(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 September 2020 (24.09.2020)

WIPO | PCT

(10) International Publication Number
WO 2020/190955 A1

(51) International Patent Classification:
A61F 13/47 (2006.01)

(21) International Application Number:
PCT/US2020/023175

(22) International Filing Date:
17 March 2020 (17.03.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/820,071 18 March 2019 (18.03.2019) US

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

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

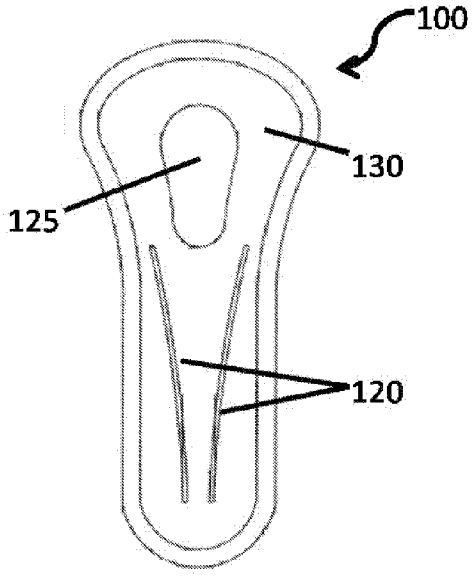
Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:
— *with international search report (Art. 21(3))*

(54) Title: ULTRATHIN ABSORBENT ARTICLES WITH ABSORBENT PODS

(57) Abstract: Provided herein are absorbent articles comprising a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer. Absorbent articles as disclosed can be used to absorb bodily fluids.

FIG.1



WO 2020/190955 A1

ULTRATHIN ABSORBENT ARTICLES WITH ABSORBENT PODS

CROSS-REFERENCE TO RELATED APPLICATIONS

[001] This application claims the benefit of U.S. Provisional Patent Application No. 62/820,071 filed on March 18, 2019. Priority is claimed pursuant to 35 U.S.C. § 119. The above noted patent application is incorporated by reference as if set forth fully herein.

FIELD

[002] Described herein are absorbent articles and methods of manufacturing the absorbent articles.

BACKGROUND

[003] Absorbent articles are essential products for absorbing bodily fluids and maintaining personal hygiene and comfort. Absorbent articles must balance the ability to absorb and store fluid with a size and shape that is not uncomfortable or irritating to the wearer. Many absorbent articles utilize wicking materials that draw fluid away from the skin of the wearer and direct the fluid to an absorbent layer where the fluid is absorbed and stored. Unfortunately, many absorbent articles do not operate with the desired efficiency and effectiveness, because some of the fluid may fail to be absorbed when the absorbent article has reached its maximum absorption and storage capacity or some of the fluid may leak before the entirety of the absorbent article has come into contact with the fluid. This can especially be a problem for absorbent articles that become saturated at the point of insult (the point where the fluid is introduced to the absorbent article), which can become supersaturated and cause additional fluid to leak off the sides of the absorbent article even though the front portion and back portion of the absorbent article are untouched by fluid. Moreover, absorption of bodily fluid is especially unreliable when the wearer is shifting postures between standing, squatting, sitting, or lying down, causing bodily fluid to flow in directions other than where the absorbent article is positioned. To counter the shortcomings associated with distributing fluid across the entirety of an absorbent article and fully absorbing fluid at the point of insult, many manufacturers have made thicker or larger absorbent articles in order to accommodate the supersaturation that can occur at the center of the pad. However, thicker and larger absorbent articles are less desirable from a comfort and a convenience standpoint. As such, there remains a need for an absorbent article with improved efficiency and effectiveness for absorbing fluids at the point of insult.

BRIEF SUMMARY

[004] In some embodiments, disclosed herein are absorbent articles comprising a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, a bottom layer, and at least one channel anchored from the top layer through the middle absorbent layer into the bottom layer, wherein the absorbent article comprises a first end and a second end, and further comprises an asymmetrical shape along a longitudinal axis. In some embodiments, the absorbent articles disclosed herein comprise a first end comprising a maximum width that is the same as a maximum width of the absorbent article and comprise a second end comprising a width that is at least 60% of the maximum width of the first end. In some embodiments, the absorbent articles disclosed herein comprise an absorbent pod located at the first end of the absorbent article. In some embodiments, the absorbent articles disclosed herein comprise a non-woven absorbent material. In some embodiments, the absorbent articles disclosed herein comprise an absorbent pod having a length of at least 25% of a length of the absorbent article. In some embodiments, the absorbent articles disclosed herein comprise a length of at least 200 millimeters. In some embodiments, the absorbent articles disclosed herein comprise a second end having a width that is at least 70% of a width of a first end. In some embodiments, the absorbent articles disclosed herein comprise two or more channels. In some embodiments, the absorbent articles disclosed herein comprise a top layer and a middle absorbent layer, wherein the top layer and the middle absorbent layer are bonded together with an adhesive. In some embodiments, the absorbent articles disclosed herein comprise a top layer comprising a plurality of holes.

[005] In some embodiments, the absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, a bottom layer, and at least one channel anchored from the top layer through the middle absorbent layer into the bottom layer, wherein the absorbent article comprises a first end and a second end, and further comprises an asymmetrical shape along a longitudinal axis, and the middle absorbent layer comprises a fluid drawing material and a fluid storage material. In some embodiments, the middle absorbent layer comprises a fluid drawing material and a fluid storage material and the fluid drawing material comprises electrospun nanofibers. In some embodiments, the absorbent articles disclosed herein comprise a middle absorbent layer comprising a fluid drawing material and a fluid storage material and the fluid storage material comprises superabsorbent polymer. In some embodiments, the absorbent articles disclosed herein comprise at least one channel, and the at least one channel is arranged in a parallel orientation to a longitudinal axis of the absorbent article. In some embodiments, the absorbent articles disclosed

herein comprise at least one channel, and the at least one channel is ultrasonically welded from the top layer through the middle absorbent layer, and into the bottom layer. In some embodiments, the absorbent articles disclosed herein comprise at least one channel, and the at least one channel is arranged such that a distance from a midline of the absorbent article to the at least one channel varies along a length of the at least one channel. In some embodiments, the absorbent articles disclosed herein comprise at least one channel, and the at least one channel extends over no more than 66% of a length of the absorbent article. In some embodiments, the absorbent articles disclosed herein comprise at least one channel, and the at least one channel extends over no more than 75% of a length of the absorbent article. In some embodiments, the absorbent articles disclosed herein comprise at least one channel, and the at least one channel penetrates to a depth of no more than 50% of a thickness of the absorbent article. In some embodiments, the absorbent articles disclosed herein comprise a bottom layer comprising an adhesive region on a side opposite to a side in contact with a middle absorbent layer. In some embodiments, the absorbent articles disclosed herein comprise an adhesive region on a side opposite to a side in contact with a middle absorbent layer is in contact with a protection paper. In some embodiments, the absorbent articles disclosed herein comprise an adhesive region on a side opposite to a side in contact with a middle absorbent layer is in contact with a protection paper and the protection paper is attached to a wrapper element. In some embodiments, the absorbent articles disclosed herein comprise an adhesive region on a side opposite to a side in contact with a middle absorbent layer is in contact with a protection paper attached to a wrapper element, and the absorbent article is folded such that the folded absorbent article is completely enclosed by the wrapper element. In some embodiments, the absorbent articles disclosed herein are at least 230 millimeters long, at least 90 millimeters wide at a first end, and at least 60 millimeters wide at a second end. In some embodiments, the absorbent articles disclosed are incontinent pads. In some embodiments, the absorbent articles disclosed herein are configured for use by a wearer to absorb bodily fluid. In some embodiments, the absorbent articles disclosed herein are placed directly beneath a wearer's urethra.

[006] In some embodiments, disclosed herein are methods of making an absorbent article, comprising forming an absorbent article comprising a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, and a bottom layer, and anchoring at least one channel in the top layer through the middle absorbent layer and into the bottom layer. In some embodiments, the methods of making an absorbent article disclosed herein comprise forming an absorbent article comprising a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent

layer, and a bottom layer, and anchoring at least one channel in the top layer through the middle absorbent layer and into the bottom layer, and anchoring the at least one channel in the top layer through the middle absorbent layer and into the bottom layer comprises ultrasonic welding.

[007] In some embodiments, disclosed herein are asymmetrical absorbent articles comprising a top layer, a middle absorbent layer, a bottom layer, and at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer, wherein the absorbent article comprises a first end and a second end, wherein the width of the first end is the same as the width of the absorbent article and the width of the second end is no more than 60% of the width of the first end. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise an absorbent pod located at a first end of the absorbent article. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise an absorbent pod comprising a non-woven absorbent material. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise an absorbent pod having a length of at least 25% of a length of the absorbent article. In some embodiments, the asymmetrical absorbent articles disclosed herein have a length of at least 200 millimeters. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a first end and a second end, wherein a width of the second end is at least 70% of a width of the first end. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise two or more channels. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a top layer, and a middle absorbent layer, and the top layer and the middle absorbent layer are bonded together with an adhesive. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a top layer comprising a plurality of holes. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a middle absorbent layer comprising a fluid drawing material and a fluid storage material. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a middle absorbent layer comprising a fluid drawing material and a fluid storage material, wherein the fluid drawing material comprises electrospun nanofibers. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a middle absorbent layer comprising a fluid drawing material and a fluid storage material, wherein the fluid storage material comprises superabsorbent polymer.

[008] In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, a bottom layer, and at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer, wherein the absorbent article comprises a first end and a second end, wherein the width of the first end is the same as the width of the absorbent article and the width of the second end is no more than 60% of the width of the

first end, and wherein the at least one channel is arranged in a parallel orientation to a longitudinal axis of the absorbent article. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise at least one channel, wherein the at least one channel is ultrasonic welded from the top layer through the middle absorbent layer, and into the bottom layer. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise at least one channel, wherein the at least one channel is arranged such that a distance from a midline of the absorbent article to the at least one channel varies along a length of the at least one channel. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise at least one channel, wherein the at least one channel extends over no more than 66% of a length of the absorbent article. In some embodiments, the asymmetrical absorbent articles described herein comprise at least one channel, wherein the at least one channel extends over no more than 75% of a length of the absorbent article. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise at least one channel, wherein the at least one channel penetrates to a depth of no more than 50% of a thickness of the absorbent article. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, and a bottom layer, wherein the bottom layer comprises an adhesive region on a side opposite to a side in contact with the middle absorbent layer. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, and a bottom layer, wherein the bottom layer comprises an adhesive region on a side opposite to a side in contact with the middle absorbent layer, and the adhesive region on a side opposite to a side in contact with the middle absorbent layer is in contact with a protection paper. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, and a bottom layer, wherein the bottom layer comprises an adhesive region on a side opposite to a side in contact with the middle absorbent layer, and the adhesive region on a side opposite to a side in contact with the middle absorbent layer is in contact with a protection paper, wherein the protection paper is attached to a wrapper element. In some embodiments, the asymmetrical absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, and a bottom layer, wherein the bottom layer comprises an adhesive region on a side opposite to a side in contact with the middle absorbent layer, and the adhesive region on a side opposite to a side in contact with the middle absorbent layer is in contact with a protection paper, wherein the protection paper is attached to a wrapper element and the absorbent article is folded such that the folded absorbent article is completely enclosed by the wrapper element. In some embodiments, the asymmetrical absorbent articles disclosed herein are about 230 millimeters long, at least 90 millimeters wide at the first end, and at least 60 millimeters wide at the second end. In some

embodiments, the asymmetrical absorbent articles disclosed herein are incontinent pads. In some embodiments, the asymmetrical absorbent articles disclosed herein are for use by a wearer to absorb bodily fluid. In some embodiments, the asymmetrical absorbent articles disclosed herein are placed directly beneath a wearer's urethra.

BRIEF DESCRIPTION OF THE DRAWINGS

[009] FIG. 1 shows an embodiment of the ultrathin absorbent articles disclosed herein, depicting a planar view of an ultrathin absorbent article having a top layer, a middle absorbent layer, an absorbent pod encapsulated by the top layer and the middle absorbent layer, and two channels anchored from the top layer through the middle absorbent layer and into the bottom layer.

[0010] FIG. 2 shows a planar view of an exemplary ultrathin absorbent article as disclosed herein, showing the absorbent pod and two channels anchored from the top layer through the middle absorbent layer and into the bottom layer.

[0011] FIG. 3 depicts various components of an embodiment of the absorbent articles disclosed herein, with individual schematic depictions of the top layer, the absorbent pod, the middle absorbent layer, the bottom layer, the channels, the release liner, the adhesive layer, and the wrapper.

DETAILED DESCRIPTION

[0012] Absorbent articles serve hygienic purposes, including absorption of urine and other bodily fluids as well as protecting the body of the wearer from irritation due to prolonged contact with fluids. Absorbent articles include, among others, adult incontinence pads and briefs, panty liners, sanitary napkins, menstrual pads, catamenial products, feminine hygiene products, and diapers. Such absorbent articles may be intended to be discarded after a single use ("disposable" absorbent articles) or may be intended for multiple uses.

[0013] The structure and particular absorbent core composition of absorbent articles can vary. Absorbent articles generally have a thickness that is fewer than 5 millimeters and utilize wicking material that draws fluid away from the skin of the wearer and directs the fluid to an absorbent layer where the fluid is absorbed and stored. Absorbent articles may utilize superabsorbent polymer (SAP) material that absorbs and stores the fluid. Unfortunately, such absorbent articles often do not operate with a desired efficiency and effectiveness, because absorbing material present in the absorbent article can reach a maximum absorption and storage capacity and fail to absorb additional fluid. Also, when the wearer shifts posture (e.g. from standing to sitting or from lying down to standing up) during the prolonged use of the absorbent articles, the flow of bodily

fluid may change to directions other than where the absorbent article is positioned. While absorbing material, such as SAP material, can be added, such additional material is undesirable as it significantly increases the cost of the absorbent article as well as the thickness and size of the absorbent articles. In addition, while additional absorbing material operates to increase the amount of fluid that can be absorbed and stored, unless the absorbing material, such as SAP material, is in direct contact with the fluid to be absorbed, the rate of absorption is uneven and not maximized.

[0014] Furthermore, absorbent articles such as hygienic pads using SAP material have decreased fluid absorption rates when the SAP material becomes fully saturated at or near the point where fluid is introduced to the absorbent article. This may cause the SAP material to form "gel blocks" or "speed bumps" that reduces or prevents fluid absorption. In order to improve the flow of fluids in saturated SAP material, surface cross-linkers can be added to the SAP material to improve the absorbency of the SAP material. Unfortunately, in many applications the use of such cross-linkers still does not provide sufficient or desired absorbency of the SAP material. Further, fluid to be absorbed often does not reach the location necessary for making contact with unsaturated portions of the SAP material, thereby not fully utilizing the SAP material within the absorbent pad and reducing the absorbent article's efficiency and effectiveness. As such, dispersing fluid across the entire area of an absorbent article allows maximum utilization of the absorbing material present in the absorbent article. However, dispersion of fluid across the entire area of an absorbent article should not come at the cost of fluid leaking at the periphery of the absorbent article. Further, strategic placement of additional absorbent material should occur in order to maximize absorption.

[0015] Provided herein are absorbent articles. As disclosed herein, "absorbent articles", "absorbent hygienic pads", absorbent liners", "incontinent pads", and "absorbent pads" refer to articles that are effective for absorbing and containing bodily fluids, including fluids emitted from the body of a user. The absorbent articles disclosed herein may be placed against or in proximity to the body of a user and operate to absorb and contain bodily fluids emitted from the user, including bodily fluids such as urine. The absorbent articles disclosed herein may comprise a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, and a bottom layer. The top layer may comprise at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer. The shape of the absorbent articles may be asymmetrical along the longitudinal axis, with a wilder end and a narrower end. The maximum width of the wider end is the same as the maximum width of the absorbent articles. In some embodiments, the absorbent articles described herein are

worn by a user and used to absorb bodily fluids, including absorbent articles worn by a human and used to absorb bodily fluids including urine. Also disclosed herein are methods of making the absorbent articles, comprising forming a top layer, a middle absorbent layer, an absorbent pod encapsulated by the top layer and the middle absorbent layer, and a bottom layer, and anchoring at least one channel from the top layer through the middle absorbent layer and into the bottom layer. In some embodiments, ultrasonic welding is used to anchor the at least one channel from the top layer through the middle absorbent layer and into the bottom layer.

[0016] The terminology used herein is for the purpose of describing particular cases only and is not intended to be limiting. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. Furthermore, to the extent that the terms "including", "includes", "having", "has", "with", or variants thereof are used in either the detailed description and/or the claims, such terms are intended to be inclusive in a manner similar to the term "comprising."

[0017] The term "about" or "approximately" means within an acceptable error range for the particular value as determined by one of ordinary skill in the art, which will depend in part on how the value is measured or determined, e.g., the limitations of the measurement system. For example, "about" can mean within 1 or more than 1 standard deviation, per the practice in the given value. Where particular values are described in the application and claims, unless otherwise stated the term "about" should be assumed to mean an acceptable error range for the particular value.

Absorbent Articles

[0018] Disclosed herein, in certain embodiments, are absorbent articles comprising a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer. In some embodiments, the absorbent articles disclosed herein are configured to absorb urine. In some embodiments, the absorbent articles disclosed herein are configured to acquire bodily fluid from a female. In some embodiments, the absorbent articles disclosed herein contain structural components reflecting the anatomical differences between the vulvar area of a female and the external male genitalia.

[0019] In some embodiments, the channels of the absorbent articles disclosed herein are anchored such that the channels remain functionally intact even as fluid is added to the absorbent article, in contrast to non-anchored channels (such as embossed channels) which lose their structure as they swell with fluid. As fluid is added to the absorbent articles disclosed herein, the

channels provide a higher contrast in depth and density to that of the material surrounding the channels. As such, the channels can function to inhibit absorption of fluid at the point of the channel. As the material surrounding the channels begins to absorb and swell with fluid, the channels provide a travel path for the fluid that is lower friction and improves the distribution of fluid.

[0020] In some embodiments, the absorbent articles disclosed herein comprise materials suitable for use in hygienic pads and bladder liners. Suitable materials for hygienic pads and bladder liners are non-irritating, durable, and flexible and include, by way of non-limiting examples, textiles of natural fiber (e.g., cotton, linen, and hemp), textiles of synthetic fiber (e.g., nylon, polyester, aramid, olefin, and acrylic), and plastic (e.g., polyvinyl chloride, low-density polyethylene, and polypropylene). In some embodiments, the absorbent articles disclosed herein comprise one or more of a skin treatment agent, a skin protective agent, or an odor-absorbing agent. In some embodiments, the absorbent articles disclosed herein comprise absorbent article packaging and release liner systems. Suitable materials for absorbent article packaging and release liner systems are easily torn and include, by way of non-limiting examples, cloth, paper, and waxed paper. In some embodiments, the absorbent articles disclosed herein comprise an adhesive that bonds the absorbent article to the inside of a wrapper. In some embodiments, the absorbent articles disclosed herein comprise an adhesive that bonds a release liner adhered to a bottom layer of the absorbent article to the inside of a wrapper. In some embodiments, the absorbent articles disclosed herein comprise an adhesive that bonds a release liner adhered to a bottom layer of the absorbent article to the inside of a wrapper and the absorbent article is folded such that the wrapper completely envelopes the absorbent article.

[0021] In some embodiments, the absorbent articles disclosed herein comprise an asymmetrical shape along the longitudinal axis with a wider end having a maximum width that is the same as a maximum width of the absorbent articles and a narrower end opposing the wider end of the absorbent article. In some embodiments, the absorbent articles disclosed herein have a first end that is the wider end and a second end that is the narrower end. In some embodiments, the absorbent articles disclosed herein are dimensioned to fit different parts of the body, such as absorbent articles dimensioned to cover human genitals. In some embodiments, the asymmetrical shape conforms to the user's body, such that the absorbent article is wider in the front part (toward the crotch of the user's body) than the rear part (toward the buttocks of the user's body). In some embodiments, the absorbent articles disclosed herein comprises a length of 150 mm, 160 mm, 170 mm, 180 mm, 190 mm, 200 mm, 205 mm, 210 mm, 215 mm, 220 mm, 225 mm, 230 mm, 235 mm, 240 mm, 245 mm, 250 mm, 255 mm, 260 mm, 265 mm, 270 mm, 280 mm, 290

mm, or 300 mm. In some instances, the absorbent articles disclosed herein comprise a wider end and a narrower end, and the ratio between the widths of the narrower end and the wider end is no more than 35%, or no more than 40%, or no more than 45%, or no more than 50%, or no more than 55%, or no more than 56%, or no more than 57%, or no more than 58%, or no more than 59%, or no more than 60%, or no more than 61%, or no more than 62%, or no more than 63%, or no more than 64%, or no more than 65%, or no more than 66%, or no more than 67%, or no more than 68%, or no more than 69%, or no more than 70%, or no more than 75%, or no more than 80%, or no more than 85%, or no more than 90%. In some cases, the width of the wider end of the absorbent articles comprises a width of 80 mm, 85 mm, 90 mm, 95 mm, 100 mm, 101 mm, 102 mm, 103 mm, 104 mm, 105 mm, 106 mm, 107 mm, 108 mm, 109 mm, 110 mm, 115 mm, 120 mm, 125 mm, or 130 mm. In some embodiments, the width of the narrower end of the absorbent articles comprises a width of 45 mm, 50 mm, 55 mm, 60 mm, 61 mm, 62 mm, 63 mm, 64 mm, 65 mm, 66 mm, 67 mm, 68 mm, 69 mm, 70 mm, 71 mm, 72 mm, 73 mm, 74 mm, 75 mm, 80 mm, 85 mm, or 90 mm. In some embodiments, the absorbent articles disclosed herein are 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275, 280, 285, 290, 295, 300, 305, 310, 315, 320, 325, 330, 335, 340, 345, 350, or more millimeters long or wide, including increments therein. In some embodiments, the absorbent articles disclosed herein are less than 2000, 1900, 1800, 1700, 1600, 1500, 1400, 1300, 1200, 1100, 1000, 975, 950, 925, 900, 875, 850, 825, 800, 775, 750, 725, 700, 675, 650, 625, 600, 575, 550, 525, 500, or less micrometers thick, including increments therein. In some embodiments, the absorbent articles disclosed herein are at least 240 mm long, with a first (wider) end that is at least 90 mm wide and a second (narrower) end that is at least 65 mm wide. In some embodiments, the absorbent articles comprises a shape of hourglass, teardrop, square, rectangular, oval, round, triangle, butterfly-shaped, dog-bone, light-bulb, cuneate, subspatulate, oblong, spatulate, ovate, reniform, lanceolate, or oblanceolate. The size and shape of the absorbent articles disclosed herein can be altered to meet absorbent capacity requirements and to provide comfort to the user or wearer. In some embodiments, the absorbent articles absorb urine or other bodily fluid. In some embodiments, the absorbent articles are incontinent pads.

Top Layers

[0022] In some embodiments, the absorbent articles described herein comprise a top layer, wherein the top layer comprises at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer. In some embodiments, the absorbent articles described herein comprise a top layer, wherein the top layer comprises at least one channel

ultrasonically welded from the top layer through the middle absorbent layer and into the bottom layer. The top layer may comprise any suitable and effective material, provided that the top layer provides a soft, compliant, and non-irritating sensation to the wearer's skin. Suitable top layer materials include liquid pervious materials oriented towards and in contact with the body of the wearer which permit bodily discharges to rapidly penetrate through the top layer without allowing fluid to flow back through the top layer to contact the skin of the wearer. Suitable top layer material can include, without limitation, woven and nonwoven materials, apertured film materials including apertured formed thermoplastic films, apertured plastic films, and fiber-entangled apertured films, hydro-formed thermoplastic films, porous foams, reticulated foams, reticulated thermoplastic films, thermoplastic scrims, and combinations thereof.

[0023] In some embodiments, the top layer comprises a plurality of holes. In some embodiments, the top layer comprises a non-woven spun sheet bound to an aperture layer. In some embodiments, the top layer comprises silicone adhesive, hydrocolloid adhesive, polyurethane adhesive, rubber-based adhesive, acrylic adhesive, coated woven material, hydrogel adhesive, and combinations thereof. In some embodiments, the aperture layer comprises a plurality of holes, cuts, slits, apertures, perforations, discontinuities, and/or bevels. In some embodiments, the distribution and spacing of the holes, cuts, slits, apertures, perforations, discontinuities, and/or bevels are regularly arranged with a separation substantially greater than their area. In some embodiments, the holes, cuts, slits, apertures, perforations, discontinuities, and/or bevels are in a shape selected from a circle, a square, a rectangle, a triangle, an oval, a pentagon, a hexagon, and a rounded rectangle. In some embodiments, the holes, cuts, slits, apertures, perforations, discontinuities, and/or bevels are circular and between 0.1 mm and 5 mm, or between 0.5 mm and 2 mm. In some embodiments, the spacing between the holes, cuts, slits, apertures, perforations, discontinuities, and/or bevels is between 0.2 and 10 mm. In some embodiments, the number of holes, cuts, slits, apertures, perforations, discontinuities, and/or bevels per unit area is between 1 and 100, or between 1 and 50, or between 1 and 20 per square centimeter.

[0024] In some embodiments, the absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer and the top layer comprises an apertured plastic film that is non-absorbent and pervious to bodily fluids and provides for minimal or no flow of bodily fluid back through the top layer. The top layer may comprise woven and nonwoven materials, of which non-limiting examples include fibrous

materials made from natural fibers, modified natural fibers, synthetic fibers, or combinations thereof. Fibrous materials include hydrophilic fibrous materials and hydrophobic fibrous materials. In some embodiments, the top layer comprises a hydrophobic material, or a material that has been rendered hydrophobic. In some embodiments, portions of the top layer can be rendered hydrophilic. The top layer can comprise hydrophilic fibers, hydrophobic fibers, or combinations thereof. In some embodiments, the top layer comprises a nonwoven fibrous material in the form of a nonwoven web, such as a nonwoven web producing by methods including spinbonding, carding, wat-laying, air-laying, melt blowing, needle-punching, mechanical entangling, thermo-mechanical entangling, and hydroentangling. In some embodiments, the top layer may comprise a low basis weight nonwoven materials, such as a nonwoven material having a basis weight of from about 18 g/m^2 to about 25 g/m^2. In some embodiments, the top layer further comprises a skin treatment agent or skin protective agent, such as a lotion or a moisturizer.

[0025] In some embodiments, the top layer comprises a non-woven liner sheet material which readily allows the passage of fluids to the underlying middle absorbent layer. Examples of suitable liner sheet materials include non-woven spun-bond or carded webs of polypropylene, polyethylene, nylon, polyester and blends of these materials. In some embodiments, the top layer comprises a top sheet formed from an air laid material. The top sheet, top layer, middle absorbent layer, and bottom layer can be attached together by means of lamination using an adhesive. The lamination can be throughout the entire pad or at one or more locations, such as along or close to the peripheral edges of the components. The top sheet operates to fit against the wearer's body to provide a compliant, soft feeling and non-irritating surface against the skin of a wearer and is pervious to fluids to allow fluid to penetrate the top sheet. In some embodiments, the top layer comprises a plurality of embedded holes that operate as micro-funnels to capture and help channel bodily fluid from an upper top surface of the top layer to the middle absorbent core thereby increasing the rate of fluid being directed to the middle absorbent layer. In some embodiments, the top layer comprises an air laid material, a cold-strued non-woven material, a non-woven spun-bond or carded web of polyester (including, but not limited to Rayon, polypropylene, and polyethylene terephthalate (PET)), or a combination thereof. In some embodiments, the top layer comprises woven and nonwoven materials comprising natural fibers, synthetic fibers or a combination thereof, porous thermoplastic and plastic films, hydroformed or reticulated thermoplastic films or other conventional materials.

Middle Absorbent Layers

[0026] In some embodiments, the absorbent articles described herein comprise a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer. In some embodiments, the middle absorbent layer is positioned between the top layer and the bottom layer. In some embodiments, the top layer and the middle absorbent layer are bonded together with an adhesive. The middle absorbent layer may comprise any material or combination of materials suitable for absorbing, distributing, and storing aqueous fluids such as urine and water found in body exudates. In some embodiments, the middle absorbent layer comprises a fluid drawing material and a fluid storage material. The fluid storage material may be configured or constructed to meet absorbent capacity requirements. Non-limiting examples of fluid storage materials suitable for use in the absorbent articles disclosed herein include comminuted wood pulp (also known as "fluff pulp"), creped cellulose wadding, absorbent gelling materials including superabsorbent polymers such as hydrogel-forming polymeric gelling agents, chemically stiffened, modified, or cross- linked cellulose fibers, melt blown polymers including coform, synthetic fibers including crimped polyester fibers, tissue including tissue wraps and tissue laminates, capillary channel fibers, absorbent foams, absorbent sponges, synthetic staple fibers, alginate fibers, chitosan or chitosan derivative fibers, acrylic fibers, non-gelling fibers, superabsorbent fibers, sphagnum moss, equivalent materials, or combinations thereof. In some embodiments, the middle absorbent layer comprises an antimicrobial fiber, such as an antimicrobial fiber comprising silver ions or metal ions.

[0027] In some embodiments, the middle absorbent layer comprises superabsorbent polymer. In some embodiments, the superabsorbent polymer is carboxymethylcellulose fiber with a degree of substitution between 0.1 and 0.5 carboxymethyl groups per cellulose unit. In some embodiments, the superabsorbent polymer is an acrylic fiber which incorporates a co-monomer and provides dye-sites in the fiber. In some embodiments, the co-monomer is selected from the group consisting of itaconic acid and 2-acrylamido methyl propane sulphonic acid. Where the fiber is an alginate fiber, it may be a calcium alginate fiber or a mixed metal alginate fiber such as a calcium/sodium alginate fiber. The alginate polymer may be one with a high mannuoronate or a high guluronate. In some embodiments, the absorbent articles disclosed herein comprise a middle absorbent layer comprising chemically modified cellulose. In some embodiments, the absorbent articles disclosed herein comprise a middle absorbent layer comprising, for example,

carboxymethylcellulose, carboxyethylcellulose, or other chemically modified cellulose. In some embodiments, the middle absorbent lay comprises laminated absorbent material.

[0028] In some embodiments, the absorbent articles described herein absorb fluid from a body. In some embodiments, the absorbent articles described herein comprise a middle absorbent layer with a minimum level of absorbency. In some embodiments, the absorbency of the absorbent articles described herein may be measured by the free swell absorbency method. In some embodiments, the absorbency of the absorbent articles described herein is at least 0.30 g/cm^2, or at least 0.40 g/cm^2, or at least 0.50 g/cm^2, or at least 0.60 g/cm^2, or at least 0.70 g/cm^2, or at least 0.80 g/cm^2, or at least 0.90 g/cm^2, or at least 1.0 g/cm^2, or at least 1.1 g/cm^2, or at least 1.2 g/cm^2, or at least 1.3 g/cm^2, or at least 1.5 g/cm^2, or at least 2.0 g/cm^2, or at least 2.5 g/cm^2. In some instances, the middle absorbent layer is at least 40 gram per square meter (gsm), or at least 50 gsm, or at least 60 gsm, or at least 70 gsm, or at least 80 gsm, or at least 90 gsm, or at least 100 gsm, or at least 110 gsm, or at least 120 gsm, or at least 130 gsm, or at least 140 gsm, or at least 150 gsm, or at least 200 gsm, or at least 250 gsm, or at least 300 gsm, or at least 350 gsm, or at least 400 gsm, or at least 450 gsm, or at least 500 gsm, or at least 550 gsm, or at least 600 gsm. In some embodiments, the absorbent articles described herein comprise a gelling fiber, an absorbent fiber, or a hydrophilic foam. In some embodiments, the absorbent articles disclosed herein comprise a middle absorbent layer comprising a material selected from the group consisting of foam, polyurethane foam, absorbent textiles, hydrogels, superabsorbent fibers, superabsorbent polymers, superabsorbent powder-fiber blends, and mixtures thereof. In some embodiments, the middle absorbent layer comprises a gelling blend of a material selected from the group consisting of foam, polyurethane foam, absorbent textiles, hydrogels, superabsorbent fibers, superabsorbent polymers, superabsorbent powder-fiber blends, and mixtures thereof. In some embodiments, the middle absorbent layer comprises a non-gelling blend of a material selected from the group consisting of foam, polyurethane foam, absorbent textiles, hydrogels, superabsorbent fibers, superabsorbent polymers, superabsorbent powder-fiber blends, and mixtures thereof. In some embodiments, the middle absorbent layer comprises low density cross-linked superabsorbent polymer. Low density cross-linked superabsorbent polymers generally have a high absorbent capacity and swell to a larger degree with a softer and stickier gel formation. In some embodiments, the middle absorbent layer comprises high density cross-linked superabsorbent polymer. High density cross-linked superabsorbent polymers exhibit lower absorbent capacity and swell, but their gel strength is firmer and can maintain particle shape even under modest pressure.

[0029] In some embodiments, the absorbent articles described herein comprise a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer, and wherein non-SAP-containing roll good materials such as latex or thermally bonded air laid fluff pulp, or synthetic spunbonded, carded, or hydro-entangled non-woven material may be positioned above or below the middle absorbent layer. In some embodiments, the middle absorbent layer comprises a central fibrous layer containing 50-95% by weight particulate or fibrous superabsorbent polymer (SAP) and at least one other fibrous or particulate material that is capable of maintaining high SAP efficiency. High SAP concentrations can also provide thinner absorbent cores that can provide new options for product design. The middle absorbent layer can be made using either a wet or a dry process.

[0030] In some embodiments, the middle absorbent layer comprises a fluid drawing material conjoined with a fluid storage material. In some embodiments, the fluid storage material is in the form of a fluid storage material layer. In some embodiments, the fluid storage material is laminated together with the fluid drawing material along their periphery edges. It should be understood that other means such as adhesives can be used to conjoin the fluid drawing material with the fluid storage material layer. In some embodiments, the fluid drawing material operates to draw the bodily fluid penetrating a top layer comprising a top sheet to the fluid storage material layer, such as by wicking or capillary action which them spreads the fluid across the fluid storage material layer, such as by wicking or capillary action. In some embodiments, the fluid drawing material and the fluid storage material are the same material that operates to spread fluid across and into the material by wicking or capillary action. In another embodiment, the fluid storage material is a superabsorbent polymer (SAP) material which when the fluid contacts the SAP material it is converted into gel thereby locking the bodily fluid away from the top layer and reducing the likelihood of fluid buildup along the surface of the wearer's body or leakage of fluid out of the absorbent pad.

[0031] In some embodiments, the middle absorbent core comprises a fluid drawing material and a fluid storage material in the form of superabsorbent polymer (SAP) packets (clumps or particles) creating a plurality of fluid reservoirs that are incorporated into and throughout the fluid drawing material. In some embodiments, the fluid drawing material is formed from a material having hydrophobic properties that operates to guide fluid, such as by wicking or capillary action, for contacting the fluid reservoirs such that the super absorbent material converts the fluid into a gel. It should be understood that the geometry and the number of SAP packets

forming fluid reservoirs are such to maximize the absorbing surface (surface that fluid cones into contact with) thereby increasing the rate that fluid is turned into a gel while reducing the likelihood of creating "gel blocks" reducing fluid absorption. In some embodiments, the fluid storage material layer or the fluid reservoirs are formed from a super absorbent polymer (SAP) material or slush powders, hydrogels, or other super-absorbent material(s). In some embodiments, the fluid drawing material is formed from a material(s) having hydrophobic properties positioned that operates to guide fluid, such as by wicking or capillary action, for absorption into the fluid storage material layer or fluid reservoirs. Such materials include, but are not limited to, spun-laced fabric made from a combination of cellulosic fibers, such as but not limited to Viscose or wet-laid cellulose pulp material preferably comprising soft wood pulp (having fibers of sufficient length to provide the necessary wicking of the fluid to be absorbed by the fluid storage material layer) or rayon or lyocell, synthetic fibers, such as but not limited to polyester fibers. In some embodiments, the fluid drawing layer contains about 50 - 95% by weight particulate or fibrous superabsorbent polymer (SAP) and at least one other fibrous or particulate material that is capable of maintaining high SAP efficiency.

[0032] In some embodiments, the absorbent articles disclosed herein comprise a middle absorbent layer comprising a fluid drawing material and a fluid storage material, wherein the fluid drawing material is electro-spun nanofibers, such as natural polymers or polymer blends creating a high porous media. In some embodiments, the nanofibers include superabsorbent material packets deposited throughout and held in place by the fibers that operate as fluid reservoirs and operate to convert bodily fluid into a gel.

Absorbent Pods

[0033] Described herein, in some embodiments, are absorbent articles comprising a top layer, a middle absorbent layer, an absorbent pod encapsulated between the top layer and the middle absorbent layer, and a bottom layer, wherein the top layer comprises at least one channel ultrasonically welded from the top layer through the middle absorbent layer and into the bottom layer. In some embodiments, the absorbent pods disclosed herein provide at least two functions, a first function in which the absorbent pod absorbs a dribble of fluid on an occasional basis until a user desires to change the pad, and a second function in which the absorbent pod absorbs a gush or higher amount of fluid and absorbs the fluid quickly and aggressively and functions in conjunction with channels to direct the fluid towards absorbent areas along the length of the absorbent article. In some embodiments, the absorbent pod is located at a specific region of the absorbent article, such as directly beneath the urethra of a female user. In some instances, selective placement of the absorbent pod allows localized placement of additional absorbency at

a discrete part of the absorbent article and dispenses with the need for addition of absorbency across the entirety of the absorbent article. In some embodiments, the placement of the absorbent pod directly beneath the urethra of a female user allows fluid released from the urethra to be rapidly absorbed by the absorbent pod and subsequently transported via the channels to the parts of the absorbent article that are distal from the absorbent pod. In some instances, the absorbent pod is encapsulated by the top layer and the middle absorbent layer. In some embodiments, an adhesive binds the top layer to one side of the absorbent pod, and another adhesive binds the other side of the absorbent pod to the middle absorbent layer. In some embodiments, the absorbent pod comprises same material as the top layer. In some embodiments, the absorbent pod comprises same material as the middle absorbent layer. In some embodiments, the absorbent pod comprises material of a combination of the top layer material and the middle absorbent layer material. In some embodiments, the absorbent pod comprises air laid paper material. In some embodiments, the air laid paper material is nonwoven fabric made from fluff pulp. In some instances, the air laid paper material is synthetic short-cut staple fibers. In some cases, the absorbent pod comprises air laid material comprised of natural or synthetic fibers or a combination thereof. In some embodiments, the absorbent pod comprises polymer emulsions, thermoplastic fibers, or a combination thereof.

[0034] In some embodiments, the absorbency of the absorbent pods as described herein is at least 0.30 g/cm^2, or at least 0.40 g/cm^2, or at least 0.50 g/cm^2, or at least 0.60 g/cm^2, or at least 0.70 g/cm^2, or at least 0.80 g/cm^2, or at least 0.90 g/cm^2, or at least 1.0 g/cm^2, or at least 1.1 g/cm^2, or at least 1.2 g/cm^2, or at least 1.3 g/cm^2, or at least 1.5 g/cm^2, or at least 2.0 g/cm^2, or at least 2.5 g/cm^2. In some instances, the absorbency of the absorbent pod is at least 10 grams per square meter (gsm), or at least 15 gsm, or at least 20 gsm, or at least 25 gsm, or at least 30 gsm, or at least 35 gsm, or at least 40 gsm, or at least 45 gsm, or at least 50 gsm, or at least 100 gsm, or at least 150 gsm, or at least 200 gsm, or at least 250 gsm, or at least 300 gsm, or at least 350 gsm, or at least 400 gsm, or at least 450 gsm, or at least 500 gsm, or at least 550 gsm, or at least 600 gsm. In some embodiments, the absorbency of the absorbent pod is between 10 and 200 grams per square meter (gsm), or between 20 and 200 gsm, or between 30 and 200 gsm, or between 40 and 200 gsm, or between 50 and 200 gsm, or between 60 and 200 gsm, or between 70 and 200 gsm, or between 80 and 200 gsm, or between 90 and 200 gsm, or between 100 and 200 gsm. In some embodiments, the absorbent pod as disclosed herein comprises a length of 50 mm, 55 mm, 56 mm, 57 mm, 58 mm, 59 mm, 60 mm, 61 mm, 62 mm, 63 mm, 64 mm, 65 mm, 66 mm, 67 mm, 68 mm, 69 mm, 70 mm, 75 mm, or 80 mm. In some embodiments, the absorbent pod comprises a width of 25 mm, 30 mm, 31 mm, 32 mm, 33 mm, 34 mm, 35 mm, 36 mm, 37 mm, 38 mm, 39

mm, 40 mm, 45 mm, or 50 mm. In some instances, the absorbent pod protrudes from the top layer of the absorbent articles disclosed herein. In some embodiments, the protrusion of the absorbent pod from the top layer of the absorbent articles disclosed herein is less than 1000, 975, 950, 925, 900, 875, 850, 825, 800, 775, 750, 725, 700, 675, 650, 625, 600, 575, 550, 525, 500, 475, 450, 425, 400, 375, 350, 325, 300, 275, 250, 225, 200, 175, 150, 125, or 100 micrometers, including increments therein. In some embodiments, the absorbent pod protrudes from the top layer of the absorbent article about 500, 525, 550, 575, 600, 625, 650, 675, 700, 725, 750, 775, 800, 825, 850, 875, 900, 925, 950, 975, or 1000 micrometers. In some embodiments, the absorbent articles disclosed herein are at least 240 mm long, with a first (wider) end that is at least 90 mm wide and a second (narrower) end that is at least 65 mm wide, and an absorbent pod that is at least 60 mm long, with a first (wider) end that is at least 35 mm wide and a second (narrower) end that is at least 20 mm wide.

[0035] In some embodiments, the absorbent pod comprises an asymmetrical shape along the longitudinal axis. In some embodiment, the absorbent pod comprises a shape that mirrors the shape of the absorbent article. In some embodiments, the absorbent pod comprises a shape of hourglass, teardrop, square, rectangular, oval, round, triangle, butterfly-shaped, cuneate, subspatulate, oblong, spatulate, ovate, reniform, lanceolate, or oblanceolate. In some embodiments, the absorbent pod comprises a wider end and a narrower end as determined by the width of absorbent pod. The size and shape of the absorbent pod disclosed herein can be altered to meet absorbent capacity requirements and to provide comfort to the user or wearer. In some instances, the absorbent pod is encapsulated by the top layer and the middle absorbent layer on the wider end of the absorbent articles. In some embodiments, the absorbent pod contacts a latitudinal axis at center of the wider end of the absorbent articles. In some embodiments, the absorbent pod is placed directly beneath the wearer's urethra during the use of the absorbent articles.

Channels

[0036] In some embodiments, the absorbent articles described herein comprise a top layer, a middle absorbent layer, an absorbent pod encapsulated by the top layer and the middle absorbent layer, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer into the middle absorbent layer and into the bottom layer. In some embodiments, the channels function as inhibitors of absorption at the location of the channel, directing fluid along the length of the channel. In some embodiments, the channels are anchored via ultrasonic welding, pressure, heat, a combination of heat and pressure, heat-pressing, embossing, stapling, sewing, melting, or a combination of any of these techniques. In some embodiments, the

channels are anchored via ultrasonic welding. In some embodiments, the channels are anchored via heat. In some embodiments, the channels are anchored via pressure. In some embodiments the channels are anchored via a combination of heat and pressure. The channels of the absorbent articles disclosed herein are anchored such that the channel remains functionally intact even as fluid is added to the absorbent article. As fluid is added, the channels provide a higher contrast in depth and density to that of the material surrounding the channels. As the material surrounding the channels begins to absorb and swell with fluid, the channels provide a travel path for the fluid that is lower friction and improves the distribution of fluid. In some embodiments, the absorbent articles disclosed herein comprise a top layer, a middle absorbent layer comprising fluid drawing material and fluid absorbing material, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer into and through the fluid drawing material and fluid absorbing material, and into the top of the bottom layer. Thus, in some embodiments, the absorbent articles disclosed herein comprise channels bonded through all layers of the absorbent article which allows the channel to distribute fluid more effectively into areas lacking channels. The absorbent articles comprising anchored channels disclosed herein provide superior fluid distribution than absorbent articles with non-anchored channels, such as absorbent articles with embossed lines or patterns. This is because as soon as a non-anchored channel begins to absorb fluid, it swells concurrently with the rest of the absorbent article and provides no differentiation for directional dispersion of fluid. The anchored channels of the absorbent articles disclosed herein provide a contrast of both density and space from the areas of the absorbent article lacking anchored channels which allows fluid to be directed along the length of the channel, leading to an increase in distribution and absorption of the fluid. This contrast is maintained even as the areas of the absorbent article lacking anchored channels begin to swell from the absorption of fluid.

[0037] In some embodiments, the absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, an absorbent pod encapsulated by the top layer and middle layer, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer, wherein the at least one channel is anchored via ultrasonic welding from the top layer through the middle absorbent layer and into the bottom layer, and wherein the at least one channel is arranged in a parallel orientation to a longitudinal axis of the absorbent article. In some embodiments, the at least one channel is arranged such that a distance from a midline of the absorbent article to the at least one channel varies along a length of the at least one channel, such as an embodiment where the at least one channel converges toward the midline at one end of the absorbent article and diverge from the midline at the opposite end of the absorbent article. In some embodiments, the at least one

channel is arranged such that the channel orientation mimics the shape of the absorbent article. In some embodiments, the at least one channel is arranged such that the channels are perpendicular to a longitudinal axis of the absorbent article. In some embodiments, the at least one channel extends over almost the entire length of the absorbent article. In some embodiments, the at least one channel extends over 99%, 98%, 97%, 96%, 95%, 90%, 85%, 80%, 75%, 70%, 69%, 68%, 67%, 66%, 65%, 64%, 63%, 62%, 61%, 60%, 55%, 50%, 45%, 40%, 35%, 30%, 25%, 20%, 15%, or 10% of a longitudinal length of the absorbent article. In some embodiments, the absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer, and wherein the channels penetrate to a depth of no more than 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, or 90% of a thickness of the absorbent article. In some embodiments, the channels of the absorbent articles disclosed herein penetrate to a depth of no more than 500 micrometers into an absorbent article that is 1000 micrometers thick. In some embodiments, the absorbent articles disclosed herein comprise at least one channel. In some embodiments, the absorbent articles disclosed herein comprise two or more channels. In some embodiments, the absorbent articles disclosed herein comprise three or more channels. In some embodiments, the absorbent articles disclosed herein comprise four or more channels. In some embodiments, the absorbent articles disclosed herein comprise 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, or more channels.

[0038] In some instances, the at least one channel comprises a width of 0.5 mm, 1 mm, 1.5 mm, 1.6 mm, 1.7 mm, 1.8 mm, 1.9 mm, 2.0 mm, 2.1 mm, 2.2 mm, 2.3 mm, 2.4 mm, 2.5 mm, 3.0 mm, or 3.5 mm. In some cases, the at least one channel is separated from another channel by 4 mm, 6 mm, 8 mm, 10 mm, 12 mm, 14 mm, 16 mm, 18 mm, or 20 mm.

[0039] In some embodiments, the absorbent articles described herein comprise channels formed by ultrasonic welding. Ultrasonic welding allows melting of materials by means of ultrasonic vibrations so that a cohesive or form-fit joint is produced. Ultrasonic welding comprises the use of an anvil and an ultrasonic horn. Two materials are placed between the anvil and the ultrasonic horn and ultrasonic vibration is applied to the ultrasonic horn to weld the materials together.

Adhesives

[0040] In some embodiments, the absorbent articles described herein comprise an adhesive. In some embodiments, the adhesive serves to hold the absorbent article to the clothing of a user. In some embodiments, the adhesive is protected by a release liner which is removed in order to expose the adhesive. In some embodiments, the adhesive serves to bind two or more of a top

layer, a middle absorbent layer, an absorbent pod, and a bottom layer of the absorbent article together. In some instances, the adhesive serves to bind the top layer to the absorbent pod. In some cases, the adhesive serves to bind the absorbent pod to the middle absorbent layer. In other cases, the adhesive serves to bind the top layer. the absorbent pod, and the middle absorbent layer together. In some embodiments, the adhesive comprises a silicone adhesive. In some embodiments, the adhesive comprises a cellulose adhesive. The adhesive may also be a hydrocolloid, polyurethane, rubber based adhesive or acrylic adhesive. In some embodiments, the top layer, middle absorbent layer, and bottom layer are thermally, ultrasonically, or chemically bonded to one another. In some embodiments, the top layer, middle absorbent layer, and bottom layer are joined using lines of hot melt adhesive or mechanical fasteners such as thread, clips, or staples. In some embodiments, a hydrophilic adhesive is used to join the top layer, the middle absorbent layer, and the bottom layer.

[0041] In some embodiments, the absorbent articles disclosed herein comprise a top layer, a middle absorbent layer, an absorbent pod encapsulated by the top layer and the middle absorbent layer, and a bottom layer, wherein the top layer comprises at least one channel anchored from the top layer through the middle absorbent layer and into the bottom layer, and wherein the top layer, the middle absorbent layer, the absorbent pod, and the bottom layer are integrally bonded together by a lamination or by a bonding material applied as a hot melt glue (such as a synthetic rubber based pressure sensitive hot melt adhesive), or a cold glue, or as a mixture of polyvinyl alcohol (PVOH) mixed with Kymene or a Kymene equivalent that integrally secures the top layer, middle absorbent layer, and the bottom layer together or such that they are bonded together along their peripheral edges. The layers may be joined using hot melt extrusion, lamination, and other processes and systems suitable for integrally securing the layers together. In some embodiments, a hydrophilic adhesive is used to join the top layer to the bottom layer. The particular joining method may be dictated by the types of materials selected for attaching the top layer, the middle absorbent layer, the absorbent pod, and the bottom layer together.

Incontinent Pads

[0042] In some embodiments, provided herein are absorbent articles comprising ultrathin bladder leakage liners / pads comprising an absorbent pod, channels formed by ultrasonic welding, and an asymmetrical shape. Such an ultrathin bladder leakage liner is depicted in **FIG. 1**, which depicts a top plan view of an exemplary ultrathin bladder leakage liner **100** including a top layer **130** with channels **120** and an absorbent pod **125**. **FIG. 2** shows a similar top plan view of an exemplary ultrathin bladder leaking liner including a top layer **230** with channels **220** visualized. An absorbent pod **225** is shown as protruding away from the top layer **230** in **FIG. 2**.

Methods of Manufacturing

[0043] In some embodiments, provided herein are methods of manufacturing absorbent articles. Processes for assembling absorbent articles include joining the bottom layer and/or the top layer to the middle absorbent layer and the absorbent pod or to each other by a uniform continuous layer of adhesive, a patterned layer of adhesive, or an array of separate lines, spirals, or spots of adhesive. In some embodiments, the methods of manufacturing absorbent articles disclosed herein comprise forming a bottom layer, forming an absorbent layer, forming an absorbent pod, forming a top layer, and combining those layers into an absorbent article, and then forming at least one channel in the top layer wherein the at least one channel is anchored through the middle absorbent layer and into the bottom layer.

[0044] In some embodiments, the absorbent articles disclosed herein comprise one or more layers manufactured by a method comprising needle punching, spunlacing, wet-laying, dry-laying, melt blowing, needle bonding, stitch-bonding, hydroentanglement, and felting. In some embodiments, the absorbent articles disclosed herein comprise an absorbent layer manufactured by a method comprising needle punching, spunlacing, wet-laying, dry-laying, meltblowing, needle bonding, stitch-bonding, hydroentanglement, and felting. In some embodiments, the middle absorbent layer is stitch bonded with strengthening fibers or yarns to provide additional strength to the middle absorbent layer such that it retains its structure when saturated with fluid. In some instances, the absorbent pod is formed by air laid material. In some embodiments, the stitch-bonded structure affords higher absorbency or a degree of extensibility to the absorbent article depending on the nature of the strengthening fibers and yarns used and their stitch-bonding pattern. In some embodiments, the absorbent articles disclosed herein are formed by methods including adhesion, flame lamination and ultrasound.

EXAMPLES

[0045] Example 1: Comparison of fluid distribution and absorption.

[0046] The absorbent article with the absorbent pod is placed by the wearer in a way that the absorbent pod comes in direct contact or in close proximity with the urethra. As such, the fluid at the point of insult is rapidly absorbed by the absorbent pod and subsequently transported via the channels to the parts of the absorbent article that are distal from the point of insult.

[0047] While preferred embodiments of the present examples have been shown and described herein, it will be obvious to those skilled in the art that such embodiments are provided by way of example only. Numerous variations, changes, and substitutions will now occur to those skilled in the art without departing from the disclosure. It should be understood that various alternatives to

the embodiments of the disclosure described herein may be employed in practicing the disclosure. It is intended that the following claims define the scope of the disclosure and that methods and structures within the scope of these claims and their equivalents be covered thereby.

CLAIMS

What is claims is:

1. An absorbent article comprising:

a top layer;

a middle absorbent layer;

an absorbent pod encapsulated between the top layer and the middle absorbent layer;

a bottom layer; and

at least one channel anchored from the top layer through the middle absorbent layer into the bottom layer,

wherein the absorbent article comprises a first end and a second end, and further comprises an asymmetrical shape along a longitudinal axis.

2. The absorbent article of claim 1, wherein the first end comprises a maximum width that is the same as a maximum width of the absorbent article and the second end comprises a width that is at least 60% of the maximum width of the first end.

3. The absorbent article of claim 1, wherein the absorbent pod is located at the first end of the absorbent article.

4. The absorbent article of claim 1, wherein the absorbent pod comprises a non-woven absorbent material.

5. The absorbent article of claim 1, wherein the absorbent pod has a length of at least 25% of a length of the absorbent article.

6. The absorbent article of claim 1, wherein the absorbent article has a length of at least 200 millimeters.

7. The absorbent article of claim 1, wherein a width of the second end is at least 70% of a width of the first end.

8. The absorbent article of claim 1, comprising two or more channels.

9. The absorbent article of claim 1, wherein the top layer and the middle absorbent layer are bonded together with an adhesive.

10. The absorbent article of claim 1, wherein the top layer comprises a plurality of holes.

11. The absorbent article of claim 1, wherein the middle absorbent layer comprises a fluid drawing material and a fluid storage material.

12. The absorbent article of claim 11, wherein the fluid drawing material comprises electrospun nanofibers.

13. The absorbent article of claim 11, wherein the fluid storage material comprises superabsorbent polymer.

14. The absorbent article of claim 1, wherein the at least one channel is arranged in a parallel orientation to a longitudinal axis of the absorbent article.

15. The absorbent article of claim 1, wherein the at least one channel is ultrasonically welded from the top layer through the middle absorbent layer, and into the bottom layer.

16. The absorbent article of claim 1, wherein the at least one channel is arranged such that a distance from a midline of the absorbent article to the at least one channel varies along a length of the at least one channel.

17. The absorbent article of claim 1, wherein the at least one channel extends over no more than 66% of a length of the absorbent article.

18. The absorbent article of claim 1, wherein the at least one channel extends over no more than 75% of a length of the absorbent article.

19. The absorbent article of claim 1, wherein the at least one channel penetrates to a depth of no more than 50% of a thickness of the absorbent article.

20. The absorbent article of claim 1, wherein the bottom layer comprises an adhesive region on a side opposite to a side in contact with the middle absorbent layer.

21. The absorbent article of claim 20, wherein the adhesive region on a side opposite to a side in contact with the middle absorbent layer is in contact with a protection paper.

22. The absorbent article of claim 21, wherein the protection paper is attached to a wrapper element.

23. The absorbent article of claim 22, wherein the absorbent article is folded such that the folded absorbent article is completely enclosed by the wrapper element.

24. The absorbent article of claim 1, wherein the absorbent article is at least 230 millimeters long, at least 90 millimeters wide at the first end, and at least 60 millimeters wide at the second end.

25. The absorbent article of claim 1, wherein the absorbent article is an incontinent pad.

26. The absorbent article of claim 1, wherein the absorbent article is configured for use by a wearer to absorb bodily fluid.

27. The absorbent article of claim 1, wherein the absorbent pod is placed directly beneath a wearer's urethra.

28. A method of making an absorbent article, the method comprising:

a) forming an absorbent article comprising:
   a top layer;
   a middle absorbent layer;
   an absorbent pod encapsulated between the top layer and the middle absorbent layer; and
   a bottom layer; and
b) anchoring at least one channel in the top layer through the middle absorbent layer and into the bottom layer.

29. The method of claim 28, wherein anchoring the at least one channel in the top layer through the middle absorbent layer and into the bottom layer comprises ultrasonic welding.

30. An asymmetrical absorbent article comprising:

a top layer;

a middle absorbent layer;

a bottom layer; and

at least one channel anchored from the top layer through the middle absorbent layer into the bottom layer,

wherein the absorbent article comprises a first end and a second end, wherein the width of the first end is the same as the width of the absorbent article and the width of the second end is no more than 60% of the width of the first end.

31. The absorbent article of claim 30, further comprising an absorbent pod located at the first end of the absorbent article.

32. The absorbent article of claim 31, wherein the absorbent pod comprises a non-woven absorbent material.

33. The absorbent article of claim 31, wherein the absorbent pod has a length of at least 25% of a length of the absorbent article.

34. The absorbent article of claim 30, wherein the absorbent article has a length of at least 200 millimeters.

35. The absorbent article of claim 30, wherein a width of the second end is at least 70% of a width of the first end.

36. The absorbent article of claim 30, comprising two or more channels.

37. The absorbent article of claim 30, wherein the top layer and the middle absorbent layer are bonded together with an adhesive.

38. The absorbent article of claim 30, wherein the top layer comprises a plurality of holes.

39. The absorbent article of claim 30, wherein the middle absorbent layer comprises a fluid drawing material and a fluid storage material.

40. The absorbent article of claim 39, wherein the fluid drawing material comprises electrospun nanofibers.

41. The absorbent article of claim 39, wherein the fluid storage material comprises superabsorbent polymer.

42. The absorbent article of claim 30, wherein the at least one channel is arranged in a parallel orientation to a longitudinal axis of the absorbent article.

43. The absorbent article of claim 30, wherein the at least one channel is ultrasonically welded from the top layer through the middle absorbent layer, and into the bottom layer.

44. The absorbent article of claim 30, wherein the at least one channel is arranged such that a distance from a midline of the absorbent article to the at least one channel varies along a length of the at least one channel.

45. The absorbent article of claim 30, wherein the at least one channel extends over no more than 66% of a length of the absorbent article.

46. The absorbent article of claim 30, wherein the at least one channel extends over no more than 75% of a length of the absorbent article.

47. The absorbent article of claim 30, wherein the at least one channel penetrates to a depth of no more than 50% of a thickness of the absorbent article.

48. The absorbent article of claim 30, wherein the bottom layer comprises an adhesive region on a side opposite to a side in contact with the middle absorbent layer.

49. The absorbent article of claim 48, wherein the adhesive region on a side opposite to a side in contact with the middle absorbent layer is in contact with a protection paper.

50. The absorbent article of claim 49, wherein the protection paper is attached to a wrapper element.

51. The absorbent article of claim 50, wherein the absorbent article is folded such that the folded absorbent article is completely enclosed by the wrapper element.

52. The absorbent article of claim 30, wherein the absorbent article is about 230 millimeters long, at least 90 millimeters wide at the first end, and at least 60 millimeters wide at the second end.

53. The absorbent article of claim 30, wherein the absorbent article is an incontinent pad.

54. The absorbent article of claim 30, for use by a wearer to absorb bodily fluid.

55. The absorbent article of claim 31, wherein the absorbent pod is placed directly beneath a wearer's urethra.

FIG.1

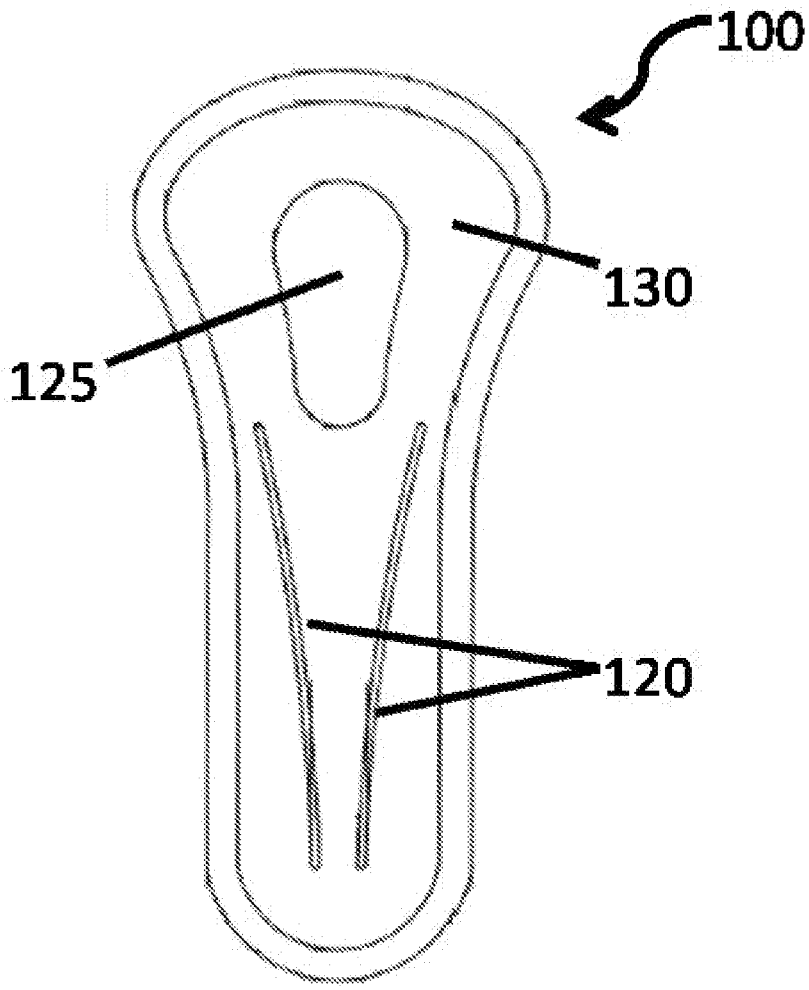
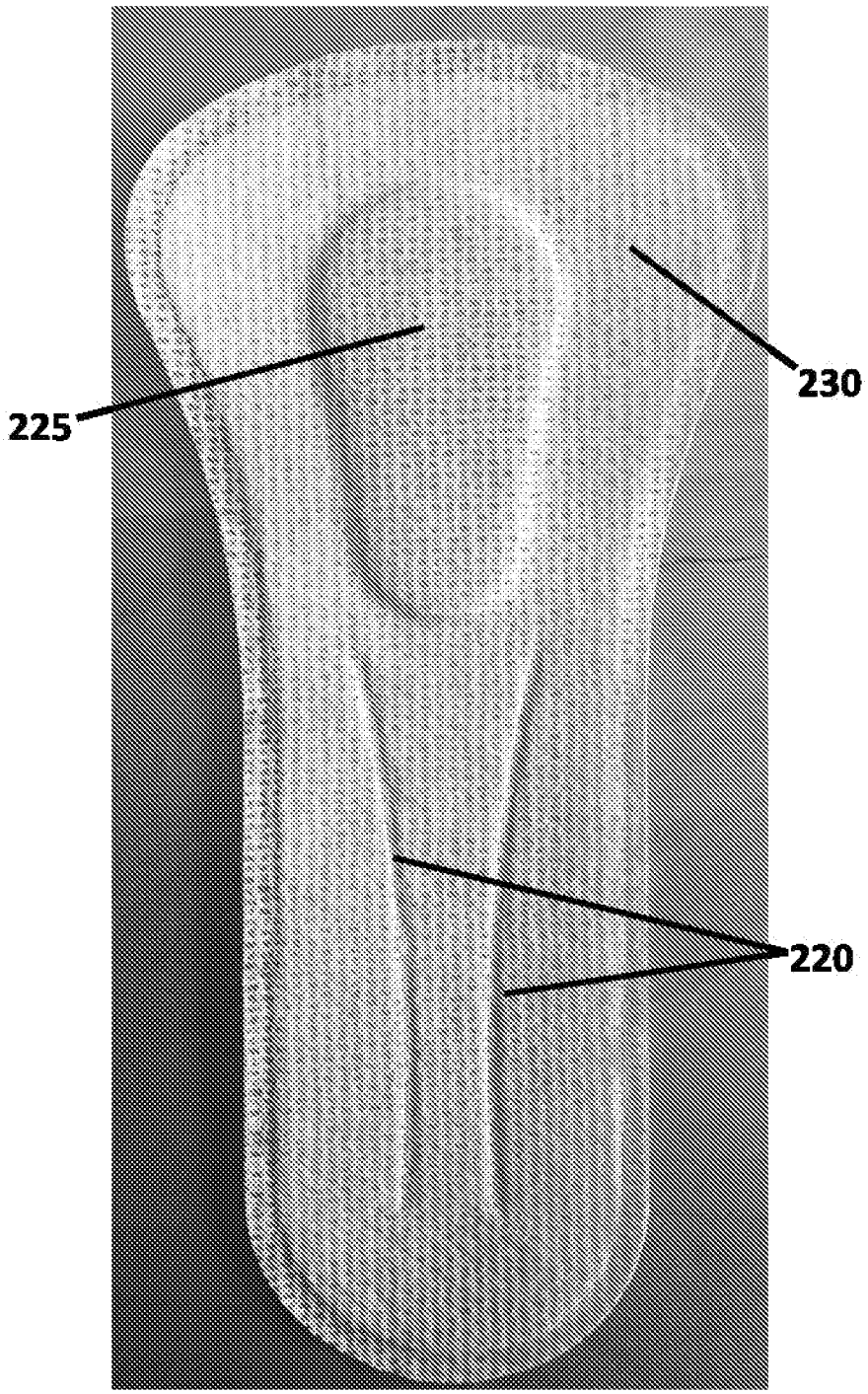


FIG. 2



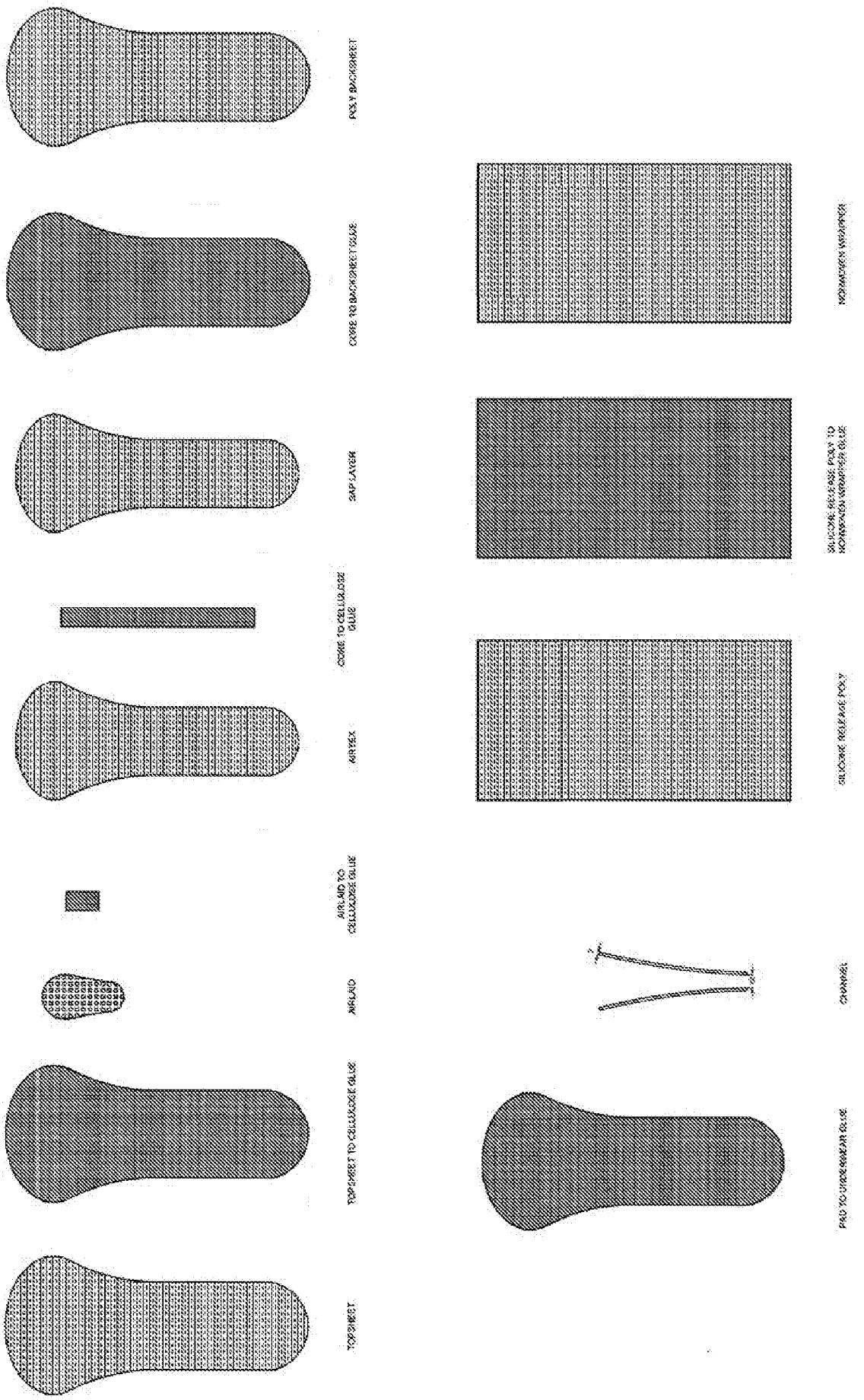

TOPSHEET
TOPSHEET TO CELLULOSE GLUE
AIRLAID
AIRLAID TO CELLULOSE GLUE
KRYTEX
CORE TO CELLULOSE GLUE
SAP LAYER
CORE TO BACKSHEET GLUE
POLY BACKSHEET
PAD TO UNDERWEAR GLUE
CHANNEL
SILICONE RELEASE POLY
SILICONE RELEASE POLY TO NONWOVEN WRAPPER GLUE
NONWOVEN WRAPPER

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/23175

A. CLASSIFICATION OF SUBJECT MATTER
IPC - A61F 13/47 (2020.01)
CPC - A61F 13/47

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 2015/0080837 A1 (THE PROCTER AND GAMBLE COMPANY); 19 March 2015 (19.03.2015); entire document, especially Fig. 4A, 5, 19; Abstract; para. [0029], [0032], [0037], [0050], [0065], [0080], [0099], [0114], [0141], [0174]-[0075].	1-18, 24-29 --- 30, 34, 37-43, 45-46, 52
X -- Y	JP 2017-093950 A (NIPPON PAPER CRECIA CO LTD); 1 June 2017 (01.06.2017); entire document, especially Fig. 1-2, 3B; pg. 4-7.	1, 19-21, 30-33, 35-36, 44, 47-49, 53-55 --- 22-23, 50-51
Y	US 5,520,674 A (LAVON et al.); 28 May 1996 (28.05.1996); entire document, especially Fig. 8; col. 14, ln 20-23; col. 16, ln 33-52.	22-23, 50-51
Y	CN 201822974 U (SHANDONG MIMOSA HEALTH TECHNOLOGY CO., LTD); 11 May 2011 (11.05.2011); entire document, especially Figs. 1-2; Abstract; Translation, pg. 1-2.	30, 34, 37-43, 45-46, 52
A	US 2006/0058761 A1 (KUDO et al.); 16 March 2006 (16.03.2006); entire document.	1-55
A	US 5,397,316 A (LAVON et al.); 14 March 1995 (14.03.1995); entire document.	1-55

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 May 2020	12 JUN 2020
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300