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- (54) Title: LOWER-BODY GARMENT WITH MULTI-AXIAL CROTCH GUSSET
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- FIG. 3
- (57) Abstract: A lower-body garment (110) includes a multi-axial crotch gusset (112). The crotch gusset includes an elongated trunk having an elongated front portion (132) and an elongated back portion where the elongated trunk continuously extends from a front side (118) of a pelvic portion of the lower-body garment adjacent a waist opening (115) to a back side of the pelvic portion of the lower-body garment adjacent the waist opening. The crotch gusset further includes a first wing (136) that extends along an inner thigh portion of a first leg portion of the lower-body garment, and a second wing (138) that extends along an inner thigh portion of a second leg portion of the lower-body garment.
- [Continued on next page]

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LOWER-BODY GARMENT WITH MULTI-AXIAL CROTCH GUSSET

FIELD OF THE INVENTION

[0001] Aspects herein related to a multi-axial crotch gusset.

BACKGROUND OF THE INVENTION

5 **[0002]** Lower-body garments are sometimes configured for physical activity, such as sports, athletics, fitness, and the like. In some instances, lower-body garments can be form-fitting. For example, lower-body garments can be constructed of elastomeric textiles that allow the garment to fit the wearer more closely and stretch and recover with wearer movement. In some instances, lower-body garment can include a crotch
10 gusset.

DETAILED DESCRIPTION OF THE DRAWINGS

[0003] The present articles and methods for a lower-body garment with a multi-axial crotch gusset are described in detail below with reference to these figures.

[0004] FIG. 1 illustrates a front perspective view of a lower-body garment in
15 accordance with an example.

[0005] FIG. 2 illustrates a back perspective view of the lower-body garment of FIG. 1 in accordance with an example.

[0006] FIG. 3 illustrates a front view of the lower-body garment of FIG. 1 in accordance with an example.

20 **[0007]** FIG. 4 illustrates a bottom view of the lower-body garment of FIG. 1 in accordance with an example.

[0008] FIG. 5 illustrates a crotch gusset pattern piece for use in the lower-body garment of FIGs. 1-4 in accordance with an example.

[0009] FIG. 6 illustrated a flow diagram of an example method of manufacturing a
25 lower-body garment with a multi-axial crotch gusset in accordance with an example.

[0010] FIG. 7 illustrates an alternative crotch gusset pattern piece for use in a lower-body garment in accordance with an example.

[0011] FIG. 8 illustrates a bottom view of the lower-body garment of FIG. 7 in accordance with an example.

DETAILED DESCRIPTION OF THE INVENTION

[0012] Examples of this disclosure are related to a multi-axial crotch gusset for use in a lower-body garment, a lower-body garment with a multi-axial crotch gusset, and methods for making the same. With respect to the lower-body garment, the lower-body garment includes a pelvic portion having a waist opening where the pelvic portion includes a front side and a back side. The lower-body garment further includes a first leg portion and a second leg portion extending from the pelvic portion and terminating in a first leg opening and a second leg opening respectively. The multi-axial crotch gusset, which can be formed from an elastomeric material, includes an elongated trunk that extends from the front side of the pelvic portion to the back side of the pelvic portion. Additionally, the multi-axial crotch gusset includes a first wing and a second wing that extend from the elongated trunk and along an inner thigh portion of a respective leg portion. In examples, the multi-axial crotch gusset decreases the likelihood that the lower-body garment might pull on the wearer during activity and potentially resist the wearer's motion, while also providing a form fit without excess material.

[0013] Traditional crotch gussets generally include several discrete configurations. In one example, the conventional crotch gusset might only extend along an inner thigh portion of the leg portions of a lower-body garment without also extending through the front side and back side of the pelvic portion of the lower-body garment. In another example, the conventional crotch gusset might extend from the front side to the back side of the pelvic portion without also extending along an inner thigh portion of the leg portions. In both of these examples, the construction of the crotch gusset may impede some types of motion and/or prevent the lower-body garment from being form fitting. In those examples where a crotch gusset may extend from the front side to the back side of the pelvic portion while also extending along the inner thigh portion of the leg portions, the crotch gusset typically has a multi-panel construction with seam lines that have less stretch and recovery compared to other portions of the conventional crotch gusset. Besides restricting movement and potentially detracting from a form fit, the seam lines may introduce chaffing points which may be particularly problematic in view of the sensitive skin in the crotch area of a wearer.

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[0014] In contrast to conventional approaches, the crotch gusset of the present disclosure both decreases the likelihood that a lower-body garment will restrict wearer motion, while also providing a form fit. That is, examples of the present disclosure can contribute to both enhanced range of motion and a form fit for the wearer.

5 **[0015]** As indicated above, the crotch gusset can include an elongated trunk that extends from the front portion of the pelvic portion to the back portion of the pelvic portion. That is, the elongated trunk can include an elongated front portion that extends from the crotch and up towards the waistband or the waist opening in the front of the pelvic portion. In some instances, the elongated front portion can extend to the
10 waistband (or waist opening) or to a position adjacent the waistband (or waist opening). In addition, the elongated trunk can include an elongated back portion that extends from the crotch and up towards the waistband (or waist opening) in the back of the pelvic portion. In some instances, the elongated back portion can extend to the waistband (in the back) or to a position adjacent the waistband or waist opening. In
15 examples, the elongated trunk can seamlessly extend from the elongated front portion to the elongated back portion.

[0016] As indicated above, the crotch gusset can include a first wing and a second wing that extend from the elongated trunk. In at least some examples, the crotch gusset that includes the elongated trunk with the first wing and the second wing is a
20 seamless gusset panel, such that the crotch gusset is a single pattern piece without seams, which can also be referred to as a one-panel construction. The absence of seams, which typically lack the stretch and recovery properties of the elastomeric material used to form the multi-axial crotch gusset, facilitates uniform multi-axial stretch of the crotch gusset. Stated differently, the multi-axial crotch gusset generally
25 exhibits uniform stretch from the front side to the back side of the pelvic portion and along an inner thigh portion of the respective leg portions such that tension or stretch imparted to one part of the multi-axial crotch gusset (e.g., along one of the wing portions) is uniformly distributed to other parts of the crotch gusset. This feature enables a wearer to exhibit a generally full range of movement of the wearer's legs.

30 **[0017]** As further described, the multi-axial crotch gusset has a shape configuration that enables the crotch gusset to be form fitting (i.e., to closely conform to an underlying body morphology of a wearer). Stated differently, the crotch gusset is configured such that there is generally not a space between the wearer's body surface

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and the crotch gusset. Moreover, the use of the elongated trunk in combination with the first and second wings in the form of a seamless, one-piece panel makes the crotch gusset less likely to pull on a wearer during movement.

5 **[0018]** In example aspects, the crotch gusset includes a peripheral edge that continuously extends around (e.g., circumscribes) the elongated trunk, the first wing, and the second wing. For example, the peripheral edge can extend from the elongated front portion to the first wing; from the first wing to the elongated back portion; from the elongated back portion to the second wing; and from the second wing back to the elongated front portion.

10 **[0019]** In at least some instances, the peripheral edge includes curvilinear or curved transitions, as opposed to linear transitions, from one part of the gusset to another part of the crotch gusset. For example, the peripheral edge can include a curvilinear or curved transition from the elongated front portion to each wing (e.g., the front transitions). In addition, the peripheral edge can include a curvilinear or curved
15 transition from the elongated back portion to each wing (e.g., the back transitions). Various properties of the transitions between the various parts of the crotch gusset can contribute to the operation of the crotch gusset. For example, the transitions may include one or more radii of curvature that contribute to the operation of the crotch gusset including helping the crotch gusset conform more closely to the underlying
20 morphology of the wearer's body. In example aspects, the radii of curvature of the front transitions may be less than the radii of curvature of the back transitions. In some aspects, having a greater radii of curvature associated with the back transitions helps to accommodate the greater size/volume of the buttocks of a wearer.

25 **[0020]** In other example aspects, each of the front transitions may include a central-most point corresponding to the center of the arc of curvature that is spaced a first distance from a midline of the gusset (e.g., a sagittal midline plane). This is known herein as the "offset distance". Similarly, each of the back transitions may include a central-most point that is spaced a second distance from the midline of the crotch gusset. In example aspects, the offset distance of the front transitions is smaller than
30 the offset distance of the back transitions. To describe this differently, the distance between the central-most points of each of the front transitions may be smaller than the distance between the central-most points of each of the back transitions which results in a greater volume of the crotch gusset toward the back of a wearer. Again,

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this configuration is optimized to better accommodate the greater size/volume of the buttocks of the wearer.

[0021] Another feature of the crotch gusset (which may contribute to the lower-body garment being form fitting and allowing a full range of motion by a wearer) is the alignment of a distal-most portion of each wing with an inseam of each respective leg portion and, in some examples, displacing the inseams in an anterior direction with respect to a coronal reference plane of the lower-body garment. As described, in general stitch points or points of securement between textile panels, such as the securement of the distal-most portions of the wings to the leg portions of the lower-body garment and of the textile panels that form the leg portions of the lower-body garment at the inseam area, may exhibit less stretch than the elastomeric material used to form the crotch gusset and/or the lower-body garment. Displacing the inseam, and the distal-most portions of each wing in an anterior direction helps to minimize the impact of the points of securement on wearer movement (e.g., restrict wearer movement). For example, the location of a wearer's adductors and abductors that initiate lateral and medial movements of the wearer's leg are in line with the coronal reference plane. By displacing the inseams anteriorly and aligning the distal-most portions of the wings with the inseams, full range of movement especially by the adductors may be achieved.

[0022] The term "lower-body garment" as used herein can include a garment configured to be worn on the lower torso of a wearer. Examples of lower-body garments can include pants of various lengths (e.g., full length, ankle length, calf, below knee, above knee, shorts, and the like). Lower-body garments can be configured to be worn during various physical activities, such as athletic activities and sports, including American football, lacrosse, baseball, basketball, hockey, and the like. In some instances, lower-body garments can be configured to be worn with pads, such as a girdle, hip pads, thigh pads, and the like. In some examples, lower-body garments can be configured to be worn without pads. In some examples, a lower-body garment can include tights, leggings, capris, or shorts. In some examples, lower-body garments can include underwear, such as boxer briefs or boy shorts. In some examples, the lower-body garment can include an inner liner that is sewn into another lower-body garment. These are examples are not meant to be limiting, and in other

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instances, the lower-body garment can be configured for a variety of other physical activities.

[0023] When describing the lower-body garment as “form fitting,” it is meant that the lower-body garment closely conforms to the underlying morphology of the wearer.

5 In some examples, this can be at least partially achieved through use of elastomeric textiles that are formed, at least in part, of elastic yarns that have stretch and recovery properties. For example, elastic yarns may be stretched up to about 200% of their length and substantially return to their original length upon removal of the stretching force. In examples of the present disclosure, the lower-body garment, including the
10 crotch gusset described herein, may comprise an elastomeric textile which contributes to the lower-body garment being form fitting. In further examples, the shape configuration of the crotch gusset also helps the lower-body garment to be form fitting.

[0024] The term “seamless” as used herein refers to a single-piece textile panel that does not include any stitch lines or points of attachment. To describe this
15 differently, and with respect to the crotch gusset described herein, if the crotch gusset comprises a knit or woven construction, the crotch gusset is seamless when a yarn from a first area of the crotch is interlooped with or interwoven with a yarn in a second area of the crotch gusset. Having a seamless crotch gusset contributes to wearer comfort by reducing chaffing points and facilitating multi-axial uniform stretch.

20 **[0025]** Positional terms used when describing the lower-body garment are with respect to the lower-body garment being worn as intended by a wearer standing upright. In some instances, reference can be made to a sagittal reference plane, which generally divides the lower-body garment into a right side and a left side; a coronal reference plane, which generally divides the lower-body garment into a front or anterior
25 half and a back or posterior half; and/or a transverse reference plane, which generally divides the lower-body garment into a top half and a bottom half.

[0026] The term “front torso,” “front pelvic,” “front side,” or “front portion” can refer to portions of the lower-body garment configured to be positioned adjacent to a lower front torso area of a wearer. The term “back torso,” “back pelvic,” “back side,” or “back
30 portion” refer to portions of the lower-body garment configured to be positioned adjacent to a back lower torso area of the wearer. The term “side” as used without the qualifier of “front” or “back” refers to portions of the lower-body garment configured to be positioned adjacent to a side torso area, side pelvic area, and/or side leg area of

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the wearer. The term “crotch” or “crotch area” as used herein refers to portions of the lower-body garment configured to be positioned adjacent to a crotch area of the wearer as that term is generally recognized. The terms “upper” and “lower” as used herein are relative terms such that, for example, an “upper edge” is located closer to a waist opening of the lower-body garment compared to a “lower edge,” and a “lower edge” is located closer to a leg opening of the lower-body garment compared to an “upper edge.”

[0027] The terms “external” and “internal” as used herein are relative terms such that a layer that is external is positioned external to one or more internal layers, and a layer that is internal is positioned internal to one or more external layers. The term “innermost-facing surface” when used with respect to the lower-body garment means a face that is positioned closest to a body surface of a wearer compared to other layers of the lower-body garment. The term “outermost-facing surface” when used with respect to the lower-body garment means a face that is positioned closest to the external environment with respect to other layers of the lower-body garment.

[0028] FIGs. 1 and 2 respectively depict front and back perspective views of a lower-body garment 110 with a one-piece, seamless crotch gusset 112 in which the crotch gusset 112 is depicted with a stipple fill. The lower-body garment 110 generally includes a pelvic portion 114 (e.g., a lower-torso portion) having a waist opening 115 that is circumscribed by an upper edge 117 of the pelvic portion 114. In example aspects, the pelvic portion 114 may optionally include a waistband 116. In this example, the upper edge 117 comprises an upper edge of the waistband 116, and the waistband 116 further includes a lower edge 119. The pelvic portion 114 further includes a front side 118 (e.g., a front pelvic portion or a front lower-torso portion), and a back side 120 (e.g., a back pelvic portion or a back lower torso portion). Additionally, the lower-body garment 110 includes a first leg portion 122 that terminates in a first leg opening (not shown) and a second leg portion 124 that terminates in a second leg opening (not shown). A crotch area 126 is positioned between the first leg portion 122 and the second leg portion 124.

[0029] In some examples, the lower-body garment 110 including the crotch gusset 112 may be formed from an elastomeric textile that exhibits two-way, four-way, or multi-axial stretch and recovery characteristics. The elastomeric textile may facilitate the lower-body garment 110 and the crotch gusset 112 in being form fitting such that

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the lower-body garment 110 may be worn during physical activity, such as sports, athletics, fitness, and everyday activity.

5 [0030] As further described with respect to FIG. 5, the crotch gusset 112 includes an elongated trunk including an elongated front portion 132 that extends from the crotch area 126 and up towards the upper edge 117 on the front side 118 of the pelvic portion 114 as seen in FIG. 1. When the lower-body garment 110 includes the waistband 116, the elongated front portion 132 may extend at least to the lower edge 119 of the waistband 116. As depicted in FIG. 2, the elongated trunk further includes an elongated back portion 134 that extends from the crotch area 126 and up towards
10 the upper edge 117 on the back side 120 of the pelvic portion 114. When the lower-body garment 110 includes the waistband 116, the elongated back portion 134 may extend at least to the lower edge 119 of the waistband 116. As depicted, the elongated back portion 134 may include a greater volume or surface area of material to better accommodate the larger muscles in the buttocks region of a wearer.

15 [0031] As depicted in FIG. 2, the crotch gusset 112 further includes a first wing 136 that extends from the elongated trunk and along an inner thigh portion of the first leg portion 122. As depicted in both FIGs. 1 and 2, the crotch gusset 112 includes a second wing 138 that extends from the elongated trunk and along an inner thigh portion of the second leg portion 124. The crotch gusset 112 including the elongated
20 trunk with the elongated front portion 132, the elongated back portion 134, the first wing 136, and the second wing 138 can include a seamless pattern piece. Stated differently, in some examples the crotch gusset 112 described might not include any seams which helps to facilitate multi-axial uniform stretch as described above.

[0032] FIG. 3 depicts a front view of the lower-body garment 110 with the first and
25 second leg portions 122 and 124 in a straddle position. As depicted the elongated front portion 132 extends toward the upper edge 117 of the lower-body garment 110, and the first and second wings 136 and 138 respectively extend along an inner-thigh portion of the first and second leg portions 122 and 124. In examples, the elongated front portion 132 transitions to the first wing 136 at a first transition 142, and the
30 elongated front portion 132 transitions to the second wing 138 at a second transition 144. As depicted, each of the first and second transitions 142 and 144 are curvilinear or curved as opposed to a linear transition. Moreover, each of the first and second transitions 142 and 144 are concave based on the edge curving into the body of the

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crotch gusset 112. As will be explained in greater detail with respect to FIG. 5, the properties of the first and second transitions 142 and 144 contribute to the functioning of the crotch gusset 112.

[0033] FIG. 4 depicts a bottom view of the lower-body garment 110. A coronal reference plane 410 is indicated which divides the lower-body garment 110 into an anterior or front side and a posterior or rear side. The first and second transitions 142 and 144 between the elongated front portion 132 and the respective first and second wings 136 and 138 are depicted. The elongated back portion 134 transitions to the first wing 136 at a third transition 146, and the elongated back portion 134 transitions to the second wing 138 at a fourth transition 148. Each of the third and fourth transitions 146 and 148 are curvilinear or curved as opposed to a linear transition. Each of the third and fourth transitions 146 and 148 are also concave based on the edge of the transitions curving into the body of the crotch gusset 112. As will be explained in greater detail with respect to FIG. 5, the properties of the third and fourth transitions 146 and 148 contribute to the functioning of the crotch gusset 112.

[0034] In example aspects, the first wing 136 terminates at a first wing distal-most portion 412, and the second wing 138 terminates at a second wing distal-most portion 414. In examples, the first wing distal-most portion 412 is aligned with a first leg portion inseam 123 (indicated by a dashed line), and the second wing distal-most portion 414 is aligned with a second leg portion inseam 125 (indicated by a dashed line). Moreover, in examples, the first wing distal-most portion 412, at least a portion of the first leg portion inseam 123, the second wing distal-most portion 414, and at least a portion of the second leg portion inseam 125 are displaced anterior to the coronal reference plane 410. When worn by a wearer, this would result in the first wing distal-most portion 412, the first leg portion inseam 123, the second wing distal-most portion 414, and the second leg portion inseam 125 being located more toward the front side of a wearer's leg instead of, for example, overtop the wearer's adductor muscles. As described, points of securement between textile panels such as where the first wing distal-most portion 412 is secured to the first leg portion 122, where the second wing distal-most portion 414 is secured to the second leg portion 124, at the first leg portion inseam 123, and at the second leg portion inseam 125, generally exhibit less stretch than, for example, the elastomeric textiles used to form the first and second leg portions 122 and 124 and/or the crotch gusset 112. Displacing the first and second

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leg portions inseams 123 and 125, and the first wing and second wing distal-most portions 412 and 414 in an anterior direction (i.e., anterior to the coronal reference plane 410) helps to minimize the impact of the points of securement on wearer movement (e.g., restrict wearer movement). For example, the location of a wearer's adductors and abductors that initiate lateral and medial movements of the wearer's leg are generally in line with the coronal reference plane 410. By displacing the first and second leg portions inseams 123 and 125 anteriorly and aligning the first wing and second wing distal-most portions 412 and 414 with the inseams 123 and 125, full range of movement especially by the adductors may better be achieved.

10 **[0035]** FIG. 5 depicts the pattern piece used to form the crotch gusset 112. The crotch gusset 112 includes the elongated trunk 130 that seamlessly extends from the front side 118 of the pelvic portion 114 to the back side 120 of the pelvic portion 114. The elongated trunk 130 includes the elongated front portion 132 that extends from the crotch area 126 and up towards the waist opening 115 on the front side 118 of the pelvic portion 114. The elongated front portion 132 terminates at a terminal edge 510. In example aspects, the terminal edge 510 may be aligned with the lower edge 119 of the waistband 116, or the terminal edge 510 may be aligned with the upper edge 117 of the of the pelvic portion 114. The elongated trunk 130 further includes the elongated back portion 134 that extends from the crotch area 126 and up towards the waist opening 115 on the back side 120 of the pelvic portion 114. The elongated back portion 134 terminates at a terminal edge 512. In example aspects, the terminal edge 512 may be aligned with the lower edge 119 of the waistband 116, or the terminal edge 512 may be aligned with the upper edge 117 of the of the pelvic portion 114. The elongated trunk 130 seamlessly extends from the elongated front portion 132 to the elongated back portion 134.

25 **[0036]** The crotch gusset 112 includes a peripheral edge 140 that continuously and sequentially extends around (e.g., circumscribes) the elongated trunk 130 (including the elongated front portion 132 and the elongated back portion 134), the first wing 136, and the second wing 138. For example, the peripheral edge 140 may extend from the elongated front portion 132 to the first wing 136; from the first wing 136 to the elongated back portion 134; from the elongated back portion 134 to the second wing 138; and from the second wing 138 back to the elongated front portion 132.

[0037] In at least some instances, the peripheral edge 140 includes the first and second transitions 142 and 144, and the third and fourth transitions 146 and 148. Each of the first, second, third, and fourth transitions 142, 144, 146, and 148 may be curvilinear or curved as opposed to linear transitions. Utilizing curvilinear or curved transitions as opposed to linear transitions ensures more gradual transitions between the different portions of the crotch gusset 112. In turn, this facilitates the crotch gusset 112 being form-fitting.

[0038] In some examples, the first and second transitions 142 and 144 may each include a radius of curvature 514 that is substantially the same and/or is symmetrical with respect to one another. Additionally, the third and fourth transitions 146 and 148 may each include a radius of curvature 516 that is substantially the same and/or is symmetrical with respect to one another. Stated differently, the first and second transitions 142 and 144 may be symmetrical with respect to one another, and the third and fourth transitions 146 and 148 may be symmetrical with respect to one another.

[0039] In examples, the radius of curvature 514 is different from the radius of curvature 516. For example, the radius of curvature 514 may be less than the radius of curvature 516. To describe this differently, each of the first and second transitions 142 and 144 may be asymmetric with respect to each of the third and fourth transitions 146 and 148. As depicted, the radii can include a simple curve, such that the radius of curvature is relatively constant for each of the first, second, third, and fourth transitions 142, 144, 146, and 148. In some cases, the radii can include a complex curve with values that change (e.g., gradually change from one part of the transition to another part of the transition). Any and all aspects, and any variation thereof, are contemplated as being within aspects herein.

[0040] Various properties of the first, second, third, and fourth transitions 142, 144, 146, and 148 may contribute to the operation of the crotch gusset 112. For example, the radius of curvature 514 of the first and second transitions 142 and 144 may be less than the radius of curvature 516 of the third and fourth transitions 146 and 148. In examples, this creates a narrower articulation angle for the first and second transitions 142 and 144 and a wider articulation angle for the third and fourth transitions 146 and 148. This reflects the underlying surface morphology of a wearer in which there is less body volume at the front side 118 of the crotch area 126 compared to the back side

120 of the crotch area 126 which accommodates the gluteal or buttocks region of a wearer.

[0041] In some examples, each of the first, second, third, and fourth transitions 142, 144, 146, and 148 can include a central-most point 143, 145, 147, and 149 (respectively) that is closest to a midline 150 of the gusset (e.g., a sagittal midline plane). In examples, the distance between the respective central-most points 143, 145, 147, and 149 and the midline 150 is known herein as an offset distance. Thus, each of the first and second transitions 142 and 144 may have an offset distance 152 from the midline 150, and each of the third and fourth transitions 146 and 148 may have an offset distance 156 from the midline 150. Aspects herein also contemplate a distance 153 between the central-most points 143 and 145 of the first and second transitions 142 and 144 respectively, and a distance 158 between the central-most points 147 and 149 of the third and fourth transitions 146 and 148.

[0042] In examples, the offset distance 152 of the first and second transitions 142 and 144 may be less than the offset distance 156 of the third and fourth transitions 146 and 148. Similarly, the distance 153 between the central-most points 143 and 145 of the first and second transitions 142 and 144 may be less than the distance 158 between the central-most points 147 and 149 of the third and fourth transitions 146 and 148. Again, this may reflect the underlying surface morphology of the human wearer in which there is less volume at the front side 118 of the crotch area 126 and more volume at the back side 120 of the crotch area 126 due to the gluteal or buttocks region of the wearer.

[0043] Because of the increase in volume in a back torso area of a wearer due to the gluteal or buttocks region, in example aspects, a length 518 as measured from the central-most point 147 (or 149) to the terminal edge 512 of the elongated back portion 134 is generally greater than a length 520 as measured from the central-most point 143 (or 145) to the terminal edge 510 of the elongated front portion 132.

[0044] In at least some examples, an overall effect of the crotch gusset 112 can include an increase in material in the crotch area 126, as compared to lower-body garments that do not include any gusset or that include a conventional gusset. For example, in FIG. 5, the zones 160, 162, and 164 represent additional material that is present in the crotch area 126 based on the properties of the crotch gusset 112. For example, the zones 160 and 164 can represent an increase in the overall width of the

crotch area 126 (e.g., side-to-side width or left-to-right width) and the zone 162 can represent an increase in the overall length of the crotch area 126 (e.g., front-to-back length). In at least some examples, the zones 160 and 164 can each add a width 161 and 165 to the overall width of the crotch area 126, and each width 161 and 165 can be in a range of 1 cm to 3 cm. In some examples, each width 161 and 165 is about 2 cm (e.g., overall additional width to the crotch area 126 is 4 cm). In some examples, the zone 162 can add a length 163 to the overall length of the crotch area 126. The length 163 can be in a range of 1 cm to 3 cm, and in some examples the length 163 is about 2 cm.

10 **[0045]** FIG. 6 depicts a flow diagram of an example method 600 of manufacturing a lower-body garment such as the lower-body garment 110 having a multi-axial crotch gusset, such as the multi-axial crotch gusset 112. In example aspects the lower-body garment includes a pelvic portion having a waist opening, a front side, a back side, a first leg portion extending from the pelvic portion, and a second leg portion extending from the pelvic portion. At a step 610, the crotch gusset is formed from a one-piece panel where the crotch gusset comprises an elongated trunk having an elongated front portion, such as the elongated front portion 132, and an elongated back portion, such as the elongated back portion 134. In addition, the crotch gusset comprises a first wing, such as the first wing 136 that extends away from the elongated trunk in a first direction at a first location between the elongated front portion and the elongated back portion. The crotch gusset further comprises a second wing, such as the second wing 138 that extends away from the elongated trunk in a second direction opposite the first direction in a second location between the elongated front portion and the elongated back portion.

25 **[0046]** At a step 612, the crotch gusset is incorporated into a crotch area, such as the crotch area 126, of the lower-body garment. When incorporated, the elongated trunk extends from the front side of the pelvic portion adjacent the waist opening to the back side of the pelvic portion adjacent the waist opening. The first wing extends from the elongated trunk and along an inner thigh portion of the first leg portion, and the second wing extends from the elongated trunk and along an inner thigh portion of the second leg portion. The method 600 may further comprise incorporating the crotch gusset such that a distal-most portion of the first wing (e.g., the distal-most portion 412), and a distal-most portion of the second wing (the distal-most portion 414) are

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displaced anteriorly and are aligned with an inseam of respective first leg portion (e.g., the first leg portion inseam 123) and the second leg portion (e.g., the second leg portion inseam 125).

[0047] In some aspects, it may be desirable to include a truncated crotch gusset in a lower-body garment. The truncated crotch gusset may substantially comprise the crotch gusset 112 described above, with a modified back portion. For example, the truncated crotch gusset may include the elongated front portion 132, first wing 136, and second wing 138. Instead of the elongated back portion 134, however, the truncated crotch gusset may have the modified back portion that extends from the transitions 146 and 148. The modified back portion may include a first perimeter edge extending from the transition 146 and a second perimeter edge extending from the transition 148. The first perimeter edge and the second perimeter edge may converge towards one another such that they meet at a terminal point. The terminal point may be at a rear of the crotch area 126, in some examples. In other examples, the terminal point may be positioned on the back side 120 of the pelvic portion 114 between the rear of the crotch area 126 and the terminal edge 512. In these aspects, a seam may extend from the terminal point to the terminal edge 512. In examples that include a waistband 116, the seam may extend from the terminal point to a lower edge of the waistband 116.

[0048] The truncated crotch gusset may provide a lower-body garment that is more aesthetically pleasing to current design trends. Further, the truncated crotch gusset may provide the advantages described above in regard to the crotch gusset 112, while reducing the amount of material used and the labor and cost needed for construction.

[0049] Fig. 7 depicts a pattern piece used to form the truncated crotch gusset 1130. Fig. 8 depicts a bottom view of a lower-body garment 1110 including the truncated crotch gusset 1130. As mentioned above, the truncated crotch gusset 1130 is substantially the same as the crotch gusset 130 from the elongated front portion 132 to the first wing 136 and second wing 138. Hence, these aspects will not be described again for sake of brevity. Unlike the crotch gusset 130, however, the truncated crotch gusset 1130 includes a truncated back portion 1134. The truncated back portion 1134 includes a first perimeter edge 1200 and a second perimeter edge 1202. The first perimeter edge 1200 may extend from the transition 146 and the second perimeter edge 1202 may extend from the transition 148. For example, the first perimeter edge

1200 may extend from the central-most point 147 and the second perimeter edge 1202 may extend from the central-most point 149. The first perimeter edge 1200 and the second perimeter edge 1202 may taper towards one another until they converge at a terminal point 1204.

5 **[0050]** The terminal point 1204 may be associated with an intermediate position on the lower-body garment. For example, the terminal point 1204 may be positioned at the rear of the crotch area 126 or the back side of the pelvic portion 114. The terminal point 1204 is spaced away from the waist opening 115 and/or waistband 116 such that in a finished lower-body garment incorporating the truncated crotch gusset 1134, a
10 seam extends from the terminal point 1202 up the back side of the pelvic portion 114 to the waist opening 115 or the waistband 116.

[0051] The following clauses represent example aspects of concepts contemplated herein. Any one of the following clauses may be combined in a multiple dependent manner to depend from one or more other clauses. Further, any combination of
15 dependent clauses (clauses that explicitly depend from a previous clause) may be combined while staying within the scope of aspects contemplated herein. The following clauses are examples and are not limiting.

[0052] Clause 1. A lower-body garment comprising: a pelvic portion comprising a waist opening, a front side, and a back side; a first leg portion and a second leg portion
20 extending from the pelvic portion; a crotch between the first leg portion and the second leg portion; and a crotch gusset comprising: an elongated trunk that extends from the front side to the back side of the pelvic portion; a first wing that extends from the elongated trunk and along an inner thigh portion of the first leg portion; and a second wing that extends from the elongated trunk and along an inner thigh portion of the
25 second leg portion.

[0053] Clause 2. The lower-body garment according to clause 1, wherein the elongated trunk, the first wing, and the second wing comprises a one-piece, seamless panel.

[0054] Clause 3. The lower-body garment according to any of clauses 1 through
30 2, wherein the elongated trunk comprises an elongated front portion terminating adjacent the waist opening on the front side of the pelvic portion and an elongated back portion terminating adjacent the waist opening on the back side of the pelvic portion.

- [0055] Clause 4. The lower-body garment according to clause 3, wherein the crotch gusset comprises a peripheral edge that continuously extends, sequentially, around the elongated front portion, the first wing, the elongated back portion, and the second wing.
- 5 [0056] Clause 5. The lower-body garment according to clause 4, wherein the peripheral edge comprises: a first transition from the elongated front portion to the first wing; a second transition from the elongated front portion to the second wing; a third transition from the elongated back portion to the first wing; and a fourth transition from the elongated back portion to the second wing.
- 10 [0057] Clause 6. The lower-body garment according to clause 5, wherein the first transition, the second transition, the third transition, and the fourth transition are curvilinear.
- [0058] Clause 7. The lower-body garment according to any of clauses 5 through 6, wherein the first transition, the second transition, the third transition, and the fourth transition comprise a concave curvature.
- 15 [0059] Clause 8. The lower-body garment according to any of clauses 5 through 7, wherein the first transition and the second transition are symmetrical based on one or more of a radius of curvature of the first transition and the second transition and an offset distance of the first transition and the second transition from a midline of the crotch gusset.
- 20 [0060] Clause 9. The lower-body garment according to any of clauses 5 through 8, wherein the third transition and the fourth transition are symmetrical based on a radius of curvature of the third transition and the fourth transition and an offset distance of the third transition and the fourth transition from a midline of the crotch gusset.
- 25 [0061] Clause 10. The lower-body garment according to any of clauses 5 through 9, wherein the first transition and the third transition are asymmetrical based on one or more of a radius of curvature of the first transition and the third transition and an offset distance of the first transition and the third transition from a midline from a midline of the crotch gusset.
- 30 [0062] Clause 11. The lower-body garment according to any of clauses 1 through 10, wherein a distal portion of each wing aligns with an inseam of a respective leg sleeve, or alternatively, wherein the crotch gusset comprises a one-piece, seamless panel.

[0063] Clause 12. The lower-body garment according to clause 11, wherein the inseam is located anterior to a coronal reference plane of the lower-body garment.

[0064] Clause 13. A crotch gusset for use in a lower-body garment, the crotch gusset comprising: an elongated trunk having an elongated front portion and an elongated back portion; a first wing extending away from the elongated trunk in a first direction at a first location between the elongated front portion and the elongated back portion; a second wing extending away from the elongated trunk in a second direction opposite the first direction at a second location between the elongated front portion and the elongated back portion; a peripheral edge that continuously extends, sequentially around the elongated front portion, the first wing, the elongated back portion, and the second wing, the peripheral edge comprising: a first curvilinear transition from the elongated front portion to the first wing; a second curvilinear transition from the elongated front portion to the second wing; a third curvilinear transition from the elongated back portion to the first wing; and a fourth curvilinear transition from the elongated back portion to the second wing.

[0065] Clause 14. The crotch gusset according to clause 13, wherein the crotch gusset comprises a one-piece, seamless panel.

[0066] Clause 15. The crotch gusset according to any of clauses 13 through 14, wherein the first transition, the second transition, the third transition, and the fourth transition comprise a concave curvature.

[0067] Clause 16. The crotch gusset according to any of clauses 13 through 15, wherein the first transition and the second transition are symmetrical based on one or more of a radius of curvature of the first transition and the second transition and an offset distance of the first transition and the second transition from a midline of the crotch gusset.

[0068] Clause 17. The crotch gusset according to any of clauses 13 through 16, wherein the third transition and the fourth transition are symmetrical based on a radius of curvature of the third transition and the fourth transition and an offset distance of the third transition and the fourth transition from a midline of the crotch gusset.

[0069] Clause 18. The crotch gusset according to any of clauses 13 through 17, wherein the first transition and the third transition are asymmetrical based on one or more of a radius of curvature of the first transition and the third transition and an offset

distance of the first transition and the third transition from a midline from a midline of the crotch gusset.

[0070] Clause 19. The crotch gusset according to any of clauses 13 through 18, wherein a radius of curvature of each of the first transition and the second transition is
5 less than a radius of curvature of each of the third transition and the fourth transition.

[0071] Clause 20. The crotch gusset according to any of clauses 13 through 19, wherein a length of the elongated back portion as measured from a center-most point of one of the third transition or the fourth transition to a terminal edge of the elongated back portion is greater than a length of the elongated front portion as measured from
10 a center-most point of one of the first transition or the second transition to a terminal edge of the elongated front portion.

[0072] Clause 21. A method of manufacturing a lower-body garment comprising a pelvic portion comprising a waist opening, a front side, and a back side, a first leg portion extending from the pelvic portion, and a second leg portion extending from the pelvic portion, the method comprising: forming, from a one-piece panel, a crotch gusset comprising: an elongated trunk having an elongated front portion and an elongated back portion, a first wing extending away from the elongated trunk in a first direction at a first location between the elongated front portion and the elongated back portion, and a second wing extending away from the elongated trunk in a second
15 direction opposite the first direction at a second location between the elongated front portion and the elongated back portion; and integrating the crotch gusset into a crotch area of the lower-body garment such that the elongated trunk extends from the front side of the pelvic portion adjacent the waist opening to the back side of the pelvic portion adjacent the waist opening, and such that the first wing extends from the elongated trunk and along an inner thigh portion of the first leg portion, and the second wing extends from the elongated trunk and along an inner thigh portion of the second leg portion.
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[0073] Clause 22. A lower-body garment comprising: a pelvic portion comprising a waist opening, a front side, and a back side; a first leg portion and a second leg portion extending from the pelvic portion; a crotch between the first leg portion and the second leg portion; and a truncated crotch gusset comprising: an elongated front portion; a first wing that extends along an inner thigh portion of the first leg portion; a second wing that extends along an inner thigh portion of the second leg portion; and
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a truncated back portion having a first perimeter edge and a second perimeter edge tapering towards one another until they converge at a terminal point.

[0074] Clause 23. The lower-body garment according to clause 22, wherein the elongated front portion terminates adjacent the waist opening on the front side of the pelvic portion.

[0075] Clause 24. The lower-body garment according to any of clauses 22 through 23, wherein the terminal point is spaced away from the waist opening on the back side of the pelvic portion.

[0076] Clause 25. The lower-body garment according to any of clauses 22 through 24, wherein a seam extends between the terminal point and the waist opening on the back side of the pelvic portion.

[0077] Clause 26. The lower-body garment according to any of clauses 22 through 24, wherein a seam extends between the terminal point and a waistband on the back side of the pelvic portion.

[0078] Clause 27. The lower-body garment according to any of clauses 22 through 26, wherein the truncated crotch gusset is symmetrical about an axis extending from a terminal edge of the elongated front portion to the terminal point.

[0079] Clause 28. The lower-body garment according to any of clauses 22 through 27, wherein the first perimeter edge curves in a concave manner between the first wing and the terminal point and the second perimeter edge curves in a concave manner between the second wing and the terminal point.

[0080] Clause 29. The lower-body garment according to any of clauses 22 through 28, wherein a first perimeter edge of the first wing between a distal-most portion of the first wing and the truncated back portion curves in a convex manner and a second perimeter edge of the second wing between a distal-most portion of the second wing and the truncated back portion curves in a convex manner.

[0081] Clause 30. The lower-body garment according to any of clauses 22 through 29, wherein an inflection between the convex curve of the first perimeter edge of the first wing and the concave curve of the first perimeter edge of the truncated back portion is positioned at a transition between the first wing and the truncated back portion.

[0082] Clause 31. The lower-body garment according to any of clauses 22 through 30, wherein an inflection between the convex curve of the second perimeter edge of

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the second wing and the concave curve of the second perimeter edge of the truncated back portion is positioned at a transition between the second wing and the truncated back portion.

[0083] This detailed description is provided in order to meet statutory requirements.

5 However, this description is not intended to limit the scope of the invention described herein. Rather, the claimed subject matter may be embodied in different ways, to include different steps, different combinations of steps, different elements, and/or different combinations of elements, similar or equivalent to those described in this disclosure, and in conjunction with other present or future technologies. The examples
10 herein are intended in all respects to be illustrative rather than restrictive. In this sense, alternative examples or implementations can become apparent to those of ordinary skill in the art to which the present subject matter pertains without departing from the scope hereof.

CLAIMS

What is claimed is:

1. A lower-body garment comprising: a pelvic portion comprising a waist opening, a front side, and a back side; a first leg portion and a second leg portion
5 extending from the pelvic portion; a crotch between the first leg portion and the second leg portion; and a crotch gusset comprising: an elongated trunk that extends from the front side to the back side of the pelvic portion; a first wing that extends from the elongated trunk and along an inner thigh portion of the first leg portion; and a second
10 wing that extends from the elongated trunk and along an inner thigh portion of the second leg portion.
2. The lower-body garment of claim 1, wherein the elongated trunk comprises an elongated front portion terminating adjacent the waist opening on the front side of the pelvic portion and an elongated back portion terminating adjacent the waist opening on the back side of the pelvic portion.
- 15 3. The lower-body garment of claim 2, wherein the crotch gusset comprises a peripheral edge that continuously extends, sequentially, around the elongated front portion, the first wing, the elongated back portion, and the second wing.
- 20 4. The lower-body garment of claim 3, wherein the peripheral edge comprises: a first transition from the elongated front portion to the first wing; a second transition from the elongated front portion to the second wing; a third transition from the elongated back portion to the first wing; and a fourth transition from the elongated back portion to the second wing.
- 25 5. The lower-body garment of claim 4, wherein the first transition, the second transition, the third transition, and the fourth transition are curvilinear.
6. The lower-body garment of claim 5, wherein the first transition, the second transition, the third transition, and the fourth transition comprise a concave curvature.

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7. The lower-body garment of claim 4, wherein the first transition and the second transition are symmetrical based on one or more of a radius of curvature of the first transition and the second transition and an offset distance of the first transition and the second transition from a midline of the crotch gusset.

5 8. The lower-body garment of claim 4, wherein the third transition and the fourth transition are symmetrical based on a radius of curvature of the third transition and the fourth transition and an offset distance of the third transition and the fourth transition from a midline of the crotch gusset.

9. The lower-body garment of claim 4, wherein the first transition and
10 the third transition are asymmetrical based on one or more of a radius of curvature of the first transition and the third transition and an offset distance of the first transition and the third transition from a midline of the crotch gusset.

10. The lower-body garment of claim 1, wherein a distal portion of each wing aligns with an inseam of a respective leg sleeve.

15 11. The lower-body garment of claim 10, wherein the inseam is located anterior to a coronal reference plane of the lower-body garment.

12. The lower-body garment of claim 1, wherein the crotch gusset comprises a one-piece seamless panel.

13. A crotch gusset comprising: an elongated trunk having an
20 elongated front portion and an elongated back portion; a first wing extending away from the elongated trunk in a first direction at a first location between the elongated front portion and the elongated back portion; a second wing extending away from the elongated trunk in a second direction opposite the first direction at a second location between the elongated front portion and the elongated back portion; a peripheral edge
25 that continuously extends, sequentially around the elongated front portion, the first wing, the elongated back portion, and the second wing, the peripheral edge comprising: a first curvilinear transition from the elongated front portion to the first wing; a second curvilinear transition from the elongated front portion to the second wing; a third curvilinear transition from the elongated back portion to the first wing; and a fourth
30 curvilinear transition from the elongated back portion to the second wing.

14. The crotch gusset of claim 13, wherein the crotch gusset comprises a one-piece, seamless panel.

15. The crotch gusset of claim 13, wherein the first curvilinear transition, the second curvilinear transition, the third curvilinear transition, and the fourth curvilinear transition comprise a concave curvature.

16. The crotch gusset of claim 13, wherein the first curvilinear transition and the second curvilinear transition are symmetrical based on one or more of a radius of curvature of the first curvilinear transition and the second curvilinear transition and an offset distance of the first curvilinear transition and the second curvilinear transition from a midline of the crotch gusset.

17. The crotch gusset of claim 13, wherein the third curvilinear transition and the fourth curvilinear transition are symmetrical based on a radius of curvature of the third curvilinear transition and the fourth curvilinear transition and an offset distance of the third curvilinear transition and the fourth curvilinear transition from a midline of the crotch gusset.

18. The crotch gusset of claim 13, wherein the first curvilinear transition and the third curvilinear transition are asymmetrical based on one or more of a radius of curvature of the first curvilinear transition and the third curvilinear transition and an offset distance of the first curvilinear transition and the third curvilinear transition from a midline of the crotch gusset.

19. The crotch gusset of claim 13, wherein a radius of curvature of each of the first curvilinear transition and the second curvilinear transition is less than a radius of curvature of each of the third curvilinear transition and the fourth curvilinear transition.

20. The crotch gusset of claim 13, wherein a length of the elongated back portion as measured from a center-most point of one of the third curvilinear transition or the fourth curvilinear transition to a terminal edge of the elongated back portion is greater than a length of the elongated front portion as measured from a center-most point of one of the first curvilinear transition or the second curvilinear transition to a terminal edge of the elongated front portion.

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21. A method of manufacturing a lower-body garment comprising a pelvic portion comprising a waist opening, a front side, and a back side, a first leg portion extending from the pelvic portion, and a second leg portion extending from the pelvic portion, the method comprising: forming, from a one-piece panel, a crotch gusset comprising: an elongated trunk having an elongated front portion and an elongated back portion, a first wing extending away from the elongated trunk in a first direction at a first location between the elongated front portion and the elongated back portion, and a second wing extending away from the elongated trunk in a second direction opposite the first direction at a second location between the elongated front portion and the elongated back portion; and integrating the crotch gusset into a crotch area of the lower-body garment such that the elongated trunk extends from the front side of the pelvic portion adjacent the waist opening to the back side of the pelvic portion adjacent the waist opening, and such that the first wing extends from the elongated trunk and along an inner thigh portion of the first leg portion, and the second wing extends from the elongated trunk and along an inner thigh portion of the second leg portion.

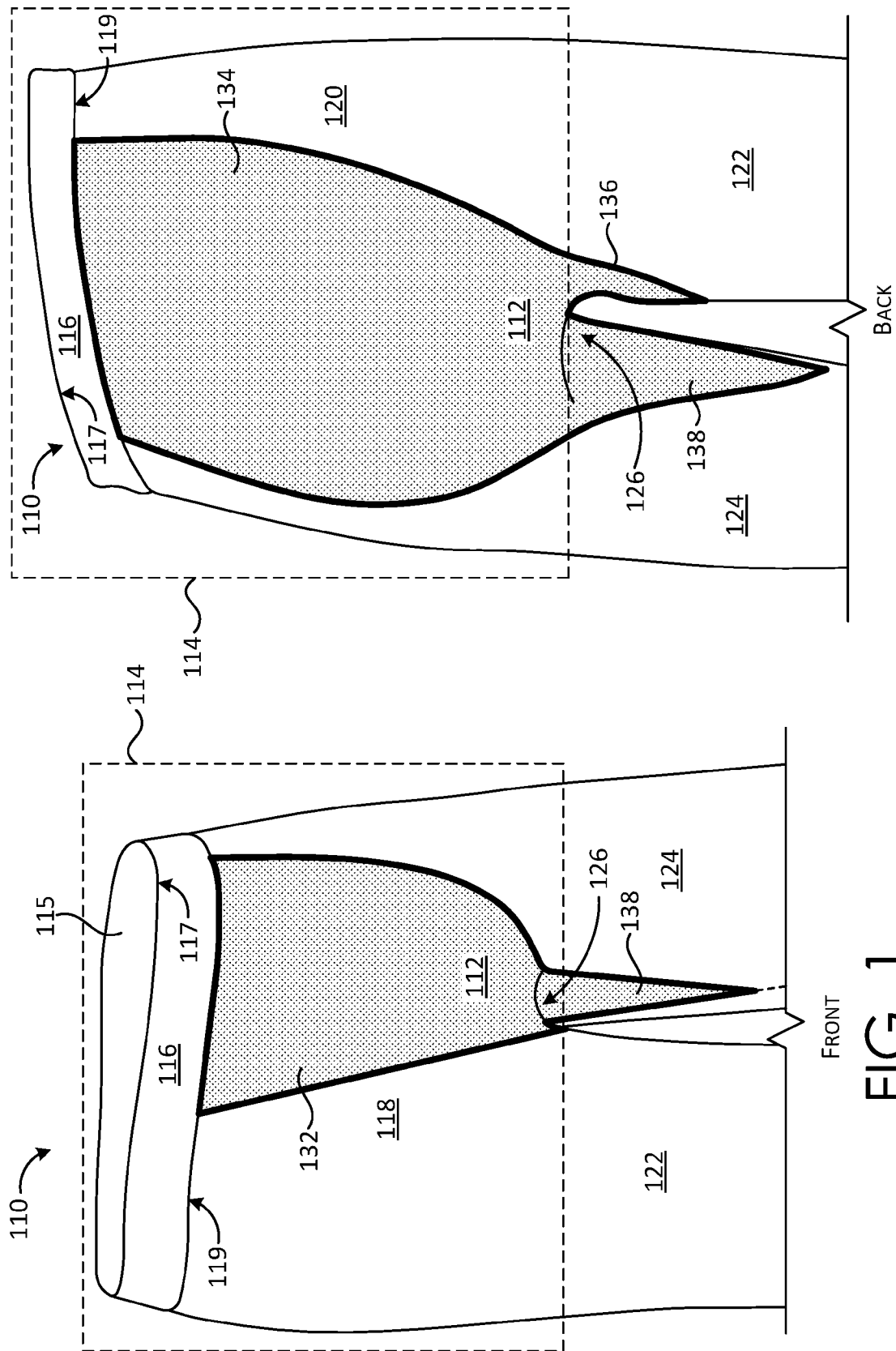
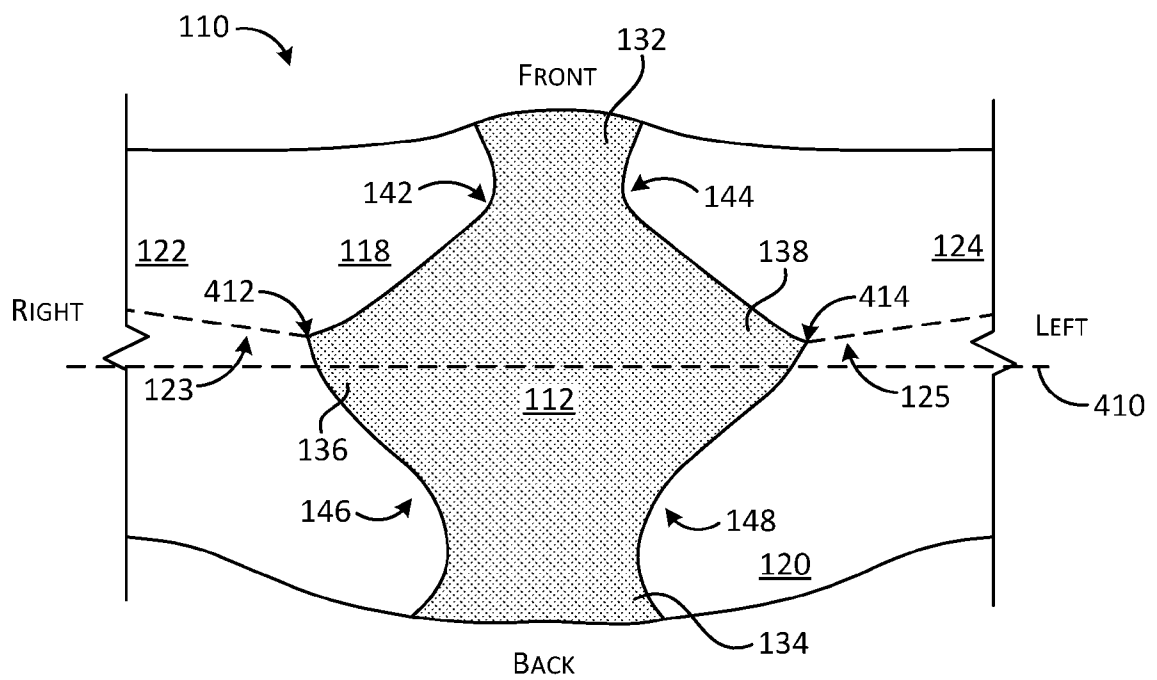
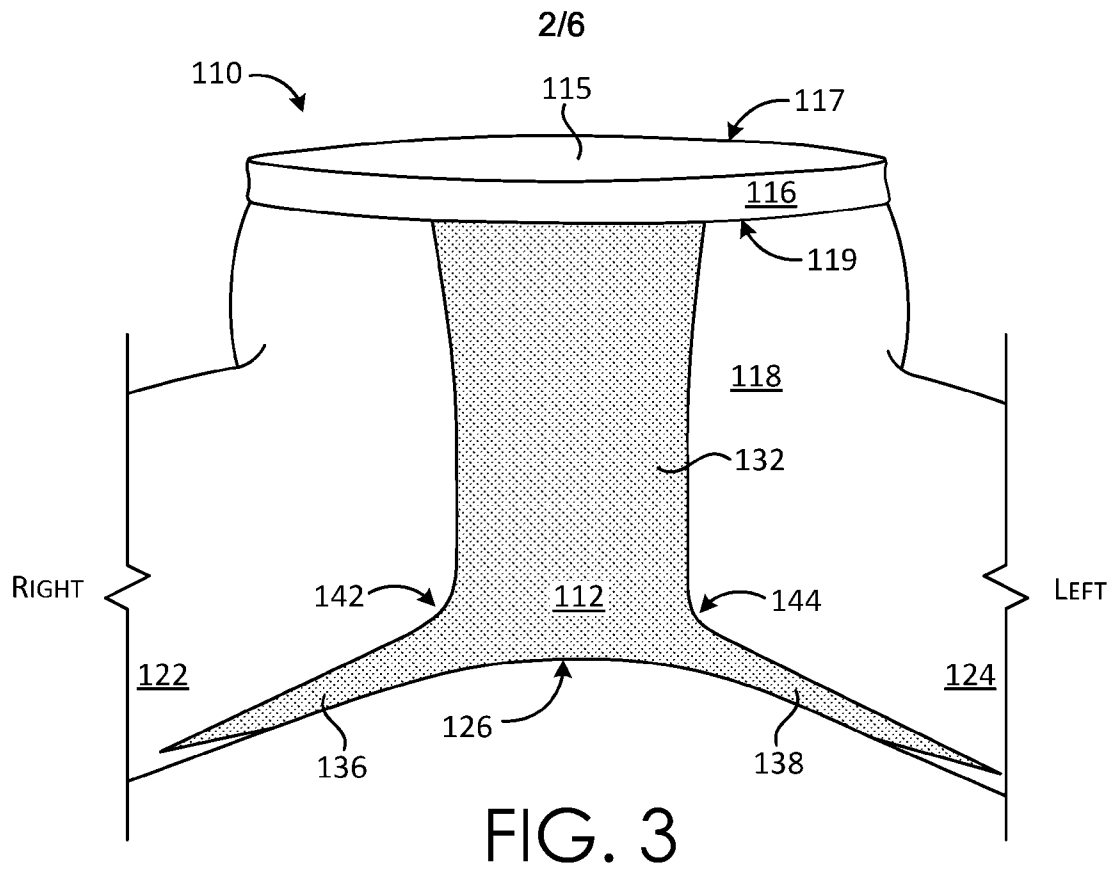
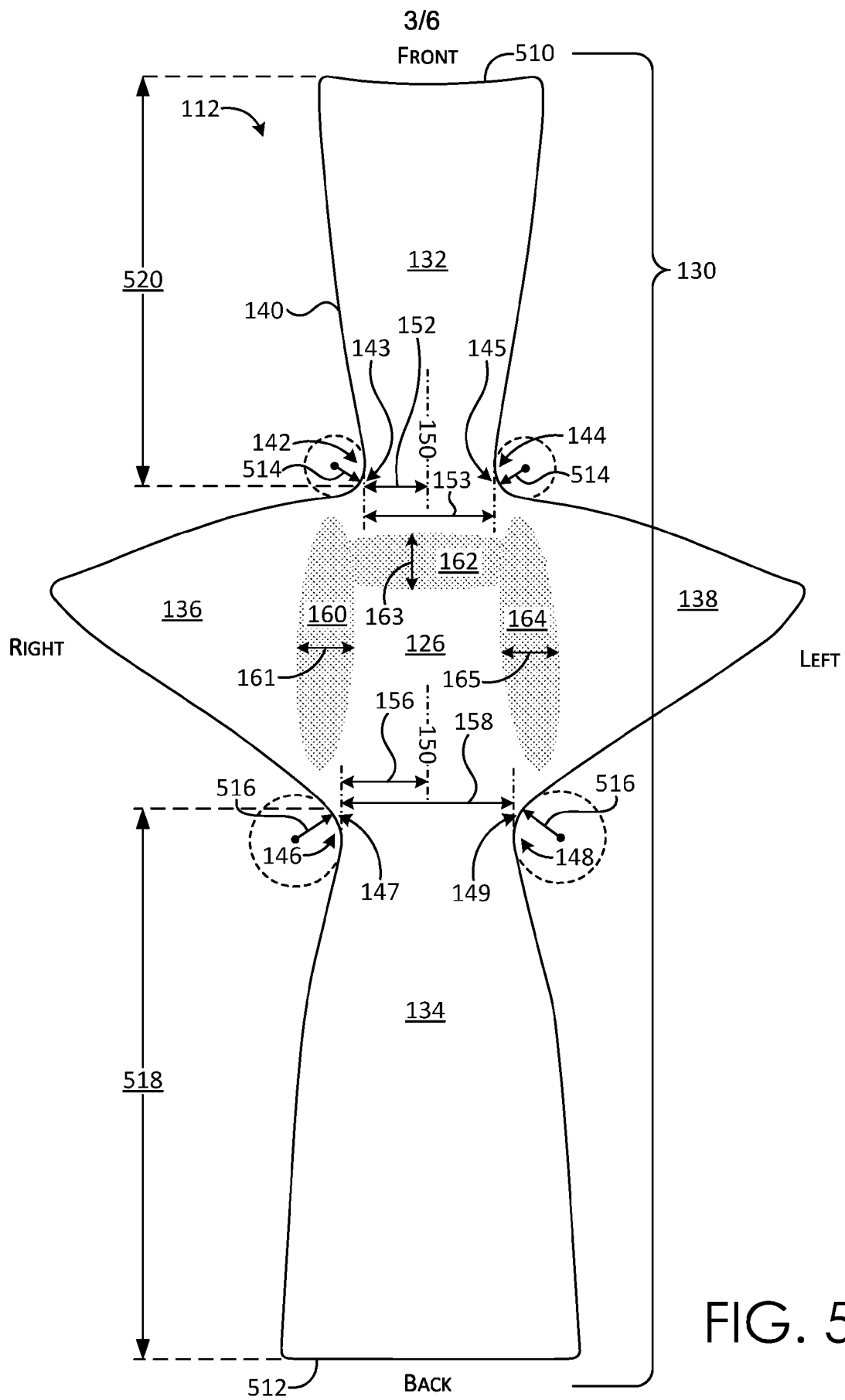


FIG. 2

FIG. 1





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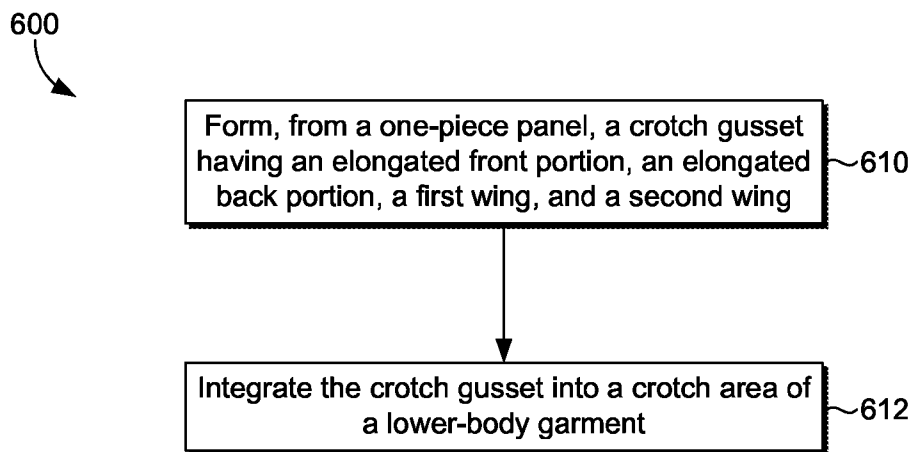


FIG. 6

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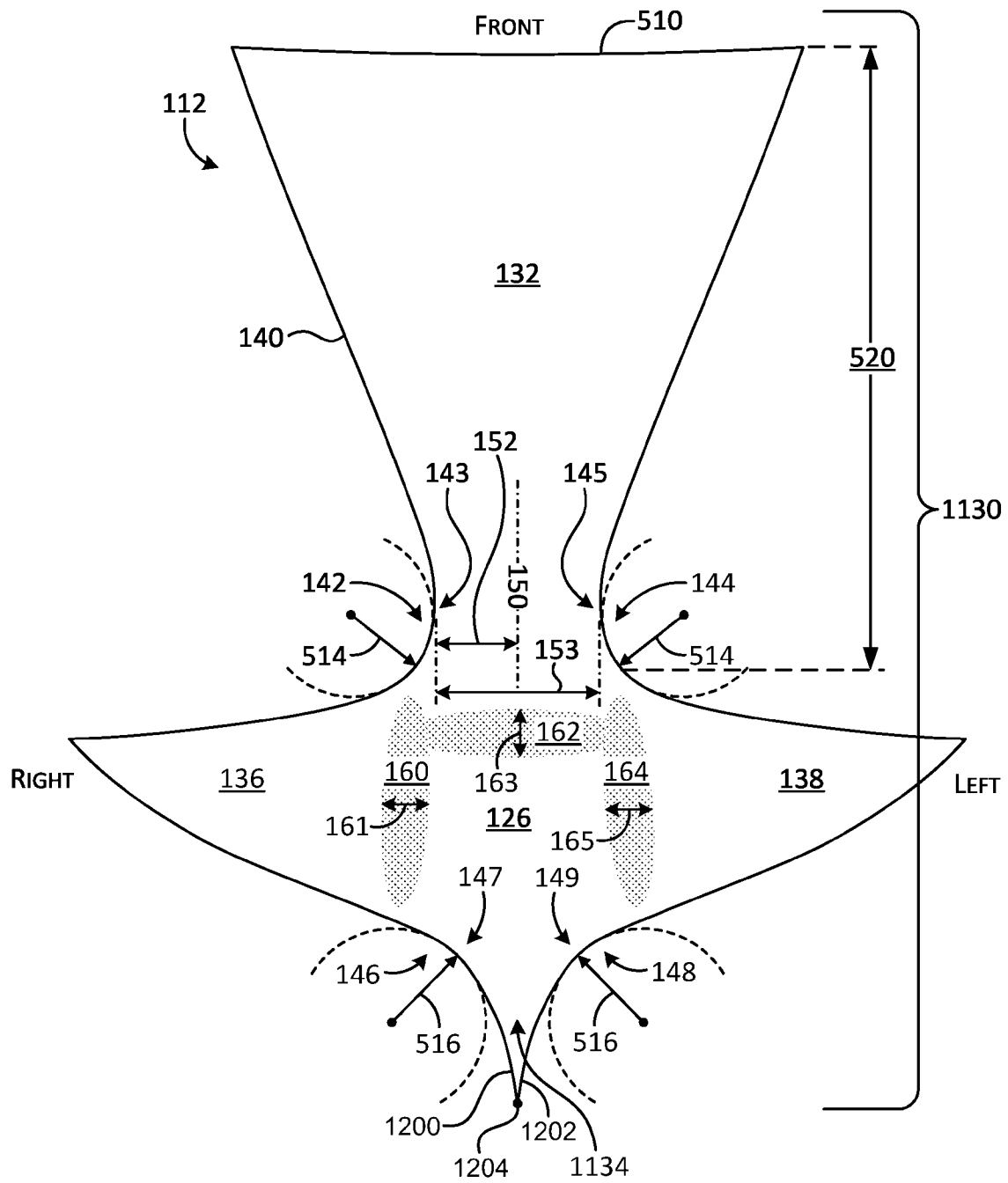


FIG. 7

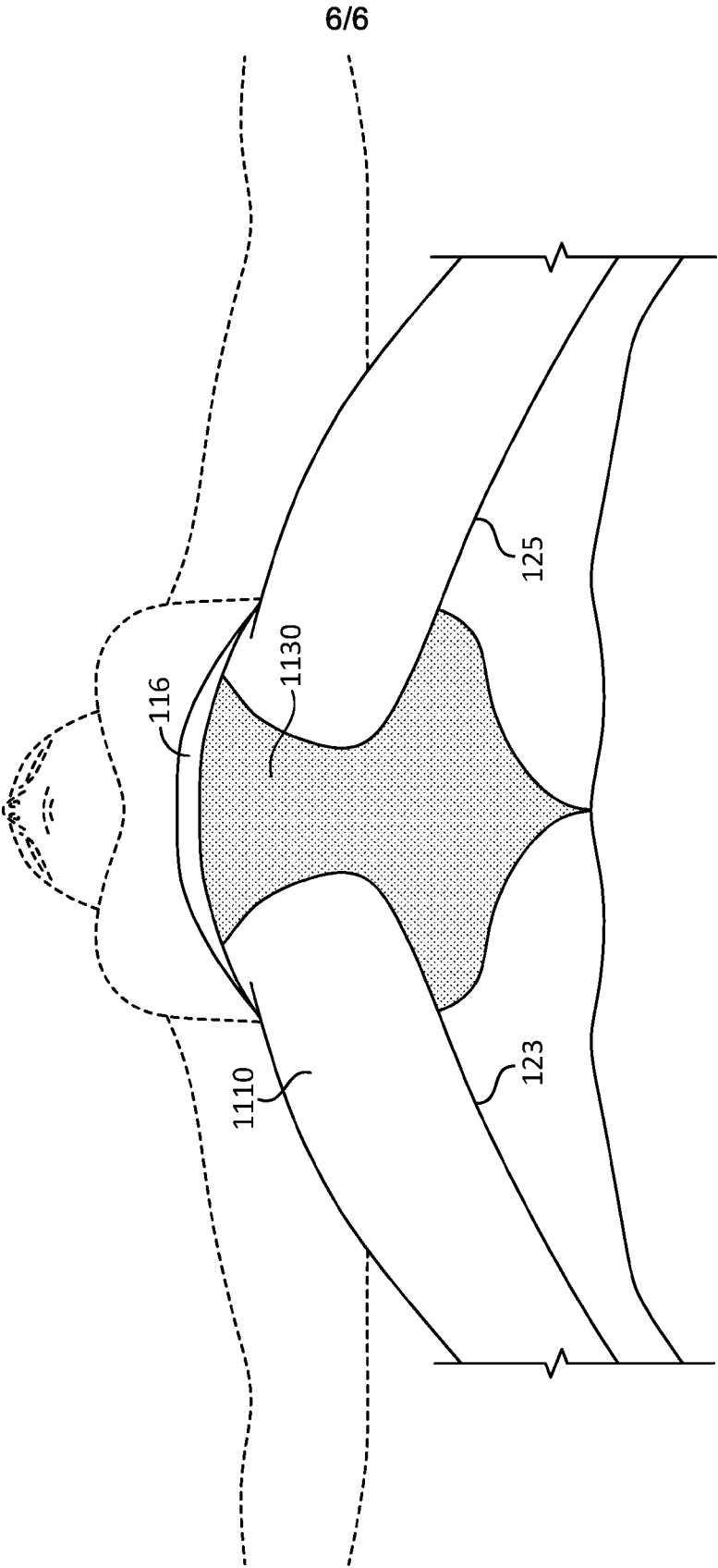


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2024/037841

A. CLASSIFICATION OF SUBJECT MATTER

INV. A41B9/00 A41D1/08
ADD.

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)

A41B A41D

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 1 629 147 A (FRANKLIN CHATFIELD) 17 May 1927 (1927-05-17) claims 1-6; figures 1-10 -----	1-21
X	US 4 488 317 A (POLSKY BERNICE B [US]) 18 December 1984 (1984-12-18)	1,10-20
A	claims 1-20; figures 1-4 -----	2-9,21
X	US 4 785 480 A (POLSKY BERNICE B [US]) 22 November 1988 (1988-11-22)	1,10-20
A	claims 1-20; figures 1-7 -----	2-9,21
X	US 6 243 879 B1 (LYDEN ROBERT M [US]) 12 June 2001 (2001-06-12)	1,2,21
A	column 15, line 45 - column 16, line 65; figures 11,12 ----- -/-	3-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

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Date of the actual completion of the international search

5 October 2024

Date of mailing of the international search report

22/10/2024

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2024/037841

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 159 721 A (SENER KARL E [US] ET AL) 3 November 1992 (1992-11-03) claims 1-3; figures 6-20 -----	1 - 21
A	US 5 033 123 A (AUDET JEAN-PIERRE [CA]) 23 July 1991 (1991-07-23) claim 1; figures 1-4 -----	1 - 21

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2024/037841

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 1629147	A	17-05-1927	NONE	

US 4488317	A	18-12-1984	AU 3312484 A	12-03-1985
			CA 1222104 A	26-05-1987
			EP 0153365 A1	04-09-1985
			US 4488317 A	18-12-1984
			WO 8500729 A1	28-02-1985

US 4785480	A	22-11-1988	NONE	

US 6243879	B1	12-06-2001	NONE	

US 5159721	A	03-11-1992	NONE	

US 5033123	A	23-07-1991	CA 1320313 C	20-07-1993
			US 5033123 A	23-07-1991
