.

[0128] Aspect 8. The stack of cups according to aspect 7 wherein for each of the inserts, a diameter of the hole in the floor portion is less than a radius of the floor portion.

[0129] Aspect 9. The stack of cups according to any one of aspects 7 to 8 wherein for each of the inserts, the floor portion comprises an inner edge that forms a boundary of the hole and the outer edge from which the sidewall portion extends, and wherein a linear distance from the outer edge to the inner edge measured along any diameter of the floor portion is constant.

[0130] Aspect 10. The stack of cups according to any one of aspects 7 to 9 wherein for each of the inserts, a value of a difference between a radius of the floor and a radius of the hole is constant taken at any location along the floor portion of the insert.

[0131] Aspect 11. The stack of cups according to any one of aspects 6 to 10 wherein for each of the plurality of cups, the floor portion of the insert comprises a bottom surface that faces the floor of the cup body and a top surface opposite the bottom surface, at least a portion of the bottom surface of the floor portion of the insert being spaced apart from the floor of the cavity of the cup.

[0132] Aspect 12. The stack of cups according to aspect 11 further comprising one or more spacers positioned between the bottom surface of the floor portion of the insert and the floor of the cavity of the cup body to maintain a space between the bottom surface of the floor portion of the insert and the floor of the cavity of the cup body.

[0133] Aspect 13. The stack of cups according to aspect 11 wherein the floor portion of each of the inserts is pleated so that first portions of the floor portion of the insert are in contact with the floor of the cavity of the cup body and second portions of the floor portion of the insert are spaced apart from the floor of the cavity of the cup body.

[0134] Aspect 14. The stack of cups according to any

one of aspects 1 to 10 wherein for each of the plurality of cups, the insert is attached and affixed directly to the floor of the cavity of the cup body.

[0135] Aspect 15. The stack of cups according to aspect 14 wherein for each of the plurality of cups, the sidewall portion of the insert is not affixed to the sidewall of the cup body so that the sidewall portion of the insert is configured to freely flex and move relative to the cup body.

[0136] Aspect 16. The stack of cups according to any one of aspects 1 to 15 wherein for each of the plurality of cups, the floor of the cavity of the cup body is recessed relative to the bottom end of the cup so that when the plurality of cups are arranged in the stack, a lower surface of the floor of each cup is spaced from the top edge of the sidewall portion of the insert positioned in the cavity of the immediate lower cup in the stack.

[0137] Aspect 17. The stack of cups according to any one of aspects 1 to 16 wherein each of the cup bodies comprises:

a sidewall member that forms the sidewall of the cup body, the sidewall member being folded at a bottom end thereof to form a folded portion of the sidewall member; and

a floor member comprising a horizontal portion that forms the floor of the cavity and a flange portion extending from the horizontal portion, the flange portion of the floor member being positioned within the folded portion of the sidewall member and attached to the folded portion of the sidewall member.

[0138] Aspect 18. The stack of cups according to aspect 17 wherein for each of the plurality of cups, the floor member and the insert are formed from the same paper-based material.

[0139] Aspect 19. The stack of cups according to any one of aspect 1 to 18 wherein for each of the plurality of cups, one or more gaps exist between the outer surface of the sidewall portion of the insert and an inner surface of the sidewall of the cup body at the top edge of the sidewall portion of the insert.

[0140] Aspect 20. The stack of cups according to aspect 1 to 19 wherein the alternating ridges and grooves form a plurality of V-shaped segments in both of the inner and outer surfaces of the sidewall portion of each of the inserts.

[0141] Aspect 21. The stack of cups according to any one of aspects 1 to 20 further comprising at least one aperture formed through the sidewall portion of each of the inserts to allow a liquid introduced into the cavity of the cup body to flow between the outer surface of the sidewall portion of the insert and the sidewall of the cup body.

[0142] Aspect 22. The stack of cups according to any one of aspects 1 to 21 wherein the insert and the cup body are both formed from a paper-based material and are free of polyethylene.

[0143] Aspect 23. A stack of cups comprising:
a plurality of cups, each of the cups comprising:

a cup body formed from a first paper-based material, the cup body comprising a sidewall and a floor that collectively define a cavity having a cavity axis; and an insert positioned within the cavity, the insert comprising a top edge that is spaced from the floor of the cup body, the insert being formed from a second paper-based material;

a powder ingredient located in the cavity of each of the plurality of cups; and

wherein the plurality of cups are arranged in a stack so that a portion of each of the plurality of cups nests within the cavity of an immediate lower cup in the stack and a bottom end of each of the plurality of cups rests atop of the top edge of the insert of the immediate lower cup in the stack.

[0144] Aspect 24. The stack of cups according to aspect 23 wherein for each of the plurality of cups, the insert is positioned within the cavity of the cup body so that a bottom end of the insert is in contact with the floor of the cup body.

[0145] Aspect 25. The stack of cups according to aspect 24 wherein the bottom end of the insert is fixedly coupled to the floor of the cup body, and wherein a sidewall portion of the insert is not fixedly coupled to the sidewall of the cup body so that the sidewall portion of the insert remains freely movable relative to the sidewall of the cup body.

[0146] Aspect 26. The stack of cups according to any one of aspects 23 to 25 wherein for each of the plurality of cups, the insert comprises a sidewall portion having a wavy outer surface that faces the sidewall of the cup body within which the insert is positioned and a wavy inner surface opposite the wavy outer surface.

[0147] Aspect 27. The stack of cups according to aspect 26 wherein for each of the plurality of cups, the sidewall portion of the insert comprises a bottom end which is adjacent to the floor of the cavity of the cup body, and wherein a distance measured between an outermost portion of the outer surface of the sidewall portion of the insert and an inner surface of the sidewall of the cup body decreases moving from the bottom end of the sidewall portion of the insert to the top end of the sidewall of the insert.

[0148] Aspect 28. The stack of cups according to aspect 27 wherein a diameter of the insert measured at the bottom end of the sidewall portion of the insert is less than a diameter of the cavity of the cup body measured at the floor of the cavity.

[0149] Aspect 29. The stack of cups according to aspect 23 wherein for each of the plurality of cups, a bottom end of the insert is in contact with the floor of the cup body, wherein each of the inserts is ring-shaped and comprises a smooth outer surface that faces the sidewall of

the cup body and a smooth inner surface that is opposite the smooth outer surface, and wherein the top edge of the insert protrudes from an inner surface of the sidewall of the cup body to form a ledge upon which the bottom end of an immediate upper cup in the stack rests to maintain the bottom end of the immediate upper cup in the stack spaced from the floor of the immediate lower cup in the stack.

[0150] Aspect 30. The stack of cups according to aspect 23 wherein for each of the plurality of cups, the insert comprises a ring-shaped support member comprising an outer surface that faces the sidewall of the cup body and an inner surface opposite the outer surface, the inner surface comprising a plurality of spaced apart protruding portions extending inwardly towards the cavity axis of the cup body, each of the protruding portions forming a ledge upon which the bottom end of an immediate upper cup in the stack rests to maintain the bottom end of the immediate upper cup in the stack spaced from the floor of the immediate lower cup in the stack.

[0151] Aspect 31. The stack of cups according to aspect 30 wherein for each of the plurality of cups, the insert is an integral structure formed from the second paper-based material so that the protruding portions on the inner surface of the ring-shaped support member form recesses on the outer surface of the ring-shaped support member, wherein gaps are present between the outer surface of the insert and the sidewall of the cup body at locations that are circumferentially aligned with the protruding portions of the inner surface of the insert.

[0152] Aspect 32. The stack of cups according to aspect 23 wherein for each of the plurality of cups, the insert comprises:

a ring-shaped backer member having a smooth outer surface that is positioned adjacent to the sidewall of the cup body and a smooth inner surface opposite the smooth outer surface; and

a ring-shaped support member coupled to the smooth inner surface of the ring-shaped backer member, the ring-shaped support member comprising a plurality of spaced apart protruding portions that protrude inwardly towards the cavity axis of the cavity of the cup body, each of the protruding portions forming a ledge upon which the bottom end of an immediate upper cup in the stack rests.

[0153] Aspect 33. The stack of cups according to aspect 23 wherein for each of the plurality of cups, the insert comprises a floor portion that is positioned in contact with and fixedly coupled to an upper surface of the floor of the cavity of the cup body and a sidewall portion that extends from the floor portion to the top edge of the insert, the sidewall portion of the insert being unaffixed relative to the cup body.

[0154] Aspect 34. The stack of cups according to aspect 33 wherein the sidewall portion of each of the inserts is corrugated so that both an inner surface and an outer surface of the sidewall portion of the insert comprises a series of adjacent V-shapes in transverse cross-section.

[0155] Aspect 35. The stack of cups according to aspect 33 or aspect 34 wherein each of the inserts comprises a hole in the floor portion.

[0156] Aspect 36. The stack of cups according to any one of aspects 23 to 35 wherein for each of the plurality of cups, the insert is completely positioned within the cavity of the cup body.

[0157] Aspect 37. A method of forming a cup comprising:

attaching a support member to a surface of a cup blank;

rolling the cup blank into a cylindrical or conical shape to form a sidewall of a cup body so that the surface of the cup blank forms an inner surface of the sidewall of the cup body and the support member protrudes from the inner surface of the sidewall into an interior of the cup body; and

attaching a bottom member to the sidewall of the cup body to form a floor of the cup body, the cup body and the support member collectively forming the cup.

[0158] Aspect 38. The method according to aspect 37 wherein the support member and the cup blank are formed from a paper-based material and the support member is attached to the surface of the cup blank via ultrasonic bonding.

[0159] Aspect 39. The method according to aspect 37 or aspect 38 wherein the support member comprises a plurality of spaced apart protruding portions that protrude from the inner surface of the sidewall into the interior of the cup body.

[0160] Aspect 40. A method of forming a stack of cups for a beverage vending machine, the method comprising:

forming a plurality of the cups in accordance with the method of any one of aspects 37 to 39;

introducing a powder ingredient into a cavity of each of the cups; and

stacking the cups by nesting each cup within the cavity of an immediate lower cup, a bottom end of each cup resting atop of the support member of the immediate lower cup.

[0161] Aspect 41. A method of forming a stack of cups for a beverage vending machine, the method comprising:

forming a cup body from a first paper-based material;

forming an insert from a second paper-based material on a mandrel;

sliding the cup body over the mandrel while the insert remains positioned on the mandrel and bonding the insert to the cup body, thereby forming a cup;

introducing a powder ingredient into a cavity of the cup so that the powder ingredient is at least partially surrounded by the insert; and

stacking a plurality of the cups by nesting each cup within the cavity of an immediate lower cup, a bottom end of each cup resting atop of a top edge of the insert that is affixed to the cup body of the immediate lower cup.

[0162] Aspect 42. A stack of cups comprising:

a plurality of cups formed from a first paper-based material, each of the cups comprising an inner surface that defines a cavity, an outer surface opposite the inner surface, and a rim;
a sleeve positioned around a portion of the outer surface of each of the cups so that a top edge of the sleeve is in contact with an underside of the rim of the cup, the sleeve being formed from a second paper-based material; and
wherein the plurality of cups are arranged in a stack so that each of the plurality of cups nests within the cavity of an immediate lower cup in the stack and a bottom edge of the sleeve positioned around each of the cups rests atop of the rim of the immediate lower cup in the stack.

[0163] Aspect 43. The stack of cups according to aspect 42 wherein a height of the sleeve measured between the bottom and top edge of the sleeve is between 10% and 20% of a height of the cup measured from a bottom end of the cup to the underside of the rim of the cup.

[0164] Aspect 44. The stack of cups according to aspect 42 or aspect 43 wherein a thickness of each of the sleeves measured between an inner surface of the sleeve which faces the cup and an outer surface of the sleeve which faces away from the cup continuously increases moving from the top edge of the sleeve to the bottom edge of the sleeve.

[0165] Aspect 45. The stack of cups according to any one of aspects 42 to 44 further comprising a powder ingredient located within the cavity of each of the cups, and wherein the sleeve is configured to maintain a sufficient cup-to-cup spacing between adjacent cups in the stack to ensure that a bottom end of each cup is spaced from the powder ingredient in the immediate lower cup in the stack.

[0166] Aspect 46. A stack of cups comprising:
a plurality of cups formed from a paper-based material, each of the cups comprising:

a cup body comprising a sidewall that surrounds a cavity having a floor and a cavity axis; and
an insert positioned within the cavity, each of the inserts comprising a floor portion that is affixed to the floor of the cup body and a sidewall portion extending upwardly from the floor portion and terminating in a top edge;
a powder ingredient located in the cavity of each of the plurality of cups; and
wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the top edge of the sidewall portion of the insert of an immediate lower cup in the stack.

[0167] Aspect 47. The stack of cups according to aspect 46 wherein the sidewall portion of each of the inserts is corrugated.

[0168] Aspect 48. The stack of cups according to aspect 46 wherein the sidewall portion of each of the inserts comprises a smooth inner surface and a smooth outer surface, and wherein the top edge of the sidewall portion of each of the inserts has a thickness of at least 0.8mm.

[0169] Aspect 49. The stack of cups according to any one of aspects 46 to 48 wherein each of the inserts is formed from a second paper-based material so that the cups are configured to be recycled as paper.

[0170] Aspect 50. The stack of cups according to aspect 46 wherein the sidewall portion of each of the inserts is a double-walled structure formed by folding the sidewall portion along a fold region, the fold region forming the top edge of the sidewall portion upon which the bottom end of an immediate upper cup in the stack rests.

[0171] Aspect 51. A stack of cups comprising:
a plurality of cups formed from a paper-based material, each of the cups comprising:

a cavity having a cavity axis;
a sidewall comprising a rim; and
a floor member comprising a top end, a floor, an inner annular flange extending from the floor to the top end, and an outer annular flange extending downwardly from the top end at a position that is radially outward of the inner annular flange so that the outer annular flange surrounds and is spaced apart from the inner annular flange and the floor, the outer annular flange coupled to a bottom end of the sidewall, the floor and the inner annular flange forming a bottom portion of the cavity that is recessed below the top end of the floor member;
a powder ingredient located at least in the bottom portion of the cavity of each of the plurality of cups; and
wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the top end of the floor member of an immediate lower cup in the stack.

[0172] Aspect 52. A stack of cups comprising:
a plurality of cups formed from a paper-based material, each of the cups comprising:

a sidewall extending from an open bottom end to an open top end;
a floor member coupled to the sidewall to close the open bottom end of the sidewall and
form a cavity of the cup, the floor member comprising:

a top edge;
a floor portion and a first sidewall portion that collectively define a powder ingredient portion of the cavity, the powder ingredient portion of the cavity being a bottom portion of the cavity; and
an annular projection portion comprising a distal end that is located below the floor portion;
a powder ingredient located at least in the powder ingredient cavity of the floor member of each of the plurality of cups; and
wherein the plurality of cups are arranged in a stack so that the annular projection portion of the floor member of each of the plurality of cups rests atop of the top edge of the floor member of an immediate lower cup in the stack.

[0173] Aspect 53. The stack of cups according to aspect 52 wherein the floor member further comprises a second sidewall located radially outward of the first sidewall and comprising the annular projection portion, the second sidewall of the floor member being coupled directly to the sidewall of the cup.

[0174] Aspect 54. The stack of cups according to aspect 52 further comprises:

the sidewall portion of the floor member comprising a groove that extends from the top edge of the floor member to a shoulder, a lower portion of the sidewall of the cup nesting within the groove with a bottom edge of the sidewall of the cup abutting the shoulder; and
wherein the annular projection portion of the floor member is positioned between the sidewall portion of the floor member and the floor of the floor member.;

[0175] Aspect 55. A stack of cups comprising:

a plurality of cups, each of the cups comprising a sidewall and a floor that define a cavity having a cavity axis, the sidewall being curled to form a rim at a top end of the cup, the sidewall comprising an outer surface having a downward facing shoulder that faces away from the rim;
wherein the plurality of cups are arranged in a stack so that at least a portion of each of the plurality of cups is disposed within the cavity of an immediate lower cup in the stack and the downward facing shoulder of an immediate upper cup in the stack rests atop of the rim of the immediate lower cup in the stack to maintain a cup-to-cup spacing distance between adjacent cups in the stack.

[0176] Aspect 56. The stack of cups according to aspect 55, further comprising a powder ingredient located in the cavity of each of the plurality of cups, and wherein the cup-to-cup spacing distance is sufficient to ensure that a bottom end of an immediate upper cup in the stack does not contact the powder ingredient in the immediate lower cup in the stack.

[0177] Aspect 57. The stack of cups according to aspect 55 or aspect 56 wherein the sidewall comprises a first portion extending from the floor to the downward facing shoulder and a second portion extending from the downward facing shoulder to the rim, the first and second portions of the sidewall being oriented at different angles relative to the cavity axis of the cup.

[0178] Aspect 58. The stack of cups according to aspect 57 wherein the first portion of the sidewall is oriented at an acute angle relative to the cavity axis of the cup, and wherein the second portion of the sidewall is parallel to the cavity axis of the cup.

[0179] Aspect 59. The stack of cups according to any one of aspects 55 to 58 wherein the downward facing shoulder is located along an upper 20% of a length of the sidewall of the cup.

[0180] Aspect 60. The stack of cups according to any one of aspects 55 to 59 wherein each of the cups in the stack is formed from a paper-based material.

[0181] Aspect 61. A stack of cups comprising:
a plurality of cups formed from a paper-based material, each of the cups comprising:

a cup body comprising a sidewall that surrounds a cavity having a floor and a cavity axis; and
an insert positioned within the cavity of the cup body, each of the inserts comprising a bottom end which is adjacent to the floor of the cavity of the cup body and a top end opposite the bottom end, and wherein a distance measured between an outermost portion of the outer surface of the sidewall portion of the insert and an inner surface of the sidewall of the cup body decreases moving from the bottom end of the insert to the top end of the insert;
a powder ingredient located in the cavity of each of the plurality of cups; and
wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the top edge of the insert of an immediate lower cup in the stack.

[0182] Aspect 62. A stack of cups comprising:
a plurality of cups formed from a paper-based material, each of the cups comprising:

a cup body comprising a sidewall that surrounds a cavity having a floor and a cavity axis, the sidewall being oriented at a first angle relative to the cavity axis; and
an insert positioned within the cavity of the cup body, each of the inserts comprising a sidewall portion having a ledge, an outermost portion of the sidewall portion being oriented at a second angle relative to the cavity axis, the second angle being greater than the first angle;

a powder ingredient located in the cavity of each of the plurality of cups; and
wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the ledge of the sidewall portion of the insert of an immediate lower cup in the stack.

[0183] Aspect 63. A paper cup comprising:

a cup body formed from a paper-based material, the cup body comprising a sidewall and a floor that collectively define a cavity having a cavity axis; and
an insert formed from a paper-based material, the insert positioned within the cavity of the cup body adjacent to the floor, the insert having a ledge that is spaced axially from the floor and that protrudes inwardly from an inner surface of the sidewall of the cup body towards the cavity axis.

[0184] Aspect 64. The paper cup according to aspect 63 wherein the insert comprises a floor portion that is adjacent to the floor of the cup body and a sidewall portion that extends upwardly from the floor portion alongside of the sidewall of the cup body.

[0185] Aspect 65. The paper cup according to aspect 64 wherein the floor portion of the insert is bonded to the floor of the cup body and the sidewall portion of the insert is not bonded or otherwise attached to the cup body.

[0186] Aspect 66. The paper cup according to aspect 64 or aspect 65 wherein the sidewall portion of the insert is corrugated.

[0187] Aspect 67. The paper cup according to any one of aspects 64 to 66 wherein the sidewall of the cup body is oriented at a first angle relative to the cavity axis and an outermost portion of the sidewall portion of the insert is oriented at a second angle relative to the cavity axis, the second angle being greater than the first angle.

[0188] Aspect 68. The paper cup according to any one of aspects 64 to 67 wherein a distance measured between an outermost portion of an outer surface of the sidewall portion of the insert and an inner surface of the sidewall of the cup body decreases moving from the floor of the cavity to an open top end of the cavity.

Claims

1. A stack of cups comprising:

a plurality of cups formed from a paper-based material, each of the cups comprising:

a cup body comprising a sidewall that surrounds a cavity having a floor and a cavity axis; and
an insert positioned within the cavity of the cup body, the insert comprising a sidewall portion having an inner surface that faces the cavity axis of the cup body, an outer surface that faces the sidewall of the cup body, and a top edge, the sidewall portion of the insert being corrugated so that the inner and outer surfaces comprise alternating ridges and grooves;

a powder ingredient located in the cavity of each of the plurality of cups, the powder ingredient at least partially surrounded by the sidewall portion of the insert; and
wherein the plurality of cups are arranged in a stack so that a bottom end of each of the plurality of cups rests atop of the top edge of the sidewall portion of the insert of an immediate lower cup in the stack.

2. The stack of cups according to claim 1, wherein for each of the plurality of cups, the sidewall portion of the insert comprises a bottom end which is adjacent to the floor of the cavity of the cup body, and wherein a distance measured between an outermost portion of the outer surface of the sidewall portion of the insert and an inner surface of the sidewall of the cup body decreases moving from the bottom end of the sidewall portion of the insert to the top end of the sidewall portion of the insert, optionally wherein an outside diameter of the insert measured at the bottom end of the sidewall portion of the insert is less than a diameter of the cavity of the cup body within which the insert is positioned measured at the floor of the cavity.

3. The stack of cups according to any one of claims 1 to 2, wherein for each of the plurality of cups, the sidewall of the cup body is oriented at a first angle relative to the cavity axis and at least a portion of the sidewall portion of the insert is oriented at a second angle relative to the cavity axis, the second angle being greater than the first angle.

4. The stack of cups according to any one of claims 1 to 3, wherein each of the inserts and each of the cup bodies is formed from a paper-based material so that each of the plurality of cups is configured to be recycled as paper.

5. The stack of cups according to any one of claims 1 to 4, wherein each of the inserts further comprises a floor portion having an outer edge from which the sidewall portion extends, and wherein for each of the plurality of cups, the floor portion of the insert is adjacent to the floor of the cavity of the cup body.

6. The stack of cups according to claim 5, further comprising a hole in the floor portion of each of the inserts, optionally wherein for each of the inserts, a diameter of the hole in the floor portion is less than a radius

of the floor portion, and optionally wherein for each of the inserts, the floor portion comprises an inner edge that forms a boundary of the hole and the outer edge from which the sidewall portion extends, and wherein a linear distance from the outer edge to the inner edge measured along any diameter of the floor portion is constant.

7. The stack of cups according to any one of claims 1 to 6, wherein for each of the plurality of cups, the insert is attached and affixed directly to the floor of the cavity of the cup body.

8. The stack of cups according to claim 7, wherein for each of the plurality of cups, the sidewall portion of the insert is not affixed to the sidewall of the cup body so that the sidewall portion of the insert is configured to freely flex and move relative to the cup body.

9. The stack of cups according to any one of claims 1 to 8, wherein for each of the plurality of cups, the floor of the cavity of the cup body is recessed relative to the bottom end of the cup so that when the plurality of cups are arranged in the stack, a lower surface of the floor of each cup is spaced from the top edge of the sidewall portion of the insert positioned in the cavity of the immediate lower cup in the stack.

10. The stack of cups according to any one of claims 1 to 9, wherein each of the cup bodies comprises:

a sidewall member that forms the sidewall of the cup body, the sidewall member being folded at a bottom end thereof to form a folded portion of the sidewall member; and
a floor member comprising a horizontal portion that forms the floor of the cavity and a flange portion extending from the horizontal portion, the flange portion of the floor member being positioned within the folded portion of the sidewall member and attached to the folded portion of the sidewall member; and
optionally wherein for each of the plurality of cups, the floor member and the insert are formed from the same paper-based material.

11. The stack of cups according to any one of claims 1 to 10, wherein for each of the plurality of cups, one or more gaps exist between the outer surface of the sidewall portion of the insert and an inner surface of the sidewall of the cup body at the top edge of the sidewall portion of the insert.

12. The stack of cups according to claim 1 to 11, wherein the alternating ridges and grooves form a plurality of V-shaped segments in both of the inner and outer surfaces of the sidewall portion of each of the inserts.

13. The stack of cups according to any one of claims 1 to 12, wherein the insert and the cup body are both formed from a paper-based material and are free of polyethylene.

14. A paper cup comprising:

a cup body formed from a paper-based material, the cup body comprising a sidewall and a floor that collectively define a cavity having a cavity axis; and
an insert formed from a paper-based material, the insert positioned within the cavity of the cup body adjacent to the floor, the insert having a ledge that is spaced axially from the floor and that protrudes inwardly from an inner surface of the sidewall of the cup body towards the cavity axis,
wherein the insert comprises a floor portion that is adjacent to the floor of the cup body and a sidewall portion that extends upwardly from the floor portion alongside of the sidewall of the cup body, and wherein the sidewall portion of the insert is corrugated.

15. The paper cup according to claim 14, wherein the sidewall of the cup body is oriented at a first angle relative to the cavity axis and an outermost portion of the sidewall portion of the insert is oriented at a second angle relative to the cavity axis, the second angle being greater than the first angle.

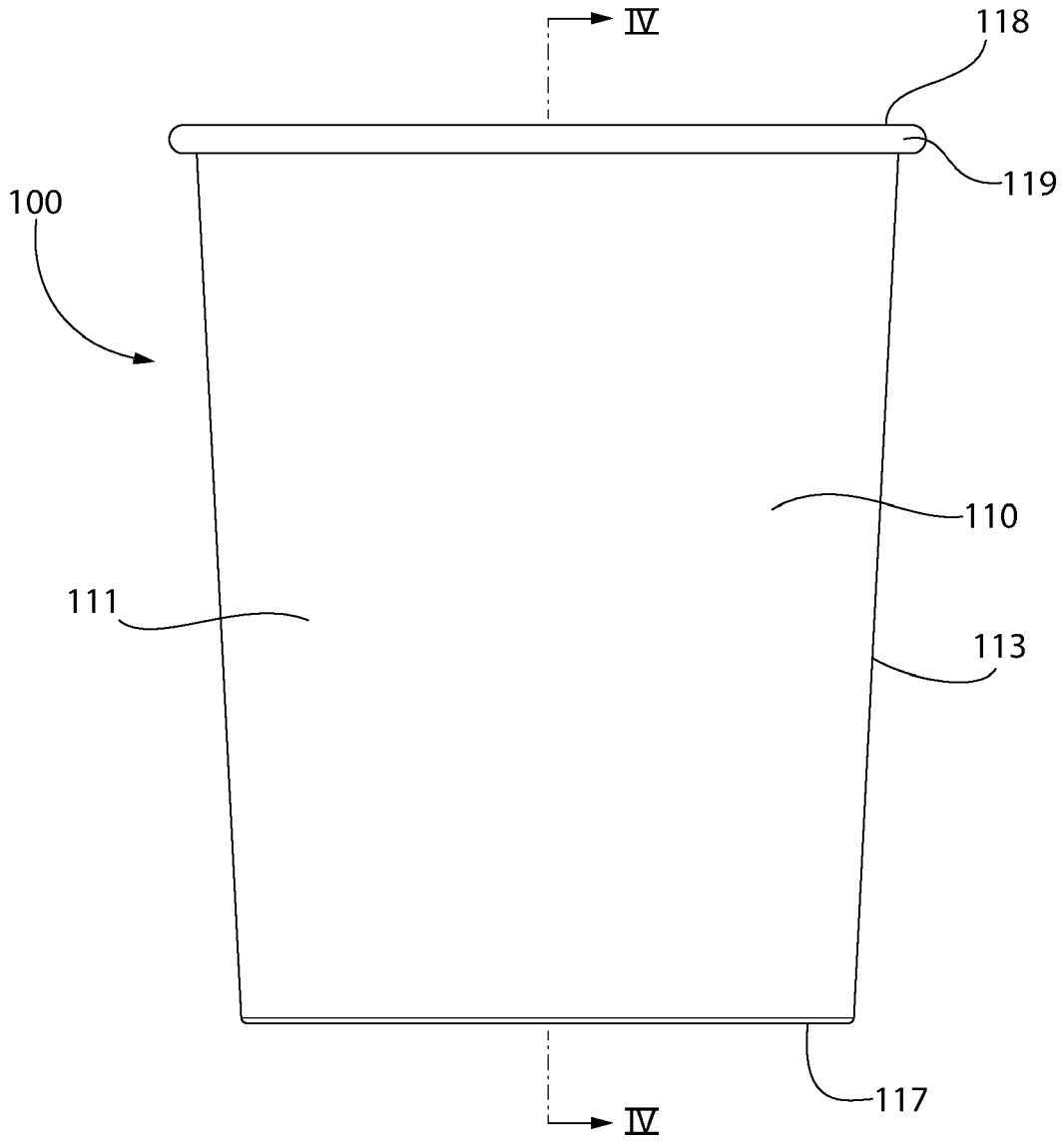

FIG. 1

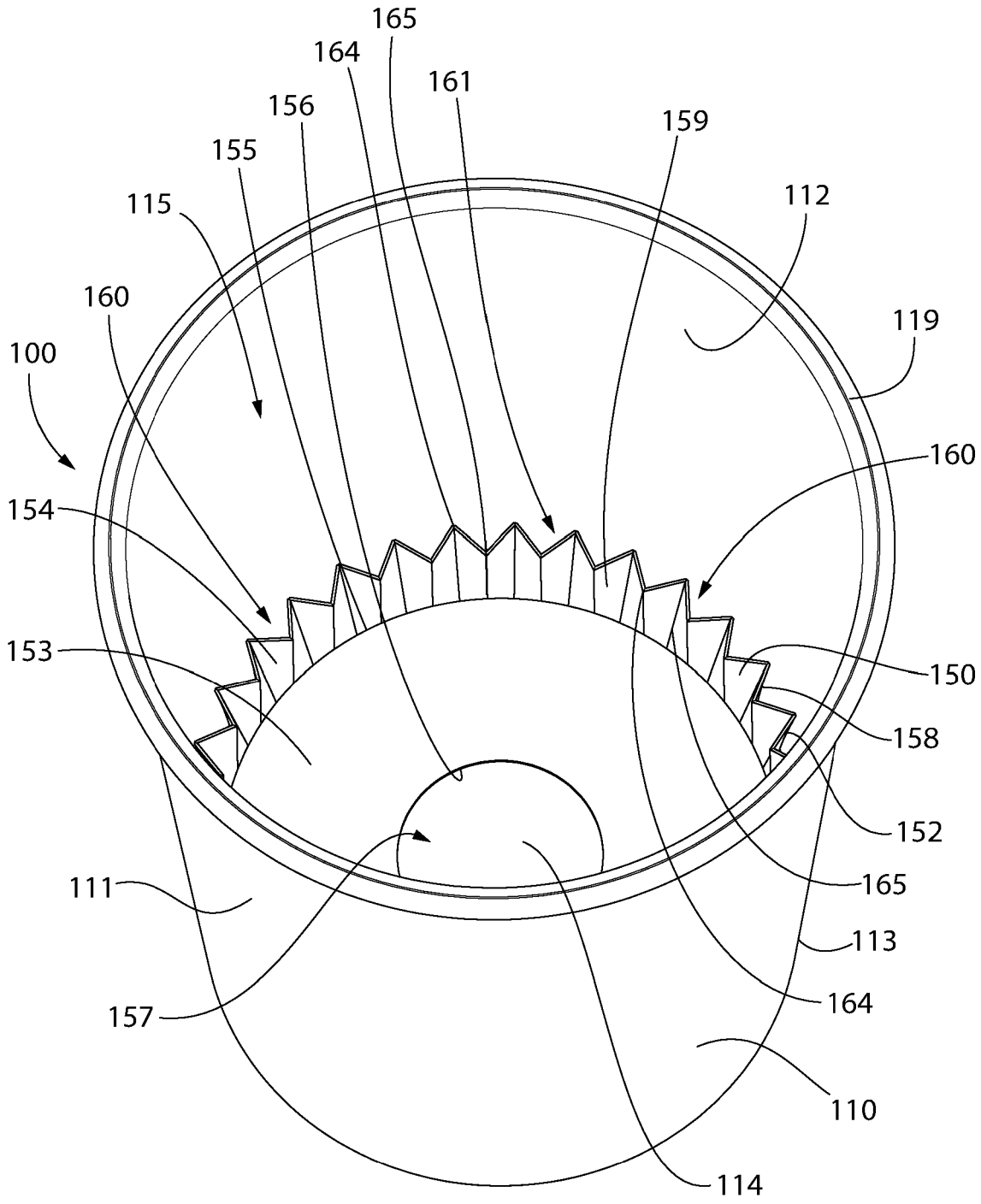
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FIG. 2

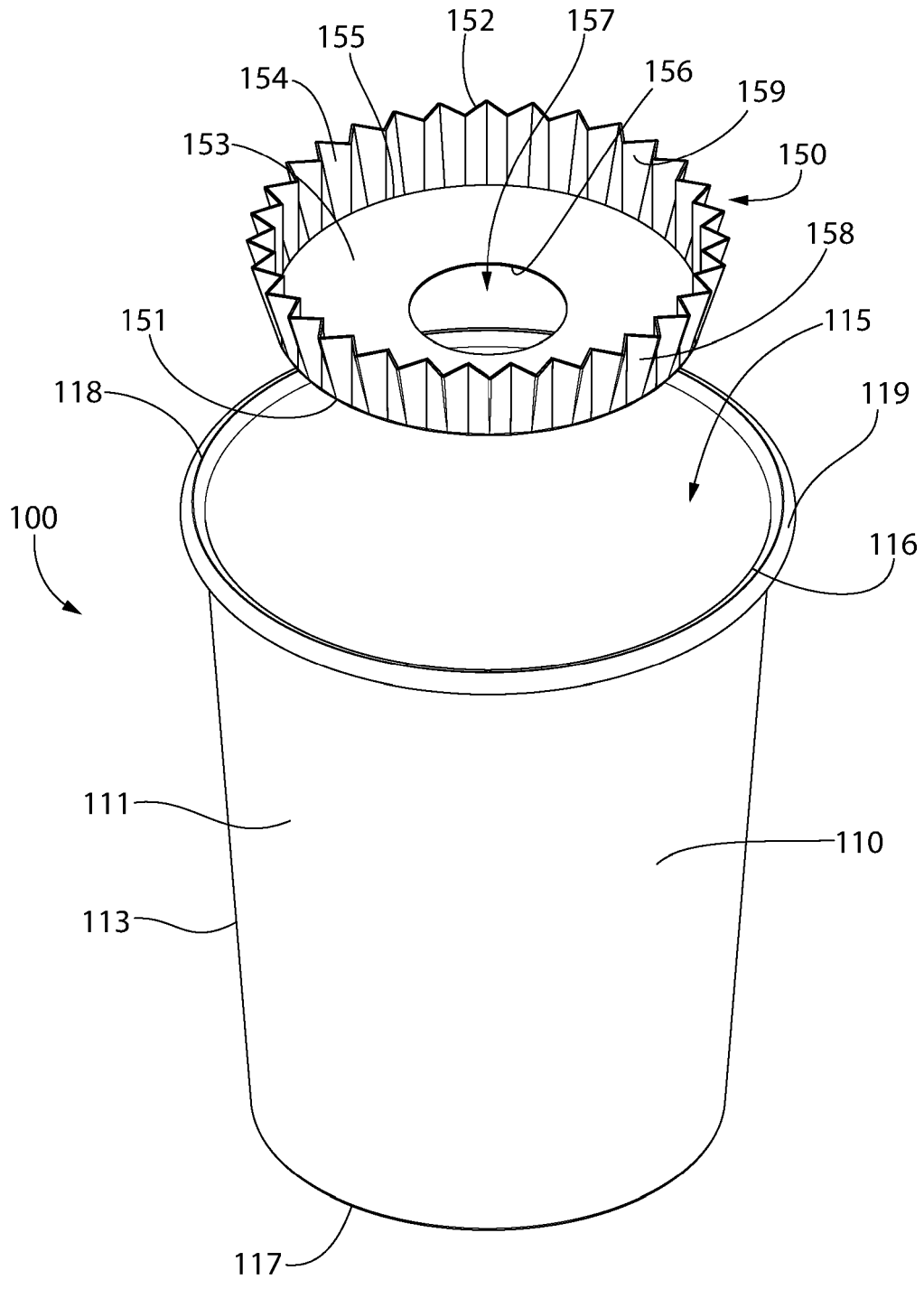
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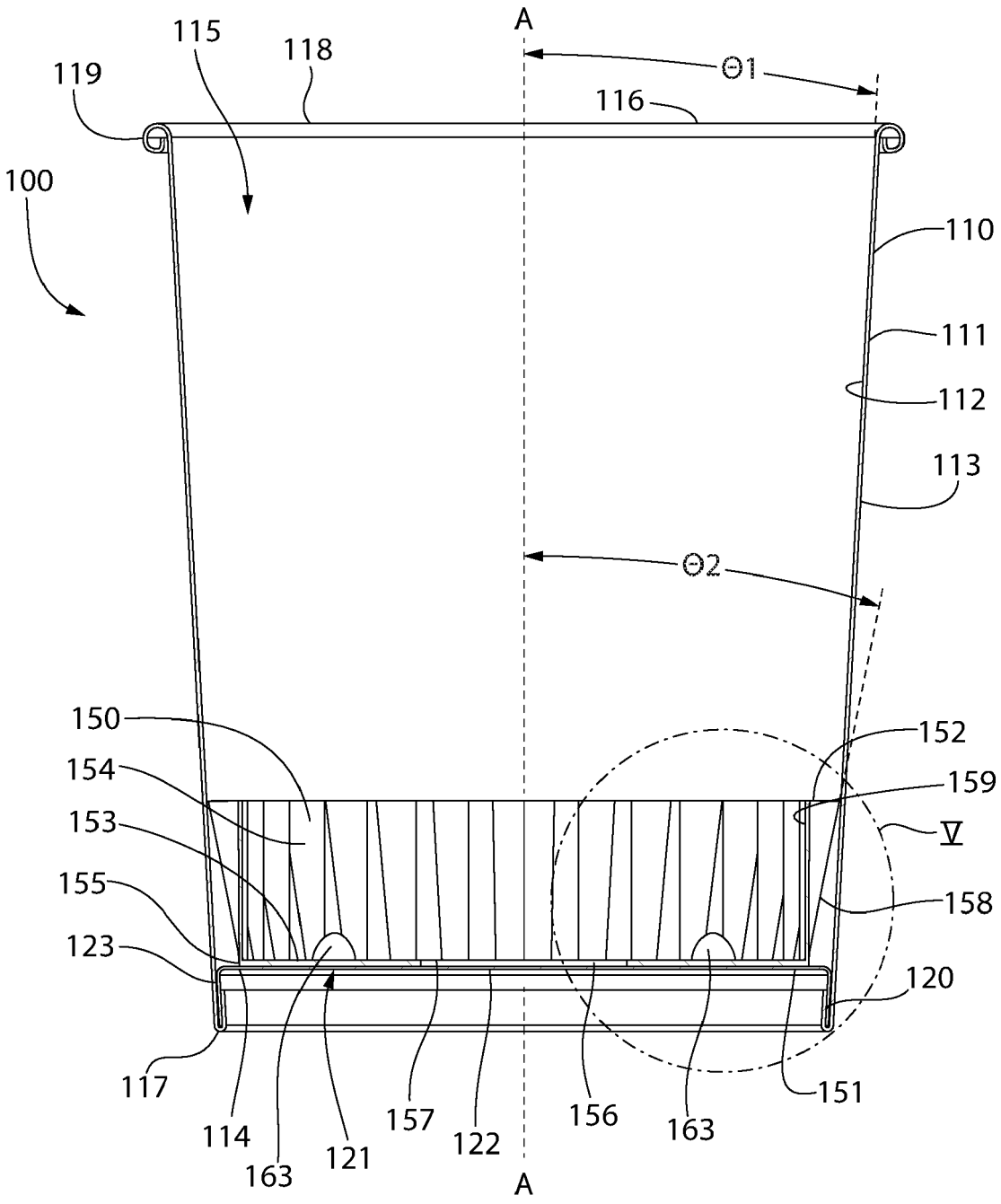
FIG. 3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Θ1
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Θ2
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A

FIG. 4

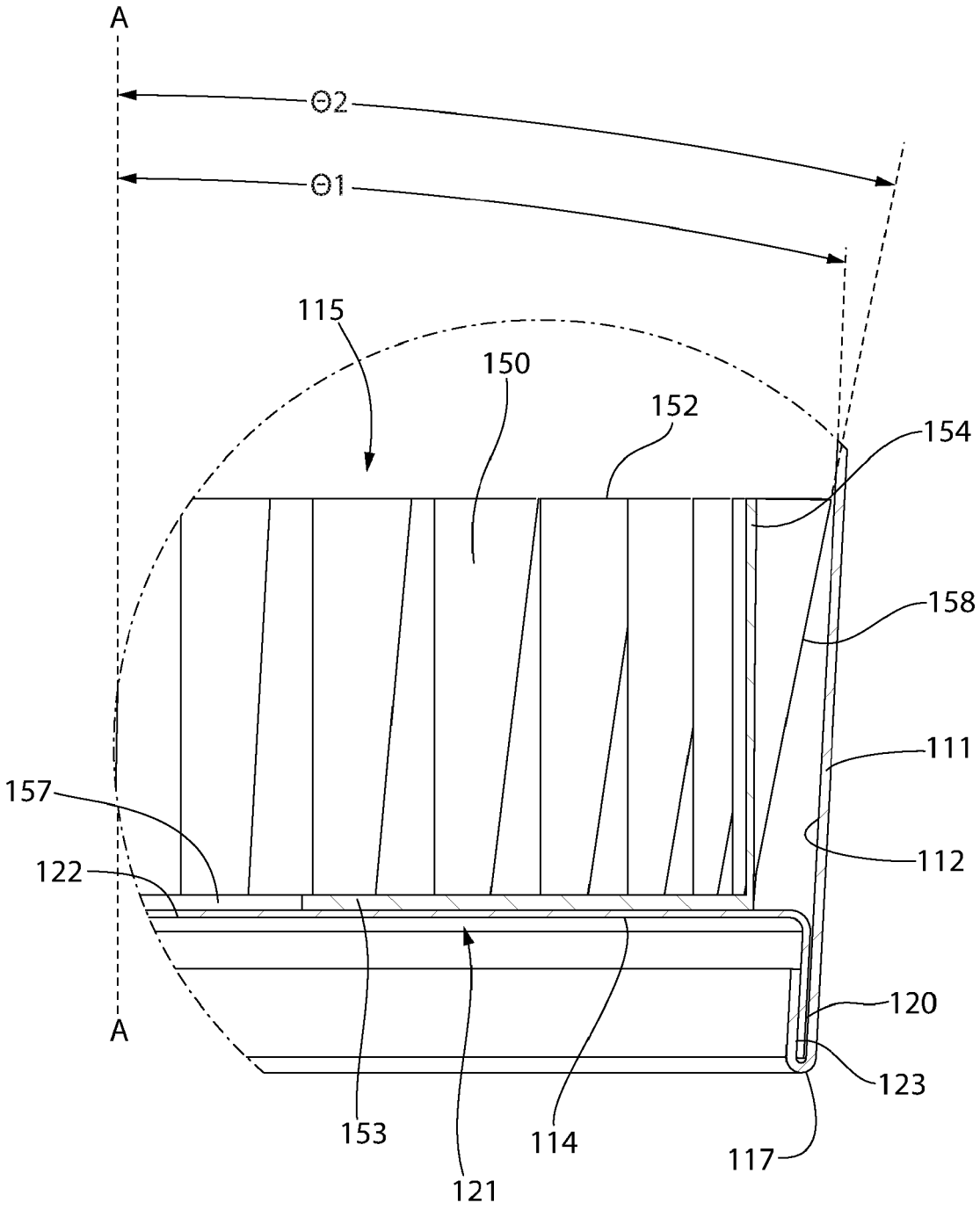
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FIG. 5

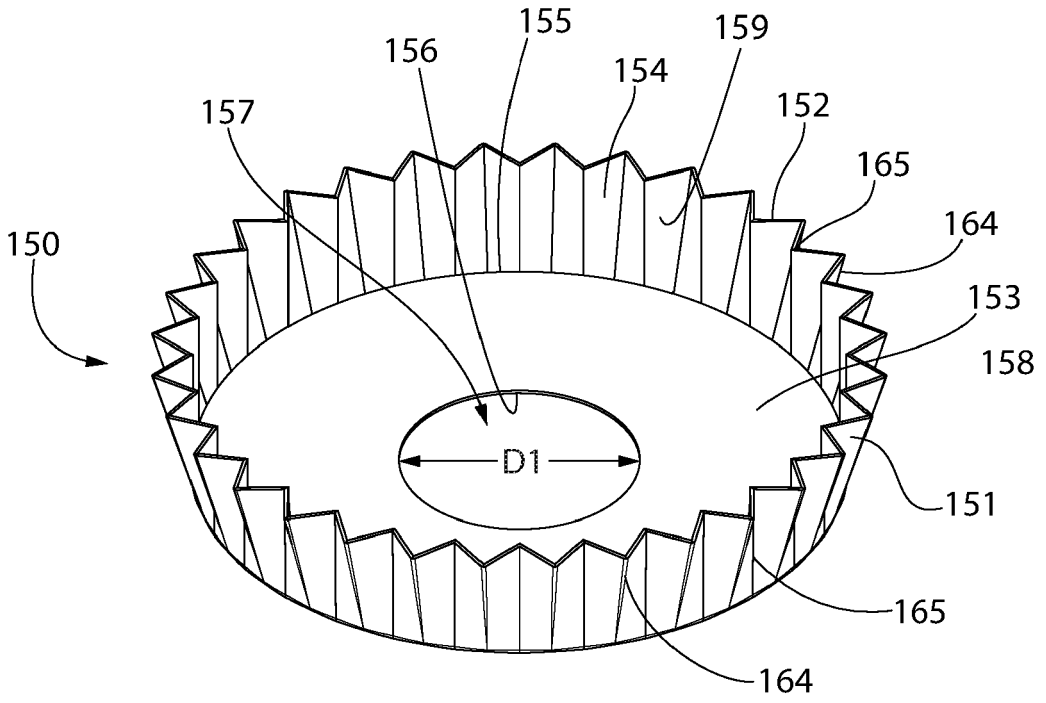
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FIG. 6A

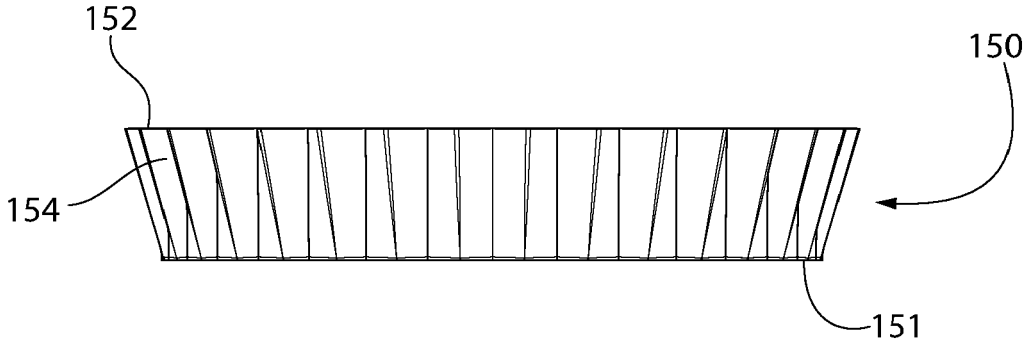
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FIG. 6B

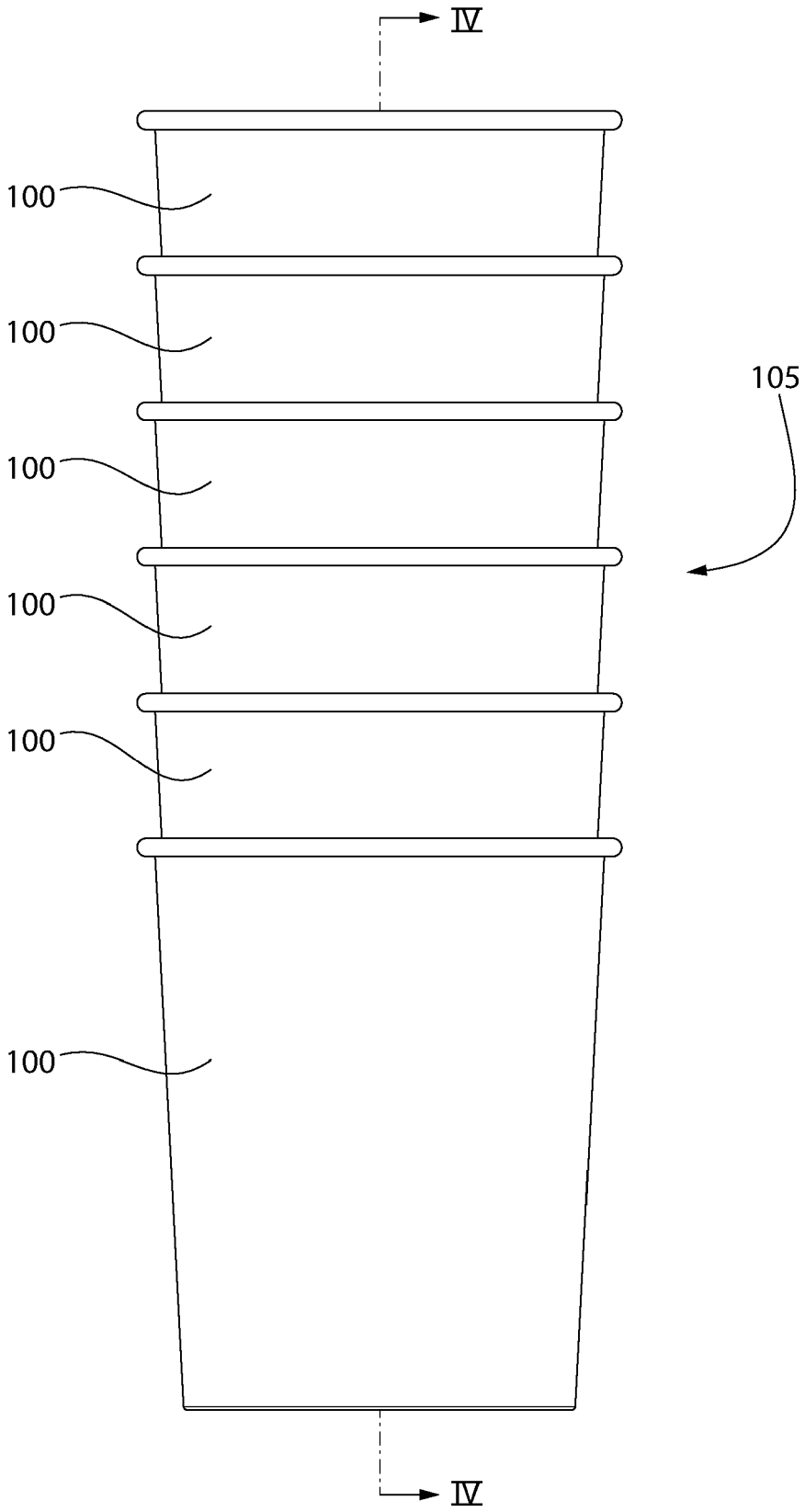

FIG. 7

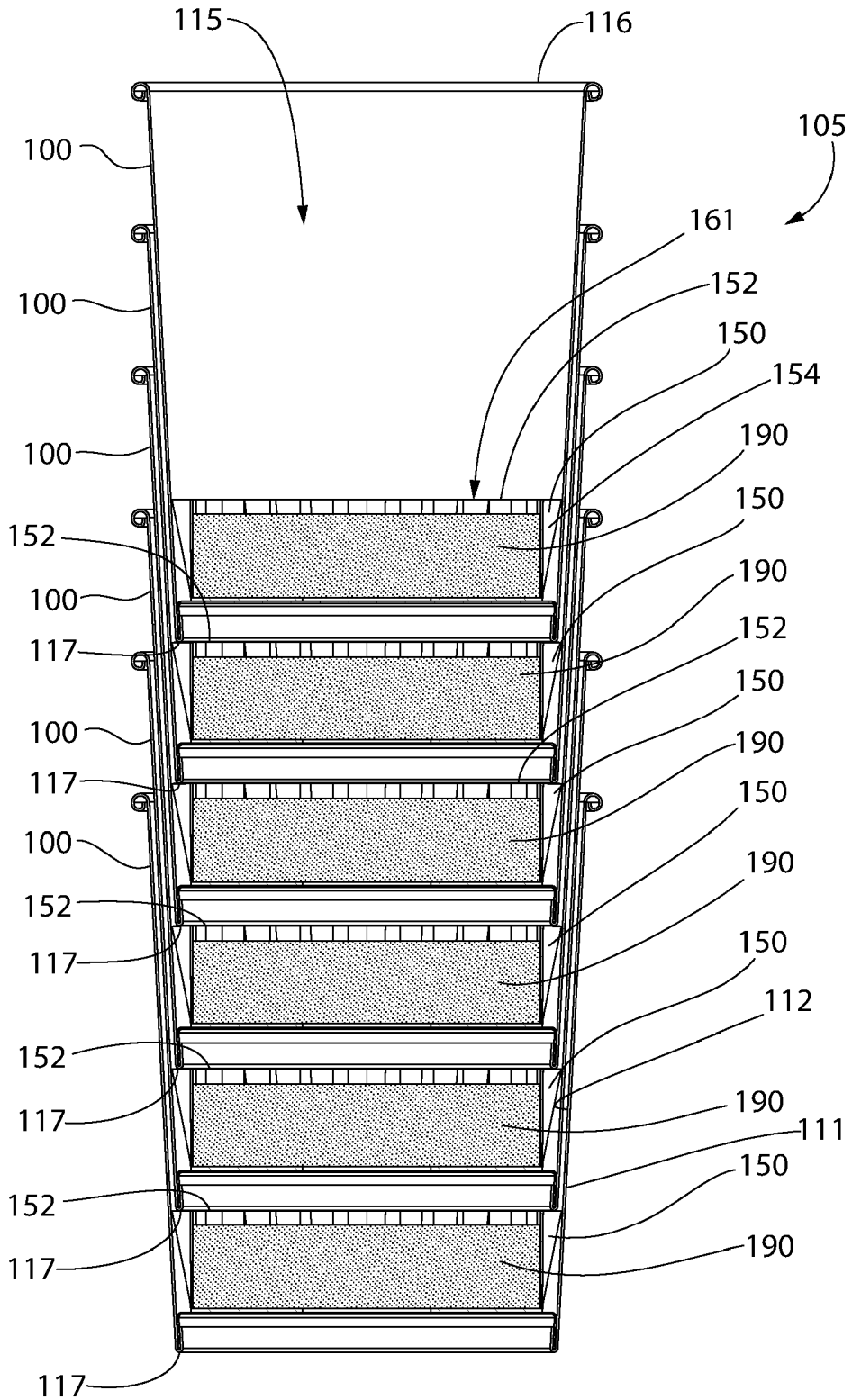

FIG. 8

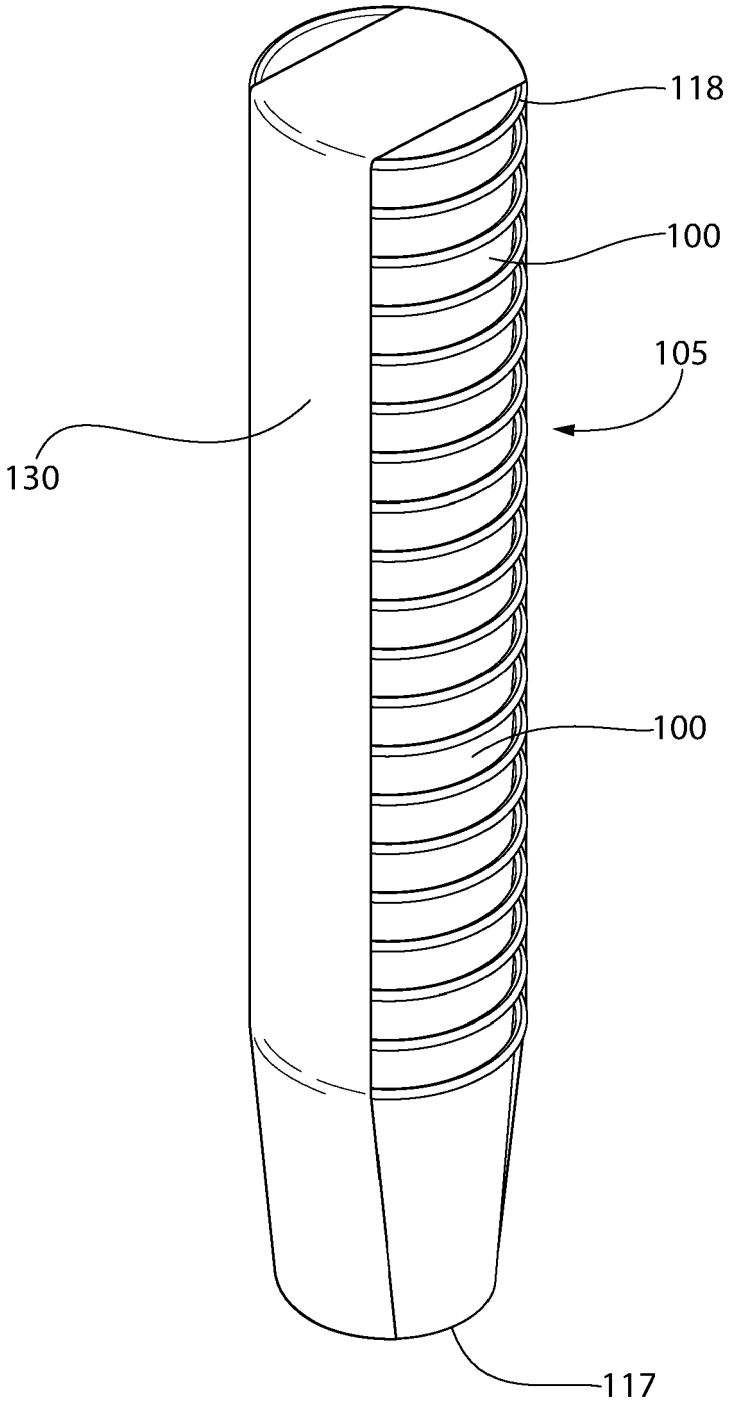

FIG. 9

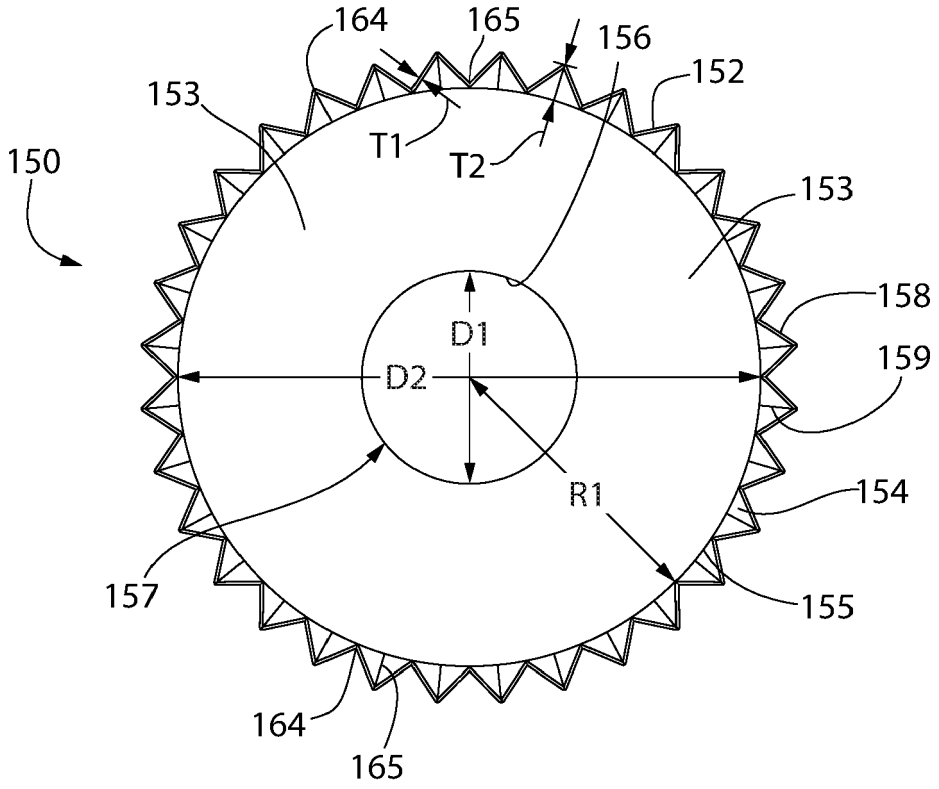

FIG. 10A

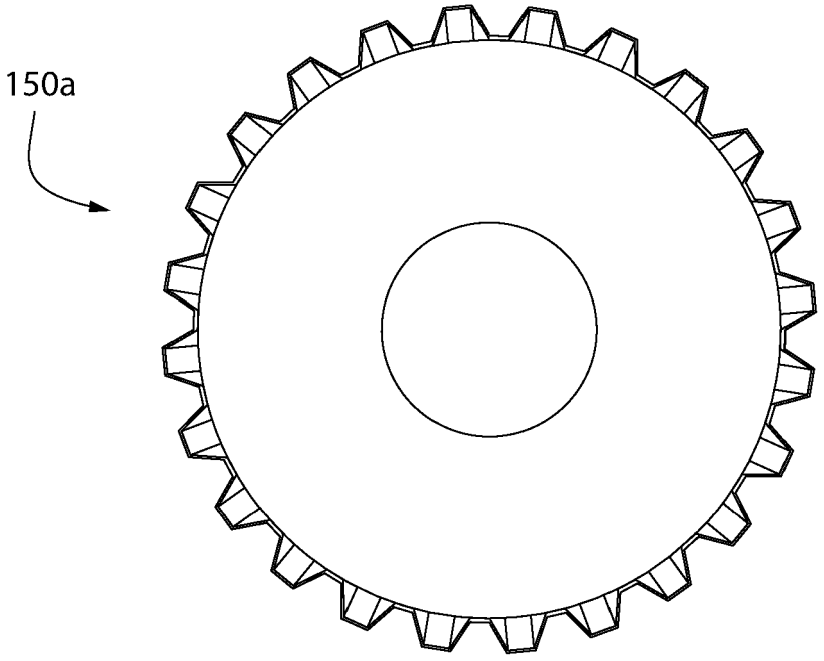

FIG. 10B

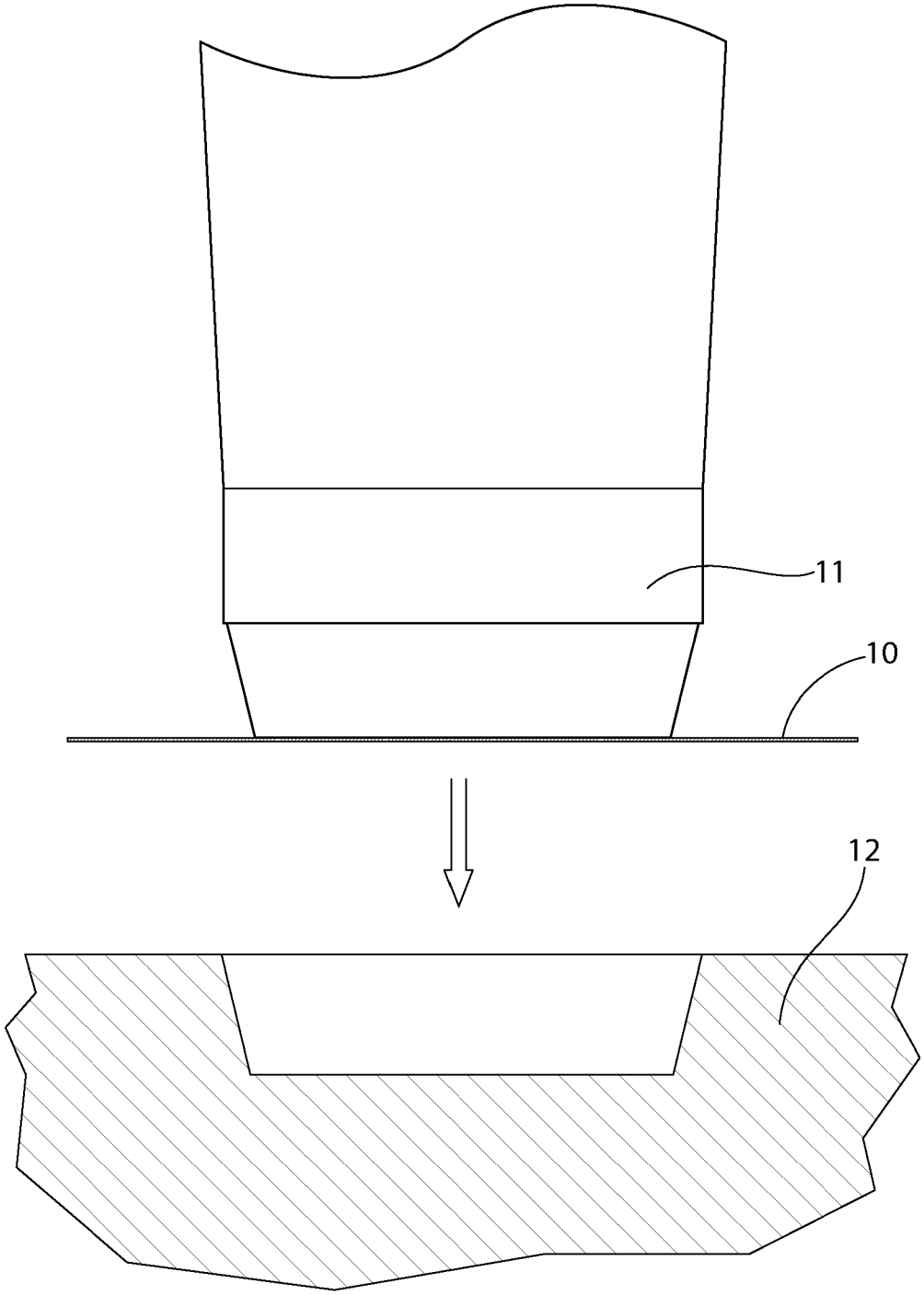

FIG. 11A

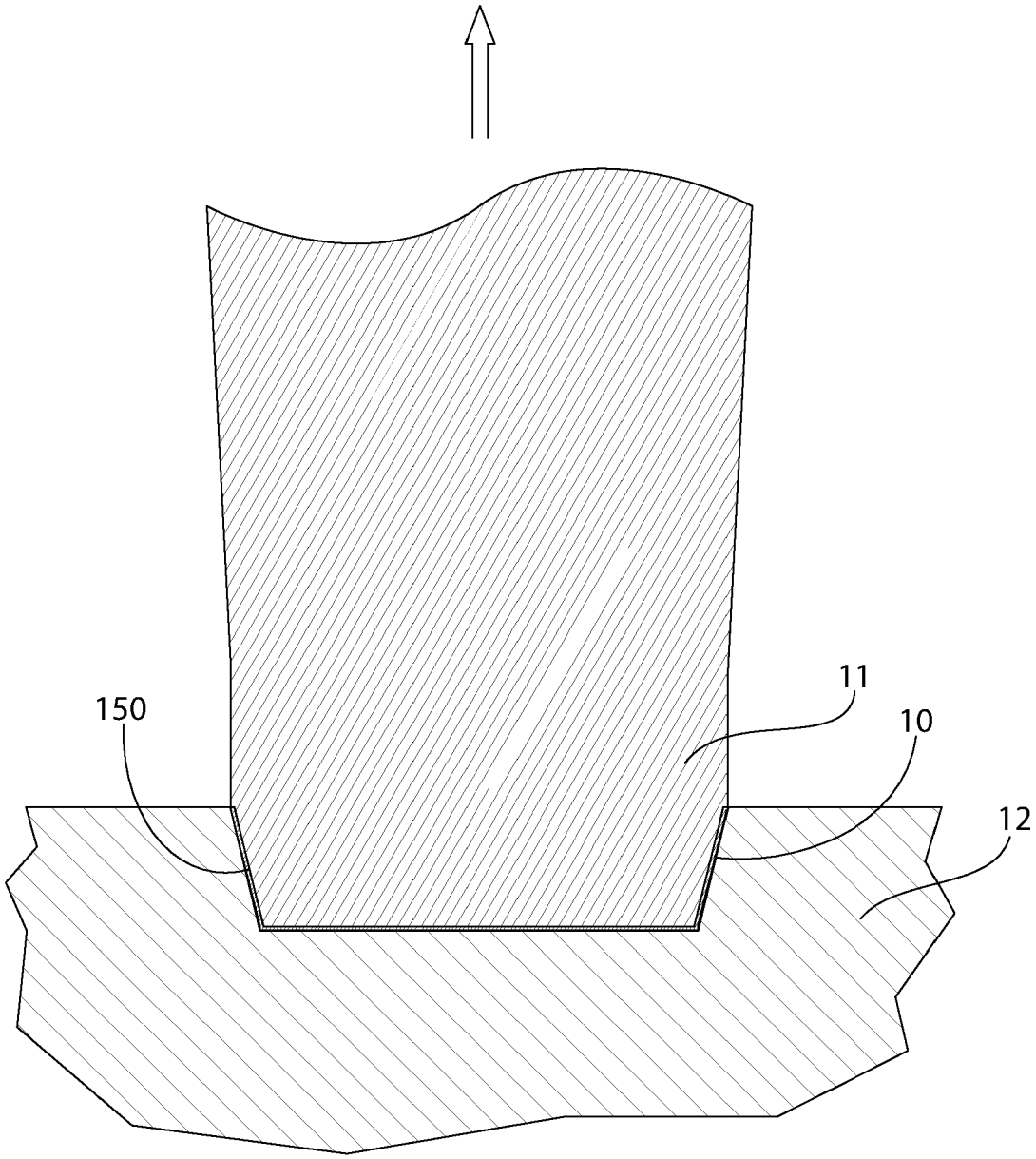

FIG. 11B

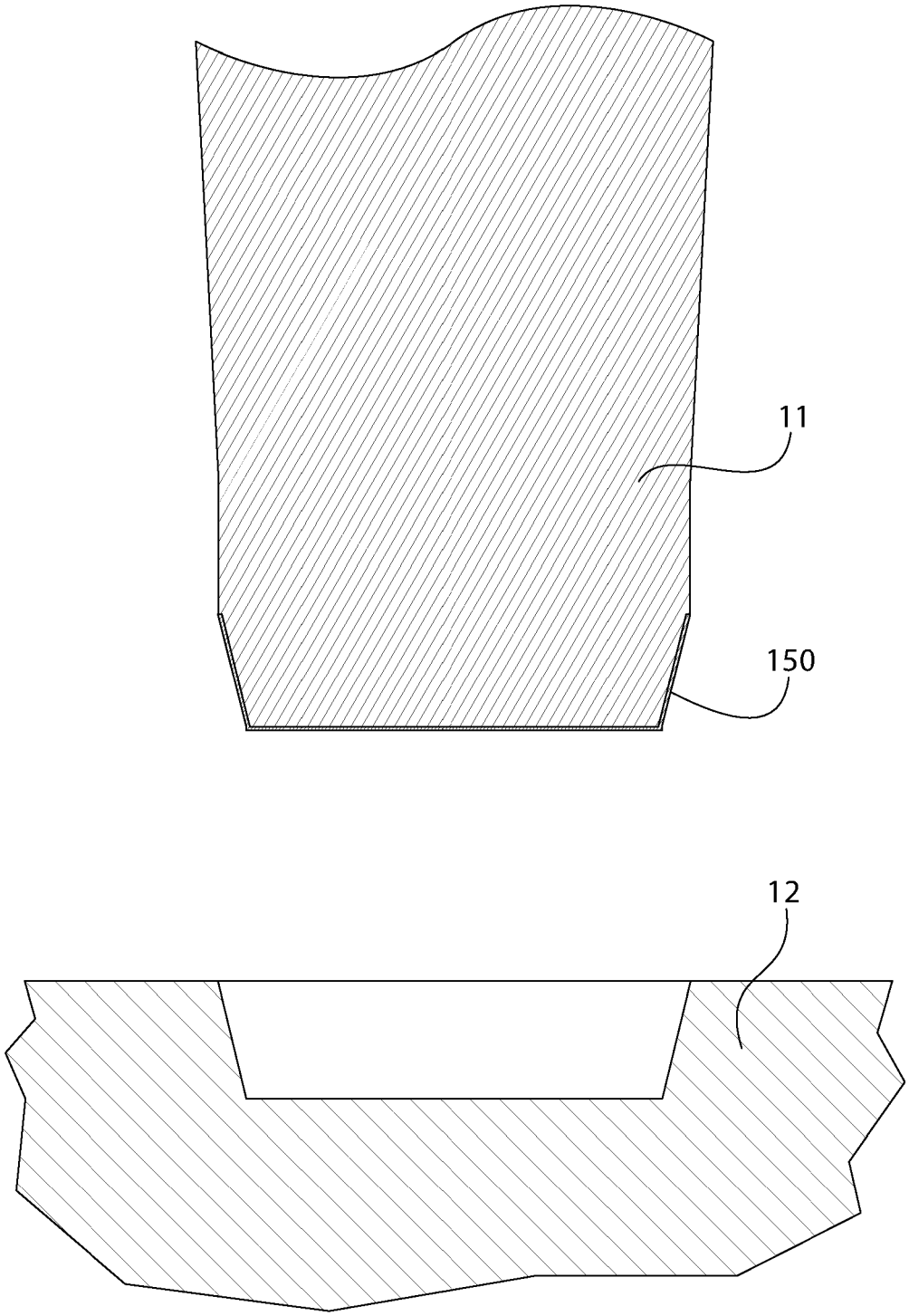

FIG. 11C

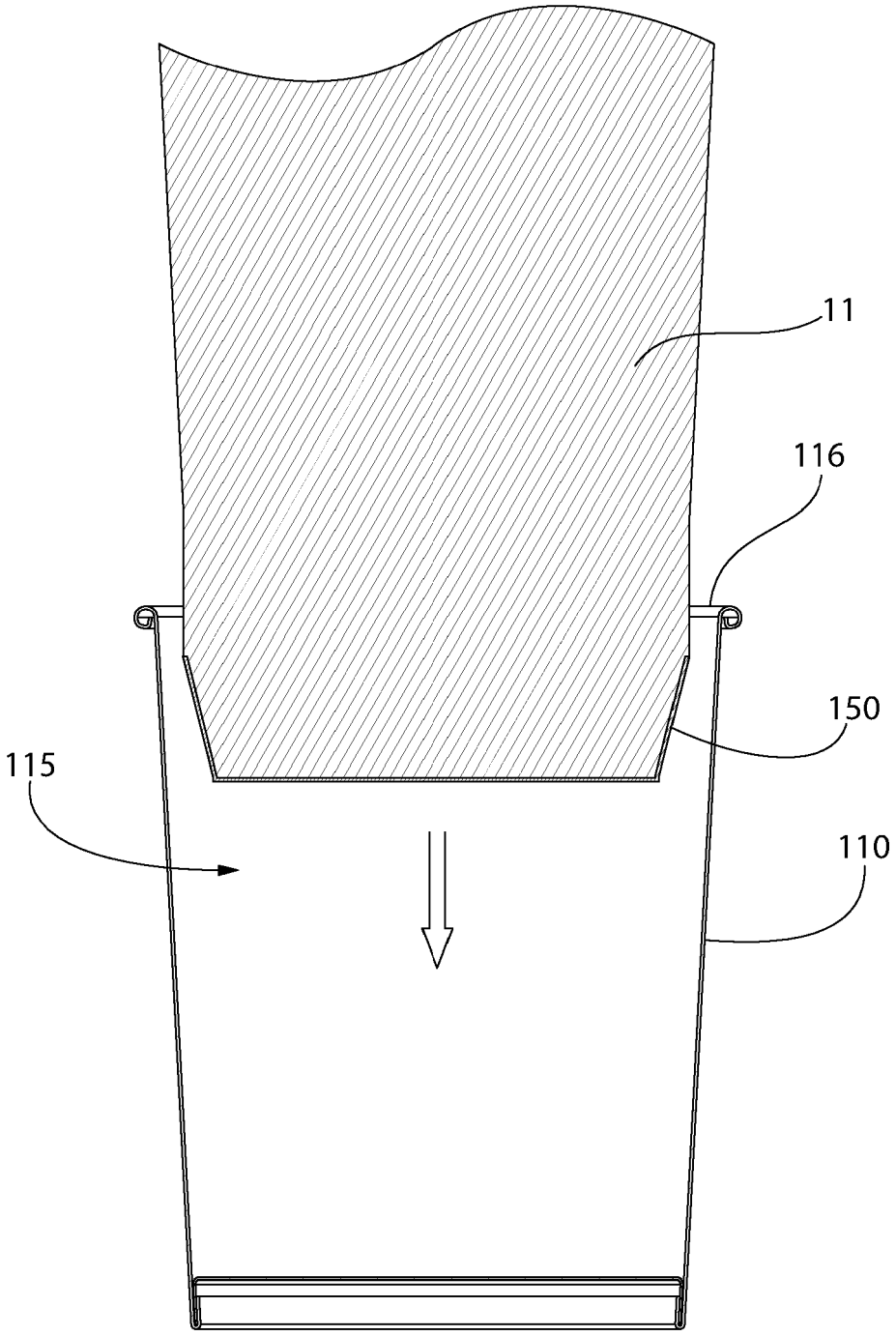

FIG. 11D

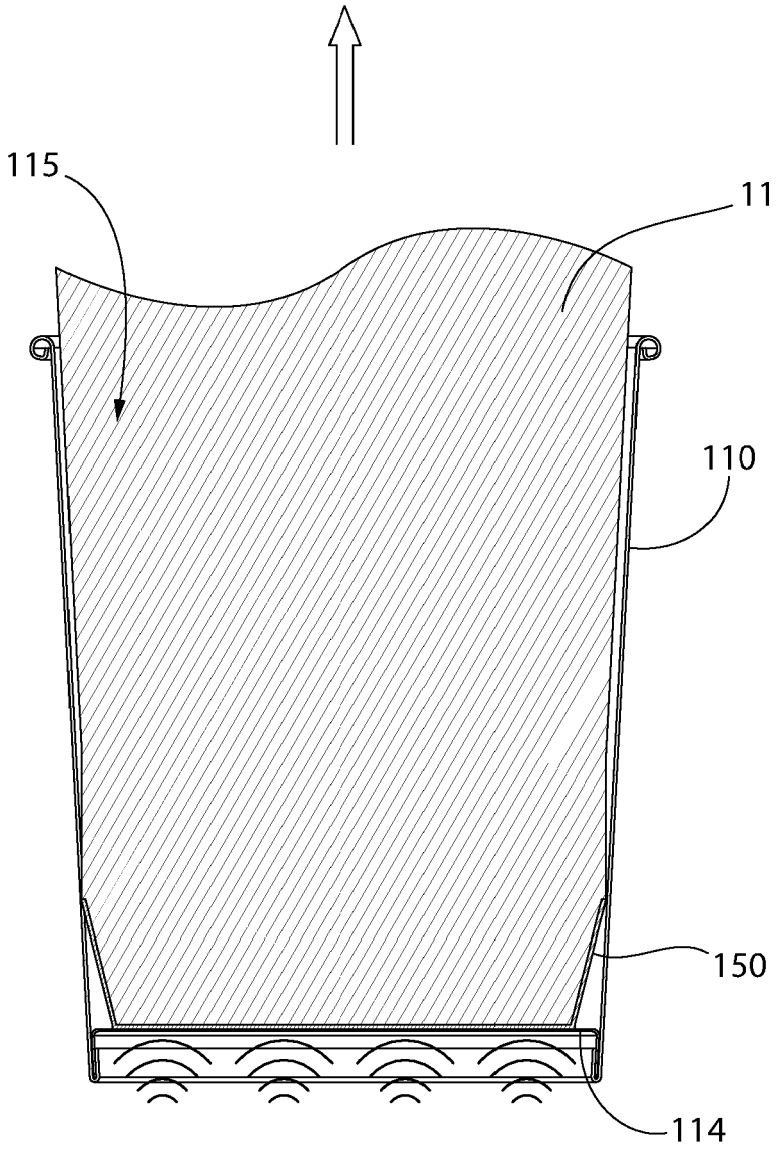

FIG. 11E

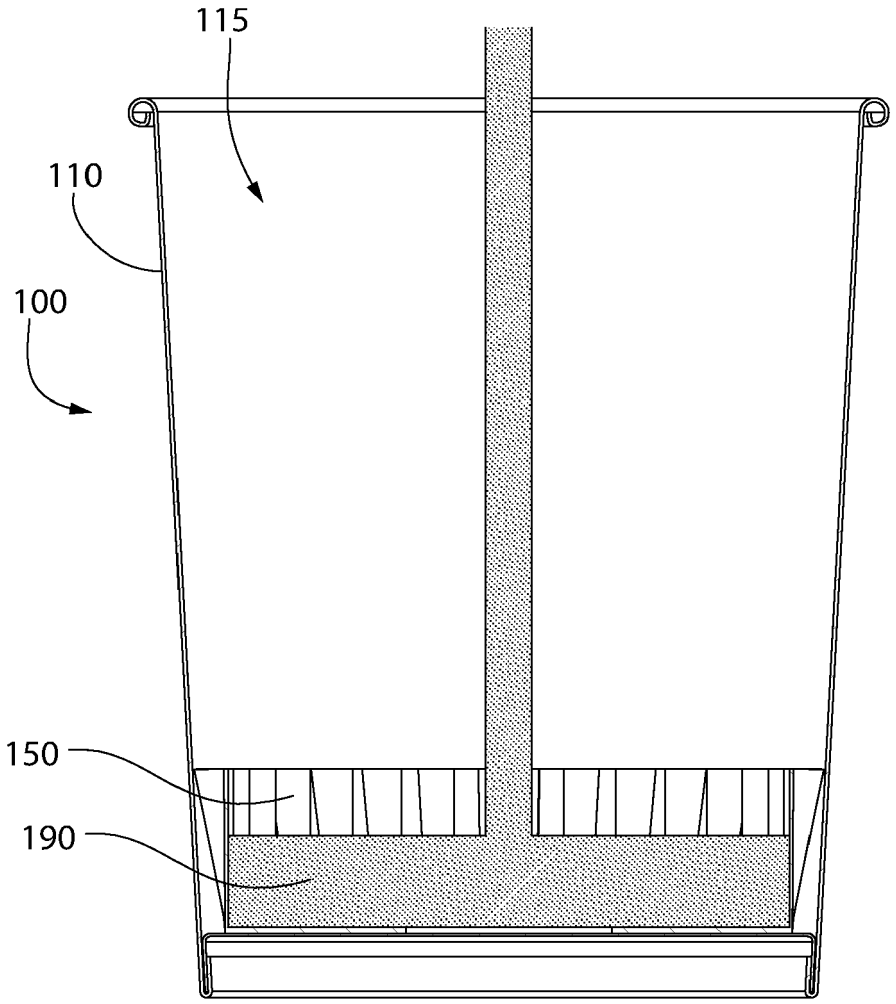

FIG. 11F

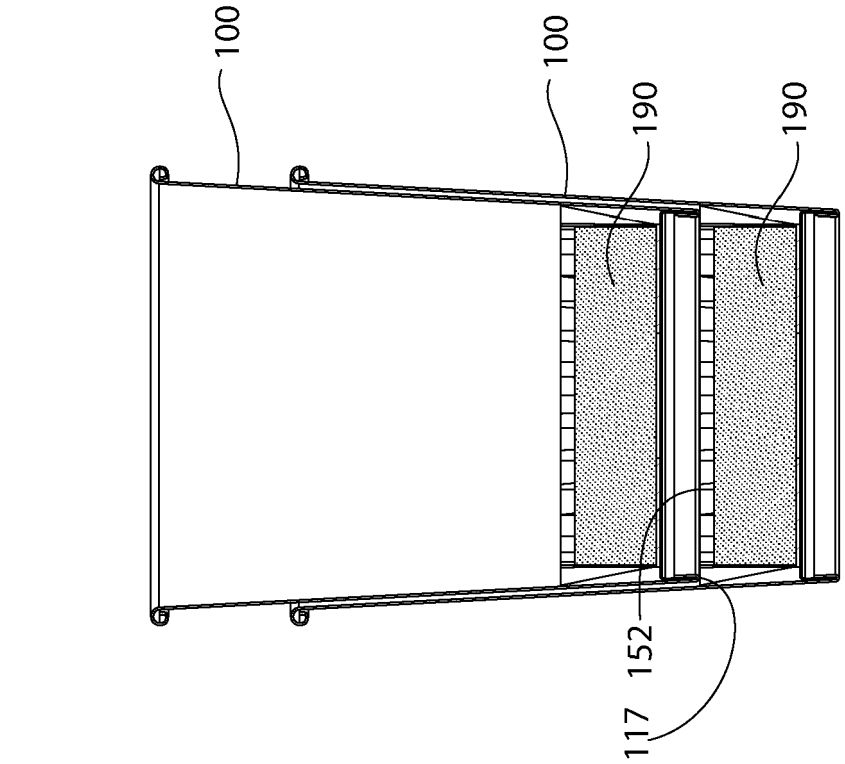

FIG. 11H

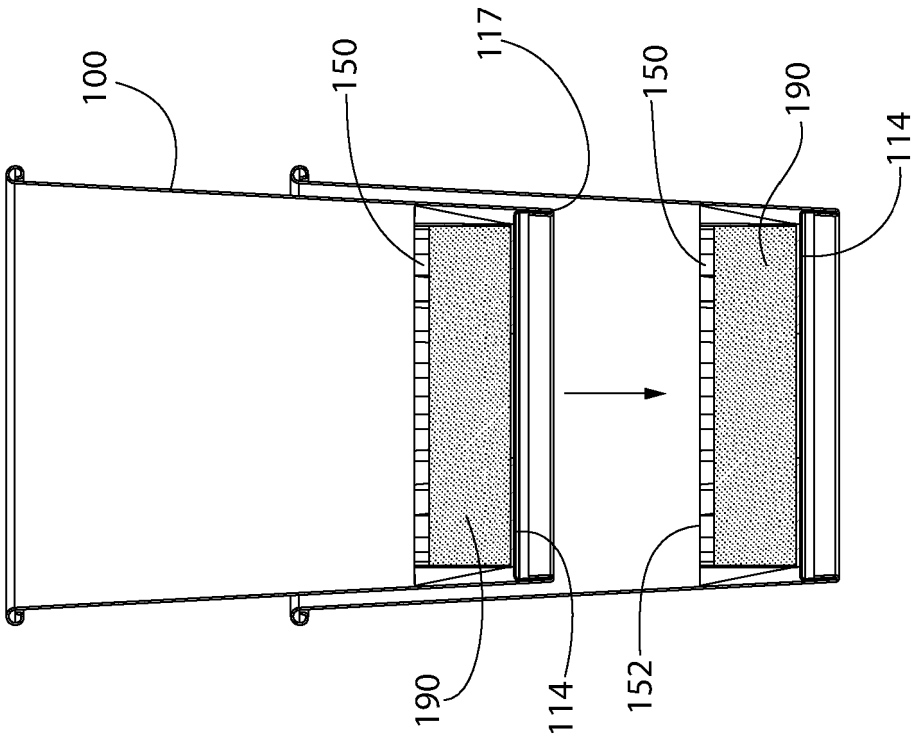

FIG. 11G

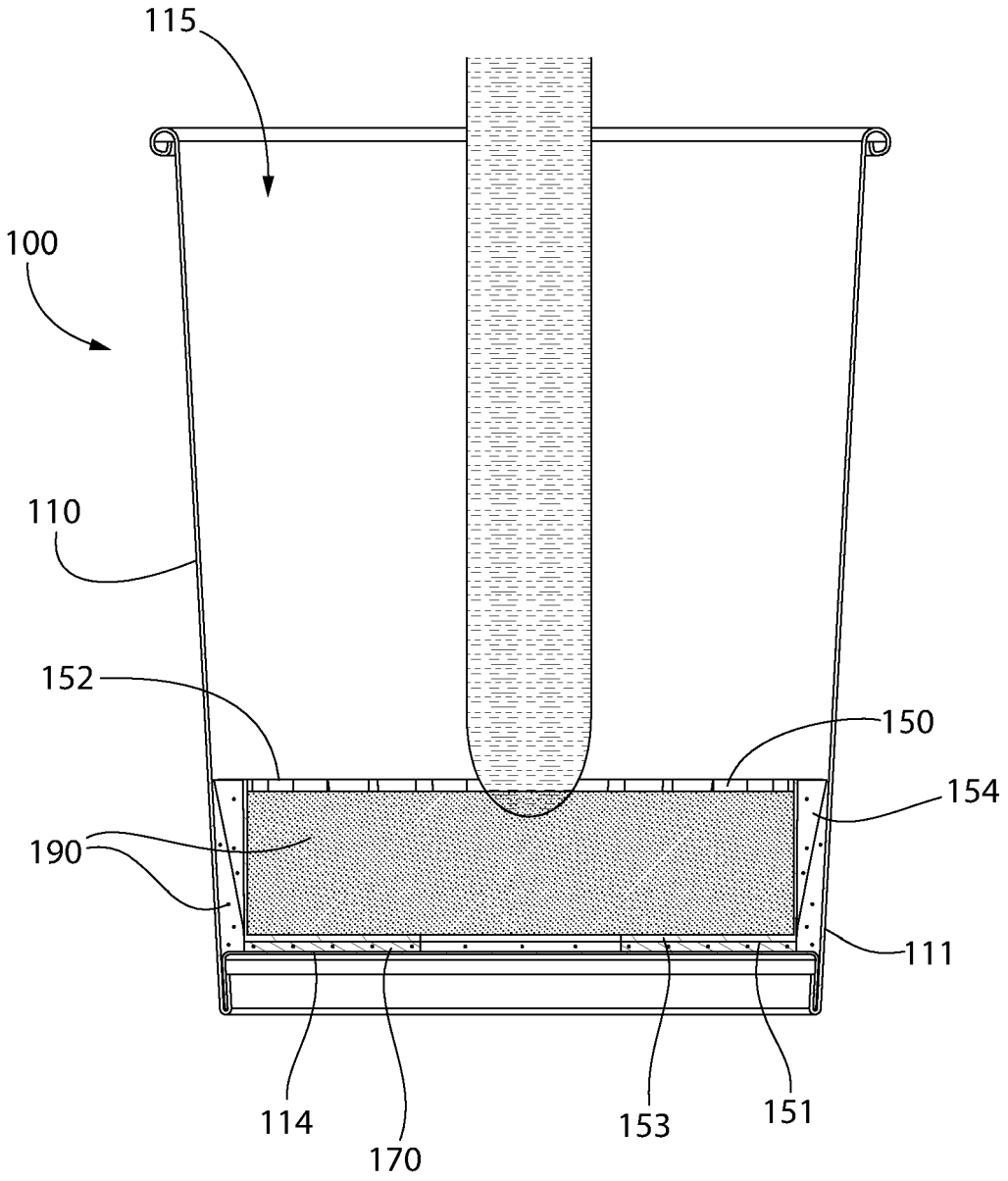

FIG. 12A

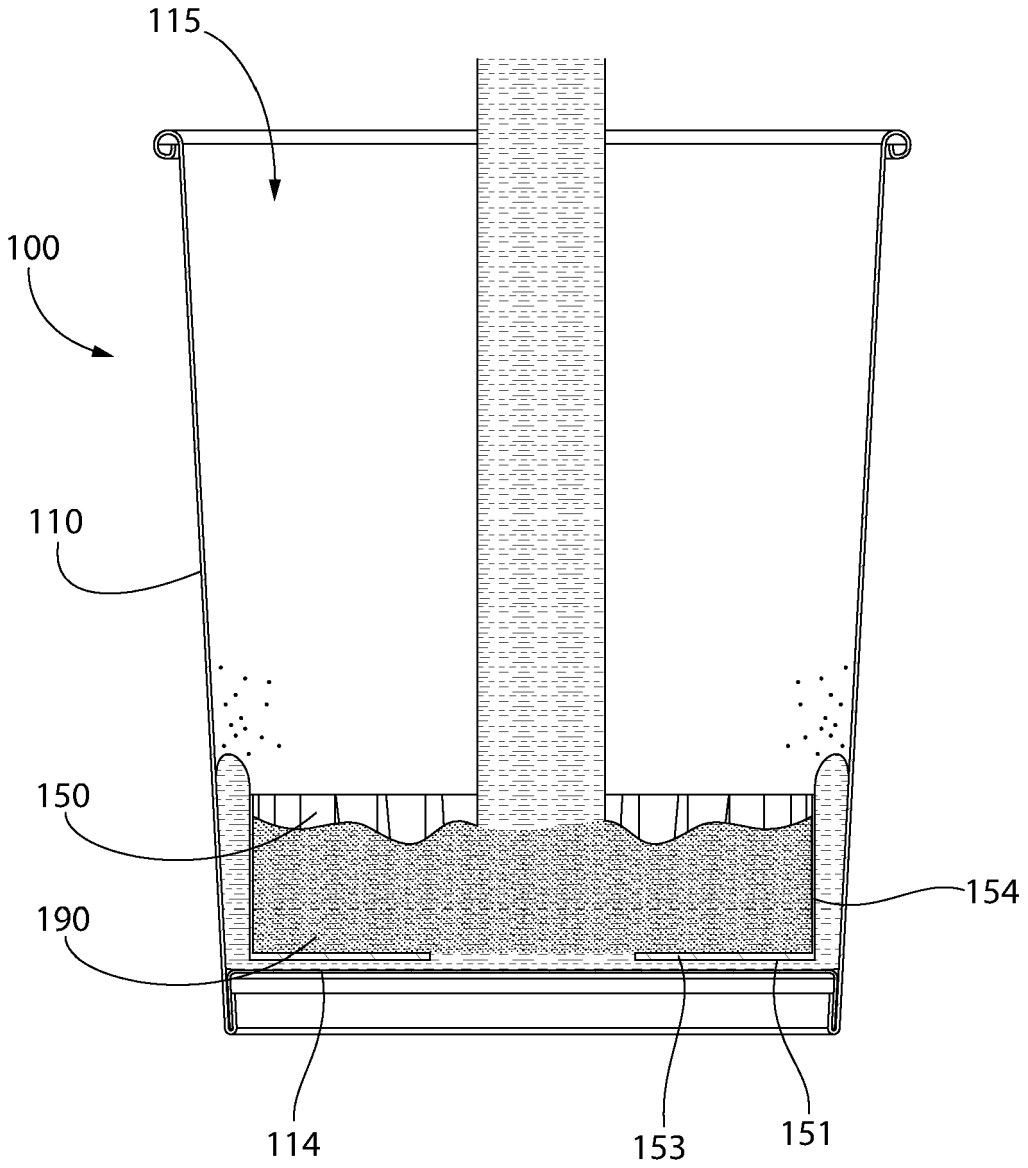

FIG. 12B

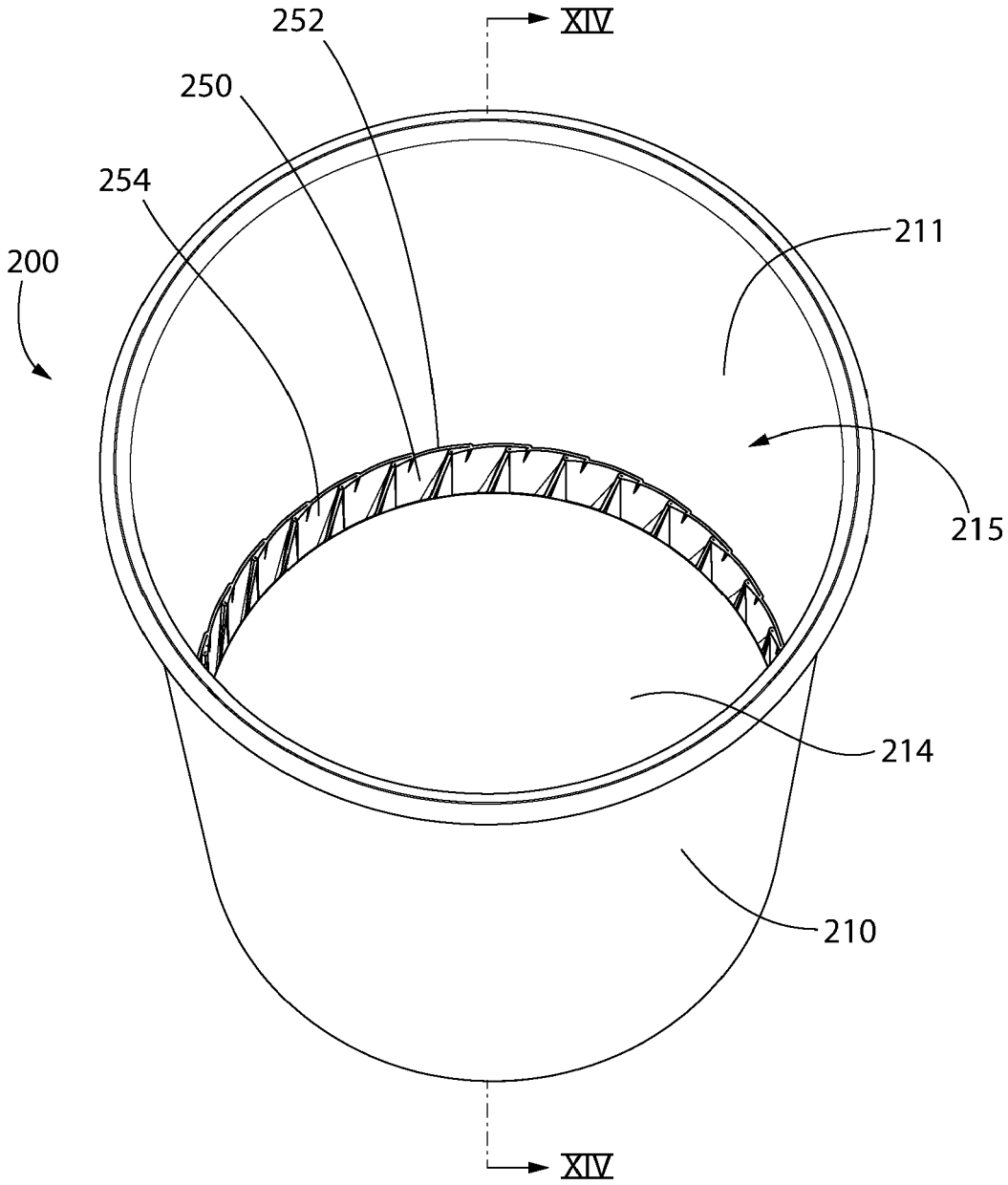

FIG. 13

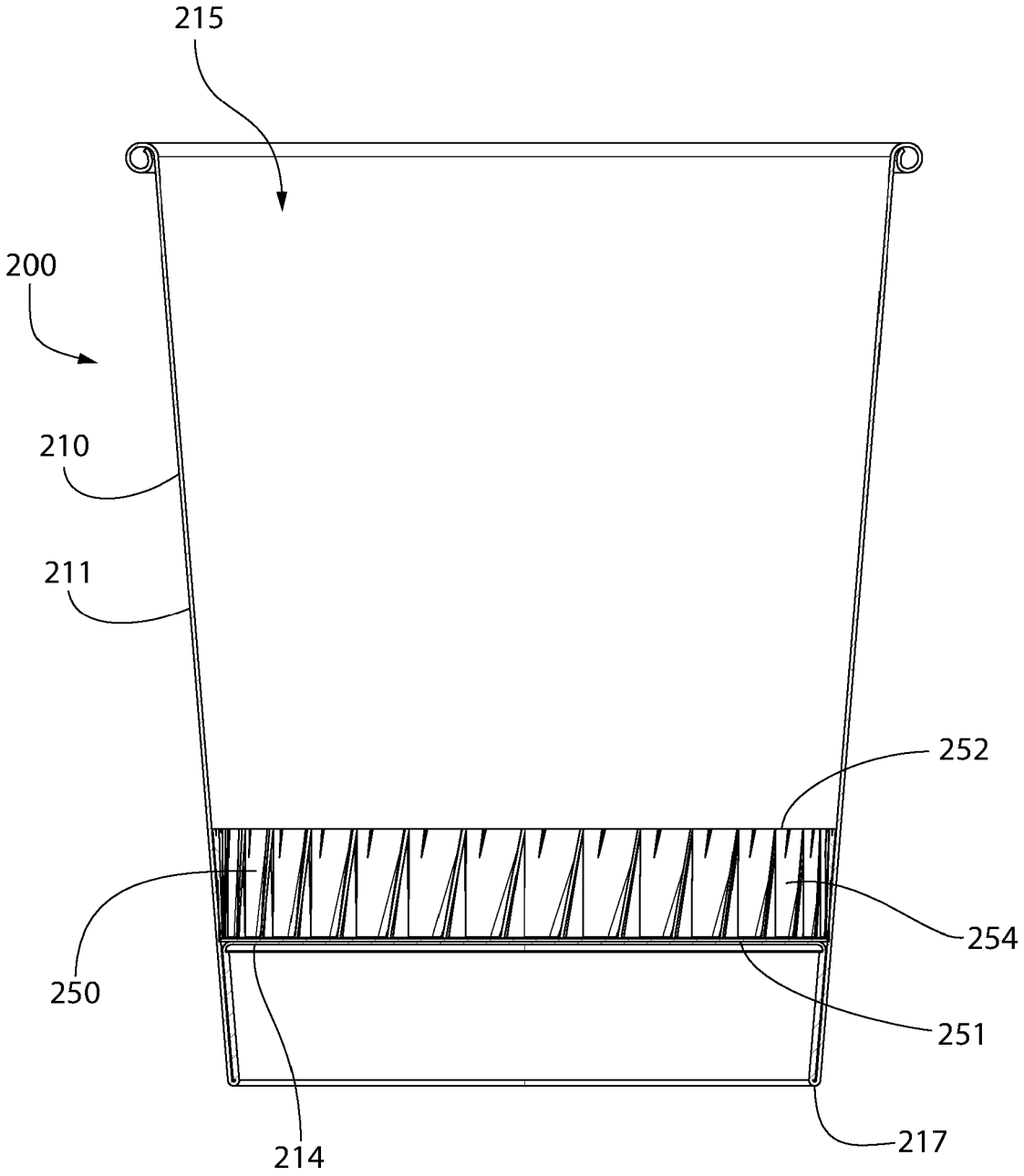

FIG. 14

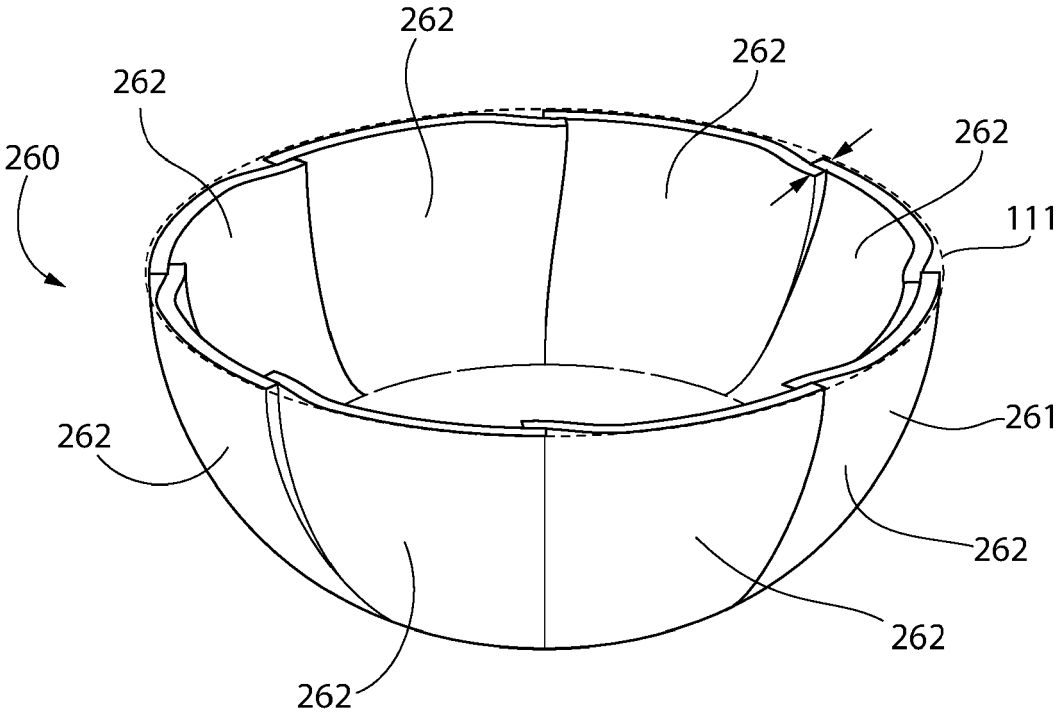

FIG. 15

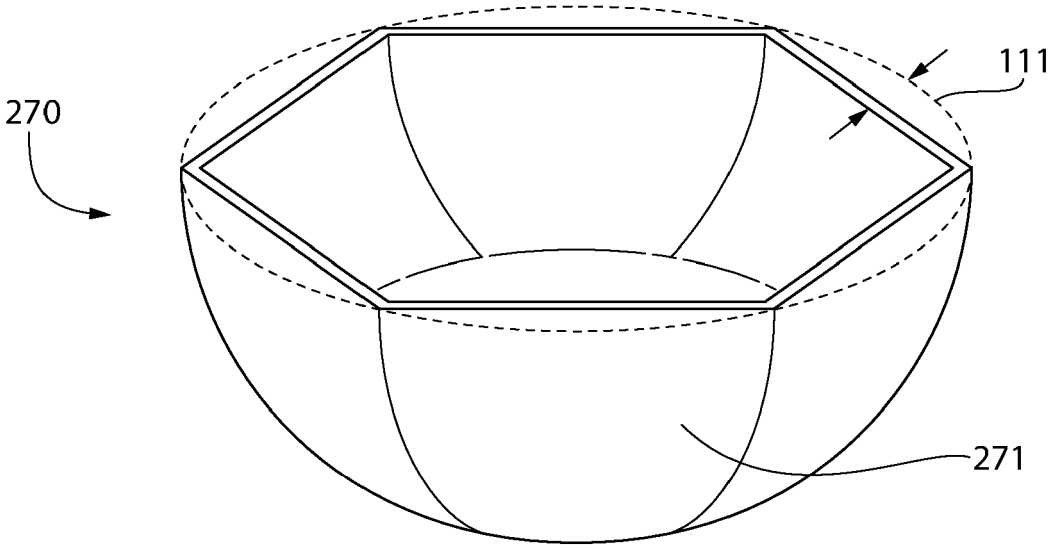

FIG. 16

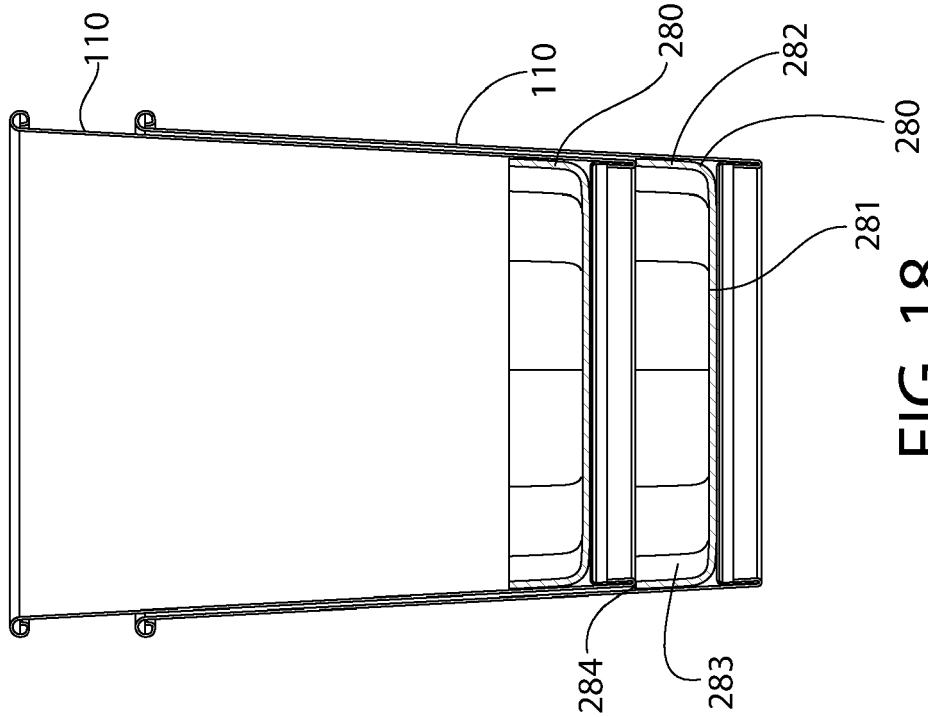
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FIG. 18

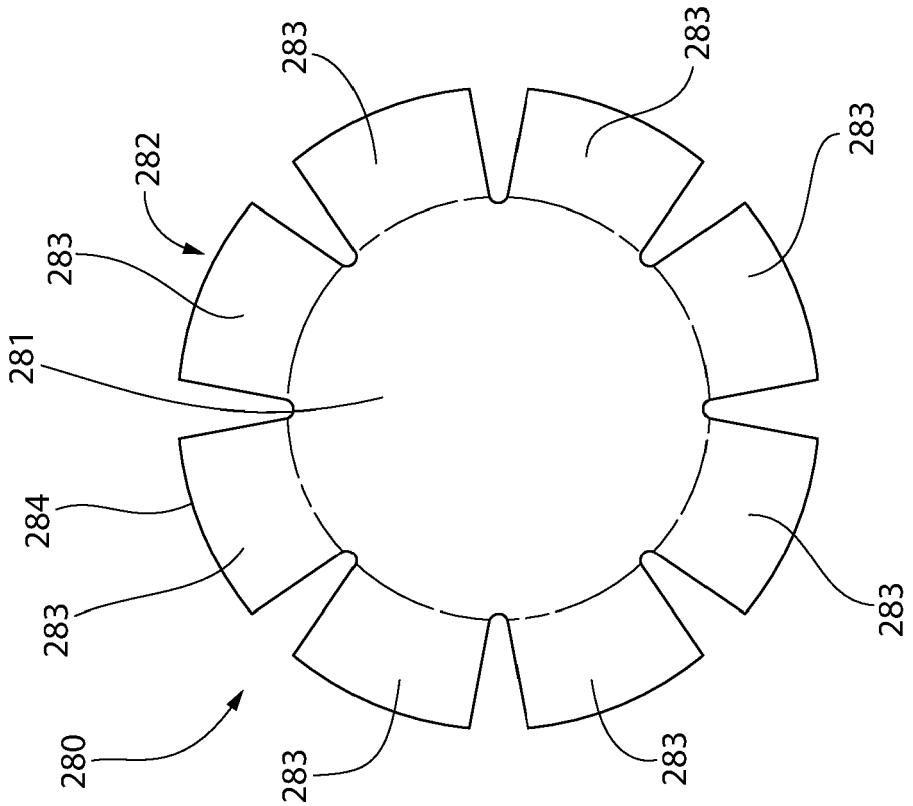
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FIG. 17

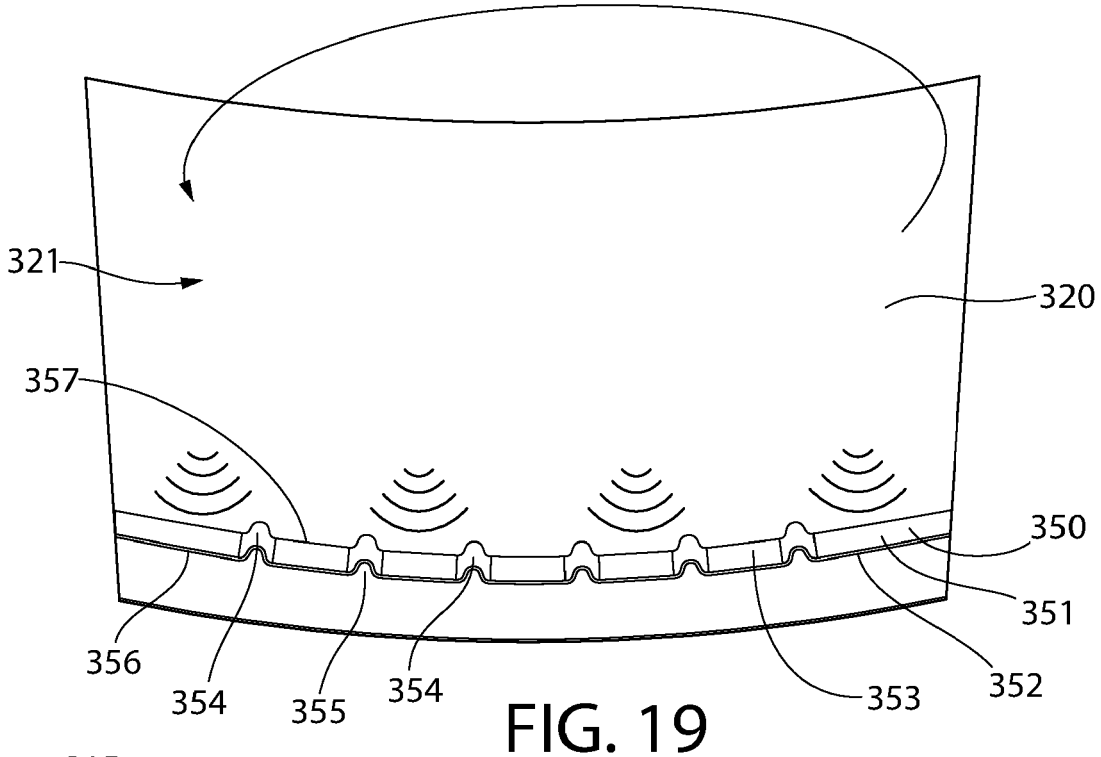


FIG. 19

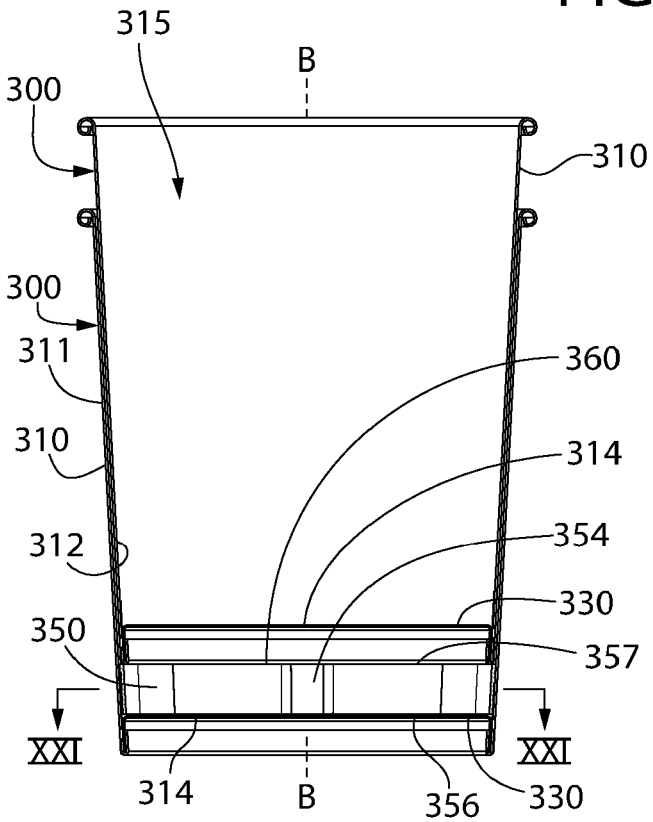


FIG. 20

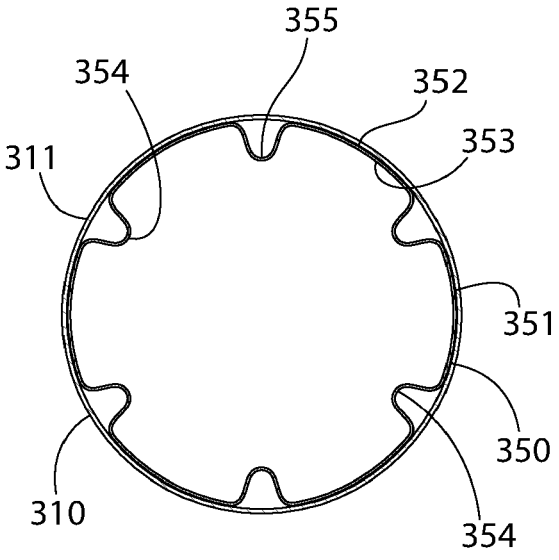


FIG. 21

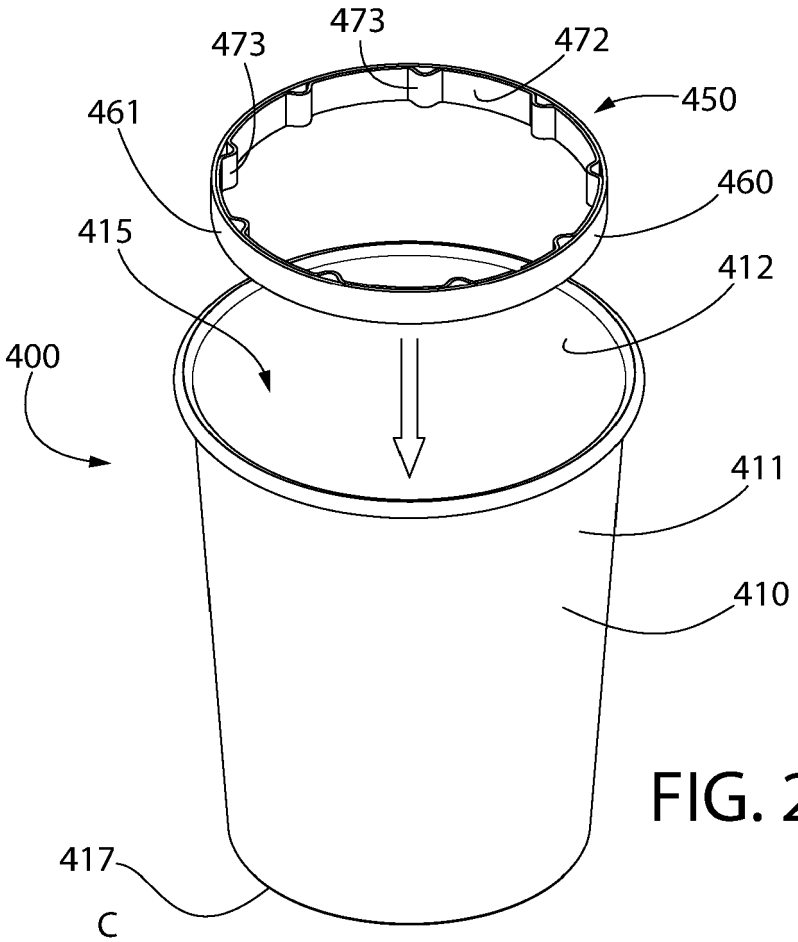


FIG. 22

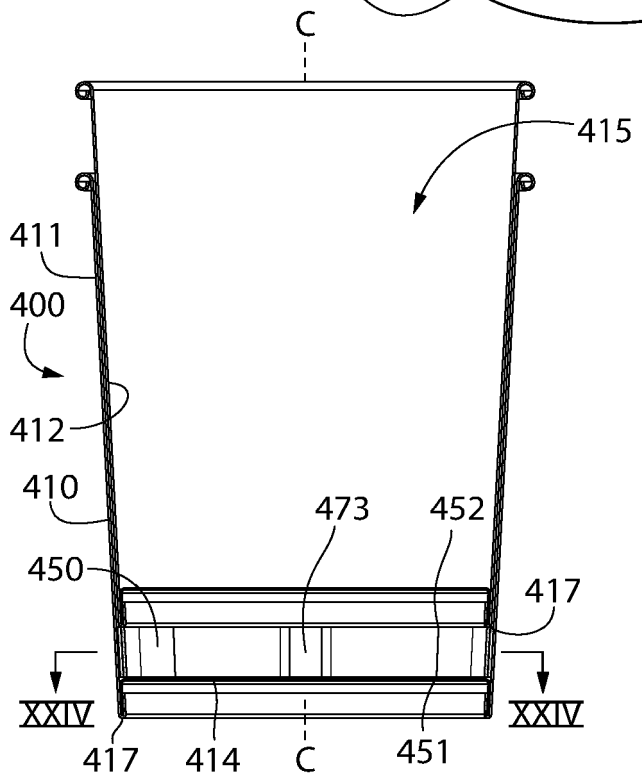


FIG. 23

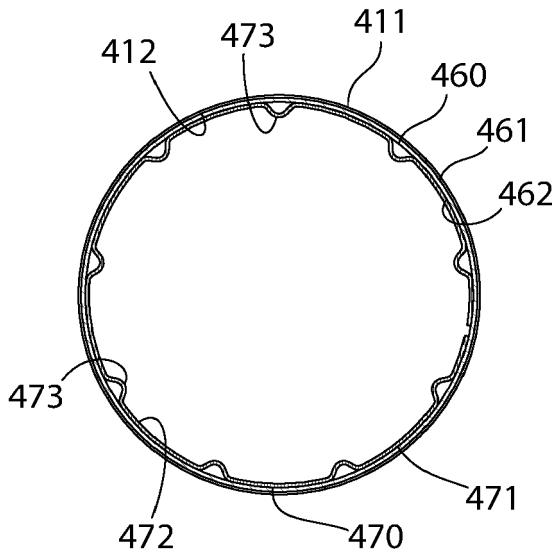


FIG. 24

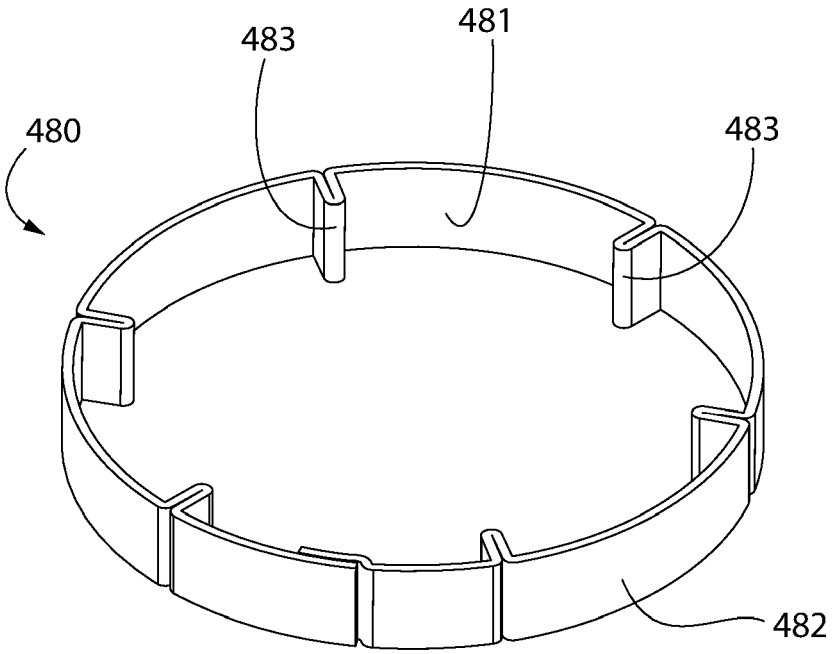


FIG. 25

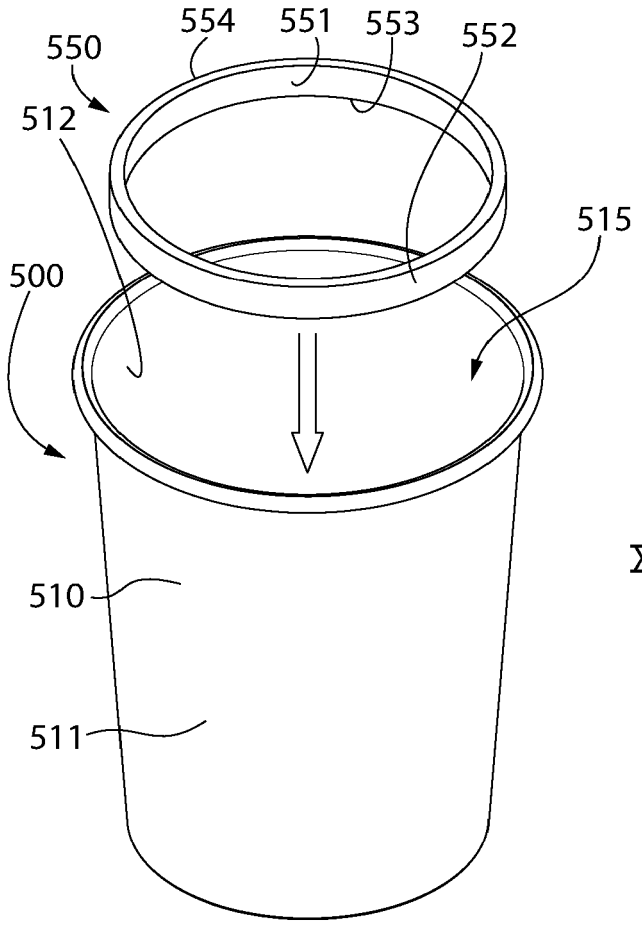


FIG. 26

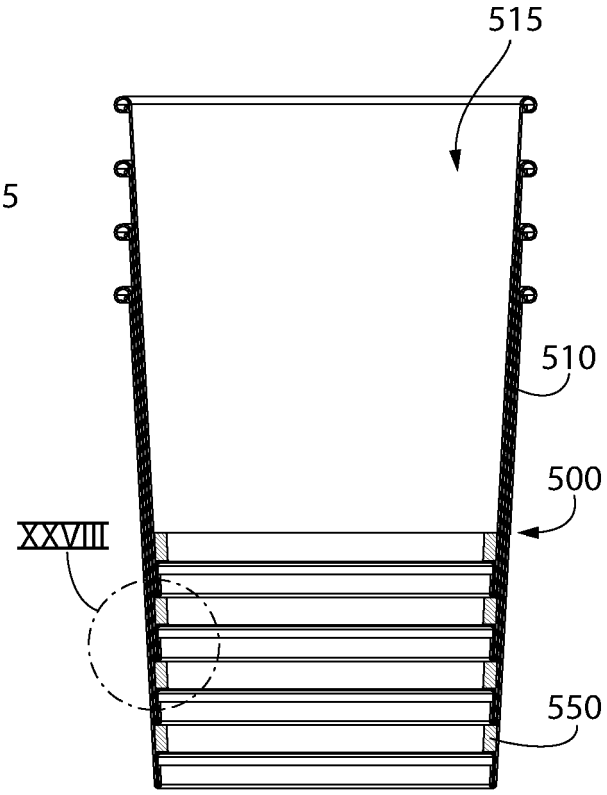


FIG. 27

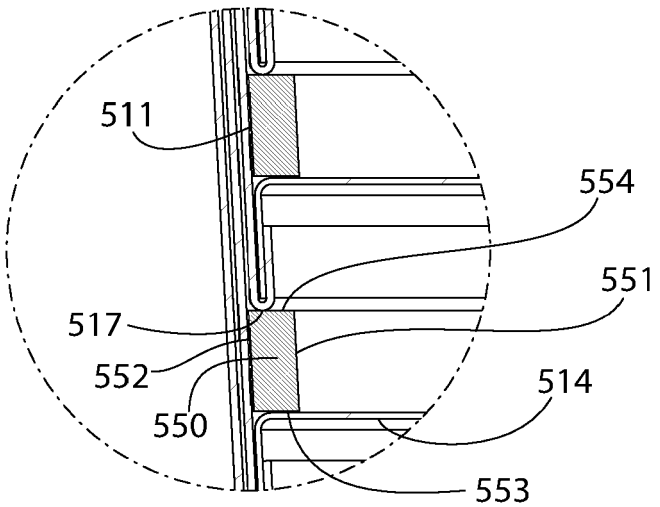


FIG. 28

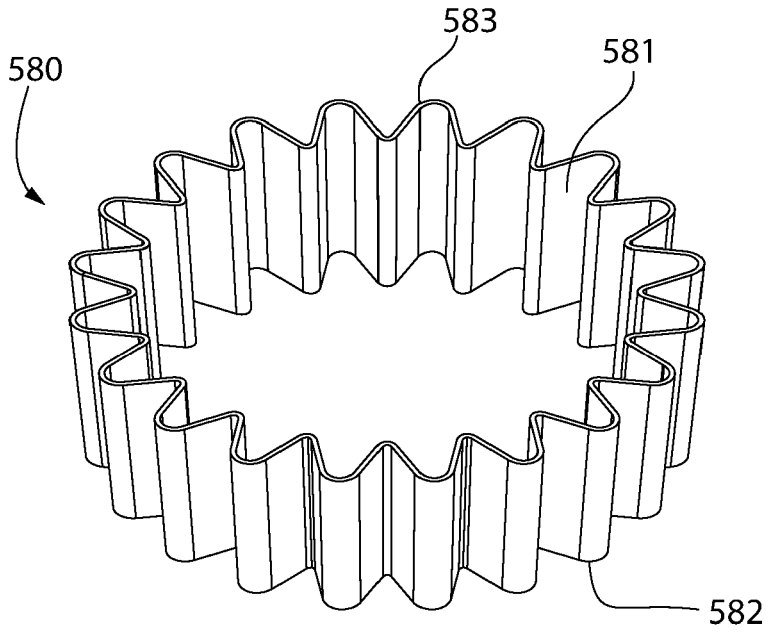


FIG. 29

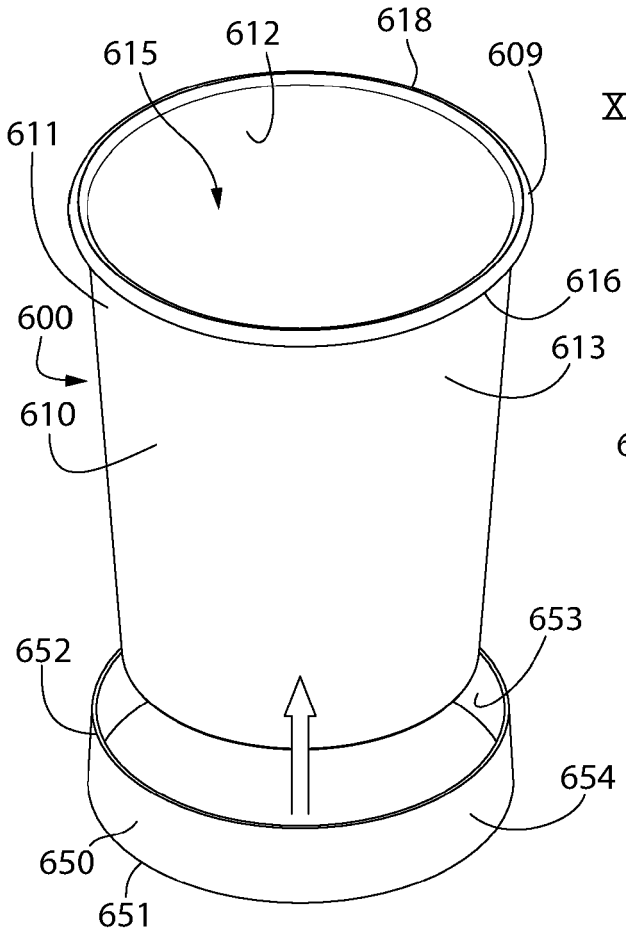


FIG. 30

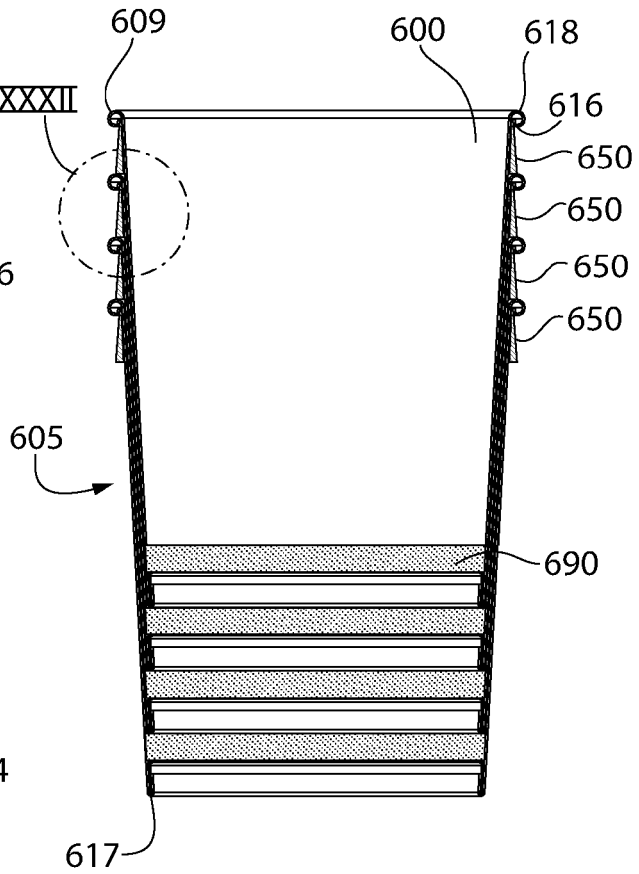


FIG. 31

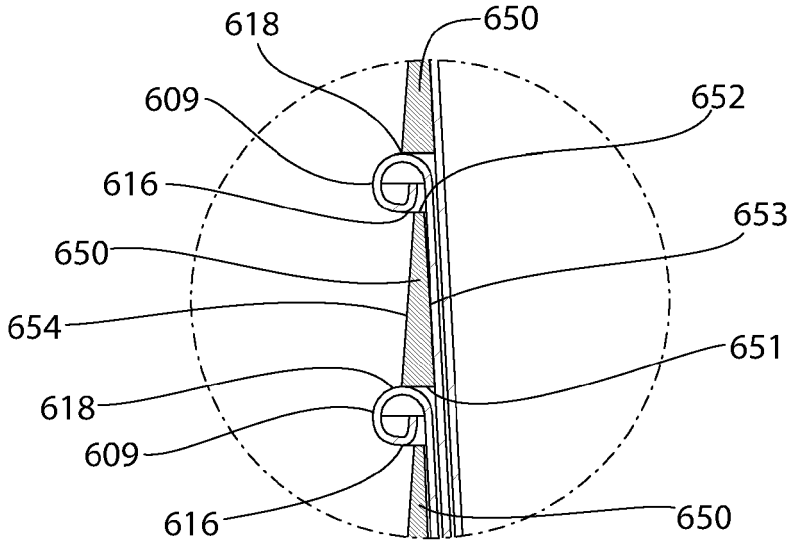


FIG. 32

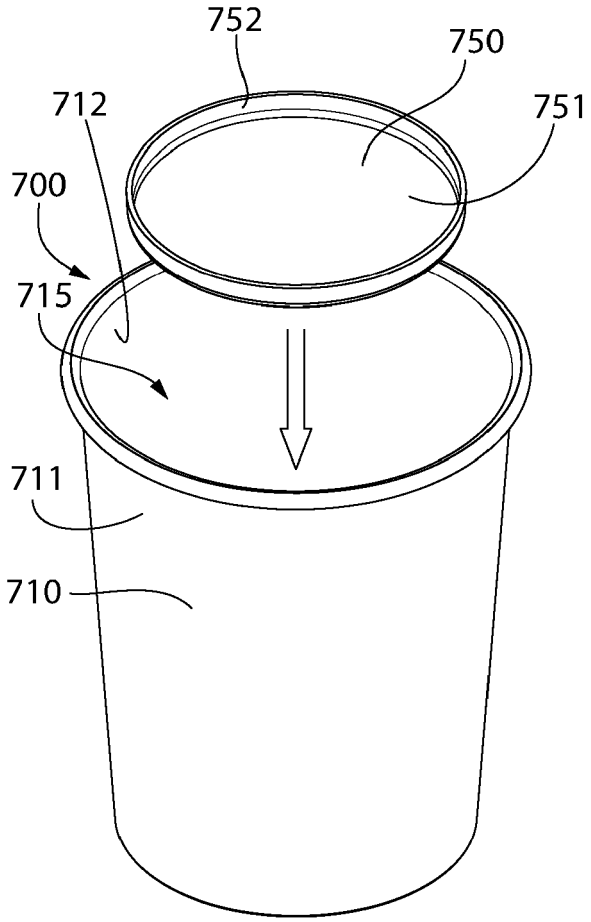


FIG. 33

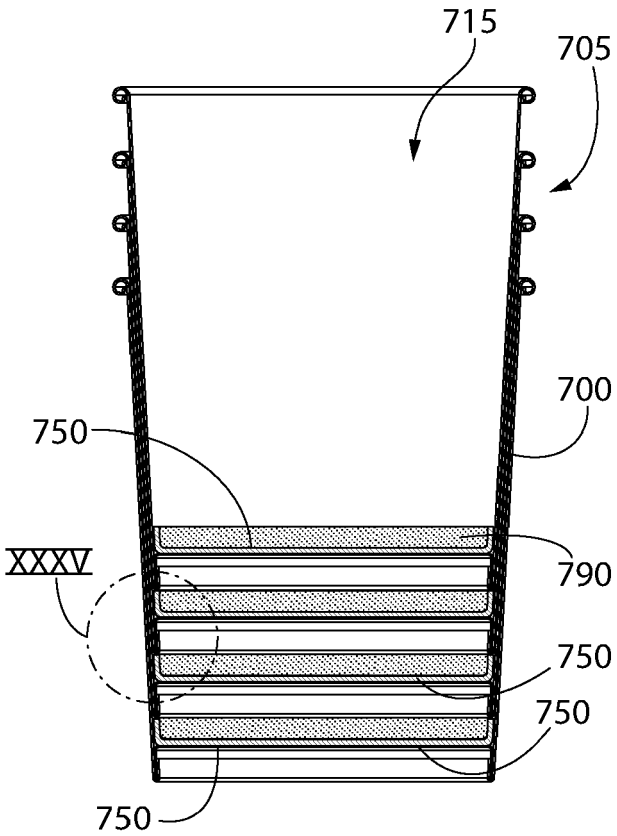


FIG. 34

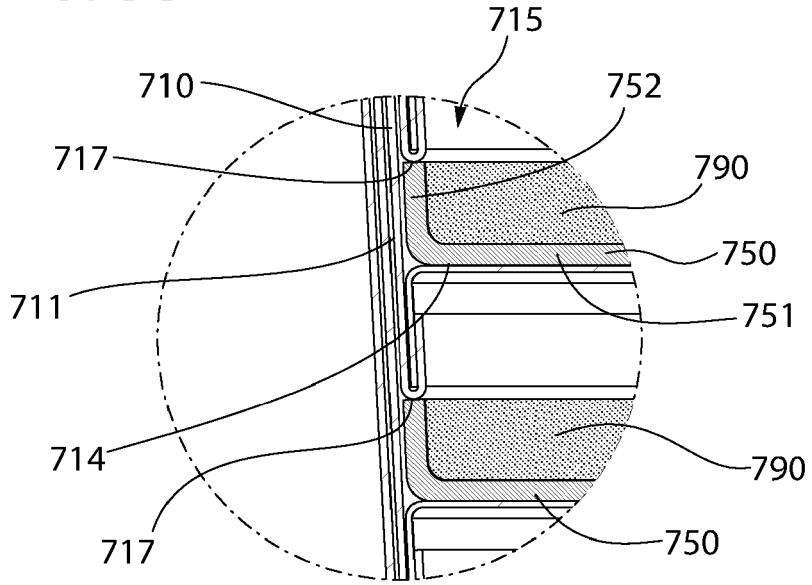


FIG. 35

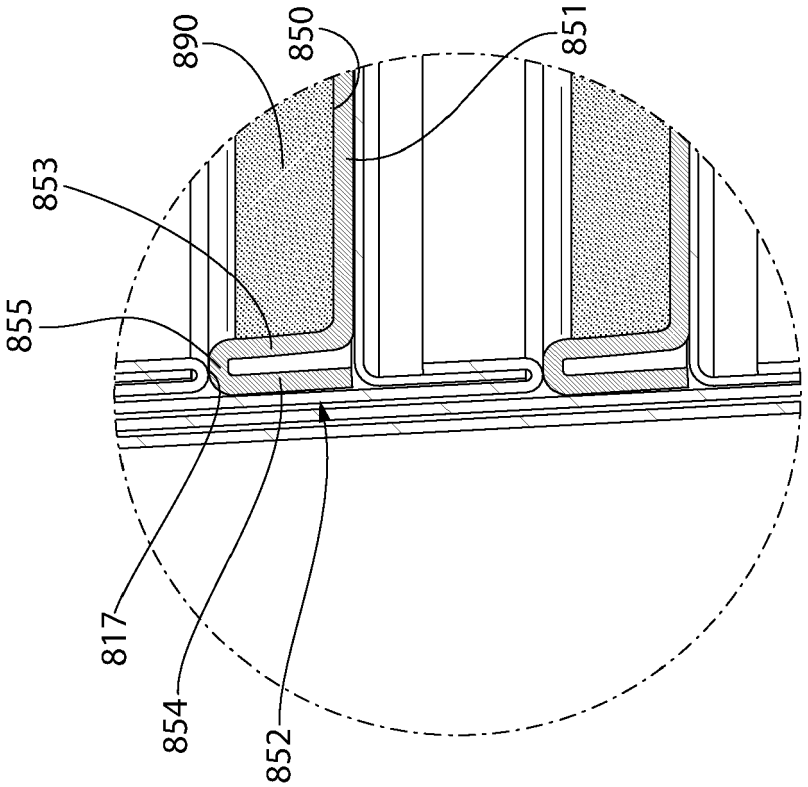

890
850
851
853
855
817
854
852

FIG. 37

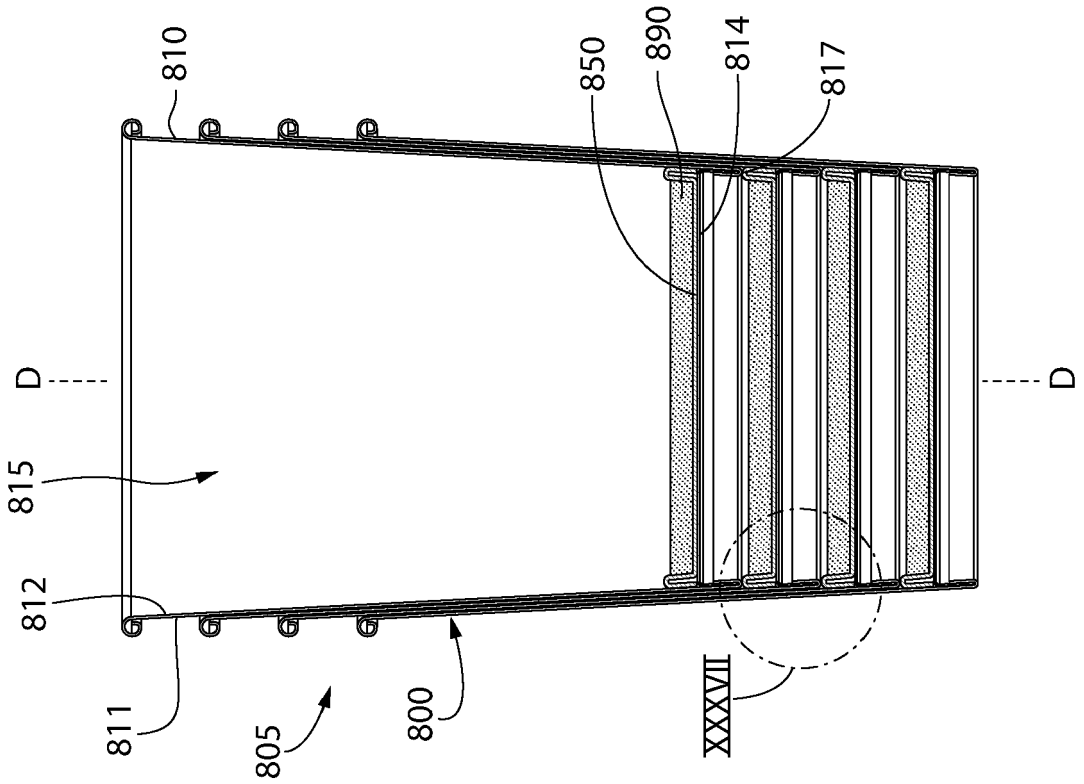

810
850
890
814
817
D
D
815
812
811
805
800
XXXVII

FIG. 36

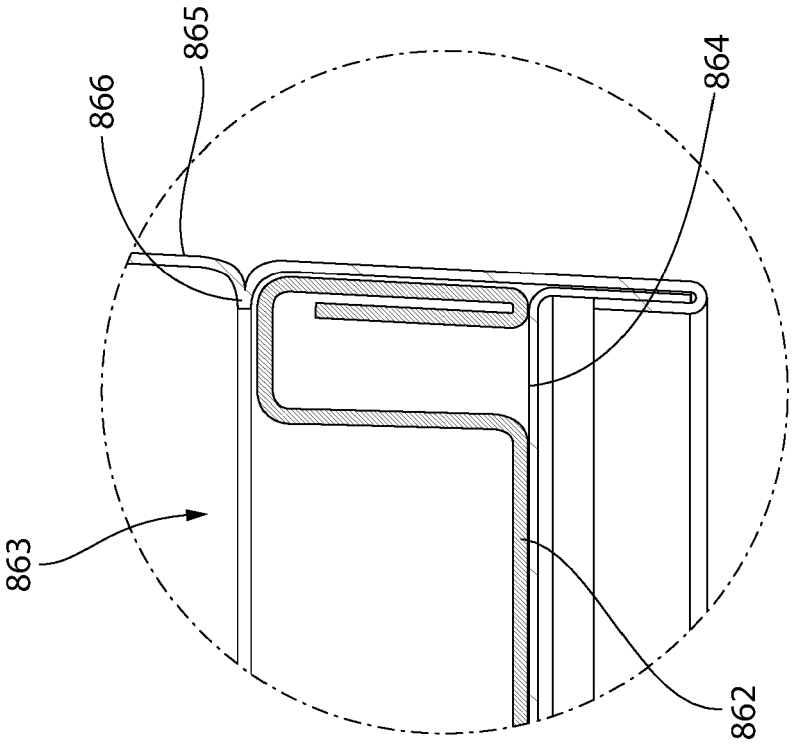


FIG. 39

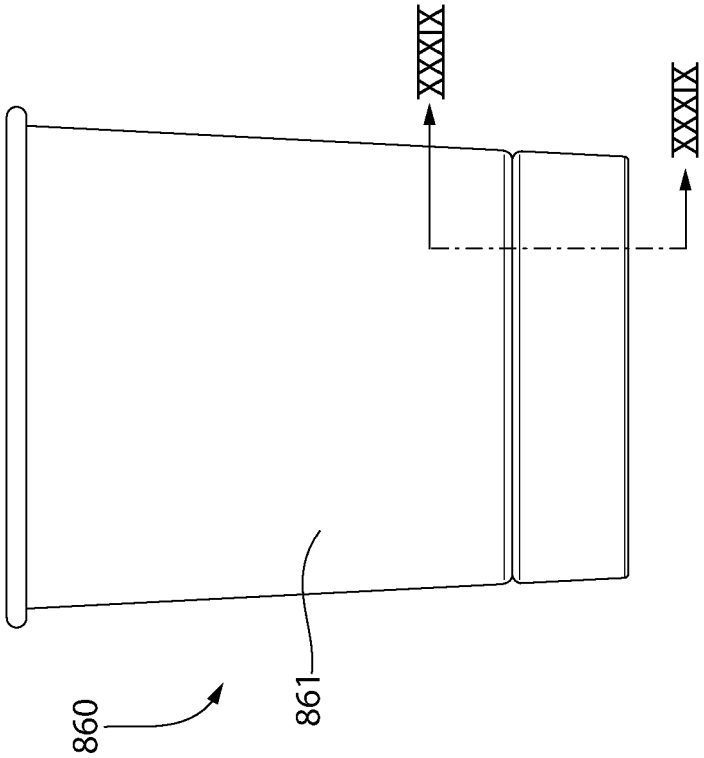


FIG. 38

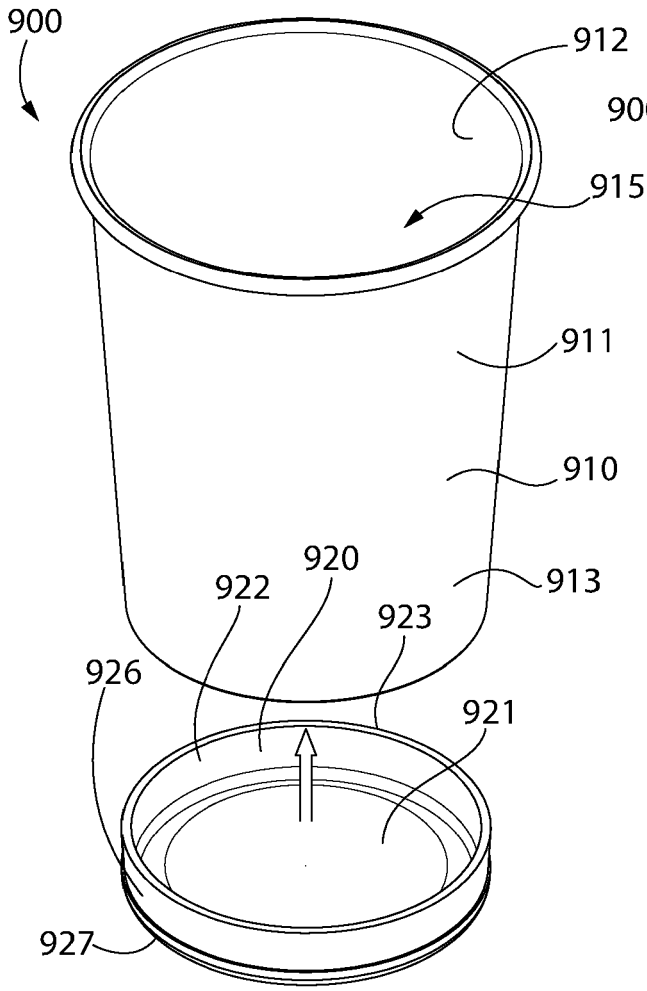


FIG. 40

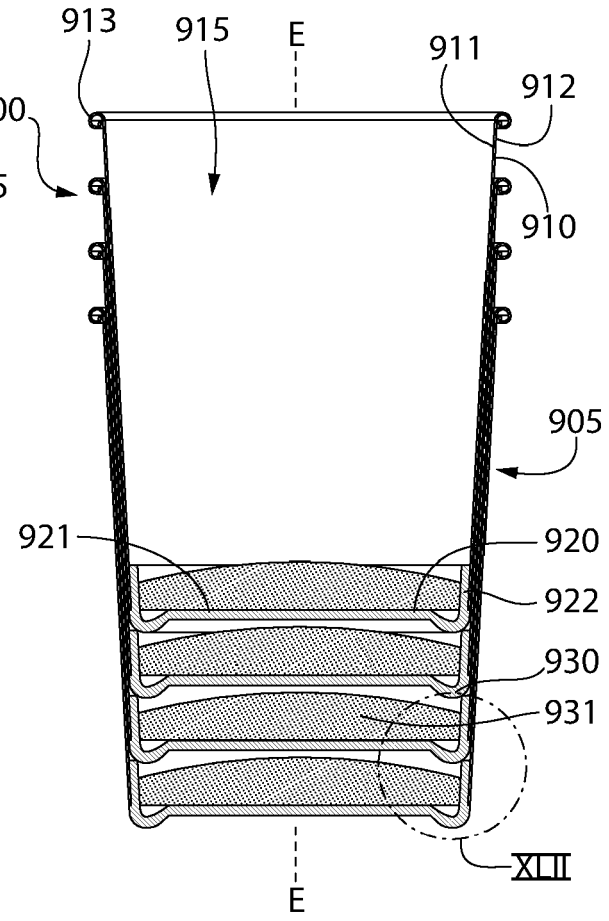


FIG. 41

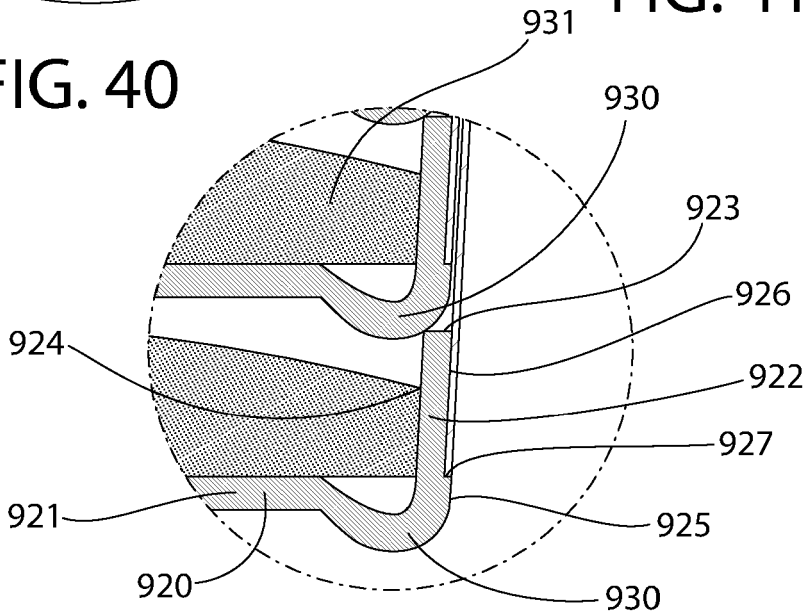


FIG. 42

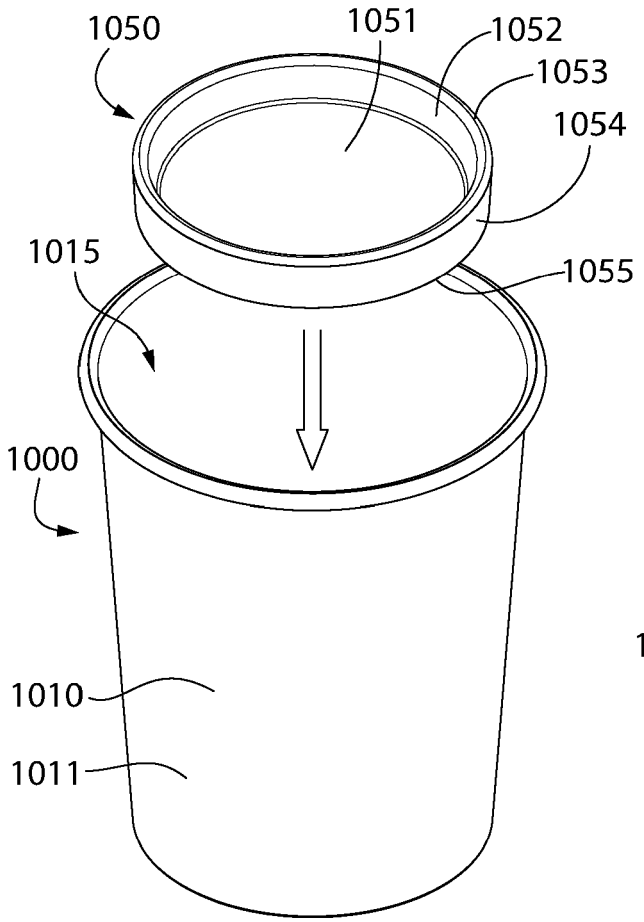


FIG. 43

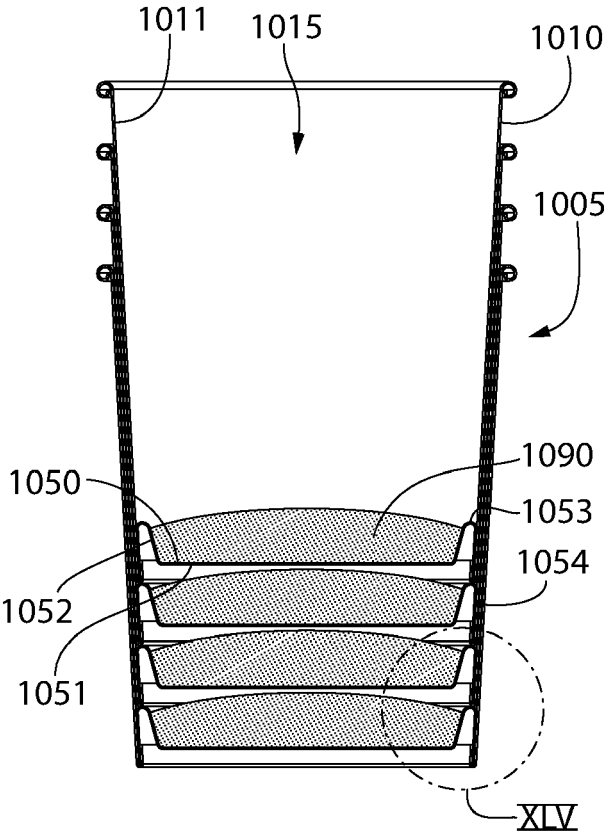


FIG. 44

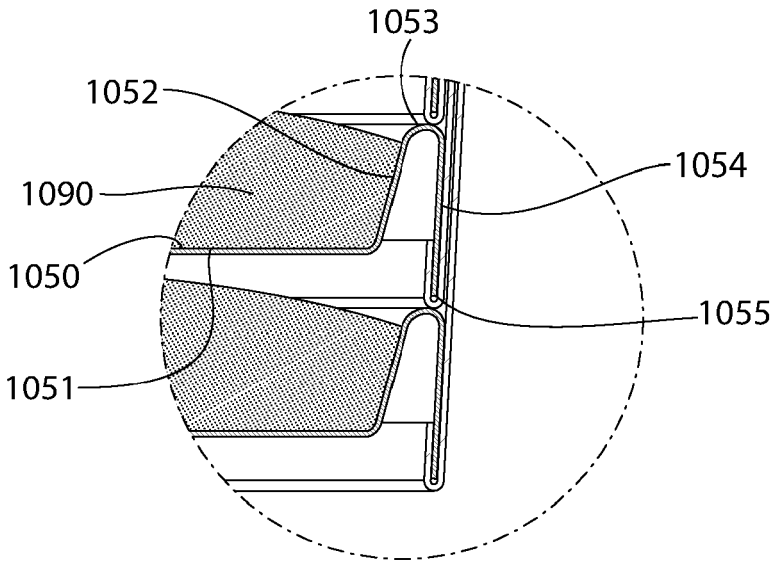
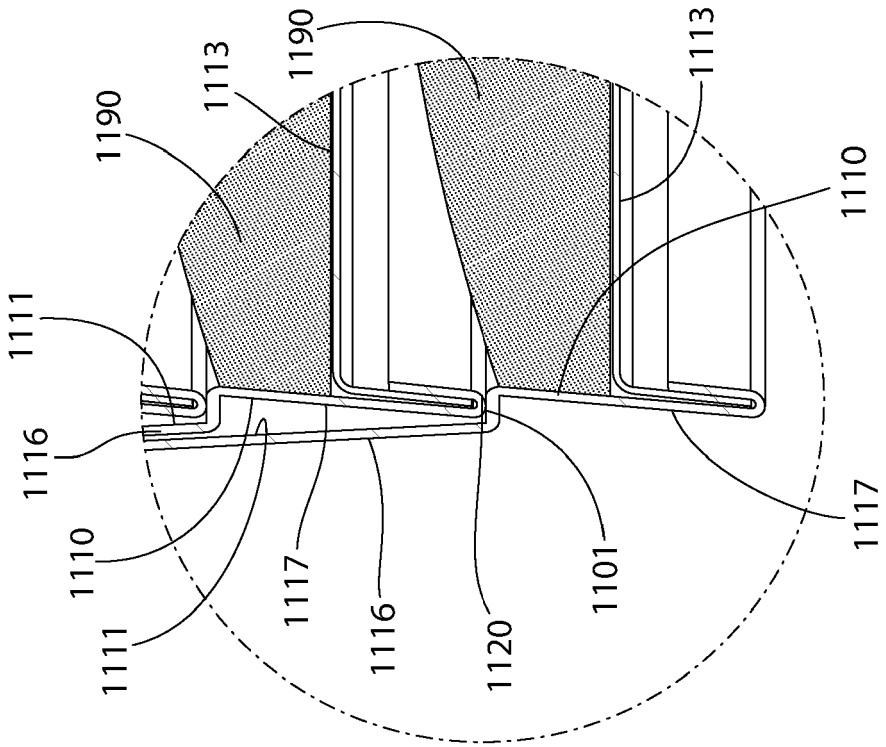


FIG. 45


1190
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1190
1113
1110
1111
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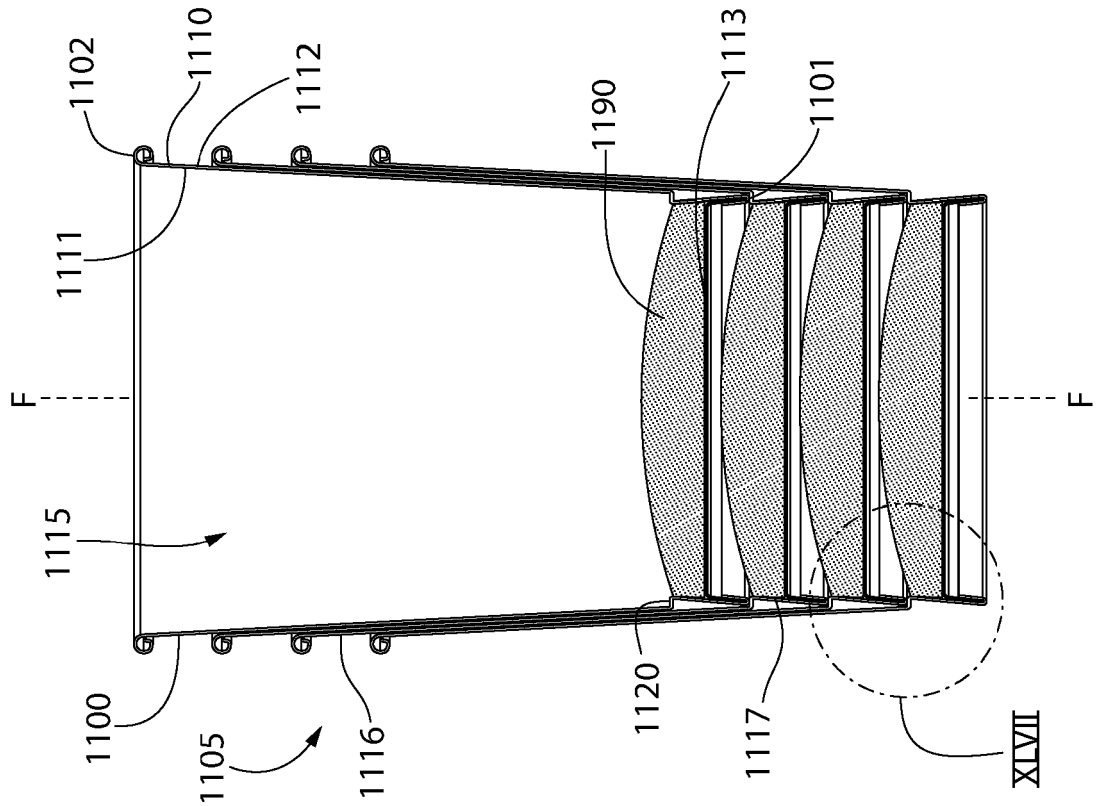
1110
1111
1117
1116
1120
1101
1117

FIG. 47


1102
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1190
1113
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F
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1115
1100
1105
1116
1120
1117
XLVIII

FIG. 46

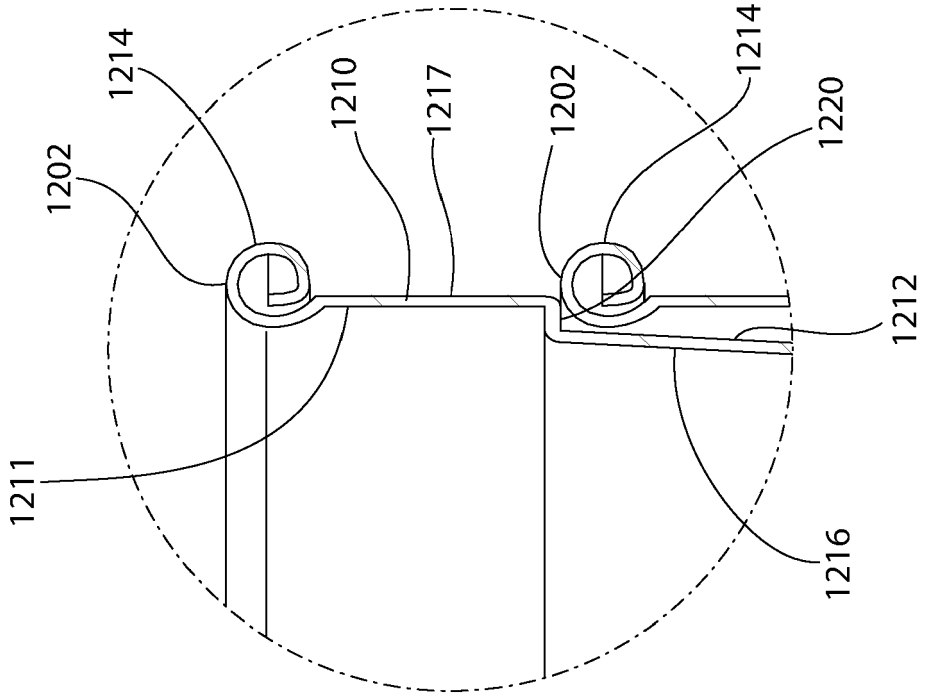
1214
1210
1217
1202
1214
1220
1202
1212
1211
1216

FIG. 49

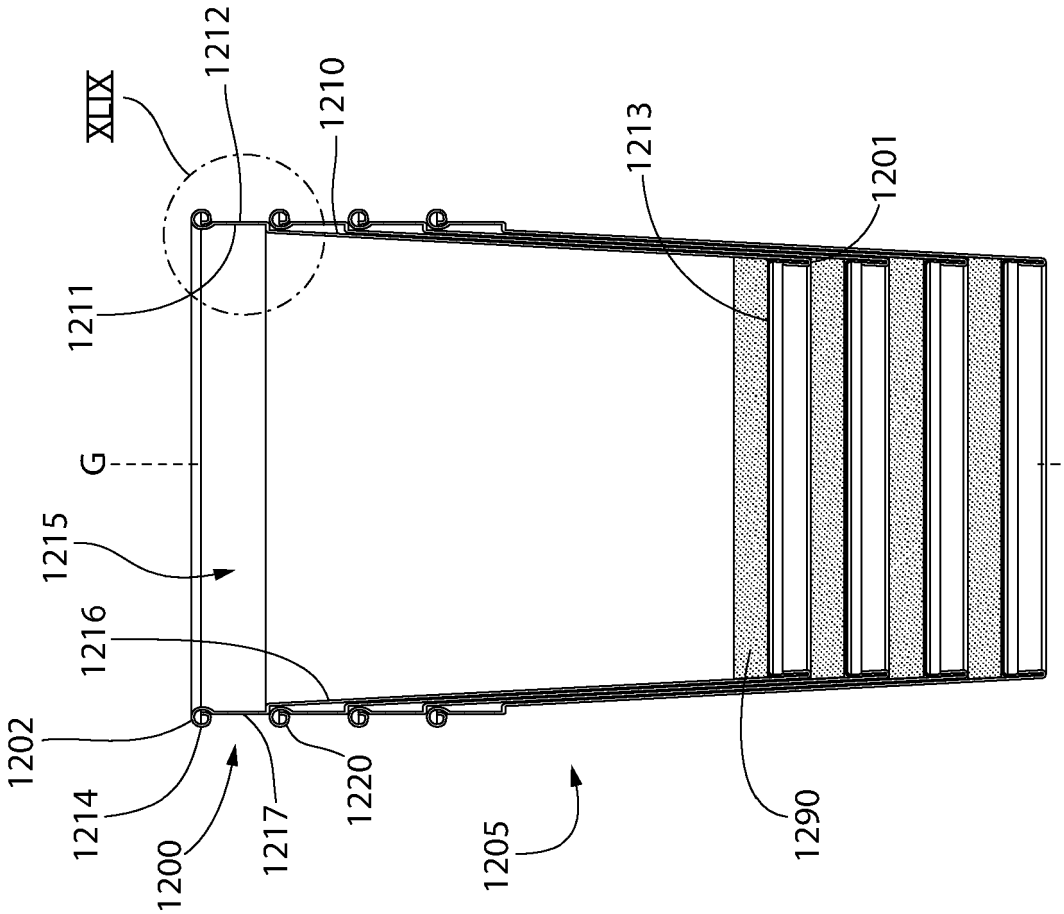
XLIX
1212
1210
1213
1201
1211
G
G
1215
1216
1202
1214
1200
1217
1220
1205
1290

FIG. 48

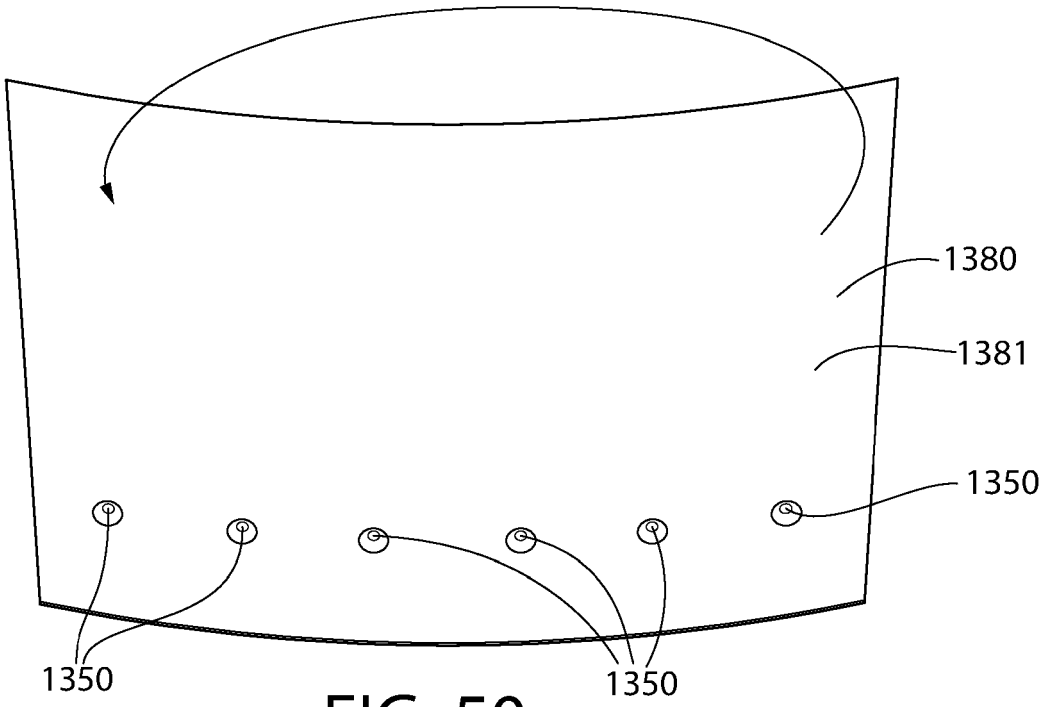

FIG. 50

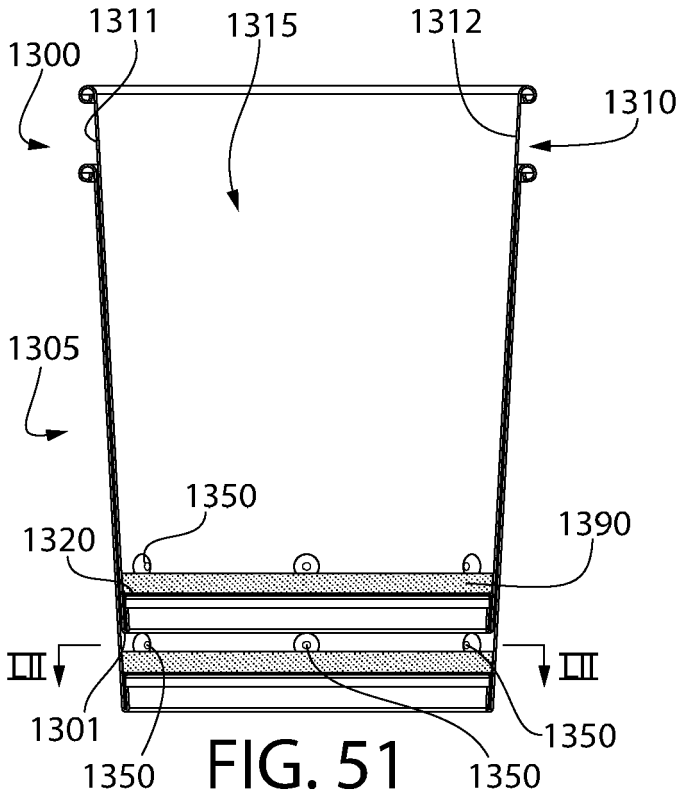

FIG. 51

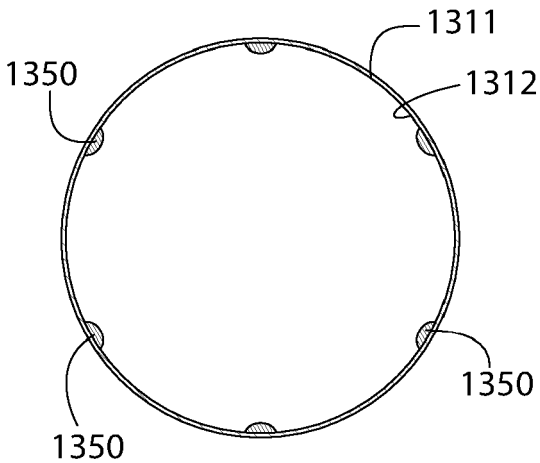

FIG. 52

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 62923844 **[0001]**
- EP 2195245 B1 **[0054]**