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(54) ARTICLE OF FOOTWEAR WITH A PRONATION FEEDBACK SYSTEM

SCHUHWERK MIT EINEM PRONATIONSRÜCKMELDESYSTEM

ARTICLE CHAUSSANT AVEC SYSTÈME DE RÉTROACTION DE PRONATION

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Description

BACKGROUND

[0001] The present embodiments relate generally to articles of footwear, and in particular to articles with cushioning provisions and methods of making such articles.

[0002] Articles of footwear generally include two primary elements: an upper and a sole member. The upper is often formed from a plurality of material elements (e.g., textiles, polymer sheet layers, foam layers, leather, synthetic leather) that are stitched or adhesively bonded together to form a void on the interior of the footwear for comfortably and securely receiving a foot. More particularly, the upper forms a structure that extends over the instep and toe areas of the foot, along medial and lateral sides of the foot, and around a heel area of the foot. The upper may also incorporate a lacing system to adjust the fit of the footwear, as well as permitting entry and removal of the foot from the void within the upper. In addition, the upper may include a tongue that extends under the lacing system to enhance adjustability and comfort of the footwear, and the upper may incorporate a heel counter.

[0003] The sole member is secured to a lower portion of the upper so as to be positioned between the foot and the ground. In athletic footwear, for example, the sole member includes a midsole and an outsole. The various sole components may be formed from a polymer foam material that attenuates ground reaction forces (i.e., provides cushioning) during walking, running, and other ambulatory activities. The sole may also include fluid-filled chambers, plates, moderators, or other elements that further attenuate forces, enhance stability, or influence the motions of the foot, for example.

[0004] Document WO 2009/106077 describes a midsole for a shoe, in particular a running shoe. The midsole is asymmetric in a midfoot area, has an upper heel portion embracing the calcaneus of a wearer and has an upwardly extending toe end. In the midfoot area a vertical medial support structure originates from the midsole and supportively embraces the arch. Correspondingly, a vertical lateral support structure supports the lateral side of the foot in the midfoot area. The medial support structure covers a larger area than the lateral support structure and is connected to the vertically extending upper heel portion of the midsole.

[0005] Document US D558,964 S describes an ornamental design for a shoe sole.

SUMMARY

[0006] The claimed invention is defined by the features set out in the independent claims. The dependent claims define specific embodiments of the claimed invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The embodiments can be better understood

with reference to the following drawings and description. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the embodiments. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views.

FIG. 1 is an isometric view of an embodiment of an article of footwear with a pronation feedback system; FIG. 2A is a cross-sectional view of the article of footwear of FIG. 1 taken at lines 2A-2A in FIG. 1; FIG. 2B is an alternate configuration of the article of footwear with the pronation feedback system of FIG. 1;

FIG. 3 is an isometric view of an embodiment of a sole structure;

FIG. 4 is an isometric view of an embodiment of a sole structure;

FIG. 5 is an isometric view of an exemplary embodiment of a sole structure, that is not part of the claimed invention;

FIG. 6 is an isometric view of an embodiment of a sole structure;

FIG. 7 is a rear fragmentary view of a pair of feet of a user experiencing pronation showing footwear in cross-sectional view on the feet;

FIG. 8 is a schematic graph of a sequence of foot positions during a gait cycle with time on the horizontal axis and illustrating three different rates of pronation;

FIG. 9 is a cross-sectional view of an embodiment of an article of footwear with a pronation feedback system during pronation;

FIG. 10 is a cross-sectional view of a conventional article of footwear during pronation;

FIG. 11 is an isometric view of an article of footwear with an embodiment of a sole structure; and

FIG. 12 is an isometric view of an exemplary article of footwear with a sole structure, that is not part of the claimed invention.

DETAILED DESCRIPTION

[0008] FIG. 1 depicts an isometric view of an embodiment of an article of footwear 100. In one embodiment, article of footwear 100 has the form of an athletic shoe. The provisions discussed herein for article of footwear 100 could be incorporated into various other kinds of footwear including, but not limited to, basketball shoes, hiking boots, soccer shoes, football shoes, sneakers, running shoes, cross-training shoes, rugby shoes, rowing shoes, baseball shoes as well as other kinds of shoes. Moreover, in some embodiments, the provisions discussed herein for article of footwear 100 could be incorporated into various other kinds of non-sports-related footwear, including, but not limited to, slippers, sandals, high-heeled footwear, and loafers.

[0009] For purposes of clarity, the following detailed

description discusses the features of article of footwear 100, also referred to simply as article 100. However, it will be understood that other embodiments may incorporate a corresponding article of footwear (e.g., a right article of footwear when article 100 is a left article of footwear) that may share some, and possibly all, of the features of article 100 described herein and shown in the figures.

[0010] As will be discussed in detail further below, in different embodiments, article 100 may include provisions for providing tactile feedback, support, and/or sensory information to the user. Article 100 includes a pronation feedback system or dynamic response portion associated with the article. It should be understood that the following figures are for purposes of illustration only, and each of the components described herein may be included or referred to in the description while not illustrated in the figures.

[0011] For consistency and convenience, directional adjectives are employed throughout this detailed description corresponding to the illustrated embodiments. The term "longitudinal" as used throughout this detailed description and in the claims refers to a direction extending a length of a component (e.g., an upper or sole component). A longitudinal direction may extend along a longitudinal axis, which itself extends between a forefoot region and a heel region of the component. Also, the term "lateral" as used throughout this detailed description and in the claims refers to a direction extending along a width of a component. A lateral direction may extend along a lateral axis, which itself extends between a medial side and a lateral side of a component. Furthermore, the term "vertical" as used throughout this detailed description and in the claims refers to a direction extending along a vertical axis, which itself is generally perpendicular to a lateral axis and a longitudinal axis. For example, in cases where an article is planted flat on a ground surface, a vertical direction may extend from the ground surface upward. This detailed description makes use of these directional adjectives in describing an article and various components of the article, including an upper, a midsole structure, and/or an outer sole structure.

[0012] The term "side," as used in this specification and in the claims, refers to any portion of a component facing generally in a lateral, medial, forward, or rearward direction, as opposed to an upward or downward direction. The term "upward" refers to the vertical direction heading away from a ground surface, while the term "downward" refers to the vertical direction heading toward the ground surface. Similarly, the terms "top," "upper," and other similar terms refer to the portion of an object substantially furthest from the ground in a vertical direction, and the terms "bottom," "lower," and other similar terms refer to the portion of an object substantially closest to the ground in a vertical direction.

[0013] The "interior" of a shoe refers to space that is occupied by a wearer's foot when the shoe is worn. The "inner side" of a panel or other shoe element refers to

the face of that panel or element that is (or will be) oriented toward the shoe interior in a completed shoe. The "outer side" or "exterior" of an element refers to the face of that element that is (or will be) oriented away from the shoe interior in the completed shoe. In some cases, the inner side of an element may have other elements between that inner side and the interior in the completed shoe. Similarly, an outer side of an element may have other elements between that outer side and the space external to the completed shoe. Further, the terms "inward" and "inwardly" shall refer to the direction toward the interior of the shoe, and the terms "outward" and "outwardly" shall refer to the direction toward the exterior of the shoe.

[0014] In addition, the term "proximal" refers to a direction that is nearer a center of a footwear component, or is closer toward a foot when the foot is inserted in the article as it is worn by a user. Likewise, the term "distal" refers to a relative position that is further away from a center of the footwear component or upper. Thus, the terms proximal and distal may be understood to provide generally opposing terms to describe the relative spatial position of a footwear layer. For example, with reference to a sole structure, the distal direction is the direction away from or further from the sole structure, while the proximal direction is the direction towards or closer to the sole structure.

[0015] For purposes of this disclosure, the foregoing directional terms, when used in reference to an article of footwear, shall refer to the article of footwear when sitting in an upright position, with the sole facing groundward, that is, as it would be positioned when worn by a wearer standing on a substantially level surface.

[0016] In addition, for purposes of this disclosure, the term "fixedly attached" shall refer to two components joined in a manner such that the components may not be readily separated (for example, without destroying one or both of the components). Exemplary modalities of fixed attachment may include joining with permanent adhesive, rivets, stitches, nails, staples, welding or other thermal bonding, or other joining techniques. In addition, two components may be "fixedly attached" by virtue of being integrally formed, for example, in a molding process.

[0017] For purposes of this disclosure, the term "removably attached" or "removably inserted" shall refer to the joining of two components or a component and an element in a manner such that the two components are secured together, but may be readily detached from one another. Examples of removable attachment mechanisms may include hook and loop fasteners, friction fit connections, interference fit connections, threaded connectors, cam-locking connectors, compression of one material with another, and other such readily detachable connectors.

[0018] Thus, the embodiments may be characterized by various directional adjectives and reference portions. These directions and reference portions may facilitate in describing the portions of an article of footwear. Moreo-

ver, these directions and reference portions may also be used in describing subcomponents of an article of footwear (e.g., directions and/or portions of a midsole structure, an outer sole structure, a support structure, which may include elongated members, an upper, or any other components).

[0019] For purposes of reference, article 100 may be characterized by a number of different regions or portions. For example, article 100 includes a forefoot region, a midfoot region, a heel region, a vamp portion, and an instep portion. Moreover, the various components of article 100 could likewise comprise corresponding portions. Referring to FIG. 1, article 100 may be divided into forefoot region 105, midfoot region 125, and heel region 145. Forefoot region 105 may be generally associated with the toes and joints connecting the metatarsals with the phalanges. Midfoot region 125 may be generally associated with the arch of a foot. Likewise, heel region 145 may be generally associated with the heel of a foot, including the calcaneus bone.

[0020] In addition, article 100 includes a lateral side 165 and a medial side 185. In particular, lateral side 165 and medial side 185 may be opposing sides of article 100. Furthermore, both lateral side 165 and medial side 185 may extend through forefoot region 105, midfoot region 125, and heel region 145.

[0021] Referring to FIG. 1, for reference purposes, a lateral axis 190 of article 100, and any components related to article 100, may extend between medial side 185 and lateral side 165 of the foot. Additionally, in some embodiments, longitudinal axis 180 may extend from forefoot region 105 to a heel region 145. It will be understood that each of these directional adjectives may also be applied to individual components of an article of footwear, such as an upper and/or a sole member. In addition, a vertical axis 170 refers to the axis perpendicular to a horizontal surface defined by longitudinal axis 180 and lateral axis 190.

[0022] FIG. 1 illustrates various features and components of article of footwear 100, including an upper 102 and a sole structure 130. FIG. 1 provides an isometric lateral view of an embodiment of the exterior of article 100, where a portion of the upper is illustrated in phantom to expose the interior of article 100.

[0023] Depending on the material of upper 102, in some embodiments, upper 102 may be configured to stretch fit over a foot without the need for additional fasteners. However, in other embodiments, the use of one or more fasteners may allow upper 102 to enlarge or tighten over a foot and/or provide the needed amount of tension to keep article 100 on the foot. For example, in some embodiments, a lace can extend through various apertures or other securing elements and permit the wearer to modify the dimensions of upper 102 to accommodate the proportions of the foot. More particularly, a lace may permit the wearer to tighten portions of upper 102 around the foot, and the lace can permit the wearer to loosen upper 102 to facilitate entry and removal of the

foot from article 100. In alternative embodiments, upper 102 may include other lace-receiving elements, such as loops, eyelets, and D-rings. In addition, upper 102 may include a tongue in some embodiments. In other embodiments, there may be other types of fasteners such as straps, cords, clips, or other fastening mechanisms.

[0024] Furthermore, in some embodiments, various portions of layers of sole structure 130 may be configured to provide traction for article 100. Thus, in different embodiments, traction elements may be included in sole structure 130. In addition to providing traction, sole structure 130 may attenuate ground reaction forces when compressed between the foot and the ground during walking, running, pushing, or other ambulatory activities. The configuration of sole structure 130 may vary significantly in different embodiments to include a variety of conventional or nonconventional structures. In some embodiments, the configuration of sole structure 130 can be configured according to one or more types of surfaces on which sole structure 130 may be used. Examples of surfaces include, but are not limited to, natural turf, synthetic turf, dirt, hardwood flooring, skims, wood, plates, footboards, boat ramps, as well as other surfaces.

[0025] The various portions of sole structure 130 may be formed from a variety of materials. For example, sole structure 130 may include a compressible polymer foam element (e.g., polyurethane or ethylvinylacetate foam) that attenuates ground reaction forces (i.e., provides cushioning) when compressed between the foot and the ground during walking, running, or other ambulatory activities. In further configurations, sole structure 130 may incorporate fluid-filled chambers, plates, moderators, or other elements that further attenuate forces, enhance stability, or influence the motions of the foot. Furthermore, other portions of sole structure 130, such as an outsole, can be formed from a wear-resistant rubber material that is textured to impart traction. It should be understood that the embodiments herein depict a configuration for sole structure 130 as an example of a sole structure that may be used in connection with upper 102, and a variety of other conventional or nonconventional configurations for sole structure 130 may also be utilized. Accordingly, the structure and features of sole structure 130 or any sole structure utilized with upper 102 may vary considerably.

[0026] Sole structure 130 is secured to upper 102 and extends between a foot and the ground when article 100 is worn. In different embodiments, sole structure 130 may include different components. For example, sole structure 130 may include an outsole. Sole structure 130 may further include a midsole and/or an insole. In some embodiments, one or more of these components may be optional. In addition, sole structure 130 may include components or portions that extend toward and/or attach to a portion of upper 102. Such components may provide additional support and compressive strength to article 100.

[0027] In different embodiments, upper 102 may be

joined to sole structure 130 and define an interior cavity 106 designed to receive a wearer's foot. In some embodiments, upper 102 includes a mouth opening that provides access for the foot into interior cavity 106 of upper 102.

[0028] Upper 102 may generally incorporate various provisions associated with uppers. Upper 102 may also be characterized by one or more layers disposed adjacent to one another. In some embodiments, each layer of upper 102 can be configured to provide various degrees of cushioning, tension, ventilation, shock absorption, energy return, support, as well as possibly other provisions.

[0029] Referring again to FIG. 1, it can be seen that in some embodiments, article 100 can include various structural components that are disposed within, integrally formed with, or associated with sole structure 130. In some embodiments, article 100 can include a first pronation feedback system ("first system") 150. For purposes of this disclosure a pronation feedback system is a system associated with article 100 that can provide a user with various tactile-sensory feedback, support, and/or information regarding the motion and/or position of the user's foot as it is positioned within the article.

[0030] An article of footwear can include a pronation feedback system that may take on various forms. In some embodiments, the pronation feedback system is internal to the footwear. In some embodiments, the pronation feedback system is integrated into the footwear. For example, the components of the pronation feedback system can be made of the same material as the remainder of the sole structure, and be formed as "one-piece" with the sole structure. In other embodiments, the pronation feedback system is removable. In some embodiments, the pronation feedback system connects to the upper. In other embodiments, the pronation feedback system connects to the sole structure. In still other embodiments, the pronation feedback system extends between the upper and the sole structure. In some of those embodiments, the pronation feedback system extends between the upper and the sole structure via the void (also known as the interior cavity) between the upper and the sole structure. Further still, in some of those embodiments, the feedback system extends between the upper and sole structure away from the peripheral edge of the upper and sole structure.

[0031] In some embodiments, first system 150 may comprise one or more "sole extensions" or elongated members 160. In some embodiments, elongated members 160 extend from the sole structure and/or comprise a portion of the sole structure. An elongated member for purposes of this disclosure can include provisions for increasing flexibility, fit, comfort, and/or stability, as well as providing sensory information or tactile feedback to a user during deformation or use of the elongated member or the article incorporating the elongated member. Further, in one or more embodiments, an elongate member as part of a support structure may provide structural support

a wearer's foot to physically reduce the rate of pronation in addition to providing feedback, e.g., a proprioceptive feedback, to the wearer regarding pronation of the wearer's foot, as will be discussed further below. For example, in one or more embodiments, the support structure, which may include an elongate member, may provide support to physically reduce the rate of pronation, e.g., a peak rate of pronation, of the wearer's foot. The wearer's rate of pronation, including the peak rate of pronation, may be lower when the wearer runs barefoot without footwear when compared to the wearer's rate of pronation while wearing footwear. In one embodiment, the support structure may reduce the rate of pronation, including the peak rate of pronation of the wearer's foot, to a rate closer to the wearer's barefoot pronation rate, which may reduce the likelihood of injury to the wearer.

[0032] In one embodiment, portions of a sole structure or sole member may incorporate or otherwise include an elongated member. In some embodiments, one or more elongated members may be joined to or integrally formed with a layer or portion of sole structure 130. In another embodiment, one or more elongated members may be embedded or fixedly attached to a portion of sole structure 130. In the embodiment of FIG. 1, elongated members 160 extend from a base portion 155 of sole structure 130. In one embodiment, elongated members 160 can be fixedly attached to the surface of a midsole. In some embodiments, elongated members 160 can be disposed within interior cavity 106, adjacent to medial side 185 of the inwardly facing surface 187 of upper 102. For example, FIG. 2B shows an alternative pronation feedback system 150A with such a configuration. In other embodiments, as shown herein, elongated members 160 can be external to upper 102. In some embodiments, elongated members 160 can extend or wrap around a medial side portion of the outer surface 189 (also called the exterior surface) of upper 102. In other words, one or more elongated members 160 can directly contact the exterior surface 189 of upper 102 in one embodiment, such as shown and described with respect to FIGS. 2A and 11.

[0033] In FIG. 1, a plurality of elongated members 160 are shown. In some embodiments, two or more elongated members 160 may be arranged adjacent to and/or contiguous with one another. The elongated members 160 include first member 162, second member 163, third member 164, fourth member 166, fifth member 167, sixth member 168, and seventh member 169. For example, as shown in FIG. 1, elongated members 160 are arranged in a manner similar to a wave, array, or a portion of a starburst, extending upward from base portion 155 of sole structure 130 in a direction substantially aligned with vertical axis 170. In some embodiments, elongated members 160 may be configured to form a fan-like array of elongated members, which can comprise first system 150. However, it should be understood that in other embodiments, elongated members 160 may be arranged further apart from or spaced from one another, or they may be arranged closer together, as will be discussed in

further detail below. In addition, in some embodiments, elongated members 160 can vary in shape and dimensions, including length, width, and thickness.

[0034] Furthermore, in different embodiments, a pronation system may be disposed or located in different portions of article 100. In some embodiments, a pronation system can be disposed in forefoot region 105, midfoot region 125, and/or heel region 145. In FIG. 1, the pronation system is disposed in midfoot region 125. Furthermore, elongated members 160 are arranged such that they are disposed along medial side 185 of upper 102. However, in other embodiments, elongated members 160 can also be disposed along and/or through multiple regions of an article of footwear, including lateral side 165. In some embodiments, elongated members 160 extend radially outward and/or upward from the sidewall or the base portion of the sole structure. In one embodiment, elongated members 160 are arranged such that they "splay" outward from a base portion 155 of the sole structure 130, extending away from the ground-contact surface 142 of the sole structure 130, and beginning above where a bite line BL at the top edge of the sidewall 300 is disposed forward of and rearward of the elongated members 160.

[0035] Embodiments may include provisions for fitting the curvature of the lengths of the elongated members to the shape of a wearer's foot at different locations along the foot. In other words, in some embodiments, one or more elongated members can include a curvature that is configured to directly contact or wrap around a portion of a user's foot (or the user's sock) when the article of footwear is in use. In some embodiments, the elongated members include a curvature that is arranged to generally fit the shape of a wearer's foot along the midfoot on the medial side. In one embodiment, one or more of the elongated members can conform to a wearer's arch. In other embodiments, the elongated members are arranged to fit the shape of a wearer's foot at the heel or forefoot. In still other embodiments, the elongated members are arranged to fit the shape of a wearer's foot at a combination of the forefoot, midfoot, or heel.

[0036] To provide a greater understanding of some of the embodiments, a cross-section of an embodiment of first system 150 is depicted in FIG. 2A with a foot 200 (shown in phantom) disposed in the interior cavity 106 of article 100. It can be seen that in some embodiments, the elongated members 160 can wrap around or be disposed or pressed against a portion of foot 200, as depicted by the fifth member 167 in FIG. 2A. In other words, the elongated member 160, including the fifth member 167 can extend upward and press against a portion of medial side 185 of foot 200 in some embodiments. In one embodiment, a curvature of the elongated members 160 can substantially correspond to the general curvature of foot 200 in the same region, as depicted by the fifth member 167 and the foot 200 in FIG. 2A. Thus, in some embodiments, first system 150 can be configured to match or correspond to the average curvature of a foot sized

for the article of footwear that comprises first system 150 to provide greater support, comfort, and/or contact with the foot. For example, various portions of each elongated member may be substantially curved in some embodiments. In other embodiments, elongated members can be substantially linear or straight.

[0037] As noted above, in other embodiments of the pronation system, there may be differences in structure such as the length, thickness, width, and/or shape of the elongated members. It should be understood that the general characteristics of the alternative embodiments described herein also include the features and characteristics described with respect to first system 150. Thus, any of the embodiments described herein can be utilized interchangeably with first system 150 as shown in FIGS. 1 and 2A. Furthermore, the features, properties, and characteristics of one embodiment can be applied to other embodiments.

[0038] In FIG. 3, an isolated view of a second sole structure 330 is depicted with a second pronation feedback system 350 ("second system"). It can be seen that the sole structure - whether comprising an outsole, midsole, and/or insole - has a sidewall 300 that extends around a majority of the perimeter of base portion 155 of the sole structure. In some embodiments, sidewall 300 can extend in a direction substantially aligned with vertical axis 170. In one embodiment, sidewall 300 can be substantially smooth and continuous, though sidewall 300 and/or other portions of base portion 155 can include a curvature, undulations, bumps, apertures, ridges, grooves, or other texturing. Furthermore, it should be understood that other embodiments may not include a sidewall, and the elongated members can be formed or attached independent of a sidewall, from a different portion of the base portion of the sole structure. In different embodiments, second system 350 can be disposed above or distally of sidewall 300. For example, in one embodiment, second system 350 is disposed in the midfoot region 125 between a forward edge 310 of sidewall and a rearward edge 320 of sidewall 300 and extends upward.

[0039] Furthermore, in some embodiments, an exterior surface of one or more of elongated members 160 is continuously formed with the sidewall of the sole structure. In some embodiments, an interior surface of one or more elongated members 160 is continuous with an interior surface of the sole structure. In other words, the outwardly facing surface of the elongated members and the sidewall can present a substantially continuous and/or smooth surface in one embodiment. Similarly, the inwardly facing surface of the elongated members and the base portion of the sole structure can present a substantially continuous and/or smooth surface in one embodiment.

[0040] In FIG. 3, second system 350 comprises five elongated members 160, including a first member 352 with a length L1, a second member 354 with a length L2, a third member 356 with a length L3, a fourth member 358 with a length L4, and a fifth member 360 with a length

L5. It can be seen that in some embodiments, one or more elongated members can differ in length and/or curvature from neighboring elongated members. The length of each member is along its central axis, extending upward from a base line B that extends along the lowest extents of the spaces between the members. For example, the length L1 of the first member 352 is smallest relative to the lengths of the remaining elongated members. Furthermore, the length L3 of the third member 356 is largest relative to the lengths of the remaining elongated members. In addition, the lengths L2, L4, and L5 of second member 354, fourth member 358, and fifth member 360, respectively, have a value between the length L1 of the first member 352 and the length L3 of the third member 356. However, it should be understood that in other embodiments, two or more elongated members can have substantially similar lengths.

[0041] It can also be seen that the curvature of each elongated member can differ from other elongated members. For example, third member 356 is relatively "straight", while first member 352 curves forward, in a direction generally toward forefoot region 105 and fifth member 360 curves rearward, in a direction generally toward heel region 145. In addition, the curvatures of second member 354, fourth member 358, and fifth member 360 can vary, and in some embodiments, the curvature can be arranged to correspond to the curvature of a foot in that region. However, it should be understood that in other embodiments, two or more elongated members can have substantially similar curvature.

[0042] The spacing between two or more elongated members can also vary in a pronation system in different embodiments. In FIG. 3, the spacing between each elongated member and its neighboring elongated member is substantially uniform. However, in other embodiments, the spacing may vary widely, such that, for example, first member 352 is further apart from second member 354 relative to the spacing between second member 354 and third member 356. For example, in first system 150 (see FIG. 1) elongated members 160 are arranged closer together than elongated members 160 in second system 350. In addition, while second system 350 includes five elongated members 160, first system 150 comprises seven elongated members 160 (see FIG. 1).

[0043] As discussed above, the lengths of one or more elongated members 160 can vary. In FIG. 4, an isolated view of a third sole structure 430 is depicted with a third pronation feedback system 450 ("third system") with five elongated members 160, including a first member 452, a second member 454, a third member 456, a fourth member 458, and a fifth member 460. Comparing third system 450 with second system 350 of FIG. 3, it can be seen that the cuts or siped regions (e.g., the spaces between the members) where each elongated member is formed in the material of the sole structure, or spaced apart from other portions of the sole structure extend further downward in third system 450 than second system 350. In other words, in FIG. 4, the base line B between

the third and fourth members 456, 458, and between the fourth and fifth members 458, 460 of the third system is lower relative to the bite line BL of the sole structure 130 so that the relative lengths of the third, fourth, and fifth members 456, 458, 460 in FIG. 4 are significantly greater than the lengths of elongated members 160 in FIG. 3. While the sipes or cuts in second system 350 extend downward and generally end at a distance below the upper edge (also referred to as the bite line BL) of sidewall 300 (see FIG. 3), the sipes in FIG. 4 extend further downward, such that some of the sipes are proximate to or adjacent to the bite line or the base of third sole structure 430. For purposes of this disclosure, a bite line is a location along the intersection of a sole structure assembly and an upper portion. Thus a lower or more distal end of the elongated member that is attached or joined to the sole structure can be disposed further down in some embodiments. In one embodiment, the lower end of an elongated member can be disposed adjacent to the bite line of the article of footwear. In some embodiments, for example a first elongated member and a second elongated member are joined above, directly adjacent, or adjoining the bite line.

[0044] For example, fourth member 458 is substantially longer than fourth member 358 in FIG. 3. Thus, in some embodiments, the lengths of one or more elongated members can be greater due to the extent that a cut or sipe is made through the sole structure. Differences in the siping or lengths of elongated member can allow the system to vary in flexibility and/or stiffness in different embodiments. For example, in some embodiments, third system 450 can be generally more flexible and pliable relative to second system 350. It should be understood that the various portions can differ from that shown here and are for reference purposes only. Thus, elongated members 160 can include any length from nearly zero to nearly the entire length of a sidewall, or even to extend upward and reach toward the maximum height of the upper in an article of footwear.

[0045] In FIG. 5, an isolated view of a fourth exemplary sole structure 530, that is not part of the claimed invention, is depicted with a fourth pronation feedback system 550 ("fourth system"). Fourth system 550 provides an illustration of elongated members 160 that are arranged closer together relative to the embodiments discussed above. In fourth system 550, each elongated member is disposed directly adjacent to a neighboring elongated member, such that little or no spacing is present between the elongated members. The siping can extend to various lengths, as described above, allowing various flexibility. In addition, the number of sipes in FIG. 5 - fifteen sipes - allows the formation of fourteen individual elongated members, including a first member 552, a second member 554, a third member 556, a fourth member 558, a fifth member 560, a sixth member 562, a seventh member 564, an eighth member 566, a ninth member 568, a tenth member 570, an eleventh member 572, a twelfth member 574, a thirteenth member 576, and a fourteenth member

578. Thus, in some embodiments, a pronation system may utilize a "fan" configuration, where two or more neighboring elongated members contact or can even overlap portions of one another. In one embodiment as shown, two or more elongated members can be understood to be contiguous, or touching, along the edges of each elongated member. For example, elongated member 554 touches the elongated members 552 and 556 along their adjacent sides. For some users, the larger number of elongated members and/or the lack of spacing between elongated members can enhance or increase the tactile feedback provided to the foot. This kind of embodiment can provide a feathery like sensation, as more elongated segments are curved around a portion of the foot, and can provide more sensitivity in feedback to a user during pronation. It should be understood that in other embodiments, one portion of a pronation system can include this type of arrangement as shown in FIG. 5 (where there is little or no spacing between the elongated members) while another portion of the same pronation system may include spacing or gaps between elongated members. For example, there may be a mix of the structural configurations that are depicted in FIGS. 3, 4, and/or 5, such that the individual elongated members vary in lengths as well as in their spacing arrangement. Similarly, the widths of each elongated member can be decreased or increased. In FIG. 5, the elongated members are relatively narrow.

[0046] Similarly, as shown in FIG. 6, another example of a system comprising generally "narrow" elongated members is shown in a fifth sole structure 630 that includes a fifth pronation feedback system 650 ("fifth system"). As discussed above, the widths of one or more elongated members 160 can vary. Fifth system 650 includes a first member 652, a second member 654, a third member 656, a fourth member 658, a fifth member 660, a sixth member 662, a seventh member 664, an eighth member 666, and a ninth member 668. Comparing fifth system 650 with second system 350 of FIG. 3, it can be seen that each elongated member is more closely arranged together in fifth system 650 than those in second system 350. Furthermore, in FIG. 6, the relative widths of elongated members 160 are significantly smaller than the widths of elongated members 160 in FIG. 3. For example, first member 652 in FIG. 6 is substantially narrower than first member 352 in FIG. 3. Thus, in some embodiments, the widths of one or more elongated members can be greater or narrower. Differences in the widths of elongated members can allow the system to vary in flexibility and/or stiffness in different embodiments. For example, in some embodiments, fifth system 650 can be generally more flexible and pliable relative to second system 350. Generally, a narrower elongated member is more flexible and pliable (i.e., less stiff) in response to a pronation force of a foot than a wider elongated member. It should be understood that the various portions can differ from that shown here and are for reference purposes only. Thus, elongated members 160 can include any

width from nearly zero to nearly the entire width of the system.

[0047] In addition, in some embodiments, the dimensions or shape of elongated members can also vary through different portions of a single elongated member. For example, the size of individual elongated members may be larger (or smaller) in some regions relative to other regions. For example, a first portion closer to the base of the sole structure can begin with a wider region and narrow or taper as it extends upward. In other embodiments, the thickness of the elongated members near the base of the sole structure can be thinner or thicker, and then vary in thickness as it extends upward. In some cases, the dimensions, shape, and number of elongated members 160 may be adjusted to increase or decrease the rigidity, responsiveness, area covered, and/or the "feel" or type of sensory information in a particular region of a foot.

[0048] In some embodiments, the overall shape of an elongated member may be either regular or irregular. For example, elongated members may be substantially flat or narrow, and/or relatively thick or wide. In other embodiments, elongated members 160 may comprise a triangular, oblong, elliptical, tapered shape, or any other regular or irregular geometry.

[0049] In some embodiments, the elongated member may have a substantially smooth outer edge. In other embodiments, an elongated member can include texturing, bumpiness, undulations, ridges, or other patterns that can affect the feel of the elongated member against a foot. Thus, the sensation for a user can be adjusted by altering the shape or patterning of the elongated members. However, in other embodiments, as shown in the Figures, the elongated members can have a substantially smooth outer surface.

[0050] The responses described herein may be useful in various applications related to articles of apparel in some embodiments. In some embodiments, the responses can be utilized in articles of footwear. For example, in different embodiments, there can be structural components associated with an article of footwear that can offer various orthopedic benefits to a user. As noted earlier, an article of footwear can include provisions that can allow a user to receive feedback regarding certain aspects of his or her behavior during particular activities. In some embodiments, first system 150 as depicted in the figures above can interact with a foot and provide a user with sensory information that can be utilized by the user to selectively (i.e., intentionally) or automatically (i.e., subconsciously) make adjustments in the behavior of his or her foot during different activities. In one embodiment, for example, first system 150 can provide tactile feedback to a user that can inform the user whether the foot is undergoing pronation. In some cases, the feedback may be related to the degree or the extent of the pronation that occurs. However, in other cases, the feedback and support may be associated with the rate of the pronation, as will be discussed below with respect to FIG. 8.

[0051] The term "pronation" as used in this disclosure is used to describe an abnormal lateral (inwards) rotation of the foot that can occur during the foot's (or footwear's) contact with the ground. A certain amount of pronation (which will be referred to herein as "normal pronation") is considered natural for a healthy gait. However, if the foot rotates beyond the normal or a healthy range of rotation, abnormal pronation (herein referred to as "pronation") is said to have occurred. Thus, pronation of the foot is not necessarily in itself injurious, but may over time leave an individual more susceptible to a number of injuries. In some cases, pronation can be understood to comprise a type of collapsing, flattening, and/or rolling-in of the foot. In one embodiment, the arch of the foot may collapse to a greater extent during (abnormal) pronation relative to normal pronation. However, it should be understood that in different cases, the timing associated with when and how quickly the foot rolls inward may also be important, as will be discussed below with respect to FIG. 8.

[0052] In different embodiments, the primary touch organ, skin, can be very sensitive to periodic applied pressures. Thus, some embodiments of the various pronation feedback systems as described herein can provide a wearable tactile feedback system that utilizes the "communication channel" of touch or sensation, to give real-time feedback to the wearer about their performance during various activities. The present embodiments can provide tactile feedback for a wearer to alert the wearer of a departure from a normal or healthy rate and/or range of pronation. The tactile feedback can help a user develop new learned behavior that supplants previous tendencies to over-pronate and assist in behavioral modification. A person's foot position and rate of pronation can thus be monitored and potentially while the user is engaged in normal activities. In one example, if a user over-pronates or pronates too quickly, the elongated members can stiffen, and the stiffening is felt by the wearer so he or she can choose to adjust their behavior.

[0053] When a foot pronates during walking or running or other activities, the lower leg and foot can rotate inwardly (medially) beyond a healthy range. This in turn can increase stresses on the muscles, tendons, and ligaments of the foot and lower leg including the shin and the knee, as the limb rotates too far inward. In FIG. 7, a pair of feet 700 belonging to an individual who abnormally pronates is shown in cross section. Pair of feet 700 is illustrated wearing a pair of footwear 730 shown in cross-section, including left article of footwear 730A and right article of footwear 730B. The footwear 730 does not include a pronation feedback system. Right foot 710 is depicted rolling inward, while a corresponding left foot 720 is in what would be considered a normal (healthy) position.

[0054] In different embodiments, during a person's gait cycle, the outside part of a first heel 750 and corresponding second heel 752 make initial contact with the ground. For purposes of this disclosure, a gait cycle is the time

period or sequence of events or movements during regular locomotion from the point at which one foot contacts the ground to the point when that same foot again contacts the ground. The angle of pronation is measured for purposes of illustration by the angle between an axis 170 and an axis 740. The axis 740 is the axis of the foot, and more specifically, the axis of the heel, extending perpendicular from the ground contact surface 742 of the footwear 730A or 730B from the center of the heel 750 or 752 of the foot and through the center of the ankle 734. The axis 741 is the axis of the ankle 734 extending through the center of the ankle 734 and along the center of the lower leg above the ankle, and the axis 170 is the vertical axis. In FIG. 7, the pronating foot (here, right foot 710), is depicted as it "rolls" inward further than the generally accepted normal range of approximately 15 percent during pronation. This is illustrated by the contrast between a first range 760 associated with right foot 710 and a second range 762 associated with a left foot 720, where second range 762 should be understood to represent an accepted normal range. As a result, in some cases, at the end of the gait cycle, the front of right foot 710 will typically tend to push off the ground using mainly the big toe and second toe (not shown). It is generally understood that pronation can often be experienced during intense locomotion, principally during athletic activities where body weight on the heel is increased.

[0055] In some embodiments, one manner in which pronation may be measured is through the degree or range of rotation by a foot during an activity. However, in other embodiments, some effects of pronation may be due to other factors. In one embodiment, the rate of pronation, in contrast to the extent of pronation, may be correlated with the susceptibility of a user to various orthopedic effects. Thus, in some cases, an article of footwear that can provide information to a user regarding either their pronation range and/or pronation rate may be beneficial.

[0056] To better illustrate the concepts discussed herein, FIG. 8 is a schematic graph that depicts an embodiment of three different rates of pronation. A first rate 800 of pronation is illustrated near the top of the graph of FIG. 8, a second or intermediate rate 801 of pronation is illustrated below first rate 800, and a third rate 802 of pronation is illustrated near the bottom of the graph of FIG. 8. In each rate, a sequence of six "snapshots" of a left foot are shown, where each snapshot represents a moment in time during a gait cycle of an individual who exhibits abnormal pronation in at least the left foot during an activity. The snapshots are the same moments during the respective gait cycles.

[0057] Furthermore, arrows are included between one snapshot and the adjacent snapshot to schematically represent the passage of time. Larger arrows (as shown in first rate 800) are representative of a greater duration of time relative to the arrows that are smaller (see second rate 801 and third rate 802). Thus, first rate 800 is in part represented by the arrows included between each of the

snapshots, second rate 801 is represented in part by the arrows included between each of the snapshots, and third rate 802 is represented in part by the arrows included between each of the snapshots. It can thus be understood that the sequence comprising each gait cycle is represented such that each cycle is completed over a different duration of time. In first rate 800, the gait cycle begins at $T = 0$ (initial time point) and occurs over a first duration $T1$, represented also by a first span of time 870. In second rate 801, the gait cycle begins at $T = 0$ (initial time point) and occurs over a second duration $T2$, represented also by a second span of time 880, and in third rate 802, the gait cycle begins at $T = 0$ (initial time point) and occurs over a third duration $T3$, represented also by a third span of time 890. First duration $T1$ can be seen to be longer than second duration $T2$. Furthermore, second duration $T2$ is longer than third duration $T3$.

[0058] Referring to first rate 800, there is a first snapshot 810 depicting the heel strike of a foot, a second snapshot 820 depicting the foot coming downward more fully, and a third snapshot 830 depicting the foot beginning to roll inward (toward the medial side). These are followed by a fourth snapshot 840 depicting the rolling of the foot continuing further inward, a fifth snapshot 850 depicting the foot beginning to near the end of the gait cycle by raising the heel higher off the ground, and a sixth snapshot 860 depicting the uneven pushing off of the foot that can occur during the end of a gait cycle that includes pronation. Similarly, second rate 801 comprises the same sequence of snapshots, including a seventh snapshot 812, an eighth snapshot 822, a ninth snapshot 832, a tenth snapshot 842, an eleventh snapshot 852, and a twelfth snapshot 862. In addition, third rate 802 includes the same sequence as well, as depicted in a thirteenth snapshot 814, a fourteenth snapshot 824, a fifteenth snapshot 834, a sixteenth snapshot 844, a seventeenth snapshot 854, and an eighteenth snapshot 864.

[0059] Thus, for purposes of illustration, each set of the six images comprises the same steps of a pronating gait cycle. It should be understood that in other embodiments, a foot that exhibits pronation can rotate in a variety of ways, and the sequence may differ from the examples shown in FIG. 8. However, while each of the gait cycle sequences depict essentially the same gait cycle, it can be seen that the rate of pronation in which the cycle occurs is different for each rate. First rate 800 may be understood to be slower than second rate 801. In addition, second rate 801 may be understood to be slower than third rate 802. In other words, the gait cycle comprising first rate 800 takes a longer period of time to complete than the same gait cycle shown in second rate 801, and the gait cycle of second rate 801 takes a longer period of time to complete than the same gait cycle shown in third rate 802.

[0060] In some embodiments, a faster rate of pronation may increase the susceptibility of an individual to orthopedic complications. Thus, in some embodiments, it may be advantageous to provide an individual with feedback

related to the rate at which the individual is pronating. In different embodiments, various structural components may be included in an article of footwear that can inform, guide, direct, or otherwise influence users to increase their awareness of their pronation rate and/or encourage them to manage their rate of pronation differently. This management may occur consciously (i.e., intentionally) as a result of the feedback in some embodiments. In other embodiments, the management of the pronation rate may occur subconsciously, such that the person's brain or nervous system responds to the tactile feedback automatically and seeks to compensate or adjust his or her behavior in response to that feedback.

[0061] For purposes of this disclosure, tactile feedback refers to feedback that is provided to an individual through the indirect or direct sensation of touch. Thus, any feedback that is given through sensations like changes in pressure (mechanoreception), temperature (thermoception), and pain (nociception) may be considered tactile. In some embodiments, the input to a person that can be registered from the sense of touch can be formed from several modalities including pressure, skin stretch, vibration, and temperature.

[0062] Thus, some embodiments may include provisions for various types of feedback to a wearer's foot. In some embodiments the feedback is tactile. One example is shown in FIGS. 9 and 10 by a comparison between footwear with a pronation system (FIG. 9) and footwear without a pronation system (FIG. 10). In FIG. 9, fifth member 167 of first system 150 is disposed against upper 102 and provides an impulse to a wearer's foot 200. In one embodiment, the curvature of elongated members 160 closely matches the shape of wearer's arch in order to conform to wearer's arch. During a roll of the foot (as discussed above), the elongated members can come to provide different types of impulses or forces or pressure to the foot. Thus, in some embodiments, the wearer will transfer his or her weight on to a plurality of elongated members 160 during a roll, giving tactile feedback as the contact switches from placing the weight on sole structure 130 to plurality of elongated members 160. In general, the elongated members 160 will have a smaller contact area with the foot compared to the sole structure 130 and upper 102, resulting in tactile feedback when weight shifts from the sole structure 130 or upper 102 to the elongated members 160. Furthermore, when a wearer's rate of pronation is greater, the impulse delivered by elongated members 160 may be different. In other words, in some embodiments, at a first rate of pronation the elongated members 160 provide a first impulse to a medial side 185 of the wearer's foot, while at a second (e.g., faster) rate of pronation, the elongated members 160 provide a second impulse to a medial side 185 of the wearer's foot 200 that is different from the first impulse. For purposes of this disclosure, an impulse can be understood to be any kind of sensory feedback or structural support response that is provided by the first pronation feedback system 150. For example, the feedback may be a reac-

tion force of the elongated members 160 in response to the weight of the wearer against the elongated members 160. Thus, in one embodiment, the impulse(s), such as the first impulse, the second impulse, or other impulses, can provide a proprioceptive feedback to the foot 200 of the wearer. In some embodiments, for example, the first impulse can help reduce the first rate of pronation and/or the second impulse can help reduce the second rate of pronation by causing the wearer to correct the over pronation.

[0063] Furthermore, in different embodiments, the embodiments described herein can provide a method of reducing a rate of pronation. Through the use of an article of footwear with a pronation feedback system that includes a sole structure with a plurality of elongated members, a wearer may be able to reduce the rate of pronation. In one embodiment, this method can comprise providing a first impulse to a medial side 185 of wearer's foot 200 in response to a first rate of pronation and providing a second impulse to the medial side 185 of the wearer's foot 200 in response to a second rate of pronation. During use of this method, it will be understood that the first rate of pronation is different than the second rate of pronation, and that the first impulse is different than the second impulse.

[0064] In some embodiments, providing tactile feedback to a wearer may affect the motion of the wearer. For example, tactile feedback could affect the wearer's gait cycle and/or the degree to which a wearer pronates. In a neutral position as in left foot 720 of FIG. 7, when the axis 740 of the foot and the axis 741 of the ankle 734 are both in alignment with the vertical axis 170 and are perpendicular to the ground, the angle between the axis 740 and the axis 741 is zero, and is within a range 762 of normal, where the normal range extends from the vertical axis until the axis 740 moves to position 740A relative to the axis 741. In the neutral position of the left foot 720, the feedback and support given by a pronation system is negligible, as little weight to no weight is placed on any elongated members (represented by elongated member 167), allowing the back of the foot and the back of the article of footwear 730A to spread weight evenly across the ground.

[0065] However, during a roll, as illustrated in right foot 710 in FIG. 7, the axis 740 of the foot and the axis 741 of the ankle are no longer aligned with one another and both perpendicular to the ground. In this position, the feedback and support that would be given by elongated members is increased, as weight is placed on elongated members (represented by elongated member 167) due to the axes being no longer aligned, and the back of the foot and the back of shoe no longer spread weight evenly across the ground. During an excessive roll, the axis 740 of the foot and the axis 741 of the ankle become even further out of alignment with one another and further from perpendicular to the ground. The feedback and support given by elongated members is increased again, as additional weight is placed on plurality of elongated mem-

bers due to the axis 740 of the foot being further out of alignment from the axis 741 of the ankle 734.

[0066] In some cases, a wearer may alter his or her pronation in response to tactile feedback from one or more elongated members. The feedback may discourage over pronation by minimizing the angle between the axis 741 of the ankle 734 and the axis 740 of the heel of the wearer's foot. Minimizing this angle, which may also be referred to as the angle of impact with the ground, increases the relative surface area of the foot striking the ground during the gait cycle. In some cases, the wearer may be discouraged from over pronating as the reinforcing elements (e.g., elongated members 160) apply local forces to the medial side 185 of the foot, which are distributed over relatively narrow contact areas (i.e., along the length of the elongated members 160).

[0067] In FIG. 9, the weight of the wearer is shifted against the elongated members (through the upper 102), creating an impact region R which is the area of contact of the foot 200 and the elongated members (represented by member 167). The impact region may provide feedback to a wearer that encourages him or her to shift his or her weight so as to reduce the over-pronation. An impact region can also provide feedback and support that can discourage any pronation.

[0068] In some embodiments, the tactile feedback is proprioceptive. For example, in FIG. 9, by closely matching plurality of elongated members 160 to the shape of the wearer's arch, the wearer will press his or her medial side weight on the elongated members only during over-pronation in some embodiments. Such feedback allows the user to feel whether the foot is properly placed, and gives awareness on the position of the foot in different embodiments. Since the wearer is aware of the position of his or her foot, the feedback is proprioceptive. The elongated members may provide more proprioceptive feedback when the foot is over-pronated than when the foot is in a neutral position, and may even provide more proprioceptive feedback than when the foot is normal pronation (i.e., within the range 762) in one embodiment. Thus, a wearer may feel the proper position of his or her foot during a roll and reduce over-pronation but may not be affected during normal pronation in some embodiments.

[0069] In some embodiments, by positioning the elongated members in a configuration that is tangential to the arch on the wearer's foot, the elongated members stay in contact with the wearer's foot, but do not press against the wearer's foot during a normal stance. However, when the foot excessively rolls during the gait cycle, the foot rolls on to the arch and thus more strongly against the elongated members (either directly when the elongated members are within the interior cavity 106, or indirectly, through the upper 102, when the elongated members 160 are exterior to the upper 102). The elongated members thus give support to the foot during the over pronation, and provide tactile feedback.

[0070] Similarly, in different embodiments, the sensory

feedback provided to a user can be greater when a relatively strong or "rapid" force is being applied to elongated members 160. Through use of the pronation system, a user may over time reduce their rate of pronation to so that the intensity of the roll experienced is relatively weak or a "slower" force 900. In different embodiments, a component or structure can be provided that can generally indicate to a user whether his or her rate of pronation is greater than or less than a particular reference level. As noted above, this information can be used to adjust the rate of pronation, if desired.

[0071] In FIG. 10, for purposes of illustration, a cross-sectional view of a conventional article of footwear is shown (i.e., without a pronation feedback system) with a foot in the article of footwear. In this case, without a pronation system as described herein, the rate of pronation may remain unchanged for a user, so that the intensity of the roll experienced is relatively large or a "faster" force 1000. For example, the upper 102 at the medial side 185 may shift slightly toward the medial side 185 under the force 1000.

[0072] Thus, in some embodiments, first system 150 can press against the upper and a foot (or a material such as a sock worn by the foot) and alter the user's tactile sensation. In some cases, such as when the rate of pronation is relatively higher, the pronation feedback system can produce a more noticeable sensation to a user. In some embodiments, the surface associated with the elongated members of first system 150 can act as specialized contact points that provide a particular pressure against a user's foot. The sensation of such regions against a foot can prompt a user to modify their behavior in different embodiments.

[0073] In some cases, the user can learn what rate causes the elongated members to yield and provide a more gentle response, and what rates cause the elongated members to provide a more pressured or less comfortable response. In some embodiments, this tactile information may allow a user to learn to maintain a desired rate of pronation over time. The pronation feedback system may thus provide a gentle alert to the wearer to assume a correct, healthier, or improved pronation rate and/or range throughout various movements and positions. The feel of the different elongated members against a foot can also continuously serve to remind the wearer to maintain the healthier gait cycle.

[0074] In some embodiments, the use of elongated members in orthotics for an article of footwear can help support weakened areas of a foot and assist the user in each step. While a relatively rigid material, as may be included in a custom sole member, can provide functional support to the foot, softer or more flexible responses associated with the dynamic pronation feedback system described herein can absorb the loads experienced by the foot and provide protection. Such softer or cushioned regions can better absorb the loads placed on a foot, increase stabilization, and take pressure off uncomfortable or sore spots of the feet.

[0075] For purposes of clarity for the reader, FIG. 11 presents an embodiment of article 100 with upper 102 and a sixth sole structure 1130 comprising a sixth system 1150. Sixth system 1150 includes seven elongated members 160 (i.e., first member 1152, second member 1154, third member 1155, fourth member 1156, fifth member 1157, sixth member 1158, and seventh member 1159). Sixth system 1150 can be understood to be similar to first system 150, except that the elongated members 160 are external to upper 102. Thus, elongated members 160 can extend upward from the sidewall and press against or be attached to medial side 185 of an exterior surface 189 of the upper 102, providing a supportive structure or a ribbed reinforcing arrangement against medial side 185 of upper 102.

[0076] In another example that is not part of the claimed invention, an article of footwear can comprise a seventh system 1250 which comprises a single sole extension, as shown in FIG. 12. In FIG. 12, it can be seen that seventh system 1250 is a support structure and is a substantially continuous portion of a seventh sole structure 1230, extending vertically upward above a surrounding bite line BL. Seventh system 1250 can include different contours and curvature, as well as variations in height, thickness, width, and shape, as described above with respect to the elongated members. In some embodiments, seventh system 1250 can substantially conform to medial side 185 of a foot in midfoot region 125. Thus, in one embodiment, the pronation feedback system can provide a more solid, one-piece support structure that can engage with a foot in a manner similar to the plurality of elongated members described herein.

[0077] As noted above, the geometry of the elongated members can vary in different embodiments. For example, in some embodiments, elongated members can include different tips or end portions, or other kinds of irregularities in their shapes. In some embodiments, each elongated member can include an end portion (the free end of the elongated member that is disposed furthest from the base portion) that has a geometry which differs from the other end portions of neighboring elongated members. For example, while a first elongated member may have a substantially rounded end portion, a second elongated member can have a substantially triangular or pointed end portion. Furthermore, a third elongated member may have a substantially rectangular or linear end portion. In addition, in one embodiment, a fourth member may have an undulating body with an end portion that becomes increasingly tapered and pointed. A fifth member may include a larger "spoon" end portion, or a round, substantially oval end portion that is larger in width than the body of the elongated member nearer to the base portion. Any pronation system can include different geometries of the elongated members, and it should be understood that the description depicts only some examples of these variations. Other embodiments can include elongated members that are all or nearly all similar in geometry. In addition, in some embodiments,

the size of an elongated member can change throughout the length of the elongated member. In other words, the width or thickness of an elongated member can vary over the length of its body. In one embodiment, an elongated member can decrease in width as it extends distally upward. In another embodiment, the body of an elongated member can have a substantially uniform width. In some embodiments, while the body of the elongated member can have a substantially uniform width, the end portion can increase or decrease in width. Each variation can be selected to provide different types of sensory responses for a wearer.

Claims

1. An article of footwear (100) comprising:

an upper (102) and a sole structure (130) secured to the upper (102) to define an interior cavity;
the sole structure (130) comprising a base portion (155) and a sidewall (300) that surrounds a substantial perimeter of the base portion (155); and
a pronation feedback system (150A) including a support structure extending from the sidewall (300) and along the upper (102) at a medial side (185) of the sole structure (130);
wherein the support structure is configured to provide proprioceptive feedback corresponding with a rate of pronation of a foot disposed in the interior cavity;
wherein the support structure comprises a set of elongated members (160) and wherein at least some of the elongated members (160) are spaced apart from and not in contact with one another, and
wherein the support structure extends only in a midfoot region of the sole structure (130).

2. The article of footwear (100) of claim 1, wherein:

the support structure provides a first impulse to a medial side of wearer's foot in response to a first rate of pronation;
the support structure provides a second impulse to the medial side of the wearer's foot in response to a second rate of pronation; and
the first rate of pronation is different than the second rate of pronation, and the first impulse is different than the second impulse.

3. The article of footwear (100) of claim 2, wherein the first impulse and the second impulse are forces against the foot; or wherein the first impulse reduces the first rate of pronation.

4. The article of footwear (100) of any of claims 1-3, wherein an exterior surface of the set of elongated members (160) is continuously formed with the sidewall of the sole structure (130).

5. The article of footwear (100) of any of claims 1-4, wherein an interior surface of the set of elongated members (160) is continuous with an interior surface of the sole structure (130).

6. The article of footwear (100) of any of claims 1-5, wherein the support structure is interior to an inner surface of the upper (102).

7. The article of footwear (100) of any of claims 1-5, wherein the support structure is exterior to an exterior surface of the upper (102).

8. The article of footwear (100) of claim 1, wherein the elongated members (160) splay apart from one another; or wherein at least some of the elongated members (160) have adjacent sides in contact with one another; or wherein at least some of the elongated members (160) have different lengths.

9. The article of footwear (100) of claim 8, wherein a forwardmost one of the elongated members (160) and a rearward most one of the elongated members (160) are shorter than at least one of the elongated members (160) between the forwardmost one and the rearward most one.

10. The article of footwear (100) of claim 1, wherein a forwardmost one of the elongated members (160) curves forward toward a forefoot region of the sole structure (130), and a rearward most one of the elongated members (160) curves rearward toward a heel region of the sole structure (130).

11. The article of footwear (100) of claim 1, wherein the elongated members (160) are straight.

12. The article of footwear (100) of claim 1, wherein a space between two adjacent ones of the elongated members (160) is entirely above a bite line of the upper (102) and the sole structure (130) forward of and rearward of the support structure.

13. A method of reducing a rate of pronation of a wearer of an article of footwear (100), the method comprising:

providing a first impulse to a medial side (185) of wearer's foot in response to a first rate of pronation; the first impulse provided by a pronation feedback system (150A) that includes a support structure extending from a sidewall (300) of a sole structure (130) at a medial side (185) of the

sole structure and along an upper (102) secured to the sole structure (130), the wearer's foot disposed in an interior cavity defined by the upper (102) and the sole structure (130);
 providing a second impulse to the medial side of the wearer's foot in response to a second rate of pronation; the second impulse provided by the pronation feedback system (150A);
 wherein the first rate of pronation is different than the second rate of pronation, and wherein the first impulse is different than the second impulse;
 wherein the support structure comprises a set of elongated members (160) and wherein at least some of the elongated members (160) are spaced apart from and not in contact with one another, and
 wherein the support structure extends only in a midfoot region of the sole structure (130).

14. The method of claim 13, wherein the first impulse and the second impulse are reaction forces provided by the elongated members (160) against the wearer's foot.

Patentansprüche

1. Fußbekleidungsartikel (100), aufweisend:

ein Obermaterial (102) und eine Sohlenstruktur (130), die an dem Obermaterial (102) befestigt ist, um einen inneren Hohlraum zu definieren; wobei die Sohlenstruktur (130) einen Bodenabschnitt (155) und eine Seitenwand (300), die einen wesentlichen Umfang des Bodenabschnitts (155) umgibt, aufweisend; und
 ein Pronationsrückmeldungssystem (150A), das eine Stützstruktur aufweist, die sich von der Seitenwand (300) und entlang des Obermaterials (102) an einer mittleren Seite (185) der Sohlenstruktur (130) erstreckt;
 wobei die Stützstruktur konfiguriert ist, um eine propriozeptive Rückmeldung zu geben, die einer Pronationsrate eines Fußes entspricht, der in dem inneren Hohlraum angeordnet ist;
 wobei die Stützstruktur eine Gruppe von länglichen Elementen (160) aufweist und wobei zumindest einige der länglichen Elemente (160) voneinander beabstandet sind und einander nicht berühren, und
 wobei sich die Stützstruktur nur in einer Mittelfußregion der Sohlenstruktur (130) erstreckt.

2. Fußbekleidungsartikel (100) nach Anspruch 1, wobei:

die Stützstruktur einen ersten Impuls einer mittleren Seite des Fußes des Trägers als Reaktion

auf eine erste Pronationsrate bereitstellt; die Stützstruktur einen zweiten Impuls der mittleren Seite des Fußes des Trägers als Reaktion auf eine zweite Pronationsrate bereitstellt; und sich die erste Pronationsrate von der zweiten Pronationsrate unterscheidet und sich der erste Impuls von dem zweiten Impuls unterscheidet.

3. Fußbekleidungsartikel (100) nach Anspruch 2, wobei der erste Impuls und der zweite Impuls Kräfte gegen den Fuß sind; oder wobei der erste Impuls die erste Pronationsrate verringert.
4. Fußbekleidungsartikel (100) nach einem der Ansprüche 1-3, wobei eine äußere Fläche der Gruppe von länglichen Elementen (160) durchgehend mit der Seitenwand der Sohlenstruktur (130) gebildet ist.
5. Fußbekleidungsartikel (100) nach einem der Ansprüche 1-4, wobei eine innere Fläche der Gruppe von länglichen Elementen (160) durchgehend mit einer inneren Fläche der Sohlenstruktur (130) ist.
6. Fußbekleidungsartikel (100) nach einem der Ansprüche 1-5, wobei die Stützstruktur bezüglich einer inneren Fläche des Obermaterials (102) innen liegt.
7. Fußbekleidungsartikel (100) nach einem der Ansprüche 1-5, wobei die Stützstruktur bezüglich einer äußeren Fläche des Obermaterials (102) außen liegt.
8. Fußbekleidungsartikel (100) nach Anspruch 1, wobei sich die länglichen Elemente (160) voneinander ausbreiten; oder wobei zumindest einige der länglichen Elemente (160) benachbarte Seiten aufweisen, die einander berühren; oder wobei zumindest einige der länglichen Elemente (160) unterschiedliche Längen besitzen.
9. Fußbekleidungsartikel (100) nach Anspruch 8, wobei ein vorderstes der länglichen Elemente (160) und ein hinterstes der länglichen Elemente (160) kürzer als zumindest eines der länglichen Elemente (160) zwischen dem vordersten und dem hintersten sind.
10. Fußbekleidungsartikel (100) nach Anspruch 1, wobei ein vorderstes der länglichen Elemente (160) nach vorne zu einer Vorderfußregion der Sohlenstruktur (130) gekrümmt ist und ein hinterstes der länglichen Elemente (160) nach hinten zu einer Fersenregion der Sohlenstruktur (130) gekrümmt ist.
11. Fußbekleidungsartikel (100) nach Anspruch 1, wobei die länglichen Elemente (160) gerade sind.
12. Fußbekleidungsartikel (100) nach Anspruch 1, wobei ein Raum zwischen zwei benachbarten der läng-

lichen Elemente (160) vollständig oberhalb einer Schnittlinie des Obermaterials (102) und der Sohlenstruktur (130) vor und hinter der Stützstruktur liegt.

13. Verfahren zum Verringern einer Pronationsrate eines Trägers eines Fußbekleidungsartikels (100), wobei das Verfahren umfasst:

Bereitstellen eines ersten Impulses an eine mittlere Seite (185) des Fußes des Trägers als Reaktion auf eine erste Pronationsrate; wobei der erste Impuls durch ein Pronationsrückmeldungssystem (150A) bereitgestellt wird, das eine Stützstruktur aufweist, die sich von einer Seitenwand (300) einer Sohlenstruktur (130) an einer mittleren Seite (185) der Sohlenstruktur und entlang eines Obermaterials (102), das an der Sohlenstruktur (130) befestigt ist, erstreckt, wobei der Fuß des Trägers in einem inneren Hohlraum angeordnet ist, der durch das Obermaterial (102) und die Sohlenstruktur (130) definiert ist;

Bereitstellen eines zweiten Impulses an die mittlere Seite des Fußes des Trägers als Reaktion auf eine zweite Pronationsrate; wobei der zweite Impuls durch das Pronationsrückmeldungssystem (150A) bereitgestellt wird; wobei sich die erste Pronationsrate von der zweiten Pronationsrate unterscheidet, und wobei sich der erste Impuls von dem zweiten Impuls unterscheidet; wobei die Stützstruktur eine Gruppe von länglichen Elementen (160) umfasst und wobei zumindest einige der länglichen Elemente (160) voneinander beabstandet sind und einander nicht berühren, und wobei sich die Stützstruktur nur in einer Mittelfußregion der Sohlenstruktur (130) erstreckt.

14. Verfahren nach Anspruch 13, wobei der erste Impuls und der zweite Impuls Reaktionskräfte sind, die durch die länglichen Elemente (160) gegen den Fuß des Trägers bereitgestellt werden.

Revendications

1. Article chaussant (100) comprenant :

une tige (102) et une structure de semelle (130) fixée à la tige (102) afin de définir une cavité intérieure ;
la structure de semelle (130) comprenant une partie base (155) et une paroi latérale (300) entourant un périmètre considérable de la partie base (155) ; et
un système de rétroaction de pronation (150A)

comprenant une structure de support s'étendant à partir de la paroi latérale (300) et le long de la tige (102) au niveau d'un côté médial (185) de la structure de semelle (130) ;

la structure de support étant conçue pour fournir une rétroaction proprioceptive correspondant à un taux de pronation d'un pied disposé dans la cavité intérieure ;

la structure de support comprenant un ensemble d'éléments allongés (160), et au moins quelques-uns des éléments allongés (160) étant espacés entre eux et n'étant pas en contact les uns avec les autres, et

la structure de support s'étendant seulement dans une région de mi-pied de la structure de semelle (130).

2. L'article chaussant (100) de la revendication 1, dans lequel :

la structure de support fournit une première impulsion à un côté médial du pied du porteur en réponse à un premier taux de pronation ;

la structure de support fournit une seconde impulsion au côté médial du pied du porteur en réponse à un second taux de pronation ; et le premier taux de pronation est différent du second taux de pronation, et la première impulsion est différente de la seconde impulsion.

3. L'article chaussant (100) de la revendication 2, dans lequel la première impulsion et la seconde impulsion sont des forces contre le pied ; ou dans lequel la première impulsion réduit le premier taux de pronation.

4. L'article chaussant (100) de l'une quelconque des revendications 1-3, dans lequel une surface extérieure de l'ensemble d'éléments allongés (160) est formée de façon à suivre immédiatement la paroi latérale de la structure de semelle (130).

5. L'article chaussant (100) de l'une quelconque des revendications 1-4, dans lequel une surface intérieure de l'ensemble d'éléments allongés (160) suit immédiatement une surface intérieure de la structure de semelle (130).

6. L'article chaussant (100) de l'une quelconque des revendications 1-5, dans lequel la structure de support est intérieure à une surface interne de la tige (102).

7. L'article chaussant (100) de l'une quelconque des revendications 1-5, dans lequel la structure de support est extérieure à une surface externe de la tige (102).

8. L'article chaussant (100) de la revendication 1, dans lequel les éléments allongés (160) s'écartent les uns des autres ; ou dans lequel au moins quelques-uns des éléments allongés (160) comportent des côtés adjacents en contact entre eux ; ou dans lequel au moins quelques-uns des éléments allongés (160) présentent des longueurs différentes. 5
9. L'article chaussant (100) de la revendication 8, dans lequel un élément le plus vers l'avant parmi les éléments allongés (160), et un élément le plus vers l'arrière parmi les éléments allongés (160), sont plus courts qu'au moins un élément, parmi les éléments allongés (160), entre l'élément le plus en avant et l'élément le plus en arrière. 10 15
10. L'article chaussant (100) de la revendication 1, dans lequel un élément le plus vers l'avant parmi les éléments allongés (160) s'incurve vers l'avant vers une région d'avant-pied de la structure de semelle (130), et un élément le plus vers l'arrière parmi les éléments allongés (160) s'incurve vers l'arrière vers une région de talon de la structure de semelle (130). 20
11. L'article chaussant (100) de la revendication 1, dans lequel les éléments allongés (160) sont droits. 25
12. L'article chaussant (100) de la revendication 1, dans lequel un espace entre deux éléments adjacents, parmi les éléments allongés (160), est entièrement au-dessus d'une ligne de morsure de la tige (102) et de la structure de semelle (130) vers l'avant et vers l'arrière de la structure de support. 30
13. Procédé de réduction d'un taux de pronation d'un porteur d'un article chaussant (100), le procédé comprenant :
- la fourniture d'une première impulsion vers un côté médial (185) du pied du porteur en réponse à un premier taux de pronation ; la première impulsion étant fournie par un système de rétroaction de pronation (150A) comprenant une structure de support s'étendant à partir d'une paroi latérale (300) d'une structure de semelle (130) au niveau d'un côté médial (185) de la structure de semelle et le long d'une tige (102) fixée à la structure de semelle (130), le pied du porteur étant disposé dans une cavité intérieure définie par la tige (102) et la structure de semelle (130) ; la fourniture d'une seconde impulsion vers le côté médial du pied du porteur en réponse à un second taux de pronation ; la seconde impulsion étant fournie par le système de rétroaction de pronation (150A) ; le premier taux de pronation étant différent du second taux de pronation, et la première impulsion étant différente de la seconde impulsion ; 40 45 50 55
- la structure de support comprenant un ensemble d'éléments allongés (160), et au moins quelques-uns des éléments allongés (160) étant espacés entre eux et n'étant pas en contact les uns avec les autres, et la structure de support s'étendant seulement dans une région de mi-pied de la structure de semelle (130).
14. Le procédé de la revendication 13, dans lequel la première impulsion et la seconde impulsion sont des forces de réaction produites par les éléments allongés (160) contre le pied du porteur.

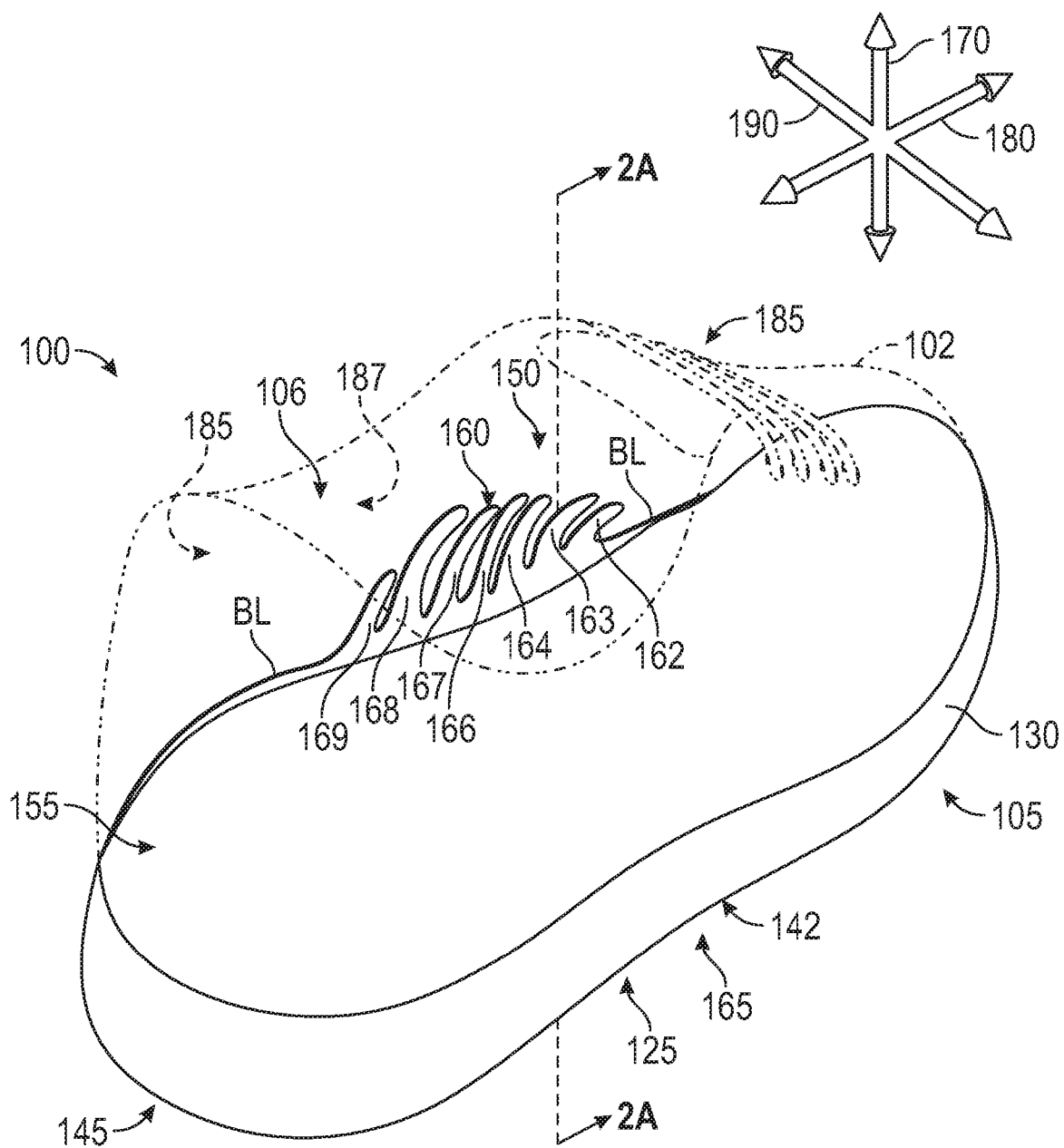


FIG. 1

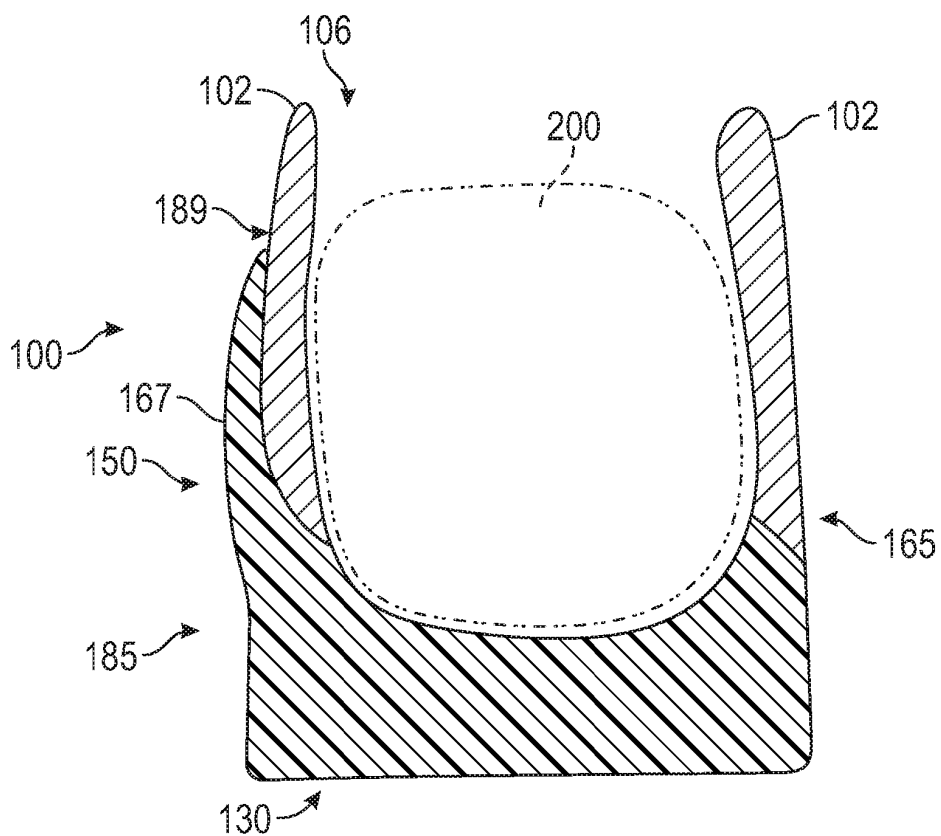


FIG. 2A

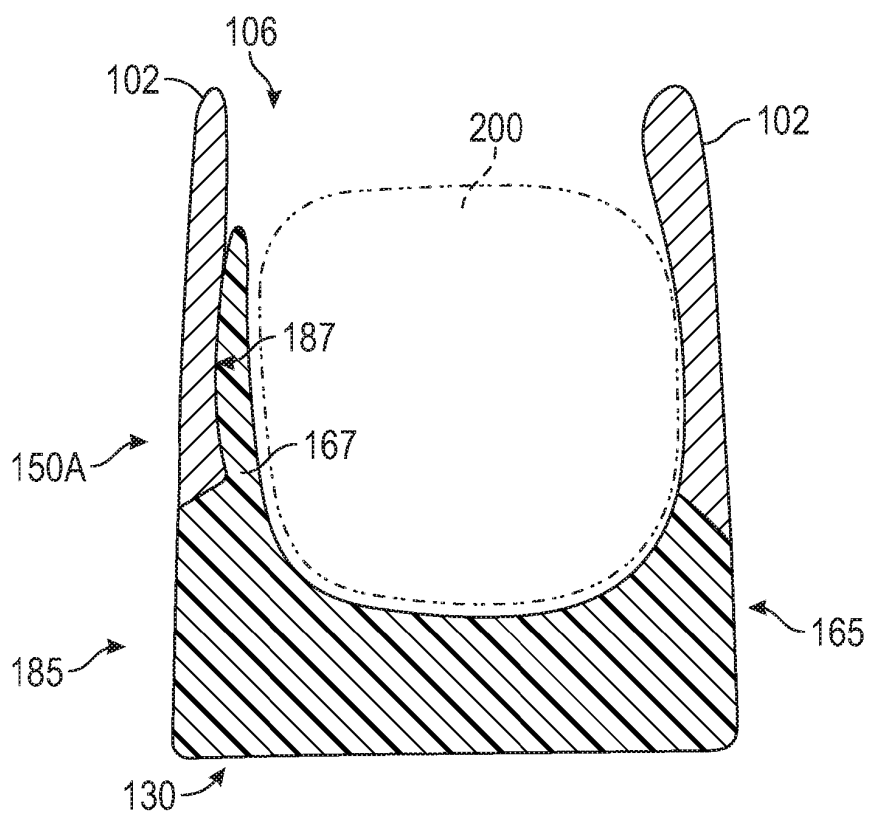


FIG. 2B

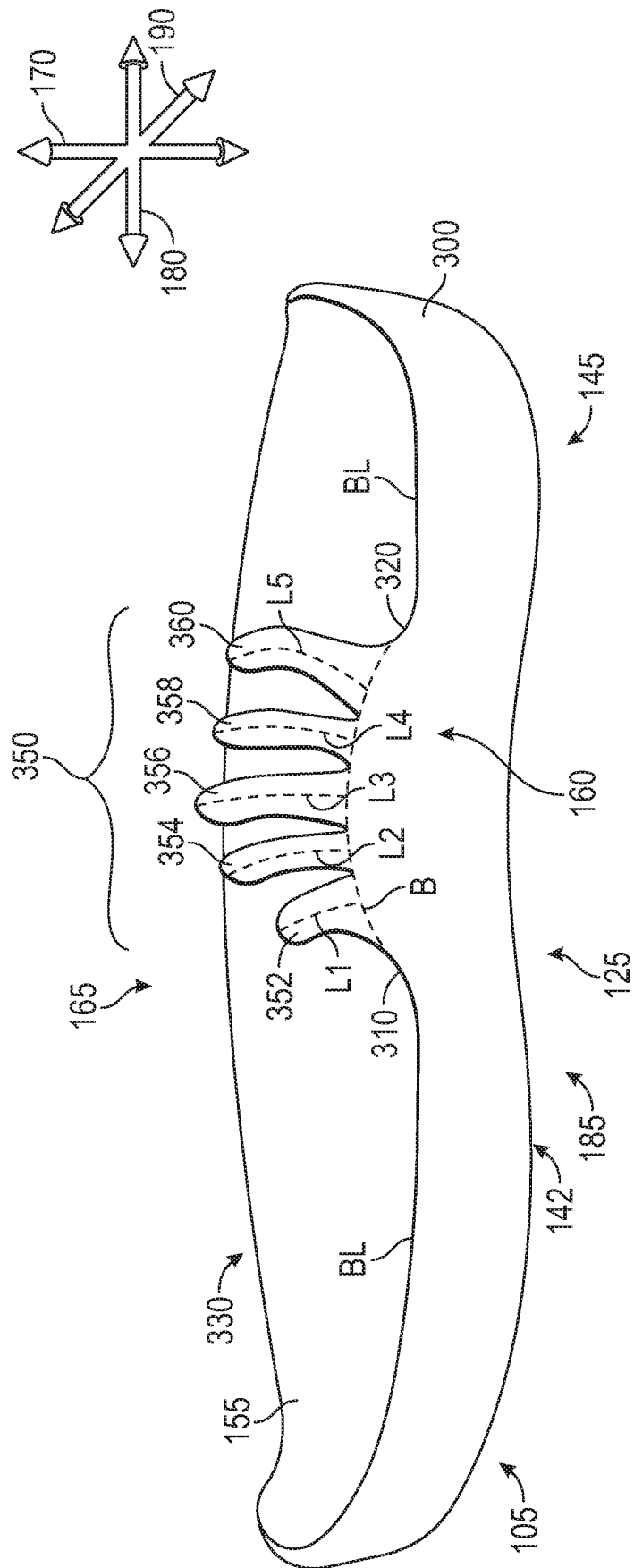


FIG. 3

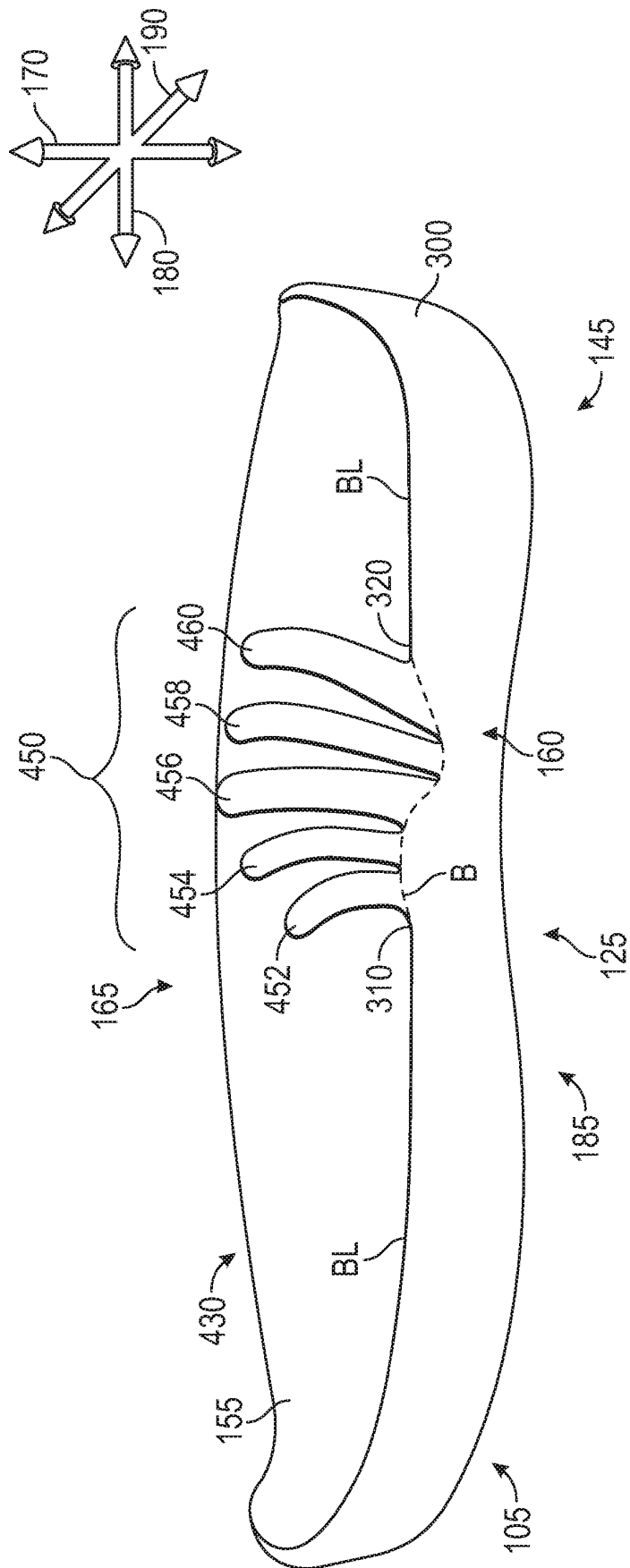


FIG. 4

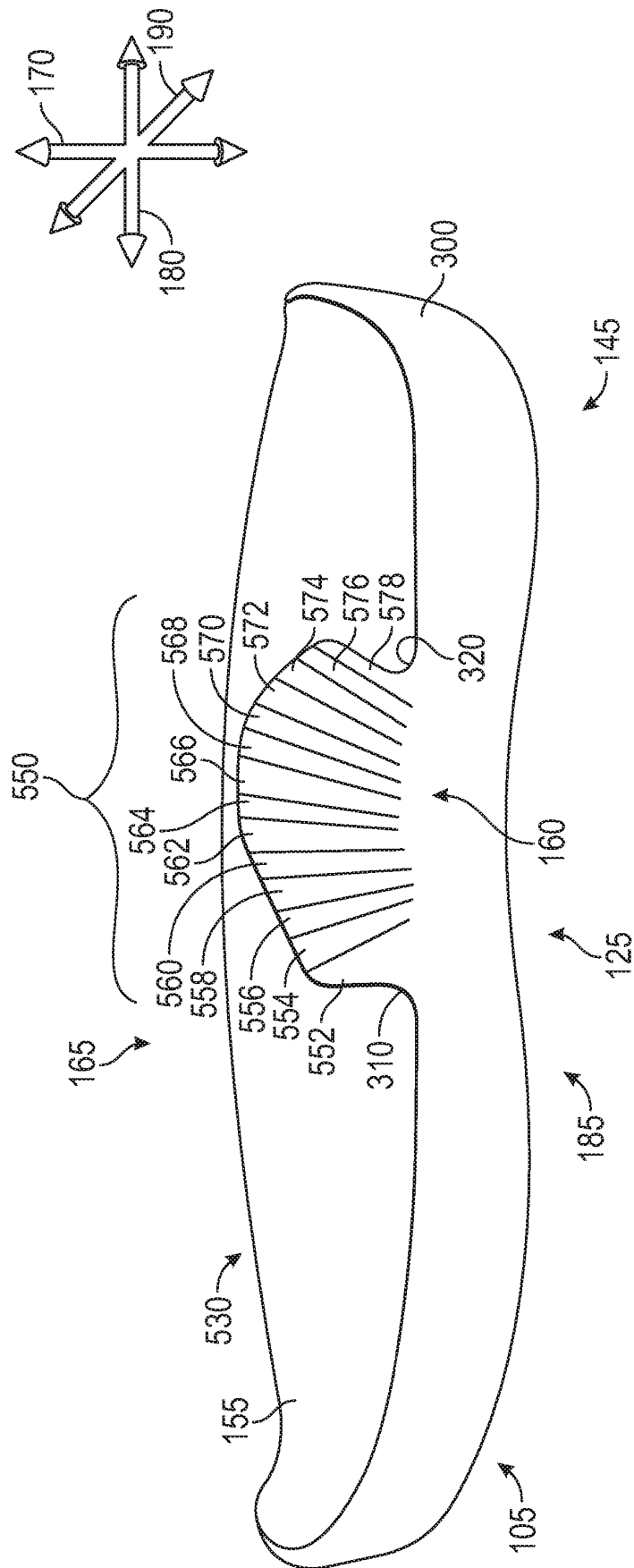


FIG. 5

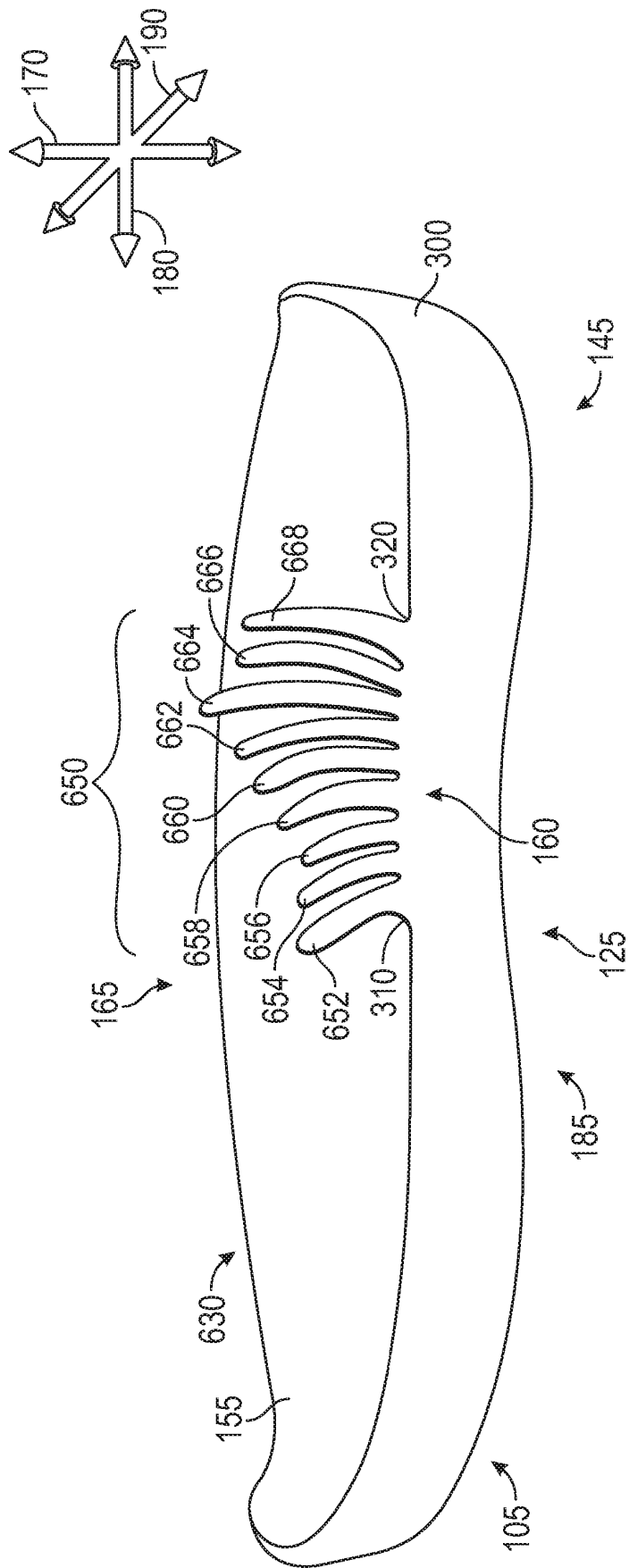


FIG. 6

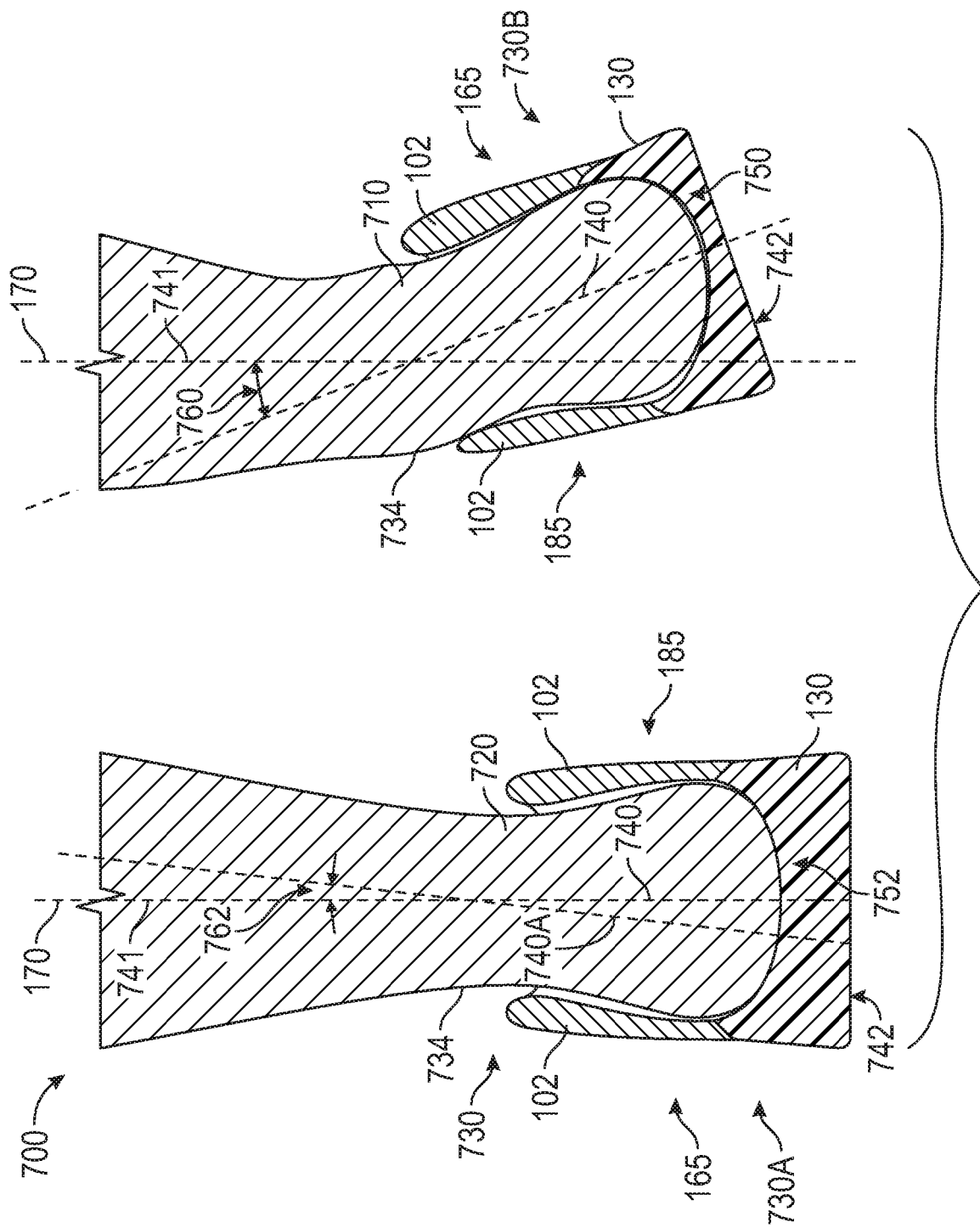


FIG. 7

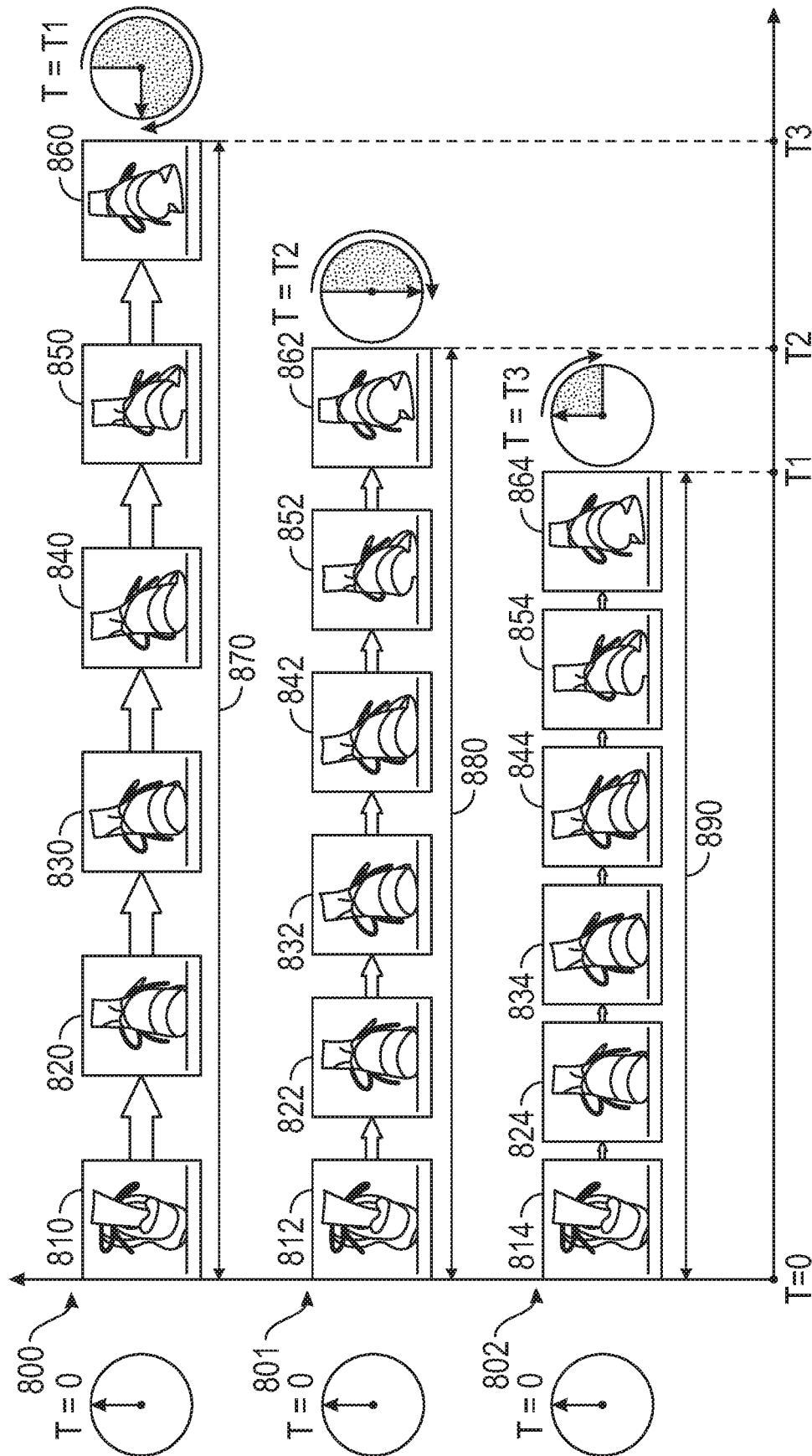


FIG. 8

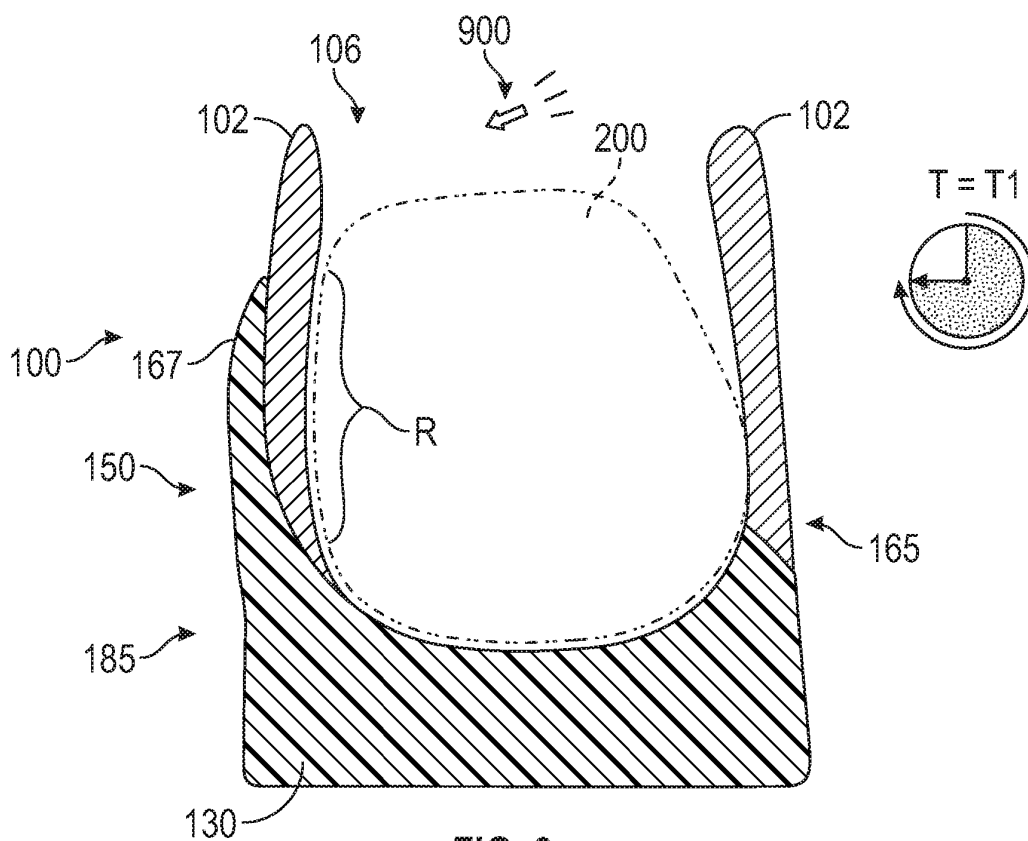


FIG. 9

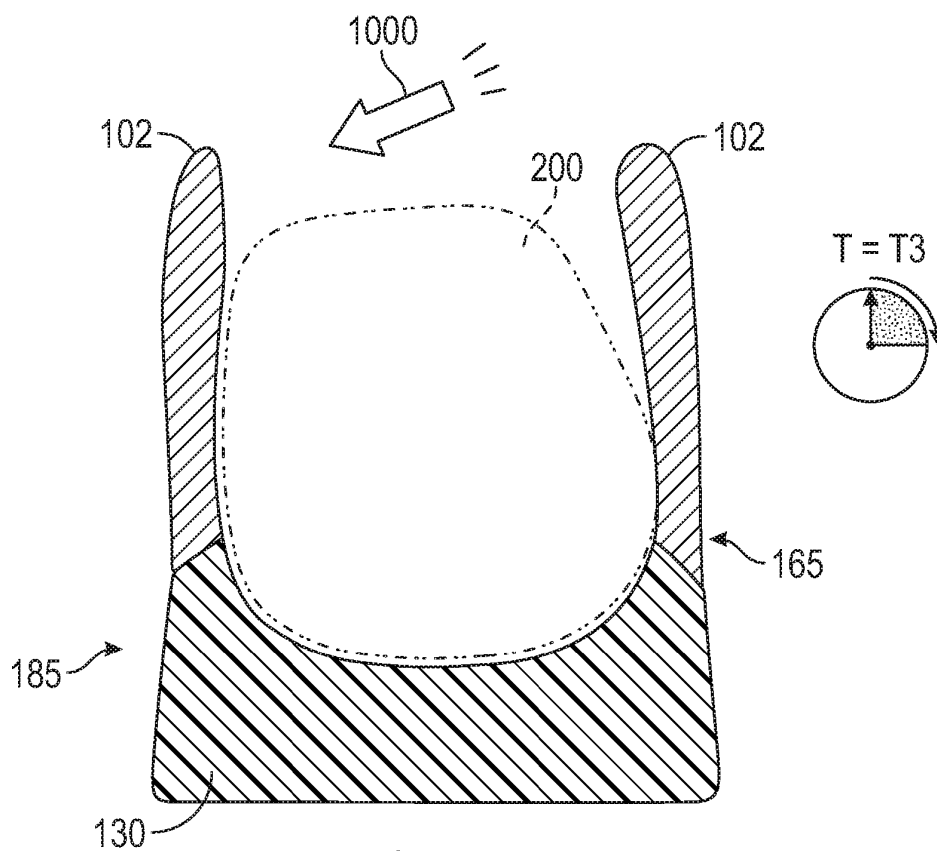
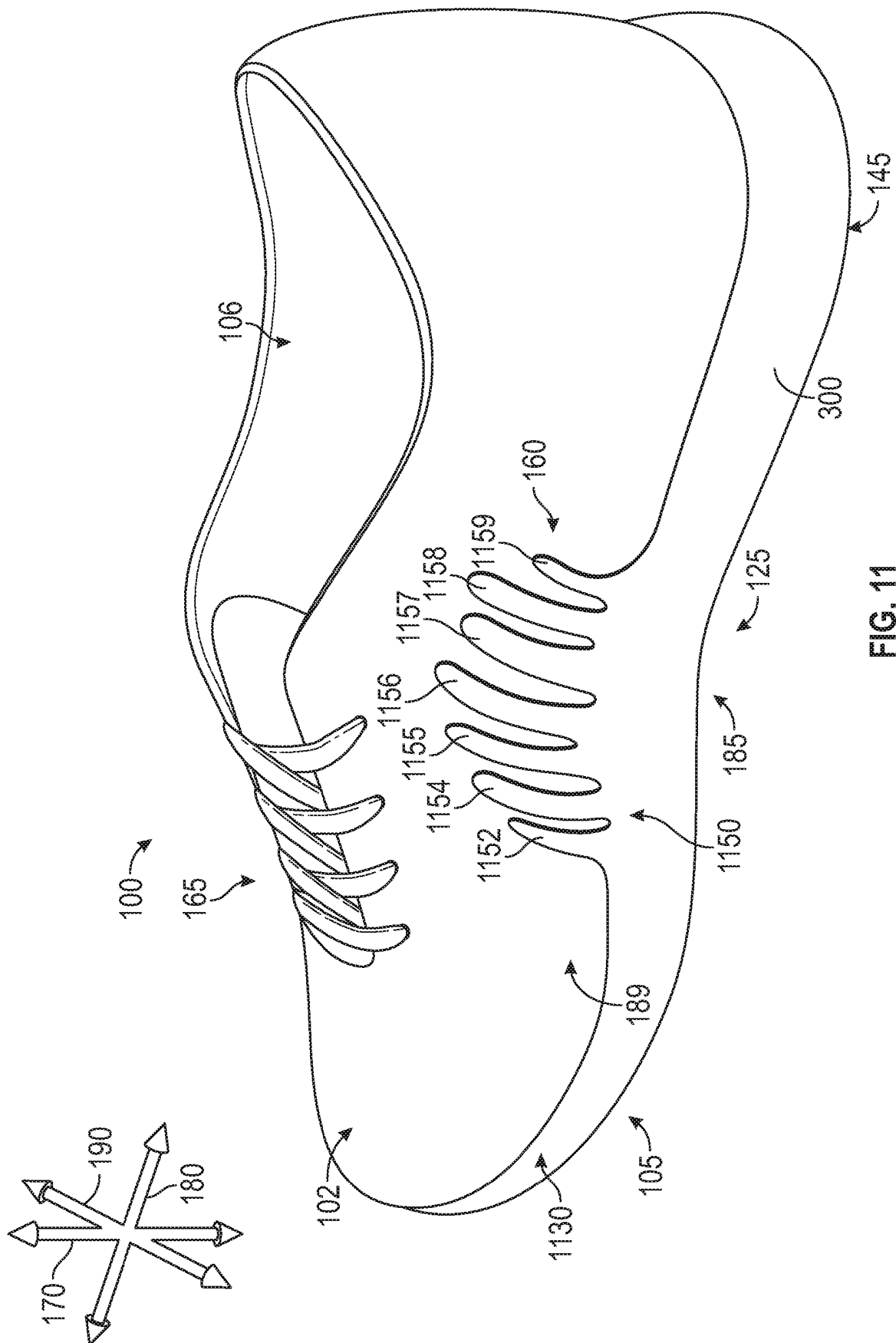


FIG. 10



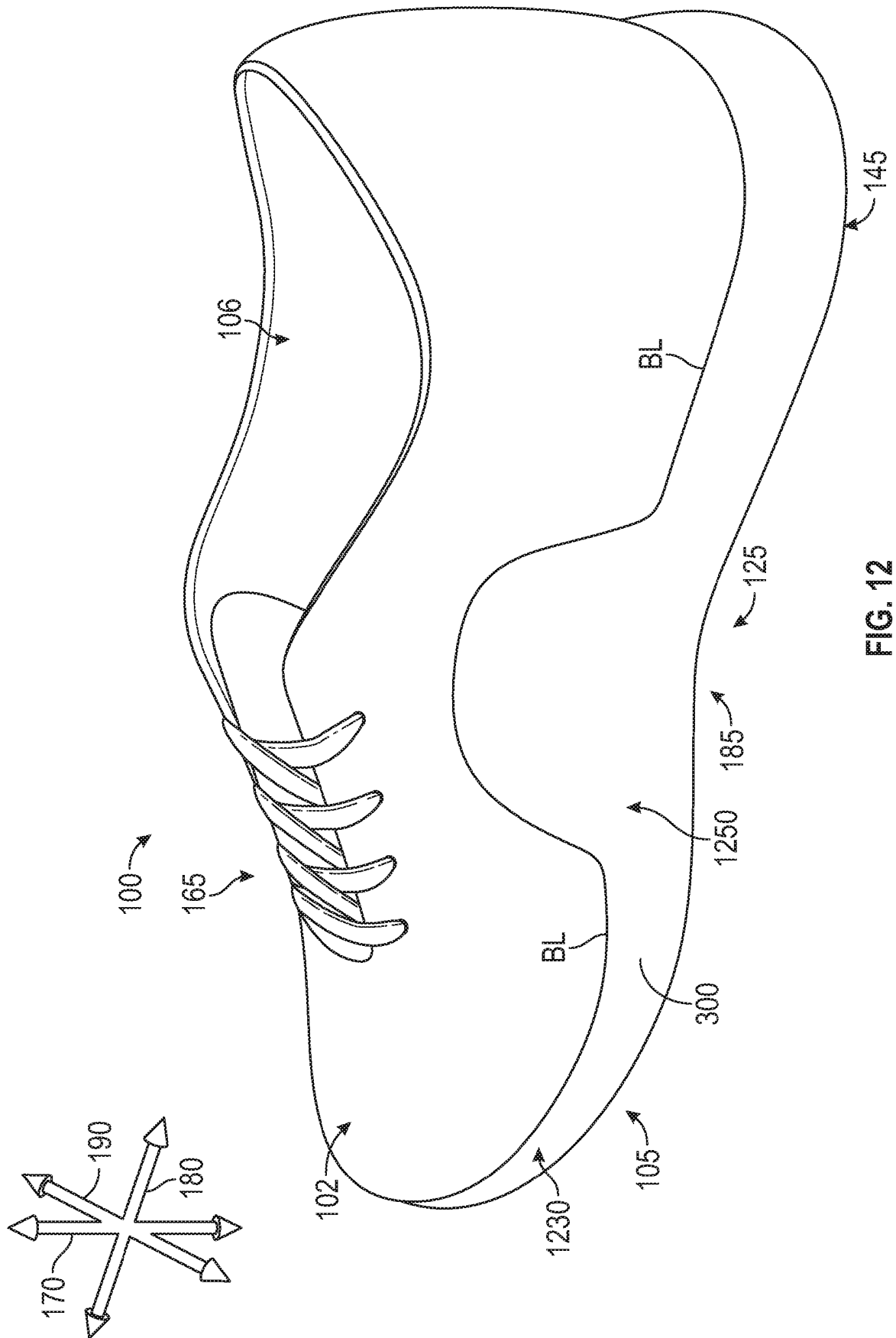


FIG. 12

REFERENCES CITED IN THE DESCRIPTION

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