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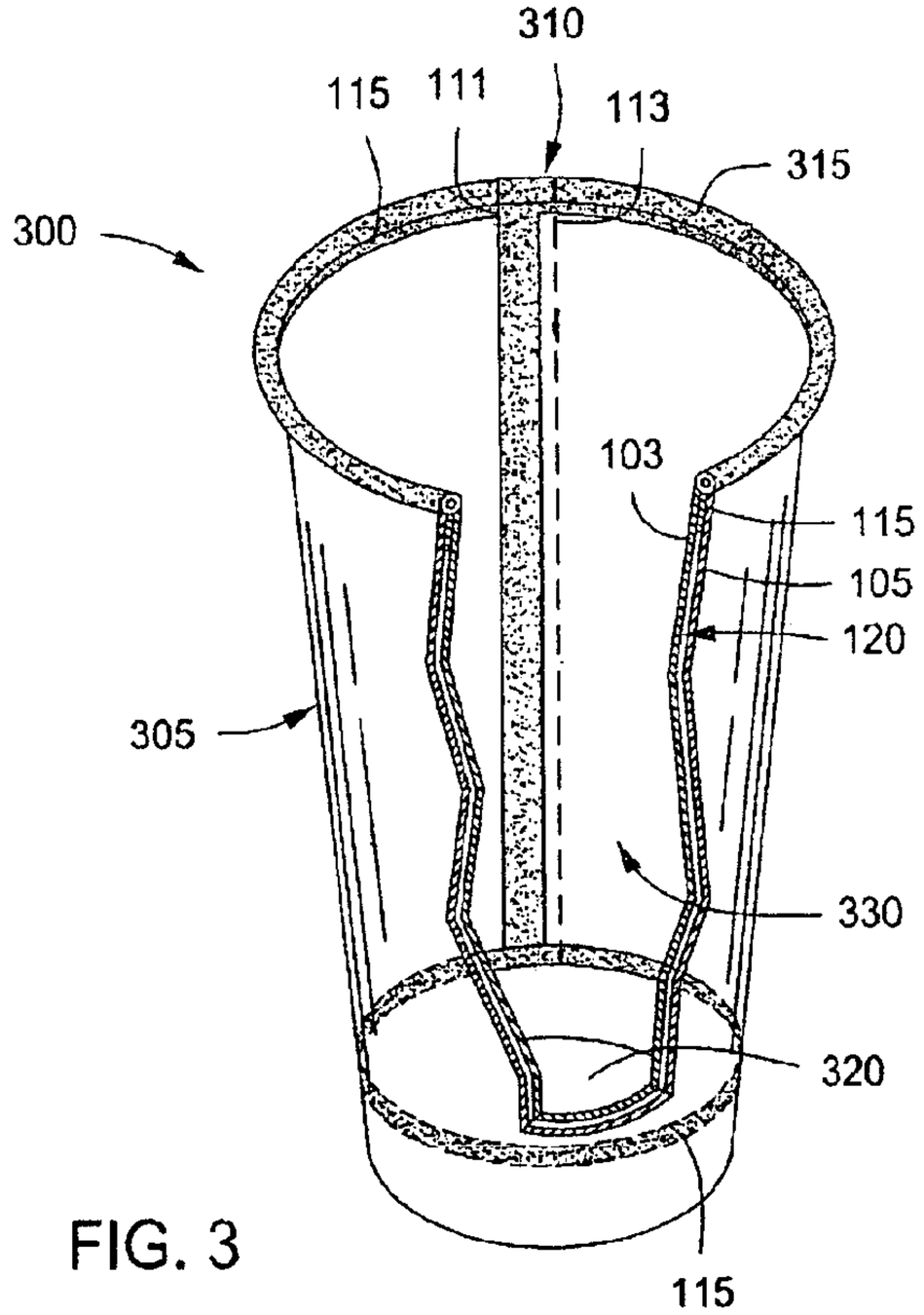

FIG. 3

(57) Abrégé/Abstract:
Methods for making containers from paperboard blanks having shrinkable films secured thereto. In one embodiment, a method for making a container may include applying adhesive about a paperboard substrate having first and second edges opposed to one

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(57) Abrégé(suite)/Abstract(continued):
another and third and a fourth edges opposed to one another, wherein the adhesive at least partially surrounds an area substantially free from adhesive. A shrinkable film may be secured to the paperboard with adhesive to produce a paperboard blank. The shrinkable film may be configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio greater than 1:1. The third and fourth edges may be overlapped to form a sidewall which may include an inner surface that includes the shrinkable film. A bottom panel may be secured to the sidewall at or adjacent second edge.

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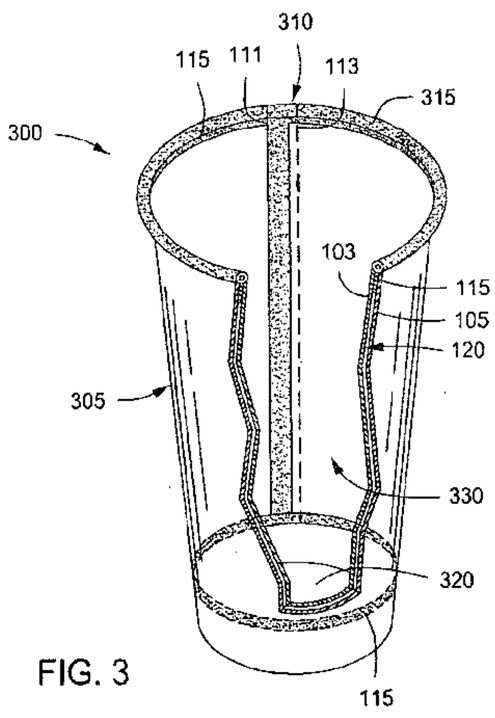

FIG. 3

(57) Abstract: Methods for making containers from paperboard blanks having shrinkable films secured thereto. In one embodiment, a method for making a container may include applying adhesive about a paperboard substrate having first and second edges opposed to one another and third and a fourth edges opposed to one another, wherein the adhesive at least partially surrounds an area substantially free from adhesive. A shrinkable film may be secured to the paperboard with adhesive to produce a paperboard blank. The shrinkable film may be configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio greater than 1:1. The third and fourth edges may be overlapped to form a sidewall which may include an inner surface that includes the shrinkable film. A bottom panel may be secured to the sidewall at or adjacent second edge.

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METHODS FOR MAKING PAPERBOARD CONTAINERS FROM PAPERBOARD BLANKS HAVING SHRINKABLE FILMS SECURED THERETO

BACKGROUND

Field

[0001] Embodiments described generally relate to methods for making paperboard containers from paperboard blanks. More particularly, the embodiments described relate to methods for making paperboard containers from paperboard blanks having shrinkable films secured thereto.

Description of the Related Art

[0002] Paperboard is used to make a wide variety of paper products, such as plates, bowls, and cups. Paper products may be insulated in a variety of ways to provide an insulated product, such as an insulated cup for hot or cold beverages. For example, the paper product may be insulated by forming an air gap within a sidewall of the container. The air gap, for example, may be located between a film that forms an inner surface of the sidewall and a paperboard substrate that forms an outer surface of the sidewall. The film may be a shrinkable film that may shrink, *e.g.*, a heat shrinkable film, to form the gap between the film and the paperboard substrate as the film shrinks.

[0003] Typically the paperboard blank that the shrinkable film is adhered to includes an outer and an inner coating of linear low density polyethylene or other polymer. When a composite structure includes paperboard and a shrink film to form an insulated container, a potential defect is that a shrink force induced by the shrink film may cause delamination within the paperboard component of the substrate. The layer of paperboard fibers which are adhered to the shrink film are peeled away as the film shrinks, producing an effect generally referred to as "peel back." Once the film peels back, the paperboard fibers are exposed and will begin to absorb liquid, *e.g.*, coffee, if present in the container. The absorption and migration of the liquid into the paperboard blank used to form the container is generally referred to as "edge wicking." The absorption of the liquid may reduce the structural integrity of the paperboard blank, is not aesthetically pleasing, and is generally undesirable.

[0004] There is a need, therefore, for improved paperboard blanks having shrinkable films secured thereto and methods for making paperboard containers therefrom.

SUMMARY

[0005] Methods for making paperboard containers from paperboard blanks having shrinkable films secured thereto are provided. In at least one specific embodiment, the method for making a paper container may include applying an adhesive about a paperboard substrate having a first edge and a second edge opposed to one another and a third edge and a fourth edge opposed to one another. The adhesive may at least partially surround an area that is substantially free from the adhesive. A shrinkable film may be secured to the paperboard substrate with the adhesive to produce a paperboard blank. The shrinkable film may be configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio that is greater than 1:1. The third edge and the fourth edge may be overlapped to form a sidewall. The sidewall may include an inner surface that includes the shrinkable film, an outer surface that includes the paperboard substrate, the first edge, and the second edge. A bottom panel may be secured to the sidewall at or adjacent the second edge. The first edge may be curled to form a brim

[0006] In at least one specific embodiment, the method for making a paper container may include applying an adhesive about a perimeter of a paperboard substrate having a first edge and a second edge opposed to one another and a third edge and a fourth edge opposed to one another. The adhesive may at least partially surround an area that is substantially free from the adhesive. A shrinkable film may be secured to the paperboard substrate with the adhesive to produce a paperboard blank. The shrinkable film may be configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio that is greater than 1:1. The third edge and the fourth edge may be overlapped with one another. The third edge and the fourth edge may be heat sealed to one another to form a sidewall. A bottom panel may be secured to the sidewall at or adjacent the second edge. The first edge may be curled to form a brim.

[0007] Paperboard blanks for making paper containers are also disclosed. In at least one specific embodiment, the paperboard blank may include a paperboard substrate and a shrinkable film. The paperboard substrate may have a first edge and a second edge opposed to one another and a third edge and a fourth edge opposed to one another. A portion of the shrinkable film may be secured to the paperboard substrate with an adhesive disposed between the paperboard substrate and the film. The shrinkable film may be configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio that is greater than 1:1.

BRIEF DESCRIPTION OF THE DRAWINGS

|0008| Figure 1 depicts a schematic view of an illustrative paperboard blank for making a cup, according to one or more embodiments described.

|0009| Figure 2 depicts a schematic cross-sectional view of the blank depicted in Figure 1 along line 2-2, according to one or more embodiments described.

|0010| Figure 3 depicts a partial cut away, perspective view of an illustrative paper cup, according to one or more embodiments described.

|0011| Figure 4 depicts a cross-section side view of a paper cup having a shrunk film and a gap formed or located between the shrunk film and a paperboard substrate, according to one or more embodiments described.

DETAILED DESCRIPTION

|0012| Figure 1 depicts a schematic view of an illustrative paperboard blank 100 for making a cup, according to one or more embodiments, and Figure 2 depicts a schematic cross-sectional view along line 2-2. Referring to Figures 1 and 2, the paperboard blank 100 may include a first layer or film 103 and a second layer or substrate 105. The film 103 and the substrate 105 may be secured to one another using any suitable method. For example, the film 103 and the substrate 105 may be at least partially bonded, coupled, affixed, joined, fastened, attached, connected, or otherwise secured to one another with an adhesive 115. In another example, the film 103 and the substrate 105 may be at least partially bonded, coupled, affixed, joined, fastened, attached, connected, or otherwise secured to one another via ultrasonic bonding. In one or more embodiments, the film 103 may be a shrinkable film and the substrate 105 may be a paperboard substrate. For simplicity and ease of description, embodiments provided herein will be further described with reference to a shrinkable film 103 and a paperboard substrate 105. When the substrate 105 is a paperboard substrate, the paperboard blank 100 may be formed into a paper product, such as a bowl, plate, container, tray, platter, deep dish container, fluted product, or cup. The terms "paper product," "paper containers," "paperboard products," and "paperboard containers" are intended to be interchangeable. For simplicity and ease of description, embodiments provided herein will be further described with reference to a paper cup.

|0013| The paperboard blank 100 may have a first or "top" edge 107, a second or "bottom" edge 109, a third or "left" edge 111, and a fourth or "right" edge 113. The particular shape of the paperboard blank 100 may depend, at least in part, on the particular container to be made

from the paperboard blank 100. For example, the paperboard blank 100 depicted in Figure 1 has arcuate first and second edges 107, 109 and straight third and fourth edges 111, 113 with the first and second edges 107, 109 generally opposed to one another and the third and fourth edges 111, 113 generally opposed to one another.

[0014] The adhesive 115 may be disposed between the shrinkable film 103 and the paperboard substrate 105. For example, the shrinkable film 103 may be secured to the paperboard substrate 105 with the adhesive 115 about at least a portion of an area or region along a perimeter, *e.g.*, edges 107, 109, 111, and 113, of the paperboard substrate 105. In at least one example, the adhesive 115 may be applied about or along the first edge 107, the second edge 109, the third edge 111, and the fourth edge 114 to form a band of adhesive 115 about the perimeter of the paperboard substrate. As used herein, the term "band" refers to a generally thin and generally flat strip of material, *e.g.*, a generally thin and a generally flat strip of the adhesive 115.

[0015] The adhesive 115 along the first edge 107 may extend from the third edge 111 to the fourth edge 113 and toward the second edge 109 to form a first portion 116 of the band of adhesive 115. The adhesive 115 along the second edge 109 may extend from the third edge 111 to the fourth edge 113 and toward the first edge 107 to form a second portion 117 of the band of adhesive 115. The adhesive 115 along the third edge 111 may extend from the first portion 116 of the band of adhesive 115 to the second portion 117 of the band of adhesive 115 and toward the fourth edge 113 to form a third portion 118 of the band of adhesive 115. The adhesive 115 along the fourth edge 113 may extend from the first portion 116 of the band of adhesive 115 to the second portion 117 of the band of adhesive 115 and toward the third edge 111 to form a fourth portion 119 of the band of adhesive 115. Accordingly, the first portion 116, the second portion 117, the third portion 118, and the fourth portion 119 may form a continuous band of adhesive 115 about the perimeter of the paperboard substrate 105.

[0016] The first portion 116, the second portion 117, the third portion 118, and the fourth portion 119 of the band of adhesive 115 may surround or at least partially surround a region or area 120 that may be free or substantially free from the adhesive 115. For example, the area 120 between the shrinkable film 103 and the paperboard substrate 105 may be free or substantially free from the adhesive 115 such that the shrinkable film 103 may be free to move away from the paperboard substrate 105 as the shrinkable film 103 shrinks. When the paperboard blank 100 has been formed into a container and the shrinkable film 103 shrinks, a

gap may be formed between the film 103 and the paperboard substrate 105 as discussed and described in further detail below with reference to Figure 4. As shown in Figures 1 and 2, the adhesive 115 along the first edge 107, the second edge 109, the third edge 111, and the fourth edge 113 may be at the outer edge or perimeter of the paperboard substrate 105. In one or more other embodiments, however, the adhesive 115 along at least one of the first edge 107, the second edge 109, the third edge 111, and/or the fourth edge 113 may be set back from the respective edge. For example, a second area free or substantially free from adhesive 115 may be located between the first edge 107, the second edge 109, the third edge 111, and/or the fourth edge 113 and the band of adhesive 115 that may surround or at least partially surround the area 120.

[0017] In one or more embodiments, the shrinkable film 103 may be adapted or configured to shrink a greater amount along a first direction or first axis as compared to an amount along a second direction or second axis that is perpendicular to the first direction or first axis when the shrinkable film 103 shrinks. For example, the shrinkable film 103 may be configured to shrink a greater amount along a first axis that runs through the third edge 111 and the fourth edge 113 of the paperboard blank as compared to a second axis that runs through the first edge 107 and the second edge 109 and is perpendicular to the first axis. The shrinkable film 103 configured to shrink a greater amount in the first axis relative to the second axis when the shrinkable film 103 shrinks may be used to form blanks 100 suitable for making a paperboard product in which the shrinkable film 103 has a reduced amount of peel back along the third edge 111 from the paperboard substrate 105 when the shrinkable film 103 shrinks as compared to a comparative blank that is the same except a shrinkable film configured to shrink in substantially the same amount along both the first direction and the second direction is used. The shrinkable film 103 configured to shrink a greater amount in the first axis relative to the second axis may also be used to form blanks 100 suitable for making a paperboard product in which the shrinkable film 103 has a reduced tendency to unwind or otherwise undo a brim curl when the shrinkable film 103 shrinks as compared to a comparative blank that is the same except a shrinkable film configured to shrink in substantially the same amount in both the first direction and the second direction is used.

[0018] In one or more embodiments, a ratio between an amount or extent the shrinkable film 103 is configured to shrink along the first axis relative to an amount the shrinkable film 103 is configured to shrink along the second axis that is perpendicular to the first axis may be greater than 1:1. For example, the ratio between the amount the shrinkable film 103 is

configured to shrink along the first axis relative to the amount the shrinkable film 103 is configured to shrink along the second axis may range from a low of about 1.05:1, about 1.1:1, about 1.2:1, about 1.3:1, about 1.6:1, or about 2:1 to a high of about 2.5:1, about 3.5:1, about 5:1, about 7:1, about 10:1, about 20:1, about 30:1, about 40:1, or about 50:1 or more. In another example, the ratio between the amount the shrinkable film 103 is configured to shrink along the first axis relative to the amount the shrinkable film 103 is configured to shrink along the second axis may range from a low of about 1.05:1, about 1.1, about 1.5, or about 2:1 to a high of about 25:1, about 35:1, about 45:1, about 60:1, about 80:1, about 90:1, about 100:1, or about 150:1 or more.

[0019] In one or more embodiments, the shrinkable film 103 may shrink when subjected to one or more predetermined triggers or conditions. For example, the shrinkable film 103 may be a heat shrinkable film, *i.e.*, a film that shrinks when heated to a sufficient temperature. For example, the shrinkable film 103 may shrink when heated to a temperature of about 40°C or more, about 80°C or more, about 90°C, about 100°C or more. In at least one example, the film 103 may shrink when exposed to a hot liquid. In at least one other example, the film 103 may shrink when heated in an oven, by contact with a flow of heated gas, or other heating means. In at least one other example, the film 103 may shrink when heated, when exposed to infrared light, when exposed to microwaves, when exposed to any other suitable trigger, or any combination thereof.

[0020] The shrinkable film 103 may be uniaxially or biaxially oriented. In at least one specific example, the shrinkable film 103 may be a biaxially oriented, heat shrinkable polymeric film configured to shrink a greater amount in the transverse direction relative to the machine direction. In at least one specific example, the shrinkable film 103 may be a uniaxially oriented, heat shrinkable polymeric film configured to shrink a greater amount in the transverse direction relative to the machine direction. The shrinkable film 103 may be a mono-layer film or a multi-layer film. A multilayer film 103 may have 2, 3, 4, 5, 6, 7, 8, or more layers. The film 103 may include a core layer or intermediate layer, and one or more outer layers or skin layers such as a first outer layer and a second outer layer. The film 103 may include a core layer or intermediate layer one or more tie layers, and one or more outer layers. For example, the film 103 may include a core layer, a first tie layer and a second tie layer disposed on opposing sides of the core layer, a first outer layer disposed on the first tie layer, and a second outer layer disposed on the second tie layer.

[0021] The shrinkable film 103 may be or include any suitable film. For example, the shrinkable film 103 may be or include a polyethylene film, a polypropylene film, a polyethylene terephthalate film, a cellophane film, a polyamide film, or any combination thereof. In another example, the shrinkable film 103 may be or include a butylene polymer, ethylene polymer, high density polyethylene (HDPE) polymer, medium density polyethylene (MDPE) polymer, low density polyethylene (LDPE) polymer, linear low density polyethylene (LLDPE), propylene (PP) polymer, isotactic polypropylene (iPP) polymer, high crystallinity polypropylene (HCPP) polymer, ethylene-propylene (EP) copolymers, ethylene-propylene-butylene (EPB) terpolymers, propylene-butylene (PB) copolymer, an ethylene elastomer, ethylene-based plastomer, propylene elastomer and combinations or blends thereof. In another example, the shrinkable film 103 may be or include polyethylene, polypropylene, polyvinylchloride (PVC), polymethylpentene, polybutene-1, polyolefin elastomers, polyisobutylene, ethylene propylene rubber, or any mixture or combination thereof.

[0022] The polyolefin film may also include one or more additives. Illustrative additives may include, but are not limited to, tackifiers, waxes, functionalized polymers such as acid modified polyolefins and/or anhydride modified polyolefins, antioxidants, oils, compatabilizers, fillers, adjuvants, adhesion promoters, plasticizers, low molecular weight polymers, blocking agents, antiblocking agents, anti-static agents, release agents, anti-cling additives, colorants, dyes, pigments, processing aids, UV stabilizers, heat stabilizers, neutralizers, lubricants, surfactants, nucleating agents, flexibilizers, rubbers, optical brighteners, colorants, diluents, viscosity modifiers, oxidized polyolefins, and any combination or mixture thereof.

[0023] The total thickness of the resulting monolayer and/or multilayer shrinkable film 103 may vary. For example, a total film thickness of about 5 μm to about 50 μm or about 10 μm to about 30 μm may be suitable for most paperboard containers. In another example, the shrinkable film 103 may have a thickness from a low of about 5 μm, about 10 μm, or about 15 μm to a high of about 20 μm, about 25 μm, about 30 μm, or about 35 μm. In one or more embodiments, the thickness of the shrinkable film 103 may be sufficient to reduce or prevent the shrinkable film 103 from breaking, tearing, ripping, or otherwise forming holes therethrough.

[0024] In one or more embodiments, a surface area of the shrinkable film 103 may shrink or reduce from an original or starting surface area to a second or final surface area in an amount

of about 5%, about 10%, about 15%, about 20%, about 25%, about 30%, about 35%, about 40%, about 45%, about 50%, about 55%, or about 60% based on the original or starting surface area. For example, the surface area of the shrinkable film 103 may shrink or reduce from an original or starting surface area to a second or final surface area in an amount of about 10% to about 30%, about 15% to about 30%, about 8% to about 20%, about 15% to about 35%, about 12% to about 33%, about 25% to about 35%, or about 10% to about 40%. In another example, a heat shrink film having a surface area of about 100 cm^2 may be reduced to about 95 cm^2, about 90 cm^2, about 85 cm^2, about 80 cm^2, about 75 cm^2, about 70 cm^2, about 65 cm^2, about 60 cm^2, about 55 cm^2, about 50 cm^2, about 45 cm^2, or about 40 cm^2 when subjected to a temperature of about 40°C to about 100°C. In at least one specific example, the surface area of the shrinkable film 103 may shrink in an amount of about 30% to about 45%, about 35% to about 50%, about 35% to about 45%, about 40% to about 50%, about 45% to about 55%, about 50% to about 60%, or about 40% to about 60% when heated to a temperature of about 102°C for a time of 10 minutes. The shrinkage of the shrinkable film 103 may be measured according to ASTM D1204.

[0025] As shown in Figure 1, the adhesive 115 may be disposed between the shrinkable film 103 and the paperboard substrate 105 along the perimeter of the paperboard blank 100. The width of the band of adhesive 115 or "glue line" disposed between the shrinkable film 103 and the paperboard substrate 105 and along the first edge 107, the second edge 109, the third edge 111, and the fourth edge 113 may range from a low of about 1 mm, about 2 mm, or about 3 mm to a high of about 5 mm, about 10 mm, about 20 mm, or about 30 mm or more.

[0026] The width of the band of adhesive 115 or glue line along each edge 107, 109, 111, and 113 of the paperboard substrate 105 may be the same or different with respect to one another. Said another way, the width of the first portion 116, the width of the second portion 117, the width of the third portion 118, and the width of the fourth portion 119 of the band of adhesive 115 may be the same or different with respect to one another. For example, the width of the band of adhesive 115 along the first edge 107 may be less than the width of the band of adhesive 115 along the second edge 109, less than the width of the band of adhesive 115 along the third edge 111, and/or less than the width of the band of adhesive 115 along the fourth edge 113. In another example, the width of the band of adhesive 115 along the third edge 111 may be less than the width of the band of adhesive 115 along the first edge 107, less than the width of the band of adhesive 115 along the second edge 109 and/or less than the width of the band of adhesive 115 along the fourth edge 113. In another example, the width

of the band of adhesive 115 along the fourth edge 113 may be less than the width of the band of adhesive 115 along the first edge 107, less than the width of the band of adhesive 115 along the second edge 109 and/or less than the width of the band of adhesive 115 along the third edge 111. In another example, the width of the band of adhesive 115 along the first edge 107 may be less than the width of the band of adhesive 115 along the third edge 111, which may be less than the width of the band of adhesive 115 along the fourth edge 113, which may be less than the width of the band of adhesive 115 along the second edge 109.

[0027] The adhesive 115 may be applied onto the shrinkable film 103 and/or the paperboard substrate 105 to provide the area 120 that may be free or substantially free from any adhesive 115 using any suitable method or combination of methods known in the art. For example, the adhesive 115 may be applied to the paperboard substrate 105 via spraying, brushing, flexographic printing, rotogravure printing, offset printing, screen printing, or any other suitable coating method. Suitable methods for applying the adhesive 115 to the shrinkable film 103 and/or the paperboard substrate 105 may also include those discussed and described in U.S. Patent Nos.: 6,536,657; 6,729,534; 7,464,856; 7,614,993; 7,600,669; 7,464,857; 7,913,873; 7,938,313; 7,513,386; 7,510,098; 7,841,974; 8,622,232 and U.S. Patent Application Publication Nos.: 2011/0031305; 2012/0312869; and 2013/0341387.

[0028] The adhesive 115 may be a single or one part adhesive or glue. As used herein, the terms "single part" and "one part," when used in conjunction with "adhesive" or "glue," refer to an adhesive or an adhesive system that does not require the addition of a hardener, catalyst, accelerant, or other cure component or agent required to make the adhesive curable. Said another way, the adhesive 115 may include two or more different components, but the adhesive may be of a type that does not require adding a second component to the adhesive to form a curable adhesive. As such, the adhesive 115 may be storage stable for weeks, months, or even years and upon application of the adhesive 115 to the first or second layer, the adhesive 115 may be cured without the need for a hardener, catalyst, accelerator, or other cure agent.

[0029] The adhesive 115 may be or include a polyethylene vinyl acetate resin or any other suitable adhesive or mixture of adhesives. The adhesive 115 may include one or more additives. Illustrative additives may include, but are not limited to, one or more tackifiers. Suitable tackifiers may include, but are not limited to, ethyl p-toluene sulfonamide. In one or more embodiments, the amount of the additive, *e.g.*, the tackifier, if present, may range from

a low of about 1 wt%, about 3 wt%, or about 5 wt% to a high of about 10 wt%, about 12 wt%, or about 15 wt%, based on the total weight of the adhesive.

[0030] Commercially available adhesives suitable for use as the adhesive 115 discussed and described above and elsewhere herein may include, but are not limited to, AQUENCE® FB 9192 VELOCITY® and AQUENCE® FB 9080 VELOCITY®, both available from Henkel Corporation. It is believed that the AQUENCE® FB 9192 VELOCITY® and AQUENCE® FB 9080 VELOCITY® adhesives are both polyethylene vinyl acetate resins, with the AQUENCE® FB 9192 VELOCITY® including the addition of ethyl p-toluene sulfonamide (tackifier) in an amount of about 5 wt% to about 10 wt%, based on the total weight of the adhesive.

[0031] The second layer 105 may be or include any paperboard material capable of forming a desired paper container. It should be noted that the second layer 105 may be or include non-paperboard or non-paper based materials such as one or more polymers, *e.g.*, polyolefins, and/or metals, *e.g.*, aluminum. In one or more embodiments, paperboard materials suitable for use as the second layer or substrate 105 may have a basis weight ranging from a low of about 163 grams, about 210 grams, or about 275 grams to a high of about 325 grams, about 400 grams, or about 500 grams per square meter of paperboard substrate. In one or more embodiments, the paperboard material may have a thickness ranging from a low of about 175 μm, about 225 μm, or about 250 μm to a high of about 350 μm, 450 μm, about 600 μm, about 750 μm, or about 1,000 μm.

[0032] If the second layer 105 is or includes paperboard, the paperboard may be coated or uncoated with one or more additional materials. For example, the paperboard may be uncoated, *e.g.*, free from wax, clay, polyethylene, and other coating material. In another example, the paperboard may be or include paperboard coated with one or more waxes, one or more clays, and/or one or more polyolefins on one or both sides. For example, the paperboard may be coated with polyethylene using any suitable process. In one example, a polyethylene coating may be applied to the paperboard via an extrusion process. Polyethylene and/or other polymeric materials may be coated onto the paperboard to provide liquid resistance properties and/or serve as a heat sealable coating. Suitable polymeric materials that may be used to coat the paperboard may include, but are not limited to, polyethylene, polypropylene, polyester, or any combination thereof. If the paperboard is coated with a material, *e.g.*, wax or polymeric material, the coating may have a thickness

ranging from a low of about 0.002 mm, about 0.01 mm, or about 0.1 mm to a high of about 0.15 mm, about 0.2 mm, or about 0.35 mm.

[0033] Commercially available paperboard material that may be used as the second layer 105 may include, but is not limited to, solid bleached sulfate (SBS) cupstock, bleached virgin board, unbleached virgin board, recycled bleached board, recycled unbleached board, or any combination thereof. For example, SBS cupstock available from Georgia-Pacific LLC may be used as the second layer 105.

[0034] In one or more embodiments, at least a portion of the surface(s) of the shrinkable film 103 and/or the second layer 105, *e.g.*, a paperboard substrate, may be oxidized via corona treatment and/or flame discharge treatment. Oxidizing the surface of the shrinkable film 103 and/or the second layer 105 may increase or raise the surface energy of the treated surface. In one or more embodiments, the shrinkable film 103 may have a surface energy, treated or untreated, greater than about 30 dyne/cm, greater than about 35 dyne/cm, greater than about 38 dyne/cm, greater than about 40 dyne/cm, greater than about 42 dyne/cm, greater than about 44 dyne/cm, or greater than about 46 dyne/cm. In at least one embodiment, the surface of the shrinkable film 103 that contacts the adhesive 115, the surface of the second layer 105 that contacts the adhesive 115, and/or the surface of the second layer 105 that may be coated with ink may be subjected to corona and/or flame treatment.

[0035] The method for securing the shrinkable film 103 to the paperboard substrate or second layer 105 may include applying the adhesive 115 to the shrinkable film 103 and/or the second layer 105. The shrinkable film 103 and the second layer 105 may be contacted with one another such that the adhesive 115 may at least partially secure the shrinkable film 103 to the second layer 105. In one or more embodiments, the amount of adhesive 115 applied to the shrinkable film 103 and/or the second layer 105 may range from a low of about 0.04 kg, about 0.1 kg, about 0.5 kg, or about 1.3 kg to a high of about 2 kg, about 3.5 kg, or about 5.5 kg of adhesive 115 per 279 square meters of the shrinkable film 103 or second layer 105. Multiple coatings of the adhesive 115 may be applied to achieve the aforementioned amounts.

[0036] The paperboard blank 100 may be formed as part of a paperboard roll (not shown) that includes a plurality of paperboard blanks 100 formed therein. The paperboard blank 100 may be cut from the paperboard roll. A paperboard roll may be formed that includes any suitable number of paperboard blanks formed therein.

[0037] Figure 3 depicts a partial cut away perspective view of a paper cup 300, according to one or more embodiments. The paperboard blank 100 may be formed, *e.g.*, rolled, folded, bent, curled, or otherwise configured to form a frusto-conical sidewall 305. For example, the third and fourth edges 111, 113 may be overlapped and secured to one another, *e.g.*, via heat sealing, to form the frusto-conical sidewall 305 having a seam 310. The shrinkable film 303 may form or provide at least a portion of an inner surface of the frusto-conical sidewall 305 and the paperboard substrate 105 may form or provide at least a portion of the outer surface of the sidewall 305. As shown in Figure 3, the shrinkable film 103 has not been shrunk to provide a shrunk film 103.

[0038] The sidewall 305 may be formed by rolling, curling, folding, bending, or otherwise placing the third and fourth edges 111, 113 of the paperboard blank 100 depicted in Figure 1 in contact with one another to form the seam 310. For example, the paperboard blank 100 may be formed around a mandrel to form the seam 310. As such, the first edge 107 may form a first or "top" edge of the sidewall 305 and the second edge 109 may form a second or "bottom" edge of the sidewall 305. If the paperboard substrate 105 is coated with a polymeric material, *e.g.*, polyethylene, the sidewall 305 may be heat sealed or ultrasonically welded to provide a sealed seam 310. The seam 310 may also be sealed with one or more adhesives, *e.g.*, the adhesive 115 or any other adhesive suitable for sealing the third and fourth edges 111, 113 to one another. As shown, the adhesive 115 may be used to secure the shrinkable film 103 to the paperboard substrate 105 along the third and fourth edges 111, 113 and, as such, may be present within the seam 310.

[0039] The first edge 107 may be rolled, folded, curled, bent, or otherwise configured to form a brim or "brim curl" 315, which becomes an edge or "top" edge of the sidewall 305. More particularly, to form the brim curl, the edge 107 of the paperboard blank 100 may be rolled, urged, or curled such that the outer or distal end of the edge turns and contacts the paperboard substrate 105 and maintains this position. The brim curl may traverse the perimeter or circumference or only a portion thereof of a first or "top" edge of the paperboard product.

[0040] The second edge 109 of the paperboard blank 100 may form a second or "bottom" edge of the sidewall 305. A bottom panel 320 of the paper cup 300 may be disposed on or otherwise secured to the sidewall 305, *e.g.*, proximate or adjacent the second edge of the sidewall, such that the sidewall 305 and the bottom panel 320 define a container volume 330. The bottom panel 320 may be coupled, affixed, joined, fastened, attached, connected, or otherwise secured to the sidewall 305 with the adhesive 115, another adhesive, and/or via

other means such as by heat sealing. For example, similar to the paperboard substrate 105, the bottom panel 320 may be coated in a polymeric material capable of forming a seal between the polymeric material, if present, on the paperboard substrate. In one or more embodiments, the second edge 109 may be folded inward and may overlap a rim or one or more tabs extending downward form the bottom panel 320.

[0041] The outer and/or inner surface of the sidewall 305 may include one or more printed patterns that may be applied to the paperboard substrate 105. "Printed patterns" and like terminology may refer to ink-printed patterns for aesthetics. Such features, however, may have a functional aspect such as indicating a fill line.

[0042] The paper cup 300 may have any suitable container volume 330. For example, the container volume 330 may range from a low of about 20 mL, about 40 mL, about 60 mL, about 80 mL, or about 100 mL to a high of about 120 mL, about 200 mL, about 300 mL, about 400 mL, about 500 mL, about 750 mL, about 1,000 mL, about 1,300 mL, or about 1,500 mL or more. For example, the container volume 330 may be from about 150 mL to about 500 mL, about 450 mL to about 1,000 mL, about 400 mL to about 900 mL, or about 800 mL to about 1,300 mL.

[0043] Figure 4 depicts a cross-sectional elevation view of a paper cup 400 a shrunk film 103 and a gap 404 formed or located between the shrunk film 103 and a paperboard substrate 105, according to one or more embodiments. The paper cup 400 may also include a brim curl 415 and a bottom panel 420. As the shrinkable film 103 shrinks, the gap 404 may be formed between the non-secured portions of the shrinkable film 103 and the paperboard substrate 105. The gap 404 may provide an insulating property to the paper cup 400. For example, a heated liquid having a temperature from a low of about 70°C, about 75°C, or about 80°C to a high of about 90°C, about 95°C, about 100°C, or about 110°C or more may be added to the paper cup 400 to cause the shrinkable film 103 to shrink and form the insulating gap 404. The formation or presence of the gap 404 may provide an outer surface of the paper cup 400 insulated from the hot liquid therein. The temperature of the outer surface of the paper cup 400 may be less than about 70°C, less than about 65°C, less than about 60°C, less than about 55°C, less than about 50°C, less than about 45°C, less than about 40°C, or less than about 35°C, when a liquid at a temperature of 95°C to about 100°C is contained within the paper cup 400. As such, a person may hold the paper cup 400 containing the heated liquid therein about the outer surface of the container without being burned or otherwise experiencing an unsatisfactory level of discomfort due to the heated liquid within the paper cup 400.

[0044] The time required for the shrinkable film 103 to shrink or transition between an initial state to a shrunk state may vary based on one or more factors such as the area of the shrinkable film, the thickness of the shrinkable film, the temperature of the hot fluid placed into contact or otherwise in a heat exchanging relationship with the shrinkable film 103, an amount or flow rate of air or other fluid into a volume or space or "gap" formed between the shrinkable film 103 and the second layer 105 as the shrinkable film 103 shrinks, or combinations of these and/or other factors. As used herein, the term "initial state" refers to the shrinkable film 103 after being secured to the paperboard substrate 105 and after the paper cup 600 has been formed. It should be noted that the shrinkable film 103 may be annealed or otherwise treated or processed during manufacture of the shrinkable film 103 and annealing or otherwise treating the shrinkable film 103 may cause the shrinkable film to shrink some, but not shrink to a maximum amount the shrinkable film 103 is capable of being shrunk.

[0045] In one or more embodiments, the amount of time required for the shrinkable film 103 to go from the initial state to the shrunk state may be about 10 seconds or less, about 9 seconds or less, about 8 seconds or less, about 7 seconds or less, about 6 seconds or less, about 5 seconds or less, about 4 seconds or less, about 3 seconds or less, about 2 seconds or less, about 1 second or less, or about 0.5 seconds or less per 100 mL of container volume 430, when a fluid at a temperature of about 70°C to about 100°C contacts the shrinkable film 103. For example, the shrinkable film 103 may transition from the initial state to the shrunk state in a time of about 0.5 seconds to 2 seconds per 100 mL of container volume 430, when a fluid at a temperature of about 80°C to about 100°C contacts the shrinkable film 103. For example, if the container volume is about 600 mL the shrinkable film 103 may transition from the initial state to the shrunk state in about 3 seconds to about 12 seconds when a fluid at a temperature of about 90°C contacts the shrinkable film 103.

[0046] As shown in Figure 4, the paperboard substrate 105 may include one or more vents (two are shown 406) formed or defined therethrough. The vent 406 may serve as a flow path for air or other gas to flow from a location exterior the paperboard substrate 105 and into the gap 103. While the shrinkable film 103 may shrink without the presence of one or more vents 406, the one or more vents 406 may help the shrinkable film 103 shrink. As the shrinkable film 103 shrinks, a vacuum may be formed between the paperboard substrate 105 and the shrinkable film 103. The presence of a vacuum may reduce and/or prevent the shrinkable film 103 from shrinking or shrinking a desired amount. Having the one or more

vents 406 formed through the paperboard substrate 105 may permit air or other fluid to flow into the gap 404 as the shrinkable film 103 shrinks. As such, the formation of the one or more vents 406 through the paperboard substrate 105 may provide a plurality of paper containers, *e.g.*, the paper cup 400, that have shrinkable films 103 that shrink in a more consistent and reliable manner. Reliable and consistent shrinkage of the shrinkable film 103 may provide a more commercially desirable product for sale to consumers.

[0047] The vents 406 may be cut through the paperboard substrate 105 using a knife, punch, pin, other rigid apparatus capable of puncturing the paperboard substrate 105, a laser, or any other suitable apparatus or technique. Suitable shapes of the one or more vents 406 may include, but are not limited to, U-shaped vents, large flaps, small flaps, slits, perforations, x-shaped cut-outs, round holes, or any other shape. If two or more vents 406 are formed through the paperboard substrate 105, the shape or configuration and/or size of the two or more vents 406 may be the same or different with respect to one another. In one or more embodiments, the vents 406 may also be formed via burning. Suitable methods form forming the vents 406 via burning may include those discussed and described in U.S. Patent Application Publication No. 2012/0312869.

[0048] As the shrinkable film 103 shrinks, the amount of liquid the paperboard container may hold may be reduced. As shown in Figure 4, the gap 404 occupies a space or volume within the paper cup 400 that would not contain any liquid if liquid were present within the internal volume 430. For example, the container volume 430 may be reduced by about 35% or less, about 30% or less, about 25% or less, about 20% or less, about 15% or less about 10% or less, or about 5% or less with the shrinkable film 103 shrunk and the gap formed 404 as compared to the container volume 430 before the shrinkable film 103 shrinks. Accordingly, the paper cup 400 may be oversized in order to provide a paper cup 400 capable of containing a desired amount of a liquid when filled.

[0049] Embodiments of the present disclosure further relate to any one or more of the following paragraphs:

[0050] 1. A method for making a paper container, comprising: applying an adhesive about a paperboard substrate having a first edge and a second edge opposed to one another and a third edge and a fourth edge opposed to one another, wherein the adhesive at least partially surrounds an area that is substantially free from the adhesive; securing a shrinkable film to the paperboard substrate with the adhesive to produce a paperboard blank, wherein the

shrinkable film is configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio that is greater than 1:1; overlapping the third edge and the fourth edge to form a sidewall, wherein the sidewall comprises: an inner surface comprising the shrinkable film and an outer surface comprising the paperboard substrate, the first edge, and the second edge; securing a bottom panel to the sidewall at or adjacent the second edge; and curling the first edge to form a brim.

[0051] 2. The method according to paragraph 1, wherein the first axis runs through the third edge and the fourth edge.

[0052] 3. The method according to paragraph 1 or 2, wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio that is greater than 5:1.

[0053] 4. The method according to any one of paragraph 1 or 2, wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio of about 2:1 to about 50:1.

[0054] 5. The method according to any one of paragraphs 1, 2, or 4, wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio of about 2:1 to about 20:1.

[0055] 6. The method according to any one of paragraphs 1 to 5, wherein the shrinkable film comprises a biaxially oriented heat shrinkable polymeric material.

[0056] 7. The method according to any one of paragraphs 1 to 6, wherein the shrinkable film comprises polyethylene, polypropylene, or a mixture thereof.

[0057] 8. The method according to any one of paragraphs 1 to 7, wherein the paperboard substrate comprises a first coating and a second coating disposed on opposing sides of a paperboard layer, and wherein the first and second coatings comprise a polyolefin.

[0058] 9. The method according to any one of paragraphs 1 to 8, wherein the adhesive is applied along the perimeter of the substrate by flexographic printing, rotogravure printing, offset printing, screen printing, or any combination thereof.

[0059] 10. The method according to any one of paragraphs 1 to 9, further comprising forming at least one aperture through the paperboard substrate prior to securing the shrinkable film to the paperboard substrate.

[0060] 11. A method for making a paper container, comprising: applying an adhesive about a perimeter of a paperboard substrate having a first edge and a second edge opposed to one another and a third edge and a fourth edge opposed to one another, wherein the adhesive at least partially surrounds an area that is substantially free from the adhesive; securing a shrinkable film to the paperboard substrate with the adhesive to produce a paperboard blank, wherein the shrinkable film is configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio that is greater than 1:1; overlapping the third edge and the fourth edge with one another; heat sealing the third edge and the fourth edge to one another to form a sidewall; securing a bottom panel to the sidewall at or adjacent the second edge; and curling the first edge to form a brim.

[0061] 12. The method according to paragraph 11, wherein the first axis runs between the first edge and the second edge, and wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio of about 2:1 to about 50:1.

[0062] 13. The method according to paragraph 11 or 12, wherein the shrinkable film comprises a biaxially oriented heat shrinkable polymeric material.

[0063] 14. The method according to any one of paragraphs 11 to 13, wherein the paperboard substrate comprises a first coating and a second coating disposed on opposing sides of a paperboard layer, and wherein the first and second coatings comprise a polyolefin.

[0064] 15. The method according to any one of paragraphs 11 to 14, further comprising forming at least one aperture through the paperboard substrate prior to securing the shrinkable film to the paperboard substrate.

[0065] 16. A paperboard blank for making a paper container, comprising: a paperboard substrate having a first edge and a second edge opposed to one another and a third edge and a fourth edge opposed to one another; and a shrinkable film, wherein a portion of the shrinkable film is secured to the paperboard substrate with an adhesive disposed between the paperboard substrate and the film, wherein the shrinkable film is configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio that is greater than 1:1.

[0066] 17. The paperboard blank according to paragraph 16, wherein the first axis runs through the first edge and the second edge, and wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio of about 2:1 to about 50:1.

[0067] 18. The paperboard blank according to paragraph 16, wherein the first axis runs through the third edge and the fourth edge, and wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio of about 2:1 to about 50:1.

[0068] 19. The paperboard blank according to paragraph 16 or 18, wherein the shrinkable film comprises polyethylene, polypropylene, or a mixture thereof.

[0069] 20. The paperboard blank according to any one of paragraphs 16 to 19, wherein the paperboard substrate comprises a first coating and a second coating disposed on opposing sides of a paperboard layer, and wherein the first and second coatings comprise a polyolefin.

[0070] 21. The paperboard blank according to any one of paragraphs 16 to 20, wherein the paperboard substrate comprises one or more apertures formed therethrough.

[0071] 22. The paperboard blank according to any one of paragraphs 16 to 21, wherein the paperboard blank is formed into a sidewall of a container.

[0072] 23. The paperboard blank according to any one of paragraphs 16 to 22, wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio that is greater than 5:1.

[0073] 24. The paperboard blank according to any one of paragraphs 16 to 22, wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio that is about 2:1 to about 20:1.

[0074] 25. The paperboard blank according to any one of paragraphs 16 to 24, wherein the shrinkable film comprises a biaxially oriented heat shrinkable polymeric material.

[0075] 26. The paperboard blank according to any one of paragraphs 16 to 25, wherein the adhesive is applied along the perimeter of the substrate by flexographic printing, rotogravure printing, offset printing, screen printing, or any combination thereof.

[0076] Certain embodiments and features have been described using a set of numerical upper limits and a set of numerical lower limits. It should be appreciated that ranges including the combination of any two values, *e.g.*, the combination of any lower value with any upper value, the combination of any two lower values, and/or the combination of any two upper values are contemplated unless otherwise indicated. Certain lower limits, upper limits and ranges appear in one or more claims below. All numerical values are "about" or "approximately" the indicated value, and take into account experimental error and variations that would be expected by a person having ordinary skill in the art.

[0077] Various terms have been defined above. To the extent a term used in a claim is not defined above, it should be given the broadest definition persons in the pertinent art have given that term as reflected in at least one printed publication or issued patent. Furthermore, all patents, test procedures, and other documents cited in this application are fully incorporated by reference to the extent such disclosure is not inconsistent with this application and for all jurisdictions in which such incorporation is permitted.

[0078] While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

Claims:

What is claimed is:

1. A method for making a paper container, comprising:

applying an adhesive about a paperboard substrate having a first edge and a second edge opposed to one another and a third edge and a fourth edge opposed to one another, wherein the adhesive at least partially surrounds an area that is substantially free from the adhesive;

securing a shrinkable film to the paperboard substrate with the adhesive to produce a paperboard blank, wherein the shrinkable film is configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio that is greater than 1:1;

overlapping the third edge and the fourth edge to form a sidewall, wherein the sidewall comprises:

an inner surface comprising the shrinkable film and an outer surface comprising the paperboard substrate,

the first edge, and

the second edge;

securing a bottom panel to the sidewall at or adjacent the second edge; and

curling the first edge to form a brim.

2. The method of claim 1, wherein the first axis runs through the third edge and the fourth edge.

3. The method of claim 1, wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio that is greater than 5:1.

4. The method of claim 1, wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio of about 2:1 to about 50:1.

5. The method of claim 1, wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio of about 2:1 to about 20:1.

6. The method of claim 1, wherein the shrinkable film comprises a biaxially oriented heat shrinkable polymeric material.

7. The method of claim 1, wherein the shrinkable film comprises polyethylene, polypropylene, or a mixture thereof.

8. The method of claim 1, wherein the paperboard substrate comprises a first coating and a second coating disposed on opposing sides of a paperboard layer, and wherein the first and second coatings comprise a polyolefin.

9. The method of claim 1, wherein the adhesive is applied along the perimeter of the substrate by flexographic printing, rotogravure printing, offset printing, screen printing, or any combination thereof.

10. The method of claim 1, further comprising forming at least one aperture through the paperboard substrate prior to securing the shrinkable film to the paperboard substrate.

11. A method for making a paper container, comprising:

applying an adhesive about a perimeter of a paperboard substrate having a first edge and a second edge opposed to one another and a third edge and a fourth edge opposed to one another, wherein the adhesive at least partially surrounds an area that is substantially free from the adhesive;

securing a shrinkable film to the paperboard substrate with the adhesive to produce a paperboard blank, wherein the shrinkable film is configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio that is greater than 1:1;

overlapping the third edge and the fourth edge with one another;

heat sealing the third edge and the fourth edge to one another to form a sidewall;

securing a bottom panel to the sidewall at or adjacent the second edge; and

curling the first edge to form a brim.

12. The method of claim 11, wherein the first axis runs between the first edge and the second edge, and wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio of about 2:1 to about 50:1.

13. The method of claim 11, wherein the shrinkable film comprises a biaxially oriented heat shrinkable polymeric material.

14. The method of claim 11, wherein the paperboard substrate comprises a first coating and a second coating disposed on opposing sides of a paperboard layer, and wherein the first and second coatings comprise a polyolefin.

15. The method of claim 11, further comprising forming at least one aperture through the paperboard substrate prior to securing the shrinkable film to the paperboard substrate.

16. A paperboard blank for making a paper container, comprising:

a paperboard substrate having a first edge and a second edge opposed to one another and a third edge and a fourth edge opposed to one another; and

a shrinkable film, wherein a portion of the shrinkable film is secured to the paperboard substrate with an adhesive disposed between the paperboard substrate and the film, wherein the shrinkable film is configured to shrink an amount along a first axis relative to an amount along a second axis that is perpendicular to the first axis in a ratio that is greater than 1:1.

17. The paperboard blank of claim 16, wherein the first axis runs between the first edge and the second edge, and wherein the shrinkable film is configured to shrink along the first axis relative to the second axis in a ratio of about 2:1 to about 50:1.

18. The paperboard blank of claim 16, wherein the shrinkable film comprises polyethylene, polypropylene, or a mixture thereof.

19. The paperboard blank of claim 16, wherein the paperboard substrate comprises a first coating and a second coating disposed on opposing sides of a paperboard layer, and wherein the first and second coatings comprise a polyolefin.

20. The paperboard blank of claim 16, wherein the paperboard substrate comprises one or more apertures formed therethrough.

21. The paperboard blank of claim 16, wherein the paperboard blank is formed into a sidewall of a container.

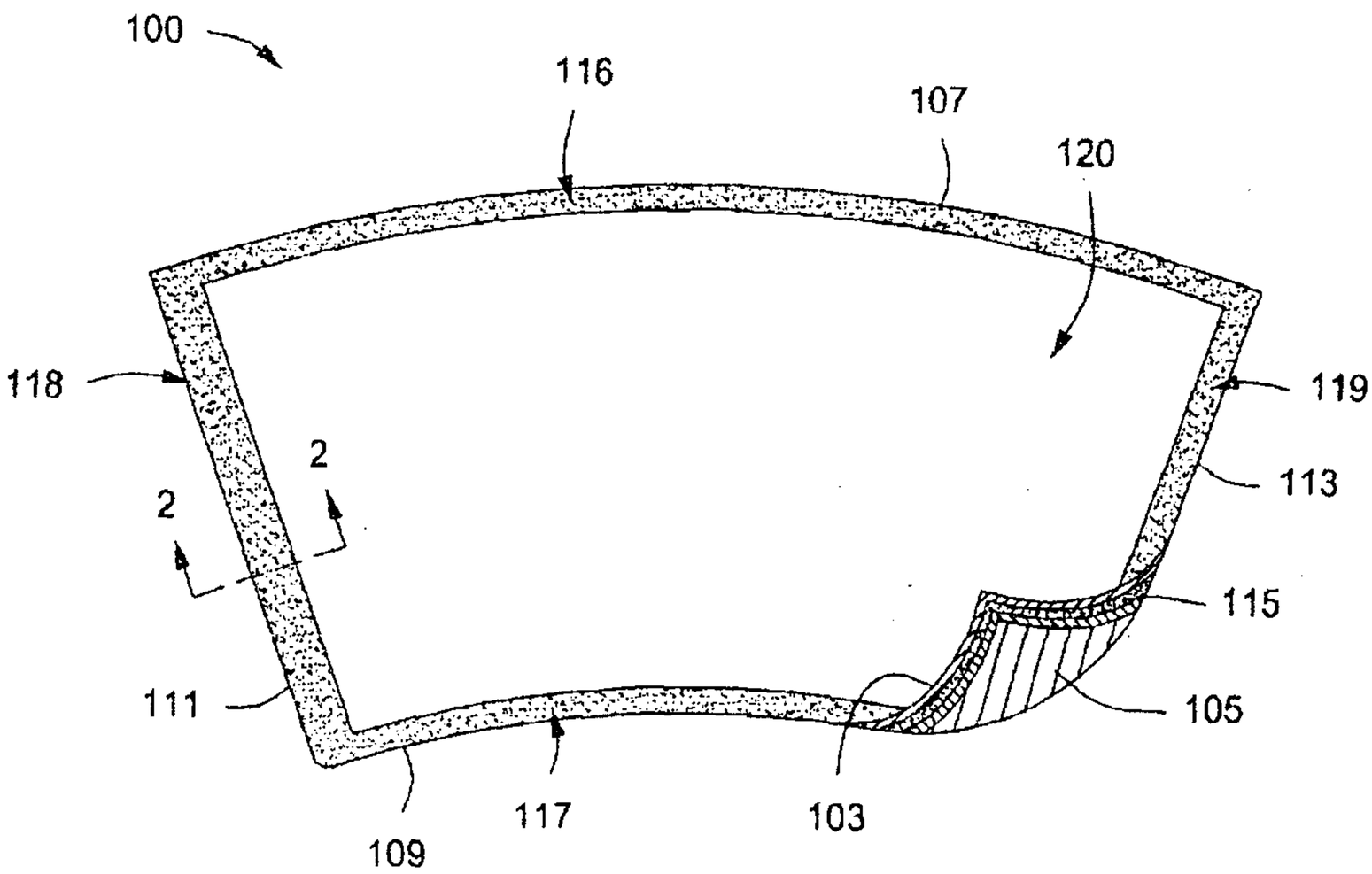
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FIG. 1

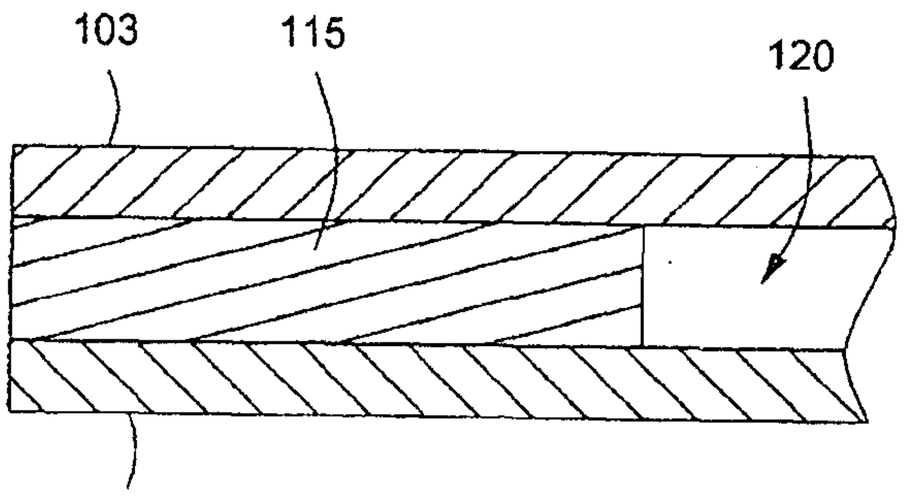
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FIG. 2

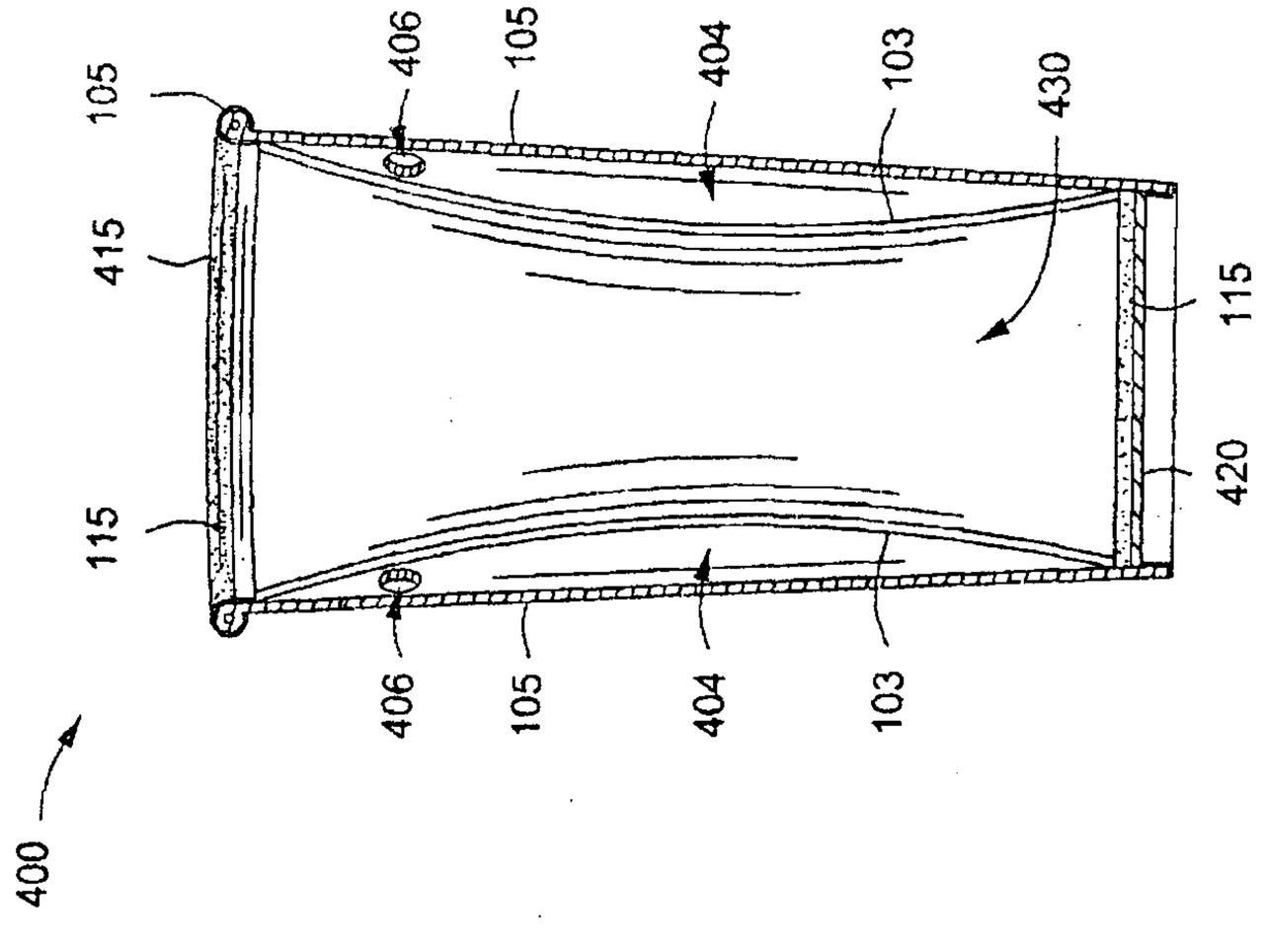
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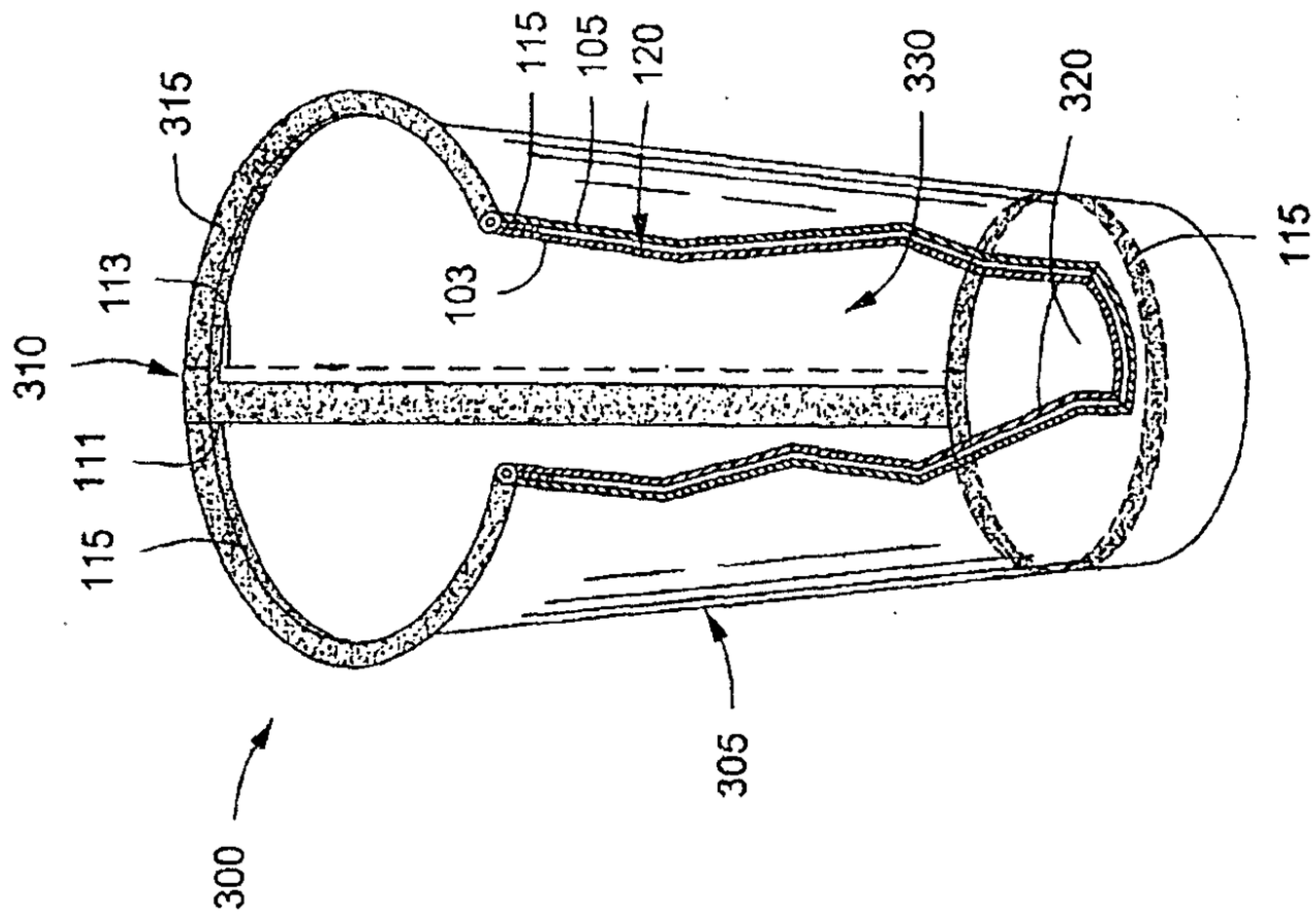
FIG. 4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305

FIG. 3

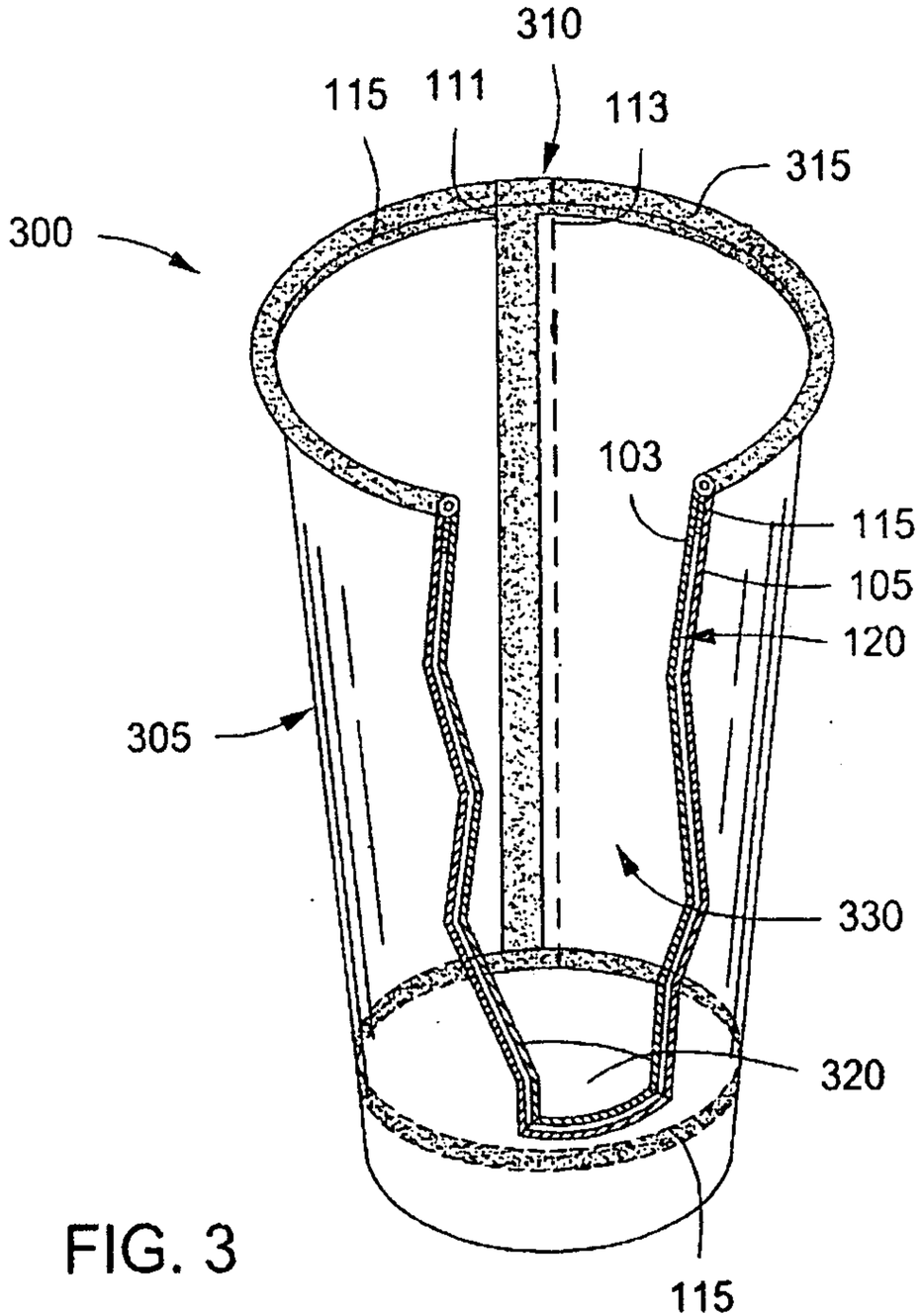

FIG. 3