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(54) **ANATOMICALLY DYNAMIC AND ERGONOMIC LEG GUARD**

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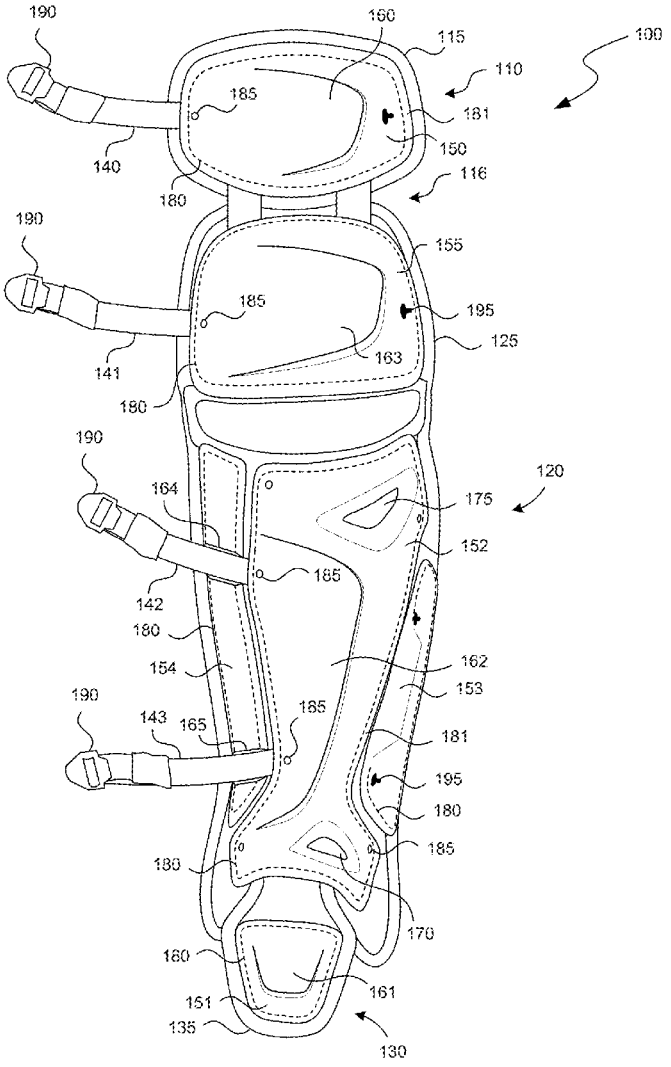
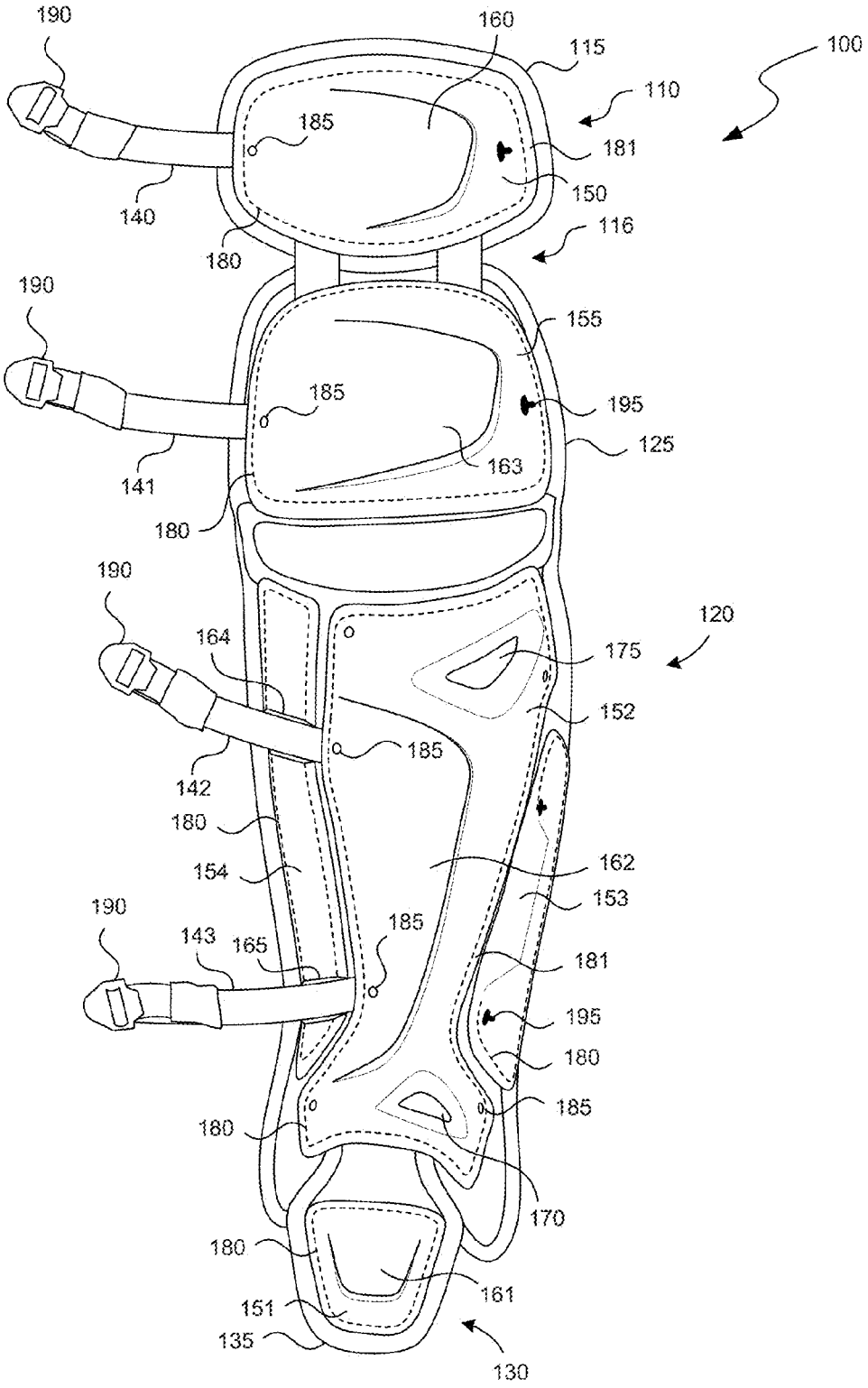
(57) **ABSTRACT**

A leg guard includes an anterior shin protective panel positioned to cover at least a portion of a user's anterior shin region, a lateral protective panel positioned to cover at least a portion of the user's lateral lower leg region, and a medial protective panel positioned to cover at least a portion of the user's medial lower leg region. The panels are mounted on one or more flexible liners in a vertically segmented orientation to articulate with respect to one another. Additional protective panels may be included to protect a user's knee, thigh, or foot. A strap for a leg guard may include a buckle having a protrusion positioned to engage an elongated opening in the leg guard. The strap may bias the buckle into a tilted position, while raised surfaces near the elongated opening resist release or rotation of the buckle.

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142
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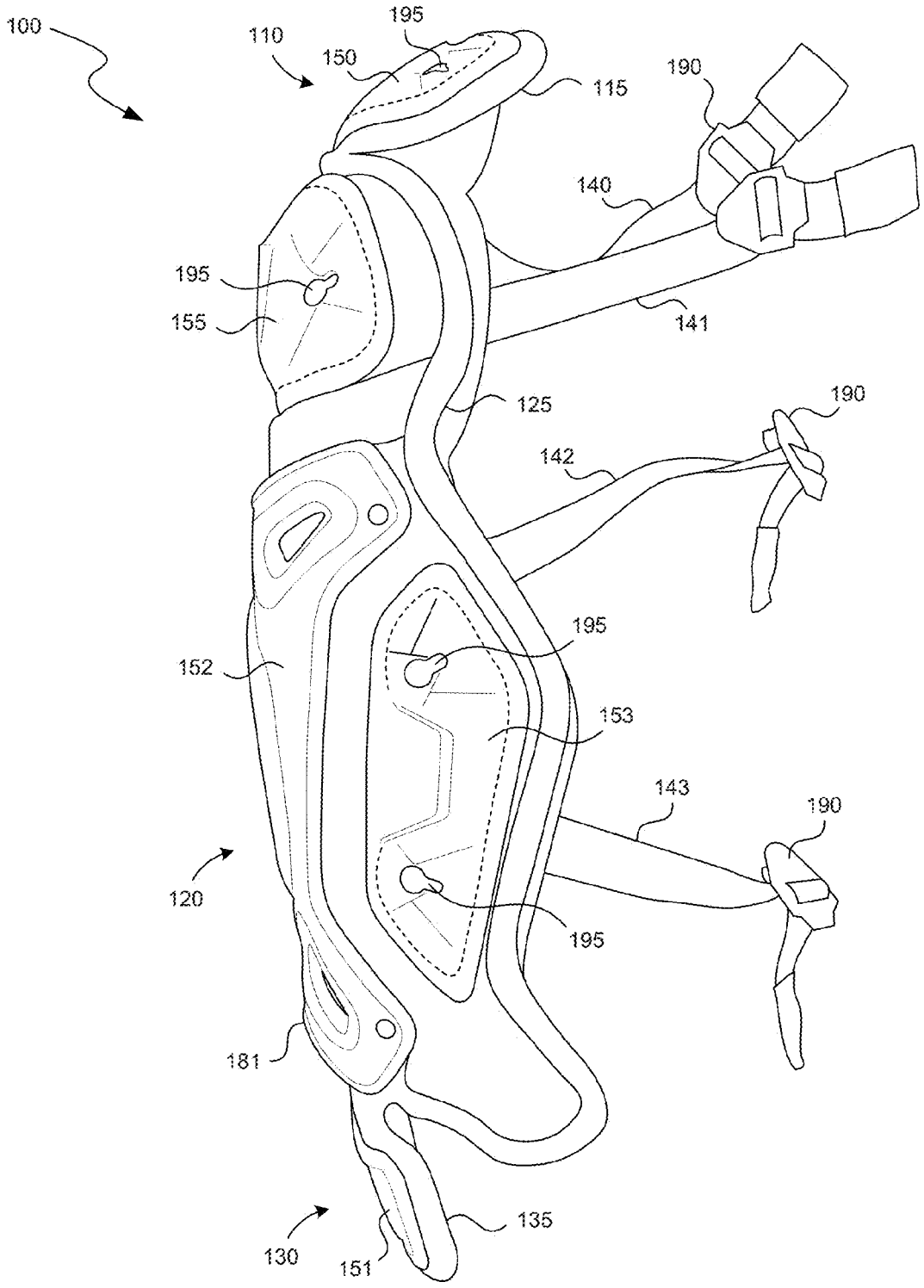
130

FIG. 1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151

FIG. 2

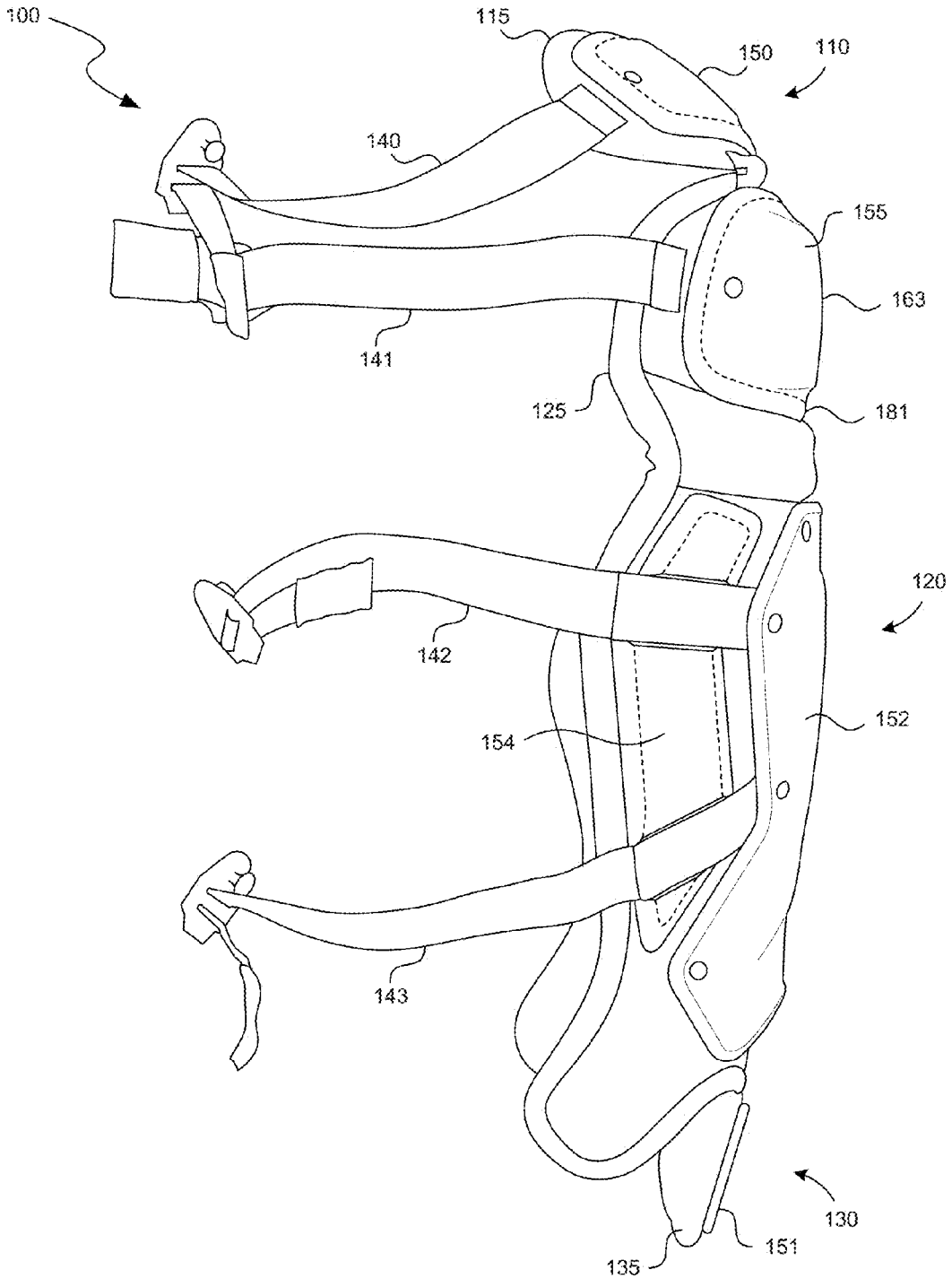
100
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FIG. 3

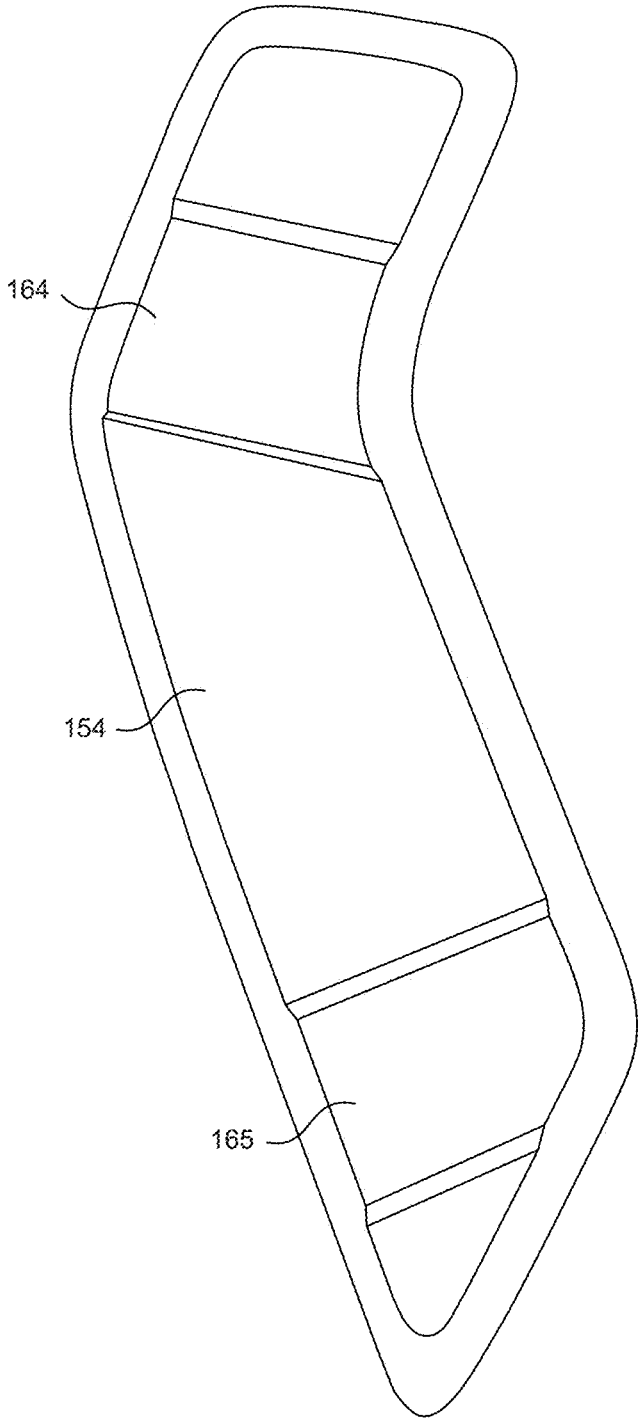


FIG. 3A

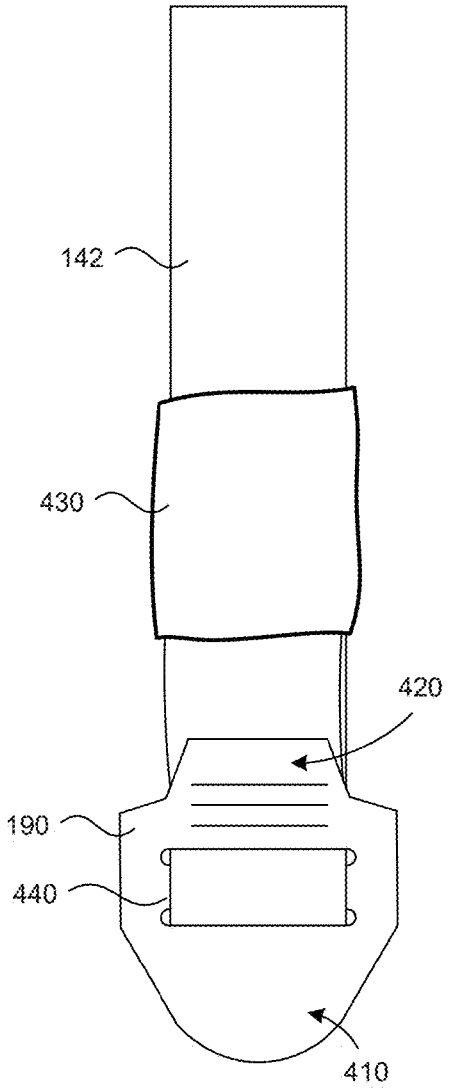
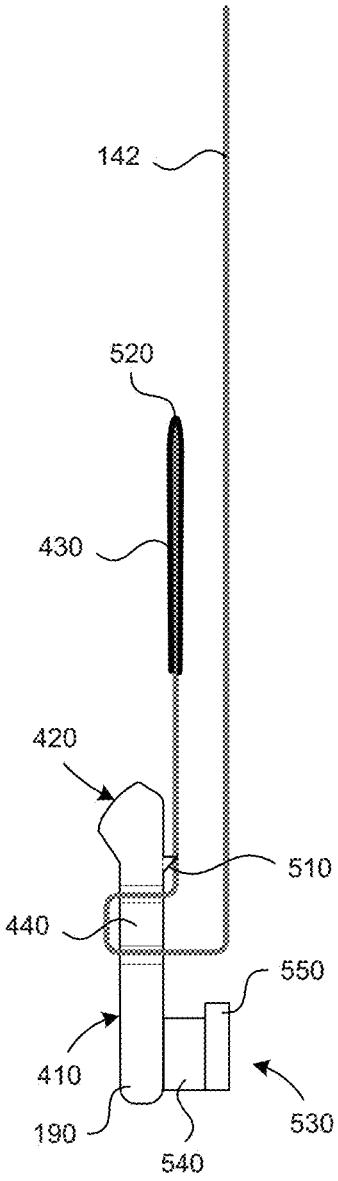

142
430
420
190
440
410

FIG. 4


142
520
430
420
510
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550
410
530
190
540

FIG. 5

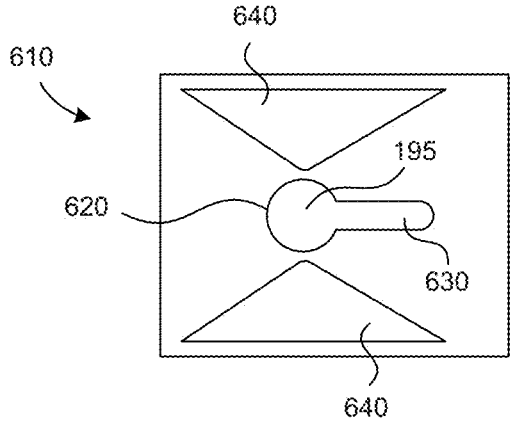

FIG. 6

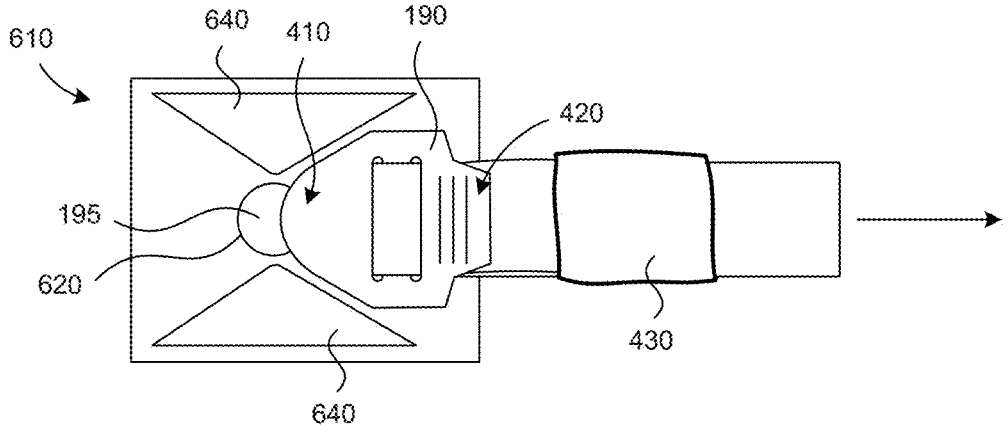

FIG. 7

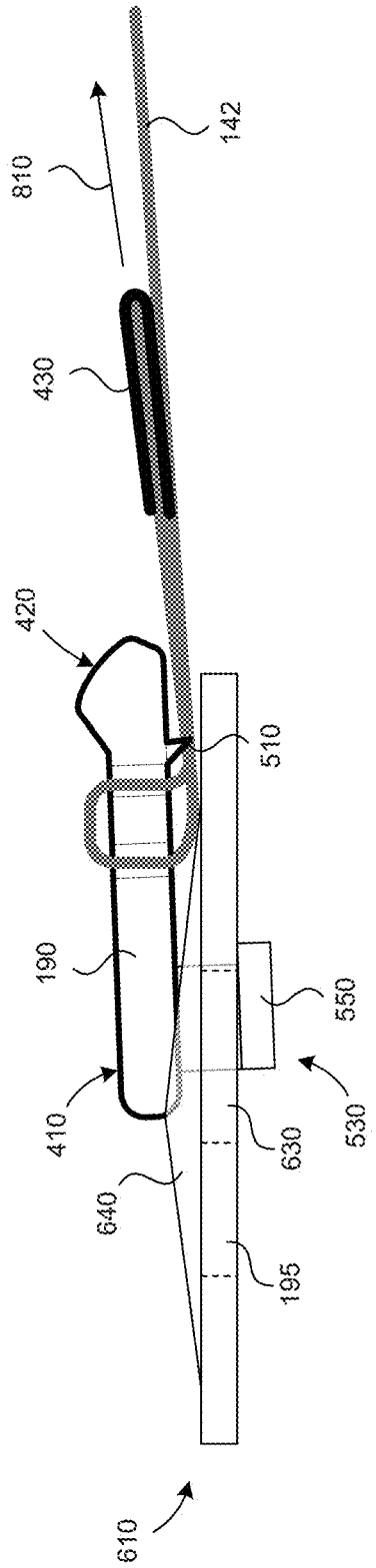

FIG. 8

ANATOMICALLY DYNAMIC AND ERGONOMIC LEG GUARD

BACKGROUND

[0001] Standard youth sports protective gear is usually scaled-down from adult protective gear. For example, a standard youth catcher's leg guard is sized from an adult catcher's leg guard. But young players (e.g., players ages 6-12) present a varying range of anthropometric measurements and qualities along with age-appropriate ergonomic limitations and performance demands, so standard youth sports protective gear is generally sized without proper regard for anatomical proportions and variances present across the youth demographic. Accordingly, standard youth sports protective gear is often bulky or awkward, which results in discomfort and poor performance or protection for the young player. This is true for youth leg protection. Standard youth leg guards typically have fixed, single-piece shin protectors, or narrow central shin protectors (sometimes with foam to protect the sides of the leg), that suffer from inadequate anatomical adaptability and protection.

[0002] Standard youth catcher's leg guards also use decades-old buckle designs that latch onto a loop or ring on a side of the leg guard. The unsecured nature of such a design is prone to disengagement during play if a player has not properly tightened the straps or if the player has placed the buckle hook backwards. Such a problem is more pronounced for younger players who may be less diligent about securing their gear.

[0003] Finally, standard youth catcher's leg guards have straps that are looped through metal D-rings at the opposite ends of the straps from the buckle ends, on the opposite side of the leg guard. After tightening such a strap, a player desiring to loosen the strap has to feed the strap back through the D-rings, which involves picking at the edges of the strap with a fingernail to create a slack loop, and then pulling at the buckle end. This is complicated and time-consuming for youth players, especially those who share protective gear that consequently must be adjusted often.

[0004] Accordingly, there is a lack of anatomically dynamic and ergonomic youth-centric protective gear for baseball or softball catchers and other players.

SUMMARY

[0005] A leg guard includes an anterior shin protective panel positioned to cover at least a portion of a user's anterior shin region, a lateral protective panel positioned to cover at least a portion of the user's lateral lower leg region, and a medial protective panel positioned to cover at least a portion of the user's medial lower leg region. The panels are mounted on one or more flexible liners in a vertically segmented orientation to articulate with respect to one another. Additional protective panels may be included to protect a user's knee, thigh, or foot. A strap for a leg guard may include a buckle having a protrusion positioned to engage an elongated opening in the leg guard. The strap may bias the buckle into a tilted position, while raised surfaces near the elongated opening resist release or rotation of the buckle.

[0006] Other features and advantages will appear hereinafter. The features described above may be used separately or together, or in various combinations of one or more of them.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] In the drawings, wherein the same reference number indicates the same element throughout the views:

[0008] FIG. **1** is a front view of a leg guard in accordance with an embodiment of the present technology.

[0009] FIG. **2** is a lateral side view of a leg guard in accordance with an embodiment of the present technology.

[0010] FIG. **3** is a medial side view of a leg guard in accordance with an embodiment of the present technology.

[0011] FIG. **3**A is a medial side view of a medial protective panel in accordance with an embodiment of the present technology.

[0012] FIG. **4** is a top view of a strap having a buckle in accordance with an embodiment of the present technology.

[0013] FIG. **5** is a side cross-sectional view of a strap having a buckle in accordance with an embodiment of the present technology.

[0014] FIG. **6** is a top view of a slide-lock area having a slide-lock hole for a leg guard in accordance with an embodiment of the present technology.

[0015] FIG. **7** is a top view of a slide-lock area engaged with a buckle in accordance with an embodiment of the present technology.

[0016] FIG. **8** is a side cross-sectional view of a slide-lock area engaged with a buckle in accordance with an embodiment of the present technology.

DETAILED DESCRIPTION

[0017] The present technology is directed to anatomically dynamic and ergonomic leg protection, including a leg guard that is easily adjustable that provides enhanced safety. Various embodiments of the technology will now be described. The following description and the attached figures provide specific details for a thorough understanding and enabling description of these embodiments. One skilled in the art will understand, however, that the invention may be practiced without many of these details. Additionally, some well-known structures or functions may not be shown or described in detail so as to avoid unnecessarily obscuring the relevant description of the various embodiments. Accordingly, the technology may have other embodiments that include additional elements or omit one or more of the elements described below with reference to FIGS. **1-8**.

[0018] The terminology used in the description presented below is intended to be interpreted in its broadest reasonable manner, even though it is being used in conjunction with a detailed description of certain specific embodiments of the invention. Certain terms may even be emphasized below; however, any terminology intended to be interpreted in any restricted manner will be overtly and specifically defined as such in this detailed description section.

[0019] Where the context permits, singular or plural terms may also include the plural or singular term, respectively. Moreover, unless the word "or" is expressly limited to mean only a single item exclusive from the other items in a list of two or more items, then the use of "or" in such a list is to be interpreted as including (a) any single item in the list, (b) all of the items in the list, or (c) any combination of items in the list. Further, unless otherwise specified, terms such as "attached" or "connected" are intended to include integral connections, as well as connections between physically separate components.

[0020] Specific details of several embodiments of the present technology are described herein with reference to baseball or softball. The technology may also be used in other sports or related industries in which lower leg protection is desired, including but not limited to cricket, hockey, or polo. The technology may also be used in adult protective gear.

[0021] Turning now to the drawings, FIGS. **1-3** illustrate a leg guard **100** having a thigh portion **110**, a knee and shin portion **120**, and a foot portion **130**. The thigh portion **110** and the foot portion **130** are connected to the knee and shin portion **120** such that the thigh portion **110** and the foot portion **130** are able to pivot, flex, or otherwise articulate with respect to the knee and shin portion **120** to accommodate flexion and extension of a user's leg. Straps **140**, **141**, **142**, and **143**, described in further detail below, may be positioned to fasten the leg guard **100** to a user's leg. For example, a thigh strap **140** may be wrapped around a user's lower or inferior thigh region, while shin straps **141**, **142**, and **143** may be wrapped around a user's knee and shin or lower leg.

[0022] Each of the thigh portion **110**, the knee and shin portion **120**, and the foot portion **130** may have a backing or support liner, such as a thigh liner **115**, knee and shin liner **125**, and foot liner **135**. The thigh liner **115** may be flexibly connected to the knee and shin liner **125** by a fabric or elastic joint **116** or by a stitched connection, or the thigh liner **115** may be integral with the knee and shin liner **125**. The foot liner **135** may be flexibly connected to the knee and shin liner **125** in a generally similar fashion. In one embodiment, the liners **115**, **125**, or **135** may include ethylene-vinyl acetate ("EVA") foam as padding, covered in a fabric mesh or polyurethane vinyl. In other embodiments, the liners **115**, **125**, or **135** may include other suitable materials or combinations of materials, such a rubber padding covered in a moisture-wicking material. The knee and shin liner **125** may be symmetrical or it may be longer on one side than the other. For example, the shin liner **125** may be longer on a side corresponding to an outer or lateral side of a user's leg than on an inner or medial side of the user's leg, as generally illustrated in FIG. **1**.

[0023] Each of the thigh portion **110**, the knee and shin portion **120**, and the foot portion **130** may have one or more stiff, rigid, or resilient protective panels positioned thereon. For example, the thigh portion **110** may include a thigh protective panel **150** mounted on the thigh liner **115** to provide protection for a user's lower thigh or upper knee. In some embodiments, the thigh protective panel **150** may be generally coextensive with the thigh liner **115**, or it may be smaller or larger in other embodiments. Similarly, the foot portion **130** may include a foot protective panel **151** mounted on the foot liner **135** to provide protection for a user's ankle or upper foot. In some embodiments, the foot panel **151** may be generally coextensive with the foot liner **135**, or it may be smaller or larger in other embodiments.

[0024] As illustrated in FIG. **1**, the knee and shin portion **120** may include multiple protective panels mounted on the knee and shin liner **125** in a segmented arrangement so that they may articulate with respect to each other.

[0025] A vertically segmented arrangement, for example, allows the leg guard **100** to easily wrap around varying leg circumferences and to adapt to differences in anatomical proportions and variance, particularly in the youth demographic, without providing a bulky or awkward fit or sacrificing protection. For example, in one embodiment, a central or anterior shin protective panel **152** may substantially coextend with a region of the knee and shin portion **120** adjacent to an anterior portion of a user's shin bone region. An outside or lateral protective panel **153** may be generally positioned on the knee and shin liner **125** to coextend with an outwardly or laterally facing portion of a user's lower leg. And an inner or medial protective panel **154** may be generally positioned on the knee and shin liner **125** to coextend with an inwardly or medially facing portion of a user's lower leg. Because the panels **152**, **153**, **154** are vertically segmented, they can articulate to provide a better fit to a user's leg without sacrificing protection and coverage.

[0026] A knee protective panel **155** may be positioned on the knee and shin liner **125** to generally coextend with a lower or inferior anterior portion of a user's knee or an upper or superior anterior portion of a user's shin. Similarly, the flexible knee and shin liner **125** may allow the knee protective panel **155** to articulate with respect to the other panels **152**, **153**, **154**. In some embodiments, the knee and shin liner **125** may be formed from a plurality of articulating liner portions, for example, one portion supporting the knee protective panel **155** and one or more portions supporting the shin protective panels **152**, **153**, **154**.

[0027] Each of the protective panels **150**, **151**, **152**, **153**, **154**, **155** may be made from a variety of suitable materials, including high-density polyethylene ("HDPE"), polypropylene ("PP"), or other plastic or metal materials that provide durable and resilient, rigid or semi-rigid, support and protection. And each of the panels may be formed to generally mimic the anatomical shape of the portion of the user's knee or leg coextending with a given panel. Accordingly, the protective panels **150**, **151**, **152**, **153**, **154**, **155** provide sufficient structural rigidity and protection to the corresponding underlying portions of the user's leg while the liners **115**, **125**, **135** allow the leg guard **100** to conform to various shapes and sizes of the user's leg.

[0028] In some embodiments, one or more of the protective panels **150**, **151**, **152**, **153**, **154**, **155** may have a raised surface, such as the illustrated raised surfaces **160**, **161**, **162**, **163**. The raised surfaces **160**, **161**, **162**, **163** may be flat or angled surfaces to provide rigidity to the respective panels. In addition, some of the raised surfaces, such as the raised surface **162** on the anterior shin panel **152**, and the raised surface **163** on the knee panel **155**, may provide additional stability for the user if the user is postured such that these surfaces contact the ground. In yet other embodiments, the medial panel **154** may have indentations or trenches **164**, **165** across the panel **154** that are shaped to accommodate the lower shin straps **142**, **143** and to position the straps **142**, **143** close to or below the surface of the medial panel **154** and to protect the straps **142**, **143** from wear or abrasion. FIG. **3**A depicts an embodiment of such a medial panel **154** having indentations or trenches **164**, **165**.

[0029] In some embodiments, one or more of the protective panels **150**, **151**, **152**, **153**, **154**, **155**, or one or more of the liners **115**, **125**, **135**, may further include vents to allow air to pass through the panels or the liners for cooling and drying the user's skin. For example, an intake vent **170** and an exhaust vent **175** on the anterior shin panel **152** may allow air to pass through an interior region of the leg guard **100** to cool and dry an underlying portion of the user's shin. Each vent may be indented or recessed into a panel.

[0030] The protective panels **150**, **151**, **152**, **153**, **154**, **155** may be stitched to the liners **115**, **125**, **135** (for example, with the illustrated perimeter stitching **180**). The panels may additionally or alternatively be riveted to the liners (such as with the illustrated rivets **185**, for example). If stitched, each of the panels **150**, **151**, **152**, **153**, **154**, **155** may have indentations, depressions, or walls **181** to position the stitching **180** below an exposed surface of the panels to protect the stitching **180** from wear or damage from abrasion. If riveted, the rivets **185** may also pass through the ends of the straps (e.g., **140**, **141**, **142**, **143**) to anchor the straps to the leg guard **100**. In other embodiments, the panels may be attached to the liners in other ways, including with adhesive, for example.

[0031] The panels **150**, **151**, **152**, **153**, **154**, **155** may include aesthetic curvature. For example, the shape of the panels, or the outline of the raised or indented surfaces or vents on the panels, may be designed to have an aggressive look or to otherwise be aesthetically pleasing.

[0032] In some embodiments, the straps **140**, **141**, **142**, **143** may have buckles **190** that releasably engage elongated openings or slide-lock holes **195** in the protective panels, as further illustrated in FIGS. **4-8**. For ease of description, while FIGS. **4-8** depict only shin strap **142**, it is to be understood that any other strap (e.g., **140**, **141**, **143**) may employ the presently disclosed technology.

[0033] For example, FIG. **4** illustrates a strap **142** with a buckle **190**, and Figures is a cutaway view of a strap **142** with a buckle **190**. The buckle **190** may have a forward end **410** and a tail end **420**. The strap end **430** may be looped through the buckle **190** towards the forward end **410** and back towards the tail end **420** through the buckle **190** around a bar **440**. In this arrangement, the strap **142** and the buckle **190** are in frictional engagement to resist movement of the strap **142** in the buckle **190** and subsequent loosening of the strap **142**.

[0034] As shown in FIG. **5**, in some embodiments, the buckle **190** may have a rough surface or strap-grabbing teeth **510** that also resist loosening of the strap **142**, as further described below. In some embodiments, the strap end **430** may have a gripping surface **520** that serves as a grasping area for the user while adjusting the strap **142**, while in yet other embodiments, the strap end **430** may not have such a gripping surface **520**. In some embodiments, the strap end **430** may be formed by folding an end of the strap **142** over itself and stitching, gluing, riveting, or otherwise suitably fastening the folded end of the strap **142** to itself. The strap **142** may be made of an elastic material and may be approximately **25** millimeters wide and 1 to 2 millimeters thick, or, in other embodiments, it may be made of other suitable materials with other suitable dimensions.

[0035] The buckle **190** may engage with a slide-lock hole **195** (see FIG. **1**, for example) via a peg and disk protrusion **530**. The peg and disk protrusion **530** may include a shaft or peg **540** extending from the buckle **190**, upon which a tab or disk **550** is mounted or otherwise attached or integrated. A detailed illustration of a slide-lock area **610** of a protective panel (e.g., panel **153**) having a slide-lock hole **195** is shown in FIG. **6**. The illustrated slide-lock hole **195** includes a wide entrance portion **620** (which may be approximately circular) and a narrow slot portion **630**. Other suitable configurations for the slide-lock hole may alternatively be used.

[0036] In operation, as illustrated in FIGS. **7** and **8**, the buckle **190** is placed against the slide-lock area **610** of a protective panel (e.g., **153**) such that the protrusion **530** passes into the wide entrance portion **620** and slides through the narrow slot portion **630**. The disk **550** is larger than the narrow slot portion **630**, so it prevents the buckle **190** from separating from the panel (e.g., **153**). As the buckle **190** moves along the slide-lock area **610**, it may pass over raised surfaces **640** positioned near the slide-lock hole **195** (e.g., on opposing sides of the slide-lock hole **195**). The action of passing the buckle **190** over the raised surfaces **640** to engage with the panel may provide audible or tactile feedback in the form of a clicking noise or sensation indicating the buckle **190** has snapped past the resistance provided by the raised surfaces **640** and locked into place.

[0037] The strap **142** may be wedged between the buckle **190** and the slide-lock area **610**. In some embodiments, the strap **142** may be wedged between the strap-grabbing teeth **510** and the slide-lock area **610**. When the strap **142** is wedged between the buckle **190** and the slide-lock area **610**, there may be pressure between the buckle **190** and the slide-lock area **610** that causes the buckle **190** to tilt or bias toward the forward end **410**. When the buckle **190** is tilted toward the forward end **410**, the forward end **410** may be positioned generally lower than the raised surfaces **640** (e.g., as generally illustrated in FIG. **8**). In this position, the raised surfaces **640** obstruct the path of the buckle **190** and resist or prevent the buckle **190** from moving back out of the slide-lock hole **195**. Additionally, frictional engagement between the disk **550** and the slide-lock area **610** may further resist movement of the buckle **190**. Accordingly, because the buckle **190** may tilt forward regardless of tension in the strap **142**, an engagement between the buckle **190** and a panel (i.e., **153**) according to the present technology keeps the buckle secure even if the strap **142** is not fully tightened. The raised surfaces **640** may also prevent a user from connecting the buckle **190** backwards or otherwise incorrectly.

[0038] The raised surfaces **640** may be shaped or formed to help guide the protrusion **530** into the slide-lock hole **195** when a user is connecting the buckle **190** to the slide-lock hole **195** (to reduce the time required to don the guard **100**, for example). The raised surfaces **640** may also resist or limit rotation of the buckle **190** about the hole **195** when it is connected to the slide-lock area **610**. Accordingly, the leg guard **100** can be mounted to a user in a more secure and stable manner.

[0039] To detach a buckle **190** from a panel (i.e., **153**) to remove the leg guard **100** from a user, the user pushes on the tail end **420** of the buckle **190** (e.g., inward toward the player's leg) to tilt the buckle **190** (e.g., about teeth **510**) to raise the forward end **410** to generally release the buckle **190** from interference with the raised surfaces **640**. When the forward end **410** is generally able to pass the raised surfaces **640**, the user may push the buckle **190** out of the slide-lock hole **195**. The tail end **420** may include an angular, textured, or otherwise grippy surface.

[0040] To tighten the strap **142**, a user pulls on the strap end **430** (in the direction of the arrow **810** in FIG. **8**), while the strap-grabbing teeth **510** resist loosening of the strap **142** in the opposite direction. To loosen the strap, a user bypasses the strap-grabbing teeth **510** by tilting the buckle **190** to disengage the teeth **510** from the strap **142** to allow the strap to slide through the buckle. In some embodiments, the pressure between the buckle **190** and the slide-lock area **610** caused by the strap **142** being positioned therebetween can resist or prevent loosening the strap while the buckle **190** is

engaged to the slide-lock hole **195**. Attaching, tightening, removing, and loosening the strap **142** and the buckle **190** from the panel (i.e., **153**) can be performed with one hand in simple motions.

[0041] From the foregoing, it will be appreciated that specific embodiments of the disclosed technology have been described for purposes of illustration, but that various modifications may be made without deviating from the technology, and elements of certain embodiments may be interchanged with those of other embodiments. For example, in some embodiments, there may be more or fewer straps (such as straps **140**, **141**, **142**, **143**), slide-lock holes **195**, or panels (e.g., **152**), or there may be other suitable methods of affixing panels (e.g., **152**) to underlying liners (e.g., **125**). The slide-lock holes **195** need not be directly in the protective panels (e.g., **153**), but they may be formed in intermediate metallic or plastic elements mounted to the protective panels, or they may be in other elements of a leg guard **100**.

[0042] Further, while advantages associated with certain embodiments of the disclosed technology have been described in the context of those embodiments, other embodiments may also exhibit such advantages, and not all embodiments need necessarily exhibit such advantages to fall within the scope of the technology. Accordingly, the disclosure and associated technology may encompass other embodiments not expressly shown or described herein, and the invention is not limited except as by the appended claims.

What is claimed is:

1. A leg guard comprising:
- an anterior protective panel positioned to cover at least a portion of a user's anterior shin region;
- a lateral protective panel positioned adjacent to the anterior protective panel to cover at least a portion of the user's lateral lower leg region; and
- a medial protective panel positioned adjacent to the anterior protective panel to cover at least a portion of the user's medial lower leg region;
- wherein the anterior protective panel, the lateral protective panel, and the medial protective panel are mounted on a flexible liner in a vertically segmented orientation and configured to articulate with respect to one another.

2. The leg guard of claim **1** further comprising:
- at least one strap having a buckle, the strap configured to retain the leg guard to the user's leg, wherein the buckle includes a protrusion configured to engage an opening in one of the protective panels.

3. The leg guard of claim **2** wherein the opening comprises an elongated opening having a generally circular portion.

4. The leg guard of claim **1** further comprising a knee protective panel positioned to cover at least a portion of the user's knee region, and configured to articulate with respect to at least one of the protective panels.

5. The leg guard of claim **4** wherein at least one of the protective panels comprises a raised surface extending in an anterior direction.

6. The leg guard of claim **1** further comprising a thigh protective panel positioned to cover at least a portion of the user's inferior thigh or superior knee region.

7. The leg guard of claim **1** further comprising a foot protective panel positioned to cover at least a portion of the user's foot.

8. The leg guard of claim **1** wherein the liner comprises a fabric or elastic material and a padding material.

9. The leg guard of claim **1** wherein at least one of the protective panels is mounted to the liner via a rivet.

10. The leg guard of claim **1** wherein at least one of the protective panels includes a depression positioned to receive stitches configured to mount the at least one protective panel to the liner.

11. The leg guard of claim **1** wherein the liner has a lateral side configured to be positioned adjacent to the lateral lower leg region, and a medial side configured to be positioned adjacent to the medial lower leg region, and wherein the lateral side is longer than the medial side.

12. A leg guard, comprising:
- a protective panel configured to cover at least portion of a user's lower leg, the panel including an opening;
- a strap attached to the leg guard positioned to retain the leg guard to the user's leg;
- a buckle attached the strap, the buckle comprising a protrusion configured to engage the opening in the panel; and
- a raised surface positioned adjacent to the elongated opening to at least partially interfere with passage of the buckle in the elongated opening.

13. The leg guard of claim **12** wherein the protective panel comprises at least three panels.

14. The leg guard of claim **12** wherein the protective panel is a first protective panel, the leg guard further comprising a knee protective panel positioned to articulate with respect to the first protective panel and to cover at least a portion of a user's knee region, and a thigh protective panel positioned to articulate with respect to the knee protective panel and to cover at least a portion of a user's thigh region.

15. A leg guard comprising a plurality of protective panels mounted to a liner and positioned to articulate with respect to each other, the leg guard further comprising:
- a strap;
- a buckle connected to the strap, wherein the buckle includes an elongated protrusion extending from the buckle and configured to engage an elongated opening in the leg guard, wherein the elongated protrusion comprises a peg connected to a disk, and wherein the elongated opening is configured to receive the disk and allow the peg to slide within the opening.

16. The leg guard of claim **15** wherein the buckle has one or more teeth positioned proximate to a slot in the buckle to resist loosening of the strap when the strap is in contact with the teeth.

17. The leg guard of claim **15** wherein the elongated opening comprises a slot portion and a generally circular entrance portion, the generally circular entrance portion having a diameter larger than a width of the slot portion.

18. The leg guard of claim **15** further comprising a raised surface near the elongated opening and positioned to at least partially interfere with passage of the buckle in the elongated opening.

19. The leg guard of claim **15** wherein when the elongated protrusion is engaged with the elongated opening, the buckle is biased into a tilted position in which friction between the buckle and the leg guard is increased to at least partially resist movement of the buckle.

20. The leg guard of claim **15** wherein the plurality of protective panels includes a plurality of elongated panels configured to extend along a portion of a user's shin region, and wherein the plurality of elongated panels are spaced apart from each other on the liner.

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